# CITY OF CAMAS

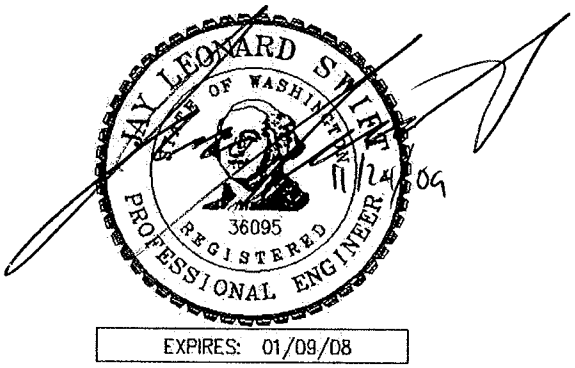
## GENERAL SEWER/WASTEWATER FACILITY PLAN

May 2007
Revised November 2009

Gray & Osborne, Inc.
CONSULTING ENGINEERS

# CITY OF CAMAS

# GENERAL SEWER / WASTEWATER FACILITY PLAN

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**Seattle**

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Appendix N – Effluent Dye Study and Mixing Zone Evaluation
Appendix O – WWTF Modeling Report
Appendix P – Sewer System Base Map
Appendix Q – Design Criteria for Developments in the Camas Sewer Service Area
Appendix R – NEPA/SERP/Environmental Report

# EXECUTIVE SUMMARY

## INTRODUCTION

This *General Sewer/Wastewater Facilities Plan* (Plan) for the City of Camas addresses the City's planning needs for wastewater collection, transmission, treatment, and disposal for the 20-year planning period. The Plan was prepared in accordance with the provisions of the Revised Code of Washington (RCW), Section 90.48, *Water Pollution Control*, Washington Administrative Code (WAC) Section 173-240-050, *General Sewer Plan*, and WAC 173-240-060, *Engineering Report*. Development of the Plan has been coordinated with the City's 2004 *Comprehensive Plan*, Clark County planning efforts, and with the City's 2001 *Water System Comprehensive Plan*.

The purpose of the Plan is to develop a Capital Improvement Plan to provide wastewater infrastructure to meet the City's needs for a 20-year planning period. Flows and loadings to the City's sewage collection and treatment systems are projected to grow substantially due to robust growth within the City's Urban Growth Area. The Plan provides proposed conceptual designs, cost estimates, a schedule, and a financing plan for recommended major facility improvements. The projects described in the Plan are consistent with Washington State regulations relating to the prevention and control of discharge of pollutants into waters of the state, anti-degradation of existing and future beneficial uses of ground waters, and anti-degradation of surface waters.

Sewage collection for the City is provided by a combination of gravity sewers, pump stations, force mains and Septic Tank Effluent Pump (STEP) systems. Wastewater treatment for the City is provided by the City's conventional activated sludge Wastewater Treatment Facility (WWTF).

## PLANNING CRITERIA

Chapters 2 –4 of the Plan include discussion of general planning issues including growth management, land use, zoning, features of the service area and population projections. Regulatory issues that are relevant to the planning and implementation of wastewater service improvements are discussed.

In Chapter 3, planning, land use and population projections are discussed. Per discussion with City staff, annual growth rates of 7.2 percent and 1.0 percent were used, respectively, to project future City population for 2005 – 2010 and 2011 – 2025. Use of these growth rates yields a 49 percent population increase by 2015 and a 64 percent population increase by 2025. The growth rates are more conservative (yield a higher overall population) than those presented in the City's 2004 Comprehensive Plan. Based on current growth projections, the population within the City's sewer service area (essentially the UGA) will grow from approximately 16,000 to over 29,000 by year 2025.

# EXISTING FACILITIES

## WASTEWATER COLLECTION SYSTEM

For the purposes of this report, the City of Camas WWTF collection system is divided into 15 collection areas, or drainage basins. These collection areas predominantly follow the natural drainage patterns of the City's service area. Sanitary sewer lines in downtown Camas, and areas to the immediate north and east of downtown, are predominantly gravity pipes, while the majority of the rest of the City is served by septic tank effluent (STE) systems. Since 1985, over 3,500 sewer connections have been added to the City's system, with most of these connections using STE facilities. It is estimated that over half of the current total sanitary sewage flow to the wastewater treatment facility consists of flow from STE systems, and that about 80 to 90 percent of the wastewater generated by new connections originates from STE systems. When the solids storage capacity of a septic tank is reached, the tank is pumped out and the resultant septage is hauled by tank truck to the City's wastewater treatment facility.

There are currently 23 pump stations serving the City. The Main Pump Station conveys the majority of the City's sewage under the Washougal River to the WWTF.

## WASTEWATER TREATMENT FACILITY

The City's activated sludge wastewater treatment facility (WWTF) has a maximum month capacity of 6.1 mgd flow and 5,616 lb/d of $BOD_5$. The WWTF includes a headworks with mechanical fine screen, aeration basins with selectors and oxic/anoxic zones for nitrogen removal operating in a Modified Ludzak-Ettinger (MLE) configuration, primary and secondary clarifiers, effluent filtration, UV disinfection, effluent pump station, aerobic digesters and a sludge dewatering centrifuge.

# WASTEWATER CHARACTERISTICS AND FLOWS

In Chapter 6, the quantity of wastewater generated in the sewer service area is estimated from WWTF flow meter readings and water consumption records during recent years. Wastewater flow originates from single-family residential and multi-family, commercial and industrial sources. The City has a number of light industrial and technical businesses that provide a significant percentage of total employment and wastewater flow within the City. Most notable are WaferTech, Heraeus Shin-Etsu America, C-Tech, Sharp, Linear Technology, and Underwriters Laboratories. The average annual flow (AAF) from each source type is estimated as 85% of metered winter potable water consumption, based on an analysis of water consumption and wastewater flow records.

The current and projected 10-year and 20-year Equivalent Residential Units (ERUs) and flows (without consideration of further expansion of the Urban Growth Area) are

summarized in Table ES-1. The projected flows and ERUs are based on use of the aforementioned growth assumptions applied to all customer classes, except the industrial category. Future industrial flows are projected based on industry expansion plans and the permitted flows in the State Waste Discharge Permits. Infiltration and inflow (I/I) were assumed to remain constant throughout the planning period; reductions in I/I are expected to be balanced by increases as the sewer system is expanded and additional infrastructure ages.

**TABLE ES-1**

**Current and Projected Future Wastewater Flows**

| **Wastewater ERUs and Flows** | **Sewer ERUs** | | | |
|---|---|---|---|---|
| **Customer Type** | **2005** | **2015** | **2025** | **Buildout** |
| Single-Family Residential | 5,613 | 8,363 | 9,205 | 13,608 |
| Multi-family Residential | 729 | 1,086 | 1,196 | 7,546 |
| Commercial | 652 | 972 | 1,070 | 2,176 |
| Industrial | 6,224 | 9,857 | 12,556 | 25,537 |
| City | 52 | 77 | 85 | 173 |
| **TOTAL** | 13,270 | 20,356 | 24,112 | 49,039 |
| **Projected Flows (mgd)** | | | | |
| Total Base Flow | 1.98 | 3.03 | 3.59 | 7.31 |
| Low-strength Industrial Reserve | 0 | 0.70 | 1.40 | 1.40 |
| Average Annual Flow | 2.29 | 4.04 | 5.30 | 7.62 |
| Maximum Month | 3.09 | 4.84 | 6.10 | 8.42 |
| Peak Day | 7.03 | 8.78 | 10.04 | 12.36 |
| Peak Hour | 9.93 | 11.47 | 13.44 | 17.06 |

Future loadings to the Camas WWTF were projected in a similar manner as future WWTF flows, and are summarized in Table ES-2.

**TABLE ES-2**

**Current and Projected WWTF Loadings**

| ERUs and Loadings | 2005 | 2015 | 2025 | Buildout |
|---|---|---|---|---|
| Total ERUs | 13,270 | 20,356 | 24,112 | 49,039 |
| Annual Average $BOD_5$, (lb/d) | 2,218 | 3,437 | 4,099 | 8,197 |
| Max Month $BOD_5$, (lb/d) | 3,039 | 4,708 | 5,615 | 11,230 |
| Annual Average TSS, (lb/d) | 3,191 | 4,937 | 5,883 | 11,791 |
| Max Month TSS, (lb/d) | 4,339 | 6,715 | 8,001 | 16,036 |
| Annual Average $NH_3$-N, (lb/d) | 730 | 1,149 | 1,389 | 2,686 |
| Max Month $NH_3$-N, (lb/d) | 1,029 | 1,618 | 1,956 | 3,788 |
| Annual Average TKN, (lb/d) | 1,017 | 1,588 | 1,917 | 3,726 |
| Max Month TKN, (lb/d) | 1,367 | 2,130 | 2,573 | 4,995 |

## COLLECTION SYSTEM IMPROVEMENTS

In Chapter 7, an evaluation of the City's collection system is presented and cost estimates are provided for capital improvement projects to address collection system deficiencies.

A computerized hydraulic model was used to assess the capacity of existing facilities and to plan future facilities for year 2025 flows.

Major problems identified and recommendations included:

- Rehabilitation is recommended for several gravity sewer pipes due to poor condition and infiltration and inflow observed during television inspection. Additionally, City staff have observed significant corrosion and odors in gravity sewers where STEP systems discharge into gravity sewers, significant corrosion in STEP pump stations, and corrosion-induced failure of sanitary sewer components. Pipes are assigned a priority ranking for rehabilitation depending upon the quantity and nature of defects (and I/I) that were noted. Additionally, a number of pipes lacked adequate capacity for 2025 flows, and therefore, replacing pipes with larger diameter lines to increase capacity is recommended.

- The wet well for the Main Pump Station is too small, provides poor access and contributes to the potential of clogging the pumps. Modifications recommended include a grinder and a larger wet well.

- The capacity of the Lacamas Creek Pump Station must be increased to 450 gpm to accommodate projected year 2025 flows.

- The 21-inch STEP Main that transports wastewater from the Western Service Area to the 6th and Joy STEP terminus has adequate capacity for 2025 flows. However, the City has concerns about the durability of this line, which is constructed of 100-psi pipe and has numerous taps. Thus, this line is recommended for replacement in phases in years 2016 through 2025. Plans for rehabilitation of this line should consider additional capacity requirements and alternatives for flow routing and satellite treatment associated with providing sewer service for an expanded UGA.

- The gravity sewer lines and Main Pump Station downstream of the 6th and Joy STEP terminus do not have sufficient capacity to transport 2025 flows. It is recommended that flows be bypassed from these lines in a new STEP Main to the WWTF. The line would cross the Washougal River on a new pedestrian bridge that is being constructed within the next two years. This alignment would require obtaining easements for routing the force main through the various properties. The total length of the force main in this alternative is approximately 8,300 feet.

Table ES-3 identifies the 15-year schedule, and estimated costs in 2006 dollars, for recommended collection system improvements. Total costs shown for the projects include engineering, construction, construction administration, tax and contingency.

## TABLE ES-3

## Recommended 15-Year Schedule and Cost Estimates for Collection System Capital Improvements

| Basin and Project | Reason for Priority | Total Estimated Cost | Project Year Total | Year to be Completed |
|---|---|---|---|---|
| **Investigative Activities** | | | | |
| Basin 10, TV Inspection and Flow Metering | Inf 2 | $15,000 | $15,000 | 2007 |
| Purchase flow meters (2) | Inf 2 | $25,000 | $25,000 | 2007 |
| TV Inspection and Flow Metering, Basin 2 | Inf 1 | $15,000 | $15,000 | 2008 |
| Inspect Condition of Force Main from Main Pump Station | Inf 1 | $10,000 | $10,000 | 2009 |
| **STEP Collection System** | | | | |
| Basin 6, STEP Main Bypass of Main Pump station | C2 | $4,480,000 | $4,480,000 | 2010 |
| Replace 21-inch STEP Main | To be Determined | | | 2016-2025 |
| **Pump Stations** | | | | |
| Annual Pump Station Rehabilitation and Conversion Allowance | Corrosion, Maintenance | $150,000 | $150,000 | 2006-2015 |
| Basin 5, Main Pump Station – Wet Well and Screening Improvements | C2 | $900,000 | $900,000 | 2010 |
| **Gravity Collection System** | | | | |
| **Basin and Project** | **Reason for Priority** | **Total Estimated Cost** | **Project Year Total** | **Year to be Completed** |
| Basin 1, Project 1 | C1, PC,Inf1, S | $776,194 | $1,154,243 | 2007 |
| Basin 2, Project 2 | C1, PC, Inf2 | $378,049 | | |
| Basin 3s, Project 6 | C1, PC, Inf4, S | $588,071 | $1,421,066 | 2008 |
| Basin 3s, Project 3 | C1, PC, Inf4 | $832,995 | | |
| Basin 1, Project 2 | PC, Inf1 | $437,285 | $1,245,697 | 2009 |
| Basin 1, Project 3 | PC, Inf1 | $466,496 | | |
| Basin 1, Project 4 | PC, Inf1 | $341,916 | | |
| Basin 4, Project 2 | C2, PC, Inf2 | $573,604 | $1,219,478 | 2010 |
| Basin 6, Project 1 | C2, Inf5, S | $645,874 | | |
| Basin 1, Project 5 | PC, Inf1 | $347,140 | $1,488,567 | 2011 |
| Basin 2, Project 1 | C1, Inf2 | $691,171 | | |
| Basin 4, Project 3 | PC, Inf2 | $450,256 | | |
| Basin 4, Project 1 | PC, Inf2 | $714,208 | $1,401,209 | 2012 |
| Basin 4, Project 4 | PC, Inf2 | $687,001 | | |
| Basin 3n, Project 3 | PC, Inf3 | $545,080 | $1,431,307 | 2013 |
| Basin 3n, Project 1 | PC, Inf3 | $886,227 | | |
| Basin 3n, Project 2 | PC, Inf3 | $611,636 | $1,083,513 | 2014 |
| Basin 3n, Project 4 | PC, Inf3 | $471,877 | | |
| Basin 5, Project 2 | C1, Inf6 | $708,507 | $708,507 | 2015 |
| Basin 3n, Project 5 | C2, Inf3 | $813,853 | $813,853 | 2016 |
| Basin 3s, Project 1 | PC, Inf4 | $473,788 | $814,034 | 2017 |

**TABLE ES-3 – (continued)**

**Recommended 15-Year Schedule and Cost Estimates for Collection System Capital Improvements**

| Basin and Project | Reason for Priority | Total Estimated Cost | Project Year Total | Year to be Completed |
|---|---|---|---|---|
| Basin 3s, Project 5 | PC, Inf4 | $340,246 | | |
| Basin 3s, Project 4 | PC, Inf4 | $827,692 | $953,293 | 2018 |
| Basin 6, Project 3 | C2, Inf5 | $125,601 | | |
| Basin 3s, Project 2 | PC, Inf4 | $557,395 | $1,064,698 | 2019 |
| Basin 6, Project 2 | C2, Inf5 | $507,303 | | |
| Basin 5, Project 1 | C2, Inf6 | $442,423 | $864,815 | 2020 |
| Basin 10, Project 1 | C2, Inf2 | $422,392 | | |
| Basin 15, Project 1 | Crown Road | $1,300,000 | $1,300,000 | 2021 |

Key:
C1 - needs immediate capacity improvement
C2 - will eventually need capacity improvement
PC - poorest condition due to broken pipe and/or severe root intrusion with subsequent unacceptable infiltration
MC - moderately bad pipe due to cracks and/or some root intrusion - some infiltration
Inf 1 - 1998 I/I Study showed this basin to have the highest I & I
Inf 2 - 1998 I/I Study showed this basin to have the 2nd highest I & I
Inf 3 - 1998 I/I Study showed this basin to have the 3rd highest I & I
Inf 4 - 1998 I/I Study showed this basin to have the 4th highest I & I
Inf 5 - 1998 I/I Study showed this basin to have the 5th highest I & I
Inf 6 - 1998 I/I Study showed this basin to have the 6th highest I & I
S - surcharging is known to occur.
Note: All costs are in 2006 dollars.

# WASTEWATER TREATMENT FACILITY IMPROVEMENTS

In Chapter 8, the regulatory and design basis for necessary modifications to the City's WWTF is described. The performance of the WWTF is discussed and evaluated. A recommended capital improvement plan with cost estimates is presented. Chapter 8 also summarizes the results of a mixing zone analysis for the City's WWTF diffuser.

## MIXING ZONE STUDY

In 2004, the City authorized Cosmopolitan Engineering to conduct an effluent dye study for Camas using the then current design flows that Ecology had cited in the City's 2004 NPDES permit fact sheet. Based on the field tests, parameters within the UM3 model used by Ecology were calibrated to more closely match measured dilution. Cosmopolitan Engineering then used Ecology's UM3 model, calibrated based on the results of the dye study, to calculate dilution factors and determine NPDES permit limits for year 2025 projected flows. The results of the mixing zone analysis demonstrated a substantial increase in dilution if modifications were made to the diffuser so that it discharged vertically. Because the Camas outfall discharges in the same direction as the river flows, and at similar velocities, there is low turbulence and only moderate dilution in the mixing zone. A change from a horizontal discharge to a vertical discharge would

increase dilution about four-fold based on the UM3 model Ecology has used to model dilution in the Camas mixing zone. The mixing zone analyses were finalized, after discussion with Ecology, in Cosmopolitan memoranda dated January 20, 2009 (for an 8-port diffuser configuration) and February 19, 2009 (for a 16-port diffuser configuration).

A letter was issued by Ecology on October 21, 2009 indicating approval of the mixing zone analysis provided in the January 20, 2009 for the 8-Port configuration. The October 21, 2009 approval letter notes the ratios identified in the January 20, 2009 memo may be used for "estimation of the reasonable potential for limits for toxic pollutants not already subject to permit limits (e.g., metals)." A letter was issued by Ecology on November 25, 2009 indicating similar approval of the mixing zone analysis for the 16-Port diffuser. (As noted in Chapter 8, the 16-Port configuration is recommended based on WWTP hydraulics.) As noted in the February 19, 2009 memorandum from Cosmopolitan, among the metals, only cadmium showed a reasonable potential to exceed water quality standards. The cadmium exceedance is based on one sample (87 µg/L in June 2006) that appears to be a statistical outlier, and may in fact be an artifact of the sampling process. Additional sampling and analysis conducted since June 2006 with clean sampling techniques has not detected cadmium.

In accordance with the October 21 and November 25 letters, and discussions with Ecology, it is understood that, after completion of the outfall modifications, Ecology will modify Condition S1.A of the City's NPDES permit by deleting the maximum daily ammonia limits. Thus, for total ammonia limits, only the monthly average limits of 20 mg/L in summer and 7 mg/L in winter will remain.

These proposed ammonia limits have been used as the basis of evaluations and calculations for this Plan.

## LIQUID STREAM IMPROVEMENTS

Each major process unit in the WRF is evaluated in Chapter 8 for its ability to adequately treat 10-year (2015) and 20-year (2025) projected flows and loadings based on industry-standard design criteria. The capacity of the mechanical fine screening, activated sludge process aeration, and UV disinfection systems are found to be inadequate for the twenty-year flows and loadings. Thus, additional capacity is recommended for these process units. A second mechanical fine screen, a fourth aeration blower with upgraded blower control system, and a fourth UV disinfection system bank of lights should be installed. Additionally, modifications to the aeration basins, including the anoxic selectors and the baffle walls between the anoxic and aerobic zones, are recommended to improve SVI control, reduce back-mixing between the zones, and increase removal of TSS, BOD and ammonia. Due to concerns about possible industrial discharge of inhibitory substances, development of local limits and implementation of a pretreatment program is recommended. Also, software to track WWTF maintenance is recommended.

Table ES-4 provides estimated costs for the WWTF capital improvement projects for liquid stream treatment improvements. Costs are estimated total project costs in 2007 dollars and include engineering, construction management, sales tax and contingency.

**TABLE ES-4**

**Cost Estimates for WWTF Liquid Stream Improvements to Accommodate 2025 Flows and Loadings**
**(Solids handling improvements not included; See Table ES-5)**

| No. | Item | Quantity | Unit Price | Amount |
|---|---|---|---|---|
| 1 | Mobilization/Demobilization | 1 LS | $250,000 | $250,000 |
| 2 | Mechanical Fine Screen | 1 LS | $125,000 | $125,000 |
| 3 | Blower (#4) | 1 LS | $60,000 | $60,000 |
| 4 | Demolish Existing Aerobic Digester No. 1 | 1 LS | $40,000 | $40,000 |
| 5 | AB Modifications (Selectors and Divider Walls) | 1 LS | $40,000 | $40,000 |
| 6 | Internal Recycle Pump Enclosure | 1 LS | $15,000 | $15,000 |
| 7 | Additional Bank of Lamps for UV Disinfection | 1 LS | $45,000 | $45,000 |
| 8 | Dissolved Oxygen and Ammonia Monitors | 1 LS | $65,000 | $65,000 |
| 9 | Computer, Software, PLC and SCADA Upgrades | 1 LS | $55,000 | $55,000 |
| 10 | Security Upgrades | 1 LS | $10,000 | $10,000 |
| 11 | Loading Dock | 1 LS | $35,000 | $35,000 |
| 12 | WWTF Outfall Modifications | 1 LS | $40,000 | $40,000 |
| 13 | Pretreatment Management Software | 1 LS | $12,000 | $12,000 |

Subtotal .....$792,000
Construction Contingency (20%).....$158,400
Subtotal .....$950,000
Washington State Sales Tax (7.9%).....$76,000
Total Estimated Construction Cost .....$1,025,000
Engineering, Administrative & Legal Services (20%).....$205,000
**Total Estimated Project Cost .....$1,231,000**

## SOLIDS TREATMENT IMPROVEMENTS

An evaluation of solids treatment capacity is provided in Chapter 9. Current solids treatment by aerobic digestion produces Class B biosolids that are dewatered and hauled to land application sites by contract. Due to the age of, and lack of capacity in, the aerobic digesters, and the City's desire to produce Class A biosolids, it is recommended that the City construct new anaerobic digesters and a sludge drying system that together will produce Class A biosolids that can be used within the community for landscaping.

Class B biosolids pose a greater risk to public health and safety than Class A biosolids. When biosolids meet the Class "A" standard, they are subject to fewer restrictions for

land application as long as they also meet the lower (WAC-173-308) Table 3 pollutant concentration thresholds and vector attraction reduction standards. After construction of this project, the Camas WWTF will produce biosolids that meet the lower pollutant threshold limits, Class "A" pathogen reduction requirements, and vector attraction reduction requirements, which will allow the biosolids to be eligible for relatively unrestricted application. Biosolids in this category are referred to as "Exceptional Quality" (EQ). EQ biosolids can be containerized and sold or given away in quantities up to one metric ton. Class A biosolids require a higher level of treatment than Class B biosolids; however, Class A biosolids have a lower level of risk to environmental and public health.

Application of Class A biosolids to areas within the local community for landscape purposes provides inherent value to the region's natural resources and green spaces. The sludge dryer will produce a 90 percent solids, pelletized product that is much easier and safer to handle, transport, and apply. The sludge dryer will reduce biosolids volumes to approximately 25 percent of existing volumes. In 2005, the City applied approximately 820 tons of Class B biosolids. In 2008, once the sludge dryer is brought online the City will produce approximately 180 tons of Class A biosolids (includes a 7.2 percent annual growth increase).

The conversion from aerobic digestion to anaerobic digestion provides a reduction in power demands decreasing the environmental impact of the sludge digestion process. The existing aerobic digesters utilize five 25 horsepower surface aerators, originally purchased in 1972, operating 24 hours a day 7 days a week. The surface aerators will no longer be in operation when the City switches to anaerobic digestion. Anaerobic digestion produces methane gas which will be used as an energy source for heating the reactor; the net energy consumption for anaerobic digestion is less than for aerobic digestion. Power costs will decrease by approximately 10 percent. Additionally, the conversion from aerobic digestion to anaerobic digestion will eliminate the generation of aerosols associated with the digestion process.

<u>Septage Storage Tank</u>:

To provide adequate treatment of septage collected from the community and delivered to the WWTF, the City will construct a septage storage tank, including cover, aeration system, and venting to the odor control system. The implementation uses an existing tank (500,000 gallons), reducing the environmental impact of construction and increasing the reliability for the STEP systems. Septage loads occasionally contain toxins that could upset the biological processes in the plant; a properly sized sludge storage basin will allow for slow metering of septage into the plant to avoid upsets. An August 12, 2005 letter from the Department of Ecology recommends, "that the odor control features needed with such digesters should also be extended to a transfer and holding tank area where septic tank contents can be delivered at the POTW." The new septage storage tank will include a cover, aeration system, and odor control system, and therefore, will directly

eliminate the concerns of the Department of Ecology indicated in the August 12, 2005 letter. Furthermore, the odor control biofilter system will be expanded.

**TABLE ES-5**

**Alternative No. 1B: Anaerobic Digestion of Camas WWTF Biosolids Followed by Sludge Drying to Produce a Class A Biosolid Preliminary Project Cost Estimate (2007 Dollars)**

| No. | Item | Quantity | Unit Price | Amount |
|---|---|---|---|---|
| 1. | Mobilization/Demobilization | 1 LS | $720,000 | $720,000 |
| 2. | Demolition | 1 LS | $40,000 | $40,000 |
| 3. | Anaerobic Digester/Dig. Building | 1 LS | $750,000 | $750,000 |
| 4. | Digester Sludge Heating System | 1 LS | $231,000 | $231,000 |
| 5. | Digester Gas Equipment | 1 LS | $152,000 | $152,000 |
| 6. | Digester Covers | 1 LS | $650,000 | $650,000 |
| 7. | Digester Mixing System | 1 LS | $300,000 | $300,000 |
| 8. | Digester Recirculation Pumps | 1 LS | $79,000 | $79,000 |
| 9. | WAS/Septage/Centrate Tank | 1 LS | $280,000 | $280,000 |
| 10. | WAS Thickening System | 1 LS | $237,000 | $237,000 |
| 11. | Digested Sludge Pumps | 1 LS | $40,000 | $40,000 |
| 12. | Plant Drain Pump Station No. 2 | 1 LS | $70,000 | $70,000 |
| 13. | Sludge Storage Building Modifications | 1 LS | $185,000 | $185,000 |
| 14. | Sludge Dryer System | 1 LS | $2,300,000 | $2,300,000 |
| 15. | Odor Control Filter and Equipment | 1 LS | $252,000 | $252,000 |
| 16. | Dewatering | 1 LS | $75,000 | $75,000 |
| 17. | Earthwork | 1 LS | $100,000 | $100,000 |
| 18. | Miscellaneous Metals | 1 LS | $80,000 | $80,000 |
| 19. | Painting | 1 LS | $150,000 | $150,000 |
| 20. | Site Work | 1 LS | $120,000 | $120,000 |
| 21. | Mechanical/Yard Piping | 1 LS | $275,000 | $275,000 |
| 22. | Electrical | 1 LS | $520,000 | $520,000 |

Subtotal ..... $ 7,606,000
Construction Contingency (20%) ..... $ 1,521,000
Subtotal ..... $ 9,127,000
Washington State Sales Tax (7.9%) ..... $ 721,000
**TOTAL ESTIMATED CONSTRUCTION COST ..... $ 9,848,000**
Engineering, Administrative, and Legal Services (20%) ..... $ 1,969,000
**TOTAL ESTIMATED PROJECT COST ..... $11,817,000**

## EVALUATION OF REUSE

Chapter 10 presents an evaluation of the feasibility of either reusing effluent from the City of Camas WWTF modified to generate reuse quality water (Alternative No. 1) or constructing a new water reclamation facility (WRF) at the north end of Lacamas Lake near Camp Currie to treat wastewater and produce water for reuse (Alternative No. 2). The chapter includes a detailed description of regulatory requirements and design criteria for various reuse alternatives. Possibilities considered include reuse by major industries, irrigation, streamflow augmentation and wetlands banking for mitigation.

Table ES-6 summarizes costs for the two major alternatives evaluated for water reclamation and reuse in the City of Camas. Production of reclaimed water is considered economically feasible if the cost of producing reclaimed water is less than or equal to the cost of purchasing water or developing additional water rights. The cost to develop and acquire the additional water rights from the four pending applications will not exceed a conservative estimate of 5 million dollars. At this time, production of reclaimed water is not economically feasible since adequate water rights are available at a relatively low cost, and the cost to produce reclaimed water is significantly more expensive than the cost to develop and acquire additional water rights.

**TABLE ES-6**

**Comparison Of Water Reclamation Alternatives(1)**

| | **Alternative No. 1 Modify Existing WWTF** | **Alternative No. 2 Construct a Satellite WRF** |
|---|---|---|
| Peak Hour Reuse Water Production | 6.1 mgd | 4.4 mgd |
| Capital Cost | $9,388,000 | $23,900,000 |
| Annual O&M Cost | $90,000 | $252,000 |
| 20-year Present Worth | $11,806,000 | $30,600,000 |

(1) Inflation assumed at 3 percent. 2006 dollars.

## FINANCIAL ANALYSIS

Chapter 11 presents an analysis of funding strategies for the City of Camas to finance recommended wastewater system capital improvements presented in the previous chapters. The financial status of the sewer utility, funding sources, and recommended funding programs to pay for the scheduled improvements are discussed.

The City is currently conducting a rate study to evaluate residential, commercial and industrial rates and system development charges. Residential customers are currently charged a flat rate monthly service charge of $23.55 per month. Commercial and industrial customers pay a monthly service charge and a volume charge. Customers outside the city pay 150 percent of the inside city rate. The City imposes a sewer system development charge (SDC) for all new connections to the sewer system to finance improvements of general benefit to the wastewater system, that are required to service future growth. The SDC for new residential connection is currently $2,349.

The analysis presented in the Plan assumes that monthly rates are increased by 10 percent annually in 2008 through 2011, and that SDCs are increased from $2,349 to $4,698 beginning in 2008. Ultimately, the rate study will be used to set new rates and SDCs for the City.

# CHAPTER 1

# INTRODUCTION

## GENERAL

This *General Sewer/Wastewater Facilities Plan* (2006 Plan) for the City of Camas addresses the City's planning needs for wastewater collection, transmission, treatment, and disposal for the 20-year planning period. This Plan was prepared in accordance with the provisions of the Revised Code of Washington (RCW), Section 90.48, *Water Pollution Control*, Washington Administrative Code (WAC) Section 173-240-050, *General Sewer Plan*, and WAC 173-240-060, *Engineering Report.* Development of the Plan has been coordinated with the City's 2004 *Comprehensive Plan*, Clark County planning efforts, and with the City's 2001 *Water System Comprehensive Plan*.

The 2006 Plan provides proposed conceptual designs, cost estimates, schedule, and financing plan for recommended major facility improvements. A State Environmental Policy Act (SEPA) checklist is provided in Appendix A. The projects described in the 2006 Plan are consistent with Washington State regulations relating to the prevention and control of discharge of pollutants into waters of the state, anti-degradation of existing and future beneficial uses of ground waters, and anti-degradation of surface waters.

The City of Camas is located within Clark County in southwest Washington State as shown in Figure 1-1.

## SCOPE OF WORK

Since the 2006 Plan is intended to be both a General Sewer Plan and a Wastewater Facilities Plan, the 2006 Plan evaluates both the wastewater collection system and the wastewater treatment system in detail. This evaluation includes collection and treatment system modeling, analysis and a capital improvement plan with cost analysis and schedule. The scope of work for the 2006 Plan includes the following items:

- Background data
- Service area characteristics
- Population and land use
- Regulatory criteria
- Projected future flow and loadings to the Wastewater Treatment Facility (WWTF)
- Pertinent performance and design criteria for system facilities
- Evaluation of the WWTF

- Computer model and evaluation of wastewater collection system
- Evaluation of water reuse alternatives
- Identification of system improvements with cost estimates
- Financing plan for capital improvement plan
- Environmental analysis

## RELATED PLANNING DOCUMENTS

The following documents were consulted in the preparation of this Wastewater Comprehensive Plan:

### GROWTH MANAGEMENT ACT (GMA) RELATED PLANS, POLICIES AND DEVELOPMENT REGULATIONS

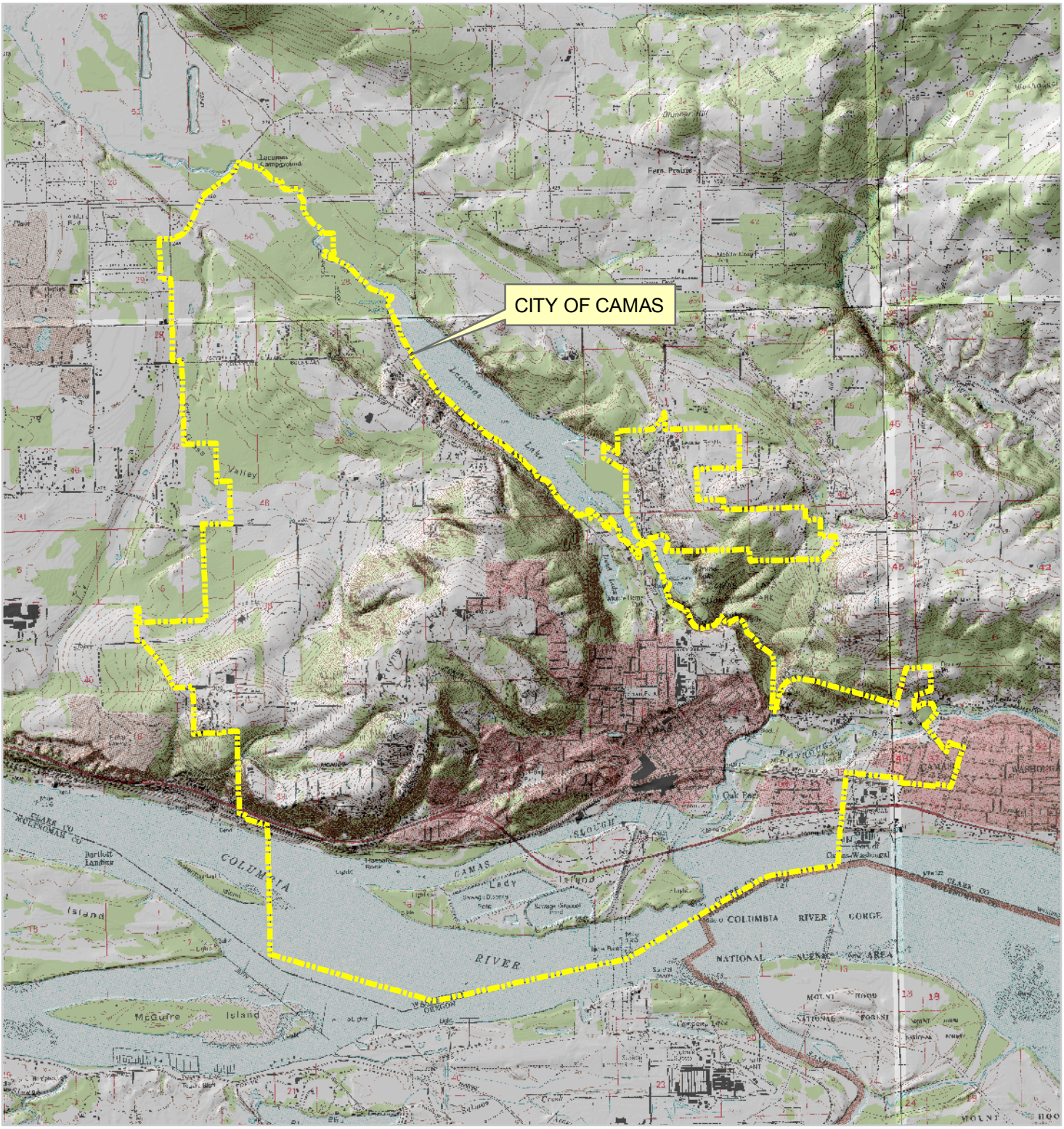
*City of Camas Comprehensive Plan*, City of Camas, March 2004.

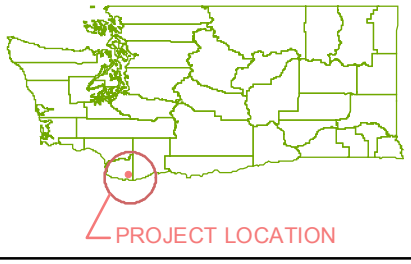
The City of Camas Comprehensive Plan, which was prepared by City of Camas staff and a consultant team, was originally adopted in 1994 and subsequently updated in March 2004. This document was developed to comply with the Growth Management Act (GMA), and is consistent with the planning policies of Clark County. The Comprehensive Plan addresses land use, transportation, housing, parks, recreation and open space, cultural and historic resources, environmental resources, economic development, capital facilities and utilities, and an implementation element. The Comprehensive Plan for the City of Camas provides:

- Policies and recommendations to direct public and private decisions affecting future growth and development,
- A framework of goals and policies adaptable to the changing attitudes and resources of the region,
- A long-range vision, based on community values and goals, of how citizens want Camas to look and function in the future as well as guidance for achieving that vision, and
- Guidelines for making decisions on growth, land use, transportation, public facilities, and services, parks, and open space.

In January 2007, the City adopted a Sensitive Lands Ordinance.

The March 2004 Comprehensive Plan used an annual growth rate of 2 percent for the City for 20-year growth projections. Per discussion with City staff, this growth rate is considered too low (since the City has averaged 7 percent growth) and discussions with the County are ongoing to increase the projected growth rate, as well as to set the city's future Urban Growth Boundary. As discussed in Chapter 3, more realistic growth rates have been used for projecting future wastewater flows and loadings.




N

0 4,500 Feet

# CITY OF CAMAS

GENERAL SEWER/WASTEWATER FACILITY PLAN

FIGURE 1-1

VICINITY MAP

Gray & Osborne, Inc.
CONSULTING ENGINEERS

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*Clark County Comprehensive Plan*, September 2004.

Clark County's first Comprehensive Plan under the GMA was adopted in 1994. An update to this plan was formally adopted by ordinance in September 2004. This document details 12 planning elements necessary for the proper management of growth that are consistent with the requirements. These 12 elements include: land use, housing, rural and natural resources, environmental, transportation, capital facilities and utilities, parks and open space, historic preservation, economic development, community design, annexation, and procedures for planning. In addition to a discussion of each element, the comprehensive plan includes a Community Framework Plan, which provides guidelines and policies for cities within the County in developing their Comprehensive Plans.

## WASTEWATER SYSTEM PLANNING

City of Camas Wastewater Facilities Plan, Part 1, March 1977/Part 2, December 1979, CH2M Hill.

This Plan included evaluation of alternatives for providing sewer service to the areas to the north and west of downtown (Ostenson Canyon, Forest Home, Northeast Prune Hill, and the area to the south of Lacamas Lake).

In this report, an I/I study estimated that a peak of 4.7 mgd of I/I - an amount determined to be "excessive" by EPA's definition - was entering into the Camas system.

Recommended system improvements to reduce I/I included:

- routing stormwater away from sewer pipe in Basin 4 with a trench drain,
- repairing and replacing broken pipe and damaged manholes,
- plugging inactive and faulty service connections, and
- disconnecting roof and fountain drains and catch basins.

According to subsequent reports by CH2M Hill, all recommended improvements were made except the replacement of faulty service connections, which was determined to be too great a financial burden on property owners.

Two new sewer lines were built after the Part One of this report was issued. Sewers were extended north of the then city limits along Fargo Street (Basin 3 North), and additional sewers were constructed in West Camas in Basin 10.

City of Camas Sewerage Facilities Plan, March 1987, Parametrix, Inc.

This report focused on the plan for construction of STEP systems for the Lacamas Heights area (Basin 15) and other areas to the west of downtown Camas. The authors found that the average dry weather flows at this time were 0.37 mgd.

City of Camas Evaluation of Sewer System Alternatives, April 1993, CH2M Hill.

This report provided an evaluation of the City's existing septic tank effluent (STE) systems, and considered alternatives to provide sewer service to the unsewered areas within the Urban Growth Boundary (UGB) and projected future UGB, including areas of current West Camas and north of Lacamas Lake. The report recommended the City implement a combined STE conventional gravity approach to providing sewer service to the study area.

City of Camas Wastewater Facilities Plan, October 1994, CH2M Hill.

This plan included a series of technical memoranda evaluating potential treatment plant improvements, sludge disposal options, and outfall improvements. The report recommended immediate construction of a secondary clarifier, future improvements to the headworks and aeration basins, and phased construction of aerobic sludge digestion or lime stabilization facilities.

City of Camas Wastewater Facility Plan, June 1997, Gray & Osborne.

The *City of Camas Wastewater Facility Plan* (1997 Plan) discusses the conditions of the existing WWTP and expansions needed to serve the projected population growth throughout the 15-year planning period, 2000-2015.

The proposed process scheme for the expanded City of Camas Wastewater Treatment Plant was that of a secondary activated sludge plant with Phase I solids treatment by aerobic digestion. At the time, Phase II solids treatment facilities were proposed to be anaerobic sludge digesters, to be constructed by 2010. The secondary activated sludge process with solids treatment by aerobic digestion, along with new headworks, clarifiers, sludge dewatering and ultraviolet disinfection, was completed and came on line in 2002.

Alternatives for Phase II solids treatment will be further reviewed in this 2006 Plan.

City of Camas Sewer System Infiltration and Inflow Study, Gray & Osborne Inc., August 1998

The *City of Camas Sewer System Infiltration and Inflow Study* evaluated the City's wastewater collection system and recommended improvements to reduce excessive infiltration and inflow (I/I). The study achieved the following objectives:

- Quantified the amount of I/I entering the sewer system,
- Determined the sources of I/I entering the system,
- Evaluated the technical feasibility and cost-effectiveness of potential sewer system rehabilitation projects to remove excessive I/I,

- Evaluated the technical feasibility and cost-effectiveness of potential wastewater treatment plant improvement projects to treat excessive I/I, and
- Provided a prioritized list of sewer system rehabilitation and treatment plant improvements, including estimated costs.

**WATER SYSTEM COMPREHENSIVE PLANS**

*City of Camas Water System Comprehensive Plan*, Gray & Osborne, Inc., February 2002

The *City of Camas Water System Comprehensive Plan* discusses the existing water system facilities, water usage and design criteria, conservation programs, system expansion, and water system improvements. The recommended system improvements include replacement of aging and undersized water mains, improvements to the City's maintenance and operations facilities, replacement of collapsed wells, and new source development and water right acquisition. The plan also highlights conservation measures to be implemented, these include:

- Distribution of water conservation devices,
- Water audits,
- Central control of irrigation systems,
- A leak detection study for the distribution system and Butler Reservoir.

## WATERSHED PLANNING

*Lewis/Salmon-Washougal Watershed Plan*, Washington Department of Ecology and Lower Columbia Fish Recovery Board, approved by Planning Unit December 2004.

The City of Camas is a participating member in the planning unit of the Lewis, Salmon & Washougal Watershed Plan (WRIAs 27/28). The following table includes a list of all entities that participate in this planning unit. The Lewis/Salmon-Washougal Watershed Plan was unanimously adopted by the planning unit on December 13, 2004. The Plan addresses issues such as water supply, water quality, instream flows, and habitat protection. The Washington State Department of Ecology, Watershed Planning, website (as of May 2005) included the following list of findings from the Plan:

- *Most communities, with the exception of Kalama and Woodland, rely on groundwater sources for public drinking water supplies.*
- *Major public water system managers anticipate significant population growth, with groundwater the most feasible source of new water. The primary issue for these water systems is acquisition of new water rights.*
- *Water system plans may not address projected growth in water demand in the commercial and industrial sector. Small public water systems are not projected to grow much in the future.*

- *Water use in the agricultural sector is not well documented. Agriculture water use is likely declining in the region.*
- *Stream in two WRIAs are low elevation rain-fed systems with very low late summer and early fall flows.*
- *Using reclaimed water from municipal and industrial supply is not practical now but may be in the future.*
- *Low Stream flow has been identified as a limiting factor for salmon throughout the two WRIA areas.*

**TABLE 1-1**

**Lewis, Salmon and Washougal Watershed Plan**

| **Planning Unit Representation(1)** | |
|---|---|
| Clark County | Port of Kalama |
| Cowlitz County | Clark Skamania Fly Fishers |
| Skamania County | Woodland Diking District |
| City of Camas | Weyerhauser |
| City of Battle Ground | Clark EDC |
| City of Kalama | Fish First |
| Cit of La Center | C-W Fish and Wildlife League |
| City of Washougal | Citizen-at-Large |
| City of Ridgefield | USFS |
| City of Vancouver | Responsible Growth Forum |
| City of Woodland | Cowlitz PUD |
| City of Yacolt | Department of Ecology |
| Cowlitz Tribe | Department of Fish & Wildlife |
| Clark County PUD | Department of Natural Resources |
| | Department of Agriculture |

(1) Washington State Department of Ecology, Watershed Planning, website (May 2005)

## STORMWATER COMPREHENSIVE PLANS

*Stormwater Management Manual for the Puget Sound Basin*, Washington Department of Ecology, 1992 (Puget Sound Manual).

*Stormwater Management Manual for Western Washington, Volume II*, Washington Department of Ecology, August 2001 (2001 Western Washington Manual).

The City has adopted the Ecology stormwater management manuals listed above. The Puget Sound Manual is used for the design of new stormwater facilities to detain stormwater runoff, and the Best Management Practices (BMPs) from the 2001 Western Washington Manual are used to avoid environmental impacts during construction. Such

erosion prevention and sediment control measures include construction entrances, temporary sediment ponds, filter fences and interceptor trenches. In terms of detention, the 2005 manual results in large detention facilities that are difficult to incorporate into areas intended for development and redevelopment. However, as a result of the February 2007 issuance of the NPDES Phase II Stormwater Permit, the City will need to adopt all minimum requirements (including detention) from the 2005 Manual, or equivalent measures.

The 2005 Western Washington Manual can be downloaded from Ecology's website or a hard copy can be ordered. The 2005 manual was updated to "correct errors, clarify statements, update design criteria and procedures, and apply recent research" (www.ecy.wa.gov/programs/wq/stormwater).

The City also controls stormwater through National Pollutant Discharge Elimination (NPDES) permits and its municipal code as described below:

- NPDES and Waste Discharge Permits are issued for construction activities equal to or greater than one acre.
- As of February 17, 2007, NPDES Phase II permits cover separate municipal storm sewer systems. (The permit is currently in place, although it is being legally contested by numerous Washington cities.)
- The City of Camas Erosion Control Plan, Municipal Code, Title 15.32, sets out sediment and erosion control requirements for construction projects and small parcels.

Due to significant changes in wetland protection policies, the City updated the 1991 Plan with the production of the 1998 Comprehensive Flood and Drainage Management Plan (1998 Plan). The newer wetland policies limited the ability of the City to use existing wetlands for stormwater drainage, which was a major approach of the 1991 Plan. The City of Camas is an area that has developed as an urban area and experiences typical problems associated with increased development versus stormwater management.

# CHAPTER 2

# SEWER STUDY AREA

The City of Camas is located in southeastern Clark County, approximately 12 miles east of Vancouver at the confluence of the Columbia and Washougal Rivers. The City is bordered by the Columbia River to the south, the City of Washougal and Woodburn Hill to the east, the City of Vancouver and Grass Valley to the west, and Lake Lacamas and Lacamas Park to the north.

The City is comprised of approximately 7,400 acres and 15,400 residents. The City has a number of light industrial and technical businesses that provide a large percentage of the total employment within the City. Most notable are WaferTech, a semiconductor and chip manufacturer; Georgia Pacific, that operates a large mill within the City; and Underwriters Laboratories.

## SEWER SERVICE AREAS

### CITY OF CAMAS

The City of Camas current sewer service area includes approximately 7,700 acres within its corporate boundaries and its Urban Growth Boundary (UGB) as shown on Figure 2-1. The collection system consists of a mixture of conventional gravity sewer systems and septic tank effluent (STE) systems. The sewage collection system consists of over 80 miles of mains and laterals that serve three drainage basins:

1. The Fisher basin extends from Fisher Swale on the west, to Lacamas/Round Lake on the east and north, and Prune Hill in the south. Sewer service within this basin is provided by means of STE systems, gravity mains, and pumping facilities.

2. The second basin includes the central business district and the area extending northwest up to the summit of Prune Hill and along its south border. This basin is primarily served with a conventional gravity sewer.

3. A third basin includes the area west of downtown along the Columbia River which includes a combination of conventional gravity sewers, STE systems, and pump stations.

## ADJACENT SEWER SERVICE AREAS

### Clark County

Clark County operates and maintains the Salmon Creek Wastewater Treatment Plant and the Clark Regional Wastewater District maintains the sewer collection system that primarily serves the unincorporated area of Hazel Dell. The treatment plant receives 85 percent of influent flow from Hazel Dell and less than 100,000 gallons per day (gpd) from the City of Battleground and the community of Hockinson. The Salmon Creek WWTP is an activated sludge plant rated for 10.3 mgd maximum month flow, with aeration basins, secondary clarifiers ultraviolet disinfection and an outfall in the Columbia River. At the Salmon Creek WWTP, sludge is thickened, blended, digested anaerobically, dewatered and the biosolids are stored, hauled away, and land applied.

The City of Vancouver provides sewer service to county residents adjacent to its corporate boundaries. The rest of the County is served by individual septic systems.

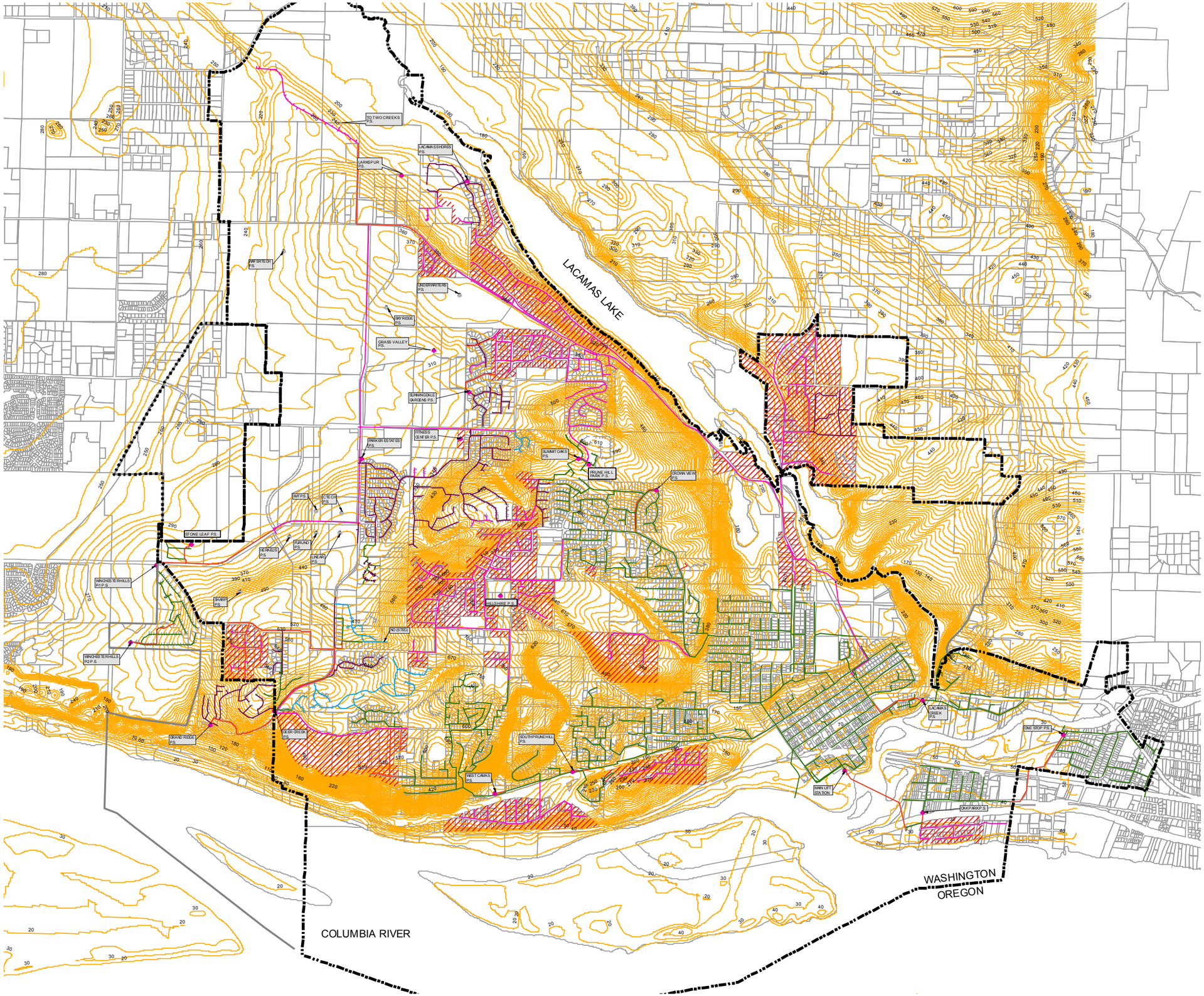
### City of Vancouver

The City of Vancouver and its sewer service area abuts the Camas UGB from the Columbia River to the north end of the Camas UGB. Vancouver's sewer service area population was 46,000 in 2003. Vancouver's sewage collection system includes about 650 miles of wastewater pipes and 29 pumping stations with developers adding 15 to 20 miles of new pipe each year. The City's collection system is divided into three sections: the Westside Basin, Eastside Basin, and Diversion Basin. All flows from the Eastside basin are treated at the Marine Park Facility. The flows from the Diversion Basin may be divided between the Marine Park facility and Westside Treatment Facility which also serves the City of Vancouver.

The Marine Park Facility and Westside Treatment Facility are activated sludge plants with six aeration basins each, secondary clarifiers (four for Marine Park and five for Westside), ultraviolet disinfection and outfalls in the Columbia River. Scum and solids removed from both the primary and secondary clarifiers at both WWTPs are incinerated in a fluidized bed furnace at the Westside WWTP; the solids from the Marine Park WWTP are pumped through a force main, and then conveyed through a gravity sewer, to the Westside WWTP. The maximum month rated capacities for the two plants are 16.1 mgd for the Marine Park Facility and 28.26 mgd for the Westside Treatment Facility.

### City of Washougal

The City of Washougal is directly east of Camas and adjoins the Camas Urban Growth Boundary (UGB) from the Columbia River up to the base of Lacamas Park. Washougal's collection system includes six duplex sewage pumping stations and approximately 8,000




N

0 2,500 5,000 Feet

## LEGEND:

- URBAN RESERVE
- CITY LIMITS
- URBAN GROWTH BOUNDARY
- Pump Station (Private)
- Pump Station (Public)
- Gravity
- Force Main
- STEP
- STEF
- STEG
- SEWER PIPES
- STEP SYSTEM AREAS (EXISTING)
- 10 FOOT CONTOURS
- PARCELS

SOURCE: CITY OF CAMAS

# CITY OF CAMAS

GENERAL SEWER/WASTEWATER
FACILITY PLAN
FIGURE 2-1
SEWAGE COLLECTION SYSTEM

Gray & Osborne, Inc.
CONSULTING ENGINEERS

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feet of force mains. Washougal's WWTP consists of an extended aeration activated sludge system with an oxidation ditch, secondary clarifier, disinfection by chlorination and an outfall in the Columbia River. A lagoon basin is used as storage for peak influent flows, while three other lagoons are used for sludge storage. The facility was designed for a maximum month capacity of 2.24 mgd.

## NATURAL ENVIRONMENT

### TOPOGRAPHY

Camas is located on terrain characterized by steep slopes, with a flat plateau centered in the core of the City. Approximately 1,237 acres within the city are classified as steep and unstable slopes. The downtown and older parts of the city are located on flat ground and are almost at the level of the Columbia River. These areas are surrounded on three sides by Prune Hill and other steep slopes, with the Columbia River forming the southern boundary. Residential areas to the north and west of downtown are built on slopes ranging from 5 to15 percent. The elevation within the city ranges from 20 feet above sea level to 752 feet at the Upper Prune Hill Standpipe located at the top of Prune Hill.

Figure 2-2 is a USGS topographic map showing the varying elevations within the City's sewer service area.

### SOILS AND GEOLOGY

Camas is located within the alluvial fan of the Columbia River and associated deposits. The majority of the soils within the City are classified as Hillsboro-Dollar-Cove Association by the SCS. This soil class is defined as deep, dominantly level to sloping, well-drained to very poorly drained, medium textured terrace soil. The area near Lacamas Lake, and portions of land that fall within the City's service area are classified as Hesson Olympic Association. This soil class is deep, nearly level to steep, moderately fine textured soils. A more detailed definition of the types and locations of the soil classifications within the Wastewater Service Area is presented in Figure 2-3, based on an NRCS Soil Survey of Clark County, Washington.

### CLIMATE

Major weather stations in the vicinity of Camas are located in Vancouver and Skamania. The City of Camas is located approximately 12 miles east of Vancouver and 20 miles west of Skamania. Table 2-1 and 2-2 provide precipitation data for both weather stations.

## TABLE 2-1

## Vancouver Station Precipitation 1995-2004

| Year | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1995 | 7.69 | 3.41 | 4.25 | 4.19 | 1.98 | 2.05 | 1.32 | 0.00 | 1.98 | 4.62 | 10.68 | 6.63 | 48.80 |
| 1996 | 7.44 | 10.58 | 2.85 | 5.40 | 4.65 | 0.94 | 0.70 | 0.23 | 2.79 | 6.17 | 9.42 | 13.26 | 64.43 |
| 1997 | 9.27 | 2.55 | 6.88 | 3.62 | 2.00 | 3.07 | 0.65 | 1.77 | 3.00 | 7.37 | 5.11 | 4.72 | 50.01 |
| 1998 | 7.46 | 5.72 | 4.69 | 1.01 | 6.18 | 1.37 | 0.40 | 0.00 | 1.27 | 3.92 | 11.15 | 7.06 | 50.23 |
| 1999 | 7.74 | 8.91 | 4.67 | 1.79 | 2.22 | 2.44 | 0.15 | 0.79 | 0.14 | 2.50 | 7.51 | 4.93 | 43.79 |
| 2000 | 6.38 | 5.62 | 3.53 | 1.79 | 3.07 | 1.01 | 0.21 | 0.35 | 0.54 | 3.76 | 2.99 | 2.17 | 31.42 |
| 2001 | 2.07 | 1.62 | 3.21 | 2.55 | 1.34 | 2.72 | 0.76 | 0.90 | 1.54 | 3.50 | 7.72 | 7.75 | 35.68 |
| 2002 | 7.20 | 3.65 | 4.15 | 2.46 | 2.39 | 1.36 | 0.44 | 0.21 | 1.23 | 0.68 | 2.45 | 10.41 | 36.63 |
| 2003 | 8.36 | 3.35 | 5.90 | 6.64 | 1.77 | 0.03 | 0.00 | 0.10 | 1.24 | 2.77 | 4.37 | 8.57 | 43.10 |
| 2004 | 4.59 | 4.61 | 2.22 | 2.21 | 1.68 | 1.21 | 0.02 | 2.58 | 1.53 | 4.07 | 2.78 | 3.78 | 31.28 |
| | | | | | | | | | | | | | |
| **Ave** | 6.82 | 5.00 | 4.24 | 3.17 | 2.73 | 1.62 | 0.47 | 0.69 | 1.53 | 3.94 | 6.42 | 6.93 | 43.54 |
| **Min** | 2.07 | 1.62 | 2.22 | 1.01 | 1.34 | 0.03 | 0.00 | 0.00 | 0.14 | 0.68 | 2.45 | 2.17 | 31.28 |
| **Max** | 9.27 | 10.58 | 6.88 | 6.64 | 6.18 | 3.07 | 1.32 | 1.77 | 3.00 | 6.17 | 11.15 | 13.26 | 64.43 |

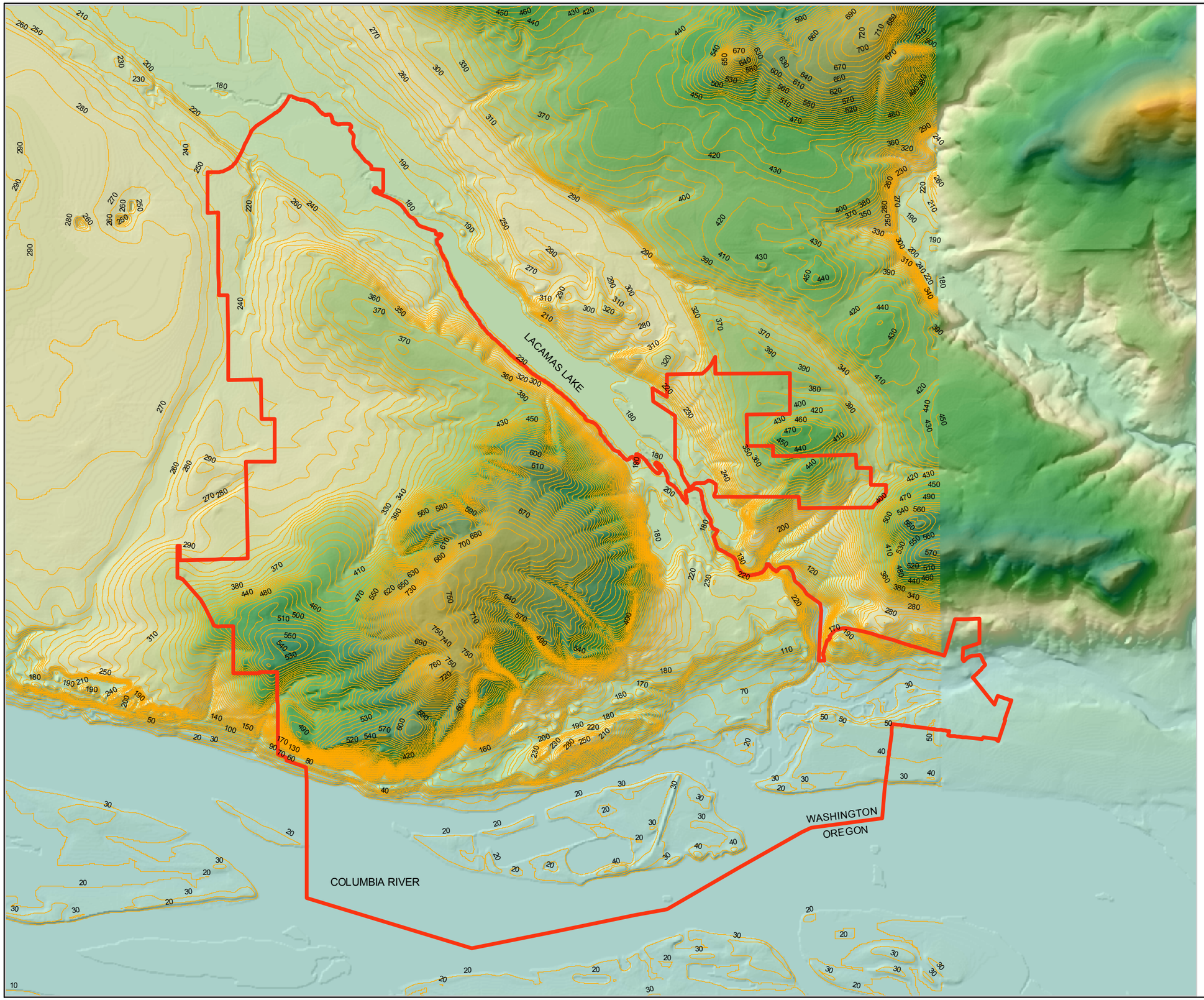
SOURCE: NOAA, National Virtual Data System, Vancouver station (144).

## TABLE 2-2

## Skamania Fish Hatchery Precipitation 1995-2004

| Year | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1995 | 12.27 | 10.51 | 6.59 | 6.97 | 3.39 | 5.39 | 1.77 | 0.00 | 5.61 | 9.66 | 23.55 | 12.01 | 97.72 |
| 1996 | 13.49 | 16.50 | 5.87 | 9.43 | 7.36 | 2.61 | 0.57 | 0.42 | 5.14 | 13.78 | 17.00 | 20.83 | 113.00 |
| 1997 | 14.62 | 5.89 | 15.40 | 10.62 | 3.30 | 4.51 | 2.62 | 2.19 | 5.27 | 13.60 | 7.72 | 8.31 | 94.05 |
| 1998 | 12.19 | 10.13 | 10.76 | 3.83 | 9.38 | 3.98 | 0.23 | 0.16 | 2.96 | 5.46 | 14.47 | 18.34 | 91.89 |
| 1999 | 12.01 | 14.43 | 8.18 | 2.44 | 8.30 | 5.12 | 1.68 | 2.00 | 0.44 | 4.94 | 17.21 | 14.30 | 91.05 |
| 2000 | 10.02 | 14.32 | 5.64 | 4.84 | 7.72 | 3.16 | 0.32 | 0.18 | 3.44 | 6.98 | 5.58 | 6.05 | 68.25 |
| 2001 | 4.71 | 3.41 | 8.14 | 7.08 | 4.40 | 5.58 | 1.10 | 2.03 | 1.48 | 7.85 | 11.77 | 14.32 | 71.87 |
| 2002 | 12.18 | 8.49 | 8.50 | 6.81 | 2.41 | 4.04 | 0.20 | 0.24 | 1.69 | 2.07 | 5.10 | 13.12 | 64.85 |
| 2003 | 11.92 | 7.20 | 15.03 | 8.33 | 3.89 | 0.42 | 0.16 | 0.06 | 3.68 | 5.87 | 9.66 | 13.45 | 79.67 |
| 2004 | 14.09 | 8.49 | 4.72 | 2.75 | 6.53 | 3.36 | 0.05 | 7.15 | 5.22 | 8.36 | 12.02 | 13.76 | 86.50 |
| | | | | | | | | | | | | | |
| **Ave** | 11.75 | 9.94 | 8.88 | 6.31 | 5.67 | 3.82 | 0.87 | 1.44 | 3.49 | 7.86 | 12.41 | 13.45 | 85.88 |
| **Min** | 4.71 | 3.41 | 4.72 | 2.44 | 2.41 | 0.04 | 0.16 | 0.06 | 0.44 | 2.07 | 5.10 | 6.05 | 64.85 |
| **Max** | 14.09 | 10.51 | 15.40 | 10.62 | 9.38 | 5.39 | 1.77 | 7.15 | 5.61 | 13.78 | 23.55 | 20.83 | 113.00 |

SOURCE: NOAA, National Virtual Data System, Skamania Fish Hatchery station (130).




N

0 1,500 3,000 6,000 Feet

SCALE 1" = 3000'

**LEGEND:**

CITY LIMITS

10 FOOT CONTOURS

# CITY OF CAMAS

GENERAL SEWER/WASTEWATER
FACILITY PLAN
TOPOGRAPHY MAP
FIGURE 2-2

Gray & Osborne, Inc.
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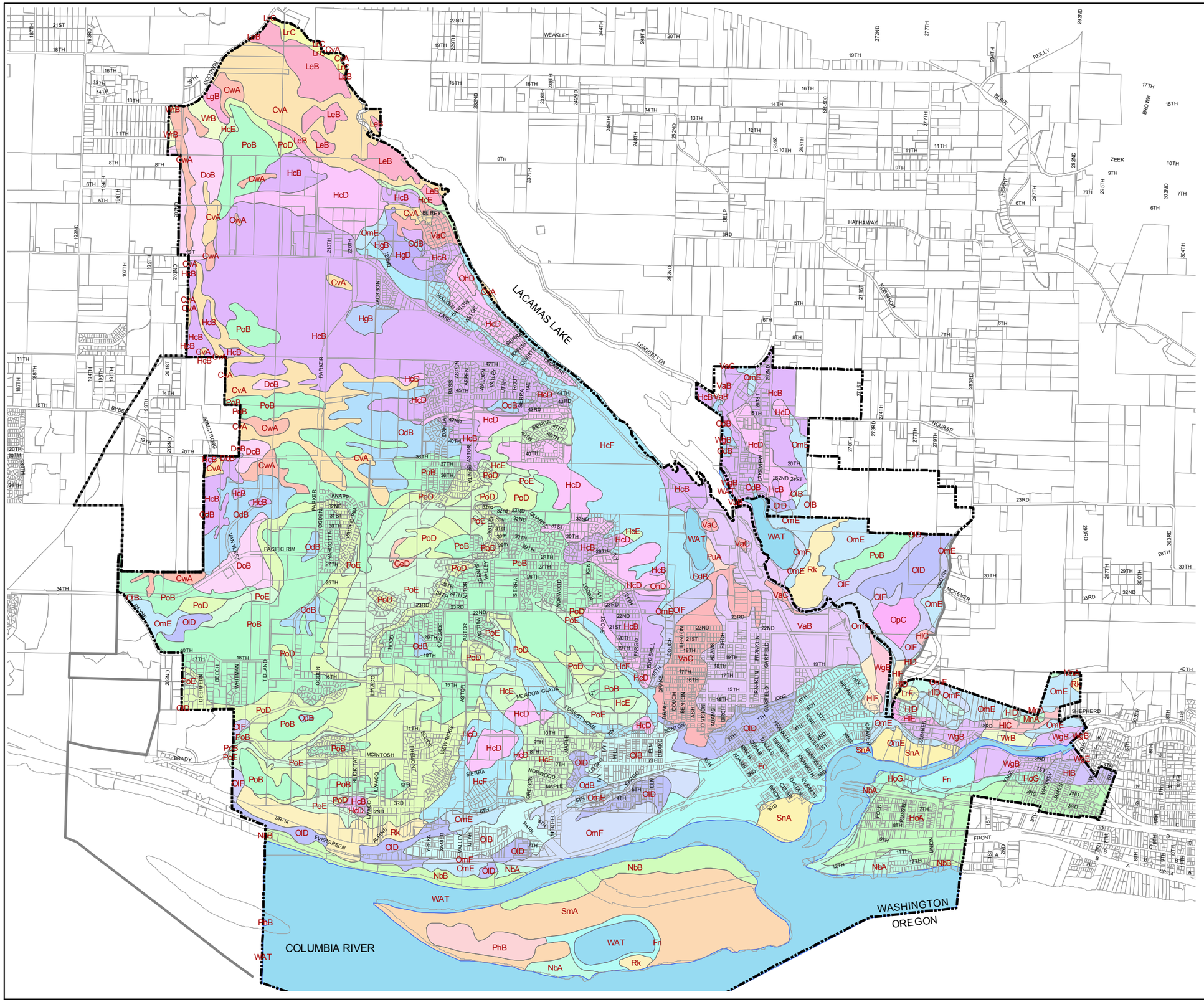


N

0 2,500 5,000 Feet

## LEGEND:

- URBAN RESERVE
- CITY LIMITS
- URBAN GROWTH BOUNDARY
- PARCELS

**GROUP, SOIL CLASS:**

- Water, WAT
- Cove, CvA
- Cove, CwA
- Dollar, DoB
- Fill Land, Fn
- Gee, GeD
- Hesson, HcB
- Hesson, HcD
- Hesson, HcE
- Hesson, HcF
- Hesson, HgB
- Hesson, HgD
- Hillsboro, HlB
- Hillsboro, HlC
- Hillsboro, HlD
- Hillsboro, HlE
- Hillsboro, HlF
- Hillsboro, HoA
- Hillsboro, HoG
- Lauren, LeB
- Lauren, LgB
- Lauren, LrC
- Lauren, LrF
- Minniece, MnA
- Newberg, NbA
- Newberg, NbB
- Odne, OdB
- Olequa, OhD
- Olympic, OlB
- Olympic, OlD
- Olympic, OlF
- Olympic, OmE
- Olympic, OmF
- Olympic, OpC
- Pilchuck, PhB
- Powell, PoB
- Powell, PoD
- Powell, PoE
- Puyallup, PuA
- Rockland, Rk
- Sauvie, SmA
- Sauvie, SnA
- Vader, VaB
- Vader, VaC
- Washougal, WgB
- Washougal, WgE
- Wind River, WrB

SOURCE: CITY OF CAMAS

# CITY OF CAMAS

GENERAL SEWER/WASTEWATER
FACILITY PLAN
SOIL GROUPS
FIGURE 2-3

Gray & Osborne, Inc.
CONSULTING ENGINEERS

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The climate in Skamania is highly distinct from that in Vancouver. Skamania lies at the southern base of the Cascade Mountains which block rain clouds from traveling any further east. Consequently, Skamania receives considerably more rainfall than Vancouver. Since Camas is essentially an equal distance between these stations, annual rainfall is a blend of the two. An interpolation of precipitation data for both stations produced a 10-year annual average precipitation of 75.35 inches. The 10-year maximum month precipitation for Vancouver is 13.26 inches in December and 23.5 inches in November at the Fish Hatchery, a 43 percent difference. The 10-year minimum annual precipitation at Vancouver is 0.00 inches in both July and August, and 0.04 inches in June at the Fish Hatchery.

Temperature in Camas ranges from a high of 61 degrees, to a minimum of 41 degrees, and a mean of 51 degrees. Winds generally come from the east-southeast with the exception of April to September when they come from the northeast. High easterly winds come on a year-round basis from the Columbia River Gorge.

## SITE SENSITIVE AREAS

The following section summarizes information regarding site-sensitive/critical areas presented in the *City of Camas Comprehensive Plan,* March 2004. Critical areas within the sewer service area include those classified as streams and watercourses, wetlands, frequently flooded areas, critical aquifer recharge areas, geologically hazardous areas, and fish and wildlife habitat conservation areas. Title 16, Environment, and Title 18, Zoning, of the Camas municipal code provides protection to site sensitive areas. Municipal code 16.50.240 (A), Critical area protective mechanism, states the follow policy:

> *Identified critical areas and their associated buffers or management zones shall be protected and preserved through a permanent protective mechanism acceptable to the city. This may include placing the critical area and its associated buffer or management zone in a separate tract; executing a protective easement; or dedicating the critical areas and its associated buffer or management zone to a public agency or public or private land trust. The mechanism shall provide for maintenance of the critical area and is associated buffer or management zone*.

In addition, the City of Camas Comprehensive Plan includes a high level of environmental stewardship as stated below:

> *One of the most demanding roles the City of Camas must fulfill is that of chief steward of the city's environment. The city has the authority to regulate land use and the responsibility to implement federal and state statues. Therefore, the city must endeavor at all times to ensure that its environment is managed wisely. The city encourages the preservation, restoration, and improvement of the natural environment. The city*

*encourages all residents and businesses to explore ways to contribute to protecting the environment.*

The following plans and regulations were prepared for the protection of the natural environment within Camas:

- Parks, Recreation, and Open Space Comprehensive Plan, adopted January 2000.
- Revised Shoreline Management Master Program, adopted 1998.
- Sensitive Areas and Open Space Ordinance, adopted January 2007.

The site sensitive areas within the sewer service area are described further below.

**Surface Water**

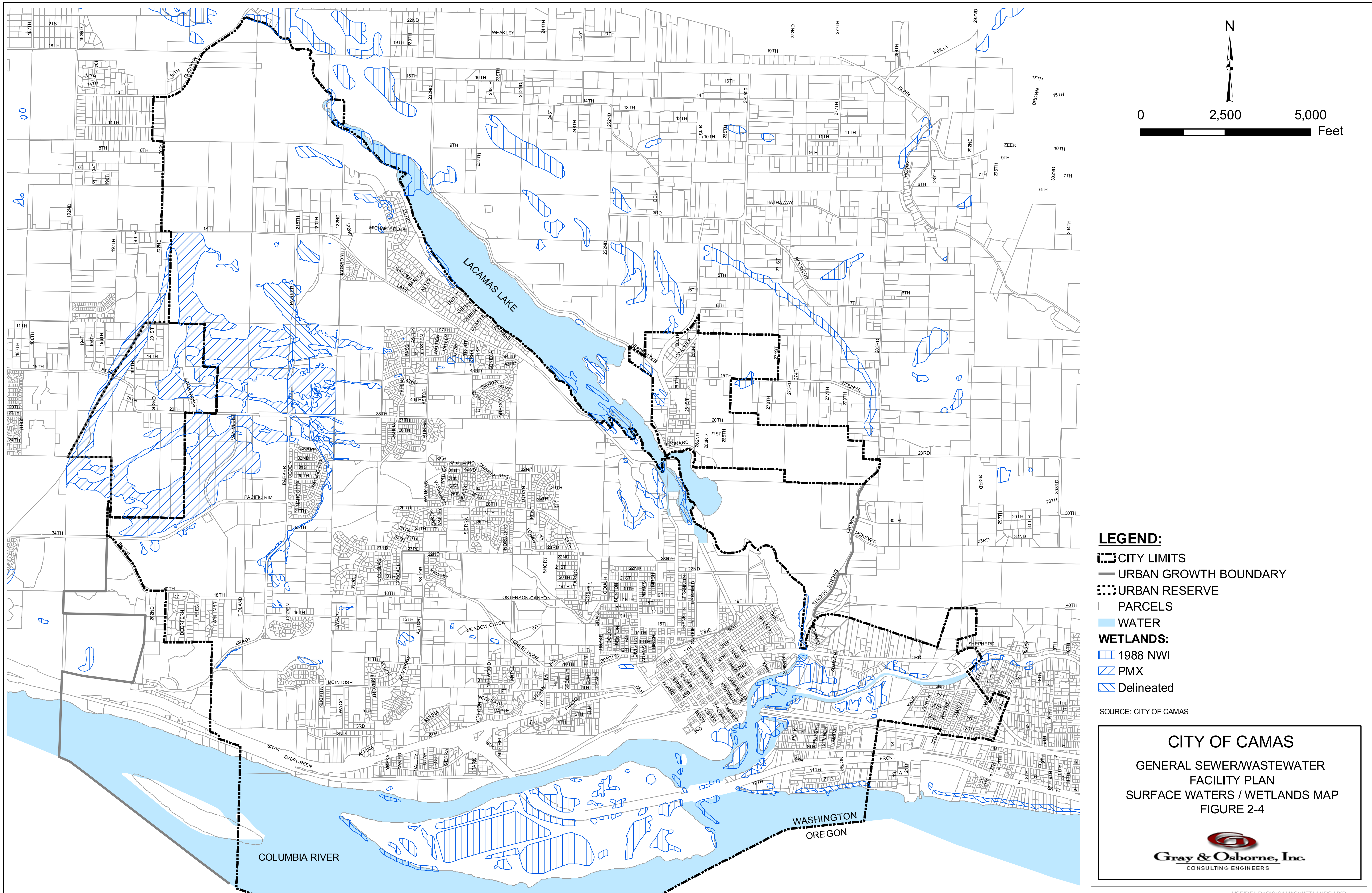
Lakes and streams are classified as sensitive areas due to the variety of plants and animals that they support. Camas' wet climate and sloping terrain provides flows to many streams and creeks. These watercourses drain into the Columbia and Washougal Rivers, or into the surrounding lakes. The major surface waters located within the Camas area include the Columbia and Washougal Rivers; Lake Lacamas; Jones, and Boulder Creeks; and Round and Fallen Leaf Lakes. The intent of municipal code, 16.06.030, Ground and Surface Water Quality, is to prevent adverse effects to water quality in the Camas area. The major surface waters are shown in Figure 2-4.

**Wetlands**

The Growth Management Act defines wetlands as areas that have surface or ground water that supports vegetation typically adapted in saturated soil conditions. Wetlands support valuable and complex ecosystems and consequently development is severely restricted if not prohibited in most wetlands and buffer areas around the wetland. There are approximately 1,200 acres within the City that are classified as wetlands. The major wetlands within the City of Camas are located on Lady Island, along the Washougal River, and adjacent to Lake Lacamas and Round and Fallen Leaf Lakes. The intent of the City's municipal code, 18.31.050, Wetland standards, is to prevent adverse effects to wetlands and wetland buffers from development effects. Figure 2-4 also shows wetland areas within the Camas UGA.

**Frequently Flooded Areas**

Flood hazard areas are areas adjacent to lakes, rivers, and streams that are prone to flooding during peak runoff periods. Construction of buildings and other development in these areas is regulated in accordance with flood hazard construction standards. The Camas 100-year flood plain map (land that has a 1 percent chance of flooding each year)




# CITY OF CAMAS

GENERAL SEWER/WASTEWATER
FACILITY PLAN
SURFACE WATERS / WETLANDS MAP
FIGURE 2-4

Gray & Osborne, Inc.
CONSULTING ENGINEERS

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is depicted in Figure 2-5. Proposed development projects within 300 feet of a frequently flooded area are required by municipal code 16.80 to provide a critical area report.

**Critical Aquifer Recharge Areas**

The City of Camas uses groundwater as a significant portion of its water supply. The City has twelve groundwater wells, eight of which are active. Since the majority of the wells are in the vicinity of downtown, critical aquifer recharge areas are important areas to protect. Camas Municipal Code 16.70.050, Aquifer Recharge Areas, requires a professional aquifer recharge area critical report for all proposed activities in such areas.

**Geologically Hazardous Areas**

Clark County exhibits traces of its geologic history including repeated inundation by fluctuating sea levels during glacial epochs, the sedimentary processes of the Columbia River, volcanic activity, periodic earthquakes, and other tectonic activity. There is an active fault in the region that runs under Lacamas Lake, and there are approximately 1,237 acres within the City that are classified as steep and unstable slopes. Figure 2-6 is a map of the steep slopes in Camas.

Seismic hazard areas are those with low-density soils that are more likely to experience greater damage due to seismic-induced subsidence, liquefaction, or landslides. Seismic hazard areas are regulated mainly with respect to public safety and with the exception of a severe earthquake, these hazard areas do not impact wastewater facilities. United States is divided into seismic hazard zones based upon historic documents. These zones range from category 1 to 4, with 4 representing the highest risk. Camas is Category 4, which means that the Camas building code must have the highest construction standards.

**Fish and Wildlife Habitat Conservation Areas**

Sensitive fish and wildlife habitat is defined as areas which meet the definition of a "Fish and Wildlife Habitat Critical Area" pursuant to WAC 365-190-080(5) and is essential for maintaining specifically listed species in suitable habitats. Any proposed activity within 300 feet of these areas, including construction related to wastewater collection systems, requires that a habitat assessment be prepared. Table 2-3 summarizes the priority anadromous and resident fish species in the Camas area.

The Columbia and Washougal Rivers provide habitat for Threatened species such as Columbia Chinook, Chum, and Steelhead salmon. Fish and wildlife habitat areas that are within the Camas UGB are shown on Figure 2-7.

**TABLE 2-3**

**Priority Anadromous and Resident Fish Species(1)**

| Species | Status | Columbia River | Washougal River | Little Washougal River | Boulder Creek | Jones Creek |
|---|---|---|---|---|---|---|
| Chinook | Threatened | √ | √ | | | |
| Coho | | | | | | |
| Sockeye | | | | | | |
| Winter Steelhead | Threatened | √ | √ | √ | √ | √ |
| Resident Cutthroat Trout | Candidate | √ | √ | | | |
| Resident Chum | Threatened | √ | | | | |

(1) Checkmark indicates species is present.

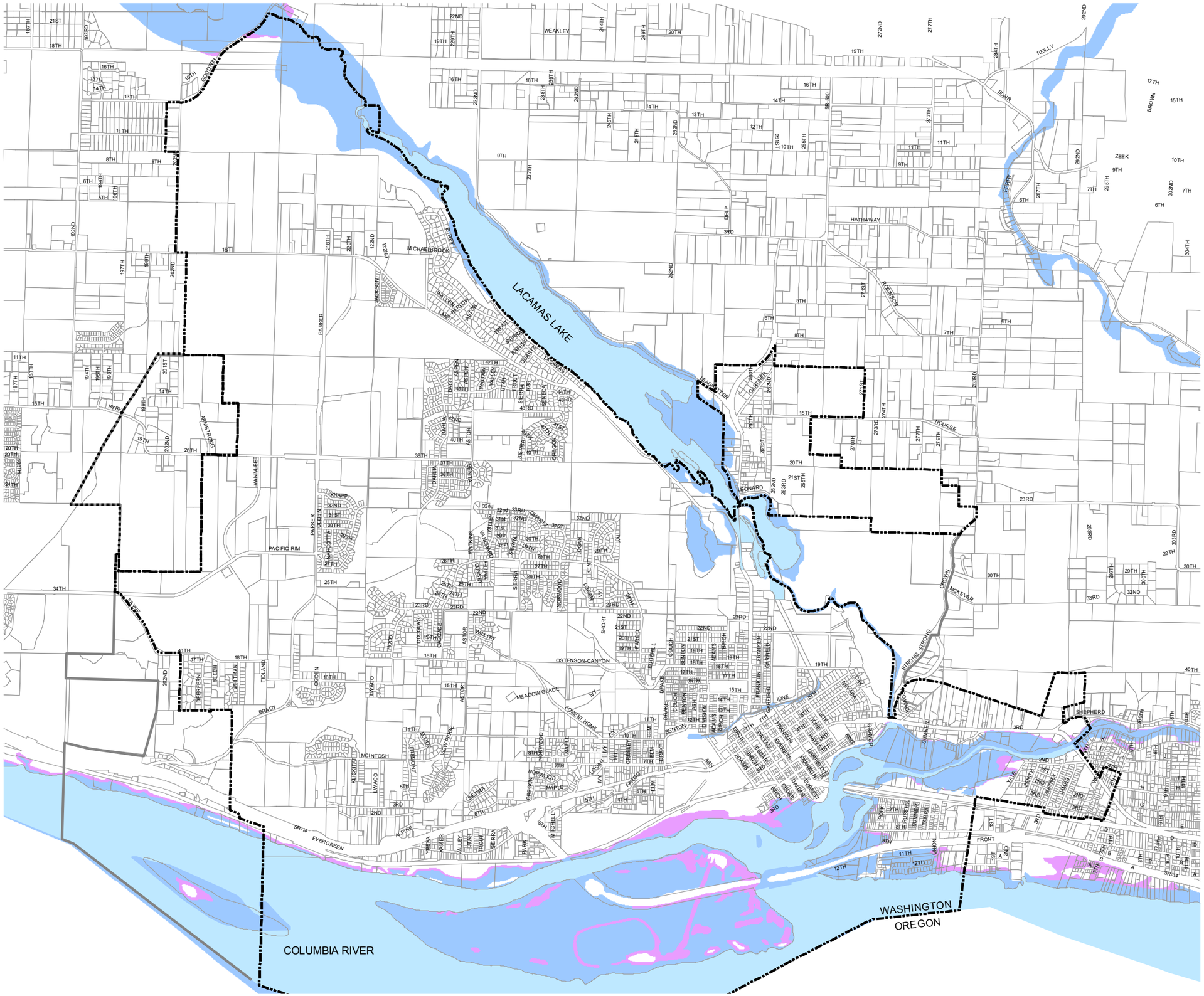
### Open Space Network

The City has developed quickly and is running out of open space and land for neighborhood parks. The City of Camas 2000 Parks and Open Space Comprehensive Plan identified approximately 2,000 acres of sensitive areas that could easily form a network of interconnected natural open space. Due to the growth in population and the high level of commercial and technology development in the last 10 years, the City's priority is to preserve as much open space as possible. The City's Open Space Network will connect any available open space with a trail system, including wooded hillsides, steep slopes, wetlands, City and County parks, school sites, and proposed neighborhood parks and special uses areas. There is already a trail system that includes 441 miles of existing and proposed trails and pathways in and around the City. Figure 2-8 shows the proposed Open Space Network.

## WATER SYSTEM

The City of Camas owns and operates a water source, treatment, transmission, distribution, and storage system. The water system serves the entire City limits and UGA. The system consists of 13 pressure zones, ranging from a hydraulic grade of 852 feet in the Upper Prune Hill area to 343 feet in the downtown area in the Butler Zone. The City currently operates eight groundwater wells, one treatment plant, over 100 miles of pipe, seven reservoirs, seven booster stations, and 46 pressure reducing valves (PRVs).

The City of Camas currently has municipal water rights issued by Department of Ecology (Ecology) for an instantaneous surface water diversion of 1,570 gallons per minute (gpm). The annual surface water diversion allocated to the City is 2,550 acre-feet. The City also holds water rights for instantaneous withdrawal from its wells totaling 8,975 gallons per minute (gpm).




**LEGEND:**

- CITY LIMITS
- URBAN GROWTH BOUNDARY
- URBAN RESERVE
- PARCELS
- WATER

FEMA FLOOD ZONES:

- A - AN AREA INUNDATED BY 100 YEAR FLOODING, FOR WHICH NO BFE'S HAVE BEEN ESTABLISHED
- X500 - AN AREA INUNDATED BY 500 YEAR FLOODING; AN AREA INUNDATED BY 100-YEAR FLOODING WITH AVERAGE DEPTHS OF LESS THAN 1 FOOT OR WITH DRAINAGE AREAS LESS THAN 1 SQUARE MILE; OR AN AREA PROTECTED BY LEVEES FROM 100 YEAR FLOODING

SOURCE: CITY OF CAMAS

# CITY OF CAMAS

GENERAL SEWER/WASTEWATER
FACILITY PLAN
FLOODPLAIN MAP
FIGURE 2-5

Gray & Osborne, Inc.
CONSULTING ENGINEERS

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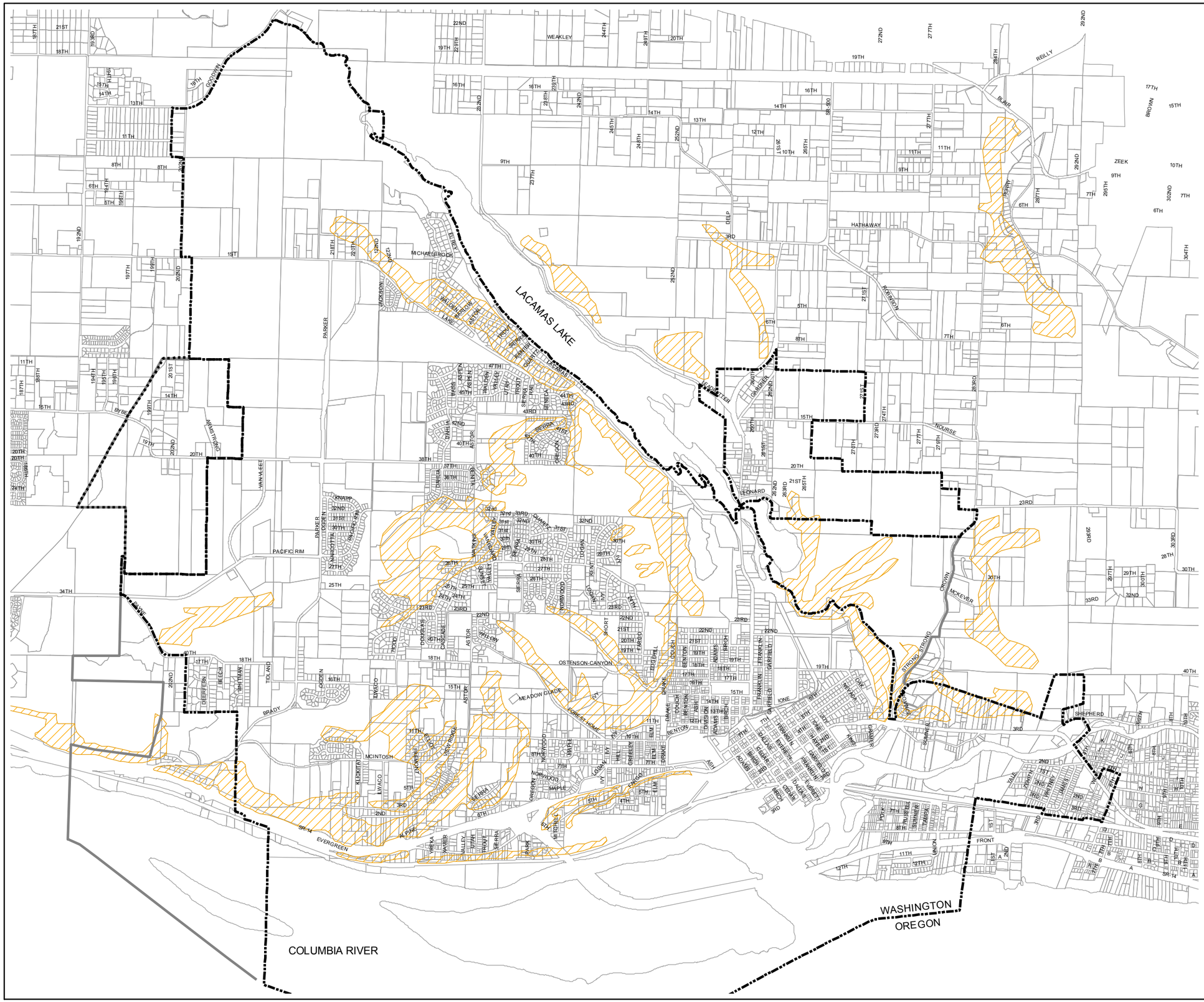


N

0 2,500 5,000 Feet

## LEGEND:

- CITY LIMITS
- URBAN GROWTH BOUNDARY
- URBAN RESERVE
- PARCELS
- STEEP SLOPES

SOURCE: CITY OF CAMAS

# CITY OF CAMAS

GENERAL SEWER/WASTEWATER
FACILITY PLAN
STEEP SLOPES MAP
FIGURE 2-6

Gray & Osborne, Inc.
CONSULTING ENGINEERS

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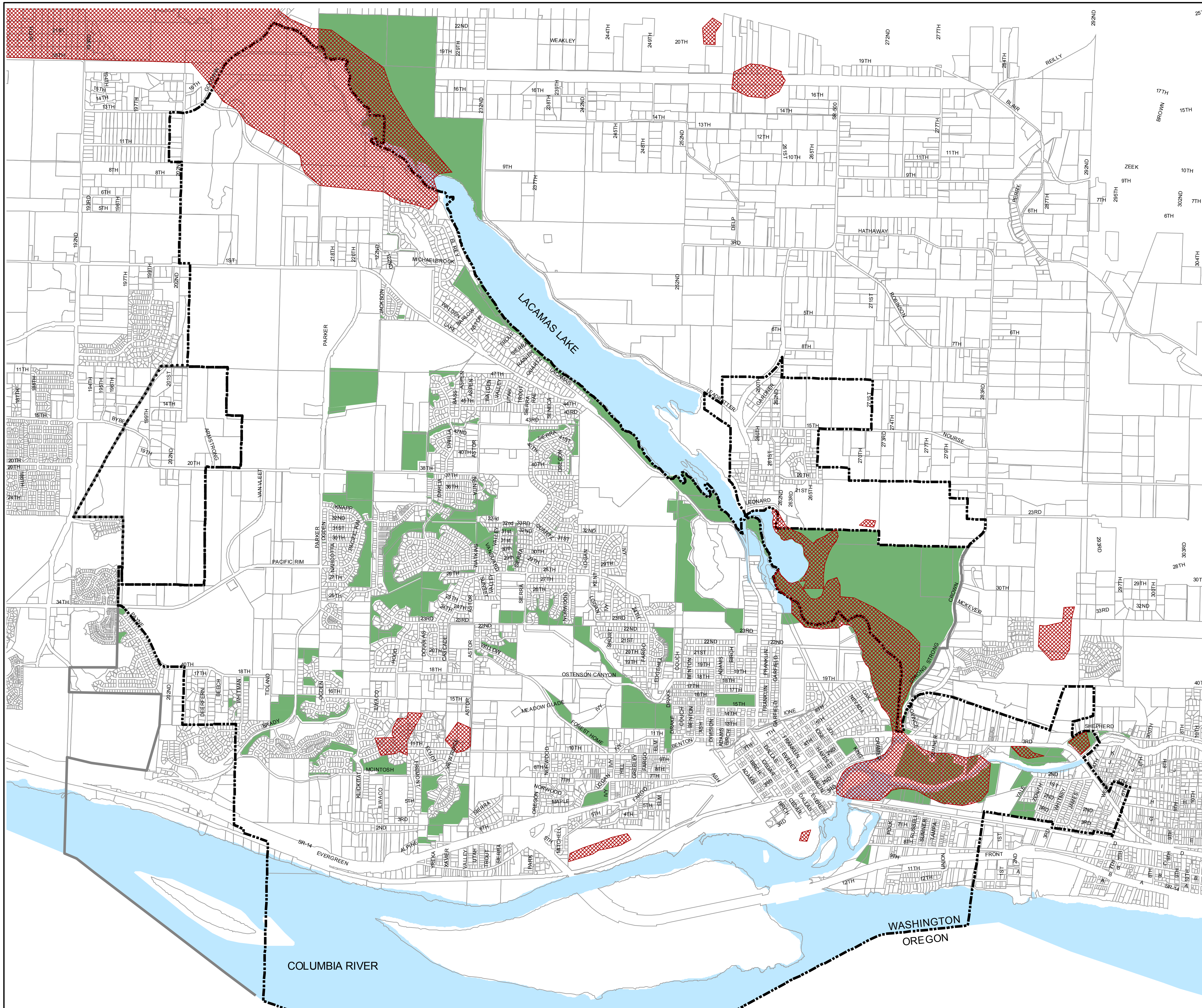


**LEGEND:**

- CITY LIMITS
- URBAN GROWTH BOUNDARY
- URBAN RESERVE
- PARCELS
- PARKS AND OPEN SPACE
- WATER
- WDFW PRIORITY HABITAT AND SPECIES AREAS

SOURCE: CITY OF CAMAS

# CITY OF CAMAS

GENERAL SEWER/WASTEWATER FACILITY PLAN
FISH AND WILDLIFE HABITAT AREAS
URBAN GROWTH AREA
FIGURE 2-7

Gray & Osborne, Inc.
CONSULTING ENGINEERS

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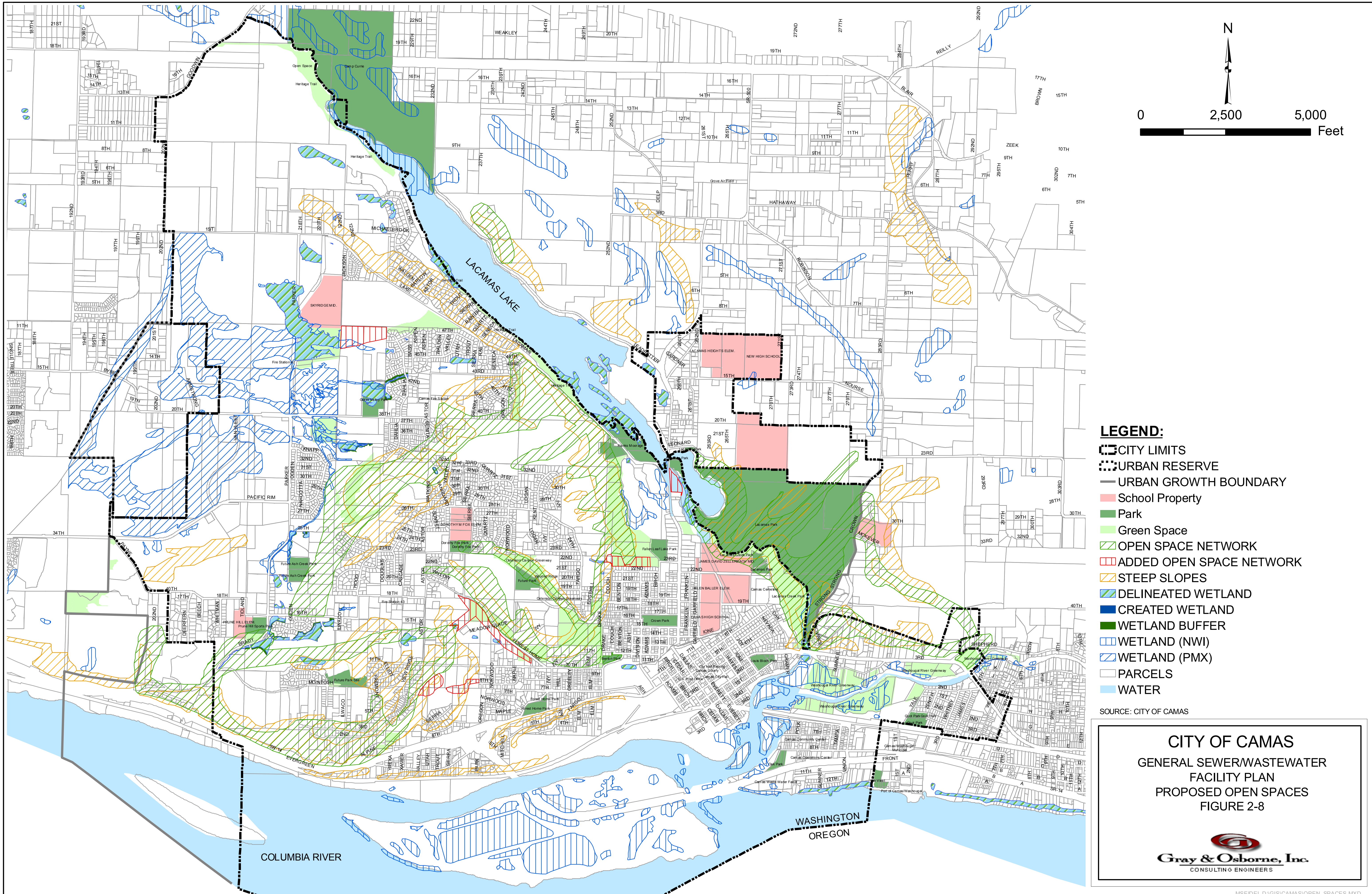



CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
PROPOSED OPEN SPACES
FIGURE 2-8

A history of the City's water system is included in Table 2-4. The City's water system began operation in 1913 with the construction of the Jones Creek Intake and the Butler Reservoir. The City drilled Well Nos. 1 and 2 in 1936. The City constructed the Chlorination Plant in 1952 and the Filter Plant in 1965, signifying the beginning of treatment of the City's water.

The City's surface water is chlorinated and filtered. Chlorination of the surface water with liquid sodium hypochlorite occurs at the City's chlorination facilities , located several miles upstream of the filter plant. The City of Camas operates two 750 gpm pressure filters (1,500 gpm total). The filters provide layers of media that vary from coarse to fine and provide the physical filtration required. The City also treats with fluoride, alum and polymer for coagulation, and sodium hydroxide (caustic soda) for pH adjustment at the filter plant.

Treatment of the City's groundwater sources includes chlorination, fluoridation, and caustic soda addition. Wells 5, 6, and 9 have individual chemical feed equipment while a single facility serves Wells 7, 8, 10, 11, and 12.

In compliance with the lead –copper rule, the City began pH adjustment to all of its sources in April 2000. Corrosion control treatment includes the addition of caustic soda at the wells and filter plant. Well No. 9, located in the 544 Zone, has water quality characteristics different from the other wells and does not require pH adjustment.

Areas outside the City limits currently served water include the Grand Ridge and Winchester Hills communities to the west of the City limits (these areas are also provided sewer service) and the Gregg Service area to the northeast (which is not currently provided sewer service).

## TABLE 2-4

## History of the Camas Water System

| Date | Event |
|---|---|
| 1845 | Camas first settled |
| 1913 | Jones Creek Intake constructed |
| 1913 | 0.6 MG Butler Reservoir, South Half |
| 1923 | 0.6 MG Butler Reservoir, North Half (1.2 MG total) |
| 1931 | Boulder Creek Intake constructed |
| 1935 | 0.5 MG Lower Prune Hill Reservoir |
| 1936 | Wells No. 1 and No. 2 constructed |
| 1945 | Well No. 3 constructed |
| 1948 | Butler Booster Station-800 gpm |
| 1949 | Forest Home Booster Station-450 gpm |
| 1952 | Chlorination Plant-injects chlorine into water from Jones Creek and Boulder Creek before it goes to the Filter Plant |
| 1959 | Well No. 4 constructed |
| 1965 | Filter Plant-1,200 gpm-filters water from Jones Creek and Boulder Creek intakes |
| 1965 | 10th Street Booster Station |
| 1968 | Well No. 5 constructed |
| 1969 | Well No. 6 constructed |
| 1971 | Well No. 7 constructed |
| 1971 | 1.5 MG Lower Prune Hill Reservoir |
| 1971 | 0.75 MG Upper Prune Hill Reservoir |
| 1971 | Lower Prune Hill Booster Station-500 gpm, 500 gpm, 750 gpm |
| 1977 | Well No. 8 constructed 1,350 gpm |
| 1978 | 0.1 MG Gregg Reservoir |
| 1978 | Gregg Booster Station-500 gpm |
| 1988 | Telemetry System installed |
| 1993 | 2.0 MG Lacamas Reservoir |
| 1993 | Lacamas Booster Station-500 gpm, 500 gpm, 1,500 gpm |
| 1998 | Forest Home Booster Station Upgrade – 1,000 gpm |
| 1999 | Butler Booster Station Upgrade |
| 2000 | Telemetry upgraded |
| 2000 | Well No. 9 constructed |
| 2001 | Angelo Booster Station constructed – 3,000 gpm capacity |
| 2001 | Lower Prune Hill Booster Station Upgrade – 1,000 gpm replacement pump |
| 2002 | Upper Prune Hill Reservoir (2.4 MG) and Booster Station (2,900 gpm capacity) constructed |
| 2003 | Wells 10,11 and 12 drilled |
| 2003 | Wells 11 and 12 developed |
| 2004 | Well 10 developed and Washougal Wellfield Chemical Treatment Facility constructed. |

# CHAPTER 3

# LAND USE AND PLANNING CRITERIA

Since the development of the City's 1997 *Wastewater Comprehensive Plan* and 2001 *Water System Plan*, the City has developed a 2004 amendment to the *City of Camas Comprehensive Plan*. The 2004 Comprehensive Plan will be used to further describe land use and provide planning criteria for this chapter.

## PLANNING PERIOD

In order to provide wastewater services for future growth, the wastewater system is in need of continuous evaluation and improvement. A planning period for the evaluation of the wastewater utility should be long enough to be useful for an extended period of time, but not so long as to be impractical. The planning period for this *General Sewer/Wastewater Facility Plan* is from 2005 through 2025, coinciding with a 20-year planning interval.

## EXISTING LAND USE

Table 3-1 shows a summary of existing land use in the City. Residential land use makes up about 46 percent of the City of Camas' total land area. Over 90 percent of this land consists of single-family residential units. In general, the single-family homes are concentrated south of Lake Lacamas, bounded by NW Parker Street to the west and Lacamas Park/Downtown Camas on the east. Multi-family development is concentrated at the confluence of the Washougal and Columbia Rivers, the northern portion of downtown Camas, and to two small areas on the east and west sides of the urban growth boundary. The existing commercial land use in Camas consists of 270 acres, most of which is in the downtown area, which is located on the east side of the Washougal River, where the Washougal and Columbia Rivers meet. Other business areas include Neighborhood commercial and Regional commercial. There is currently about 975 acres of industrial zoned areas concentrated south and east of downtown along the Camas Slough and on Lady Island. Along much of the west side of the UGA are light industrial and business park sites totally 1,717 acres. These zones are bordered by NW Parker Street to the east, NW 18$^{th}$ Avenue to the south, and NE Goodwin Road and Camp Currie to the north. The City has two major areas dedicated as parks, Camp Currie that is located on the north tip of Lacamas Lake and Lacamas Park located on the southern tip of the Lake.

**TABLE 3-1**

**City of Camas Zoning and Land Use[1]**

| Land Use Designation | Acres | Percent |
|---|---|---|
| Single-Family | 3102.4 | 42.0% |
| Multi-Family | 288.6 | 3.9% |
| Commercial | 269.8 | 3.6% |
| Industrial | 974.4 | 13.2% |
| Light Industrial/Business Park | 1717.9 | 23.2% |
| Parks | 626.3 | 8.5% |
| Green Space | 379.2 | 5.1% |
| Public Facilities | 36.2 | 0.5% |
| Total | 7394.8 | 100.0% |

SOURCE: City of Camas, *2004 Comprehensive Plan*, Table 4.

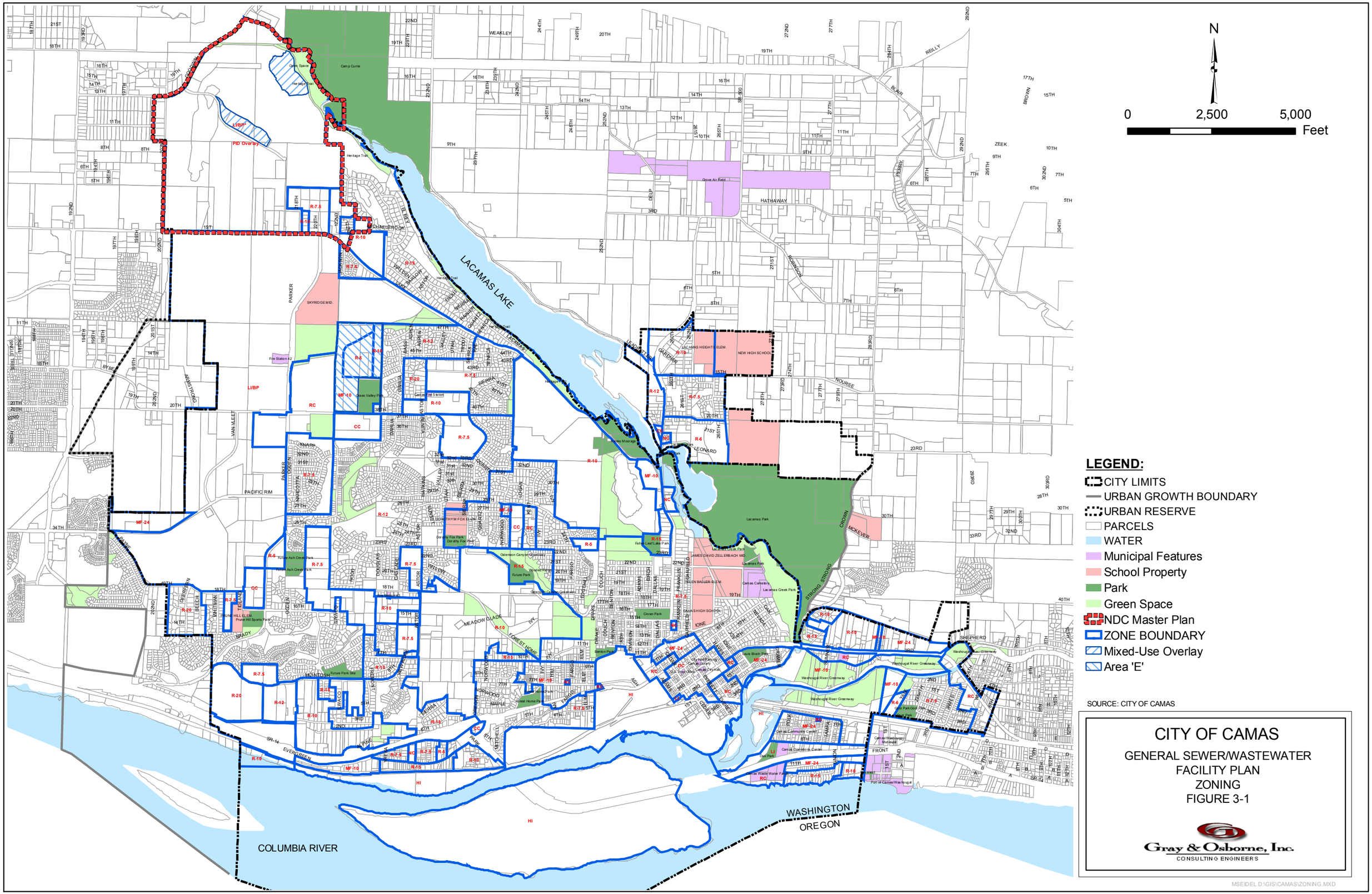
(1) Tables 1, 4, and 5 in the City's 2004 Comprehensive Plan does not include parks, green space and public facilities in compiling a total of 6,401 acres

Figure 3-1 shows the zoning within Camas and Figure 3-2 shows existing land use.

## FUTURE LAND USE

The City's 2004 Comprehensive Plan included an analysis of the Clark County Buildable Lands Report, 1995-2000. This report indicated that the City of Camas and its UGA "could accommodate approximately 6,500 people and just over 3,100 jobs." New construction is currently taking place along Lacamas Lake, on and below Prune Hill, and in Grass Valley where the topography is flat and is conducive to residential development. The City has a number of areas within its UGA that will be annexed within the next few years as shown on Figure 3-3, Urban Growth Boundary Expansion. Also, as shown in Figure 3-3, there are several possible ultimate future urban growth boundaries for the City, particularly in the area northeast of Lacamas Lake. The City is currently discussing with the County and other stakeholders what the ultimate boundary will be: (1) the draft discussion area, (2) the new urban reserve, or (3) the entire Gregg Service Area. However, per City staff, based on the most recent discussions (October 2006), the likely boundaries and land use for the City's UGA in the Gregg service area (north and east parts of the City) in the near term will be as shown in Figure 3-4.

Figure 3-5, Future Land Use, shows developments that are currently active within the City's UGB.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LEGEND:
CITY LIMITS
URBAN GROWTH BOUNDARY
URBAN RESERVE
PARCELS
WATER
Municipal Features
School Property
Park
Green Space
NDC Master Plan
ZONE BOUNDARY
Mixed-Use Overlay
Area 'E'
SOURCE: CITY OF CAMAS
CITY OF CAMAS
GENERAL SEWER/WASTEWATER
FACILITY PLAN
ZONING
FIGURE 3-1
Gray & Osborne, Inc.
CONSULTING ENGINEERS
LACAMAS LAKE
COLUMBIA RIVER
WASHINGTON
OREGON
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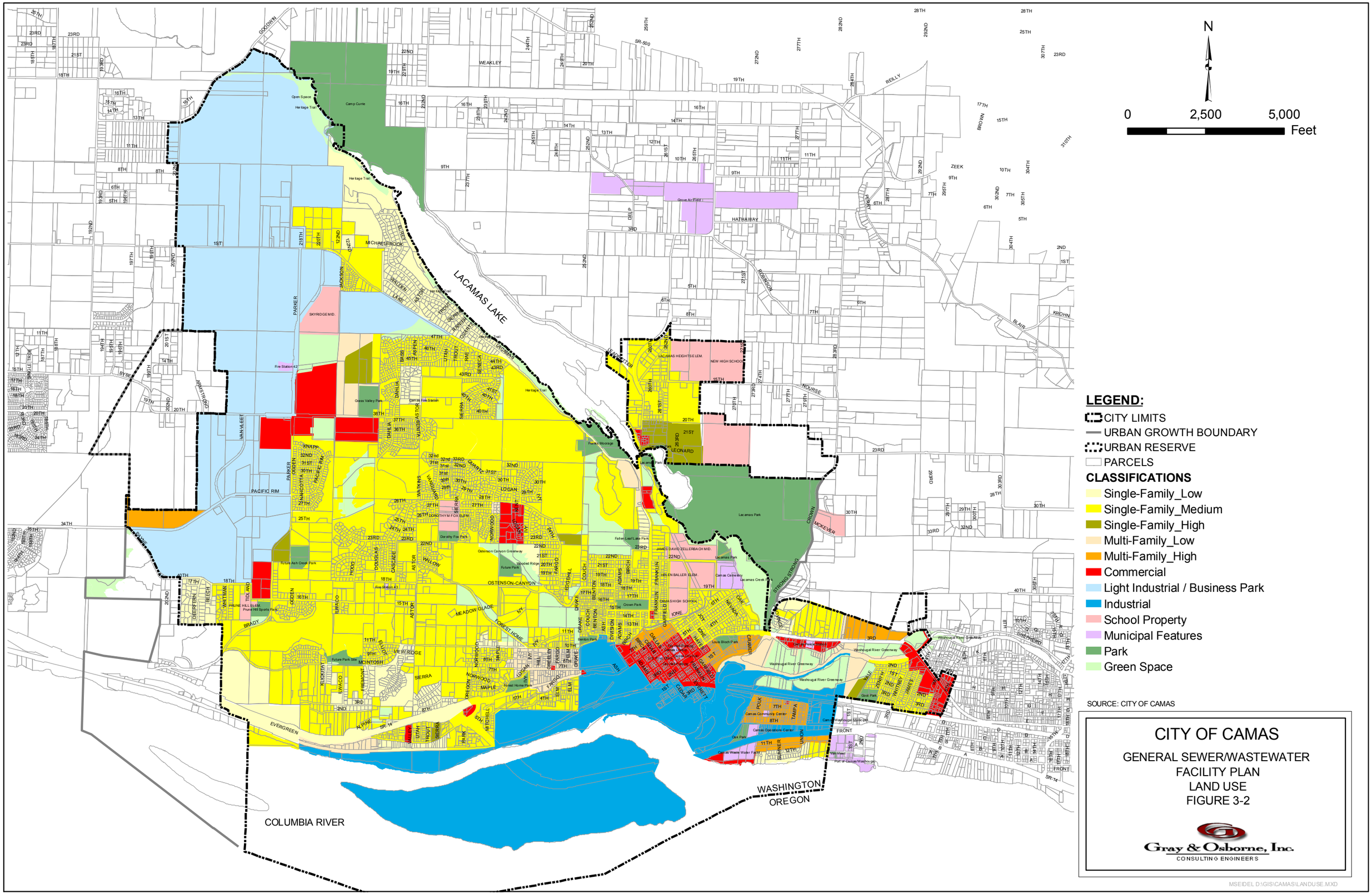
N
0
2,500
5,000
Feet
LEGEND:
CITY LIMITS
URBAN GROWTH BOUNDARY
URBAN RESERVE
PARCELS
CLASSIFICATIONS
Single-Family_Low
Single-Family_Medium
Single-Family_High
Multi-Family_Low
Multi-Family_High
Commercial
Light Industrial / Business Park
Industrial
School Property
Municipal Features
Park
Green Space
SOURCE: CITY OF CAMAS
LACAMAS LAKE
COLUMBIA RIVER
WASHINGTON
OREGON
CITY OF CAMAS
GENERAL SEWER/WASTEWATER
FACILITY PLAN
LAND USE
FIGURE 3-2
Gray & Osborne, Inc.
CONSULTING ENGINEERS
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Two objectives of the City's Land Use Element, as it relates to accommodating future growth within is UGB, are restated below:

- *Accommodate the projected growth through well-planned utilization of its land and, as warranted, a judicious process of expansion of the Urban Growth Boundary;*

- *Focus on continued growth of the Business Parks (Cascade Business Park and North Dwyer Creek Subarea) as employment centers.*

## ADJACENT JURISDICTIONS

### City of Vancouver

The City of Vancouver lies wholly within Clark County and borders Camas to the west. The City of Vancouver was incorporated in 1857 and has a 2004 population of 152,900. While several Vancouver neighborhoods border the Camas UGB, Camas does not provide sewer service to these areas.

### City of Washougal

City of Washougal resides wholly within Clark County and borders the Camas UGB in the southeast. Washougal was incorporated in 1908 and has a 2004 population of 10,770. Camas has a force main from the One Stop Lift Station that travels through Washougal that provides no service to Washougal customers.

## CURRENT POPULATION

The Washington State Office of Financial Management (OFM) provided a history of population for Camas over a 20-year period, 1994 to 2004, as shown in Table 3-2. Since the OFM data for housing units is currently available only to 2002, this plan will use population data from that same year to calculate persons per household (pph). OFM estimated the number of housing units in Camas at 5,153. The City's 2002 population was estimated to be 13,540. This equates to an average population of 2.6 pph. This number is consistent with OFM estimates for Clark County at 2.65 pph for year 2005.

**TABLE 3-2**

**City of Camas Historical Population 1994 to 2004**

| Year | Population | Annual Growth Rate |
|---|---|---|
| 1994 | 7,693 | -- |
| 1995 | 8,355 | 8.61% |
| 1996 | 9,356 | 11.98% |
| 1997 | 10,213 | 9.16% |
| 1998 | 11,169 | 9.36% |
| 1999 | 11,929 | 6.80% |
| 2000 | 12,534 | 5.07% |
| 2001 | 12,970 | 3.48% |
| 2002 | 13,540 | 4.39% |
| 2003 | 14,200 | 4.87% |
| 2004 | 15,360 | 8.17% |
| 2005 | 15,460 | 0.65% |
| 2006 | 15,880 | 2.72% |
| **Average** | | **6.3%** |

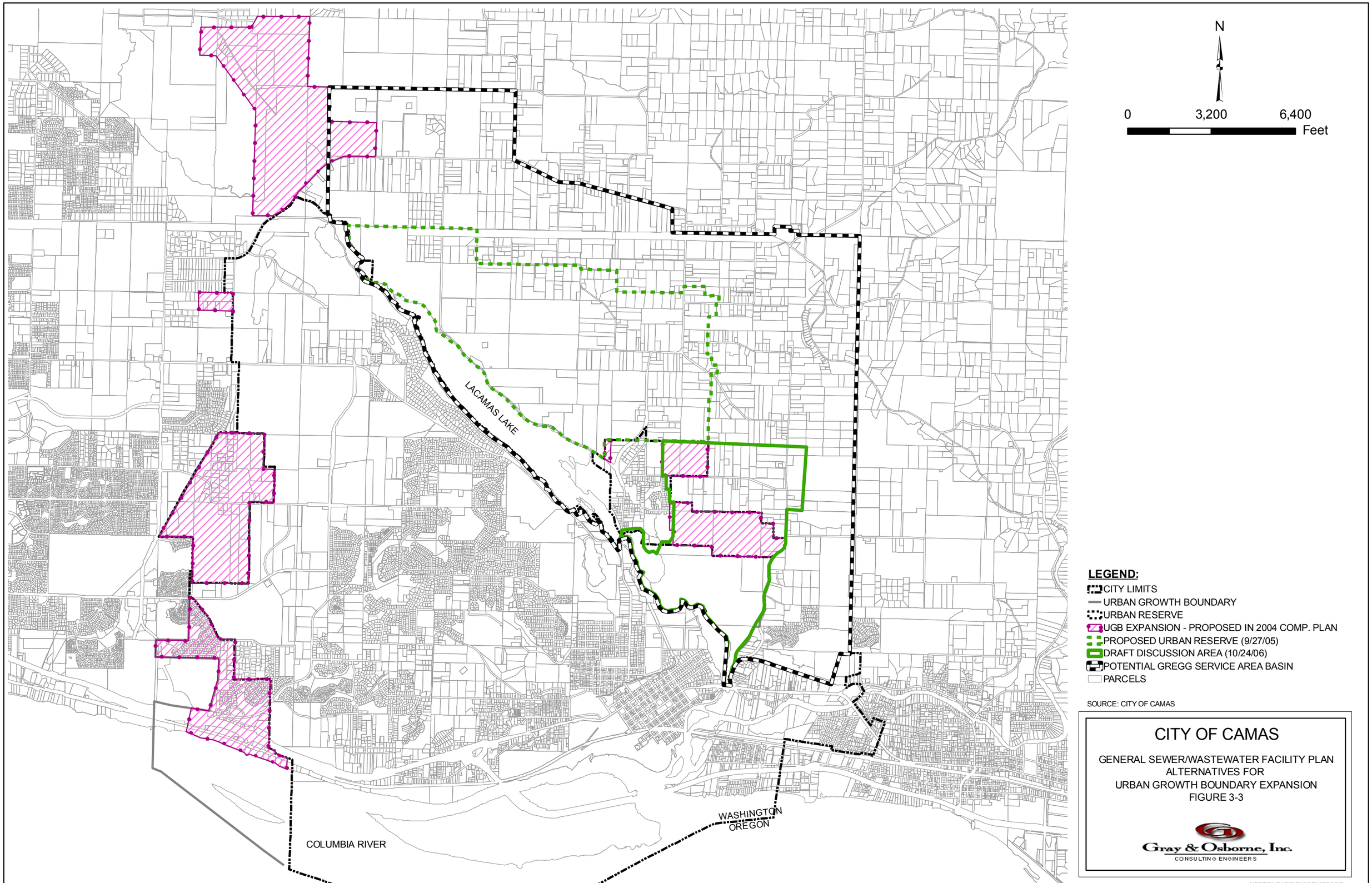
SOURCE: Washington State Office of Financial Management (OFM).
Population estimated as of April 1 of each year.

## PROJECTED FUTURE CITY POPULATION

The City's *2004 Comprehensive Plan* indicated that Clark County allocated an additional 7,000 people within the Camas corporate boundaries over the next 20 years. Therefore, the projected 2025 population within its current boundaries was estimated to be 22,360, and including the population within its UGB, was estimated to be 24,700, as noted in the 2004 *City Comprehensive Plan*. However, this value is less than the 2020 UGA population cited in the 2001 *City of Camas Water System Comprehensive Plan*, of 28,890, and is not considered to be representative of current growth rates. Per discussion with City staff, representative growth rates and projected annexation boundaries and rates will be established jointly by the City and County in the near future. However, for the purposes of this plan, representative and reasonably conservative growth rates must be established for future wastewater flows and loadings.

Alternatives for estimating growth in the City's projected population are shown in Table 3-3, based on:

1. The City's 2004 *Comprehensive Plan*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Feet
LACAMAS LAKE
COLUMBIA RIVER
WASHINGTON
OREGON
LEGEND:
CITY LIMITS
URBAN GROWTH BOUNDARY
URBAN RESERVE
UGB EXPANSION - PROPOSED IN 2004 COMP. PLAN
PROPOSED URBAN RESERVE (9/27/05)
DRAFT DISCUSSION AREA (10/24/06)
POTENTIAL GREGG SERVICE AREA BASIN
PARCELS
SOURCE: CITY OF CAMAS
CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
ALTERNATIVES FOR
URBAN GROWTH BOUNDARY EXPANSION
FIGURE 3-3
Gray & Osborne, Inc.
CONSULTING ENGINEERS
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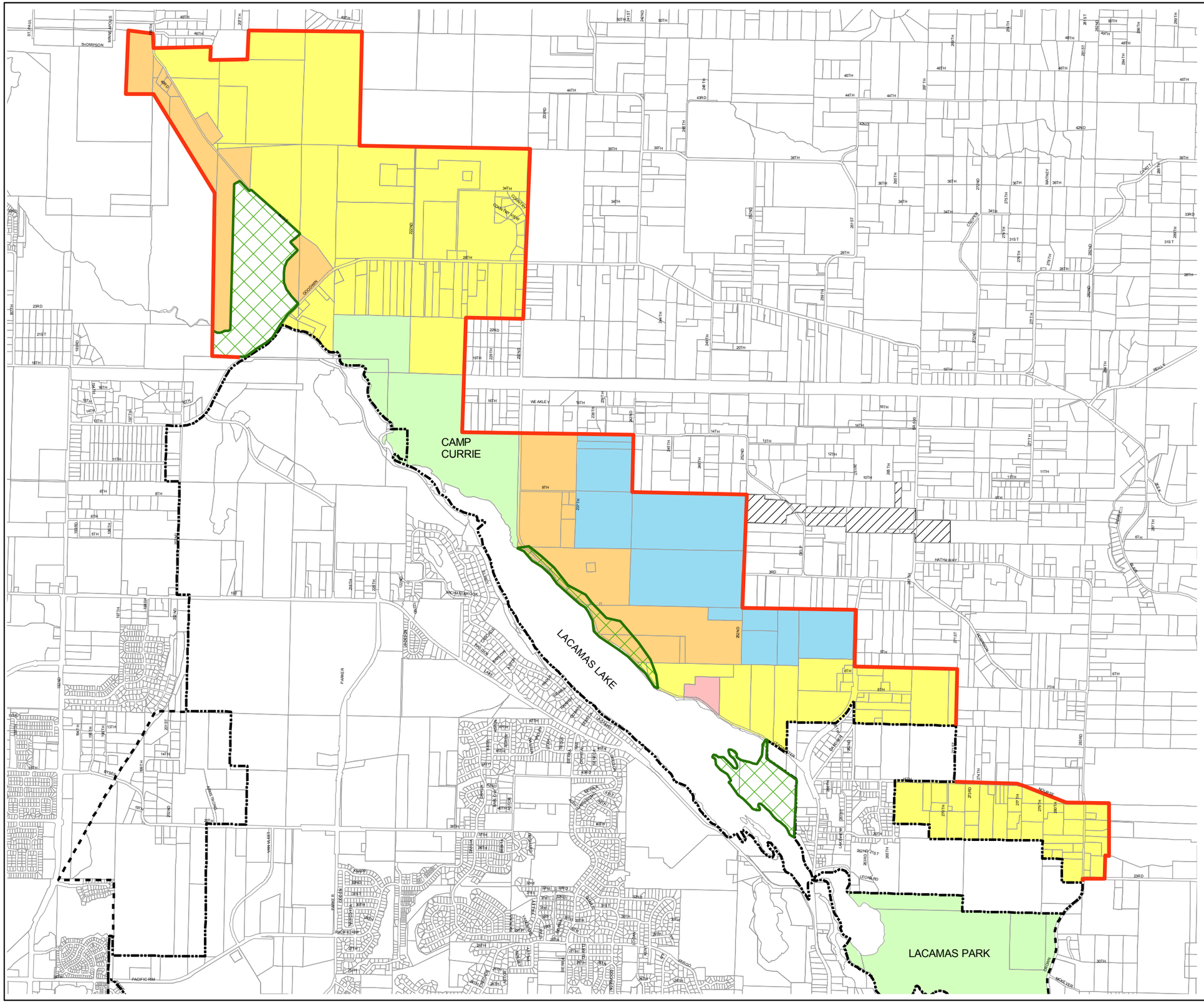


**LEGEND:**

- CITY LIMITS
- URBAN GROWTH BOUNDARY
- PROPOSED URBAN GROWTH BOUNDARY

**Proposed Designation (Acreage)**

- COMMERCIAL (11)
- Mixed Use (364)
- Employment Center \ Jobs (319)
- Urban Low Density Residential (1,104)
- Airport
- Existing Regional Parks
- Green Space \ Parks (195)

*Developable & Redevelopable Lands
Gross Acreage Excluding
Parcels Less Than 2.5 Acres
& Tax Exempt

SOURCE: CITY OF CAMAS

CITY OF CAMAS
GENERAL SEWER/WASTEWATER
FACILITY PLAN
FUTURE DEVELOPMENT
FIGURE 3-4

Gray & Osborne, Inc.
CONSULTING ENGINEERS

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2. The more aggressive growth rate shown in the City's 2001 *Water Comprehensive Plan,* along with the UGA boundaries shown in Figure 3-4.

3. Five years of an annual growth rate of 7.2 percent, reflective of current growth rates, followed by 15 years of 1.0 percent annual growth per discussion with City staff. Overall, these growth rates yield more conservative (i.e., higher) projections of future population than the 2004 Comprehensive Plan, and are considered to be more accurate and up-to-date than either the 2004 Comprehensive Plan or the 2001 Water Plan.

**TABLE 3-3**

**City of Camas Projected Population**

| Year | Projected Population within City Limits(1) | Projected Population Within UGA(2) | Projected Population Within UGA | Projected Water Service Area Population | Projected Population within City Limits | Projected Population Within UGA |
|---|---|---|---|---|---|---|
| **Basis** | **2004 Comp Plan** | | **2001 Water Plan** | | **Current estimates(5)** | |
| 2005 | 15,710(1) | 15,710(1) | | | 15,710 | 16,714 |
| 2006 | 16,060(1) | 16,060(1) | 17,512 | 18,277 | 16,841 | 17,917 |
| 2007 | 16,410 | 17,010 | | | 18,054 | 19,207 |
| 2008 | 16,760 | 17,360 | | | 19,354 | 20,590 |
| 2009 | 17,110 | 17,710 | | | 20,747 | 22,072 |
| 2010 | 17,460 | 18,060 | | | 22,241 | 23,662 |
| 2015 | 19,210 | 22,160 | | | 23,375 | 24,869 |
| 2020 | 20,960 | 23,910 | 28,890 | 30,859 | 24,568 | 27,863 |
| 2025 | 22,360 | 24,700 | 34,000(3) | 36,000(3) | 25,821 | 29,284 |
| Buildout | | 52,847(7) | 43,687 | 54,253(4) | | 52,847(7) |

(1) Population shown is for the corporate boundaries of the City of Camas, and is based on 7,000 new people over the next 20 years per Clark County allocations (City of Camas 2004 Comprehensive Plan, page 1-7). 2005 and 2006 populations shown are for December 31 of the year shown

(2) The City's projected 2025 population, inclusive of the UGB, was noted in the Comprehensive Plan as 24,700, or roughly 10,000 more people within the UGB over the next 20 years.

(3) Based on linear extrapolation of growth rate in 2001 Water System Plan.

(4) Including 10,566 in Gregg Service Area based on a density of four homes per acre in the residential areas shown in Figure 3-4.

(5) Based on current estimates of 7.2 percent for 5 years and 1.0 percent for following 15 years, per City staff.

(6) There were 386 water service connections outside the City boundaries within the UGA in 2005 (386 *2.6 = 1004 people).

(7) See Table 3-4.

The City of Camas is bounded by the corporate boundaries of Vancouver on the west and Washougal at the southeast UGB; therefore no expansion of the sewer service area will

occur in these regions. Alternatives for future annexations are shown in Figures 3-3 and 3-4. As shown by Figure 3-3, there are several alternatives for the City's ultimate UGB, particularly to the north and the northeast of the City. The 2004 *Comprehensive Plan* showed only small areas in east Camas (east of Lacamas Lake) as proposed UGB expansion. City staff believes ultimately that the City UGB and sewer service boundary will extend all the way to the Gregg Service Area boundary shown in Figure 3-3. Recent discussions with the County and stakeholders, however, have resulted in planning maps showing the substantially smaller area indicated by the 10/24/06 DRAFT Discussion Area and Proposed Urban Reserve Boundary in Figure 3-3, and the boundaries shown in Figure 3-4. Current negotiations with the County and stakeholders may result in revisions to these boundaries, but for now the boundaries shown in Figure 3-4 are used for projections. The projected Camas buildout population within the existing UGA, based on Table 5 in the 2004 Comprehensive Plan, is summarized in Table 3-4.

**TABLE 3-4**

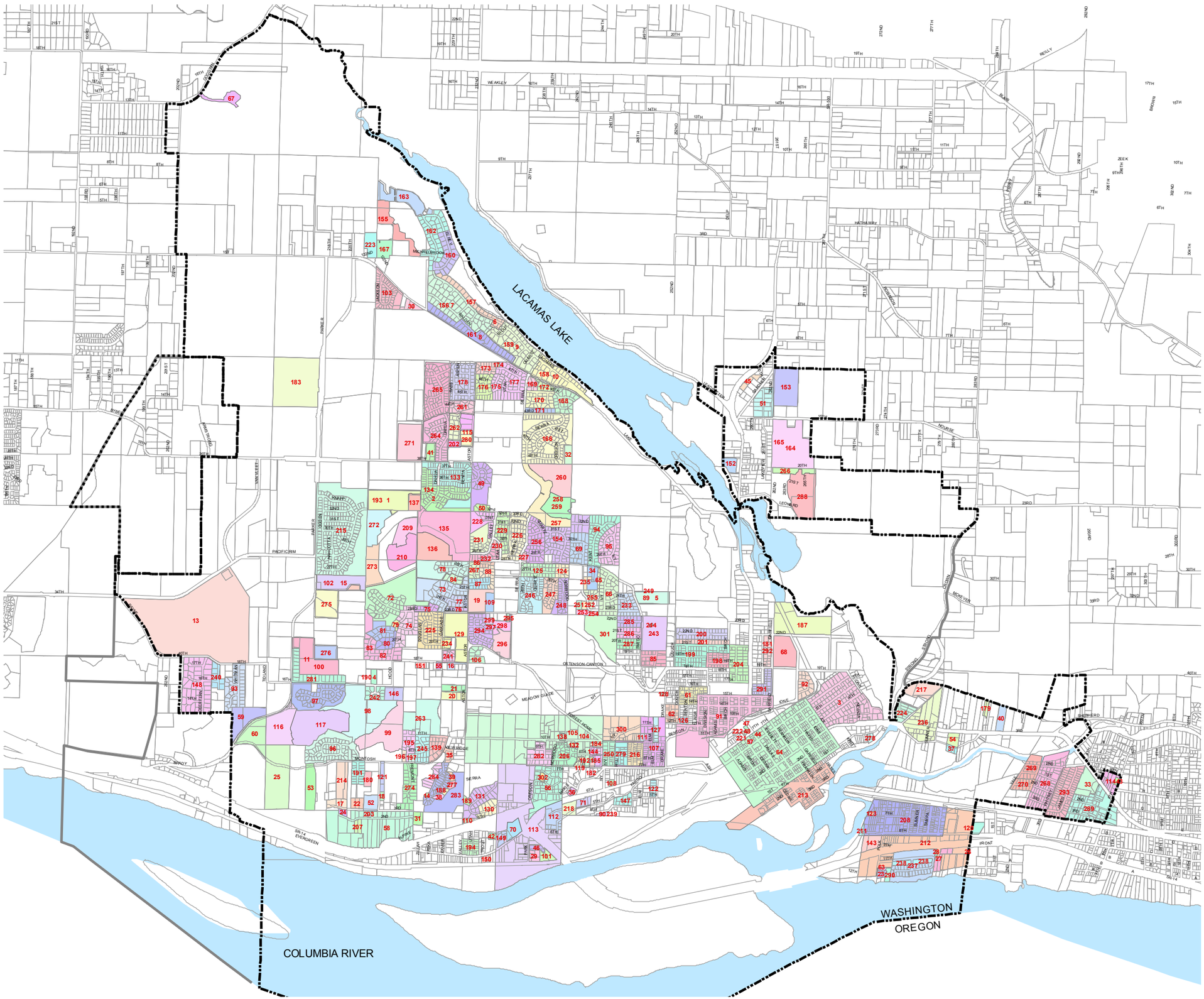
**City of Camas Projected Buildout Population**
**(Based on 2004 Comprehensive Plan)**

| Zoning Classification(1) | Acres | Dwellings Units per Acre | Dwelling Units | Projected Buildout Population |
|---|---|---|---|---|
| R5 | 8.1 | 8.7 | 70 | 199 |
| R7.5 | 1,004.2 | 5.8 | 5,824 | 16,483 |
| R10 | 835.4 | 4.3 | 3,592 | 10,166 |
| R12 | 759.9 | 3.6 | 2,736 | 7,742 |
| R15 | 432.4 | 2.9 | 1,254 | 3,549 |
| R20 | 62.4 | 2.1 | 131 | 371 |
| MF10 | 115.3 | 10 | 1,153 | 3,263 |
| MF18 | 41 | 18 | 738 | 2,089 |
| MF24 | 132.3 | 24 | 3,175 | 8,986 |
| **TOTAL** | **6,353** | | **18,674** | **52,847** |

(1) The density of dwelling units (DU) for the City's zoning classification is as follows: the number after R indicates the average lot size, in thousands of square feet, for single-family residential zoning, while the number after the MF indicates the average dwelling units per acre for multi-family.

## SEWER CONNECTIONS

Table 3-5 provides an estimate of the average number of sewer connections to the City of Camas sewer system from 2002-2005, based on billing records obtained from the City's Finance Department.




N

0 2,500 5,000 Feet

**LEGEND:**

- CITY LIMITS
- URBAN GROWTH BOUNDARY
- URBAN RESERVE
- PARCELS
- WATER

SOURCE: CITY OF CAMAS

# CITY OF CAMAS

GENERAL SEWER/WASTEWATER FACILITY PLAN
CITY OF CAMAS DEVELOPMENTS
FIGURE 3-5

Gray & Osborne, Inc.
CONSULTING ENGINEERS

MSEIDEL D:\GIS\CAMAS\DEVELOPMENTS.MXD

**TABLE 3-5**

**City of Camas Average Sewer Service Connections by Customer Class[(1)]**

| | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|
| Single-Family Residential | 4,850 | 5,131 | 5,419 | 5,546 |
| Multi-family Residential | 298 | 336 | 376 | 414 |
| Commercial | 179 | 183 | 197 | 202 |
| Industrial | 29 | 31 | 30 | 31 |
| City | 30 | 30 | 30 | 31 |
| **TOTAL** | **5,386** | **5,711** | **6,052** | **6,223** |

(1) Both water and sewer billing data provided by the City's new billing database were used to estimate the number of connections in the customer classes.

## INDUSTRIES IN THE SEWER SERVICE AREA

As required by its NPDES permit, the City completed an Industrial User Survey (IUS) in early 2005. The survey identified nine Significant Industrial Users (SIUs) and five Minor Industrial Users (MIUs). The SIUs identified included:

1. Bodycote, Inc.
2. Brown's Chevron
3. Columbia Litho, Inc.
4. Heraeus Shin-Etsu America
5. C-Tech
6. Linear Technology
7. Sharp Electronics Corporation
8. Shell Oil Products
9. Wafertech

The MIUs included:

1. Georgia Pacific
2. Furuno USA Inc.
3. Lemon Aid Automotive
4. Post Record
5. Westlie Motors

A description of some of the major SIUs follows. Additional information regarding the quantity and nature of their discharges is provided in Chapter 6.

**LANDA**

LANDA, incorporated in 1969, builds pressure washing equipment, automatic parts washers, evaporators, and wastewater treatment/recycle systems. The company produces a wide range of types and sizes of these products. The raw materials used in the manufacturing processes are pre-formed metal tubing, pipe, sheet and plate and surface coating materials. Metals utilized are steel, stainless steel, and aluminum. Surface coatings are the powder type, which are applied using electrostatic charge and are baked on.

The manufacturing processes are cutting, forming, welding, cleaning, surface-coating, assembly, and product testing. To a large extent, components (pumps, motors, filters, tanks, plumbing, and controls) of the end products are procured from other manufacturers, often off-the-shelf items made for other specific or general purposes. These components are arranged and assembled, along with some components made by LANDA, into the various products which LANDA has designed to perform the special functions already mentioned.

**SHARP**

The Sharp Laboratories of America, Inc. (SLA) is a wholly owned subsidiary of Sharp Electronics Corporation in Mahwah New Jersey. SLA operates at the Camas, Washington location which is owned by Sharp Electronics Corporation (SEC). SLA is a research and development (R&D) facility, conducting R&D in the areas of multimedia (e.g., video, imaging, telecommunications, software, copiers, printers, etc.), integrated circuits (ICs), and Liquid Crystal Display-Thin Film Transistor (LCD-TFT) technologies.

SLA does no manufacturing; the main product is intellectual property and patents resulting from research and development activities.

**HERAEUS SHIN-ETSU AMERICA**

Heraeus Shin-Etsu America, Inc. has operated a quartz glass manufacturing industry in Camas since 1991. The facility is jointly owned by Heraeus Amersil, Inc. and Shin-Etsu Quartz Products. The finished product is a high purity glass crucible that is used in the semi-conductor industry in the manufacture of silicon wafers. The facility consumes 300,000 pounds of silica sand per month to produce 6,500 pieces of high purity glass crucibles.

**LINEAR TECHNOLOGY**

Linear Technology Corporation (LTC) has operated a semiconductor wafer production in Camas since 1996. LTC specializes in developing new market niches, and thus are a relatively low production facility. Production is significantly influenced by market

conditions. At full production, their output capability is approximately 5,000 wafer starts per week. Currently, production is about 1,500 to 1,700 wafer starts per week. LTC currently has about 200 employees and operates 24 hours a day, 7 days per week, but with restricted shifts.

## WAFERTECH

WaferTech is a semiconductor integrated circuit (IC) fabrication facility. Blank silicon wafers are used as the main raw material in the IC fabrication process. The ICs are constructed on the surface of the blank wafers by conveying the wafers through a number of different process areas. Process areas include Etching, Photolithography, Diffusion, Implant, Physical Vaporized Deposition, Chemical Vapor Deposition, Chemical/Mechanical Polishing (CMP), and Backside Grinding (BG). Wafers proceed through the process areas several times in various sequences depending on the specific type of IC. The end products of the fabrication process are wafers that contain several different types of ICs, or "die," which are packaged and shipped to WaferTech's clients. The WaferTech facility produces Mixed Mode, Logic, and SRAM wafers. Finished product quantities can vary significantly depending on customer demand. However, full capacity of the facility is 45,000 wafers per month.

# CHAPTER 4

# REGULATORY REQUIREMENTS

## INTRODUCTION

Federal and state regulatory requirements were used in developing the design criteria for improvements to the City of Camas's wastewater collection, treatment, and disposal facilities. The purpose of this Chapter is to identify and summarize the regulations that affect the planning, design, and approval of improvements discussed in this report.

This chapter does not describe each regulation in detail; rather, it addresses important facets of the regulations that affect the planning and design process. Subsequent sections of this report address technical requirements of the regulations at a level of detail appropriate for the evaluation provided by that section. For instance, Chapters 7, 8, and 9 contain more detailed information regarding wastewater collection and treatment system and biosolids management regulations.

## FEDERAL AND STATE STATUTES, REGULATIONS AND PERMITS

This section discusses some of the various federal and state laws that may affect wastewater system construction and operations, as well as other relevant permits, programs, and regulations.

### FEDERAL CLEAN WATER ACT

The Federal Water Pollution Control Act is the principal law regulating the water quality of the nation's waterways. Originally enacted in 1948, it was significantly revised in 1972 and 1977, when it was given the common title of the "Clean Water Act" (CWA). The CWA has been amended several times since 1977. The 1987 amendments replaced the Construction Grants program with the Water Pollution Control State Revolving Fund (SRF) that provides low-cost financing for a range of water quality infrastructure projects.

The National Pollutant Discharge Elimination System (NPDES) program was established by Section 402 of the CWA and its subsequent amendments. The Department of Ecology administers NPDES permits for the U.S. Environmental Protection Agency (EPA). Most NPDES permits have a 5-year term and place limits on the quantity and quality of pollutants that may be discharged. The City's current NPDES permit, No. WA0020249, is attached as Appendix B. The City's current permit effluent limits are shown in Table 5-3 in Chapter 5. Condition S.1 of the City's permit requires the treatment plant effluent to meet limits for 5-day biochemical oxygen demand ($BOD_5$), total suspended solids (TSS), fecal coliform bacteria, pH, and total ammonia.

Condition S.2.lists monitoring requirements including influent and effluent flow, $BOD_5$, TSS, pH, temperature, total ammonia, fecal coliform, priority pollutant metals, oil and grease and cyanide. A program to address oil and grease is also required. The City must monitor twice per 5 years for effluent whole effluent toxicity, and conduct quarterly and yearly priority pollutant monitoring of its influent and effluent in support of its industrial pretreatment program. Additionally, per the terms of the City's coverage under the Statewide Biosolids permit, the City must annually test its biosolids for pollutants and compliance with pathogen reduction and vector attraction reduction criteria.

Condition S.4.A specifies the WWTF design capacity for maximum month $BOD_5$ loading is 5,616 lbs/day and 6,405 lbs/day for TSS. The peak hour flow, dry weather monthly average, and maximum month average flow capacities for the WWTF are 11.09, 2.86 and 6.10 million gallons per day (mgd), respectively. Condition S.4.B requires the City to prepare a plan to maintain adequate capacity when flows and loadings to the WWTF exceed 85 percent of design capacity for 3-consecutive months.

Chapter 8 of this Plan includes an evaluation of the WWTF operating conditions and provides recommendations for improving and maintaining adequate treatment capacity to ensure long-term NPDES permit compliance.

Section 307 of the CWA established the National Pretreatment Program. This program is designed to protect publicly owned treatment works (POTWs) and limits the amount of industrial or other non-residential pollutant discharged to municipal sewer systems. The City's pretreatment program is summarized and evaluated in Chapter 10 of this Plan.

## PROPOSED CAPACITY, MANAGEMENT, OPERATION AND MAINTENANCE REGULATIONS

EPA has proposed a new round of regulations titled Capacity, Management Operation and Maintenance (CMOM). Though the regulations are yet to be formally adopted by EPA, some municipalities are anticipating the adoption and have moved forward with implementation. CMOM focuses on the failure of collection systems and requires a program for long-term financing and repair. Under its authority granted by the federal Clean Water Act, EPA seeks to address sanitary sewer overflows (SSO) under the CMOM program. It is expected that elements of CMOM could be incorporated into NPDES permits.

In general the CMOM requirements can be summarized in the following elements:

1. General performance standards including system maps, information management, and odor control.

2. Program documentation including the goals, organizational and legal authority of the organization operating the collection system.

3. An overflow response plan that requires response in less than 1 hour and is demonstrated to have sufficient and adequate personnel and equipment, etc. Estimated volumes and duration of overflows must be accurately measured and reported to the regulatory agency.

4. System evaluation requires that the entire system be cleaned on a scheduled basis (for example, once every 5 years), be regularly TV inspected, and that a program for short and long term rehabilitation replacement be generated. EPA has proposed, as a rule of thumb, a 1.5 to 2 percent system replacement rate which implies that an entire collection system is replaced somewhere in the range of a 50- to 70-year time period.

5. A capacity assurance plan that will use flow meters to model I&I, ensure lift stations are properly operated and maintained, and that source control is maintained.

6. A self-audit program to evaluate and adjust performance.

7. A communication program to communicate problems, costs, and improvements to the public and decision-makers.

EPA is considering some changes in design standards for collection systems including requiring that sanitary sewer overflows not occur except in extreme storms. They have also decided that they will not predefine the type of storm, leaving that decision to the design engineer.

## FEDERAL ENDANGERED SPECIES ACT

On March 16, 1999, the National Marine Fisheries Service (NMFS) listed the Puget Sound Chinook as "threatened" under the Endangered Species Act (ESA). In 1999, the United States Fish and Wildlife Service (USFWS) listed the Bull Trout as "threatened." ESA listings impact activities that affect salmon and trout habitat, such as water use, land use, construction activities, and wastewater disposal. Impacts to the greater Camas area may include longer timelines for permit applications, and more stringent regulation of construction impacts and activities in riparian corridors.

In response to existing and proposed ESA listings of salmon, steelhead, and trout species throughout Washington State, Governor Locke established the Office of Salmon Recovery in 1997 to direct the State's salmon recovery efforts. Rather than attempting to avert additional ESA listings, the Statewide Strategy provides local input into, and maintains some local control over, the salmon recovery regulatory processes that affects the majority of Washington State.

In order to minimize liability under the ESA, local governments need to demonstrate that their land use regulations will not result in a prohibited "take" of a listed species, including adverse

modification of critical habitat.

Per the *City of Camas Comprehensive Plan (2002 Amendment),* Camas provides (or likely provides) habitat for the following species listed as endangered by the WDFW: Great Blue Heron, Wood Duck, Columbian Black-tailed Deer, Pileated Woodpecker and Bald Eagle. Other species that may occur in the Camas area that are listed as Candidate or Threatened species include the following: Little Willow Flycatcher, Northern Red-legged Frog and Spotted Frog. In addition, Chinook salmon and Bull trout are expected to be present in the vicinity of the outfall and could potentially impact future WWTF and outfall modifications.

## RECLAIMED WATER STANDARDS

The standards for the use of reclaimed water are outlined in RCW 90.46 and in a separate document published by the Washington State Department of Health and Ecology entitled "Water Reclamation and Reuse Standards." Reclaimed water is the effluent derived from a wastewater treatment system that has been adequately and reliably treated, such that it is no longer considered sewage and is suitable for a beneficial use or a controlled use that would not otherwise occur. The legislature has declared that "the utilization of reclaimed water by local communities for domestic, agricultural, industrial, recreational, and fish and wildlife habitat creation and enhancement purposes (including wetland enhancement) will contribute to the peace, health, safety, and welfare of the people of the State of Washington."

The *Water Reclamation and Reuse Standards* define the water quality standards for reclaimed water. The City of Camas WWTF does not generate reclaimed water; however, an evaluation of the feasibility of reuse, either generated at the existing WWTF (after appropriate modifications) or a possible new satellite WWTF, is provided in Chapter 9. The generation of Class "A" reclaimed water has four minimum requirements that are described below:

**Continuously Oxidized -** Wastewater that at all times has been stabilized such that the monthly average $BOD_5$ and TSS are less than 30 mg/L, is non-putrescable and contains dissolved oxygen.

**Continuously Coagulated -** Oxidized wastewater that at all times has been treated by a chemical or equally effective method to destabilize and agglomerate colloidal and finely suspended matter prior to filtration.

**Continuously Filtered -** Oxidized and coagulated wastewater that at all times has been passed through a filtering media so that the turbidity of the filtered effluent does not exceed an average of 2 nephelometric turbidity units (NTU), determined monthly, and does not exceed 5 NTU at any time.

**Continuously Disinfected -** Oxidized, coagulated and filtered wastewater that at all times has been disinfected to destroy or inactivate pathogenic organisms. A group of indicator microorganisms, coliform bacteria, are used to measure the effectiveness of the disinfection process. The Class "A" reclaimed water standard is a total coliform density of 2.2 per 100 milliliters (ml) for the median of the last 7 days of samples, with no sample having a density greater than 23 per 100 ml.

### NATIONAL ENVIRONMENTAL POLICY ACT

The National Environmental Policy Act (NEPA) was established in 1969 and requires federal agencies to determine environmental impacts on all projects requiring federal permits or funding. Federally delegated activities such as NPDES permits or Section 401 Certification are considered state actions and do not require NEPA compliance. If a project involves federal action (through, for example, an Army Corps of Engineers Section 404 permit), and is determined to be environmentally insignificant, a Finding of No Significant Impact (FONSI) is issued, otherwise an Environmental Assessment (EA) or Environmental Impact Statement (EIS) would be required. NEPA is not applicable to projects that do not include a federal component.

### FEDERAL CLEAN AIR ACT

The Federal Clean Air Act requires all wastewater facilities to plan to meet the air quality limitations of the region. The City falls in the jurisdiction of the Southwest Clean Air Agency. The Southwest Clean Air Agency (SWCAA) is responsible for enforcing federal, state and local outdoor air quality standards and regulations in Clark, Cowlitz, Lewis, Skamania and Wahkiakum counties of southwest Washington state. The Camas generator is permitted by SWCAA.

## STATE STATUTES, REGULATIONS AND PERMITS

### STATE WATER POLLUTION CONTROL ACT

The intent of the state Water Pollution Control Act is to "maintain the highest possible control standards to ensure the purity of all waters of the state consistent with public health and the enjoyment…the propagation and protection of wildlife, birds, game, fish and other aquatic life, and the industrial development of the state." Under the Revised Code of Washington (RCW) 90.48 and the Washington Administrative Code (WAC) 173-240, Ecology issues permits for wastewater treatment facilities and land application of wastewater under WAC 246-271.

#### Submission of Plans and Reports for Construction of Wastewater Facilities, WAC 173-240

Prior to construction or modification of domestic wastewater facilities, engineering reports and plans, and specifications must be submitted to and approved by Ecology.

This regulation outlines procedures and requirements for the development of an engineering report that thoroughly examines the engineering and administrative aspects of a domestic wastewater facility project. This state regulation defines a facility plan as an engineering report under federal regulations, 40 CFR Part 35.

Key provisions of WAC 173-240 are provided below:

- An engineering report for a wastewater facility project must contain everything required for a general sewer plan unless an up-to-date general sewer plan is on file with Ecology.
- An engineering report shall be sufficiently complete so that plans and specifications can be developed from it without substantial changes.
- A wastewater facility engineering report must be prepared under the supervision of a professional engineer.

### Criteria for Sewage Works Design, Washington State Department of Ecology

Ecology has published design criteria for collection systems and wastewater treatment plants. While these criteria are not legally binding, their use is strongly encouraged by Ecology since the criteria are used by the agency to review engineering reports for upgrading wastewater treatment systems. Commonly referred to as the "Orange Book," these design criteria primarily emphasize unit processes through secondary treatment, and also includes criteria for planning and design of wastewater collection systems. Any expansion or modification of the City of Camas collection system and/or WWTF plant will require continued conformance with Ecology criteria.

### Certification of Operators of Wastewater Treatment Plants, WAC 173-230

Wastewater treatment plant operators are certified by the state Water and Wastewater Operators Certification Board. The operator assigned overall responsibility for operation of a wastewater treatment plant is defined by WAC 173-230 as the "operator in responsible charge." This individual must have state certification at or above the classification rating of the plant.

The City of Camas WWTF is currently assigned a Class 4 rating and the operating staff assigned to the plant have the required certification. (One of the operators has a Class 4 certification; two have Class 3 certification, and one has Class 2 certification.)

## SURFACE-WATER QUALITY STANDARDS (WAC 173-201A)

In the State of Washington, WAC 173-201A establishes water quality standards for surface waters based on maintaining public health, recreational use and protection of fish, shellfish, and wildlife. Surface water quality standards include five groups: AA (extraordinary), A (excellent), B (good), C (fair), and Lake Class. Each class has its own characteristic use and measurable criteria. Measurable parameters used to distinguish the

different surface water classifications include fecal coliform levels, dissolved oxygen concentration, temperature, pH, and turbidity. The surface water criteria include twenty-nine toxic substances, including ammonia, residual chlorine, several heavy metals, polychlorinated biphenyls (PCBs), and pesticides.

It is the policy of the State of Washington to maintain existing beneficial uses of surface water by preventing degradation of existing water quality. However, certain allowances are made by Ecology for discharging treated wastewater into a surface water that enable a temporary or mitigated degradation to occur. These allowances are made by establishing mixing zones and determining the assimilative capacity of the receiving water.

Discharging to surface water requires an NPDES permit issued by Ecology under WAC 173-220. Wastewater treatment plants must generally meet technology-based limits that include 30 mg/L Total Suspended Solids (TSS) and 30 mg/L 5-day Biochemical Oxygen Demand, $BOD_5$ (typically termed "30 –30 limits"). Additionally, under WAC 173-201A-060, State Water Quality Standards, Ecology is authorized to condition NPDES permits so that the discharge meets water quality standards. Therefore, other permit conditions in addition to or more stringent than the 30-30 limits could be added to ensure that the water quality of the receiving water is not degraded. For example, the City has limits of 20 mg/L TSS and 20 mg/L $BOD_5$ due to the dilute nature of its influent and requirements to percent removal for TSS and $BOD_5$. In addition, effluent limits for ammonia were included in the City's 2004 permit.

Ecology has issued changes to its water quality standards. The changes are pending approval from the EPA. These proposed changes include changing the current class-based system to a use-based system. Depending on the use of the particular water body, water quality standards for temperature and dissolved oxygen in the water body could change also. Ecology has also proposed changing the indicator of bacteriological contamination from fecal coliform to enterococci for some water bodies.

## STATE ENVIRONMENTAL POLICY ACT

WAC 173-240-050 requires a statement in all wastewater comprehensive plans regarding proposed projects in compliance with the State Environmental Policy Act (SEPA), if applicable. The capital improvements proposed in this plan will fall under SEPA regulations. A SEPA checklist is included in Appendix A of this report for use in the environmental review for the project. In most cases a determination of non-significance is issued (DNS); however, if a project will have a probable significant adverse environmental impact an environmental impact statement (EIS) will be required.

## ACCREDITATION OF ENVIRONMENTAL LABORATORIES (WAC 173-050)

The State of Washington established a requirement that all laboratories reporting data to comply with NPDES permits must be generated by an accredited laboratory. This accreditation program establishes specific tasks for quality control and quality assurance

(QA/QC) that are intended to ensure the integrity of laboratory procedures. Accreditation requirements must be met for any on-site laboratory or outside laboratory used to analyze samples. Only accredited laboratories may be used for analyses reported for compliance with NPDES permits. In planning for an on-site laboratory, staffing must be sufficient to allow for QA/QC procedures to be performed. The Camas WWTF lab is currently accredited for determination of the following parameters TSS, $BOD_5$, ammonia, dissolved oxygen , pH and fecal coliform.

## MINIMAL STANDARDS FOR SOLID WASTE HANDLING (WAC 173-304)

Grit and screenings are not subject to the sludge regulations in WAC 173-308, but their disposal is regulated under the state solid waste regulations, WAC 173-304. Waste placed in a municipal solid waste landfill must not contain free liquids, nor exhibit any of the criteria of a hazardous waste as defined by WAC 173-303. To be placed in a municipal solid waste landfill, grit, screenings, and incinerator ash must pass the paint filter test. This test determines the amount of free liquids associated within the solids, and includes the toxic characteristic leachate procedure (TCLP) test, which determines if the waste has hazardous characteristics.

## WETLANDS

### Dredging and Filling Activities in Natural Wetlands (Section 404 of the Federal Water Pollution Control Act)

A Corps permit is required when locating a structure, excavating, or discharging dredged or fill material in waters of the United States or transporting dredged material for the purpose of dumping it into ocean waters. Typical projects requiring these permits include the construction and maintenance of piers, wharves, dolphins, breakwaters, bulkheads, jetties, mooring buoys, and boat ramps.

If wetland fill activities cannot be avoided, the negative impacts can be mitigated by creating new wetland habitat in upland areas. If other federal agencies agree, the Corps would generally issue a permit.

### Wetlands Executive Order 11990

This order directs federal agencies to minimize degradation of wetlands and enhance and protect the natural and beneficial values of wetlands. This order could affect siting of lift stations and sewer lines.

## SHORELINE MANAGEMENT ACT

The Shoreline Management Act of 1971 (RCW 90.58) establishes a broad policy giving preference to shoreline uses that protect water quality and the natural environment, depend on proximity to the water, and preserve or enhance public access to the water.

The Shoreline Management Act jurisdiction extends to lakes or reservoirs of 20 acres or greater, streams with a mean annual flow of 20 cubic feet per second (CFS) or greater, marine waters, and an area inland 200 feet from the ordinary high water mark. Projects are reviewed by local governments according to state guidelines and a local Shoreline Master Program. The Camas wastewater treatment plant and portions of the collection system are located within shoreline areas.

The City implemented its own Shoreline Master Program in 1998.

### FLOODPLAIN DEVELOPMENT PERMIT

Local governments that participate in the National Flood Insurance Program are required to review projects in a mapped floodplain and impose conditions to reduce potential flood damage from flood water. A Floodplain Development Permit is required prior to construction, including projects involving wastewater collection facilities.

### HYDRAULIC PROJECT APPROVAL

Under the Washington State Hydraulic Code (WAC 220-110), the WDFW requires a hydraulic project approval (HPA) for activities that will "use, divert, obstruct, or change the natural flow or bed" of any waters of the state. For City activities such as pipeline crossings of streams or WWTF outfall modifications, an HPA will be required. The HPA will include provisions necessary to minimize project specific and cumulative impacts to fish.

## CITY SEWER ORDINANCES AND PLANNING POLICIES

The Camas Municipal Code, Title 13, Division II, addresses rules and regulations for the City's sewer system. Table 4-1 lists the chapters in Title 13. These chapters of the municipal code have been included in Appendix C. As shown in Table 4-1, the sewer ordinances address such issues as requirements for connections to sewer system, STEP systems, permits for sewer installation by developers, rates for sewer service, development requirements for private sewer systems, conditions for sewer service extensions, and sewage pretreatment regulations.

## TABLE 4-1

## Camas Municipal Code Sewer System

| Chapter | Title | Description |
|---|---|---|
| 13.60 | Sanitary Disposal System | Provides general information such as a permits, required connection, flush toilet for private system, non-conforming systems, enforcement, and penalties for violations. |
| 13.60.040 | Construction-Permit Required | Establishes that it is unlawful to construct any means of sewerage disposal without first acquiring a permit. |
| 13.60.050 | Connection-Required | Includes requirements for connections to sewer system when it is available. |
| 13.60.060 | Private System-Flush Toilet | Requires all homes and businesses, where there are no public sewer lines available, to provide a private water flush toilet. |
| 13.60.080 | Enforcement | City Health Officers duty to enforce provisions of Chapter 13.60. |
| 13.60.90<br>13.60.100 | Violations | Anyone who violates or refuses or fails to comply with Chapter 13.60 shall be guilty of a misdemeanor and submit to fines or imprisonment. |
| 13.62 | Septic Tank Effluent Pumping Systems | Provides general information such as standard specifications, application to connect, inspection fee, right-of-entry, ownership, damage and repair, and landscaping. |
| 13.62.010 | Definitions | Includes definitions related to STE and STEP systems. |
| 13.64 | Sewer Service Charges | Provides rate schedule for residential and commercial and industrial users, describes adjustment for broken water lines, and sets connection rates. |
| 13.68 | Sewer Use | |
| 13.68.010 | Definitions | Definitions relating to NPDES permit effluent parameters, wastes, buildings, etc. |
| 13.68.020 | Use Provisions | Prohibition of hazardous and inappropriate discharges to the sewer. |
| 13.68.030 | Inspection | Inspections to ensure compliance with this chapter. |
| 13.68.050<br>13.68.060 | Violation | Written notice of violation and noncompliance is a misdemeanor and a conviction shall be fined and imprisoned not to exceed 60 days. |
| 13.72 | Sewer Service Development Charge | Provides rules and fees for property owners who seek to connect property to the sewer system of the city to be assessed a charge in order that such property shall bear its equitable share of the cost of the sewer system |

# CHAPTER 5

# EXISTING FACILITIES

## INTRODUCTION

This Chapter describes existing facilities that compose the City of Camas's wastewater collection and treatment systems. These facilities include pressure and gravity sewers, pump stations, wastewater treatment facilities, and river outfall.

### WASTEWATER COLLECTION SYSTEM

#### Septic Tank Effluent (STE) Systems

In 1985, the City of Camas adopted a wastewater collection plan which was based on the use of septic tank effluent (STE) systems for new residential, commercial and industrial connections to the City sewer. In this type of system, a significant portion of the suspended solids in the raw wastewater settle out in the STE tank at the customer's property. The solids remain in the tank for 5 to 7 years and are partially stabilized by biological digestion. When the solids storage capacity of a tank is reached, the tank is pumped out and the resultant septage is hauled by tank truck to the City's wastewater treatment facility. All STE tanks, except commercial tanks and certain private, custom installations, are owned and maintained by the City. Custom installations are inspected regularly for compliance with City ordinances. As part of the City's sewer system maintenance program, all City-owned tanks receive ongoing maintenance.

There are three major types of STE systems, which include:

- STEP: Septic Tank Effluent Pump systems
- STEF: Septic Tank Effluent Filter systems
- STEG: Septic Tank Effluent Gravity Flow systems

Most of the STE systems at Camas are STEP systems.

Since 1985, over 3,500 sewer connections have been added to the City's system, with most of these connections using STE facilities. It is estimated that over half of the current total sanitary sewage flow to the wastewater treatment facility consists of flow from STE systems, and that about 80 to 90 percent of the wastewater generated by new connections originates from STE systems. As of 2005, there were 6,223 sewer utility customers.

The use of STE systems has resulted in a decrease in the strength of the influent wastewater entering the treatment facility, as compared to typical domestic wastewater.

Medium strength wastewater is estimated to have both $BOD_5$ and TSS concentrations of 220 mg/L (Metcalf and Eddy, 2nd Edition), and the existing secondary treatment standard of 85 percent removal of pollutants is based on typical influent $BOD_5$ and TSS concentrations of 200 mg/L. According to USEPA publication 660/K-93/001 (January 1993), a typical septic tank provides a 40 to 50 percent reduction in $BOD_5$ and a 60 to 80 percent reduction in TSS. Based on this removal performance for typical domestic wastewater, a septic tank would be expected to produce an effluent with $BOD_5$ concentration in the range of 100 to 130 mg/L and TSS in the range of 40 to 90 mg/L. Samples from the City's wastewater treatment facility influent during the dry weather months of July through September 2004-2005 indicated average $BOD_5$ and TSS concentrations of 150 mg/L and 180 mg/L, respectively. These influent concentrations are somewhat lower than those normally associated with typical domestic wastewater, and indicate substantial amounts of low-strength septic tank effluent. Since infiltration and inflow would be low during these dry weather months, the low influent strength can partially be attributed to the $BOD_5$ and TSS removal in the City's STE systems.

Another factor in the low influent strength is dilution by low strength industrial flows. About one third of the Camas water supply is consumed by industries, and much of this is discharged to the WWTF at lower strength (for $BOD_5$ and TSS, but not necessarily for other pollutants) than ordinary municipal wastewater. Wafertech, for instance, one of the City's largest dischargers, is known to discharge wastewater low in $BOD_5$ and TSS but high in TKN (Total Kjeldahl Nitrogen, the sum of organic and ammonia nitrogen).

Although the use of STE systems will decrease the strength of the City's influent, hauling and treatment of septage from the STE systems at the City's WWTF will add substantially to the demands of the solids handling system and contribute to $BOD_5$ and TKN loadings through internal recycle streams.

**Pump Stations**

The City of Camas has sixteen major pump stations within its sanitary sewer system. The locations of these pump stations are shown in Figure 2-2. Basic information about the pump stations is included in Table 2-1. Only the Main Pump Station has variable frequency drive (VFD) control. A description of the various basins in which the pump stations are located appears in the next section.

# TABLE 5-1

## Pump Stations

| | Pump Station | Location | Basin No. Located In | Qty. of Pumps | Pump Motor Size (HP) | Pump Capacity (gpm, ea.) | Total Station Capacity (gpm, w/1 out of service) | TDH (ft.) | Force Main Dia. (in.) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Main | SE 3rd and Dallas | 5 | 3 | 125 | 3,850 | 7,700 | 85 | 18 |
| 2 | Oak Park | SE 9th and SE Polk | 8 | 2 | 10 | 350 | 350 | 57 | 6 |
| 3 | One Stop | NE 2nd and Yale | 9 | 2 | 5 | 231 | 231 | 36.2 | 6 |
| 4 | South Prune Hill | NW 6th and Oregon | 10 | 2 | 15 | 510 | 510 | 39 | 10 |
| 5 | West Camas | NW 6th Avenue and NW 6th Place | 1 | 2 | 30 | 810 | 810 | 74 | 6 |
| 6 | Crown View Plaza | NW Kent and NW Ivy | 3 | 2 | 25 | 325 | 325 | 126 | 6 |
| 7 | Lacamas Creek | NE 3rd Loop and NE 3rd Avenue | 7 | 2 | 18 | 300 | 300 | 79 | 6 |
| 8 | Parker Estates | NW Parker Street and NW Knapp Lane | 13 | 2 | 20 | 312 | 312 | 120 | 6 |
| 9 | Winchester Hills No. 1 | NW Pacific Rim Blvd. and NW Payne Road | 13 | 2 | 6 | 148 | 148 | 74.5 | 4 |
| 10 | Winchester Hills No. 2 | West end of SE 42nd Street | 13 | 2 | 5 | 125 | 125 | 65 | 4 |
| 11 | Grand Ridge | SE Grand Ridge Drive | 11 | 2 | 10 | 65 | 65 | 160 | 4 |
| 12 | Brady Road | SE Brady Road and NW MacIntosh Road | 11 | 2 | 35 | 500 | 500 | 154 | 8 |
| 13 | Sunningdale Gardens 1 | NW Dahlia Loop | 14 | 2 | 5 | 95 | 94 | 63 | 4 |
| 14 | Lacamas Shores | NW Lacamas Shores Drive and NW El Rey Drive | 14 | 2 | 15 | 200 | 200 | 175 | 6 |
| 15 | Prune Hill Park | NW Sierra Drive and NW 35th Circle | 13 | 2 | 7.5 | 350 | 350 | 53 | 6 |
| 16 | Hunter Ridge Estates | | | | Not | yet | submitted | | |
| 17 | Larkspur | End of NW Larkspur | 14 | 2 | 23 | 264 | 264 | 154 | 4 |
| 18 | Hillshire | End of NW Artz Court | | 2 | 10 | 175 | 175 | 70.1 | 6 |
| 19 | Stoneleaf | NW 25th and NW Knight | 13 | 2 | 23 | 423 | 423 | 81 | 6 |
| 20 | Two Creeks "A" | NW Quinault and NW 72nd Loop | 14 | 2 | 10 | 166 | 166 | 71 | 6 |
| 21 | Two Creeks "B" | NW Camas Meadows Drive | 14 | 2 | 35 | 221 | 221 | 222 | 6 |
| 22 | Grass Valley | West end of NW 45th Avenue | 14 | 2 | 23 | 173 | 176 | 203 | 6 |

## Gravity Collection System

Sanitary sewer lines in downtown Camas, and areas to the immediate north and east of downtown, were constructed from the 1920s through the 1950s. The first sewer lines in this core area were constructed of vitrified clay pipe (VCP); subsequently, cast iron, and concrete pipe, were added. Much of this original sewer pipe is still in place today. As the City has grown, primarily to the northwest and southeast of downtown, additional concrete pipe has been added to the system. Since the 1980s, improved sewer construction and pipe materials have been used, including non-porous piping materials (PVC pipe) and rubber-gasket type joints to reduce infiltration and improve the condition of the sanitary sewer system. The sewer systems installed in the 1990s for many of the residential and commercial developments on the periphery of Camas have been septic tank effluent (STE) systems with small diameter HDPE and PVC pipes.

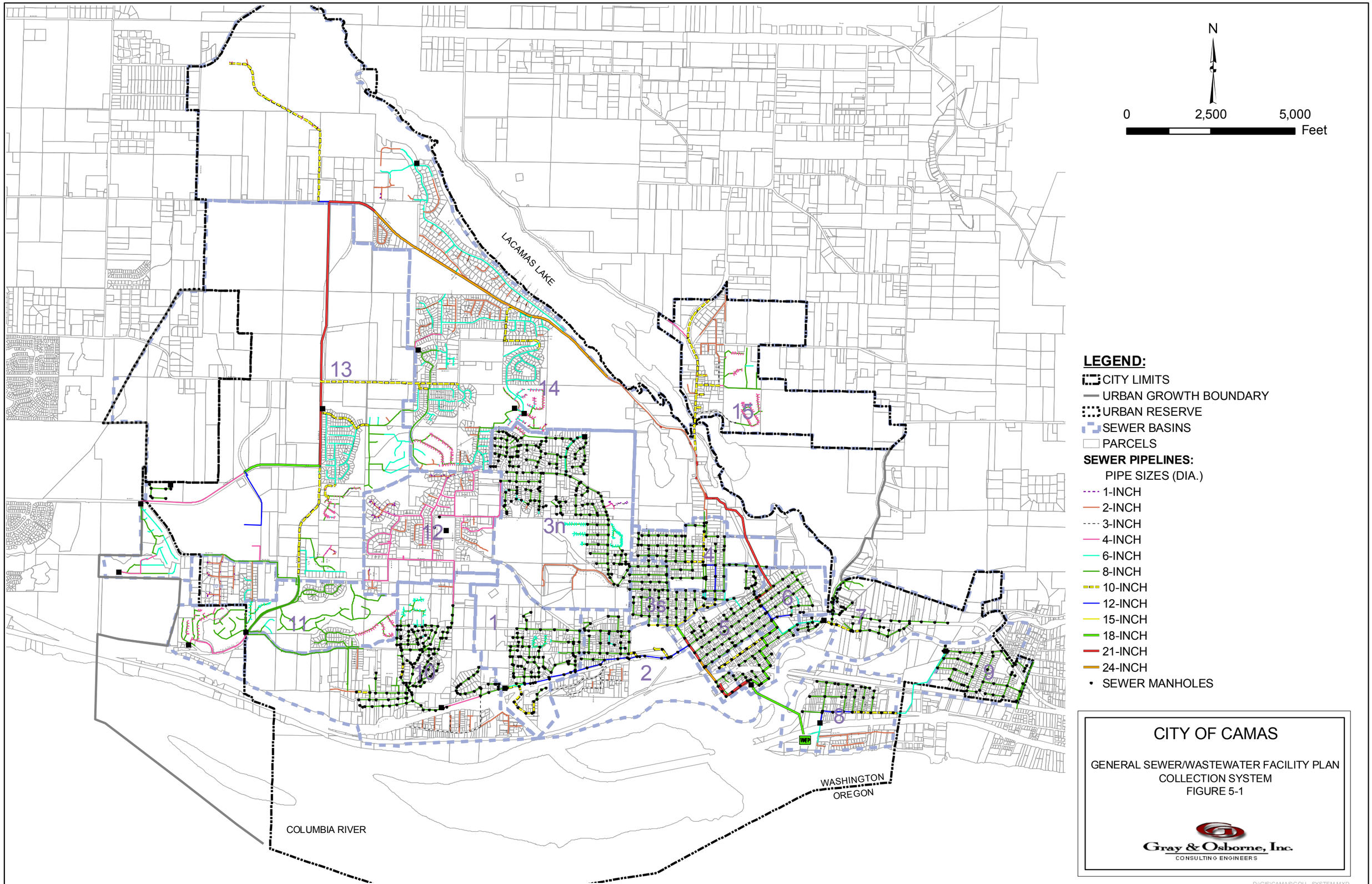
Figure 2-2 shows the existing sewer system. Wastewater is discharged to the City's secondary wastewater treatment facility, which has an outfall on the Columbia River. The sewer system service area in Camas generally slopes toward the confluence of the Washougal and Columbia Rivers, where the treatment facility is located. Thus, much of the collection system consists of gravity sewers. However, the system also contains pump stations, pressure lines, and the STE systems. STE systems are concentrated in the northern and western portions of the City. The current system consists of 2-inch to 27-inch-diameter pipe, constructed of VCP, concrete, cast iron and PVC. Figure 2-3 shows the sewer system with sewer pipe diameters identified.

A summary of the various diameters and the percentage of each within the City's gravity sewer system are provided in Table 2-2. This summary is an estimate based on manhole inspections conducted in 1998, review of as-built drawings and previous television inspection and information provided by the City.

The City's sanitary sewer system also contains approximately 800 manholes. These manholes vary in construction material from all brick to the newer precast concrete manholes. The older, all brick and concrete block manholes present a greater opportunity for infiltration to occur, due to the mortar joints between the bricks or concrete blocks, than the newer precast manholes.

## Collection Areas

For the purposes of this report, the City of Camas WWTF collection system is divided into 15 collection areas, or drainage basins. These collection areas predominantly follow the natural drainage patterns of the City's service area. The fifteen major basins are shown in Figure 2-2. The locations and names of the different basins are generally consistent with and equivalent to those used in previous reports. However, basin boundaries have been modified to reflect new developments and new flow routing, including changes to the direction of flow in pressure lines and new gravity sewer lines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2
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8
WASHINGTON
OREGON
COLUMBIA RIVER
LEGEND:
CITY LIMITS
URBAN GROWTH BOUNDARY
URBAN RESERVE
SEWER BASINS
PARCELS
SEWER PIPELINES:
PIPE SIZES (DIA.)
1-INCH
2-INCH
3-INCH
4-INCH
6-INCH
8-INCH
10-INCH
12-INCH
15-INCH
18-INCH
21-INCH
24-INCH
SEWER MANHOLES
CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
COLLECTION SYSTEM
FIGURE 5-1
Gray & Osborne, Inc.
CONSULTING ENGINEERS
D:\GIS\CAMAS\COLL_SYSTEM.MXD

(particularly in Basins 11, 12, 13). As discussed in Chapter 7, the 15 basins have been subdivided into smaller basins for the purposes of modeling the sewer system.

**TABLE 5-2**

**Sewer Pipe Summary**
**(All lengths in feet)**

| Pipe Diameter | Pipe Length(ft.) | | Sewer Type | Pipe Length (ft.) |
|---|---|---|---|---|
| 4 | 48,670 | | Gravity | 291,540 |
| 6 | 85,764 | | Force Main | 41,925 |
| 8 | 238,396 | | STEP | 53,427 |
| 10 | 39,095 | | STEF | 27,171 |
| 12 | 9,569 | | STEG | 13,376 |
| 15 | 2,733 | | Unknown | 35,000 |
| 18 | 8,329 | | | |
| 21 | 19,569 | | | |
| 24 | 9,369 | | | |
| **TOTAL** | **462,000 feet (87.5 miles)** | | | |

The sewers in the downtown core area, including Basins 2, 5, 6, 7, 8, and 9, were constructed on alluvial deposits of silt and gravel. The groundwater table in this area fluctuates with the river elevation. Sewers constructed in the hills to the north and west of downtown, including those in Basins 3, 4, and 12, are constructed in sandstone deposits located above the groundwater table. During extended rainy periods, however, the soil around the sewers may become saturated, with the sandstone layer underneath acting as an aquitard. The sewer trench may then act as a natural drain for runoff, channeling the runoff water along the sewer pipe until it reaches a defect in the pipe or in a manhole, where it enters the sewer system and contributes to I/I.

The following section describes the boundaries and land use designations of each basin, as well as information about the sewer lines within each basin.

Basin 1

Basin 1 consists of an area of about 230 acres in West Camas around Forest Home Park. The approximate boundaries of this basin are SR 14 on the south, Forest Home Road on the north, and Ivy Street on the east. The designated land use in most of Basin 1 is single-family residences.

Sewage from Basin 1 is conveyed by gravity to the south through two separate 8-inch concrete pipe systems installed in 1962. The flow is conveyed into a 12-inch vitrified

clay (VCP) main from these two system at separate connections east of the West Camas Pump Station. The 12-inch VCP main transports the sewage to Basin 2 to the east.

Basin 2

Basin 2 consists of an area of about 200 acres east of Forest Home Park and just west of downtown. The approximate boundaries of this basin are the Camas Slough on the south, Ivy Street (and Basin 1) on the west, NW Ivy Drive (and Basin 3) on the north, and a boundary just west of Adams Street near downtown. Basin 2 includes areas with designated land use for single- and multi-family residences, and a large area designated for heavy industrial for portions of the Georgia Pacific pulp and paper mill.

The area of Basin 2 north of NW 6$^{th}$ Avenue is served predominantly by vitrified clay pipe installed in the 1930s. Sewage from this area flows by gravity to the south into the 12-inch VCP main, which conveys the sewage to the east and into Basin 5. The area of Basin 2 south of NW 6$^{th}$ Avenue is served by a STEP system that includes 2-inch and 6-inch pipe. Sewage from the south side of NW 6$^{th}$ Avenue is ultimately conveyed north to the same 12-inch main accepting flow from the north side of NW 6$^{th}$ Avenue. A number of sewer pipes in Basin #2 have been recently replaced with HDPE pipe.

Basin 3

Basin 3 is a relatively long and narrow basin located near the geographic center of the current Camas city limits. Basin 3 is divided into Basin 3 North, consisting of about 460 acres and Basin 3 South, consisting of about 91 acres. Basin 3 North includes much of Crown Hill and the area around NW Fargo Road, which leads up to Crown Hill from the downtown area. The approximate boundaries of Basin 3 North are Forest Home Road to the south, NW Sierra Street to the west, NW 32$^{nd}$ Avenue to the north, and NW Fargo Road and NW Drake Street to the east. Basin 3 South includes the area just to the northwest of downtown. The approximate boundaries of Basin 3 South are NW Drake Street to the west, NW 18$^{th}$ Avenue and Crown Park to the north, and the Georgia Pacific facility water supply ditch to the southeast. The designated land use for a majority of the land within Basin 3 is for single-family residences, with smaller portions of the land zoned for multi-family residences and parks.

The northeastern and northwestern sections of Basin 3 North, respectively, are served by 8-inch concrete pipe (installed in the late 1970s and early 1980s), and 8-inch PVC (installed in 1994). Sewage from these areas is conveyed by gravity to the Crown View Plaza Pump Station, from which it is pumped south through a force main and then flows by gravity to the southeast and Basin 3 South. The southwest corner of Basin 3 North, along NW Ostenson Canyon Road, is served by a STEP system, while the southeast corner, along NW Fargo, is served by 8-inch pipe installed in 1962. Sewage from Basin 3 South is conveyed by 8-inch vitrified clay pipe installed in the 1930s, as well as a 15-inch main that conveys the combined flow to Basin 5. In the last six years, a gravity sewer on

NW 27th was replaced between NW Sierra Street and NW Norwood Street, and a force main was replaced on Kent Street.

Basin 4

Basin 4 consists of an area of about 140 acres just north of downtown. Basin 4 borders Basin 3 South and Crown Park on the southwest. The approximate other boundaries are Couch Street to the west, NW 22nd Street, Fallen Leaf Park and Zellerbach Middle School to the north, and Camas High School to the southeast. This basin includes a "panhandle," to the east around NE 19th Avenue. The designated land use in Basin 4 consists of single- and multi-family residences, parks, and schools.

The majority of Basin 4 is serviced by gravity flow 8-inch concrete and VCP pipe, and additional sections of 10-, 12-, and 15-inch pipe. Combined flow from these pipes flows into an 18-inch line that transmits the flow along the southern border of Basin 3 South and into Basin 5. In the last 6 years, sewers have been rehabilitated on NE Garfield Street between NE 22nd Avenue and NE 15th Avenue, and on NE 18th Avenue between Division and Dallas Streets.

Basin 5

Basin 5 consists of an area of about 120 acres in downtown Camas. The approximate boundaries of this basin are Basins 2, 3 and 4 to the west and north, Joy Street to the northwest, and NE 3rd Avenue to the southeast. Basin 5 also includes a "panhandle" south of the railroad tracks near the Main Pump Station. Most of the designated land use in Basin 5 is commercial and industrial, with smaller portions to the north for municipal use and multi-family residences.

The majority of Basin 5 is served by 8-inch VCP pipe installed from 1927 to 1951. Relatively short sections have been recently replaced with concrete and PVC pipe, including a section of sewer on 3rd Avenue from Adams Street to Cedar Street within the last 5 years. Flow from Basin 5 enters a 24-inch trunk line flowing along Adams Street. This trunk line flows into a 21-inch line before entering the Main Pump Station, where the flow combines with that from Basin 6. The Main Pump Station pumps the combined flow across the Washougal River through a force main and into the treatment facility.

Basin 6

Basin 6 consists of an area of about 110 acres in downtown Camas. The approximate boundaries of this basin are NE 3rd Avenue (and Basin 5) to the west, Lacamas Creek Park to the east, and the railroad tracks and Washougal River to the south. Most of the designated land use in Basin 6 is commercial and multi-family, with smaller areas within the basin designated for parks and heavy industrial facilities.

Basin 6 is served primarily by 8-, 10-, and 12-inch pipes (installed in 1927 to 1951) flowing by gravity. Sewage from these pipes, as well as flow from the 24-inch STEP line in Basin 14, flows into an 18-inch trunk line in Basin 6 that discharges into the Main Pump Station.

Basin 7

Basin 7 consists of an area of about 160 acres immediately to the east of downtown Camas. The approximate boundaries of this basin are Lacamas Creek Park (and Basin 6) to the west, the Washougal River to the south, and a boundary running parallel to and north of NE 3rd Avenue N to the north. Basin 7 is zoned for single- and multi-family residences, commercial facilities, and parks.

Basin 7 is served by 8-inch concrete pipe that was installed from 1927 to 1951. Sewage is conveyed by gravity through this system to the Lacamas Creek Pump Station, from which sewage travels by 6-inch force main to Basin 6.

Basin 8

Basin 8 consists of an area of 170 acres near the confluence of the Washougal and Columbia rivers, across the Washougal River from downtown Camas. The approximate boundaries of this basin are the Columbia River to the south the Washougal River to the north and west, and a boundary running parallel to and east of Union Street to the east. The designated land use in Basin 8 is single- and multi-family residences, light industry, commercial facilities and municipal facilities, including the City of Camas WWTF and Operations Center.

The area in Basin 8 to the north of SR 14 is served by 8- and 12-inch concrete gravity lines, which transfer sewage to the Oak Park Pump Station and through the force main and into the treatment facility. Sewage from the area to the south of SR 14 is pumped by a STEP system into the force main where it merges with the flow from the north side of SR 14.

Basin 9

Basin 9 consists of an area of about 100 acres on the extreme eastern boundary of the City limits along 3rd Avenue NE. The approximate boundaries of this basin are the Washougal River to the north, Yale Street and Goot Park to the west, Lechner Street to the east, and the railroad tracks to the south. Basin 9 is zoned for single- and multi-family residences, parks and commercial facilities.

Sewage from Basin 9 is conveyed by gravity flow though 8-inch concrete pipe (installed in 1972) to the One Stop Pump Station. From here, flow from this basin is conveyed through a 6-inch force main to Basin 8.

Basin 10

Basin 10 consists of an area of about 550 acres in the western part of Camas, centered around Prune Hill. This basin is bordered on the east by Basin 1. The approximate other boundaries of this basin are the Camas Slough to the south, Klickitat Street to the west and a northern boundary of NW McIntosh to in the western portion and NW 18th Avenue in the east. The vast majority of the land in this basin is designated for single-family housing with small sections of multi-family houses, parks, and commercial facilities in the south portion of the basin.

Sewage from the north side of SR 14 in Basin 10 generally flows by gravity through 8-inch concrete pipe (installed in 1982). STEP effluent from Basin 12 enters Basin 10 in a 4-inch STEP line on NW Astor Street. Additionally, a PVC line installed in the 1990s runs down Fremont Street. Sewage from these lines is conveyed to the south, where near SR 14, it reaches the West Camas Pump Station, where the sewage is pumped into Basin 1 to the east. The south side of SR 14 is served by a STEP system that combines with the flow from the north side of SR 14 in Basin 10 upstream of the South Prune Hill Pump Station.

Basin 11

Basin 11 consists of an area of about 410 acres in the extreme southwestern corner of Camas. The approximate boundaries of this basin are Fremont Street (and Basins 10 and 12) to the east, Basin 10 to the south, the Camas Urban Growth Boundary to the west. Most of the area of Basin 11 is designated for single-family housing.

Basin 11 is served primarily by STEP, STEF and STEG systems consisting of 2-inch, 6-inch, and 8-inch pipe. A small section around NW Whitman St. is served by a 6-inch gravity main and a STEF system. Sewage from Basin 11 is ultimately collected by the Brady Road Pump Station and conveyed to the north, where it flows into Basin 13 on NW Brady Road. Sewage collected from the southwest corner of Basin 11 is conveyed by the Grand Ridge Pump Station to the Brady Road Pump Station.

Basin 12

Basin 12 consists of an area of about 270 acres in central-west Camas, including Dorothy M. Fox Elementary School and portions of Prune Hill. Basin 12 borders Basins 1, 3 and 10 on the west and south. The approximate extent of Basin 12 to the north is NW 28th Avenue, while to the west the boundary is west of NW Hood Street, Columbia Summit Drive, and NW Ilwaco Court. Most of Basin 12 is designated for single-family housing, while the northeast corner is designated for schools and parks.

Sewage from Basin 12 is conveyed to the south (to Basin 10) by a STEP system. The diameters of pipes in this basin are 2 and 4 inches.

Basin 13

Basin 13 consists of an area of about 1,700 acres along the western border of the Camas city limits. Basin 13 borders Basins 11, 12, and 14 to the south, southeast, and east, respectively, while the west boundary is near the Camas Urban Growth Boundary. Most of Basin 13 is designated for light industrial, while portions are designated for single-family residences, commercial facilities, and schools. Basin 13 includes several large industries, including Wafertech, Linear, Sharp, Landa, and Heraeus Shin Etsu.

Sewage in Basin 13 is conveyed through STEP systems (10- and 18-inch pipes) and STEF systems (6- and 10-inch pipes) into a 21-inch pressure line. The 21-inch line, which was installed in 1991, conveys sewage north to Basin 14. The southwest corner of Basin 13 is served by the Winchester Hills 1 and Winchester Hills 2 Pump Stations, and the western portion is served by the Parker Estates Pump Station.

Basin 14

Basin 14 consists of an area of about 1,800 acres in northern Camas stretching from just north of downtown to the northwest corner of the Camas City limits on Lacamas Lake. This basin borders Lacamas Lake on the north and Basins 13, 12, 3, and 4 to the south. The majority of the land in Basin 14 has land use designations for single-family housing, with sections devoted to commercial facilities, multi-family housing, schools, parks and public facilities.

Most of Basin 14 is served by a STEP system. However, the area near El Rey Drive is served by a STEG system, and the area around NW Valley Street is served by STEF. Sewage in Basin 14 is conveyed by 2-, 4-, 6-, 8-, 10-, and 24-inch pipes to a 24-inch trunk line that runs southeast along Lacamas Lake to Basin 6. Pump stations in Basin 14 include the Lacamas Shores Pump Station serving the area just south of the northwest corner of Lacamas Lake, and Sunningdale Gardens 1, Sunningdale Gardens 2, and Summit Oaks Pump Stations serving the area south of central Lacamas Lake.

Basin 15

Basin 15 consists of an area of 180 acres north of Round Lake in the Lacamas Heights area. The area is outside of the Camas city limits, but inside the urban growth boundary. The approximate boundaries of this basin are Round Lake to the south, Lacamas Lake to the southwest, west of Everett Street to the west, and Lacamas Heights Elementary School to the northwest. Most of Basin 15 is designated for single-family residences, with portions designated for parks and schools (Lacamas Heights Elementary School). Camas High School is located just east of Basin 15.

Basin 15 is served by a STEP system that ultimately pumps sewage south to Basin 14. The collection system includes 2-inch and 4-inch pipes that discharge into a 10-inch line that connects with the main in Basin 14.

## WASTEWATER TREATMENT FACILITY

The original wastewater treatment facility (WWTF) was constructed in 1972. The facility was rated at 2.33 mgd capacity using a complete mix activated sludge system operating in an extended aeration configuration. The original facility was modified in 1994 by the expansion of the sludge drying beds, increasing the waste solids handling capacity.

The facility underwent several improvements in 1995. The original comminutor was replaced with an automatic mechanical fine screen and the small feedwell on the existing secondary clarifier was replaced with a larger, more efficient feedwell and energy dissipating inlet. Process control improvements included:

- Addition of a programmable logic controller (PLC) to control the operation of the aerators and enhance nitrification during cold weather conditions thus elevating the pH.

- Addition of a PLC control program and a motorized actuator on the aeration basin bypass valve to automatically bypass peak flows to the secondary clarifiers, thereby reducing high solids flux rate of MLSS to the secondary clarifier to help control effluent TSS.

- Installation of a polymer feed system to automatically add polymer to the clarifier influent and thus improve solids settling and help control effluent TSS during high flows.

In 1997 an additional secondary clarifier was constructed.

The facility was upgraded and expanded to 6.1 mgd capacity in 2000. The existing aeration basins were converted to aerobic digesters, and the new treatment facility included a headworks with mechanical fine screen, primary and secondary clarifiers, aeration basin with selectors and oxic/anoxic zones for nitrogen removal, effluent filtration, UV disinfection, effluent pump station and a sludge dewatering centrifuge. New laboratory/office, equipment, and effluent filter/UV disinfection buildings, sludge storage facility, and a soil biofilter for odor control were also constructed.

In 2002, an alkalinity addition and control system was added that stores and feeds 25 percent sodium hydroxide to the headworks or aeration basins. The system consists of two 10,000-gallon tanks in a secondary containment enclosure, two peristaltic pumps, and piping to convey the alkalinity source to the feed points.

The Department of Ecology issued the current City of Camas NPDES operating permit effective December 1, 2004, granting the City the request for a relaxed percent removal of influent BOD and TSS from the previous permit due to dilute influent from WaferTech industries and to the many Septic Tank Effluent Pump (STEP) tanks throughout the system. The permit requires 70 percent removal of influent TSS and BOD and effluent concentrations of both TSS and BOD of 20 mg/L. The permit was renewed effective December 1, 2004 and expires November 30, 2009.

Figures 5-2 and 5-3 show a process schematic and a layout/process schematic for the WWTF. The WWTF liquid stream treatment processes include influent screening, primary settling, biological treatment in aeration basins, secondary settling, and UV disinfection. Sludge handling includes degritted primary sludge and waste activated sludge co-thickened in the gravity thickener. Thickened sludge and scum from primary clarifiers, gravity thickener, secondary clarifiers, and the aeration splitter box is transferred to the aerobic digesters then dewatered by a polymer fed centrifuge. Sludge from the centrifuge is conveyed by a screw conveyor to the Sludge Storage Building. A brief description of each unit process and facility component for the existing facility follows.

## HEADWORKS

The headworks are designed for flow metering, screening and influent flow sampling. Influent first passes through a 24-inch Parshall flume for influent flow measurement before approaching the mechanical fine screen with a bar spacing of 1/4-inch. If the fine screen is out of service or if the influent flow exceeds 11.1 mgd, the excess wastewater is diverted to the manual bypass coarse bar screen, with a bar spacing of 3/4-inch. The screenings are transported by a screenings screw conveyor to a dumpster located adjacent to the headworks structure. pH and dissolved oxygen are also measured at the headworks.

## PRIMARY CLARIFIERS

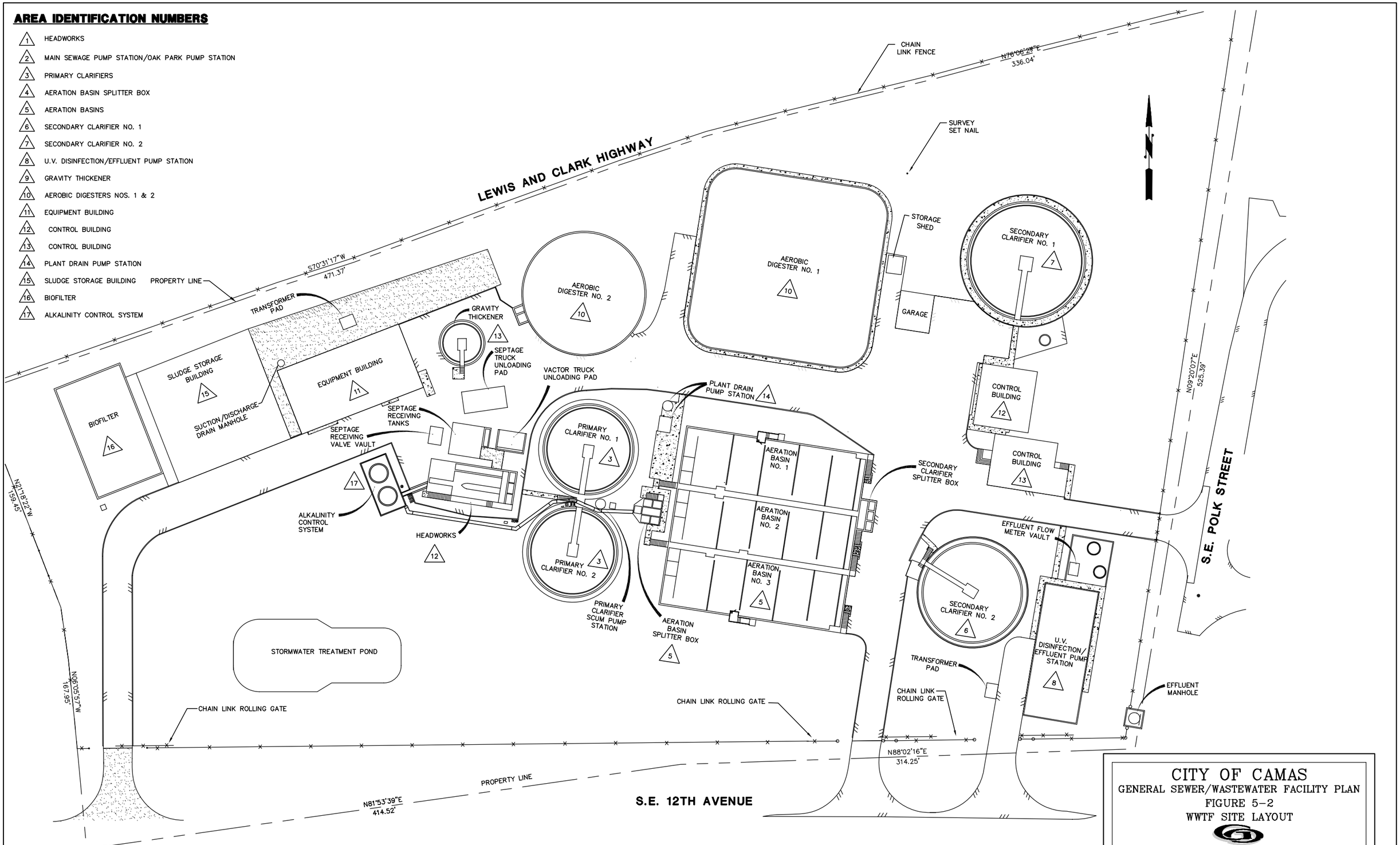
Two 60-foot-diameter circular primary clarifiers remove grit and other settleable solids from the screened wastewater. The flow split between the two clarifiers is controlled by slide gates in the primary clarifier splitter box at the end of the headworks. The grit-laden sludge is pumped to the grit removal facility by three 10-hp recessed impeller torque flow pumps with a capacity of 220 gpm at a TDH of 32 feet. Scum collected from the primary clarifiers is conveyed by gravity to the primary clarifier scum pump station.

## AERATION BASINS

In the aeration basin splitter box, primary effluent is mixed with Return Activated Sludge (RAS). Alkalinity chemical addition for pH control can be added at the aeration basin splitter box, or at the headworks.

## AREA IDENTIFICATION NUMBERS

1. HEADWORKS
2. MAIN SEWAGE PUMP STATION/OAK PARK PUMP STATION
3. PRIMARY CLARIFIERS
4. AERATION BASIN SPLITTER BOX
5. AERATION BASINS
6. SECONDARY CLARIFIER NO. 1
7. SECONDARY CLARIFIER NO. 2
8. U.V. DISINFECTION/EFFLUENT PUMP STATION
9. GRAVITY THICKENER
10. AEROBIC DIGESTERS NOS. 1 & 2
11. EQUIPMENT BUILDING
12. CONTROL BUILDING
13. CONTROL BUILDING
14. PLANT DRAIN PUMP STATION
15. SLUDGE STORAGE BUILDING
16. BIOFILTER
17. ALKALINITY CONTROL SYSTEM




**SITE PLAN**
SCALE: 1"=30'

CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
FIGURE 5-2
WWTF SITE LAYOUT

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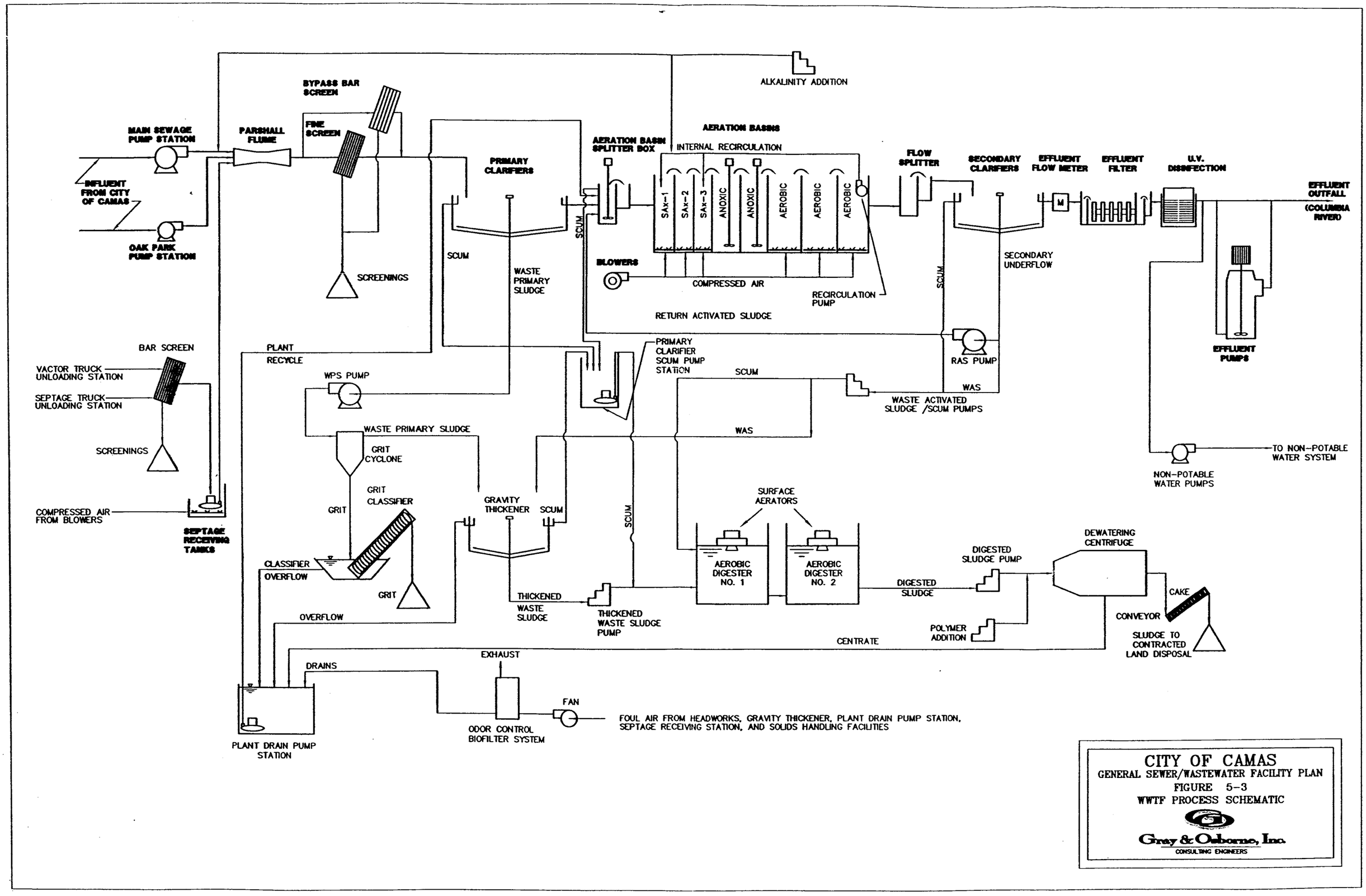



CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
FIGURE 5-3
WWTF PROCESS SCHEMATIC

Gray & Osborne, Inc.
CONSULTING ENGINEERS

Biological treatment of the wastewater is provided in the three 100,800 cubic feet aeration basins. The basins contain selector, anoxic, and aerobic activated sludge zones configured in a predenitrification mode. Aeration and mixing is accomplished using an air distribution system consisting of fine and coarse bubble diffusers. Air is supplied to the diffusers by three 150-hp multi-stage centrifugal blowers. Submersible mixers provide mixing for the anoxic zones. Low head, high-volume 4-hp propeller pumps recirculate nitrified mixed liquor from the aerobic zones back to the selector zones operating with a capacity of 3,125 gpm at a TDH of 1.7 feet.

### SECONDARY CLARIFIERS

Two 75-foot circular secondary clarifiers provide efficient and effective solids separation producing high quality effluent. The return activated sludge (RAS) underflow from the secondary clarifiers is pumped back to the aeration basin splitter box using four 10-hp submersible pumps. Each pump is equipped with a variable frequency drive to allow the RAS flow to vary as a function of facility flow. Waste activated sludge (WAS) is removed from the secondary clarifiers and pumped to the gravity thickener using three 5-hp plunger pumps. Scum from the secondary clarifiers is also pumped directly to the aerobic digesters by the 5-hp WAS/Scum Pumps.

### EFFLUENT FILTERS

The secondary clarifier effluent flows by gravity to two fabric-covered disk filters, for additional removal of suspended and colloidal matter. Flow is measured using a magnetic flow meter upstream of the disk filters. The filters are used to help the WWTF meet the required percent removal requirement (70 percent removal) when influent flows are diluted by infiltration and inflow.

### ULTRAVIOLET DISINFECTION

After filtration the effluent is exposed to the ultraviolet (UV) disinfection system. The UV disinfection system consists of mercury, low pressure lamps configured in a horizontal open channel. There are a total of 288 lamps configured in three banks in one channel (96 lamps per bank).

## EFFLUENT PUMP STATION AND OUTFALL

The effluent from the UV disinfection system passes into the effluent pump wet well. The wet well drains to the effluent and outfall manholes, which connect with the outfall diffuser in the Columbia River. Under high river conditions, head loss is too great for gravity flow; the effluent is pumped to the Columbia River using three vertical propeller effluent pumps. The outfall consists of a 36-inch outfall pipeline with 6-inch risers spaced every 10 feet along the pipe. The sixteen risers have 90-degree bends such that

they discharge in the same direction as the current. Eight of the 16 ports are currently capped and are reserved for future use.

## GRIT REMOVAL

Primary sludge is pumped from the primary clarifiers by four recessed impeller pumps to the primary sludge degritting room where two cyclones separate the grit slurry from the sludge. Grit is separated from the grit slurry by an auger classifier and the dewatered grit is collected in a watertight dumpster for disposal.

## SLUDGE THICKENING

The degritted sludge flows by gravity into the gravity thickener for co-thickening with the WAS. The thickened waste sludge is transferred by a progressive cavity pump to the aerobic digesters.

## SCUM PUMP STATION

Scum from the primary clarifiers, gravity thickener, and the aeration basin splitter box is conveyed by gravity to the primary clarifier scum pump station. This submersible pump station transfers the scum to the aerobic digesters.

## AEROBIC DIGESTION

Two aerobic digesters in series stabilize the thickened waste sludge and the scum. The aerobic digesters are open tanks with mechanical aerators. Sludge flows by gravity from the first digester to the second.

## SLUDGE DEWATERING

The digested sludge pumps pump sludge from the second aerobic digester to the dewatering centrifuge. Polymer is fed into the digested sludge for conditioning before sludge enters the centrifuge. The thickened sludge cake from the centrifuge is moved to the Sludge Storage Building by a solids conveyor, and the centrate flows to the facility drain pump station.

## SEPTAGE RECEIVING STATION

A septage receiving station is provided to receive septage from septage trucks and vactor trucks. Septage is screened, stored, aerated and pumped to the treatment facility headworks. The City receives septage only from customer STE tanks within the City's sewer service area.

## ODOR CONTROL

The headworks area, septage receiving station, gravity thickener, facility drain pump station, and solids handling facilities are incorporated into the odor control system. The off-gases are collected by the biofilter fan and vented to the odor control facility that is equipped with a soil biofilter.

## DESIGN CRITERIA

The design criteria for the Camas Wastewater Treatment Facilities, as presented in the 1997 Wastewater Facility Plan and the current City's NPDES permit, are shown in Table 5-3.

As required by the City's NPDES permit, when either the actual flow or waste load reaches 85 percent of the design capacity or, when the projected increases would reach design capacity within 5 years, whichever occurs first, the City is required to submit to the Department of Ecology a plan and a schedule for continuing to maintain capacity at the facility sufficient to achieve the effluent limitations and other conditions of the NPDES permit.

The City's effluent limits for ammonia were first issued in 2004 (the current permit). In accordance with communications with Ecology, it is understood that, after completion of upcoming outfall modifications, Ecology will modify Condition S1.A of the City's NPDES permit by deleting the maximum daily ammonia limits. Thus, for total ammonia limits, only the monthly average limits of 20 mg/L in summer and 7 mg/L in winter will remain. These proposed ammonia limits have been used as the basis of evaluations and calculations for this Plan.

**TABLE 5-3**

**Wastewater Treatment Facility Existing NPDES Permit Limits**

| **NPDES Influent Design Criteria** | | |
|---|---|---|
| **Parameter** | **Value** | |
| Maximum Month Flow (MGD) | 6.10 | |
| Maximum Monthly Loading, $BOD_5$ (lb/d) | 5,616 | |
| Maximum Monthly Loading, TSS (lb/d) | 6,405 | |
| **NPDES Effluent Limitations(1)** | | |
| **Parameter** | **Average Monthly** | **Average Weekly** |
| 5-day Biochemical Oxygen Demand ($BOD_5$)(2) | 20 mg/L, 1017 lbs/day<br>70% removal of influent BOD | 30 mg/L, 1525 lbs/day |
| Total Suspended Solids (TSS)[c] | 20 mg/L, 1017 lbs/day<br>70% removal of influent TSS | 30 mg/L, 1525 lbs/day |
| Fecal Coliform Bacteria | 200/100 mL | 400/100 mL |
| pH | Daily minimum is equal to or greater than 6 and daily maximum is less than or equal to 9. | |
| **Parameter** | **Average Monthly** | **Maximum Daily(2)** |
| Total Ammonia (as $NH_3$-N) Summer(3) | 20 mg/L | 41 mg/L |
| Total Ammonia (as $NH_3$-N) Winter(3) | 7 mg/L | 15 mg/L |

(1) The average monthly and weekly effluent limitations are based on the arithmetic mean of the samples taken with the exception of fecal coliform, which is based on the geometric mean.

(2) The maximum daily effluent limitation is defined as the highest allowable daily discharge. The daily discharge means the discharge of a pollutant measured during a calendar day. For pollutants with limitations expressed in units of mass, the daily discharge is calculated as the total mass of the pollutant discharged over the day. For other units of measurement, the daily discharge is the average measurement of the pollutant over the day.

(3) Summer ammonia limits apply to the months of June through September. Winter ammonia limits apply to the months of October through May.

# CHAPTER 6

# EXISTING AND PROJECTED WASTEWATER FLOWS AND CHARACTERISTICS

## INTRODUCTION

In this Chapter, the existing wastewater characteristics for the service area will be analyzed and projections made for future conditions.

Adequate design of wastewater treatment and conveyance facilities requires the determination of the quantity and quality of wastewater generated from each of the contributing sources. Typically, wastewater is predominantly domestic in origin with lesser amounts contributed by commercial and industrial businesses and by public use facilities such as schools, parks, hospitals, and municipal functions. However, the City of Camas WWTF has a significant amount of flow from industrial sources also. Additionally, significant infiltration and inflow (I/I) contributions result from groundwater and surface water entering the sewer system during periods of high groundwater levels and rainfall, respectively, as occurs in many other communities in western Washington.

### DEFINITIONS OF TERMS

The terms and abbreviations used in the analysis are described below, listed in alphabetical order.

### AVERAGE ANNUAL FLOW

Average Annual Flow is the average daily flow over a calendar year. This flow parameter is used to estimate annual operation and maintenance costs for treatment and lift station facilities.

### AVERAGE DRY WEATHER FLOW

Average Dry Weather Flow is wastewater flows during periods when the groundwater table is low and precipitation is at its lowest of the year. The dry weather flow period in western Washington normally occurs during June through September. During this time, the wastewater strength is highest, due to the lack of dilution with the ground and surface water components of infiltration and inflow. The higher strength coupled with higher temperatures and longer detention times in the sewer system create the greatest potential for system odors during this time. The average dry weather flow is the average daily flow during the three lowest consecutive flow months of the year. For this study, average flows for July, August, and September are used.

## BIOCHEMICAL OXYGEN DEMAND (BOD)

Biochemical Oxygen Demand (BOD) is a measure of the oxygen required by microorganisms in the biochemical oxidation (digestion) of organic matter. BOD is an indicator of the organic strength of the wastewater. If BOD is discharged untreated to the environment, biodegradable organics will deplete natural oxygen resources and result in the development of septic (anaerobic) conditions. BOD data together with other parameters are used in the sizing of the treatment facilities and provide a measurement for determining the effectiveness of the treatment process. BOD is expressed as a concentration in terms of milligrams per liter (mg/L) and as a load in terms of pounds per day (lb/d). The term BOD typically refers to a 5-day BOD, often written $BOD_5$, since the BOD test protocol requires five days for completion. $BOD_5$ of a wastewater is composed of two components – a carbonaceous oxygen demand ($CBOD_5$) and a nitrogenous oxygen demand ($NBOD_5$). The use of $CBOD_5$ as a parameter for evaluating wastewater strength removes the influence of nitrogenous components, including ammonia and organic nitrogen.

## CHLORINE

Chlorine is a chemical element that acts as a strong oxidant when exposed to certain components of organic matter. Chlorine is widely used as a disinfectant in wastewater treatment, and is available both in gaseous (elemental chlorine) and solution forms (hypochlorite). Chlorine is a toxic chemical and is lethal to aquatic biota if present in too high a concentration. Additionally, some organic constituents may react with the chlorine to interfere with chlorination or form toxic compounds, such as chloroform, that can have long-term adverse effect on the beneficial uses of the waters to which they are discharged. To minimize the effects of potentially toxic chlorine residuals on the environment, it has sometimes been found necessary to dechlorinate wastewater treated with chlorine or substitute alternative disinfection systems such as ultraviolet disinfection, as the City of Camas uses. The City occasionally uses hypochlorite for other purposes at the WWTF.

## CONTAMINANTS OF CONCERN

Contaminants of concern in wastewater, in addition to chlorine, BOD and TSS discussed elsewhere in this section, include nutrients, priority pollutants, heavy metals and dissolved organics. The City's NPDES permit requires the removal of biodegradable organics ($CBOD_5$), suspended solids and pathogens. Many of the more stringent standards that have been developed and applied recently to other facilities deal with the removal of nutrients and priority pollutants.

Nutrients such as nitrogen and phosphorus, along with carbon, are essential requirements for growth. When discharged to the aquatic environment, these nutrients can lead to the growth of undesirable aquatic life. When discharged in excessive amounts on land, they

can also lead to the pollution of groundwater. Additionally, in too high a concentration, nutrients, particularly ammonia, can be toxic to aquatic life.

Priority pollutants are organic and inorganic compounds selected on the basis of their known or suspected carcinogenicity, mutagenicity, teratogenicity, or high acute toxicity. Many of these compounds are found in wastewater. Inorganic constituents, including heavy metals, are often present in wastewater due to commercial and industrial activities and may have to be removed if the presence of the metals will adversely affect the receiving water, or, if the wastewater is to be reused. Some heavy metals (most notably copper) can be present in wastewater due to leaching from drinking water pipes. Per the terms of its NPDES permit, Camas is required to monitor for heavy metals in WWTF influent and effluent quarterly and sludge once during the permit cycle.

## DOMESTIC WASTEWATER

Domestic Wastewater is wastewater generated from single and multifamily residences, permanent mobile home courts, and group housing facilities such as nursing homes. Domestic wastewater flow is generally expressed as a unit flow based on the average contribution from each person per day. The unit quantity is expressed in terms of gallons per capita per day (gpcd).

## EQUIVALENT RESIDENTIAL UNIT (ERU)

An Equivalent Residential Unit (ERU) is a baseline wastewater generator that represents the average single family residential household. An ERU can also express the average annual flow contributed by a single-family household, in units of gallons per day, or an annual average loading (of 5-day biochemical oxygen demand or total suspended solids) contributed by a single-family household, in units of pounds per day.

## INFILTRATION

Infiltration is groundwater entering a sewer system by means of defective pipes, pipe joints or manhole walls. Infiltration quantities exhibit seasonal variation in response to groundwater levels. Storm events or irrigation trigger a rise in the groundwater levels and increase infiltration. The greatest infiltration is observed following significant storm events prolonged periods of precipitation. Since infiltration is related to the total amount of piping and appurtenances in the ground and not to any specific water use component, it is generally expressed in terms of the total land area being served. The unit quantity generally used is gallons per acre per day.

## INFLOW

Inflow is surface water entering the sewer system from yard, roof and footing drains, from cross connections with storm drains and through holes in manhole covers. Peak inflow occurs during heavy storm events when storm sewer systems are taxed beyond their capacity, resulting in hydraulic backups and local ponding. Inflow, like infiltration, can be expressed in terms of gallons per capita day or gallons per acre per day.

WWTF flow records are utilized to characterize combined infiltration and inflow (I/I) in the Camas system in terms of peak hour, peak day, maximum month, and average annual I/I.

## MAXIMUM MONTH FLOW (TREATMENT DESIGN FLOW)

Maximum Month Flow is the highest monthly flow during a calendar year. In western Washington, the maximum month flow normally occurs in the winter due to the presence of more I/I. This wintertime flow is composed of the normal domestic, commercial and public use flows with significant contributions from inflow and infiltration. The predicted maximum month flow at the end of the design period is used as the design flow for sizing treatment processes and selecting treatment equipment.

## NON-RESIDENTIAL WASTEWATER

Non-residential wastewater is wastewater generated from commercial activities, such as restaurants, retail and wholesale stores, service stations, and office buildings, and industrial flow (process wastewater, rinse water and other industrial activities). Non-residential wastewater quantities for commercial and industrial wastewater are expressed in this Plan in terms of equivalent residential units (ERUs).

## PEAK HOUR FLOW

Peak Hour Flow is the highest hourly flow during a calendar year. The peak hour flow in western Washington usually occurs in response to a significant storm event preceded by prolonged periods of rainfall which have previously developed a high groundwater table in the service area. Peak hour flows are used in sizing the hydraulic capacity of wastewater collection, treatment and pumping components. Peak hour flow is typically determined from treatment facility flow records and projected future flows.

## SUSPENDED SOLIDS

Suspended Solids is the solid matter carried in the waste stream. The Total Suspended Solids (TSS) in a wastewater sample is determined by filtering a known volume of the sample, drying the filter paper and measuring the increase in weight of the filter paper. TSS is expressed in the same terms as BOD; milligrams per liter for concentration and

pounds per day for mass load. The amount of TSS in the wastewater is used in the sizing of treatment facilities and provides another measure of the treatment effectiveness. The concentration of TSS in wastewater affects the treatment facility biosolids production rate, treatment and storage requirements, and ultimate disposal requirements.

### WASTEWATER

Wastewater is water-carried waste from residential, business, industry and public use facilities, together with quantities of groundwater and surface water which enter the sewer system through defective piping and direct surface water inlets. The total wastewater flow is quantitatively expressed in millions of gallons per day (mgd).

## EXISTING WASTEWATER FLOWS AND LOADING

WWTF records for the 7-year period from 1998 through 2004 were reviewed and analyzed to determine current wastewater characteristics and influent loadings. Current wastewater flows and loadings were then used in conjunction with projected population data to determine projected future wastewater flows and loadings.

### WASTEWATER FLOWS AT CITY OF CAMAS WWTF

Table 6-1 summarizes reported WWTF effluent flows for the 8-year period of 1998 to 2005. The monthly average effluent WWTF flows ranged from 1.10 mgd to 3.09 mgd.

The 2005 dry season average of 1.98 mgd includes 0.08 mgd average dry season infiltration, based on an analysis of WWTF effluent flow indicated by circular flow charts. Hence, base flow (sanitary flow without infiltration and inflow) is estimated to be 1.90 mgd.

The WWTF monitors effluent flow (the flow upstream of the outfall) and influent (the flow entering the WWTF, upstream of the mechanical fine screen).

**TABLE 6-1**

**Historical WWTF Effluent Flows (1998 to 2004)**

| Flow Type | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|
| Average Base Sanitary Flow | 1.20 | 1.20 | 1.25 | 1.30 | 1.35 | 1.40 | 1.75 | 1.90 |
| Average Dry Weather Flow(1) | 1.48 | 1.61 | 1.43 | 1.34 | 1.44 | 1.49 | 1.93 | 1.98 |
| Annual Average Flow | 2.00 | 2.00 | 1.81 | 1.64 | 1.76 | 1.88 | 2.10 | 2.29 |
| Maximum Monthly Flow | 2.97 | 2.85 | 2.98 | 2.59 | 2.40 | 2.49 | 2.71 | 3.09 |
| Peak Day Flow | 5.19 | 5.11 | 4.91 | 4.37 | 4.46 | 5.63 | 4.23 | 7.03 |
| Peak Hour Flow | 6.9 | 6.5 | -- | -- | -- | 6.5 | -- | 8.8(2) |

(1) Average of July, August, September.

(2) Peak flow occurred on December 31, 2005. As described later in the chapter, an estimated 1.1 mgd was constrained by pipe capacity and did not reach the WWTP during the peak hour storm event.

Monthly discharge monitoring report (DMR) data for this period are provided in Appendix D and summarized in Table 6-2. Graphical representations of daily and average monthly WWTF flows, and influent $BOD_5$/TSS loadings for the period from 1998 through 2005 are shown in Figures 6-1, 6-2, and 6-3, respectively.

Peak day and peak hour flows occurred during a major storm event on December 30, 2005. Reported influent flow at the WWTP was 7.03 mgd, and the reported peak hour flow was 8.8 mgd.

**TABLE 6-2**

**Summary of Discharge Monitoring Reports (DMRs)**
**WWTF Influent Monthly Averages**

| Year | Avg. Monthly Flow mgd | Min. Daily Flow mgd | Max. Daily Flow mgd | BOD5 (mg/L) | BOD5 (lb/d) | TSS (mg/L) | TSS (lb/d) |
|---|---|---|---|---|---|---|---|
| Jan-98 | 2.61 | 1.45 | 4.62 | 90 | 1,959 | 125 | 2,721 |
| Feb-98 | 2.18 | 1.68 | 3.40 | 121 | 2,200 | 150 | 2,727 |
| Mar-98 | 2.31 | 1.51 | 4.54 | 90.5 | 1,744 | 138.5 | 2,668 |
| Apr-98 | 1.62 | 1.42 | 1.95 | 166 | 2,241 | 153 | 2,066 |
| May-98 | 2.21 | 1.41 | 4.37 | 129 | 2,378 | 150 | 2,765 |
| Jun-98 | 1.70 | 1.44 | 2.38 | 150 | 2,127 | 152 | 2,155 |
| Jul-98 | 1.50 | 1.35 | 1.60 | 150 | 1,877 | 157 | 1,964 |
| Aug-98 | 1.47 | 1.34 | 1.56 | 143 | 1,752 | 141 | 1,727 |
| Sep-98 | 1.47 | 1.28 | 1.96 | 172 | 2,114 | 164 | 2,016 |
| Oct-98 | 1.53 | 1.35 | 2.05 | 168 | 2,148 | 151 | 1,931 |
| Nov-98 | 2.40 | 1.46 | ` | 195 | 3,898 | 138 | 2,759 |
| Dec-98 | 2.97 | 1.72 | 5.19 | 117 | 2,898 | 121 | 2,997 |
| Jan-99 | 2.80 | 1.73 | 4.92 | 166 | 3,876 | 90 | 2,102 |

## TABLE 6-2 – (continued)

## Summary of Discharge Monitoring Reports (DMRs)
## WWTF Influent Monthly Averages

| Year | Avg. Monthly Flow mgd | Min. Daily Flow mgd | Max. Daily Flow mgd | BOD5 (mg/L) | BOD5 (lb/d) | TSS (mg/L) | TSS (lb/d) |
|---|---|---|---|---|---|---|---|
| Feb-99 | 2.85 | 1.79 | 4.86 | 139 | 3,304 | 103 | 2,448 |
| Mar-99 | 2.50 | 1.74 | 4.72 | 172 | 3,580 | 136 | 2,831 |
| Apr-99 | 1.79 | 1.48 | 2.50 | 182 | 2,715 | 192 | 2,865 |
| May-99 | 1.69 | 1.37 | 2.41 | 198 | 2,796 | 198 | 2,796 |
| Jun-99 | 1.68 | 1.44 | 2.94 | 190 | 2,657 | 250 | 3,497 |
| Jul-99 | 1.62 | 1.49 | 2.08 | 188 | 2,538 | 188 | 2,538 |
| Aug-99 | 1.62 | 1.52 | 1.71 | 192 | 2,591 | 234 | 3,158 |
| Sep-99 | 1.60 | 1.42 | 1.76 | 216 | 2,882 | 260 | 3,469 |
| Oct-99 | 1.61 | 1.32 | 2.15 | 217 | 2,907 | 259 | 3,469 |
| Nov-99 | 2.30 | 1.60 | 5.11 | 176 | 3,369 | 250 | 4,785 |
| Dec-99 | 2.00 | 1.28 | 4.11 | 136 | 2,268 | 235 | 3,920 |
| Jan-00 | 2.27 | 1.27 | 4.91 | 65 | 1,231 | 81 | 1,533 |
| Feb-00 | 2.16 | 1.45 | 4.01 | 103 | 1,857 | 145 | 2,615 |
| Mar-00 | 1.83 | 1.38 | 2.46 | 151 | 2,306 | 139 | 2,123 |
| Apr-00 | 1.35 | 1.10 | 1.84 | 135 | 1,519 | 126 | 1,418 |
| May-00 | 1.49 | 1.27 | 2.31 | 145 | 1,802 | 488 | 6,064 |
| Jun-00 | 1.41 | 1.17 | 1.89 | 213 | 2,503 | 231 | 2,714 |
| Jul-00 | 1.47 | 1.16 | 1.90 | 196 | 2,405 | 298 | 3,656 |
| Aug-00 | 1.36 | 1.23 | 1.45 | 164 | 1,866 | 258 | 2,935 |
| Sep-00 | 1.45 | 1.26 | 1.97 | 173 | 2,089 | 259 | 3,128 |
| Oct-00 | 1.92 | 1.28 | 3.16 | 156 | 2,502 | 363 | 5,822 |
| Nov-00 | 2.98 | 1.95 | 4.72 | 157 | 3,907 | 232 | 5,774 |
| Dec-00 | 1.97 | 1.52 | 3.65 | 154 | 2,531 | 171 | 2,811 |
| Jan-01 | 1.65 | 1.39 | 2.26 | 172 | 2,371 | 193 | 2,661 |
| Feb-01 | 1.68 | 1.36 | 3.05 | 156 | 2,190 | 153 | 2,148 |
| Mar-01 | 1.75 | 1.35 | 3.13 | 144 | 2,103 | 203 | 2,964 |
| Apr-01 | 1.69 | 1.33 | 2.75 | 158 | 2,224 | 186 | 2,618 |
| May-01 | 1.41 | 1.11 | 2.11 | 195 | 2,296 | 252 | 2,968 |
| Jun-01 | 1.42 | 1.24 | 1.88 | 175 | 2,072 | 205 | 2,428 |
| Jul-01 | 1.36 | 1.19 | 1.68 | 182 | 2,061 | 211 | 2,390 |
| Aug-01 | 1.33 | 1.21 | 1.84 | 150 | 1,669 | 181 | 2,014 |
| Sep-01 | 1.34 | 1.18 | 1.72 | 177 | 1,972 | 215 | 2,396 |
| Oct-01 | 1.49 | 1.26 | 2.31 | 158 | 1,958 | 172 | 2,132 |
| Nov-01 | 2.01 | 1.46 | 4.37 | 125 | 2,099 | 147 | 2,468 |
| Dec-01 | 2.59 | 1.55 | 4.21 | 91 | 1,969 | 113 | 2,445 |
| Jan-02 | 2.40 | 1.56 | 4.10 | 110 | 2,200 | 326 | 6,520 |
| Feb-02 | 2.13 | 1.50 | 3.87 | 126 | 2,235 | 119 | 2,111 |

## TABLE 6-2 – (continued)

## Summary of Discharge Monitoring Reports (DMRs)
## WWTF Influent Monthly Averages

| Year | Avg. Monthly Flow mgd | Min. Daily Flow mgd | Max. Daily Flow mgd | BOD5 (mg/L) | BOD5 (lb/d) | TSS (mg/L) | TSS (lb/d) |
|---|---|---|---|---|---|---|---|
| Mar-02 | 2.20 | 1.50 | 3.53 | 100 | 1,834 | 110 | 2,017 |
| Apr-02 | 1.77 | 1.34 | 3.02 | 130 | 1,919 | 140 | 2,067 |
| May-02 | 1.54 | 1.37 | 1.76 | 127 | 1,633 | 133 | 1,710 |
| Jul-02 | 1.46 | 1.29 | 1.55 | 134 | 1,629 | 156 | 1,897 |
| Aug-02 | 1.42 | 1.25 | 1.53 | 133 | 1,574 | 139 | 1,645 |
| Sep-02 | 1.43 | 1.29 | 1.67 | 147 | 1,757 | 120 | 1,434 |
| Oct-02 | 1.45 | 1.29 | 2.07 | 131 | 1,581 | 139 | 1,677 |
| Nov-02 | 1.50 | 1.32 | 1.84 | 130 | 1,626 | 166 | 2,077 |
| Dec-02 | 2.07 | 1.35 | 4.46 | 115 | 1,981 | 132 | 2,273 |
| Jan-03 | 2.43 | 1.67 | 4.78 | 95 | 1,925 | 108 | 2,189 |
| Feb-03 | 2.22 | 1.52 | 5.63 | 101 | 1,869 | 97 | 1,795 |
| Mar-03 | 2.49 | 1.63 | 4.15 | 99 | 2,054 | 106 | 2,199 |
| Apr-03 | 2.05 | 1.74 | 2.63 | 110 | 1,883 | 128 | 2,191 |
| May-03 | 1.67 | 1.41 | 1.89 | 151 | 2,103 | 152 | 2,117 |
| Jun-03 | 1.52 | 1.42 | 1.61 | 160 | 2,028 | 190 | 2,409 |
| Jul-03 | 1.48 | 1.36 | 1.57 | 145 | 1,793 | 169 | 2,090 |
| Aug-03 | 1.45 | 1.35 | 1.54 | 164 | 1,983 | 226 | 2,733 |
| Sep-03 | 1.55 | 1.44 | 1.86 | 182 | 2,351 | 206 | 2,661 |
| Oct-03 | 1.62 | 1.34 | 2.05 | 156 | 2,106 | 159 | 2,147 |
| Nov-03 | 1.90 | 1.51 | 3.09 | 148 | 2,349 | 160 | 2,539 |
| Dec-03 | 2.17 | 1.88 | 5.34 | 137 | 2,475 | 148 | 2,674 |
| Jan-04 | 2.71 | 1.98 | 4.23 | 127 | 2,867 | 129 | 2,912 |
| Feb-04 | 2.42 | 1.77 | 3.80 | 112 | 2,261 | 105 | 2,120 |
| Mar-04 | 1.95 | 1.60 | 2.66 | 136 | 2,211 | 133 | 2,162 |
| Apr-04 | 1.63 | 1.16 | 1.88 | 133 | 1,804 | 133 | 1,804 |
| May-04 | 1.92 | 1.72 | 2.51 | 146 | 2,339 | 157 | 2,515 |
| Jun-04 | 2.00 | 1.77 | 2.60 | 146 | 2,430 | 211 | 3,512 |
| Jul-04 | 1.83 | 1.70 | 1.95 | 155 | 2,371 | 175 | 2,677 |
| Aug-04 | 2.00 | 1.72 | 2.73 | 140 | 2,329 | 169 | 2,812 |
| Sep-04 | 1.95 | 1.71 | 2.44 | 138 | 2,242 | 170 | 2,762 |
| Oct-04 | 2.09 | 1.74 | 2.64 | 144 | 2,508 | 227 | 3,953 |
| Nov-04 | 2.20 | 1.84 | 3.55 | 125 | 2,294 | 161 | 2,954 |
| Dec-04 | 2.49 | 2.08 | 3.26 | 110 | 2,287 | 126 | 2,620 |
| Jan-05 | 2.26 | 1.94 | 3.01 | 102 | 1,923 | 109 | 2,055 |
| Feb-05 | 2.17 | 1.81 | 3.23 | 104 | 1,878 | 106 | 1,914 |
| Mar-05 | 2.35 | 1.86 | 4.73 | 116 | 2,270 | 148 | 2,896 |
| Apr-05 | 2.16 | 1.37 | 3.29 | 91 | 1,636 | 111 | 1,996 |
| May-05 | 2.61 | 1.98 | 3.74 | 102 | 2,218 | 128 | 2,783 |

**TABLE 6-2 – (continued)**

**Summary of Discharge Monitoring Reports (DMRs)**
**WWTF Influent Monthly Averages**

| Year | Avg. Monthly Flow mgd | Min. Daily Flow mgd | Max. Daily Flow mgd | BOD5 (mg/L) | BOD5 (lb/d) | TSS (mg/L) | TSS (lb/d) |
|---|---|---|---|---|---|---|---|
| Jun-05 | 2.07 | 1.86 | 2.53 | 118 | 2,033 | 208 | 3,584 |
| Jul-05 | 1.92 | 1.78 | 2.05 | 147 | 2,358 | 242 | 3,881 |
| Aug-05 | 1.98 | 1.85 | 2.16 | 123 | 2,032 | 186 | 3,073 |
| Sep-05 | 2.03 | 1.90 | 3.34 | 130 | 2,201 | 213 | 3,606 |
| Oct-05 | 2.21 | 1.95 | 4.33 | 137 | 2,527 | 235 | 4,335 |
| Nov-05 | 2.67 | 2.15 | 4.92 | 118 | 2,624 | 179 | 3,980 |
| Dec-05 | 3.09 | 2.05 | 7.03 | 118 | 3,042 | 160 | 4,125 |
| **Ave.** | **1.94** | **1.51** | **3.00** | **143** | **2,252** | **175** | **2,745** |
| **Max.** | **3.09** | **2.15** | **7.03** | **217** | **3,907** | **488** | **6,520** |
| **Min.** | **1.33** | **1.10** | **1.45** | **65** | **1,231** | **81** | **1,418** |

## HISTORICAL INFLUENT LOADING AT WWTF

The annual average and maximum month $BOD_5$ and TSS mass loading for 1998 through 2005 are listed in Table 6-3.

**TABLE 6-3**

**WWTF Influent Annual Average $BOD_5$ and TSS[(1)]**

| Year | Annual Average Effluent Flow (mgd) | Annual Average $BOD_5$ (lb/d) | Annual Average TSS (lb/d) | Maximum Month $BOD_5$ (lb/d) | Maximum Month TSS (lb/d) |
|---|---|---|---|---|---|
| 1998 | 1.998 | 2,278 | 2,375 | 3,898 | 2,997 |
| 1999 | 2.004 | 2,957 | 3,156 | 3,876 | 4,785 |
| 2000 | 1.806 | 2,210 | 3,383 | 3,907 | 6,064 |
| 2001 | 1.644 | 2,082 | 2,469 | 2,371 | 2,968 |
| 2002 | 1.760 | 1,815 | 2,312 | 2,235 | 6,520 |
| 2003 | 1.879 | 2,077 | 2,312 | 2,475 | 2,733 |
| 2004 | 2.098 | 2,329 | 2,734 | 2,867 | 3,953 |
| 2005 | 2.290 | 2,228 | 3,186 | 3,042 | 4,335 |
| **Average[(1)]** | **1.935** | **2,247** | **2,741** | **3,084** | **4,294** |

(1) Average of monthly averages.

Influent loadings decreased in 2000 and 2001 relative to 1998 and 1999, then increased significantly in 2003 through 2005.

As shown in Figures 6-1 through 6-4, the data indicate that the design flow of 6.1 mgd for the existing facility has not been exceeded as a monthly average over the period of 1998 to 2005. Similarly, the maximum loading, per the NPDES permit, of 5,616 lb/day $BOD_5$ and 6,405 lb/day TSS have not been exceeded as a monthly average during this period.

## EXISTING EQUIVALENT RESIDENTIAL UNITS (ERUS)

To determine the number of residential units with sewer service, water consumption, water billing and sewer billing records were reviewed.

### SEWER CONNECTIONS

Table 3-4 provided the average number of sewer service connections by year and customer class. As seen in the Table 3-4, the majority of the sewer service connections are in the single-family residential customer class. The average numbers of connections in 2005 were 5,546 single-family residential, 414 multi-family, 202 commercial, 31 industrial and 31 City (6,223 total connections).

### WINTER WATER CONSUMPTION

The City's winter water consumption has increased over the past seven years in all of the customer classes (except City consumption). The winter water use is used to estimate wastewater volumes entering the collection system because the amount of winter water consumption typically is equal to wastewater flow except for a minor amount of water that does not enter the sewer system (such as winter irrigation flows, spills and evaporation).

Winter water consumption records for the period of 2001 through 2005 were available from the City's computer billing database. Table 6-4 presents the winter water consumption in millions of gallons per day (mgd) by customer class obtained from the database. A more detailed summary of winter water consumption records is provided in Appendix E.

**Figure 6-1**
**City of Camas WWTP**
**Daily Average Influent Flows**

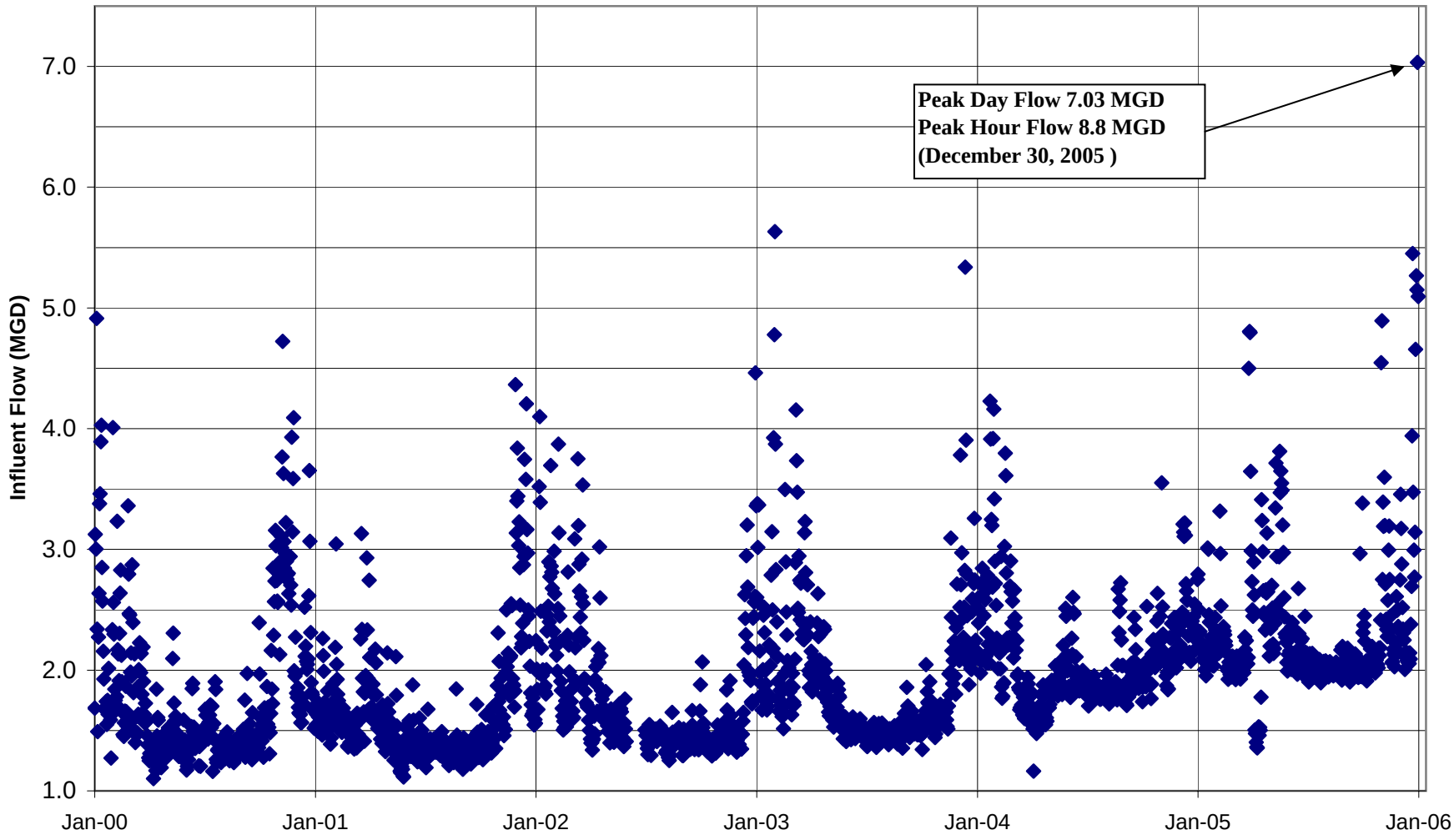


**Figure 6-2**
**Monthly Peak Day WWTF Effluent Flow**

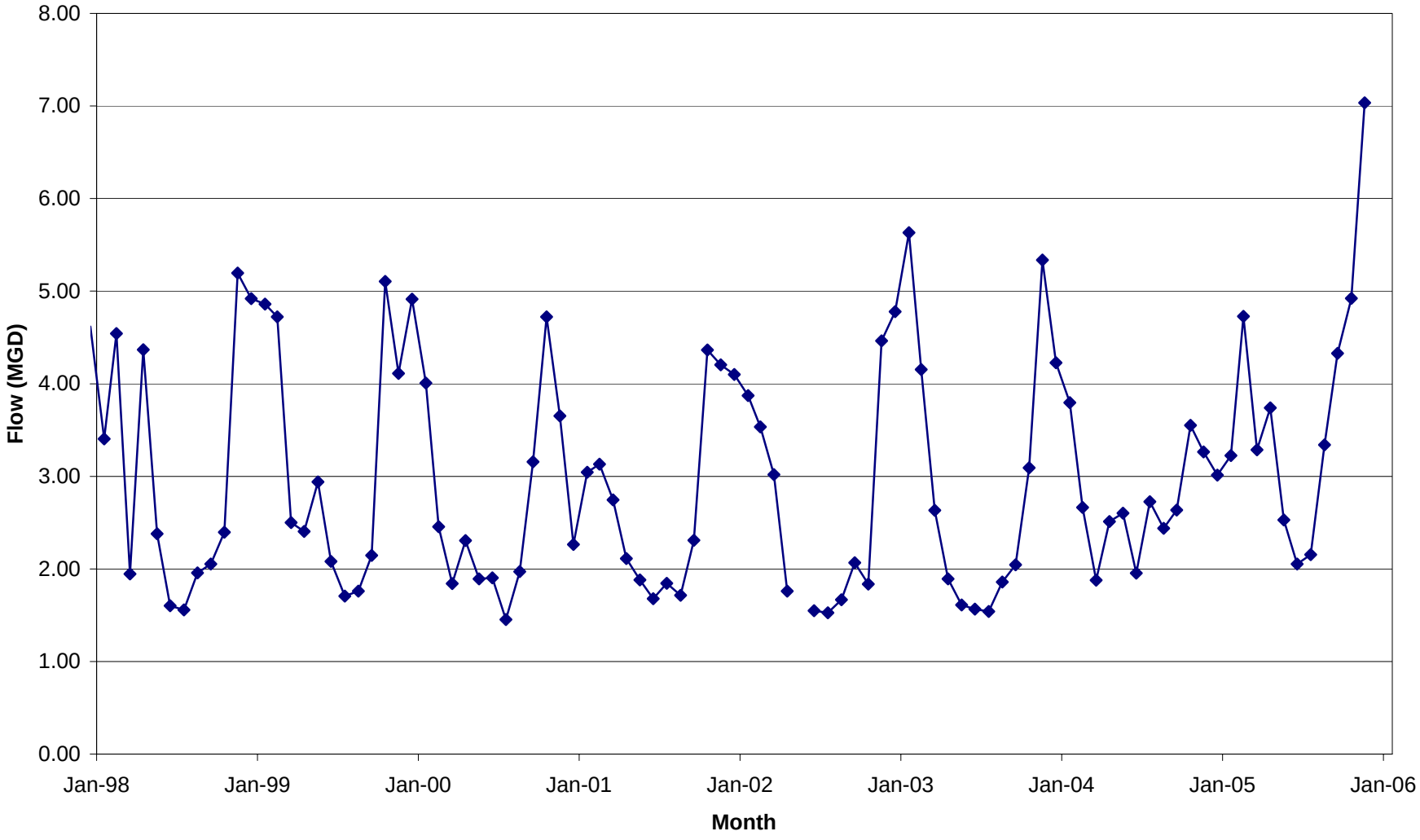


**Figure 6-3**
**Monthly Average WWTF Effluent Flow**

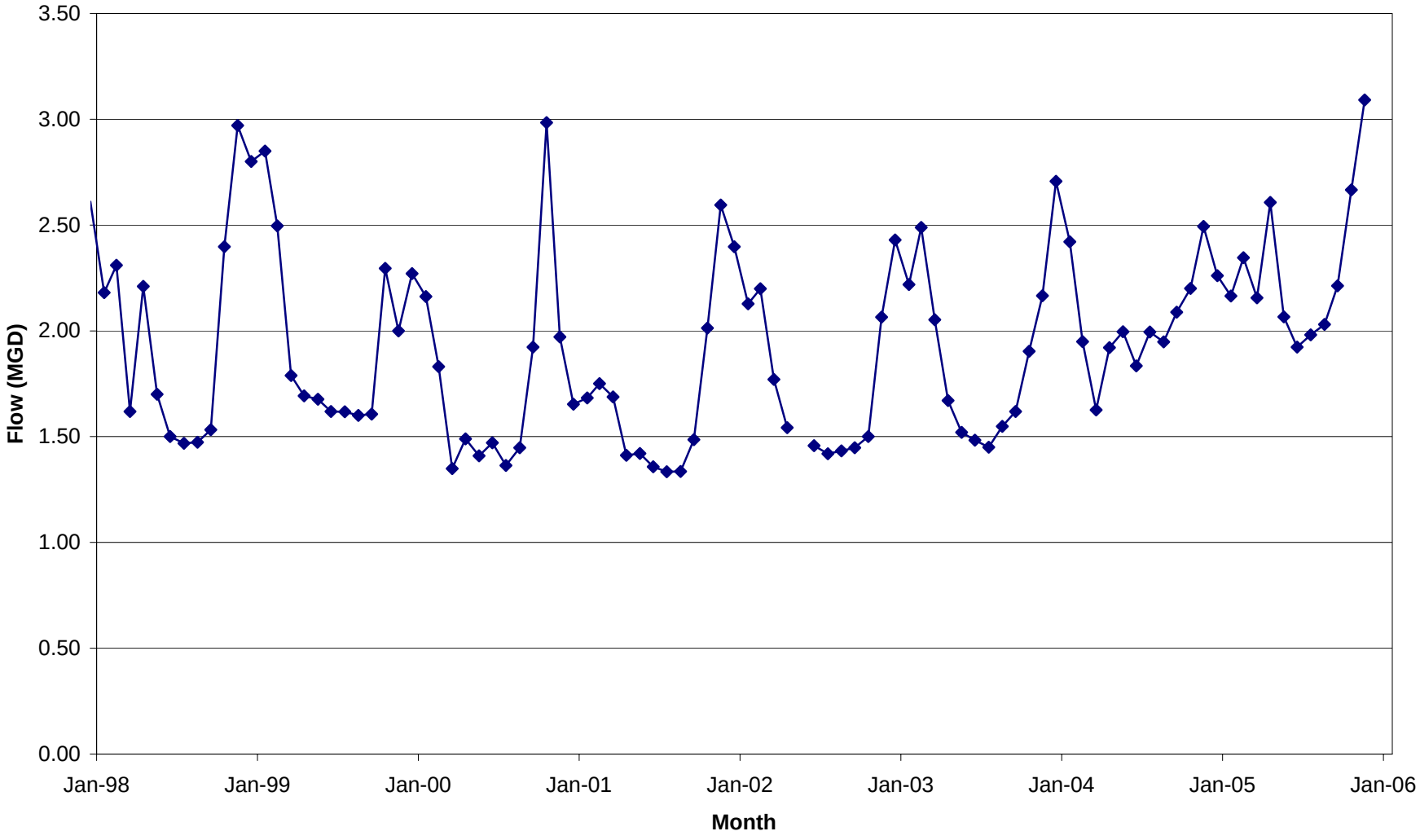


**Figure 6-4**
**Monthly Average Influent Loading**

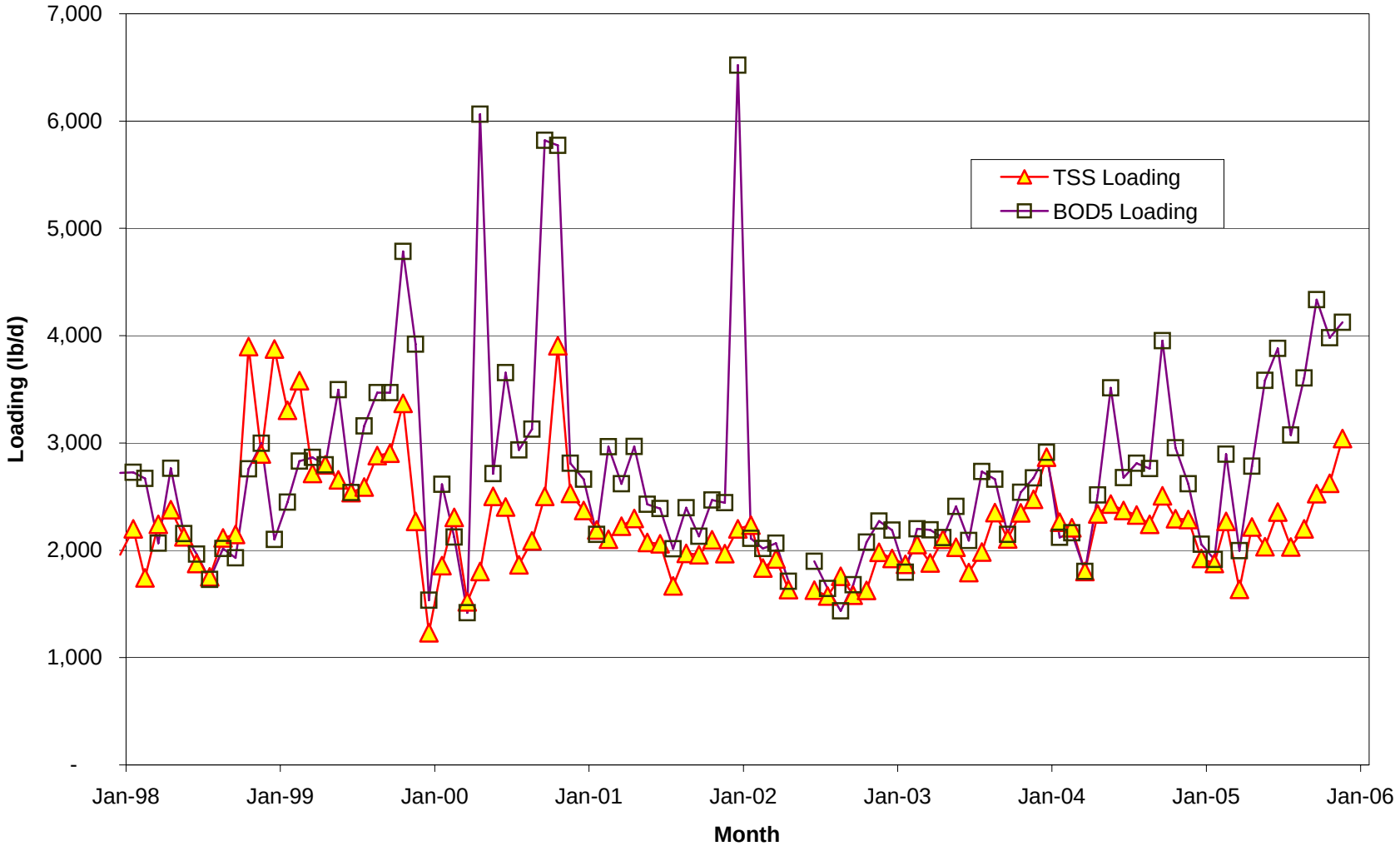


**TABLE 6-4**

**Winter Water Use by Year and Customer Class**

| Customer Type | Winter Water Use by Sewer Customers (mgd)(1) | | | |
|---|---|---|---|---|
| | 2001-2002 | 2002-2003 | 2003-2004 | 2004-2005 |
| Single-Family Residential | 0.849 | 0.866 | 0.955 | 0.983 |
| Multi-family Residential | 0.115 | 0.108 | 0.122 | 0.128 |
| Commercial | 0.093 | 0.098 | 0.125 | 0.114 |
| Industrial | 0.950 | 0.955 | 1.120 | 1.091 |
| City | 0.028 | 0.006 | 0.004 | 0.009 |
| **TOTAL** | **2.034** | **2.033** | **2.326** | **2.325** |

(1) Water consumption is totaled and billing completed on the 15th of every odd month. Thus, winter is defined as November 16 to March 15 for the purposes of this analysis.

As shown in Table 6-4, the total winter water use ranged from 2.034 mgd to 2.326 mgd.

## EQUIVALENT RESIDENTIAL UNITS

Use of Equivalent Residential Units (ERUs) is a way to express the amount of water or sewer use by non-residential customers as an equivalent number of residential customers. Table 6-5 summarizes the City's winter water consumption ERU value for 2001 to 2005.

**TABLE 6-5**

**Camas Single Family Residential (SFR) Equivalent Residential Units (ERUs) and Winter Water Use 2001 to 2005**

| | 2001-2002 | 2002-2003 | 2003-2004 | 2004-2005 |
|---|---|---|---|---|
| SFR Winter Water Use (gpd) | 848,943 | 865,842 | 955,383 | 982,766 |
| SF Residential Service Connections | 4,631 | 5,066 | 5,407 | 5,613 |
| **ERU value (gpd/ERU)** | **183.3** | **170.9** | **176.7** | **175.1** |

As shown in Table 6-5, the average daily single-family residential winter water use (which is equivalent to one water use ERU) for the City from 2001 to 2005 ranged from a high of 183.3 gpd/ERU to a low of 170.9 gpd/ERU.

The *wastewater* ERU value is calculated based on *winter* water use (in order to exclude irrigation flows). For the City of Camas, it is estimated that 15 percent of the winter water consumption does not enter the wastewater collection system (such as winter irrigation flows, spills and evaporation), so the wastewater ERU value is calculated by dividing the winter water use for single-family residential (SFR) units by the number of single-family units and multiplying by 0.85. Based on 2004 to 2005 water use records,

average winter single-family residential water use is 176 gallons per SFR household. Eighty-five percent of this value is 149 gallons per SFR household or ERU**.** Thus, the wastewater ERU value is 149 gpd/ERU.

Table 6-6 summarizes current wastewater ERUs based on an analysis of winter water use during the winter of 2004 to 2005. As previously discussed, each wastewater ERU is defined as 149 gpd/ERU.

**TABLE 6-6**

**Current Wastewater ERUs**

| CUSTOMER TYPE | Average Winter Water Use (mgd) | 85% of Average Winter Water Use (mgd) | Sewer ERUs | % of Total ERUs |
|---|---|---|---|---|
| Single-Family Residential | 0.983 | 0.835 | 5,613 | 42.3% |
| Multi-family Residential | 0.128 | 0.109 | 729 | 5.5% |
| Commercial | 0.114 | 0.097 | 652 | 4.9% |
| Industrial | 1.091 | 0.927 | 6,224 | 46.9% |
| City | 0.0091 | 0.008 | 52 | 0.4% |
| **TOTAL** | **2.325** | **1.976** | **13,271** | **100%** |

## INFILTRATION AND INFLOW

The amount of infiltration and inflow (I/I) can be estimated on an annual average, maximum month, and maximum day basis by subtracting the dry weather flow at the WWTF from the annual average, maximum month, and maximum day flows at the WWTF.

For this report, infiltration and inflow is expressed in units of gallons per acre per day (gpad). The total area of the City of Camas is approximately 7,400 acres. The *developed* sewer service area, which includes the majority of Camas plus small areas to the southeast, is comprised of approximately 4,400 acres.

As stated earlier the City experienced an exceptional storm event on December 30, 2005, including a daily average influent flow of 7.03 mgd and a peak hour flow of 8.8 mgd (and corresponding effluent flows of 7.7 mgd and 9.3 mgd, respectively). Previous analysis of flow charts that recorded WWTF effluent flow showed that peak hour flow prior to this date was 6.5 mgd on February 1, 2005. WWTF influent is predominantly pumped flow from the Main Lift Station.

Table 6-7 summarizes the infiltration/inflow analysis for current conditions. The data contained in this table is useful as a baseline for evaluating changes in infiltration and inflow in the future. This data is also used to estimate future flows.

**TABLE 6-7**

**Estimated Infiltration and Inflow**

| Flow Type | Influent Flow at WWTF (mgd) | Base Flow (mgd) | I/I (mgd) | Service Area (acre)(1) | I/I (gpad) |
|---|---|---|---|---|---|
| Annual Average (2005) | 2.29 | 1.9 | 0.39 | 4,400 | 89 |
| Max. Month | 3.09 | 1.9 | 1.19 | 4,400 | 270 |
| Peak Day | 7.03 | 1.9 | 5.13 | 4,400 | 1,166 |
| Peak Hour | 9.93 (2) | 3.46 (2,3) | 6.47 (2) | 4,400 | 1,471 |

(1) Developed areas only in the Camas sewer service area (total acreage of the City is 7,400 acres).
(2) Includes an estimated 1.1 mgd, based on sewer system hydraulic modeling, of "constrained I/I" that did not reach the WWTP during the peak hour storm event that would be expected to reach the WWTP after increasing pipe sizes.
(3) A peaking factor of 1.8 (peak hour to annual average) is applied to baseflow to calculate peak hour diurnal flow.

### Infiltration and Inflow Analysis Using EPA Criteria

Another analysis of infiltration and inflow was performed to compare estimates of per capita I/I to EPA criteria. These infiltration and inflow rates are summarized in Table 6-8.

The U.S. EPA manual entitled *I/I Analysis and Project Certification* provides recommended guidelines for determining if infiltration and/or inflow is excessive.

1. To determine if excessive *infiltration* is occurring, a threshold value of 120 gallons per capita per day (gpcd) is used. This infiltration value is based on an average daily flow over a seven to fourteen day non-rainfall period during seasonal high ground water conditions.

2. To determine if excessive *inflow* is present in a collection system, the USEPA uses a threshold value of 275 gpcd. If the average daily flow (excluding major commercial and industrial flows greater than 50,000 gpd each) during periods of significant rainfall exceeds 275 gpcd, the amount of inflow is considered excessive.

**TABLE 6-8**

**Per Capita Infiltration and Inflow Based on EPA Criteria**

| Parameter | EPA Criteria for Excessive I/I (gpcd) | Estimated Camas I/I Value (gpcd) |
|---|---|---|
| EPA Excessive Infiltration Criteria | 120 | 62 |
| EPA Excessive Inflow Criteria | 275 | 382 |

**Infiltration**

Rainfall records from the National Oceanic and Atmospheric Administration show a 7-day period, February 14 through 20, 2005, during which only trace amounts of rainfall were measured. This would also be a period of relatively high groundwater. The average daily flow recorded during this time period is 1.99 mgd. (The highest daily flow was 2.237 mgd.) Since the intent of the EPA criteria was to only include domestic flows, 1.024 mgd of commercial and industrial flow was neglected. With a total population of sewer users in 2005 of 15,710, and a residential flow of 0.97 mgd (equal to 1.99 mgd minus 1.024 mgd) for this period, the "EPA I/I Infiltration Value" for Camas is estimated at 62 gpcd. Because this value is less than the EPA guideline of 120 gpcd, Camas is not considered to have excessive infiltration by EPA criteria.

**Inflow**

The maximum day influent flow at the WWTF over the period of 1998 to 2004 was 7.03 mgd (recorded on December 30, 2005), as shown in Table 6-1. Since the intent of the EPA criteria was to only include domestic (residential) flows, the estimated 1.024 mgd of commercial and industrial flow was neglected. With a total population of sewer users in 2005 of 15,710, and a non-commercial flow of 6.01 mgd (equal to 7.03 mgd minus 1.024 mgd) for this day, the "EPA I/I Inflow Value" for Camas is estimated at 383 gpcd. Because this value is greater than the EPA guideline of 275 gpcd, Camas is considered to have excessive inflow by EPA criteria.

## INDUSTRIAL FLOWS

As shown in Table 6-4, winter water use by industries in Camas ranged from 0.95 mgd to 1.12 mgd the winter of 2001 to 2002 to 2004 to 2005. Assuming 85 percent of the winter water use is discharged to the sewer, 0.81 mgd to 0.95 mgd was discharged. Table 6-9 summarizes the following information for the industrial dischargers to the City sewer:

- Annual water consumption (excluding flows explicitly labeled as irrigation) for 2002 through 2004.

- Current permitted and estimated actual wastewater flows for 2005 based on review of the City's NPDES permit, State Waste Discharge Permits, DMRs and the City's recent Industrial User Survey.

- Projected flows for annual average, maximum month, peak day and peak hour flows based on the assumption that all industries are discharging maximum permitted flows by 2025. Peaking factors of 1.15 for maximum month to annual average, 1.25 for peak day to annual average, and 1.2 for peak hour to peak day have been used, in the absence of more specific information, based on a review of DMRs and diurnal discharge patterns. A reserve of 500,000 gallons per day annual average flow has been allocated for year 2025 to accommodate unanticipated growth of existing industries and potential new industries. 2015 flows were calculated assuming linear growth of flows from 2005 to 2025.

- Projected ERUs are provided based on projected annual average flows and the ERU value of 149 gpd/ERU.

Additional information about the volume and character of industrial flows of some of the major Significant Industrial Users (SIUs) is provided below, based on information in NPDES permit fact sheets and other sources. As discussed above and in Chapter 3, the City recently completed an Industrial User Survey that detailed the activities and discharge characteristics of its SIUs, Minor Industrial Users (MIUs) and domestic-equivalent dischargers.

**C-TECH**

C-Tech, incorporated as LANDA in 1969, builds pressure washing equipment, automatic parts washers, evaporators, and wastewater treatment/recycle systems. The manufacturing processes are cutting, forming, welding, cleaning, surface-coating, assembly, and product testing. A water-based cleaning process is used to prepare parts for surface coating. (No volatile organic solvents are used.) There is some wastewater discharge from this recycle process, and there are accumulated residuals (which are disposed of as solid or hazardous wastes). There is also a wastewater discharge from product testing and one from the charging of ion exchange media used in some water treatment products. As shown in Table 6-9, C-Tech is permitted for a discharge of 43,000 gpd, but currently consumes and discharges 5,000 to 7,000 gpd.

Water containing a cleaning agent is continuously reused in the parts washing process and evaporated when it is no longer effective, leaving no liquid discharge. Rinse water is also continuously reused, but carry-over of the cleaning agent (Chemcoa 1022, containing

phosphoric acid) from the washing unit to the rinsing unit necessitates the constant blow-down (and replenishment with clean water) of about 5 gallons per minute to maintain adequate rinse water quality. The blow-down occurs for eight to ten hours per day, and is the only discharge from the parts washing process. Occasionally, the two rinse tanks, like the wash tank must be drained and cleaned (quarterly or semi-annually). When this happens, the contents are not discharged, but evaporated, with the residue properly disposed of as a solid waste, according to its designation.

The major wastestream discharged to the WWTF is from product testing. This water (which comes from the City's supply) is exposed only to the internal surfaces of the components of the product being tested. A small amount of methanol is added to some of the products after testing to assure that any residual test water will not freeze and damage the product. The excess is blown back out of the product and some of this methanol enters the product testing wastewater stream.

C-Tech is expanding into water treatment products which include an ion exchange unit process. The ion exchange resin must be charged, which requires passing a concentrated sodium chloride solution through the resin. It is estimated that 300 to 900 pounds per month of sodium chloride will be used and discharged in the total flow of 260,000 to 476,000 gallons per month.

**SHARP**

The Sharp Laboratories of America, Inc. (SLA) is a research and development (R&D) facility, conducting R&D in the areas of multimedia (e.g., video, imaging, telecommunications, software, copiers, printers, etc.), integrated circuits (ICs), and Liquid Crystal Display-Thin Film Transistor (LCD-TFT) technologies. The IC and LCD laboratories generate an average wastewater flow of about 20,000 gpd, with peak daily discharges of 31,000 gpd. Testing is conducted in small "clean rooms" using equipment and processes such as photomasking, stripping, etching, chemical, metal organic, and physical vapor deposition, rinsing and drying of wafers and LCD glass. Sharp is permitted for a maximum daily discharge of 48,000 gpd and an average monthly discharge of 35,500 gpd.

The IC Process Technology Labs perform research and development related to various processes and chemicals used in the development of integrated circuits. Basic processes, chemicals, and equipment are those found in a typical wafer or IC manufacturing facility, but the volume is very low, as would be expected in R&D. The LCD Process Technology Lab performs research and development related to various processes and chemicals used in the development of Liquid Crystal Displays (LCDs). Basic processes, chemicals, and equipment are those found in a typical LCD manufacturing facility, but R&D is limited to only the Thin Film Transistor or TFT portion of a completed LCD device. Again, volume is very low, as would be expected in R&D. In addition to the process groups mentioned

above, some wastewater is generated by basic facilities maintenance and janitorial cleaning services.

The majority of wastewater is generated from air pollution control (air scrubber) equipment. Some additional wastewater is generated from rinsing, etching, stripping, cleaning, anodic oxidation, polishing, and reverse osmosis processes. These processes utilize chemicals such as polishing slurry, sulfuric acid, phosphoric acid, hydrogen peroxide, ammonium hydroxide, ammonium tartrate, ammonium fluoride, and hydrofluoric acid. The photodeveloping stations use tetramethylammonium hydroxide and surfactants. Deionized water is used for all processes and rinsing, except for air scrubbing. Reverse osmosis and ion exchange are used to deionize the water. The wastewater and concentrate from the deionization process enter the sanitary sewer through the neutralization treatment tank.

The photographic process for both IC and LCD processes consists of several rinses with deionized water. The rinses from these processes are combined with the wastewater streams and treated if necessary by a pH neutralization system prior to discharge to the sanitary sewer. Three air scrubbers treat exhaust from fume hoods, benches and tools that generate corrosive emissions. The IC scrubber generates about 170 gallons per day, the LCD scrubber generates about 11,500 gallons per day. The gas pad scrubber only generates wastewater in the event of an emergency. The wastewater generated from the scrubbers is routed to the pH neutralization tanks (one in each lab) prior to being discharged to the sanitary sewer.

Potential pollutants in the raw wastewater from these R&D activities include residues of the various cleaning agents (solvents, surfactants, corrosives), fluoride, and metals. Sharp is permitted for a discharge of up to 17.4 mg/L fluoride and has discharged as high as 9.2 mg/L fluoride as a monthly average. Sharp discharges 300 month of a 10 percent boric acid solution to the City of Camas wastewater treatment plant. Such a small amount is not expected to cause any disruption to the City's wastewater treatment or collection systems. However, it is recommended that the City require that, prior to discharge, the boric acid solution be diluted with copious amounts of water and neutralized to a pH range of 6 to 9. The boric acid discharge, if diluted into the City's influent would dilute the boron to < 0.01 mg/L and lower. The range of threshold concentrations of boron reported to inhibit the activated sludge process is 0.05 to 100 mg/L, while the threshold for inhibition of biological nitrification is reported as < 1.0 mg/L boron. Thus, the boron in the Sharp discharge should not cause inhibition of the treatment process at the City's wastewater treatment plant. However, it is recommended that requests to discharge any larger volumes of this waste stream be scrutinized carefully. Significantly increased volumes could cause boron to exceed the inhibitory concentrations mentioned above.

A pH neutralization and monitoring system comprises the only wastewater treatment system for this facility.

## HERAEUS SHIN-ETSU AMERICA

Heraeus Shin-Etsu America, Inc.'s quartz glass manufacturing facility is permitted for a discharge of a maximum of 35,000 gallons of wastewater per day, and has recently discharged an average of about 12,000 gallons per day, as shown in Table 6-9. At Heraues' facility, sand is purified using heat and hydrogen chloride and then formed into stainless steel molds and fused into quartz glass crucibles using a high power electric arc. The fusion equipment and quartz glass is cooled during and after the process with an open tower process cooling water system. The crucibles thus formed are sand blasted to remove loose sand from the outside surface and then rinsed with deionized water. The tops of the crucibles are then cut to height and the outside diameter is ground to meet customer specifications. Deionized water is used as coolant for the cutting and grinding operations. The crucibles are finally rinsed with deionized water. Depending upon customer specifications some crucibles are pressure washed with high pressure water jet using deionized water.

All wastewater generated during this process is sent to the onsite pretreatment system. Crucibles that pass inspection are etched with hydrofluoric acid solution, rinsed with deionized water, and dried with heat. Wastewater generated is again sent to the onsite pretreatment system.

Two distinct wastewater streams are generated at Heraeus Shin-Etsu America Inc. as discussed below:

1. A fluoride-containing waste stream including wastewater produced during hydrofluoric acid etching of the crucibles and subsequent washing with deionized water and heat drying (batch), Acid (HF) fume scrubber wastewater, lab wastewater, and furnace cleaning wastewater (batch).

   The fluoride containing wastewater is treated in a fluoride treatment system where lime is added to treat fluoride. This is followed by pH neutralization, coagulation/flocculation, and settling. Sludge produced is dewatered using filter press and the sludge cake is disposed of with the facility's other solid wastes. The supernatant is combined with treated non-fluoride waste stream before being discharged to the Camas sanitary sewer.

2. Non-fluoride containing wastewater from finishing operations, gas scrubber blowdown, non-contact process cooling water blowdown, reverse osmosis containment stormwater, waste treatment chemical storage, and reverse osmosis reject water.

The pH of the non-fluoride waste stream is neutralized before this stream is combined with the treated fluoride waste stream and subsequent discharge to the sanitary sewer.

## LINEAR TECHNOLOGY

Linear Technology Corporation (LTC) has operated a semiconductor wafer production facility in Camas since 1996. At full production, their output capability is approximately 5,000 wafer starts per week. Currently, production is about 1,500-1,700 wafer starts per week. LTC currently has about 200 employees and operates 24 hours a day, 7 days per week, but with restricted shifts. As shown in Table 6-9, LTC is permitted for a maximum day discharge of 299,000 gpd and has recently discharged an average of about 180,000 to 190,000 gpd.

LTC uses the following processing steps: diffusion, oxidation, photolithography, deposition, etching, cleaning, and grinding. Supporting operations include air handling, fume wet scrubbers, cooling water, and reverse osmosis to produce de-ionized water. Wastewater sources include: neutralized acid wastewater, treated hydrofluoric acid wastewater, process rinse water, gray water, reverse osmosis reject waste, condensate, fume control scrubber blowdown, cooling water, boiler blowdown, and cooling tower blowdown.

LTC has two main treatment processes: acid wastewater neutralization (AWN) using sodium hydroxide, and the fluoride treatment system (FTS), which precipitates fluoride as calcium fluoride using calcium chloride. FTS discharge, scrubber blowdown, and excess gray water are treated in the AWN system, then discharged to the Camas sewer system.

LTC is permitted for a maximum of 32 mg/L fluoride and has discharged as high as 11 mg/L fluoride.

## WAFERTECH

Wafertech, a semiconductor integrated circuit (IC) fabrication facility, is the largest industrial discharger to the City's sewer system. As shown in Table 6-9, Wafertech is permitted for 1,437,500 gallons per day (maximum day) and currently discharges an average of about 500,000 gpd. Wafertech has a substantial wastewater treatment system including the following:

- **DI/TMAH Neutralization:** The system automatically neutralizes tetramethylammoniumhydroxide (TMAH) wastewater and the wastewater from the regeneration of the deionizing (DI) unit with the addition of sulfuric acid.

- **Ammonia Stripper:** The ammonia stripper removes the ammonia from alkaline wastewater in a packed bed tower using a two-pass, semi-continuous batch process. The treated wastewater is collected in the stripper sump tank and then pumped to the HF batch treatment system.

- **HF Batch Treatment for Fluoride Removal:** This process precipitates fluoride using $CaCl_2$, forming insoluble calcium fluoride salts. Precipitated fluoride sludge is removed by sedimentation in a clarifier.

- **Chemical/Mechanical Polish and Back-grind Treatment:** Treatment of this wastewater includes flocculation/clarification with the use of a polymer, NaOH, and sulfuric acid. Effluent flows to the cooling towers.

- **Acid Waste Neutralization:** Water coming from the fabrication process is neutralized in these tanks using NaOH and sulfuric acid and then sent to the recycle system.

- **Recycle System:** The recycle treatment system includes activated carbon beds to remove low-level organics and residual oxidants from the treated water. Following this step, multivalent and some monovalent cations and anions are removed using ion exchange, and the water is sterilized with ultraviolet lamps and treated with reverse osmosis.

Wafertech has recently applied for, received approval for, discharge of a biocide. The MSDS for the biocide supplied with the original request indicated the biocide contains three hazardous substances: Dibromoacetonitrile (5 %), 2,2-Dibromo-3-nitrilopropionamide (30%), and Polyethylene Glycol (30%). The 0.18-gallon per day biocide discharge, if diluted into WaferTech's current average daily flow of 444,000 gallons, would result in a dilution (weight / volume) of 1,900,000 x and dilute the biocide in the discharge to 0.53 mg/L. Substantial additional dilution would occur when the discharge reached the City's wastewater treatment plant, further diluting the biocide to approximately 0.1 mg/L (100 ug/L). Because little information is available regarding the possible inhibitory potential of the biocide, the City should have some concerns about the proper use and discharge of this biocide at Wafertech, and there should be procedures for reporting to the City any changes to the use, or any spills of this chemical at its application point.

Wafertech's discharge contains high concentrations of total dissolved solids (mostly calcium, sodium, chloride, sulfate, and fluoride). As stated in Wafertech's State Waste Discharge fact sheet:

> "ion imbalances arising from TDS can cause toxicity to the common whole effluent toxicity (WET) test organisms. The Permittee's discharge to the City of Camas wastewater treatment plant (WWTP) contains very high concentrations of TDS (4,800 *mg/L*) consisting of several of the ions known to adversely affect organisms in toxicity tests. The proposal to add the sulfuric acid wastestream to this discharge would increase TDS to 5,200 *mg/L* and increase the amount of sulfate discharged to the city WWTP.

**Table 6-9**
**City of Camas**
**Historical and Projected Future Industrial Water Consumption and Wastewater Flows**

| Industry | Business Type | Annual Average Water Consumption (excluding Irrigation) | | | Wastewater Flow | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 2004 gpd | 2003 gpd | 2002 gpd | From 2005 DMRs gpd | Noted in City's NPDES Permit Application gpd | Industry State Waste Discharge Permit gpd Max Daily | Industry State Waste Discharge Permit gpd Ave Monthly | Industrial User Survey gpd | Hours of Discharge |
| Wafertech | Semiconductor Manufacturing | 561,565 | 502,771 | 437,589 | 455,669 | 1,150,000 | 1,437,500 | 1,150,000 | 450,000 | Likely 24 h/d |
| Linear | Semiconductor Manufacturing | 186,419 | 175,052 | 186,146 | 187,350 | 299,000 | 334,000 | 299,000 | | Likely 24 h/d |
| Sharp | Semiconductors and LCD R&D | 19,595 | 16,564 | 15,633 | 9,085 | 13,000 | 48,000 | 35,500 | 16,745 | Likely 24 h/d |
| Landa | Manufacturing Industrial Cleaning Systems / Metal Finishing | 5,860 | 5,669 | 7,301 | Not Reported | 43,000 | | | 9,500 | 16 hours /day |
| Underwriters Lab | Electrical Product Testing | 6,473 | 6,526 | 4,777 | Not Reported | | | | | |
| Heraeus Shin Etsu | Quartz Glass Manufacturing | 11,733 | 12,166 | 12,871 | 16,950 | 35,000 | 35,000 | | | |
| Other (Including Reserve) | | 90,000 | 80,000 | 70,000 | | | | | | |
| Annual Average | | 881,645 | 798,749 | 734,317 | | | | | | |

| | 2005 | | | | 2015 | | | | 2025 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Annual Average gpd | Max. Mo. gpd | Peak Day gpd | Peak Hour gpd | Annual Average gpd | Max. Mo. gpd | Peak Day gpd | Peak Hour gpd | Annual Average gpd | Max. Mo. gpd | Peak Day gpd | Peak Hour gpd |
| Wafertech | 589,643 | 678,090 | 737,054 | 884,465 | 839,045 | 943,527 | 1,160,982 | 1,282,022 | 1,000,000 | 1,150,000 | 1,437,500 | 1,725,000 |
| Linear | 195,740 | 225,101 | 244,675 | 293,610 | 242,551 | 271,838 | 313,805 | 321,675 | 260,000 | 299,000 | 334,000 | 400,800 |
| Sharp | 20,574 | 23,660 | 25,718 | 30,861 | 27,265 | 30,609 | 39,431 | 42,432 | 30,870 | 35,500 | 48,000 | 57,600 |
| Landa | 6,153 | 7,076 | 7,692 | 9,230 | 22,234 | 25,346 | 26,115 | 41,217 | 37,391 | 43,000 | 43,000 | 60,200 |
| Underwriters Lab | 6,796 | 7,816 | 8,495 | 10,194 | 8,256 | 9,248 | 12,597 | 13,128 | 8,696 | 10,000 | 15,000 | 18,000 |
| Heraeus Shin Etsu | 12,320 | 14,167 | 15,399 | 18,479 | 22,301 | 25,200 | 26,740 | 32,151 | 30,435 | 35,000 | 35,000 | 42,000 |
| Other (Including Reserve) | 94,500 | 108,675 | 118,125 | 141,750 | 304,338 | 346,563 | 383,375 | 527,169 | 500,000 | 575,000 | 625,000 | 750,000 |
| TOTAL FLOW | 925,727 | 1,064,586 | 1,157,158 | 1,388,590 | 1,465,989 | 1,652,329 | 1,963,045 | 2,259,794 | 1,867,391 | 2,147,500 | 2,537,500 | 3,053,600 |
| **TOTAL ERUs** | **6,224** | | | | **9,857** | | | | **12,556** | | | |

> The City of Camas may someday be required by its NPDES permit to demonstrate compliance with chapter 173-205 WAC by monitoring the effluent discharge for whole effluent toxicity."

The fact sheet also discusses the possibility of osmotic stress on bacteria due to the high TDS. To date, nitrification inhibition testing performed by the City has not shown any negative effects from Wafertech's effluent. However, it is recommended that the City periodically monitor Wafertech's discharge for toxicity and inhibitory effects.

## CHARACTERISTICS OF COMBINED INDUSTRIAL WASTEWATER

Table 6-10 provides the known characteristics, including conventional parameters and major ions, of the major industrial discharges, based on review of DMRs, permit fact sheets and operating records. Insufficient data exists to estimate the concentrations of these constituents for the combined industrial flow; however, since Wafertech's flow comprises the majority of the combined flow, the composition of the combined industrial stream will be assumed to be similar to that from Wafertech. Compared to domestic wastewater, the combined industrial wastewater is more dilute with respect to $BOD_5$ and TSS, significantly more concentrated (about an order of magnitude) with respect to calcium, sodium, chloride, sulfate, and fluoride, and about double the strength of ammonia and TKN.

**TABLE 6-10**

**Reported Characteristics of Major Industrial Discharges(1)**

| | | Wafertech | Linear | Sharp | Landa | Underwriter's Lab | Heraeus Shin Etsu |
|---|---|---|---|---|---|---|---|
| Flow (gpd, Year 2025) | | 1,000,000 | 260,000 | 30,870 | 37,400 | 8,700 | 30,400 |
| BOD5 | mg/L | 16.6 | N/A | N/A | 40 | N/A | N/A |
| TSS | mg/L | 24 | N/A | N/A | 24 | N/A | 78 |
| Ammonia-N | mg/L | 53.2 | N/A | N/A | N/A | N/A | N/A |
| TKN | mg/L | 67.8 | N/A | N/A | N/A | N/A | 3.5 |
| Nitrate plus Nitrite Nitrogen | mg/L | 2.76 | N/A | N/A | N/A | N/A | N/A |
| Calcium | mg/L | 393 | N/A | N/A | N/A | N/A | N/A |
| Sodium | mg/L | 403 | N/A | N/A | N/A | N/A | N/A |
| Chloride | mg/L | 896 | N/A | N/A | N/A | N/A | N/A |
| Sulfate | mg/L | 621 | N/A | N/A | 23 | N/A | N/A |
| Fluoride | mg/L | 12 | 11 | 9.2 | 1.7 | N/A | 8 |
| Alkalinity | mg/L | 80 | N/A | N/A | N/A | N/A | N/A |

(1) N/A indicates Not Analyzed or Not Reported.

## PROJECTED SEWER SERVICE AREA POPULATION, ERUS AND FLOWS

As discussed in Chapter 3, according to the Office of Financial Management (OFM), the City of Camas estimated 2005 population is 15,710. In the City's Comprehensive Plan, the City's projected 2025 population, within City limits was noted as 22,460 and inclusive of the Urban Growth Area, was noted as 24,700, a 57 percent increase in the UGA population from 2005. Year 2015 population is projected to be 19,210 within City limits and 22,160 within the Urban Growth Area, a 41 percent increase in the UGA population from 2005. However, use of these population increases, which are based on an annual population growth rate of 2.3 percent, is not considered to be reflective of the actual City growth rate, which has averaged 7.2 percent over the last ten years, as shown in Table 3-2. Per discussion with City staff, annual growth rates of 7.2 percent and 1.0 percent were used, respectively, to project future City population for next 5 years and subsequent 15 years. Use of these growth rates yields a 49 percent population increase by 2015 and a 64 percent population increase by 2025.

The current and projected 10-year and 20-year ERUs and flows (without consideration of further expansion of the Urban Growth Area) are summarized in Table 6-11. The projected flows and ERUs are based on use of the growth assumptions applied to all customer classes except the industrial category. Projected future industrial flows developed in Table 6-9 are used, which have somewhat higher growth rates (a 58 percent increase by 2015 and a 102 percent increase by 2025 of industrial flows). In addition to the flows indicated in Table 6-11, a special industrial reserve of 0.7 mgd for 2015 and 1.4 mgd for 2025 has been included for low strength wastewater (less than 8 mg/L $BOD_5$, 10 mg/L TSS, and 10 mg/L TKN).

I/I is assumed to be constant throughout the period. (In other words, increases in I/I due to the addition of new pipes and deterioration of old pipes are assumed to equal to decreases in I/I due to ongoing I/I reduction efforts.)

Future WWTF flows are projected based on a dry weather flow of 149 gpd/ERU. To estimate future annual average, maximum month, and peak day flows, the I/I flowrates were added to the base level wastewater flows derived from the population projections to obtain the respective future WWTF influent flowrates.

**TABLE 6-11**

**Current and Projected Future**

| Wastewater ERUs and Flows | Sewer ERUs | | | |
|---|---|---|---|---|
| **Customer Type** | **2005** | **2015** | **2025** | **Buildout(2)** |
| Single-Family Residential | 5,613 | 8,363 | 9,205 | 13,608 |
| Multi-family Residential | 729 | 1,086 | 1,196 | 7,546 |
| Commercial | 652 | 972 | 1,070 | 2,176 |
| Industrial | 6,224 | 9,857 | 12,556 | 25,537 |
| City | 52 | 77 | 85 | 173 |
| **TOTAL** | 13,270 | 20,356 | 24,112 | 49,039 |
| **Projected Flows (mgd)(1)** | | | | |
| Total Base Flow | 1.98 | 3.03 | 3.59 | 7.31 |
| Low-strength Industrial Reserve | 0 | 0.70 | 1.40 | Included in Industrial ERUs |
| Average Annual Flow | 2.29 | 4.04 | 5.30 | 7.62 |
| Maximum Month | 3.09 | 4.84 | 6.10 | 8.42 |
| Peak Day | 7.03 | 8.78 | 10.04 | 12.36 |
| Peak Hour | 9.93(3) | 11.47 | 13.44 | 17.06 |

(1) I/I assumed to remain constant during planning period. However, currently "constrained I/I" is projected to reach WWTP in future. See Note #3.

(2) Buildout ERUs and flows assume that commercial, industrial and City ERUs grow at the same rate as the overall population.

(3) Includes an estimated 1.1 mgd of "constrained I/I" that did not reach the WWTP during the peak hour storm event that would be expected to reach the WWTP after increasing pipe sizes.

## EXISTING AND PROJECTED INFLUENT $BOD_5$ AND TSS LOADING

Influent monitoring data for $BOD_5$ and TSS concentrations and loadings reported in DMRs includes the influence of septage receiving on the concentrations, since the monitoring point is downstream of the septage receiving point. Some of the significant variability observed in $BOD_5$ and TSS concentrations and loadings is likely due to the receipt of septage, which is not received every day or every week.

## EXISTING $BOD_5$ LOADING

Monthly average influent $BOD_5$ loadings ranged from 1,231 lb/d to 3,907 lb/d for the 8-year period of analysis as shown in Table 6-2 and Figure 6-1. The monthly average influent $BOD_5$ rated loading of 5,616 lb/d was never exceeded during the 7-year period of analysis. The average influent $BOD_5$ concentration for the 6-year period is 143 mg/L, which would be considered low strength domestic wastewater. The average $BOD_5$ loading for the 7 years, as summarized in Table 6-3, was 2,252 lb/d.

With a service population of 15,710 for 2005, and an annual average $BOD_5$ loading of 2,228 lb/d, the 2005 annual average $BOD_5$ loading was 0.142 lb/cap/d. This value is lower than the DOE Orange Book criteria of 0.2 lb/cap/d, likely due to the presence of dilute STEP system discharges. Reported maximum monthly loadings were significantly higher in 1998-2000 than in 2001-2005. However, the 2001 to 2005 data is considered to be more representative of current loading.

To convert the maximum month $BOD_5$ loading to a per capita and an ERU basis, the 2005 service population of 15,710 and number of ERUs (13,271) and maximum month $BOD_5$ of 3,042 lbs for 2001-2005 were used to calculate a maximum month per capita and ERU $BOD_5$ loading of 0.194 lb/cap/d and 0.229 lb/ERU/d, respectively. The ratio, for 2005, of the maximum month $BOD_5$ loading to the annual average $BOD_5$ loading is 3,042: 2,228 or 1.37:1. This ratio is used in the development of future flow and loadings to the WWTF later in the chapter.

## EXISTING TOTAL SUSPENDED SOLIDS LOADING

A review of Table 6-2 shows that monthly average TSS loadings ranged from 1,418 lb/d to 6,520 lb/d. The monthly average influent rated TSS loading of 6,405 lb/d was exceeded once during the 7-year period of analysis. This exceedance is not considered representative of actual current loadings. The 2005 average loading of 3,186 lb/d and a 2005 service population and average ERUs of 15,710 and 13,271, respectively, translate to an annual average TSS loading for 2005 of approximately 0.203 lb/cap/d or 0.240 lb/ERU/d.

The 2005 maximum month TSS loading is 4,335 lbs/d. Using the same values for the 2005 service population and average ERUs of 15,710 and 13,271, yields a maximum month value of 0.276 lbs TSS/cap/d or 0.327 lb/ERU/d. The ratio of the maximum month TSS loading to the annual average TSS loading is 4,335 : 3,186 or 1.36:1. This ratio is used in the development of future flow and loadings to the WWTF later in the chapter.

## EXISTING AMMONIA NITROGEN AND TKN LOADING

Current (2005) average influent ammonia loading to the Camas WWTP is about 730 lb/d (average of 39 mg/L). Maximum month (May 2005) ammonia loading was 930 lb/d. TKN in the City's influent and septage is not frequently monitored, but a typical $NH_3$-N / TKN ratio or domestic wastewater is 0.62 (equal to 25 mg/L $NH_3$-N / 40 mg/L TKN).

The influent $NH_3$-N / TKN ratio actually may be higher than that for typical domestic wastewater (0.62), due to the impact of preferential STEP tank removal of organic nitrogen over ammonia. However, since STEP tank septage is ultimately brought to the

WWTP, the overall $NH_3$-N/TKN ratio for influent plus septage is likely closer to the 0.62 value.

Wafertech's average flow for 2004-2005 was about 560,000 gpd. Average ammonia and TKN concentrations (per NPDES fact sheet characterization and verified in recent DMRs) and loadings for Wafertech are:

| | |
|---|---|
| Ammonia -N | 53.2 mg/L, 248 lb/d |
| TKN | 67.8 mg/L, 317 lb/d |

Thus, Wafertech contributes ~ 317 lb /1177 lb, or about 27 percent, of the TKN load to the WWTP. Non-Wafertech average loadings are thus calculated to be 482 lb/d (730 lb/d minus 248 lb/d) ammonia and 860 lb/d (1177 lb/d minus 317 lb/d) TKN.

To facilitate the projection of future ammonia and TKN loadings, Wafertech and non-Wafertech loadings are considered separately, and non-Wafertech industrial wastewater is considered to be at domestic strength. The 2005 average non-Wafertech ammonia loading of 482 lb/d and a 2005 service population and average non-Wafertech ERUs of 15,710 and 9,299, respectively, translate to an annual average ammonia loading for 2005 of approximately 0.0465 lb/cap/d or 0.0518 lb/non-Wafertech ERU/d.

The 2005 maximum month non-Wafertech ammonia loading was 682 lbs/d. Using the same values for the 2005 service population and average non-Wafertech ERUs of 15,710 and 9,299, yields a maximum month value of 0.0592 lb $NH_3$-N/cap/d or 0.0733 lb $NH_3$-N/ERU/d. The ratio of the maximum month ammonia loading to the annual average ammonia loading is 682:482 or 1.41.:1. This ratio is used in the development of future flow and loadings to the WWTF later in the chapter.

For the estimated current 3,971 Wafertech ERUs, the average ammonia loadings are 0.0625 lb/Wafertech ERU/d, and maximum month is estimated to be 0.0813 lb/Wafertech ERU/d, based on historical ratios of maximum month to average annual concentrations.

Non-Wafertech TKN loadings are estimated based on an ammonia/TKN ratio of 0.62, and Wafertech's TKN loadings are estimated based on an ammonia/TKN ratio of 0.78, based on the composition of Wafertech's wastewater.

## PROJECTED FUTURE WASTEWATER LOADINGS

Future WWTF maximum month $BOD_5$ and TSS loadings are estimated by multiplying the projected number of ERUs by the respective ERU-based loadings, and adding additional loading for a low-strength industrial reserve as indicated below. Future ERU-based annual average $BOD_5$ and TSS loadings are estimated using the ratio of the maximum month to annual average loadings of these parameters. The current maximum

month $BOD_5$ and TSS loadings are 0.229 lb $BOD_5$/ERU/d and 0.327 lb TSS/ERU/d. The ratio of the maximum month to annual average $BOD_5$ is 1.37:1. The ratio of the maximum month to annual average TSS is 1.36:1. Table 6-12 provides a summary of projected future WWTF influent $BOD_5$ and TSS loadings.

It is assumed that STEP system septage will continue to be hauled to the WWTP at the current rate, relative to the flow discharged, for the 20-year period. Thus, the composition of domestic wastewater plus STEP septage is assumed to stay the same.

The strength of the combined industrial wastewater with regard to $BOD_5$ and TSS *for the industrial ERUs* indicated in Table 6-11 discharged to the City is assumed to be that of domestic wastewater for this analysis. The industrial ERUs in Table 6-11 include a reserve of 0.50 MGD of domestic strength industrial wastewater beyond the NPDES-permitted maximum flows. (It is likely that the combined industrial wastewater is more dilute than domestic, but due to a lack of information regarding $BOD_5$ and TSS concentrations for current and future industries, use of domestic concentrations is appropriate and conservative.) However, the *industrial low-strength reserve* of 0.7 mgd for 2015 and 2025 for 1.4 mgd shown in Table 6-11 is assumed to be low strength (e.g., pretreated) with concentrations not exceeding 8 mg/L $BOD_5$, 10 mg/L TSS, and 10 mg/L TKN.

Ammonia nitrogen concentrations and loadings are estimated based on the projected number of Wafertech and non-Wafertech ERUs. Non-Wafertech TKN loadings are estimated based on a ammonia/TKN ratio of 0.62, and industrial TKN loadings are estimated based on a ammonia/TKN ratio of 0.78, based on the composition of Wafertech's wastewater.

**TABLE 6-12**

**Current and Projected WWTF Loadings**

| ERUs and Loadings | 2005 | 2015 | 2025 | Buildout |
|---|---|---|---|---|
| Total ERUs | 13,270 | 20,356 | 24,112 | 49,039 |
| Annual Average $BOD_5$, (lb/d) | 2,218 | 3,437 | 4,099 | 8,197 |
| Max Month $BOD_5$, (lb/d) | 3,039 | 4,708 | 5,615 | 11,230 |
| Annual Average TSS, (lb/d) | 3,191 | 4,937 | 5,883 | 11,791 |
| Max Month TSS, (lb/d) | 4,339 | 6,715 | 8,001 | 16,036 |
| Annual Average $NH_3$-N, (lb/d) | 730 | 1,149 | 1,389 | 2,686 |
| Max Month $NH_3$-N, (lb/d) | 1,029 | 1,618 | 1,956 | 3,788 |
| Annual Average TKN, (lb/d) | 1,017 | 1,588 | 1,917 | 3,726 |
| Max Month TKN, (lb/d) | 1,367 | 2,130 | 2,573 | 4,995 |

As shown in Table 6-12, the projected year 2025 maximum month TSS loadings without UGA Expansion exceeds the rated WWTF capacity of 6,405 lb/d, and $BOD_5$ capacity of 5,616 lb/d is reached by 2025.

Analysis of flows within each basin, as well as each major sewer line and at each lift station, is provided in Chapter 7, Collection System Evaluation and Recommendations.

# CHAPTER 7

# COLLECTION SYSTEM EVALUATION

In Chapter 7, an evaluation of the City's collection system is provided and cost estimates are provided for capital improvement projects to address collection system deficiencies. The evaluation of the collection system includes:

- Review of previous reports
- Evaluation of pump stations and pump station run time meter data collected in 1998-2005
- Field observations
- Evaluation of television inspection
- Evaluation of results of sewer system modeling (described in more detail in Appendix F and Appendix G)
- Evaluation of information provided by City staff

Following the evaluation, collection system capital improvement projects are proposed.

## REVIEW OF PREVIOUS REPORTS REGARDING THE COLLECTION SYSTEM

City of Camas Sewerage Facilities Plan, March 1987, Parametrix, Inc.

This report focused on the plan for construction of STEP systems for the Lacamas Heights area (Basin 15) and other areas to the west of downtown Camas. Average dry weather flows at this time were 0.37 mgd.

City of Camas Evaluation of Sewer System Alternatives, April 1993, CH2M Hill.

This report provided an evaluation of the City's existing septic tank effluent (STE) systems, and considered alternatives to provide sewer service to the unsewered areas within the Urban Growth Boundary (UGB) and projected future UGB, including areas of current West Camas and north of Lacamas Lake. The report recommended the City implement a combined STE/conventional gravity approach to providing sewer service to the study area.

City of Camas Wastewater Facilities Plan, October 1994, CH2M Hill.

This Plan provided a capital improvement plan through 2043, including recommended upgrades to all of the City's pump stations. The then current total peak I/I in the system was estimated to be 3.54 mgd. Based on a new present worth analysis, it was concluded in this report that it was more cost-effective by a factor of about three to treat the I/I by adding capacity to the treatment plant than it was to remove I/I from the system.

City of Camas Sewer System Infiltration and Inflow Study, August 1998, Gray & Osborne.

The *City of Camas Sewer System Infiltration and Inflow Study* evaluated the City's wastewater collection system and recommended improvements to reduce excessive infiltration and inflow (I/I). According to EPA criteria, the City had excessive inflow and infiltration entering its sewer system. Based on the findings of previous reports and employee interviews, and the above criteria, it was decided to focus field investigations in an I/I study on Basins 1, 2, 3, 4, 5, 6, 7 and 10.

An estimate of I/I for each basin was developed based on the flow monitoring conducted. The basins with the highest estimated I/I were (in order from highest) Basins 3 North, 4, 1, and 2. The estimates of I/I in each basin have been updated and are presented in Table 7-3 in this Plan.

The I/I Study recommended that the City complete the following tasks between 1999 and 2005:

1. Sewer Main repairs in Basin 1 (NW Ivy Street), Basin 2 (NW 10th Avenue), Basin 3 (multiple projects, including NW 11th, NW Ivy Lane, NW 15th Avenue, NW 30th Avenue), Basin 4 (NE Everett Street), Basin 6 (SE 3rd Avenue), and Basin 10 (NW 11th Avenue).

2. TV inspection of 71,000 feet of sewer main and 92,000 feet of side sewer in Basins 1, 2, and 4.

3. Manhole repairs in all the non-STEP basins.

4. Repairs to catch basins in Basins 2, 3, 4, 5, and 6.

5. Installation of an effluent filter at the WWTP to enable the plant to achieve 85 percent removal of $BOD_5$ and TSS during periods of dilute influent due to I/I.

All of these major recommendations were completed.

304 Stainless Steel Saddle Failure Analysis Report, December 5, 2001, MDE Engineers

This report discussed a failure analysis of a 304 stainless steel saddle removed from the sewer near the Prune Hill Estates Sub-division. The analysis, conducted using microscopy and long-term microbiological testing, determined the presence of sulfate reducing bacteria, which led to microbiologically influenced corrosion and the failure of the saddle. The sulfate likely was present from the oxidation of sulfide that had formed due to anaerobic conditions in the STEP system.

This report is included as Appendix H.

## MAJOR FIELD OBSERVATIONS

City staff has reported the following major observations regarding the collection system:

- Significant sewer system surcharging during storms in Basins 1, 2, 3 South, and 6. Surcharging occurred in the vicinity of Manholes 1-1-3 through 1-1-3, Manholes 3-1-6 through 3-1-10, and Manholes 6-1-2 through 6-1-3.

- Significant corrosion and odors in gravity sewers in Basin 10, Basin 5 and Basin 3-North where STEP systems discharge into gravity sewers.

- Significant corrosion in STEP pump stations, especially the Brady Road Pump station. A list of pump station issues is included in Table 7-1.

- Corrosion-induced failure of sanitary sewer components, as discussed in the *304 Stainless Steel Saddle Failure Analysis Report* listed above.

## EVALUATION OF PUMP STATIONS

### FIELD OBSERVATIONS

Based on inspections, field measurements and communications with City staff, City pump stations were evaluated for the purposes of this Plan. A summary of the evaluations is provided in Table 7-1.

As shown in Table 7-1, a number of the stations have significant corrosion issues, particularly those in areas with STEP systems. Additionally, a number of stations have high run-time hours and low MEGs and need to be upgraded within the 20-year planning period.

**TABLE 7-1**

**Pump Station Evaluations**

| Pump Station | Basin | MEG Reading[1] | Total Run-Time Hours[1] Pump 1/Pump 2 | Inspection Notes |
|---|---|---|---|---|
| Main | 5 | NR[2] | NR | Poor access to wet well, small wet well |
| Oak Park | 8 | NR | NR | Good condition |
| One Stop | 9 | NR | NR | Good condition |
| South Prune Hill | 10 | NR | NR | Good condition. |
| West Camas | 1 | NR | NR | Some corrosion of ductile iron pipes. |
| Crown View Plaza | 3 | NR | NR | Good condition, but grease accumulation |
| Parker Estates | 13 | 2070/3500 | 3407/2727 | Significant corrosion of bolts and piping |
| Winchester Hills No. 1 | 13 | 0/4000 | 2964/1209 | Significant corrosion of bolts and piping |
| Winchester Hills No. 2 | 13 | 120/3680 | 3529/2407 | Significant corrosion in valve vaults |
| Grand Ridge | 11 | 4000/1400 | 119/1766 | Minor corrosion observed |
| Brady Road | 11 | 7.81/4000 | 3298/3881 | Severe corrosion of bolts and piping |
| Sunningdale Grdns. 1 | 14 | NR | NR | Significant corrosion of bolts and piping |
| Lacamas Shores | 14 | 152/142 | 1583/1187 | Significant corrosion of bolts and piping |
| Prune Hill Park | | 12/40.2 | 6670/6382 | Significant corrosion of bolts and piping |

(1) Based on inspections in March 2005
(2) NR = Not reported.

In order to optimize performance and streamline maintenance, the City has standardized its new pump stations around a several components, including the following:

- ROMTEC pump stations with conical bottom
- Flygt pumps
- Multitrode level sensors
- Monitor Pro run-time monitoring and MT2PC controls
- Sonotrol telemetry for alarms only
- Generators
- Odor control at STEP stations

As pump stations are upgraded, components will be converted to the standardized items as practicable.

## PUMP STATION RUN-TIME DATA

Estimated historical wastewater flows for several drainage basins, based on pump station run-time data, are provided in Appendix I. For the purposes of this report, it was generally assumed that, when running, each pump was pumping at its design capacity.

Because run-time data is not recorded every day, some of the flows are averages of 2 or 3 day's flows.

Key daily pump station run-time data and corresponding WWTP influent flows are summarized in Table 7-2. This table includes the following flows:

- 2005 average baseflow based on an evaluation of winter water use and summer dry weather flow
- Daily flows for December 22, 2005, with the *third highest* daily flow since 2000, and I/I calculated by subtracting the base flow from the 12/22/05 flow for each pump station and WWTP influent
- Daily flows for December 31, 2005, with the *highest* daily flow since 2000, and I/I calculated by subtracting the base flow from the 12/31/05 flow for each pump station and WWTP influent
- Percentage of total I/I for 12/22/05 and 12/31/05, calculated by dividing the I/I for each pump station into the WWTP influent flow.

**TABLE 7-2**

**Pump Station Run-Time Data and Infiltration and Inflow (Daily Flows)**

| | | 2005 Ave. Baseflow | | 12/22/05 | | | 12/31/05 | | |
|---|---|---|---|---|---|---|---|---|---|
| **Pump Station** | **Sub-Basin(s) Served** | **Base Flow (mgd)** | **% of Total Base Flow** | **Flow (mgd)** | **I/I (mgd)** | **% of Total I/I** | **Flow (mgd)** | **I/I (mgd)** | **% of Total I/I** |
| Lacamas Creek | 7 all | 0.041 | 2% | 0.236 | 0.195 | 5% | 0.22 | 0.175 | 3% |
| Crown View | 3nH | 0.066 | 3% | 0.189 | 0.122 | 3% | 0.32 | 0.257 | 5% |
| West Camas | 10A-E, 12 | 0.191 | 10% | 0.909 | 0.718 | 20% | 0.78 | 0.586 | 11% |
| South Prune Hill | 10 all, 12 | 0.147 | 8% | 0.814 | 0.667 | 19% | 0.74 | 0.597 | 12% |
| **WWTP Influent** | **All** | **1.90** | **100%** | **5.45** | **3.55** | **100%** | **7.03** | **5.13** | **100%** |

As shown in Table 7-2, I/I enters the system from the basins served by all of the basins evaluated. The basins where the highest amount of I/I enters the collection system, among those evaluated, include those served by the West Camas and South Prune Hill Pump Station, which received 11 to 20 percent of the total I/I entering the system. The information in Table 7-2 was used for calibration and corroboration of the sewer system hydraulic model.

A number of basins are served only by the Main Pump Station. Since the Main Pump Station is controlled by variable frequency drives, and thus has a variable flow rate

pumped, an accurate quantification of flows from this station is not possible from the runtime data.

## DISCUSSION OF SPECIFIC PUMP STATIONS

### Brady Road Pump Station

The Brady Road Pump Station serves Basin 11 in the southwest corner of Camas. The Brady Road Pump Station receives STEP effluent from the Grand Ridge Pump Station to the southwest and individual STEP systems throughout Basin 11, and pumps the combined flows up Brady Road to NW Parker Street. The pump station houses two 20-hp STEP effluent pumps.

As shown in Table 7-1, the Brady Road Pump station has exhibited severe corrosion due to STEP effluent. This pump station will be rehabilitated in 2007. A memorandum prepared for the Brady Road Pump station upgrade is included in Appendix J.

### Main Pump Station

The Main Pump Station is a wet well –dry well station and conveys sewage from almost the entire service area (excepting only Basins 8 and 9) across the Washougal River to the WWTP. The Main Pump Station has variable frequency drive (VFD) control. The *peak hour* capacity of the Main Pump Station is 7,700 gpm (11.1 mgd). Based on WWTP influent records, *peak hour flows* from the Main Pump Station have approached 9 mgd. An evaluation of the Main Pump Station's capability to accommodate the 2025 flow is provided in the discussion of sewer system hydraulic modeling later in this chapter.

The Main Pump Station has a very small wet well that hinders both maintenance and the ability of instruments to control pump operation. The pumps cycle too frequently and there is little reaction time to respond to changes in flow. The small wet well makes it extremely difficult to stop the pumps for even a short maintenance activity. As discussed later in this chapter, it is recommended that this wet well be enlarged.

### Lacamas Creek Pump Station

Lacamas Creek Pump Station is a wet well – dry well station serving Basin 7 in the southeast corner of the City, and conveys Basin 7 flow to Manhole 6-1-9 in Basin 6. The *peak hour* capacity of the Lacamas Creek Pump Station is 300 gpm (0.432 mgd). As shown in Appendix I and Table 7-2, although base flow is only 0.041 mgd, daily average flows from the Lacamas Creek Pump Station have reached 0.23 mgd.

The Lacamas Creek Pump Station could be upgraded to accommodate flows from a new Crown Road Sewer line that would serve the Southeast Gregg Service Area (the east side of Basin 15). This new sewer could connect to existing Manhole 7-3-5 at Crown Road in

Basin 7. At Manhole 7-1-1, sewage from Crown Road would mix with flow from the rest of Basin 7. This possible collection system configuration is discussed later in this chapter.

**Other Pump Stations**

As shown in Table 7-1, a number of pump stations particularly those exposed to STEP effluent, have experienced significant corrosion. Additionally, a number of pump stations need to have their pumps replaced, as indicated by the MEG readings provided in Table 7-1. Per discussion with City staff, the City will need to budget for, on average, one to two major upgrades of pump stations per year. Typically, when upgraded the pump stations are provided with standardized features of the "Camas spec," including Flygt pumps, Multitrode level sensors, Monitor Pro run-time monitoring and MT2PC controls, Sonotrol telemetry for alarms only.

As shown in Table 7-3, a number of pump stations are approaching or exceeding capacity, and may need to be upgraded if efforts to decrease infiltration and inflow or to reroute flows are not successful. The flows in Table 7-3 are estimated current *peak hour* flows, and are generally 20 to 50 percent higher than the historical peak day flows calculated from run-time data.

As discussed below in the Evaluation of Sewer System Modeling section, the hydraulic modeling indicates that current estimated peak hour flows to the Main Pump Station are 1.1 mgd (765 gpm) less than would occur if flow were not constrained from reaching the Main Pump Station by over-capacity sewer pipes. Thus, after upsizing sewer pipes tributary to the Main Pump Station, 1.1 mgd additional flow at the Main Pump Station would be expected if the historical peak hour storm events occurred.

Additional information regarding alternatives for pump station improvements is provided later in this chapter.

**TABLE 7-3**

**Flows To Pump Stations**

| Pump Station | Basin No. | Pump Capacity (gpm, each) | Total Station Pumping Capacity (gpm, w/1 out of service) | Current Estimated Peak Hour Flow (gpm) |
|---|---|---|---|---|
| Main | 5 | 3,850 | 7,700 | 6,106(1) |
| Oak Park | 8 | 350 | 350 | 213 |
| One Stop | 9 | 231 | 231 | 100 |
| South Prune Hill | 10 | 510 | 510 | 776 |
| West Camas | 1 | 810 | 810 | 1052 |
| Crown View Plaza | 3 | 325 | 325 | 391 |
| Lacamas Creek | 7 | 300 | 300 | 265 |

(1) If flow upstream was unconstrained, estimated total peak hour flow would be 6,871 gpm.

## EVALUATION OF WESTERN SERVICE AREA AND STEP COLLECTION SYSTEM

As discussed above, City staff have observed significant corrosion and odors in gravity sewers where STEP systems discharge into gravity sewers, significant corrosion in STEP pump stations, and corrosion-induced failure of sanitary sewer components. Maintenance of the STEP collection system, and impacts from STEP effluent on the other portions of the collection system, constitute a significant maintenance burden on City staff.

The City has installed two stations where a chemical odor control agent, Bioxide is fed into STEP mains. (Bioxide provides an alternative electron acceptor, nitrate, to prevent the formation of odors from the generation of sulfide from the reduction of sulfate.) One of these stations is near Round Lake, downstream of where the STEP main serving the Western Service Area is joined by the STEP main from Basin 15. The other Bioxide station is located on NW18$^{th}$ Avenue upstream of where the STEP Main serving Basin 12 discharges STEP effluent to Basin 10. The Round Lake Bioxide station has been successful at reducing corrosion and odor to some degree, though the other station is less effective, and annual Bioxide costs have reached $65,000.

Based on the problems associated with STEP areas, City staff wish to install gravity sewers instead of STEP systems where feasible, in the future. Where possible, new developments will be required to use conventional gravity systems. Where conventional systems are not feasible, housing developments of over 15 units will be required to convey sewage to small regional pump stations.

As detailed in the discussion of the hydraulic model, the 21-inch STEP Main that transports wastewater from the Western Service Area to the STEP terminus at NE 6th Avenue and Joy Street has adequate capacity for 2025 flows. However, the City has concerns about the durability of this line, which is constructed of 100-psi pipe and has numerous taps. Thus, this line is recommended for replacement in phases in years 2016 through 2025. The gravity sewer lines and Main Pump Station downstream of the 6th and Joy STEP terminus do not have sufficient capacity to transport 2025 flows. Thus, it is recommended that flows from the 21-inch STEP Main be bypassed in a new STEP Main to the WWTP, as discussed in the Collection System Improvements discussion below.

## EVALUATION OF GRAVITY COLLECTION SYSTEM

As discussed above, City staff has observed significant sewer system surcharging during storms in Basins 1, 3 South, and 6 due to I/I. The City has rehabilitated a number of sewers identified as deficient in the *1998 I/I Study*, and has conducted television inspection of problem areas identified in the *1998 I/I Study*. Review of those inspections is discussed below. To date, the City has not required rehabilitation of side sewers on private property; however, if rehabilitation of public sewers removes an insufficient amount of I/I, the City may require rehabilitation of private sewers, which have previously been identified as a source of I/I.

As discussed in the Collection System Improvements section below, construction of a new gravity sewer line down Crown Road to service new development in the eastern portion of Basin 15 is recommended.

### Review of Television Inspection Videos

City staff provided sewer system television inspection videos, covering a period of November 1997 through January 2002, for problem areas in Basins 1, 2, 3n, 3S, and 4. TV inspection of these areas was recommended in the *1998 I/I study*. Based on a review of documentation provided with the tapes, a number of pipelines were identified as needing repair or replacement. Major defects were considered to be:

- Greater than 20 percent of joints leak
- I/I is estimated to be greater than 0.75 gpm
- Broken pipes, circumferential cracking, holes
- Poor condition
- Plugging due to roots
- Lateral cracking in conjunction with qualifier (e.g., roots, pinhole leaks)

Pipes were assigned a priority ranking for rehabilitation depending upon the quantity and nature of defects that were noted. Pipes in poor condition are identified in Figures 7-1 through 7-4.

## EVALUATION OF SEWER SYSTEM MODELING

As described in Appendix F, the major sewer lines of the City's collection system were modeled with the MOUSE hydraulic model software, developed by DHI, Inc. This model has three main functions: (1) to assess the ability of the existing system to transport current flows; (2) to make recommendations for future improvements to convey projected future flows; and (3) to determine the effects of individual future developments and additions to the system. A capacity evaluation was performed by generating the peak hour flow to each modeled collection system component from the contributing area and units or connections. The output from this model was used to evaluate the capacity of the existing collection system and to identify improvements that will be necessary in the future. Each model run identifies sewers that may be hydraulically deficient if a peak hour flow event happened with the estimated or projected populations.

Fifteen basins (catchments) were delineated based on the natural drainage patterns of the City's service area. The fifteen basins are similar to those evaluated in the *1998 I/I Study*, except the boundaries have been changed to reflect development, annexations and rerouting of flows since 1998. The basins were further subdivided into smaller subbasins, as shown in Figures G-1 through G-11 in Appendix G. Flows for each subbasin were determined based on the number and zoning of the parcels within the subbasin. Parcel information was provided in the "camparc" parcels shape file supplied by the City. All developed parcels zoned residential within the basin were considered to be single ERUs and ascribed a flow of 149 gallons per day, the average daily flow per ERU as developed in Chapter 6.

A peaking factor was used to determine the peak hour diurnal base flow. The peaking factor for residential flows was calculated using an equation provided by the *1998 Department Of Ecology Criteria for Sewage Works Design* (Orange Book). The equation calculates a peaking factor based on population. As population increases, the peaking factor decreases to account for greater attenuation of flows in the presumed larger system.

$$PeakingFac\ tor = \left(18 + \sqrt{Population/1000}\right) / \left(4 + \sqrt{Population/1000}\right)$$

A peak hour to peak day peaking factors of 1.75 was used for I/I –related flows, based on an examination of historical influent flow records.

The Camas network is comprised of gravity sewer, STEP (septic tank effluent pump) and force main systems. The model did not evaluate the network components (pumps and sewer lines associated with individual homes and subdivisions) of the STEP systems within the City. The portions of the network serviced by STEP systems were modeled based on the assumption that the system behaved essentially as a gravity system. This

assumption is valid due to the similarity in flow patterns of gravity flow to that from a large number of STEP tanks.

In addition to residentially zoned parcels, flows were also ascribed to parcels zoned commercial, industrial, and other (school/church). Parcels zoned commercial were ascribed a flow rate of 3,000 gallons per acre per day. Industrial flow rates were based on the permitted flow and water consumption and sewage production records of the individual industry as described in Chapter 6. School and church parcels were ascribed a flow rate based on attending populations. The Department of Ecology ascribes a base flow of 10 gallons per day per student for schools with cafeterias but no showers, and 15 gallons per day per student with for schools with cafeterias and showers, including infiltration. School flows were peaked by a factor of three, assuming an 8-hour school day. This value was considered a conservative estimate of the flows as infiltration within the school system is also peaked.

Peak hour Infiltration and inflow (I&I) was added to the base flow from each basin based on average I&I rates in terms of gpad established in the *1998 I/I Study* normalized to a peak hour I/I rate, and adjusted to reflect changes in developed acreage in each basin. Additionally, the flow from Basin 10 was increased substantially based on an analysis of run-time data from the West Camas and South Prune Hill Pump Stations. I/I estimates used in the model are summarized in Table 7-4. Total I//I of 5.13 mgd peak day and 6.57 mgd peak hour were used based on historical flow records. The hydraulic modeling indicates that current estimated peak hour flows to the Main Pump Station are 1.1 mgd (765 gpm) less than would occur if flow was not constrained from reaching the Main Pump Station by over-capacity sewer pipes. Thus, after upsizing sewer pipes tributary to the Main Pump Station, 1.1 mgd additional I/I at the Main Pump Station would be expected if the historical peak hour storm events occurred.

The flow developed for each subbasin was entered into the network system at the input nodes as shown in Figures G-1 to G-11 in Appendix G. The input nodes were generally located at the upstream end of the network system of each sub-basin to provide a level of conservatism in the flows within each subbasin.

Future flows for residential parcels in the basins were developed utilizing a peak design flow of 149 gallons per ERU. Undeveloped parcels within the basin were ascribed a number of ERUs based on the size and established zoning of the parcel. Basins were assumed to grow at the growth rates established in Chapter 6 over the 20-year planning period.

If a basin reached theoretical buildout prior to accepting the allotted number of ERUs based on the growth rate, these ERUs were transferred to basins with available parcels to handle the growth. The transfer of ERUs to other basins was in part based on discussions with the City regarding known developments within the basins.

Commercial flows were similarly increased based on available commercial acreage. I/I rates were increased at the rate of increase of additional acreage of service area. The model evaluated flows generated in the years 2006, 2015, and 2025.

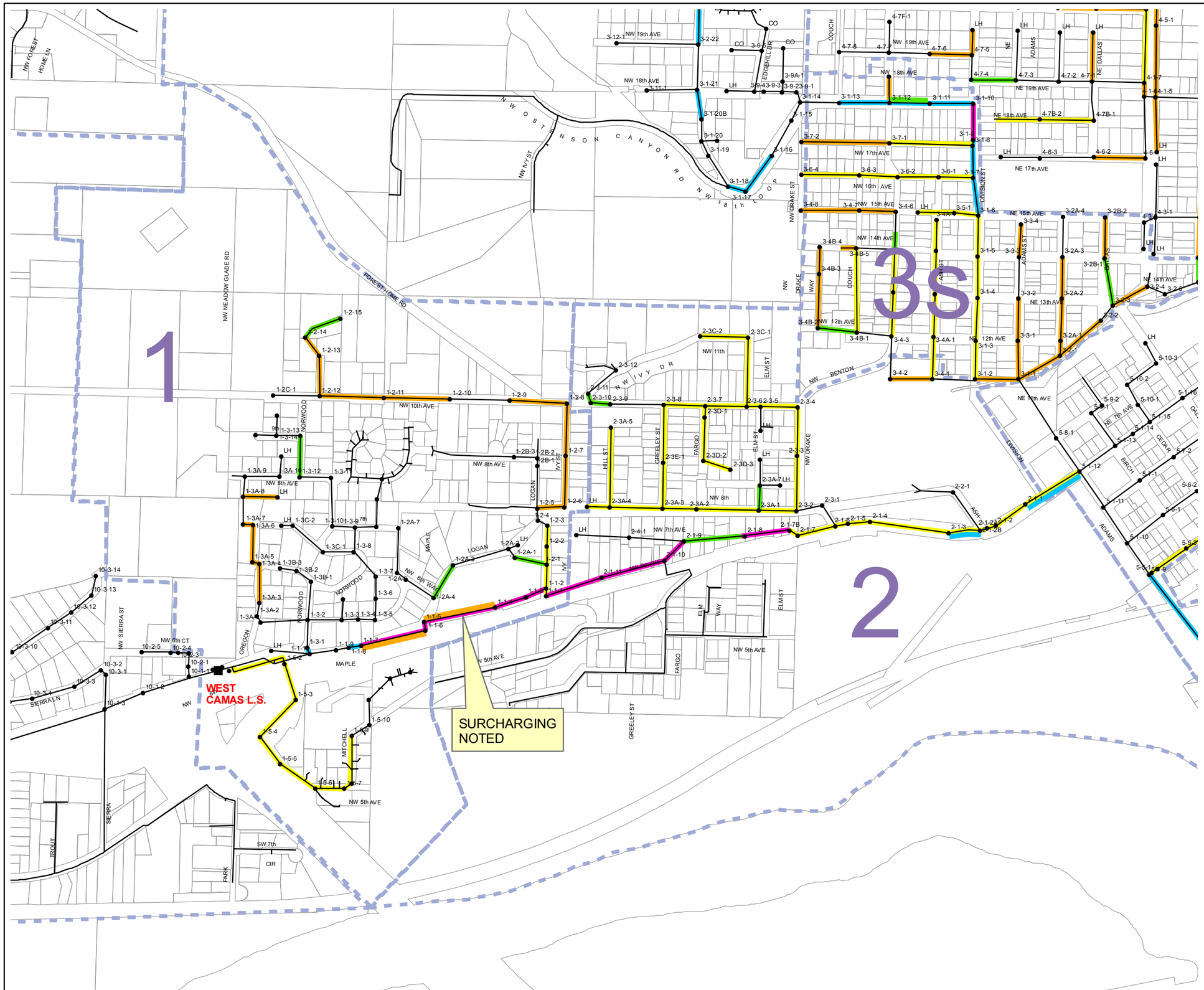
**TABLE 7-4**

**I/I Estimates Used for Hydraulic Model**

| | | Developed Area (2006) | | Total I/I | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total Area (2006) | (acres) | % of Total | (gpd) Peak Day | (gpd) Peak Hour | % of Total | gpad Total Peak Day | gpad Developed Peak Day | gpad Developed Peak Hour |
| 1 | 231 | 95 | 2.7% | 1,109,217 | 1,420,576 | 24% | 4,802 | 11,676 | 14,953 |
| 2 | 203 | 58 | 1.6% | 453,957 | 581,384 | 9% | 2,236 | 7,827 | 10,024 |
| 3 South | 91 | 43 | 1.2% | 149,790 | 191,837 | 3% | 1,646 | 3,483 | 4,461 |
| 3 North | 462 | 216 | 6.1% | 1,065,951 | 1,365,165 | 20% | 2,307 | 4,935 | 6,320 |
| 4 | 142 | 88 | 2.5% | 735,301 | 941,701 | 14% | 5,178 | 8,356 | 10,701 |
| 5 | 129 | 46 | 1.3% | 54,177 | 69,384 | 1% | 420 | 1,178 | 1,508 |
| 6 | 111 | 57 | 1.6% | 119,136 | 152,577 | 2% | 1,073 | 2,090 | 2,677 |
| 7 | 163 | 91 | 2.6% | 166,718 | 213,516 | 3% | 1,023 | 1,832 | 2,346 |
| 8 | 171 | 68 | 1.9% | 13,563 | 17,370 | < 1% | 79 | 199 | 255 |
| 9 | 105 | 80 | 2.3% | 14,133 | 18,100 | < 1% | 135 | 177 | 226 |
| 10 | 548 | 286 | 8.1% | 705,011 | 902,909 | 14% | 1,287 | 2,465 | 3,157 |
| 11 | 411 | 154 | 4.4% | 11,756 | 15,056 | < 1% | 29 | 76 | 98 |
| 12 | 270 | 167 | 4.7% | 46,531 | 59,592 | < 1% | 172 | 279 | 357 |
| 13 | 1700 | 1022 | 28.9% | 261,126 | 334,424 | 5% | 154 | 256 | 327 |
| 14 | 1787 | 963 | 27.2% | 193,326 | 247,593 | 4% | 108 | 201 | 257 |
| 15 | 184 | 100 | 2.8% | 40,546 | 51,927 | 1% | 220 | 405 | 519 |
| **Total** | **6,708** | **3,534** | **100.0%** | **5,130,000** | **6,570,000** | **100%** | **N/A** | **N/A** | **N/A** |

## RESULTS OF HYDRAULIC MODEL

The model results show a number of areas with capacity issues within the City's system. A pipe was determined to be over capacity if the flow through the pipe, as determined by the model, was greater than the theoretical maximum flow the pipe could effectively convey. The majority of the capacity deficiencies identified were within Basins 1, 2, and 3 North. Many of these areas with capacity problems, particularly those identified in Basins 1 and 2 are a result of undersized pipes and shallow slopes.


1
2
3s
WEST CAMAS L.S.
SURCHARGING NOTED
NW 19th AVE
NW 18th AVE
NW 17th AVE
NW 16th AVE
NW 15th AVE
NW 14th AVE
NW 12th AVE
NW 11th
NW 10th AVE
NW 8th AVE
NW 8th
NW 7th AVE
NW 6th AVE
NW 5th AVE
NE 19th AVE
NE 18th AVE
NE 17th AVE
NE 15th AVE
NE 14th AVE
NE 13th AVE
NE 12th AVE
NE 11th AVE
NE 7th AVE
NW 6th CT
NW FOREST HOME LN
NW MEADOW GLADE RD
NW IVY ST
NW DRAKE ST
NW DRAKE WAY
NW BENTON
DIVISION ST
ADAMS ST
NE DALLAS
COUCH
EDGEHILL DR
NW LOOP
NW IVY DR
ELM ST
HILL ST
GREELEY ST
FARGO
LOGAN
NORWOOD
MAPLE
OREGON
MITCHELL
SIERRA ST
SIERRA LN
TROUT
PARK
SW 7th CIR
CEDAR
BIRCH
ASH
ELM WAY
0
600
1,200
Feet
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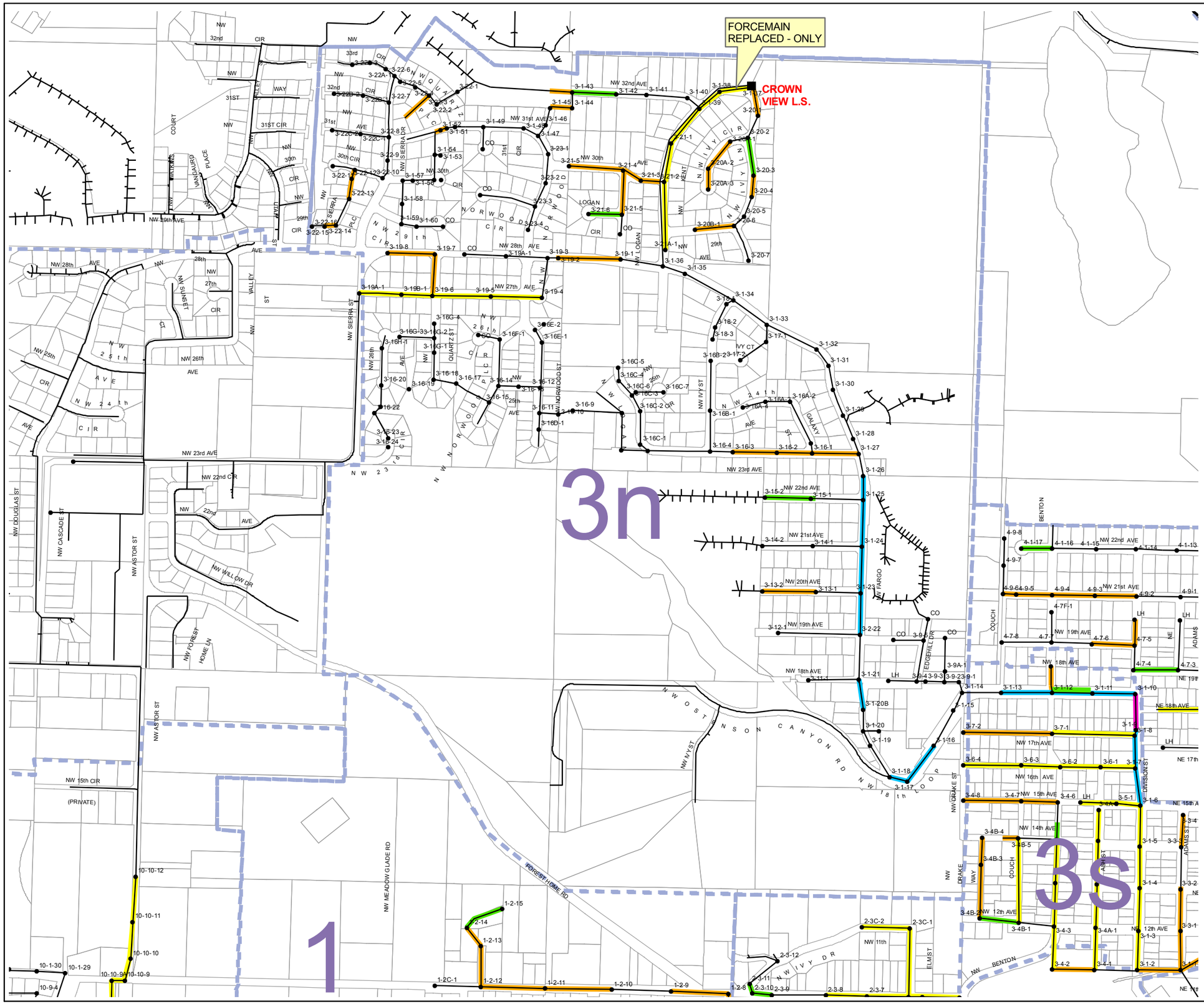
LEGEND:
CITY LIMITS
URBAN GROWTH BOUNDARY
URBAN RESERVE
SEWER BASINS
SEWER REPLACEMENT:
NO. 1 PRIORITY BASED ON CAPACITY
NO. 2 PRIORITY BASED ON CAPACITY
NO. 1 PRIORITY BASED ON CONDITION
NO. 2 PRIORITY BASED ON CONDITION
SEWER PIPES REPLACED SINCE 1998 I/I REPORT
PARCELS
SEWER PIPELINES:
SEWER MANHOLES
PUMP STATIONS
CITY OF CAMAS
GENERAL SEWER / WASTEWATER FACILITY PLAN
SEWER SYSTEM DEFICIENCIES BASIN 1 & 2
FIGURE 7-1
Gray & Osborne, Inc.
CONSULTING ENGINEERS
L:\CAMAS\05471\GIS\SEWER_REPLACEMENT_FIGURES\FIG_7-1.MXD




**LEGEND:**

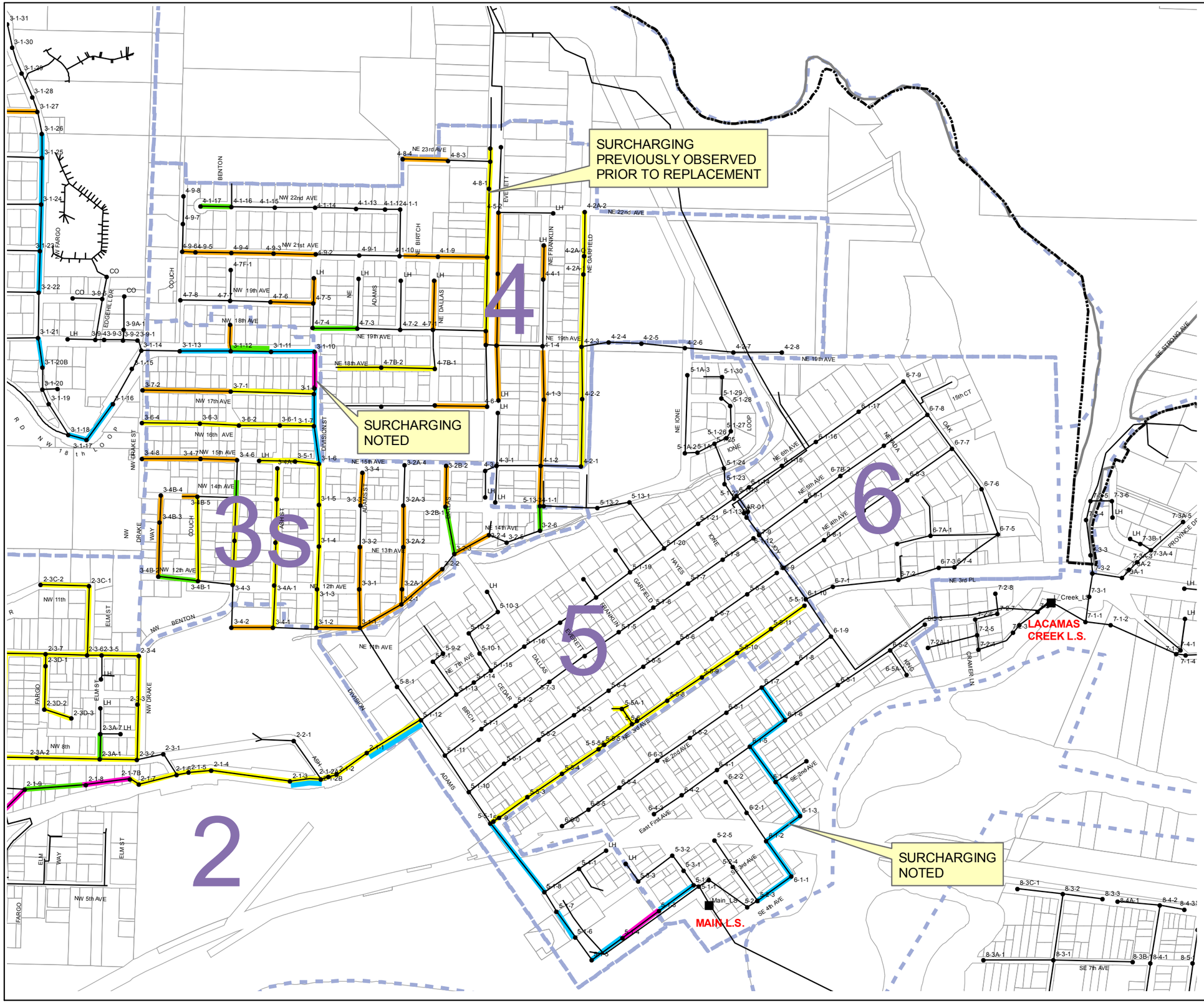
- CITY LIMITS
- URBAN GROWTH BOUNDARY
- URBAN RESERVE
- SEWER BASINS
- NO. 1 PRIORITY BASED ON CAPACITY
- NO. 2 PRIORITY BASED ON CAPACITY
- NO. 1 PRIORITY BASED ON CONDITION
- NO. 2 PRIORITY BASED ON CONDITION
- SEWER PIPES REPLACED SINCE 1998 I/I REPORT
- PARCELS
- SEWER PIPELINES:
- SEWER MANHOLES
- PUMP STATIONS

# CITY OF CAMAS

GENERAL SEWER / WASTEWATER FACILITY PLAN
SEWER SYSTEM DEFICIENCIES BASIN 3n
FIGURE 7-2

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\05471\GIS\SEWER_REPLACEMENT_FIGURES\FIG_7-2.MXD




**LEGEND:**

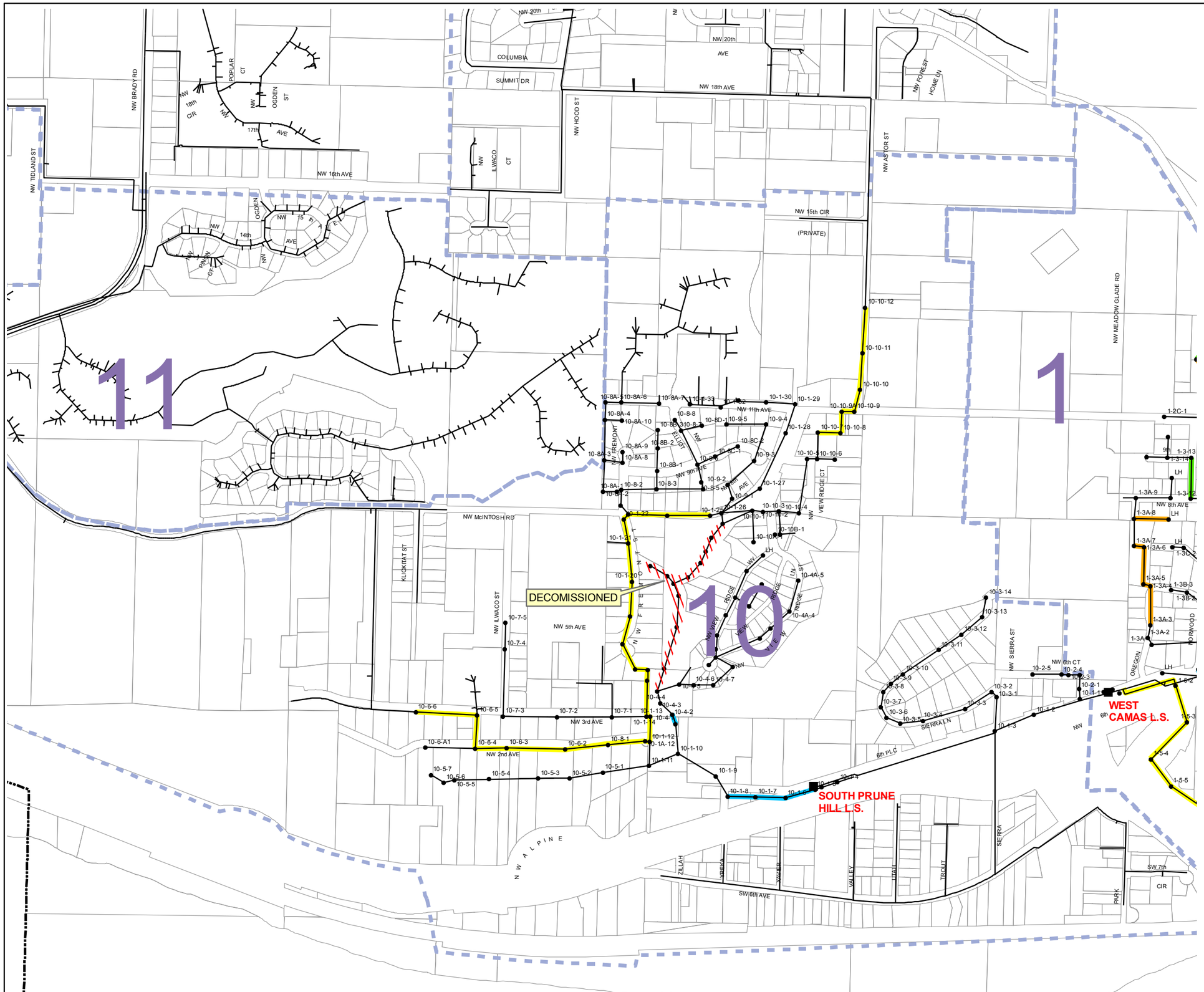
- CITY LIMITS
- URBAN GROWTH BOUNDARY
- URBAN RESERVE
- SEWER BASINS
- NO. 1 PRIORITY BASED ON CAPACITY
- NO. 2 PRIORITY BASED ON CAPACITY
- NO. 1 PRIORITY BASED ON CONDITION
- NO. 2 PRIORITY BASED ON CONDITION
- SEWER PIPES REPLACED SINCE 1998 I/I REPORT
- PARCELS
- SEWER PIPELINES:
- SEWER MANHOLES
- PUMP STATIONS

# CITY OF CAMAS

GENERAL SEWER / WASTEWATER FACILITY PLAN
SEWER SYSTEM DEFICIENCIES BASIN 3s, 4, 5 & 6
FIGURE 7-3

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\05471\GIS\SEWER_REPLACEMENT_FIGURES\FIG_7-3.MXD




**LEGEND:**

- CITY LIMITS
- URBAN GROWTH BOUNDARY
- URBAN RESERVE
- SEWER BASINS

**SEWER REPLACEMENT:**

- NO. 1 PRIORITY BASED ON CAPACITY
- NO. 2 PRIORITY BASED ON CAPACITY
- NO. 1 PRIORITY BASED ON CONDITION
- NO. 2 PRIORITY BASED ON CONDITION
- SEWER PIPES REPLACED SINCE 1998 I/I REPORT
- PARCELS
- SEWER PIPELINES:
- SEWER MANHOLES
- PUMP STATIONS

# CITY OF CAMAS

GENERAL SEWER / WASTEWATER FACILITY PLAN
SEWER SYSTEM DEFICIENCIES BASIN 1 & 2
FIGURE 7-4

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\05471\GIS\SEWER_REPLACEMENT_FIGURES\FIG_7-4.MXD

Figures 7-1 through 7-4 show the gravity collection system deficiencies based on the hydraulic modeling conducted. The criteria for listing a sewer as "deficient" are that, at peak hour flow, the pipe is full and a manhole surcharge depth exceeds 1 foot. Deficiencies were categorized as a number one or two priority based upon the degree to which the flow is expected to exceed capacity and upon the degree of surcharging, as shown in Appendix F.

**TABLE 7-5**

**Modeled 2025 Flows to Pump Stations**

| Pump Station | Basin No. | Pump Capacity (gpm, each) | Total Station Pumping Capacity (gpm, w/1 out of service) | Modeled Current Peak Hour Flow (gpm) | Modeled 2025 Peak Hour Flow (gpm) |
|---|---|---|---|---|---|
| Main | 5 | 3,850 | 7,700 | 6,106 | 9,378 |
| Oak Park | 8 | 350 | 350 | 213 | 238 |
| One Stop | 9 | 231 | 231 | 100 | 102 |
| South Prune Hill | 10 | 510 | 510 | 776 | 849 |
| West Camas | 1 | 810 | 810 | 1,052 | 1,150 |
| Crown View Plaza | 3 | 325 | 325 | 391 | 396 |
| Lacamas Creek | 7 | 300 | 300 | 265 | 407 |

Table 7-5 shows the projected 2025 flow to the major pump stations, based on the hydraulic modeling of the current collection system. Several pump stations are projected to be over capacity unless one of the following occurs:

- The capacity of the pump station is upgraded,
- Infiltration and inflow upstream of the pump station is removed, or
- Upstream flows are diverted.

As discussed below, it is recommended that flows from the STEP main to the Main Pump Station be diverted to a new line over the Lacamas River. This new line would also accommodate flows from the proposed Crown Road sewer such that the capacity of the existing Lacamas Creek Pump Station would not need to be increased. It is expected that the remainder of the projected pump station capacity exceedances can be prevented by I/I reduction, i.e., that repair and replacement of pipes and rehabilitation of side sewers will reduce infiltration and inflow such that pump stations will not have to be upgraded. Otherwise, the capacity of some pump stations may have to be increased.

# COLLECTION SYSTEM CAPITAL IMPROVEMENT PROJECTS

Recommended collection system capital improvement projects for the pump stations and the gravity sewers are listed below, with costs estimates presented for each. Projects were grouped based upon qualifiers that included geography, capacity, condition, known surcharging, propensity for infiltration and inflow, and dollar amounts. Project segments with the most deficiencies were rated the most in need of replacement or repair. Everything being equal, upstream project segments were rated highest, such that repairing them first would relieve the load on downstream problematic segments. Finally, pipeline segments were grouped to keep yearly pipeline project costs to under $1.5 million in 2006 dollars.

The projects are shown in Figures 7-5 through 7-8.

## PUMP STATIONS

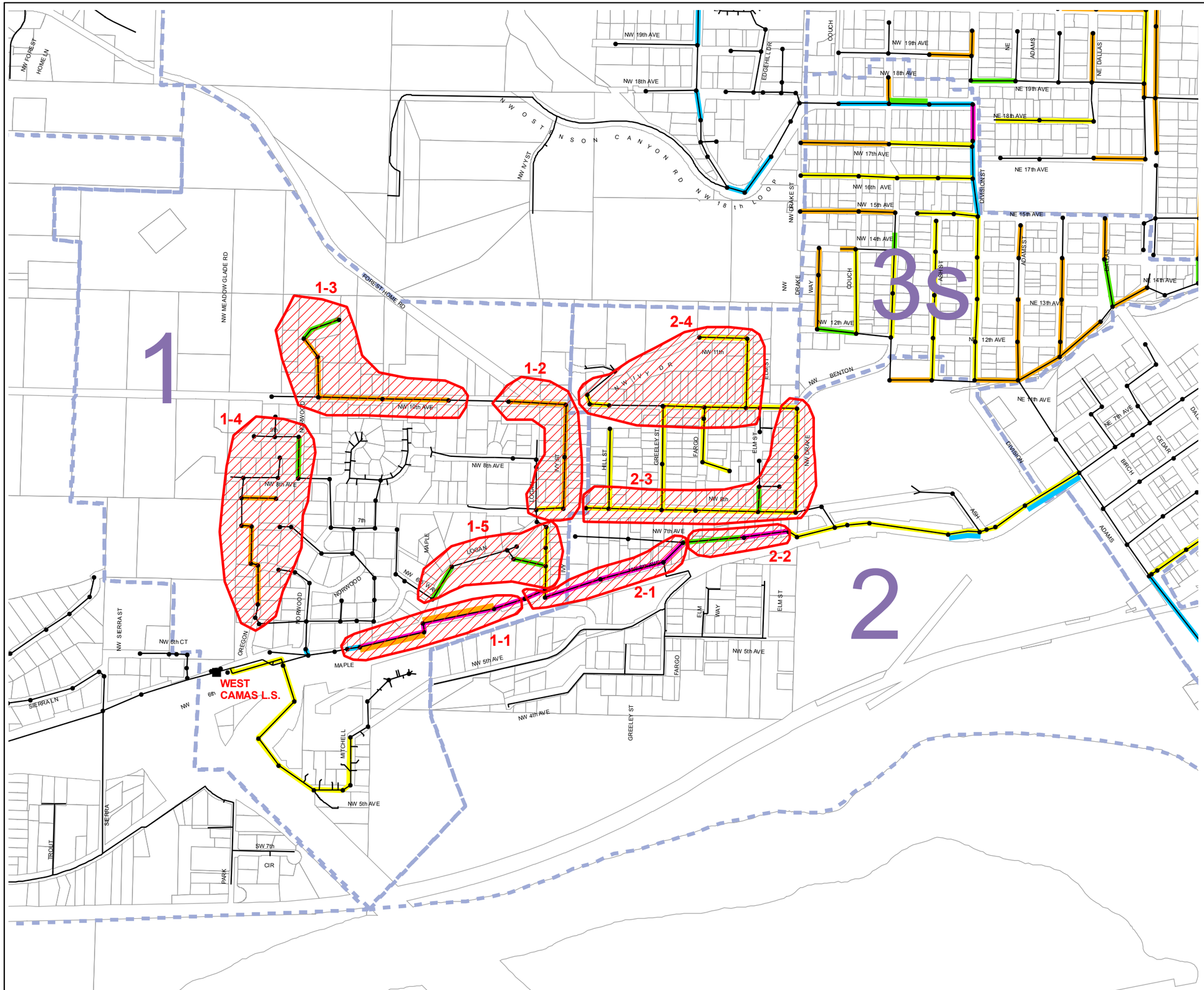
### Pump Station Upgrade Schedule

Per discussion with City staff, the City will need to budget for, on average, one to two major upgrades of pump station per year. Typically, when upgraded, the pump stations are provided with portions of the "Camas spec," including Flygt pumps, Multitrode level sensors, Monitor Pro run-time monitoring and MT2PC controls, Sonotrol telemetry for alarms only. An annual allowance of $150,000 has been included for this purpose. The first pump stations to be upgraded will be the Brady Road and Winchester Hill Pump Stations, scheduled for 2007. These pump stations are prioritized based on the significant corrosion identified in inspections, as summarized in Table 7-1.

Upgrades to the Lacamas Creek and Main Pump Stations are required due to capacity and are addressed separately below.

### Lacamas Creek Pump Station

Modeling results indicate that the Lacamas Creek Pump Station has insufficient excess capacity to pump the additional flows from the proposed 450 homes associated with new development in the east side of Basin 15. As described below, this new area of development is expected to be served by a developer-financed pump station and a new gravity sewer line on Crown Road. Current excess capacity at the Lacamas Creek Pump Station could accommodate additional flows from only approximately 235 new homes. Pump station improvements would be required in order to provide a station capacity of approximately 0.592 mgd (410 gpm) at the Lacamas Creek Pump Station in order to convey peak hour flows for the entire 450 homes. (Note: pump station capacities are noted with one pump on standby, as required by Department of Ecology criteria.)




**LEGEND:**

- CITY LIMITS
- URBAN GROWTH BOUNDARY
- URBAN RESERVE
- SEWER BASINS

**SEWER REPLACEMENT:**

- NO. 1 PRIORITY BASED ON CAPACITY
- NO. 2 PRIORITY BASED ON CAPACITY
- NO. 1 PRIORITY BASED ON CONDITION
- NO. 2 PRIORITY BASED ON CONDITION
- SEWER PIPES REPLACED SINCE 1998 I/I REPORT
- PARCELS
- SEWER PIPELINES:
- SEWER MANHOLES
- PUMP STATIONS

2-4

BASIN # PROJECT #

# CITY OF CAMAS

GENERAL SEWER / WASTEWATER FACILITY PLAN
SEWER SYSTEM REHABILITATION PROJECTS
BASIN 1 & 2
FIGURE 7-5

Gray & Osborne, Inc.
CONSULTING ENGINEERS

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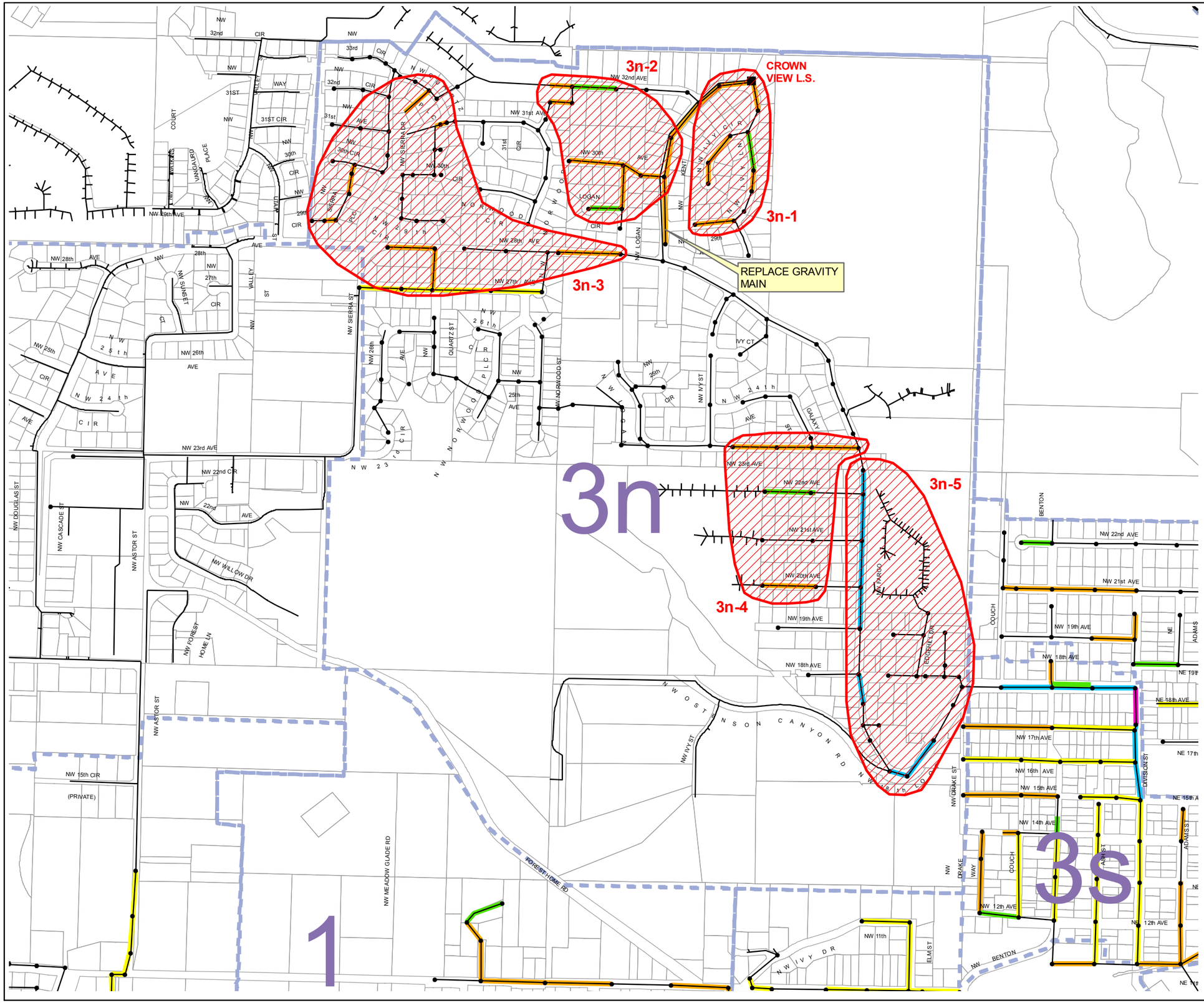


**LEGEND:**

- CITY LIMITS
- URBAN GROWTH BOUNDARY
- URBAN RESERVE
- SEWER BASINS
- NO. 1 PRIORITY BASED ON CAPACITY
- NO. 2 PRIORITY BASED ON CAPACITY
- NO. 1 PRIORITY BASED ON CONDITION
- NO. 2 PRIORITY BASED ON CONDITION
- SEWER PIPES REPLACED SINCE 1998 I/I REPORT
- PARCELS
- SEWER PIPELINES:
- SEWER MANHOLES
- PUMP STATIONS

2-4

BASIN # PROJECT #

# CITY OF CAMAS

GENERAL SEWER / WASTEWATER FACILITY PLAN
SEWER SYSTEM REHABILITATION PROJECTS
BASIN 3n
FIGURE 7-6

Gray & Osborne, Inc.
CONSULTING ENGINEERS

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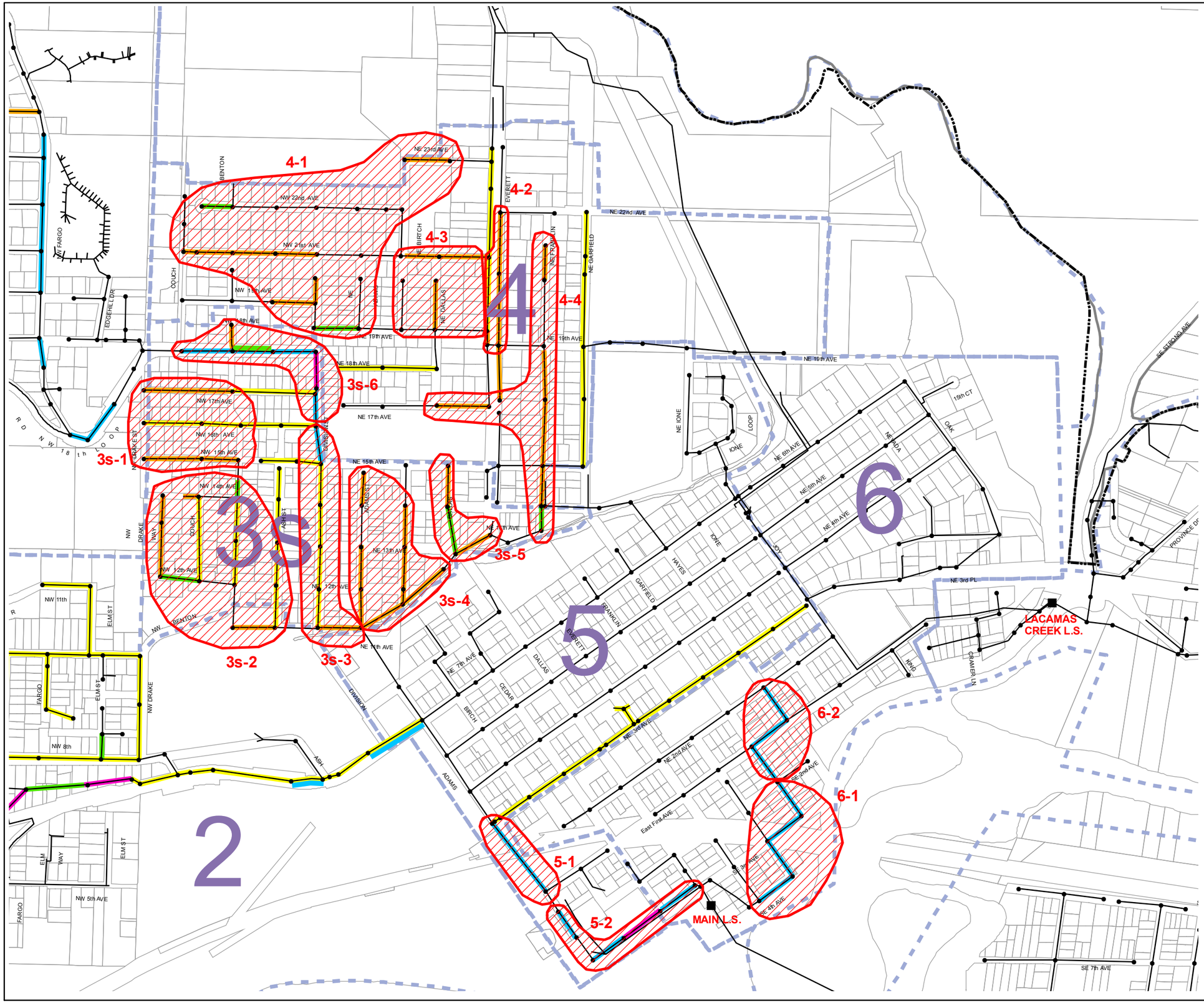



N

0 600 1,200 Feet

**LEGEND:**

- CITY LIMITS
- URBAN GROWTH BOUNDARY
- URBAN RESERVE
- SEWER BASINS
- NO. 1 PRIORITY BASED ON CAPACITY
- NO. 2 PRIORITY BASED ON CAPACITY
- NO. 1 PRIORITY BASED ON CONDITION
- NO. 2 PRIORITY BASED ON CONDITION
- SEWER PIPES REPLACED SINCE 1998 I/I REPORT
- PARCELS
- SEWER PIPELINES:
- SEWER MANHOLES
- PUMP STATIONS

2-4

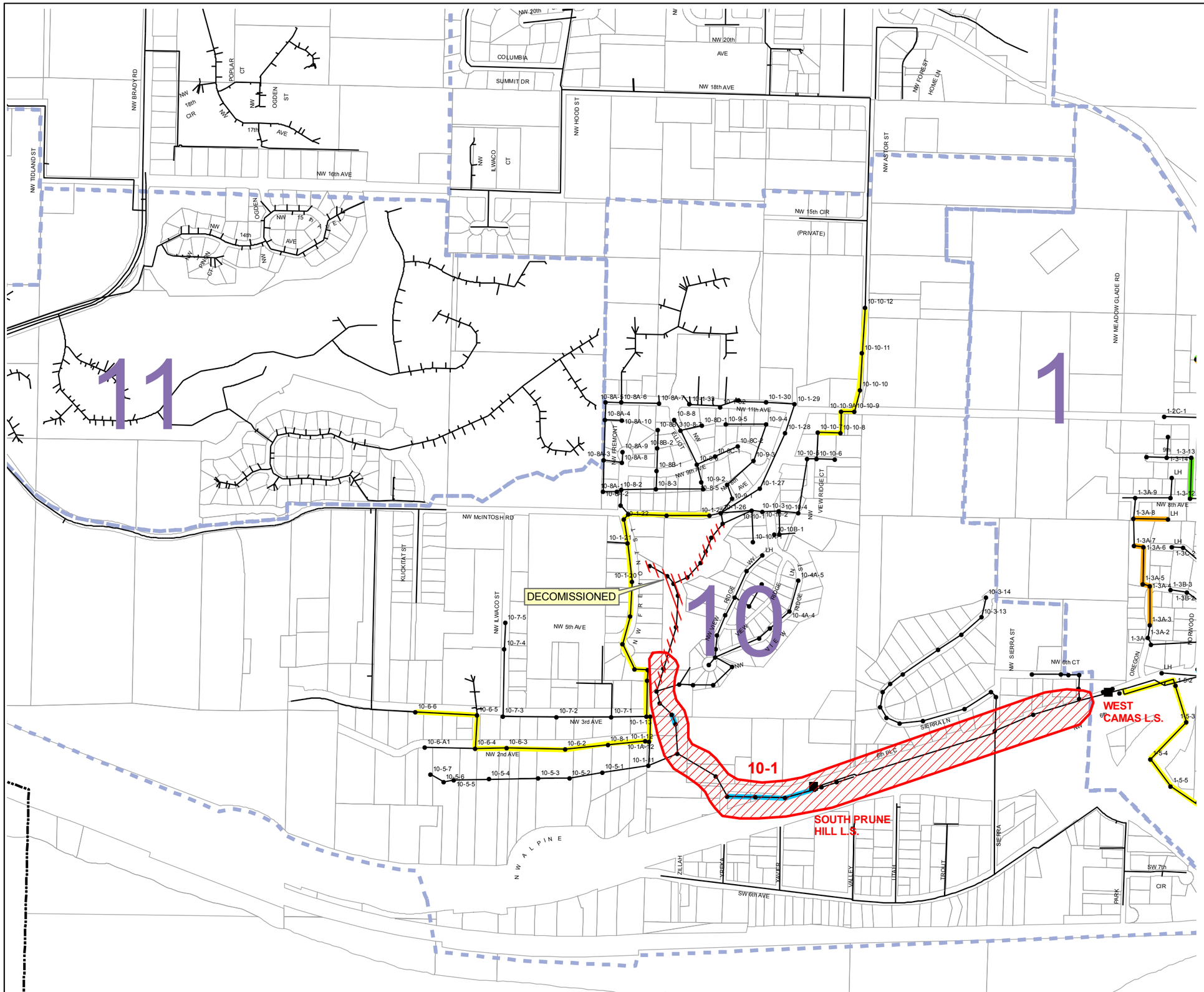
BASIN # PROJECT #

# CITY OF CAMAS

GENERAL SEWER / WASTEWATER FACILITY PLAN
SEWER SYSTEM REHABILITATION PROJECTS
BASIN 3s, 4, 5 & 6
FIGURE 7-7

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\05471\GIS\SEWER_REPLACEMENT_FIGURES\FIG_7-7.MXD




**LEGEND:**

- CITY LIMITS
- URBAN GROWTH BOUNDARY
- URBAN RESERVE
- SEWER BASINS

**SEWER REPLACEMENT:**

- NO. 1 PRIORITY BASED ON CAPACITY
- NO. 2 PRIORITY BASED ON CAPACITY
- NO. 1 PRIORITY BASED ON CONDITION
- NO. 2 PRIORITY BASED ON CONDITION
- SEWER PIPES REPLACED SINCE 1998 I/I REPORT
- PARCELS
- SEWER PIPELINES:
- SEWER MANHOLES
- PUMP STATIONS

2-4

BASIN # PROJECT #

# CITY OF CAMAS

GENERAL SEWER / WASTEWATER FACILITY PLAN
SEWER SYSTEM REHABILITATION PROJECTS
BASIN 1 & 2
FIGURE 7-8

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\05471\GIS\SEWER_REPLACEMENT_FIGURES\FIG_7-8.MXD

The Lacamas Creek Pump station could be relatively easily expanded to accommodate the peak hour flow of 0.592 mgd (410 gpm) anticipated from the combination of the entire 450 home development and existing flows by simply replacing the existing PACO pumps with larger pumps and providing a new electrical control panel. The estimated cost for this upgrade is $140,000. Cost estimates are provided in Appendix K. PACO no longer manufactures or sells the pumps that are currently at the pump station. Replacements for PACO pumps are manufactured by ABS and marketed as Pumpex pumps by Pumptech in the northwest.

The pump station capacity could be expanded to as much as 550 gpm by replacing the existing pumps with new pumps; however, this would require major electrical upgrades to the pump station. Expanding beyond 550 gpm would require considerably more expense, including replacing the force main, use of a different pump family, and additional associated mechanical and electrical pump station modifications.

**Main Pump Station**

As shown in Table 7-5, projected 2025 flows to the Main Pump Station exceed its capacity (7,700 gpm). As previously discussed, the Main Pump Station has a very small wet well that complicates both maintenance and the ability of instruments to control pump operation.

The size of the wet well needs to be increased to provide reliable operation and maintenance of the pump station. Additionally, since projected peak hour flows exceed the capacity of the Main Pump Station, either modifications to the station to increase capacity or rerouting of flows, will be required.

As discussed earlier in this chapter, based on sewer system modeling, and observations of surcharging by City staff, it is evident that the sewer reach between Manholes 6-1-13 to 5-5-1, upstream of the Main Pump Station, is over capacity at current flows, due to infiltration and inflow during storm events. With future increases in flow due to growth in the City, this area may be at risk of surcharges or overflows during storm events. If flow from the STEP Main serving the Western Service Area, then these lines have sufficient capacity for year 2025 flows.

There are two alternatives to addressing capacity deficiencies at this pump station:

1. modifications to the Main Pump Station and upstream sewers to increase capacity, or

2. rerouting of flows.

Alternative 1 – Increasing the Capacity of Main Pump Station

Under Alternative No. 1, the Main Pump Station would be upgraded to accommodate the projected peak hour year 2025 flow of 11,600 gpm. The existing wet well would be expanded and the pumps, motors and emergency generator must be replaced, as well as the electrical and control system upgraded. The estimated cost for this upgrade is $1.4 to $1.7 million. In addition, the following additional projects must be completed to avoid future sewer system surcharging in the downtown area if Alternative 1 is chosen:

- Replacing 1,051 lineal feet of 18-inch pipe with 21-inch pipe along East First Avenue and along Garfield and Hayes Streets. The lines are currently undersized to handle the expected flows. A portion of this segment is known to surcharge. (Shown as Project 6-1 in Figure 7-7. Estimated cost is $650,000. This project is not required if Alternative 2 is selected.)

- Replacing 815 lineal feet of 18-inch pipe with 21-inch pipe along East First Avenue and along Garfield and Hayes Streets. The lines are currently undersized to handle the expected flows. (Shown as Project 6-2 in Figure 7-7. Estimated cost is $507,000. This project is not required if Alternative 2 is selected.)

- Additionally, the Lacamas Creek Pump Station must be upgraded to accommodate flows from the new Crown Road sewer.

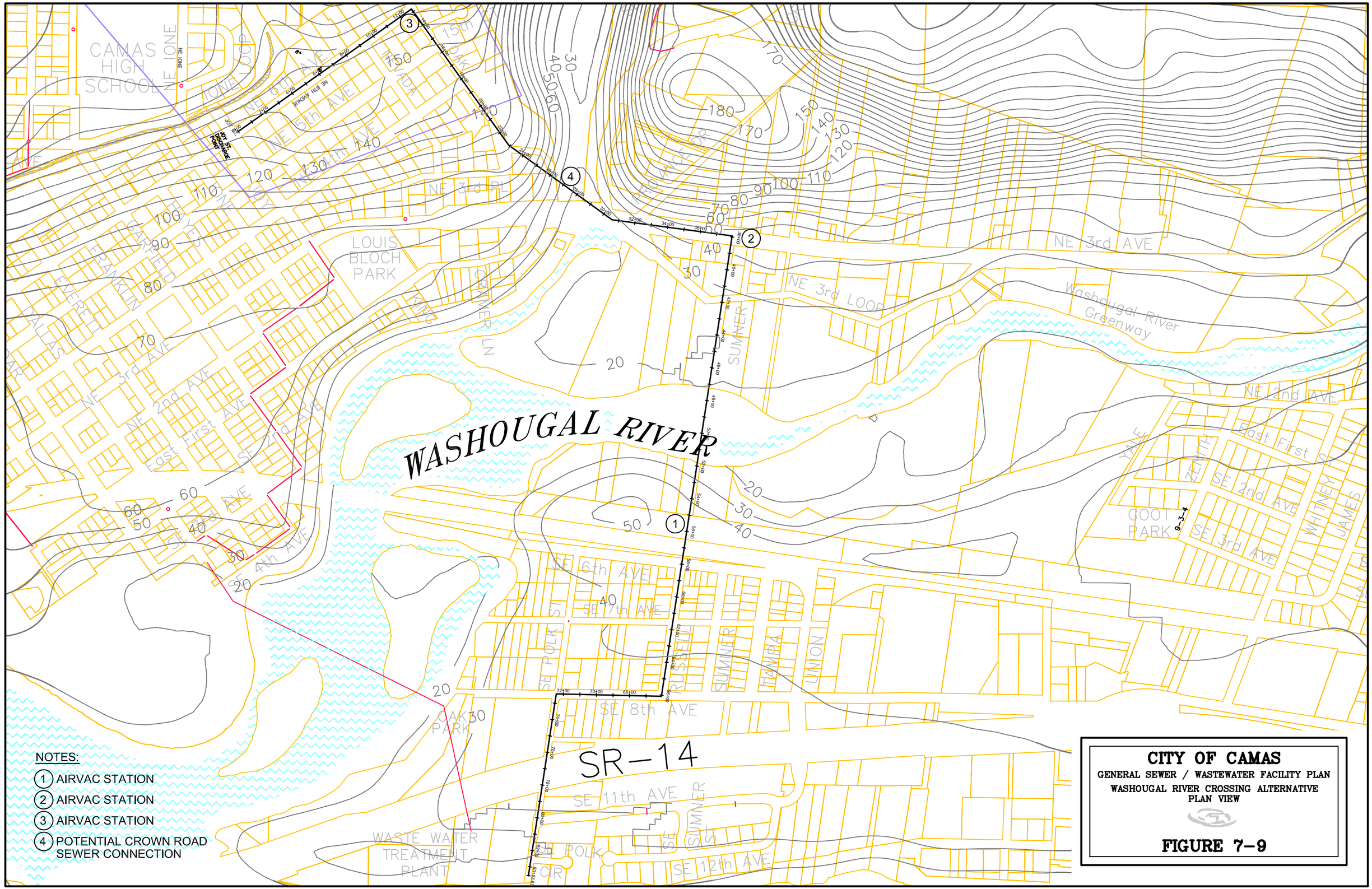
Alternative 2 – STEP Main Bypass

As described above, the gravity sewer lines and Main Pump Station downstream of the 6$^{th}$ and Joy STEP terminus do not have sufficient capacity to transport 2025 flows. In Alternative 2, these flows would be bypassed from these lines in a new STEP Main to the WWTP. Plan and profile views of a possible routing of this line are shown in Figures 7-9, 7-10 and 7-11. The line would cross the Washougal River on a new pedestrian bridge that is being constructed within the next 2 years. This alignment would require obtaining easements for routing the force main through the various properties. The total length of the force main under this alternative is approximately 8,300 feet.

The estimated project cost for construction of the STEP Main Bypass is $4.48 million. Construction of the STEP Main Bypass would allow future growth in the sewer service area and expansion of the UGA.

Discussion

Alternative 2 is the recommended alternative, since it would provide initial improvements that will allow future growth in the sewer service area and expansion of the UGA. It




NOTES:

1. AIRVAC STATION
2. AIRVAC STATION
3. AIRVAC STATION
4. POTENTIAL CROWN ROAD SEWER CONNECTION

**CITY OF CAMAS**

**GENERAL SEWER / WASTEWATER FACILITY PLAN**

**WASHOUGAL RIVER CROSSING ALTERNATIVE**
**PLAN VIEW**

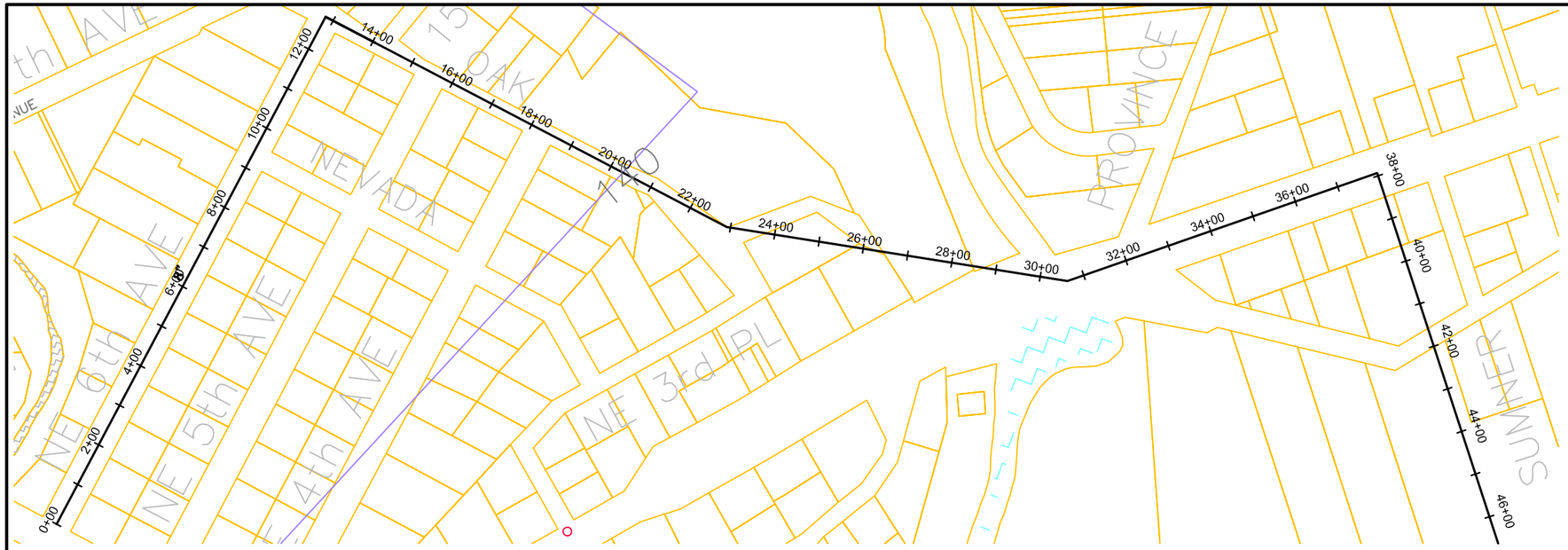
**FIGURE 7-9**

# CITY OF CAMAS

GENERAL SEWER / WASTEWATER FACILITY PLAN

WASHOUGAL RIVER CROSSING ALTERNATIVE PROFILE

## FIGURE 7–10

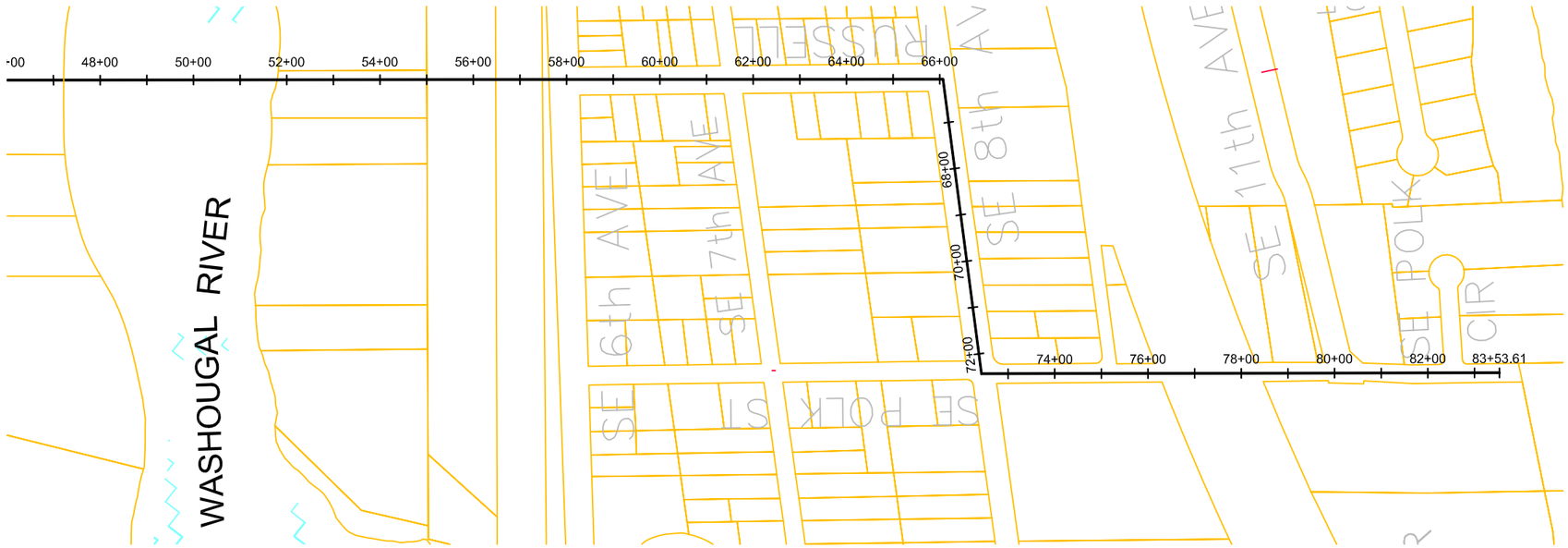


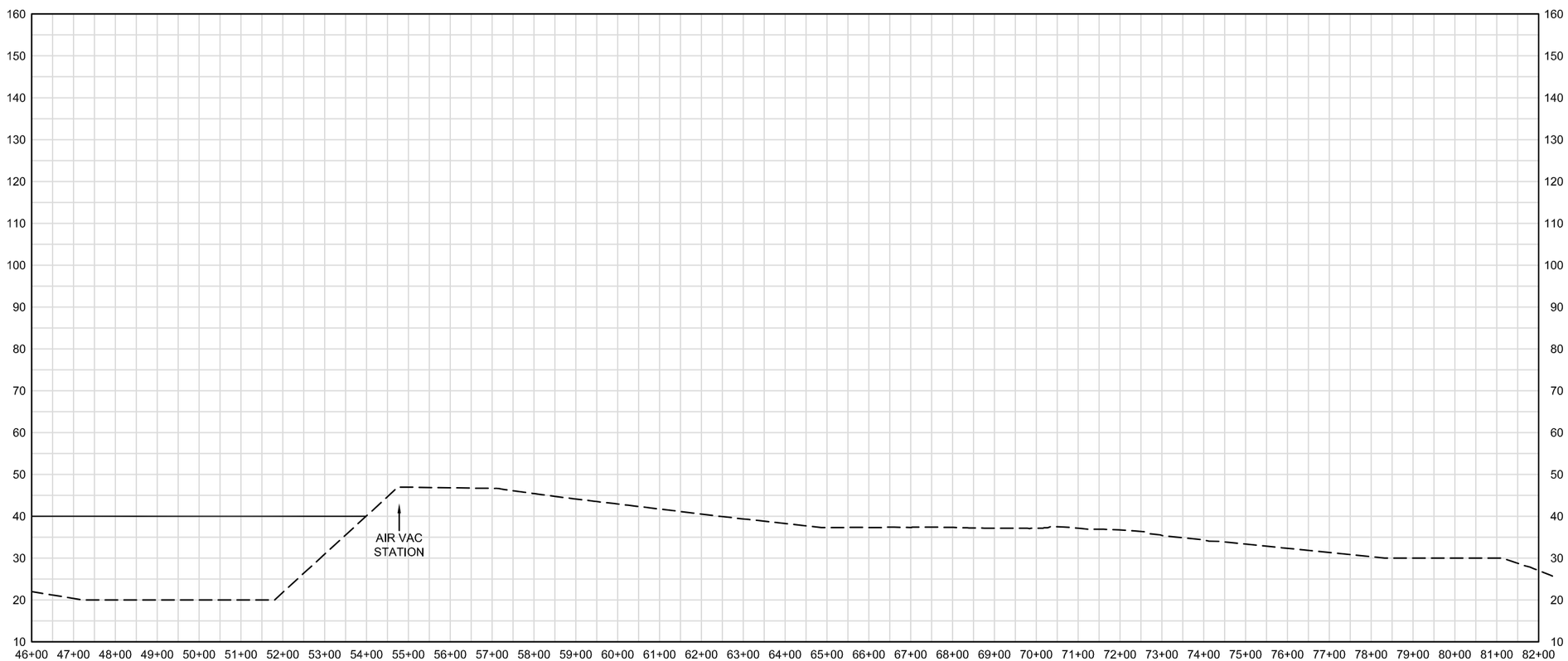
# CITY OF CAMAS

GENERAL SEWER / WASTEWATER FACILITY PLAN

WASHOUGAL RIVER CROSSING ALTERNATIVE PROFILE

## FIGURE 7–11



would also keep the majority of STEP flows out of gravity sewers near the downtown area.

As described above, construction of a new wet well for the Main Pump Station is recommended for either alternative, due to concerns about lack of available space for maintenance and future upgrades, and ongoing safety concerns. The new wet well could be a precast wet well installed adjacent to the existing wet well. It should be possible to use the existing wet well and change-over to the new wet well with minimum disruption. A coarse mechanical screen or grinder would be installed to reduce downstream maintenance and reliability concerns. A coarse mechanical screen would require a dumpster or other container and handling of screenings, which would require a building or other structure near or under the road. A grinder system (e.g., Muffin Monster) would require less maintenance and not require a structure for handling screenings, and is thus recommended. The estimated cost for a new wet well and grinder system is $900,000.

It is recommended that the force main from the Main Pump Station be inspected, since the line has been in place since 1972 without inspection.

Detailed cost estimates are included in Appendix K.

## GRAVITY SEWER REPLACEMENT

This section includes discussion of alternative means of gravity sewer rehabilitation, as well as capital improvement projects to replace portions of the gravity sewer collection system.

### METHODS FOR PIPELINE AND MANHOLE REHABILITATION

Different methods of rehabilitation for trunk sewers and manholes reaching the end of their design life are described in this section.

#### Pipe Replacement by Open Cut

Pipe replacement by open cut installation has been the conventional way to rehabilitate sewer pipes in past years. This method requires either removing the existing sewer pipe and installing new pipe on the same alignment or abandoning the existing pipe and installing new pipe on a different alignment. Surface restoration costs when the sewer segment is located in a paved roadway are high and generally will cause more disruption to the area in terms of the number of working days to construct the work than a trenchless rehabilitation method.

The advantage of this method is the hydraulic capacity of the sewer segment can be increased by selecting a larger pipe diameter. Furthermore, when existing sewer

segments are observed to have major sags and side sewer laterals are separated from the mainline, this method becomes the preferred option.

**Cured-in-Place Pipe**

Cured-in-place pipe (CIPP) is a method of rehabilitation where a new pipe is formed within an existing pipe. A resin impregnated liner is inserted into the sewer segment from the manhole and extended to the other manhole, expanded using hydrostatic head of water to press the liner firmly against the existing host pipe and heated to activate the resin to cure against the host pipe. Active side sewers are reinstated by remote controlled cutters used in conjunction with CCTV video inspection. Typically a CIPP installer will clean, internally televise (with close circuit television, CCTV) the sewer segment (before and after the installation) and take exact inside pipe diameter dimensions prior to mobilizing.

The thickness of the liner (7.5 mm minimum) and physical properties of the resins can be specified to suit the specific application. When the resin cures, the inside diameter becomes smaller than the host pipe, but the hydraulic capacity may not be reduced, as the Manning's roughness coefficient becomes lower than that for the host pipe. It is desirable to maintain sewage flow at a self-cleansing velocity of 2 feet per second based on full flow conditions and Manning's roughness coefficient of 0.013. Generally, the capacity of the CIPP – rehabilitated segments will increase slightly for pipe diameters over 18 inches due to the new pipe having a lower Manning's roughness coefficient; however, for pipe sizes of 8, 10, 12, and 15 inches, the hydraulic capacity will decrease by approximately 17, 11, 6, and 2 percent, respectively.

The advantages of using this technology is it is the least disruptive to the surface and can be completed in a relatively short period of time as opposed to pipe replacement by open cut or other trenchless methods.

Pipe segments that would be candidates for this method should have little to no sags, side sewer laterals intact with the mainline and segment slope that provides a self-cleansing velocity of 2 feet per second.

**Pipe Bursting**

Pipe bursting is a semi-trenchless method capable of increasing the diameter of the existing host pipe by using a pneumatically powered bursting head to pull in a welded High Density Polyethylene Pipe (HDPE). The pipe bursting process is the only trenchless pipe rehabilitation method that allows the installation to increase the diameter of the sewer pipes without excavating. Active laterals are individually excavated for reinserting into the new pipe. There are several methods that can be used for pipe bursting. In the most common method, a pneumatic pipe bursting head is inserted from one manhole and pulled through a breakable host pipe by a winch, the percussive action breaks apart the

existing pipe as the head moves through the pipe and displaces the pipe fragments into the surrounding pipe zone. The head can be equipped with an expander that can further displace the host pipe fragments. The replacement pipe is usually standard diameter (SDR) 17 HDPE to protect against gouging during pipe installation.

Sewer segments that are candidates for this method are in areas that require the benefits of minimal surface disturbance such as resident, business or environmental areas, increasing hydraulic capacity, silty-clay soil conditions, and an easily breakable host pipe. This method will not eliminate sags in the mainline. Depth is also a factor in considering sewer segments for pipe bursting; exceptionally deep sewers require proper shoring and dewatering, and pipe drag due to the weight of the soil is an issue.

Difficult pipe bursting conditions are encountered in sandy gravel soils with cobbles and the host pipe material is reinforced concrete. As a rule of thumb, contractors can install pipe that is up to double the diameter of the existing pipe.

**Sliplining**

Sliplining is a rehabilitation method that inserts a new High Density Polyethylene (HDPE) pipe inside a host pipe, decreasing the resulting inside diameter. The annular space between the host and new pipe is back-grouted, providing additional structural capacity. Access to the host pipe is provided from an existing manhole, and active laterals are reconnected to the mainline by an open cut installation using gasketed *Insert-a-Tee* connections.

Sliplining creates minimal surface disturbances and results in a shorter construction period compared to pipe replacement by excavation. However, sliplining decreases hydraulic capacity and does not eliminate sags in mainline and broken laterals.

**CIPP Internal Point Repair**

Cured-in-place-pipe internal point repair rehabilitates damaged pipe using a resin-impregnated tube, up to 10 feet in length with diameters from 6 to 24 inches, without digging.

This method is used for repairing localized structural defects due to localized settling, an offset joint, excess loading conditions, corrosion or poor initial construction in an otherwise sound sewer pipe. Point repairs may stop infiltration at the location of the repair, but the groundwater may find another location to enter the pipe.

Point repairs are non-disruptive and completed from the surface by inserting a resin-impregnated tube through a manhole into the pipe to the place of repair using visual monitoring. Once the tube is in place, the point repair is pressed against the host pipe walls and cured in place.

Point repairs are non-disruptive to the ground surfaces and can be completed in a few hours without disrupting sewage flow.

**Chemical Grouting**

Chemical grouting is a solution to prevent infiltration in structurally adequate sewer systems. It is the oldest pipeline rehabilitation process and was first developed and applied in 1955.

Grouting chemicals are forced through cracks and joints extending out into the surrounding soil where it gels with the soil to form a waterproof collar around a leaking pipe or manhole. This watertight collar adheres to the outer surface of the pipe or manhole and will remain indefinitely unless removed by an excavation.

**Manhole Rehabilitation**

The City's sewer system manholes are generally in good condition. However, within the 20-year planning period, some of the older manholes may need to be rehabilitated or replaced. Manholes are rehabilitated to correct structural deficiencies, to address maintenance concerns, and eliminate I/I. Some manhole rehabilitation options include lining, sealing, grouting, or replacing various components of the entire manhole.

Inflow typically occurs through holes in the manhole lid or around the manhole rim and lid. Manhole lids can be sealed by replacing them with new watertight covers, by sealing existing covers through the use of rubber cover gaskets with rubber vent and pick hole plugs, by installing water-tight inserts under the existing manhole covers or raising the manhole rim. Grouting is also commonly employed to reduce infiltration.

Historically, manhole voids were repaired by hand with cement. However this is considered a temporary solution. Today, aging brick and concrete manholes are not only repaired to stop ground water infiltration, but are structurally rehabilitated with a cementitious and/or epoxy coating.

Before the cementitious coating is sprayed onto the inside of the mortar and brick, CMU, or precast concrete manhole, a chemical grout is applied to the inside of the manhole to dry the brick or concrete. Once the inside surface is satisfactorily dry, a cementitious and/or epoxy coating is sprayed on the inside of the manhole, creating a durable corrosion-resistant manhole-within-a-manhole that is designed to eliminate infiltration caused by hydrostatic pressure from groundwater.

### Side Sewers

The City has implemented a TV inspection program, using outside vendors. As a result, many failed pipes have been identified. However, failed pipes are not the only potential source of infiltration and inflow. Side sewers can also contribute significantly to the problem. Collapsed or leaking service laterals or side sewers are common in many sewer systems. Side sewers are usually installed at shallow depths with a minimum self-cleansing grade from the building or residential unit to the property line. From the property line to the main sewer line, the grade may change abruptly as the side sewer descends to the elevation of the main sewer line.

Research studies sponsored by the USEPA indicate that a significant percentage of I/I is often caused by defects in side sewers, including cracked, broken, or open-jointed pipes, which can allow storm-induced infiltration. In addition to I/I from the laterals, infiltration frequently results from a leaky connection of the lateral to the main sewer and leakage at main sewer joints close to the lateral.

The potential for infiltration from service connections depends on the number of connections and total length of the connection lines. In some instances, the total length of service connections can be equal to or greater than the sewer main length. Effective infiltration control of side sewers requires testing and repairing by grouting or replacement to ensure long-term effectiveness. Service connections can also transport water from inflow sources such as roof drains, basement and foundation drains, and basement sump pumps that are illegally connected to the side sewer. Inflow control requires an effective disconnection and enforcement program.

## NEW GRAVITY SEWERS

### Crown Road

Per discussion between developers seeking to construct subdivisions in the east side of Basin 15 and the City, hydraulic model analyses were run to determine the improvements that were necessary to provide the Gregg Reservoir Annexation (formerly known as the Loyal Lands Development) with sewer service for approximately 700 houses. Based on the topography of the Gregg Reservoir Annexation (GRA) area, it is proposed that approximately 50 acres (250 homes) in the northwest portion of the 700 home GRA development will be served by the existing STEP system on Leonard Road in Basin 15. The remaining estimated 90 acres (450 homes) are proposed to be served by a new gravity sewer line to the southeast of the GRA area along Crown Road. A memorandum discussing service to these areas is included in Appendix L.

The year 2025 peak hour flow for the Northwest GRA Service Area (served by STEP) is projected to be 141,000 gpd, while the peak hour flow for the Southeast GRA Service Area (served by gravity on Crown Road) is projected to be 351,900 gpd.

A new developer-financed pump station sited at the southern end of the east side of the GRA area could serve the entire eastern GRA. The pump station would convey the collected sewage approximately 900 feet to the proposed new Crown Road Sewer line. The new Crown Hill Sewer line serving the Southeast Gregg Service Area would connect to existing Manhole 7-3-5 at Crown Road in Basin 7. From here, there are two alternatives to convey the flow to the treatment plant. Under Alternative 1, at Manhole 7-1-1, sewage from Crown Road would mix with flow from the rest of Basin 7. This combined flow would be then conveyed to the Lacamas Creek Pump station, where it would be pumped to Manhole 6-1-9. At Manhole 6-1-9, the flow from Basin 7 would merge with the flow from Basins 6, 11, 13, 14, and 15. At the Main Pump Station, this combined flow would be combined with flow from Basins 1, 2, 3, 4, 5, 10, and 12.

Under Alternative 2, flow from the Crown Road sewer would be merged with flow from in the STEP Main Bypass.

The following describes flow routing, system modeling, and necessary system improvements for Alternative 1.

<u>New Crown Road Sewer to Manhole 7-3-5</u>

Modeling results show a pipe size of 8 inches connecting to the existing system would be sufficient to handle the flow generated from the 450 homes proposed from the new development in the east side of Basin 15.

The estimated cost for this new gravity line is $1.30 million dollars. A detailed cost estimate for this project is included in Appendix K.

<u>Manhole 7-3-5 to Lacamas Creek Pump Station</u>

The existing system currently has enough excess capacity to convey the additional flows from the new development in the east side of Basin 15.to the Lacamas Creek Pump Station.

<u>Lacamas Creek Pump Station and Force Main to Manhole 6-1-9</u>

As previously discussed, modeling results indicate that the Lacamas Creek Pump station has insufficient excess capacity to pump the additional flows from the proposed 450 homes associated with the new development. Current excess capacity at the pump station could accommodate additional flows from only approximately 235 new homes based on our analysis. Pump station improvements would require a pumping capacity of approximately 0.592 mgd (410 gpm) at the Lacamas Creek Pump station in order to convey peak hour flows for the entire 450 homes. Such an expansion would be required assuming the STEP Main Bypass is not constructed.

The pump station could be expanded to as much as 550 gpm by replacing the existing pumps with new pumps; however, this would require major electrical upgrades to the pump station. Expanding beyond 550 gpm would require considerably more expense, including replacing the force main, use of a different pump family, and additional associated mechanical and electrical pump station modifications.

Gravity Sewer from Manhole 6-1-9 to the Main Pump Station

The results of the model indicate that the existing system has sufficient excess capacity to convey the additional flows resulting from the 700 homes in the proposed development.

Recommendations and Cost Estimates

Given concerns regarding solids deposition associated with mixing gravity flows from the Crown Road Sewer with flows from the STEP Bypass, it is recommended that the Lacamas Creek Pump Station be upgraded. Plans for improvements to this pump station should consider additional capacity requirements and alternatives for flow routing and satellite treatment associated with providing sewer service for an expanded UGA. Depending on the magnitude and routing of future flows associated with an expanded UGA, the City may wish to replace the Lacamas Creek Pump Station with a new station on adjacent property.

Table 7-5 summarizes projected City costs to provide service to the GRA area. Detailed cost estimates are provided with the memo in Appendix L. Cost estimates are total project costs including tax, engineering and contingency. Developer costs, including the new developer pump station and force main, are not included. Construction of the Crown Road sewer is listed as Project 15-1 in the Gravity Collection System Capital Improvement Projects system below.

**TABLE 7-6**

**Capital Costs to Provide Sewer Service to the GRA Area**

| Item | Cost Estimate |
|---|---|
| Crown Road Sewer (8" diameter) | $1,300,000 |
| Upgrade Lacamas Creek Pump Station to 410 gpm | $ 140,000 |
| **TOTAL** | **$1,440,000** |

## REPLACEMENT OF EXISTING SEWER LINES

Fifteen gravity collection system replacement/rehabilitation projects were identified in the development of this Plan. Each project is briefly described below. Total costs for the projects, which include engineering, construction, construction administration, tax and

contingency, are shown in Table 7-6. The projects are shown in Figures 7-5 through 7-8. Detailed cost estimates are included in Appendix K.

**Project 1-1**

Project 1-1 replaces 221 lineal feet of 8-inch pipe with 10-inch pipe, 112 lineal feet of 12-inch pipe with 15-inch pipe, 668 lineal feet of 12-inch pipe with 21-inch pipe, and 413 lineal feet of 12-inch pipe with 24-inch pipe along NW 6$^{th}$ Avenue. The lines are currently undersized to handle the expected projected future flows. One or more lines have root intrusion, or have serious cracks and/or holes, allowing infiltration. Portions of this segment have been known to surcharge.

**Project 1-2**

Project 1-2 replaces 1062 lineal feet of 8-inch pipe with 8-inch pipe along NW 8$^{th}$ Avenue, Ivy Street and NW 10$^{th}$ Avenue. One or more lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

**Project 1-3**

Project 1-3 replaces 34 lineal feet of 6-inch pipe with 6-inch pipe and 1,093 lineal feet of 8-inch pipe with 8-inch pipe along NW 10$^{th}$ Avenue and adjacent areas. One or more lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

**Project 1-4**

Project 1-4 replaces 845 lineal feet of 8-inch pipe with 8-inch pipe along Norwood Drive and NW Norwood Street and parallel to NW 8$^{th}$ Avenue. One or more lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

**Project 1-5**

Project 1-5 replaces 891 lineal feet of 8-inch pipe with 8-inch pipe along Logan and NW Ivy Streets. One or more lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

**Project 2-1**

Project 2-1 is essentially an extension of Project 1-1 and replaces 388 lineal feet of pipe with 12-inch pipe, 843 lineal feet pipe with 21-inch pipe, and 20 lineal feet of pipe with 30-inch pipe along NW 6$^{th}$ Avenue. The lines are currently undersized to handle the projected future flows.

**Project 2-2**

Project 2-2 is essentially an extension of Project 2-1 and replaces 354 lineal feet of 12-inch pipe with 15-inch pipe, and 320 lineal feet of 12-inch pipe with 18-inch pipe along NW 6th Avenue. The lines are currently undersized to handle the expected required hydraulic capacity. One or more lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

**Project 3 North-1**

Project 3n-1 replaces 2,300 lineal feet of 8-inch pipe with 8-inch pipe along NW 29th Avenue, NW Ivy Circle, Kent and NW Ivy Lane. One or more lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

**Project 3 North-2**

Project 3n-2 replaces 1,432 lineal feet of 8-inch pipe with 8-inch pipe along NW Logan Circle, NW Logan Street, NW 30th avenue, and 32nd Avenue. One or more lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

**Project 3 North-3**

Project 3n-3 replaces 1,322 lineal feet of 8-inch pipe with 8-inch pipe along NW Sierra Place, NW Quartz Street and Place, NW 28th Avenue, NW Quartz Place, and NW 31st Avenue. One or more lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

**Project 3 North-4**

Project 3n-4 replaces 1,087 lineal feet of 8-inch pipe with 8-inch pipe along NW 20th Avenue, NW 22nd Avenue, and NW 23rd Avenue. One or more lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

**Project 3 North-5**

Project 3n-5 replaces 1680 lineal feet of 8-inch pipe with 10-inch pipe and 276 lineal feet of 8-inch pipe with 12-inch pipe along NW Fargo Street and NW 18th Loop. The lines are currently undersized to handle the expected flows.

**Project 3 South-1**

Project 3S-1 replaces 951 lineal feet of 8-inch pipe with 8-inch pipe along NW 15th and 17th Avenues. One or more lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

**Project 3 South-2**

Project 3S-2 replaces 1,020 lineal feet of 8-inch pipe with 8-inch pipe and 261 lineal feet of 15-inch pipe with 15-inch pipe along Drake Way, and NW 11th, 12th and 14th Avenues. One or more lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

**Project 3 South-3**

Project 3S-3 replaces 258 lineal feet of 8-inch pipe with 8-inch pipe, 1,057 lineal feet of 8-inch pipe with 10-inch pipe, 258 lineal feet of 8-inch pipe with 12-inch pipe, and 261 lineal feet of 15-inch pipe with 15-inch pipe along 11th Avenue and Division Street. The lines are currently undersized to handle the expected flows. (Note: these lines were recently replaced with 8-inch HDPE. In lieu of replacement, the City could monitor surcharges and flow in this area to confirm the need for replacement.)

**Project 3 South-4**

Project 3S-4 replaces 1,187 lineal feet of 8-inch pipe with 8-inch pipe and 662 lineal feet of 15-inch pipe with 15-inch pipe along NE Adams and NE Birch Streets. The lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

**Project 3 South-5**

Project 3S-5 replaces 553 lineal feet of 8-inch pipe with 8-inch pipe and 229 lineal feet of 15-inch pipe with 15-inch pipe along Dallas Street. The lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

**Project 3 South-6**

Project 3S-6 replaces 184 lineal feet of 8-inch pipe with 8-inch pipe, 866 lineal feet of 8-inch pipe with 10-inch pipe, and 242 lineal feet of 8-inch pipe with 15-inch pipe along Division and Benton Streets and NW 18th Avenue. The lines are currently undersized to handle the expected flows. The portion of the segment along Division Street is known to surcharge. (Note: these lines were recently replaced with 8-inch HDPE. In lieu of replacement, the City could monitor surcharges and flow in this area to confirm the need for replacement.)

**Project 4-1**

Project 4-1 replaces 1,769 lineal feet of 8-inch pipe with 8-inch pipe along NE and NW 19th Avenues, NW 21st and 22nd Avenues, and Division Street. The lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

**Project 4-2**

Project 4-2 replaces 851 lineal feet of 8-inch pipe with 8-inch pipe and 550 lineal feet of 10-inch pipe with 10-inch pipe along Everett Street. The lines are currently undersized to handle the expected flows. One or more lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

**Project 4-3**

Project 4-3 replaces 1,181 lineal feet of 8-inch pipe with 8-inch pipe along NE 19$^{th}$ and NW 21$^{st}$ Avenues and along NE Dallas Street. One or more lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

**Project 4-4**

Project 4-4 replaces 283 lineal feet of 8-inch pipe with 8-inch pipe, 1,010 lineal feet of 12-inch pipe with 12-inch pipe, and 140 lineal feet of 15-inch pipe with 15-inch pipe along NE 17$^{th}$ Avenue and NE Franklin Street. One or more lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

**Project 5-1**

Project 5-1 replaces 551 lineal feet of 24-inch pipe with 30-inch pipe along Adams Street. The lines are currently undersized to handle the expected flows.

**Project 5-2**

Project 5-2 replaces 467 lineal feet of 21-inch pipe with 24-inch pipe, 240 lineal feet of 21-inch pipe with 30-inch pipe, and 289 lineal feet of 21-inch pipe with 36-inch pipe along Adams Street and SE Third Avenue. The lines are currently undersized to handle the expected flows.

**Project 10-1**

Project 10-1 replaces 1,205 lineal feet of 8-inch pipe with 10-inch pipe and 186 lineal feet of 8-inch pipe with 12-inch pipe along NW 6$^{th}$ Place. The lines are currently undersized to handle the expected flows.

**Project 15-1**

Project 15-1 constructs the new Crown Road sewer line as discussed above.

## STEP SYSTEM IMPROVEMENT PROJECTS

### STEP Main Replacement

As detailed in the discussion of the hydraulic model, the 21-inch STEP Main that transports wastewater from the Western Service Area to the 6th and Joy STEP terminus has adequate capacity for 2025 flows. However, the City has concerns about the durability of this line, which is constructed of 100-psi pipe and has numerous taps. Thus, this line is recommended for replacement in phases in years 2016 through 2025. Plans for rehabilitation of this line should consider additional capacity requirements and alternatives for flow routing and satellite treatment associated with providing sewer service for an expanded UGA.

### STEP Main Extension

As described above, the gravity sewer lines and Main Pump Station downstream of the 6th and Joy STEP terminus do not have sufficient capacity to transport 2025 flows.

Thus, it is recommended that these flows be bypassed from these lines in a new STEP Main to the WWTP. Plan and profile views of a possible routing of this line are shown in Figures 7-9, 7-10, and 7-11. The line would cross the Washougal River on a new pedestrian bridge that is being constructed within the next two years. This alignment would require obtaining easements for routing the force main through the various properties. The cost estimate for the STEP Main Extension is $4.48 million dollars. The detailed project cost estimate is included in Appendix K.

## ADDITIONAL INVESTIGATIVE ACTIVITIES

Additional investigative activities are recommended to determine sources of I/I to enable removal of I/I sources. Basin 10 appears to be a major source of I/I; thus, it is recommended that television inspection be conducted in Basin 10 this winter, and Basin 2 (around the Mill) the following winter.

Also, it is recommended that the City purchase and utilize two sewer flow meters to assist in measuring flows in the collection system. The flow meters could be installed before and after major rehabilitation projects to allow measurement of flow reductions associated with particular projects. The flow meters should be deployed in Basin 10 this winter, and Basin 2 (around the Mill) the following winter.

Finally, it is recommended that the City record run-time data on a daily basis at all of their pump stations, especially during storm events, to enhance understanding of flows in the system.

## COLLECTION SYSTEM EXTENSIONS WITHIN THE UGA

Memoranda prepared to address design flows in areas within the UGA are included in Appendix J (for Basin 11 and the Brady Road Pump Station) and Appendix L (for the Crown Road Sewer servicing the Gregg Service Area).

## COLLECTION SYSTEM CAPITAL IMPROVEMENT PROJECT SUMMARY

Table 7-6 identifies the 15-year schedule, and projected costs in 2006 dollars, for collection system improvements. Total costs for the projects, including engineering, construction, construction administration, tax and contingency, are provided. Detailed cost estimates are included in Appendix K.

**TABLE 7-7**

**Recommended 15-Year Schedule and Cost Estimates for Collection System Capital Improvements**

| Basin and Project | Reason for Priority | Total Estimated Cost | Project Year Total | Year to be Completed |
|---|---|---|---|---|
| **Investigative Activities** | | | | |
| Basin 10, TV Inspection and Flow Metering | Inf 2 | $15,000 | $15,000 | 2007 |
| Purchase flow meters (2) | Inf 2 | $25,000 | $25,000 | 2007 |
| TV Inspection and Flow Metering, Basin 2 | Inf 1 | $15,000 | $15,000 | 2008 |
| Inspect Condition of Force Main from Main Pump Station | Inf 1 | $10,000 | $10,000 | 2009 |
| **STEP Collection System** | | | | |
| Basin 6, STEP Main Bypass of Main Pump station | C2 | $4,480,000 | $4,480,000 | 2010 |
| Replace 21-inch STEP Main | To be Determined | | | 2016-2025 |
| **Pump Stations** | | | | |
| Annual Pump Station Rehabilitation and Conversion Allowance | Corrosion, Maintenance | $150,000 | $150,000 | 2006-2015 |
| Basin 5, Main Pump Station – Wet Well and Screening Improvements | C2 | $900,000 | $900,000 | 2010 |
| **Gravity Collection System** | | | | |
| **Basin and Project** | **Reason for Priority** | **Total Estimated Cost** | **Project Year Total** | **Year to be Completed** |
| Basin 1, Project 1 | C1, PC,Inf1, S | $776,194 | $1,154,243 | 2007 |
| Basin 2, Project 2 | C1, PC, Inf2 | $378,049 | | |
| Basin 3s, Project 6 | C1, PC, Inf4, S | $588,071 | $1,421,066 | 2008 |
| Basin 3s, Project 3 | C1, PC, Inf4 | $832,995 | | |
| Basin 1, Project 2 | PC, Inf1 | $437,285 | $1,245,697 | 2009 |
| Basin 1, Project 3 | PC, Inf1 | $466,496 | | |
| Basin 1, Project 4 | PC, Inf1 | $341,916 | | |
| Basin 4, Project 2 | C2, PC, Inf2 | $573,604 | $1,219,478 | 2010 |

## TABLE 7-7 – (continued)

## Recommended 15-Year Schedule and Cost Estimates for Collection System Capital Improvements

| Basin and Project | Reason for Priority | Total Estimated Cost | Project Year Total | Year to be Completed |
|---|---|---|---|---|
| Basin 6, Project 1 | C2, Inf5, S | $645,874 | | |
| Basin 1, Project 5 | PC, Inf1 | $347,140 | $1,488,567 | 2011 |
| Basin 2, Project 1 | C1, Inf2 | $691,171 | | |
| Basin 4, Project 3 | PC, Inf2 | $450,256 | | |
| Basin 4, Project 1 | PC, Inf2 | $714,208 | $1,401,209 | 2012 |
| Basin 4, Project 4 | PC, Inf2 | $687,001 | | |
| Basin 3n, Project 3 | PC, Inf3 | $545,080 | $1,431,307 | 2013 |
| Basin 3n, Project 1 | PC, Inf3 | $886,227 | | |
| Basin 3n, Project 2 | PC, Inf3 | $611,636 | $1,083,513 | 2014 |
| Basin 3n, Project 4 | PC, Inf3 | $471,877 | | |
| Basin 5, Project 2 | C1, Inf6 | $708,507 | $708,507 | 2015 |
| Basin 3n, Project 5 | C2, Inf3 | $813,853 | $813,853 | 2016 |
| Basin 3s, Project 1 | PC, Inf4 | $473,788 | $814,034 | 2017 |
| Basin 3s, Project 5 | PC, Inf4 | $340,246 | | |
| Basin 3s, Project 4 | PC, Inf4 | $827,692 | $953,293 | 2018 |
| Basin 6, Project 3 | C2, Inf5 | $125,601 | | |
| Basin 3s, Project 2 | PC, Inf4 | $557,395 | $1,064,698 | 2019 |
| Basin 6, Project 2 | C2, Inf5 | $507,303 | | |
| Basin 5, Project 1 | C2, Inf6 | $442,423 | $864,815 | 2020 |
| Basin 10, Project 1 | C2, Inf2 | $422,392 | | |
| Basin 15, Project 1 | Crown Road | $1,300,000 | $1,300,000 | 2021 |

Key:
C1 - needs immediate capacity improvement
C2 - will eventually need capacity improvement
PC - poorest condition due to broken pipe and/or severe root intrusion with subsequent unacceptable infiltration
MC - moderately bad pipe due to cracks and/or some root intrusion - some infiltration
Inf 1 - 1998 I/I Study showed this basin to have the highest I & I
Inf 2 - 1998 I/I Study showed this basin to have the 2nd highest I & I
Inf 3 - 1998 I/I Study showed this basin to have the 3rd highest I & I
Inf 4 - 1998 I/I Study showed this basin to have the 4th highest I & I
Inf 5 - 1998 I/I Study showed this basin to have the 5th highest I & I
Inf 6 - 1998 I/I Study showed this basin to have the 6th highest I & I
S - surcharging is known to occur.
Note: All costs are in 2006 dollars.

# CHAPTER 8

# WASTEWATER TREATMENT FACILITY EVALUATION

The purpose of this chapter is to evaluate the wastewater treatment facility (WWTF) for its ability to meet its treatment objectives based on projected future flow and loadings, and provide recommendations for improvements. The treatment plant effluent quality must meet maximum monthly average limits of 20 mg/L for TSS and 20 mg/L for $BOD_5$, as well as limits for ammonia, fecal coliform and pH. These criteria were discussed in Chapter 5 and are listed in Table 5-3.

This evaluation focuses on the following treatment issues, at current and design loadings:

- Analysis of WWTF flow and loading projections;
- Projection of NPDES permit limits;
- TSS and BOD removal, including biological treatment performance and solids/liquid separation in the secondary clarifiers and cloth media filters;
- Removal of ammonia-nitrogen;
- Ability to denitrify (for total nitrogen removal) at current and design loadings (Although not required by the City's NPDES permit, denitrification is desired for process stability, energy savings, alkalinity recovery and pH control);
- Disinfection;
- Standby power considerations;
- Other WWTF requirements.

Solids handling and biosolids management are discussed in Chapter 9.

## RECENT WWTF IMPROVEMENTS

The facility was upgraded and expanded to 6.1 mgd capacity in 2000. The existing aeration basins were converted to aerobic digesters, and the new treatment facility included a headworks with mechanical fine screen, primary and secondary clarifiers, aeration basin with selectors and oxic/anoxic zones for $BOD_5$ and ammonia-nitrogen removal, centrifugal aeration blowers, effluent filters, UV disinfection system, effluent pump station, gravity thickener, a sludge dewatering centrifuge, and various associated pumping . New laboratory/office, equipment, and effluent filter/UV disinfection buildings, dewatered biosolids storage facility, and a soil biofilter for odor control were also constructed.

In 2002, an alkalinity addition and control system was added to control aeration basin and plant effluent pH. The facilities store and feed 25 percent sodium hydroxide to either the headworks or the aeration basins. The system includes two 10,000-gallon tanks in a

secondary containment enclosure, two peristaltic pumps, and piping to convey the alkalinity source to the feed points.

The Department of Ecology issued the current City of Camas NPDES operating permit effective December 1, 2004, granting the City the request for a relaxed percent removal of influent BOD and TSS from the previous permit due to dilute influent from Wafertech industries and because of the many septic tank effluent pump (STEP) tanks throughout the system. The permit requires 70 percent removal of influent TSS and BOD and effluent concentrations of both TSS and BOD of 20 mg/L. The permit was renewed effective December 1, 2004 and expires November 30, 2009.

The City's effluent limits for ammonia were first issued in 2004 (the current permit), and are based on the use of default parameters in the mixing zone dilution model UM3, and historical river pH data. With the encouragement of Ecology, the City has obtained additional information that may lead to a modification of the ammonia permit limits (including deletion of daily maximum limits for ammonia) through an effluent dye study. Additionally, the City has obtained the necessary approvals to modify its diffuser to increase dilution in the river. This issue is discussed in more detail below.

## HISTORICAL PLANT PERFORMANCE

Historical performance with regard to removal of BOD5, TSS , Fecal Coliform and Ammonia is discussed below.

### $BOD_5$ and TSS Removal

Monthly average effluent TSS and $BOD_5$ concentrations for the period of 1998-2005 are shown in Figure 8-1. The Camas WWTF has exhibited good performance and has generally met its permit effluent limits for $BOD_5$ and TSS. Average monthly effluent values for the period of 1998 to 2005 were 7 mg/L for TSS and 13 mg/L for $BOD_5$. The maximum month effluent limits for $BOD_5$ concentration in the City's NPDES permit was exceeded once during this period, while the TSS limit was not exceeded. As shown in Figure 8-1, effluent TSS and $BOD_5$ concentrations decreased substantially after completion of the upgrades in 2000; however, in the period of 2004 to 2005, concentrations have increased slightly but remain within limits.

Appendix M provides a series of charts that compare performance in 2001 to 2002 with that in 2004 to 2006. The higher effluent concentrations of $BOD_5$ and TSS in 2004 to 2006 are related to changes in the sludge volume index (SVI). SVI is a measure of how well sludge settles. The lower the SVI, the better settling characteristics of the sludge. As shown in Figure 8-2, SVIs increased quite dramatically from 2002 to 2005, from 100 to 200 mL/g to 200 – 600 mL/g. SVIs exceeding 200 to 300 mL/g are indicative of poorly settling (bulking) sludge. As discussed later in this chapter, low F/M in the selector will lead to the growth of filaments and high SVIs, since the selector relies on a relatively high F/M in the selector to encourage the growth of floc-forming bacteria, which have

**FIGURE 8-1**
**City of Camas WWTP**
**Monthly Average Effluent BOD5 and TSS Concentrations**

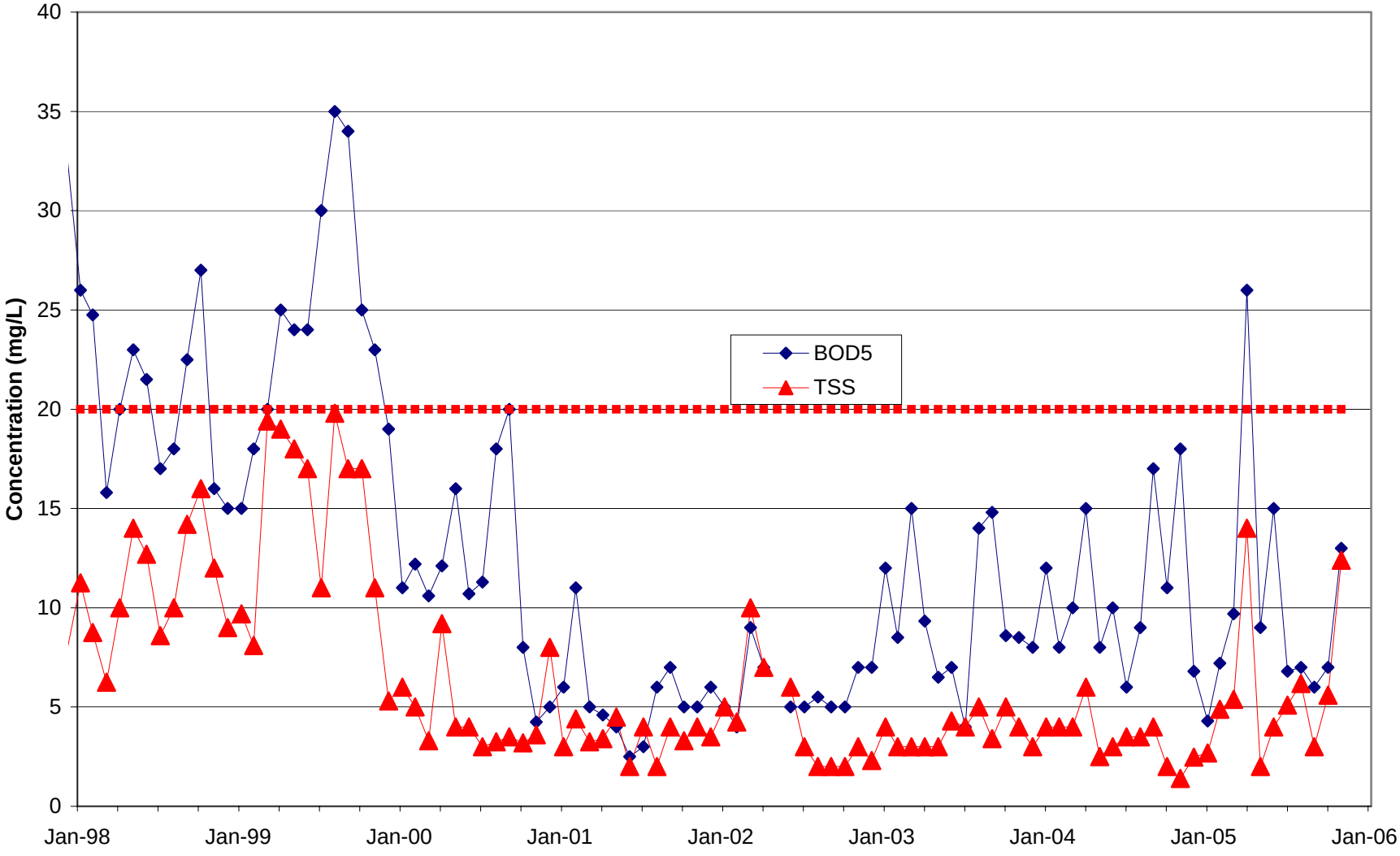
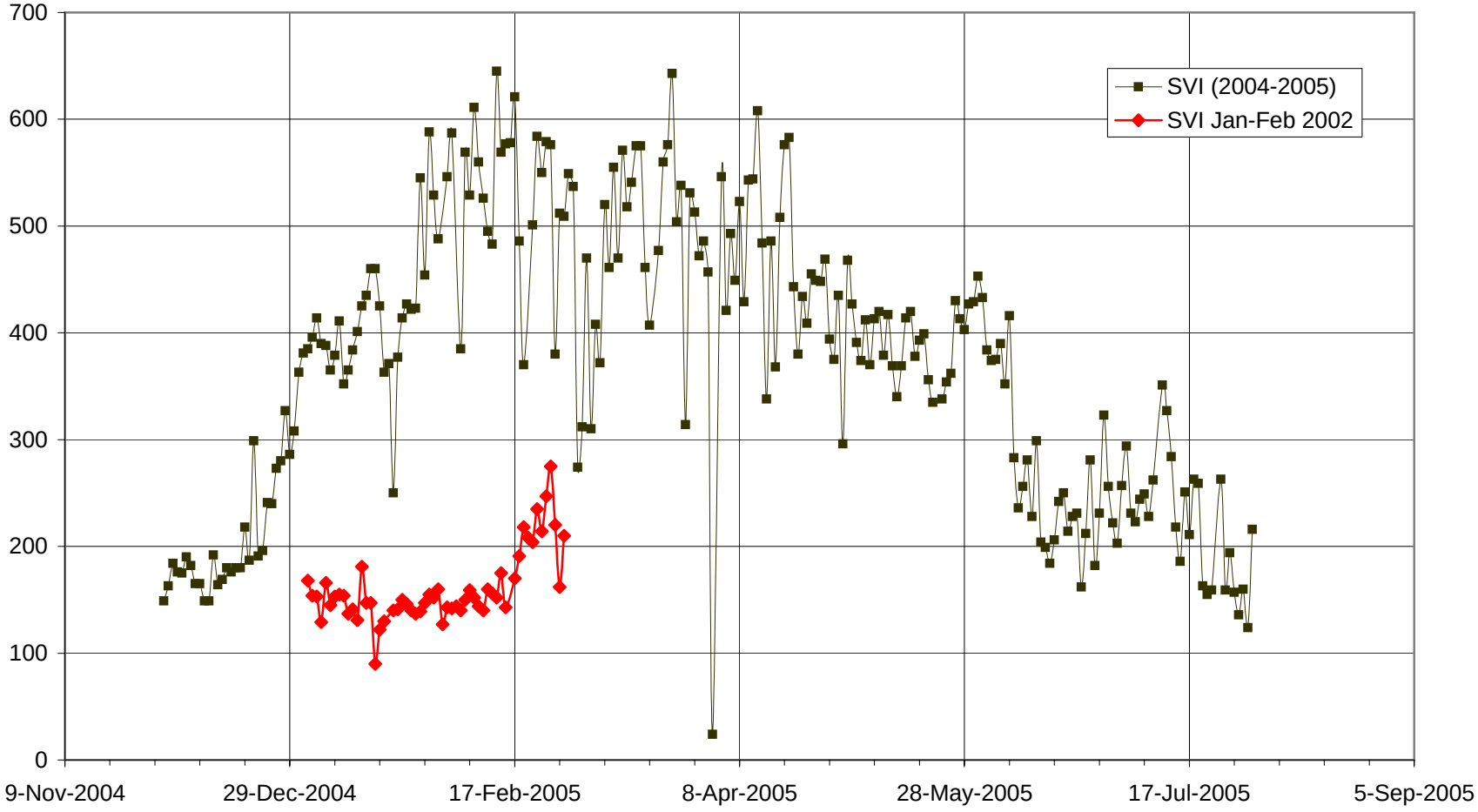


**FIGURE 8-2**
**Sludge Volume Index (SVI)**
**City of Camas WWTP**



higher growth rates than filamentous bacteria at high soluble BOD concentrations. However, operation at too *high* of a F/M (greater than about 10 to 12 lb $BOD_5$/lb MLSS) can yield the formation of a viscous, non-filamentous ("hydrous") bulking sludge that also settles poorly and also yields high SVIs (Metcalf and Eddy, 2002). Although there are established design criteria for selector F/M, there typically is a plant-specific optimal range of selector F/M that is best determined by trial and error. Recommendations for selector modifications are provided later in this chapter.

### Fecal Coliform Removal

Since 1998, the WWTF has consistently met its fecal coliform limits of 200 MPN/ 100 mL average weekly and 400 MPN/100 mL average monthly. Monthly average effluent fecal coliform concentrations for the period of 1998 to 2005 are shown in Figure 8-3. Although generally excellent performance has been observed and the system has been compliant with permit criteria, the disinfection system has shown some variability in performance, with typically several samples each year over 100 MPN/ 100 mL. These sporadic single high fecal coliform measurements have not caused violations of the monthly average limit, and, has been observed with other facilities, are likely the result of occasional lack of homogeneity during sampling (inclusion of heterogeneous particulate) rather than actual performance issues with the disinfection system.

### Ammonia Removal

Effluent ammonia concentrations are summarized in Figure 8-4. As shown, WWTF effluent ammonia concentrations have been highly variable. Data suggests that nitrification performance may have been diminished by inhibition. One potential cause of inhibition is fuel oil, since evidence suggests that dumping of diesel into the collection system has occurred. A detailed evaluation of nitrification performance and recommendations are included in the Plant Evaluation At New Design Loadings section below.

## ANALYSIS OF WWTF FLOW AND LOADING PROJECTIONS

Figures 6-1 through 6-4 showed monthly average flow and loadings to the City of Camas WWTF for the period of 1998 through 2005. This data, along with effluent flows and loadings for the same period, is presented in Tables 6-1 and 6-2. A summary of current and projected flows and loadings is provided in Table 8-1.

### FLOW

As shown in Table 8-1, the projected maximum month influent flows to the WWTF, approach, but do not exceed, the rated capacity of the WWTF (6.10 mgd) for the 20-year period. However, projected peak day and peak hour flows do exceed design values, requiring an evaluation of the capacity of the plant to treat the higher flows.

## LOADING

As shown in Table 8-1, the projected maximum month $BOD_5$ loading to the WWTF approaches, but does not exceed, the rated capacity of the WWTF (5,616 lb/d) for the 20-year period. However, projected maximum month TSS, TKN and ammonia nitrogen loadings do exceed the design values for the current plant, requiring an evaluation of the capacity of the plant to treat the higher loadings.

**TABLE 8-1**

**Comparison of Design Criteria and Current and Projected Future Flow and Loadings**

| Parameter | Design Criteria | 85% of NPDES Permitted Design Criteria(2) | Current Value | Projected 2015 Value | Projected 2025 Value |
|---|---|---|---|---|---|
| Average Annual Flow (mgd) | 3.77 | -- | 2.29 | 4.04 | 5.30 |
| Maximum Month Flow(1) (mgd) | 6.10 | 5.19 | 3.09 | 4.84 | 6.10 |
| Peak Day Flow (mgd) | 7.8 | -- | 7.03 | 8.78 | 10.04 |
| Peak Hour Flow (mgd) | 11.09 | -- | 9.93 | 11.47 | 13.44 |
| Average Annual $BOD_5$ Loading(1) (lb/day) | -- | -- | 2,218 | 3,437 | 4,099 |
| Maximum Month $BOD_5$ Loading (lb/day) | 5,616 | 4,774 | 3,039 | 4,708 | 5,616 |
| Average Annual TSS Loading (lb/day) | | -- | 3,191 | 4,937 | 5,883 |
| Maximum Month TSS Loading(1) (lb/day) | 6,405 | 5,444 | 4,339 | 6,715 | 8,001 |
| Average Annual $NH_3$-N Loading (lb/day) | | -- | 730 | 1,149 | 1,389 |
| Maximum Month $NH_3$-N Loading (lb/day) | | -- | 1,029 | 1,618 | 1,956 |
| Average Annual TKN Loading (lb/day) | | -- | 1,017 | 1,588 | 1,917 |
| Maximum Month TKN Loading (lb/day) | 942 | -- | 1,367 | 2,130 | 2,573 |

(1) Condition S.4.A of City's NPDES permit
(2) Condition S.4.B of City's NPDES permit

Additional planning and development of capital improvement projects for expansion of WWTF capacity will be needed at the WWTF, based on future capacity concerns at the

**FIGURE 8-3**
**City of Camas WWTF**
**Monthly Average Effluent Fecal Coliform**

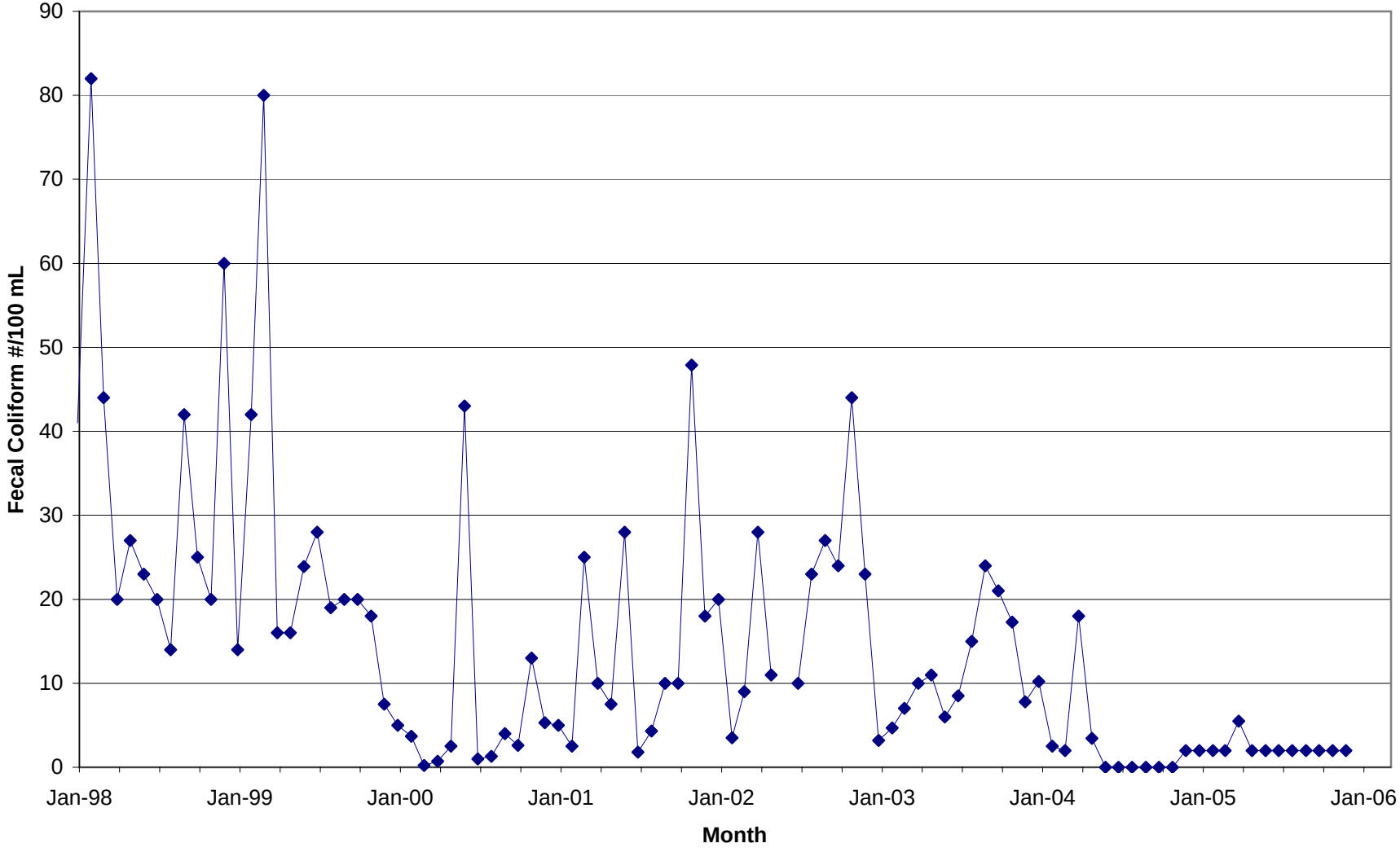
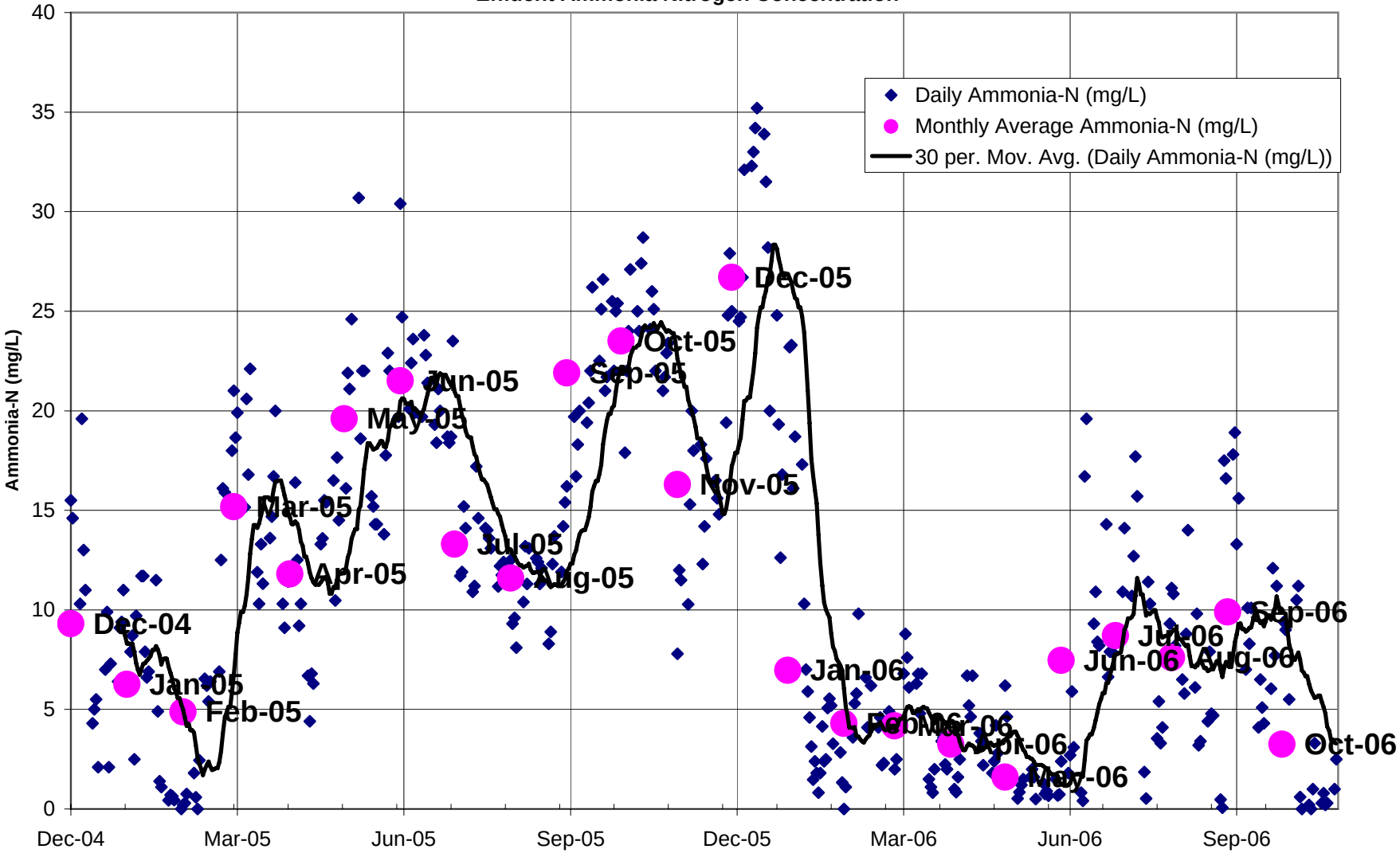


**FIGURE 8-4**
**City of Camas WWTF**
**Effluent Ammonia Nitrogen Concentration**



WWTF. This need is due to the requirement in the City's NPDES permit that when actual monthly average influent flow or loading to the WWTF exceed 85 percent of design criteria for 3 consecutive months, or if the City has *projected* increases in wastewater flow or loading that would cause exceedance of design capacity within 5 years, the City must submit a plan and schedule to maintain adequate capacity to Ecology. The 85 percent and 5-year requirements are needed to provide sufficient time for municipalities to plan, design and construct sufficient capacity. Based on projections, the City may exceed the 85 percent flow criterion prior to 2025, unless infiltration and inflow are reduced significantly. As shown in Figure 8-5, it is projected that the maximum month influent flow will exceed 85 percent of capacity in 2018, and, will exceed 85 percent of permitted capacity for three consecutive months by 2020. Based on this figure, the City may need to submit another plan and schedule to maintain adequate capacity to Ecology by 2020.

The maximum month flow projected in this Plan for year 2025 is the same as the design criteria for the existing plant. However, the projected values for year 2025 for the following parameters exceed the corresponding design criteria for the existing plant:

- Average Annual Flow
- Peak Day Flow
- Peak Hour Flow
- Maximum Month TSS Loading
- Maximum Month TKN Loading

The maximum month TSS and TKN parameters for the existing plant are projected to be exceeded by 2015. The ability of the WWTF to successfully accommodate the increases in these flow and loading parameters is addressed below.

## PROJECTION OF FUTURE NPDES PERMIT LIMITS

### Dye Tracer and Mixing Zone Study

In 2004, the City authorized Cosmopolitan Engineering to conduct an effluent dye study for Camas using the then current design flows that Ecology had cited in the City's 2004 NPDES permit fact sheet. A copy of the *Dye Tracer and Mixing Zone Study* (Study) is included in Appendix N. Field tests for the dye study were conducted by Cosmopolitan on February 16, 2005 and October 4, 2005. Based on the field tests, parameters within the UM3 model used by Ecology were calibrated to more closely match measured dilution.

Cosmopolitan Engineering then used Ecology's UM3 model, calibrated based on the results of the dye study, to calculate dilution factors and determine NPDES permit limits for year 2025 projected flows shown in Table 8-1. The results are summarized in Part III of the Cosmopolitan report, included in Appendix N.

In accordance with comments from Ecology, the critical dilutions identified in the Study for the outfall modified (for vertical discharge through Tideflex diffusers) were amended in a pair of

technical memoranda dated January 20, 2009 (for an 8-port diffuser configuration) and February 19, 2009 (for a 16-port diffuser configuration). These memoranda are included in the back of Appendix N.

The results of the mixing zone analysis demonstrated a substantial increase in dilution if modifications were made to the diffuser so that it discharged vertically. Because the Camas outfall discharges in the same direction as the river flows, and at similar velocities, there is low turbulence and poor dilution in the mixing zone. A change from a horizontal discharge to a vertical discharge would increase dilution about four-fold based on the UM3 model Ecology has used to model dilution in the Camas mixing zone.

The dilution factors established in the memoranda are summarized in Table 8-1 B.

**TABLE 8-1 B**

**Critical Dilution Factors Established in Mixing Zone Analysis**

| Condition | 8-Port | | 16-Port | |
|---|---|---|---|---|
| | Acute | Chronic | Acute | Chronic |
| Winter | 19:1 | 122:1 | 23:1 | 121:1 |
| Summer | 27:1 | 156:1 | 27:1 | 185:1 |

As noted in the memoranda, projected water quality-based permit limits were assessed for metals based on effluent samples taken in 2005-2008, and historical ambient pollutant concentrations cited in the NPDES permit fact sheet.

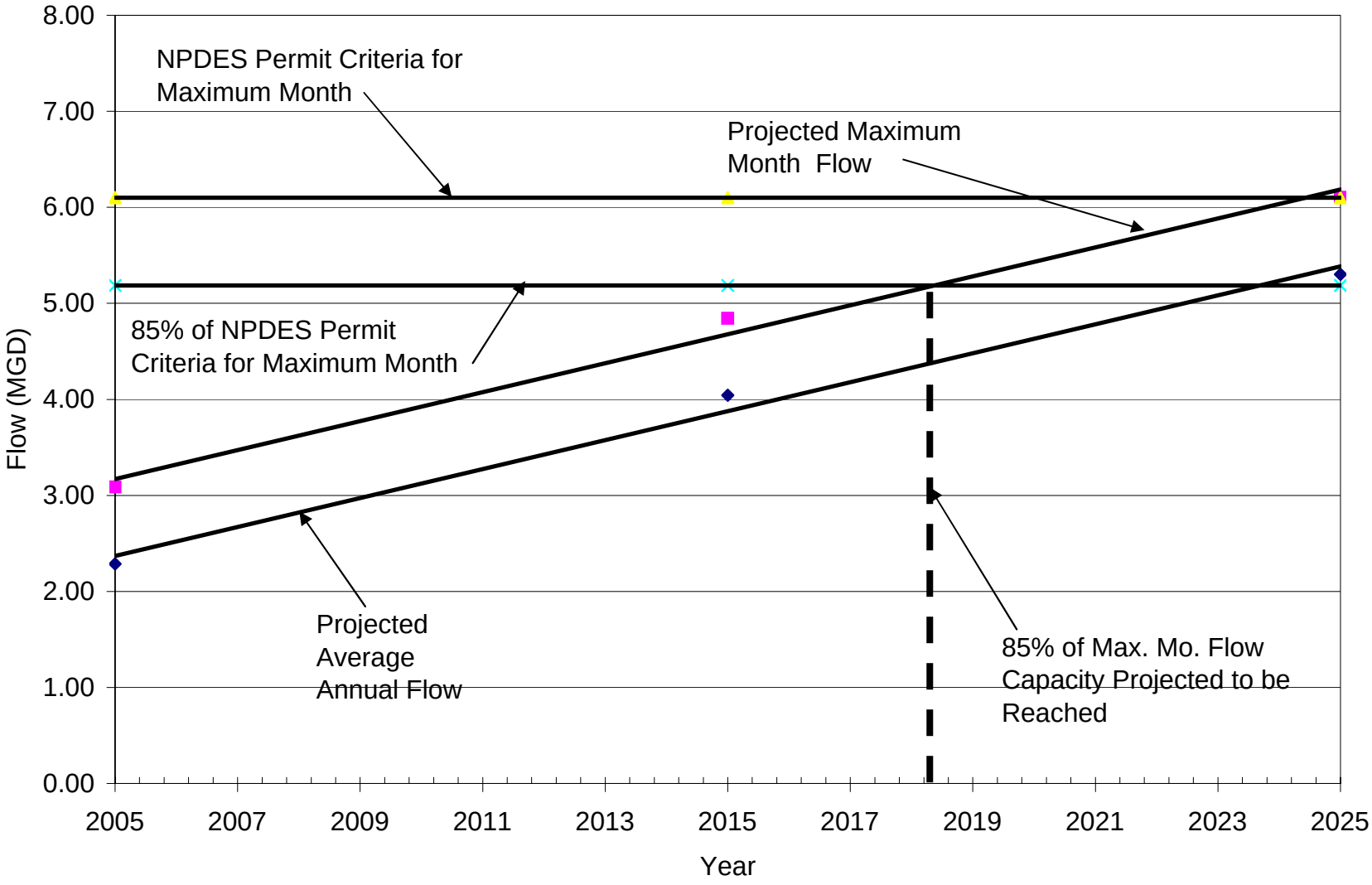
A letter was issued by Ecology on October 21, 2009 indicating approval of the mixing zone analysis provided in the January 20, 2009 for the 8-Port configuration. The October 21, 2009 approval letter notes the applicable ratios in Table 8-1B may be used for "estimation of the reasonable potential for limits for toxic pollutants not already subject to permit limits (e.g., metals)." A letter was issued by Ecology on November 25, 2009 indicating approval of the mixing zone analysis for the 16-Port diffuser. (As noted later in the Outfall section later in this chapter, the 16-Port configuration is recommended based on WWTP hydraulics.)

As noted in the February 19, 2009 memorandum from Cosmopolitan, among the metals, only cadmium showed a reasonable potential to exceed water quality standards. The cadmium exceedance is based on one sample (87 µg/L in June 2006) that appears to be a statistical outlier, and may in fact be an artifact of the sampling process. Additional sampling and analysis conducted since June 2006 with clean sampling techniques has not detected cadmium.

**Ammonia Limits**

Ecology's October 21, 2009 letter notes that regarding pollutants presently subject to NPDES permit limits (i.e., ammonia), "it is within Ecology's discretion to conclude that monthly ammonia limits are appropriately protective since daily limits are based on the effluent's

**FIGURE 8-5**
**Projected Versus Currently Permitted**
**Camas WWTF Influent Flows**



variability and these monthly limits. Accordingly, Ecology will have the basis to remove the daily maximum limits for ammonia from the permit with the completion of this outfall upgrade, and it is our intention to do so. Monthly average limits for ammonia will continue to be applicable to the discharges – either the limits presently in the permit, or limits similar to those, with some adjustment for seasonality." Similarly, Ecology's November 25, 2009 letter reiterates Ecology's expectation to "retain the monthly average limit for ammonia, as we have discussed previously."

In accordance with the October 21 and November 25 letters, and discussions with Ecology, it is understood that, after completion of the outfall modifications, Ecology will modify Condition S1.A of the City's NPDES permit by deleting the maximum daily ammonia limits. Thus, for total ammonia limits, only the monthly average limits of 20 mg/L in summer and 7 mg/L in winter will remain.

These proposed ammonia limits have been used as the basis of evaluations and calculations for this Plan.

# PLANT EVALUATION AT NEW DESIGN CRITERIA

A new hydraulic profile, based on the WWTF flows summarized in Table 8-2, is provided in Figure 8-6. The profile indicates flooding of the weirs in the troughs in the secondary clarifier splitter box. As indicated in Table 8-5, it is recommended that the weirs be raised to 33.87 feet (approximately 3/4 inch) to accommodate the new projected peak hour flows. Additional impacts of the increase in projected peak hour flows are described in the evaluation of process units below.

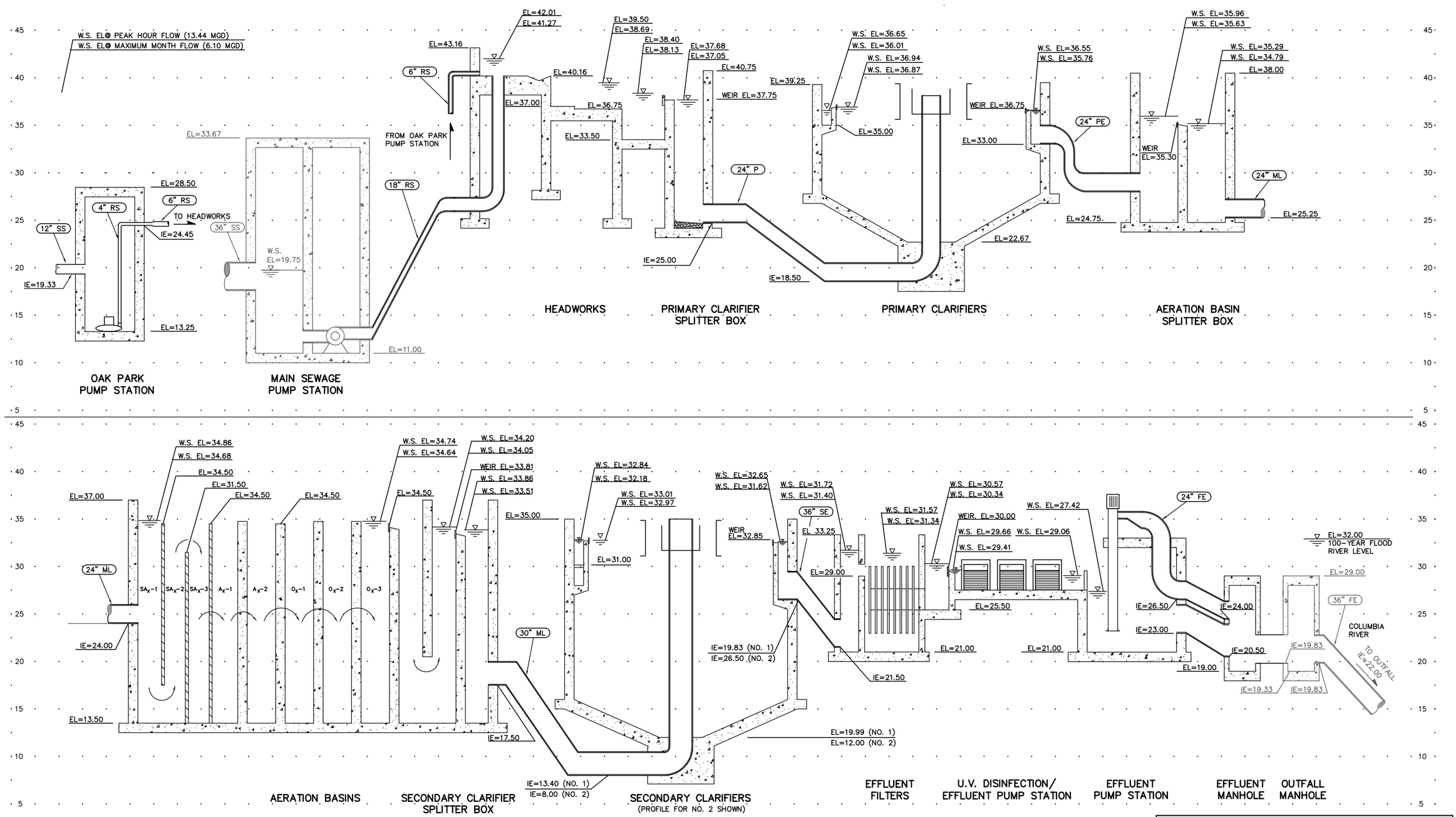
In the following sections, the capacities of major WWTF components at 2015 and 2025 projected flow and loadings are evaluated, and, where applicable, compared to accepted design criteria, such as published in the Ecology *Criteria for Sewage Works Design* (1998), WEF *Manual of Practice #8* and Metcalf and Eddy *Wastewater Engineering* (3rd Edition, 1991). This evaluation is also summarized in Table 8-2. Abbreviations used in this table include:

- AAF = Annual Average Flow
- MMF = Maximum Month Flow
- PDF = Peak Day Flow
- PHF = Peak Hour Flow

**TABLE 8-2**

**Comparison of Component Design Criteria and Projected Flow and Loadings**

| Component (Parameter) | Capacity/Criteria | Reference[3] | 2015 Operating Condition (meets criteria?) | 2025 Operating Condition (meets criteria?) |
|---|---|---|---|---|
| Mechanical Fine Screen (Capacity) | 12.78 mgd PHF | Manufacturer | 11.47 (yes) | 13.44 (no) |
| Primary Clarifiers (Overflow Rate) | 800 – 1,200 gpd/sf AAF | Ecology, 1998 | 715 (yes)[1] | 938 (yes) |
| | 2,000-3,000 gpd/sf PHF | Ecology, 1998 | 2,029 (yes) | 2,378 (yes) |
| Primary Clarifiers (Weir Loading) | 10,000 – 40,000 gpd/lf AAF | Ecology, 1998 | 10,745 (yes) | 14,096 (yes) |
| | MMF | | 12,872 (yes) | 16,223 (yes) |
| | PHF | | 30,505 (yes) | 35,745 (yes) |




**HYDRAULIC PROFILE**

SCALE: VERT 1"=10'-0", HORIZ NOT TO SCALE

CITY OF CAMAS

GENERAL SEWER/WASTEWATER FACILITY PLAN

FIGURE 8-6

WWTF HYDRAULIC PROFILE

Gray & Osborne, Inc.

CONSULTING ENGINEERS

L:\CAMAS\05471 WW FAC PLAN\FIGURES\FIG8-6.DWG, 8-6, 2/21/2007 11:57:21 AM, 0.5:1, BY: M NAGEL

**TABLE 8-2 – (continued)**

**Comparison of Component Design Criteria and Projected Flow and Loadings**

| Component (Parameter) | Capacity/Criteria | Reference[1] | 2015 Operating Condition (meets criteria?) | 2025 Operating Condition (meets criteria?) |
|---|---|---|---|---|
| Primary Clarifiers (Detention Time) | ≤ 2.5 hr AAF | Ecology, 1998 | 2.5 (yes) | 1.9 (yes) |
| | MMF | | 2.1 (yes) | 1.7 (yes) |
| | PHF | | 1.16 (yes) | 1.01 (yes) |
| Biological Selector (Detention Time at max. mo. flow) | 10-45 min. design<br>5-25 min. design<br>20-60 min. design | Ecology, 1998<br>WEF, 1991<br>M&E, 2003 | 24.7 (yes) | 31. (yes) |
| Biological Selector (F/M Ratio) 1st Compartment | 3-8 lb BOD/ lb MLSS | M&E, 2003 | 6.4 (yes) | 5.1 (yes) [3] |
| 3 Compartments | 2 lb BOD/ lb MLSS | M&E, 2003 | 1.6 (yes) | 1.7 (yes) [3] |
| Aeration Capacity (TKN Capacity at Projected BOD load) | Analysis in Table 8-5<br>2,130 lb/d (2015)<br>2,573 lb/d (2025) | G&O, 2006 | 2170 (no) | 2024 (no) |
| Aeration Basin Solids Retention Time (SRT) | 9.5 days MMF<br>(7 – 20 days) | M&E, 2003 | 11.9 days (yes) | 9.5 days (yes) |
| Secondary Clarifiers[4] (Overflow Rate) Max. Month | 400-700 gpd/sf.<br>300-1,000 gpd/sf | M&E, 2003<br>WEF, 1991 | 577 (Clar. 2) (yes)<br>519 (Clar. 1) (yes) | 700 (Clar. 2) (yes)<br>680 (Clar. 1) (yes) |
| Peak Hour | 1000-1600 gpd/sf<br>1000-1600 gpd/sf | M&E, 2003<br>WEF, 2009 | 1366 (Clar. 2) (yes)<br>1230 (Clar. 1) (yes) | 1600 (Clar. 2) (yes)<br>1440 (Clar. 1) (yes) |

**TABLE 8-2 – (continued)**

**Comparison of Component Design Criteria and Projected Flow and Loadings**

| Component (Parameter) | Capacity/Criteria | Reference[1] | 2015 Operating Condition (meets criteria?) | 2025 Operating Condition (meets criteria?) |
|---|---|---|---|---|
| Secondary Clarifiers[4] (Solids Loading Rate) Max. Month | 24-36 lb/sq. ft. d.<br>20-30 lb/sq. ft. d. | M&E, 2003<br>WEF, 2010 | 20.5 (Clar. 2) (yes)<br>18.1 (Clar. 1) (yes) | 25.4 (Clar. 2) (yes)<br>22.9 (Clar. 1) (yes) |
| Peak Hour | 43 lb/sq. ft. d.<br>50 lb/sq. ft. d. | M&E, 2003<br>WEF, 1991 | 36.6 (Clar. 2) (yes)<br>33.0 (Clar. 1) (yes) | 41.9 (Clar. 2) (yes)<br>37.7 (Clar. 1) (yes) |
| Filtration System (Capacity) | 6.1 mgd (max. mo.) | Manufacturer | 4.84 (yes) | 6.1 (yes) |
| UV Disinfection System (Capacity) | 9.15 mgd peak day | Manufacturer | 8.78 (yes) | 10.04 (no) |
| | 6.1 mgd (max. mo.) | Manufacturer | 4.84 (yes) | 6.1 (yes) |
| Effluent Pumps | 13.44 mgd (peak hour)[2] | Manufacturer | 11.47 (yes) | 13.44 (yes) |

(1) Sources include Water Environment Federation (WEF, MOP No. 8, 5th Ed., 2009), the Washington State Department of Ecology (Criteria for Sewage Works Design, 1998) and Metcalf and Eddy (M&E, Wastewater Engineering, 4th Ed., 2004). See the reference list at the end of the chapter.
(2) See discussion in text.
(3) Projected operating conditions at 2015 and 2025 meet criteria; however, due to settling issues, current operation does not meet criteria.
(4) Secondary clarifier operating conditions and criteria compliance based on 52% of flow to Clarifier No. 1 and mixed liquor suspended solids SVI less than 150 mL/g.

## HEADWORKS

The headworks includes a 24-inch Parshall flume for influent flow measurement and a mechanical fine screen with a bar spacing of 1/4 inch. Currently, if the fine screen is out of service or if the influent flow exceeds 11.1 mgd, the excess wastewater is diverted to the manual bypass coarse bar screen, with a bar spacing of 3/4 inch. The existing screen has had many problems and is considered unreliable due to maintenance burdens.

It is recommended that an additional screen be provided to:

- Provide adequate capacity for the projected year 2025 flow of 13.4 mgd.
- Improve the reliability of the screening operation.

The Parshall flume, with a capacity of 21.4 mgd, can accommodate 2025 flows.

## PRIMARY CLARIFIERS

Two 60-foot diameter circular primary clarifiers remove grit and other settleable solids from the screened wastewater. The grit-laden sludge is pumped to the grit removal facility by three 10-hp recessed impeller torque flow pumps with a capacity of 220 gpm at a TDH of 32 feet. Scum collected from the primary clarifiers is conveyed by gravity to the primary clarifier scum pump station.

As shown in Table 8-2, the primary clarifiers have adequate capacity for year 2015 and year 2025 flows.

## AERATION CAPACITY

Biological treatment of the wastewater is provided in the aeration basins. The activated sludge in the basins is mixed and supplied with oxygen by blowers through submerged air distribution piping and diffusers. Automatic control of aeration blower output is accomplished based on continuous measurement of the dissolved oxygen (D.O.) in the aeration basins by submerged D.O. probes. As shown in Table 8-1, year 2025 TKN (which is predominantly converted to ammonia in the WWTF) exceeds the existing design concentrations. Thus, the aeration basins must be evaluated for their ability to accommodate the increased TKN.

The aeration basin oxygen demand is decreased by the process of denitrification and by the periodic wasting of biomass growth. In the *Wasteload Assessment Report - Aeration System Capacity Analysis* (G&O, May 2006), the recorded air flow delivered by the blowers in operation at the WWTF was correlated to the actual, approximate oxygen required to achieve BOD and ammonia removal. A correlation factor, *K*, was determined to describe the correlation between the actual oxygen required (AOR) and the airflow (standard cubic feet per minute, SCFM) delivered:

$$\text{SCFM} = K \times \text{AOR}$$

Average air flow values were used for the calculation. The correlation factor, *K*, is an expression of the efficiency of the blowers and the air diffusion system to deliver oxygen. The AOR is defined by the following equation:

$$\text{AOR} = 1.3 \times \text{BOD}_{\text{removed}} + 4.57 \times \text{TKN}_{\text{oxidized}} - 2.86 \times \text{DN} - 1.42 \times \text{P}_{\text{x,bio}}$$

The $\text{BOD}_{\text{removed}}$ is the amount of BOD oxidized, and the $\text{TKN}_{\text{oxidized}}$ is the nitrogen oxidized to ammonia. DN is the amount of nitrogen denitrified, which results in a decrease in oxygen demand. $\text{P}_{\text{x,bio}}$ is the amount of biomass wasted. The AOR was determined using biological kinetic factors, stoichiometric factors, and actual plant conditions and performance for the time period from March 2006 through April 2006.

Assumptions used in this analysis are presented in Table 8-3. Values for biological kinetic and stoichiometric factors were assumed based on typical values presented in *Wastewater Engineering* (Metcalf and Eddy, Fourth Edition, 2003). The treatment plant was operating with two aeration basins, an MLSS concentration of approximately 2,000 mg/L and an aerobic SRT of approximately 11.4 days at approximately 16°C between March 2006 and April 2006. During this period, effluent $BOD_5$ averaged 6 mg/L and effluent ammonia averaged 3.7 mg/L.

**TABLE 8-3**

**Assumptions for Determination of Correlation Factor (K) and $BOD_5$ and Ammonia Loads**

| Parameter | Value | Units | Source |
|---|---|---|---|
| 2 AB volume | 2.6 | MG | Measured |
| **Kinetic And Stoichiometric Constants** | | | |
| Primary BOD effluent/BOD influent | 0.7 | None | Typical |
| bCOD/$BOD_5$ Ratio | 1.64 | None | Typical |
| (WAS) bTKN/$P_{x,bio}$ ratio | 0.12 | None | Typical |
| Initial assumed fraction of TKN consumed | 0.7 | None | Typical |
| nbTKN/TKN Ratio | 0.05 | None | Typical |
| NH4/TKN Ratio | 0.7 | None | Typical |
| Fraction of nitrified nitrogen denitrified | 0.6 | None | Estimated |
| $Y_H$ (heterotrophic yield) | 0.4 | lb/lb | Typical |
| $Y_n$ (heterotrophic yield) | 0.12 | lb/lb | Typical |
| $f_d$ (fraction of cell mass remaining as cell debris) | 0.15 | lb/lb | Typical |
| $k_{d,20}$ (endogenous heterotrophic decay coefficient) | 0.12 | $d^{-1}$ | Typical |
| $k_{dn,20}$ (endogenous nitrogenous decay coefficient) | 0.17 | $d^{-1}$ | Typical |
| $\mu_{m,\ max,\ 20}$ (heterotrophic growth rate) | 6.0 | g/g*d | Typical |
| $\mu_{n,\ max,\ 20}$ (autotrophic growth rate) | 0.9 | d-1 | Typical |
| $K_s$ (substrate half-saturation coefficient) | 20 | $g/m^3$ | Typical |
| $K_{n,20}$ (ammonia half-saturation coefficient) | 0.7 | $g/m^3$ | Typical |
| $K_o$ (oxygen half-saturation coefficient) | 0.5 | $g/m^3$ | Typical |
| Design Temperature | 15 | $^oC$ | Measured |
| $\mu_{m,\ max,\ t}$ (heterotrophic growth rate) | 4.28 | g/g*d | Calculated |
| $k_{d,t}$ (endogenous heterotrophic decay coefficient) | 0.099 | $d^{-1}$ | Calculated |
| $\mu_{n,\ max,\ t}$ (autotrophic growth rate) | 0.636 | g/g*d | Calculated |
| $k_{dn,t}$ (endogenous nitrogenous decay coefficient) | 0.1474 | $d^{-1}$ | Calculated |
| $K_{n,t}$ (ammonia half-saturation coefficient) | 0.541 | $g/m^3$ | Calculated |
| **Additional Assumptions for $BOD_5$ and Ammonia Load Calculations** | | | |
| Average K (Airflow/AOR) | 0.2775 | SCFM/lb/d | Calculated |
| MLSS Concentration | 2000 | mg/L | Measured |
| WAS | 1157 | lb/d | Measured |
| SRT | 11.4 | d | Measured |

The correlation factor, K, was then used to estimate the aeration system capacity for biological removal of both carbonaceous and nitrogenous loads, given the air available and delivered by a maximum of two blowers in service. The blowers at the Camas WWTF are each rated at 1,650 standard cubic feet per minute (SCFM) @ 9.5 psig. Assuming two blowers in service (3,300 SCFM total air available), 95 percent removal of $BOD_5$, and complete nitrification, the influent $BOD_5$ and ammonia loads that can be treated are summarized in Table 8-4. The values used for the calculation are presented in greater detail in Table 8-5.

As shown in Table 8-4, the maximum TKN the WWTF can treat while treating a design loading of 5,620 lb/d $BOD_5$ is 2,024 lb/d. Thus, the analysis shows that the existing blowers cannot accommodate the projected 2025 design loadings of 5,616 lb/d $BOD_5$ and TKN of 2,573 lb/d simultaneously. An additional blower is required.

**TABLE 8-4**

**Projected BOD and Ammonia Load Capacity with Two Blowers (3,300 SCFM total) in Service(1)**

| BOD Load (lb/d) | Ammonia Load (lb/d) |
|---|---|
| 1,000 | 2,805 |
| 1,500 | 2,721 |
| 2,000 | 2,636 |
| 2,500 | 2,552 |
| 3,000 | 2,467 |
| 3,500 | 2,382 |
| 4,000 | 2,298 |
| 4,500 | 2,213 |
| 5,000 | 2,129 |
| 5,620 | 2,024 |

(1) $BOD_5$ and ammonia loads on each row are calculated loads that can be treated using the existing aeration blowers, assuming two aeration basins online, an aerobic SRT of 11.4 days, 95 percent BOD removal, and complete nitrification. Also assumes that basin dissolved oxygen is maintained at minimum concentration to achieve full nitrification. In actual operation, less than 100 percent nitrification will be achieved.

**TABLE 8-5**

**Evaluation of Oxygen Demand with Two Blowers in Service**

| $BOD_{in}$ (lb/d) | $BOD_r$ (lb/d) | $TKN_{ox}$ (lb/d) | $P_{xbio}$ (lb/d) | DN (lb/d) | AOR (lb/d) | Airflow (SCFM) | *K* (SCFM/lb/d) | $Ammonia_{in}$ Capacity (lb/d) |
|---|---|---|---|---|---|---|---|---|
| 1,000 | 950 | 3,955 | 443 | 2,373 | 11,893 | 3,300 | 0.2775 | 2,805 |
| 1,500 | 1,425 | 3,815 | 597 | 2,289 | 11,893 | 3,300 | 0.2775 | 2,721 |
| 2,000 | 1,900 | 3,676 | 752 | 2,206 | 11,893 | 3,300 | 0.2775 | 2,636 |
| 2,500 | 2,375 | 3,536 | 907 | 2,122 | 11,893 | 3,300 | 0.2775 | 2,552 |
| 3,000 | 2,850 | 3,397 | 1,061 | 2,038 | 11,893 | 3,300 | 0.2775 | 2,467 |
| 3,500 | 3,325 | 3,258 | 1,216 | 1,955 | 11,893 | 3,300 | 0.2775 | 2,382 |
| 4,000 | 3,800 | 3,118 | 1,371 | 1,871 | 11,893 | 3,300 | 0.2775 | 2,298 |
| 4,500 | 4,275 | 2,979 | 1,525 | 1,787 | 11,893 | 3,300 | 0.2775 | 2,213 |
| 5,000 | 4,750 | 2,839 | 1,680 | 1,704 | 11,893 | 3,300 | 0.2775 | 2,129 |
| 5,620 | 5,339 | 2,667 | 1,872 | 1,600 | 11,893 | 3,300 | 0.2775 | 2,024 |

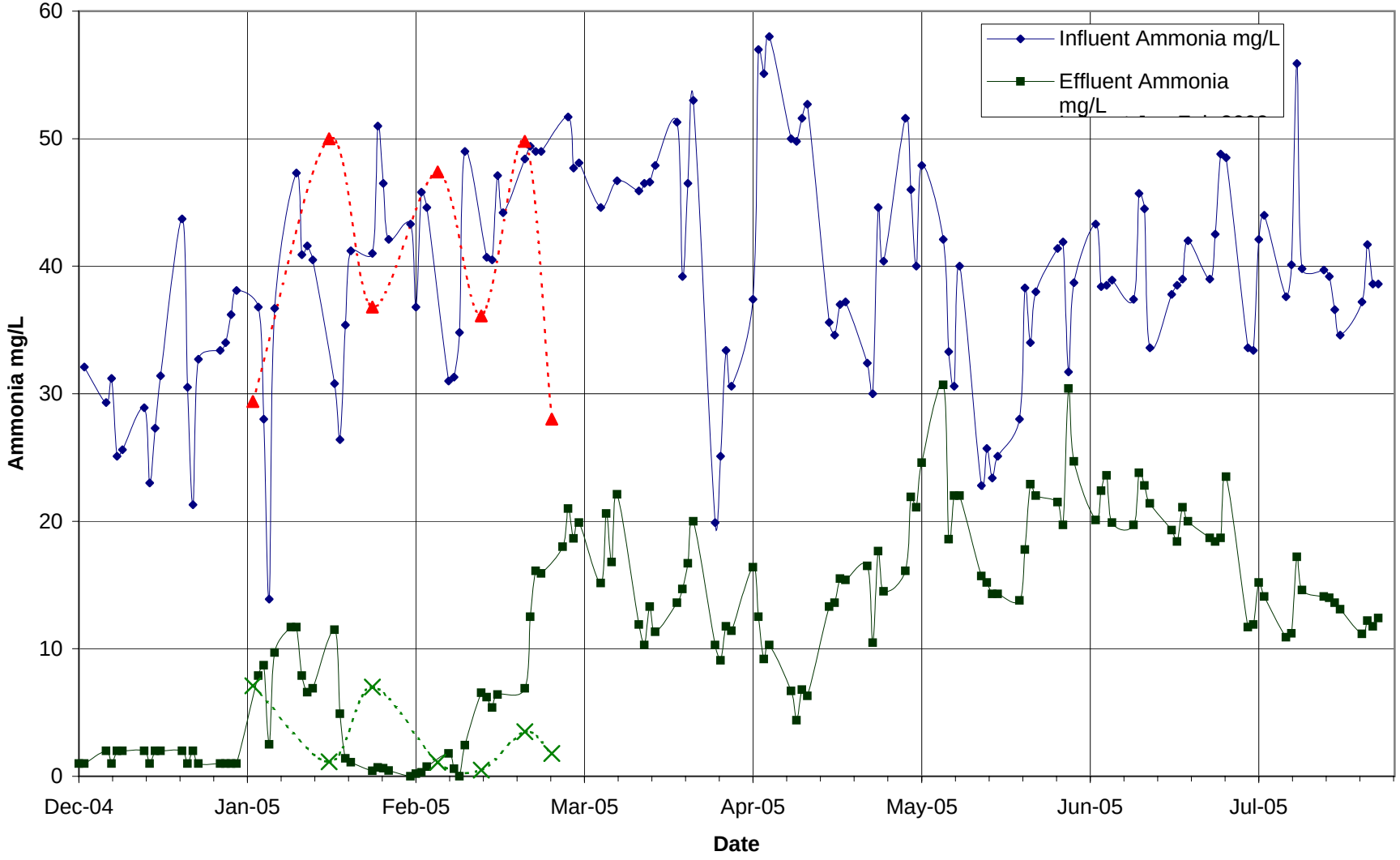
**Nitrification and Denitrification**

In untreated domestic wastewater, nitrogen will be found primarily in the form of organic nitrogen ammonium ion ($NH_4^+$). Analytically organic nitrogen and total ammonia nitrogen are measured simultaneously with total Kjeldahl nitrogen (TKN). If nitrate or nitrite is present in the wastewater, the TKN test will not include them. Ammonia in wastewater is dissolved (soluble). Organic nitrogen can be soluble (e.g., urea) or particulate (e.g., insoluble proteins). Organic nitrogen can be converted to ammonium through bacterial decomposition and hydrolysis of urea and other organic compounds. Nitrification is the process whereby ammonium is oxidized to nitrate; this process is typically ascribed to two different autotrophic (using inorganic carbon as a carbon source) genera of microorganisms, *Nitrosomonas* and *Nitrobacter*. Denitrification is the process that transforms nitrate to nitrogen gas by heterotrophic (using organic carbon as a carbon source) denitrifying microorganisms in the absence of oxygen. Biological treatment systems can be designed to nitrify and denitrify by providing the proper conditions for the nitrifying and denitrifying microorganisms.

Nitrification is defined as the oxidation of ammonia to nitrate. The oxidation occurs in two steps – the oxidation of ammonia to nitrite by the bacterium *Nitrosomonas* followed by the oxidation of nitrite to nitrate by the bacterium *Nitrobacter*. The stoichiometric equations for nitrification are

| | | | |
|---|---|---|---|
| Step 1: | $2NH_4^+ + 3O_2 \rightarrow$ | $2NO_2^- + 4H^+ + 2H_2O$ | (Performed by *Nitrosomonas*) |
| Step 2: | $2NO_2^- + O_2 \rightarrow$ | $2NO_3^-$ | (Performed by *Nitrobacter*) |
| | $NH_4^+ + 2O_2 \rightarrow$ | $NO_3^- + 2H^+ + 2H_2O$ | (Overall reaction) |

**FIGURE 8-7**
**City of Camas WWTP**
**Influent and Effluent Ammonia (mg/L)**



Influent and effluent concentrations for ammonia at the Camas WWTF for 2004 to 2006 are compared to 2002 performance in Figure 8-7. As shown, the efficacy of ammonia removal has decreased since 2002. To achieve consistent nitrification:

1. It is necessary to maintain the desired SRT (> 9.5 days) by operating at a high enough MLSS.

2. Aeration basin temperature must be sufficiently high.

3. The biomass must be maintained in suspension.

4. Sufficient alkalinity must be present to meet the requirement for nitrification and keep the pH near the optimal range. Nitrification results in the decrease in bicarbonate alkalinity as well as an increase in the carbon dioxide concentration, both of which lower the pH. If the wastewater has a relatively low alkalinity to provide buffering capacity, a significant drop in pH can occur. In turn, the low pH can significantly reduce the rate of nitrification. Below a pH of 7.2, the rate falls precipitously, approaching zero at a pH of 6. Approximately 7.2 mg of bicarbonate alkalinity (as $CaCO_3$) are required to neutralize the hydrogen ions produced by the oxidation of 1 mg of ammonium nitrogen to nitrite.

5. The dissolved oxygen must be maintained at 2 mg/L or higher.

6. Concentrations of toxic metals and compounds must be very low (below inhibitory thresholds).

7. Extreme variation in influent conditions, including pH, TKN and ammonia, should be minimized.

For a minimum temperature of 12°C, the required minimum aerobic SRT for a nitrifying system is 4.75 days (see calculations, Appendix O). With a safety factor of 2.0, the design SRT is 9.5 days. The projected aerobic SRT with the current nitrification-denitrification scheme for years 2025 is 9.5 days. The Camas WWTF has adequate capacity to nitrify at 2025 flows and loadings, provided that discharge of inhibitory materials is controlled. Periodic failure, as occurred in 2005, to fully nitrify suggests the possibility of inhibition.

An activated sludge computer modeling program was used to model and evaluate the capacity of the Camas WWTF. The model was created using Hydromantis, Inc. General Purpose Simulator (GPS-X Version 5.0) software and physical design data for the treatment facility. GPS-X uses a series of mathematical algorithms to simulate the activated sludge and secondary clarification processes. The results of this evaluation indicate that the existing three aeration basin treatment trains with three secondary

clarifiers have sufficient capacity to meet permit limits and achieve sufficient nitrification to yield an effluent ammonia concentration below permit limits at the maximum month design flow and loads. Additional calculations were performed to confirm the results of the activated sludge model. The results of the model and calculations are provided in Appendix O.

In general, as the MLSS is increased, leading to very long SRTs, the ability to provide for a sludge that settles well becomes more difficult. However, operation at too *low* of an MLSS can also lead to poorly settling sludge, since the selector used to facilitate the growth of easily settlable, floc-forming bacteria in the aeration basins has an optimal range of food-to-mass ratio (F/M) that is a function of the MLSS concentration (F/M = lb $BOD_5$/d/lb MLSS).

It is recommended that the City continue to monitor potential causes of poor nitrification at the Camas WWTF. The high ammonia load combined with low BOD load is not an influent characteristic that would prevent full nitrification, assuming other environmental conditions (dissolved oxygen, SRT, temperature, pH, toxics) are favorable. A likely explanation of the inability of the WWTF to fully nitrify is the presence of materials in the influent that are toxic to the nitrifying bacteria. Environmental conditions in the Camas activated sludge appear on the surface to be conducive to good nitrification efficiency, yet high ammonia levels in the effluent continue to be measured. Additional possible factors contributing to nitrification problems may be fluctuating TKN/ammonia loading (potentially caused, to some degree, by receipt of City septage), and during use of a single basin at high influent ammonia loading at low hydraulic and solids retention times.

## CONTROL OF SLUDGE SETTLEABILITY

### Biological Selectors

The selectors provide compartmentalization to create an environment with a high food/mass (F/M) ratio to favor the growth of floc-forming (readily settling) organisms, and produce a low sludge volume index (SVI). The lower the SVI, the better settling characteristics of the sludge. This is a key operating parameter for the operation of activated sludge systems, since poorly settling sludge (SVI > 150 mL/g) may require selector modifications, operational modifications, or increased clarification capacity. Based on a review of recent operating records (in 2005 and 2006), SVIs have been quite variable. Examining a two-month period of operation with one basin on-line (July – August 2006) reveals that SVIs ranged from 200 to 400 mL/g in early July and dropped to 100 to 150 mL/g as the biomass acclimated to operation with the single basin.

The probable cause of filamentous growth in the Camas activated sludge system is the low F:M and high dissolved oxygen in the biological selector zones at the inlet of the aeration basin. Low F:M is the result of a weak wastewater entering the WWTF, due to the significant amount of low-BOD industrial wastewater and the large number of STEP

systems in the community. High dissolved oxygen in the selector zones is due to the use of air to mix the selector volume, and because of the addition of dissolved oxygen contained in the internal basin recycle from the last aerobic zone (to return nitrates).

The City has experienced problems with poor settling solids (high SVI) when two basins are in operation, probably due to filamentous bacteria growth in the bioselectors caused by low F:M and high dissolved oxygen concentrations. The resulting poor floc formation (bulking sludge) has led to solids washout in the secondary clarifiers. Consequently, the City has found that operation of a single aeration basin results in fewer filaments and a better settling sludge, which reduce the risk of effluent TSS violations. However, it is true that additional aeration basin volume should increase nitrification performance, and thus modifications to the selector, as discussed below, are recommended.

In the interim, recommended actions to help control the growth of filamentous bacteria at the Camas WWTF include the following:

1. Turn down the air supply to the selectors as low as possible, while leaving enough air flow to prevent settling. Since the flow to the aeration basin has already been settled, there should not be many suspended solids anyway, and the air flow can be kept low. Recommended dissolved oxygen concentration is 0 to 0.3 mg/L. (Note: new fluorescence-type oxygen meters can measure accurately to this low dissolved oxygen concentration.) It is most important to keep a low dissolved oxygen concentration during the peak load periods of the day, when the available BOD is greatest.

2. Close the valve on the recycle line to the first selector zone, forcing all the recycle flow to the third selector zone. This change will keep dissolved oxygen in the recycle from entering the first selector zone.

3. If necessary, occasionally reduce the filament population by chlorinating the RAS, or injecting hydrogen peroxide into the RAS. About 2 to 4 days of chlorination or hydrogen peroxide addition should be adequate. Even if the selectors are operated at low dissolved oxygen now, it will take a very long time to reduce the filaments unless chlorination or hydrogen peroxide injection is performed to kill the existing population. This treatment can be performed without killing the nitrifiers if the dose is controlled. The recommended dose should be discussed with Gray & Osborne before performing this action.

4. Maintain the dissolved oxygen concentration in the last aerobic zone, from which internal recycle originates, at about 2 mg/L to prevent excessive amounts of dissolved oxygen from being returned to the biological selector and anoxic zone.

It is recommended that the divider walls in the selectors be moved to provide a design F/M gradient of 6:3:1.5 lb BOD/ lb MLSS in the three selector compartments at current operating conditions. An additional issue that may be contributing to problems with solids settling performance (as well as nitrification and scum accumulation) is hydraulic short-circuiting due to back-mixing in the aeration basins. The divider walls in the aeration basins could be converted from their "end-around" configuration to an "overflow" configuration with sufficient head-loss to prevent back-mixing. Additionally, it is recommended that fiberglass enclosures be constructed around the internal recycle pumps to reduce dissolved oxygen in the internal recycle stream. Finally, it is recommended that on-line probes be installed to monitor influent and effluent ammonia to provide a more effective and robust means of control.

## ALKALINITY ADDITION

It is conceivable that the sodium in the sodium hydroxide currently used at the Camas WWTF to supplement influent alkalinity is adversely affecting settling. Research has shown that the ratio of monovalent to divalent cations is an indicator for potential settling and dewatering problems at wastewater treatment plants. High ratios (greater than approximately 2:1) of monovalent (predominantly sodium and potassium) to divalent cations (calcium and magnesium) have been associated with poor settling and dewatering properties, and a high sodium concentration has been found to be a potential problem. If high sodium concentration negatively impacts settling, the effect can be reversed by the addition of divalent cations (calcium and magnesium) or reduction in the monovalent cations. (Higgins, et al, 1999) However, it is not expected that the use of sodium hydroxide has any impact, since: (1) SVIs were low (settling was good) in previous years when the City was using sodium hydroxide, and (2) Wafertech discharges a high concentration of calcium that should counteract the impact of sodium.

Switching to calcium-based or magnesium-based alkalinity sources certainly is not a panacea to avoid impacts to WWTPs, since these other cations can cause problems when present at high concentrations. Calcium phosphate precipitation can take place when the concentrations of both species are high enough to exceed the solution product at any given pH (even at relatively low levels such as a 100 mg/L of calcium and 50 mg/L of ortho-phosphorus phosphate). At facilities with hard water, or those that add lime to increase the alkalinity of the water, lime can result in a significant increase of overall energy costs in the digester. This increase derives from increased required digester retention time (heating, mixing) and required digester volume (retention time, primary solids removal). Furthermore the reduced volatile solids destruction causes higher sludge hauling costs and reduced gas production. Magnesium has been shown to precipitate as well.

It is not recommended that the rate of chemical addition be flow paced to the WWTF influent flow, since the demand for supplemental alkalinity is highly dependent on other factors such as influent alkalinity, nitrification and denitrification rates, acid-base

reactions, and influent BOD, which affect alkalinity requirements enough to prevent good control of pH by flow-paced chemical injection.

The sizing of the existing alkalinity storage system was based on two-week nitrification requirements for a projected maximum month 2017 TKN loading of 2,227 lbs/day, (an alkalinity addition requirement of 51.4 kilo-equivalents) which is less than the projected 2025 loading of 2,573 lbs/day. However, the WWTF could receive its alkalinity source once per week and have more than enough capacity for the 20-year planning period. It is projected that the WWTF will need to need to replace the storage tanks once in the 20-year planning period (projected for 2015).

## SECONDARY CLARIFIERS

The WWTF has two secondary clarifiers in current operation. Under current normal conditions, only Clarifier No. 2 is operated. Both clarifiers are operated during high seasonal flow conditions. Clarifier No. 2 has a greater capacity than the Clarifier No. 1, and the recommended flow split is approximately 55:45 when both clarifiers are in operation.

The factors that influence the performance of secondary clarifiers include the clarifier overflow rate, solids loading rate and sludge settleability/removal. Selector performance should control SVI to below 150 mL/g, which would enable the Camas WWTF clarifiers to operate at the design ranges of overflow and solids loading rates.

### Clarifier Overflow Rate

As shown in Table 8-2, at design (maximum monthly average) flow, Metcalf & Eddy (*Wastewater Engineering*) lists 700 gallons per day per square foot (gpd/sf) as a recommended limit for secondary clarifiers settling mixed liquor in activated sludge systems with selectors. WEF Manual of Practice #8 lists maximum month design ranges of 300 to 1,000 gpd/sf. At projected year 2015 and 2025 flows, the clarifier overflow rates fall within these criteria.

Metcalf & Eddy and WEF Manual of Practice #8 both list peak (hour) flow design ranges of 1,000 to 1,600 gpd/sf. At projected year 2015 and 2025 flows, the peak clarifier overflow rates meet these criteria.

### Solids Loading Rate

As shown in Table 8-3, the maximum *design* solids loading rate recommended by Metcalf & Eddy and WEF are 36 and 30 lb/sq. ft.-d, respectively. At the design maximum month flow and loadings the respective solids loading rates are 20.5 (for Clarifier 1) and 18.1 lb/sq. ft.-d (for Clarifier 2) for year 2015 and 25.4 (for Clarifier 1) and 22.9 lb/sq. ft.-d (for Clarifier 2) year 2025.

The *peak* solids loading rate recommended by Metcalf & Eddy and WEF are 43 and 50 lb/sq. ft.-d, respectively. At projected year 2015 and year 2025 peak hour flow and loadings, the respective peak solids loading rates are 36.6 (for Clarifier 1) and 33.0 lb/sq. ft.-d (for Clarifier 2) for year 2015, and 41.9 (for Clarifier 1) and 37.7 lb/sq. ft.-d (for Clarifier 2) for year 2025.

It is expected that modifications to the selector as described above, combined with higher mixed liquor suspended solids concentrations (closer to the design concentration of 2,800 mg/L) and occasional RAS chlorination or other measures, such as improved dissolved oxygen control in the aeration basins, would result in successful operation of the existing clarifiers without additional clarifiers throughout the 20-year planning period.

**Filtration Facilities**

The filtration system consists of two parallel fabric media filters, located in the UV Disinfection Building. Each filter consists of a steel tank, 12 fabric media covered disks, backwash system, sludge removal system, high-pressure spray wash system and disk drive assembly. The capacity of each filter is 3.0 mgd (maximum month). The filters have sufficient capacity for projected year 2015 and 2025 flows and loadings.

**Ultraviolet Disinfection System**

Filtered effluent from the disk filters flows by gravity through the UV channel where disinfection occurs. Three banks of Trojan 3000 (low-pressure low-intensity) UV lamps operate in series within the disinfection channel. The system is rated for disinfection at a peak instantaneous flow of 6.1 mgd, each bank with a capacity up to 3.05 mgd. The third bank provides redundancy; it will be called in case of a major alarm on either in-use bank, and provides treatment for the peak day flow (7.8 mgd). With the third bank on, the system capacity is 9.15 mgd. For the purposes of developing the CIP at the end of this chapter, it is assumed that one additional UV bank with low-pressure low-intensity lamps will be added providing a peak day capacity of 12.2 mgd and a maximum month capacity of 9.15 mgd.

**Impacts of Industrial Dischargers**

There has been speculation by Ecology that the performance of the City's UV system has been impacted by industrial discharges. Reductions in ultraviolet transmittance (UVT) below design values could conceivably occur due to process upsets that increase solids loading to the UV system that blocks transmission of UV light. Also, a number of substances, including iron and synthetic organic compounds discharged by a number of industries, can pass-through the WWTF and lower effluent UVT significantly. (Swift, et

al, 2001, 2003.) Industries that have been found in recent years to cause this problem include:

- Printed circuit board manufacturers
- Central waste treatment facilities
- Organic chemical manufacturers
- Instant coffee producers

The following recommendations are made for routine monitoring of industrial impacts to UV disinfection:

1. When there is a significant deterioration in disinfection performance, the City should monitor UVT once a week on an effluent 24-hour composite sample with the City's laboratory bench-top transmittance meter.

2. If UVT is less than 60 percent (more than 10 percentage units below the design of 70 percent), the City should measure the transmittance of the effluent after laboratory filtration through a 0.45-micron filter. If UVT is still low, the presence of dissolved UV-absorbing constituents is indicated.

3. The City should save a liter of any low dissolved transmittance sample, preferably in glass bottles rated for semi-volatile organic compound preservation. (However, based on previous studies Gray & Osborne has conducted, the most likely UV-absorbing constituents that could be discharged from computer component manufacturing cannot be determined with conventional methods used for volatile and semi-volatile analysis and require high performance liquid chromatography and substantial method development.)

4. If low dissolved transmittance samples are identified, the City should contact its largest industries and jointly test the dissolved transmittance of their wastewaters, and quantify the "absorbance loading," of the major waste streams. If low effluent transmittance is a recurring problem, the installation of an on-line transmittance meter and an accompanying alarm is recommended. If indications are that the low effluent transmittance is due to an industrial discharge, the City may wish to develop local limits for transmittance.

## EFFLUENT PUMPS

The effluent pumps are vertical propeller, wet pit, mixed flow pumps rated at 4,300 gpm @ 18' TDH. Transitions between gravity and pumped effluent flow are performed automatically when the pumps are placed in "auto" mode. Whenever the level of the Columbia River rises, gravity effluent discharge will be stopped by the closing of the flap gate in the Effluent Manhole

The operation of two of the three effluent pumps can pump the design peak hour flow of 13.4 mgd at 100-year flood elevation at a water surface elevation of 29.0' in the effluent pump station (this is a pump station depth = 8 ft., which is 1 foot above the ultrasonic level sensor high level alarm and 1 feet below the float switch Pump 1 call).

## OUTFALL

The existing 36-inch corrugated metal pipe (CMP) Camas WWTP outfall extends approximately 850 feet south into the Columbia River channel. The diffuser portion of the outfall is located along the outer 150 feet of the pipe. The existing outfall includes 16 vertical risers, each with 90-degree bends pointed downstream. The eight diffusers closest to shore are capped off and not currently in operation. The eight risers in use discharge effluent parallel to the flow of the Columbia River.

Because the Camas outfall discharges in the same direction as the river flows, and at similar velocities, there is low turbulence and poor dilution in the mixing zone. A change from a horizontal discharge to a vertical discharge will increase dilution about four-fold based on the UM3 model used to model dilution in the Camas mixing zone. With the modified model and vertical orientation of the diffusers. The proposed project would uncap the eight diffusers currently not in use, and re-orient all sixteen diffuser risers vertically and install Tideflex Valves on the ends of the risers to minimize entrainment of debris in the diffuser pipe.

## SEPTAGE HANDLING

The City currently receives sanitary septage from two sources: Wafertech septic tanks and City STEP tanks. 4,000 gallons of septage from Wafertech is currently brought by a contracted hauler to the City WWTF every other week. For the purposes of estimating future quantities of septage, Wafertech septage is projected to grow at the same rate as its wastewater flow, to 4,000 gallons delivered one day *every week*.

The septage from City STEP tanks is currently hauled by a contractor and deposited in manholes in the City's collection system at various points (mostly in Gravity Basins 5 and 6). City septage is currently hauled typically for five consecutive days every other week during dry months (April through October), and less frequently during wet months. During hauling periods, 5 to 7 STEP tanks with 1,500 to 3,000 gallons of septage each per day are hauled and deposited in the collection system (approximately 7,500 to 20,000 total per day during hauling periods).

Originally, all the STEP tanks for individual residences were 1,500 gallons; however, new STEP tanks for individual residences are typically 3,000 gallons and new clusters of homes are often served by larger tanks. Within a year, the number of STEP tanks pumped per year will be increased from 600 to 800. The number is expected to increase in the future as additional sewer customers (ERUs) are added to the City. For the

purposes of estimating future quantities of septage, the number of tanks is expected to grow at the same rate as ERUs (i.e., by a total of 81 percent) to 1,450 by year 2025. It was also assumed that the average tank size in 2025 is 2,250 gallons (i.e., equal numbers of 1,500 gallon and 3,000 gallon tanks, and 2,250 gallons of tankage *per residence* in a cluster). Thus, projected annual City STEP septage production for 2025 is 3.26 million gallons, or 8,900 gallons per day on average. However, it is assumed that up to 30,000 gallons of City septage (up to 34,000 including Wafertech septage) will still be sent to the City WWTF as a maximum day septage volume.

Because incoming septage is accounted for by influent flow and composite concentrations and loading data, the growth of septage loading is included in year 2025 projections in Table 6-12. However, because it is not introduced continuously into the WWTF, the impact of loading of key constituents must be examined. There is little data regarding the strength of STEP septage from Camas customers; however, the strength can be estimated based on conservative septage design criteria published by EPA and WEF. Table 8-6 presents the combined projected loading from City and Wafertech septage for year 2025. As shown in Table 8-6, septage is typically much higher strength than normal domestic wastewater. Using the conservative EPA design values in Table 8-6, the projected maximum day year 2025 septage $BOD_5$, TSS and TKN loading accounts for 48 percent, 72 percent, and 10 percent, respectively, of the total year 2025 maximum month loading shown in Table 6-12. Given the potential short-term impact of septage and high variability in concentration ranges reported by EPA and summarized in Table 8-6, it is recommended that the City analyze several batches of septage to determine actual concentrations.

There are several concerns with the current septage management scheme:

- Deposition of debris in the collection system.
- Clogging of debris in the headworks.
- Variability and strength of loadings of TKN, TSS and BOD to the WWTF. Fluctuating, high loads of TKN into the liquid treatment process can result in breakthrough of ammonia into the effluent.
- Potential for toxicity/inhibition.

**TABLE 8-6**

**Typical Septage Characteristics[(1),(2)]**

| Parameter | Range (EPA) (mg/L) | Average (EPA) (mg/L) | Suggested Design Value (EPA) (mg/L) | Ratio of Septage Design Concentrations to Typical Municipal Wastewater | 2025 Ave. Day Loading to Camas WWTF (lb/d) | 2025 Max. Day Loading to Camas WWTF (lb/d) |
|---|---|---|---|---|---|---|
| Total Solids | 1,100 – 130,500 | 34,100 | 40,000 | 56 | 3,002 | 11,342 |
| Total Volatile Solids | 350 – 71,400 | 23,100 | 25,000 | 68 | 1,877 | 7,089 |
| Total Suspended Solids | 310 – 93,400 | 12,900 | 15,000 | 68 | 1,126 | 4,253 |
| Volatile Suspended Solids | 95 – 51,500 | 9,000 | 10,000 | 61 | 751 | 2,836 |
| 5 –day Biochemical Oxygen Demand | 440 – 78,600 | 6,500 | 7,000 | 32 | 525 | 1,985 |
| Soluble $BOD_5$ | -- | 800 | 800 | 6 | 60 | 227 |
| Chemical Oxygen Demand | 1,500 – 703,000 | 31,900 | 15,000 | 30 | 1,126 | 4,253 |
| Total Kjeldahl Nitrogen | 66 –1,060 | 590 | 700 | 18 | 53 | 198 |
| Ammonia-N | 3 – 116 | 97 | 150 | 6 | 11 | 43 |
| Total Phosphorus | 20 –760 | 210 | 250 | 31 | 19 | 71 |
| Alkalinity | 520 – 4,200 | 970 | 1,000 | 10 | 75 | 284 |
| Oil and Grease | 210 – 23,400 | 5,600 | 8,000 | 80 | 600 | 2,268 |
| pH | 1.5 – 12.6 | -- | 6.0 | -- | -- | -- |

(1) Based on *WEF Septage Handling Manual of Practice No. 24, 1997,* based on information reported by the EPA in 1984 and 1994.

(2) All units are in mg/L, except pH.

Due to the concerns regarding deposition in the collection system, the City desires to receive the majority of future septage at the WWTF. Because of the concerns regarding the impacts of septage on WWTF operation, the City desires the flexibility to store septage and meter it into the WWTF liquid stream or solids treatment stream (potentially blending the septage with waste activated sludge). This flexibility will be provided by adding an additional 30,000-gallon septage storage tank. The new additional holding tank will be equipped with a new positive displacement blower, coarse bubble air diffusion system, submersible septage pumps and discharge piping to allow septage from this tank to be pumped to the existing storage tanks, headworks or solids handling system. Typically, septage should be metered to the headworks so that the solids in the septage can be removed in the primary clarifiers, pumped to the hydrocyclones for grit removal, and transferred to the gravity thickener for thickening, and finally pumped to the anaerobic digesters. The new tank also will allow storage and evaluation of potentially toxic or high strength batches of septage prior to treatment, particularly if treating septage impacts WWTF operation in the future. Additionally, given the

likelihood of variability in TKN, TSS and BOD loadings due to septage treatment and industrial flows, it would be useful to more frequently quantify these parameters in *influent* with and without septage, and note whether septage is included in the influent stream.

It is recommended that under typical conditions, the majority of future septage will be treated with the liquid stream, where primary clarification and grit removal will aid in reducing impacts to the WWTF. After the septage loading of BOD and TKN is better understood, more specific plans to manage the septage introduction into the plant can be formulated. If the impacts to liquid stream performance are determined to be significant at current loadings, the City can partially direct septage loads directly to the anaerobic digester. If the City pumps the septage directly to the digesters, City staff will need to monitor septage loading and digester performance to verify that the inclusion of septage is not causing inhibition, shock loading or other problems in the digestion process, since it is possible that the concentrations of ammonia and toxic pollutants in some batches of septage may exceed inhibitory or shock-loading thresholds for anaerobic digestion or reach.

Costs for septage handling modifications are included in Chapter 9 with the other solids handling improvements.

## ELECTRICAL AND SCADA SYSTEMS

Based on a review of electric utility billings, the available electrical capacity at the plant is sufficient for the loads associated with the new equipment discussed in this chapter (and the anaerobic digester and sludge dryer discussed in Chapter 9) with plenty of margin for additional loads in the future. It is not anticipated that the sludge dryer will be served by the WWTF generator; therefore, no increase in generator capacity is required or anticipated for the 20-year planning period.

It is recommended that the City replace its existing computers, uninterruptible power supplies, SCADA software, and PLC firmware with current versions of these items. Additionally, it is recommended that the City add on-line ammonia for WWTF influent and effluent to complement the existing laboratory measurement of ammonia.

## INDUSTRIAL PRETREATMENT/FOG CONTROL EVALUATION

As a POTW (Publicly Owned Treatment Works) without pretreatment program responsibilities delegated to it from the Department of Ecology, the Camas WWTF is not required to fulfill significant requirements regarding pretreatment program management, other than what is in its NPDES permit. However, as discussed below, considering the large number of industries, apparent history of discharge of inhibitory materials, large number of restaurants/fast food establishments, automotive facilities, and potential problems from industrial and FOG disposal in the sewer, it is recommended that the City consider developing elements of a pretreatment program including:

- A program to control Fats, Oils and Grease
- Development of local limits to control industrial discharges from Significant Industrial Users
- The purchase of a software program to manage information from industrial dischargers and FOG and staffing to manage the pretreatment program

**Fats, Oils and Grease**

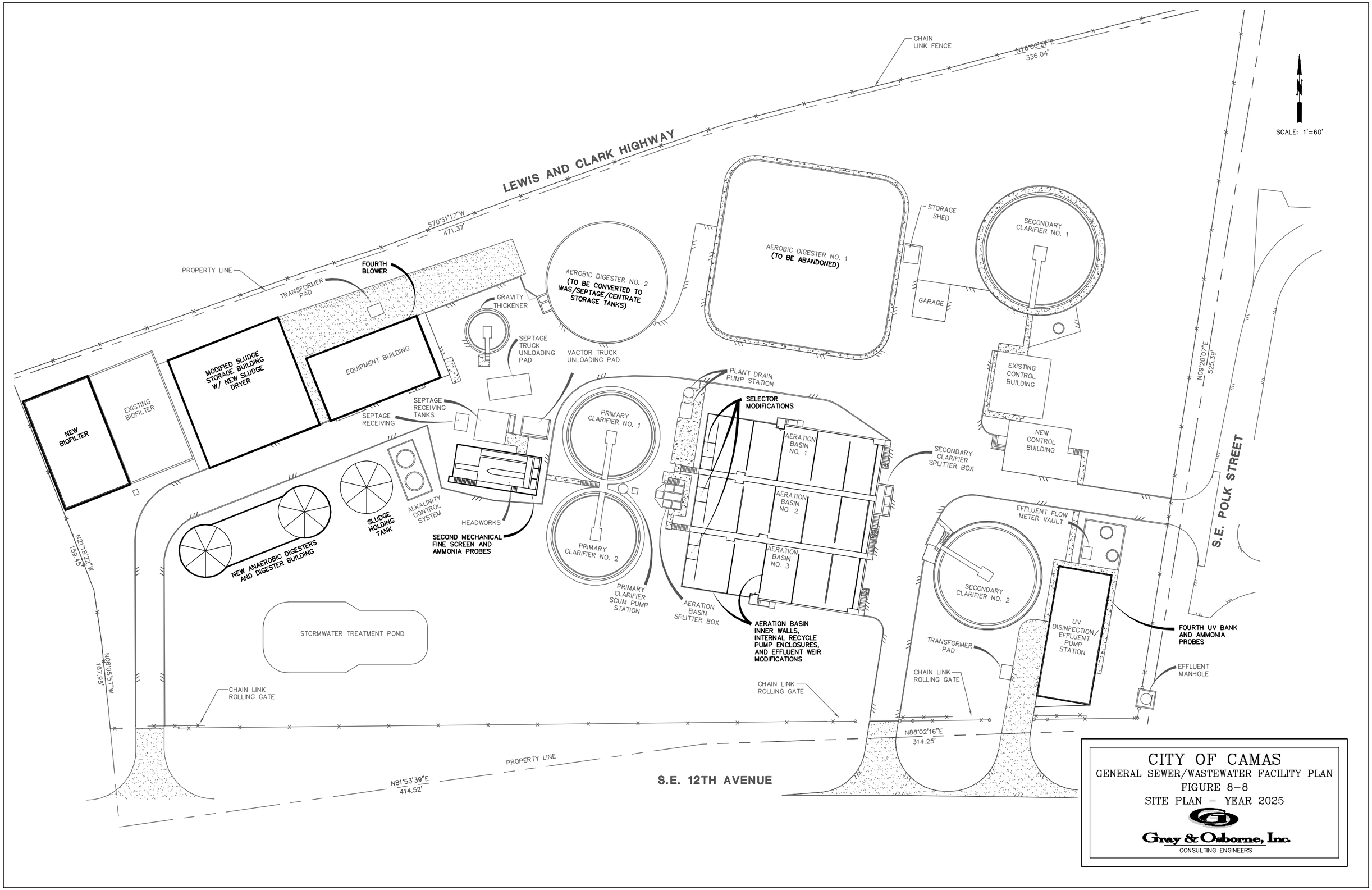
Fats, Oil and Grease (FOG) can have negative impacts on wastewater collection and treatment systems. Two types of FOG pollutants are common to wastewater systems. Petroleum-based oil and grease ("non-polar" FOG) occurs at businesses using oil and grease, such as automotive service facilities and car washes. Non-polar FOG typically has the potential to cause toxicity or inhibition to WWTF biological processes. Animal and vegetable-based oil and grease ("polar" FOG) are discharged by restaurants, fast-food outlets and other food processing facilities. Most wastewater collection system blockages can be traced to polar FOG. Blockages in the wastewater collection system can cause sewage spills, manhole overflows, or sewage backups in homes and businesses. Per discussion with WWTF staff, the City has had a couple of blockages in the downtown area, some of which resulted in overflows and flooding of a restaurant upstream of the One Stop Pump Station.

It is recommended that the City consider instituting a program to reduce the discharge of FOG into the sewer. One tool for such a program is to provide an incentive in commercial sewer rates for proper sizing and management of grease *interceptors.* Restaurants would obtain the incentive by proper sizing of grease interceptors and submission of a FOG Control Plan, but would lose the incentive if they failed to submit pumping receipts at required intervals or if inspections indicated that the grease interceptor was not being adequately maintained (more than 1/3 full of grease and/or sediment). The incentive, with limited exceptions, should not be provided for grease *traps,* which often fail to adequately remove FOG.

**Significant Industrial Users**

As required by its NPDES permit, the City completed an Industrial User Survey (IUS) in early 2005. The survey identified nine Significant Industrial Users (SIUs) and five Minor Industrial Users (MIUs). The SIUs identified included:

1. Bodycote, Inc.
2. Brown's Chevron
3. Columbia Litho, Inc.
4. Heraeus Shin-Etsu America
5. C-Tech
6. Linear Technology




CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
FIGURE 8-8
SITE PLAN - YEAR 2025

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\07511 WWTF DESIGN PHASE 2\WWTF DESIGN\FIGURES\FIG8-8.DWG, 8-8, 11/25/2009 9:08:13 AM, 0.5:1, BY: MNAGEL

7. Sharp Electronics Corporation
8. Shell Oil Products
9. Wafertech

The MIUs included:

1. Georgia Pacific
2. Furuno USA Inc.
3. Lemon Aid Automotive
4. Post Record
5. Westlie Motors

Industrial wastewater (and wastewater from commercial enterprises that is industrial in nature) does not typically have the same concentrations of organics, solids and nutrients found in residential wastewater. Industrial wastewater can also contain higher concentrations of trace pollutants which are toxic to the biological treatment process used in the WWTF. Any industry siting in the sewer service area that has a discharge potentially deleterious to the wastewater collection or treatment systems must be required to provide adequate on-site industrial pretreatment, consistent with the City's pretreatment program, to prevent such impacts.

Considering the relatively large proportion of industrial flow, and relatively large number of industries in the City, it is recommended that the City consider developing local limits for the protection of its WWTF. Local limits are developed to implement site-specific prohibitions to protect against the discharge of pollutants at a quantity or rate that may cause pass-through or interference at (or otherwise detrimentally impact) a POTW.

**Pretreatment Program**

It is recommended that the City consider the purchase a computer program to track its industrial users. There are several options for pretreatment management database programs. Vendors include LINKO, Operator 10, PACS and PREWIN. All of these software programs offer similar functions to the user. In general, each program has the ability to:

- Store industrial user information
- Store sample and result information
- Make queries of stored information
- Store certain industry specific information (flow rates, pretreatment processes, etc.)
- Import and Export capabilities, also LIMS compatibility
- Generate reports and letters of violation
- Log notes, phone calls, track maintenance records, etc.

Costs, depending on the vendor and the features in the system, range between $2,500 and $20,000, including tax.

## RECOMMENDED WWTF PLAN

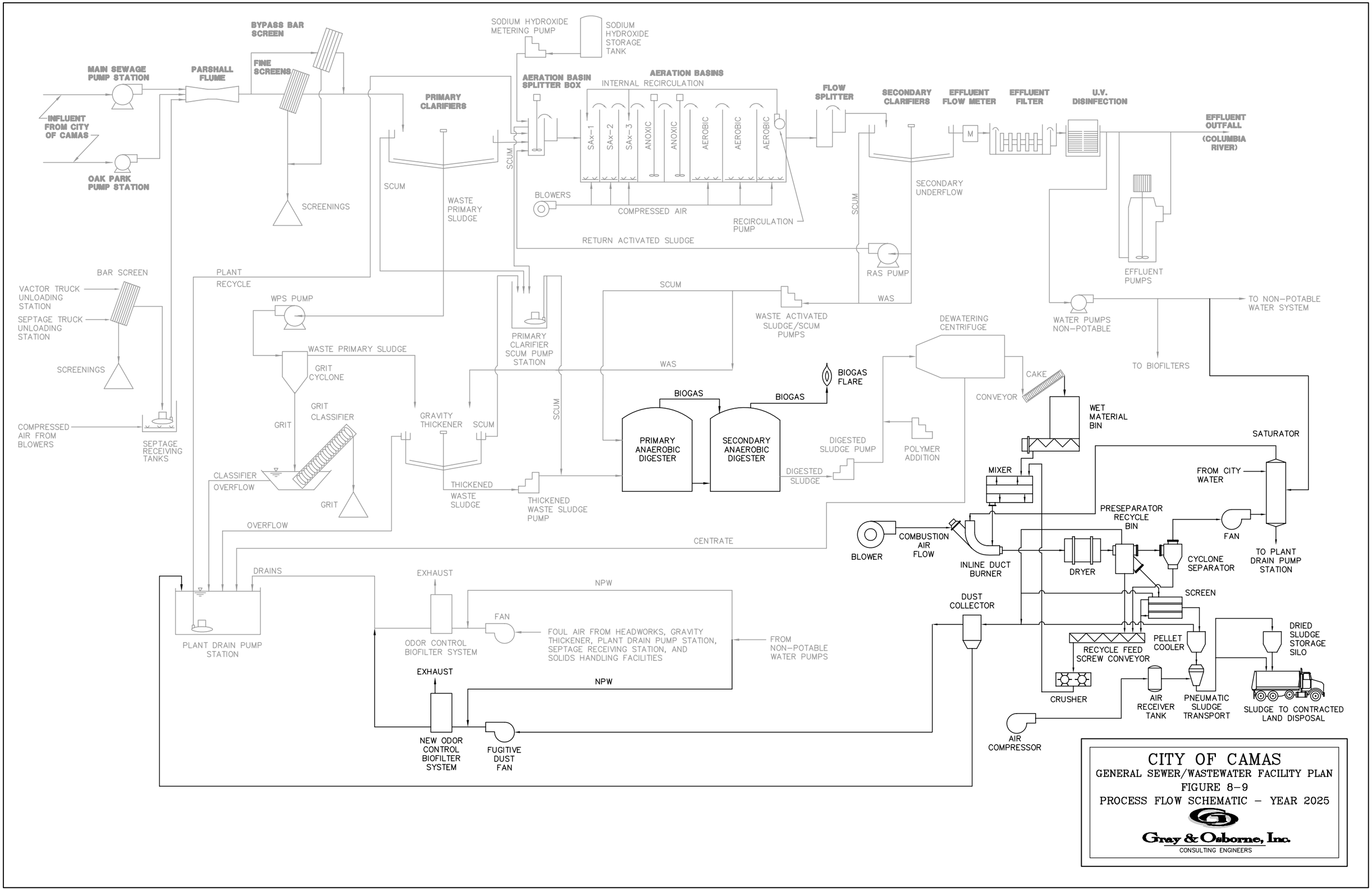
The recommended future (year 2025) site layout and process flow diagram for the WWTF, showing recommended improvements from both Chapter 8 and Chapter 9 (biosolids treatment), are presented in Figure 8-8 and 8-9. Table 8-6 provides costs for the capital improvement projects. Sources for the costs are indicated by the footnotes. Costs are estimated total project costs in 2007 dollars and include engineering, construction management, sales tax and contingency.

**TABLE 8-7**

**Cost Estimates for WWTF Upgrades to Accommodate 2025 Flows and Loadings (Solids and Septage Handling Improvements Not Included; See Chapter 9)**

| No. | Item | Quantity | | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | Mobilization/Demobilization | 1 | LS | $250,000 | $250,000 |
| 2 | Mechanical Fine Screen | 1 | LS | $125,000 | $125,000 |
| 3 | Blower (#4) | 1 | LS | $60,000 | $60,000 |
| 4 | Demolish Existing Aerobic Digester No. 1 | 1 | LS | $40,000 | $40,000 |
| 5 | AB Modifications (Selectors and Divider Walls) | 1 | LS | $40,000 | $40,000 |
| 6 | Internal Recycle Pump Enclosure | 1 | LS | $15,000 | $15,000 |
| 7 | Additional Bank of Lamps for UV Disinfection | 1 | LS | $45,000 | $45,000 |
| 8 | Dissolved Oxygen and Ammonia Monitors | 1 | LS | $65,000 | $65,000 |
| 9 | Computer, PLC and SCADA Upgrades | 1 | LS | $55,000 | $55,000 |
| 10 | Security Upgrades | 1 | LS | $10,000 | $10,000 |
| 11 | Loading Dock | 1 | LS | $35,000 | $35,000 |
| 12 | WWTF Outfall Modifications | 1 | LS | $40,000 | $40,000 |
| 13 | Pretreatment Management Software | 1 | LS | $12,000 | $12,000 |

Subtotal .....$792,000
Construction Contingency (20%) .....$158,000
Subtotal .....$950,000
Washington State Sales Tax (7.9%).....$76,000
Total Estimated Construction Cost .....$1,025,000
Engineering, Administrative & Legal Services (20%) .....$ 205,000
**Total Estimated Project Cost.....$1,231,000**




CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
FIGURE 8-9
PROCESS FLOW SCHEMATIC – YEAR 2025

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\05471 WW FAC PLAN\FIGURES\FIG8-9.DWG, 8-9, 2/21/2007 11:50:49 AM, 0.5:1, BY: M NAGEL

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# CHAPTER 9

# BIOSOLIDS TREATMENT AND MANAGEMENT

## INTRODUCTION

This Chapter summarizes current federal and State biosolids regulations, discusses the City's current biosolids treatment and management program, provides a discussion of wastewater solids treatment alternatives, and recommends a process for treating solids generated at the expanded Camas WWTF. Alternatives for disposal and/or utilization of the treated solids (biosolids) are also discussed and a recommended plan for their management is provided.

## BIOSOLIDS REGULATIONS

Regulations pertaining to biosolids include 40 CFR Part 403, WAC 173-308, and WAC 173-200.

### 40 CFR PART 503

Federal 40 CFR Part 503, regulating the disposition of municipal sewage sludge, went into effect in 1993. The 503 rule applies to the sewage sludge generated from municipal wastewater systems, i.e., municipal wastewater treatment systems, and domestic septic tanks. EPA allows states the ability to enforce their own version of biosolids regulations. Under 40 CFR 503, these state biosolids regulations must be at least as stringent as the federal 503 regulations.

### WAC-173-308 BIOSOLIDS MANAGEMENT

The State of Washington has adopted its own regulations governing the use or disposal of biosolids, WAC 173-308. These regulations became effective in March 1998 and are enforced by the State Department of Ecology (Ecology). The requirements in WAC 173-308 are very similar to the requirements of the federal 503 regulations.

There are three fundamental elements of the federal 503 and State 308 regulations that establish minimum criteria for beneficial use of biosolids:

1. Pollutant concentrations and application rates;
2. Pathogen reduction measures; and
3. Vector attraction reduction measures.

## Pollutant Concentrations and Application Rates

Maximum allowable concentrations in biosolids are established for nine heavy metals (arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc). If a biosolids sample exceeds the ceiling concentration in Table 1 of WAC 173-308 of any of these metals, it cannot be land applied. A second pollutant threshold concentration is identified for Exceptional Quality (EQ) biosolids in WAC 173-308 Table 3. If biosolids are shown to be below these concentrations, they may be considered EQ, and thus be eligible for relatively unrestricted land application, provided they meet other EQ requirements. To be considered EQ, biosolids must not only meet the EQ *pollutant* requirement, but also meet Class "A" pathogen reduction requirements and vector attraction reduction requirements (see below).

As shown in Table 9-1, historical Camas biosolids pollutant concentrations have not exceeded Table 1 or Table 3 concentrations. However, molybdenum concentrations have been within 10 percent of ceiling and EQ limits.

Cumulative trace pollutant loading rates for biosolids are designated for these nine heavy metals. These rates cannot be exceeded during the life of an application site. Once a cumulative loading limit is reached for a particular limiting pollutant, the land can no longer receive biosolids containing any level of the limiting pollutant. Annual trace pollutant loading rates are also set for the same nine heavy metals.

**TABLE 9-1**

**Historical Camas Biosolids Pollutant Concentrations**

| | Units | WAC-173-308 Table 3 Threshold (EQ) | WAC-173-308 Table 1 Ceiling Conc. Limits | Camas Biosolids[1] | | | |
|---|---|---|---|---|---|---|---|
| | | | | 2001 | 2002 | 2003 | 2005 |
| Arsenic | mg/kg | 41 | 75 | 26 | 21 | 5 | 3.2 |
| Cadmium | mg/kg | 39 | 85 | 0.55 | 1.35 | <0.2 | 2.0 |
| Copper | mg/kg | 1,500 | 4,300 | 604 | 605 | 1 | 640 |
| Lead | mg/kg | 300 | 840 | 16 | 12 | <0.2 | 21 |
| Mercury | mg/kg | 17 | 57 | 0.42 | 1.61 | 0.30 | 0.80 |
| Molybdenum | mg/kg | 75 | 75 | 41 | 68 | 10 | 71 |
| Nickel | mg/kg | 420 | 420 | 11 | 51 | 126 | 26.8 |
| Selenium | mg/kg | 100 | 100 | <1.5 | <1.0 | <3 | 5.6 |
| Zinc | mg/kg | 2,800 | 7,500 | 580 | 654 | 49 | 1,030 |
| Nitrate/Nitrite-N | mg/kg | NA | NA | ND | ND | ND | 20 |
| Total Kjeldahl N | mg/kg | NA | NA | ND | ND | ND | 50,500 |
| Ammonia N | mg/kg | NA | NA | ND | ND | ND | 4,500 |
| Phosphate P | mg/kg | NA | NA | ND | ND | ND | 35,600 |

**TABLE 9-1 – (continued)**

**Historical Camas Biosolids Pollutant Concentrations**

| | Units | WAC-173-308 Table 3 Threshold (EQ) | WAC-173-308 Table 1 Ceiling Conc. Limits | Camas Biosolids[1] | | | |
|---|---|---|---|---|---|---|---|
| | | | | 2001 | 2002 | 2003 | 2005 |
| Total Solids | % | NA | NA | ND | ND | ND | 17.8 |
| Volatile Solids | % | NA | NA | ND | ND | ND | 12.9 |
| pH | pH units | NA | NA | ND | ND | ND | 6.11 |

(1) Biosolids are aerobically digested and dewatered by centrifuge.
NA = Not applicable.
ND = No data.

## Pathogen Reduction Requirements

In order for biosolids to be land applied, they must meet specific criteria demonstrating a minimum level of treatment to reduce the density or limit growth of pathogenic bacteria. By meeting these minimum criteria, a biosolids sample is referred to as meeting Class "B" pathogen reduction requirements. The term "Class B biosolids" is sometimes erroneously referred to as any biosolids meeting all minimum criteria that allow the biosolids to be land applied, which is not the case. Biosolids must meet vector attraction reduction requirements and minimum pollutant concentration standards as well as Class "B" pathogen reduction requirements (at a minimum) in order to be acceptable for land application.

Class "B" biosolids must meet one or more of three alternative criteria for pathogen reduction described in the 503 and 308 regulations. A higher level of treatment known as a Process to Further Reduce Pathogens (PFRP) will permit biosolids to meet Class "A" pathogen reduction requirements. The 503 and 308 regulations provide six alternative PFRP standards for Class "A" biosolids. When biosolids meet the Class "A" standard, they are subject to fewer restrictions for land application as long as they also meet the lower (WAC 173-308) Table 3 pollutant concentration thresholds and vector attraction reduction standards.

## Vector Attraction Reduction Requirements

The third minimum requirement for biosolids to be land applied is the vector attraction requirement. This measure is designed to make the biosolids less attractive to disease-carrying pests such as rodents and insects. These measures typically reduce the liquid content and/or volatile solids content of the biosolids or they make the biosolids relatively inaccessible to vector contact by soil injection or tilling. The 503 and 308 regulations list seven alternative treatment techniques and/or laboratory tests that would qualify a sludge as meeting vector attraction reduction requirements. If biosolids are not

treated by one of the listed treatment techniques to provide vector attraction reduction and if it does not pass the laboratory tests for vector attraction reduction, then it can meet the requirements during land application by subsurface injection or immediate tilling into the ground.

**Management Practices**

For biosolids that are Class "B" with respect to pathogens and have met the three criteria discussed above, the 503 and 308 regulations identify specific management practices that must be followed during land application of biosolids. The biosolids must be applied at a rate that is equal to or less than the agronomic rate. The placement of biosolids on land cannot adversely affect a threatened or endangered species. Biosolids cannot be applied to ground in a manner that would cause it to enter wetlands or a surface water body (e.g., on frozen ground or snow-covered ground) nor can it be applied within 10 meters or less of a surface water. Class "B" biosolids may not be applied to lawns or gardens.

If biosolids meet lower pollutant threshold limits, Class "A" pathogen reduction requirements, and vector attraction reduction requirements, they are eligible for relatively unrestricted application. Biosolids in this category are referred to as "Exceptional Quality" (EQ). EQ biosolids can be containerized and sold or given away in quantities up to 1 metric ton provided a label or information sheet is provided with:

1. The biosolids preparer's name and address;

2. Sufficient information (nitrogen concentrations) for the recipient to determine an agronomic rate of application; and

3. A statement that application is prohibited except in accordance with instructions provided with the container.

**Monitoring Requirements**

Monitoring frequencies are based on quantities of biosolids produced. (It is not generally necessary to verify that pathogen and vector attraction reduction measures are met for each individual load of biosolids that is land applied, per WAC 173-308-150(3).) The actual monitoring frequencies will depend on the frequency of applications.

**Recordkeeping, Reporting, and Certifications**

The 503 and 308 regulations have specific recordkeeping, reporting, and certification requirements for land application of biosolids. The general biosolids permit implements requirements for recordkeeping and reporting in accordance with WAC 173-308-290 and –295. Records must be kept for meeting all pathogen reduction and vector attraction reduction requirements for biosolids and domestic septage. For biosolids, records must

be kept of analyses performed for meeting trace pollutant criteria. Ecology requires that *all* facilities, regardless of size, make annual reports to both Ecology's headquarters and the appropriate regional office, by March 1 of each year.

**Permitting**

WAC 173-308-310 lists permitting requirements for municipalities managing biosolids. The primary permit required for biosolids management activities is *the State General Permit for Biosolids Management*. When applying for coverage under the General Permit, the permittee must carry out public notice as required under WAC 173-308-310(11), and public hearings if required in accordance with WAC 173-308-310(12), and comply with requirements of the State Environmental Policy Act (SEPA) as stipulated under WAC 173-308-310(030). Public notice requirements for facilities subject to this permit vary depending on the purpose the notice is serving and the quality of biosolids being managed. Notification must be made to the general public, affected local health departments, and interested parties.

## SOLIDS TREATMENT ALTERNATIVES PRESELECTION

The *1997 Wastewater Facility Plan* recommended expansion of the biosolids management system in two phases. Phase I was designed for biosolids treatment approximately up to 2007, and Phase II recommendations were designed for biosolids treatment to 2027. Phase I, which was constructed in 2002, consisted of expanding the existing aerobic digestion system and installing a gravity thickener for sludge thickening and a centrifuge for dewatering. The waste solids are currently thickened in a gravity thickener and thickened sludge is pumped to the aerobic digester, which provides a retention time of at least 60 days, meeting Class B biosolids requirements for pathogen reduction as a Process to Significantly Reduce Pathogens (PSRP). The digested sludge is then dewatered with a centrifuge to approximately 20 percent solids. The digested, dewatered sludge is trucked and hauled to a land application site by a contractor. Chapter 5 of this report provides a detailed description of the solids treatment process and presents the design criteria for each of the individual solids treatment components. The existing WWTF site plan and the process flow schematic are shown in Figures 5-2 and 5-3, respectively.

The *1997 Wastewater Facility Plan* provided an analysis of four solids treatment alternatives for Phase II expansion complete with capital and O&M costs for each alternative. The four alternatives analyzed for Phase II are listed below, followed by a description of each process:

- Aerobic Digestion
- Anaerobic Digestion
- Lime Stabilization

- Incineration

## AEROBIC DIGESTION

Aerobic digestion is similar to the activated sludge process. Waste solids from the underdrains of primary and secondary clarifiers is conveyed to the aerobic digesters. The sludge is aerated and mixed in the digesters to provide oxygen to microorganisms which break down available food to carbon dioxide, water, and cell tissue. As the supply of available food is depleted, the microorganisms begin to consume their own cell mass to obtain energy for cell maintenance. When this occurs, cell mass is oxidized aerobically to form carbon dioxide, water, and ammonia. A major objective of aerobic digestion is to reduce the mass of the solids for disposal. This reduction takes place predominantly with the biodegradable (organic) content of the sludge, although there may be some removal of inorganics through biological processes as well.

## ANAEROBIC DIGESTION

In the anaerobic digestion process, the organic material in mixtures of settled primary and waste activated sludges is converted biologically, in the absence of oxygen, to a variety of end products, including methane ($CH_4$) and carbon dioxide ($CO_2$). The process is carried out in a heated, mixed, airtight reactor which receives solids from the underdrains of the primary and secondary clarifiers. Sludge, introduced continuously or intermittently, is retained in the reactor for varying periods of time. The stabilized sludge, withdrawn continuously or intermittently from the reactor, is reduced in organic and pathogen content and is nonputrescible.

## LIME STABILIZATION

In the lime stabilization process, lime is added to untreated sludge in sufficient quantity to raise the pH to 12 or higher. The high pH does not allow survival of microorganisms; therefore, the sludge will not putrefy, create odors, or pose a health hazard as long as the sludge is maintained at this pH level. Lime may be added to sludge prior to dewatering (termed “lime pretreatment”) or after dewatering (termed “lime post treatment”). Usually, either hydrated lime, $Ca(OH)_2$, or quicklime, CaO, are used for lime stabilization.

## INCINERATION

Sewage sludge incineration involves the thermal oxidation of sewage sludge in a furnace termed an “incinerator.” Byproducts of the incineration process include off-gases, ash residue, and wastewater. In a municipal sludge application, the incinerator receives dewatered primary and secondary sludges for incineration. Sewage treatment solids waste streams such as screenings and scum can also be fed to the incinerator. The use of an incinerator negates the need for the digestion process.

## ALTERNATIVE BIOSOLIDS MANAGEMENT CONSIDERATIONS

Consideration of alternative systems was based on compatibility with the existing solids treatment system and their ability to yield a biosolids product that can be economically disposed of or utilized offsite. Both aerobic and anaerobic digestion can yield a Class B biosolid with respect to pathogens if adequate detention time (digester volume) is provided. Lime stabilization and incineration are also capable of producing Class B biosolids if certain process requirements are met. Each of the alternatives can be constructed within the constraints of the existing WWTF site boundaries and would be able to handle projected solids loadings.

The four alternatives presented above and the recommended alternative provided in the *1997 Wastewater Facility Plan* are considered valid for this current Plan because the current projected influent wastewater loading for the year 2025 is similar to that projected for the Phase II design period presented in the 1997 Plan. The capital and O&M cost estimates provided in the *1997 Wastewater Facility Plan* are also considered valid for relative comparison purposes because material, construction, and energy costs for each alternative have increased proportionally.

The City of Camas has recently been in communication with the City of Washougal about the possibility of having the City of Camas treat Washougal biosolids in an effort to reduce the costs associated with biosolids treatment and disposal for both cities by sharing the capital and O&M cost burden. The City of Camas would therefore like to compare the capital and O&M costs for both the alternative of treating Camas biosolids only and the alternative of treating Camas and Washougal biosolids together. Therefore, one of the four alternatives has been preselected for a detailed cost comparison of the two biosolids loading options to produce a Class B biosolid for the year 2025 based on the analysis and recommendations of the *1997 Wastewater Facility Plan*. The costs associated with the various Class B biosolids disposal options are discussed in the following Biosolids Management Alternatives section of this chapter. Additionally, the options to expand the biosolids treatment process to produce a Class A biosolids are also addressed.

### SOLIDS TREATMENT PRESELECTION ALTERNATIVE COMPARISON SUMMARY

A comparison summary of the four biosolids treatment preselection alternatives consistent with the analysis performed in the *1997 Wastewater Facility Plan* is presented in Table 9-2.

**TABLE 9-2**

**Camas WWTF Solids Treatment Preselection Alternative Summary**

| | Aerobic Digestion | Anaerobic Digestion | Lime Stabilization | Incineration |
|---|---|---|---|---|
| Compatibility with Current Disposal Method | Process can meet the pathogen reduction requirements of a Class B biosolid if the biosolids are agitated with air or oxygen to maintain aerobic conditions for a specific time and at a specific temperature, ranging from 40 days at 20°C to 60 days at 15°C. | Process can meet the pathogen reduction requirements of a Class B biosolid if the biosolids are treated in the absence of air for a specific time and at a specific temperature, ranging between 15 days at 35°C to 55°C and 60 days at 20°C. | To meet Class B standards, enough lime must be added to the biosolids to immediately raise the pH to 12 and to remain above 12 after 2 hours of contact. | Incineration would be compatible with 40 CFR 503 requirements as it would destroy the biosolids and negate the need for disposal. There would be a remaining ash that would require disposal. |
| Adaptability to Higher Level of Treatment | Process is not recognized as a Process to Further Reduce Pathogens (PFRP) by 40 CFR 503 which is required to produce a Class A biosolid. However, modifications to the process could be made to upgrade the digestion method to thermophillic aerobic digestion which is recognized as a PFRP. In place of facilities upgrades, additional changes in operations including monitoring for fecal coliforms may result in a process approved by the Department of Ecology as a PFRP. | Process is not recognized as a Process to Further Reduce Pathogens (PFRP) by 40 CFR 503 which is required to produce a Class A biosolid. However, additional changes in operations including monitoring for fecal coliforms may result in a process approved by the Department of Ecology as a PFRP. These potential process changes include pasteurization and heat drying. | Lime stabilization can be used to meet pathogen reduction requirements for Class A. The pH of the biosolids must be maintained at 12 or higher for at least 72 hours, with temperature during the 72-hour period greater than 52°C for at least 12 hours. After 72 hours at pH above 12, the biosolids must be air-dried to greater than 50 percent total solids. | There would be no need to adapt the technique for a higher level of treatment as the biosolids would be destroyed by thermal oxidation. |

**TABLE 9-2 – (continued)**

**Solids Treatment Preselection Alternative Summary**

| | Aerobic Digestion | Anaerobic Digestion | Lime Stabilization | Incineration |
|---|---|---|---|---|
| Operational Considerations | This aerobic digestion process is already in place at the Camas WWTP and is familiar to the plant operators. The process is relatively easy to operate and produces supernatants low in biological oxygen demand, suspended solids, and nitrogen. The relatively rapid bacteria growth rates allow more flexibility to handle changes in waste loadings to the digester. The process is also relatively low in labor demand. However, the process is susceptible to foaming problems and may produce solids that are relatively difficult to dewater. The absence of temperature control may also limit the ability of the plant to meet 40 CFR 503 regulations for pathogen and vector attraction reduction. Aeration energy requirements results in high O&M costs. | Anaerobic digestion is a proven technology that results in a greater reduction in sludge mass than aerobic digestion. Biosolids derived from anaerobic digestion are generally more stable and contain the least amount of volatile solids than those derived from aerobic digestion. Thus, the solids are more likely to meet 40 CFR 503 requirements. Anaerobic digestion produces methane gas which can be used as an energy source for heating the reactor giving the process more temperature control. However, due to the slow growth rate of the bacteria that produce methane, the ability to adjust to changes in waste loadings and temperature is less than for aerobic digestion. Therefore, the process requires good process control and is more susceptible to upsets than aerobic digestion. | The lime stabilization process is relatively simple to operate with limited process control requirements. However, the lime and quicklime are relatively difficult to handle. The chemicals are often non-homogeneous and contain consolidated "chunks" that can clog feed hoppers. The method is relatively high in maintenance requirements and requires more maintenance than aerobic and anaerobic digestion. In addition, the process results in a high pH biosolids and a net increase in biosolids mass with a corresponding increase in storage requirements. Also, lime is a caustic dry chemical and its handling can be hazardous to workers. Special procedures to prevent chemical contact with skin and dust inhalation are required. | Incineration would require a relatively high level of process control. The technique is reliable, but would require a dedicated full-time plant operator at all times the incinerator is in operation. The operator would be responsible for incineration and other sludge handling processes. Incineration would require operating permits from the Southwest (Washington) Air Pollution Control Authority (SWAPCA). Incinerator control efficiencies are specific to incinerator design and would have to be verified by stack tests during test burns. Regulations 40 CFR 503, NAAQS, and NESHAP place restrictions on beryllium, mercury, lead, arsenic, cadmium, chromium, nickel, and total hydrocarbon releases. The ability to obtain the necessary permits for operation at this alternative screening stage is difficult to determine without stack test results. |

**TABLE 9-2 – (continued)**

**Solids Treatment Preselection Alternative Summary**

| | Aerobic Digestion | Anaerobic Digestion | Lime Stabilization | Incineration |
|---|---|---|---|---|
| Economic Analysis | Moderate High Capital Cost and O&M Cost | Moderate Capital Cost and Low O&M Cost | Low Capital Cost and High O&M Cost | Very High Capital Cost and Low O&M Cost |
| Aesthetics | The stabilization process does not generally generate nuisance odors. However, there may be nuisance odors associated with sludge storage. | Anaerobic digestion is the least offensive sludge treatment alternative. Treatment occurs in enclosed reactors with recycle and use of the waste gases (methane). Solids derived from this process are usually less odorous than those produced by aerobic digestion. | Lime treatment does not destroy the volatile solids in the sludge. Therefore, as the pH in the sludge drops after treatment, significant odors and biological regrowth can occur. The potential for reoccurrence of odors and the elevated pH of the sludge may limit the number and types of customers who would be willing to accept the treated sludge. | An incinerator would be the most visible treatment technique of those evaluated, although odor problems are anticipated to be minimal due to destruction of the biosolids. However, there is the potential for public opposition to an incinerator. |

**RECOMMENDED PRESELECTION ALTERNATIVES**

Anaerobic digestion was the recommended option for Phase II expansion because it had the lowest combined present worth capital cost and O&M cost, required the least land area, and required the least amount of handling of hazardous chemicals of the four alternatives as presented in the *1997 Wastewater Facility Plan*. As previously discussed, the design criteria for the design period of this Plan have not changed significantly from that of Phase II for the *1997 Wastewater Facility Plan*; therefore, anaerobic digestion is the recommended alternative to produce a Class B biosolid. This Plan considers two separate alternative criteria for the year 2025: Alternative No. 1 considers the treatment of Camas WWTF biosolids only, and Alternative No. 2 considers treatment of both Camas and Washougal WWTF biosolids. These Alternatives are further broken down into two separate subcategories A and B: subcategory A for each of the alternatives considers the treatment of the design biosolids loading to a Class B biosolid via anaerobic digestion, and subcategory B for each alternative considers the treatment of the design biosolids loading to produce a Class A biosolids. The summary of the alternatives considered is presented below:

- Alternative No. 1A: Anaerobic Digestion of Camas WWTF Biosolids and Contract Disposal of Class B Biosolids
- Alternative No. 2A: Anaerobic Digestion of Camas and Washougal WWTF Biosolids and Contract Disposal of Class B Biosolids
- Alternative No. 1B: Anaerobic Digestion of Camas WWTF Biosolids Followed by Sludge Drying to Produce a Class A Biosolid
- Alternative No. 2B: Anaerobic Digestion of Camas and Washougal WWTF Biosolids Followed by Sludge Drying to Produce a Class A Biosolid

The options to expand these two alternatives to produce a Class A biosolid are discussed later in this Chapter as Alternatives No. 2A and No. 2B. A description of the biosolids treatment Alternatives No. 1A and No. 1B (to provide a Class B biosolid) and a capital and O&M cost estimate for each alternative are presented below.

## ALTERNATIVE NO. 1A: ANAEROBIC DIGESTION OF CAMAS WWTF BIOSOLIDS

The design criteria for this alternative are presented in Table 9-3. The maximum month and annual average influent wastewater TSS loadings are based on the 2025 projected values. The maximum month influent wastewater $BOD_5$ is based on the current NPDES permit value. The annual average influent wastewater $BOD_5$ value is estimated by multiplying the maximum month $BOD_5$:TSS ratio by the annual average TSS value.

**TABLE 9-3**

**Alternative No. 1A: Anaerobic Digestion of Camas WWTF Biosolids Design Criteria (Design Year 2025)**

| | Maximum Month | Annual Average |
|---|---|---|
| WWTF Influent $BOD_5$ (lb/d) | 5,616 | 4,099 |
| WWTF Influent TSS (lb/d) | 8,001 | 5,883 |
| Waste Primary Sludge (lb/d) | 5,990 | 4,409 |
| Waste Activated Sludge (lb/d) | 3,218 | 2,353 |
| Total Waste Sludge (lb/d) | 9,208 | 6,762 |

This alternative combines thickened waste primary sludge (WPS) and thickened waste activated sludge (WAS) and stabilizes the mixed solids in an anaerobic digester. A site layout and process flow schematic are presented in Figures 9-1 and 9-2, respectively. Anaerobic digestion is a proven method of solids treatment with wide application in municipal treatment. Digestion yields methane gas, a useful byproduct that can be used to reduce energy consumption at the WWTF. Anaerobic digestion is designated by the EPA 503 regulations as a Process to Significantly Reduce Pathogens (PSRP). Anaerobic digestion yields Class B biosolids with respect to pathogens if the mean cell residence time within the digesters is between 15 days at 35°C to 55°C and 60 days at 20°C.

The requirement for vector attraction reduction is satisfied if the volatile solids content is lowered by 38 percent or more. Class B biosolids may be applied to agricultural land, forest sites, public contact sites, and reclamation sites. However, unlike Class A biosolids, Class B biosolids cannot be sold or given away and are subject to restrictions pertaining to crop harvesting, animal grazing, and public contact.

The existing Aerobic Digester No. 2 will be modified to serve as a holding tank with three separate compartments for WAS, dewatering centrifuge centrate, and septage storage. Each of the three holding tanks will have a dedicated aeration blower and coarse bubble diffuser system. Submersible centrifugal pumps will be installed in the centrate storage tank to transfer centrate to the aeration basin splitter box during low plant influent load periods. Submersible centrifugal pumps will be installed in the septage storage tank to allow septage to be transferred to the headworks. Additional septage discharge piping will be installed to allow the septage to also be transferred to the existing septage receiving tank or to the WAS storage tank, where it can be mixed with the WAS and transferred to the WAS thickener.

The existing digested sludge pumps will be used to transfer WAS from the WAS holding tank to the sludge thickening system, which will be located in the new digester building. The new sludge thickening system will consist of a rotary screen thickener, thickening polymer addition system, thickener magnetic flow meter, and two thickened WAS pumps. Thickened WAS will drop from the rotary screen thickener drum into a hopper

equipped with two progressing cavity thickened WAS pumps, which will transfer thickened WAS to the digesters. Two new progressing cavity digested sludge pumps will be installed in the digester building to pump digested sludge to the existing dewatering centrifuge from the sludge storage tank or the anaerobic.

The existing thickened waste sludge pump will pump the thickened WPS from the existing gravity thickener to the new anaerobic digesters. The volume and surface area of the existing gravity thickener will be sufficient to thicken the WPS. The existing gravity thickener will be modified to include a non-potable dilution water supply line to maintain the overflow rate of 25 gallons/square foot/day. The existing dewatering centrifuge has a rated capacity of 160 gpm and the new digested sludge pumps will have a rated capacity of 160 gpm at 30 psi. With a digested sludge rate of 18,000 gpd and the pumping capacity of 160 gpm, the centrifuge will be required to operate approximately 10 hours/week during maximum month loading conditions for the 2025 design year. The centrifuge will be required to operate approximately 17 hours/week during annual average loading conditions for the design 2025 year. The existing primary sludge pumps, grit removal system, WAS pumps, and thickened waste sludge pumps have sufficient capacity to treat the biosolids associated with the design year 2025.

Two primary anaerobic digesters and one sludge holding tank are proposed for this alternative. The volume of the primary digesters would provide sufficient capacity to produce a Class B biosolid for the year 2025. The new digesters would be built west of the existing headworks at the location shown in Figure 9-1. Digested sludge from the primary digesters will be routed to the new sludge holding tank.

The new primary digesters will each have a diameter of 35 feet, a side water depth of 25 feet, and a working volume of 24,100 cubic feet (180,000 gallons). A fixed cover will be installed on each of the new primary digesters and the sludge holding tank. A new digester control building will be constructed between the digesters to house the heat exchangers, gas boiler, sludge thickening system, recirculation pumps, digested sludge pumps and associated piping, and control equipment. A new second plant drain pump station will be constructed adjacent to the digester building to pump the drain flows from the digester building to the aeration basin splitter box.

Design hydraulic retention time and volatile solids loading in the primary digesters for the year 2025 are projected to be 20 days and 6,760 lb VSS/day, respectively, under monthly maximum flow conditions in the year 2025. The primary digesters will be heated to a temperature of approximately 35°C using energy derived from the methane gas produced during digestion. The design hydraulic retention time and operating temperatures will allow the process to meet the Class B pathogen reduction criteria in the WAC 173-308 regulations, as well as the criteria for vector attraction reduction (38 percent VSS reduction or greater).

The new primary digesters will be mixed with top mounted mechanical mixers. Heat for the primary digesters will be provided by a hot water boiler capable of burning either digester gas or commercial natural gas. Each primary digester will have one spiral heat exchanger for heating of thickened feed sludges. Two recirculation pumps and a backup will be provided for the digesters to allow for heating of digester contents. Digester equipment will be housed within a new control building. Digested sludge from the primary digesters will be conveyed by gravity to the sludge holding tank. Sludge within the sludge holding tank will not be heated or mixed. Excess gas will be burned at a waste gas burner, which will be located near the digester complex.

The design criteria for the primary anaerobic digesters, sludge holding tank and associated equipment are provided below:

**Alternative No. 1A Anaerobic Digesters Design Criteria**

| | |
|---|---|
| Primary Anaerobic Digesters | |
| Quantity of New Primary Digesters | 2 |
| Volume (each) | 24,000 cubic feet |
| Diameter | 35 feet |
| Side Water Depth | 25 feet |
| Total Primary Digester Volume | 48,000 cubic feet |
| Influent Sludge Feed Rate | 18,000 gpd |
| Hydraulic Retention Time | 20 days |
| Influent Sludge Solids Concentration | 5.6 percent |
| Total Solids Loading | 8,400 lb/day |
| Volatile Solids Loading | 6,760 lb/day |
| Volatile Solids Loading | 0.14 lb VS/ft$^3$/d |
| Digester Operating Temperature | 35°C to 38°C |
| Estimated Volatile Solids Reduction | 40 percent |
| Sludge Holding Tank | |
| Quantity | 1 |
| Volume | 12,000 cubic feet |
| Diameter | 35 feet |
| Side Water Depth | 12.4 feet |
| Sludge Flow Rate | 18,000 gpd |
| Effluent Sludge Solids Concentration | 3.3 percent |
| Hydraulic Retention Time | 5 days |
| Digester Mixing | |
| Type of Mixing | Mechanical |

| | |
|---|---|
| No. of Mixers per Digester | 1 |
| Mixer Pump Capacity | 9,000 gpm |
| Turnover Time | 20 minutes |
| Motor Size | 10 hp |

Heating

| | |
|---|---|
| Quantity of Boilers | 1 |
| Boiler Type | Fire Tube |
| Boiler Size | 1,004,000 BTU/hr |
| Quantity of Spiral Heat Exchangers | 2 |
| Heat Exchanger Type | Spiral |
| Heat Exchanger Capacity | 500,000 BTU/hr |
| Quantity of Boiler Water Pumps | 2 |
| Boiler Water Pump Type | Centrifugal |
| Boiler Water Pump Capacity | 200 gpm |
| Boiler Water Pump TDH | 23 feet |
| Boiler Water Pump Motor Size | 7.5 hp |

Recirculation Pumps

| | |
|---|---|
| Type | Rotary Lobe |
| Quantity of Pumps | 3 |
| TDH | 23 feet |
| Pump Capacity | 200 gpm |
| Motor Size | 7.5 hp |

WAS Storage Tank

| | |
|---|---|
| Volume | 150,000 gallons |
| No. of Aeration Blowers | 1 |
| Blower Type | Positive Displacement |
| Blower Capacity | 320 SCFM |
| Blower Discharge Pressure | 4.6 psig |
| Blower Motor Size | 15 hp |

Centrate Storage Tank

| | |
|---|---|
| Volume | 45,000 gallons |
| No. of Aeration Blowers | 1 |
| Blower Type | Positive Displacement |
| Blower Capacity | 120 SCFM |
| Blower Discharge Pressure | 4.6 psig |
| Blower Motor Size | 5 hp |

| | |
|---|---|
| No. Centrate Pumps | 2 |
| Pump Type | Submersible Centrifugal |
| **Septage Storage Tank** | |
| Volume | 30,000 gallons |
| No. of Aeration Blowers | 1 |
| Blower Type | Positive Displacement |
| Blower Capacity | 80 SCFM |
| Blower Discharge Pressure | 4.6 psig |
| Blower Motor Size | 5 hp |
| No. of Septage Pumps | 2 |
| Pump Type | Submersible Centrifugal |
| **WAS Thickener** | |
| Quantity | 1 |
| Type | Rotary Screen Thickener |
| Flow Capacity | 200 gpm |
| Feed Solids | 1% |
| Thickened Solids | 5-7% |
| Motor Sizes: | 5 hp |
| Flocculator | 1 hp |
| Drum Main Drive | 2 hp |
| Booster Pump | 2 hp |
| **Thickening Polymer Feed System** | |
| Quantity | 1 |
| Type | 2-Tank |
| Polymer Type | Liquid or Dry |
| Mixing Tank Volume | 520 gallons |
| Holding Tank Volume | 500 gallons |
| Solution Feed Pump Capacity | 100 gph |
| Active Polymer Capacity | 2 lb/hr |
| Volumetric Screw Feeder Motor Size | ¼ hp |
| Liquid Polymer Feed Pump Motor Size | ½ hp |
| Solution Feed Pump Motor Size | ¾ hp |
| **Thickened WAS Pumps** | |
| Quantity | 2 |
| Type | Progressing Cavity |
| Capacity | 50 gpm |

| | |
|---|---|
| Pump Head | 60 psi |
| Motor Size | 10 hp |
| | |
| Digested Sludge Pumps | |
| Quantity | 2 |
| Type | Progressing Cavity |
| Capacity | 160 gpm |
| Pump Head | 60 psi |
| Motor Size | 10 hp |
| | |
| Plant Drain Pump Station No. 2 | |
| Quantity of Pumps | 2 |
| Type of Pumps | Submersible Centrifugal |
| Capacity | 500 gpm |
| Pump Head | 40 ft |
| Motor Size | 10 hp |

A new digester control building will be constructed to house process equipment and piping used to operate the new digesters. The equipment will include the boiler, two spiral heat exchangers, two boiler water pumps, three recirculation pumps, two digested sludge pumps, and the WAS thickening system. Process piping will include conveyance for raw thickened sludge, sludge recirculation, digested sludge, bypass and emergency piping routes, drains, gas handling, and valving for distributing feed sludge. The control building will be located between the two digesters. The size of the control building will be 1,800 square feet.

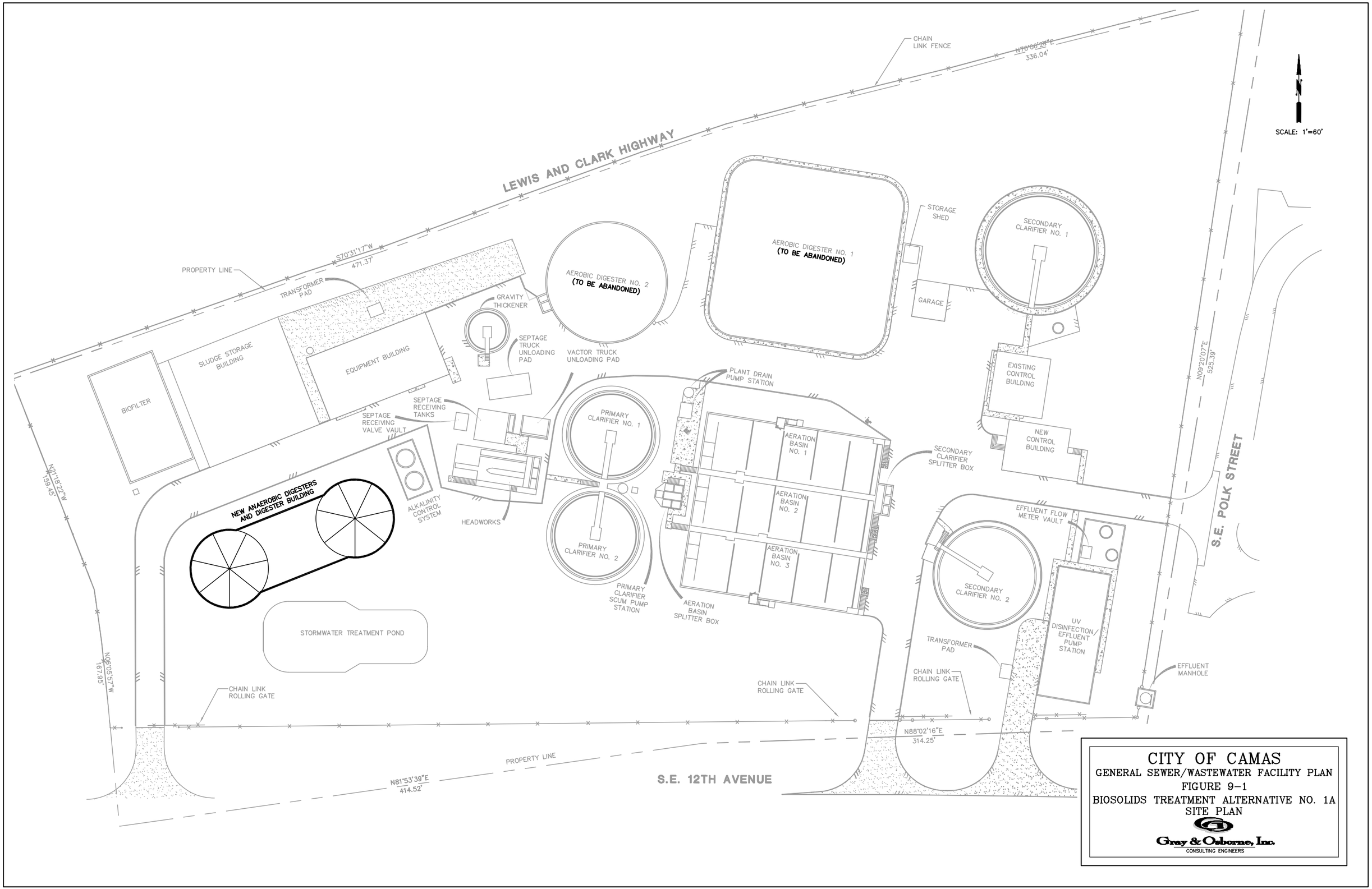
The capital and O&M costs associated with Alternative No. 1A are presented in Tables 9-4 and 9-5, respectively. The O&M cost for Alternative No. 1A includes the cost of contracted biosolids hauling off site.

**TABLE 9-4**

**Alternative No. 1A: Anaerobic Digestion of Camas Biosolids Preliminary Project Cost Estimate (2007 Dollars)**

| No. | Item | Quantity | Unit Price | Amount |
|---|---|---|---|---|
| 1. | Mobilization/Demobilization | 1 LS | $450,000 | $450,000 |
| 2. | Demolition | 1 LS | $40,000 | $40,000 |
| 3. | Anaerobic Digester/Sludge Holding Tank/Dig. Building | 1 LS | $750,000 | $750,000 |
| 4. | Digester Sludge Heating System | 1 LS | $231,000 | $231,000 |
| 5. | Digester Gas Equipment | 1 LS | $152,000 | $152,000 |
| 6. | Digester Covers | 1 LS | $650,000 | $650,000 |
| 7. | Digester Mixing System | 1 LS | $300,000 | $300,000 |
| 8. | Digester Recirculation Pumps | 1 LS | $79,000 | $79,000 |
| 9. | WAS/Septage/Centrate Tank | 1 LS | $280,000 | $280,000 |
| 10. | WAS Thickening System | 1 LS | $237,000 | $237,000 |
| 11. | Digested Sludge Pumps | 1 LS | $40,000 | $40,000 |
| 12. | Plant Drain Pump Station No. 2 | 1 LS | $70,000 | $70,000 |
| 13. | Dewatering | 1 LS | $75,000 | $75,000 |
| 14. | Earthwork | 1 LS | $100,000 | $100,000 |
| 15. | Miscellaneous Metals | 1 LS | $50,000 | $50,000 |
| 16. | Painting | 1 LS | $90,000 | $90,000 |
| 17. | Site Work | 1 LS | $100,000 | $100,000 |
| 18. | Mechanical/Yard Piping | 1 LS | $250,000 | $250,000 |
| 19. | Electrical | 1 LS | $350,000 | $350,000 |

Subtotal ..... $4,294,000
Construction Contingency (20%)..... $ 859,000
Subtotal ..... $5,153,000
Washington State Sales Tax (7.9%)..... $ 407,000
**TOTAL ESTIMATED CONSTRUCTION COST..... $5,560,000**
Engineering, Administrative, and Legal Services (20%)..... $1,112,000
**TOTAL ESTIMATED PROJECT COST..... $6,672,000**




CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
FIGURE 9-1
BIOSOLIDS TREATMENT ALTERNATIVE NO. 1A
SITE PLAN

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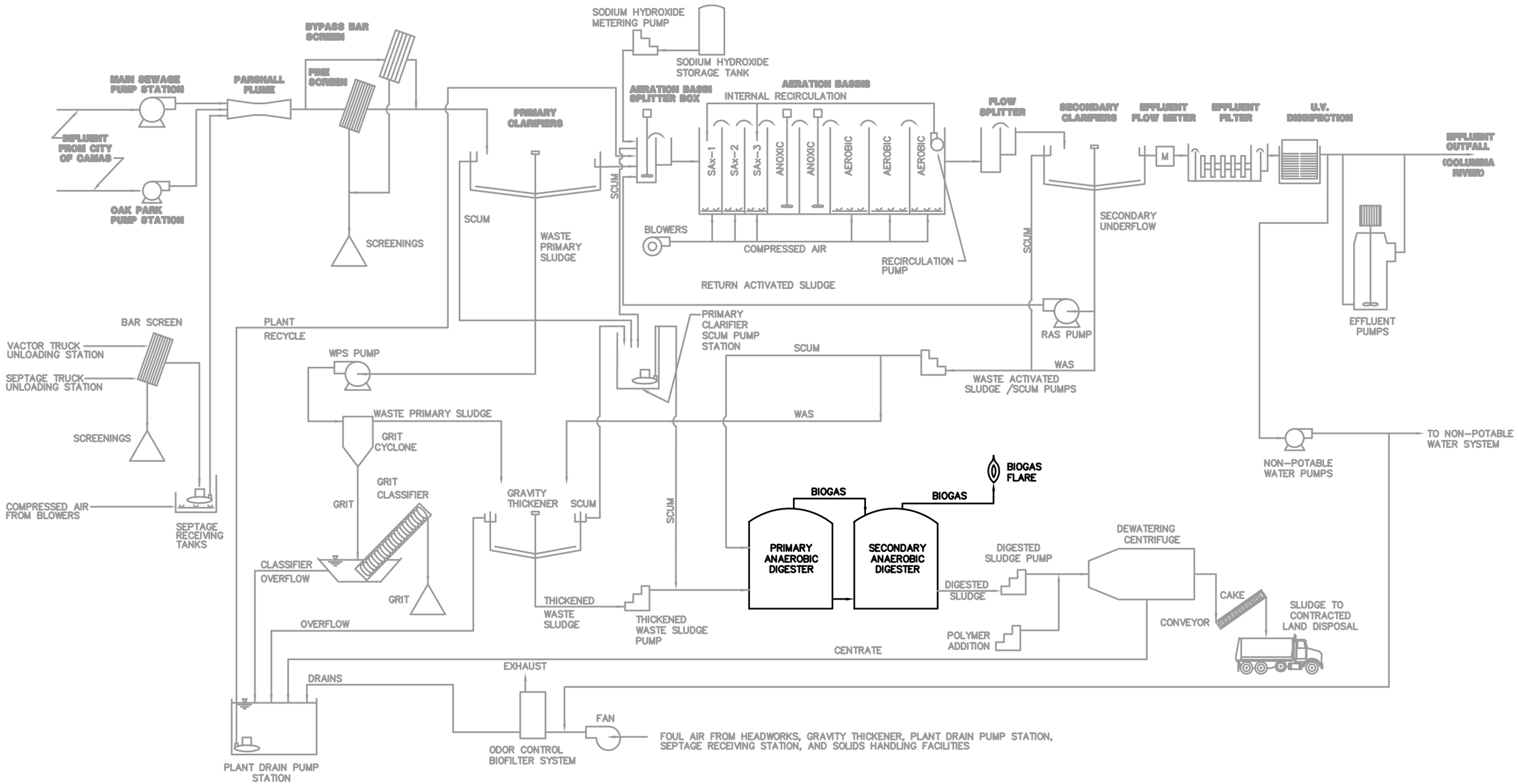
CONSULTING ENGINEERS

L:\CAMAS\05471 WW FAC PLAN\FIGURES\FIG9-1.DWG, 9-1, 9/29/2006 11:43:01 AM, 0.5:1, BY: M NAGEL




CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
FIGURE 9-2
BIOSOLIDS TREATMENT ALTERNATIVE NO. 1A
PROCESS FLOW SCHEMATIC

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\05471 WW FAC PLAN\FIGURES\FIG9-2.DWG, 9-2, 9/29/2006 11:42:34 AM, 1:1, BY: M NAGEL

**TABLE 9-5**

**Alternative No. 1A: Anaerobic Digestion of Camas Biosolids O&M Cost Estimate (Design Year 2025)**

| Item | Costs (Year 2007 $) |
|---|---|
| Labor ($38/hr) | $ 79,000 |
| Power ($0.07/kWh) | $ 41,000 |
| Polymer ($2.50/lb) | $ 48,000 |
| Natural Gas ($1.15/therm) | $ 12,000 |
| Contracted Hauling and Land Application ($60/wet TN) | $225,000 |
| Equipment Maintenance and Repair | $ 11,000 |
| Testing/Permitting | $ 5,000 |
| **Total Annual Cost** | **$421,000** |

## ALTERNATIVE NO. 2A: ANAEROBIC DIGESTION OF CAMAS AND WASHOUGAL WWTF BIOSOLIDS

The design criteria for this alternative are presented in Table 9-6 and are equivalent to the design criteria for Alternative No. 1A with the addition of thickened WAS from the City of Washougal WWTF. The design TSS loading (lb TSS/d) criteria for the thickened WAS from Washougal was provided by Wallis Engineering. This alternative assumes that Washougal will thicken their WAS to 4 percent prior to hauling to the Camas WWTF. A site layout and process flow schematic for Alternative No. 2A are presented in Figures 9-3 and 9-4, respectively.

**TABLE 9-6**

**Alternative No. 2A: Anaerobic Digestion of Camas WWTF and Washougal WWTF Biosolids Design Criteria (Design Year 2025)**

| | Maximum Month | Annual Average |
|---|---|---|
| Camas WWTF Influent $BOD_5$ (lb/d) | 5,616 | 4,030 |
| Camas WWTF Influent TSS (lb/d) | 8,001 | 5,883 |
| Camas Waste Primary Sludge (lb/d) | 6,428 | 4,754 |
| Camas Waste Activated Sludge (lb/d) | 3,439 | 2,528 |
| Camas WAS Flow (gpd) @ 1% solids | 41,200 | 30,300 |
| Washougal Waste Activated Sludge (lb/d) | 4,476 | 3,715 |
| Washougal Waste Activated Sludge Flow (gpd) @ 4% solids | 13,400 | 11,100 |
| Total Waste Activated Sludge (lb/d) | 7,916 | 6,243 |
| Total Waste Sludge (lb/d) to Digesters | 13,038 | 9,993 |
| Total Waste Sludge Flow to Digesters (gpd) | 28,900 | 22,200 |
| Digester Waste Sludge Concentration (%) | 5.4% | 5.4% |

Additional WAS holding tank volume for the Washougal sludge is required for this option to provide sufficient holding capacity to allow a steady flow of sludge to the primary anaerobic digesters. The sludge holding tank will have a volume of 165,000 gallons to provide a holding capacity for 3 days of Washougal and Camas WAS at maximum month loading conditions. A sludge loading pump is required to transfer sludge from the sludge hauling truck to the sludge holding tank, and a dedicated blower and coarse bubble diffuser system are required to keep the sludge aerated and prevent foul odors. For this alternative, the Camas primary sludge and WAS will be treated identically as described for Alternative No. 1A, with the exception that the Camas WAS will be commingled and stored with the Washougal WAS in a common WAS storage tank. The combined WAS mixture will then be transferred to the new WAS thickening system.

The existing Aerobic Digester No. 2 will be modified to serve as a holding tank with three separate compartments for the combined Camas and Washougal WAS, dewatering centrifuge centrate, and septage. Each of the three holding tanks will have a dedicated aeration blower and coarse bubble diffuser system. Submersible centrifugal pumps will be installed in the centrate storage tank to transfer centrate to the aeration basin splitter box during low plant influent load periods. Submersible centrifugal pumps will be installed in the septage storage tank to allow septage to be transferred to the headworks. Additional septage discharge piping will be installed to allow the septage to also be transferred to the existing septage receiving tank or to the WAS storage tank, where it can be mixed with the WAS and transferred to the WAS thickener.

The existing digested sludge pumps will be used to transfer WAS from the WAS holding tank to the sludge thickening system, which will be located in the new digester building.

The new sludge thickening system will consist of a rotary screen thickener, thickening polymer addition system, thickener magnetic flow meter, and two thickened WAS pumps. Thickened WAS will drop from the rotary screen thickener drum into a hopper equipped with two progressing cavity thickened WAS pumps, which will transfer thickened WAS to the digesters. Two new progressing cavity digested sludge pumps will be installed in the digester building to pump digested sludge to the existing dewatering centrifuge from the sludge holding tank or the anaerobic digesters.

The existing thickened waste sludge pump will pump the thickened WPS from the existing gravity thickener to the new anaerobic digesters. The volume and surface area of the existing gravity thickener will be sufficient to thicken the WPS. The existing gravity thickener will be modified to include a non-potable dilution water supply line to maintain the overflow rate of 25 gallons/square foot/day. The existing dewatering centrifuge has a rated capacity of 160 gpm and the new digested sludge pumps will have a rated capacity of 160 gpm at 30 psi. With a digested sludge rate of 28,000 gpd and the pumping capacity of 160 gpm, the centrifuge will be required to operate approximately 20 hours/week during maximum month loading conditions for the 2025 design year. The centrifuge will be required to operate approximately 16 hours/week during annual average loading conditions for the design 2025 year. The existing primary sludge pumps, grit removal system, WAS pumps, and thickened waste sludge pumps have sufficient capacity to treat the biosolids associated with the design year 2025.

Two primary anaerobic digesters and one sludge holding tank are proposed for this alternative. The volume of the primary digesters would provide sufficient capacity to produce a Class B biosolid for the year 2025. The new digesters would be built west of the existing headworks at the location shown in Figure 9-3. Digested sludge from the primary digesters will be routed to the new sludge holding tank.

The new primary digesters will each have a diameter of 35 feet, a side water depth of 40 feet, and a working volume of 38,600 cubic feet (289,000 gallons). A fixed cover will be installed on each of the new primary digesters and the sludge holding tank. A new digester control building will be constructed between the digesters to house the heat exchangers, gas boiler, sludge thickening system, recirculation pumps, digested sludge pumps and associated piping, and control equipment. A new second plant drain pump station will be constructed adjacent to the digester building to pump the drain flows from the digester building to the aeration basin splitter box.

Design hydraulic retention time and volatile solids loading in the primary digesters for the year 2025 are projected to be 20 days and 6,760 lb VSS/day, respectively, under monthly maximum flow conditions in the year 2025. The primary digesters will be heated to a temperature of approximately 35°C using energy derived from the methane gas produced during digestion. The design hydraulic retention time and operating temperatures will allow the process to meet the Class B pathogen reduction criteria in the WAC 173-308

regulations, as well as the criteria for vector attraction reduction (38 percent VSS reduction or greater).

The new primary digesters will be mixed with top mounted mechanical mixers. Heat for the primary digesters will be provided by a hot water boiler capable of burning either digester gas or commercial natural gas. Each primary digester will have one spiral heat exchanger for heating of thickened feed sludges. Two recirculation pumps and a backup will be provided for the digesters to allow for heating of digester contents. Digester equipment will be housed within a new control building. Digested sludge and from the primary digesters will be conveyed by gravity to the sludge holding tank. Sludge within the sludge holding tank will not be heated or mixed. Excess gas will be burned at a waste gas burner, which will be located near the digester complex.

The design criteria for the primary anaerobic digesters, sludge holding tank, and associated equipment are provided below.

**Alternative No. 2A Anaerobic Digesters Design Criteria**

| | |
|---|---|
| Primary Anaerobic Digesters | |
| Quantity of New Primary Digesters | 2 |
| Volume (each) | 38,600 cubic feet |
| Diameter | 35 feet |
| Side Water Depth | 40 feet |
| Total Primary Digester Volume | 77,200 cubic feet |
| Influent Sludge Feed Rate | 28,900 gpd |
| Hydraulic Retention Time | 20 days |
| Influent Sludge Solids Concentration | 5.4 percent |
| Total Solids Loading | 13,000 lb/day |
| Volatile Solids Loading | 10,600 lb/day |
| Volatile Solids Loading | 0.11, lb VS/ft$^3$/d |
| Digester Operating Temperature | 35°C to 38°C |
| Estimated Volatile Solids Reduction | 40 percent |
| Sludge Holding Tank | |
| Quantity | 1 |
| Volume | 19,300 cubic feet |
| Diameter | 35 feet |
| Side Water Depth | 20 feet |
| Sludge Flow Rate | 28,900 gpd |
| Effluent Sludge Solids Concentration | 3.4 percent |
| Hydraulic Retention Time | 5 days |
| Digester Mixing | |
| Type of Mixing | Mechanical |

| | |
|---|---|
| No. of Mixers per Digester | 1 |
| Mixer Pump Capacity | 14,000 gpm |
| Turnover Time | 20 minutes |
| Motor Size | 15 hp |

Heating

| | |
|---|---|
| Quantity of Boilers | 1 |
| Boiler Type | Fire Tube |
| Boiler Size | 1,004,000 BTU/hr |
| Quantity of Spiral Heat Exchangers | 2 |
| Heat Exchanger Type | Spiral |
| Heat Exchanger Capacity | 750,000 BTU/hr |
| Quantity of Boiler Water Pumps | 2 |
| Boiler Water Pump Type | Centrifugal |
| Boiler Water Pump Capacity | 300 gpm |
| Boiler Water Pump TDH | 29 feet |
| Boiler Water Pump Motor Size | 10 hp |

Recirculation pumps

| | |
|---|---|
| Type | Rotary Lobe |
| Quantity of Pumps | 3 |
| Pump Capacity | 300 gpm |
| TDH | 30 feet |
| Motor Size | 10 hp |

WAS Storage Tank

| | |
|---|---|
| Volume | 165,000 gallons |
| No. of Aeration Blowers | 1 |
| Blower Type | Positive Displacement |
| Blower Capacity | 450 SCFM |
| Blower Discharge Pressure | 4.6 psig |
| Blower Motor Size | 20 hp |

Centrate Storage Tank

| | |
|---|---|
| Volume | 45,000 gallons |
| No. of Aeration Blowers | 1 |
| Blower Type | Positive Displacement |
| Blower Capacity | 120 SCFM |
| Blower Discharge Pressure | 4.6 psig |
| Blower Motor Size | 5 hp |
| No. Centrate Pumps | 2 |
| Pump Type | Submersible Centrifugal |

| | |
|---|---|
| WAS Loading Pumps | |
| Type | Progressing Cavity |
| Quantity of Pumps | 1 |
| Pump Capacity | 100 gpm |
| TDH | 60 psi |
| Motor Size | 15 hp |
| | |
| Septage Storage Tank | |
| Volume | 30,000 gallons |
| No. of Aeration Blowers | 1 |
| Blower Type | Positive Displacement |
| Blower Capacity | 80 SCFM |
| Blower Discharge Pressure | 4.6 psig |
| Blower Motor Size | 5 hp |
| No. of Septage Pumps | 2 |
| Pump Type | Submersible Centrifugal |
| | |
| WAS Thickener | |
| Quantity | 1 |
| Type | Rotary Screen Thickener |
| Flow Capacity | 200 gpm |
| Feed Solids | 1% |
| Thickened Solids | 5-7% |
| Motor Sizes: | 5 hp |
| Flocculator | 1 hp |
| Drum Main Drive | 2 hp |
| Booster Pump | 2 hp |
| | |
| Thickening Polymer Feed System | |
| Quantity | 1 |
| Type | 2-Tank |
| Polymer Type | Liquid or Dry |
| Mixing Tank Volume | 520 gallons |
| Holding Tank Volume | 500 gallons |
| Solution Feed Pump Capacity | 100 gph |
| Active Polymer Capacity | 2 lb/hr |
| Volumetric Screw Feeder Motor Size | 1/4 hp |
| Liquid Polymer Feed Pump Motor Size | 1/2 hp |
| Solution Feed Pump Motor Size | 3/4 hp |

Thickened WAS Pumps

| | |
|---|---|
| Quantity | 2 |
| Type | Progressing Cavity |
| Capacity | 50 gpm |
| Pump Head | 60 psi |
| Motor Size | 10 hp |

Digested Sludge Pumps

| | |
|---|---|
| Quantity | 2 |
| Type | Progressing Cavity |
| Capacity | 160 gpm |
| Pump Head | 60 psi |
| Motor Size | 10 hp |

Plant Drain Pump Station No. 2

| | |
|---|---|
| Quantity of Pumps | 2 |
| Type of Pumps | Submersible Centrifugal |
| Capacity | 500 gpm |
| Pump Head | 40 ft |
| Motor Size | 10 hp |

The capital and O&M costs associated with Alternative No. 2A are presented in Tables 9-7 and 9-8, respectively. The O&M cost for Alternative No. 2A includes the cost of contracted biosolids hauling off site.

**TABLE 9-7**

**Alternative No. 2A: Anaerobic Digestion of Camas and Washougal Biosolids Preliminary Project Cost Estimate (2007 Dollars)**

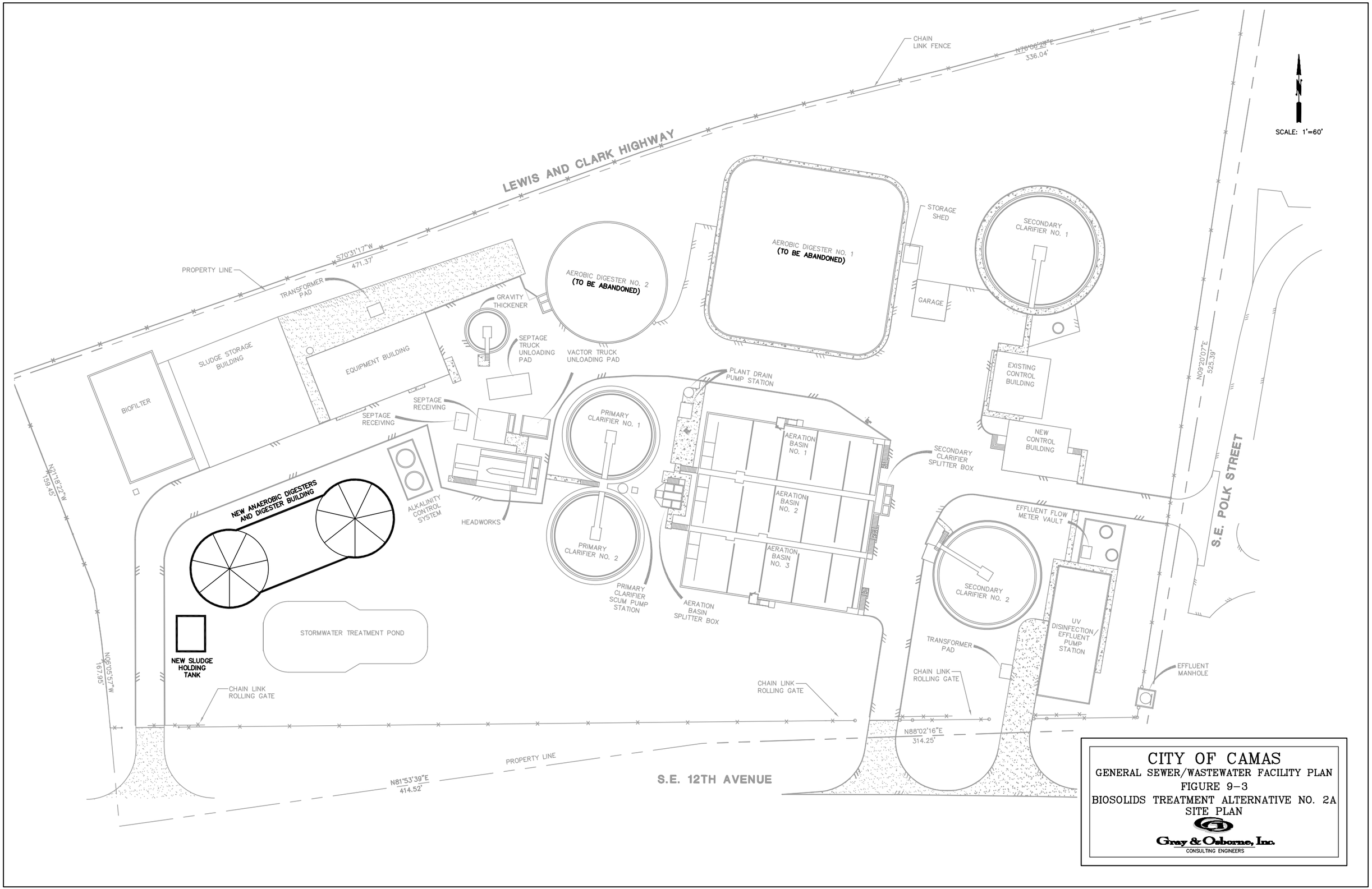
| No. | Item | Quantity | Unit Price | Amount |
|---|---|---|---|---|
| 1. | Mobilization/Demobilization | 1 LS | $540,000 | $540,000 |
| 2. | Demolition | 1 LS | $40,000 | $40,000 |
| 3. | Anaerobic Digester/Dig. Building | 1 LS | $1,150,000 | $1,150,000 |
| 4. | Digester Sludge Heating System | 1 LS | $253,000 | $253,000 |
| 5. | Digester Gas Equipment | 1 LS | $167,000 | $167,000 |
| 6. | Digester Covers | 1 LS | $650,000 | $650,000 |
| 7. | Digester Mixing System | 1 LS | $340,000 | $340,000 |
| 8. | Digester Recirculation Pumps | 1 LS | $87,000 | $87,000 |
| 9. | WAS/Septage/Centrate Tank | 1 LS | $300,000 | $300,000 |

**TABLE 9-7 – (continued)**

**Alternative No. 2A: Anaerobic Digestion of Camas and Washougal Biosolids**
**Preliminary Project Cost Estimate (2007 Dollars)**

| No. | Item | Quantity | Unit Price | Amount |
|---|---|---|---|---|
| 10. | WAS Thickening System | 1 LS | $237,000 | $237,000 |
| 11. | Digested Sludge Pumps | 1 LS | $40,000 | $40,000 |
| 12. | Plant Drain Pump Station No. 2 | 1 LS | $70,000 | $70,000 |
| 13. | Dewatering | 1 LS | $75,000 | $75,000 |
| 14. | Earthwork | 1 LS | $220,000 | $220,000 |
| 15. | Miscellaneous Metals | 1 LS | $60,000 | $60,000 |
| 16. | Painting | 1 LS | $110,000 | $110,000 |
| 17. | Site Work | 1 LS | $120,000 | $120,000 |
| 18. | Mechanical/Yard Piping | 1 LS | $305,000 | $305,000 |
| 19. | Electrical | 1 LS | $430,000 | $430,000 |

Subtotal .....$5,194,000
Construction Contingency (20%).....$1,038,000
Subtotal .....$6,232,000
Washington State Sales Tax (7.9%).....$ 492,000
**TOTAL ESTIMATED CONSTRUCTION COST.....$6,725,000**
Engineering, Administrative, and Legal Services (20%).....$1,345,000
**TOTAL ESTIMATED PROJECT COST.....$8,070,000**




# CITY OF CAMAS

GENERAL SEWER/WASTEWATER FACILITY PLAN

FIGURE 9-3

BIOSOLIDS TREATMENT ALTERNATIVE NO. 2A SITE PLAN

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CONSULTING ENGINEERS

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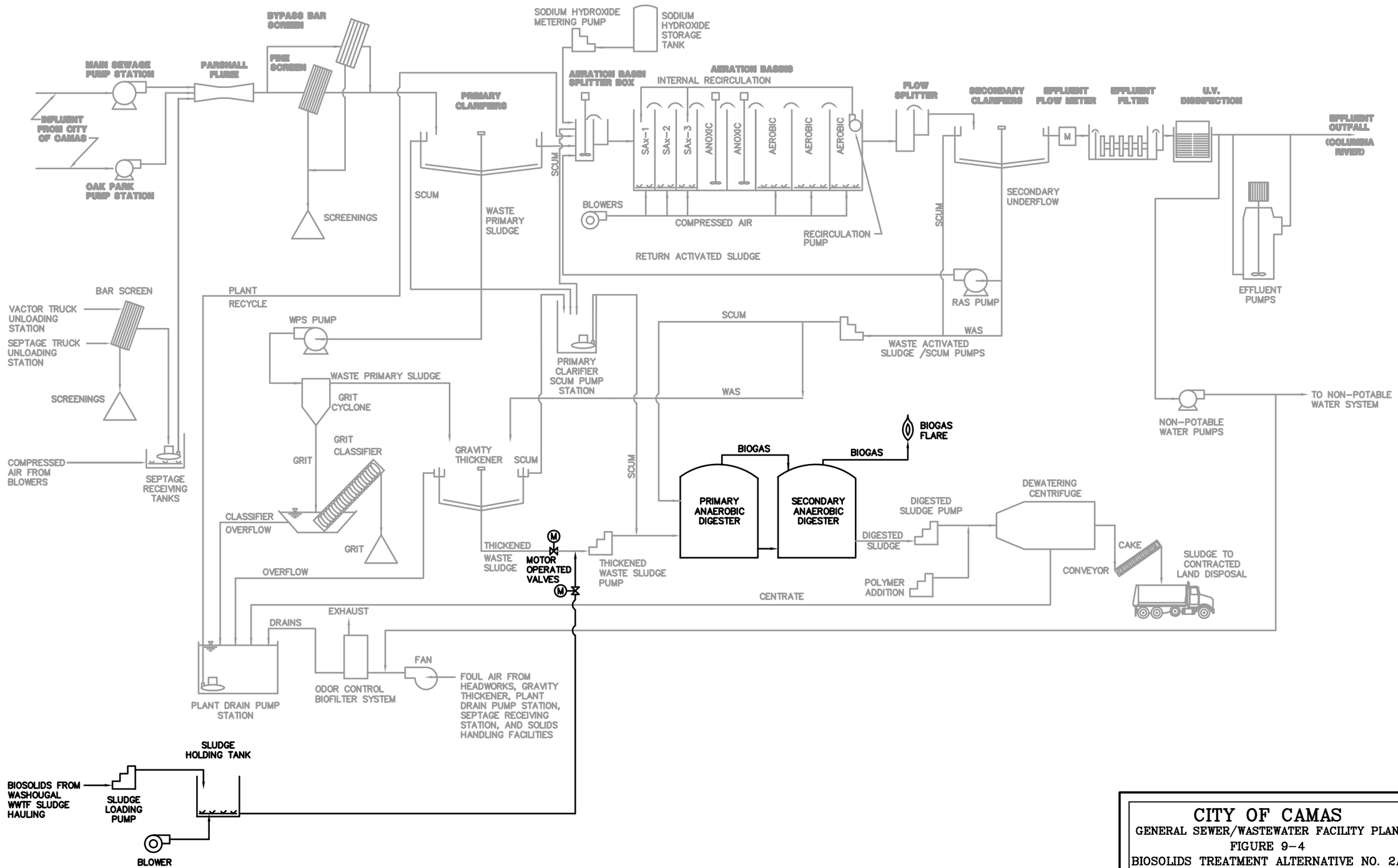



CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
FIGURE 9-4
BIOSOLIDS TREATMENT ALTERNATIVE NO. 2A
PROCESS FLOW SCHEMATIC

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\05471 WW FAC PLAN\FIGURES\FIG9-4.DWG, 9-4, 9/29/2006 11:41:33 AM, 1:1, BY: M NAGEL

**TABLE 9-8**

**Alternative No. 2A: Anaerobic Digestion of Camas and Washougal Biosolids O&M Cost Estimate (Design Year 2025)**

| Item | Costs (Year 2007 $) |
|---|---|
| Labor ($38/hr) | $ 79,000 |
| Power ($0.07/kWh) | $ 70,000 |
| Polymer ($2.50/lb) | $ 75,000 |
| Natural Gas ($1.15/therm) | $ 16,000 |
| Contracted Hauling and Land Application ($60/wet TN) | $350,000 |
| Equipment Maintenance and Repair | $ 14,000 |
| Testing/Permitting | $ 5,000 |
| **Total Annual Cost** | **$609,000** |

## BIOSOLIDS MANAGEMENT ALTERNATIVES

The City of Camas currently disposes of its Class B biosolids by contracting with a sludge hauler, which is consistent with the recommendations of the *1997 Wastewater Facility Plan*. Continued disposal of Class B biosolids by a contract hauler will be compared to an option to produce a Class A biosolid. The options considered for biosolids treatment to produce a Class A biosolid include composting, lime stabilization, and sludge drying.

Composting of the WWTF biosolids was eliminated due to the high land area, labor, and O&M requirements. This process is highly labor intensive and requires a large amount of bulking agents such as sawdust, straw, wood chips, tree trimmings, etc., to be mixed with the sludge. Due to these reasons and the risks associated with potential odor problems, this option was eliminated.

Lime stabilization was discussed previously in this chapter and was considered as a treatment option in the *1997 Wastewater Facility Plan*. This treatment process is relatively high in maintenance requirements and results in a net increase in biosolids mass with a corresponding increase in storage and application requirements due to the addition of lime to the biosolids. Lime is a caustic dry chemical and its handling can be hazardous to workers. Therefore, special procedures to prevent chemical contact with skin and dust inhalation are required. Based on the relatively high maintenance requirements, the safety risks involved, and the difficulties of disposing of high pH biosolids, lime stabilization was eliminated as an option.

A detailed comparison the continued land application of Class B biosolids and the option to produce a Class A biosolid by the method of sludge drying is provided below. For both treatment alternatives, treating Camas-only biosolids and treating Camas and

Washougal biosolids together are evaluated. The biosolids management alternatives considered are listed below.

- Alternative No. 1A: Anaerobic Digestion of Camas WWTF Biosolids and Contract Disposal of Class B Biosolids
- Alternative No. 2A: Anaerobic Digestion of Camas and Washougal WWTF Biosolids and Contract Disposal of Class B Biosolids
- Alternative No. 1B: Anaerobic Digestion of Camas WWTF Biosolids Followed by Sludge Drying to Produce a Class A Biosolid
- Alternative No. 2B: Anaerobic Digestion of Camas and Washougal WWTF Biosolids Followed by Sludge Drying to Produce a Class A Biosolid

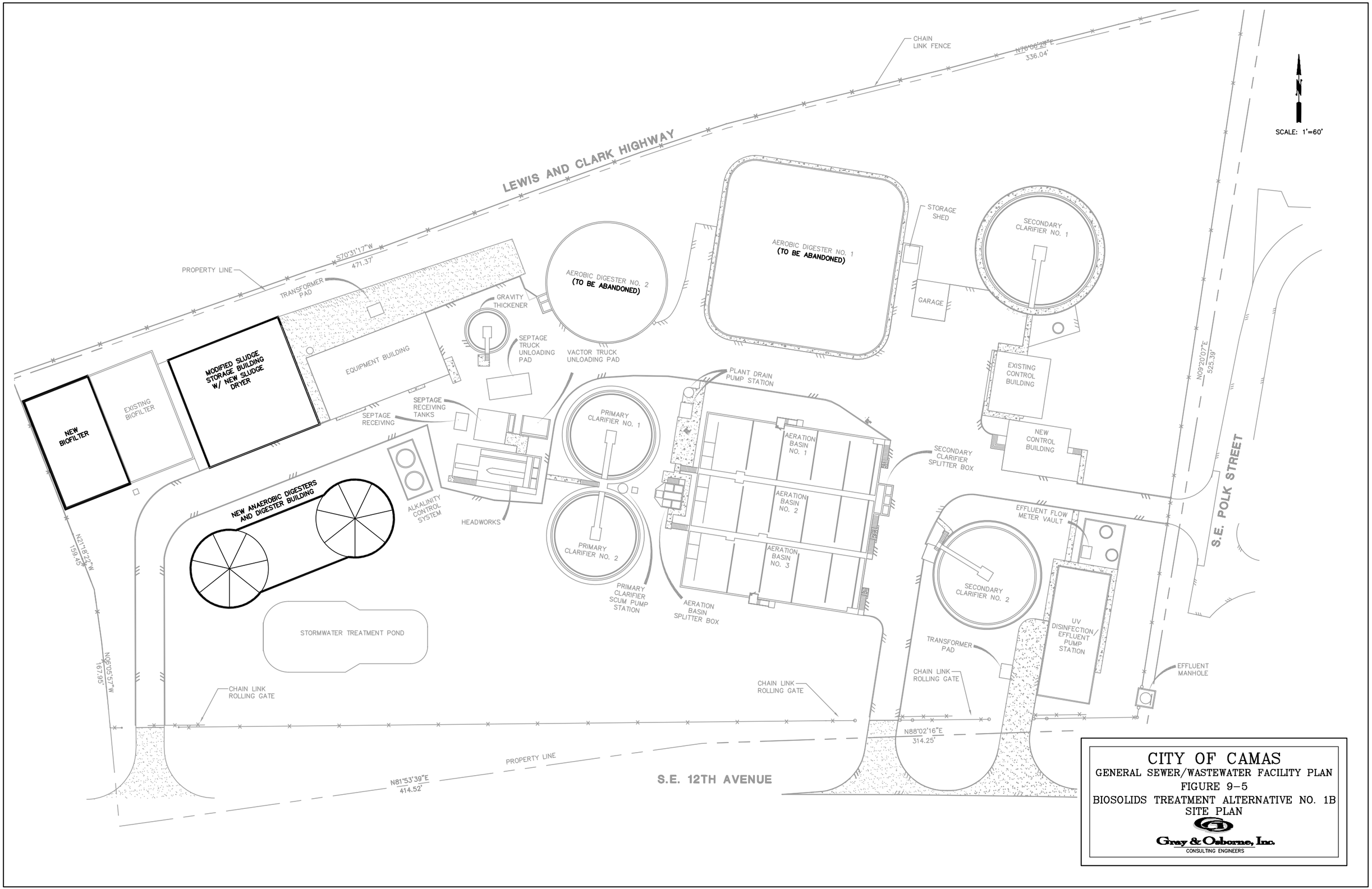
Alternatives No. 1A and No. 2A are discussed in the preceding sections of this Chapter. Alternatives No. 1B and No. 2B are discussed below, followed by a comparison of all four alternatives.

## ALTERNATIVE NO. 1B: ANAEROBIC DIGESTION OF CAMAS WWTF BIOSOLIDS FOLLOWED BY SLUDGE DRYING TO PRODUCE A CLASS A BIOSOLID

A site layout and process flow schematic for Alternative No. 1B are presented in Figures 9-5 and 9-6, respectively. For this alternative, it is assumed that a new sludge dryer system will be installed at the existing sludge storage building. A drying system with a capacity of 1.54 wet tons/hr is required. Based on the projected maximum month and annual average quantities of dewatered sludge at 20 percent solids, the dryer would have the following operational features:

| | |
|---|---|
| Sludge Dryer Operation | |
| Capacity | 1.54 wet tons/hr |
| Hours of Operation/Workday (249 work day/yr) | |
| Maximum Month | 16 |
| Annual Average | 12 |
| Drying Energy Required | 1,400 BTU/lb of water |
| Electricity Required | 63 kW |
| Nonpotable Water Required | 242 gpm |
| Potable Water Required | 44 gpm |

The existing sludge storage building will be modified to be an enclosed structure to house the new sludge drying system. Providing an enclosed structure for the sludge drying system provides freeze protection of the system, allows for odor control, and increases the efficiency of the system during cold weather. Additional odor control facilities that




# CITY OF CAMAS

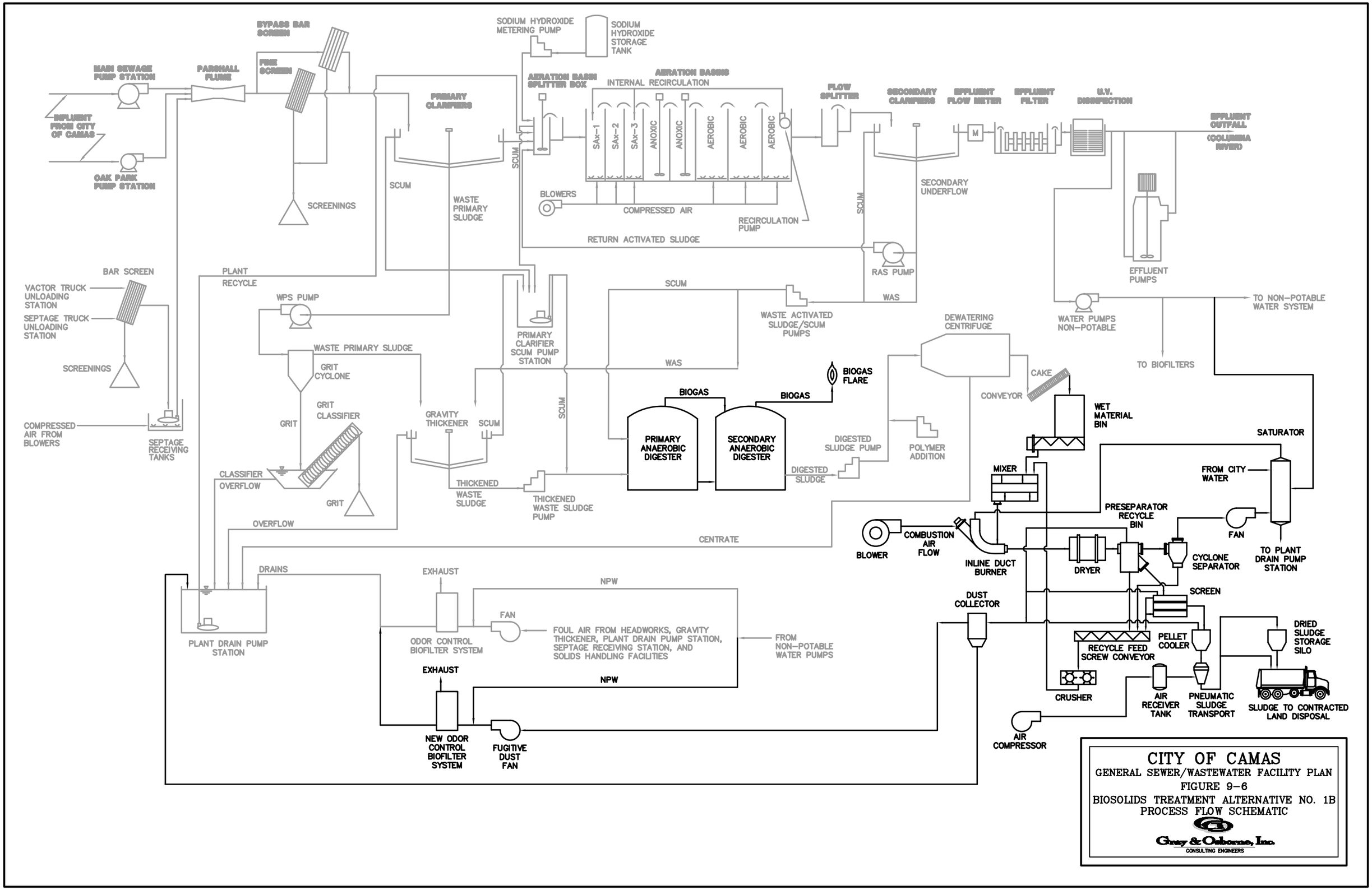
GENERAL SEWER/WASTEWATER FACILITY PLAN

FIGURE 9–5

BIOSOLIDS TREATMENT ALTERNATIVE NO. 1B
SITE PLAN

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\05471 WW FAC PLAN\FIGURES\FIG9-5.DWG, 9-5, 9/29/2006 11:40:56 AM, 0.5:1, BY: M NAGEL




CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
FIGURE 9-6
BIOSOLIDS TREATMENT ALTERNATIVE NO. 1B
PROCESS FLOW SCHEMATIC

L:\CAMAS\05471 WW FAC PLAN\FIGURES\FIG9-6.DWG, 9-6, 9/29/2006 11:40:15 AM, 1:1, BY: M NAGEL

would be installed for this alternative include a new additional biofilter, biofilter fan, humidification tower, and odor control ducts. The design criteria for the odor control system are presented below:

| | |
|---|---|
| Odor Control System | |
| Type | Biofilter |
| Quantity of Units | 1 new, 1 existing |
| System Size | 3,600 square feet |
| Media Depth | 63 inches |
| | |
| Biofilter Fan | |
| Type | Centrifugal |
| Quantity of Units | 1 new, 1 existing |
| Fan Capacity | 3,600 scfm |
| Fan Motor Size | 15 hp |

The capital and O&M costs associated with Alternative No. 1B are presented in Tables 9-9 and 9-10, respectively.

**TABLE 9-9**

**Alternative No. 1B: Anaerobic Digestion of Camas WWTF Biosolids Followed by Sludge Drying to Produce a Class A Biosolid Preliminary Project Cost Estimate (2007 Dollars)**

| No. | Item | Quantity | Unit Price | Amount |
|---|---|---|---|---|
| 1. | Mobilization/Demobilization | 1 LS | $720,000 | $720,000 |
| 2. | Demolition | 1 LS | $40,000 | $40,000 |
| 3. | Anaerobic Digester/Dig. Building | 1 LS | $750,000 | $750,000 |
| 4. | Digester Sludge Heating System | 1 LS | $231,000 | $231,000 |
| 5. | Digester Gas Equipment | 1 LS | $152,000 | $152,000 |
| 6. | Digester Covers | 1 LS | $650,000 | $650,000 |
| 7. | Digester Mixing System | 1 LS | $300,000 | $300,000 |
| 8. | Digester Recirculation Pumps | 1 LS | $79,000 | $79,000 |
| 9. | WAS/Septage/Centrate Tank | 1 LS | $280,000 | $280,000 |
| 10. | WAS Thickening System | 1 LS | $237,000 | $237,000 |
| 11. | Digested Sludge Pumps | 1 LS | $40,000 | $40,000 |
| 12. | Plant Drain Pump Station No. 2 | 1 LS | $70,000 | $70,000 |
| 13. | Sludge Storage Building Modifications | 1 LS | $185,000 | $185,000 |
| 14. | Sludge Dryer System | 1 LS | $2,300,000 | $2,300,000 |
| 15. | Odor Control Filter and Equipment | 1 LS | $252,000 | $252,000 |
| 16. | Dewatering | 1 LS | $75,000 | $75,000 |
| 17. | Earthwork | 1 LS | $100,000 | $100,000 |

**TABLE 9-9 – (continued)**

**Alternative No. 1B: Anaerobic Digestion of Camas WWTF Biosolids Followed by Sludge Drying to Produce a Class A Biosolid Preliminary Project Cost Estimate (2007 Dollars)**

| No. | Item | Quantity | Unit Price | Amount |
|---|---|---|---|---|
| 18. | Miscellaneous Metals | 1 LS | $80,000 | $80,000 |
| 19. | Painting | 1 LS | $150,000 | $150,000 |
| 20. | Site Work | 1 LS | $120,000 | $120,000 |
| 21. | Mechanical/Yard Piping | 1 LS | $275,000 | $275,000 |
| 22. | Electrical | 1 LS | $520,000 | $520,000 |

Subtotal ..... $ 7,606,000
Construction Contingency (20%) ..... $ 1,521,000
Subtotal ..... $ 9,127,000
Washington State Sales Tax (7.9%) ..... $ 721,000
**TOTAL ESTIMATED CONSTRUCTION COST ..... $ 9,848,000**
Engineering, Administrative, and Legal Services (20%) ..... $ 1,969,000
**TOTAL ESTIMATED PROJECT COST ..... $11,817,000**

**TABLE 9-10**

**Alternative No. 1B: Anaerobic Digestion of Camas WWTF Biosolids Followed by Sludge Drying to Produce a Class A Biosolid O&M Cost Estimate (Design Year 2025)**

| Item | Costs (Year 2007 $) |
|---|---|
| Labor ($38/hr) | $159,000 |
| Power ($0.07/kWh) | $ 54,000 |
| Polymer ($2.50/lb) | $ 48,000 |
| Natural Gas ($1.15/therm) | $105,000 |
| Potable Water ($4.80/ccf) | $ 50,000 |
| Non-Potable Water ($1.00/ccf) | $ 58,000 |
| Equipment Maintenance and Repair | $ 37,000 |
| Testing/Permitting | $ 15,000 |
| **Total Annual Cost** | **$526,000** |

## ALTERNATIVE NO. 2B: ANAEROBIC DIGESTION OF CAMAS AND WASHOUGAL WWTF BIOSOLIDS FOLLOWED BY SLUDGE DRYING TO PRODUCE A CLASS A BIOSOLID

A site layout and process flow schematic for Alternative No. 2B are presented in Figures 9-7 and 9-8, respectively. For this alternative, it is assumed that a new sludge dryer system will be installed at the existing sludge storage building. A drying system with a capacity of 2.54 wet tons/hr has been selected. Based on the projected maximum month and annual average quantities of dewatered sludge at 20 percent solids, the dryer would have the following operational features:

| | |
|---|---|
| Sludge Dryer Operation | |
| Capacity | 2.54 wet tons/hr |
| Hours of Operation/Workday (249 work day/yr) | |
| Maximum Month | 12 |
| Annual Average | 11 |
| Drying Energy Required | 1,800 BTU/lb of water |
| Electricity Required | 120 kW |
| Nonpotable Water Required | 400 gpm |
| Potable Water Required | 72 gpm |

The existing sludge storage building will be modified to be an enclosed structure to house the new sludge drying system. Providing an enclosed structure for the sludge drying system provides freeze protection of the system, allows for odor control, and increases the efficiency of the system during cold weather. Additional odor control facilities that would be installed for this alternative include a new additional biofilter, biofilter fan, humidification tower, and odor control ducts. The design criteria for the odor control system are presented below:

| | |
|---|---|
| Odor Control System | |
| Type | Biofilter |
| Quantity of Units | 1 new, 1 existing |
| System Size | 3,600 square feet |
| Media Depth | 63 inches |
| | |
| Biofilter Fan | |
| Type | Centrifugal |
| Quantity of Units | 1 new, 1 existing |
| Fan Capacity | 3,600 scfm |
| Fan Motor Size | 15 hp |

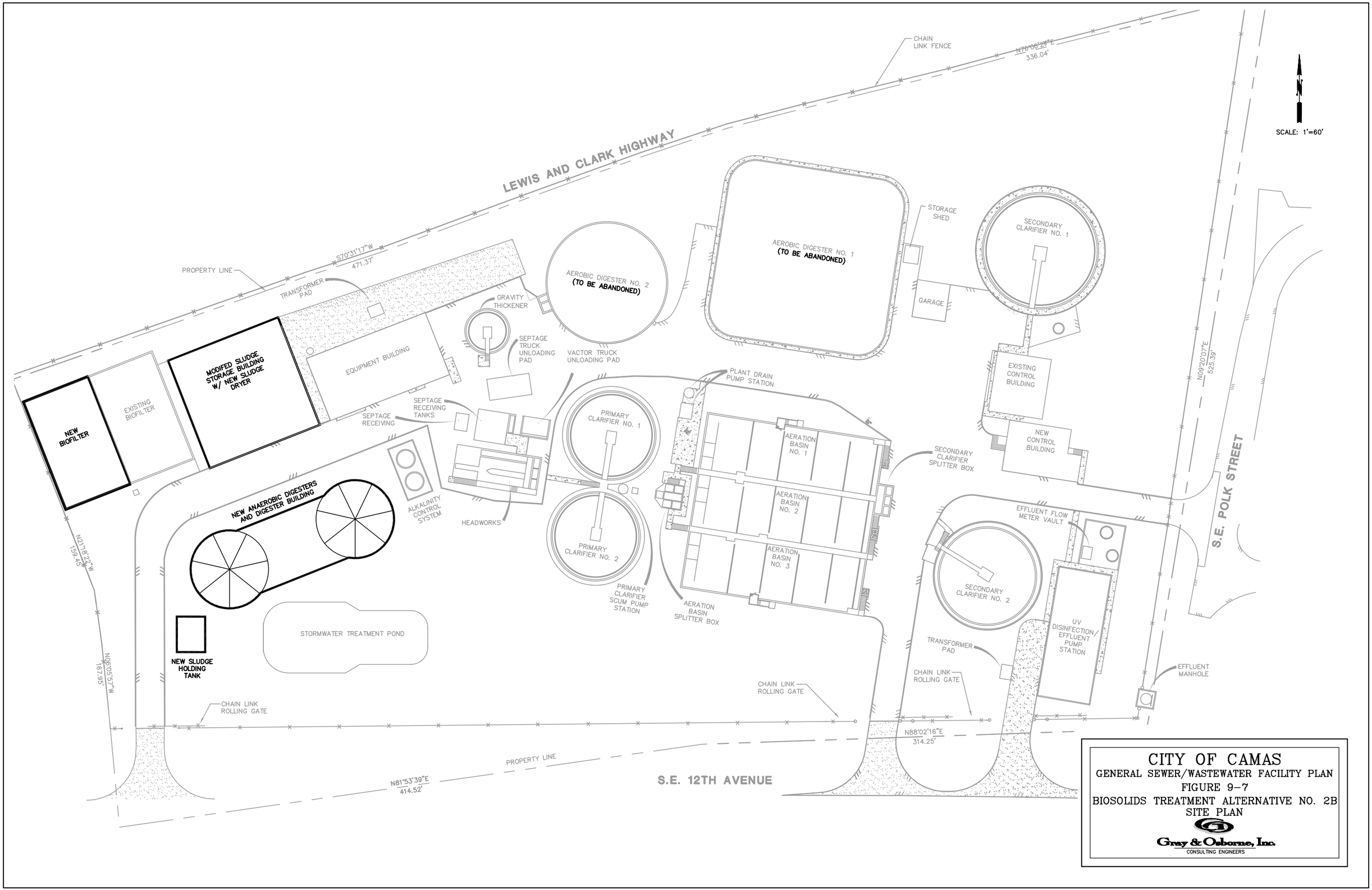
The capital and O&M costs associated with Alternative No. 2B are presented in Tables 9-11 and 9-12, respectively.

**TABLE 9-11**

**Alternative No. 2B: Anaerobic Digestion of Camas and Washougal WWTF Biosolids Followed by Sludge Drying to Produce a Class A Biosolid Preliminary Project Cost Estimate (2007 Dollars)**

| No. | Item | Quantity | Unit Price | Amount |
|---|---|---|---|---|
| 1. | Mobilization/Demobilization | 1 LS | $540,000 | $540,000 |
| 2. | Demolition | 1 LS | $40,000 | $40,000 |
| 3. | Anaerobic Digester/Dig. Building | 1 LS | $1,150,000 | $1,150,000 |
| 4. | Digester Sludge Heating System | 1 LS | $253,000 | $253,000 |
| 5. | Digester Gas Equipment | 1 LS | $167,000 | $167,000 |
| 6. | Digester Covers | 1 LS | $650,000 | $650,000 |
| 7. | Digester Mixing System | 1 LS | $340,000 | $340,000 |
| 8. | Digester Recirculation Pumps | 1 LS | $87,000 | $87,000 |
| 9. | WAS/Septage/Centrate Tank | 1 LS | $300,000 | $300,000 |
| 10. | WAS Thickening System | 1 LS | $237,000 | $237,000 |
| 11. | Digested Sludge Pumps | 1 LS | $40,000 | $40,000 |
| 12. | Plant Drain Pump Station No. 2 | 1 LS | $70,000 | $70,000 |
| 13. | Sludge Storage Building Modifications | 1 LS | $185,000 | $$185,000 |
| 14. | Sludge Dryer System | 1 LS | $3,000,000 | $3,000,000 |
| 15. | Odor Control Filter and Equipment | 1 LS | $252,000 | $252,000 |
| 16. | Dewatering | 1 LS | $75,000 | $75,000 |
| 17. | Earthwork | 1 LS | $220,000 | $220,000 |
| 18. | Miscellaneous Metals | 1 LS | $90,000 | $90,000 |
| 19. | Painting | 1 LS | $160,000 | $160,000 |
| 20. | Site Work | 1 LS | $140,000 | $140,000 |
| 21. | Mechanical/Yard Piping | 1 LS | $330,000 | $330,000 |
| 22. | Electrical | 1 LS | $600,000 | $600,000 |

Subtotal ..... $ 8,926,000
Construction Contingency (20%) ..... $ 1,785,000
Subtotal ..... $10,711,000
Washington State Sales Tax (7.9%) ..... $ 846,000
**TOTAL ESTIMATED CONSTRUCTION COST ..... $11,557,000**
Engineering, Administrative, and Legal Services (20%) ..... $ 2,311,000
**TOTAL ESTIMATED PROJECT COST ..... $13,868,000**




# CITY OF CAMAS

GENERAL SEWER/WASTEWATER FACILITY PLAN

FIGURE 9-7

BIOSOLIDS TREATMENT ALTERNATIVE NO. 2B SITE PLAN

Gray & Osborne, Inc.
CONSULTING ENGINEERS

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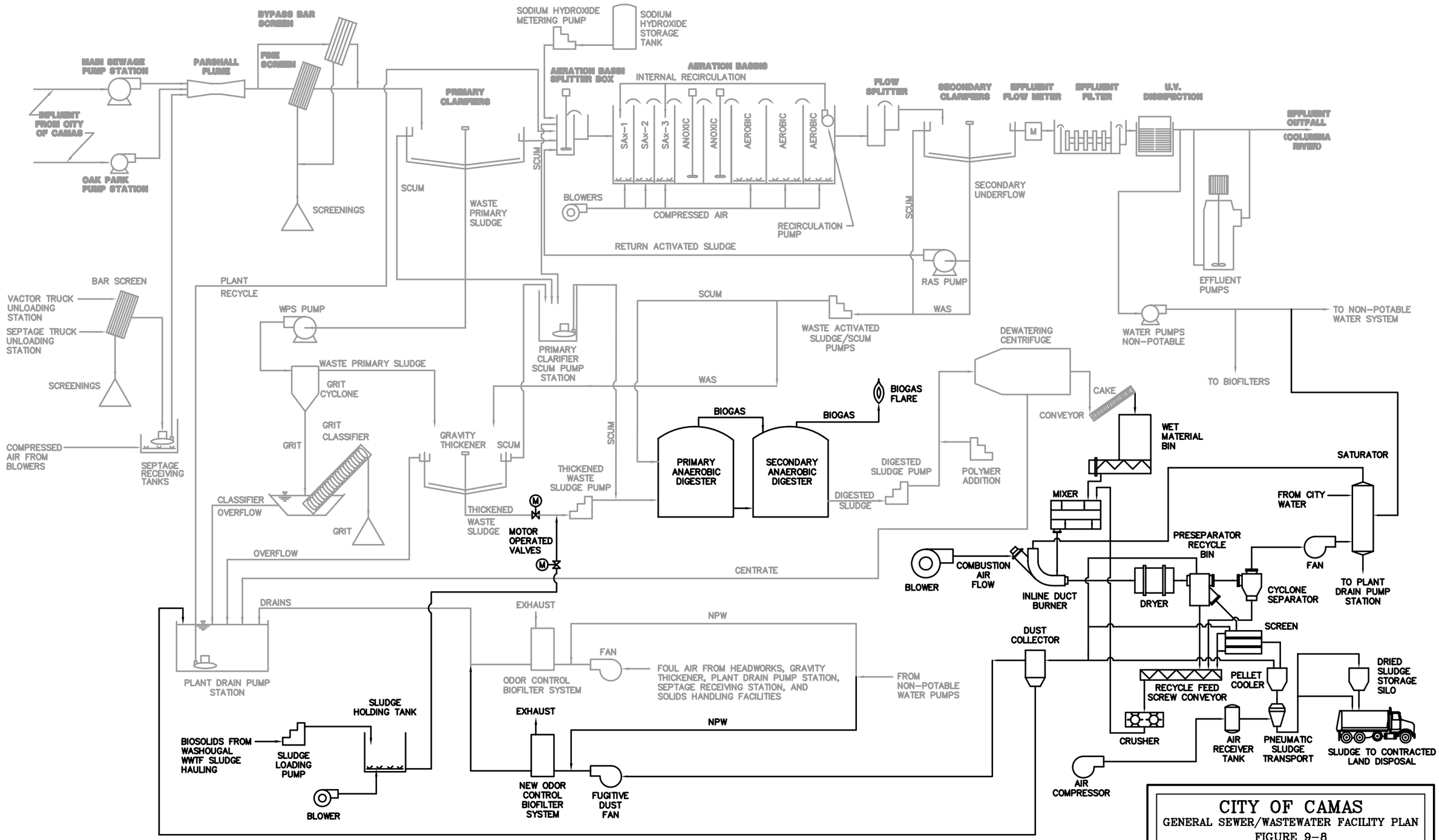


CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
FIGURE 9-8
BIOSOLIDS TREATMENT ALTERNATIVE NO. 2B
PROCESS FLOW SCHEMATIC

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\05471 WW FAC PLAN\FIGURES\FIG9-8.DWG, 9-8, 9/29/2006 11:43:39 AM, 1:1, BY: M NAGEL

**TABLE 9-12**

**Alternative No. 2B: Anaerobic Digestion of Camas and Washougal WWTF Biosolids Followed by Sludge Drying to Produce a Class A Biosolid O&M Cost Estimate (Design Year 2025)**

| Item | Costs (Year 2007 $) |
|---|---|
| Labor ($38/hr) | $159,000 |
| Power ($0.07/kWh) | $ 93,000 |
| Polymer ($2.50/lb) | $ 75,000 |
| Natural Gas ($1.15/therm) | $207,000 |
| Non-Potable Water ($1.00/ccf) | $ 33,000 |
| Equipment Maintenance and Repair | $ 50,000 |
| Testing/Permitting | $ 15,000 |
| **Total Annual Cost** | **$632,000** |

## COMPARISON OF BIOSOLIDS TREATMENT AND DISPOSAL ALTERNATIVES AND SELECTED ALTERNATIVE

A comparison of the capital and annual operation and maintenance costs for the four biosolids treatment and disposal alternatives is provided in Table 9-13.

**TABLE 9-13**

**Biosolids Treatment and Disposal Alternatives Comparison**

| Alternative | Capital Cost(1) | Annual O&M Cost(1) |
|---|---|---|
| No. 1A Anaerobic Digestion of Camas Biosolids and Contracted Hauling | $ 6,672,000 | $421,000 |
| No. 2A: Anaerobic Digestion of Camas and Washougal Biosolids and Contracted Hauling | $ 8,070,000 | $609,000 |
| No. 1B: Anaerobic Digestion of Camas WWTF Biosolids Followed by Sludge Drying to Produce a Class A Biosolid | $11,817,000 | $526,000 |
| No. 2B: Anaerobic Digestion of Camas and Washougal WWTF Biosolids Followed by Sludge Drying to Produce a Class A Biosolid | $13,868,000 | $632,000 |

(1) 2007 dollars.

The selected option is Alternative No. 1B: Anaerobic Digestion of Camas WWTF Biosolids Followed by Sludge Drying to Produce a Class A Biosolid. This selection is based on (1.) Washougal's May 2007 decision to treat and manage their biosolids on their

own, (2.) concern regarding future viability of land application sites for Class B biosolids, and (3.) the desires of Camas to control future biosolids management.

# CHAPTER 10

# EVALUATION OF REUSE

## INTRODUCTION

Wastewater reclamation can potentially be cost effective through reducing potable water costs, creating an additional new water supply, and generating revenue by selling reclaimed water to customers for irrigation and other non-potable water uses. The production and beneficial use of reclaimed water is the development of a new water supply. This chapter presents an evaluation of the feasibility of reusing effluent from the City of Camas WWTF or constructing a new water reclamation facility (WRF) to treat wastewater and produce water for reuse.

## REGULATIONS CONCERNING REUSE

The regulations governing water reuse in the State of Washington are the Water Reclamation and Reuse (Reuse) Standards (September 1997). The Reuse Standards, which were developed jointly by the Washington Departments of Health and Ecology, are directed primarily toward the public health aspects of water reuse. The use of reclaimed water must also meet the applicable water quality standards. An application to a surface water body is required to comply with the Surface Water Quality Standards (WAC 173-201A). Likewise, an application of reclaimed water to groundwater is required to comply with the Groundwater Quality Standards (WAC 173-200).

## WATER RECLAMATION AND REUSE STANDARDS

The legislation authorizing water reuse in this state, Chapter 90.46 RCW, Reclaimed Water Use, was passed in 1992. This initial legislation required the Washington Departments of Health (DOH) and Ecology (Ecology) to jointly develop interim standards for the implementation of water reclamation and reuse. The Water Reclamation and Reuse Interim Standards were issued as interim standards in 1993 and became final in September 1997. The Department of Ecology is currently drafting an update to the Standards; the update is expected to be promulgated in 2009-2010.

The Reuse Standards apply to reclaimed wastewater that is utilized for a direct beneficial use. The primary focus of the Reuse Standards is to provide for the protection of public health.

## TREATMENT CRITERIA

The Reuse Standards establish the treatment and water quality requirements for reclaimed water based on four classifications, Class A, B, C and D, and the class necessary for application to various uses. The class of reclaimed water is dependent upon the degree of stabilization and disinfection provided by the treatment process *prior* to any reuse application. Class A is the highest quality of reclaimed water, while Class D is essentially the equivalent of a wastewater effluent meeting secondary treatment standards. These treatment requirements are shown in Table 10-1.

**TABLE 10-1**

**Reclaimed Water Treatment Requirements**

| Reuse Class | Continuously Oxidized(1) | Continuously Coagulated(2) | Continuously Filtered(3) | Disinfection(4) (Total Coliform Density) | |
|---|---|---|---|---|---|
| | | | | 7-Day Median Value | Single Sample |
| **D** | Yes | No | No | ≤240/100 mL | No standard |
| **C** | Yes | No | No | ≤23/100 mL | 240/100l |
| **B** | Yes | No | No | ≤2.2/100m1 | 23/100 mL |
| **A** | Yes | Yes | Yes | ≤2.2/100 mL | 23/100 mL |

(1) **Continuous Oxidation.** Oxidized wastewater is defined as wastewater in which the organic matter has been stabilized. The concentration of five-day biochemical oxygen demand ($BOD_5$) and total suspended solids (TSS) cannot exceed 30 mg/L on a monthly average basis. The wastewater must be non-putrescable (i.e., no foul smell) and must contain dissolved oxygen.

(2) **Continuous Coagulation.** Coagulated wastewater is defined as an oxidized wastewater in which colloidal and finely divided suspended matter have been destabilized and agglomerated prior to filtration by the addition of chemicals or an equally effective method.

(3) **Continuous Filtration.** Filtered wastewater is defined as an oxidized, coagulated wastewater that has been passed through natural undisturbed soils or filter media, such as sand or anthracite. The resulting turbidity, as determined by an approved laboratory method, cannot exceed an average operating turbidity of 2 nephelometric turbidity units (NTU) on a monthly average basis. The turbidity cannot exceed 5 NTU at any time. The turbidity must be monitored continuously.

(4) **Disinfection.** Disinfected wastewater is defined as wastewater in which pathogenic organisms have been destroyed by physical, chemical or biological means. Disinfection standards generally use coliform density as the representative measure of pathogen destruction.

## GROUNDWATER RECHARGE

Reclaimed water may be used to recharge groundwater by surface percolation or through direct injection. Reclaimed water must meet Class A treatment criteria in order to be used for groundwater recharge by surface percolation. The quality of the reclaimed water must also meet the "groundwater recharge criteria," which are defined in the Reuse Standards as the equivalent of the DOH Drinking Water Standards. A major contaminant of concern in groundwater is nitrate nitrogen ($NO_3^-$-N). The Reuse Standards contain a

requirement that, for surface percolation, the treatment process "include an additional step to reduce nitrogen prior to the final discharge to groundwater."

Groundwater recharge projects must also be in compliance with the state's groundwater regulations in Chapter 173-200 WAC. This regulation contains groundwater quality criteria that are to be met in the saturated zone. The groundwater quality criteria are very similar to the Drinking Water Standards, and consequently, the groundwater recharge criteria mentioned above.

Direct injection is permitted to a drinking water aquifer as well as a non-drinking water aquifer. The treatment criteria for direct injection, particularly to a drinking water aquifer, require additional treatment beyond that required to produce Class A reclaimed water. Groundwater recharge through direct injection is not considered as a potential use for reclaimed water in Camas because there are several other alternatives available to the City at this time that do not require the additional treatment beyond Class A. Therefore, additional discussion of the treatment requirements for direct injection will not be presented here.

Recharge of groundwater with reclaimed water would require a State Waste Discharge Permit issued by Ecology. Ecology may also require the development of a groundwater monitoring program to ensure degradation does not occur. Application of Class A reclaimed water to land for the purpose of irrigation, if applied at agronomic rates with no intent to recharge the groundwater, is not expected to require a State Waste Discharge Permit or a groundwater monitoring program.

## STREAMFLOW AUGMENTATION

Reclaimed water may be discharged to provide flow augmentation to a stream for flow enhancement, fish and wildlife habitat, irrigation supply, or water right replenishment or transfer. A beneficial use of the reclaimed water must be established for the project to be accepted as a stream flow augmentation project.

Discharge of reclaimed water for the purpose of stream flow augmentation must comply with Chapter 173-201A WAC, the regulation that establishes water quality standards for surface water in this state. A stream flow augmentation project would require review and approval by the Washington Department of Fish and Wildlife (WDFW). If in stream work was necessary, a Hydraulic Project Approval (HPA) from WDFW might also be required. Streamflow augmentation is a potential option for reuse for the City of Camas.

## RELIABILITY CRITERIA

The level of treatment reliability required for water reclamation facilities is a major difference from conventional wastewater treatment. The Reuse Standards require

*continuous* compliance, which means that the treatment standard must be met on a continuous basis or the treated water cannot be used as reclaimed water.

The Reuse Standards contain a number of operational and reliability requirements for a water reclamation facility. Some key requirements are summarized below:

- Equipment and process failures must be signaled by an alarm condition.
- Emergency storage or disposal must be provided in the event of plant failure.
- Bypassing of treatment facilities to the point of use is not allowed for untreated or partially treated water.
- Standby power supply must be provided for alarms and automatic actuating valves and other equipment and devices necessary to provide immediate short-term disposal or storage upon failure of any treatment system component.
- Operators must be certified to the levels required of municipal wastewater treatment plants with similar process equipment.
- Operating records must be provided to DOH as well as Ecology.

## ALTERNATIVE DISPOSAL AND STORAGE

Short-term storage or an alternative disposal system (e.g., an outfall) must be provided for use in situations where the reclaimed water cannot be used due to bad weather, reduced demand, etc. Provision must also be made for storage or disposal of water that does not meet the treatment and water quality criteria, perhaps due to a treatment upset, equipment failure, etc. If the facility does not have an outfall discharge or some other disposal alternative, emergency storage must be provided for at least 20 days of flow. Storage areas must be equipped with pumps and valving to route the inadequately treated water back through the reclamation facility once it is operating properly. Diversion to a different type of reuse requiring a lesser quality of reclaimed water is also possible if the quality is sufficient for that particular use.

## REDUNDANT PROCESS UNITS AND EQUIPMENT

The Reuse Standards require reliability for individual treatment units such as biological treatment, secondary clarification, coagulation, filtration, and disinfection. Generally, if long-term storage or an alternative disposal method is not available, one of two reliability features must be provided: (1) the facility must have redundant units each capable of treating the entire flow or (2) short-term storage with standby replacement equipment

provided. The City of Camas has an alternative disposal method, the outfall, and therefore, is not required to provide redundant units or short-term storage. Coagulation and chlorination unit processes must have standby chemical feed equipment provided, regardless of storage and disposal options, to ensure uninterrupted chemical feed.

## REUSE AREA CRITERIA

The Reuse Standards include a number of requirements that apply to the actual point of use for the reclaimed water. These requirements are primarily for the protection of public health, although some apply to operation and maintenance concerns and water quality protection.

### Reclaimed Water Classification by Type of Use

Table 10-2 presents a comprehensive list of approved uses of reclaimed water and the class of reclaimed water required for each. It is recommended that if the City of Camas wishes to produce reclaimed water, Class A water be produced to allow for maximum reuse opportunity. Class A reclaimed water is approved for all identified uses of reclaimed water listed in Table 10-2. There are no public health limitations on its use except that it cannot be used for potable drinking water. Additional treatment would be required for the reclaimed water to be utilized for direct aquifer recharge through groundwater injection.

# TABLE 10-2

## Reclaimed Water Classification by Type of Use

| Use | Class of Reclaimed Water Required | | | |
|---|---|---|---|---|
| | Class A | Class B | Class C | Class D |
| **Irrigation of Non-Food Crops** | | | | |
| Trees and fodder, fiber, and seed crops | YES | YES | YES | YES |
| Sod, ornamental plants for commercial use, pasture to which milking cows or goats have access | YES | YES | YES | NO |
| **Irrigation of Food Crops** | | | | |
| Spray Irrigation: | | | | |
| All food crops | YES | NO | NO | NO |
| Food crops which undergo physical or chemical processing sufficient to destroy all pathogenic agents | YES | YES | YES | YES |
| Surface Irrigation: | | | | |
| Food crops where there is no reclaimed water contact with edible portion of crop | YES | YES | NO | NO |
| Root crops | YES | NO | NO | NO |
| Orchards and vineyards | YES | YES | YES | YES |
| Food crops which undergo physical or chemical processing sufficient to destroy all pathogenic agents | YES | YES | YES | YES |
| **Landscape Irrigation** | | | | |
| Restricted access areas (e.g. cemetaries, freeway landscaping) | YES | YES | YES | NO |
| Open access areas (e.g. golf courses, parks, playgrounds, etc.) | YES | NO | NO | NO |
| **Impoundments** | | | | |
| Landscape impoundments | YES | YES | YES | NO |
| Restricted recreational impoundments | YES | YES | NO | NO |
| Nonrestricted recreational impoundments | YES | NO | NO | NO |
| **Fish Hatchery Basins** | YES | YES | NO | NO |
| **Decorative Fountains** | YES | NO | NO | NO |
| **Flushing of Sanitary Sewers** | YES | YES | YES | YES |
| **Street Cleaning** | | | | |
| Street sweeping, brush dampening | YES | YES | YES | NO |
| Street washing, spray | YES | NO | NO | NO |
| **Washing of Corporation Yards, Lots, and Sidewalks** | YES | YES | NO | NO |
| **Dust Control (Dampening Unpaved Roads, Other Surfaces)** | YES | YES | YES | NO |
| **Dampening of Soil for Compaction (Construction, Landfills, etc)** | YES | YES | YES | NO |
| **Water Jetting for Consolidation of Backfill Around Pipelines** | | | | |
| Pipelines for reclaimed water, sewage, storm drainage, gas, electrical | YES | YES | YES | NO |
| **Fire Fighting and Protection** | | | | |
| Dumping from aircraft | YES | YES | YES | NO |
| Hydrants or sprinkler systems in buildings | YES | NO | NO | NO |
| **Toilet and Urinal Flushing** | YES | NO | NO | NO |
| **Ship Ballast** | YES | YES | YES | NO |
| **Washing Aggregate and Making Concrete** | YES | YES | YES | NO |
| **Industrial Boiler Feed** | YES | YES | YES | NO |
| **Industrial Cooling** | | | | |
| Aerosols or other mist not created | YES | YES | YES | NO |
| Aerosols or other mist created (e.g. cooling towers, spraying) | YES | NO | NO | NO |
| **Industrial Process** | | | | |
| Without exposure of workers | YES | YES | YES | NO |
| With exposure of workers | YES | NO | NO | NO |

**Setbacks from Potable Water Systems**

The Reuse Standards establish criteria for siting and identifying water reclamation projects and their facilities. Water reclamation storage facilities, valves and piping must be clearly labeled and adequate measures must be taken to prevent cross connections between potable water and reclaimed water lines. Minimum separation distances between reclaimed water lines and potable water lines are similar to those required for sewer lines. A minimum horizontal separation of 10 feet and a minimum vertical separation of 18 inches must be maintained between the two.

The Reuse Standards also include setback requirements for the four classifications of reclaimed water. Setback distances are required from potable water supply pipelines, wells, property lines, water bodies, etc.; distances vary depending on the class of reclaimed water. Table 10-3 summarizes setback requirements for water reclamation facilities.

**TABLE 10-3**

**Setback Distances for Reclaimed Water**

| Reclaimed Water Use/Facility | Minimum Distance to Potable Water Well (Feet) | | | |
|---|---|---|---|---|
| | Class A | Class B | Class C | Class D |
| Spray or Surface irrigation | 50 | 50 | 100 | 300 |
| Unlined storage pond or impoundment | 500 | 500 | 500 | 1000 |
| Lined storage pond or impoundment | 100 | 100 | 100 | 200 |
| Pipeline | 50 | 100 | 100 | 300 |
| Minimum distance between irrigation area and public areas | 0 | 50 | 50 | 100 |

**Cross-Connection Control Requirements**

The proponent of a water reuse program is required to establish a cross-connection control and inspection program consistent with WAC 246-290-490 to prevent contamination of the potable water supply. The program must be developed in coordination with the potable water supplier and be reviewed and approved by DOH. Documentation must address cross-connection control equipment, oversight responsibilities, and operation, inspection and testing activities.

All valves, piping, outlets, and storage facilities in the reclaimed water system must be clearly identified as containing reclaimed water with a warning against use as drinking water. The public must be provided notification of the use of reclaimed water at all use areas with signs, written notices, or other methods.

**Residual Chlorine Requirements for Distribution System Protection**

The Reuse Standards recommend that a chlorine residual of 0.5 mg/L be maintained during conveyance from the reclamation plant to the use area. This provision is meant as an operation and maintenance measure to prevent biological growth in the pipeline and sprinkler heads.

## GROUNDWATER QUALITY

The State of Washington recognizes the potential benefit of replenishing groundwater with reclaimed water, thus, groundwater recharge is allowed under current state regulations. As stated previously, a discharge of reclaimed water to groundwater for the purpose of recharge must comply with Chapter 173-200 WAC, the Groundwater Quality Standards. The Groundwater Quality Standards apply to all groundwaters of the state that occur in the saturated zone beneath the land surface. While groundwater may support a number of beneficial uses, the overriding basis for the regulations is to protect all groundwater as a potential drinking water source. Accordingly, the groundwater quality criteria in WAC 173-200 are human health based standards, which, for many parameters, are equivalent to the DOH Drinking Water Standards.

### PARAMETERS OF CONCERN

According to the regulations, the reclaimed water must be applied in a manner that "will not cause pollution of any groundwaters below the root zone." Compared to surface water, groundwater is relatively immobile. Groundwater residence times can vary from a few weeks to thousands of years. This fact alone makes the assimilative capacity of groundwater limited. Once reaching an underground aquifer the physical and chemical characteristics of water change slowly.

The parameters of major concern with the recharge of reclaimed municipal wastewater are nitrogen and pathogenic bacteria. The Reuse Standards require treatment equivalent to Class A reclaimed water for groundwater recharges by surface percolation. This treatment level is expected to ensure that pathogen levels in the groundwater will not exceed drinking water standards (<1 total coliform/100 mL).

Nitrate nitrogen ($NO_3^-$-N) is the form of nitrogen of greatest concern because of its potential impact on human health. The groundwater standard for nitrate is 10 mg/L, the same as the current drinking water standard. Nitrate is a highly soluble and mobile species. If it is not taken up in the root zone, it will readily migrate to groundwater. Reduced forms of nitrogen such as organic nitrogen and ammonia are readily oxidized to nitrate. Reduction of total nitrogen (TN) to less than 10 mg/L prior to land application is required if application rates exceed agronomic requirements. If agronomic application rates are used it is not essential that the applied water is <10 mg/L TN; however,

monitoring of groundwater and soil is a prudent step to ensure groundwater quality is not adversely affected by the application.

### ANTIDEGRADATION

The goal of the Groundwater Quality Standards is to prevent degradation of groundwater quality beyond existing background conditions. Degradation to the extent that pollutant concentrations exceed background levels can be allowed when "an overriding consideration of the public interest will be served" and "all contaminants have been provided with all known, available, and reasonable methods of prevention, control and treatment (AKART) prior to entry." This policy is known as "anti-degradation."

Chapter 90.46 RCW, however, includes language that allows additional flexibility for the use of reclaimed water. The legislation states that reclaimed water may be applied to groundwater if the reclaimed water meets the "groundwater recharge criteria." The groundwater recharge criteria are defined in RCW 90.46 as "contaminant criteria found in the drinking water quality standards adopted by the State Board of Health." This allowance, in effect, supersedes the anti-degradation policy stated in the Groundwater Quality Standards. When reclaimed water is used to recharge groundwater (i.e., penetrate below the root zone) by surface spreading, it is only necessary that the application not cause the DOH Drinking Water Standards to be exceeded in the groundwater that is being recharged.

### MONITORING

It is anticipated monitoring would be required for a groundwater recharge project to monitor groundwater impacts and ensure there is no significant degradation. When establishing a monitoring program, it is generally necessary to determine ambient groundwater conditions including the direction of flow and groundwater quality up gradient of the land application area. This characterization is based on a minimum of eight samples taken over a period of not less than 12 months, with no two samples taken in the same month. Ongoing monitoring requirements would be established by Ecology in the State Waste Discharge Permit.

## SURFACE WATER QUALITY

The discharge of reclaimed water to surface water to augment streamflow will be subject to Chapter 173-201A WAC, the State Surface Water Quality Standards. The Surface Water Quality Standards are based on maintaining public health, recreational use and protection of fish, shellfish and wildlife. Surface water quality standards are broken into five groups: AA (extraordinary), A (excellent), B (good), C (fair) and Lake Class. Each class has its own characteristic use and measurable criteria. Parameters used to distinguish the different surface water classifications include fecal coliform, dissolved oxygen, temperature, pH and turbidity. The surface water quality criteria include 29 toxic

substances, including ammonia, residual chlorine, several heavy metals, polychlorinated biphenyls (PCBs) and common and persistent pesticides.

The goal of the surface water quality standards is to maintain existing beneficial uses of surface water by preventing degradation of existing water quality. However, some allowances are made for discharges into a surface water that enable a temporary or mitigated degradation to occur. These allowances are made by establishing *mixing zones* and determining the *assimilative capacity* of the receiving water.

## MIXING ZONES

Mixing zones may be granted when the water quality criteria cannot be achieved by the wastewater treatment process. Before a mixing zone is granted, the discharger is required to apply AKART, "all known, available, and reasonable methods of prevention, control, and treatment," prior to discharge. AKART represents the most current methodology that can be reasonably required for preventing, controlling or treating the pollutants in the discharge.

The mixing zone is the portion of the water body where mixing results in the dilution of the discharge with the receiving water. If a mixing zone is granted, water quality standards may be exceeded within the mixing zone. However, at the outer limit of the mixing zone, water quality standards must be met. For toxic substances, the standards include acute and chronic toxicity criteria that may result in both acute and chronic mixing zones.

## ASSIMILATIVE CAPACITY

Assimilative capacity describes the surface water's ability to accept pollutant loadings without a permanent degradation of water quality and impairment of beneficial uses. Ecology annually conducts waste load capacity studies for watersheds across the state. The studies are used to determine the assimilative capacity of the water body for various pollutants such as $BOD_5$, chlorine, ammonia, metals, etc. For example, the assimilative capacity of a surface water with respect to $BOD_5$ will be based on the mass of an oxygen-depleting substance (e.g., organic matter and ammonia) that can be discharged into a surface water without depleting dissolved oxygen to levels that would be detrimental to aquatic life.

## TECHNOLOGY-BASED VERSUS WATER QUALITY-BASED STANDARDS

Treatment of discharges to surface water from wastewater treatment facilities are required to meet minimum "technology-based" standards for secondary treatment presented in Chapter 173-221-040 WAC. The technology-based standards are presented in Table 10-4.

**TABLE 10-4**

**Technology-Based Standards**

| Parameter | Monthly Average | Weekly Average |
|---|---|---|
| $BOD_5$ | 30 mg/l | 45 mg/l |
| TSS | 30 mg/l | 45 mg/l |
| Fecal Coliform(1) | 200/100 ml | 400/100 ml |
| pH | Between 6.0 and 9.0 | |

(1) Geometric average.
(2) Monthly average removal cannot be less than 85 percent.

If these minimum limits are not sufficient for the discharge to meet the "water quality-based" standards established in WAC 173-201A, more stringent limits and/or additional limits must be developed by Ecology. For water reclamation facilities, the "health-based" criteria established in the Reuse Standards would supersede water quality criteria for parameters that are more stringent (e.g., total coliform).

### PARAMETERS OF CONCERN

The primary parameters of concern in providing stream flow augmentation with reclaimed water are dissolved oxygen, temperature, nitrogen, phosphorous, chlorine, and potentially metals. Dissolved oxygen is critical for the viability of aquatic life in the stream. It can be depleted through the breaking down of organic matter and the conversion of ammonia-nitrogen to nitrate-nitrogen. Ammonia, chlorine, and metals are toxic to fish and other aquatic life at levels above the water quality criteria. Elevated temperature is detrimental and even fatal to aquatic life and results in lower dissolved oxygen levels.

## WATER RIGHTS

RCW 90.46.120 states that "the Owner of a wastewater treatment facility that is reclaiming water with a permit issued under this chapter has the exclusive right to any reclaimed water generated by the wastewater treatment facility."

However, guidance from Department of Ecology indicates that the reclaimed water should normally be retained and utilized in the general use area or basin from which the water originated and for which the original water right was issued. The Reuse Standards require proponents of groundwater recharge projects to provide information on the intended water rights status (i.e., artificial storage or abandonment of the reclaimed water). RCW 90.46.120 further states that when proposed uses of reclaimed water are intended to augment or replace potable water supplies, such uses must be reflected in the potable water purveyor's water comprehensive plan.

The City of Camas would hold the water rights for most of the water being transported to the water reclamation facility, and as the producer of the reclaimed water, would retain the water rights over it. It is not anticipated at this time that holding the rights to the reclaimed water would impact the potable water rights currently held by the City. However, the City would need to perform a Water Rights Impairment Analysis for any uses of its reclaimed water. This analysis is required by the Water Reclamation and Reuse Standards to ensure that any diversions that occur due to new reclaimed water uses will not impair the previous uses of the water or infringe on the City's rights to the water. This issue will be of particular concern in evaluating groundwater recharge and stream flow augmentation projects because the City will not want to surrender any rights to its reclaimed water.

## CURRENT WATER SYSTEM

Based on the water rights analysis in the City's *2001 Water System Comprehensive Water System Plan*, the City of Camas currently does not have adequate water supply capacity to meet maximum day demand requirements through the year 2020. However, since the 2001 Plan, the City has maximized their current sources and is in the process of securing water rights to meet the demands over the next twenty years. The *2001 Water System Comprehensive Plan* sited several alternatives for the City to maximize current sources and developed a CIP to ensure adequate water rights to meet the demands for the 20-year planning period. The following list updates the completed projects and status of remaining projects:

- In an effort to maximize capacities of existing sources and water rights the City has:

  - Replaced Well Nos. 1, 2, and 3 with Well Nos. 10, 11, and 12; and
  - Replacement well for Well No. 4 has been drilled and will be equipped in 2007.

- The City is in the process of transferring existing water rights from Georgia Pacific to the City.

- The City may attempt to expedite the identification of water rights in the region for purchase and transfer by participating in the Department of Ecology's Cost Recovery Program to expedite the water right application.

The City must acquire additional water rights in the immediate future and for the 20-year planning period; however, the actual time period and quantity depends on the needs of the planned Phase 2 and Phase 3 of WaferTech, which has yet to be determined. Nonetheless, the City has begun to maximize the capacities of existing water sources and water rights and has been exploring opportunities to expedite the process to fulfill the

immediate need for additional water rights. The long-term capacity needs will most likely be met once the water rights from Georgia Pacific are transferred to the City.

Although the City does not have a need to develop additional water rights at this time, the potential for reclaimed water is evaluated. There may be a need for reclaimed water in the future, particularly if the proposed water rights transfer is delayed or unsuccessful.

## POTENTIAL FOR REUSE

The potential applications for reclaimed water in the Camas area include industrial process water, irrigation, constructed wetlands for mitigation banking, and stream flow augmentation. Each reuse application is first discussed, and then the treatment alternatives are described. The advantages and disadvantages of the reuse application alternatives are highlighted in the discussion below.

### INDUSTRIAL PROCESS WATER

The City of Camas' five largest water users and their 1999 and 2004 average daily demand (from the *2001 Water System Plan*) are presented in Table 10-5.

**TABLE 10-5**

**City of Camas Five Largest Water Users**

| Customer | 1999 Average Daily Demand(1) (MGD) | 2004 Average Daily Demand(1) (MGD) |
|---|---|---|
| Wafertech Industries | 0.32 | 0.56 |
| Georgia Pacific | 0.32 | NA(2) |
| Linear Technologies | 0.10 | 0.19 |
| Hewlett Packard | 0.03 | NA(2) |
| Sharp Electronics | 0.02 | 0.02 |

(1) Excludes Irrigation.
(2) Not Analyzed.

WaferTech, the City's largest individual water user, is planning to construct two additional fabrication plants in the City of Camas. WaferTech will have a substantial increase in the daily water demand if the two fabrication plants are constructed. It is projected that WaferTech will require as much as 3.5 mgd once the two fabrication plants are operating (*2001 Water System Plan*). Currently, WaferTech uses potable water for the industrial processes; the potable water is treated with reverse osmosis (RO) at the WaferTech facility. It is possible WaferTech could use a significant amount of reclaimed water for their industrial process.

The potential users of reclaimed water for industrial processes also include Underwriters Laboratories and Heraeus Shin-etsu. The industries listed in Table 10-5, Underwriters Laboratories, and Heraeus Shin-etsu could also potentially use reclaimed water for irrigation purposes. Most of the industrial facilities have significant sized lawns that require irrigation during the dry season.

WaferTech has a projected daily water demand of 3.5 mgd and the remaining industrial customers have a combined projected daily water demand of 1.73 mgd by 2020 (*2001 Water System Plan*). Some of this water demand will be for non-industrial, non-irrigation uses such as toilet flushing. The total reclaimed water potentially used by industrial processes and irrigation of the lawns at the industries is estimated at 4.73 mgd (approximately 90 percent of the total water demand).

The advantage to using reclaimed water for an industrial process is that it is a potential application for year-round use of reclaimed water. The distribution system could be costly; however, most of the industries that will use reclaimed water are clustered near the northwest boundary of the City of Camas. The distribution system from a satellite water reclamation facility (WRF) situated at the north end of Lacamas Lake to the northwest corridor of the City is presented on Figure 10-1. The proximity of a satellite WRF to the industrial corridor could allow the distribution system to be cost effective. It may be an option to site a water reclamation facility on-site at the WaferTech facility since most of the reclaimed water produced will be used at the facility; however, this option is not evaluated at this time.

## IRRIGATION

Reclaimed water could be used for irrigation and landscaping purposes during the summer months. The Camas region has an annual average rainfall of approximately 75 inches, but the summer rainfall can average as little as 0.56 inches per month (Chapter 2). Due to the significant amount of rainfall during winter months, reclaimed water could only be used for irrigation during the summer months. Distribution will be cost-prohibitive if all parks and public property throughout the City of Camas are considered. Therefore, only the properties in the vicinity of the WWTF are considered for irrigation with reclaimed water, including some of the City's public parks, municipal property (includes City Hall, the Community Center, and the Library) and, public schools, and the Camas Cemetery. Table 10-6 lists the estimated potential reclaimed water usage rates for irrigation purposes at these properties. The irrigation usage rates are based on an irrigation rate of 14 inches/year and an irrigation season of 3 months/year. The total potential peak day demand for irrigation is 0.338 mgd, applying a peak factor of two to the average usage. The limitation of using reclaimed water for irrigation purposes is that irrigation is only necessary approximately 3 months per year.

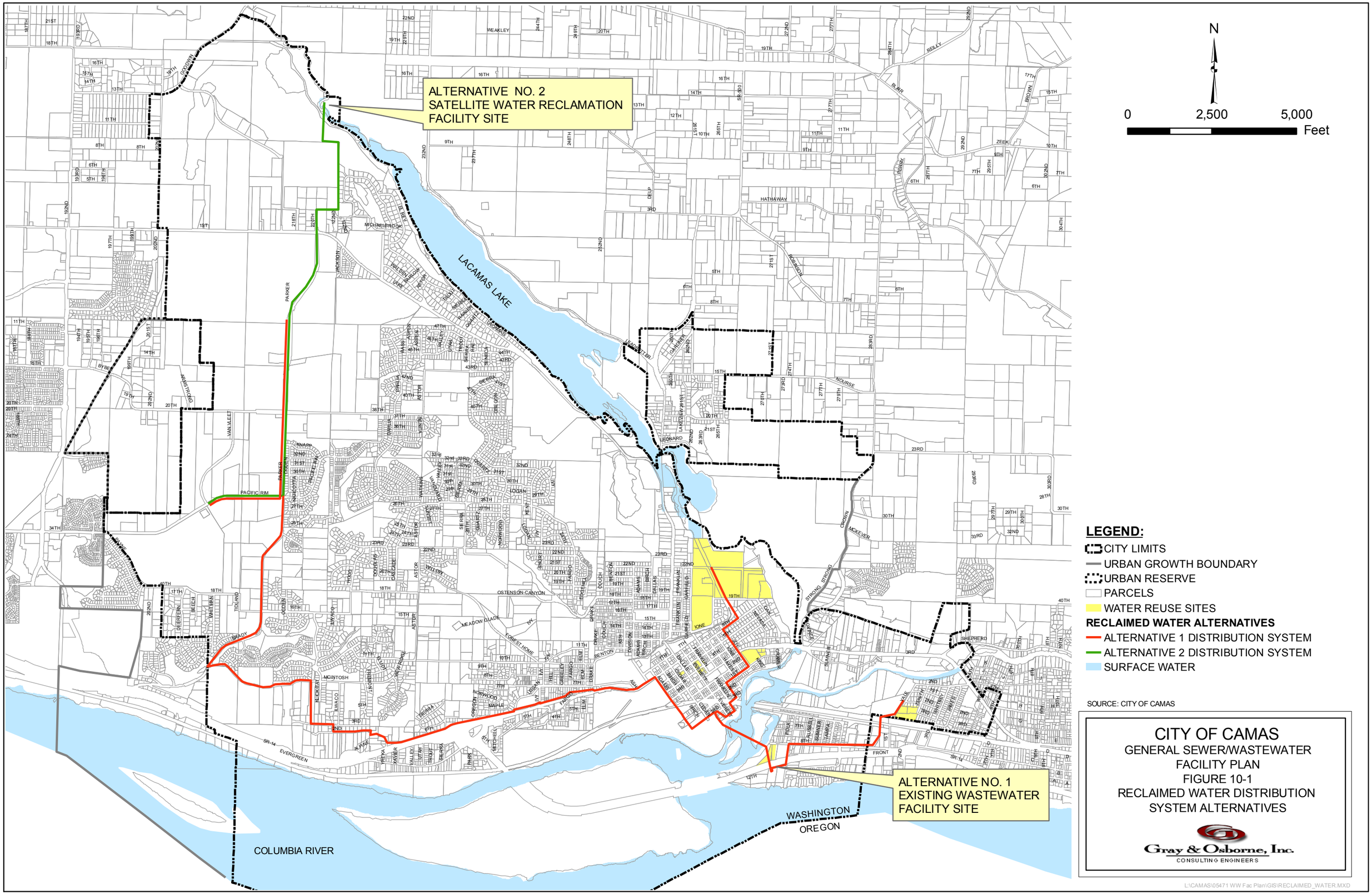
ALTERNATIVE NO. 2
SATELLITE WATER RECLAMATION
FACILITY SITE
ALTERNATIVE NO. 1
EXISTING WASTEWATER
FACILITY SITE
LACAMAS LAKE
COLUMBIA RIVER
WASHINGTON
OREGON
N
0
2,500
5,000
Feet
LEGEND:
CITY LIMITS
URBAN GROWTH BOUNDARY
URBAN RESERVE
PARCELS
WATER REUSE SITES
RECLAIMED WATER ALTERNATIVES
ALTERNATIVE 1 DISTRIBUTION SYSTEM
ALTERNATIVE 2 DISTRIBUTION SYSTEM
SURFACE WATER
SOURCE: CITY OF CAMAS
CITY OF CAMAS
GENERAL SEWER/WASTEWATER
FACILITY PLAN
FIGURE 10-1
RECLAIMED WATER DISTRIBUTION
SYSTEM ALTERNATIVES
Gray & Osborne, Inc.
CONSULTING ENGINEERS
L:\CAMAS\05471 WW Fac Plan\GIS\RECLAIMED_WATER.MXD

**TABLE 10-6**

**Potential Reclaimed Water Usage Rates(1)**

| Irrigation/Landscaping Use(1) | Irrigated Area (Acres) | Annual Average Usage (MG/year) | Peak Day (gpd) |
|---|---|---|---|
| Public Schools | 10 | 3.8 | 0.084 |
| Other Municipal Property | 3 | 1.1 | 0.025 |
| Camas Cemetery | 12 | 4.6 | 0.101 |
| Public Parks | 15 | 6 | 0.127 |
| **Total Potential Reclaimed Water Usage** | | | **0.338** |

(1) Irrigation rate based on 14 inches per year over a 3-month irrigation season, and peak day factor of 2.0.

The irrigation sites and the distribution system from the existing WWTF are identified on Figure 10-1. The advantage of irrigation is that there are several potential irrigation sites clustered in the southeast corridor of the City, near the existing treatment facility; therefore, distribution costs could be reasonable if the existing plant is modified to a water reclamation facility. The disadvantage to irrigation as a reuse application is that irrigation is only necessary during summer months; during the remaining months the City would not need to reclaim water and would have to use the existing outfall.

## MITIGATION WETLANDS BANK

The City of Camas has received funding to establish a mitigation wetlands bank in the Lacamas Watershed. A mitigation wetlands bank typically involves a larger mitigation wetlands site, providing more ecological value than several smaller mitigation wetlands. Furthermore, the potential for success of a mitigation wetland bank is greater than a smaller mitigation wetland. Mitigation wetland banks require the up-front compensation prior to impacting an existing wetland at a site undergoing development. With proper implementation and guidelines, mitigation wetland banks have the potential to increase ecological benefits, save money for project applicants, and improve efficiencies in application and permitting processes. Reclaimed water could be used to enhance the wetlands mitigation bank.

The mitigation wetlands bank in the Lacamas Watershed project will acquire 63 acres on Fifth Plain Creek, a tributary to Lacamas Creek. The property includes a 26-acre riparian zone as well as connected wetlands and uplands. The City has received funding to restore/enhance 24 acres of the site, and the remaining 39 acres will be utilized for future restoration as banking revenues are received.

Hydrogeological studies will be required to determine the suitability of the site for the purpose of using reclaimed water. Furthermore, monitoring wells will be required if the

site is developed for the use of reclaimed water. The disadvantage to using reclaimed water for the wetlands mitigation bank is that both the hydrogeological studies and the monitoring wells will be very costly. The advantage to using reclaimed water for the wetlands mitigation bank is the potential for year-round use.

### STREAM FLOW AUGMENTATION

The reclaimed water could be used to augment stream flows in the Dwyer Creek basin. The habitat in the Dwyer Creek basin has been compromised due to increased development in the drainage basin. The City could augment stream flows in Dwyer Creek to enhance habitat in the drainage basin. The City would have to work with the Washington State Departments of Ecology and Fish and Wildlife to develop a stream flow augmentation system at Dwyer Creek using reclaimed water. Issues associated with this alternative that have to be addressed are as follows:

- Establish beneficial use for the additional stream flow.
- Direct discharge of reclaimed water into Dwyer Creek may not be allowed. Based on past experience, this may require the construction of an additional structure, a lined pond and a conveyance channel to reaerate, cool and polish the reclaimed water prior to its introduction to Dwyer Creek.
- Flow of reclaimed water into the creek may be required to be maintained at a constant rate 24-hours a day year round.
- The City will have to determine the quantity of water they are willing to permanently give up in order to use their reclaimed water for stream flow augmentation. Once the water begins flowing into the creek, any interruption of flow could have adverse impacts on the creek's habitat.
- Hydraulic capacity of the creek channel as well as in-stream flow goals must be established by the Department of Fish and Wildlife.
- Water quality impacts to the small stream must be established. This impact includes the effect of parameters such as dissolved oxygen, nutrients, toxics and coliform bacteria.

## EVALUATION OF ALTERNATIVES

The City of Camas has several alternatives available for the production of reclaimed water. The reuse application varies with the treatment alternative based on the proximity of the reclaimed water production site. Alternatives available to the City include:

- Alternative No. 1 - Modify the Existing Treatment facility for a Reuse Application of Irrigation and Industrial Process Water.
- Alternative No. 2 - Construct a Satellite Water Reclamation Facility for a Reuse Application of Industrial Process Water and Irrigation.
- Alternative No. 3 - Construct a Satellite Water Reclamation Facility for a Reuse Application of Wetlands Banking Mitigation.
- Alternative No. 4 - Construct a Satellite Water Reclamation Facility for a Reuse Application of Stream flow Augmentation.

Alternatives No. 3 and No. 4 are not evaluated at this time since many of the total project costs will be very similar to the cost of Alternative No. 2. The treatment costs will be the same and the distribution costs may be similar; however, Alternatives No.3 and No. 4 will require hydrogeological studies to determine if either of these sites is adequate for a reuse application. Furthermore, the cost of hydrological studies, permitting, and monitoring wells could be cost prohibitive. Alternatives No. 1 and No. 2 are evaluated in greater detail.

**ALTERNATIVE NO. 1 – MODIFY THE EXISTING WWTF FOR A REUSE APPLICATION OF IRRIGATION AND INDUSTRIAL PROCESS WATER**

The City could modify the existing WWTF to produce Class A water reclamation. The Class A reclaimed water treatment process will be designed for the peak hour flow of 4.73 mgd. The remaining effluent would likely be discharged out the outfall. The peak hour reclaimed water demands are projected at 4.73 mgd at this time. The advantage to modifying the existing facility is that most of the infrastructure exists already at the treatment facility.

Additional electrical reliability components would be required for the Class A water reclamation facility. The generator capacity must also be upgraded to meet Reliability Class I and additional alarms and telemetry would be required. However, additional equipment reliability components are not required since the City has an existing outfall as an alternative disposal method. The City would be required to provide a UV disinfection system designed to produce Class A reclaimed water. The newest edition of the Department of Ecology's Criteria for Sewage Works Design requires the UV disinfection system for reuse applications to comply with the 2003 Guidelines published by the National Water Research Institute (NWRI) in collaboration with the American Water Works Association Research Foundation (AWWARF).

## CONCEPTUAL DESIGN AND COST ESTIMATE

### Coagulation and Filtration

The City's existing Aqua-Aerobics AquaDisk fabric filter has been approved for Title 22 reuse applications. This filter utilizes a series of rotating disks, which can be continuously backwashed while the filter continues to operate. Periodically, flow to the filter must be stopped to allow for a more intense washing of the fabric as well as to clean out solids that deposit in the filter tank. The existing filters are designed to treat a peak hour flow of 6.1 mgd (24 disks with 0.25 mgd approximate capacity per disk). The system would be reconfigured so that an alarm will trigger when the peak hour flow is greater than 6.1 mgd, at that point, the flow will be diverted to the outfall.

### UV Disinfection

The City has an existing low pressure / high intensity UV disinfection system capable of treating a peak hour design flow of 6.1 mgd. An inline UV disinfection system could provide the additional UV dose needed to meet the requirements for Class A reclaimed water. The UV disinfection system would be installed downstream of the existing UV disinfection system. The peak hour reuse water demand currently is estimated at 4.73 mgd. However, the secondary treatment system has a peak hour design capacity of 6.1 mgd and the existing filters have sufficient capacity to treat a Class A reclaimed water peak hour flow of 6.1 mgd. Rather than limit the Class A reclaimed water production peak hour flow capacity to 4.73 mgd (the projected peak hour demand), it is only slightly more expensive to design the inline UV disinfection system to a peak hour flow of 6.1 mgd. The additional reclaimed water peak hour design flow capacity of 6.1 mgd allows for the potential to reuse a greater amount of treated effluent in the future should the beneficial reuse alternatives become more cost effective.

The inline ultraviolet disinfection system for NWRI compliance results in addition capital and operating cost of the UV system, due to several factors:

- Use of conservative design transmittance; the $10^{th}$ percentile of transmittance measured three times per day for 6 months or 55 percent, whichever is higher. The design transmittance is projected at 65 percent.

- Use of a *validated* (based on performance testing of seeded pathogens) design delivered dosage of 100 $mJ/cm^2$

- Use of conservative lamp fouling and end-of-life factors

- Flowrate, UV intensity and UV transmittance must be monitored continuously. Monitoring these three parameters will allow continuous monitoring of calculated operational dose, which is also required by the

Guidelines. Additionally, turbidity must be monitored continuously.

- UV intensity monitors must be calibrated at least monthly. UV transmittance monitors and turbidity monitors must be calibrated in accordance with manufacturer's recommendations. Laboratory measurements of UV transmittance must be used to verify the accuracy of on-line transmittance monitoring equipment on a weekly basis.

- The UV system must be operated at the same velocity range and flow per lamp as used for performance validation, and with total headloss less than or equal to that measured in equipment validation testing.

**Alarms and Telemetry**

The use of reclaimed water in open access areas demands a higher level of quality control than normal WWTF operations. An alarm system would need to be installed so that if the coagulation, filtration, or disinfection systems fail, then reclaimed water production will cease, the operator will be notified, and effluent will be directed to the WWTF outfall.

**Storage**

Industrial water users require water and produce wastewater at sporadic times of the day, Irrigation water is often applied to open access areas at night from about 12:00 a.m. to 4:00 a.m., so that water has time to percolate into the ground before public contact. Reclaimed water will be generated in larger amounts during the diurnal peak hours and will be generated in smaller amounts throughout the night. To match reclaimed water production and reclaimed water demand, 200,000 gallons of equalizing storage onsite at the WWTF is recommended. In addition, the industrial users of reuse water may also opt to provide additional reuse water storage onsite at the industrial facility. The City would also have the option to discharge reclaimed water via the outfall during periods of peak reclaimed water production and low reclaimed water demand.

**Distribution**

A pump station will be required to maintain pressure in the reclaimed water distribution system and to convey the reclaimed water to the irrigation sites and the industries that will use reclaimed water. The preliminary cost of the pump station is estimated at $110,000. The distribution system totals 25,540 linear feet and is presented on Figure 10-1.

The capital costs to modify the existing facility and construct the irrigation distribution system are summarized in Tables 10-7 and 10-8. The O&M costs for Alternative No. 1 are the costs above the O&M costs already incurred by the City for operating the existing WWTF are minimal. An annual O&M cost estimate includes one additional full time

employee (FTE) and additional power costs to operate the UV disinfection system and the alarm system.

**TABLE 10-7**

**Alternative No. 1 – Modify Existing Facility for Production of Reclaimed Water for Irrigation and Industrial Process Treatment Costs (2006 Dollars)**

| Item | Quantity | Unit | Unit Price | Total Price |
|---|---|---|---|---|
| Mobilization/Demobilization | 1 | LS | $134,583 | $134,583 |
| Class "A" Inline UV Disinfection System | 1 | LS | $300,000 | $300,000 |
| 200,000 Gallon Storage Tank | 200 | CY | $750 | $150,000 |
| Reuse Pumps | 2 | EA | $60,000 | $120,000 |
| Standby Generator | 1 | LS | $76,000 | $76,000 |
| Subtotal | | | | $780,583 |
| Site Work (5% of subtotal) | | | | $68,000 |
| Piping (12% of subtotal) | | | | $162,000 |
| Alarms/electrical (20% of subtotal) | | | | $270,000 |
| Painting (3% of subtotal) | | | | $41,000 |
| Misc. metals (2% of subtotal) | | | | $27,000 |
| Subtotal | | | | $1,348,583 |
| Contingency (25%) | | | | $338,000 |
| Sales Tax (7.9%) | | | | $134,000 |
| **Total Construction Cost** | | | | **$1,820,583** |
| Engineering and Administrative Costs (25%) | | | | $456,000 |
| **Total Estimated Project Cost** | | | | **$2,277,000** |

**TABLE 10-8**

**Alternative No. 1 – Modify Existing Facility for Production of Reclaimed Water for Irrigation and Industrial Process Distribution Costs (2006 Dollars)**

| Item | Quantity | Unit | Unit Price | Total Price |
|---|---|---|---|---|
| Mobilization/Demobilization | 1 | LS | $349,000 | $349,000 |
| Booster Pump Station | 1 | LS | $500,000 | $500,000 |
| Irrigation Supply Piping | 33,000 | LF | $80 | $2,640,000 |
| Subtotal | | | | $3,489,000 |
| Contingency (25%) | | | | $873,000 |
| Sales Tax (7.9%) | | | | $345,000 |
| **Total Construction Cost** | | | | **$4,707,000** |
| Engineering and Administrative Costs (25%) | | | | $1,177,000 |
| **Total Estimated Project Cost** | | | | **$5,884,000** |

## ALTERNATIVE NO. 2 – CONSTRUCT A SATELLITE WATER RECLAMATION FACILITY FOR A REUSE APPLICATION OF INDUSTRIAL PROCESS AND IRRIGATION

For Alternative No. 2, the City would construct a satellite water reclamation facility sited at the north end of Lacamas Lake near Camp Currie. The location is in the vicinity of the customers that would use the reclaimed water produced at the facility, although the City would be required to negotiate with the County to locate the satellite WRF in the County Park. The satellite WRF would treat commercial, industrial, and residential flows and loadings from Basin Nos. 11, 12, and 13, and about two-thirds of the total flows and loadings from Basin No. 1. The flows from these basins would be rerouted to the satellite WRF and no longer be treated at the existing WWTF site. The satellite water reclamation facility would serve as a scalping plant. Only the liquid stream would be treated at the satellite WRF, solids would be pumped through city sewers and treated at the existing treatment facility. (Some minor modifications would be needed to the STEP line to accommodate the conveyance of solids.) The existing WWTF would continue to treat the flows from the remaining basins. The existing outfall would continue to serve the flows treated at the existing WWTF; furthermore, the existing outfall could serve as a backup to the WRF if needed. The water reclamation facility would be sized for the 2025 peak hour flow of Basin Nos. 11, 12, and 13, and about two-thirds of the flow from Basin No. 1, estimated in Chapter 6 at 4.73 mgd. The maximum month design flow for the satellite WRF would be 2.1 mgd, equal to the maximum month design flow estimated for these basins in Chapter 6.

## CONCEPTUAL DESIGN AND COST ESTIMATE

The reclaimed water system would require tertiary treatment, storage, and distribution. This section will briefly describe each component of the process and provide a cost estimate, based on costs for other water reclamation facilities in the State, including those at Sequim, Ephrata and Royal City.

The preferred alternative for construction of the satellite water reclamation facility is a membrane bioreactor (MBR) activated sludge process. The MBR process produces a very high quality effluent in a small footprint. In an MBR, secondary effluent is separated from the activated sludge solids by filtration through membranes submerged in the aeration basin, instead of separated by gravity in secondary clarifiers. The membrane filters produce a higher quality than typical tertiary filters, such as sand or cloth disc filters. Therefore, secondary clarifiers and tertiary filters are not required for MBR systems, and the facility footprint is smaller than for a reclaimed water facility using conventional activated sludge. Waste activated sludge is removed directly from the aeration basin, and would be pumped to the existing treatment facility for further treatment.

### Influent Pump Station

The Lacamas Shores L.S. would be modified to serve as an influent pump station to the satellite WRF. Construction of a main sewer trunk to the satellite WRF will be required to convey influent from the influent pump station.

### Headworks

The headworks would consist of an influent flow meter, sampler, mechanical fine screens, and a grit removal system. MBR processes require at least 3-mm fine screening to protect the membrane cassettes. Two mechanical fine screens (band screen or rotary drum) will be placed in two parallel channels, each sized for the maximum hydraulic flow of 4.73 mgd (one duty, one standby). A bypass bar screen will not be provided because its operation, even temporarily, could allow material into the MBR basin that may damage the membrane cassettes. The grit removal system would consist of an aerated grit chamber, a grit slurry pump, grit hydrocyclone, and classifier. Grit would be collected in a dumpster, while degritted slurry is returned to the grit chamber.

### Membrane Bioreactor

In this particular process, solids in the aeration basin would be separated from the liquid by an in-basin membrane unit. The membrane microfilter system evaluated in this section is produced by Kubota, and marketed in the US by Enviroquip, Inc. Other membrane systems are available that may be used for the satellite WRF. In the Kubota system, membrane cassettes containing large numbers of flat-plate membranes (with

nominal 0.4 μm pores) are placed directly into the aeration basin to provide clarification and filtration. Air is added through coarse-bubble diffusers mounted directly below the membrane cassettes to scour the membrane surfaces. The flow of air upward along the membranes promotes flow of mixed liquor upward across the membrane surfaces. Permeate (membrane effluent) passes through the membrane walls into the interior of the flat-plate membrane in a cross-flow pattern, with the driving force provided by either the elevation difference between the aeration basin water depth and the elevation of the downstream processes, or by permeate suction pumps.

In-place cleaning of the membranes with chlorine solution should be performed every 6 months, by injecting a chemical cleaning solution into the permeate lines and allowing the solution to soak in the interior of the membrane. Chemical solution tanks and feed pumps are provided. In addition, the manufacturer suggests periodically relaxing the membranes, by closing the permeate valves while continuing to scour the membranes with air, for 1 minute per 10 minutes of operation.

Operation of the aeration basin is not controlled by the gravity settling characteristics of the mixed liquor (as measured by the SVI). Therefore, the mixed liquor concentration can be maintained at three to four times the typical concentrations used in activated sludge processes. For this MBR, it is recommended to operate at a mixed liquor suspended solids (MLSS) concentration of 10,000 mg/L. Due to the high MLSS concentration, longer solids retention times (SRT) can be maintained in a tank with a short hydraulic retention time (HRT). The SRT is controlled by the rate that excess sludge is removed from the reactor. To remove excess sludge, the basins are equipped with waste activated sludge (WAS) pumps that transfer the sludge to the aerobic digestion system. Reducing the WAS removal rate will lengthen the SRT and increase the MLSS concentration. Membrane bioreactors have operated at concentrations up to 20,000 mg/L, without a negative long-term effect on membrane life.

Internal recycle pumps would transfer mixed liquor from the MBR tanks to the pre-aeration tanks, to keep the influent wastewater in contact with the activated sludge. Coarse bubble aeration diffusers would provide process air in the pre-aeration tanks. The MBR tanks are aerated by diffusers mounted to the bottom of the membrane cassettes. Two MBR tanks would be provided in parallel, allowing one tank to be taken off-line for maintenance or repair independently. In addition, redundant membrane cassettes would be provided in each tank to allow a cassette to be taken offline while providing treatment of the design flow.

Membrane permeate would flow by gravity or through permeate pumps to the UV disinfection facility. Permeate lines are equipped with pressure gauges and effluent magnetic flow meters.

Kubota membranes have a standard warranty of 5 years; replacement is recommended after 8 to 10 years. Extended warrantees are available, in which, for a fixed annual fee,

the manufacturer will replace membranes as needed to maintain the design flux rate and performance.

The membrane bioreactor would be sized for a maximum month design flow of 2.1 mgd.

**Coagulation and Filtration**

The Class A reclaimed water standards require continuous oxidation, coagulation, filtration and disinfection of the wastewater. The MBR process will not produce higher quality effluent (in terms of BOD, TSS and turbidity) with the addition of coagulation or flocculation processes. Without coagulation, MBRs produce reclaimed water with higher quality than reclaimed water from conventional tertiary processes. The Washington State Departments of Ecology and Health have indicated that they would accept the MBR process without coagulation in a water reclamation application on a case-by-case basis. Therefore, coagulation facilities are not included in this evaluation.

Filtration is provided by the membrane microfilters in the MBR process.

**UV Disinfection**

Numerous UV disinfection systems that meet the Class A disinfection criteria have been installed in Washington State. Pilot testing has demonstrated that microfiltration membranes are capable of physically removing most bacteria, generally meeting the Class A disinfection standard (2.2 total coliform/100 mL) prior to disinfection. Pilot testing has demonstrated that virus removal is highly variable, and has been measured at less than 1-log (90 percent) removal in some pilot tests (City of San Diego, Point Loma Wastewater Treatment Plant). This is because viruses are generally smaller than the pore size of the microfilter.

The Washington State Department of Ecology's Criteria for Sewage Works Design has indicated that the future requirements of the UV disinfection must follow the National Water Research Institute (NWRI) guidelines. The implications of the NWRI guidelines on the design of the UV disinfection system are highlighted earlier in this chapter. However, MBR effluent requires a *validated* (based on performance testing of seeded pathogens) design delivered dosage of 80 $mJ/cm^2$. The UV disinfection system will be designed to disinfect the peak hour design flow of 4.73 with one bank out of service.

**Alarms and Telemetry**

An alarm system will be installed to notify staff if MBR or disinfection systems fail, or if the reclaimed water quality falls below an acceptable level. At this point, the reclaimed water production will cease and effluent will be pumped to the existing WWTF for further treatment and ultimately will be discharged via the City's existing outfall.

**Storage**

Industrial water users require water and produce wastewater at sporadic times of the day, Irrigation water is often applied to open access areas at night from about 12:00 a.m. to 4:00 a.m., so that water has time to percolate into the ground before public contact. Reclaimed water will be generated in larger amounts during the diurnal peak hours and will be generated in smaller amounts throughout the night. To match reclaimed water production and reclaimed water demand, 200,000 gallons of equalizing storage onsite at the WWTF is recommended. In addition, the industrial users of reuse water may also opt to provide additional reuse water storage onsite at the industrial facility. The City would also have the option to discharge reclaimed water via the outfall during periods of peak reclaimed water production and low reclaimed water demand.

**Solids Handling**

Mixed liquor must be wasted from the aeration basin to maintain a constant MLSS concentration and sludge age in the activated sludge system. The waste activated sludge (WAS) would be pumped to a city sewer for conveyance to the existing WWTF.

**Distribution**

A pump station would be required to maintain a pressure in the reclaimed water distribution system and to convey reclaimed water to the industrial corridor.

The capital costs to construct a satellite WRF and for the distribution system are summarized in Tables 10-9 and 10-10. The O&M costs for Alternative No. 2 are estimated based on experience from other existing water reclamation facilities throughout the State. It is estimated that the satellite WRF and distribution system will add 1 FTE to the City's labor requirement. Annual equipment maintenance costs are estimated as three percent of the initial equipment capital cost. In addition, UV lamps will need to be replaced, with an average replacement rate of 40 percent per year ($12,000) and the annual UV power requirements are estimated at $8,000. The membrane cartridges must be periodically replaced, with an average life of eight to 10 years. The cost of an extended warranty, which includes replacement of membranes as needed, was quoted at $25,000 per year. The membranes would also require sodium hypochlorite, and possibly oxalic acid, as cleaning chemicals. The total annual O&M cost for Alternative No. 2 is estimated at $200,000.

**TABLE 10-9**

**Alternative No. 2 – Construct a Satellite Water Reclamation Facility with a Reuse Application of Industrial Process and Irrigation Treatment Costs (2006 Dollars)**

| Item | Quantity | Unit | Unit Price | Total Price |
|---|---|---|---|---|
| Mobilization/Demobilization | 1 | LS | $295,000 | $295,000 |
| Influent Pump Station and Distribution System | 1 | LS | $800,000 | $800,000 |
| Headworks (incl. fine screens, grit removal) | 1 | LS | $477,000 | $477,000 |
| MBR concrete tanks | 1 | LS | $608,000 | $608,000 |
| MBR equipment | 1 | LS | $5,200,000 | $5,200,000 |
| WAS Pump Station and Piping to Sewer | 1 | LS | $300,000 | $300,000 |
| Class "A" UV Disinfection System | 1 | LS | $350,700 | $350,700 |
| UV Disinfection System Channel | 20 | CY | $750 | $15,000 |
| Effluent flow meter and sampler | 1 | LS | $30,000 | $30,000 |
| 200,000 Gallon Storage Tank | 200 | CY | $750 | $150,000 |
| Standby Generator | 1 | LS | $100,000 | $100,000 |
| Subtotal | | | | $8,325,700 |
| Site Work (5% of subtotal) | | | | $417,000 |
| Piping (12% of subtotal) | | | | $1,000,000 |
| Alarms/electrical (20% of subtotal) | | | | $1,666,000 |
| Painting (3% of subtotal) | | | | $250,000 |
| Misc. metals (2% of subtotal) | | | | $167,000 |
| Subtotal | | | | $11,825,700 |
| Contingency (25%) | | | | $2,957,000 |
| Sales Tax (7.9%) | | | | $1,168,000 |
| **Total Construction Cost** | | | | **$15,950,700** |
| Engineering and Administrative Costs (25%) | | | | $3,988,000 |
| **Total Estimated Project Cost** | | | | **$19,938,700** |

**TABLE 10-10**

**Alternative No. 2 – Construct a Satellite Water Reclamation Facility with a Reuse Application of Industrial Process and Irrigation Distribution Costs (2006 Dollars)**

| Item | Quantity | Unit | Unit Price | Total Price |
|---|---|---|---|---|
| Mobilization/Demobilization | 1 | LS | $235,000 | $235,000 |
| Supply Pump Station | 1 | LS | $110,000 | $110,000 |
| Subtotal | | | | $345,000 |
| Site Work (5% of subtotal) | | | | $18,000 |
| Piping (15% of subtotal) | | | | $52,000 |
| Alarms/electrical (15% of subtotal) | | | | $52,000 |
| Painting (3% of subtotal) | | | | $11,000 |
| Misc. metals (2% of subtotal) | | | | $7,000 |
| Irrigation Supply Piping | 15,200 | LF | $80 | $1,216,000 |
| Subtotal | | | | $1,701,000 |
| Contingency (25%) | | | | $426,000 |
| Sales Tax (7.9%) | | | | $169,000 |
| **Total Construction Cost** | | | | **$2,296,000** |
| Engineering and Administrative Costs (25%) | | | | $574,000 |
| **Total Estimated Project Cost** | | | | **$2,870,000** |

## FEASIBILITY OF REUSE

### BENEFITS OF REUSE

The City and the surrounding community can benefit indirectly from the use of reclaimed water. The reuse application to augment streamflows in Dwyer Creek and for wetlands mitigation banking both will have potential environmental and social benefits to the City of Camas that are difficult to evaluate. For example, creating wetlands and enhancing Dwyer Creek can provide additional outdoor recreational uses for the community. The application to use reclaimed water for irrigation of parks and playfields can add value to the community as a whole, potentially increasing property values. In addition, reusing water for irrigation and industrial uses rather than using potable water supports a cultural value of conserving the quality and quantity of the City's water resources.

Industrial water customers can benefit from the production of reuse water by having a flexible and reliable alternative water source. Initially, industrial use of reclaimed water would likely require the industry to invest additional time and costs to adapt the existing system to the use of reclaimed water. However, the additional cost could potentially be

minimal to retrofit the existing system since many of the industries currently have additional water treatment components that are applied to the potable water that they are currently purchasing.

## ECONOMIC FEASIBILITY

Production of reclaimed water is considered economically feasible if the cost of producing reclaimed water is less than or equal to the cost of purchasing water or developing additional water rights. The 20-year present worth for reuse Alternative No. 1 and Alternative No. 2 is presented in Table 10-11. The cost for Alternative No. 1, to modify the existing WWTF, is much less than the cost for Alternative No. 2, to construct a satellite WRF. However, at this time, production of reclaimed water is not economically feasible since adequate water rights are available at a relatively low cost. It is likely the City will acquire additional water rights through a transfer from Georgia Pacific. The cost to develop and acquire the additional water rights from Georgia Pacific will not exceed a conservative estimate of 5 million dollars. The cost to produce reclaimed water is significantly more expensive than the cost to develop and acquire additional water rights from Georgia Pacific.

**TABLE 10-11**

**Comparison of Alternatives(1)**
**(2006 Dollars)**

| | **Alternative No. 1 Modify Existing WWTF** | **Alternative No. 2 Construct a Satellite WRF** |
|---|---|---|
| Peak Hour Reuse Water Production | 6.1 mgd | 4.73 mgd |
| Capital Cost | $ 8,161,000 | $ 22,808,700 |
| Annual O&M Cost (2004) | $ 90,000 | $ 200,000 |
| 20-year Present Worth | $ 10,579,334 | $ 28,182,775 |

(1) Inflation assumed at 3 percent.

The alternatives for reuse may be reevaluated in the future as treatment costs become more competitive.

# CHAPTER 11

# FINANCIAL ANALYSIS

This chapter presents an analysis of funding strategies for the City of Camas to finance recommended wastewater system capital improvements presented in the previous chapters. The financial status of the sewer utility, funding sources, and recommended funding programs to pay for the scheduled improvements are discussed.

## FINANCIAL STATUS OF EXISTING SEWER UTILITY

### CURRENT SEWER RATES

The sewer rates are presented in Chapter 13.64 of the City's municipal code, which is included in Appendix C. Chapter 13.64 establishes a variable sewer rate for 2003 through 2008. The monthly sewer rates for each customer class are summarized in Table 11-1. Residential customers are charged a flat rate monthly service charge. Commercial and industrial customers pay a monthly service charge and a volume charge. Customers outside the city pay 150 percent of the inside city rate. Multifamily residential customers are billed as commercial customers.

**TABLE 11-1**

**Monthly Sewer Rates(1)**

| Customer Class | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|
| **Monthly Base Charge** | | | | | | |
| Residential Inside City | $20.75 | $22.25 | $22.60 | $23.05 | $23.55 | $24.05 |
| Residential Outside City | $31.13 | $33.38 | $33.90 | $34.58 | $35.33 | $36.08 |
| Commercial(2) and Industrial Inside City | $ 4.65 | $ 4.65 | $ 5.00 | $ 5.25 | $ 5.50 | $ 5.75 |
| Commercial(2) and Industrial Outside City | $ 6.98 | $ 6.98 | $ 7.50 | $ 7.88 | $ 8.25 | $ 8.63 |
| **Volume Charge ($/ccf)** | | | | | | |
| Residential Inside City | $ 0 | $ 0 | $ 0 | $ 0 | $ 0 | $ 0 |
| Residential Outside City | $ 0 | $ 0 | $ 0 | $ 0 | $ 0 | $ 0 |
| Commercial(2) and Industrial Inside City | $ 2.10 | $ 2.15 | $ 2.25 | $ 2.30 | $ 2.35 | $ 2.45 |
| Commercial(2) and Industrial Outside City | $ 3.15 | $ 3.23 | $ 3.38 | $ 3.45 | $ 3.53 | $ 3.68 |

(1) Source: Chapter 13.64 City of Camas Municipal Code.
(2) Multifamily residential are billed monthly as commercial customers.

## SEWER SYSTEM DEVELOPMENT CHARGES

The City of Camas imposes a sewer system development charge (SDC) for all new connections to the sewer system to finance improvements of general benefit to the wastewater system, that are required to service future growth. SDCs are generally established as one-time charges assessed against new sewer customers as a way to recover a part of the cost of additional system capacity constructed for their use. Chapter 13.72 of the City's municipal code defines the sewer system development charges. The intent is that all new system customers will pay an equitable share for existing and planned facilities of general benefit. Typical items of construction financed by the sewer system development charge are wastewater treatment facilities, pump stations, interceptors, and other general improvements that benefit the entire system. SDCs are levied on single-family, multi-family, commercial, and industrial users.

The City has two classifications of commercial customers. Commercial I customers are charged based on the size of the water meter. Commercial II customers are non-residential customers that contribute higher than average flows or loads to the sewer system and includes industrial and unusual requirement customers. Commercial II customers pay an SDC determined by the Public Works Director; the factors used to determine the Commercial II SDC include average daily flow, peaking factor, and BOD and TSS loads. The SDC for residential and Commercial I customer classes are summarized in Table 11-2.

**TABLE 11-2**

**Sewer System Development Charges(1)**

| Customer/Meter Size | Charge |
|---|---|
| Residential (All) | $ 2,349 |
| Commercial I | |
| 5/8 Inch | $ 2,349 |
| 3/4 Inch | $ 3,523 |
| 1 Inch | $ 5,872 |
| 1-1/2 Inch | $ 11,745 |
| 2 Inch | $ 18,792 |
| 3 Inch | $ 37,584 |
| 4 Inch | $ 58,725 |
| 6 Inch | $117,449 |
| 8 Inch | $187,919 |

(1) Source: Chapter 13.72 City of Camas Municipal Code.

## HISTORICAL FINANCIAL OPERATIONS

Historical financial operations for the sewer utility for the years 2003 through 2006 are summarized in Table 11-3.

**TABLE 11-3**

**Historical Financial Operations of the Sewer Utility[1]**

| **Revenues** | **2003** | **2004** | **2005** | **2006** |
|---|---|---|---|---|
| Residential Sewer Service (Flat Rate) | $1,487,239 | $1,651,704 | $1,745,669 | $ 1,840,246 |
| Measured Sewer Commercial and Industrial | $ 610,716 | $ 653,402 | $ 671,726 | $ 695,419 |
| Measured Sewer Industrial / WaferTech | $ 489,498 | $ 498,959 | $ 541,862 | $ 632,748 |
| Measured Sewer Residential-Commercial [2] | $ 17,644 | $ 3,263 | $ - | $ - |
| Miscellaneous Sewer Revenue [3] | $ 11,000 | $ 9,350 | $ 32,145 | $ 17,656 |
| Interest [4] | $ 74,520 | $ 47,531 | $ 26,506 | $ 76,054 |
| **Total Operating Revenue** | **$2,690,618** | **$2,864,209** | **$3,017,908** | **$3,262,123** |
| **Expenses** | **2003** | **2004** | **2005** | **2006** |
| Collection Operations and Maintenance[5] | $ 203,500 | $ 142,709 | $ 313,200 | $ 382,308 |
| Sewer Pumping Operations and Maintenance[5] | $ 271,250 | $ 289,816 | $ 332,917 | $ 407,741 |
| Treatment Operations and Maintenance[5] | $ 586,726 | $ 679,834 | $ 932,109 | $ 959,757 |
| Customer Accounts Expense [6] | $ 41,128 | $ 16,909 | $ 16,679 | $ 11,708 |
| Administrative and General Expense [5], [6] | $ 381,636 | $ 444,844 | $ 453,174 | $ 446,890 |
| Taxes | $ 68,799 | $ 70,886 | $ 60,057 | $ 77,135 |
| **Total Operating Expenses** | **$1,553,039** | **$ 1,644,997** | **$2,108,136** | **$2,285,539** |
| Net Operating Revenue | $1,137,579 | $ 1,219,212 | $ 909,772 | $ 976,584 |
| Debt Service[7] | $1,262,217 | $ 1,259,418 | $1,268,305 | $ 1,424,188 |
| System Development Charges | $ 537,389 | $ 430,206 | $ 764,909 | $ 339,174 |
| Capital Expenditures | $ 499,204 | $ 357,783 | $ 300,849 | $ 393,805 |
| **Change in Cash Reserves** | **($ 86,453)** | **$ 32,217** | **$ 105,527** | **$ (502,235)** |

(1) Source: From the City of Camas Water-Sewer Utility Fund Comparative Statement of Revenue and Expense.
(2) The billing codes have changed and the measured sewer residential-commercial category no longer exists as of February 2004.
(3) Includes sewer hook-up fees and I/I fees.
(4) Interest includes interfund loan interest designated for the sewer fund and a conservative estimate of 40 percent of the combined water-sewer fund interest revenue.
(5) Includes salaries, benefits, supplies, small tools, chemicals, professional services, communication, operating rentals, insurance, repairs and maintenance, and public utilities.
(6) Assumes the sewer utility pays 60 percent of the combined water-sewer utility expense, to provide a conservative estimate.
(7) Annual interest and principal for the 1996 Refunding Revenue Bonds, 1998 Revenue and Refunding Bonds, two Department of Ecology Loans, and a Public Works Trust Fund Loan.

# PROJECTED GROWTH

In order to project future revenues, the growth of the number of customers must be estimated. In Chapter 6, the number of residential, commercial, and city sewer ERUs was projected to grow approximately 7.2 percent annually from 2007 through 2010 and approximately 1.0 percent annually from 2011 through 2025. It is assumed that revenue from industrial customers increases at the same rate as the other customer classes.

## PROJECTED EXPENSES, REVENUES, AND RESERVES

### Future Operating Expenses

The projected operating expenses for 2007 through 2012 are summarized in Table 11-4. The values are based on the City's 2005 and 2006 Sewer Utility Fund. Future operating expenses in 2007 through 2012 are estimated to increase due to growth in the sewer service area, inflation, and changes to the wastewater treatment plant process. All expenses are increased annually by 3.0 percent per year to adjust for increases in expenses due to inflation. All expenses, except salaries and benefits, are also increased annually by 7.2 percent in 2007 through 2010 and 1.0 percent in 2011 and 2012 to account for population growth in the sewer service area.

In 2009, due to the wastewater treatment plant upgrade, a total of two additional full time employees (FTE) ($66,768 for salary and benefits in 2007 dollars) are projected to be added, with an allocation of 0.5 FTE to Sewer Pumping O&M (STEP system) and 1.5 FTE added to the Treatment O&M for the operation of solids digestion and drying facilities. In addition, in 2010, the Treatment O&M costs are increased annually by a total of $111,000 (2007 dollars) primarily due to increases in utility costs associated with the solids treatment facilities as discussed below.

The net O&M cost increase ($111,000, 2007 dollars) in 2010 is calculated using the annual population growth rate and the 2025 O&M costs identified in Table 9-10. Testing and permitting are consequently assumed to increase by $15,000 (2007 dollars) to provide a conservative estimate. It is assumed the power costs for the existing treatment plant operation include the continuous operation of five 25-horsepower aerators in the aerobic digesters, which will no longer be in operation beginning in 2010 and consequently the cost is subtracted from the total treatment plant power costs ($49,000, 2007 dollars). The power cost for the operation of the new biosolids management system results in a net decrease in power costs compared to the existing biosolids management operation. The net decrease in power costs is estimated to be $5,500 (2007 dollars) beginning in 2010. It is estimated that the polymer expense will decrease by 25 percent due to the reduced polymer dosage associated with anaerobic digestion as opposed to aerobic digestion. The new biosolids management operation will require additional utility expenses for natural gas, potable water, and non-potable water; these additional utility expenses are added to the budget beginning in 2010 (total $172,000, 2007 dollars).

In recent years, the City has used contracted hauling to permitted third-party land application sites as its means of biosolids disposal. In 2006, the approximate annual cost of contract hauling was $94,000 (based on actual receipts for 10 months in 2006, extrapolated to 12 months). New biosolids hauling costs are not included, once the biosolids management operation upgrade is complete in 2010, since it is projected that costs for hauling to sites within the City area will be offset by revenue from the sale of Class A biosolids. The equipment and repair costs are anticipated to include an additional $30,000 (2007 dollars) beginning in 2020.

**TABLE 11-4**

**Projected Operating Expenses**

| Expenses | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|
| Collection O&M(1)(2) | $ 407,654 | $ 434,825 | $ 463,952 | $ 495,177 | $ 499,826 | $ 504,521 |
| Sewer Pumping O&M(1)(2)(3) | $ 420,241 | $ 433,641 | $ 483,423 | $ 498,822 | $ 501,115 | $ 503,431 |
| Treatment O&M(1)(2)(4)(5) | $ 1,011,906 | $ 1,067,811 | $ 1,236,867 | $ 1,425,457 | $ 1,436,235 | $ 1,447,120 |
| Customer Accounts Expense(1)(2) | $ 19,742 | $ 21,164 | $ 22,687 | $ 24,321 | $ 24,564 | $ 24,810 |
| Administrative and General Expense(1)(2) | $ 514,742 | $ 541,349 | $ 569,872 | $ 600,449 | $ 605,001 | $ 609,599 |
| Taxes(2) | $ 73,220 | $ 80,846 | $ 89,267 | $ 98,565 | $ 102,537 | $ 106,670 |
| **Operating Expenses** | $ 2,447,506 | $ 2,579,636 | $ 2,866,069 | $ 3,142,791 | $ 3,169,278 | $ 3,196,151 |

(1) Assumes a 3.0 percent annual increase due to inflation.
(2) All expenses, except salaries and benefits, include a 7.2 percent annual increase due to growth in 2007 through 2010, and a 1.0 percent increase due to growth in 2011 and 2012.
(3) 0.5 additional full time employees are projected to be added beginning in 2009 to meet the increased demands of septage pumping and collection.
(4) 1.5 additional full time employees are projected to be added beginning in 2009 as a result of the WWTF upgrade.
(5) Includes a net total increase of $111,000 beginning in 2010 due to upgrade and changes in the treatment plant process; see text for details.

## Future Operating Revenues

Table 11-5 summarizes the projected operating revenues for the years 2007 through 2012. The revenue from residential sewer service charges, measured commercial and industrial charges, and from interest is projected to increase by 7.2 percent annually in 2007 through 2010 and 1.0 percent annually in 2011 and 2012, consistent with the growth rate of ERUs. The revenue from measured sewer industrial / WaferTech is projected to increase by 5.5 percent, 5.2 percent, 5.0 percent, 4.7 percent, 4.5 percent, and 4.3 percent annually for 2007 through 2012, respectively, which is calculated based on the rate of increase in industrial sewer ERUs projected in Chapter 6 interpolating for 2007 through

2012 by assuming a linear increase in the number of industrial sewer ERUs between 2005 and 2015.

**TABLE 11-5**

**Projected Operating Revenues 2007 to 2012**

| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|
| Residential Sewer Service (Flat Rate)(1) | $ 1,972,744 | $ 2,114,781 | $ 2,267,046 | $ 2,430,273 | $ 2,454,576 | $ 2,479,121 |
| Measured Sewer Commercial and Industrial(1) | $ 736,011 | $ 774,482 | $ 812,952 | $ 851,423 | $ 889,893 | $ 928,364 |
| Measured Sewer Industrial / WaferTech(2) | $ 669,682 | $ 704,686 | $ 739,689 | $ 774,693 | $ 809,696 | $ 844,700 |
| Interest Earnings(1) | $ 81,530 | $ 87,400 | $ 93,693 | $ 100,439 | $ 101,443 | $ 102,458 |
| **Total** | **$ 3,459,967** | **$3,681,348** | **$ 3,913,380** | **$ 4,156,827** | **$ 4,255,608** | **$4,354,642** |

(1) The revenue is estimated to increase by 7.2 percent annually for 2007 through 2010 and 1.0 percent annually for 2011 and 2012.

(2) The industrial revenue is estimated to increase by 5.5 percent, 5.2 percent, 5.0 percent, 4.7 percent, 4.5 percent, and 4.3 percent annually for 2007 through 2012, respectively (from Chapter 6).

## Capital Expenditures and Reserves

The City's projected number of new sewer customers and SDC revenue are presented in Table 11-6. The number of new customers is based on the number of ERUs for each customer class predicted in Chapter 6. The SDC is increased from $2,349 to $4,698 beginning in 2008 to mitigate financing of the Capital Improvement Plan. The City is currently undergoing a rate study to determine the impact on SDCs; the rate study will establish the actual SDC increase. To provide a conservative estimate of SDC revenue, it is assumed there are no new industrial sewer customers in the years 2007 through 2012.

**TABLE 11-6**

**Projected Sewer System Development Charge (SDC) Revenue 2007-2012**

| | Single-Family Residential | Multi-Family Residential | Commercial | Total |
|---|---|---|---|---|
| **2007** | | | | |
| New Connections | 433 | 56 | 50 | |
| SDC Revenue | $1,017,666 | $132,165 | $118,259 | **$1,268,090** |
| **2008** | | | | |
| New Connections | 464 | 60 | 54 | |
| SDC Revenue(1) | $2,181,876 | $283,363 | $253,547 | **$2,718,786** |
| **2009** | | | | |
| New Connections | 498 | 65 | 58 | |
| SDC Revenue(1) | $2,338,971 | $303,765 | $271,802 | **$2,914,538** |
| **2010** | | | | |
| New Connections | 534 | 69 | 62 | |
| SDC Revenue(1) | $2,507,377 | $325,636 | $291,372 | **$3,124,385** |
| **2011** | | | | |
| New Connections | 79 | 10 | 9 | |
| SDC Revenue(1) | $ 373,321 | $ 48,484 | $ 43,382 | **$ 465,186** |
| **2012** | | | | |
| New Connections | 80 | 10 | 9 | |
| SDC Revenue(1) | $ 377,054 | $ 48,968 | $ 43,816 | **$ 469,838** |

(1) The SDC is increased from $2,349 to $4,698 beginning in 2008.

## Capital Improvement Projects

Capital improvement projects to be funded over the period 2007 through 2012 are summarized in Table 11-7. Capital improvement projects include collection system studies and improvements and a WWTF upgrade. The collection system capital improvements are described in Chapter 7 and include investigative activities (Projects No. I-1 through I-4), STEP collection system improvements (Project No. S-1), pump station improvements (P-1 through P-6), and gravity collection system improvements (Projects No. G-1 through G-13). The WWTF upgrade, biosolids management system upgrade, and the main pump station improvements are constructed over three funded phases (T-2, T-3, and T-4) and the complete design is funded as project T-1 in 2007.

## TABLE 11-7

## Capital Improvement Projects
## (2006 Dollars)

| Project No. | Project | Total Estimated Cost | Year |
|---|---|---|---|
| T-1 | WWTF upgrade design (1) | $1,395,000 | 2007 |
| I-1 | Basin 10, TV Inspection and Flow Metering | $15,000 | 2007 |
| I-2 | Purchase flow meters (2) | $25,000 | 2007 |
| P-1 | Brady Road Pump Station Rehabilitation | $300,000 | 2007 |
| G-1 | Basin 1, Project 1 | $776,194 | 2007 |
| G-2 | Basin 2, Project 2 | $378,049 | 2007 |
| **2007 Total** | | **$3,215,443** | |
| T-2 | WWTF and Biosolids Management Upgrade and Main Pump Station Improvements Phase 1 (2) | $3,872,700 | 2008 |
| I-3 | TV Inspection and Flow Metering, Basin 2 | $15,000 | 2008 |
| P-2 | Pump Station Rehabilitation | $200,000 | 2008 |
| G-3 | Basin 3s, Project 6 | $588,071 | 2008 |
| G-4 | Basin 3s, Project 3 | $832,995 | 2008 |
| **2008 Total** | | **$5,508,766** | |
| T-3 | WWTF and Biosolids Management Upgrade and Main Pump Station Improvements Phase 2 (2) | $4,807,600 | 2009 |
| I-4 | Inspect Condition of Force Main from Main Pump Station | $10,000 | 2009 |
| P-3 | Pump Station Rehabilitation | $200,000 | 2009 |
| G-5 | Basin 1, Project 2 | $437,285 | 2009 |
| G-6 | Basin 1, Project 3 | $466,496 | 2009 |
| G-7 | Basin 1, Project 4 | $341,916 | 2009 |
| **2009 Total** | | **$9,201,097** | |
| T-4 | WWTF and Biosolids Management Upgrade and Main Pump Station Improvements Phase 3 (2) | $3,872,700 | 2010 |
| S-1 | Basin 6, STEP Main Bypass of Main Pump Station | $4,480,000 | 2010 |
| P-4 | Pump Station Rehabilitation | $150,000 | 2010 |
| G-8 | Basin 4, Project 2 | $573,604 | 2010 |
| G-9 | Basin 6, Project 1 | $645,874 | 2010 |
| **2010 Total** | | **$9,722,178** | |
| P-5 | Pump Station Rehabilitation | $150,000 | 2011 |
| G-10 | Basin 1, Project 5 | $347,140 | 2011 |
| G-11 | Basin 2, Project 1 | $691,171 | 2011 |
| G-12 | Basin 4, Project 3 | $450,256 | 2011 |
| **2011 Total** | | **$1,638,567** | |
| P-6 | Pump Station Rehabilitation | $150,000 | 2012 |
| G-13 | Basin 4, Project 1 | $714,208 | 2012 |
| G-14 | Basin 4, Project 4 | $687,001 | 2012 |
| **2012 Total** | | **$1,551,209** | |
| **2007 through 2012 Total** | | **$30,837,260** | |

(1) Includes the design of Projects No. T-2, T-3, and T-4; 2007 dollars.
(2) From Tables 7-7, 8-7, and 9-9 minus the cost of design (Project No. T-1); 2007 dollars.

The WWTF upgrade is described in Chapter 8, the biosolids management upgrade is described in Chapter 9, and improvements to the main pump station are described in Chapter 7. Funding of the CIP is summarized in Table 11-8.

Table 11-8 includes the total projected wastewater capital expenditures financed by the City in the years 2007 through 2012 of approximately $30,800,000.

To fund the CIP, Table 11-8 includes an increase in SDCs and an increase in the monthly rates beginning in 2008. These estimated increases in rates and SDCs are based on the simplifying assumptions noted in the tables. It is not meant to represent a detailed rate study. The total revenue from rates is increased 10 percent annually in 2008 through 2011. The SDCs are increased from $2,349 to $4,698 beginning in 2008 (the SDCs are doubled). The increases in the SDCs and the monthly rates, presented in Table 11-8, serve to mitigate financing the CIP. The City is currently in the process of conducting a rate study to determine the impacts of financing the CIP on the SDCs and the monthly rates; the actual increase in SDCs and monthly rates will be finalized upon completion of the rate study. The funding scenario presented in Table 11-8 assumes the City uses a combination of loans and bonds to finance the capital improvement projects. The new annual debt service results from a combination of loans and bonds and is summarized in Table 11-9.

The availability of funding for the Capital Improvement Projects will depend on the SDC revenue and the number of new connections predicted for 2007 through 2012. If the City does not experience the growth that is predicted, then the Capital Improvement Program will need to be delayed or the rates will need to be further adjusted.

The projected year-end reserves are also presented in Table 11-8. Maintaining cash reserves at an appropriate level to provide for operations, revenue stabilization, emergency repair or replacement of essential equipment, and for capital maintenance is an element of sound utility management. It is recommended to maintain cash reserves equal to approximately 3 months of operating expenses.

## TABLE 11-8

## Projected Capital Expenditures and Reserves 2007 to 2012

| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|
| Reserves, Jan 1[1] | $ 948,504 | $ 539,910 | $ 4,025,053 | $ 3,309,705 | $ 888,383 | $ 2,180,715 |
| Operating Revenue[2] | $ 3,459,967 | $ 3,681,348 | $ 3,913,380 | $ 4,156,827 | $ 4,255,608 | $ 4,354,642 |
| Rate Increase[3] | $ - | $ 368,135 | $ 782,676 | $ 1,247,048 | $ 1,702,243 | $ 1,741,857 |
| Operating Expenses[4] | $ 2,447,506 | $ 2,579,636 | $ 2,866,069 | $ 3,142,791 | $ 3,169,278 | $ 3,196,151 |
| Net Operating Revenue | $ 1,012,461 | $ 1,469,847 | $ 1,829,987 | $ 2,261,084 | $ 2,788,573 | $ 2,900,348 |
| SDC[5] | $ 1,268,090 | $ 2,718,786 | $ 2,914,538 | $ 3,124,385 | $ 465,186 | $ 469,838 |
| Existing Debt Service[6] | $ (1,428,875) | $ (1,398,368) | $ (1,393,120) | $ (1,243,128) | $ (1,206,385) | $ (1,389,062) |
| New Debt Service[7] | $ - | $ (80,539) | $ (258,979) | $ (748,220) | $ (1,355,493) | $ (1,555,261) |
| Net Revenue | $ 851,676 | $ 2,709,726 | $ 3,092,427 | $ 3,394,121 | $ 691,880 | $ 425,863 |
| Loans[7] | $ 1,000,000 | $ 5,000,000 | $ 3,000,000 | $ - | $ - | $ - |
| Bond Revenue[7] | $ 1,000,000 | $ 1,500,000 | $ 3,000,000 | $ 5,000,000 | $ 2,500,000 | $ - |
| Capital Projects[8] | $ (3,260,270) | $ (5,724,583) | $ (9,807,774) | $ (10,815,443) | $ (1,899,548) | $ (1,852,225) |
| Cash Flow | $ (408,594) | $ 3,485,143 | $ (715,348) | $ (2,421,322) | $ 1,292,332 | $ (1,426,362) |
| **Ending Reserve[9]** | $ 539,910 | $ 4,025,053 | $ 3,309,705 | $ 888,383 | $ 2,180,715 | $ 754,353 |

(1) 2007 beginning reserves are based on comments from the City Accountant dated March 16, 2007.
(2) From Table 11-5.
(3) Revenue from monthly rates is increased by 10 percent annually in 2008 through 2011. This is an estimated monthly rate increase; the City is currently undergoing a rate study to determine the actual amount of the increase.
(4) From Table 11-4.
(5) From Table 11-6; SDCs are increased from $2,349 to $4,698 beginning in 2008. This is an estimated SDC increase; the City is currently undergoing a rate study to determine the actual amount of the increase.
(6) Existing debt service includes annual interest and principal for the 1996 Refunding Revenue Bonds, 1998 Revenue and Refunding Bonds, two Department of Ecology Loans, and a Public Works Trust Fund Loan.
(7) From Table 11-9.
(8) From Table 11-7 adjusted 3.0 percent annually for inflation.
(9) This is the total cash in the system development fund and the net income.

**TABLE 11-9**

**Estimated New Debt Service 2007 to 2012**
**(Annual Debt Payment)**

| Revenue Source | Loan Amt | Terms | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|
| Preconstruction PWTF | $ 1,000,000 | 20 yr / 0.5% | $0 | $ 0 | $ 57,632 | $ 57,368 | $ 57,105 | $ 56,842 |
| Construction PWTF | $ 5,000,000 | 20 yr / 0.5% | $0 | $ 0 | $ 0 | $288,158 | $ 286,842 | $ 285,526 |
| SRF | $ 3,000,000 | 20 yr / 3.3% | $0 | $ 0 | $ 0 | $ 0 | $ 206,157 | $ 206,157 |
| 2007 Bonds | $ 1,000,000 | 20 yr / 4.95% | $0 | $ 80,539 | $ 80,539 | $ 80,539 | $ 80,539 | $ (80,539) |
| 2008 Bonds | $ 1,500,000 | 21 yr / 4.95% | $0 | $ 0 | $120,808 | $ 120,808 | $ 120,808 | $ 120,808 |
| 2009 Bonds | $ 3,000,000 | 20 yr / 4.95% | $0 | $ 0 | $ 0 | $ 201,347 | $ 201,347 | $ 201,347 |
| 2010 Bonds | $ 5,000,000 | 20 yr / 4.95% | $0 | $ 0 | $ 0 | $ 0 | $ 402,695 | $ 402,695 |
| 2011 Bonds | $ 2,500,000 | 20 yr / 4.95% | $0 | $ 0 | $ 0 | $ 0 | $ 0 | $ 201,347 |
| **Total New Debt Service** | NA | NA | $0 | $ 80,539 | $ 258,979 | $ 748,220 | $ 1,355,493 | $ 1,555,261 |

(1) Public Works Trust Fund.
(2) State Revolving Fund.
(3) Bank of America Bond Revenue Index Forecast (1-23-2007).

## AVAILABLE FUNDING SOURCES

**Grants:** Centennial Clean Water Fund (CCWF)
Community Development Block Grant (CDBG)
Community Investment Fund (CIF)
US Economic Development Administration (US EDA)
US EPA State and Tribal Assistance Grant (STAG)
USDA Forest Service, Rural Assistance Program (USFS)
USDA Rural Development (RD)

**Loans:** Water Pollution Control State Revolving Fund (SRF)
Public Works Trust Fund (PWTF)
Community Economic Revitalization Board (CERB)
USDA Rural Development (RD)

**Bonds:** Revenue Bonds
General Obligation Bonds

**Other:** Utility Local Improvement Districts

### CENTENNIAL CLEAN WATER FUND (CCWF)

The Department of Ecology administers the State Revolving Fund (SRF) and Centennial Clean Water Fund (CCWF) programs that provide low interest loans for water pollution control projects. Currently, Ecology offers 20-year loans at 1.5 percent interest rates, and 5-year loans at 0.5 percent interest rates. The primary program requirements are to have an approved facilities plan for treatment works and to demonstrate the ability to repay the loan through a dedicated funding source. The loans can be used to finance sewer system replacement for the elimination of excessive infiltration and inflow and for the construction of facilities with reserve capacities to accommodate flows corresponding to the 20-year projected growth in the service area. Land acquisition is not eligible for SRF funding.

Grant money is available only to those who can document hardship. Where financial hardship is determined, the total eligible project cost cannot exceed $10 million and the grant amount cannot be more than half or $5 million. Hardship is demonstrated when project costs for construction of facilities result in total cost for debt service and operation and maintenance in excess of 1.5 percent of the median household income. A project may be phased and receive funds from several cycles to complete the project. In addition, a higher grant amount may be available if the three-year average local unemployment rate exceeds the three-year average statewide unemployment rate. Grants require a 50 percent matching fund, which is provided by a mandatory SRF loan. If the project is enrolled in Ecology's Small Town Environmental Program, an in-kind match may be used.

## COMMUNITY DEVELOPMENT BLOCK GRANT (CDBG)

The Community Development Block Grant program is a competitive source of federal funding for a broad range of community development projects. A primary requirement of the CDBG program is that the project must principally benefit at least 51 percent of the low-to-moderate income residents of the project area. The State typically receives about $7.5 million in federal funds per funding cycle. CDBG has two programs including General Purpose and Planning Only. The General Purpose program provides grant funds for the design, construction, or reconstruction of water and sewer systems up to the amount of $1,000,000. The Planning Only program includes projects such as comprehensive plans, community development plans, capital improvement plans, and other plans such as land use and urban environmental design, economic development, floodplain and wetlands management, transportation, and utilities. Planning Only grants are limited to $24,000 for a single applicant or $40,000 for a joint applicant.

Eligible applicants for the CDBG programs include cities and towns with less than 50,000 people or counties with populations less than 200,000. Though port districts and economic development districts are not eligible to apply directly, a city or county can submit a joint application and include these entities as partners.

## COMMUNITY INVESTMENT FUND (CIF)

The Community Investment Fund partners with CDBG to fund projects that benefit at least 51 percent low-to-moderate income residents. An applicant would first apply to the CDGB General Purpose program, and meet the income limits of that program. At the discretion of the Public Work Board and if the applicant is turned down for the General Purpose program, an applicant may be asked to apply to the Community Investment Fund. Additional grant funding, in the amount of approximately $1 million may be obtained.

To qualify for CIF, the project must be rated as one of the top three of the local WA-CERT Priority Rating Process, serve a minimum of 51.5 percent low-to-moderate income residents, and receive at least 65 points with the General Purpose application.

## US ECONOMIC DEVELOPMENT ADMINISTRATION (US EDA)

US EDA offers competitive grants up to $1 million for projects within Region 10. Projects are selected locally by an economic development district and submitted to Congress for competitive selection among other regions in the US. Similar to CERB, applicants must have an industrial partner ready to proceed or a feasibility study that establishes realistic job creation.

## US EPA STATE AND TRIBAL ASSISTANCE GRANT (STAG)

Local jurisdictions within the state of Washington can apply to the State and Tribal Assistance Grant program through the office of their local Congressional representative. The Congressional representative will work to add the project as a line item to the VA/HUD Appropriations Bill. Applicants can obtain grant funds up to approximately $2 million.

## US FOREST SERVICE (USFS)

Forest Service grants are available through the Rural Community Assistance Program to assist rural communities that are dependent on natural resources. Project proposals must show a broad community benefit that results in greater ability to improve economically, socially, or environmentally. The project must have the potential for economic development and/or job creation/retention. An application must be located within 100 miles of a Forest Service office and be able to document a history of at least 15 percent dependency on forest products. Grant funds are available for components of planning and design and are limited to $50,000.

## USDA RURAL DEVELOPMENT (RD)

The RD Rural Utility Service administers a water and wastewater loan and grant program to improve the quality of life and promote economic development in rural areas.

Rural Development has a loan program that, under certain conditions, includes a limited grant program. Grants may be awarded when the annual debt service portion of the utility rate exceeds 1.0 percent to 1.5 percent of the municipality's median household income.

In addition, RD has a loan program for needy communities that cannot obtain funding by commercial means through the sale of revenue bonds. The loan program provides 30- to 40-year loans at an interest rate that is based on federal rates and varies with the commercial market. RD loans are revenue bonds with a 1.1 debt coverage factor.

Eligible projects include the construction, expansion, extension or improvement of rural water, sanitary sewers, solid waste disposal, storm, and wastewater disposal facilities.

Basic criteria for RD funding follows:

- Dependent on inability to obtain funds from other sources at reasonable terms.
- A 45 percent grant is available if the median household income of the service area exceeds 80 percent of the statewide non-metropolitan median household income.

- A 75 percent grant is eligible if the service area is below the higher of the poverty line or 80 percent of the state non-metropolitan median household income, and the project is necessary to alleviate a health and safety issue.

Eligible applicants include municipalities; counties; non-profit corporations, associations, or cooperatives; and federally recognized Indian tribes in rural areas with populations less than 10,000.

**PUBLIC WORKS TRUST FUND (PWTF)**

The Public Works Trust Fund is a revolving loan fund designed to help local governments finance public works projects through low-interest loans and technical assistance. The PWTF, established in 1985 by legislative action, offers loans substantially below market rates, payable over periods ranging up to 20 years. To be eligible for the PWTF programs, an applicant must be a local government such as a city, county, or a special purpose utility district.

PWTF has four loan programs including Construction, Pre-Construction, Planning, and Emergency. PWTF loan terms are summarized in Table 11-10.

**TABLE 11-10**

**Public Works Trust Fund Loan Types and Terms**

| Loan Type | Local Match | Interest Rate | Term | Loan Limit |
|---|---|---|---|---|
| Construction | 15% | 0.50% | 20 Years | $ 7,000,000 |
| | 10% | 1.00% | 20 Years | $ 7,000,000 |
| | 5% | 2.00% | 20 Years | $ 7,000,000 |
| Preconstruction(1) | 15% | 0.50% | 20 Years | $ 1,000,000 |
| | 10% | 1.00% | 20 Years | $ 1,000,000 |
| | 5% | 2.00% | 20 Years | $ 1,000,000 |
| Planning(2) | 0% | 0.00% | 6 Years | $ 100,000 |
| Emergency(2) | 0% | 3.00% | 20 Years | $ 500,000 |

(1) Preconstruction loans can be refinanced to a 20-year term, if the applicant obtains a subsequent PWTF Construction loan.

(2) While a match is not required, it is recommended.

The Construction Program accepts applications once per year in the spring, and the money becomes available approximately one year later. The Preconstruction and Planning programs are open on a year-round basis and must be submitted to the Public Works Board prior the to the 15th of the month to be reviewed at the next Board meeting. These funds become available shortly after the Public Works Board makes their final decision as to the award. Emergency projects must have a locally declared emergency

and are applied for on an open cycle depending on the availability of funds. Project expenditures are reimbursable from the date of the declared emergency.

An applicant must have a long-term plan for financing its public works needs. If the applicant is a county or city, it must adopt the 1/4 percent real estate excise tax that is dedicated to public works construction projects. Eligible public works projects include streets and roads, bridges, storm sewers, sanitary sewer collection and treatment systems, and domestic water. Loans are presently offered only for purposes of repair, replacement, rehabilitation, reconstruction, or improvement of existing eligible public works systems. Eligible project costs can include expenses related to serving 20-year forecasted growth as identified in growth management comprehensive plans.

Since substantially more trust fund dollars are requested than are available, local jurisdictions must compete for the available funds. The applications are carefully evaluated, and the Public Works Board submits a prioritized list of those projects to the Legislature that are recommended to receive low-interest financing. The Legislature reviews the list and indicates its approval through the passage of an appropriation from the Public Works Assistance Account to cover the cost of the proposed loans. Once the Governor has signed the appropriation bill into law (an action that usually occurs by the following April), those local governments recommended to receive loans are offered a formal loan agreement with appropriate interest rates and terms as determined by the Public Works Board.

## COMMUNITY ECONOMIC REVITALIZATION BOARD (CERB)

The Community Economic Revitalization Board's prime mission is to partner with business and private industry and local governments to maintain and create jobs. Established by the Legislature in 1982, CERB provides low-interest loans, and in unique circumstances grants, to help finance local public infrastructure necessary to develop or retain stable business and industrial activities. Projects eligible for funding include roads, domestic and industrial water systems, sanitary and storm sewers, port facilities, and general-purpose industrial buildings.

CERB provides loans up to $1 million and, and where applicable, grants in the amount of $300,000. The interest rate is tied to the current cost of a 10-year bond and a local match of 10 percent is required.

Eligible applicants include Washington State subdivisions in partnership with private enterprise. If there is no economic partner, a local government can produce a feasibility study that documents realistic job retention or creation. Applications must be submitted 45 days prior to a regularly scheduled CERB Meeting, which typically meets in January, March, July, and November

## REVENUE BONDS

The most common source of funds for construction of major utility improvements is the sale of revenue bonds. These are tax-free bonds issued by a city. The major source of funds for debt service on revenue bonds is from monthly sewer service charges. In order to make qualify to sell revenue bonds marketable to investors, the bonds typically have contractual provisions for the city to meet debt coverage requirements. The City must show that its annual net operating income (gross income less operation and maintenance expenses) is must be equal to or greater than a factor, typically 1.2 to 1.4 times the annual debt service on all par debt. If a coverage factor has not been specified it will be determined at the time of any future bond issues.

## GENERAL OBLIGATION BONDS

A city may by council action or special election issue general obligation bonds to finance almost any projects of general benefit to the City. The bonds are repaid by tax assessments levied against all privately owned properties within the City. This includes vacant property that would not otherwise contribute to the cost of the specific improvements. This type of bond issue is usually reserved for municipal improvements that are of general benefit to the public, such as arterial streets, bridges, lighting, municipal buildings, fire fighting equipment, parks, and water and wastewater facilities. General obligation bonds are the most attractive bonds to investors because they are backed by the municipality's full taxing authority and carry the lowest rate of interest of any type of bond that a city may issue.

Disadvantages of general obligation bonds include the following:

- Voter approval is often required. The City will incur the legal costs of drafting a ballot measure and pay for the cost of holding a special election. There is also the additional cost of investing staff time in public education of the need for the project, yet there is always uncertainty to the outcome of elections.

- There are legal, as well as practical limits on the amount of general obligation debt a city can issue. Financing capital improvements through general obligation debt reduces the ability of the city to issue additional general obligation debt, which is often the only source of outside financing for many general government facilities.

## UTILITY LOCAL IMPROVEMENT DISTRICTS

Another potential source of funds for improvements can be obtained through the formation of Utility Local Improvement Districts (ULIDs) involving a special assessment made against properties benefiting by the improvements. ULID bonds are further backed by a legal claim to the revenues generated by the utility, similar to revenue bonds.

Sewer system expansion is a frequent application of ULID financing. Typically, ULIDs are formed by the city at the written request (by petition) of the property owners within a specific section of the city's service area. Upon receipt of a sufficient number of signatures or petitions, and acceptance by the city council, the local improvement area is formed. Therefore, a sewer system is designed for that particular area in accordance with the city's sewer comprehensive plan. Each separate property in the ULID is assessed in accordance with the special benefits the property receives from the water or wastewater system improvements. A citywide ULID could form part of a financing package for large-scale capital projects such as sewer line extensions or replacements that benefit all residents in the service area. The assessment places a lien on the property that must be paid in full upon sale of the property. ULID participants have the option of paying their assessment immediately upon receipt, thereby reducing the portion of the costs financed by the ULID bonds.

The advantages of ULID financing, as opposed to rate financing, to the property owner include:

- The ability to avoid interest costs by early payment of assessments.
- If the ULID assessment is paid in installments, it may be eligible to be deducted from federal income taxes.
- Low-income senior citizens may be able to defer assessment payments until the property is sold.
- Some Community Block Grant funds are available to property owners with incomes near or below poverty level. Funds are available only to reduce assessments.

The major disadvantage to the ULID process is that it may be politically difficult to approve formation. The ULID process may be stopped if 40 percent of the property owners protest its formation. Also, there are significant legal and administrative costs associated with the ULID process, which increases total project costs by approximately 30 percent over other financing options.

# APPENDIX A

# SEPA CHECKLIST

**To Be Provided**

# APPENDIX B

# CURRENT NPDES PERMIT

Issuance Date: November 3, 2004
Effective Date: December 1, 2004
Expiration Date: November 30, 2009

WASHINGTON STATE DEPARTMENT OF ECOLOGY

# NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM WASTE DISCHARGE PERMIT NO. WA0020249

State of Washington
Department Of Ecology
Olympia, Washington 98504-7600

In compliance with the provisions of
The State of Washington Water Pollution Control Law
Chapter 90.48 Revised Code of Washington
and
The Federal Water Pollution Control Act
(The Clean Water Act)
Title 33 United States Code, Section 1251 et seq.

**City of Camas**

**P.O. Box 1055**

**Camas, WA 98607**

| | |
|---|---|
| Plant Location: 12th and Polk Street | Receiving Water: Columbia River |
| Water Body I.D. No.: Old ID:WA-CR-1010<br>New ID: 1220169456238 | Discharge Location:<br>Latitude: 45° 34' 36" N<br>Longitude: 122° 23' 28" W |
| Plant Type: Activated sludge with filtration capability and UV disinfection | |

is authorized to discharge in accordance with the special and general conditions that follow.

Kelly Susewind P.E., P.G.
Southwest Regional Manager
Water Quality Program
Washington State Department of Ecology

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**SUMMARY OF PERMIT REPORT SUBMITTALS**

Refer to the Special and General Conditions of this permit for additional submittal requirements.

| Permit Section | Submittal | Frequency | First Submittal Date |
|---|---|---|---|
| S3. | Discharge Monitoring Report | Monthly | January 15, 2005 |
| S3.E | Noncompliance Notification | As necessary | |
| S4.B. | Plans for Maintaining Adequate Capacity | As necessary | |
| S4.D. | Notification of New or Altered Sources | As necessary | |
| S4.E. | Infiltration and Inflow Evaluation | Annually | May 15, 2005 |
| S4.F. | Waste load Assessment | Annually | May 15, 2005 |
| S6.D. | Industrial User Survey | 1/permit cycle | October 15, 2008 |
| S8.A. | Acute Toxicity Characterization Data | 2/permit cycle: Once in winter and Once in Summer | Testing shall begin by February 1, 2005, with the first data submittal by April 15, 2005 |
| S8.C. | Acute Toxicity Compliance Monitoring Reports | Biannually if an acute limit is needed. | November 15, 2006, if needed |
| S8.D | Acute Toxicity: "Causes and Preventative Measures for Transient Events." | As necessary | |
| S8.D | Acute Toxicity TI/TRE Plan | As necessary | |
| S8.E | If No Limit is Required, then Re-test Effluent for Acute Toxicity with Permit Renewal Application | 2/permit cycle | October 15, 2008: Once in the Last Summer & Once in the Last Winter Prior to Submission of the Renewal Application) |
| S9.A | Chronic Toxicity Characterization Data | 2/permit cycle: Once in winter and Once in Summer | Testing shall begin by February 1, 2005, with the fist data submittal by April 15, 2005 |
| S9.A | Chronic Toxicity Tests Characterization Summary Report | 1/permit cycle | 90 days following the last characterization sampling event |
| S9.D | Chronic Toxicity: "Causes and Preventative Measures for Transient Events." | As necessary | |
| S9.D | Chronic Toxicity TI/TRE Plan | As necessary | |

| Permit Section | Submittal | Frequency | First Submittal Date |
|---|---|---|---|
| S9.E | If no Limit is Required then Re-test Effluent for Chronic Toxicity with Permit Renewal Application | 2/permit cycle | October 15, 2008:<br>Once in the Last Summer & Once in the Last Winter Prior to Submission of the Renewal Application |
| S10. | Outfall Evaluation | 1/permit cycle | November 15, 2008 |
| G1. | Notice of Change in Authorization | As necessary | |
| G4. | Reporting Planned Changes | As necessary | |
| G5. | Engineering Report for Construction or Modification Activities | As necessary | |
| G7. | Application for Permit Renewal | 1/permit cycle | February 15, 2009 |
| G21 | Reporting Anticipated Non-compliance | As necessary | |
| G22 | Reporting Other Information | As necessary | |

## SPECIAL CONDITIONS

### S1. DISCHARGE LIMITATIONS

A. Effluent Limitations

All discharges and activities authorized by this permit shall be consistent with the terms and conditions of this permit. The discharge of any of the following pollutants more frequently than, or at a level in excess of, that identified and authorized by this permit shall constitute a violation of the terms and conditions of this permit.

Beginning on the effective date of this permit and lasting through the expiration date the Permittee is authorized to discharge municipal wastewater at the permitted location subject to complying with the following limitations:

| | **EFFLUENT LIMITATIONS[a]: OUTFALL #** 001 | |
|---|---|---|
| **Parameter** | **Average Monthly** | **Average Weekly** |
| Biochemical Oxygen Demand (5 day) | 20 mg/L, 1,017 lbs/day<br>70% removal of influent BOD | 30 mg/L, 1,525 lbs/day |
| Total Suspended Solids | 20 mg/L, 1,017 lbs/day<br>70% removal of influent TSS | 30 mg/L, 1,525 lbs/day |
| Fecal Coliform Bacteria | 200/100 ml | 400/100 ml |
| pH | Daily minimum is equal to or greater than 6 and the daily maximum is less than or equal to 9. | |
| **Parameter** | **Average Monthly** | **Maximum Daily[b]** |
| Total Ammonia (as $NH_3$-N) (summer)[c] | 20 mg/L | 41 mg/L |
| Total Ammonia (as $NH_3$-N) (winter)[c] | 7 mg/L | 15 mg/L |
| [a]The average monthly and weekly effluent limitations are based on the arithmetic mean of the samples taken with the exception of fecal coliform, which is based on the geometric mean. | | |
| [b]The maximum daily effluent limitation is defined as the highest allowable daily discharge. The daily discharge means the discharge of a pollutant measured during a calendar day. For pollutants with limitations expressed in units of mass, the daily discharge is calculated as the total mass of the pollutant discharged over the day. For other units of measurement, the daily discharge is the average measurement of the pollutant over the day. | | |
| [c]Summer ammonia limits apply to the months of June through September. Winter ammonia limits apply to the months of October through May. | | |

B. Mixing Zone Descriptions

The maximum boundaries of the mixing zones are defined according to Chapter 173-201(A) Washington Administrative Code (WAC) as follows:

1. Not extend in a downstream direction for a distance from the discharge ports greater than three hundred feet plus the depth of water over the discharge ports; or

2. Extend upstream for a distance of over 100 feet;

3. Not utilize greater than 25 percent of the flow; and not occupy greater than 25 percent of the width of the water body.

Therefore, the chronic mixing zone boundary is 321 feet downstream during 7Q10 Columbia River discharge conditions. The acute mixing zone boundary is 32 feet downstream. The dilution ratios determined by the Department of Ecology (Department) in March 2004 were summer acute of 8:1, summer chronic of 45:1, and winter acute of 7:1 and winter chronic of 24:1.

## S2. MONITORING REQUIREMENTS

A. Monitoring Schedule

The Permittee shall monitor in accordance with the following schedule:

| Category | Parameter | Units | Sample Point | Minimum Sampling Frequency | Sample Type |
|---|---|---|---|---|---|
| Wastewater Influent | Flow | MGD | Parshall Flume | Continuous[a] | Recording On-line |
| Wastewater Influent | $BOD_5$ | mg/L, lbs/day | Influent sampling station | 4/week | 24-hr composite |
| Wastewater Influent | TSS | mg/L, lbs/day | Influent sampling station | 4/week | 24-hr composite |
| Wastewater Influent | pH | Standard Units | Influent sampling station | Continuous[a] | Recording On-line |
| Wastewater Influent | Total Ammonia | mg/L | Influent sampling station | 4/week | 24-hr composite |
| Wastewater Influent | Oil and grease, priority pollutant metals, and cyanide | µg/L | Influent sampling station | Quarterly[d] | 24-hr composite, except grab for O&G |
| | | | | | |

| Category | Parameter | Units | Sample Point | Minimum Sampling Frequency | Sample Type |
|---|---|---|---|---|---|
| Wastewater Effluent | Flow | MGD | Prior to filter | Continuous[a] | Recording On-line |
| Wastewater Effluent | $BOD_5$ | mg/L, lbs/day, % Removal[b] | Final effluent[c] Sampling Station After UV | 4/week | 24-hr composite |
| Wastewater Effluent | TSS | mg/L, lbs/day, % Removal[b] | Final effluent[c] Sampling Station After UV | 4/week | 24-hr composite |
| Wastewater Effluent | pH | Standard Units | Final effluent[c] Sampling Station After UV | Continuous[a] | Recording On-line |
| Wastewater Effluent | Temperature (daily max) | °C | Final effluent[c] Sampling Station After UV | Contiuous[a] | Recording (on-line or download) |
| Wastewater Effluent | Total Ammonia | mg/L | Final effluent[c] Sampling Station After UV | 4/week | 24-hr composite |
| Wastewater Effluent | Fecal Coliform | Org./100 ml | Final effluent[c] Sampling Station After UV | Daily | Grab |
| Wastewater Effluent | Oil and grease, priority pollutant metals, and cyanide | µg/L | Final effluent[c] Sampling Station After UV | Quarterly[d] | 24-hr composite, except grab for O&G |
| | | | | | |
| Sludge | priority pollutantmetals | mg/kg | sludge | 1 sample taken 30 days after an influent sample | grab |
| | | | | | |
| Pretreatment | Priority Pollutant Scan for non metals as outlined in 40 CFR 122, Appendix D, Table II. Sample influent, and effluent, annually by 24-hour composite and sludge | | | | |

| Category | Parameter | Units | Sample Point | Minimum Sampling Frequency | Sample Type |
|---|---|---|---|---|---|
| | annually by a grab sample. | | | | |
| | | | | | |
| Acute Toxicity Testing | As specified in section S8. | | | | |
| Chronic Toxicity Testing | As specified in section S9. | | | | |

[a] Continuous means uninterrupted except for brief lengths of time for calibration, for power failure, or for unanticipated equipment repair or maintenance. Sampling shall be taken twice daily when continuous monitoring is not possible. Temperature may be recorded with either a down loadable data logger (thermister known as TIDBITs) on may be on-line. Reporting shall be of the daily maximum and minimum values determined over the period.

[b] Percent removal of BOD and TSS shall be calculated with the following algorithm (concentrations in mg/L): (Average Monthly Influent Concentration - Average Monthly Effluent Concentration/Average Monthly Influent Concentration).

[c] "Final Effluent" means wastewater which is exiting, or has exited, the last treatment process or operation. Typically, this is after or at the exit from the chlorine contact chamber or other disinfection process.

[d] Quarterly means testing and reporting with the March, June, September and December DMRs.

B. Sampling and Analytical Procedures

Samples and measurements taken to meet the requirements of this permit shall be representative of the volume and nature of the monitored parameters, including representative sampling of any unusual discharge or discharge condition, including bypasses, upsets and maintenance-related conditions affecting effluent quality.

Sampling and analytical methods used to meet the monitoring requirements specified in this permit shall conform to the latest revision of the *Guidelines Establishing Test Procedures for the Analysis of Pollutants* contained in 40 Code of Federal Regulations (CFR) Part 136 or to the latest revision of *Standard Methods for the Examination of Water and Wastewater* (APHA), unless otherwise specified in this permit or approved in writing by the Department.

C. Flow Measurement

Appropriate flow measurement devices and methods consistent with accepted scientific practices shall be selected and used to ensure the accuracy and reliability of measurements of the quantity of monitored flows. The devices shall be installed, calibrated, and maintained to ensure that the accuracy of the measurements are consistent with the accepted industry standard for that type of device. Frequency of calibration shall be in conformance with manufacturer's recommendations and at a minimum frequency of

at least one calibration per year. Calibration records shall be maintained for at least three years.

D. Laboratory Accreditation

All monitoring data required by the Department shall be prepared by a laboratory registered or accredited under the provisions of, *Accreditation of Environmental Laboratories*, Chapter 173-50 WAC. Flow, temperature, settleable solids, conductivity, pH, and internal process control parameters are exempt from this requirement. Conductivity and pH shall be accredited if the laboratory must otherwise be registered or accredited. The Department exempts crops, soils, and hazardous waste data from this requirement pending accreditation of laboratories for analysis of these media.

## S3. REPORTING AND RECORDKEEPING REQUIREMENTS

The Permittee shall monitor and report in accordance with the following conditions. The falsification of information submitted to the Department shall constitute a violation of the terms and conditions of this permit.

A. Reporting

The first monitoring period begins on the effective date of the permit. Monitoring results shall be submitted monthly. Monitoring data obtained during each monitoring period shall be summarized, reported, and submitted on a Discharge Monitoring Report (DMR) form provided, or otherwise approved, by the Department. DMR forms shall be received by the Department no later than the 15th day of the month following the completed monitoring period, unless otherwise specified in this permit. Priority pollutant analysis data shall be submitted no later than 45 days following the monitoring period. Unless otherwise specified, all toxicity test data shall be submitted within 60 days after the sample date. The report(s) shall be sent to the Southwest Regional Office, Department of Ecology, P.O. BOX 47775, Olympia, Washington 98504-7775.

All laboratory reports providing data for organic and metal parameters shall include the following information: sampling date, sample location, date of analysis, parameter name, CAS number, analytical method/ number, method detection limit (MDL), laboratory practical quantitation limit (PQL), reporting units, and concentration detected.

Discharge Monitoring Report forms must be submitted monthly whether or not the facility was discharging. If there was no discharge during a given monitoring period, submit the form as required with the words "no discharge" entered in place of the monitoring results.

B. Records Retention

The Permittee shall retain records of all monitoring information for a minimum of three years. Such information shall include all calibration and maintenance records and all original recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit. This period of retention shall be extended during the course of any unresolved

litigation regarding the discharge of pollutants by the Permittee or when requested by the Department.

C. Recording of Results

For each measurement or sample taken, the Permittee shall record the following information: 1) the date, exact place, method, and time of sampling or measurement; 2) the individual who performed the sampling or measurement; 3) the dates the analyses were performed; 4) the individual who performed the analyses; 5) the analytical techniques or methods used; and 6) the results of all analyses.

D. Additional Monitoring by the Permittee

If the Permittee monitors any pollutant more frequently than required by this permit using test procedures specified by Condition S2 of this permit, then the results of such monitoring shall be included in the calculation and reporting of the data submitted in the Permittee's DMR.

E. Noncompliance Notification

In the event the Permittee is unable to comply with any of the terms and conditions of this permit due to any cause, the Permittee shall:

1. Immediately take action to stop, contain, and cleanup unauthorized discharges or otherwise stop the noncompliance, correct the problem and, if applicable, repeat sampling and analysis of any noncompliance immediately and submit the results to the Department within 30 days after becoming aware of the violation.

2. Immediately notify the Department of the failure to comply.

3. Submit a detailed written report to the Department within 30 days (five days for upsets and bypasses), unless requested earlier by the Department. The report shall contain a description of the noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

Compliance with these requirements does not relieve the Permittee from responsibility to maintain continuous compliance with the terms and conditions of this permit or the resulting liability for failure to comply.

F. Maintaining a Copy of This Permit

A copy of this permit must be kept at the treatment plant and be made available upon request to the public or the Department inspectors.

## S4. FACILITY LOADING

A. Design Criteria

Flows or waste loadings of the following design criteria for the permitted treatment facility shall not be exceeded:

| | |
|---|---|
| Average flow for the maximum month: | 6.10 mgd |
| Monthly average dry weather flow: | 2.86 mgd |
| Instantaneous peak flow (hourly) | 11.09 mgd |
| $BOD_5$ loading for maximum month: | 5,616 lbs/day* |
| TSS loading for maximum month: | 6,405 lbs/day |

*The rated BOD capacity presumes that ammonia concentrations are approximately 20 percent of $BOD_5$ concentrations. For higher ammonia concentrations, $BOD_5$ capacity is reduced by four pounds for every extra pound of ammonia.

B. Plans for Maintaining Adequate Capacity

The Permittee shall submit to the Department a plan and a schedule for continuing to maintain capacity when:

1. The actual flow or waste load reaches 85 percent of any one of the design criteria in S4.A for three consecutive months; or

2. When the projected increase would reach design capacity within five years, whichever occurs first. If such a plan is required, it shall contain a plan and schedule for continuing to maintain capacity. The capacity as outlined in this plan must be sufficient to achieve the effluent limitations and other conditions of this permit. This plan shall address any of the following actions or any others necessary to meet the objective of maintaining capacity.

3. Analysis of the present design including the introduction of any process modifications that would establish the ability of the existing facility to achieve the effluent limits and other requirements of this permit at specific levels in excess of the existing design criteria specified in paragraph A above.

4. Reduction or elimination of excessive infiltration and inflow of uncontaminated ground and surface water into the sewer system.

5. Limitation on future sewer extensions or connections or additional waste loads.

6. Modification or expansion of facilities necessary to accommodate increased flow or waste load.

7. Reduction of industrial or commercial flows or waste loads to allow for increasing sanitary flow or waste load.

Engineering documents associated with the plan must meet the requirements of WAC 173-240-060, "Engineering Report," and be approved by the Department prior to any construction. The plan shall specify any contracts, ordinances, methods for financing, or other arrangements necessary to achieve this objective.

C. Duty to Mitigate

The Permittee is required to take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this permit that has a reasonable likelihood of adversely affecting human health or the environment

D. Notification of New or Altered Sources

The Permittee shall submit written notice to the Department whenever any new discharge or a substantial change in volume or character of an existing discharge into the Publicly Owned Treatment Works (POTW) is proposed which: (1) would interfere with the operation of, or exceed the design capacity of, any portion of the POTW; (2) is not part of an approved general sewer plan or approved plans and specifications; or (3*)* would be subject to pretreatment standards under 40 CFR Part 403 and Section 307(b) of the Clean Water Act. This notice shall include an evaluation of the POTW's ability to adequately transport and treat the added flow and/or waste load, the quality and volume of effluent to be discharged to the POTW, and the anticipated impact on the Permittee's effluent [40 CFR 122.42(b)].

E. Infiltration and Inflow Evaluation

1. The Permittee shall conduct an infiltration and inflow evaluation. Refer to the U.S. EPA publication, *I/I Analysis and Project Certification*, available as Publication No. 97-03 at: Publications Office, Department of Ecology, P.O. Box 47600, Olympia, Washington 98504-7600. Plant monitoring records may be used to assess measurable infiltration and inflow.

2. A report shall be prepared which summarizes any measurable infiltration and inflow. If infiltration and inflow have increased by more than 15 percent from that found in the first report based on equivalent rainfall, the report shall contain a plan and a schedule for: (1) locating the sources of infiltration and inflow; and (2) correcting the problem.

3. The report shall be submitted by **May 15, 2005,** and **annually** thereafter.

F. Wasteload Assessment

The Permittee shall conduct an **annual** assessment of their flow and waste load and submit a report to the Department by **May 15, 2005,** and **annually** thereafter. The report shall contain the following: an indication of compliance or noncompliance with the permit effluent limitations; a comparison between the existing and design monthly average dry weather and wet weather flows, peak flows, BOD, and total suspended solids loadings; and the percentage increase in these parameters since the last annual report. Because of the industrial loading to Camas, the report shall detail the oxygen consumption of ammonia and BOD against the oxygen delivery capability of the plant (lbs of oxygen required for treatment vs. oxygen delivery capacity of the POTW). The

report shall also state the present and design population or population equivalent, projected population growth rate, and the estimated date upon which the design capacity is projected to be reached, according to the most restrictive of the parameters above. The interval for review and reporting may be modified if the Department determines that a different frequency is sufficient.

## S5. OPERATION AND MAINTENANCE

The Permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed to achieve compliance with the terms and conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems, which are installed by a Permittee only when the operation is necessary to achieve compliance with the conditions of this permit.

A. Certified Operator

An operator certified for at least a Class IV plant by the state of Washington shall be in responsible charge of the day-to-day operation of the wastewater treatment plant. An operator certified for at least a Class III plant shall be in charge during all regularly scheduled shifts.

B. O & M Program

The Permittee shall institute an adequate operation and maintenance program for the entire sewage system. Maintenance records shall be maintained on all major electrical and mechanical components of the treatment plant, as well as the sewage system and pumping stations. Such records shall clearly specify the frequency and type of maintenance recommended by the manufacturer and shall show the frequency and type of maintenance performed. These maintenance records shall be available for inspection at all times.

C. Short-term Reduction

If a Permittee contemplates a reduction in the level of treatment that would cause a violation of permit discharge limitations on a short-term basis for any reason, and such reduction cannot be avoided, the Permittee shall give written notification to the Department, if possible, 30 days prior to such activities, detailing the reasons for, length of time of, and the potential effects of the reduced level of treatment. This notification does not relieve the Permittee of its obligations under this permit.

D. Electrical Power Failure

The Permittee is responsible for maintaining adequate safeguards to prevent the discharge of untreated wastes or wastes not treated in accordance with the requirements of this permit during electrical power failure at the treatment plant and/or sewage lift stations either by means of alternate power sources, standby generator, or retention of inadequately treated wastes.

The Permittee shall maintain Reliability Class II (EPA 430-99-74-001) at the wastewater treatment plant, which requires a backup power source sufficient to operate all vital components and critical lighting and ventilation during peak wastewater flow conditions.

E. Prevent Connection of Inflow

The Permittee shall strictly enforce their sewer ordinances and not allow the connection of inflow (roof drains, foundation drains, etc.) to the sanitary sewer system.

F. Bypass Procedures

Bypass, which is the intentional diversion of waste streams from any portion of a treatment facility, is prohibited, and the Department may take enforcement action against a Permittee for bypass unless one of the following circumstances (1, 2, or 3) is applicable.

1. Bypass for essential maintenance without the potential to cause violation of permit limits or conditions.

   Bypass is authorized if it is for essential maintenance and does not have the potential to cause violations of limitations or other conditions of this permit, or adversely impact public health as determined by the Department prior to the bypass. The Permittee shall submit prior notice, if possible at least 10 days before the date of the bypass.

2. Bypass which is unavoidable, unanticipated and results in noncompliance of this permit.

   This bypass is permitted only if:

   a. Bypass is unavoidable to prevent loss of life, personal injury, or severe property damage. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which would cause them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass.

   b. There are no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, stopping production, maintenance during normal periods of equipment downtime (but not if adequate backup equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventative maintenance), or transport of untreated wastes to another treatment facility.

   c. The Department is properly notified of the bypass as required in Condition S3E of this permit.

3. Bypass which is anticipated and has the potential to result in noncompliance of this permit

The Permittee shall notify the Department at least 30 days before the planned date of bypass. The notice shall contain: (1) a description of the bypass and its cause; (2) an analysis of all known alternatives which would eliminate, reduce, or mitigate the need for bypassing; (3) a cost-effectiveness analysis of alternatives including comparative resource damage assessment; (4) the minimum and maximum duration of bypass under each alternative; (5) a recommendation as to the preferred alternative for conducting the bypass; (6) the projected date of bypass initiation; (7) a statement of compliance with State Environmental Policy Act (SEPA); (8) a request for modification of water quality standards as provided for in WAC 173-201A-110, if an exceedance of any water quality standard is anticipated; and (9) steps taken or planned to reduce, eliminate, and prevent reoccurrence of the bypass.

For probable construction bypasses, the need to bypass is to be identified as early in the planning process as possible. The analysis required above shall be considered during preparation of the engineering report or facilities plan and plans and specifications and shall be included to the extent practical. In cases where the probable need to bypass is determined early, continued analysis is necessary up to and including the construction period in an effort to minimize or eliminate the bypass.

The Department will consider the following prior to issuing an administrative order for this type bypass:

a. If the bypass is necessary to perform construction or maintenance-related activities essential to meet the requirements of this permit.

b. If there are feasible alternatives to bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, stopping production, maintenance during normal periods of equipment down time, or transport of untreated wastes to another treatment facility.

c. If the bypass is planned and scheduled to minimize adverse effects on the public and the environment.

After consideration of the above and the adverse effects of the proposed bypass and any other relevant factors, the Department will approve or deny the request. The public shall be notified and given an opportunity to comment on bypass incidents of significant duration, to the extent feasible. Approval of a request to bypass will be by administrative order issued by the Department under Revised Code of Washington (RCW) 90.48.120.

G. Operations and Maintenance Manual

The approved Operations and Maintenance Manual shall be kept available at the treatment plant and all operators shall follow the instructions and procedures of this manual.

## S6. PRETREATMENT

A. General Requirements

The Permittee shall work with the Department to ensure that all commercial and industrial users of the POTW are in compliance with the pretreatment regulations promulgated in 40 CFR Part 403 and any additional regulations that may be promulgated under Section 307(b) (pretreatment) and 308 (reporting) of the Federal Clean Water Act.

B. Wastewater Discharge Permit Required

The Permittee shall not allow significant industrial users (SIUs) to discharge wastewater to the Permittee's sewerage system until such user has received a wastewater discharge permit from the Department in accordance with Chapter 90.48 RCW and Chapter 173-216 WAC, as amended.

C. Identification and Reporting of Existing, New, and Proposed Industrial Users

1. The Permittee shall take continuous, routine measures to identify all existing, new, and proposed SIUs and potential significant industrial users (PSIUs) discharging or proposing to discharge to the Permittee's sewerage system (see Appendix B of Fact Sheet for definitions).

2. Within 30 days of becoming aware of an unpermitted existing, new, or proposed industrial user who may be an SIU, the Permittee shall notify such user by registered mail that, if classified as an SIU, they shall be required to apply to the Department and obtain a State Waste Discharge Permit. A copy of this notification letter shall also be sent to the Department within this same 30-day period.

3. The Permittee shall also notify all PSIUs, as they are identified, that if their classification should change to an SIU, they shall be required to apply to the Department for a State Waste Discharge Permit within 30 days of such change.

D. Industrial User Survey

The Permittee shall complete and submit to the Department an Industrial User Survey listing all SIUs and PSIUs discharging to the POTW. The survey shall be conducted once during the permit cycle and shall be received by the Department by **October 15, 2008**. At a minimum, the list of SIUs and PSIUs shall be developed by means of a telephone book search, a water utility billing records search, and a physical reconnaissance of the service area. Information on PSIUs shall at least include: the business name, telephone number, address, description of the industrial process(es), and the known wastewater volumes and characteristics. For assistance with the development of the Industrial User Survey, the Permittee shall refer to the Department's guidance document entitled "Performing an Industrial User Survey."

E. Duty to Enforce Discharge Prohibitions

1. In accordance with 40 CFR 403.5(a), the Permittee shall not authorize or knowingly allow the discharge of any pollutants into its POTW which cause pass through or interference, or which otherwise violates general or specific discharge prohibitions contained in 40 CFR Part 403.5 or WAC-173-216-060.

2. The Permittee shall not authorize or knowingly allow the introduction of any of the following into their treatment works:

   a. Pollutants which create a fire or explosion hazard in the POTW (including, but not limited to waste streams with a closed cup flashpoint of less than 140 degrees Fahrenheit or 60 degrees Centigrade using the test methods specified in 40 CFR 261.21).

   b. Pollutants which will cause corrosive structural damage to the POTW, but in no case discharges with pH lower than 5.0, or greater than 11.0 standard units, unless the works are specifically designed to accommodate such discharges.

   c. Solid or viscous pollutants in amounts that could cause obstruction to the flow in sewers or otherwise interfere with the operation of the POTW.

   d. Any pollutant, including oxygen demanding pollutants, (BOD, etc.) released in a discharge at a flow rate and/or pollutant concentration which will cause interference with the POTW.

   e. Petroleum oil, nonbiodegradable cutting oil, or products of mineral origin in amounts that will cause interference or pass through.

   f. Pollutants which result in the presence of toxic gases, vapors, or fumes within the POTW in a quantity which may cause acute worker health and safety problems.

   g. Heat in amounts that will inhibit biological activity in the POTW resulting in interference but in no case heat in such quantities such that the temperature at the POTW headworks exceeds 40ºC (104ºF) unless the Department, upon request of the Permittee, approves, in writing, alternate temperature limits.

   h. Any trucked or hauled pollutants, except at discharge points designated by the Permittee.

   i. Wastewaters prohibited to be discharged to the POTW by the Dangerous Waste Regulations (Chapter 173-303 WAC), unless authorized under the Domestic Sewage Exclusion (WAC 173-303-071).

3. All of the following are prohibited from discharge to the POTW unless approved in writing by the Department under extraordinary circumstances (such as a lack of direct discharge alternatives due to combined sewer service or the need to augment sewage flows due to septic conditions):

a. Noncontact cooling water in significant volumes.

b. Stormwater, and other direct inflow sources.

c. Wastewaters significantly affecting system hydraulic loading, which do not require treatment, or would not be afforded a significant degree of treatment by the system.

4. The Permittee shall notify the Department if any industrial user violates the prohibitions listed in this section.

## S7. RESIDUAL SOLIDS

Residual solids include screenings, grit, scum, primary sludge, waste activated sludge, and other solid waste. The Permittee shall store and handle all residual solids in such a manner so as to prevent their entry into state ground or surface waters. The Permittee shall not discharge leachate from residual solids to state surface or ground waters. The Permittee shall comply with WAC 173-308 and any associated order for handling biosolids.

## S8. ACUTE TOXICITY

A. Effluent Characterization

The Permittee shall conduct acute toxicity testing on the final effluent to determine the presence and amount of acute (lethal) toxicity. The two acute toxicity tests listed below shall be conducted on each sample taken for effluent characterization.

Effluent characterization for acute toxicity shall be conducted twice in one year. Acute toxicity testing shall follow protocols, monitoring requirements, and quality assurance/quality control procedures specified in this section. A dilution series consisting of a minimum of five concentrations and a control shall be used to estimate the concentration lethal to 50 percent of the organisms ($LC_{50}$). The percent survival in 100 percent effluent shall also be reported.

Testing shall begin by **February 1, 2005**. A written report shall be submitted to the Department **April 15, 2005**. Acute toxicity tests shall be conducted with the following species and protocols:

1. Fathead minnow, *Pimephales promelas* (96 hour static-renewal test, method: EPA/600/4-90/027F).

2. Daphnid, *Ceriodaphnia dubia*, *Daphnia pulex*, or *Daphnia magna* (48 hour static test, method: EPA/600/4-90/027F). The Permittee shall choose one of the three species and use it consistently throughout effluent characterization.

B. Effluent Limit for Acute Toxicity

The Permittee has an effluent limit for acute toxicity if, after completing one year of effluent characterization, either:

1. The median survival of any species in 100 percent effluent is below 80 percent, or

2. Any one test of any species exhibits less than 65 percent survival in 100 percent effluent.

If an effluent limit for acute toxicity is required by this subsection at the end of one year of effluent characterization, the Permittee shall immediately complete all applicable requirements in subsections C, D, and F.

If no effluent limit is required by this subsection at the end of one year of effluent characterization, then the Permittee shall complete all applicable requirements in subsections E and F.

**The effluent limit for acute toxicity is no acute toxicity detected in a test concentration representing the acute critical effluent concentration (ACEC).**

In the event of failure to pass the test described in subsection C of this section for compliance with the effluent limit for acute toxicity, the Permittee is considered to be in compliance with all permit requirements for acute whole effluent toxicity as long as the requirements in subsection D are being met to the satisfaction of the Department.

The ACEC means the maximum concentration of effluent during critical conditions at the boundary of the zone of acute criteria exceedance assigned pursuant to WAC 173-201A-100. The zone of acute criteria exceedance is authorized in Section S1 of this permit. The ACEC equals 14.3 percent effluent (dilution factor of 7:1).

C. Monitoring for Compliance With an Effluent Limit for Acute Toxicity

Monitoring to determine compliance with the effluent limit shall be conducted biannually for the remainder of the permit term using each of the species listed in subsection A on a rotating basis and performed using at a minimum 100 percent effluent, the ACEC, and a control. The Permittee shall schedule the toxicity tests in the order listed in the permit unless the Department notifies the Permittee in writing of another species rotation schedule. The percent survival in 100 percent effluent shall be reported for all compliance monitoring.

If testing is required because of an acute toxicity limit, an acute toxicity compliance monitoring report is required by **November 15, 2006**, and twice a year thereafter.

Compliance with the effluent limit for acute toxicity means no statistically significant difference in survival between the control and the test concentration representing the ACEC. The Permittee shall immediately implement subsection D if any acute toxicity test conducted for compliance monitoring determines a statistically significant difference in survival between the control and the ACEC using hypothesis testing at the 0.05 level of significance (Appendix H, EPA/600/4-89/001). If the difference in survival between the control and the ACEC is less than 10 percent, the hypothesis test shall be conducted at the 0.01 level of significance.

D. Response to Noncompliance With an Effluent Limit for Acute Toxicity

If the Permittee violates the acute toxicity limit in subsection B, the Permittee shall begin additional compliance monitoring within one week from the time of receiving the test results. This additional monitoring shall be conducted weekly for four consecutive weeks using the same test and species as the failed compliance test. Testing shall determine the $LC_{50}$ and effluent limit compliance. The discharger shall return to the original monitoring frequency in subsection C after completion of the additional compliance monitoring.

If the Permittee believes that a test indicating noncompliance will be identified by the Department as an anomalous test result, the Permittee may notify the Department that the compliance test result might be anomalous and that the Permittee intends to take only one additional sample for toxicity testing and wait for notification from the Department before completing the additional monitoring required in this subsection. The notification to the Department shall accompany the report of the compliance test result and identify the reason for considering the compliance test result to be anomalous. The Permittee shall complete all of the additional monitoring required in this subsection as soon as possible after notification by the Department that the compliance test result was not anomalous. If the one additional sample fails to comply with the effluent limit for acute toxicity, then the Permittee shall proceed without delay to complete all of the additional monitoring required in this subsection. The one additional test result shall replace the compliance test result upon determination by the Department that the compliance test result was anomalous.

If all of the additional compliance monitoring conducted in accordance with this subsection complies with the permit limit, the Permittee shall search all pertinent and recent facility records (operating records, monitoring results, inspection records, spill reports, weather records, production records, raw material purchases, pretreatment records, etc.) and submit a report to the Department on possible causes and preventive measures for the transient toxicity event which triggered the additional compliance monitoring.

If toxicity occurs in violation of the acute toxicity limit during the additional compliance monitoring, the Permittee shall submit a Toxicity Identification/Reduction Evaluation (TI/RE) plan to the Department. The TI/RE plan submittal shall be within 60 days after the sample date for the fourth additional compliance monitoring test. If the Permittee decides to forgo the rest of the additional compliance monitoring tests required in this subsection because one of the first three additional compliance monitoring tests failed to meet the acute toxicity limit, then the Permittee shall submit the TI/RE plan within 60 days after the sample date for the first additional monitoring test to violate the acute toxicity limit. The TI/RE plan shall be based on WAC 173-205-100(2) and shall be implemented in accordance with WAC 173-205-100(3).

E. Monitoring When There Is No Permit Limit for Acute Toxicity

The Permittee shall test final effluent once in the last summer and once in the last winter prior to submission of the application for permit renewal. All species used in the initial acute effluent characterization or substitutes approved by the Department shall be used

and results submitted to the Department as a part of the permit renewal application process.

If no limit is required, then testing will still be required twice in the last year before the permit is due to expire. The testing data will be required by **October 15, 2008**.

F. Sampling and Reporting Requirements

1. All reports for effluent characterization or compliance monitoring shall be submitted in accordance with the most recent version of Department of Ecology Publication #WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria* in regards to format and content. Reports shall contain bench sheets and reference toxicant results for test methods. If the lab provides the toxicity test data on floppy disk for electronic entry into the Department's database, then the Permittee shall send the disk to the Department along with the test report, bench sheets, and reference toxicant results.

2. Testing shall be conducted on 24-hour composite effluent samples. Composite samples taken for toxicity testing shall be cooled to 4 degrees Celsius while being collected and shall be sent to the lab immediately upon completion. Grab samples must be shipped on ice to the lab immediately upon collection. If a grab sample is received at the testing lab within one hour after collection, it must have a temperature below 20°C at receipt. If a grab sample is received at the testing lab within 4 hours after collection, it must be below 12°C at receipt. All other samples must be below 8°C at receipt. The lab shall begin the toxicity testing as soon as possible but no later than 36 hours after sampling was ended. The lab shall store all samples at 4°C in the dark from receipt until completion of the test.

3. All samples and test solutions for toxicity testing shall have water quality measurements as specified in Department of Ecology Publication #WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria* or most recent version thereof.

4. All toxicity tests shall meet quality assurance criteria and test conditions in the most recent versions of the EPA manual listed in subsection A and the Department of Ecology Publication #WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*. If test results are determined to be invalid or anomalous by the Department, testing shall be repeated with freshly collected effluent.

5. Control water and dilution water shall be laboratory water meeting the requirements of the EPA manual listed in subsection A or pristine natural water of sufficient quality for good control performance.

6. The whole effluent toxicity tests shall be run on an unmodified sample of final effluent.

7. The Permittee may choose to conduct a full dilution series test during compliance monitoring in order to determine dose response. In this case, the series must have a minimum of five effluent concentrations and a control. The series of concentrations must include the ACEC.

8. All whole effluent toxicity tests, effluent screening tests, and rapid screening tests that involve hypothesis testing, and do not comply with the acute statistical power standard of 29 percent as defined in WAC 173-205-020, must be repeated on a fresh sample with an increased number of replicates to increase the power.

## S9. CHRONIC TOXICITY

A. Effluent Characterization

The Permittee shall conduct chronic toxicity testing on the final effluent. The two chronic toxicity tests listed below shall be conducted on each sample taken for effluent characterization.

Testing shall begin by **February 1, 2005**. A written report shall be submitted to the Department **April 15, 2005**.

Effluent testing for chronic toxicity shall be conducted twice in one year. The Permittee shall conduct chronic toxicity testing during the effluent characterization on a series of at least five concentrations of effluent in order to determine appropriate point estimates. This series of dilutions shall include the ACEC. The Permittee shall compare the ACEC to the control using hypothesis testing at the 0.05 level of significance as described in Appendix H, EPA/600/4-89/001.

Chronic toxicity tests shall be conducted with the following two species and the most recent version of the following protocols:

| Freshwater Chronic Toxicity Test Species | | Method |
|---|---|---|
| Fathead minnow | *Pimephales promelas* | EPA/600/4-91/002 |
| Water flea | *Ceriodaphnia dubia* | EPA/600/4-91/002 |

B. Effluent Limit for Chronic Toxicity

After completion of effluent characterization, the Permittee has an effluent limit for chronic toxicity if any test conducted for effluent characterization shows a significant difference between the control and the ACEC at the 0.05 level of significance using hypothesis testing (Appendix H, EPA/600/4-89/001) and shall complete all applicable requirements in subsections C, D, and F.

If no significant difference is shown between the ACEC and the control in any of the chronic toxicity tests, the Permittee has no effluent limit for chronic toxicity and only subsections E and F apply.

**The effluent limit for chronic toxicity is no toxicity detected in a test concentration representing the chronic critical effluent concentration (CCEC).**

In the event of failure to pass the test described in subsection C, of this section, for compliance with the effluent limit for chronic toxicity, the Permittee is considered to be in compliance with all permit requirements for chronic whole effluent toxicity as long as the requirements in subsection D are being met to the satisfaction of the Department.

The CCEC means the maximum concentration of effluent allowable at the boundary of the mixing zone assigned in Section S1 pursuant to WAC 173-201A-100. The CCEC equals 4.2 percent effluent (based on a dilution factor of 24:1).

If no test resulted in a NOEC less than the ACEC or if no significant difference is shown between the ACEC and the control in any of the chronic toxicity tests, the Permittee has no effluent limit for chronic toxicity and only subsections E and F apply.

C. Monitoring for Compliance With an Effluent Limit for Chronic Toxicity

Monitoring to determine compliance with the effluent limit shall be conducted biannually for the remainder of the permit term using each of the species listed in subsection A on a rotating basis and performed using at a minimum the CCEC, the ACEC, and a control. The Permittee shall schedule the toxicity tests in the order listed in the permit unless the Department notifies the Permittee in writing of another species rotation schedule.

If testing is required because of a chronic toxicity limit, a chronic toxicity compliance monitoring report is required by **November 15, 2006**, and twice a year thereafter.

Compliance with the effluent limit for chronic toxicity means no statistically significant difference in response between the control and the test concentration representing the CCEC. The Permittee shall immediately implement subsection D if any chronic toxicity test conducted for compliance monitoring determines a statistically significant difference in response between the control and the CCEC using hypothesis testing at the 0.05 level of significance (Appendix H, EPA/600/4-89/001). If the difference in response between the control and the CCEC is less than 20 percent, the hypothesis test shall be conducted at the 0.01 level of significance.

In order to establish whether the chronic toxicity limit is eligible for removal from future permits, the Permittee shall also conduct this same hypothesis test (Appendix H, EPA/600/4-89/001) to determine if a statistically significant difference in response exists between the ACEC and the control.

D. Response to Noncompliance With an Effluent Limit for Chronic Toxicity

If a toxicity test conducted for compliance monitoring under subsection C determines a statistically significant difference in response between the CCEC and the control, the Permittee shall begin additional compliance monitoring within one week from the time of receiving the test results. This additional monitoring shall be conducted monthly for three consecutive months using the same test and species as the failed compliance test. Testing shall be conducted using a series of at least five effluent concentrations and a control in order to be able to determine appropriate point estimates. One of these effluent concentrations shall equal the CCEC and be compared statistically to the nontoxic control

in order to determine compliance with the effluent limit for chronic toxicity as described in subsection C. The discharger shall return to the original monitoring frequency in subsection C after completion of the additional compliance monitoring.

If the Permittee believes that a test indicating noncompliance will be identified by the Department as an anomalous test result, the Permittee may notify the Department that the compliance test result might be anomalous and that the Permittee intends to take only one additional sample for toxicity testing and wait for notification from the Department before completing the additional monitoring required in this subsection. The notification to the Department shall accompany the report of the compliance test result and identify the reason for considering the compliance test result to be anomalous. The Permittee shall complete all of the additional monitoring required in this subsection as soon as possible after notification by the Department that the compliance test result was not anomalous. If the one additional sample fails to comply with the effluent limit for chronic toxicity, then the Permittee shall proceed without delay to complete all of the additional monitoring required in this subsection. The one additional test result shall replace the compliance test result upon determination by the Department that the compliance test result was anomalous.

If all of the additional compliance monitoring conducted in accordance with this subsection complies with the permit limit, the Permittee shall search all pertinent and recent facility records (operating records, monitoring results, inspection records, spill reports, weather records, production records, raw material purchases, pretreatment records, etc.) and submit a report to the Department on possible causes and preventive measures for the transient toxicity event which triggered the additional compliance monitoring.

If toxicity occurs in violation of the chronic toxicity limit during the additional compliance monitoring, the Permittee shall submit a Toxicity Identification/Reduction Evaluation (TI/RE) plan to the Department. The TI/RE plan submittal shall be within 60 days after the sample date for the third additional compliance monitoring test. If the Permittee decides to forgo the rest of the additional compliance monitoring tests required in this subsection because one of the first two additional compliance monitoring tests failed to meet the chronic toxicity limit, then the Permittee shall submit the TI/RE plan within 60 days after the sample date for the first additional monitoring test to violate the chronic toxicity limit. The TI/RE plan shall be based on WAC 173-205-100(2) and shall be implemented in accordance with WAC 173-205-100(3).

E. Monitoring When There Is No Permit Limit for Chronic Toxicity

The Permittee shall test final effluent once in the last summer and once in the last winter prior to submission of the application for permit renewal. All species used in the initial chronic effluent characterization or substitutes approved by the Department shall be used and results submitted to the Department as a part of the permit renewal application process.

If no limit is required, then testing will still be required twice in the last year before the permit is due to expire. The testing data will be required by **October 15, 2008**.

F. Sampling and Reporting Requirements

1. All reports for effluent characterization or compliance monitoring shall be submitted in accordance with the most recent version of Department of Ecology Publication #WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria* in regards to format and content. Reports shall contain bench sheets and reference toxicant results for test methods. If the lab provides the toxicity test data on floppy disk for electronic entry into the Department's database, then the Permittee shall send the disk to the Department along with the test report, bench sheets, and reference toxicant results.

2. Testing shall be conducted on 24-hour composite effluent samples. Composite samples taken for toxicity testing shall be cooled to 4 degrees Celsius while being collected and shall be sent to the lab immediately upon completion. Grab samples must be shipped on ice to the lab immediately upon collection. If a grab sample is received at the testing lab within one hour after collection, it must have a temperature below 20°C at receipt. If a grab sample is received at the testing lab within 4 hours after collection, it must be below 12°C at receipt. All other samples must be below 8°C at receipt. The lab shall begin the toxicity testing as soon as possible but no later than 36 hours after sampling was ended. The lab shall store all samples at 4°C in the dark from receipt until completion of the test.

3. All samples and test solutions for toxicity testing shall have water quality measurements as specified in Department of Ecology Publication #WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria* or most recent version thereof.

4. All toxicity tests shall meet quality assurance criteria and test conditions in the most recent versions of the EPA manual listed in subsection A and the Department of Ecology Publication #WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*. If test results are determined to be invalid or anomalous by the Department, testing shall be repeated with freshly collected effluent.

5. Control water and dilution water shall be laboratory water meeting the requirements of the EPA manual listed in subsection A or pristine natural water of sufficient quality for good control performance.

6. The whole effluent toxicity tests shall be run on an unmodified sample of final effluent.

7. The Permittee may choose to conduct a full dilution series test during compliance monitoring in order to determine dose response. In this case, the series must have a minimum of five effluent concentrations and a control. The series of concentrations must include the ACEC and the CCEC.

8. All whole effluent toxicity tests, effluent screening tests, and rapid screening tests that involve hypothesis testing, and do not comply with the chronic statistical power standard of 39 percent as defined in WAC 173-205-020, must be repeated on a fresh sample with an increased number of replicates to increase the power.

## S10. OUTFALL EVALUATION

The Permittee shall inspect, once per permit the submerged portion of the outfall line and diffuser to document its integrity and continued function. If conditions allow for a photographic verification, it shall be included in the report. By **November 15, 2008**, the inspection report shall be submitted to the Department.

## GENERAL CONDITIONS

### G1. SIGNATORY REQUIREMENTS

All applications, reports, or information submitted to the Department shall be signed and certified.

A. All permit applications shall be signed by either a principal executive officer or a ranking elected official.

B. All reports required by this permit and other information requested by the Department shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

1. The authorization is made in writing by a person described above and submitted to the Department.

2. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility, such as the position of plant manager, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.)

C. Changes to authorization. If an authorization under paragraph B.2 above is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph B.2 above must be submitted to the Department prior to or together with any reports, information, or applications to be signed by an authorized representative.

D. Certification. Any person signing a document under this section shall make the following certification:

> I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

### G2. RIGHT OF INSPECTION AND ENTRY

The Permittee shall allow an authorized representative of the Department, upon the presentation of credentials and such other documents as may be required by law:

A. To enter upon the premises where a discharge is located or where any records must be kept under the terms and conditions of this permit.

B. To have access to and copy - at reasonable times and at reasonable cost - any records required to be kept under the terms and conditions of this permit.

C. To inspect - at reasonable times - any facilities, equipment (including monitoring and control equipment), practices, methods, or operations regulated or required under this permit.

D. To sample or monitor - at reasonable times - any substances or parameters at any location for purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act.

## G3. PERMIT ACTIONS

This permit may be modified, revoked and reissued, or terminated either at the request of any interested person (including the Permittee) or upon the Department's initiative. However, the permit may only be modified, revoked and reissued, or terminated for the reasons specified in 40 CFR 122.62, 122.64 or WAC 173-220-150 according to the procedures of 40 CFR 124.5.

A. The following are causes for terminating this permit during its term, or for denying a permit renewal application:

1. Violation of any permit term or condition.

2. Obtaining a permit by misrepresentation or failure to disclose all relevant facts.

3. A material change in quantity or type of waste disposal.

4. A determination that the permitted activity endangers human health or the environment, or contributes to water quality standards violations and can only be regulated to acceptable levels by permit modification or termination [40 CFR Part 122.64(3)].

5. A change in any condition that requires either a temporary or permanent reduction, or elimination of any discharge or sludge use or disposal practice controlled by the permit [40 CFR Part 122.64(4)].

6. Nonpayment of fees assessed pursuant to RCW 90.48.465.

7. Failure or refusal of the Permittee to allow entry as required in RCW 90.48.090.

B. The following are causes for modification but not revocation and reissuance except when the Permittee requests or agrees:

1. A material change in the condition of the waters of the state.

2. New information not available at the time of permit issuance that would have justified the application of different permit conditions.

3. Material and substantial alterations or additions to the permitted facility or activities which occurred after this permit issuance.

4. Promulgation of new or amended standards or regulations having a direct bearing upon permit conditions, or requiring permit revision.

5. The Permittee has requested a modification based on other rationale meeting the criteria of 40 CFR Part 122.62.

6. The Department has determined that good cause exists for modification of a compliance schedule, and the modification will not violate statutory deadlines.

7. Incorporation of an approved local pretreatment program into a municipality's permit.

C. The following are causes for modification or alternatively revocation and reissuance:

1. Cause exists for termination for reasons listed in A1 through A7 of this section, and the Department determines that modification or revocation and reissuance is appropriate.

2. The Department has received notification of a proposed transfer of the permit. A permit may also be modified to reflect a transfer after the effective date of an automatic transfer (General Condition G8) but will not be revoked and reissued after the effective date of the transfer except upon the request of the new Permittee.

## G4. REPORTING PLANNED CHANGES

The Permittee shall, as soon as possible, but no later than 60 days prior to the proposed changes, give notice to the Department of planned physical alterations or additions to the permitted facility, production increases, or process modification which will result in: 1) the permitted facility being determined to be a new source pursuant to 40 CFR 122.29(b); 2) a significant change in the nature or an increase in quantity of pollutants discharged; or 3) a significant change in the Permittee's sludge use or disposal practices. Following such notice, and the submittal of a new application or supplement to the existing application, along with required engineering plans and reports, this permit may be modified, or revoked and reissued pursuant to 40 CFR 122.62(a) to specify and limit any pollutants not previously limited. Until such modification is effective, any new or increased discharge in excess of permit limits or not specifically authorized by this permit constitutes a violation of the terms and conditions of this permit.

## G5. PLAN REVIEW REQUIRED

Prior to constructing or modifying any wastewater control facilities, an engineering report and detailed plans and specifications shall be submitted to the Department for approval in accordance with Chapter 173-240 WAC. Engineering reports, plans, and specifications shall be submitted at least 180 days prior to the planned start of construction unless a shorter time is approved by the Department. Facilities shall be constructed and operated in accordance with the approved plans.

## G6. COMPLIANCE WITH OTHER LAWS AND STATUTES

Nothing in this permit shall be construed as excusing the Permittee from compliance with any applicable federal, state, or local statutes, ordinances, or regulations.

## G7. DUTY TO REAPPLY

The Permittee shall apply for permit renewal by **February 15, 2009**.

## G8. TRANSFER OF THIS PERMIT

In the event of any change in control or ownership of facilities from which the authorized discharge emanate, the Permittee shall notify the succeeding owner or controller of the existence of this permit by letter, a copy of which shall be forwarded to the Department.

A. Transfers by Modification

Except as provided in paragraph (B) below, this permit may be transferred by the Permittee to a new owner or operator only if this permit has been modified or revoked and reissued under 40 CFR 122.62(b)(2), or a minor modification made under 40 CFR 122.63(d), to identify the new Permittee and incorporate such other requirements as may be necessary under the Clean Water Act.

B. Automatic Transfers

This permit may be automatically transferred to a new Permittee if:

1. The Permittee notifies the Department at least 30 days in advance of the proposed transfer date.

2. The notice includes a written agreement between the existing and new Permittees containing a specific date transfer of permit responsibility, coverage, and liability between them.

3. The Department does not notify the existing Permittee and the proposed new Permittee of its intent to modify or revoke and reissue this permit. A modification under this subparagraph may also be minor modification under 40 CFR 122.63. If this notice is not received, the transfer is effective on the date specified in the written agreement.

## G9. REDUCED PRODUCTION FOR COMPLIANCE

The Permittee, in order to maintain compliance with its permit, shall control production and/or all discharges upon reduction, loss, failure, or bypass of the treatment facility until the facility is restored or an alternative method of treatment is provided. This requirement applies in the situation where, among other things, the primary source of power of the treatment facility is reduced, lost, or fails.

## G10. REMOVED SUBSTANCES

Collected screenings, grit, solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall not be resuspended or reintroduced to the final effluent stream for discharge to state waters.

## G11. DUTY TO PROVIDE INFORMATION

The Permittee shall submit to the Department, within a reasonable time, all information which the Department may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The Permittee shall also submit to the Department upon request, copies of records required to be kept by this permit.

## G12. OTHER REQUIREMENTS OF 40 CFR

All other requirements of 40 CFR 122.41 and 122.42 are incorporated in this permit by reference.

## G13. ADDITIONAL MONITORING

The Department may establish specific monitoring requirements in addition to those contained in this permit by administrative order or permit modification.

## G14. PAYMENT OF FEES

The Permittee shall submit payment of fees associated with this permit as assessed by the Department.

## G15. PENALTIES FOR VIOLATING PERMIT CONDITIONS

Any person who is found guilty of willfully violating the terms and conditions of this permit shall be deemed guilty of a crime, and upon conviction thereof shall be punished by a fine of up to $10,000 and costs of prosecution, or by imprisonment in the discretion of the court. Each day upon which a willful violation occurs may be deemed a separate and additional violation.

Any person who violates the terms and conditions of a waste discharge permit shall incur, in addition to any other penalty as provided by law, a civil penalty in the amount of up to $10,000 for every such violation. Each and every such violation shall be a separate and distinct offense, and in case of a continuing violation, every day's continuance shall be deemed to be a separate and distinct violation.

## G16. UPSET

Definition – “Upset” means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the requirements of the following paragraph are met.

A Permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that: 1) an upset occurred and that the Permittee can identify the cause(s) of the upset; 2) the permitted facility was being properly operated at the time of the upset; 3) the Permittee submitted notice of the upset as required in Condition S3.E; and 4) the Permittee complied with any remedial measures required under S4.C of this permit.

In any enforcement proceeding the Permittee seeking to establish the occurrence of an upset has the burden of proof.

## G17. PROPERTY RIGHTS

This permit does not convey any property rights of any sort, or any exclusive privilege.

## G18. DUTY TO COMPLY

The Permittee shall comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application.

## G19. TOXIC POLLUTANTS

The Permittee shall comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if this permit has not yet been modified to incorporate the requirement.

## G20. PENALTIES FOR TAMPERING

The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than two years per violation, or by both. If a conviction of a person is for a violation committed after a first conviction of such person under this Condition, punishment shall be a fine of not more than $20,000 per day of violation, or by imprisonment of not more than four years, or by both.

## G21. REPORTING ANTICIPATED NON-COMPLIANCE

The Permittee shall give advance notice to the Department by submission of a new application or supplement thereto at least 180 days prior to commencement of such discharges, of any facility expansions, production increases, or other planned changes, such as process modifications, in the permitted facility or activity which may result in noncompliance with permit limits or conditions. Any maintenance of facilities, which might necessitate unavoidable interruption of operation and degradation of effluent quality, shall be scheduled during noncritical water quality periods and carried out in a manner approved by the Department.

## G22. REPORTING OTHER INFORMATION

Where the Permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application, or in any report to the Department, it shall promptly submit such facts or information.

## G23. COMPLIANCE SCHEDULES

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each schedule date.

# FACT SHEET FOR NPDES PERMIT WA0020249
# CITY OF CAMAS

11/3/2004

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## INTRODUCTION

The Federal Clean Water Act (FCWA, 1972, and later modifications, 1977, 1981, and 1987) established water quality goals for the navigable (surface) waters of the United States. One of the mechanisms for achieving the goals of the Clean Water Act is the National Pollutant Discharge Elimination System (NPDES) of permits, which is administered by the Environmental Protection Agency (EPA). The EPA has authorized the state of Washington to administer the NPDES permit program. Chapter 90.48 Revised Code of Washington (RCW) defines the Department of Ecology's (Department) authority and obligations in administering the wastewater discharge permit program.

The regulations adopted by the state include procedures for issuing permits [Chapter 173-220 Washington Administrative Code (WAC)], technical criteria for discharges from municipal wastewater treatment facilities (Chapter 173-221 WAC), water quality criteria for surface and ground waters (Chapters 173-201A and 200 WAC), and sediment management standards (Chapter 173-204 WAC). These regulations require that a permit be issued before discharge of wastewater to waters of the state is allowed. The regulations also establish the basis for effluent limitations and other requirements which are to be included in the permit. One of the requirements (WAC 173-220-060) for issuing a permit under the NPDES permit program is the preparation of a draft permit and an accompanying fact sheet. Public notice of the availability of the draft permit is required at least thirty days before the permit is issued (WAC 173-220-050). The fact sheet and draft permit are available for review (see Appendix A--Public Involvement of the fact sheet for more detail on the Public Notice procedures).

The fact sheet and draft permit have been reviewed by the Permittee. Errors and omissions identified in this review have been corrected before going to public notice. After the public comment period has closed, the Department will summarize the substantive comments and the response to each comment. The summary and response to comments will become part of the file on the permit and parties submitting comments will receive a copy of the Department's response. The fact sheet will not be revised. Comments and the resultant changes to the permit will be summarized in Appendix D--Response to Comments.

| GENERAL INFORMATION | |
|---|---|
| Applicant | City of Camas |
| Facility Name and Address | City of Camas Wastewater Treatment Plant<br>P.O. Box 1055<br>Camas, WA 98507 |
| Type of Treatment | Activated sludge with filtration capability and UV disinfection |
| Discharge Location | Columbia River<br>Latitude: 45º 34' 36" N Longitude: 122º 23' 28" W. |
| Water Body ID Number | Old ID No. WA-CR-1010, New ID No. 1220169456238 |

## BACKGROUND INFORMATION

### *DESCRIPTION OF THE FACILITY*

The City of Camas wastewater treatment starts in the collection system where over a thousand customers have septic tanks that discharge to the centralized sewage treatment plant. There are also several industrial customers. These sources have resulted in dilute influent to the plant. The plant itself has

influent screening, primary clarifiers, followed by an activated sludge system. Primary clarifiers are used to remove sludge and grit. To control pH, a sodium hydroxide solution or lime slurry may be mixed in downstream of the influent Parshall flume or mixed in at the aeration splitter box. The wastewater flows to up to three separate aeration basins which are designed for nitrogen removal via selectors, anoxic zones, and internal recycle. The effluent then flows to secondary clarifiers and then on to optional cloth filters. The effluent is disinfected with UV lights before being discharged to the Columbia River.

### HISTORY

The existing facility for the City of Camas (City) was originally constructed in 1972 and has had several modifications since that time. The latest upgrade and expansion was completed in February of 2000. The current system should be able to effectively treat flows projected through the year 2015. The solids treatment was split into two phases with the first phase having been completed in 2000 and the second phase to be completed in 2007 and last through 2027.

### COLLECTION SYSTEM STATUS

The collection system is comprised partly of conventional gravity flow sewers and septic tank effluent (STE). Most of these STE systems discharge by gravity to the pump stations and treatment plant and therefore do not have individual pumps. There were over 1,500 STE systems installed from 1985 to 1997 (facility plan was written in 1997). The City is not continuing to install new septic tanks. The Inflow and Infiltration (I/I) from the STE tanks appears to be negligible. However, I/I from the rest of the system does appear to be excessive according to the 1997 facility plan. The City has a continuing I/I reduction program. Because the City has Septic tanks discharging to the system, which reduced the loading to the plant, the City applied for exemption from the 85 percent removal requirement under the previous permit. The 1999 permit was granted with an 83 percent removal requirement for BOD and 81 percent for TSS. The City has again applied for a further reduction of these removal requirements. The City also receives dilute wastewater from Wafer Tech, one of several industrial customers. As of 1997, approximately one-third of the flow to the sewage treatment plant was from STE systems. There are seven pump stations serving the City, all of which are conventional gravity/lift systems.

### TREATMENT PROCESSES

The wastewater for approximately one-third of the city starts at a septic tank where solids settle out and effluent flows by gravity to the treatment plant. The STE systems are checked on a yearly basis and pumped when full, which is three to five years for residences and as short as six-months for some businesses.

The treatment plant receives influent at the headworks where the flow is measured at a Parshall flume and a 24-hour sampler is available. The wastewater next passes through an inclined rotating fine screen or course bypass-screen and then on to two primary clarifiers (See the plant Schematic in Appendix B). The effluent from the primary clarifiers can be mixed with sodium-hydroxide or lime slurry to control pH as a result of industrial effluent from Wafer Tech. The pH control may also aid in the nitrogen removal process. Grit and sludge from the primary clarifiers is sent to the solids handling system which will be discussed later.

The flow enters one of three aeration basins that each has three selector zones. Aeration and mixing is driven by course and then fine bubble diffusers. The selector zones are followed by two anoxic zones, and then followed by three oxic zones. On-line dissolved oxygen (DO) meters aid in control of aeration blowers that are set to automatically turn on at certain DO levels.

The flow from the aeration basins can be returned for internal recycling or sent on to the two secondary clarifiers. The clarifiers are conventional round center-feed systems that allow for return activated sludge and waste activated sludge.

A magnetic flow meter follows the secondary clarifiers. A fabric filtration system manufactured by AQUADISC may be used if the TSS is not low enough to satisfy limits. The final treatment consists of UV disinfection which is set up in three horizontal banks with 12 modules each. There are a total of 288 bulbs for peak flow and redundancy requirements.

The plant is an activated sludge process with flow greater than one MGD, which according to WAC 173-230-140 places the facility at a Class IV certification. Because of the use of filtration the facility is considered to be tertiary treatment. The lead operator in charge of the treatment plant must therefore have a Class IV certification or higher and the operator in charge of each shift must be certified at Class III or higher. There are currently four operators working at the plant with each having one of the following certifications: Group I, II, III, and IV. The plant hours of operation are 6:00 a.m. to 4:30 p.m. during the weekdays and from 7:00 a.m. to 3:00 p.m. on weekends.

The facility upgrades were financed through a variety of sources with a large part coming from a State Revolving Fund (SRF) Loan for 20 years and a Public Works Trust Fund (PWTF) loan for 10 years, and through revenue bonds. A new facility plan upgrade is budgeted and scheduled for late 2004. The next plant upgrade is scheduled to include engineering for the new construction in 2005, design and bid for new construction in 2006, and the actual construction to take place in 2007. There is a 1998 refunding bond which has a life until April 2016, and there is a PWTF loan that will continue to be paid back until July 2019. A 1998 Department loan will be paid until September 2020. There is also a Department loan for an additional secondary clarifier which has a life through April 2017.

### DISCHARGE OUTFALL

Secondary treated and disinfected effluent is discharged from the facility via an outfall into the Columbia River. The outfall extends approximately 850-feet from the north bank of the Columbia River and terminates at a depth of approximately 21 feet below Columbia River Datum (CRD) during low flows. The outfall is constructed of a 36-inch diameter corrugated steel pipe that terminates in a 150-foot long diffuser. The diffuser currently consists of eight 6-inch diameter port risers that are on 10-foot centers. All ports are in a vertical position and all are discharging horizontally downstream. Eight more ports are in place but closed off with blind flanges which were proposed to be opened during the plant expansion in 2007. Recent dilution modeling by the Department in March 2004 does not show an improvement in acute dilution in opening the diffuser flanges at the current design flow.

### RESIDUAL SOLIDS

Solids are screened at the headworks. Solids from the primary clarifiers are sent first to a grit removal system, and then the liquid part goes on to a gravity thickener. Thickened sludge and scum are sent to one of two aerobic digesters that work in tandem. The digested sludge is mixed with a polymer to aid in thickening and dewatered at a centrifuge. The final sludge cake or biosolids are stored under cover until shipped off-site.

Grit is shipped off site for use in as soil amendments and rags, scum, and screenings are drained and disposed of as solid waste at the local solid waste transfer station. Solids removed from the final biosolids storage area are sent off-site to Fire Mountain Farms, or another permitted biosolids facility.

*PERMIT STATUS*

The previous permit for this facility was issued on February 19, 1999. The previous permit placed effluent limitations on 5-day Biochemical Oxygen Demand ($BOD_5$), Total Suspended Solids (TSS), pH, Fecal Coliform bacteria, Total Residual Chlorine, and Ammonia (narrative).

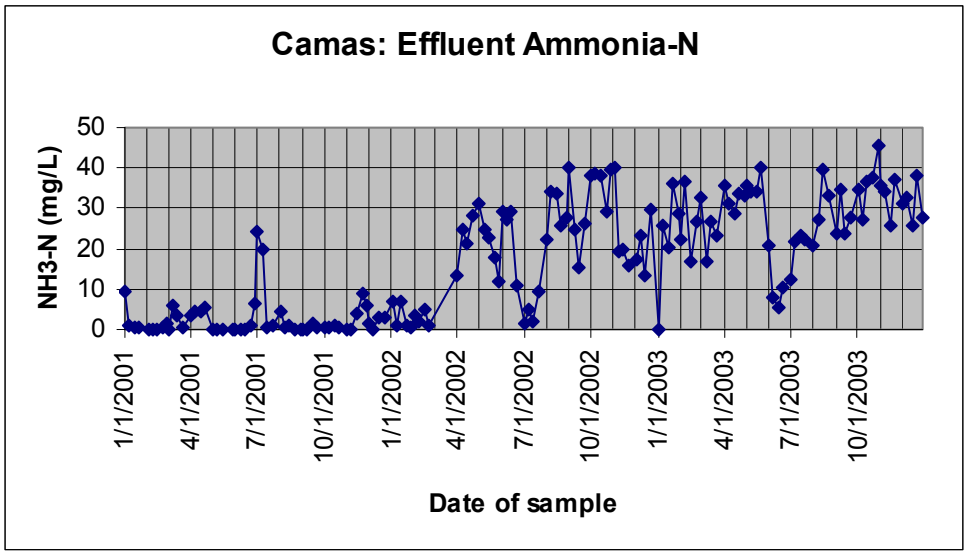
An application for permit renewal was submitted to the Department on August 21, 2003, and accepted by the Department on October 23, 2003.

*SUMMARY OF COMPLIANCE WITH THE PREVIOUS PERMIT*

The facility received its last inspection on February 25, 2004. The facility appeared to be operating properly at that time.

Since the upgrade of the plant in February 2000 there have been no violations of permit conditions, based on Discharge Monitoring Reports (DMRs) submitted to the Department. However, there has been a narrative ammonia limit in the permit that states "Optimize plant operation for nitrification and monitor." It appears that the plant was doing a good job of removing ammonia from January 2001 through March 2002. But in the last two years, from April of 2002, the facility has not been optimizing removal of ammonia (see figure 1 below).

Figure 1: Ammonia Removal at Camas from January 2001 to October 2003




Ammonia toxicity will be explained more thoroughly under "Considerations for Surface Water Quality" and "Toxic Pollutants" below.

The facility has stated in their 1997 facility plan that Inflow and Infiltration (I/I) is a problem. Federal regulation states that infiltration is excessive when average daily flow during a 7-14 day, non-rainfall period of seasonal high groundwater, is greater than 120 gallons per capita day (gpcd). Inflow is excessive when the average daily flow during periods of significant rainfall, such as during a storm event that causes ponding, is greater than 275 gpcd or causes hydraulic overloading of the treatment plant.

A March 2003 I/I report showed average rainfall for each month and therefore included rainfall and non-rainfall periods. The report shows the gallons per capita day (GPCD) which is the highest monthly flows divided by the population equivalent served. This GPCD is shown in the table below:

| Year | Highest monthly flow | Population Equivalent | GPCD | Total Yearly Rainfall (in.) |
|---|---|---|---|---|
| 2002 | 2.398 | 13,500 | 177.6 | 40.21 |
| 2001 | 2.594 | 12,500 | 207.5 | 35.12 |
| 2000 | 2.984 | 12,000 | 248.7 | 34.66 |

The report shows that I/I in general have been going down slightly each year over each of the last three years. It is not clear if this is due to a decrease in rainfall or any reductions on the part of the City. The 177.6 gpcd is still higher than the 120 gpcd that is considered excessive for the infiltration rate. It is therefore recommended that the City continue a program of fixing I/I problems, monitoring, and issuing a report each year.

*WASTEWATER CHARACTERIZATION*

The concentration of pollutants in the discharge was reported in the NPDES application and in discharge monitoring reports. The effluent is characterized as follows:

**Table 1: Wastewater Characterization. Plant Upgraded in February 2000. Data examined for March 2000 through January 2004.** (The following statistics are based on the monthly averages reported in the DMRs except for the ammonia which was calculated with all available daily entries.)

| Parameter | Concentration |
|---|---|
| Flow | 1.76 mgd (Avg.),<br>2.56 mgd (95th percentile) |
| BOD | 218 lbs/day (95th percentile)<br>15.7 mg/L (95th percentile)<br>87% removal (5th percentile) |
| TSS | 104 lbs/day (95th percentile)<br>7.75 mg/L (95th percentile)<br>95% removal (5th percentile) |
| pH (July 2000 – January 2004)<br>pH was not under control until July 2000 | 6.03 S.U. (min), 6.1 (5th percentile)<br>8.13 S.U. (max), 7.6 (95th percentile) |
| Ammonia | **Summer (June – Sept)**<br>37 mg/L (95th percentile, 33 samples from June '02 – Sept '03)<br>**Winter (Oct – May)**<br>39.1 mg/L (95th percentile, 67 samples from Jan '02 – Dec '03) |
| Fecal Coliform | 120 org./100ml (95th percentile of 7-day geomean)<br>28 org./100ml (95th percentile of 30-day geomean) |

The flow has been well within the design flow of the facility. Under phase I, which was completed in 2000 the facility was designed to treat a maximum monthly flow of 6.1 mgd and an average annual flow of 3.77 mgd. The flow averaged 1.76 mgd and was less than 2.56 mgd 95 percent of the time. BOD was within the allowable limit of 955 lbs/day and the plant was under 218 lbs/day 95 percent of the time. The BOD concentration was below 15.7 mg/L 95 percent of the time with a design limit was 30 mg/L on a monthly basis. The facility was able to remove 87 percent of the BOD 95 percent of the time. The minimum removal of BOD was limited to 83 percent.

The plant was within the allowable TSS limit of 1217 lbs/day and was under 104 lbs/day 95 percent of the time. With a concentration limit of 30 mg/L the facility was below 7.75 mg/L TSS. The facility was able to remove 95 percent of the TSS 95 percent of the time. The minimum removal of TSS was limited to 81 percent.

The facility has applied for a lower BOD and TSS removal rate which will be discussed later in this fact sheet.

The pH never went above 8.13 or below 6.03 standard units which kept the facility within the pH limits of 6.0 to 9.0 standard units.

As stated above the ammonia does not appear to have been optimized during the last two years of operation.

The fecal coliform was kept within the limits of 200 to 400 org/100 ml with the fecal coliform below 120 org/100 ml 95 percent of the time.

*SEPA COMPLIANCE*

The facility plan of 1994 would have required State Environmental Policy Act (SEPA) compliance. No other actions related to this permit have triggered SEPA compliance.

## PROPOSED PERMIT LIMITATIONS

Federal and state regulations require that effluent limitations set forth in a NPDES permit must be either technology- or water quality-based. Technology-based limitations for municipal discharges are set by regulation (40 CFR 133, and Chapters 173-220 and 173-221 WAC). Water quality-based limitations are based upon compliance with the Surface Water Quality Standards (Chapter 173-201A WAC), Ground Water Standards (Chapter 173-200 WAC), Sediment Quality Standards (Chapter 173-204 WAC) or the National Toxics Rule (Federal Register, Volume 57, No. 246, Tuesday, December 22, 1992.) The most stringent of these types of limits must be chosen for each of the parameters of concern. Each of these types of limits is described in more detail below.

The limits in this permit are based in part on information received in the application and through an examination of DMRs. The effluent constituents in the application were evaluated on a technology- and water quality-basis. The limits necessary to meet the rules and regulations of the state of Washington were determined and included in this permit. The Department does not develop effluent limits for all pollutants that may be reported on the application as present in the effluent**.** Some pollutants are not treatable at the concentrations reported, are not controllable at the source, are not listed in regulation, and do not have a reasonable potential to cause a water quality violation**.** Effluent limits are not always developed for pollutants that may be in the discharge but not reported as present in the application. In those circumstances the permit does not authorize discharge of the non-reported pollutants. Effluent discharge conditions may change from the conditions reported in the permit application. If significant changes occur in any constituent, as described in 40 CFR 122.42(a), the Permittee is required to notify the Department. The Permittee may be in violation of the permit until the permit is modified to reflect additional discharge of pollutants.

*DESIGN CRITERIA*

In accordance with WAC 173-220-150 (1)(g), flows or waste loadings shall not exceed approved design criteria.

The design criteria for this treatment facility are taken from the 1998 facility plan and the 2002 As Built Drawing Plans prepared by Gray and Osborne, Inc. and are as follows:

**Table 2: Design Standards for the Camas WWTP.**

| Parameter | Design Quantity |
|---|---|
| Monthly average flow (max. month) | 6.10 mgd |
| Monthly average dry weather flow | 2.86 mgd |
| Instantaneous peak flow (hourly) | 11.09 mgd |
| $BOD_5$ influent loading | 5,616 lbs/day |
| TSS influent loading | 6,405 lbs/day |
| TKN loading | 942 lbs/day |

The population equivalent used in the above design criteria is 23,548 (from the 1997 facility plan projected for the year 2015).

*TECHNOLOGY-BASED EFFLUENT LIMITATIONS*

Municipal wastewater treatment plants are a category of discharger for which technology-based effluent limits have been promulgated by federal and state regulations. These effluent limitations are given in the Code of Federal Regulations (CFR) 40 CFR Part 133 (federal) and in Chapter 173-221 WAC (state). These regulations are performance standards that constitute all known available and reasonable methods of prevention, control, and treatment for municipal wastewater.

The following technology-based limits for pH, fecal coliform, $BOD_5$, and TSS are taken from Chapter 173-221 WAC are:

**Table 3: Technology-based Limits from Regulation (Before Changes to BOD and TSS. See table 4).**

| Parameter | Limit |
|---|---|
| pH: | shall be within the range of 6 to 9 standard units. |
| Fecal Coliform Bacteria | Monthly Geometric Mean = 200 organisms/100 ml<br>Weekly Geometric Mean = 400 organisms/100 ml |
| $BOD_5$<br>(concentration) | Average Monthly Limit is the most stringent of the following:<br>- 30 mg/L<br>- may not exceed fifteen percent (15%) of the average influent concentration *<br>Average Weekly Limit = 45 mg/L |
| TSS<br>(concentration) | Average Monthly Limit is the most stringent of the following:<br>- 30 mg/L<br>- may not exceed fifteen percent (15%) of the average influent concentration *<br>Average Weekly Limit = 45 mg/L |

*The previous permit had reduced limits for percent removal of BOD and TSS. This reduced limit was 83 percent removal for BOD and 81 percent removal for TSS. The Permittee has requested to have the percent removal requirement relaxed further due to dilute influent from WaferTech industries and due to the many STEP tanks throughout the system. Our permit guidance allows for BOD and TSS removal rates to be reduced in cases of dilute influent.

Because the influent is diluted, this means the effluent concentration limits should also be reduced. Gray and Osborne, the Permittee's consultant, submitted a final faxed letter on May 23, 2000, after a series of communications requesting a lower percent removal in the permit.

The consultants have shown that the influent during the maximum monthly flow of 6.1 mgd is comprised of 3.134 mgd from WaferTech and Linear Technologies and 2.966 mgd from conventional domestic, commercial, and I/I.

With the safeguard of a maximum limit of 20 mg/L for effluent BOD and TSS, a 70 percent removal rate is acceptable. This is based on several calculations as follows:

(Plant design loading)/(plant design flow)(8.34 lbs/gal) = (5,616 lbs./d BOD)/6.1 mgd)(8.34 lbs/gal) = 110 mg/L BOD.

The results for TSS are slightly higher, but a compromise was made to keep both TSS and BOD the same. The reduction rate was calculated as follows:

Removal of TSS and BOD = 0.83/(1+(3.134/2.966)(20/110)) = 70 percent

The effluent mass loading will need to be reduced to account for the reduced permit limit. The rationale for this is to maintain consistency with the method of calculating mass effluent limits. The Permittee had requested to have the effluent mass loading limit reduced from 1,217 lbs/day to 1,115 lbs/day. However, using the standard method of calculating mass effluent limit, the following effluent loading was determined for BOD and TSS:

Monthly effluent mass loadings (lbs/day) were calculated as the maximum monthly design flow (6.1 mgd) x Concentration limit (20 mg/L) x 8.34 (conversion factor) = mass limit 1,017 lbs/day.

The technology-based mass limits are based on WAC 173-220-130(3)(b) and 173-221-030(11)(b).

The weekly average effluent mass loading is calculated as 1.5 x monthly loading = 1,525 lbs/day.

**Table 4: Technology-based Limits (After Changes to BOD and TSS Due to Dilute Influent).**

| Parameter | Limit |
|---|---|
| pH: | shall be within the range of 6 to 9 standard units. |
| Fecal Coliform Bacteria | Monthly Geometric Mean = 200 organisms/100 ml<br>Weekly Geometric Mean = 400 organisms/100 ml |
| $BOD_5$ (concentration) | Average Monthly Limit is the most stringent of the following:<br>- 20 mg/L<br>- may not exceed thirty percent (30%) of the average influent concentration<br>Average Weekly Limit = 30 mg/L |
| TSS (concentration) | Average Monthly Limit is the most stringent of the following:<br>- 20 mg/L<br>- may not exceed thirty percent (30%) of the average influent concentration<br>Average Weekly Limit = 30 mg/L |

*SURFACE WATER QUALITY-BASED EFFLUENT LIMITATIONS*

In order to protect existing water quality and preserve the designated beneficial uses of Washington's surface waters, WAC 173-201A-060 states that waste discharge permits shall be conditioned such that the discharge will meet established Surface Water Quality Standards. The Washington State Surface Water Quality Standards (Chapter 173-201A WAC) is a state regulation designed to protect the beneficial uses of the surface waters of the state. Water quality-based effluent limitations may be based on an individual waste load allocation (WLA) or on a WLA developed during a basin-wide total maximum daily loading study (TMDL).

NUMERICAL CRITERIA FOR THE PROTECTION OF AQUATIC LIFE

"Numerical" water quality criteria are numerical values set forth in the state of Washington's Water Quality Standards for Surface Waters (Chapter 173-201A WAC). They specify the levels of pollutants allowed in a receiving water while remaining protective of aquatic life. Numerical criteria set forth in the

Water Quality Standards are used along with chemical and physical data for the wastewater and receiving water to derive the effluent limits in the discharge permit. When surface water quality-based limits are more stringent or potentially more stringent than technology-based limitations, they must be used in a permit.

### NUMERICAL CRITERIA FOR THE PROTECTION OF HUMAN HEALTH

The state was issued 91 numeric water quality criteria for the protection of human health by the U.S. EPA (EPA 1992). These criteria are designed to protect humans from cancer and other disease and are primarily applicable to fish and shellfish consumption and drinking water from surface waters.

### NARRATIVE CRITERIA

In addition to numerical criteria, "narrative" water quality criteria (WAC 173-201A-030) limit toxic, radioactive, or deleterious material concentrations below those which have the potential to adversely affect characteristic water uses, cause acute or chronic toxicity to biota, impair aesthetic values, or adversely affect human health. Narrative criteria protect the specific beneficial uses of all fresh (WAC 173-201A-130) and marine (WAC 173-201A-140) waters in the state of Washington.

### ANTIDEGRADATION

The state of Washington's Antidegradation Policy requires that discharges into a receiving water shall not further degrade the existing water quality of the water body. In cases where the natural conditions of a receiving water are of lower quality than the criteria assigned, the natural conditions shall constitute the water quality criteria. Similarly, when receiving waters are of higher quality than the criteria assigned, the existing water quality shall be protected. More information on the State Antidegradation Policy can be obtained by referring to WAC 173-201A-070.

One difficulty in implementing this policy is that the natural conditions of the water cannot be easily discerned from the conditions in the ambient environment as they exist today.

The Department has reviewed existing records and is unable to determine if ambient water quality is either higher or lower than the designated classification criteria given in Chapter 173-201A WAC; therefore, the Department will use the designated classification criteria for this water body in the proposed permit. The discharges authorized by this proposed permit should not cause a loss of beneficial uses.

A Total Maximum Daily Load Study (TMDL) is underway for the Columbia River System for Temperature. There are several parameters listed in the 303(d) list of limited water bodies. The 1998 303(d) listing of WRIA 28 has listings for Arsenic, fecal coliform, sediment bioassay, temperature, and total dissolved gas.

The total dissolved gas is almost entirely a product of excess water spilled at the upstream hydropower facilities and is not a product of wastewater facilities. The fecal coliform listings are a mile or more downstream of the Camas discharge.

Because the Camas facility uses UV disinfection, the discharge rates should be low enough that no fecal coliform will be detectable downstream at the 303(d) listed areas.

The arsenic was listed both upstream and downstream of the City of Camas in the 303(d) list, however the background in the vicinity of the Camas outfall was measured several orders of magnitude below the water quality criterion for arsenic. Arsenic was measured in the effluent but at low levels that were near the background levels. The sediment bioassay was down more than a mile and their does not appear to be toxics in the discharge that would settle out in the sediments.

There are temperature listings along most of the length of the Columbia. Diminishing riparian vegetation, increase thermal absorption due to dams (with shallower backwaters due to silt buildup), return flows from irrigation, and increased numbers of thermal discharges have all had significant effects on the Columbia River temperature as a whole. From relevant data, we have concluded that the POTW is not a significant source of thermal pollution.

The 90$^{th}$ percentile value for temperature in the summer months (June-September of 2000 - 2003) in the Columbia at Washougal was 21.48ºC based on 453 data points. This is above the temperature criterion for this section of the Columbia which is 20ºC.

A temperature TMDL is being done for the Columbia and Snake Rivers. However the TMDL is not completed. The temperature studies have shown that the main cause of the increased temperature in the system is the solar gain in the reservoirs (Ecology, 2004). More will be discussed about temperature at the Camas discharge later in this fact sheet.

### CRITICAL CONDITIONS

Surface water quality-based limits are derived for the waterbody's critical condition, which represents the receiving water and waste discharge condition with the highest potential for adverse impact on the aquatic biota, human health, and existing or characteristic water body uses.

### MIXING ZONES

The Water Quality Standards allow the Department to authorize mixing zones around a point of discharge in establishing surface water quality-based effluent limits. Both "acute" and "chronic" mixing zones may be authorized for pollutants that can have a toxic effect on the aquatic environment near the point of discharge. The concentration of pollutants at the boundary of these mixing zones may not exceed the numerical criteria for that type of zone. Mixing zones can only be authorized for discharges that are receiving all known, available, and reasonable methods of prevention, control and treatment (AKART) and in accordance with other mixing zone requirements of WAC 173-201A-100.

The National Toxics Rule (EPA, 1992) allows the chronic mixing zone to be used to meet human health criteria. A new dilution modeling study was conducted by the Department in March of 2004 using available data (See Appendix C).

### DESCRIPTION OF THE RECEIVING WATER

The facility discharges to the Columbia River which is designated as a Class A receiving water in the vicinity of the outfall. Other nearby point source outfalls include the City of Washougal which is more than one mile upstream and the Fort James Camas L.L.C. paper mill, which is more than a mile downstream. All other outfalls are significantly more than a mile up or down stream. Significant nearby non-point sources of pollutants include stormwater from city and roads in the area.

Characteristic uses of Class A water include the following: water supply (domestic, industrial, agricultural); stock watering; fish migration; fish rearing, spawning and harvesting; wildlife habitat; primary contact recreation; sport fishing; boating and aesthetic enjoyment; commerce and navigation.

Water quality of this class shall meet or exceed the requirements for all or substantially all uses.

### SURFACE WATER QUALITY CRITERIA

Applicable criteria are defined in Chapter 173-201A WAC for aquatic biota. In addition, U.S. EPA has promulgated human health criteria for toxic pollutants (EPA 1992). Criteria for this discharge are summarized below:

| | |
|---|---|
| Fecal Coliforms | 100 organisms/100 ml maximum geometric mean |
| Dissolved Oxygen | 8 mg/L minimum |
| Temperature | 20 degrees Celsius maximum or incremental increases above background |
| pH | 6.5 to 8.5 standard units |
| Turbidity | less than 5 NTUs above background |
| Toxics | No toxics in toxic amounts (see Appendix C for numeric criteria for toxics of concern for this discharge) |

CONSIDERATION OF SURFACE WATER QUALITY-BASED LIMITS FOR NUMERIC CRITERIA

Pollutant concentrations in the proposed discharge exceed water quality criteria with technology-based controls which the Department has determined to be AKART. A mixing zone is authorized in accordance with the geometric configuration, flow restriction, and other restrictions for mixing zones in Chapter 173-201A WAC and are defined as follows:

> A dilution analysis was last conducted in 1994 before the new plant came on-line. Some of the ambient conditions in the Columbia River have changed over time and more detailed information regarding temperature is now available through the USGS and ACOE web sites. The 1994 dilution analysis used UDKHDEN dilution model which tends to over predict the dilution compared to the UM3 model for these waters. The model also used a flux average model prediction rather than a centerline prediction which is recommended in the Department guidance for unidirectional water. The 1994 study assumed that the diffuser would have all 16 ports open, however; only 8 of the 16 ports were open. The other ports were closed with a blind flange.

It was therefore determined that, because of all these reasons, a new dilution analysis should be run. The considerations that went into the dilution model and the results of all of the model runs conducted by the Department in March 2004 are shown in Appendix C.

The UM3 model was run 25 times for both a critical summer and critical winter seasons. These runs produced four dilution factors that will be used in the following situations:

| | Acute | Chronic |
|---|---|---|
| Aquatic Life (summer) | 8 | 48 |
| Aquatic Life (winter) | 7 | 24 |
| Human Health, Carcinogen | | 24 |
| Human Health, Non-carcinogen | | 24 |

The summer low flow season is June through September and the winter is October through May.

Pollutants in an effluent may affect the aquatic environment near the point of discharge (near field) or at a considerable distance from the point of discharge (far field). Toxic pollutants, for example, are near-field pollutants--their adverse effects diminish rapidly with mixing in the receiving water. Conversely, a pollutant such as BOD is a far-field pollutant whose adverse effect occurs away from the discharge even after dilution has occurred. Thus, the method of calculating water quality-based effluent limits varies with the point at which the pollutant has its maximum effect.

The derivation of water quality-based limits also takes into account the variability of the pollutant concentrations in both the effluent and the receiving water.

The critical summer condition for the Columbia River is the seven day average low river flow with a recurrence interval of ten years (7Q10). The critical winter conditions used a median river flow and a high river flow that used the seven day average high flow with a recurrence interval of ten years (7Q90). Ambient data at critical conditions in the vicinity of the outfall were taken from a variety of reports. The flow, velocity and physical river data were taken from the 1994 Wastewater Facilities Plan by CH2MHill which was used in the 1994 dilution study. The temperature was taken from the USGS/ACOE web pages for the Columbia River dissolved gas network. The summer temperatures were taken from the Camas/Washougal station which had hourly data from May through late September. The maximum daily values were used to establish a 90$^{th}$ percentile. The winter temperatures were taken from the Warrendale station which is the nearest station with winter data. The pH percentiles were determined by combining two sets of data. There was only 12 months of monthly pH sampling. In 2002-2003 the Department sampled pH and a number of other parameters used in this report at station 28A100 which is near Vancouver Washington on the Columbia. In 1994 the USGS sampled pH 11 times. Because the pH sampling was so minimal, these two data sources were combined. The other conventional parameters and metals come from the 2002-2003 the Department sampling at station 28A100, which may be found at: http://www.ecy.wa.gov/apps/watersheds/riv/station.asp?theyear=&tab=prelim_data&scrolly=267&wria=28&sta=28A100.

**Ambient Columbia River Conditions Used In This Report**

| Parameter | Value used | | |
|---|---|---|---|
| | Low | Med | High |
| Flow | 81,400 cfs (7Q10) | 192,400 cfs (Median) | 522,000 cfs (7Q90) |
| Velocity | 0.26 m/sec | 0.58 m/sec | 0.99 m/sec |
| Depth | 21 ft | 26.6 ft | 40.9 ft |
| Temperature | 21.48$^{o}$C (summer 90$^{th}$ percentile based on 453 points)<br>15.13 $^{o}$C (winter 90$^{th}$ based on 728 points)<br>12.6 $^{o}$C (yearly median based on 1125 points)<br>4.6 $^{o}$C (winter 10$^{th}$ percentile based on 728 points) | | |
| pH (high) | 8.46 S.U. (winter 90$^{th}$ percentile based on 15 data points)<br>7.988 S.U. (summer 90$^{th}$ percentile based on 8 data points) | | |
| Dissolved Oxygen | 8.9 mg/L (10$^{th}$ percentile) | | |
| Total Ammonia-N | 27 µg/L (summer geomean x 1.74, approximates 90$^{th}$ percentile for small pop.)<br>19 µg/L (winter geomean x 1.74, approx. 90$^{th}$ percentile) | | |
| Fecal Coliform | 28 org./100 ml (summer geomean x 1.74, approx. 90$^{th}$ percentile)<br>7 org./100 ml (winter geomen x 1.74, approx. 90$^{th}$ percentile) | | |
| Turbidity | 5.14 NTU 90$^{th}$ percentile | | |
| Hardness | 48.75 mg/L as CaCO3 (10$^{th}$ percentile) | | |

| | |
|---|---|
| Arsenic | 1.12 µg/L (90th percentile) |
| Cadmium | 0.525 µg/L (90th percentile dissolved) |
| Chromium | 0.415 µg/L (90th percentile dissolved) |
| Copper | 0.86 µg/L (90th percentile dissolved) |
| Lead | 0.06 µg/L (90th percentile dissolved) |
| Nickel | 0.555 µg/L (90th percentile dissolved) |
| Silver | 0.1 µg/L (90th percentile dissolved) |
| Zinc | 2.0 µg/L (90th percentile dissolved) |
| All Other Metals | 0.0 (below detection limits) |

$BOD_5$--Under critical conditions there is no predicted violation of the Water Quality Standards for Surface Waters. Therefore, the technology-based effluent limitation for $BOD_5$ was placed in the permit.

The impact of BOD on the receiving water was modeled using simple mixing (as shown in table C3 in Appendix C), at critical condition and with the technology-based effluent limitation for $BOD_5$ described under "Technology-Based Effluent Limitations" above. A Streeter-Phelps (Dosag) analysis was also run for summer and winter conditions. The Dosag was run with zero BOD input and with a conservative BOD based on high ammonia. Ambient DO was 8.9 mg/L. With initial dilution DO was 8.59 mg/L. With the far field reduction predicted by Dosag the final DO would be 8.58. The DO criterion is 8.0 mg/L. The conservative assumption shows a DO reduction of only 0.01 mg/L which is not enough to put the final DO below the criterion.

Temperature and pH--The impact of pH and temperature were modeled using the calculations from EPA, 1988. The input variables were dilution factor 45, upstream temperature 21.48°C, upstream pH 7.99, upstream alkalinity 53(as mg $CaCO_3$/L), effluent temperature of 22°C was assumed, effluent pH of 6, effluent pH of 9, and effluent alkalinity 150 (as mg $CaCO_3$/L). Effluent temperature appears not to have been monitored since before the 1994 dilution study which used the above effluent temperature. Using simple mixing, the temperature would increase by 0.01°C, which is well below 0.3°C and the maximum pH is already well below the criterion of 9.0 S.U.

The differential between the effluent and ambient temperature is always very small which results in a small amount of energy dissipated into the Columbia. It is not possible at this time to determine if the contribution from all point sources is greater than 1.1°C as specifically stated in the water quality standards for this segment of the Columbia River. This analysis requires a TMDL. As stated earlier in this report, a TMDL is in progress that will attempt to determine temperature allocations for each existing source. Because the Columbia is an interstate waterway with federal hydropower facilities, the TMDL is being conducted by EPA. At this time, the loading from all municipal point sources appears to be very small compared to the solar heating in the reservoirs and some of the industrial sources. “The dams appear to be the major cause of warming of the temperature regimes of the rivers.” (EPA, 2001)

Under critical conditions there is no predicted violation of the Water Quality Standards for Surface Waters. Therefore, the technology-based effluent limitations for pH was placed in the permit and temperature was not limited.

Fecal coliform--The numbers of fecal coliform were modeled by simple mixing analysis using the technology-based limit of 400 organisms per 100 ml and a dilution factor of 45.

Under critical conditions there is no predicted violation of the Water Quality Standards for Surface Waters with the technology-based limit. Therefore, the technology-based effluent limitation for fecal coliform bacteria was placed in the proposed permit. With UV disinfection and proper maintenance, the Permittee should have no problem meeting the water quality criteria for fecal coliform.

Toxic Pollutants--Federal regulations (40 CFR 122.44) require NPDES permits to contain effluent limits for toxic chemicals in an effluent whenever there is a reasonable potential for those chemicals to exceed the surface water quality criteria. This process occurs concurrently with the derivation of technology-based effluent limits. Facilities with technology-based effluent limits defined in regulation are not exempted from meeting the Water Quality Standards for Surface Waters or from having surface water quality-based effluent limits.

The following toxics were determined to be present in the discharge: ammonia, and heavy metals. The Permittee also examined 78 priority pollutant chemicals that were required in the application and all were below detection. A reasonable potential analysis (See Appendix C, Table C2) was conducted on the ammonia and metals to determine whether or not effluent limitations would be required in this permit.

A winter critical condition and a summer critical condition were examined. The only parameter that appeared to have a reasonable potential for violating water quality standards was ammonia. The parameters used in the critical condition modeling are as follows: summer acute dilution factor 8 , summer chronic dilution factor 45, winter acute dilution factor 7, winter chronic dilution factor 24, receiving water hardness of 48.75, summer pH of 7.99, and winter pH of 8.46. The high pH appears to be a driving factor along with the high effluent ammonia detected over the last two years of operation. The $90^{th}$ percentile ammonia concentration was 37 mg/L in the summer and 39.1 mg/L in the winter from 2002 through 2003. The reasonable potential analysis shows that ammonia is likely to violate water quality standards in both the summer and winter.

A permit limit was calculated for both summer and winter ammonia (See Appendix C, Table C4). These calculations show:

Ammonia limits

| Season of limit | Average Monthly | Maximum Daily |
|---|---|---|
| Summer Limit (June – Sept) | 20 mg/L | 41 mg/L |
| Winter Limit (Oct – May) | 7 mg/L | 15 mg/L |

Because the Camas facility has the ability to nitrify and denitrify to remove ammonia, it should have no trouble meeting these limits. Data from January 2001 through March of 2002 shows the facility is able to operate in such a manner as to remove ammonia.

Water quality criteria for metals in Chapter 173-201A WAC are based on the dissolved fraction of the metal.

The Permittee may provide data clearly demonstrating the seasonal partitioning of the dissolved metal in the ambient water in relation to an effluent discharge. Metals criteria may be adjusted on a site-specific basis when data is available clearly demonstrating the seasonal partitioning in the ambient water in relation to an effluent discharge.

Metals criteria may also be adjusted using the water effects ratio approach established by USEPA, as generally guided by the procedures in USEPA Water Quality Standards Handbook, December 1983, as supplemented or replaced.

Valid ambient background data and effluent data were available for arsenic, cadmium, chromium, copper, lead, nickel, silver, and zinc. Ambient data was not available on selenium, and thallium, therefore a background of zero was assumed. The lowest dilution factors of 7 for acute and 24 for chronic were used. Calculations using all applicable data resulted in a determination that there is no reasonable potential for the discharge of these metals to cause a violation of water quality standards. All other metals were assumed to be below detection. This determination assumes that the Permittee meets the other effluent limits of this permit.

WHOLE EFFLUENT TOXICITY

The Water Quality Standards for Surface Waters require that the effluent not cause toxic effects in the receiving waters. Many toxic pollutants cannot be detected by commonly available detection methods. However, toxicity can be measured directly by exposing living organisms to the wastewater in laboratory tests and measuring the response of the organisms. Toxicity tests measure the aggregate toxicity of the whole effluent, and therefore this approach is called whole effluent toxicity (WET) testing. Some WET tests measure acute toxicity and other WET tests measure chronic toxicity.

Acute toxicity tests measure mortality as the significant response to the toxicity of the effluent. Dischargers who monitor their wastewater with acute toxicity tests are providing an indication of the potential lethal effect of the effluent to organisms in the receiving environment.

Chronic toxicity tests measure various sub lethal toxic responses such as retarded growth or reduced reproduction. Chronic toxicity tests often involve either a complete life cycle test of an organism with an extremely short life cycle or a partial life cycle test on a critical stage of one of a test organism's life cycles. Organism survival is also measured in some chronic toxicity tests.

Accredited WET testing laboratories have the proper WET testing protocols, data requirements, and reporting format. Accredited laboratories are knowledgeable about WET testing and capable of calculating an NOEC, $LC_{50}$, $EC_{50}$, $IC_{25}$, etc. All accredited labs have been provided the most recent version of the Department of Ecology Publication # WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria* which is referenced in the permit. Any Permittee interested in receiving a copy of this publication may call the Department Publications Distribution Center (360) 407-7472 for a copy. The Department recommends that Permittees send a copy of the acute or chronic toxicity sections(s) of their permits to their laboratory of choice.

An effluent characterization for acute and chronic toxicity was conducted during the previous permit term. In accordance with WAC 173-205-060, the Permittee must repeat this effluent characterization for the following reason:

> The Permittee has made changes to processes, materials, or treatment that could result in an increase in effluent toxicity. In accordance with WAC 173-205-060(1), the proposed permit requires another effluent characterization for toxicity. The Permittee has also experienced an increase in industrial discharge and cannot demonstrate that the new source is nontoxic or that the pretreatment program and local limits are adequate to control toxicity from the new source. In accordance with WAC 173-205-060(1), the proposed permit requires another effluent characterization for toxicity.

HUMAN HEALTH

Washington's water quality standards now include 91 numeric health-based criteria that must be considered in NPDES permits. These criteria were promulgated for the state by the U.S. EPA in its National Toxics Rule (Federal Register, Volume 57, No. 246, Tuesday, December 22, 1992).

The Department has determined that the effluent is likely to have chemicals of concern for human health. The discharger's high priority status is based on its status as a major discharger.

A determination of the discharge's potential to cause an exceedance of the water quality standards was conducted as required by 40 CFR 122.44(d). The reasonable potential determination was evaluated with procedures given in the Technical Support Document for Water Quality-Based Toxics Control (EPA/505/2-90-001) and the Department's Permit Writer's Manual (Ecology Publication 92-109, July, 1994). The determination indicated that the discharge has no reasonable potential to cause a violation of water quality standards, thus an effluent limit is not warranted.

SEDIMENT QUALITY

The Department has promulgated aquatic sediment standards (Chapter 173-204 WAC) to protect aquatic biota and human health. These standards state that the Department may require Permittees to evaluate the potential for the discharge to cause a violation of applicable standards (WAC 173-204-400).

The Department has determined through a review of the discharger characteristics and effluent characteristics that this discharge has no reasonable potential to violate the Sediment Management Standards.

*GROUND WATER QUALITY LIMITATIONS*

The Department has promulgated Ground Water Quality Standards (Chapter 173-200 WAC) to protect uses of ground water. Permits issued by the Department shall be conditioned in such a manner so as not to allow violations of those standards (WAC 173-200-100).

This Permittee has no discharge to ground and therefore no limitations are required based on potential effects to ground water.

*COMPARISON OF EFFLUENT LIMITS WITH THE EXISTING PERMIT ISSUED FEB 1999*

| Parameter | Existing Limits (Phase II) | | Proposed Limits | |
|---|---|---|---|---|
| | **Avg Monthly** | **Avg Weekly** | **Avg Monthly** | **Avg Weekly** |
| **$BOD_5$** | 30 mg/L | 45 mg/L | 20 mg/L | 30 mg/L |
| | 955 lb/day | 1,432 lb/day | 1,017 lb/day | 1,525 lb/day |
| | 83% removal | | 70% removal | |
| **TSS** | 30 mg/L | 45 mg/L | 20 mg/L | 30 mg/L |
| | 1217 lb/day | 1,825 lb/day | 1,017 lb/day | 1,525 lb/day |
| | 81% removal | | 70% removal | |
| **Fecal coliform bacteria** | 200/100 ml | 400/100 ml | 200/100 ml | 400/100 ml |
| **Ammonia** | Optimize plan operation for nitrification and monitor | | **Avg Monthly** | **Max Daily** |
| | | | 20 mg/L (summer) | 41 mg/L (summer) |
| | | | 7 mg/L (winter) | 15 mg/L (winter) |
| **pH** | Shall not be outside the range 6.0 to 9.0 | | Shall not be outside the range 6.0 to 9.0 | |

## MONITORING REQUIREMENTS

Monitoring, recording, and reporting are required (WAC 173-220-210 and 40 CFR 122.41) to verify that the treatment process is functioning correctly and the effluent limitations are being achieved.

Monitoring for effluent temperature is being required to further characterize the effluent. This pollutant could have a significant impact on the quality of the surface water. The Permittee will again be required to test for metals which are recognized as priority pollutants during the last two years of the permit term. Four samples are to be collected using clean sampling methods. This sampling is necessary to assure that new industrial discharges do not contain priority pollutants and that the Camas WWTP can effectively treat the wastewater.

Monitoring of sludge quantity and quality is necessary to determine the appropriate uses of the sludge. Sludge monitoring is required by the current state and local solid waste management program and also by EPA under 40 CFR 503.

The monitoring schedule is detailed in the proposed permit under Condition S.2. Specified monitoring frequencies take into account the quantity and variability of discharge, the treatment method, past compliance, significance of pollutants, and cost of monitoring. The required monitoring frequency is consistent with agency guidance given in the current version of the Department's *Permit Writer's Manual* (July 1994) for an activated sludge plant of greater than 2.0 mgd.

*LAB ACCREDITATION*

With the exception of certain parameters the permit requires all monitoring data to be prepared by a laboratory registered or accredited under the provisions of Chapter 173-50 WAC, *Accreditation of Environmental Laboratories.* The laboratory at this facility is accredited for: Ammonia, Biological Oxygen Demand (BOD/CBOD), Dissolved Oxygen, pH, Solids-Total Suspended, and Microbiology—Fecal coliform (count).

## OTHER PERMIT CONDITIONS

*REPORTING AND RECORDKEEPING*

The conditions of S3 are based on the authority to specify any appropriate reporting and recordkeeping requirements to prevent and control waste discharges (WAC 173-220-210).

*PREVENTION OF FACILITY OVERLOADING*

Overloading of the treatment plant is a violation of the terms and conditions of the permit. To prevent this from occurring, RCW 90.48.110 and WAC 173-220-150 require the Permittee to take the actions detailed in proposed permit requirement S.4 to plan expansions or modifications before existing capacity is reached and to report and correct conditions that could result in new or increased discharges of pollutants. Condition S.4 restricts the amount of flow.

*OPERATION AND MAINTENANCE (O&M)*

The proposed permit contains Condition S.5 as authorized under RCW 90.48.110, WAC 173-220-150, Chapter 173-230 WAC, and WAC 173-240-080. It is included to ensure proper operation and regular maintenance of equipment, and to ensure that adequate safeguards are taken so that constructed facilities are used to their optimum potential in terms of pollutant capture and treatment.

*RESIDUAL SOLIDS HANDLING*

To prevent water quality problems the Permittee is required in permit Condition S7 to store and handle all residual solids (grit, screenings, scum, sludge, and other solid waste) in accordance with the requirements of RCW 90.48.080 and State Water Quality Standards, WAC 173-201A, and Biosolids Handling regulations covered under WAC 173-308.

The final use and disposal of sewage sludge from this facility is regulated by U.S. EPA under 40 CFR 503, and by the Department under Chapter 70.95J RCW and Chapter 173-308 WAC. The disposal of other solid waste is under the jurisdiction of the local County Health Department.

*PRETREATMENT*

*Federal and State Pretreatment Program Requirements*

Under the terms of the addendum to the "Memorandum of Understanding between Washington Department of Ecology and the United States Environmental Protection Agency, Region 10" (1986), the Department has been delegated authority to administer the Pretreatment Program [i.e. act as the Approval Authority for oversight of delegated Publicly Owned Treatment Works (POTWs)]**.** Under this delegation of authority, the Department has exercised the option of issuing wastewater discharge permits for significant industrial users discharging to POTWs which have not been delegated authority to issue wastewater discharge permits.

There are a number of functions required by the Pretreatment Program which the Department is delegating to such POTWs because they are in a better position to implement the requirements (e.g. tracking the number and general nature of industrial dischargers to the sewerage system). The requirements for a Pretreatment Program are contained in Title 40, Part 403 of the Code of Federal Regulations. Under the requirements of the Pretreatment Program [40 CFR 403.8(f)(1)(iii)], the Department is required to approve, condition, or deny new discharges or a significant increase in the discharge for existing significant industrial users (SIUs) [40 CFR 403.8 (f)(1)(i)].

The Department is responsible for issuing State Waste Discharge Permits to SIUs and other industrial users of the Permittee's sewer system. Industrial dischargers must obtain these permits from the Department prior to the Permittee accepting the discharge [WAC 173-216-110(5)] (Industries discharging wastewater that is similar in character to domestic wastewater are not required to obtain a permit. Such dischargers should contact the Department to determine if a permit is required.). Industrial dischargers need to apply for a State Waste Discharge Permit 60 days prior to commencing discharge. The conditions contained in the permits will include any applicable conditions for categorical discharges, loading limitations included in contracts with the POTW, and other conditions necessary to assure compliance with state water quality standards and biosolids standards.

The Department requires this POTW to fulfill some of the functions required for the Pretreatment Program in the NPDES permit (e.g. tracking the number and general nature of industrial dischargers to the sewage system). The POTW's NPDES permit will require that all SIUs currently discharging to the POTW be identified and notified of the requirement to apply for a wastewater discharge permit from the Department. None of the obligations imposed on the POTW relieve an industrial or commercial discharger of its primary responsibility for obtaining a wastewater discharge permit (if required), including submittal of engineering reports prior to construction or modification of facilities [40 CFR 403.12(j) and WAC 173-216-070 and WAC 173-240-110, et seq.].

*Wastewater Permit Required*

RCW 90.48 and WAC 173-216-040 require SIUs to obtain a permit prior to discharge of industrial waste to the Permittee's sewerage system. This provision prohibits the POTW from accepting industrial wastewater from any such dischargers without authorization from the Department.

*Requirements for Routine Identification and Reporting of Industrial Users*

The NPDES permit requires non-delegated POTWs to "take continuous, routine measures to identify all existing, new, and proposed SIUs and potential significant industrial users (PSIUs) discharging to the Permittee's sewerage system." Examples of such routine measures include regular review of business tax licenses for existing businesses and review of water billing records and existing connection authorization records. System maintenance personnel can also be diligent during performance of their jobs in identifying and reporting as-yet unidentified industrial dischargers. Local newspapers, telephone directories, and word-of-mouth can also be important sources of information regarding new or existing discharges. The POTW is required to notify an industrial discharger, in writing, of their responsibilities regarding application for a state waste discharge permit and to send a copy of the written notification to the Department. The Department will then take steps to solicit a state waste discharge permit application.

*Requirements for Performing an Industrial User Survey*

This POTW has the potential to serve significant industrial or commercial users and is required to perform an Industrial User Survey. The goal of this survey is to develop a list of SIUs and PSIUs, and of equal importance, to provide sufficient information about industries which discharge to the POTW, to determine which of them require issuance of state waste discharge permits or other regulatory controls.

An Industrial User Survey is an important part of the regulatory process used to prevent interference with treatment processes at the POTW and to prevent the exceedance of water quality standards. The Industrial User Survey also can be used to contribute to the maintenance of sludge quality, so that sludge can be a useful biosolids product rather than an expensive waste problem. An Industrial User Survey is a rigorous method for identifying existing, new, and proposed significant industrial users and potential significant industrial users. A complete listing of methodologies is available in the Department guidance document entitled "Conducting an Industrial User Survey."

*Duty to Enforce Discharge Prohibitions*

This provision prohibits the POTW from authorizing or permitting an industrial discharger to discharge certain types of waste into the sanitary sewer. The first portion of the provision prohibits acceptance of pollutants which cause pass through or interference. The definitions of pass through and interference are in Appendix B of the fact sheet.

The second portion of this provision prohibits the POTW from accepting certain specific types of wastes, namely those which are explosive, flammable, excessively acidic, basic, otherwise corrosive, or obstructive to the system. In addition wastes with excessive BOD, petroleum based oils, or which result in toxic gases are prohibited to be discharged. The regulatory basis for these prohibitions is 40 CFR Part 403, with the exception of the pH provisions which are based on WAC 173-216-060.

The third portion of this provision prohibits certain types of discharges unless the POTW receives prior authorization from the Department. The discharges include cooling water in significant volumes, stormwater and other direct inflow sources, and wastewaters significantly affecting system hydraulic loading, which do not require treatment.

*Support by the Department for Developing Partial Pretreatment Program by POTW*

The Department has committed to providing technical and legal assistance to the Permittee in fulfilling these joint obligations, in particular assistance with developing an adequate sewer use ordinance, notification procedures, enforcement guidelines, and developing local limits and inspection procedures.

*OUTFALL EVALUATION*

Proposed permit Condition S.10 requires the Permittee to conduct an outfall inspection and submit a report detailing the findings of that inspection. The purpose of the inspection is to determine the condition of the discharge pipe and diffusers and to determine if sediment is accumulating in the vicinity of the outfall.

*GENERAL CONDITIONS*

General Conditions are based directly on state and federal law and regulations and have been standardized for all individual municipal NPDES permits issued by the Department.

## PERMIT ISSUANCE PROCEDURES

*PERMIT MODIFICATIONS*

The Department may modify this permit to impose numerical limitations, if necessary to meet Water Quality Standards, Sediment Quality Standards, or Ground Water Standards, based on new information obtained from sources such as inspections, effluent monitoring, outfall studies, and effluent mixing studies.

The Department may also modify this permit as a result of new or amended state or federal regulations.

*RECOMMENDATION FOR PERMIT ISSUANCE*

This proposed permit meets all statutory requirements for authorizing a wastewater discharge, including those limitations and conditions believed necessary to protect human health, aquatic life, and the beneficial uses of waters of the State of Washington. The Department proposes that this permit be issued for five years.

**REFERENCES FOR TEXT AND APPENDICES**

Environmental Protection Agency (EPA)

2001. Columbia/Snake River Temperature TMDL Problem Assessment. USEPA Region 10, Seattle, Washington.

1992. National Toxics Rule. Federal Register, V. 57, No. 246, Tuesday, December 22, 1992.

1991. Technical Support Document for Water Quality-based Toxics Control. EPA/505/2-90-001.

1988. Technical Guidance on Supplementary Stream Design Conditions for Steady State Modeling. USEPA Office of Water, Washington, D.C.

1985. Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants in Surface and Ground Water. EPA/600/6-85/002a.

1983. Water Quality Standards Handbook. USEPA Office of Water, Washington, D.C.

Gray and Osborne, Inc.

1997. City of Camas Wastewater Facility Plan. G&O No. 95723. Seattle, Washington

Metcalf and Eddy.

1991. Wastewater Engineering, Treatment, Disposal, and Reuse. Third Edition.

Tsivoglou, E.C., and J.R. Wallace.

1972. Characterization of Stream Reaeration Capacity. EPA-R3-72-012. (Cited in EPA 1985 op.cit.)

Washington State Department of Ecology.

Laws and Regulations( http://www.ecy.wa.gov/laws-rules/index.html )

2003, March. Paul Pickett, Mike Herold. Department of Ecology. Personal communication regarding the Columbia River temperature TMDL.

Permit and Wastewater Related Information (http://www.ecy.wa.gov/programs/wq/wastewater/index.html

Washington State Department of Ecology.

1994. Permit Writer's Manual. Publication Number 92-109

Water Pollution Control Federation.

1976. Chlorination of Wastewater.

Wright, R.M., and A.J. McDonnell.

1979. In-stream Deoxygenation Rate Prediction. Journal Environmental Engineering Division, ASCE. 105(EE2). (Cited in EPA 1985 op.cit.)

## APPENDIX A--PUBLIC INVOLVEMENT INFORMATION

The Department has tentatively determined to reissue a permit to the applicant listed on page 1 of this fact sheet. The permit contains conditions and effluent limitations which are described in the rest of this fact sheet.

Public notice of application was published on May 4, 2004, in the *Camas-Washougal Post* to inform the public that an application had been submitted and to invite comment on the reissuance of this permit.

The Department will publish a Public Notice of Draft (PNOD) on August 17, 2004, in the *Camas-Washougal Post* to inform the public that a draft permit and fact sheet are available for review. Interested persons are invited to submit written comments regarding the draft permit. The draft permit, fact sheet, and related documents are available for inspection and copying between the hours of 8:00 a.m. and 5:00 p.m. weekdays, by appointment, at the regional office listed below. Written comments should be mailed to:

Carey Cholski
Water Quality Permit Administrator
Department of Ecology
Southwest Regional Office
P.O. Box 47775
Olympia, WA 98504-7775

Any interested party may comment on the draft permit or request a public hearing on this draft permit within the 30-day comment period to the address above. The request for a hearing shall indicate the interest of the party and the reasons why the hearing is warranted. The Department will hold a hearing if it determines there is a significant public interest in the draft permit (WAC 173-220-090). Public notice regarding any hearing will be circulated at least 30 days in advance of the hearing. People expressing an interest in this permit will be mailed an individual notice of hearing (WAC 173-220-100).

Comments should reference specific text followed by proposed modification or concern when possible. Comments may address technical issues, accuracy and completeness of information, the scope of the facility's proposed coverage, adequacy of environmental protection, permit conditions, or any other concern that would result from issuance of this permit.

The Department will consider all comments received within 30 days from the date of public notice of draft indicated above, in formulating a final determination to issue, revise, or deny the permit. The Department's response to all significant comments is available upon request and will be mailed directly to people expressing an interest in this permit.

Further information may be obtained from the Department by telephone, (360) 407-6554, or by writing to the address listed above.

This permit and fact sheet were written by Eric Schlorff.

## APPENDIX B--GLOSSARY

**Acute Toxicity**--The lethal effect of a pollutant on an organism that occurs within a short period of time, usually 48 to 96 hours.

**AKART**-- An acronym for "all known, available, and reasonable methods of prevention, control, and treatment".

**Ambient Water Quality**--The existing environmental condition of the water in a receiving water body.

**Ammonia**--Ammonia is produced by the breakdown of nitrogenous materials in wastewater. Ammonia is toxic to aquatic organisms, exerts an oxygen demand, and contributes to eutrophication. It also increases the amount of chlorine needed to disinfect wastewater.

**Average Monthly Discharge Limitation** --The highest allowable average of daily discharges over a calendar month, calculated as the sum of all daily discharges measured during a calendar month divided by the number of daily discharges measured during that month (except in the case of fecal coliform). The daily discharge is calculated as the average measurement of the pollutant over the day.

**Average Weekly Discharge Limitation --** The highest allowable average of daily discharges over a calendar week, calculated as the sum of all daily discharges measured during a calendar week divided by the number of daily discharges measured during that week. The daily discharge is calculated as the average measurement of the pollutant over the day.

**Best Management Practices (BMPs)**--Schedules of activities, prohibitions of practices, maintenance procedures, and other physical, structural and/or managerial practices to prevent or reduce the pollution of waters of the State. BMPs include treatment systems, operating procedures, and practices to control: plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage. BMPs may be further categorized as operational, source control, erosion and sediment control, and treatment BMPs.

**$BOD_5$**--Determining the Biochemical Oxygen Demand of an effluent is an indirect way of measuring the quantity of organic material present in an effluent that is utilized by bacteria. The $BOD_5$ is used in modeling to measure the reduction of dissolved oxygen in a receiving water after effluent is discharged. Stress caused by reduced dissolved oxygen levels makes organisms less competitive and less able to sustain their species in the aquatic environment. Although BOD is not a specific compound, it is defined as a conventional pollutant under the federal Clean Water Act.

**Bypass**--The intentional diversion of waste streams from any portion of a treatment facility.

**CBOD5** – The quantity of oxygen utilized by a mixed population of microorganisms acting on the nutrients in the sample in an aerobic oxidation for five days at a controlled temperature of 20 degrees Celsius, with an inhibitory agent added to prevent the oxidation of nitrogen compounds. The method for determining CBOD5 is given in 40 CFR Part 136.

**Chlorine**--Chlorine is used to disinfect wastewaters of pathogens harmful to human health. It is also extremely toxic to aquatic life.

**Chronic Toxicity**--The effect of a pollutant on an organism over a relatively long time, often 1/10 of an organism's lifespan or more. Chronic toxicity can measure survival, reproduction or growth rates, or other parameters to measure the toxic effects of a compound or combination of compounds.

**Clean Water Act (CWA)**--The Federal Water Pollution Control Act enacted by Public Law 92-500, as amended by Public Laws 95-217, 95-576, 96-483, 97-117; USC 1251 et seq.

**Combined Sewer Overflow (CSO)**--The event during which excess combined sewage flow caused by inflow is discharged from a combined sewer, rather than conveyed to the sewage treatment plant because either the capacity of the treatment plant or the combined sewer is exceeded.

**Compliance Inspection - Without Sampling**--A site visit for the purpose of determining the compliance of a facility with the terms and conditions of its permit or with applicable statutes and regulations.

**Compliance Inspection - With Sampling**--A site visit to accomplish the purpose of a Compliance Inspection - Without Sampling and as a minimum, sampling and analysis for all parameters with limits in the permit to ascertain compliance with those limits; and, for municipal facilities, sampling of influent to ascertain compliance with the percent removal requirement. Additional sampling may be conducted.

**Composite Sample**--A mixture of grab samples collected at the same sampling point at different times, formed either by continuous sampling or by mixing a minimum of four discrete samples. May be "time-composite"(collected at constant time intervals) or "flow-proportional" (collected either as a constant sample volume at time intervals proportional to stream flow, or collected by increasing the volume of each aliquot as the flow increased while maintaining a constant time interval between the aliquots).

**Construction Activity**--Clearing, grading, excavation and any other activity which disturbs the surface of the land. Such activities may include road building, construction of residential houses, office buildings, or industrial buildings, and demolition activity.

**Continuous Monitoring** –Uninterrupted, unless otherwise noted in the permit.

**Critical Condition**--The time during which the combination of receiving water and waste discharge conditions have the highest potential for causing toxicity in the receiving water environment. This situation usually occurs when the flow within a water body is low, thus, its ability to dilute effluent is reduced.

**Dilution Factor**--A measure of the amount of mixing of effluent and receiving water that occurs at the boundary of the mixing zone. Expressed as the inverse of the effluent fraction e.g., a dilution factor of 10 means the effluent comprises 10% by volume and the receiving water 90%.

**Engineering Report**--A document which thoroughly examines the engineering and administrative aspects of a particular domestic or industrial wastewater facility. The report shall contain the appropriate information required in WAC 173-240-060 or 173-240-130.

**Fecal Coliform Bacteria**--Fecal coliform bacteria are used as indicators of pathogenic bacteria in the effluent that are harmful to humans. Pathogenic bacteria in wastewater discharges are controlled by disinfecting the wastewater. The presence of high numbers of fecal coliform bacteria in a water body can indicate the recent release of untreated wastewater and/or the presence of animal feces.

**Grab Sample**--A single sample or measurement taken at a specific time or over as short period of time as is feasible.

**Industrial User**-- A discharger of wastewater to the sanitary sewer which is not sanitary wastewater or is not equivalent to sanitary wastewater in character.

**Industrial Wastewater**--Water or liquid-carried waste from industrial or commercial processes, as distinct from domestic wastewater. These wastes may result from any process or activity of industry, manufacture, trade or business, from the development of any natural resource, or from animal operations such as feed lots, poultry houses, or dairies. The term includes contaminated storm water and, also, leachate from solid waste facilities.

**Infiltration and Inflow (I/I)**--"Infiltration" means the addition of ground water into a sewer through joints, the sewer pipe material, cracks, and other defects. "Inflow" means the addition of precipitation-caused drainage from roof drains, yard drains, basement drains, street catch basins, etc., into a sewer.

**Interference** -- A discharge which, alone or in conjunction with a discharge or discharges from other sources, both:

Inhibits or disrupts the POTW, its treatment processes or operations, or its sludge processes, use or disposal and;

Therefore is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation) or of the prevention of sewage sludge use or disposal in compliance with the following statutory provisions and regulations or permits issued there under (or more stringent State or local regulations): Section 405 of the Clean Water Act, the Solid Waste Disposal Act (SWDA) (including title II, more commonly referred to as the Resource Conservation and Recovery Act (RCRA), and including State regulations contained in any State sludge management plan prepared pursuant to subtitle D of the SWDA), sludge regulations appearing in 40 CFR Part 507, the Clean Air Act, the Toxic Substances Control Act, and the Marine Protection, Research and Sanctuaries Act.

**Major Facility--**A facility discharging to surface water with an EPA rating score of > 80 points based on such factors as flow volume, toxic pollutant potential, and public health impact.

**Maximum Daily Discharge Limitation**--The highest allowable daily discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. The daily discharge is calculated as the average measurement of the pollutant over the day.

**Method Detection Level (MDL)--**The minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is above zero and is determined from analysis of a sample in a given matrix containing the analyte.

**Minor Facility--**A facility discharging to surface water with an EPA rating score of < 80 points based on such factors as flow volume, toxic pollutant potential, and public health impact.

**Mixing Zone**--A volume that surrounds an effluent discharge within which water quality criteria may be exceeded. The area of the authorized mixing zone is specified in a facility's permit and follows procedures outlined in State regulations (Chapter 173-201A WAC).

**National Pollutant Discharge Elimination System (NPDES)**--The NPDES (Section 402 of the Clean Water Act) is the Federal wastewater permitting system for discharges to navigable waters of the United States. Many states, including the State of Washington, have been delegated the authority to issue these permits. NPDES permits issued by Washington State permit writers are joint NPDES/State permits issued under both State and Federal laws.

**Pass through** -- A discharge which exits the POTW into waters of the–State in quantities or concentrations which, alone or in conjunction with a discharge or discharges from other sources, is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation), or which is a cause of a violation of State water quality standards.

**pH**--The pH of a liquid measures its acidity or alkalinity. A pH of 7 is defined as neutral, and large variations above or below this value are considered harmful to most aquatic life.

**Potential Significant Industrial User**--A potential significant industrial user is defined as an Industrial User which does not meet the criteria for a Significant Industrial User, but which discharges wastewater meeting one or more of the following criteria:

a. Exceeds 0.5 % of treatment plant design capacity criteria and discharges <25,000 gallons per day or;

b. Is a member of a group of similar industrial users which, taken together, have the potential to cause pass through or interference at the POTW (e.g. facilities which develop photographic film or paper, and car washes).

The Department may determine that a discharger initially classified as a potential significant industrial user should be managed as a significant industrial user.

**Quantitation Level (QL)--** A calculated value five times the MDL (method detection level).

**Significant Industrial User (SIU)--**

1) All industrial users subject to Categorical Pretreatment Standards under 40 CFR 403.6 and 40 CFR Chapter I, Subchapter N and;

2) Any other industrial user that: discharges an average of 25,000 gallons per day or more of process wastewater to the POTW (excluding sanitary, noncontact cooling, and boiler blow-down wastewater); contributes a process wastestream that makes up 5 percent or more of the average dry weather hydraulic or organic capacity of the POTW treatment plant; or is designated as such by the Control Authority* on the basis that the industrial user has a reasonable potential for adversely affecting the POTW's operation or for violating any pretreatment standard or requirement (in accordance with 40 CFR 403.8(f)(6)).

Upon finding that the industrial user meeting the criteria in paragraph 2, above, has no reasonable potential for adversely affecting the POTW's operation or for violating any pretreatment standard or requirement, the Control Authority* may at any time, on its own initiative or in response to a petition received from an industrial user or POTW, and in accordance with 40 CFR 403.8(f)(6), determine that such industrial user is not a significant industrial user.

*The term "Control Authority" refers to the Washington State Department of Ecology in the case of non-delegated POTWs or to the POTW in the case of delegated POTWs.

**State Waters**--Lakes, rivers, ponds, streams, inland waters, underground waters, salt waters, wetlands, and all other surface waters and watercourses within the jurisdiction of the state of Washington.

**Stormwater**--That portion of precipitation that does not naturally percolate into the ground or evaporate, but flows via overland flow, interflow, pipes, and other features of a storm water drainage system into a defined surface water body, or a constructed infiltration facility.

**Technology-based Effluent Limit**--A permit limit that is based on the ability of a treatment method to reduce the pollutant.

**Total Suspended Solids (TSS)**--Total suspended solids are the particulate materials in an effluent. Large quantities of TSS discharged to a receiving water may result in solids accumulation. Apart from any toxic effects attributable to substances leached out by water, suspended solids may kill fish, shellfish, and other aquatic organisms by causing abrasive injuries and by clogging the gills and respiratory passages of various aquatic fauna. Indirectly, suspended solids can screen out light and can promote and maintain the development of noxious conditions through oxygen depletion.

**Upset**--An exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, lack of preventative maintenance, or careless or improper operation.

**Water Quality-based Effluent Limit**--A limit on the concentration or mass of an effluent parameter that is intended to prevent the concentration of that parameter from exceeding its water quality criterion after it is discharged into a receiving water.

## APPENDIX C--TECHNICAL CALCULATIONS

Several of the Excel® spreadsheet tools used to evaluate a discharger's ability to meet Washington State water quality standards can be found on the Department's homepage at (http://www.ecy.wa.gov/programs/wq/wastewater/index.html

Table C1

Calculation Of Ammonia Concentration and Criteria for fresh water. Based on EPA Quality Criteria for Water (EPA 400/5-86-001) and WAC 173-201A. Revised 1-5-94 (corrected total ammonia criterion). Revised 3/10/95 to calculate chronic criteria in accordance with EPA Memorandum from Heber to WQ Stds Coordinators dated July 30, 1992.

**Summer** (June - Sept) based on temperature from USGS gages at Washougal 2000-2003. The pH is based on 1994 data from USGS combined with 2002 data from Ecology EAP (7 data points).

---

INPUT

1. Ambient Temperature (deg C; 0<T<30)
2. Ambient pH (6.5<pH<9.0)
3. Acute TCAP (Salmonids present- 20; absent- 25)
4. Chronic TCAP (Salmonids present- 15; absent- 20)

---

OUTPUT

1. Intermediate Calculations:
   - Acute FT
   - Chronic FT
   - FPH
   - RATIO
   - pKa
   - Fraction Of Total Ammonia Present As Un-ionized

2. Un-ionized Ammonia Criteria
   - Acute (1-hour) Un-ionized Ammonia Criterion (ug NH3/L)
   - Chronic (4-day) Un-ionized Ammonia Criterion (ug NH3/L)

3. Total Ammonia Criteria:
   - Acute Total Ammonia Criterion (mg NH3+ NH4/L)
   - Chronic Total Ammonia Criterion (mg NH3+ NH4/L)

4. Total Ammonia Criteria expressed as Nitrogen:
   - Acute Ammonia Criterion as mg N
   - Chronic Ammonia Criterion as N

Calculation Of Ammonia Concentration and Criteria for fresh water. Based on EPA Quality Criteria for Water (EPA 400/5-86-001) and WAC 173-201A. Revised 1-5-94 (corrected total ammonia criterion). Revised 3/10/95 to calculate chronic criteria in accordance with EPA Memorandum from Heber to WQ Stds Coordinators dated July 30, 1992.

**Winter** (October - May) based on temperature from USGS gages at Warrendale 2000-2003 (winter data not available at Washougal). The pH is based on 1994 data from USGS combined with 2002 data from Ecology EAP (14 data points).

---

INPUT

1. Ambient Temperature (deg C; 0<T<30)
2. Ambient pH (6.5<pH<9.0)
3. Acute TCAP (Salmonids present- 20; absent- 25)
4. Chronic TCAP (Salmonids present- 15; absent- 20)

---

OUTPUT

1. Intermediate Calculations:
   - Acute FT
   - Chronic FT
   - FPH
   - RATIO
   - pKa
   - Fraction Of Total Ammonia Present As Un-ionized

2. Un-ionized Ammonia Criteria
   - Acute (1-hour) Un-ionized Ammonia Criterion (ug NH3/L)
   - Chronic (4-day) Un-ionized Ammonia Criterion (ug NH3/L)

3. Total Ammonia Criteria:
   - Acute Total Ammonia Criterion (mg NH3+ NH4/L)
   - Chronic Total Ammonia Criterion (mg NH3+ NH4/L)

4. Total Ammonia Criteria expressed as Nitrogen:
   - Acute Ammonia Criterion as mg N
   - Chronic Ammonia Criterion as N

| Table C2: Reasonable Potential Calculation for Ammonia and Metals | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | State Water Quality Standard | | Max concentration at edge of... | | |
| | Metal Criteria Translator as decimal | Metal Criteria Translator as decimal | Ambient Concentration (metals as dissolved) | Acute | Chronic | Acute Mixing Zone | Chronic Mixing Zone | **LIMIT REQ'D?** |
| Parameter | Acute | Chronic | *ug/L* | *ug/L* | *ug/L* | *ug/L* | *ug/L* | |
| Ammonia (Summer Dry) | 1.00 | 1.00 | 27.0000 | 5370.61 | 976.98 | 5370.61 | 917.60 | YES |
| Ammonia (Winter Wet | 1.00 | 1.00 | 19.0000 | 5407.31 | 1590.59 | 7562.64 | 1733.46 | YES |
| Arsenic | 1.00 | 1.00 | 1.1200 | 1.96 | 1.36 | 2.29 | 1.39 | NO |
| Cadmium | 0.94 | 0.94 | 0.5250 | 0.52 | 0.52 | 0.52 | 0.52 | NO |
| Chromium | 0.32 | 0.86 | 0.4150 | 1.44 | 1.26 | 1.85 | 1.34 | NO |
| Copper | 1.00 | 1.00 | 0.8600 | 3.68 | 1.68 | 4.81 | 1.76 | NO |
| Lead | 0.47 | 0.47 | 0.0600 | 0.26 | 0.12 | 0.34 | 0.12 | NO |
| Nickel | 1.00 | 1.00 | 0.5550 | 2.95 | 1.25 | 3.90 | 1.31 | NO |
| Silver | 0.85 | NA | 0.1000 | 0.27 | NA | 0.34 | NA | NO |
| Zinc | 1.00 | 1.00 | 2.0000 | 13.85 | 5.46 | 18.60 | 5.77 | NO |

| | | INPUTS FOR ABOVE REASONABLE POTENTIAL | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Effluent percentile value | | Max effluent conc. measured (metals as total recoverable) | Coeff Variation | | # of samples | Multiplier | Acute Dil'n Factor | Chronic Dil'n Factor |
| Parameter | | *Pn* | *ug/L* | *CV* | *s* | *n* | | | |
| Ammonia (Summer Dry) | 0.95 | 0.913 | 36540.00 | 0.60 | 0.55 | 33 | 1.17 | 8 | 45 |
| Ammonia (Winter Wet | 0.95 | 0.956 | 39100.00 | 0.60 | 0.55 | 67 | 0.97 | 7 | 24 |
| Arsenic | 0.95 | 0.473 | 2.70 | 0.60 | 0.55 | 4 | 2.59 | 7 | 24 |
| Cadmium | 0.95 | 0.473 | 0.20 | 0.60 | 0.55 | 4 | 2.59 | 7 | 24 |
| Chromium | 0.95 | 0.473 | 9.30 | 0.60 | 0.55 | 4 | 2.59 | 7 | 24 |
| Copper | 0.95 | 0.473 | 8.00 | 0.60 | 0.55 | 4 | 2.59 | 7 | 24 |
| Lead | 0.95 | 0.473 | 1.20 | 0.60 | 0.55 | 4 | 2.59 | 7 | 24 |
| Nickel | 0.95 | 0.473 | 6.70 | 0.60 | 0.55 | 4 | 2.59 | 7 | 24 |
| Silver | 0.95 | 0.473 | 0.60 | 0.60 | 0.55 | 4 | 2.59 | 7 | 24 |
| Zinc | 0.95 | 0.473 | 33.00 | 0.60 | 0.55 | 4 | 2.59 | 7 | 24 |

Table C3

Dissolved oxygen concentration following initial dilution.

References: EPA/600/6-85/002b and EPA/430/9-82-011

Based on Lotus File IDOD2.WK1 Revised 19-Oct-93

| **INPUT** | |
|---|---|
| 1. Dilution Factor at Mixing Zone Boundary: | 24 |
| 2. Ambient Dissolved Oxygen Concentration (mg/L): | 8.9 |
| 3. Effluent Dissolved Oxygen Concentration (mg/L): | 2 |
| 4. Effluent Immediate Dissolved Oxygen Demand (mg/L): | 0 |
| **OUTPUT** | |
| Dissolved Oxygen at Mixing Zone Boundary (mg/L): | 8.61 |

Table C4: Ammonia Limits Calculation

## Permit Limit Calculation Summary

| PARAMETER | Acute Dil'n Factor | Chronic Dil'n Factor | Metal Criteria Translator Acute | Metal Criteria Translator Chronic | Ambient Concentration *ug/L* | Water Quality Standard Acute *ug/L* | Water Quality Standard Chronic *ug/L* | Average Monthly Limit (AML) ug/L | Maximum Daily Limit (MDL) ug/L |
|---|---|---|---|---|---|---|---|---|---|
| Ammonia (summer dry) | 8.0 | 45.00 | 1.00 | 1.00 | 27.0000 | 5100.0000 | 830.0000 | **20242.9** | **40611.0** |
| Ammonia (winter wet) | 7.00 | 24.00 | 1.00 | 1.00 | 19.00 | 2100.00 | 470.00 | **7270.5** | **14586.0** |

| **Waste Load Allocation (WLA) and Long Term Average (LTA) Calculations** | | | | | | | Statistical variables for permit limit calculation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| WLA Acute *ug/L* | WLA Chronic *ug/L* | LTA Acute *ug/L* | LTA Chronic *ug/L* | LTA Coeff. Var. (CV) *decimal* | LTA Prob'y Basis *decimal* | Limiting LTA *ug/L* | Coeff. Var. (CV) *decimal* | AML Prob'y Basis *decimal* | MDL Prob'y Basis *decimal* | # of Samples per Month *n* | |
| 40611 | 36162.00 | 13039.5 | 19073.0 | 0.60 | 0.99 | 13039.5 | 0.60 | 0.95 | 0.99 | 4.00 | 1.00 |
| 14586 | 10843.00 | 4683.3 | 5719.0 | 0.60 | 0.99 | 4683.3 | 0.60 | 0.95 | 0.99 | 4.00 | 1.00 |

**Table C5**

**Calculation of pH of a mixture of two flows.**

Based on the procedure in EPA's DESCON program (EPA, 1988. Technical Guidance on Supplementary Stream Design Conditions for Steady State Modeling. USEPA Office of Water, Washington D.C.)

Based on Lotus File PHMIX2.WK1 Revised 19-Oct-93

| INPUT | |
|---|---|
| 1. DILUTION FACTOR AT MIXING ZONE BOUNDARY | 45.000 |
| 1. UPSTREAM/BACKGROUND CHARACTERISTICS | |
| Temperature (deg C): | 21.43 |
| pH: | 7.99 |
| Alkalinity (mg CaCO3/L): | 53.00 |
| 2. EFFLUENT CHARACTERISTICS | |
| Temperature (deg C): | 22.00 |
| pH: | 7.64 |
| Alkalinity (mg CaCO3/L): | 150.00 |

| OUTPUT | |
|---|---|
| 1. IONIZATION CONSTANTS | |
| Upstream/Background pKa: | 6.37 |
| Effluent pKa: | 6.37 |
| 2. IONIZATION FRACTIONS | |
| Upstream/Background Ionization Fraction: | 0.98 |
| Effluent Ionization Fraction: | 0.95 |
| 3. TOTAL INORGANIC CARBON | |
| Upstream/Background Total Inorganic Carbon (mg CaCO3/L): | 54.28 |
| Effluent Total Inorganic Carbon (mg CaCO3/L): | 158.03 |
| 4. CONDITIONS AT MIXING ZONE BOUNDARY | |
| Temperature (deg C): | 21.44 |
| Alkalinity (mg CaCO3/L): | 55.16 |
| Total Inorganic Carbon (mg CaCO3/L): | 56.58 |
| pKa: | 6.37 |
| pH at Mixing Zone Boundary: | 7.96 |

**Table C6: PREDICTED DILUTIONS FOR THE CITY OF CAMAS**

| **Model Run** | **Ambient Conditions** | | | | **Effluent Conditions** | | | | | | **Final Centerline Dilution** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **New 2004** | **River Discharge Rate (cfs)** | **Discharge Depth ft (m)** | **Current Speed (m/s)** | **Amb. Temp (deg C)** | **Flow Rate (mgd)** | | | | | **Eff. Temp (deg C)** | **Acute Dilution (32 feet)** | **Chronic Dilution (321 feet)** |
| | | | | | **Chron Dry** | **Acut Dry** | **ChronWet** | **Acut Wet** | **Max (2015)** | | | |
| NC1 | 81,400 | 21.0 (6.4) | 0.26 | 21.48 | 1.55 | | | | | 22.0 | | **45** |
| NC2 | | | | | | **2.195** | | | | | **8** | |
| NC8 | 192,200 | 26.6 (8.1) | 0.58 | 15.13 | | | 2.98 | | | 10.0 | | 60 |
| NC9 | | | | | | | | 5.632 | | | 9 | |
| NC10 | | | | | | | | | 7.8 | | 10 | 43 |
| NC13 | | | | 4.6 | | | 2.98 | | | 10.0 | | 33 |
| NC14 | | | | | | | | 5.632 | | | 8 | |
| NC15 | | | | | | | | | 7.8 | | 10 | 49 |
| NC18 | | | | **12.6** | | | 2.98 | | | 16.0 | | 44 |
| NC19 | | | | | | | | 5.632 | | | 9 | |
| NC20 | | | | | | | | | 7.8 | | 10 | 38 |
| NC22B | 522,000 | 40.9 (12.5) | 0.99 | 12.6 | | | 2.5 | | | 16.0 | | **24** |
| NC24 | | | | | | | | 5.632 | | | **7** | |
| NC25 | | | | | | | | | 7.8 | | 8 | 37 |

**TABLE C7: MODEL RUNS NOT RELEVANT**

| **Model Run** | **Ambient Conditions** | | | | **Effluent Conditions** | | | | | | **Final Centerline Dilution** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | **Flow Rate (mgd)** | | | | | | | |
| **New 2004** | **River Discharge Rate (cfs)** | **Discharge Depth ft (m)** | **Current Speed (m/s)** | **Amb. Temp (deg C)** | **Chron Dry** | **Acut Dry** | **ChronWet** | **Acut Wet** | **Max (2015)** | **Eff. Temp (deg C)** | **Acute Dilution (32 feet)** | **Chronic Dilution (321 feet)** |
| NC2A | 81,400 | 21.0 (6.4) | 0.26 | 21.48 | | **2.195** | | | | 22.0 | 5 | |
| **NC3** | | | | | | | 2.98 | | | | | 49 |
| **NC4** | | | | | | | | 5.632 | | | 11 | |
| **NC5** | | | | | | | | | 7.8 | | 12 | 39 |
| **NC6** | 192,200 | 26.6 (8.1) | 0.58 | 15.13 | 1.55 | | | | | 10.0 | | 63 |
| **NC7** | | | | | | **2.195** | | | | | 5 | |
| **NC11** | | | | 4.6 | 1.55 | | | | | 10.0 | | 18 |
| **NC12** | | | | | | 2.195 | | | | | 5 | |
| NC13A | | | | | | | 2.98 | | | | | 18 |
| **NC16** | | | | **12.6** | 1.55 | | | | | 16.0 | | 59 |
| **NC17** | | | | | | 2.195 | | | | | 5 | |
| **NC21** | 522,000 | 40.9 (12.5) | 0.99 | 12.6 | 1.55 | | | | | 16.0 | | 27 |
| **NC22** | | | | | | 2.195 | | | | | 1.7 | |
| NC22A | | | | | | 2.195 | | | | | 3.8 | |
| **NC23** | | | | | | | 2.98 | | | | | 24 |
| NC24A | | | | | | | | 5.632 | | | 3 | |

NC2A, NC13A, NC22A and NC24A were model runs with all 16 diffuser ports open. All other runs have only 8 ports open.

MODEL RUNS NOT USED FOR CAMAS

The following model runs were not found to be relevant because of a variety of reasons (see table C7). Model runs NC2A, NC13A, NC22A, and NC24A were model runs with all 16 diffuser ports open. The diffuser currently has only half of the diffuser ports open. All runs in table C6 above have only 8 ports open. During the summer low river flows, only the low effluent flows of 1.55 and 2.195 were kept in table C6 of the predicted dilution factors as required in the Department dilution guidance. The model runs shown in table C7 representing higher effluent flows were determined unlikely to occur during the summer low flows. Likewise, the model runs that represented low effluent flows were unlikely to occur during the winter and spring months when the ambient river flows were higher. Therefore, only the flows at 2.98, 5.632, and 7.8 mgd were kept in table C6. Model Run NC22B shown in table C6 represents the effluent flow expected in the spring (February – May) run-off period and is based on the maximum day flow for that period. Therefore the model run using 2.195 mgd was not displayed in table C6.

## CONSIDERATIONS FOR DILUTION MODELING

The dilution ratios were recalculated due to changes in the guidance for dilution modeling that the Department of Ecology uses. When the modeling was last conducted in 1994, Ecology allowed flux average dilution for chronic boundary dilution. Ecology uses centerline dilution for both the acute and chronic boundaries in unidirectional waters. The original current velocity analysis conducted for the 1994 CH2M Hill report shows unidirectional flow. A dilution study conducted for the City of Vancouver also showed unidirectional water. The 1994 analysis for Camas used the UDKHDEN model. UDKHDEN was used for the Salmon Creek POTW discharge downstream of Camas and the model was found to slightly over predict dilution compared to the UM3 model based on a dye study and dilution modeling. The UDKHDEN model appears to do a better job of predicting the dilution factor when there are a lot of obstructions such as boulder and pilings in the river. Therefore the UM3 model was run in March 2004 using visual plumes. A port contraction coefficient of 0.61 was used because the ports were considered to be sharp edged. The results are shown in the above tables C6 and C7.

Following public comments in September2004, the dilution models were reexamined and a couple of errors were found. These errors were limited to an incorrect port spacing and port depth used in the following runs: NC1, NC2, NC8, NC9, NC19, NC20, NC22B, NC24, and NC25. These errors were not in the ambient or effluent conditions shown in table C6 but rather in not using these same conditions through out the model runs. These model runs were rerun and resulted in one or two points in each dilution factor. In a couple of cases the dilution went down when the port depth should have been in shallower water.

**How the mixing zone model inputs were derived**

Ambient Flow

The 1994 analysis of river discharge rate, discharge depth, and current speed (velocity) for Camas in 1994 appeared to be reasonable and should not have changed over time. The first discharge rate of 81,400 cfs is the 7Q10 flow and represents the dry season flow. The discharge depth of 21.0 feet (6.4 m) is the calculated depth at that flow. The current speed of 0.26 m/s was determined from drift card observations and is shown in the 1994 report. The median flow of 0.58 m/s and the winter maximum flow of 0.99 m/s were also taken from the 1994 report.

Ambient Temperature

The 21.48º C summer water temperature (June-September) represents a recalculation using Summer temperatures from July through October from the Army Corps of Engineers (ACOE) and USGS dissolved

gas data base for Washougal. This temperature data may be found at: http://oregon.usgs.gov/projs_dir/pn307.tdg.

The summer maximum temperature of 21.48º C is based on a 90th percentile of daily maximums and used 453 data points from 2000-2003. All of the ambient temperature data was recalculated using ACOE/USGS data rather than use the 1994 data. Winter temperature data is not available at the Washougal station; therefore, data from the Warrendale station were used instead. This appears to be the only temperature station operating in this section of the river during the winter months. The 15.13ºC is a winter maximum which was determined using a 90th percentile of daily maximums from October through May for 2000 through 2003 and represents 728 data points. The yearly average of 12.6ºC was determined as a mean of daily means for all temperatures from October 2000 through September 2003 and represents 1,125 data points. The winter low of 4.6ºC was determined as 5th percentile of daily minimums from October through May for 2000 through 2003.

Effluent Flows

The effluent flows were recalculated because conditions at the plant have changed (plant upgraded in 2000) and the flows could be determined from discharge monitoring records (DMRs). The Department guidance requires that the flow-rate to use depends on how close to design capacity the plant is presently operating. The facility is operating at less than 85 percent of design flow; therefore, the flow-rate we used for the acute boundary is the highest daily maximum plant effluent flow for the past three years during the season in which the critical condition is likely to occur. The summer critical season was based on the daily maximum flow for June to September of 2000 to 2003 which was 2.195 mgd. The winter maximum flow for October through May of 2000 to 2003 was 5.632 mgd.

The POTW flow rate corresponding to the calculation of the chronic mixing zone ratio is: the highest monthly average plant flow for the past three years during the season in which the critical condition is likely to occur. During the summer the maximum average monthly flow would be 1.55 mgd. The winter maximum average monthly flow was 2.98 mgd which was used for the 1994 study. We also included the maximum projected flow the plant was designed to handle by 2015 which was 7.8 mgd. This maximum projected flow of 7.8 mgd was also used in the new analysis. Because this 7.8 mgd is a maximum flow expected only during winter months, model runs using this flow were eliminated from the summer acute and chronic results shown in table C6 above.

Effluent Temperature

The effluent temperatures were borrowed from the 1994 study because temperature has not been monitored regularly at the upgraded plant and the original values appear reasonable. These values include: 22.0ºC for the summer maximum, 10.0ºC for the winter minimum, and 16.0ºC for the average temperature.

Dilution Ratios Based on Updated Modeling Results:

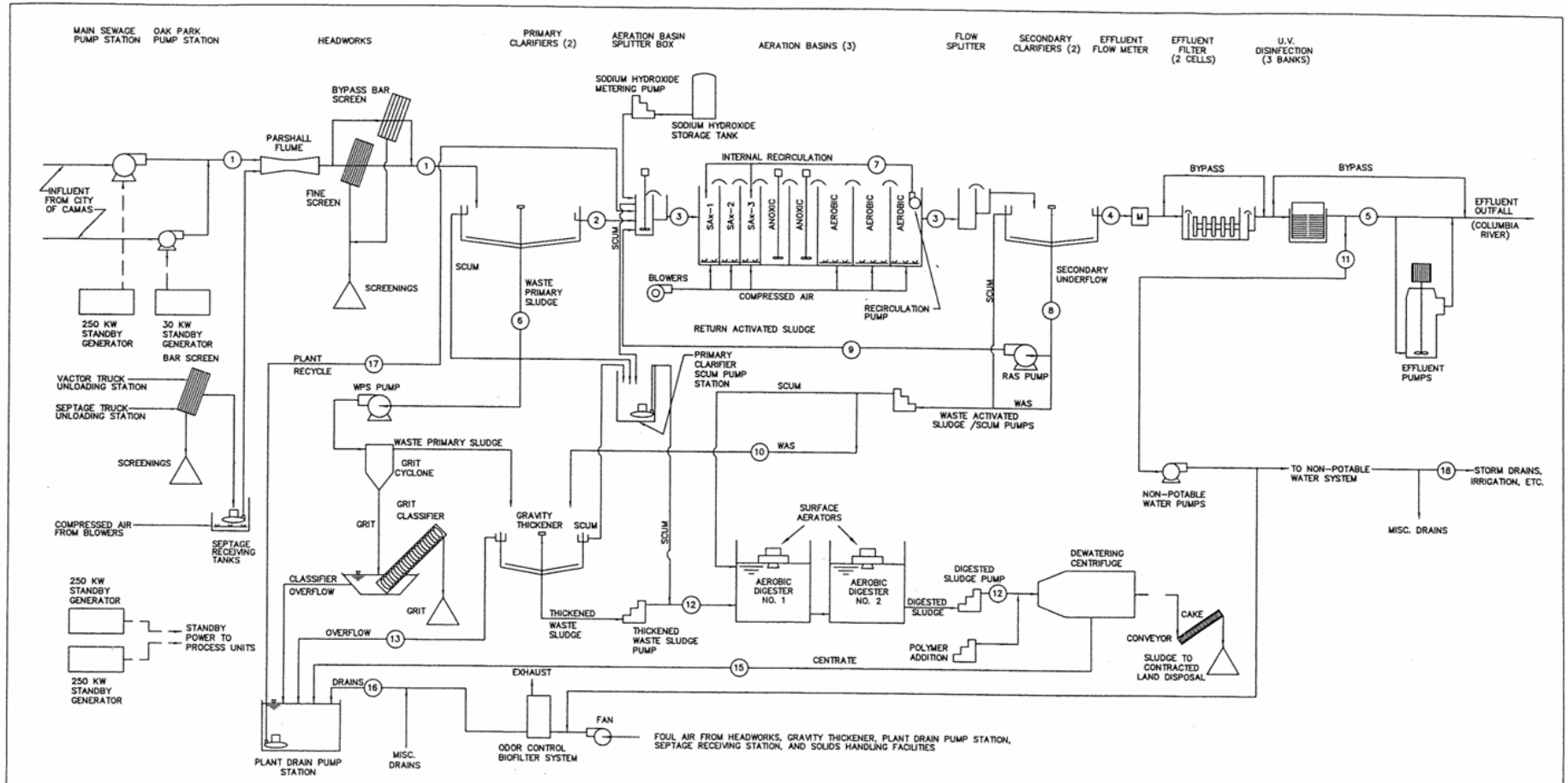
The dilution values are derived using the best modeling tool currently available together with updated values for effluent conditions as described in the preceding paragraphs. These values are:

| Condition | Dilution Factor | POTW flow (mgd) | River Flow (cfs) | River Velocity (m/s) | Number of Ports open |
|---|---|---|---|---|---|
| Summer acute | 8 | 2.195 | 81,400 | 0.26 | 8 |
| Summer chronic | 45 | 1.55 | 81,400 | 0.26 | 8 |
| Winter acute | 7 | 5.632 | 522,000 | 0.99 | 8 |
| Winter chronic | 24 | 2.5 | 522,000 | 0.99 | 8 |

During the critical summer condition, the river was at the 7Q10 flow and effluent flows were reasonably low at the max monthly average flow of 1.55 mgd and the max daily flow of 2.195 mgd for the summer for a dilution value of 8:1. The lowest chronic value observed in the model runs for the summer season was 45:1.

The lowest acute dilution factor occurring during the winter season was 7:1. This value occurred when the ambient flow was highest and when plant flow was matched with the winter maximum daily flow of 5.632 mgd and average yearly temperatures. The lowest chronic flow during the winter season was 24:1 which occurred when the ambient flow was at a maximum, ambient and effluent temperatures were median and effluent flow was at 2.5 mgd. The effluent flow of 2.5 mgd represents the average daily flow for the months of February through May when the spring floods occur. The maximum daily effluent flow during this same spring period is 5.632 mgd.

The difference between 8 ports open and all 16 open: 8 ports appears to show an increase in acute dilution and a reduction in chronic dilution in almost all cases. This difference is a few points for both acute and chronic. A difference of a few points in the chronic factors does not make as big a difference as a few point does in the acute factors, e.g., model runs for acute dilution NC24 and NC24A where 6.5.




## WATER BALANCE

1. INFLUENT Q = 6.10 MGD
2. PE Q = 6.047 MGD
3. MIXED LIQUOR Q = 8.236 MGD
4. SE Q = 6.177 MGD
5. EFFLUENT Q = 6.01 MGD
6. WPS Q = 0.053 MGD
7. IR Q = 13.5 MGD
8. SEC. UNDERFLOW Q = 2.059 MGD
9. RAS Q = 2.024 MGD
10. WAS Q = 0.035 MGD
11. NPW Q = 0.168 MGD
12. TWS Q = 0.02 MGD
13. THICKENER OF Q = 0.068 MGD
14. DEWATERED CAKE Q = 0.002 MGD
15. CENTRATE Q = 0.018 MGD
16. DRAINS Q = 0.079 MGD
17. PDD Q = 0.165 MGD
18. UNRECOVERED NPW Q = 0.089 MGD

## DESCRIPTION OF PROCESS

Influent wastewater is measured, sampled and screened at the headworks. Primary clarifiers remove sludge and grit. The primary effluent flows to aeration basins designed for nitrogen removal, with selectors, anoxic zones, and internal recycle. Secondary effluent passes through a cloth disc filter and a UV disinfection channel before discharge to the Columbia River. Effluent pumps are available for use in high river flow periods. Primary sludge and WAS are co-thickened in a gravity thickener and pumped to aerobic digesters. Digested sludge is dewatered using a centrifuge and hauled off-site for land application.

## LEGEND

| | |
|---|---|
| IR | INTERNAL RECYCLE |
| OF | OVERFLOW |
| PDD | PLANT DRAIN PUMP DISCHARGE |
| PE | PRIMARY EFFLUENT |
| RAS | RETURN ACTIVATED SLUDGE |
| SE | SECONDARY EFFLUENT |
| TWS | THICKENED WASTE SLUDGE |
| WAS | WASTE ACTIVATED SLUDGE |
| WPS | WASTE PRIMARY SLUDGE |

CITY OF CAMAS
NPDES PERMIT APPLICATION
FIGURE 2
PROCESS FLOW SCHEMATIC

Gray & Osborne, Inc.
CONSULTING ENGINEERS

## APPENDIX D--RESPONSE TO COMMENTS

On September 20, 2004, the following comments were received by the City of Camas, Department of Public Works. The responses represent the Department's review and action.

*Comments on the Permit*

Comment 1:

Page 1, Delete "Extended air" from the Plant Type description. The treatment plant activated sludge process is not an extended air process.

Response:

This change will be made to the permit.

Comment 2:

Page 6, Section S1.A: No effluent limitations for ammonia should be included in the permit, based on a lack of reasonable potential to exceed water quality standards using the CORMIX mixing zone model for the treatment plant diffuser. See also Comment No.15 below.

Response:

The Department disagrees that the UM3 model used was in error and will address this issue under point 15. Therefore the ammonia limit will remain.

Comment 3:

Page 7-8, Section S2.A. Monitoring Schedule: The expanded monitoring requirements in the draft permit are not justified and would significantly burden the City with additional capital (incubators and other test apparatus) and labor (greater than 0.25 additional FTE) costs. The superior record of O&M performance and the history of compliance by the City's treatment plant and its operations staff indicate that current levels of monitoring are adequate. Larger treatment facilities in this state are required by their NPDES permits to monitor parameters such as BOD, TSS, and ammonia on a schedule of three times per week, yet this draft permit requires the City to monitor these parameters five times per week. The City requests that the frequency of testing for these influent and effluent constituents be reduced from the level in the draft permit. Plant operating staff has also estimated that the cost of additional equipment needed to perform the added testing is in the range of $10,000. Operating staff has also raised concerns with regard to the additional lab time taking them away from other important maintenance functions that are required to operate and maintain the plant at its peak efficiency. Increasing the lab testing frequencies will cause other areas of the operation to shift downward on the priority list for the operating staff.

Response:

The City of Camas WWTP has a design capacity of 6.10 mgd. The Department policy for monitoring requires plants to monitor five times per week for BOD and TSS when the facility has a design capacity of greater than 5.0 mgd. The Department has reviewed the City's performance

and determined that the City's performance on BOD & TSS over the last two years is good. However, Camas is grown and has one of the largest percentages of industrial flows for any of our municipal facilities. This industrial wastewater has great potential to cause upset in the plant which could cause a BOD or Ammonia violations. Therefore, the Department will reduce the monitoring frequency from five (5) days per week to four (4) days per week for BOD, TSS, and Ammonia.

Comment 4:

Page 8, Section S2.A: In the "Pretreatment" category, the priority pollutant scan for non-metals should indicate that the sample for sludge will be a grab sample rather than a 24-hour composite.

Response:

This change will be made to the permit.

Comment 5:

Page 8, Section S2.A: In the "Wastewater Effluent" category, the "Parameter" should be listed as "Oil and grease, priority pollutant metals, and cyanide" rather than "Oil and grease, priority pollutant metals, and cyanide."

Response:

This change will be made to the permit.

Comment 6:

Page 8, Section S2.A: In the "Sludge" category, the parameter should be listed as "priority pollutant metals," rather than "priority pollutants metals." Units should be "mg/kg", not "ug/L."

Response:

This change will be made to the permit.

Comment 7:

Page 12, Section S4.A: The footnote in the Design Criteria incorrectly limits the plant treatment capacity at influent ammonia concentrations greater than a certain percentage of the influent BOD5 concentration. We assume that this limit is based on a perceived inadequacy by the Department of the design capacity of the plant's blower and aeration system to handle higher ammonia loads. This proposed limit does not consider additional system capacity due to cell uptake of ammonia, BOD5 removal in the anoxic denitrification zone, allowable ammonia residual in the effluent, excess blower capacity at actual backpressures, and excess oxygen transfer efficiency provided by the actual diffuser system. It is requested that this limit be deleted from the permit. High loadings of ammonia, such as from industrial sources, will be limited by pretreatment requirements if these loadings are limiting the plant's ability to maintain adequate dissolved oxygen in the treatment process.

Response:

The footnote referred to in this comment in essence requires that BOD capacity be reduced by a factor equal to about four pounds of BOD for every pound of ammonia over 20 percent of the

BOD loading concentration. This reflects the level at which our experience tells us that ammonia concentrations would exceed domestic loadings for this pollutant. The condition is needed because the POTW was designed to accommodate wastewater essentially domestic in strength and nature. Section S4 recognizes the BOD loading capacity anticipated, but did not include the ammonia capacity the POTW was designed to treat. This was done to provide the POTW additional flexibility to accept higher ammonia loadings, but the oxygen demanding effects of accepting such loadings still need to be recognized. Additional ammonia loadings accordingly reduce the POTWs ability to accept other oxygen demanding pollutants (carbonaceous BOD). Presently the POTW is receiving a high proportion of its ammonia loadings from a semiconductor manufacturer. The POTW must treat both BOD and ammonia by its permit, and both require the oxygenation of wastewater. Therefore, both carbonaceous BOD loadings and ammonia loadings are competing for the oxygen delivery capacity of the treatment plant.

In addition, the footnote in S4 relating to the capacity allows that the Permittee would begin reducing its BOD capacity when ammonia exceeded 20 percent of the rated BOD capacity. This means that the rated BOD capacity of 5,616 lb/day would be reduced when ammonia loadings to the POTW exceed 1,120 lbs/day. The Permittee (in comment 6) argues that adjustment should be made to account for certain other mechanisms in which ammonia uptake is realized. The Permittee (in comment 11) notes that the design nitrogen loading is 942 lbs/day TKN, not 1,017 lbs/day ammonia. Since TKN is the sum of ammonia and organic nitrogen, and is measured as a weight of nitrogen, it would normally be higher than the ammonia concentration as ammonia is normally about 60 percent of influent TKN, and organic nitrogen comprises the other 40 percent. Therefore, the 942 lbs/day TKN equates to about 565.2 lbs/day of ammonia-N, or (17/14)*565.2 = 686 lbs/day of ammonia (when reported as a weight of the ammonia molecule rather than the nitrogen atoms in the ammonia molecule). Therefore, allowing ammonia loadings to equal 20 percent of BOD rated capacity before reducing raw BOD loading capacity is already quite generous, and doesn't require further upward adjustment in the Department's opinion.

*Response to Specific Portions of This Comment (In Order)*:

Comment 8a:

"We assume that this limit is based on a perceived inadequacy by the Department of the design capacity of the plant's blower and aeration system to handle higher ammonia loadings."

Response:

The Department perceives no deficiency in the POTWs ability to accommodate its rated flow and loadings, however, the rated ammonia loading is representative of the anticipated domestic load at the rated flow and BOD loading of the POTW. The permit condition requires the POTW to accordingly reduce its BOD capacity if it desires to allow higher than domestic ammonia loadings. Such additional ammonia loadings were not anticipated when the POTW was designed.

Comment 8b:

"The proposed limit does not consider additional system capacity due to cell uptake of ammonia."

Response:

When the POTW was designed, the design rating did allow a factor for cell uptake of ammonia, however when additional ammonia is added (through industrial discharges), additional cell uptake

of ammonia does not occur beyond that already anticipated. Therefore, while its appropriate to reduce aeration requirements for a portion of the ammonia because some ammonia is used by cell production, this consideration has already been accounted for in the design loading for ammonia. The additional ammonia loadings don't spur more cell growth, and therefore such loadings should not be reduced for (bacteria) cell uptake.

Comment 8c:

"The proposed limit does not consider additional system capacity due to... …BOD5 removal in the anoxic denitrification zone…".

Response:

Under anoxic conditions, nitrates are reduced to nitrogen gas when the oxygen from the nitrate molecules are used as a source of oxygen for digestion of carbonaceous BOD. The POTW was constructed as a step-feed system, with the ability to be run in a mode where raw wastewater is introduced at a point where ammonia had been nitrified (oxidized) to nitrates, and the denitrification process could occur. During our inspections, the facility has not been employing the step-feed system to denitrify its effluent (and the POTW is not required to do so or to produce a de-nitrified effluent). If the POTW is operating in a denitrifying mode, and can show consistent total nitrate levels of 10 mg/L or less, it would be strong evidence that denitrification has been successfully employed. Then if they can project how they would continue to employ this process at their rated flow and loading rates, Ecology would be hard pressed not to consider this evidence, especially if it were part of a comprehensive POTW re-rating. To date such evidence has not been provided.

Comment 8d:

"The proposed limit does not consider additional system capacity due to... …allowable ammonia residual in the effluent…".

Response:

The POTW would need to nitrify to meet current ammonia limits even if there were no non-domestic sources of ammonia. Therefore, the Department presumes that additional ammonia loadings in the POTWs influent directly relate to either increases to the effluent concentrations or loadings that must be removed by the treatment process (through aeration). Again, what we are talking about is the loadings of ammonia over and above what domestic wastewater would contain.

Comment 8e:

"The proposed limit does not consider additional system capacity due to... …excess blower capacity at actual backpressures…".

Response:

The City has provided no evidence to support the inference that backpressures are less than their designer presumed they would be when the POTW was designed. The vast majority of blower backpressure is due to the depth of water above the diffusers in the aeration basin. Even if the POTW built aeration basins shallower than plans showed, there would be no need to revisit the

presumptions used. If aeration basins were shallower, the oxygen transfer efficiency would proportionately decrease, and there still would not be a net increase in oxygen delivery capacity. The comment provides no rationale for adjusting the backpressures used in designing this POTW. Even were the diffuser backpressures measured, and were less than what the designer presumed, aerators are subject to fouling over time, and the rating provided for this POTW is based on anticipating a degree of reduced performance for fouling.

Comment 8f:

"The proposed limit does not consider additional system capacity due to... ...excess oxygen transfer efficiency provided by the actual diffuser system."

Response:

The City has provided no evidence of any kind to support the inference that the oxygen transfer efficiency might be greater than their designer presumed it would be when the POTW was designed. If the POTW wishes to engage in a facility rerating, then the procedures outlined in the Department's "Criteria for Sewage Works Design", Ecology, 1998, need to be followed. No data has been provided to the Department that allow for such an assessment, and no desire for a facility rerating has been expressed to date. The Department finds that there is equal basis to speculate that the oxygen transfer efficiency may be lower than presumed in the design of this facility.

Comment 8g:

"It is requested that this limit be deleted from the permit."

Response:

The proposed footnote is not a limit, but a mechanism for adjusting the rated capacity of the POTW. It is needed as significant non-domestic loadings of oxygen demanding pollutants are anticipated to be discharged to this POTW, and it is necessary to account for the amount of the POTWs oxygen delivery capacity required for their treatment.

Comment 8h:

"High loadings of ammonia, such as from industrial sources, will be limited by pretreatment requirements if these loadings are limiting the plant's ability to maintain adequate dissolved oxygen in the treatment process."

Response:

The Department administers a pretreatment permit for each of the principal non-domestic dischargers to the POTW. The Department's permits will continue to reflect the loading limits for oxygen demanding pollutants (BOD and ammonia) which the City agrees to accept from these sources of indirect discharges to the POTW. Other agreements by the City such as user contracts should be in place to provide the ability of the POTW to respond to more immediate problems at the POTW. The Department is glad to have this confirmation that such authorities and mechanisms exist. They are, however, not proactive measures to prevent non-compliance. Once the POTW finds that agreed-to loadings from industries and domestic sources are too much for the POTW to handle, it may take several years to install additional capacity at the POTW. The

effects of additional ammonia loadings on the POTWs BOD capacity can easily be anticipated through the means spelled out in the footnote in question. The Department's position is that such problems should be avoided wherever possible. The intent of this footnote is to do just that, and our review finds that the draft wording is appropriate.

Comment 9:

Fact Sheet, Page 1: Delete "extended air" from Type of Treatment description in table.

Response:

This change will be made to the permit.

Comment 10:

Fact Sheet, Page 2, 1st paragraph: Delete "extended air" in first sentence. Regarding 2nd sentence, either lime slurry or sodium hydroxide will be used to adjust pH (operator's option). The primary clarifiers are not used to mix the lime slurry or sodium hydroxide. The application and mixing points are either downstream of the influent Parshall flume or at the aeration basin splitter box.

Response:

This change will be written into the permit.

*The following comments were made on the fact sheet.*

Comment 11:

Fact Sheet, Page 2, last paragraph, 2nd sentence: The selector zones are followed by two anoxic mixing zones.

Response:

This change will be written into the Fact Sheet.

Comment 12:

Fact Sheet, Page 3, 2nd paragraph, last sentence: There are a total of 288 UV lamps.

Response:

This change will be written into the Fact Sheet.

Comment 13:

Fact Sheet, Page 7, Table 2: The nitrogen design loading is 942 lbs/day TKN, not 1,017 lbs/day ammonia.

Response:

This change will be made to the Fact Sheet. The Permittee should note that this line was not carried over into the permit.

Comment 14:

Fact Sheet, Page 8, last line: Plant design loading is 5,616 lbs/day, not 5.616 lbs/day.

Response:

This change will be made to the permit.

Comment 15:

Fact Sheet, Page 18: The Proposed Limits for TSS (30/45 mg/L) in the Effluent Limits table do not agree with the effluent limitations in section S1 of the permit, page 6.

Response:

The permit was correct. The permit was finished after the fact sheet and the fact sheet will need to be changed to show what is now in the permit. The limits in the permit for both BOD and TSS were reduced to 20 mg/L and 30 mg/L to recognize the fact that the facility could produce a BOD and TSS in the effluent even though the influent removal rate was decreased for dilute influent.

Flows from semi-conductor industries in Camas have slowly ramped up to the point where they are up to 38 percent of flows in some months. The concession of requiring only a 70 percent removal rate for BOD and TSS was based on the presumption that such flows would eventually consume up to 52 percent of the POTWs flows at their 6.1 MGD design capacity (for the currently constructed phase). Therefore, the flows are in line with the prior analyses in this regard.

With respect to I&I, our analysis showed that over the past year, I&I flows have been as much as 45 percent of monthly average flows (January 2004). When dilute flows from semi-conductor industries are subtracted from the equation, I&I flows in this month were 1.2 MG of the remaining 2.14 MG of flows. This means that I&I flows of 1.2 MGD exceeded domestic flows of 0.94 MG, and far exceeded our target of 40 percent or less of domestic flows (at ~130 percent). Therefore, the I&I requirements of this permit are an essential component of future management of the wastewater infrastructure in this community.

Comment 16:

Fact Sheet, Page 30: An ambient river pH of 8.0 should be used for winter conditions for the un-ionized ammonia and reasonable potential calculations. A pH of 8.0 was used for the un-ionized ammonia and reasonable potential calculations for the Salmon Creek WWTP outfall in similar calculations performed earlier in 2004. This value is based on data taken at Ecology Station 28A100 with modern monitoring techniques in 2002-2003. A pH of 8.46, based on data collected in 1994, does not reflect current conditions.

Response:

The Department disagrees with this assessment. The Department thinks the analysis conducted by USGS in 1994 is of high quality and should be used along side of the Department 2002-2003

data. It is unfortunate that the only recent data available on pH is very limited. Because of the small populations in both data sets, the Department thought it would be best to combine the data. The high pH values seen in 1994 were of concern and although the pH in 2002 is lower, it is still high. The Department does not want to base the important calculations for ammonia toxicity on one year of data when it is known that pH has been high in the past. Permit writers must consider the worst case scenario to protect the aquatic life. If is the 1994 data reflects the pH in the Columbia at certain times, it is a serious condition when ammonia is present. The comment above also quotes the Salmon Creek permit which is in the process of being re-written. It is likely that Salmon Creek and Vancouver Marine Park NPDES permits will use this same analysis of pH and will therefore likely use the pH of 8.46 for reasonable potential calculations. This pH value represents the best information we have at this time and the value will be used as is in the new permit. During the next permit cycle, the Permittee may want to have a program to sample the ambient water on a regular basis for pH in a study that has quality control and quality assurance. A sampling program where pH has been sampled more than twice per month over two years would be most beneficial to each of the Permittees involved.

Comment 17:

Fact Sheet, Page 37: The 1994 Wastewater Facilities Plan for the City of Camas analyzed the treatment plant discharge diffuser with the computer software model UDKHDEN. As reported in the current Fact Sheet, the Washington State Department of Ecology (WDOE) in 2004 ran a new series of modeling scenarios utilizing the UM3 model. According to WDOE the reason for changing the model was that UDKHDEN "tends to over predict the dilution compared to the UM3 model for these waters. The model also used a flux average model prediction rather than a centerline prediction which is recommended in the Department guidance for unidirectional water."

The UM3 model was run 25 times by WDOE for both critical summer and critical winter season conditions. These runs produced four dilution factors that [were] used in the following situations:"

| | **Acute** | **Chronic** |
|---|---|---|
| Aquatic Life (summer) | 8 | 48 |
| Aquatic Life (winter) | 5 | 22 |
| Human Health, Carcinogen | | 22 |
| Human Health, Non-carcinogen | | 22 |

The City's consultant, Gray & Osborne, Inc., modeled the City of Camas diffuser using the CORMIX mixing zone model with the identical input values used by WDOE based on the draft NPDES Permit, Fact Sheet, and hard copy UM3 model runs provided by WDOE (see attached CORMIX model run data). In addition, Gray & Osborne checked their CORMIX model results by having Dr. Robert Doneker, P.E., (Portland State University) a developer of the CORMIX model, independently model the Camas diffuser (see Dr. Doneker letter attached). The dilution results are characterized below for both the UM3 and CORMIX models based on *Table C6: Predicted Dilutions for the City of Camas*, contained within the NPDES Fact Sheet.

| **Model Run** | **Discharge Season** | **UM3** | | **CORMIX** | |
|---|---|---|---|---|---|
| | | **Acute Dilution (32 feet)** | **Chronic Dilution (321 feet)** | **Acute Dilution (32 feet)** | **Chronic Dilution (321 feet)** |

| | | | | | |
|---|---|---|---|---|---|
| NC1 | Summer | | 48 | 501 | 662 |
| NC2 | Summer | 8 | | 354 | 470 |
| NC8 | Winter | | 60 | 80 | 549 |
| NC9 | Winter | **5** | | 92 | 332 |
| NC10 | Max. | 11 | 43 | 89 | 263 |
| NC13 | Winter | | 33 | 746 | 1,013 |
| NC14 | Winter | 8 | | 396 | 537 |
| NC15 | Max. | 10 | 49 | 287 | 388 |
| NC18 | Winter | | 44 | 746 | 1,013 |
| NC19 | Winter | 9 | | 396 | 537 |
| NC20 | Max. | 11 | 38 | 287 | 388 |
| NC22B | Winter | | **22** | *>1,000 | *>2,000 |
| NC24 | Winter | 6 | | 1,023 | 1,472 |
| NC25 | Max. | 7 | 33 | 739 | 1,064 |

*Estimated dilution values

In the model run NC22B, the input parameters of the small discharge velocity relative to the high ambient velocity will provide wake-like conditions without any jet mixing. This wake attachment is a dynamic interaction of the effluent plume with the bottom that is forced by the receiving water crossflow. This is an actual physical condition that occurs with these input variables. The UM3 model or other similar models do no have the capability to predict that this process is even occurring. The dilution values derived from the UM3 modeling for model run NC22B are not valid since UM3 is not capable of modeling this known physical process.

The two model results are drastically different and would indicate that effluent ammonia limits are not necessary due to the significant increase in dilution as shown by the CORMIX model results. The following table shows the respective minimum dilution values for both a critical summer and critical winter season.

| **Discharge Season** | **UM3** | | **CORMIX** | |
|---|---|---|---|---|
| | **Acute Dilution (32 feet)** | **Chronic Dilution (321 feet)** | **Acute Dilution (32 feet)** | **Chronic Dilution (321 feet)** |
| Summer | 8 | 48 | 354 | 470 |
| Winter | 5 | 22 | 80 | 332 |
| Human Health, Carcinogen | | 22 | | 332 |
| Human Health, Non-carcinogen | | 22 | | 332 |

Please note that UM3 uses a jet-integral model for near field mixing, which should only be applied to a stable near-field without dynamic attachments. Stable discharge conditions usually occur with a combination of strong buoyancy, weak momentum and deep water. The location of the City of Camas diffuser in the Columbia River is conducive to recirculation phenomena of unstable discharge conditions, created by shallow water and low buoyancy, near-horizontal discharges. This local recirculation leads to re-entrainment of already mixed water back into the buoyant jet region. Boundary interactions control discharge stability in the vicinity of the discharge. The CORMIX model accounts for both vertical and lateral boundaries, which are always present in the Columbia River. Determination of flow stability is particularly important for near-field mixing of riverine discharges. The UM3 model does not address the effects of vertical or horizontal boundaries or the stability of the discharge. It assumes the ambient water

body is infinite. Therefore, use of the CORMIX model is recommended for modeling the Camas diffuser.

Response:

The Department does not agree that the UM3 (Visual Plumes) is the wrong model to use for this section of the Columbia. The UM3 and UDKHDEN models were used in other permits in this stretch of the Columbia River. The UM3 model was shown to better match the dilution observed during a dye study for the Salmon Creek outfall. The Salmon Creek outfall diffuser is in similar shallow conditions as the Camas outfall. The Vancouver Marine Park outfall and diffuser was also modeled and a dye study was conducted to calibrate the model. The UDKHDEN model was used and fit well with the dye study data. At this time there is no reason to believe that CORMIX will do a better job in modeling the discharge plume at Camas. The results of the CORMIX data provided in comment 15 are 2-3 orders of magnitude higher than those provided by either UM3 for Camas or any of the other facility dilution studies mentioned above.

The following comments are made specifically on the use of CORMIX2:

1. CORMIX2 uses a 2-D prediction model in the nearfield and assumes the discharge from 8 ports ensues from a 2-dimensional slot of equivalent port area. This attempts to approximate the details of the merging process of the individual jets from each port/nozzle. This approximation impairs the prediction of dilution factors within the nearfield zone where the acute zone boundary (32 feet) is located and the plumes from the individual ports are not merged, as assumed. The 3-dimensional UM3 (Visual Plumes) prediction shows that the acute zone is within the nearfield zone where the plumes have not merged. A CORMIX1 analysis using one of the 8 ports also suggests that the regulatory mixing zone (acute zone) is well within the nearfield region.

2. A 3-D analyses of plume(s) in the nearfield is most appropriate and can be done by using UM3 interface in Visual Plumes.

3. In module MOD238 of the output file for CORMIX2, the dilution factors are flux averaged. The dilution factors for freshwater in unidirectional flow should be based on centerline concentrations (the Department's Permit Writer's Manual). Thus, the dilution factors predicted by CORMIX2 (flux average) are not comparable to those of UM3 (centerline). In UM3 prediction file the centerline dilution is approximately 1/3 of the flux average dilution factors.

4. The ambient flow rate (3017.49 m3/s = 106561 cfs, see output "session report") used in CORMIX2 analyses (see Case NC9)was much lower compared to the flow rate (192,000 cfs) used in UM3 analyses. This would imply that the ambient river dimensions are wrong assuming that the ambient current used was correct. Other cases were not checked.

5. The plume is also characterized by passive diffusive mixing in the farfield region which in CORMIX2 is accomplished through a constant diffusion for bounded channels. UM3 interface in Visual Plumes also uses constant diffusivity (in Brooks farfield solution) to predict farfield dilution. However, the farfield dilution prediction depends upon the nearfield model output for initial conditions; therefore it is important that the nearfield dilution be as accurately predicted as possible.

6. In model run NC22B the discharge velocity at each port is 76 percent of the ambient velocity which is not a relatively small number as alluded to in the comments

7. There was also a comment suggesting the presence of local recirculation at the outfall and that this would lead to re-entrainment of already mixed water back into the buoyant jet region. First, there was no physical basis provided to indicate presence of local recirculation. Secondly, the re-entrainment of already mixed water would tend to reduce dilution factor compared to entrainment of ambient water that has not previously mixed with the effluent. Thirdly, the plume is not buoyant as eluded to (see Case NC9).

Due to the large difference in dilution prediction between UM3 (Visual Plumes) and CORMIX2 and the discussion provided above, the Department will only consider CORMIX2 if it is field verified, i.e. through a dye study. The Permittee may wish to conduct such a study over the life of the new permit. This is not required, but the Permittee may do so to satisfy and perfect the dilution factors used. The Department will not hold the permit up for these future studies.

Following these comments, the Department reexamined the dilution modeling conducted by Ecology for the permit and all details and parameters that went into them. As a result a couple of errors were found. These errors were limited to an incorrect port spacing and port depth used in the following runs: NC1, NC2, NC8, NC9, NC19, NC20, NC22B, NC24, NC25. These errors were not in the ambient or effluent conditions shown in table C6 but rather in not using these same conditions as we said we did through out the model runs. These model runs were rerun and resulted in one or two points in each dilution factor. In a couple of cases the dilution went down when the port depth should have been in shallower water, e.g., the dry season chronic dilution went from 48 to 45. The winter acute dilution went from 5 to 6.5, therefore the number was rounded to 7 and all the reasonable potential evaluations were recalculated. The previous low acute dilution occurred during medium river discharge, however, after recalculating this dilution was no longer the lowest. The new lowest acute dilution occurred during the high flows and average yearly temperatures (See table C6 in Appendix C of this fact sheet).

The resultant changes did not make a large difference in the reasonable potential evaluation and resulted in only minor changes to limits already proposed.

It should be noted that the Permittee is required to provide the Department all pertinent information which they wish considered in development of their permit with the permit application. From this information and the best information available to the Department we develop a permit. In the future, the Permittee is encouraged to provide all information it wishes to be considered with its application for permit renewal.

# APPENDIX C

# SEWER ORDINANCE

# City of Camas Municipal Code

## Title 13 – Public Services-Division II

### CHAPTER 13.60 SANITARY DISPOSAL SYSTEM

**13.60.010 Administration--Receipt deposit.**

The sanitary sewage disposal system of the city, including the treatment plant and all other parts of such system and all additions and improvements thereto and extensions thereof, which may be made hereafter, shall be considered as a part of and belonging to the water works utility of the city. The cost of the construction and installation of the hereinafter provided additions, improvements and extensions and the cost of maintenance and operation of such system as improved shall be charged to the water works utility of the city, and any rates and charges which may be collected hereafter for sewage disposal service shall be paid into the "water and sewer revenue fund" of the city, to be hereafter created. (Prior code § 13.24.010)

**13.60.020 Applicability.**

Sections 13.60.020 through 13.60.110 shall apply to all territory embraced within the corporate limits of the city and areas of police jurisdiction thereof. (Prior code § 10.08.010)

**13.60.030 Approved means required.**

On and after the first day of May, 1949, it is unlawful to maintain or use any residence, place of business or other building or place where persons reside, congregate or are employed which is not provided with means for the disposal of human excreta, waste from kitchen sinks, bathtubs, slop receptacles, laundry and dishwater, waste and all organic matter, liquid and solid, which may be classified as harmful to health either by flush-toilet connected with a sewerage system or septic tank, approved by the city health officer, or his authorized agent. (Prior code § 10.08.020)

**13.60.040 Construction--Permit required.**

On and after May 1, 1949, it shall be unlawful to construct any means of sewerage or excreta disposal such as septic tanks without having first obtained a permit from the city health officer or his authorized representative. (Prior code § 10.08.030)

**13.60.050 Connection--Required when.**

A. All property owners whose property abuts a street or alley in which there is a public sanitary sewer or which is within one hundred fifty feet of a public sanitary sewer may be required to connect their private drains and sewers to the city sanitary sewer system at the direction of the city engineer. Those properties which abut a street or alley in which there is a public sanitary sewer or which are located within one

hundred fifty feet of a public sanitary sewer, and which are located within a designated health hazard area or which pose a threat to the general health, shall be connected to the sanitary sewer. Such connection shall be in the most direct manner possible and with a separate connection for each residence or structure.

B. There is imposed upon those property owners who are within the area served by the sanitary system and who refuse to connect to such sanitary sewer system a penalty in an amount equal to the charge that would have been made for sewer service if such property had been connected to the sanitary sewer system. Such penalties as provided herein shall accrue monthly until such property is connected to the sanitary sewer system. All penalties collected pursuant to this provision shall be considered revenue of the sanitary sewer system. (Ord. 1874 § 1, 1992; Ord. 1828 § 1, 1991: prior code § 10.08.040)

**13.60.055 Lien.**

A. The city shall have a lien against premises to which sewer service is available for delinquent and unpaid charges for sewer services, for penalties levied pursuant to Section 13.60.050(B), for unpaid connection charges, and for unpaid sewer system development charges. All such delinquent charges shall bear interest at the rate of eight percent per annum. Such lien shall be superior to all other liens and encumbrances except general taxes and local and special assessments.

B. Notice of such sewage lien shall be provided in accordance with RCW 35.67.210, and such sewage lien may be foreclosed as provided by RCW 35.67.220 through 35.67.250. (Ord. 1828 § 2, 1991)

**3.60.060 Private system--Flush-toilet.**

Every residence, place of business or other building or place where persons congregate, reside or are employed and which does not abut a street or alley in which there is a public sanitary sewer shall be provided with a private water-flush toilet by the owner or agent of the premises; said water-flush toilet system to be built or rebuilt, constructed and maintained in such a manner as to meet the requirements of construction and maintenance hereinafter described.

**Private Sewer System:**

At any residence, place of business or other building where there is installed a water-flush system of excreta and waste disposal which is not connected to a public sewer system approved by the State Department of Health and city health officer, and where the customary users do not exceed ten in number, there shall also be established or installed a private sewerage disposal system, the disposal system to consist of a septic tank with submerged “T's” for inlets and outlets and a system of underground drains for the disposal of the septic tank effluent. The tank and drains shall be so constructed as to meet the requirements of construction and maintenance hereafter described.

1. Septic Tanks.

   The sizes of septic tanks shall be as follows:

   Minimum size 67 cubic feet -- 500 gallons
   Serving 8 persons 87 cubic feet -- 650 gallons
   Serving 10 persons 100 cubic feet -- 750 gallons

   Septic tanks shall have a covered manhole of sufficient size to allow the cleaning of the tank.

2. Drains.

   Sufficient four inch open joint drain tile shall be provided and the construction and maintenance shall be such that the overflow from the septic tank, kitchen sinks, bathtubs, laundry trays, and other organic wastes shall not directly or indirectly drain or discharge over or upon the surface of the ground or into any stream, bodies of surface or groundwater either natural or artificial.

   Drain tile shall be laid on a flat grade not to exceed one-half-inch fall in ten feet. One hundred feet of drain shall be recognized as a minimum for four persons or less; serving over four persons, twenty-five feet of drain per person. The open joints of the drain tiles shall be loosely wrapped with strips of asphalt roofing or tar paper to exclude sand and silt.

3. Drain Line Trenches.

   Drain line trenches shall be eighteen inches in width and eighteen inches to two feet in depth. The drain line shall be laid in a bed of crushed stone or clean gravel covering the full width of the trench. The bottom of the drain tile shall be twelve inches above the bottom of the ditch and the gravel then filled in around the tile in such a manner as to completely cover the tile. The backfilling of the trench shall provide an earth covering of not less than ten inches nor more than eighteen inches; provided, however, that variations of the depth of the tile may be made upon written approval of the city health officer, or his duly authorized agent.

4. Subsurface Drainage.

   When the groundwater conditions are such that the soil will not receive the drainage from the drain tile described in subsection A2 of this section, a subsurface drainage system shall be provided for the purpose of reducing the groundwater table. The subsurface drain tile shall consist of two horizontal lines of four inch tile, one on each side of and parallel to the septic tank drain tile, a distance of five feet horizontally from the septic tank drain tile and a vertical distance of two feet below the septic tank drain tile. Subsurface drain lines shall be laid in trenches eighteen inches in width, with open joints loosely wrapped with strips of asphalt roofing or tar paper to exclude sand and gravel or sand and

silt, in a bed of crushed stone or clean gravel covering the full width of the trench. The outlet end of the subsurface drain tile may discharge onto the surface of the ground or into an open ditch or waterway. There shall not be any physical connection between the subsurface drainage tile and the sanitary drainage tile which the effluent from the septic tank is discharged into.

5. Filter Trench.

When the porosity of the soil is such that it will not receive the drainage from the drain tile described subsection A2 of this section, a filter trench shall be substituted for the drain line. The filter trench shall consist of 2 four-inch drain tiles, one laid directly above the other in the same ditch. The lower tile shall be laid in the bottom of the ditch and four feet of clean coarse sand and gravel placed over it. The joints of the lower tile shall be loosely wrapped with strips of asphalt roofing or tar paper to exclude the sand and gravel. The upper four-inch tile line shall be laid on top of the two-foot bed of sand and coarse cinders, clean gravel or crushed stone shall be placed around the upper tile so as to cover it completely. The following lengths of filter trench shall be required:

Minimum 80 feet
Serving 8 persons 100 feet
Serving 10 persons 125 feet

The backfilling of the trench shall provide an earth covering of from ten to fourteen inches. Both the upper and lower drain tile of the filter trench shall be laid on a flat grade not to exceed one-half-inch fall in ten feet.

The ditch used in construction of the filter trench shall be three feet in width and not less than five feet in depth.

6. Dry Wells.

Dry wells may be acceptable in certain areas where soil conditions and groundwater table is satisfactory. Approval of area subject to Health Department. In no case shall the dry well be less than eight feet in depth below the lowest point of inlet; diameter not to be less than four feet. In cases where no primary treatment (septic tank) is provided, then it shall be necessary to provide a grease trap of ample size.
At any residence, place of business or other building where there is installed a water-flush system of excreta and waste disposal which is not connected to a public sewer system approved by the State Department of Health or city health officer or his authorized agent and where the customary users exceed ten in number the plans and construction of which in each separate case, shall be approved by the State Department of Health or city health officer or his authorized agent. (Prior code § 10.08.050)

**13.60.070 Nonconforming system--Nuisance.**

Any privy or private sewerage disposal system existing or being maintained which does not conform to the requirements of Sections 13.60.020 through 13.60.110 shall be and is declared a nuisance, dangerous and a menace to the public health and the city health officer or his authorized agent of Camas, Washington, shall have the power and authority to abate any such nuisance in accordance with the provisions of this Sections 13.60.020 through 13.60.110. (Prior code § 10.08.060)

**13.60.080 Enforcement.**

It shall be the duty of the city health officer or his authorized agent to enforce the provisions of Sections 13.60.020 through 13.60.110 and in the performance of this duty the health officer or his duly authorized agent is authorized to enter at any reasonable hour any premises as may be necessary in the enforcement of Sections 13.60.020 through 13.60.110. (Prior code § 10.08.070)

**13.60.090 Violation--Penalty.**

Any person, firm or corporation who violates or refuses or fails to comply with any of the provisions of Sections 13.60.020 through 13.60.110 shall be guilty of a misdemeanor and shall be punished by a fine of not less than twenty-five dollars nor more than one hundred dollars, or imprisoned in the city jail for a period of thirty days or by both such fine and prison term. (Prior code § 10.08.080)

**13.60.100 Violation--Each day a separate offense.**

Every person, firm or corporation shall be deemed guilty of a separate offense for each and every day during any portion of which any violation of any provisions of Sections 13.60.020 through 13.60.110 is committed, continued, or permitted by such person, firm or corporation and shall be punishable therefore as provided by Sections 13.60.020 through 13.60.110. (Prior code § 10.08.090)

**13.60.110 Severability.**

If any section, subsection, sentence, clause or phrase of Sections 13.60.020 through 13.60.110 is for any reason held to be invalid or unconstitutional, such decision shall not affect the validity of the remaining portions of Sections 13.60.020 through 13.60.110. The city council of the city declares that it would have passed Sections 13.60.020 through 13.60.110 and each section, subsection, sentence, clause and phrase thereof, irrespective of the fact that any one or more other sections, subsections, sentences, clauses or phrases be declared invalid or unconstitutional. (Prior code § 10.08.100)

## CHAPTER 13.62 SEPTIC TANK EFFLUENT PUMPING SYSTEMS

### 13.62.010 Definitions.

Unless the context specifically indicates otherwise, the terms used in this chapter shall have the following meanings:

"City" means the city of Camas.

"Control unit" means an electrical panel with pump switches that is mounted in an easily accessible location at separate STEP or STE service.

"Owner" means any individual, firm, partnership, corporation, company, association, or any other legal entity which holds title to property upon which a STEP or STE system now or hereafter is located.

"Right-of-entry agreement" means an agreement which permits the city to access an owner's property to maintain and inspect an STEP or STE system.

"Service box" means a utility box located at the property line that houses the valve and discharge line which runs from the pump to the main sewage transmission line.

"Standard specifications" means those specifications and standards set forth in a manual entitled "City of Camas, Septic Tank Effluent Pumping (STEP) System."

"STE system" means a sanitary sewage system which operates by siphonage instead of pumping and which contains a high-level alarm and electrical panel.

"STEP system" means a sanitary sewage system which utilizes a high head pump, alarms, and a control panel to pump waste from a collection tank into pressurized mainlines.

"Use provisions" means the provisions set forth in Section 13.68.020 of this code. (Ord. 1901 § 2, 1992)

### 13.62.020 Standard specifications adopted.

The manual entitled "City of Camas, Septic Tank Effluent Pumping (STEP) System" is adopted by reference and incorporated herein as the standard specifications for STEP and STE sanitary sewer systems. (Ord. 1901 § 3, 1992)

### 13.62.030 Application to connect.

Any property owner seeking to connect his property to the sanitary sewer system of the city by means of a STEP system shall file an application with the public works department on a form provided by the city. The application shall contain the name and address of the owner, the location of the property to be connected to the sanitary sewer

system, the nature of the structure to be constructed on the subject property, the proposed use of the subject property, the proposed location of the STEP system, the design of the STEP system, and such other information as the public works department may require. Upon receipt of any such application, the public works director, or his authorized designee, shall review the application and grant the same if he determines that the subject property is suitable for use of a STEP sanitary sewer system, and if the design, location and other information set forth in the application comply with the standards and specifications adopted by the city for STEP systems and the criteria set forth in this chapter. (Ord. 1901 § 4, 1992)

**13.62.040 Installation responsibility--Inspection fee.**

A. The individual owner shall be responsible for and shall pay for the installation of the STEP/STE system, including but not limited to, service connection per CMC 13.64.050 if required, the tank, pump apparatus, control box, electrical wiring, conduit, plumbing from the structure to the tank, plumbing from the tank to the service box, excavation and backfill material. The city shall, prior to installation, determine the appropriate size tank.

B. During and at the completion of installation, the STEP/STE system shall be inspected by the city to insure that it has been properly installed. There shall be a fee of one hundred fifty dollars for inspection of the STEP system, which fee shall be collected by the building department at the time the permit for connection to the municipal sewer system is issued. (Ord. 2381 § 1, 2004: Ord. 1901 § 5, 1992)

**13.62.050 Right-of-entry agreement.**

Any owner seeking to connect his property to the sanitary sewer system of the city by means of a STEP system shall be required to execute a right-of-entry agreement authorizing the city and its employees to have access to the owner's property for the purpose of maintaining and inspecting the STEP system and appurtenances thereto. Such right-of-entry agreement shall be executed upon approval of an application for a STEP system. (Ord. 1901 § 6, 1992)

**13.62.050 Right-of-entry agreement.**

Any owner seeking to connect his property to the sanitary sewer system of the city by means of a STEP system shall be required to execute a right-of-entry agreement authorizing the city and its employees to have access to the owner's property for the purpose of maintaining and inspecting the STEP system and appurtenances thereto. Such right-of-entry agreement shall be executed upon approval of an application for a STEP system. (Ord. 1901 § 6, 1992)

**13.62.060 Ownership of system.**

A. Residential. After inspection and acceptance of an installed STEP system on residential property, the city shall be the owner of all components of the STEP system with the exception of the sewer line from the structure to the tank, which shall be

owned by the property owner. The city will be responsible for maintaining the components of the STEP system owned by the city, and in addition will be responsible for pumping the STEP tank and disposing of waste material when required. The owner will be responsible for maintaining the sewer line connecting the tank to the structure on the subject property. The owner will further be responsible for paying for all electrical costs associated with the operation of the STEP system.

B. Commercial and Industrial. All STEP systems serving commercial, industrial, and other nonresidential properties shall be owned by the owner of the subject property, except for the service box at the point where the STEP system connects to the city sanitary sewer system, which shall be owned by the city. The owner shall be responsible for maintaining all components of the STEP system and its ownership, and shall be responsible for pumping the STEP tank as needed and for disposing of the waste in an approved manner. The owner shall further be responsible for paying all electrical costs associated with the operation of the STEP system. (Ord. 1901 § 7, 1992)

**13.62.070 Damage to STEP system--Repair costs.**

The cost of repairing any damage to a STEP system which has resulted from the negligence, gross negligence, or intentional acts of the owner shall be the responsibility of the owner. This responsibility includes any clogging which may result due to improper use of the STEP system by the owner. (Ord. 1901 § 8, 1992)

**13.62.080 Landscaping over STEP or STE tanks.**

Under no circumstances will STEP or STE users be permitted to cover any portion of the riser lids to the access chambers of the septic tanks associated with the sewer system. The riser lid to the access chamber shall be accessible at all times to insure proper and timely emergency and/or maintenance response to the system. Accessible shall mean visible to the naked eye and with a minimum distance of one-inch separation from the top of the riser lid to the adjacent ground surface.

The owner of any property having a system found not to be in compliance with this requirement shall be notified by mail and shall have four weeks to correct the noted deficiency. Any corrective measures not completed within the specified time shall be completed by the city, and any costs associated with such corrections shall be billed to the property owner. (Ord. 2051 § 1, 1996)

## CHAPTER 13.64 SEWER SERVICE CHARGES

### 13.64.010 Monthly sewer service charge--Sewer service available.

All customers shall be charged for sanitary sewer service where sanitary sewer service is available in accordance with the rates set forth in Table 13.64.010.

Table 13.64.010
City of Camas Sewer Rate Schedule

RESIDENTIAL

| **Customer Class** | | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** |
|---|---|---|---|---|---|---|---|
| Inside City | Monthly Service Charge | $20.75 | $22.25 | $22.60 | $23.05 | $23.55 | $24.05 |
| Outside City | Monthly Service Charge | 31.13 | 33.38 | 33.90 | 34.58 | 35.33 | 36.08 |

COMMERCIAL AND INDUSTRIAL

| **Customer Class** | | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** |
|---|---|---|---|---|---|---|---|
| Inside City | Monthly Service Charge | $4.65 | $4.65 | $5.00 | $5.25 | $5.50 | $5.75 |
| | Volume Charge ($/ccf) | 2.10 | 2.15 | 2.25 | 2.30 | 2.35 | 2.45 |
| Outside City | Monthly Service Charge | 6.98 | 6.98 | 7.50 | 7.88 | 8.25 | 8.63 |
| | Volume Charge ($/ccf) | 3.15 | 3.23 | 3.38 | 3.45 | 3.53 | 3.68 |

(Ord. 2352 § 1, 2004: Ord. 2282 § 2, 2000: Ord. 2251 § 1, 1999: Ord. 1999 § 1, 1994; Ord. 1853 § 1, 1992: Ord. 1697 § 1, 1989: Ord. 1664 § 1, 1988: prior code § 13.08.280)

### 13.64.020 Adjustment--Commercial.

Those commercial and industrial customers whose sewer charges increase substantially during summer months due to the watering of lawns and shrubbery and whose existing service was installed prior to November 15, 1999, may make application with the finance department for adjustment of their sewer charges. If the finance department finds that there is an undue increase which is attributable to watering of lawns and shrubbery, then the sewer charges shall be adjusted so that the monthly charge is equal to the average of the charges incurred in the months of November through May, inclusive. Those

commercial and industrial customers that connect to the water system after November 15, 1999, and that do not want additional sewer charges due to irrigation, shall be required to install a separate water meter solely for irrigation. Any person whose application for adjustment is denied may appeal the decision of the water department to the board of adjustment. (Ord. 2229 § 1, 1999: prior code § 13.08.285)

**13.64.030 Adjustment for broken water line.**

A. Non-residential customers may apply for a reduction in sewer charges when, due to a broken water line on the customer's premises, the sewer charge is substantially increased. The amount of the reduction shall be the difference between the average of the two prior sewer billings and the current sewer billing.
B. Eligibility for the adjustment provided herein shall be contingent upon repair of the broken water line as provided for in Section 13.44.030, Camas Municipal Code. Any adjustment allowed shall be limited to a maximum of two billing periods. (Ord. 2339 § 1, 2003)

**13.64.040 Septage users.**

A. There is imposed upon customers of the city of Camas water and sewer utility who have septic tanks or chemical toilets and reside within the city limits a service charge of five cents per gallon when waste from the septic tank or chemical toilet is dumped into the city sanitary sewer system.

B. Septic tank waste or chemical toilet waste generated outside of the city limits of Camas may not be dumped into the city sanitary sewer system. (Ord. 1977 § 1, 1994: Ord. 1942 § 1, 1993: Ord. 1853 § 2, 1992: Ord. 1697 § 2, 1989: Ord. 1664 § 2, 1988: prior code § 13.08.295)

**13.64.050 Connection charges for STEP systems.**

A. Except as hereinafter provided, the connection charge for connecting a STEP/STE sewer system to the Camas municipal sewer system shall be the cost of materials, the costs of labor for city personnel at then prevailing rate for such personnel, and the amount of any fees or charges required to be paid to any third parties in order to make such connection.
B. The connection charge for connecting a STEP/STE sewer system to the Camas municipal sanitary sewer system with a one inch service line or less shall be one thousand four hundred dollars, or the actual cost to the city calculated in accordance with subsection A of this section, whichever is greater.
C. No connection charge will be assessed if a service line has already been installed connecting the subject property to the city sanitary sewer system. (Ord. 2381 § 2, 2004: Ord. 1934 § 1, 1993: Ord. 1923 § 1, 1993)

## CHAPTER 13.68 SEWER USE

### 13.68.010 Definitions.

Unless the context specifically indicates otherwise, the meaning of terms used in this chapter shall be as follows:

A. "Apartment" means any multiple-family dwelling having units which have separate kitchen plumbing facilities.

B. "BOD" (denoting biochemical oxygen demand) means the quantity of oxygen utilized in the biochemical oxidation of organic matter under standard laboratory procedure in five days at twenty degrees Centigrade, expressed in parts per million by weight.

C. "Building drain" means that part of the lowest horizontal piping of a drainage system which receives the discharge from soil, waste, and other drainage pipes inside the walls of the building and conveys it to the building sewer, beginning five feet outside the inner face of the building wall.

D. "Building sewer" means the extension from the building drain to the public sewer or other place of disposal.

E. "Garbage" means solid wastes from the preparation, cooking, and dispensing of food, and from the handling, storage and sale of produce.

F. "Industrial wastes" means the liquid wastes from industrial processes as distinct from sanitary sewage.

G. "Natural outlet" means any outlet into a watercourse, pond, ditch, lake or other body of surface or ground water.

H. "Person" means any individual, firm, company, association, society, corporation or group.

I. "pH" means the logarithm of the reciprocal of the weight of hydrogen ions in grams per liter of solution.

J. "Properly shredded garbage" means the wastes from the preparation, cooking and dispensing of food that have been shredded to such degree that all particles will be carried freely under the flow conditions normally prevailing in public sewers, with no particle greater than one-half inch in any dimension.

K. "Public sewer" means a sewer in which all owners of abutting properties have equal right, and is controlled by public authority.

L. "Sanitary sewer" means a sewer which carries sewage and to which storm, surface and ground waters are not intentionally admitted.

M. “Sewage” means a combination of the water-carried wastes from residences, business buildings, institutions, and industrial establishments, together with such ground, surface and storm waters as may be present.

N. “Sewage treatment plant” means any arrangement of devices and structures used for treating sewage.

O. “Sewage works” means all facilities for collecting, pumping, treating and disposing of sewage.

P. “Sewer” means a pipe or conduit for carrying sewage.

Q. “Shall” is mandatory. “May” is permissive.

R. “Storm sewer” or “storm drain” means a sewer which carries storm and surface waters and drainage, but excludes sewage and polluted industrial wastes.

S. “Superintendent” means the water-sewer superintendent of the city of Camas, or his authorized deputy or representative.

T. “Suspended solids” means solids that either float on the surface of, or are in suspension in water, sewage or other liquids; and which are removable by laboratory filtering.

U. “Watercourse” means a channel in which a flow of water occurs, either continuously or intermittently. (Prior code § 13.28.010)

**13.68.020 Use provisions.**

A. No person shall discharge or cause to be discharged any stormwater, surface water, ground water, roof runoff, subsurface drainage, cooling water or unpolluted industrial process waters to any sanitary sewer. Any person in violation of this subsection shall have ninety days to take appropriate corrective action following notification of such violation by the public works director. The public works director, for good cause, may extend such time period for remedial action an additional ninety days.
B. Stormwater and all other unpolluted drainage shall be discharged to such sewers as are specifically designated as combined sewers or storm sewers, or to a natural outlet approved by the superintendent. Industrial cooling water or unpolluted process waters may be discharged, upon approval of the superintendent, to a storm sewer, combined sewer or natural outlet.
C. Except as hereinafter provided, no person shall discharge or cause to be discharged any of the following described water or wastes to any public sewer:
    1. Any liquid or vapor having a temperature higher than one hundred fifty degrees Fahrenheit;
    2. Any water or waste which may contain more than one hundred parts per million by weight, of fat, oil or grease;
    3. Any gasoline, benzene, naphtha, fuel oil, motor oil, lubricants or other flammable or explosive liquid, solid or gas;

4. Any garbage that has not been properly shredded;
5. Any ashes, cinders, sand, mud, straw, shavings, metal, glass, rags, feathers, tar, plastics, wood, paunch manure, or any other solid or viscous substance capable of causing obstruction to the flow in sewers or other interference with the proper operation of the sewage works;
6. Any waters or wastes having a Ph lower than 5.5 or higher than 9.0, or having any other corrosive property capable of causing damage or hazard to structures, equipment, and personnel of the sewage works;
7. Any waters or wastes containing a toxic or poisonous substance in sufficient quantity to injure or interfere with any sewage treatment process, constitute a hazard to humans or animals, or create any hazard in the receiving waters of the sewage treatment plant;
8. Any waters or wastes containing suspended solids of such character and quantity that unusual attention or expense is required to handle such materials at the sewage treatment plant;
9. Any noxious or malodorous gas or substance capable of creating a public nuisance.

D. The admission into the public sewers of any waters or wastes having a five-day biochemical oxygen demand greater than three hundred parts per million by weight, or containing more than three hundred fifty parts per million by weight of suspended solids, or containing any quantity of substances having the characteristics described in subsection C of this section, or having an average daily flow greater than two percent of the average daily sewage flow of the city, shall be subject to the review and approval of the superintendent. Where necessary, in the opinion of the superintendent, the owner shall provide, at his expense, such preliminary treatment as may be necessary to reduce the biochemical oxygen demand to three hundred parts per million and the suspended solids to three hundred fifty parts per million by weight, or reduce objectionable characteristics or constituents to within the maximum limits provided for in subsection C of this section, or control the quantities and rates of discharge of such waters or wastes. Plans, specifications, and any other pertinent information relating to proposed preliminary treatment facilities shall be submitted for the approval of the superintendent and of the Water Pollution Control Commission of the state, and no construction of such facilities shall be commenced until said approvals are obtained in writing.

E. Where preliminary treatment facilities are provided for any waters or wastes, they shall be maintained continuously in satisfactory and effective operation, by the owner at his expense.

F. When required by the superintendent, the owner of any property served by a building sewer carrying industrial wastes shall install a suitable control manhole in the building sewer to facilitate observation, sampling and measurement of the wastes. Such manhole, when required, shall be accessibly and safely located, and shall be constructed in accordance with plans approved by the superintendent. The manhole shall be installed by the owner at his expense, and shall be maintained by him so as to be safe and accessible at all times.

G. All measurements, tests, and analyses of the characteristics of waters and wastes to which reference is made shall be determined in accordance with “Standard Methods for the Examination of Water and Sewage,” and shall be determined at the control manhole provided for in subsection F of this section or upon suitable samples taken at

said control manhole. In the event that no special manhole has been required, the control manhole shall be considered to be the nearest downstream manhole in the public sewer to the point at which the building sewer is connected.

H. Grease, oil and sand interceptors shall be provided, when in the opinion of the superintendent, they are necessary for the proper handling of liquid wastes containing grease in excessive amounts, or any flammable wastes, sand, and other harmful ingredients, except that such interceptors shall not be required for private living quarters. All interceptors shall be of a type and capacity approved by the superintendent and shall be located as to be readily and easily accessible for cleaning and inspection.

   Where installed, all grease, oil and sand interceptors shall be maintained by the owner, at his expense, in continuously efficient operations at all times.

I. No statement contained in this chapter shall be construed as preventing any special agreement or arrangement between the city and any industrial concern whereby an industrial waste of unusual strength or character may be accepted by the city for treatment, subject to payment therefore by the industrial concern. (Ord. 2197 § 1, 1999; prior code § 13.28.020)

**13.68.030 Inspection.**

The superintendent and other duly authorized employees of the city bearing proper credentials and identification shall be permitted to enter upon all properties for the purpose of inspecting, observing, measuring, sampling, and testing sewer connections, operations, and facilities in accordance and to insure compliance with the provisions of this chapter. No such entry or inspection shall be made without the consent of the owner or occupant of such building or premises unless the city employee shall have obtained a search warrant, or unless exigent circumstances exist that would justify an inspection and entry without obtaining a warrant. (Ord. 1610 § 1, 1986: prior code § 13.28.030)

**13.68.040 Damage prohibited.**

No unauthorized person shall maliciously, wilfully, or negligently break, damage, destroy, uncover, deface or tamper with any structure, appurtenance, or equipment which is a part of the municipal sewage works. (Prior code § 13.28.040(a))

**13.68.050 Violation--Notice.**

Any person found to be violating any provision of this chapter shall be served in person or by mail by the city with written notice stating the nature of the violation and providing for the satisfactory correction thereof within thirty days from the date of such service. The offender shall, within the period of time stated in such notice, permanently cease all violations. (Prior code § 13.28.040(b))

**13.68.060 Violation--Designated--Penalty.**

Any person violating Section 13.68.040 and any person who shall continue any violation beyond the time limit provided for in Section 13.68.050 shall be guilty of a misdemeanor, and upon conviction thereof shall be fined in an amount not exceeding one hundred

dollars or by imprisonment in the city jail not to exceed sixty days or by both such fine and imprisonment for each violation. Each day in which any such violation continues shall be deemed a separate offense. (Prior code § 13.28.040(c))

**13.68.070 Violation--Liability.**

Any person violating any of the provisions of this chapter shall become liable to the city for any expense, loss or damage occasioned by the city by reason of such violation. (Prior code § 13.28.040 (d))

## CHAPTER 13.72 SEWER SERVICE DEVELOPMENT CHARGE

### 13.72.010 Purpose.

Pursuant to the authority conferred upon cities and towns by RCW 35.92.020 and 35.92.025, the city council of the city finds that property owners who seek to connect property to the sewer system of the city should be assessed a charge in order that such property shall bear its equitable share of the cost of the sewer system. The council further finds that the charge should be based upon the property owner's anticipated use of the sewer system as related to the historical cost of the sewer system and the projected cost of additions to the sewer system to meet new demand. That portion of the charge based upon the historical costs of the sewer system shall be measured by the undepreciated value of the sewer system and plant in service at the time the charge is imposed. That portion of the charge based upon the projected cost of future improvements shall be based upon appropriate studies by engineers and/or financial consultants. The charge imposed by this chapter shall be denominated as a “sewer system development charge” and shall be in addition to any sewer connection or permit fees imposed by other ordinances of the city. (Ord. 2119 § 1, 1997: prior code § 13.30.010)

### 13.72.020 Definitions.

Unless otherwise specifically defined, the terms used in this chapter shall have the following meanings:

“Average day flow” means the average volume of waste water flowing from a user over a twenty-four-hour period measured in million gallons per day (MGD).

“Biochemical oxygen demand (BOD)” means the quantity of oxygen utilized in the biochemical oxidation of organic matter under standard laboratory procedure in five days at twenty degrees Centigrade, and shall be measured in pounds per day.

“City” means that use classification for the city and other public or nonprofit customers whose waste flows are typical of those associated with single-family residential structures.

“Commercial I” means that use classification of nonresidential properties who contribute flows to the sewer system except those users classified as Commercial II.

“Commercial II” means that use classification of nonresidential property owners who contribute higher than average flows or strengths to the sewer system, and shall include industrial and unusual requirement customers.

“Engineer” means the engineer of the city of Camas, or his duly authorized deputies or representatives.

“Industrial and unusual requirement customers” means that use classification of nonresidential property owners who contribute sewage with a flow and strength in excess of the Commercial II class.

“Multifamily” means that use classification of residential property owners whose structure contains two or more residential dwelling units.
“Peaking factors” means the numeric value resulting from the peak hour flow volume divided by the average day flow volume.

“Sewer system” means all facilities for collecting, transporting, pumping, treating and disposing of sewage.

“Sewage” means a combination of water-carried waste from residences, business buildings, institutions and industrial establishments, together with such ground, surface, and storm waters as may be present.

“Single-family” means that use classification of residential property owners whose structure contains one residential dwelling unit.

“Suspended solids (SS)” means solids that either float on the surface of or are suspended in water, sewage, or other liquids, and which are removable by laboratory filtering, and which shall be measured in pounds per day.

“City” means that use classification for the city and other public or nonprofit customers whose waste flows are typical of those associated with single-family residential structures. (Ord. 2119 §§ 2, 3, 1997; Ord. 1830 §§ 1--3, 1991; prior code § 13.30.020)

**13.72.030 Imposition.**

Except as provided in Section 13.72.040, there is imposed on every property that connects to the city sewer system of the city a sewer system development charge, which charge shall be assessed in accordance with the rates set forth in Section 13.72.050 and shall be collected prior to inspection by the city of the connection of the sewer line to the structure on the property owner's premises. (Prior code § 13.30.030)

A. Credit for Prior Connection.

    1. Those properties that have been disconnected from the city's sewer system since January 1, 1972, shall receive a credit for the prior connection.
    2. The credit for the prior connection shall be in an amount equal to the sewer system development charge for the use classification of the prior connection, and the sewer system development charge imposed under this chapter shall be the difference between the amount due under the present use classification less the amount that would have been assessed under the use classification for the prior connection; provided, however, that the city shall not be required to reimburse the property owner in the event that the credit exceeds the sewer system development charge for the new connection.

B. Credit. Those properties that are not presently connected to the city's sewer system but which have been assessed and paid a monthly sewer service charge shall receive a credit against the sewer system development charge in an amount equal to the total

monthly sewer service charges paid prior to connection. (Ord. 2310 § 1, 2002; Prior code § 13.30.040)

**13.72.050 Application.**

A. Any property owner seeking to connect his property to the sewer system of the city shall file with the engineer an application to be on a form provided by the city. The application shall contain the name and address of the property owner, the location of the property to be connected to the sewer system, the nature of the structure to be constructed on the subject property, the proposed use of the subject property, and any other relevant information deemed necessary by the engineer to process the application.

B. Upon receipt of the completed application, the engineer shall designate the use classification of the property as single-family, multi-family, Commercial I, Commercial II, or industrial and unusual customer requirement. The applicant shall then be informed in writing by the engineer of the amount of the sewer system development charge, which shall be based upon the use classification of the property and shall be in accordance with the rates set forth in Section 13.72.060. (Prior code § 13.30.050)

**13.72.060 Rates.**

A. The sewer system development charge for properties classified as single-family, multifamily, city, and commercial I shall be as follows:

| Meter Size | Equivalent Meter Factors | Sewer Utility |
|---|---|---|
| Residential | | |
| All | All | $ 2,349 |
| Commercial | | |
| 5/8” | 1 | $ 2,349 |
| 3/4” | 1.5 | 3,523 |
| 1” | 2.5 | 5,872 |
| 1.5” | 5 | 11,745 |
| 2” | 8 | 18,792 |
| 3” | 16 | 37,584 |
| 4” | 25 | 58,725 |
| 6” | 50 | 117,449 |
| 8” | 80 | 187,919 |

B. The sewer system development charge for properties classified as commercial II, including industrial and unusual customer requirements, shall be determined by the public works director. The factors used to determine the commercial II system

development charges shall include the average daily flow, peaking factor, BOD pounds per day, and SS pounds per day. (Ord. 2355 § 1, 2004: Ord. 1830 § 4, 1991; prior code § 13.30.060)

Table 13.72.060
Commercial II Worksheet

| Reimbursement Fee | Historic | Future | Units | Charge |
|---|---|---|---|---|
| Average Day Flow (MGD) | $0.00 | + $1,550,000.00 | X _____ | = $ _____ |
| Peaking Factor | $1,168,000.00 | + $492,000.00 | X _____ | = $ _____ |
| BOD (Lbs/Day) | $0.00 | + $1,659.00 | X _____ | = $ _____ |
| SS (Lbs/Day) | $0.00 | + $1,014.00 | X _____ | = $ _____ |
| | Total $_____ | | | |

**13.72.070 Payment of sewer system development charge.**

A. The sewer system development charge owing under the provisions of this chapter shall be paid by the applicant at the time of issuance of the plumbing permit or building permit, whichever shall first occur, or as scheduled by a separate agreement with the city.

B. No sewer service shall be furnished to the property of any person seeking to connect to the sewer system of the city until the sewer system development charge imposed by this chapter has been paid to the city treasurer or until such time as the city and the applicant have entered into a separate agreement providing for the payment of such sewer system development charge. (Ord. 1872 § 1, 1992: prior code § 13.30.070)

**13.72.080 Revenue disposition.**

All revenues collected pursuant to this chapter shall be paid into the water and sewer capital reserve fund, and shall be used for the purpose of financing system improvements. Such revenues shall not be used to offset current operation or maintenance costs. (Prior code § 13.30.080)

**13.72.090 Appeal.**

A. Any applicant aggrieved by the amount of the sewer system development charge found by the engineer to be required under the provisions of this chapter, may appeal to the board of adjustment from such finding by filing a written notice of appeal with the city clerk within twenty days from the time such property owner is given notice of such amount. The chairman of the board of adjustment shall cause a

notice of the time and place of hearing to be mailed to the applicant. At such hearing, the applicant shall be entitled to be heard and to introduce evidence on his own behalf. The board of adjustment shall thereupon ascertain the correct amount of the sewer system development charge, and the city clerk shall immediately notify the appellant thereof, by mail, which amount, together with the costs of appeal, if appellant is unsuccessful therein, must be paid within ten days after such notice is given.

B. The chairman of the board of adjustment may, by subpoena, require the attendance at any appeal of any person, and may also require him to produce any pertinent books and records. Any person served with such subpoena shall appear at the time and place therein stated, and shall produce the books and records required, if any, and shall testify truthfully under oath administered by the chairman in charge of the hearing on appeal, as to any matter required of him pertinent to the appeal, and it is unlawful for him to fail or refuse to do so. (Prior code § 13.30.090)

**13.72.100 Notice recordation.**

Pursuant to RCW 65.08.170, the engineer shall cause to be recorded in the office of the auditor of Clark County a notice in the form and containing the information prescribed by said statute. (Prior code § 13.30.100)

# APPENDIX D

# FLOW, LOADING, AND EFFLUENT QUALITY DATA

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month January
Facility Name CAMAS STP | FINAL LIMITS | Year 2002
Receiving Water Columbia River | Plant Operator J. Dickinson
Plant Type Activated Sludge System | Population 12,500

| | INFLUENT | | | | EFFLUENT | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | N-OR |
| 1 | | | 1.559 | 6.68 | | | | | | | | | | | |
| 2 | 99 | 82 | 2.244 | 7.1 | 6 | 94 | 112 | 2 | 98 | 37 | | 7.1 | | | .66 |
| 3 | 123 | 154 | 2.008 | 6.69 | 4 | 97 | 67 | 2 | 99 | 33 | | | | | .12 |
| 4 | | | 1.841 | 6.3 | | | | | | | 720 | | | | .16 |
| 5 | | | 1.675 | 6.5 | | | | | | | | | | | .12 |
| 6 | | | 1.980 | 6.41 | | | | | | | | | | | .34 |
| 7 | | | 3.52 | 6.43 | | | | | | | | | | | .78 |
| 8 | | | 4.10 | 6.24 | | | | | | | | | | | .65 |
| 9 | 79 | 150 | 3.391 | 6.67 | 1 | 99 | 28 | 4 | 97 | 113 | 7 | | | | .02 |
| 10 | 81 | 42 | 2.487 | 6.30 | 9 | 89 | 187 | 6 | 86 | 124 | 7 | | | | Ø |
| 11 | | | 2.182 | 6.57 | | | | | | | | 1.14 | | | .01 |
| 12 | | | 1.954 | 6.6 | | | | | | | | | | | .13 |
| 13 | | | 2.002 | 6.03 | | | | | | | | | | | .11 |
| 14 | | | 2.00 | 6.03 | | | | | | | | | | | .01 |
| 15 | | | 1.854 | 6.87 | | | | | | | 29 | | | | ~~0~~ |
| 16 | 141 | 170 | 1.822 | 6.77 | 6 | 96 | 91 | 4 | 98 | 61 | 39 | 7.0 | | | ~~0~~ |
| 17 | 200 | 2320 | 1.872 | 6.68 | 13 | 94 | 203 | 7 | 99 | 109 | | | | | .23 |
| 18 | | | 1.802 | 6.33 | | | | | | | | | | | .05 |
| 19 | | | 2.004 | 6.20 | | | | | | | | | | | .38 |
| 20 | | | 2.325 | 6.61 | | | | | | | | | | | .17 |
| 21 | | | 2.455 | 6.52 | | | | | | | | | | | .11 |
| 22 | | | 2.530 | 6.30 | | | | | | | 40 | | | | .46 |
| 23 | 77 | 82 | 2.898 | 6.35 | 4 | 95 | 97 | 5 | 94 | 121 | | | | | .06 |
| 24 | 80 | 77 | 2.399 | 6.7 | 3 | 96 | 60 | 1 | 99 | 20 | | 1.1 | | | .06 |
| 25 | | | 2.773 | 6.6 | | | | | | | 28 | | | | .79 |
| 26 | | | 3.694 | 6.6 | | | | | | | | | | | .23 |
| 27 | | | 2.861 | 6.11 | | | | | | | | | | | .33 |
| 28 | | | 2.810 | 6.5 | | | | | | | 14 | | | | .25 |
| 29 | | | 2.679 | 6.45 | | | | | | | | | | | .04 |
| 30 | 101 | 76 | 2.318 | 6.7 | 8 | 92 | 155 | 1 | 99 | 19 | | .48 | | | .16 |
| 31 | 115 | 104 | 2.320 | 6.30 | 4 | 97 | 77 | 3 | 97 | 58 | 0 | | | | .07 |
| Total | | (104) | 74.35 | 9 | | | | | | | | | | | .44 |
| | AVG 110 | AVG 326 | AVG 2.398 | MIN 6.03 | AVG 6 | AVG 95 | AVG 108 | AVG 3.5 | AVG 97 | AVG 69.5 | GEM 20 | AVG 3.364 | | | 6.94 |
| Permit | | | | 6 | 30 | 83 | 956 | 30 | 81 | 1217 | 200 | | | | |
| | AVW 171 | AVW 1245 | MAX 4.10 | MAX 7.10 | AVW 8.5 | | AVW 147 | AVW 5.5 | | AVW 118.5 | GM7 70 | MAX 7.1 | | | |
| Limits | | | | 9 | 45 | | 1217 | 45 | | 1826 | 400 | | | | |

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law that I have personally examined the information submitted herein; and based on my inquiry of those individuals immediately responsible, I believe the information to be accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and/or imprisonment. (Penalties under statutes 18 & 33 U.S.C. may include fines up to $10,000 and/or maximum imprisonment of five years.)

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

| | | | |
|---|---|---|---|
| Permit No. | WA0020249 | | Month February |
| Facility Name | CAMAS STP | *FINAL LIMITS* | Year 2002 |
| Receiving Water | Columbia River | | Plant Operator J. Dickinson |
| Plant Type | Activated Sludge System | | Population 12500 |

| | INFLUENT | | | | EFFLUENT | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | R 7-Q |
| 1 | | | 2.985 | 6.5 | | | | | | | | | | | .01 |
| 2 | | | 2.631 | 6.3 | | | | | | | | | | | .06 |
| 3 | | | 2.231 | 6.32 | | | | | | | | | | | .08 |
| 4 | | | 2.20 | 6.30 | | | | | | | | | | | Θ |
| 5 | | | 2.124 | 6.47 | | | | | | | 51 | 3.5 | | | .21 |
| 6 | 143 | 164 | 1.991 | 6.51 | 8 | 94 | 133 | 4 | 98 | 66 | | | | | .50 |
| 7 | 91 | 84 | 2.509 | 6.57 | 4 | 96 | 84 | 1 | 99 | 21 | | | | | .92 |
| 8 | | | 3.871 | 6.08 | | | | | | | 0 | | | | .02 |
| 9 | | | 3.139 | 6.28 | | | | | | | | | | | .02 |
| 10 | | | 2.449 | 6.15 | | | | | | | | | | | .20 |
| 11 | | | 2.235 | 6.45 | | | | | | | | | | | Ø |
| 12 | | | 1.907 | 6.36 | | | | | | | | | | | Θ |
| 13 | 130 | 138 | 1.832 | 6.75 | 3 | 98 | 46 | 4 | 97 | 61 | 0 | 1.8 | | | Θ |
| 14 | 150 | 145 | 1.684 | 6.93 | 3 | 98 | 42 | 2 | 99 | 28 | | | | | Θ |
| 15 | | | 1.619 | 6.8 | | | | | | | 0 | | | | .06 |
| 16 | | | 1.503 | 6.84 | | | | | | | | | | | Θ |
| 17 | | | 1.577 | 6.66 | | | | | | | | | | | .03 |
| 18 | | | 1.523 | 6.50 | | | | | | | 4 | | | | .4 |
| 19 | | | 1.681 | 6.55 | | | | | | | | | | | Θ |
| 20 | 120 | 87 | 1.746 | 6.89 | 6 | 95 | 87 | 5 | 94 | 73 | | | | | .19 |
| 21 | 135 | 96 | 1.530 | 6.78 | 11 | 92 | 140 | 6 | 94 | 77 | | 4.9 | | | .01 |
| 22 | | | 1.657 | 6.53 | | | | | | | 8 | | | | .87 |
| 23 | | | 2.290 | 6.59 | | | | | | | | | | | .02 |
| 24 | | | 2.814 | 6.55 | | | | | | | | | | | Θ |
| 25 | | | 2.208 | 6.38 | | | | | | | | | | | Θ |
| 26 | | | 1.986 | 6.36 | | | | | | | | 1.0 | | | Θ |
| 27 | 132 | 144 | 1.828 | 6.22 | 5 | 96 | 76 | 8 | 94 | 122 | 3 | | | | Ø |
| 28 | 106 | 96 | 1.833 | 6.50 | 3 | 97 | 46 | 7 | 93 | 107 | | | | | Θ |
| 29 | | | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | | | |
| 31 | | | | | | | | | | | | | | | |
| Total | | | 59.583 | | | | | | | | | | | | |
| | AVG 126 | AVG 119 | AVG 2.127 | MIN 6.08 | AVG 5 | AVG 96 | AVG 82 | AVG 5 | AVG 96 | AVG 69 | GEM 3.5 | AVG 2.8 | | | 3.65 |
| Permit | | | | 6 | 30 | 83 | 955 | 30 | 81 | 1217 | 200 | | | | |
| | AVW 140 | AVW 142 | MAX 3.871 | MAX 6.93 | AVW 8.5 | | AVW 114 | AVW 7.5 | | AVW 115 | GM7 75 | MAX 4.9 | | | |
| Limits | | | | 9 | 45 | | 1217 | 45 | | 1825 | 400 | | | | |

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law that I have personally examined the information submitted herein; and based on my inquiry of those individuals immediately responsible, I believe the information to be accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and/or imprisonment. (Penalties under statutes 18 & 33 U.S.C. may include fines up to $10,000 and/or maximum imprisonment of five years.)

**Please Circle ALL Permit Violations** Mail to P.O. Box 47775, Olympia WA 98504-7775

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month March

Facility Name CAMAS STP | FINAL LIMITS | Year 2002

Receiving Water Columbia River | Plant Operator J. Dickinson

Plant Type Activated Sludge System | Population 12500

| | INFLUENT | | | | EFFLUENT | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | RAINFALL " |
| 1 | | | 1.740 | 6.26 | | | | | | | 44 | | | | 0 |
| 2 | | | 1.655 | 6.29 | | | | | | | | | | | 0 |
| 3 | | | 1.595 | 6.62 | | | | | | | | | | | 0 |
| 4 | | | 1.662 | 6.60 | | | | | | | 6 | | | | .04 |
| 5 | | | 1.605 | 6.68 | | | | | | | | | | | .97 |
| 6 | 91 | 110 | 1.919 | 6.97 | 1 | 99 | 16 | 2 | 98 | 32 | | 12.9 | | | .47 |
| 7 | 78 | 92 | 3.087 | 6.66 | 1 | 99 | 26 | 8 | 91 | 206 | | | | | .04 |
| 8 | | | 2.185 | 6.45 | | | | | | | | | | | .07 |
| 9 | | | 1.877 | 6.90 | | | | | | | | | | | .19 |
| 10 | | | 1.905 | 6.89 | | | | | | | | | | | .22 |
| 11 | | | 2.273 | 6.65 | | | | | | | 40 | | | | .92 |
| 12 | | | 3.750 | 6.58 | | | | | | | | | | | .28 |
| 13 | 59 | 38 | 3.198 | 6.61 | 8 | 79 | 48 | 8 | 79 | 213 | | | | | .28 |
| 14 | 108 | 69 | 2.876 | 6.86 | 3 | 97 | 72 | 2 | 97 | 48 | | | | | .08 |
| 15 | | | 2.655 | 6.45 | | | | | | | 4 | 9.6 | | | .12 |
| 16 | | | 2.440 | 6.6 | | | | | | | | | | | .09 |
| 17 | | | 2.308 | 6.79 | | | | | | | | | | | .25 |
| 18 | | | 2.608 | 6.53 | | | | | | | 4 | | | | .67 |
| 19 | | | 2.920 | 6.42 | | | | | | | | | | | .03 |
| 20 | 95 | 44 | 3.533 | 6.92 | 3 | 97 | 88 | 4 | 91 | 118 | | | | | 0 |
| 21 | 93 | 108 | 2.550 | 7.01 | 4 | 96 | 85 | 2 | 98 | 43 | | 9.3 | | | 0 |
| 22 | | | 2.246 | 6.6 | | | | | | | 2 | | | | 0 |
| 23 | | | 1.931 | 6.83 | | | | | | | | | | | .17 |
| 24 | | | 1.824 | 6.74 | | | | | | | | | | | .03 |
| 25 | | | 1.923 | 6.96 | | | | | | | | | | | 0 |
| 26 | | | 1.729 | 6.91 | | | | | | | 22 | | | | .01 |
| 27 | 105 | 92 | 1.711 | 7.0 | 6 | 94 | 86 | 2 | 98 | 29 | | | | | 0 |
| 28 | 171 | 324 | 1.694 | 7.01 | 3 | 98 | 42 | 6 | 98 | 85 | | 24.6 | | | 0 |
| 29 | | | 1.692 | 6.8 | | | | | | | 4 | | | | 0 |
| 30 | | | 1.585 | 6.71 | | | | | | | | | | | 0 |
| 31 | | | 1.502 | 6.53 | | | | | | | | | | | 0 |
| Total | | | 68.178 | | | | | | | | | | | | |
| | AVG 100 | AVG 110 | AVG 2.199 | MIN 6.26 | AVG 4 | AVG 95 | AVG 58 | AVG 4.25 | AVG 94 | AVG 97 | GEM 9 | AVG 14.1 | | | 4.93" |
| Permit | | | | 6 | 30 | 83 | 955 | 30 | 81 | 1217 | 200 | | | | |
| | AVW 138 | AVW 208 | MAX 3.533 | MAX 7.01 | AVW 6 | | AVW 87 | AVW 5 | | AVW 131 | GM7 15 | MAX 24.6 | | | |
| Limits | | | | 9 | 45 | | 1217 | 45 | | 1825 | 400 | | | | |

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law that I have personally examined the information submitted herein; and based on my inquiry of those individuals immediately responsible, I believe the information to be accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and/or imprisonment. (Penalties under statutes 18 & 33 U.S.C. may include fines up to $10,000 and/or maximum imprisonment of five years.)

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

| | | | |
|---|---|---|---|
| Permit No. | WA0020249 | Month | April |
| Facility Name | CAMAS STP — *FINAL LIMITS* | Year | 2002 |
| Receiving Water | Columbia River | Plant Operator | J. Dickinson |
| Plant Type | Activated Sludge System | Population | 12500 |

| | INFLUENT | | | | EFFLUENT | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | | |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | | RAIN |
| 1 | | | 1.501 | 6.62 | | | | | | | 5 | | | | | Ø |
| 2 | | | 1.428 | 6.76 | | | | | | | | | | | | Ø |
| 3 | 175 | 138 | 1.395 | 6.90 | 7 | 96 | 81 | 37 | 73 | 430 | 2 | 13.4 | | | | Ø |
| 4 | 159 | 172 | 1.401 | 7.14 | 16 | 90 | 201 | 14 | 92 | 164 | | | | | | Ø |
| 5 | | | 1.338 | 7.00 | | | | | | | | | | | | .17 |
| 6 | | | 1.419 | 7.37 | | | | | | | | | | | | .06 |
| 7 | | | 1.429 | 7.08 | | | | | | | | | | | | .04 |
| 8 | | | 1.619 | 7.11 | | | | | | | | | | | | .07 |
| 9 | | | 1.473 | 7.12 | | | | | | | 124 | 25 | | | | .71 |
| 10 | 126 | 84 | 1.924 | 7.27 | 9 | 93 | 144 | 6 | 93 | 96 | 15 | | | | | .26 |
| 11 | 104 | 124 | 2.029 | 7.26 | 14 | 87 | 237 | 2 | 98 | 34 | | | | | | .01 |
| 12 | | | 1.883 | 7.04 | | | | | | | | | | | | .21 |
| 13 | | | 1.658 | 7.5 | | | | | | | | | | | | .50 |
| 14 | | | 2.076 | 7.10 | | | | | | | | | | | | .04 |
| 15 | | | 2.179 | 6.94 | | | | | | | 32 | 21.4 | | | | .15 |
| 16 | | | 2.064 | 6.94 | | | | | | | | | | | | .59 |
| 17 | 90 | 126 | 3.020 | 7.14 | 11 | 88 | 277 | 2 | 98 | 50 | 120 | | | | | .17 |
| 18 | 91 | 84 | 2.599 | 6.95 | 7 | 92 | 152 | 6 | 93 | 130 | | | | | | [illegible] |
| 19 | | | 2.120 | 6.85 | | | | | | | | | | | | Ø |
| 20 | | | 1.831 | 7.09 | | | | | | | | | | | | Ø |
| 21 | | | 1.760 | 7.00 | | | | | | | | | | | | Ø |
| 22 | | | 1.793 | 7.06 | | | | | | | 24 | | | | | Ø |
| 23 | | | 1.689 | 6.94 | | | | | | | | 28 | | | | Ø |
| 24 | 132 | 104 | 1.611 | 6.9 | 3 | 98 | 40 | 4 | 96 | 54 | | | | | | Ø |
| 25 | 165 | 286 | 1.646 | 7.3 | 4 | 98 | 55 | 6 | 98 | 82 | | | | | | Ø |
| 26 | | | 1.576 | 7.13 | | | | | | | 150 | | | | | .68 |
| 27 | | | 1.823 | 7.08 | | | | | | | | | | | | .01 |
| 28 | | | 1.608 | 6.72 | | | | | | | | | | | | Ø |
| 29 | | | 1.617 | 7.00 | | | | | | | | | | | | Ø |
| 30 | | | 1.540 | 6.87 | | | | | | | | | | | | |
| 31 | | | 53.[illegible] | 109 | | | | | | | | | | | | |
| Total | | | | | | | | | | | | | | | | |
| | AVG 130 | AVG 140 | AVG 1.770 | AVG 6.62 | AVG 9 | AVG 93 | AVG 148 | AVG 10 | AVG 93 | AVG 130 | GEM 28 | AVG 22 | | | | 3.62 |
| Permit | | | | 6 | 30 | 83 | 1955 | 30 | 81 | 1217 | 200 | | | | | |
| | AVW 167 | AVW 195 | MAX 3.020 | MAX 7.37 | AVW 12 | | AVW 215 | AVW 26 | | AVW 297 | GM7 60 | MAX 28 | | | | |
| Limits | | | | 9 | 45 | | 1217 | 45 | | 1826 | 400 | | | | | |

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law that I have personally examined the information submitted herein; and based on my inquiry of those individuals immediately responsible, I believe the information to be accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and/or imprisonment. (Penalties under statutes 18 & 33 U.S.C. may include fines up to $10,000 and/or maximum imprisonment of five years.)

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month May

Facility Name CAMAS STP | *FINAL LIMITS* | Year 2002

Receiving Water Columbia River | Plant Operator J. Dickinson

Plant Type Activated Sludge System | Population 12500

| | INFLUENT | | | | EFFLUENT | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | RAIN IN. |
| 1 | 138 | 90 | 1.494 | 7.23 | 12 | 91 | 150 | 4 | 96 | 50 | | 31 | | | Ø |
| 2 | 111 | 156 | 1.488 | 7.15 | 6 | 95 | 74 | 15 | 90 | 186 | 12 | | | | .01 |
| 3 | | | 1.500 | 7.05 | | | | | | | | | | | Ø |
| 4 | | | 1.397 | 7.23 | | | | | | | | | | | Ø |
| 5 | | | 1.494 | 7.02 | | | | | | | | | | | .07 |
| 6 | | | 1.679 | 6.94 | | | | | | | 14 | | | | .03 |
| 7 | | | 1.653 | 6.86 | | | | | | | | 25 | | | Ø |
| 8 | 136 | 120 | 1.604 | 7.22 | 3 | 98 | 40 | 5 | 96 | 67 | 42 | | | | Ø |
| 9 | 112 | 66 | 1.582 | 6.63 | 13 | 88 | 172 | 5 | 92 | 66 | | | | | .05 |
| 10 | | | 1.595 | 6.86 | | | | | | | | | | | Ø |
| 11 | | | 1.403 | 6.79 | | | | | | | | | | | Ø |
| 12 | | | 1.412 | 6.92 | | | | | | | | | | | Ø |
| 13 | | | 1.521 | 6.99 | | | | | | | 11 | | | | .07 |
| 14 | | | 1.594 | 6.83 | | | | | | | | | | | Ø |
| 15 | 129 | 142 | 1.511 | 7.01 | 4 | 97 | 50 | 6 | 96 | 76 | 1 | 23 | | | Ø |
| 16 | 122 | 130 | 1.558 | 6.97 | 4 | 97 | 52 | 4 | 97 | 52 | | | | | .24 |
| 17 | | | 1.526 | 6.79 | | | | | | | | | | | Ø |
| 18 | | | 1.461 | 6.92 | | | | | | | | | | | .09 |
| 19 | | | 1.498 | 6.53 | | | | | | | | | | | .11 |
| 20 | | | 1.72 | 6.76 | | | | | | | 22 | | | | .05 |
| 21 | | | 1.672 | 6.65 | | | | | | | | | | | .04 |
| 22 | 148 | 159 | 1.682 | 6.65 | 5 | 97 | 70 | 8 | 95 | 112 | 4 | 18 | | | .07 |
| 23 | 123 | 104 | 1.655 | 6.78 | 5 | 96 | 69 | 9 | 91 | 124 | | | | | Ø |
| 24 | | | 1.569 | 6.79 | | | | | | | | | | | Ø |
| 25 | | | 1.435 | 6.80 | | | | | | | | | | | .03 |
| 26 | | | 1.438 | 6.94 | | | | | | | | | | | .02 |
| 27 | | | 1.368 | 6.79 | | | | | | | | | | | .15 |
| 28 | | | 1.564 | 6.81 | | | | | | | | | | | .37 |
| 29 | 164 | 220 | 1.760 | 6.93 | 9 | 95 | 132 | 8 | 96 | 117 | 4 | | | | .11 |
| 30 | 87 | 142 | 1.513 | 6.50 | 8 | 91 | 101 | 4 | 97 | 50 | 151 | 12 | | | .14 |
| 31 | | | 1.410 | 6.88 | | | | | | | | | | | Ø |
| Total | | | 49.32 | 8 | | | | | | | | | | | |
| | AVG 127 | AVG 133 | AVG 1.542 | MIN 6.50 | AVG 7 | AVG 95 | AVG 91 | AVG 7 | AVG 95 | AVG 90 | GEM 11 | AVG 22 | | | 1.65 |
| Permit | | | | 6 | 30 | 83 | 958 | 30 | 81 | 1217 | 200 | | | | |
| | AVW 136 | AVW 181 | MAX 1.760 | MAX 7.23 | AVW 9 | | AVW 117 | AVW 10 | | AVW 118 | GM7 25 | MAX 31 | | | |
| Limits | | | | 9 | 45 | | 1217 | 45 | | 1325 | 400 | | | | |

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law that I have personally examined the information submitted herein; and based on my inquiry of those individuals immediately responsible, I believe the information to be accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and/or imprisonment. (Penalties under statutes 18 & 33 U.S.C. may include fines up to $10,000 and/or maximum imprisonment of five years.)

**Please Circle ALL Permit Violations** Mail to P.O. Box 47775, Olympia WA 98504-7775

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month JULY

Facility Name CAMAS STP | FINAL LIMITS | Year 2002

Receiving Water Columbia River | Plant Operator JIM DICKINSON

Plant Type Activated Sludge System | Population 12500

| | INFLUENT | | | | EFFLUENT | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | RAIN |
| 1 | | | 1.505 | 6.94 | | | | | | | | | | | Ø |
| 2 | | | 1.508 | 6.88 | | | | | | | 8 | | | | Ø |
| 3 | 157 | 230 | 1.459 | 6.69 | 2 | 99 | 24 | 7 | 97 | 85 | | 1.7 | | | .05 |
| 4 | 149 | 158 | 1.393 | 6.72 | 5 | 97 | 58 | 3 | 98 | 35 | | | | | Ø |
| 5 | | | 1.351 | 6.74 | | | | | | | 1 | | | | Ø |
| 6 | | | 1.301 | 6.50 | | | | | | | | | | | Ø |
| 7 | | | 1.367 | 6.48 | | | | | | | | | | | .16 |
| 8 | | | 1.548 | 6.45 | | | | | | | 90 | | | | .04 |
| 9 | | | 1.545 | 6.67 | | | | | | | | | | | Ø |
| 10 | 140 | 134 | 1.486 | 6.63 | 5 | 96 | 67 | 10 | 93 | 124 | | 4.8 | | | Ø |
| 11 | 145 | 286 | 1.293 | 6.63 | 3 | 98 | 32 | 5 | 98 | 54 | | | | | Ø |
| 12 | | | 1.465 | 6.45 | | | | | | | 5 | | | | Ø |
| 13 | | | 1.407 | 6.46 | | | | | | | | | | | Ø |
| 14 | | | 1.416 | 6.35 | | | | | | | | | | | Ø |
| 15 | | | 1.513 | 6.26 | | | | | | | 10 | 1.8 | | | Ø |
| 16 | | | 1.508 | 7.10 | | | | | | | | | | | Ø |
| 17 | 109 | 118 | 1.450 | 7.31 | 7 | 94 | 85 | 11 | 91 | 133 | | | | | R |
| 18 | 139 | 160 | 1.505 | 7.01 | 3 | 98 | 38 | 1 | 99 | 13 | | | | | Ø |
| 19 | | | 1.512 | 6.83 | | | | | | | 40 | | | | Ø |
| 20 | | | 1.431 | 7.0 | | | | | | | | | | | Ø |
| 21 | | | 1.408 | 6.74 | | | | | | | | | | | Ø |
| 22 | | | 1.459 | 6.82 | | | | | | | 12 | | | | Ø |
| 23 | | | 1.458 | 6.93 | | | | | | | | | | | Ø |
| 24 | 148 | 124 | 1.498 | 6.96 | 3 | 98 | 37 | 3 | 98 | 37 | | 9.6 | | | Ø |
| 25 | 93 | 66 | 1.504 | 6.84 | 8 | 91 | 100 | 9 | 86 | 113 | 4 | | | | Ø |
| 26 | | | 1.537 | 6.88 | | | | | | | | | | | Ø |
| 27 | | | 1.442 | 6.78 | | | | | | | | | | | Ø |
| 28 | | | 1.438 | 6.63 | | | | | | | | | | | Ø |
| 29 | | | 1.492 | 6.97 | | | | | | | | | | | Ø |
| 30 | | | 1.509 | 7.04 | | | | | | | 12 | | | | Ø |
| 31 | 127 | 130 | 1.485 | 7.09 | 7 | 94 | 87 | 2 | 98 | 25 | | | | | Ø |
| Total | | | 45.19 | 3 | | | | | | | | | | | |
| | AVG 134 | AVG 156 | AVG 1.458 | AVG 6.26 | AVG 5 | AVG 96 | AVG 59 | AVG 6 | AVG 95 | AVG 69 | GEM 10 | AVG 4.5 | | | .25 |
| Permit | | | | 6 | 30 | 83 | 1955 | 30 | 81 | 1217 | 200 | | | | |
| | AVW 153 | AVW 210 | MAX 1.548 | MAX 7.31 | AVW 5.5 | | AVW 69 | AVW 7.5 | | AVW 89 | MAX 22 | MAX 9.6 | | | |
| Limits | | | | 9 | 45 | | 1217 | 45 | | 1825 | 400 | | | | |

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law that I have personally examined the information submitted herein; and based on my inquiry of those individuals immediately responsible, I believe the information to be accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and/or imprisonment. (Penalties under statutes 18 & 33 U.S.C. may include fines up to $10,000 and/or maximum imprisonment of five years.)

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

Jim Dickinson - Chief Opr.
Name and Title

Jim Dickinson
Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month August

Facility Name CAMAS STP | FINAL LIMITS | Year 2002

Receiving Water Columbia River | Plant Operator J. Dickinson

Plant Type Activated Sludge System | Population 13500

| | INFLUENT | | | | | | EFFLUENT | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | RAIN |
| 1 | 148 | 162 | 1.482 | 7.16 | 87 | 96 | 74 | 6 | 96 | 74 | | 22.2 | | | Ø |
| 2 | | | 1.422 | 7.25 | | | | | | | | | | | Ø |
| 3 | | | 1.406 | 6.87 | | | | | | | | | | | .02 |
| 4 | | | 1.316 | 7.13 | | | | | | | | | | | Ø |
| 5 | | | 1.426 | 7.13 | | | | | | | 25 | | | | Ø |
| 6 | | | 1.334 | 7.17 | | | | | | | | | | | Ø |
| 7 | 111 | 130 | 1.331 | 7.17 | 2 | 98 | 22 | 2 | 98 | 22 | | | | | Ø |
| 8 | 93 | 106 | 1.376 | 7.18 | 4 | 99 | 46 | 1 | 99 | 11 | | 34.1 | | | Ø |
| 9 | | | 1.276 | 7.14 | | 96 | | | | | 10 | | | | Ø |
| 10 | | | 1.251 | 7.12 | | | | | | | | | | | Ø |
| 11 | | | 1.301 | 7.01 | | | | | | | | | | | Ø |
| 12 | | | 1.409 | 6.92 | | | | | | | 7 | 33.9 | | | Ø |
| 13 | | | 1.457 | 7.07 | | | | | | | | | | | Ø |
| 14 | 126 | 130 | 1.475 | 7.06 | 6 | 95 | 74 | 3 | 98 | 37 | | | | | Ø |
| 15 | 140 | 166 | 1.465 | 6.85 | 5 | 96 | 61 | 3 | 98 | 37 | 30 | | | | Ø |
| 16 | | | 1.486 | 6.98 | | | | | | | | | | | Ø |
| 17 | | | 1.413 | 7.13 | | | | | | | | | | | Ø |
| 18 | | | 1.373 | 7.22 | | | | | | | 152 | | | | Ø |
| 19 | | | 1.482 | 7.13 | | | | | | | 12 | | | | Ø |
| 20 | | | 1.485 | 7.01 | | | | | | | | | | | Ø |
| 21 | 157 | 126 | 1.475 | 7.08 | 9 | 94 | 111 | 8 | 94 | 98 | | | | | Ø |
| 22 | 151 | 154 | 1.457 | 7.14 | 4 | 97 | 49 | 1 | 99 | 12 | | 25.9 | | | Ø |
| 23 | | | 1.445 | 6.86 | | | | | | | | | | | Ø |
| 24 | | | 1.450 | 6.83 | | | | | | | | | | | Ø |
| 25 | | | 1.412 | 7.09 | | | | | | | | | | | Ø |
| 26 | | | 1.525 | 6.96 | | | | | | | 32 | | | | Ø |
| 27 | | | 1.516 | 7.06 | | | | | | | | | | | Ø |
| 28 | 150 | 172 | 1.510 | 6.89 | 7.5 | 95 | 94 | 3 | 98 | 38 | | 27.9 | | | Ø |
| 29 | 121 | 106 | 1.455 | 7.10 | 4 | 97 | 49 | 3 | 97 | 36 | | | | | Ø |
| 30 | | | 1.427 | 6.94 | | | | | | | 26 | | | | Ø |
| 31 | | | 1.379 | 6.88 | | | | | | | | | | | |
| Total | | | 44.016 | | | | | | | | | | | | |
| | AVG 133 | AVG 139 | AVG 1.419 | MIN 6.83 | AVG 5 | AVG 96 | AVG 64 | AVG 3 | AVG 97 | AVG 40.5 | GEM 23 | AVG 28.8 | | | .02 |
| Permit | | | | 6 | 30 | 83 | 1955 | 50 | 81 | 1217 | 200 | | | | |
| | AVW 154 | AVW 148 | MAX 1.525 | MAX 7.25 | AVW 6 | | AVW 80 | AVW 4.5 | | AVW 55 | GM7 43 | MAX 34.1 | | | |
| Limits | | | | 9 | 45 | | 1217 | 45 | | 1826 | 400 | | | | |

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law that I have personally examined the information submitted herein; and based on my inquiry of those individuals immediately responsible, I believe the information to be accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and/or imprisonment. (Penalties under statutes 18 & 33 U.S.C. may include fines up to $10,000 and/or maximum imprisonment of five years.)

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

Name and Title

Signature

| | | | |
|---|---|---|---|
| Permit No. | WA0020249 | | Month September |
| Facility Name | CAMAS STP | FINAL LIMITS | Year 2002 |
| Receiving Water | Columbia River | | Plant Operator J. Dickinson |
| Plant Type | Activated Sludge System | | Population 13500 |

| | INFLUENT | | EFFLUENT | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | RAINFALL |
| 1 | | | 1.295 | 6.85 | | | | | | | | | | | Ø |
| 2 | | | 1.291 | 6.94 | | | | | | | | | | | Ø |
| 3 | | | 1.512 | 6.85 | | | | | | | 104 | | | | Ø |
| 4 | 123 | 120 | 1.362 | 7.00 | 6 | 95 | 66 | 2 | 98 | 2.2 | | 39.9 | | | Ø |
| 5 | 213 | 106 | 1.353 | 6.83 | 3 | 99 | 34 | 4 | 96 | 45 | 86 | | | | Ø |
| 6 | | | 1.392 | 7.04 | | | | | | | | | | | Ø |
| 7 | | | 1.423 | 6.72 | | | | | | | | | | | Ø |
| 8 | | | 1.438 | 6.93 | | | | | | | | | | | Ø |
| 9 | | | 1.492 | 6.88 | | | | | | | 0 | | | | Ø |
| 10 | | | 1.454 | 6.79 | | | | | | | | | | | Ø |
| 11 | 216 | 116 | 1.428 | 6.66 | 2 | 99 | 24 | 1 | 99 | .12 | 5 | | | | Ø |
| 12 | 118 | 160 | 1.463 | 6.78 | 4 | 97 | 49 | 4 | 98 | 49 | | | | | Ø |
| 13 | * | | 1.470 | 6.84 | | | | | | | | 24.7 | | | Ø |
| 14 | | | 1.345 | 6.83 | | | | | | | | | | | Ø |
| 15 | | | 1.365 | 6.88 | | | | | | | | | | | Ø |
| 16 | | | 1.537 | 6.68 | | | | | | | | | | | .29 |
| 17 | | | 1.666 | 6.87 | | | | | | | 38 | | | | .03 |
| 18 | 121 | 102 | 1.541 | 6.89 | 4 | 97 | 51 | 3 | 97 | 39 | | 15.1 | | | Ø |
| 19 | 121 | 142 | 1.410 | 6.81 | 4 | 97 | 47 | 3 | 98 | 3.5 | | | | | Ø |
| 20 | | | 1.493 | 6.64 | | | | | | | 137 | | | | Ø |
| 21 | | | 1.342 | 6.79 | | | | | | | | | | | Ø |
| 22 | | | 1.392 | 6.93 | | | | | | | | | | | Ø |
| 23 | | | 1.475 | 6.88 | | | | | | | 19 | | | | Ø |
| 24 | | | 1.447 | 6.87 | | | | | | | | | | | — |
| 25 | 111 | 100 | 1.443 | 6.72 | 15 | 86 | 181 | 0 | 100 | 0 | | | | | Ø |
| 26 | 156 | 110 | 1.408 | 6.85 | 6 | 96 | 70 | 2 | 98 | 2.3 | 33 | | | | Ø |
| 27 | | | 1.428 | 6.80 | | | | | | | | 26.3 | | | Ø |
| 28 | | | 1.340 | 6.90 | | | | | | | | | | | .05 |
| 29 | | | 1.348 | 6.93 | | | | | | | | | | | .35 |
| 30 | | | 1.662 | 6.99 | | | | | | | | | | | .69 |
| 31 | | | | | | | | | | | | | | | |
| Total | | | 43.015 | | | | | | | | | | | | |
| | AVG 147 | AVG 120 | AVG 1.433 | GEM 6.64 | AVG 5.5 | AVG 96 | AVG 65 | AVG 2 | AVG 98 | AVG 28 | GEM 27 | AVG 26.5 | | | 1.41" |
| Permit | | | | 6.5 | 30 | 85 | 1965 | 30 | 81 | 1217 | 200 | | | | |
| | AVG 168 | AVG 138 | MAX 1.666 | MAX 7.04 | AVG 10.5 | | AVG 125.5 | AVG 3 | | AVG 37 | GEM 93 | MAX 39.9 | | | |
| Limits | | | | 9 | 45 | | 1217 | 45 | | 1825 | 400 | | | | |

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law that I have personally examined the information submitted herein; and based on my inquiry of those individuals immediately responsible, I believe the information to be accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and/or imprisonment. (Penalties under statutes 18 & 33 U.S.C. may include fines up to $10,000 and/or maximum imprisonment of five years.)

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

Name and Title

Signature

| | | | |
|---|---|---|---|
| Permit No. | WA0020249 | | Month October |
| Facility Name | CAMAS STP | FINAL LIMITS | Year 2002 |
| Receiving Water | Columbia River | | Plant Operator Jim Dickinson |
| Plant Type | Activated Sludge System | | Population 13500 |

| | INFLUENT | | | | | | EFFLUENT | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | N-PD |
| 1 | | | 1.881 | 6.91 | | | | | | | 70 | | | | .01 |
| 2 | 158 | 206 | 1.509 | 7.0 | 9 | 94 | 113 | 7 | 97 | 88 | | 37.9 | | | .11 |
| 3 | 110 | 144 | 1.549 | 7.14 | 6 | 95 | 78 | 3 | 98 | 39 | | | | | .75 |
| 4 | | | 2.068 | 6.85 | | 95.50 | | | | | | | | | .02 |
| 5 | | | 1.524 | 7.0 | | | | | | | | | | | .07 |
| 6 | | | 1.560 | 6.95 | | | | | | | | | | | 0 |
| 7 | | | 1.459 | 7.01 | | | | | | | | | | | 0 |
| 8 | | | 1.428 | 6.95 | | | | | | | | | | | 0 |
| 9 | 140 | 112 | 1.386 | 6.88 | 6 | 96 | 69 | 2 | 98 | 23 | 10 | 38.4 | | | 0 |
| 10 | 131 | 104 | 1.375 | 7.04 | 1 | 99 | 11 | 2 | 98 | 23 | | | | | .04 |
| 11 | | | 1.337 | 7.07 | | | | | | | 0 | | | | 0 |
| 12 | | | 1.332 | 6.85 | | | | | | | | | | | 0 |
| 13 | | | 1.323 | 7.11 | | | | | | | | | | | 0 |
| 14 | | | 1.439 | 6.86 | | | | | | | | | | | 0 |
| 15 | | | 1.423 | 6.97 | | | | | | | 142 | | | | 0 |
| 16 | 139 | 110 | 1.366 | 7.14 | 6 | 96 | 68 | 1 | 99 | 11 | | 38.2 | | | 0 |
| 17 | 133 | 134 | 1.358 | 7.01 | 5 | 96 | 57 | 4 | 97 | 45 | | | | | 0 |
| 18 | | | 1.400 | 6.91 | | | | | | | 88 | | | | 0 |
| 19 | | | 1.326 | 6.86 | | | | | | | | | | | 0 |
| 20 | | | 1.289 | 6.86 | | | | | | | | | | | 0 |
| 21 | | | 1.431 | 7.06 | | | | | | | 20 | | | | 0 |
| 22 | | | 1.387 | 6.92 | | | | | | | | | | | 0 |
| 23 | 114 | 102 | 1.291 | 7.07 | 7 | 94 | 81 | 2 | 98 | 23 | | 29 | | | 0 |
| 24 | 174 | 260 | 1.392 | 6.77 | 3 | 98 | 35 | 1 | 99 | 12 | 14 | | | | 0 |
| 25 | | | 1.415 | 6.78 | | | | | | | | | | | 0 |
| 26 | | | 1.312 | 6.84 | | | | | | | | | | | .01 |
| 27 | | | 1.322 | 6.92 | | | | | | | | | | | .05 |
| 28 | | | 1.454 | 6.93 | | | | | | | 68 | | | | .03 |
| 29 | | | 1.545 | 6.80 | | | | | | | | | | | 0 |
| 30 | 110 | 134 | 1.423 | 6.83 | 3 | 97 | 36 | 1 | 99 | 12 | | 39.4 | | | 0 |
| 31 | 99 | 81 | 1.464 | 6.91 | 7 | 93 | 85 | 1 | 99 | 12 | | | | | 0 |
| Total | | | 44.868 | | | | | | | | | | | | |
| | AVW 131 | AVW 139 | AVW 1.447 | GEM 6.80 | AVW 5 | AVW 96 | AVW 63 | AVW 2 | AVW 98 | AVW 29 | GEM 24 | AVW 37 | | | 1.09 |
| Permit | | | | 8 | 30 | 83 | 1956 | 30 | 81 | 1217 | 200 | | | | |
| | AVW 144 | AVW 181 | MAX 2.068 | MAX 7.14 | AVW 7.5 | | AVW 96 | AVW 5 | | AVW 64 | GM 110 | MAX 39.4 | | | |
| Limits | | | | 9 | 45 | | 1217 | 45 | | 1825 | 400 | | | | |

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law that I have personally examined the information submitted herein; and based on my inquiry of those individuals immediately responsible, I believe the information to be accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and/or imprisonment. (Penalties under statutes 18 & 33 U.S.C. may include fines up to $10,000 and/or maximum imprisonment of five years.)

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

Name and Title

Signature

| | | | |
|---|---|---|---|
| Permit No. | WA0020249 | | Month November |
| Facility Name | CAMAS STP | FINAL LIMITS | Year 2002 |
| Receiving Water | Columbia River | | Plant Operator J. Dickinson |
| Plant Type | Activated Sludge System | | Population 13500 |

| | INFLUENT | | | | EFFLUENT | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | J-O/P |
| 1 | | | 1.475 | 6.79 | | | | | | | 186 | | | | Ø |
| 2 | | | 1.375 | 6.90 | | | | | | | | | | | Ø |
| 3 | | | 1.383 | 6.72 | | | | | | | | | | | Ø |
| 4 | | | 1.490 | 6.71 | | | | | | | | | | | Ø |
| 5 | | | 1.465 | 6.91 | | | | | | | 80 | | | | Ø |
| 6 | 105 | 156 | 1.465 | 6.91 | 3 | 97 | 37 | 1 | 99 | 12 | | 40.1 | | | Ø |
| 7 | 124 | 140 | 1.438 | 6.87 | 3 | 98 | 36 | 1 | 99 | 12 | | | | | .42 |
| 8 | | | 1.497 | 6.73 | | | | | | | 206 | | | | .08 |
| 9 | | | 1.407 | 6.83 | | | | | | | | | | | .06 |
| 10 | | | 1.573 | 6.50 | | | | | | | | | | | .02 |
| 11 | | | 1.428 | 6.52 | | | | | | | | | | | .53 |
| 12 | | | 1.519 | 6.70 | | | | | | | 39 | | | | .62 |
| 13 | 170 | 200 | 1.836 | 6.75 | 10 | 94 | 153 | 3 | 99 | 46 | | | | | .42 |
| 14 | 123 | 150 | 1.670 | 6.50 | 9 | 93 | 125 | 2 | 99 | 28 | | 19.5 | | | .01 |
| 15 | | | 1.505 | 6.62 | | | | | | | 144 | | | | Ø |
| 16 | | | 1.350 | 6.77 | | | | | | | | | | | .14 |
| 17 | | | 1.543 | 6.74 | | | | | | | | | | | Ø |
| 18 | | | 1.542 | 6.65 | | | | | | | | | | | .58 |
| 19 | | | 1.91 | 6.58 | | | | | | | 85 | | | | Ø |
| 20 | 104 | 124 | 1.626 | 6.56 | 1 | 99 | 14 | 2 | 98 | 27 | | 19.9 | | | Ø |
| 21 | 141 | 252 | 1.514 | 6.83 | 1 | 99 | 13 | 2 | 99 | 25 | | | | | Ø |
| 22 | | | 1.495 | 6.66 | | | | | | | 1 | | | | .01 |
| 23 | | | 1.396 | 6.50 | | | | | | | | | | | .01 |
| 24 | | | 1.425 | 6.58 | | | | | | | | | | | Ø |
| 25 | | | 1.538 | 6.55 | | | | | | | | | | | Ø |
| 26 | | | 1.513 | 6.50 | | | | | | | 1 | | | | Ø |
| 27 | 127 | 138 | 1.433 | 6.85 | 7 | 94 | 84 | Ø | 100 | Ø | | 16 | | | Ø |
| 28 | 144 | 166 | 1.460 | 6.53 | 4 | 97 | 49 | 2 | 99 | 24 | | | | | Ø |
| 29 | | | 1.423 | 6.68 | | | | | | | 96 | | | | Ø |
| 30 | | | 1.32 | 6.64 | | | | | | | | | | | |
| 31 | | | | | | | | | | | | | | | |
| Total | | | 45.0 | 14 | | | | | | | | | | | |
| | AVG 130 | AVG 166 | AVG 1.50 | GEM 6.50 | AVG 5 | AVG 96 | AVG 64 | AVG 2 | AVG 99 | AVG 22 | AVW 44 | AVG 23.8 | | | 2.90 |
| Permit | | | | 8 | 30 | 83 | 1966 | 30 | 81 | 1217 | 200 | | | | |
| | AVG 136 | AVG 188 | MAX 1.836 | MAX 6.91 | AVG 10 | | AVW 139 | AVW 2.5 | | AVW 37 | GM7 120 | MAX 40.1 | | | |
| Limits | | | | 9 | 45 | | 1217 | 45 | | 1825 | 400 | | | | |

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law that I have personally examined the information submitted herein; and based on my inquiry of those individuals immediately responsible, I believe the information to be accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and/or imprisonment. (Penalties under statutes 18 & 33 U.S.C. may include fines up to $10,000 and/or maximum imprisonment of five years.)

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

Name and Title

Signature

| | | | |
|---|---|---|---|
| Permit No. | WA0020249 | | Month December |
| Facility Name | CAMAS STP | FINAL LIMITS | Year 2002 |
| Receiving Water | Columbia River | | Plant Operator Jim Dickinson |
| Plant Type | Activated Sludge System | | Population 13500 |

| | INFLUENT | | | | EFFLUENT | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | 5-DRP |
| 1 | | | 1.421 | 6.52 | | | | | | | | | | | Ø |
| 2 | | | 1.456 | 6.52 | | | | | | | 46 | | | | Ø |
| 3 | | | 1.484 | 6.62 | | | | | | | | | | | .05 |
| 169 OTT 4 | 269 | 232 | 1.385 | 6.36 | 5 | 97 | 58 | 4 | 98 | 46 | 70 | 17.5 | | | .01 |
| 5 | 79 | 122 | 1.464 | 6.64 | 1 | 99 | 12 | 0 | 100 | 0 | | | | | Ø |
| 6 | | | 1.481 | 6.60 | | | | | | | | | | | Ø |
| 7 | | | 1.347 | 6.51 | | | | | | | | | | | 0 |
| 8 | | | 1.347 | 6.35 | | | | | | | | | | | Ø |
| 9 | | | 1.469 | 6.47 | | | | | | | | 23.3 | | | .42 |
| 10 | | 252 | 1.576 | 6.39 | | | | 2 | 99 | 26 | 30 | | | | .39 |
| 11 | 133 | 118 | 1.660 | 6.50 | 10 | 92 | 138 | 7 | 94 | 96 | 10 | | | | .47 |
| 12 | 90 | 74 | 2.043 | 6.60 | 5 | 94 | 85 | 2 | 97 | 34 | | | | | 1.03 |
| 13 | | | 2.626 | 6.67 | | | | | | | | | | | .62 |
| 14 | | | 2.428 | 6.38 | | | | | | | | | | | .12 |
| 15 | | | 2.294 | 6.10 | | | | | | | | | | | 1.14 |
| 16 | | | 2.947 | 6.63 | | | | | | | 224 | | | | .32 |
| 17 | | | 3.701 | 6.23 | | | | | | | | | | | .24 |
| 18 | 86 | 52 | 2.689 | 6.60 | 4 | 96 | 90 | 2 | 96 | 45 | | | | | .14 |
| 19 | 92 | 112 | 2.188 | 6.45 | 12 | 87 | 219 | 6 | 95 | 109 | 8 | 13.5 | | | Ø |
| 20 | | | 1.984 | 6.31 | | | | | | | | | | | .33 |
| 21 | | | 1.954 | 6.41 | | | | | | | | | | | .14 |
| 22 | | | 1.979 | 6.27 | | | | | | | | | | | .23 |
| 23 | | | 1.915 | 6.40 | | | | | | | | | | | .02 |
| 24 | | | 1.737 | 6.65 | | | | | | | 55 | | | | .08 |
| 25 | 130 | 106 | 1.720 | 6.74 | 5 | 96 | 72 | 5 | 95 | 72 | | | | | .37 |
| 26 | 138 | 122 | 1.745 | 6.73 | 11 | 92 | 160 | 1 | 99 | 15 | | 29.9 | | | .69 |
| 27 | | | 2.430 | 6.72 | | | | | | | 0 | | | | .12 |
| 28 | | | 2.444 | 6.70 | | | | | | | | | | | .42 |
| 29 | | | 2.562 | 6.36 | | | | | | | | | | | .59 |
| 30 | | | 2.611 | 6.75 | | | | | | | | | | | 1.24 |
| 31 | | | 4.462 | 6.25 | | | | | | | | | | | .12 |
| Total | | | 62.69 | 2 | | | | | | | | | | | |
| | AVG 115 | AVG 132 | AVG 2.065 | MIN 6.1 | AVG 7 | AVG 94 | AVG 104 | AVG 3 | AVG 97 | AVG 49 | GEM 23 | AVG 21 | | | 9.30 |
| Permit | | | | 6.5 | 30 | 85 | 1955 | 30 | 85 | 1217 | 200 | | | | |
| | AVG 134 | AVG 148 | MAX 4.462 | MAX 6.75 | AVG 8 | | AVG 155 | AVG 4 | | AVG 77 | GM7 40 | MAX 29.9 | | | |
| Limits | | | | 9 | 45 | | 1217 | 45 | | 1825 | 400 | | | | |

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law that I have personally examined the information submitted herein; and based on my inquiry of those individuals immediately responsible, I believe the information to be accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and/or imprisonment. (Penalties under statutes 18 & 33 U.S.C. may include fines up to $10,000 and/or maximum imprisonment of five years.)

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

Name and Title

Signature

| | | | |
|---|---|---|---|
| Permit No. | WA0020249 | | Month January |
| Facility Name | CAMAS STP | FINAL LIMITS | Year 2003 |
| Receiving Water | Columbia River | | Plant Operator Jim Dickinson |
| Plant Type | Activated Sludge System | | Population 13500 |

| | INFLUENT | | | | EFFLUENT | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | N-DR |
| 1 | 86 | 108 | 3.361 | 6.21 | 8 | 91 | 224 | 1 | 99 | 28 | | | | | .06 |
| 2 | 69 | 86 | 2.603 | 6.21 | 6 | 91 | 130 | 1 | 99 | 22 | 2 | ⊖ | | | .64 |
| 3 | | | 3.379 | 6.28 | | | | | | | | | | | .48 |
| 4 | | | 3.016 | 6.38 | | | | | | | | | | | .21 |
| 5 | | | 3.367 | 6.32 | | | | | | | | | | | ⊖ |
| 6 | | | 2.555 | 6.54 | | | | | | | 80 | | | | ⊖ |
| 7 | | | 2.158 | 6.58 | | | | | | | | 25.5 | | | ⊖ |
| 8 | 100 | 132 | 1.979 | 6.60 | 3 | 97 | 50 | 4 | 97 | 66 | | | | | ⊖ |
| 9 | 70 | 58 | 1.889 | 6.50 | 6 | 91 | 95 | 4 | 93 | 63 | | | | | ⊖ |
| 10 | | | 1.795 | 6.76 | | | | | | | 0 | | | | ⊖ |
| 11 | | | 1.670 | 6.56 | | | | | | | | | | | .60 |
| 12 | | | 2.004 | 6.61 | | | | | | | | | | | .28 |
| 13 | | | 2.454 | 6.52 | | | | | | | 1 | | | | .41 |
| 14 | | | 2.521 | 6.46 | | | | | | | | | | | / |
| 15 | 115 | 120 | 2.310 | 6.87 | 6 | 95 | 116 | 1 | 99 | 19 | | 20.3 | | | ⊖ |
| 16 | 101 | 100 | 1.996 | 6.63 | 7 | 93 | 117 | 1 | 99 | 17 | | | | | ⊖ |
| 17 | | | 1.885 | 6.82 | | | | | | | 8 | | | | ⊖ |
| 18 | | | 1.736 | 6.70 | | | | | | | | | | | ⊖ |
| 19 | | | 1.670 | 6.59 | | | | | | | | | | | ⊖ |
| 20 | | | 1.701 | 6.61 | | | | | | | | | | | ⊖ |
| 21 | | | 1.800 | 6.60 | | | | | | | 4 | | | | .35 |
| 22 | 96 | 114 | 1.756 | 6.81 | 3 | 97 | 44 | 3 | 97 | 44 | | 35.9 | | | .33 |
| 23 | 107 | 188 | 2.211 | 7.21 | 4 | 96 | 74 | 2 | 98 | 37 | | | | | .28 |
| 24 | | | 2.038 | 6.44 | | | | | | | 0 | | | | .22 |
| 25 | | | 2.179 | 6.74 | | | | | | | | | | | .59 |
| 26 | | | 2.786 | 6.40 | | | | | | | | | | | .15 |
| 27 | | | 3.147 | 6.28 | | | | | | | <1 | | | | .20 |
| 28 | | | 2.50 | 6.33 | | | | | | | | | | | .05 |
| 29 | 124 | 96 | 2.179 | 6.90 | 12 | 90 | 218 | 3 | 97 | 55 | | 28.7 | | | 1.35 |
| 30 | 78 | 76 | 3.926 | 6.72 | 13 | 83 | 426 | 3 | 98 | 98 | 7 | | | | 1.40 |
| 31 | | | 4.779 | 6.41 | | | | | | | | | | | 1.23 |
| Total | | | 75.35 | | | | | | | | | | | | |
| | AVG 95 | AVG 108 | AVG 2.43 | GEM 6.21 | AVG 7 | AVG 92 | AVG 149 | AVG 2.3 | AVG 97 | AVG 45 | GEM 3.2 | AVG 22.1 | | | 8.83 |
| Permit | | | | 6 | 30 | 83 | 955 | 30 | 81 | 1217 | 200 | | | | |
| | AVW 108 | AVW 151 | MAX 4.779 | MAX 7.21 | AVW 12.5 | | AVW 322 | AVW 4 | | AVW 76 | GM7 12 | MAX 35.9 | | | |
| Limits | | | | 9 | 45 | | 1217 | 45 | | 1825 | 400 | | | | |

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law that I have personally examined the information submitted herein; and based on my inquiry of those individuals immediately responsible, I believe the information to be accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and/or imprisonment. (Penalties under statutes 18 & 33 U.S.C. may include fines up to $10,000 and/or maximum imprisonment of five years.)

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

| | | | |
|---|---|---|---|
| Permit No. | WA0020249 | | Month February |
| Facility Name | CAMAS STP | FINAL LIMITS | Year 2003 |
| Receiving Water | Columbia River | | Plant Operator J. Dickinson |
| Plant Type | Activated Sludge System | | Population 13500 |

| | INFLUENT | | | | | | | EFFLUENT | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | | |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | RAIN | | | |
| 1 | | | 5.632 | 6.27 | | | | | | | | | .06 | | | |
| 2 | | | 3.871 | 6.46 | | | | | | | | | .08 | | | |
| 3 | | | 2.832 | 6.62 | | | | | | | | | .03 | | | |
| 4 | | | 2.399 | 7.07 | | | | | | | 2 | | Ø | | | |
| 5 | 52 | 100 | 2.11 | 6.81 | 11 | 79 | 194 | 2 | 98 | 35 | | 22.2 | Ø | | | |
| 6 | 83 | 64 | 1.906 | 6.95 | 11 | 87 | 175 | 0 | 100 | 0 | | | Ø | | | |
| 7 | | | 1.765 | 6.56 | | | | | | | 10 | | Ø | | | |
| 8 | | | 1.658 | 6.61 | | | | | | | | | Ø | | | |
| 9 | | | 1.742 | 6.59 | | | | | | | | | .04 | | | |
| 10 | | | 1.833 | 7.04 | | | | | | | | | Ø | | | |
| 11 | | | 1.712 | 6.66 | | | | | | | 4 | | Ø | | | |
| 12 | 159 | 172 | 1.682 | 7.22 | 19 | 88 | 267 | 5 | 97 | 70 | | | Ø | | | |
| 13 | 95 | 86 | 1.615 | 7.02 | 5 | 95 | 67 | 2 | 98 | 27 | | 36.4 | Ø | | | |
| 14 | | | 1.656 | 6.68 | | | | | | | 3 | | .01 | | | |
| 15 | | | 1.515 | 6.80 | | | | | | | | | .44 | | | |
| 16 | | | 1.837 | 6.74 | | | | | | | | | .50 | | | |
| 17 | | | 1.972 | 6.83 | | | | | | | | | 1.13 | | | |
| 18 | | | 3.496 | 6.34 | | | | | | | 3 | | .13 | | | |
| 19 | 29 | 56 | 2.897 | 6.44 | 7 | 76 | 48 | 1 | 98 | 24 | | 16.9 | .17 | | | |
| 20 | 195 | 68 | 2.481 | 6.55 | 16 | 92 | 331 | 1 | 98 | 21 | | | .06 | | | |
| 21 | | | 2.291 | 6.54 | | | | | | | 1 | | .04 | | | |
| 22 | | | 2.080 | 6.62 | | | | | | | | | .02 | | | |
| 23 | | | 2.009 | 6.29 | | | | | | | | | Ø | | | |
| 24 | | | 2.020 | 6.80 | | | | | | | | | Ø | | | |
| 25 | | | 1.868 | 6.74 | | | | | | | 2 | | Ø | | | |
| 26 | 89 | 108 | 1.824 | 6.81 | 19 | 79 | 289 | 13 | 88 | 198 | | 26.6 | Ø | | | |
| 27 | 105 | 122 | 1.728 | 6.70 | 9 | 91 | 130 | 11 | 91 | 159 | | | Ø | | | |
| 28 | | | 1.738 | 6.77 | | | | | | | 190 | | .04 | | | |
| 29 | | | | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | | | | |
| 31 | | | | | | | | | | | | | | | | |
| Total | | | 62.17 | | | | | | | | | | | | | |
| | AVG 101 | AVG 97 | AVW 2.219 | MIN 6.27 | AVG 12 | AVG 86 | AVG 188 | AVG 4 | AVG 96 | AVG 67 | GEM 4.7 | AVG 25.5 | 2.75" | | | |
| Permit | | | | 6.5 | 30 | 85 | 955 | 30 | 85 | 1217 | 200 | | | | | |
| | AVG 127 | AVG 129 | MAX 5.632 | MAX 7.22 | AVW 14 | | AVW 210 | AVW 12 | | AVW 179 | MAX 20 | MAX 364 | | | | |
| Limits | | | | 9 | 45 | | 1217 | 45 | | 1825 | 400 | | | | | |

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law that I have personally examined the information submitted herein; and based on my inquiry of those individuals immediately responsible, I believe the information to be accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and/or imprisonment. (Penalties under statutes 18 & 33 U.S.C. may include fines up to $10,000 and/or maximum imprisonment of five years.)

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

Name and Title

Signature

| | | | |
|---|---|---|---|
| Permit No. | WA0020249 | | Month March |
| Facility Name | CAMAS STP | FINAL LIMITS | Year 2003 |
| Receiving Water | Columbia River | | Plant Operator J. Dickinson |
| Plant Type | Activated Sludge System | | Population 13500 |

| | INFLUENT | | | | | | EFFLUENT | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | X - ARD |
| 1 | | | 1.629 | 6.86 | | | | | | | | | | | ⊖ |
| 2 | | | 1.572 | 6.73 | | | | | | | | | | | .22 |
| 3 | | | 1.859 | 6.83 | | | | | | | | | | | ⊖ |
| 4 | | | 1.735 | 6.78 | | | | | | | | | | | .11 |
| 5 | 126 | 110 | 1.711 | 7.02 | 9 | 93 | 128 | 3 | 97 | 43 | 23 | 32.5 | | | .48 |
| 6 | 104 | 76 | 2.090 | 7.0 | 11 | 89 | 192 | 1 | 99 | 17 | 5 | | | | 1.18 |
| 7 | | | 2.891 | 6.67 | | | | | | | | | | | .60 |
| 8 | | | 4.154 | 6.42 | | | | | | | | | | | .49 |
| 9 | | | 3.735 | 6.57 | | | | | | | | | | | .05 |
| 10 | | | 3.474 | 6.56 | | | | | | | 4 | | | | ⊖ |
| 11 | | | 2.512 | 6.67 | | | | | | | | | | | .07 |
| 12 | 77 | 64 | 2.248 | 7.09 | 9 | 88 | 169 | 5 | 92 | 94 | | 16.6 | | | .65 |
| 13 | 174 | 78 | 2.946 | 6.75 | 12 | 84 | 295 | 2 | 97 | 49 | | | | | .22 |
| 14 | | | 2.745 | 6.39 | | | | | | | 3 | | | | .15 |
| 15 | | | 2.418 | 6.66 | | | | | | | | | | | .23 |
| 16 | | | 2.720 | 6.53 | | | | | | | | | | | .24 |
| 17 | | | 2.755 | 6.49 | | | | | | | | | | | ⊖ |
| 18 | | | 2.307 | 6.61 | | | | | | | <1 | | | | .11 |
| 19 | 134 | 164 | 2.259 | 6.77 | 6 | 98 | 113 | 1 | 99 | 19 | | 26.9 | | | [illegible] |
| 20 | 86 | 140 | 2.385 | 6.77 | 6 | 93 | 119 | 2 | 99 | 40 | | | | | .61 |
| 21 | | | 2.252 | 6.78 | | | | | | | | | | | .68 |
| 22 | | | 3.139 | 6.53 | | | | | | | 23 | | | | .23 |
| 23 | | | 3.230 | 6.24 | | | | | | | | | | | .09 |
| 24 | | | 2.808 | 6.55 | | | | | | | | | | | .07 |
| 25 | | | 2.384 | 6.82 | | | | | | | | | | | .50 |
| 26 | 112 | 170 | 2.371 | 6.90 | 8 | 93 | 158 | 7 | 96 | 138 | 27 | 23.5 | | | .07 |
| 27 | 80 | 44 | 2.707 | 6.83 | 7 | 91 | 158 | 1 | 98 | 23 | | | | | .01 |
| 28 | | | 2.291 | 6.65 | | | | | | | | | | | ⊖ |
| 29 | | | 1.995 | 6.92 | | | | | | | 4 | | | | ⊖ |
| 30 | | | 1.886 | 6.48 | | | | | | | | | | | .33 |
| 31 | | | 1.964 | 6.62 | | | | | | | | | | | .18 |
| Total | | | 77.14 | | | | | | | | | | | | |
| | AVW 99 | AVW 106 | AVG 2.488 | AVW 6.24 | AVG 8.5 | AVG 91 | AVG 166.5 | AVG 3 | AVG 97 | AVG 53 | GEM 7 | AVG 24.8 | | | 7.49 |
| Permit | | | | 6 | 30 | 85 | 1956 | 30 | 81 | 1217 | 200 | | | | |
| | AVW 115 | AVW 152 | MAX 4.154 | MAX 7.09 | AVW 10.5 | | AVW 232 | AVW 3.5 | | AVW 81 | GM7 23 | MAX 32.5 | | | |
| Limits | | | | 9 | 45 | | 1217 | 45 | | 1825 | 400 | | | | |

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law that I have personally examined the information submitted herein; and based on my inquiry of those individuals immediately responsible, I believe the information to be accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and/or imprisonment. (Penalties under statutes 18 & 33 U.S.C. may include fines up to $10,000 and/or maximum imprisonment of five years.)

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

| | | | |
|---|---|---|---|
| Permit No. | WA0020249 | | Month APRIL |
| Facility Name | CAMAS STP | *FINAL LIMITS* | Year 2003 |
| Receiving Water | Columbia River | | Plant Operator J. DICKINSON |
| Plant Type | Activated Sludge System | | Population 13500 |

| | INFLUENT | | | | EFFLUENT | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | N-APR |
| 1 | | 88 | 2.399 | 6.7 | | | | 2 | 98 | 40 | 20 | | | | .22 |
| 2 | 79 | | 2.156 | 6.68 | 13 | 84 | 167 | | | | | | | | .04 |
| 3 | 110 | 90 | 2.043 | 7.01 | 12 | 89 | 216 | 6 | 93 | 107 | 10 | | | | .05 |
| 4 | | | 1.821 | 6.82 | | | | | | | | 35.4 | | | .05 |
| 5 | | | 1.974 | 6.85 | | | | | | | | | | | .26 |
| 6 | | | 1.965 | 6.62 | | | | | | | | | | | .11 |
| 7 | | | 2.105 | 6.51 | | | | | | | | | | | .08 |
| 8 | | | 1.931 | 6.74 | | | | | | | | 31.4 | | | .18 |
| 9 | 117 | 74 | 1.915 | 7.19 | 10 | 91 | 161 | 1 | 97 | 16 | 88 | | | | .12 |
| 10 | 162 | 158 | 2.072 | 6.82 | 14 | 91 | 224 | 1 | 99 | 16 | 18 | | | | .18 |
| 11 | | | 1.879 | 6.71 | | | | | | | | | | | .13 |
| 12 | | | 2.391 | 6.69 | | | | | | | | | | | .56 |
| 13 | | JD | 2.633 | 6.65 | | | | | | | | | | | .03 |
| 14 | | 2.277 | ~~2.059~~ | 6.45 | | | | | | | | | | | .03 |
| 15 | | | 2.039 | 6.93 | | | | | | | 5 | 28.9 | | | .03 |
| 16 | 217 | 100 | 2.084 | 7.06 | 33 | 85 | 561 | 4 | 96 | 68 | | | | | .46 |
| 17 | 181 | 102 | 2.298 | 6.57 | 30 | 83 | 521 | 3 | 97 | 52 | | | | | .28 |
| 18 | | | 2.014 | 6.64 | | | | | | | 0 | | | | ~~0~~ |
| 19 | | | 1.889 | 6.81 | | | | | | | | | | | ∅ |
| 20 | | | 1.929 | 6.80 | | | | | | | | | | | .13 |
| 21 | | | 1.944 | 6.78 | | | JD | | | | | | | | .02 |
| 22 | | | 1.787 | 6.73 | 6↓ | 94↓ | 92↓ | | | | 0 | 33.6 | | | .09 |
| 23 | 101 | 118 | 2.360 | 6.94 | 18 | ~~88~~ | ~~199~~ | 1 | 99 | 15 | | | | | .50 |
| 24 | 147 | 322 | 2.337 | 6.94 | 6 | 96 | 117 | 2 | 99 | 39 | 1.6 | | | | .08 |
| 25 | | | 2.053 | 6.95 | | | | | | | | | | | .15 |
| 26 | | | 1.995 | 6.86 | | | | | | | | | | | .03 |
| 27 | | | 1.882 | 6.84 | | | | | | | | | | | .01 |
| 28 | | | 1.903 | 6.68 | | | | | | | | | | | .14 |
| 29 | | | 1.736 | 6.68 | | | | | | | 20 | 33.2 | | | .07 |
| 30 | 101 | 103 | 1.746 | 6.91 | 6 | 94 | 87 | 6 | 94 | 87 | | | | | .01 |
| 31 | | | | | | | | | | | | | | | |
| Total | | | 61.557 | | | | | | | | | | | | 4.04 |
| | AVG 110 | AVG 128 | AVG 2.052 | AVG 6.45 | AVG 15 | AVG 90 | AVG 238 | AVG 3 | AVG 97 | AVG 49 | GEM 10 | AVG 32.5 | | | |
| Permit | | | | 6.5 | 30 | 85 | 1955 | 30 | 85 | 1217 | 200 | | | | |
| | AVW 199 | AVW 220 | MAX 2.633 | MIN 7.19 | AVW 31.5 | | AVW 541 | AVW 3.5 | | AVW 74 | GM7 28 | MAX 35.4 | | | |
| Limits | | | | 9 | 45 | | 1217 | 45 | | 1825 | 400 | | | | |

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law that I have personally examined the information submitted herein; and based on my inquiry of those individuals immediately responsible, I believe the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and/or imprisonment. (Penalties under statutes 18 & 33 U.S.C. may include fines up to $10,000 and/or maximum imprisonment of five years.)

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month May

Facility Name CAMAS STP | FINAL LIMITS | Year 2003

Receiving Water Columbia River | Plant Operator J. Dickinson

Plant Type Activated Sludge System | Population 13500

| | INFLUENT | | | | EFFLUENT | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | Cl-2 R |
| 1 | 153 | 184 | 1.653 | 7.12 | 13 | 92 | 189 | 5 | 97 | 73 | 5 | | | | Ø |
| 2 | | | 1.622 | 7.06 | | | | | | | | | | | Ø |
| 3 | | | 1.699 | 6.81 | | | | | | | | | | | .23 |
| 4 | | | 1.853 | 6.68 | | | | | | | | | | | .23 |
| 5 | | | 1.746 | 7.00 | | | | | | | | | | | .08 |
| 6 | | | 1.616 | 6.81 | | | | | | | 5 | | | | .01 |
| 7 | 169 | 142 | 1.689 | 7.16 | 12 | 93 | 162 | 3 | 98 | 40 | | | | | .15 |
| 8 | 139 | 188 | 1.586 | 6.98 | 3 | 98 | 42 | 1 | 99 | 14 | 11 | | | | Ø |
| 9 | | | 1.529 | 6.84 | | | | | | | | 35.4 | | | Ø |
| 10 | | | 1.591 | 6.83 | | | | | | | | | | | Ø |
| 11 | | | 1.632 | 6.87 | | | | | | | | | | | .10 |
| 12 | | | 1.668 | 6.69 | | | | | | | | | | | .01 |
| 13 | | | 1.548 | 6.72 | | | | | | | 0 | | | | Ø |
| 14 | 104 | 108 | 1.611 | 7.10 | 4 | 96 | 52 | 5 | 95 | 65 | | 34.1 | | | Ø |
| 15 | 213 | 184 | 1.692 | 6.93 | 13 | 94 | 175 | 3 | 98 | 40 | 0 | | | | .15 |
| 16 | | | 1.892 | 6.73 | | | | | | | | | | | .61 |
| 17 | | | 1.838 | 6.77 | | | | | | | | | | | .34 |
| 18 | | | 1.788 | 6.67 | | | | | | | | | | | Ø |
| 19 | | | 1.775 | 6.99 | | | | | | | | | | | Ø |
| 20 | | | 1.616 | 6.91 | | | | | | | | 34.3 | | | Ø |
| 21 | 94 | 96 | 1.597 | 7.00 | 6 | 94 | 81 | 3 | 97 | 40 | 10 | | | | Ø |
| 22 | 174 | 141 | 1.564 | 7.35 | 18 | 90 | 240 | 5 | 96 | 67 | 47 | | | | Ø |
| 23 | | | 1.510 | 6.79 | | | | | | | | | | | Ø |
| 24 | | | 1.524 | 6.51 | | | | | | | | | | | .10 |
| 25 | | | 1.432 | 6.67 | | | | | | | | | | | .01 |
| 26 | | | 1.616 | 6.58 | | | | | | | | | | | Ø |
| 27 | | | 1.512 | 6.71 | | | | | | | | | | | Ø |
| 28 | 152 | 126 | 1.612 | 6.99 | 5 | 97 | 63 | 2 | 98 | 25 | 7 | 39.9 | | | Ø |
| 29 | 164 | 202 | 1.429 | 6.80 | 10 | 94 | 134 | 2 | 99 | 27 | 35 | | | | Ø |
| 30 | | | 1.410 | 6.70 | | | | | | | | | | | Ø |
| 31 | | | 1.477 | 6.71 | | | | | | | | | | | Ø |
| Total | | | 51.889 | | | | | | | | | | | | 2.0 |
| | AVW 151 | AVW 152 | AVW 1.67 | AVW 6.51 | AVW 9.33 | AVW 94 | AVW 126 | AVW 3 | AVW 97 | AVW 43 | AVW 11 | AVW 36 | | | |
| Permit | [illegible] | [illegible] | [illegible] | 8 | 30 | 85 | 1955 | 30 | 85 | 1217 | 200 | [illegible] | [illegible] | [illegible] | [illegible] |
| | AVW 159 | AVW 165 | MAX 1.892 | MIN 7.35 | AVW 12 | | AVW 161 | AVW 4 | | AVW 54 | MAX 20 | MAX 39.9 | | | |
| Limits | [illegible] | [illegible] | [illegible] | 9 | 45 | [illegible] | 1217 | 45 | [illegible] | 1825 | 400 | [illegible] | [illegible] | [illegible] | [illegible] |

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law that I have personally examined the information submitted herein; and based on my inquiry of those individuals immediately responsible, I believe the information is to be accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and/or imprisonment. (Penalties under statutes 18 & 33 U.S.C. may include fines up to $10,000 and/or maximum imprisonment of five years.)

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month June

Facility Name CAMAS STP | FINAL LIMITS | Year 2003

Receiving Water Columbia River | Plant Operator J. Dickinson

Plant Type Activated Sludge System | Population 13500

| | INFLUENT | | | | | | EFFLUENT | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | J-QR |
| 1 | | | 1.571 | 6.42 | | | | | | | | | | | Ø |
| 2 | | | 1.504 | 6.54 | | | | | | | | | | | Ø |
| 3 | | | 1.513 | 6.54 | | | | | | | | 20.6 | | | Ø |
| 4 | 226 | 213 | 1.507 | 6.75 | 7 | 97 | 88 | 2 | 99 | 25 | 3 | | | | Ø |
| 5 | 165 | 172 | 1.498 | 6.84 | 10 | 94 | 126 | 2 | 99 | 25 | | | | | Ø |
| 6 | | | 1.447 | 6.54 | | | | | | | 13 | | | | Ø |
| 7 | | | 1.424 | 6.57 | | | | | | | | | | | Ø |
| 8 | | | 1.559 | 6.79 | | | | | | | | | | | Ø |
| 9 | | | 1.561 | 6.62 | | | | | | | | | | | Ø |
| 10 | | | 1.612 | 6.59 | | | | | | | | 7.8 | | | Ø |
| 11 | 197 | 180 | 1.520 | 7.01 | 16 | 92 | 215 | 1 | 99 | 13 | 30 | | | | Ø |
| 12 | 119 | 118 | 1.511 | 7.05 | 3 | 97 | 38 | 1 | 99 | 13 | | | | | .11 |
| 13 | * | | 1.573 | 6.65 | | | | | | | 7 | | | | .06 |
| 14 | | | 1.433 | 6.32 | | | | | | | | | | | Ø |
| 15 | | | 1.568 | 6.46 | | | | | | | | | | | Ø |
| 16 | | | 1.519 | 6.72 | | | | | | | | 5.6 | | | Ø |
| 17 | | | 1.533 | 7.08 | | | | | | | | | | | Ø |
| 18 | 148 | 276 | 1.576 | 7.04 | 2 | 99 | 26 | 4 | 99 | 51 | 0 | | | | Ø |
| 19 | 177 | 290 | 1.551 | 7.28 | 3 | 98 | 39 | 3 | 99 | 39 | | | | | Ø |
| 20 | | | 1.521 | 6.75 | | | | | | | | | | | .18 |
| 21 | | | 1.485 | 6.63 | | | | | | | 0 | | | | .17 |
| 22 | | | 1.596 | 6.43 | | | | | | | | | | | Ø |
| 23 | | | 1.562 | 6.92 | | | | | | | | | | | Ø |
| 24 | | | 1.495 | 6.66 | | | | | | | | | | | Ø |
| 25 | 120 | 142 | 1.445 | 6.88 | 4 | 97 | 50 | 3 | 98 | 37 | 5 | 10.6 | | | Ø |
| 26 | 131 | 126 | 1.5 | 7.21 | 7 | 95 | 95 | 6 | 95 | 72 | 26 | | | | Ø |
| 27 | | | 1.5 | 6.72 | | | | | | | | | | | Ø |
| 28 | | | 1.5 | 6.74 | | | | | | | | | | | Ø |
| 29 | | | 1.5 | 6.67 | | | | | | | | | | | Ø |
| 30 | | | 1.5 | 6.77 | | | | | | | | | | | Ø |
| 31 | | | | | | | | | | | | | | | |
| Total | | | 45.565 | | | | | | | | | | | | |
| | AVG 160 | AVG 190 | AVG 1.520 | AVG 6.32 | AVG 6.5 | AVG 96 | AVG 85 | AVG 3 | AVG 98 | AVG 34 | AVG 6 | AVG 11.15 | | | .52 |
| Permit | | | | 8.5 | 30 | 83 | 1955 | 30 | 131 | 1217 | 200 | | | | |
| | AVW 196 | AVW 283 | AVW 1.612 | AVW 7.21 | AVW 9.5 | | AVW 126.5 | AVW 4.5 | | AVW 54.5 | AVW 13 | AVW 20.6 | | | |
| Limits | | | | 9.2 | 45 | | 1217 | 45 | | 1826 | 400 | | | | |

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law that I have personally examined the information submitted herein; and based on my inquiry of those individuals immediately responsible, I believe the information to be accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and/or imprisonment. (Penalties under statutes 18 & 33 U.S.C. may include fines up to $10,000 and/or maximum imprisonment of five years.)

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month July
Facility Name CAMAS STP | FINAL LIMITS | Year 2003
Receiving Water Columbia River | Plant Operator J. Dickinson
Plant Type Activated Sludge System | Population 14200

| | INFLUENT | | | | EFFLUENT | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | J-QR |
| 1 | | | 1.5 est | 6.77 | | | | | | | | 12.6 | | | Ø |
| 2 | 191 | 80 | 1.423 | 6.98 | 5 | 97 | 63 | 8 | 90 | 100 | 5 | | | | Ø |
| 3 | 123 | 144 | 1.374 | 6.94 | 4 | 97 | 47 | 2 | 99 | 24 | 30 | | | | Ø |
| 4 | | | 1.368 | 6.78 | | | | | | | | | | | Ø |
| 5 | | | 1.424 | 6.85 | | | | | | | | | | | Ø |
| 6 | | | 1.509 | 6.76 | | | | | | | | | | | Ø |
| 7 | | | 1.521 | 6.73 | | | | | | | 32 | | | | Ø |
| 8 | | | 1.512 | 6.77 | | | | | | | | | | | Ø |
| 9 | 93 | 106 | 1.529 | 6.90 | 10 | 89 | 126 | 6 | 94 | 76 | | 21.9 | | | Ø |
| 10 | 112 | 108 | 1.476 | 7.07 | 4 | 96 | 51 | 2 | 98 | 26 | 18 | | | | Ø |
| 11 | | | 1.477 | 6.70 | | | | | | | | | | | Ø |
| 12 | | | 1.432 | 6.68 | | | | | | | | | | | Ø |
| 13 | | | 1.529 | 6.34 | | | | | | | | | | | Ø |
| 14 | | | 1.55 | 6.73 | | | | | | | | | | | Ø |
| 15 | | | 1.567 | 6.76 | | | | | | | 4 | | | | Ø |
| 16 | 133 | 240 | 1.494 | 6.81 | 9 | 93 | 118 | 9 | 96 | 118 | | 23.3 | | | Ø |
| 17 | 215 | 258 | 1.498 | 7.00 | 6 | 97 | 75 | 4 | 98 | 50 | | | | | Ø |
| 18 | | | 1.40 | 6.72 | | | | | | | 13 | | | | Ø |
| 19 | | | 1.360 | 6.63 | | | | | | | | | | | Ø |
| 20 | | | 1.463 | 6.44 | | | | | | | | | | | Ø |
| 21 | | | 1.488 | 6.70 | | | | | | | | | | | Ø |
| 22 | | | 1.519 | 6.63 | | | | | | | 5 | | | | Ø |
| 23 | 130 | 170 | 1.558 | 6.85 | 7 | 95 | 89 | 2 | 99 | 25 | | 22.3 | | | Ø |
| 24 | 143 | 188 | 1.465 | 6.83 | 4 | 97 | 52 | 4 | 98 | 52 | 30 | | | | Ø |
| 25 | | | 1.458 | 6.56 | | | | | | | | | | | Ø |
| 26 | | | 1.468 | 6.66 | | | | | | | | | | | Ø |
| 27 | | | 1.533 | 6.82 | | | | | | | | | | | Ø |
| 28 | | | 1.561 | 6.78 | | | | | | | 2 | | | | Ø |
| 29 | | | 1.526 | 6.62 | | | | | | | | | | | Ø |
| 30 | 194 | 284 | 1.518 | 6.65 | 2 | 99 | 25 | 2 | 99 | 25 | | | | | Ø |
| 31 | 119 | 112 | 1.496 | 6.93 | 16 | 87 | 203 | 4 | 96 | 51 | 2 | | | | Ø |
| Total | | | 44.572 | | | | | | | | | | | | |
| | AVG 145 | AVG 169 | AVG 1.483 | AVG 6.34 | AVG 7 | AVG 95 | AVG 85 | AVG 4.3 | AVG 97 | AVG 55 | AVG 8.5 | AVG 20 | | | Ø |
| Permit | | | | 6 | 30 | 83 | 1966 | 30 | 81 | 1217 | 200 | | | | |
| | AVW 174 | AVW 249 | MAX 1.567 | MAX 7.07 | AVW 9 | | AVW 114 | AVW 6.5 | | AVW 84 | MAX 27 | MAX 23.3 | | | |
| Limits | | | | 9 | 45 | | 1217 | 45 | | 1825 | 400 | | | | |

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law that I have personally examined the information submitted herein; and based on my inquiry of those individuals immediately responsible, I believe the information to be accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and/or imprisonment. (Penalties under statutes 18 & 33 U.S.C. may include fines up to $10,000 and/or maximum imprisonment of five years.)

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month AUGUST

Facility Name CAMAS STP | FINAL LIMITS | Year 2003

Receiving Water Columbia River | Plant Operator JIM DICKINSON

Plant Type Activated Sludge System | Population 14200

| | INFLUENT | | | | | | EFFLUENT | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | Cl-2 |
| 1 | | | 1.507 | 6.66 | | | | | | | | | | | Ø |
| 2 | | | 1.486 | 6.75 | | | | | | | | | | | Ø |
| 3 | | | 1.453 | 6.78 | | | | | | | | | | | Ø |
| 4 | | | 1.464 | 6.61 | | | | | | | 20 | | | | Ø |
| 5 | | | 1.412 | 6.63 | | | | | | | | | | | .05 |
| 6 | 209 | 350 | 1.408 | 6.66 | 3 | 99 | 35 | 1 | 99 | 12 | | 20.6 | | | .6 |
| 7 | 168 | 152 | 1.396 | 7.15 | 3 | 98 | 35 | 6 | 96 | 70 | | | | | Ø |
| 8 | | | 1.382 | 6.75 | | | | | | | 9 | | | | .01 |
| 9 | | | 1.457 | 6.76 | | | | | | | | | | | .01 |
| 10 | | | 1.516 | 6.76 | | | | | | | | | | | Ø |
| 11 | | | 1.505 | 6.70 | | | | | | | 23 | | | | Ø |
| 12 | | | 1.422 | 6.73 | | | | | | | | | | | Ø |
| 13 | 211 | 296 | 1.500 | 6.82 | 2 | 99 | 24 | 1 | 99 | 12 | | 27.4 | | | Ø |
| 14 | 141 | 234 | 1.487 | 7.30 | 4 | 97 | 50 | 5 | 98 | 63 | 35 | | | | Ø |
| 15 | | | 1.493 | 7.11 | | | | | | | | | | | Ø |
| 16 | | | 1.447 | 7.07 | | | | | | | | | | | Ø |
| 17 | | | 1.461 | 7.11 | | | | | | | | | | | Ø |
| 18 | | | 1.539 | 7.13 | | | | | | | | | | | Ø |
| 19 | | | 1.452 | 7.24 | | | | | | | 53 | | | | Ø |
| 20 | 66 | 218 | 1.436 | 7.43 | 7 | 89 | 85 | 7 | 97 | 85 | | | | | Ø |
| 21 | 185 | 180 | 1.430 | 7.02 | 3.5 | 98 | 42 | 1 | 99 | 12 | | 39.6 | | | Ø |
| 22 | | | 1.498 | 7.29 | | | | | | | 20 | | | | .02 |
| 23 | | | 1.387 | 7.08 | | | | | | | | | | | Ø |
| 24 | | | 1.400 | 7.24 | | | | | | | | | | | Ø |
| 25 | | | 1.449 | 7.23 | | | | | | | 12 | | | | Ø |
| 26 | | | 1.446 | 7.09 | | | | | | | | | | | Ø |
| 27 | 158 | 208 | 1.433 | 7.32 | 5 | 97 | 60 | 4 | 98 | 48 | | 33.4 | | | Ø |
| 28 | 176 | 170 | 1.437 | 7.43 | 5 | 97 | 60 | 3 | 98 | 36 | | | | | Ø |
| 29 | | | 1.422 | 7.07 | | | | | | | 46 | | | | Ø |
| 30 | | | 1.474 | 6.99 | | | | | | | | | | | |
| 31 | | | 1.353 | 7.21 | | | | | | | | | | | |
| Total | | | 44.955 | | | | | | | | | | | | 0.09 |
| | AVG 164 | AVG 226 | AVG 1.45 | GEM 6.61 | AVG 4 | AVG 97 | AVG 49 | AVG 4 | AVG 98 | AVG 42 | GEM 15 | AVG 30 | | | |
| Permit | | | | 6.5 | 30 | 83 | 1956 | 30 | 81 | 1217 | 200 | | | | |
| | AVW 789 | AVW 265 | MAX 1.539 | MAX 7.43 | AVW 5 | | AVW 64 | AVW 4 | | AVW 49 | MAX 40 | MAX 39.6 | | | |
| Limits | | | | 9 | 45 | | 1217 | 45 | | 1825 | 400 | | | | |

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law that I have personally examined the information submitted herein; and based on my inquiry of those individuals immediately responsible, I believe the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and/or imprisonment. (Penalties under statutes 18 & 33 U.S.C. may include fines up to $10,000 and/or maximum imprisonment of five years.)

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

Name and Title

Signature

| | | | | | |
|---|---|---|---|---|---|
| Permit No. | WA0020249 | | | Month | September |
| Facility Name | CAMAS STP | FINAL LIMITS | | Year | 2003 |
| Receiving Water | Columbia River | | | Plant Operator | J. Dickinson |
| Plant Type | Activated Sludge System | | | Population | 14200 |

| | INFLUENT | | | | | | EFFLUENT | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | R-01 |
| 1 | | | 1.593 | 6.95 | | | | | | | | | | | Ø |
| 2 | | | 1.531 | 7.01 | | | | | | | | | | | Ø |
| 3 | 190 | 222 | 1.642 | 7.39 | 14 | 93 | 179 | 4 | 98 | 51 | 86 | | | | Ø |
| 4 | 183 | 124 | 1.547 | 7.0 | 18 | 90 | 246 | 5 | 96 | 68 | | 24 | | | Ø |
| 5 | | | 1.462 | 7.05 | | | | | | | 44 | | | | Ø |
| 6 | | | 1.481 | 7.04 | | | | | | | | | | | .03 |
| 7 | | | 1.858 | 7.01 | | | | | | | | | | | .56 |
| 8 | | | 1.618 | 7.01 | | | | | | | | | | | .15 |
| 9 | | | 1.702 | 7.04 | | | | | | | | 34.5 | | | .12 |
| 10 | 146 | 166 | 1.608 | 7.11 | 6 | 96 | 85 | 7 | 96 | 99 | 143 | | | | .05 |
| 11 | 213 | 262 | 1.571 | 7.23 | 5 | 98 | 67 | 3 | 99 | 40 | | | | | .03 |
| 12 | | | 1.442 | 7.00 | | | | | | | 195 | | | | Ø |
| 13 | | | 1.455 | 6.80 | | | | | | | | | | | .02 |
| 14 | | | 1.551 | 6.93 | | | | | | | | | | | Ø |
| 15 | | | 1.605 | 7.09 | | | | | | | 30 | | | | .08 |
| 16 | | | 1.658 | 7.01 | | | | | | | | | | | .18 |
| 17 | 176 | 190 | 1.524 | 7.29 | 4 | 98 | 55 | 4 | 98 | 55 | | 23.7 | | | .06 |
| 18 | 159 | 260 | 1.519 | 7.16 | 10 | 94 | 127 | 3 | 99 | 38 | 1000 | | | | .04 |
| 19 | | | 1.515 | 7.33 | | | | | | | | | | | .0 |
| 20 | | | 1.474 | 6.8 | | | | | | | | | | | .0 |
| 21 | | | 1.597 | 6.99 | | | | | | | | | | | Ø |
| 22 | | | 1.526 | 7.24 | | | | | | | | | | | Ø |
| 23 | | | 1.565 | 7.29 | | | | | | | 1 | | | | Ø |
| 24 | 217 | 190 | 1.488 | 7.10 | 42 | 81 | 548 | 11 | 94 | 144 | | 27.7 | | | Ø |
| 25 | 171 | 236 | 1.464 | 7.09 | 15 | 91 | 186 | 6 | 97 | 74 | | | | | Ø |
| 26 | | | 1.502 | 6.91 | | | | | | | 1 | | | | Ø |
| 27 | | | 1.467 | 6.8 | | | | | | | | | | | Ø |
| 28 | | | 1.516 | 7.10 | | | | | | | 0 | | | | Ø |
| 29 | | | 1.535 | 7.07 | | | | | | | | | | | Ø |
| 30 | | | 1.458 | 7.10 | | | | | | | | | | | Ø |
| 31 | | | | | | | | | | | | | | | |
| Total | | | 46.47 | 4 | | | | | | | | 24 | | | |
| | AVG 182 | AVG 206 | AVG 1.549 | MIN 6.80 | AVG 14 | AVG 93 | AVG 187 | AVG 5 | AVG 97 | AVG 71 | GEM 19 | AVG 27.5 | | | 1.36 |
| Permit | | | | 6 | 30 | 83 | 958 | 30 | 81 | 1217 | 200 | | | | |
| | AVW 194 | AVW 225 | MAX 1.858 | MAX 7.39 | AVW 29 | | AVW 367 | AVW 8.5 | | AVW 109 | GM7 55 | MAX 34.5 | | | |
| Limits | | | | 9 | 45 | | 1217 | 45 | | 1825 | 400 | | | | |

175

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law that I have personally examined the information submitted herein; and based on my inquiry of those individuals immediately responsible, I believe the information to be accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and/or imprisonment. (Penalties under statutes 18 & 33 U.S.C. may include fines up to $10,000 and/or maximum imprisonment of five years.)

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

Name and Title

Signature

| | | | |
|---|---|---|---|
| Permit No. | WA0020249 | | Month October |
| Facility Name | CAMAS STP | *FINAL LIMITS* | Year 2003 |
| Receiving Water | Columbia River | | Plant Operator Jim Dickinson |
| Plant Type | Activated Sludge System | | Population 14200 |

| | INFLUENT | | | | EFFLUENT | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | RAINFALL |
| 1 | 152 | 164 | 1.469 | 7.32 | 8 | 95 | 97 | 4 | 98 | 49 | 76 | 34.8 | | | Ø |
| 2 | 196 | 178 | 1.474 | 7.3 | 12 | 94 | 147 | 5 | 97 | 61 | | | | | .02 |
| 3 | | | 1.342 | 7.13 | | | | | | | 64 | | | | .02 |
| 4 | | | 1.480 | 6.8 | | | | | | | | | | | Ø |
| 5 | | | 1.614 | 6.92 | | | | | | | | | | | Ø |
| 6 | | | 1.564 | 7.04 | | | | | | | 54 | | | | .08 |
| 7 | | | 1.569 | 7.07 | | | | | | | | | | | .02 |
| 8 | 201 | 272 | 1.663 | 6.93 | 7 | 97 | 92 | 2 | 99 | 26 | | 27.3 | | | .02 |
| 9 | 65 | 58 | 2.045 | 7.23 | 61 | 6 | 846 | 3 | 95 | 42 | | | | | 1.31 |
| 10 | | | 1.607 | 7.09 | | | | | | | 5 | | | | .05 |
| 11 | | | 1.822 | 6.5 | | | | | | | | | | | .35 |
| 12 | | | 1.734 | 6.95 | | | | | | | | | | | Ø |
| 13 | | | 1.726 | 6.98 | | | | | | | 6 | | | | .03 |
| 14 | | | 1.644 | 7.01 | | | | | | | | | | | Ø |
| 15 | 139 | 127 | 1.904 | 7.23 | 6 | 96 | 82 | 4 | 97 | 55 | | 36.4 | | | .55 |
| 16 | 179 | 138 | 1.715 | 7.36 | 22 | 87 | 349 | 5 | 96 | 79 | 33 | | | | Ø |
| 17 | | | 1.520 | 6.91 | | | | | | | | | | | Ø |
| 18 | | | 1.612 | 6.5 | | | | | | | | | | | .29 |
| 19 | | | 1.737 | 6.86 | | | | | | | | | | | Ø |
| 20 | | | 1.691 | 7.03 | | | | | | | | | | | .01 |
| 21 | | | 1.628 | 7.00 | | | | | | | 633 | | | | Ø |
| 22 | 222 | 318 | 1.625 | 7.24 | 9 | 96 | 122 | 3 | 99 | 41 | | 37.5 | | | .14 |
| 23 | 146 | 126 | 1.579 | 7.41 | 7 | 95 | 95 | 4 | 97 | 54 | | | | | .01 |
| 24 | | | 1.443 | 7.11 | | | | | | | 2 | | | | Ø |
| 25 | | | 1.472 | 6.5 | | | | | | | | | | | Ø |
| 26 | | | 1.537 | 7.15 | | | | | | | | | | | Ø |
| 27 | | | 1.568 | 7.21 | | | | | | | 5 | | | | .01 |
| 28 | | | 1.531 | 7.27 | | | | | | | | | | | .13 |
| 29 | 124 | 106 | 1.673 | 7.50 | 6 | 95 | 77 | 3 | 97 | 38 | | 45.5 | | | .05 |
| 30 | 138 | 98 | 1.590 | 7.51 | 10 | 93 | 140 | 1 | 99 | 14 | | | | | Ø |
| 31 | | | 1.609 | 7.27 | | | | | | | 10 | | | | Ø |
| Total | | | 50.18 | 9 | | | | | | | | | | | 3.09 |
| | AVG 156 | AVG 159 | AVG 1.69 | MIN 6.5 | AVG 148 | AVG 85 | AVG 205 | AVG 3.4 | AVG 97 | AVG 46 | GEM 21 | AVG 36.3 | | | |
| Permit | | | | 6 | 30 | 83 | 966 | 30 | 81 | 1217 | 200 | | | | |
| | AVW 184 | AVW 222 | MAX 2045 | MAX 7.51 | AVW 34 | | AVW 469 | AVW 4.5 | | AVW 67 | GM7 37 | MAX 45.5 | | | |
| Limits | | | | 9 | 45 | | 1217 | 45 | | 1825 | 400 | | | | |

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law that I have personally examined the information submitted herein; and based on my inquiry of those individuals immediately responsible, I believe the information to be accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and/or imprisonment. (Penalties under statutes 18 & 33 U.S.C. may include fines up to $10,000 and/or maximum imprisonment of five years.)

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Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month NOVEMBER

Facility Name CAMAS STP | FINAL LIMITS | Year 2003

Receiving Water Columbia River | Plant Operator JIM DICKINSON

Plant Type Activated Sludge System | Population 14200

| | INFLUENT | | | | EFFLUENT | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | RAIN |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | |
| 1 | | | 1.608 | 7.5 | | | | | | | | | | | ∅ |
| 2 | | | 1.717 | 7.22 | | | | | | | | | | | ∅ |
| 3 | | | 1.675 | 7.19 | | | | | | | 3 | | | | ∅ |
| 4 | 140 | 180 | 1.645 | 7.21 | 5 | 96 | 69 | 3 | 98 | 41 | | 35.8 | | | ∅ |
| 5 | 121 | 112 | 1.587 | 7.43 | 6 | 95 | 79 | 3 | 97 | 40 | | | | | ∅ |
| 6 | | | 1.567 | 7.40 | | | | | | | | | | | ∅ |
| 7 | | | 1.586 | 7.12 | | | | | | | 20 | | | | ∅ |
| 8 | | | 1.539 | 7.5 | | | | | | | | | | | .01 |
| 9 | | | 1.664 | 7.18 | | | | | | | | | | | .01 |
| 10 | | | 1.707 | 7.20 | | | | | | | 14 | | | | .30 |
| 11 | 162 | 222 | 1.655 | 7.13 | 10 | 94 | 138 | 8 | 96 | 110 | | | | | .01 |
| 12 | 214 | 196 | 1.589 | 7.35 | 10 | 95 | 132 | 7 | 96 | 93 | | 34.4 | | | ∅ |
| 13 | | | 1.533 | 7.38 | | | | | | | | | | | ∅ |
| 14 | | | 1.514 | 7.10 | | | | | | | 0 | | | | .11 |
| 15 | | | 1.704 | 7.5 | | | | | | | | | | | .28 |
| 16 | | | 1.968 | 7.21 | | | | | | | | | | | .42 |
| 17 | | | 1.795 | 7.30 | | | | | | | 10 | | | | .14 |
| 18 | 155 | 160 | 1.984 | 7.02 | 10 | 94 | 165 | 6 | 96 | 99 | | 25.5 | | | .93 |
| 19 | 92 | 106 | 3.093 | 7.24 | 9 | 90 | 232 | 3 | 97 | 77 | | | | | .57 |
| 20 | | | 2.437 | 7.28 | | | | | | | | | | | .17 |
| 21 | | | 2.160 | 6.98 | | | | | | | 142 | | | | .24 |
| 22 | | | 1.987 | 7.40 | | | | | | | | | | | .05 |
| 23 | | | 2.078 | 7.02 | | | | | | | | | | | .26 |
| 24 | | | 2.160 | 7.14 | | | | | | | 42 | | | | .21 |
| 25 | 148 | 146 | 2.240 | 7.11 | 10 | 93 | 187 | 4 | 97 | 75 | | | | | .25 |
| 26 | 150 | 158 | 1.951 | 7.36 | 9 | 94 | 146 | 5 | 97 | 81 | 161 | 37.2 | | | .03 |
| 27 | | | 1.800 | 7.36 | | | | | | | | | | | .01 |
| 28 | | | 2.351 | 7.20 | | | | | | | | | | | 1.27 |
| 29 | | | 2.714 | 7.14 | | | | | | | | | | | .03 |
| 30 | | | 2.188 | 7.13 | | | | | | | | | | | .27 |
| 31 | | | | | | | | | | | | | | | |
| Total | | | 57.09 | | | | | | | | | | | | |
| | AVG 148 | AVG 160 | AVG 1.903 | AVG 6.98 | AVG 8.6 | AVG 94 | AVG 144 | AVG 5 | AVG 97 | AVG 77 | AVG 17.3 | AVG 33 | | | 5.57 |
| Permit | | | | 6 | 30 | 83 | 1956 | 30 | 331 | 1217 | 200 | | | | |
| | AVW 188 | AVW 209 | AVW 3.093 | AVW 7.50 | AVW 10 | | AVW 199 | AVW 7.5 | | AVW 102 | AVW 82 | AVW 37.2 | | | |
| Limits | | | | 9 | 45 | | 1217 | 45 | | 1825 | 400 | | | | |

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law that I have personally examined the information submitted herein; and based on my inquiry of those individuals immediately responsible, I believe the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and/or imprisonment. (Penalties under statutes 18 & 33 U.S.C. may include fines up to $10,000 and/or maximum imprisonment of five years.)

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month DECEMBER

Facility Name CAMAS STP | FINAL LIMITS | Year 2003

Receiving Water Columbia River | Plant Operator JIM DICKINSON

Plant Type Activated Sludge System | Population 14200

| | INFLUENT | | | | EFFLUENT | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | NH3-N |
| 1 | | | 2.114 | 7.15 | | | | | | | | | | | .02 |
| 2 | 103 | 48 | 2.088 | 7.09 | 9 | 91 | 157 | 2 | 96 | 35 | 48 | 31.3 | | | .34 |
| 3 | 127 | 184 | 2.080 | 7.34 | 10 | 92 | 173 | 5 | 97 | 87 | | | | | ⊖ |
| 4 | | | 2.522 | 7.41 | | | | | | | | | | | 1.12 |
| 5 | | | 3.781 | 7.03 | | | | | | | 278 | | | | .68 |
| 6 | | | 2.706 | 7.15 | | | | | | | | | | | .22 |
| 7 | | | 2.973 | 6.83 | | | | | | | | | | | .37 |
| 8 | | | 2.427 | 6.92 | | | | | | | | | | | .02 |
| 9 | 120 | 202 | 2.135 | 6.95 | 10 | 92 | 178 | 7 | 97 | 125 | | 32.7 | | | .15 |
| 10 | 130 | 130 | 2.272 | 7.17 | 7 | 95 | 133 | 5 | 96 | 94 | 2 | | | | .20 |
| 11 | | | 2.522 | 7.26 | | | | | | | | | | | .61 |
| 12 | | | 2.827 | 7.06 | | | | | | | 5 | | | | .38 |
| 13 | | | 5.337 | 7.18 | | | | | | | | | | | 2.11 |
| 14 | | | 3.904 | 6.60 | | | | | | | | | | | .08 |
| 15 | | | 2.797 | 6.79 | | | | | | | 15 | | | | ⊖ |
| 16 | 167 | 246 | 2.451 | 7.01 | 7 | 96 | 143 | 3 | 99 | 61 | | | | | .13 |
| 17 | 169 | 174 | 2.214 | 7.21 | 10 | 94 | 185 | 6 | 97 | 110 | | 25.6 | | | ⊖ |
| 18 | | | 2.089 | 7.12 | | | | | | | | | | | ⊖ |
| 19 | | | 1.881 | 6.97 | | | | | | | 5 | | | | .04 |
| 20 | | | 2.046 | 7.32 | | | | | | | | | | | .41 |
| 21 | | | 2.154 | 7.05 | | | | | | | 7 | | | | .03 |
| 22 | | | 2.012 | 7.06 | | | | | | | | | | | ⊖ |
| 23 | 145 | 120 | 2.006 | 7.01 | 10 | 93 | 167 | 2 | 98 | 33 | | | | | .25 |
| 24 | 144 | 132 | 2.483 | 7.26 | 5 | 97 | 104 | 3 | 98 | 62 | 2 | | | | .66 |
| 25 | | | 2.590 | 7.23 | | | | | | | | 38.1 | | | .06 |
| 26 | | | 2.223 | 7.03 | | | | | | | | | | | .30 |
| 27 | | | 2.717 | 7.12 | | | | | | | | | | | .36 |
| 28 | | | 3.258 | 7.10 | | | | | | | | | | | .45 |
| 29 | | | 2.746 | 6.83 | | | | | | | 2 | | | | ⊖ |
| 30 | 143 | 153 | 2.246 | 6.81 | 7 | 95 | 131 | 4 | 97 | 75 | | 27.8 | | | |
| 31 | 124 | 92 | 2.156 | 7.11 | 9 | 93 | 162 | 4 | 96 | 72 | 3 | | | | |
| Total | | | 67.146 | | | | | | | | | | | | |
| | AVW 137 | AVW 148 | AVW 2.166 | AVW 6.60 | AVW 8.5 | AVW 94 | AVW 153 | AVW 4 | AVW 97 | AVW 75 | AVW 7.8 | AVW 31 | | | 8.99 |
| Permit | [illegible] | [illegible] | [illegible] | 6.8 | 30 | 83 | 1956 | 30 | 81 | 1217 | 200 | [illegible] | [illegible] | [illegible] | [illegible] |
| | AVW 168 | AVW 210 | AVW 5.337 | AVW 7.41 | AVW 9.5 | | AVW 164 | AVW 6 | | AVW 110 | AVW 115.5 | AVW 38.1 | | | |
| Limits | [illegible] | [illegible] | [illegible] | 9 | 45 | [illegible] | 1217 | 45 | [illegible] | 1326 | 400 | [illegible] | [illegible] | [illegible] | [illegible] |

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7 =highest 7-day Geometric Mean

I certify under penalty of law that I have personally examined the information submitted herein; and based on my inquiry of those individuals immediately responsible, I believe the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and/or imprisonment. (Penalties under statutes 18 & 33 U.S.C. may include fines up to $10,000 and/or maximum imprisonment of five years.)

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Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249

Facility Name CAMAS STP — FINAL LIMITS

Receiving Water Columbia River

Plant Type Activated Sludge System

Month January

Year 2004

Plant Operator J. Dickinson

Population 14200

| Frequency | INFLUENT 2/wk | | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | EFFLUENT 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | | Rain |
| 1 | | | 2.149 | 7.16 | | | | | | | | | | | | |
| 2 | | | 2.592 | 6.76 | | | | | | | | | | | | .45 |
| 3 | | | 2.511 | 7.11 | | | | | | | | | | | | .22 |
| 4 | | | 2.390 | 7.07 | | | | | | | | | | | | .05 |
| 5 | | | 2.139 | 6.93 | | | | | | | | | | | | 0 |
| 6 | 176 | 182 | 2.092 | 7.12 | 8 | 95 | 140 | 2 | 99 | 35 | 2 | | | | | .25 |
| 7 | 153 | 172 | 1.975 | 7.09 | 6 | 96 | 99 | 2 | 99 | 33 | | | | | | .15 |
| 8 | | | 2.075 | 7.25 | | | | | | | | | | | | .30 |
| 9 | | | 2.703 | 6.96 | | | | | | | 10 | 40.0 | | | | .20 |
| 10 | | | 2.844 | 7.10 | | | | | | | | | | | | .05 |
| 11 | | | 2.733 | 7.07 | | | | | | | | | | | | 0 |
| 12 | | | 2.635 | 6.91 | | | | | | | | | | | | .01 |
| 13 | 182 | 116 | 2.45 | 6.92 | 4.5 | 96 | 92 | 2 | 98 | 41 | 3 | 31.4 | | | | .03 |
| 14 | 145 | 124 | 2.704 | 6.92 | 13 | 91 | 293 | 2 | 98 | 45 | | | | | | .01 |
| 15 | | | 2.583 | 7.12 | | | | | | | | | | | | .32 |
| 16 | | | 2.114 | 6.93 | | | | | | | | | | | | .08 |
| 17 | | | 2.060 | 7.10 | | | | | | | 10 | | | | | .05 |
| 18 | | | 2.307 | 7.00 | | | | | | | | | | | | .03 |
| 19 | | | 2.785 | 7.14 | | | | | | | | | | | | .06 |
| 20 | 95 | 132 | 2.214 | 6.98 | 3 | 97 | 55 | 2 | 98 | 37 | 200 | | | | | .06 |
| 21 | 128 | 118 | 2.058 | 6.89 | 18 | 86 | 309 | 9 | 92 | 154 | | 28.0 | | | | 0 |
| 22 | | | 2.157 | 7.11 | | | | | | | | | | | | 0 |
| 23 | | | 4.227 | 6.99 | | | | | | | | | | | | .49 |
| 24 | | | 3.914 | 6.87 | | | | | | | 7 | | | | | 1.39 |
| 25 | | | 3.249 | 6.81 | | | | | | | | | | | | .31 |
| 26 | | | 3.198 | 6.83 | | | | | | | | | | | | .24 |
| 27 | 145 | 114 | 2.687 | 6.83 | 9 | 94 | 202 | 3 | 97 | 67 | 7 | 22.8 | | | | .08 |
| 28 | 73 | 72 | 3.918 | 7.10 | 6 | 92 | 196 | 2 | 97 | 65 | | | | | | .20 |
| 29 | | | 4.162 | 7.04 | | | | | | | | | | | | .95 |
| 30 | | | 3.418 | 6.72 | | | | | | | | | | | | .51 |
| 31 | | | 2.902 | 6.99 | | | | | | | 20 | | | | | .05 |
| Total | | | 84.215 | | | | | | | | | | | | | .19 |
| | 127 | 129 | 2.707 | 6.72 | 8 | 93 | 173 | 3 | 97 | 60 | 10.2 | 30.5 | | | | 6.73 |
| Permit | [illegible] | [illegible] | [illegible] | 6.5 | 30 | 85 | 1956 | 30 | 85 | 1217 | 200 | [illegible] | [illegible] | [illegible] | [illegible] | |
| | 165 | 177 | 4.227 | 7.25 | 10.5 | | 199 | 5.5 | | 96 | 37.4 | 40 | | | | |
| Limits | [illegible] | [illegible] | [illegible] | 8.5 | 45 | [illegible] | 1217 | 45 | [illegible] | 1875 | 400 | [illegible] | [illegible] | [illegible] | [illegible] | |

Avg=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

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# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month February

Facility Name CAMAS STP | FINAL LIMITS | Year 2004

Receiving Water Columbia River | Plant Operator J. DICKINSON

Plant Type Activated Sludge System | Population 14200

| | INFLUENT | | | | EFFLUENT | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | RAIN |
| 1 | | | 2.717 | 6.87 | | | | | | | | | | | .23 |
| 2 | | | 2.536 | 6.90 | | | | | | | | | | | .02 |
| 3 | 173 | | 2.264 | 6.92 | 12 | 93 | 227 | | | | | 29.9 | | | .18 |
| 4 | 58 | 92 | 2.175 | 7.23 | 7 | 88 | 127 | 4 | 96 | 75 | | | | | .03 |
| 5 | | 41 | 2.012 | 7.15 | | | | 3 | 93 | 84 | 4 | | | | .05 |
| 6 | | | 2.222 | 7.21 | | | | | | | 2 | | | | .39 |
| 7 | | | 2.148 | 7.12 | | | | | | | | | | | .09 |
| 8 | | | 2.141 | 6.89 | | | | | | | | | | | .02 |
| 9 | | | 2.010 | 6.98 | | | | | | | 3 | | | | ⊖ |
| 10 | 102 | 116 | 2.941 | 6.95 | 5 | 95 | 123 | 3 | 97 | 74 | | 31.6 | | | ⊖ |
| 11 | 131 | 118 | 1.859 | 7.03 | 7 | 95 | 109 | 2 | 98 | 31 | | | | | ⊖ |
| 12 | | | 1.768 | 7.11 | | | | | | | | | | | ⊖ |
| 13 | | | 1.783 | 6.94 | | | | | | | 6 | | | | .22 |
| 14 | | | 1.890 | 6.92 | | | | | | | | | | | .29 |
| 15 | | | 1.896 | 6.73 | | | | | | | | | | | .21 |
| 16 | | | 3.026 | 6.86 | | | | | | | 4 | | | | .64 |
| 17 | 120 | 116 | 3.797 | 7.23 | 28 | 77 | 887 | 6 | 95 | 190 | | | | | 1.20 |
| 18 | 81 | 54 | 3.611 | 6.97 | 16 | 80 | 482 | 3 | 94 | 90 | | | | | .19 |
| 19 | | | 2.805 | 7.29 | | | | | | | | | | | ⊖ |
| 20 | | | 2.265 | 7.01 | | | | | | | 1 | 24.7 | | | .01 |
| 21 | | | 2.204 | 6.72 | | | | | | | | | | | ⊖ |
| 22 | | | 2.245 | 6.82 | | | | | | | | | | | .05 |
| 23 | | | 2.224 | 7.23 | | | | | | | 0 | | | | .38 |
| 24 | 129 | 224 | 2.271 | 7.00 | 10 | 92 | 189 | 3 | 99 | 57 | | | | | .21 |
| 25 | 101 | 78 | 2.696 | 7.33 | 9 | 91 | 202 | 5 | 94 | 112 | | 24.5 | | | .51 |
| 26 | | | 2.903 | 7.28 | | | | | | | 3 | | | | .23 |
| 27 | | | 2.650 | 7.04 | | | | | | | | | | | .31 |
| 28 | | | 2.388 | 6.72 | | | | | | | | | | | .02 |
| 29 | | | 2.572 | 7.02 | | | | | | | | | | | .29 |
| 30 | | | | | | | | | | | | | | | |
| 31 | | | | | | | | | | | | | | | |
| Total | | | 70.02 | | | | | | | | | | | | |
| | 112 | 105 | 2.421 | 6.72 | 12 | 89 | 293 | 4 | 96 | 85 | 2.5 | 27.6 | | | 5.77 |
| Permit | | | | 6.5 | 30 | 85 | 1956 | 30 | 81 | 1217 | 200 | | | | |
| | 117 | 151 | 3.797 | 7.33 | 22 | | 685 | 4.5 | | 140 | 4.2 | 31.6 | | | |
| Limits | | | | 6.5 | 45 | | 1217 | 45 | | 1825 | 400 | | | | |

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law that I have personally examined the information submitted herein; and based on my inquiry of those individuals immediately responsible, I believe the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and/or imprisonment. (Penalties under statutes 18 & 33 U.S.C. may include fines up to $10,000 and/or maximum imprisonment of five years.)

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month MARCH
Facility Name CAMAS STP | FINAL LIMITS | Year 2004
Receiving Water Columbia River | Plant Operator J. DICKINSON
Plant Type Activated Sludge System | Population 14200

| | INFLUENT | | | | | | EFFLUENT | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | RAIN |
| 1 | | | 2.279 | 7.17 | | | | | | | 3 | | | | Ø |
| 2 | 107 | 102 | 2.102 | 7.20 | 9 | 92 | 158 | 9 | 91 | 158 | | 30.5 | | | .03 |
| 3 | 95 | 66 | 2.663 | 7.43 | 2.5 | 97 | 56 | 5 | 92 | 111 | | | | | .59 |
| 4 | | | 2.435 | 7.26 | | | | | | | 1 | | | | .10 |
| 5 | | | 2.368 | 7.14 | | | | | | | | | | | .31 |
| 6 | | | 2.165 | 7.11 | | | | | | | | | | | .10 |
| 7 | | | 2.246 | 7.13 | | | | | | | | | | | .01 |
| 8 | | | 1.953 | 7.09 | | | | | | | 2 | | | | Ø |
| 9 | 115 | 90 | 1.968 | 7.14 | 6 | 95 | 98 | 4 | 96 | 66 | | | | | Ø |
| 10 | 135 | 148 | 1.855 | 7.36 | 5 | 96 | 77 | 1 | 99 | 15 | 0 | | | | Ø |
| 11 | | | 1.838 | 7.34 | | | | | | | | | | | Ø |
| 12 | | | 1.673 | 7.27 | | | | | | | | | | | .01 |
| 13 | | | 1.690 | 6.78 | | | | | | | | | | | Ø |
| 14 | | | 1.815 | 7.24 | | | | | | | | | | | Ø |
| 15 | | | 1.713 | 7.17 | ↓8 | 93 | 111 | | | | 0 | | | | Ø |
| 16 | 121 | 104 | 1.659 | 7.21 | ~~4~~ | ~~96~~ | ~~58~~ | 4 | 96 | 55 | | 32.9 | | | Ø |
| 17 | 108 | 88 | 1.631 | 7.44 | 5 | 95 | 95 | 2 | 98 | 27 | | | | | Ø |
| 18 | | | 1.776 | 7.35 | | | | | | | 3 | | | | .10 |
| 19 | | | 1.617 | 7.23 | | | | | | | | | | | .10 |
| 20 | | | 1.599 | 6.84 | | | | | | | | | | | Ø |
| 21 | | | 1.713 | 7.15 | | | | | | | | | | | Ø |
| 22 | | | 1.669 | 7.13 | | | | | | | 0 | | | | Ø |
| 23 | 164 | 206 | 1.65 | 7.15 | 10 | 94 | 138 | 4 | 98 | 55 | | 38.0 | | | .16 |
| 24 | 133 | 130 | 1.694 | 7.29 | 7 | 95 | 99 | 1 | 99 | 14 | | | | | .07 |
| 25 | | | 1.939 | 7.43 | | | | | | | | | | | .31 |
| 26 | | | 1.886 | 7.19 | | | | | | | 2 | | | | .26 |
| 27 | | | 1.806 | 6.76 | | | | | | | | | | | Ø |
| 28 | | | 1.780 | 7.12 | | | | | | | | | | | Ø |
| 29 | | | 1.826 | 7.20 | | | | | | | | | | | .08 |
| 30 | 151 | 155 | 1.787 | 7.29 | 16 | 89 | 238 | 5 | 97 | 75 | | | | | .14 |
| 31 | 233 | 236 | 1.701 | 7.62 | 13 | 94 | 184 | 2 | 99 | 28 | 15 | | | | Ø |
| Total | | | 58.496 | | | | | | | | | | | | |
| | AVG 136 | AVG 133 | AVG 1.949 | AVG 6.76 | AVG 8 | AVG 94 | AVG 125 | AVG 4 | AVG 97 | AVG 60 | AVG 2 | AVG 33.8 | | | 2.28 |
| Permit | [illegible] | [illegible] | [illegible] | 6 | 30 | 85 | 1958 | 30 | 85 | 1337 | 200 | [illegible] | [illegible] | [illegible] | [illegible] |
| | AVW 192 | AVW 196 | AVW 2.663 | AVW 7.62 | AVW 15 | | AVW 211 | AVW 7 | | AVW 135 | AVW 5 | AVW 38 | | | |
| Limits | [illegible] | [illegible] | [illegible] | 9 | 45 | [illegible] | 1217 | 45 | [illegible] | 1875 | 400 | [illegible] | [illegible] | [illegible] | [illegible] |

AVG=Average AVW=Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law that I have personally examined the information submitted herein; and based on my inquiry of those individuals immediately responsible, I believe the information to be accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and/or imprisonment. (Penalties under statutes 18 & 33 U.S.C. may include fines up to $10,000 and/or maximum imprisonment of five years.)

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Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month April
Facility Name CAMAS STP | FINAL LIMITS | Year 2004
Receiving Water Columbia River | Plant Operator J. Dickinson
Plant Type Activated Sludge System | Population 14200

| | INFLUENT | | EFFLUENT | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | N-P R |
| 1 | | | 1.66 | 7.48 | | | | | | | | | | | ⊖ |
| 2 | | | 1.542 | 7.38 | | | | | | | 2 | | | | ⊖ |
| 3 | | | 1.512 | 6.78 | | | | | | | | | | | ⊖ |
| 4 | | | 1.163 | 7.15 | | | | | | | | | | | ⊖ |
| 5 | | | 1.525 | 7.22 | | | | | | | | | | | ⊖ |
| 6 | 67 | 58 | 1.555 | 7.19 | 11 | 84 | 143 | 5 | 91 | 65 | | | | | ⊖ |
| 7 | 119 | 180 | 1.597 | 7.41 | 12 | 90 | 160 | 7 | 96 | 93 | 69 | | | | ⊖ |
| 8 | | | 1.547 | 7.52 | | | | | | | | | | | ⊖ |
| 9 | | | 1.476 | 7.22 | | | | | | | 117 | | | | ⊖ |
| 10 | | | 1.495 | 6.78 | | | | | | | | | | | ⊖ |
| 11 | | | 1.564 | 7.12 | | | | | | | | | | | ⊖ |
| 12 | | | 1.606 | 7.38 | | | | | | | 20 | | | | ⊖ |
| 13 | 166 | 142 | 1.545 | 7.33 | 10 | 94 | 129 | 7 | 95 | 90 | | 39.8 | | | .06 |
| 14 | 116 | 126 | 1.707 | 7.36 | 5 | 96 | 71 | 1 | 99 | 14 | | | | | .48 |
| 15 | | | 1.706 | 7.49 | | | | | | | | | | | .05 |
| 16 | | | 1.586 | 7.42 | | | | | | | 11 | | | | .01 |
| 17 | | | 1.612 | 6.90 | | | | | | | | | | | .03 |
| 18 | | | 1.805 | 7.15 | | | | | | | 6 | | | | .08 |
| 19 | | | 1.784 | 7.20 | | | | | | | | | | | .28 |
| 20 | 126 | 106 | 1.877 | 7.26 | 5 | 96 | 78 | 3 | 97 | 47 | | | | | .44 |
| 21 | 118 | 106 | 1.820 | 7.40 | 9 | 92 | 137 | 5 | 95 | 76 | | 27.7 | | | ⊖ |
| 22 | | | 1.634 | 7.26 | | | | | | | 5 | | | | ⊖ |
| 23 | | | 1.567 | 7.26 | | | | | | | | | | | ⊖ |
| 24 | | | 1.549 | 6.89 | | | | | | | | | | | ⊖ |
| 25 | | | 1.605 | 7.30 | | | | | | | | | | | ⊖ |
| 26 | | | 1.577 | 7.54 | | | | | | | | | | | ⊖ |
| 27 | 191 | 218 | 1.838 | 7.32 | 9 | 95 | 138 | 3 | 99 | 46 | | | | | ⊖ |
| 28 | 157 | 130 | 1.844 | 7.61 | 16 | 90 | 246 | 9 | 93 | 138 | 24 | 49.6 | | | ⊖ |
| 29 | | | 1.820 | 7.14 | | | | | | | | | | | ⊖ |
| 30 | | | 1.688 | 7.19 | | | | | | | 72 | | | | ⊖ |
| 31 | | | | | | | | | | | | | | | |
| Total | | | 48.806 | | | | | | | | | | | | |
| | 133 | 133 | 1.626 | 6.78 | 10 | 92 | 138 | 4 | 96 | 71 | 18 | 39 | | | 1.43 |
| Permit | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | | | [illegible] |
| | 174 | 174 | 1.877 | 7.61 | 12.5 | | 192 | 6 | | 92 | 48 | 49.6 | | | |
| Limits | [illegible] | [illegible] | [illegible] | [illegible] | 15 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | | | [illegible] |

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law that I have personally examined the information submitted herein; and based on my inquiry of those individuals immediately responsible, I believe the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and/or imprisonment. (Penalties under statutes 18 & 33 U.S.C. may include fines up to $10,000 and/or maximum imprisonment of five years.)

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Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month May

Facility Name CAMAS STP | FINAL LIMITS | Year 2004

Receiving Water Columbia River | Plant Operator J. Dickinson

Plant Type Activated Sludge System | Population 14200

| | INFLUENT | | | | EFFLUENT | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | Rain |
| 1 | | | 1.717 | 6.8 | | | | | | | | | | | ⊖ |
| 2 | | | 1.824 | 7.51 | | | | | | | | | | | ⊖ |
| 3 | | | 1.832 | 7.36 | | | | | | | | | | | ⊖ |
| 4 | 126 | 124 | 1.915 | 7.29 | 12 | 90 | 192 | 5 | 96 | 80 | | | | | ⊖ |
| 5 | ~~127~~ | 188 | 1.841 | 7.40 | 13 | 90 | 200 | 4 | 98 | 61 | 233 | 43.5 | | | ⊖ |
| 6 | 127↑ | | 1.786 | 7.46 | | | | | | | | | | | .01 |
| 7 | | | 1.839 | 7.54 | | | | | | | 84 | | | | .20 |
| 8 | | | 1.854 | 7.08 | | | | | | | | | | | .11 |
| 9 | | | 1.918 | 7.25 | | | | | | | | | | | ⊖ |
| 10 | | | 2.037 | 7.26 | | | | | | | | | | | .18 |
| 11 | 149 | 101 | 1.921 | 7.36 | 11 | 93 | 176 | 14 | 86 | 224 | | | | | .02 |
| 12 | 169 | 117 | 1.935 | 7.54 | 19 | 89 | 307 | 4 | 97 | 65 | ⊖ | | | | .01 |
| 13 | ↑ | | 1.871 | 7.62 | | | | | | | | 47.8 | | | ⊖ |
| 14 | | | 1.788 | 7.15 | | | | | | | ⊖ | | | | ⊖ |
| 15 | | | 1.859 | 6.87 | | | | | | | | | | | .04 |
| 16 | | | 1.937 | 7.08 | | | | | | | | | | | ⊖ |
| 17 | | | 1.895 | 7.33 | | | | | | | ⊖ | | | | .06 |
| 18 | 134 | 95 | 1.903 | 7.30 | 20 | 85 | 317 | 5 | 95 | 79 | | | | | ⊘ |
| 19 | 166 | 264 | 1.890 | 7.36 | 20 | 88 | 315 | 8 | 97 | 126 | | | | | |
| 20 | | | 1.844 | 7.42 | | | | | | | | 55.2 | JD | | ⊖ |
| 21 | | | 1.798 | 7.35 | | | | | | | ⊖ | ~~64.5~~ | | | .02 |
| 22 | | | 2.089 | 6.88 | | | | | | | | | | | .59 |
| 23 | | | 2.206 | 6.89 | | | | | | | | | | | .19 |
| 24 | | | 1.998 | 7.33 | | | | | | | | | | | ⊖ |
| 25 | 143 | 180 | 1.842 | 7.23 | 8 | 94 | 123 | 3 | 98 | 46 | ⊖ | | | | ⊖ |
| 26 | 150 | 188 | 2.014 | 7.38 | 17 | 89 | 286 | 5 | 97 | 84 | | 49.4 | | | .10 |
| 27 | | | 2.513 | 7.30 | | | | | | | | | | | .07 |
| 28 | | | 2.446 | 7.25 | | | | | | | ⊖ | | | | .02 |
| 29 | | | 2.127 | 6.76 | | | | | | | | | | | .01 |
| 30 | | | 1.995 | 6.77 | | | | | | | | | | | .02 |
| 31 | | | 2.088 | 6.78 | | | | | | | | | | | |
| Total | | | ~~64.51~~ | 60.552 | | | | | | | | | | | |
| | AVG 146 | AVG 157 | AVG 1.921 | AVG 6.76 | AVG 15 | AVG 90 | AVG 240 | AVG 6 | AVG 96 | AVG 96 | AVG 3.44 | AVG 48.9 | | | 1.65 |
| Permit | [illegible] | [illegible] | [illegible] | 6.8 | 30 | 85 | 1955 | 30 | 85 | 1317 | 200 | [illegible] | [illegible] | [illegible] | [illegible] |
| | MAX 159 | MAX 184 | MAX 2.513 | MAX 7.62 | MAX 20 | | MAX 316 | MAX 9 | | MAX 145 | MAX 140 | MAX 55.2 | | | |
| Limits | [illegible] | [illegible] | [illegible] | 6.0 | 45 | [illegible] | 1717 | 45 | [illegible] | 1375 | 400 | [illegible] | [illegible] | [illegible] | [illegible] |

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

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Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

| | | | |
|---|---|---|---|
| Permit No. | WA0020249 | Month | JUNE |
| Facility Name | CAMAS STP — *FINAL LIMITS* | Year | 2004 |
| Receiving Water | Columbia River | Plant Operator | J. DICKINSON |
| Plant Type | Activated Sludge System | Population | 14500 |

| | INFLUENT | | | | EFFLUENT | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | |
| 1 | 143 | 124 | 1.864 | 7.25 | 6 | 96 | 93 | 1 | 99 | 16 | | | | | ⊖ |
| 2 | 125 | 116 | 1.857 | 7.42 | 4 | 97 | 62 | 2 | 98 | 31 | ⊖ | | | | ⊖ |
| 3 | | | 1.861 | 7.53 | | | | | | | | 35.7 | | | ⊖ |
| 4 | | | 1.773 | 7.33 | | | | | | | ⊖ | | | | ⊖ |
| 5 | | | 1.994 | 6.81 | | | | | | | | | | | ⊖ |
| 6 | | | 2.264 | 7.34 | | | | | | | | | | | .54 |
| 7 | | | 2.129 | 7.14 | | | | | | | ⊖ | | | | .37 |
| 8 | 137 | 307 | 2.603 | 7.23 | 7 | 95 | 152 | 2 | 99 | 43 | | | | | .51 |
| 9 | 165 | 296 | 2.480 | 7.55 | 7 | 96 | 145 | 2 | 99 | 41 | | | | | .10 |
| 10 | | | 2.465 | 7.38 | | | | | | | ⊖ | 20.8 | | | ⊖ |
| 11 | | | 2.105 | 7.26 | | | | | | | | | | | ⊖ |
| 12 | | | 1.972 | 6.71 | | | | | | | | | | | ⊖ |
| 13 | | | 2.109 | 7.16 | | | | | | | | | | | ⊖ |
| 14 | | | 1.995 | 7.27 | | | | | | | | | | | ⊖ |
| 15 | 158 | 258 | 1.931 | 7.23 | 6 | 96 | 97 | 3 | 99 | 48 | ⊖ | | | | ⊖ |
| 16 | 125 | 122 | 1.911 | 7.44 | 4 | 97 | 64 | 3 | 98 | 48 | | 36.8 | | | ⊖ |
| 17 | | | 1.893 | 7.42 | | | | | | | | | | | ⊖ |
| 18 | | | 1.830 | 7.11 | | | | | | | ⊖ | | | | ⊖ |
| 19 | | | 1.830 | 6.70 | | | | | | | | | | | ⊖ |
| 20 | | | 1.924 | 7.21 | | | | | | | | | | | ⊖ |
| 21 | | | 1.890 | 7.15 | | | | | | | ⊖ | | | | ⊖ |
| 22 | 170 | 274 | 1.921 | 7.19 | 15 | 91 | 240 | 2 | 99 | 32 | | 35.2 | | | ⊖ |
| 23 | 122 | 204 | 1.915 | 7.40 | 9 | 93 | 144 | 4 | 98 | 64 | | | | | ⊖ |
| 24 | | | 1.998 | 7.38 | | | | | | | | | | | ⊖ |
| 25 | | | 1.835 | 7.28 | | | | | | | ⊖ | | | | ⊖ |
| 26 | | | 1.855 | 6.77 | | | | | | | | | | | / |
| 27 | | | 1.931 | 7.45 | | | | | | | | | | | / |
| 28 | | | 1.968 | 7.49 | | | | | | | | | | | ⊖ |
| 29 | 120 | 1140 | 1.8688 | 7.49 | 15 | 88 | 236 | 3 | 98 | 47 | | | | | / |
| 30 | 191 | 2606 | 1.902 | 7.52 | 8 | 96 | 127 | 3 | 99 | 48 | ⊖ | | | | ⊖ |
| 31 | | | | | | | | | | | | | | | |
| Total | | | 59.893 | | | | | | | | | | | | |
| | AVG 146 | AVG 211 | AVG 1.996 | AVG 6.70 | AVG 8 | AVG 94.5 | AVG 136 | AVG 2.5 | AVG 98.6 | AVG 42 | AVG 0 | AVG 32.1 | | | 1.52 |
| Permit | [illegible] | [illegible] | [illegible] | [illegible] | 30 | 85 | 1955 | 30 | 85 | 1217 | 200 | [illegible] | [illegible] | [illegible] | [illegible] |
| | AVW 156 | AVW 302 | AVW 2.603 | AVW 7.55 | AVW 12 | | AVW 194 | AVW 3 | | AVW 48 | AVW 0 | AVW 36.8 | | | |
| Limits | [illegible] | [illegible] | [illegible] | [illegible] | 45 | [illegible] | 1217 | 45 | [illegible] | 1826 | 400 | [illegible] | [illegible] | [illegible] | [illegible] |

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

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Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month JULY

Facility Name CAMAS STP | FINAL LIMITS | Year 2004

Receiving Water Columbia River | Plant Operator JIM DICKINSON

Plant Type Activated Sludge System | Population 14500

| | INFLUENT | | | | | | | EFFLUENT | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | RAIN |
| 1 | | | 1.787 | 7.37 | | | | | | | | | | | ⊖ |
| 2 | | | 1.829 | 7.21 | | | | | | | | | | | / |
| 3 | | | 1.872 | 6.97 | | | | | | | | | | | / |
| 4 | | | 1.702 | 7.14 | | | | | | | | | | | ⊖ |
| 5 | | | 1.938 | 7.13 | | | | | | | | | | | / |
| 6 | 194 | 190 | 1.887 | 7.21 | 9 | 95 | 142 | 4 | 98 | 63 | Ø<1 | JD | | | ⊖ |
| 7 | 115 | 118 | 1.913 | 7.40 | 5 | 96 | 80 | 2 | 98 | 32 | | | | | / |
| 8 | | | 1.861 | 7.51 | | | | | | | Ø<1 | JD | | | ⊖ |
| 9 | | | 1.821 | 7.05 | | | | | | | | 18.4 | | | ⊖ |
| 10 | | | 1.808 | 6.48 | | | | | | | | | | | / |
| 11 | | | 1.850 | 6.46 | | | | | | | | | | | ⊖ |
| 12 | | | 1.905 | 7.12 | | | | | | | | | | | .12 |
| 13 | 113 | 142 | 1.953 | 7.07 | 7.5 | 93 | 122 | 6 | 96 | 98 | Ø<1 | JD | | | ⊖ |
| 14 | 137 | 129 | 1.843 | 7.36 | 12 | 91 | 187 | 3 | 98 | 47 | | | | | ⊖ |
| 15 | | | 1.864 | 7.24 | | | | | | | | 36.5 | | | ⊖ |
| 16 | | | 1.762 | 7.25 | | | | | | | Ø<1 | JD | | | ⊖ |
| 17 | | | 1.804 | 7.41 | | | | | | | | | | | / |
| 18 | | | 1.821 | 7.22 | | | | | | | | | | | .12 |
| 19 | | | 1.842 | 7.28 | | | | | | | Ø<1 | JD | | | ⊖ |
| 20 | 186 | 232 | 1.842 | 7.25 | 4 | 98 | 61 | 1 | 99 | 15 | | | | | ⊖ |
| 21 | 157 | 208 | 1.813 | 7.36 | 28 | 82 | 423 | 1 | 99 | 15 | | 27.6 | | | / |
| 22 | | | 1.866 | 7.21 | | | | | | | Ø<1 | JD | | | ⊖ |
| 23 | | | 1.759 | 7.13 | | | | | | | | | | | ⊖ |
| 24 | | | 1.760 | 7.18 | | | | | | | | | | | / |
| 25 | | | 1.856 | 7.28 | | | | | | | | | | | ⊖ |
| 26 | | | 1.811 | 7.24 | | | | | | | JD | | | | ⊖ |
| 27 | 133 | 166 | 1.810 | 7.26 | 8 | 94 | 121 | 4 | 98 | 60 | Ø<1 | 31.2 | | | ⊖ |
| 28 | 206 | 216 | 1.786 | 7.32 | 6 | 97 | 89 | 1 | 99 | 15 | | | | | ⊖ |
| 29 | | | 1.821 | 7.46 | | | | | | | <1 | | | | ⊖ |
| 30 | | | 1.832 | 7.24 | | | | | | | | | | | ⊖ |
| 31 | | | 1.787 | 7.24 | | | | | | | | | | | ⊖ |
| Total | | | 56.805 | | | | | | | | | | | | |
| | AVG 155 | AVG 175 | AVG 1.834 | AVG 6.46 | AVG 10 | AVG 93 | AVG 153 | AVG 3 | AVG 98 | AVG 43 | AVG <1 | AVG 28.4 | | | .24 |
| Permit | [illegible] | [illegible] | [illegible] | [illegible] | 30 | 85 | 1955 | 30 | 85 | [illegible] | 200 | [illegible] | [illegible] | [illegible] | [illegible] |
| | AVW 172 | AVW 220 | AVW 1.953 | AVW 7.51 | AVW 16 | | AVW 242 | AVW 4.5 | | AVW 73 | AVW <1 | AVW 36.5 | | | |
| Limits | [illegible] | [illegible] | [illegible] | [illegible] | 45 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 400 | [illegible] | [illegible] | [illegible] | [illegible] |

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law that I have personally examined the information submitted herein; and based on my inquiry of those individuals immediately responsible, I believe the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and/or imprisonment. (Penalties under statutes 18 & 33 U.S.C. may include fines up to $10,000 and/or maximum imprisonment of five years.)

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month August
Facility Name CAMAS STP | FINAL LIMITS | Year 2004
Receiving Water Columbia River | Plant Operator Jim Dickinson
Plant Type Activated Sludge System | Population 14500

| | INFLUENT | | | | EFFLUENT | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | NH3-N |
| 1 | | | 1.866 | 7.22 | | | | | | | | | | | Ø |
| 2 | | | 1.966 | 7.16 | | | | | | | <1 | | | | Ø |
| 3 | 180 | 210 | 1.817 | 7.20 | 4 | 98 | 61 | 2 | 99 | 30 | | | | | Ø |
| 4 | 152 | 130 | 1.887 | 7.30 | 6 | 96 | 94 | 4 | 97 | 63 | | | | | .36 |
| 5 | | | 1.847 | 7.31 | | | | | | | | 37.9 | | | Ø |
| 6 | | | 1.911 | 7.22 | | | | | | | <1 | | | | .35 |
| 7 | | | 1.721 | 6.58 | | | | | | | | | | | Ø |
| 8 | | | 1.840 | 7.15 | | | | | | | | | | | Ø |
| 9 | | | 1.764 | 7.18 | | | | | | | <1 | | | | Ø |
| 10 | 150 | 196 | 1.805 | 7.11 | 8 | 95 | 120 | 5 | 97 | 75 | | | | | Ø |
| 11 | 106 | 108 | 1.803 | 7.31 | 4 | 96 | 60 | 1 | 99 | 15 | | | | | Ø |
| 12 | | | 1.831 | 7.34 | | | | | | | | 29.5 | | | Ø |
| 13 | * | | 1.809 | 7.31 | | | | | | | <1 | | | | Ø |
| 14 | | | 1.847 | 6.59 | | | | | | | | | | | Ø |
| 15 | | | 1.879 | 7.16 | | | | | | | | | | | Ø |
| 16 | | | 1.897 | 7.19 | | | | | | | | | | | Ø |
| 17 | 147 | 142 | 1.854 | 7.25 | 9 | 94 | 139 | 5 | 96 | 77 | <1 | .5 | | | Ø |
| 18 | 201 | 312 | 1.905 | 7.28 | 3 | 99 | 48 | 2 | 99 | 32 | | | | | Ø |
| 19 | | | 1.850 | 7.30 | | | | | | | | | | | Ø |
| 20 | | | 1.753 | 7.06 | | | | | | | <1 | | | | Ø |
| 21 | | | 2.041 | 6.62 | | | | | | | | | | | .67 |
| 22 | | | 2.671 | 7.23 | | | | | | | | | | | .58 |
| 23 | | | 2.310 | 7.16 | | | | | | | | | | | .28 |
| 24 | 104 | 92 | 2.485 | 7.08 | 6 | 94 | 124 | 5 | 95 | 104 | | | | | .96 |
| 25 | 126 | 98 | 2.580 | 6.96 | 9.5 | 92 | 204 | 5 | 95 | 107 | | 15.3 | | | .29 |
| 26 | | | 2.725 | 7.05 | | | | | | | <1 | | | | .42 |
| 27 | | | 2.249 | 7.38 | | | | | | | <1 | | | | Ø |
| 28 | | | 2.038 | 6.51 | | | | | | | | | | | Ø |
| 29 | | | 2.036 | 7.02 | | | | | | | | | | | Ø |
| 30 | | | 2.040 | 7.26 | | | | | | | <1 | | | | Ø |
| 31 | 93 | 230 | 1.820 | 7.53 | 8 | 91 | 121 | 3 | 98 | 40 | | | | | Ø |
| Total | | | 62.247 | | | | | | | | | | | | |
| | AVG 140 | AVG 169 | AVG 1.995 | AVG 6.51 | AVG 6 | AVG 95 | AVG 108 | AVG 3.5 | AVG 97 | AVG 65 | AVG <1 | AVG 20.8 | | | 3.91 |
| Permit | [illegible] | [illegible] | [illegible] | 6.8 | 30 | 83 | 1956 | 30 | 83 | 1217 | 200 | [illegible] | [illegible] | [illegible] | [illegible] |
| | AVW 174 | AVW 227 | AVW 2.725 | AVW 7.53 | AVW 8 | | AVW 764 | AVW 5 | | AVW 706 | AVW <1 | AVW 37.9 | | | |
| Limits | [illegible] | [illegible] | [illegible] | 9.2 | 45 | [illegible] | 1217 | 45 | [illegible] | 1826 | 400 | [illegible] | [illegible] | [illegible] | [illegible] |

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law that I have personally examined the information submitted herein; and based on my inquiry of those individuals immediately responsible I believe the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and/or imprisonment. (Penalties under statutes 18 & 33 U.S.C. may include fines up to $10,000 and/or maximum imprisonment of five years.)

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Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month SEPT

Facility Name CAMAS STP — FINAL LIMITS | Year 04

Receiving Water Columbia River | Plant Operator

Plant Type Activated Sludge System | Population 14500

| | INFLUENT | | | | EFFLUENT | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | Cl-2 R |
| 1 | 109 | 115 | 1.861 | 7.12 | 3 | 97 | 47 | 2 | 98 | 31 | | | | | .06 |
| 2 | | | 1.887 | 7.04 | | | | | | | | | | | .02 |
| 3 | | | 1.760 | 7.44 | | | | | | | <1 | | | | Ø |
| 4 | | | 1.719 | 6.50 | | | | | | | | | | | Ø |
| 5 | | | 1.707 | 7.09 | | | | | | | | | | | Ø |
| 6 | | | 1.902 | 7.15 | | | | | | | | | | | Ø |
| 7 | 144 | 139 | 1.852 | 7.10 | 11 | 92 | 170 | 3 | 98 | 46 | <1 | | | | Ø |
| 8 | 126 | 212 | 1.779 | 7.28 | 9 | 93 | 134 | 5 | 98 | 74 | | 22.3 | | | Ø |
| 9 | | | 1.920 | 7.23 | | | | | | | | | | | Ø |
| 10 | | | 1.799 | 7.09 | | | | | | | <1 | | | | .14 |
| 11 | | | 1.881 | 6.55 | | | | | | | | | | | / |
| 12 | | | 1.993 | 6.78 | | | | | | | | | | | .16 |
| 13 | | | 2.057 | 7.30 | | | | | | | | | | | .10 |
| 14 | 132 | 108 | 1.951 | 7.20 | 7 | 95 | 114 | 3 | 97 | 49 | <1 | | | | .12 |
| 15 | 133 | 278 | 1.959 | 7.27 | 10 | 92 | 163 | 3 | 99 | 49 | | 20 | | | .01 |
| 16 | | | 2.049 | 7.36 | | | | | | | | | | | .40 |
| 17 | | | 2.438 | 7.11 | | | | | | | <1 | | | | 1.06 |
| 18 | | | 2.075 | 6.55 | | | | | | | | | | | .09 |
| 19 | | | 2.337 | 7.44 | | | | | | | | | | | .29 |
| 20 | | 206 | 2.169 | 7.34 | | | | 5 | 98 | 86 | | | | | Ø |
| 21 | 175 | 102 | 2.051 | 6.98 | 15 | 91 | 257 | 4 | 96 | 66 | <1 | 28.7 | | | Ø |
| 22 | 120 | | 1.985 | 7.36 | 9 | 93 | 149 | | | | | | | | Ø |
| 23 | | | 1.943 | 7.24 | | | | | | | | | | | Ø |
| 24 | | | 1.917 | 7.21 | | | | | | | <1 | | | | Ø |
| 25 | | | 1.848 | 6.62 | | | | | | | | | | | Ø |
| 26 | | | 1.984 | 7.21 | | | | | | | | | | | Ø |
| 27 | | | 1.940 | 6.92 | | | | | | | <1 | | | | Ø |
| 28 | 185 | 258 | 1.901 | 7.00 | 12 | 94 | 190 | 4 | 98 | 63 | | | | | Ø |
| 29 | 117 | 113 | 1.911 | 7.20 | 9 | 92 | 143 | 3 | 97 | 48 | | 24.9 | | | Ø |
| 30 | | | 1.865 | 7.34 | | | | | | | | | | | Ø |
| 31 | | | | | | | | | | | | | | | |
| Total | | | 58.44 | | | | | | | | | | | | |
| | AVG 138 | AVG 170 | AVG 1.948 | AVG 6.50 | AVG 9 | AVG 93 | AVG 152 | AVG 3.5 | AVG 98 | AVG 57 | AVG <1 | AVG 23.9 | | | 2.45 |
| Permit | [illegible] | [illegible] | [illegible] | [illegible] | 30 | 85 | 1956 | 30 | 85 | 1212 | 200 | [illegible] | [illegible] | [illegible] | [illegible] |
| | 151 | 186 | 2.438 | 7.44 | 12 | | 203 | 4.5 | | 76 | <1 | 28.7 | | | |
| Limits | [illegible] | [illegible] | [illegible] | [illegible] | 45 | [illegible] | 2217 | 45 | [illegible] | 1326 | 400 | [illegible] | [illegible] | [illegible] | [illegible] |

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law that I have personally examined the information submitted herein; and based on my inquiry of those individuals immediately responsible, I believe the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and/or imprisonment. (Penalties under statutes 18 & 33 U.S.C. may include fines up to $10,000 and/or maximum imprisonment of five years.)

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Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month October

Facility Name CAMAS STP | FINAL LIMITS | Year 2004

Receiving Water Columbia River | Plant Operator Jim Dickinson

Plant Type Activated Sludge System | Population 14500

| | INFLUENT | | | | | | | EFFLUENT | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | 3-DR |
| 1 | | | 1.738 | 7.29 | | | | | | | <1 | | | | ⊖ |
| 2 | | | 1.861 | 6.60 | | | | | | | | | | | — |
| 3 | | | 1.923 | 7.02 | | | | | | | | | | | ⊖ |
| 4 | | | 1.888 | 7.23 | | | | | | | | | | | ⊖ |
| 5 | 168 | 260 | 2.042 | 7.22 | 4 | 98 | 68 | 6 | 98 | 102 | <1 | | | | .81 |
| 6 | 140 | 192 | 1.970 | 7.26 | 5 | 96 | 82 | 8 | 96 | 131 | | 10.7 | | | .01 |
| 7 | | | 1.863 | 7.40 | | | | | | | | | | | .42 |
| 8 | | | 2.527 | 7.48 | | | | | | | <1 | | | | .64 |
| 9 | | | 2.079 | 7.34 | | | | | | | | | | | .05 |
| 10 | | | 2.079 | 6.91 | | | | | | | | | | | ⊖ |
| 11 | | | 2.031 | 7.12 | | | | | | | | | | | ⊖ |
| 12 | 172 | 262 | 1.988 | 7.35 | 11 | 94 | 173 | 2 | 99 | 31 | <1 | | | | ⊖ |
| 13 | | | 1.888 | 7.55 | | | | | | | | | | | .01 |
| 14 | 131 | 202 | 1.873 | 7.08 | 10 | 92 | 156 | 4 | 98 | 62 | <1 | 25.3 | | | ⊖ |
| 15 | | | 1.765 | 7.28 | | | | | | | | | | | ⊖ |
| 16 | | | 1.885 | 7.28 | | | | | | | | | | | .35 |
| 17 | | | 2.131 | 7.37 | | | | | | | | | | | .15 |
| 18 | | | 2.241 | 7.34 | | | | | | | <1 | | | | .51 |
| 19 | 135 | 232 | 2.253 | 7.43 | 34 | 75 | 639 | 5 | 98 | 94 | | | | | .12 |
| 20 | 172 | 341 | 2.129 | 7.38 | 22 | 87 | 391 | 2 | 99 | 36 | | 21.0 | | | .35 |
| 21 | | | 2.149 | 7.47 | | | | | | | | | | | .06 |
| 22 | | | 2.022 | 7.40 | | | | | | | <1 | | | | .10 |
| 23 | | | 2.110 | 6.89 | | | | | | | | | | | .24 |
| 24 | | | 2.131 | 7.37 | | | | | | | | | | | .01 |
| 25 | | | 2.406 | 7.18 | | | | | | | <1 | | | | .62 |
| 26 | 117 | 128 | 2.636 | 7.30 | 33 | 72 | 725 | 2 | 98 | 44 | | | | | .15 |
| 27 | 116 | 198 | 2.231 | 7.15 | 15 | 87 | 279 | 1 | 99 | 19 | | 21.6 | | | .01 |
| 28 | | | 2.195 | 7.30 | | | | | | | | | | | .13 |
| 29 | | | 2.102 | 7.17 | | | | | | | <1 | | | | .25 |
| 30 | | | 2.445 | 6.68 | | | | | | | | | | | .28 |
| 31 | | | 2.268 | 7.34 | | | | | | | | | | | .05 |
| Total | | | 63.749 | | | | | | | | | | | | |
| | 144 | 227 | 2.088 | 6.6 | 17 | 88 | 314 | 4 | 98 | 65 | <1 | 19.65 | | | 5.32 |
| Permit | [illegible] | [illegible] | [illegible] | 8 | 30 | 83 | 1955 | 30 | 83 | 1217 | 200 | [illegible] | [illegible] | [illegible] | [illegible] |
| | 154 | 287 | 2.636 | 7.55 | 28 | | 515 | 7 | | 117 | <1 | 25.3 | | | |
| Limits | [illegible] | [illegible] | [illegible] | 9.0 | 45 | [illegible] | 1717 | [illegible] | [illegible] | 1375 | 400 | [illegible] | [illegible] | [illegible] | [illegible] |

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

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Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month NOVEMBER

Facility Name CAMAS STP | *FINAL LIMITS* | Year 2004

Receiving Water Columbia River | Plant Operator JIM DICKINSON

Plant Type Activated Sludge System | Population 14500

| | INFLUENT | | | | | | | EFFLUENT | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 2/wk | 2/wk | Cont | 7/wk | 2/wk | CALC | 2/wk | 2/wk | CALC | 2/wk | 2/wk | 1/wk | | | | |
| Date | BOD 5-day 20 D mg/L | TSS mg/L | FLOW MGD | pH Standard Units | BOD 5-day 20 D mg/L | BOD Removal Percent | BOD 5-day 20 d lbs/day | TSS mg/L | TSS Removal Percent | TSS lbs/day | Fecal Coliform #/100 ml | Ammonia-Nitrog mg/L | | | | RAIN |
| 1 | | | 2.285 | 7.17 | | | | | | | <1 | | | | | .11 |
| 2 | 120 | 156 | 3.552 | 7.19 | 18 | 85 | 533 | 5 | 97 | 59 | | | ←22.4 | | | .75 |
| 3 | 107 | 104 | 2.523 | 7.18 | 14 | 87 | 295 | 2 | 98 | 42 | | | | | | Ø |
| 4 | | | 2.297 | 7.22 | | | | | | | <1 | | | | | Ø |
| 5 | | | 2.267 | 7.09 | | | | | | | | | | | | Ø |
| 6 | | | 2.120 | 6.56 | | | | | | | | | | | | Ø |
| 7 | | | 2.144 | 7.21 | | | | | | | | | | | | Ø |
| 8 | | | 2.060 | 7.30 | | | | | | | | | | | | Ø |
| 9 | 165 | 286 | 1.950 | 7.07 | 14 | 92 | 228 | 1 | 99 | 16 | <1 | 29.7 | | | | .01 |
| 10 | 122 | 180 | 1.870 | 7.20 | 11 | 91 | 172 | 2 | 99 | 31 | | | | | | .01 |
| 11 | | | 1.981 | 7.17 | | | | | | | | | | | | Ø |
| 12 | | | 1.837 | 6.89 | | | | | | | <1 | | | | | .01 |
| 13 | | | 1.845 | 6.49 | | | | | | | | | | | | Ø |
| 14 | | | 1.976 | 6.89 | | | | | | | | | | | | Ø |
| 15 | | | 2.268 | 7.12 | | | | | | | | | | | | .43 |
| 16 | 102 | 165 | 2.634 | 7.04 | 11 | 89 | 187 | 2 | 99 | 34 | <1 | | | | | .12 |
| 17 | 115 | 120 | 2.265 | 7.11 | 11 | 90 | 208 | 1 | 99 | 19 | | | | | | .45 |
| 18 | | | 2.387 | 7.03 | | | | | | | | 27.1 | | | | .0 |
| 19 | | | 2.108 | 6.87 | | | | | | | <1 | | | | | Ø |
| 20 | | | 2.109 | 6.82 | | | | | | | | | | | | Ø |
| 21 | | | 2.151 | 6.96 | | | | | | | | | | | | .07 |
| 22 | | | 2.123 | 6.89 | | | | | | | <1 | | | | | .05 |
| 23 | 134 | 125 | 2.438 | 7.14 | 6.5 | 95 | 132 | 1 | 99 | 20 | | 26.8 | | | | .43 |
| 24 | 143 | 204 | 2.391 | 7.17 | 9 | 94 | 179 | 2 | 99 | 40 | <1 | | | | | .10 |
| 25 | | | 2.300 | 7.08 | | | | | | | | | | | | .01 |
| 26 | | | 2.020 | 7.06 | | | | | | | | | | | | .08 |
| 27 | | | 2.068 | 7.15 | | | | | | | | | | | | .03 |
| 28 | | | 2.160 | 6.85 | | | | | | | | | | | | Ø |
| 29 | | | 2.181 | 6.99 | | | | | | | | | | | | .26 |
| 30 | 117 | 108 | 2.358 | 7.05 | 6 | 95 | 118 | 1 | 99 | 20 | | 24.6 | | | | .20 |
| 31 | | | | | | | | | | | | | | | | |
| Total | | | 66.0 | 68 | | | | | | | | | | | | |
| | AVG 125 | AVG 161 | AVG 2.20 | MIN 6.56 | AVW 11 | AVG 91 | AVG 228 | AVG 2 | AVG 99 | AVG 31 | AVW <1 | AVG 26.5 | | | | 2.62 |
| Permit | | | | 6.5 | 30 | 83 | 1955 | 30 | 81 | 1217 | 200 | | | | | |
| | AVG 144 | AVG 233 | MAX 3.552 | MAX 7.30 | AVW 16 | | AVG 414 | AVG 3.5 | | AVG 51 | MAX <1 | MAX 29.7 | | | | |
| Limits | | | | 9 | 45 | | 1217 | 45 | | 1325 | 200 | | | | | |

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law that I have personally examined the information submitted herein; and based on my inquiry of those individuals immediately responsible, I believe the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and/or imprisonment. (Penalties under statutes 18 & 33 U.S.C. may include fines up to $10,000 and/or maximum imprisonment of five years.)

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month DEC. | Year 2004

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator

Plant Type Activated Sludge w/UV Disinfection | Population

EFFLUENT CONT.

| Frequency | 4/WEEK | CONT | CONT | 4/WEEK | 4/WEEK | DAILY | 4/YR | 4/YR | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | TSS LBS/DAY | pH STANDARD UNITS | TEMPERATURE DEG C | AMMONIA MG/L (WINTER) | AMMONIA MG/L (SUMMER) | FECAL COLIFORM #/100 ML | OIL & GREASE UG/L | CYANIDE UG/L | [illegible] | | | | | | |
| 1 | 19 | 7.26 | 17.1 | 15.5 | | <1 | | | 0 | | | | | | |
| 2 | 18 | 7.11 | 16.9 | 14.6 | | <1 | | | 0 | | | | | | |
| 3 | | 7.29 | 16.9 | | | <1 | | | 0 | | | | | | |
| 4 | | 6.50 | 16.8 | | | <1 | | | .29 | | | | | | |
| 5 | | 7.34 | 16.8 | | | <1 | | | .11 | | | | | | |
| 6 | 42 | 7.14 | 16.6 | 10.3 | | <1 | | | .19 | | | | | | |
| 7 | 27 | 7.02 | 16.5 | 19.6 | | <1 | | | .66 | | | | | | |
| 8 | 58 | 7.00 | 16.6 | 13.0 | | <1 | | | .20 | | | | | | |
| 9 | 52 | 7.29 | 16.4 | 11.0 | | <1 | | | .39 | | | | | | |
| 10 | | 6.82 | 16.3 | | | <1 | | | .40 | | | | | | |
| 11 | | 6.83 | 15.6 | | | 12 | | | Ø | | | | | | |
| 12 | | 6.88 | 15.5 | | | <1 | | | Ø | | | | | | |
| 13 | 45 | 7.44 | 16.7 | 4.3 | | <1 | | | .33 | | | | | | |
| 14 | 22 | 7.35 | 16.4 | 5.0 | | <1 | | | .07 | | | | | | |
| 15 | 40 | 6.97 | 16.8 | 5.5 | | <1 | | | Ø | | | | | | |
| 16 | 38 | 6.91 | 16.4 | 2.1 | | <1 | | | Ø | | | | | | |
| 17 | | 6.70 | 16.3 | | | <1 | | | Ø | | | | | | |
| 18 | | 6.82 | 16.6 | | | <1 | | | Ø | | | | | | |
| 19 | | 6.86 | 16.5 | | | <1 | | | .04 | | | | | | |
| 20 | 34 | 6.85 | 16.6 | 7.0 | | <1 | | | Ø | | | | | | |
| 21 | 23 | 6.82 | 16.5 | 9.9 | | <1 | | | .65 | | | | | | |
| 22 | 41 | 6.73 | 16.3 | 7.1 | | <1 | | | .02 | | | | | | |
| 23 | 20 | 6.80 | 16.1 | 7.3 | | <1 | | | Ø | | | | | | |
| 24 | | 6.85 | 16.1 | | | <1 | | | Ø | | | | | | |
| 25 | | 6.91 | 16.17 | | | 10 | | | .49 | | | | | | |
| 26 | | 6.93 | 16.2 | | | <1 | | | Ø | | | | | | |
| 27 | 20 | 6.91 | 16.0 | 6.4 | | <1 | | | Ø | | | | | | |
| 28 | 20 | 6.91 | 15.6 | 9.1 | | <1 | | | .10 | | | | | | |
| 29 | 20 | 6.92 | 15.6 | 9.4 | | <1 | | | .12 | | | | | | |
| 30 | 19 | 6.94 | 15.6 | 11.0 | | <1 | | | .07 | | | | | | |
| 31 | | 7.00 | 15.6 | | | <1 | | | .74 | | | | | | |
| Total | | | | | | | | | | | | | | | |
| | AVG 31 | MIN 6.50 | | AVG 9.3 | AVG | GEM 2 | AVG | AVG | 4.87 | | | | | | |
| Permit | 1017 | 6 | | 7 | 20 | 200 | | | | | | | | | |
| | AVW 44.75 | MAX 7.44 | MXD 17.1 | MXD 19.6 | MXD | GM7 2 | | | | | | | | | |
| Limits | 1525 | 9 | | 15 | 41 | 400 | | | | | | | | | |

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=highest 7-day Geometric Mean

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name and Title

Signature

Facility Name City of Camas

Receiving Water Columbia River

Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection

Population 14500

| | INFLUENT | | | | | | | | | EFFLUENT | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK | CONT | 4/WEEK | 4/YR | 4/YR | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK |
| Date | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY LBS/DAY | TSS MG/L | TSS LBS/DAY | PH STANDARD UNITS | AMMONIA MG/L | OIL & GREASE MG/L | CYANIDE MG/L | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY % REMOVAL | BOD 5-DAY LBS/DAY | TSS MG/L | TSS % REMOVAL |
| 1 | 2.329 | 136 | 2642 | 112 | 2175 | 6.97 | | | | 2.394 | 12 | 91 | 233 | 1 | 99 |
| 2 | 2.212 | | | 90 | 1660 | 7.33 | | | | 2.280 | | | | 1 | 99 |
| 3 | 2.098 | | | | | 7.43 | | | | 1.90 | | | | | |
| 4 | 2.189 | | | | | 6.50 | | | | 2.277 | | | | | |
| 5 | 2.419 | | | | | 7.57 | | | | 2.478 | | | | | |
| 6 | 2.480 | 100 | 2068 | 119 | 2461 | 7.30 | 29.3 | | | 2.515 | 24 | 76 | 503 | 2 | 98 |
| 7 | 3.264 | 91 | 2435 | 95 | 2542 | 7.32 | 31.2 | | | 3.208 | 18 | 80 | 482 | 1 | 99 |
| 8 | 3.143 | 80 | 2097 | 90 | 2359 | 6.95 | 25.1 | | | 3.225 | 30 | 63 | 807 | 2 | 98 |
| 9 | 3.107 | | | 65 | 1684 | 7.59 | 25.6 | | | 3.237 | | | | 2 | 97 |
| 10 | 3.219 | | | | | 6.49 | | | | 3.446 | | | | | |
| 11 | 3.115 | | | | | 6.69 | | | | 3.271 | | | | | |
| 12 | 2.715 | | | | | 7.06 | | | | 2.819 | | | | | |
| 13 | 2.657 | 103 | 2282 | 121 | 2681 | 7.49 | 28.9 | | | 2.672 | 23 | 78 | 513 | 2 | 98 |
| 14 | 2.579 | 116 | 2495 | 83 | 1805 | 7.42 | 23.0 | | | 2.608 | 25 | 78 | 544 | 1 | 99 |
| 15 | 2.408 | 81 | 1687 | 84 | 1687 | 7.39 | 27.3 | | | 2.420 | 22 | 73 | 444 | 2 | 98 |
| 16 | 2.285 | 122 | 2325 | 77 | 1467 | 7.37 | 31.4 | | | 2.282 | 19 | 84 | 362 | 2 | 97 |
| 17 | 2.123 | | | | | 6.10 | | | | 2.132 | | | | | |
| 18 | 2.147 | | | | | 6.24 | | | | 2.168 | | | | | |
| 19 | 2.126 | | | | | 7.13 | | | | 2.129 | | | | | |
| 20 | 2.075 | 120 | 2077 | 105 | 1817 | 7.12 | 43.7 | | | 2.067 | 11 | 91 | 190 | 2 | 98 |
| 21 | 2.710 | 119 | 2680 | 89 | 2012 | 7.18 | 30.5 | | | 2.710 | 9 | 92 | 203 | 1 | 99 |
| 22 | 2.406 | 94 | 1886 | 79 | 1585 | 7.08 | 21.3 | | | 2.463 | 15 | 84 | 308 | 2 | 97 |
| 23 | 2.322 | 117 | 2266 | 110 | 2130 | 7.10 | 32.7 | | | 2.398 | 26 | 78 | 520 | 1 | 99 |
| 24 | 2.276 | | | | | 6.37 | | | | 2.284 | | | | | |
| 25 | 2.444 | | | | | 7.11 | | | | 2.480 | | | | | |
| 26 | 2.548 | | | | | 6.15 | | | | 2.62 | | | | | |
| 27 | 2.347 | 108 | 2114 | 100 | 1957 | 7.06 | 33.4 | | | 2.428 | 18 | 83 | 364 | 1 | 99 |
| 28 | 2.277 | 115 | 2184 | 126 | 2393 | 6.98 | 34.0 | | | 2.349 | 5 | 96 | 98 | 1 | 99 |
| 29 | 2.343 | 144 | 2814 | 117 | 2286 | 7.01 | 36.2 | | | 2.410 | 14 | 90 | 281 | 1 | 99 |
| 30 | 2.186 | 119 | 2170 | 119 | 2170 | 7.02 | 38.1 | | | 2.327 | 10 | 92 | 194 | 1 | 99 |
| 31 | 2.751 | | | | | 6.82 | | | | 2.857 | | | | | |
| Total | ~~2.493~~ | 74.185 | | | | | | | | 78.85 | | | | | |
| | AVG 2.493 | AVG 110 | AVG 2265 | AVG 98.9 | AVG 2048 | MIN 6.10 | AVG 30.7 | AVG | AVG | AVG 2.543 | AVG 18 | AVG 83 | AVG 378 | AVG 1.4 | AVG 98.4 |
| Permit | 6.1 | | 5616 | | 6405 | | | | | | 20 | 70 | 1017 | 20 | 70 |
| | MAX 3.264 | MAX 144 | MAX 2814 | MAX 126 | MAX 2681 | MAX 7.59 | MAX 43.7 | | | MAX 3.446 | AVW 22 | | AVW 466 | AVW 1.75 | |
| Limits | | | | | | | | | | | 30 | | 1525 | 30 | |

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AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=highest 7-day Geometric Mean

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Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month January | Year 2005

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator Jim Dickinson

Plant Type Activated Sludge w/UV Disinfection | Population 14,500

| | INFLUENT | | | | | | | | | EFFLUENT | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK | CONT | 4/WEEK | 4/YR | 4/YR | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK |
| Date | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY LBS/DAY | TSS MG/L | TSS LBS/DAY | pH STANDARD UNITS | AMMONIA MG/L | OIL & GREASE UG/L | CYANIDE UG/L | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY % REMOVAL | BOD 5-DAY LBS/DAY | TSS MG/L | TSS % REMOVAL |
| 1 | 2.795 | | | | | 6.82 | | | | 2.880 | | | | | |
| 2 | 2.503 | | | | | 6.93 | | | | 2.569 | | | | | |
| 3 | 2.304 | 89 | 1710 | 96 | 1845 | 6.16 | 36.8 | | | 2.337 | 9 | 90 | 175 | 1 | 998 |
| 4 | 2.319 | 116 | 2243 | 149 | 2882 | 6.38 | 28.0 | | | 2.343 | 5 | 96 | 98 | 12 | 90 |
| 5 | 2.206 | 129 | 2373 | 102 | 1877 | 6.98 | 13.9 | | | 2.231 | 8 | 94 | 149 | 6 | 94 |
| 6 | 2.169 | 117 | 2116 | 114 | 2118 | 6.74 | 36.7 | | | 2.228 | 6 | 95 | 111 | 2 | 98 |
| 7 | 2.157 | | | | | 6.68 | | | | 2.253 | | | | | |
| 8 | 2.181 | | | | | 6.28 | | | | 2.230 | | | | | |
| 9 | 2.144 | | | | | 6.10 | | | | 2.281 | | | | | |
| 10 | 2.101 | 102 | 1787 | 76 | 1332 | 7.54 | 47.3 | | | 2.149 | 8 | 92 | 143 | 1 | 99 |
| 11 | 2.075 | ~~103~~ 59 | ~~1787~~ 1021 | 78 | 1350 | 7.54 | 40.9 | | | 2.075 | ~~8~~ 7 | ~~82~~ 88 | ~~123~~ 123 | 1 | 99 |
| 12 | 2.003 | 58 | 969 | 46 | 768 | 7.62 | 41.6 | | | 2.003 | 9 | 84 | 152 | 1 | 99 |
| 13 | 2.005 | 122 | 2040 | 135 | 2257 | 7.90 | 40.5 | | | 2.026 | 9 | 93 | 152 | 1 | 99 |
| 14 | 1.937 | | | | | 7.74 | | | | 1.953 | | | | | |
| 15 | 2.085 | | | | | 7.61 | | | | 2.091 | | | | | |
| 16 | 2.199 | | | | | 7.67 | | | | 2.109 | | | | | |
| 17 | 3.013 | 110 | 2764 | 148 | 3719 | 7.59 | 30.8 | | | 2.625 | 6 | 95 | 131 | 1 | 99 |
| 18 | 3.000 | 110 | 2752 | 89 | 2227 | 7.36 | 26.4 | | | 2.801 | 7 | 94 | 164 | 1 | 99 |
| 19 | 2.460 | 114 | 2339 | 97 | 1990 | 7.46 | 35.4 | | | 2.490 | 10 | 91 | 208 | 8 | 92 |
| 20 | 2.398 | | | 85 | 1700 | 7.47 | 41.2 | | | 2.443 | | | | 1 | 99 |
| 21 | 2.129 | 55 | 1099 | | | 7.46 | | | | 2.155 | 7 | 84 | 143 | | |
| 22 | 2.156 | | | | | 7.53 | | | | 2.154 | | | | | |
| 23 | 2.274 | | | | | 7.54 | | | | 2.272 | | | | | |
| 24 | 2.130 | 155 | 2753 | 181 | 3215 | 7.50 | 41.0 | | | 2.175 | 8 | 95 | 145 | 1 | 99 |
| 25 | 2.037 | 111 | 1886 | 104 | 1767 | 7.87 | 50.5 | | | 2.081 | 6 | 95 | 104 | 1 | 99 |
| 26 | 2.101 | 97 | 1665 | 106 | 1857 | 7.49 | 46.5 | | | 2.165 | 2 | 99 | 36 | 2 | .98 |
| 27 | 2.034 | 89 | 1510 | 111 | 1883 | 7.54 | 42.1 | | | 2.148 | 2 | 98 | 36 | 1 | 99 |
| 28 | 2.123 | | | | | 7.55 | | | | 2.175 | | | | | |
| 29 | 2.434 | | | | | 7.47 | | | | 2.506 | | | | | |
| 30 | 2.334 | | | | | 7.74 | | | | 2.386 | | | | | |
| 31 | 2.255 | 104 | 1956 | 130 | 2445 | 7.17 | 43.3 | | | 2.306 | 7 | 93 | 135 | 1 | 99 |
| Total | | | | | | | | | | | | | | | |
| | AVG 2.261 | AVG 102 | AVG 1940 | AVG 108.6 | AVG 2072 | MIN 6.10 | AVG 37.8 | AVG | AVG | AVG 2.278 | AVG 6.8 | AVG 92.7 | AVG 129.7 | AVG 2.47 | AVG 97.6 |
| Permit | 6.1 | | 5615 | | 6405 | | | | | | 20 | 70 | 1017 | 20 | 70 |
| | MAX 3.013 | MAX 155 | MAX 2764 | MAX 181 | MAX 3719 | MAX 7.90 | MAX 50.5 | | | MAX 2.880 | AVW 8.25 | | AVW 161.5 | AVW 5.25 | |
| Limits | | | | | | | | | | | 30 | | 1525 | 30 | |

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AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=highest 7-day Geometric Mean

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Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month January | Year 2005

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator Jim Dickinson

Plant Type Activated Sludge w/UV Disinfection | Population 14,500

EFFLUENT CONT.

| Frequency | 4/WEEK | CONT | CONT | 4/WEEK | 4/WEEK | DAILY | 4/YR | 4/YR | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | TSS LBS/DAY | pH MAX STANDARD UNITS | TEMPERATURE DEG C | AMMONIA MG/L (WINTER) | AMMONIA MG/L (SUMMER) | FECAL COLIFORM #/100 ML | OIL & GREASE UG/L | CYANIDE UG/L | pH MIN. STD. UNITS | | | | | | Rain |
| 1 | | 7.0 | | | | <1 | | | 6.92 | | | | | | .08 |
| 2 | | 6.92 | | | | <1 | | | 6.79 | | | | | | 0 |
| 3 | 19 | 6.92 | 14.9 | 7.9 | | <1 | | | 6.88 | | | | | | 0 |
| 4 | 234 | 7.26 | 14.7 | 8.7 | | <1 | | | 6.38 | | | | | | 0 |
| 5 | 112 | 7.26 | 14.6 | 2.5 | | <1 | | | 7.17 | | | | | | 0 |
| 6 | 37 | 7.19 | 15.1 | 9.7 | | <1 | | | 7.15 | | | | | | 0.11 |
| 7 | | 7.19 | 15.0 | | | <1 | | | 7.17 | | | | | | .18 |
| 8 | | 7.19 | 14.8 | | | 3 | | | 7.11 | | | | | | .02 |
| 9 | | 7.17 | 15.07 | 16.7 | | <1 | | | 7.11 | | | | | | .06 |
| 10 | 18 | 7.10 | 14.6 | 16.7 | | <1 | | | 7.05 | | | | | | 0 |
| 11 | 17 | 7.11 | 14.8 | 7.9 | | <1 | | | 7.04 | | | | | | 0 |
| 12 | 17 | 7.09 | 15.20 | 6.6 | | <1 | | | 7.02 | | | | | | .07 |
| 13 | 17 | 7.11 | 15.4 | 6.9 | | <1 | | | 7.05 | | | | | | 0 |
| 14 | | 7.11 | 15 | | | 8 | | | 6.93 | | | | | | 0 |
| 15 | | 7.11 | 14.2 | | | 3 | | | 7.00 | | | | | | .01 |
| 16 | | 7.13 | 14.2 | | | 1 | | | 7.04 | | | | | | .06 |
| 17 | 22 | 7.11 | 15.2 | 11.5 | | <1 | | | 7.07 | | | | | | .83 |
| 18 | 23 | 6.87 | 14.4 | 4.9 | | 8 | | | 6.78 | | | | | | .02 |
| 19 | 1666 | 7.05 | 15.0 | 1.4 | | <1 | | | 6.45 | | | | | | 0 |
| 20 | 20 | 7.14 | 15.21 | 1.1 | | <1 | | | 6.92 | | | | | | 0 |
| 21 | | 6.96 | 15.4 | | | <1 | | | 6.88 | | | | | | .08 |
| 22 | | 7.03 | 15.6 | | | <1 | | | 6.99 | | | | | | .01 |
| 23 | | 7.05 | 15.8 | | | <1 | | | 7.01 | | | | | | 0 |
| 24 | 18 | 7.05 | 15.8 | .40 | | <1 | | | 7.01 | | | | | | 0 |
| 25 | 17 | 7.05 | 15.6 | .73 | | <1 | | | 6.99 | | | | | | .01 |
| 26 | 36 | 7.05 | 15.61 | .64 | | <1 | | | 7.03 | | | | | | .09 |
| 27 | 18 | 7.05 | 15.8 | .45 | | <1 | | | 7.01 | | | | | | 0 |
| 28 | | 7.05 | 15.6 | | | <1 | | | 6.99 | | | | | | .47 |
| 29 | | 6.99 | 15.61 | | | 1.5 | | | 6.81 | | | | | | .13 |
| 30 | | 6.94 | 15.81 | | | <1 | | | 6.83 | | | | | | .04 |
| 31 | 19 | 7.06 | 15.8 | 0.0 | | <1 | | | 6.96 | | | | | | .01 |
| Total | | | | | | | | | | | | | | | |
| | AVG 47.6 | MIN 6.87 | | AVG 4.88 | AVG | GEM 2 | AVG | AVG | MIN 6.38 | | | | | | 2.28" |
| Permit | 1017 | 6 | | 7 | 20 | 200 | | | | | | | | | |
| | AVW 100.5 | MAX 7.26 | MXD 15.81 | MXD 11.7 | MXD | GM7 2.11 | | | MAX 7.17 | | | | | | |
| Limits | 1525 | 9 | | 15 | 41 | 400 | | | | | | | | | |

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GM7=highest 7-day Geometric Mean

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Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

ermit No. WA0020249 | Month *February* Year 2005

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection | Population 14500

EFFLUENT CONT.

| Frequency | 4/WEEK | CONT | CONT | 4/WEEK | 4/WEEK | DAILY | 4/YR | 4/YR | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | TSS LBS/DAY | pH STANDARD UNITS | TEMPERATURE DEG C | AMMONIA MG/L (WINTER) | AMMONIA MG/L (SUMMER) | FECAL COLIFORM #/100 ML | OIL & GREASE UG/L | CYANIDE UG/L | pH MINIMUM | | | | | | RAIN |
| 1 | 53 | 7.07 | 15.6 | .20 | | <1 | | | 6.92 | | | | | | Ø |
| 2 | 37 | 7.01 | 15.8 | .30 | | <1 | | | 6.94 | | | | | | .02 |
| 3 | 37 | 7.00 | 15.6 | .75 | | 4 | | | 6.40 | | | | | | .05 |
| 4 | | 7.00 | 15.6 | | | <1 | | | 6.98 | | | | | | .26 |
| 5 | | 7.07 | 16.60 | | | 2 | | | 6.89 | | | | | | .19 |
| 6 | | 7.09 | 15.40 | | | <1 | | | 7.00 | | | | | | .61 |
| 7 | 25 | 7.00 | 14.60 | 1.8 | | <1 | | | 6.96 | | | | | | Ø |
| 8 | 21 | 7.00 | 14.40 | .59 | | <1 | | | 6.52 | | | | | | Ø |
| 9 | 19 | 6.95 | 14.8 | Ø | | <1 | | | 6.89 | | | | | | Ø |
| 10 | 78 | 7.06 | 14.8 | 2.45 | | <1 | | | 6.23 | | | | | | Ø |
| 11 | | 7.43 | 16.40 | | | <1 | | | 6.98 | | | | | | .05 |
| 12 | | 7.19 | 15.20 | | | <1 | | | 7.06 | | | | | | .30 |
| 13 | | 7.21 | 15.40 | 6.54 | | 14 | | | 7.15 | | | | | | .08 |
| 14 | 19 | 7.19 | 15.2 | 6.2 | | <1 | | | 7.08 | | | | | | Ø |
| 15 | 56 | 7.08 | 15.0 | 5.4 | | <1 | | | 7.02 | | | | | | Ø |
| 16 | 92 | 7.04 | 14.9 | 6.4 | | <1 | | | 7.00 | | | | | | Ø |
| 17 | 89 | 7.02 | 14.9 | | | <1 | | | 6.98 | | | | | | Ø |
| 18 | | 7.58 | 16.10 | | | <1 | | | 6.83 | | | | | | Ø |
| 19 | | 7.06 | 16.30 | | | 1 | | | 6.98 | | | | | | Ø |
| 20 | | 7.08 | 15.3 | | | <1 | | | 7.04 | | | | | | Ø |
| 21 | 34 | 7.13 | 15.3 | ~~48.4~~ 6.9 | | <1 | | | 7.04 | | | | | | Ø |
| 22 | 68 | 7.11 | 15.3 | ~~49.4~~ | 12.5 | <1 | | | 7.09 | | | | | | Ø |
| 23 | 51 | 7.13 | 16.31 | 16.10 | | 2 | | | 7.07 | | | | | | Ø |
| 24 | 34 | 7.17 | 15.71 | 15.9 | | <1 | | | 7.11 | | | | | | Ø |
| 25 | | 7.17 | 15.91 | | | <1 | | | 7.09 | | | | | | Ø |
| 26 | | 7.09 | 15.91 | | | 2 | | | 7.02 | | | | | | Ø |
| 27 | | 7.16 | 15.91 | | | 4 | | | 7.09 | | | | | | .11 |
| 28 | 69 | 7.09 | 16.11 | 18.23 | | <1 | | | 7.02 | | | | | | .14 |
| 29 | | | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | | | |
| 31 | | | | | | | | | | | | | | | |
| Total | | | | | | | | | | | | | | | |
| | AVG 48.9 | MIN 6.95 | | AVG 6.26 | AVG | GEM 2 | AVG | AVG | 6.23 | | | | | | 1.81 |
| Permit | 1017 | 6 | | 7 | 20 | 200 | | | | | | | | | |
| | AVW 64 | MAX 7.58 | MAX 16.4 | MAX 18.23 | MAX | GM7 2 | | | 7.15 | | | | | | |
| Limits | 1625 | 9 | | 15 | 41 | 400 | | | | | | | | | |

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GM7=highest 7-day Geometric Mean

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Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month February Year 2005

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection | Population 14 500

| | INFLUENT | | | | | | | | | EFFLUENT | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK | CONT | 4/WEEK | 4/YR | 4/YR | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK |
| Date | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY LBS/DAY | TSS MG/L | TSS LBS/DAY | pH STANDARD UNITS | AMMONIA MG/L | OIL & GREASE MG/L | CYANIDE MG/L | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY % REMOVAL | BOD 5-DAY LBS/DAY | TSS MG/L | TSS % REMOVAL |
| 1 | 2.119 | 127 | 2244 | 123 | 2213 | 7.61 | 36.8 | | | 2.157 | 2 | 98 | 44 | 3 | 98 |
| 2 | 2.128 | 88 | 1562 | 57 | 1012 | 7.52 | 45.8 | | | 2.192 | 3 | 97 | 55 | 2 | 96 |
| 3 | 2.139 | 113 | 2016 | 114 | 2034 | 7.35 | 44.6 | | | 2.203 | 5 | 92 | 96 | 2 | 98 |
| 4 | 2.131 | | | | | 6.81 | | | | 2.139 | | | | | |
| 5 | 2.201 | | | | | 6.58 | | | | 2.274 | | | | | |
| 6 | 3.225 | | | | | 6.81 | | | | 3.318 | | | | | |
| 7 | 2.761 | 96 | 2211 | 80 | 1842 | 6.65 | 31.0 | | | 2.965 | 6 | 94 | 148 | 1 | 99 |
| 8 | 2.492 | 59 | 1226 | 70 | 1455 | 7.30 | 31.3 | | | 2.533 | 3 | 95 | 63 | 1 | 99 |
| 9 | 2.279 | 88 | 1673 | 85 | 1616 | 7.46 | 34.8 | | | 2.333 | 3 | 97 | 58 | 1 | 99 |
| 10 | 2.241 | 59 | 1103 | 74 | 1383 | 7.46 | 49.0 | | | 2.341 | 5 | 95 | 98 | 4 | 95 |
| 11 | 2.165 | | | | | 7.15 | | | | 2.168 | | | | | |
| 12 | 2.368 | | | | | 7.51 | | | | 2.360 | | | | | |
| 13 | 2.349 | | | | | 7.72 | | | | 2.325 | | | | | |
| 14 | 2.215 | 106 | 1958 | 93 | 1718 | 7.56 | 40.7 | | | 2.294 | 4 | 96 | 77 | 1 | 99 |
| 15 | 2.166 | 149 | 2692 | 113 | 2041 | 7.53 | 40.5 | | | 2.237 | 6 | 96 | 112 | 3 | 97 |
| 16 | 2.133 | 72 | 1281 | 92 | 1636 | 7.52 | 47.1 | | | 2.205 | 7 | 90 | 129 | 5 | 95 |
| 17 | 1.998 | 113 | 1883 | 102 | 1700 | 7.53 | 44.2 | | | 2.142 | 5 | 96 | 89 | 5 | 95 |
| 18 | 1.967 | | | | | 7.02 | | | | 2.018 | | | | | |
| 19 | 1.906 | | | | | 7.57 | | | | 1.998 | | | | | |
| 20 | 1.903 | | | | | 7.57 | | | | 1.924 | | | | | |
| 21 | 2.035 | 106 | 1799 | 116 | 1969 | 7.60 | ~~48.4~~ 48.4 | | | 2.066 | 5 | 95 | 86 | 2 | 98 |
| 22 | 1.965 | 125 | 2049 | 113 | 1852 | 7.92 | 49.4 | | | 2.038 | 4 | 97 | 68 | 4 | 96 |
| 23 | 1.946 | ~~15~~ 118 | 1915 | 99 | 1607 | 7.75 | 49 | | | 2.042 | 3 | 97 | 51 | 3 | 97 |
| 24 | 1.921 | 141 | 2259 | 254 | 4069 | 7.55 | 49.0 | | | 2.030 | 3.1 | 98 | 52 | 2 | 99 |
| 25 | 1.808 | | | | | 7.66 | | | | 1.945 | | | | | |
| 26 | 1.925 | | | | | 7.32 | | | | 1.992 | | | | | |
| 27 | 2.070 | | | | | ~~8~~ 7.66 | | | | 2.116 | | | | | |
| 28 | 2.052 | 109 | 1865 | 101 | 1728 | 7.65 | 46.6 | | | 2.060 | 5 | 95 | 86 | 4 | 96 |
| 29 | | | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | | | |
| 31 | | | | | | | | | | | | | | | |
| Total | | | | | | | | | | | | | | | |
| | AVG 2.165 | AVG 104.3 | AVG 1858.5 | AVG 105.5 | AVG 1867 | MIN 6.58 | AVG 43 | AVG | AVG | AVG 2.229 | AVG 4.3 | AVG 95.5 | AVG 82 | AVG 2.69 | AVG 97.25 |
| Permit | 6.1 | | 5615 | | 6405 | | | | | | 20 | 70 | 1017 | 20 | 70 |
| | MAX 3.225 | MAX 149 | MAX 2692 | MAX 254 | MAX 4069 | MAX 7.92 | MAX 49.4 | | | MAX 3.318 | AVW 5.5 | | AVW 101.8 | AVW 6.5 | |
| Limits | | | | | | | | | | | 30 | | 1526 | 30 | |

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=highest 7-day Geometric Mean

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

ermit No. WA0020249 — Month March Year 2005

acility Name City of Camas — County Clark

eiving Water Columbia River — Plant Operator JIM DICKINSON

ant Type Activated Sludge w/UV Disinfection — Population 14500

EFFLUENT CONT.

| Frequency | 4/WEEK | CONT | CONT | 4/WEEK | 4/WEEK | DAILY | 4/YR | 4/YR | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | TSS LBS/DAY | pH STANDARD UNITS | TEMPERATURE DEG C | AMMONIA MG/L (WINTER) | AMMONIA MG/L (SUMMER) | FECAL COLIFORM #/100 ML | OIL & GREASE UG/L | CYANIDE UG/L | pH MINIMUM | | | | | | N-P R |
| 1 | 138 | 7.11 | 16.21 | 21 | | <1 | | | 7.09 | | | | | | .01 |
| 2 | 136 | 7.09 | 16.41 | 18.65 | | <1 | | | 7.05 | | | | | | .03 |
| 3 | 33 | 7.14 | 16.61 | 19.9 | | <1 | | | 7.03 | | | | | | ⊖ |
| 4 | | 7.16 | 16.61 | | | <1 | | | 7.11 | | | | | | ⊖ |
| 5 | | 7.14 | 16.81 | | | <1 | | | 7.09 | | | | | | ⊖ |
| 6 | | 7.11 | 17.01 | | | 5 | | | 7.06 | | | | | | ⊖ |
| 7 | 17 | 7.11 | 17.0 | 15.16 | | <1 | | | 7.04 | | | | | | ⊖ |
| 8 | 50 | 7.10 | 17.41 | 20.6 | | <1 | | | 7.04 | | | | | | ⊖ |
| 9 | 85 | 7.07 | 16.9 | 16.8 | | <1 | | | 7.04 | | | | | | ⊖ |
| 10 | 52 | 7.07 | 17.61 | 22.1 | | <1 | | | 6.7 | | | | | | ⊖ |
| 11 | | 7.16 | 17.81 | | | <1 | | | 7.05 | | | | | | ⊖ |
| 12 | | 7.18 | 17.81 | | | <1 | | | 7.11 | | | | | | ⊖ |
| 13 | | 7.18 | 17.61 | | | <1 | | | 7.09 | | | | | | ⊖ |
| 14 | 84 | 7.36 | 17.59 | 11.89 | | <1 | | | 6.74 | | | | | | ⊖ |
| 15 | 223 | 7.08 | 17.37 | 10.30 | | <1 | | | 7.04 | | | | | | .17 |
| 16 | 71 | 7.10 | 16.93 | 13.3 | | <1 | | | 7.04 | | | | | | ⊖ |
| 17 | 52 | 7.06 | 17.17 | 11.32 | | <1 | | | 7.02 | | | | | | .08 |
| 18 | | 7.13 | 17.19 | | | <1 | | | 7.02 | | | | | | .55 |
| 19 | | 7.18 | 16.74 | | | 1 | | | 7.08 | | | | | | .14 |
| 20 | | 7.24 | 16.52 | | | <1 | | | 7.10 | | | | | | ⊖ |
| 21 | 104 | 7.13 | 16.74 | 13.61 | | <1 | | | 7.08 | | | | | | ⊖ |
| 22 | 37 | 7.10 | 16.57 | 14.68 | | <1 | | | 7.07 | | | | | | .10 |
| 23 | 17 | 7.15 | 16.13 | 16.70 | | <1 | | | 7.08 | | | | | | .01 |
| 24 | 85 | 7.15 | 16.5 | 20 | | <1 | | | 7.10 | | | | | | .31 |
| 25 | | 7.24 | 16.78 | | | 2 | | | 7.08 | | | | | | 2.06 |
| 26 | | 7.21 | 21.50 | | | <1 | | | 7.17 | | | | | | .44 |
| 27 | | 7.19 | 15.31 | | | <1 | | | 7.06 | | | | | | .53 |
| 28 | 200 | 7.08 | 14.70 | 10.3 | | <1 | | | 7.01 | | | | | | .09 |
| 29 | 122 | 7.04 | 14.51 | 9.1 | | <1 | | | 6.99 | | | | | | .05 |
| 30 | 224 | 7.13 | 15.11 | 11.75 | | 6 | | | 7.04 | | | | | | .08 |
| 31 | 137 | 7.22 | 15.31 | 11.42 | | <1 | | | 7.09 | | | | | | |
| Total | | | | | | | | | | | | | | | 4.65 |
| | AVG 98.2 | MIN 7.04 | | AVG 15.18 | AVG | GEM 2 | AVG | AVG | 6.70 | | | | | | |
| Permit | 1017 | 5 | | 7 | 20 | 200 | | | | | | | | | |
| | AVW 170.8 | MAX 7.36 | MOD 21.5 | MOD 22.1 | MOD | GM7 2 | | | 7.17 | | | | | | |
| Limits | 1625 | 9 | | 15 | 41 | 400 | | | | | | | | | |

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AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=highest 7-day Geometric Mean

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month March | Year 2005

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection | Population 14 500

| | INFLUENT | | | | | | | | | EFFLUENT | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK | CONT | 4/WEEK | 4/YR | 4/YR | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK |
| Date | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY LBS/DAY | TSS MG/L | TSS LBS/DAY | pH STANDARD UNITS | AMMONIA MG/L | OIL & GREASE MG/L | CYANIDE MG/L | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY % REMOVAL | BOD 5-DAY LBS/DAY | TSS MG/L | TSS % REMOVAL |
| 1 | 2.010 | 104 | 1743 | 103 | 1726 | 7.52 | 51.7 | | | 2.074 | 5 | 95 | 86 | 8 | 92 |
| 2 | 1.983 | 123 | 2034 | 111 | 1836 | 7.68 | 47.7 | | | 2.038 | 6 | 95 | 102 | 8 | 93 |
| 3 | 1.907 | 106 | 1685 | 106 | 16860 | 7.65 | 48.1 | | | 1.956 | 9.5 | 97 | 155 | 2 | 98 |
| 4 | 1.864 | | | | | 7.64 | | | | 1.922 | | | | | |
| 5 | 1.954 | | | | | 7.79 | | | | 2.023 | | | | | |
| 6 | 2.035 | | | | | 7.73 | | | | 2.117 | | | | | |
| 7 | 2.007 | 135 | 2260 | 158 | 2645 | 7.61 | 44.6 | | | 2.08 | 8 | 94 | 139 | 1 | 99 |
| 8 | 1.919 | 154 | 2465 | 256 | 4097 | 7.61 | 53.4 | | | 2.024 | 12 | 92 | 203 | 3 | 99 |
| 9 | 1.929 | 111 | 1786 | 162 | 2606 | 7.60 | 46.7 | | | 2.027 | 6.5 | 94 | 110 | 5 | 97 |
| 10 | 1.955 | 107 | 1745 | 184 | 3216 | 7.55 | 46.7 | | | 2.096 | 8 | 93 | 140 | 3 | 98 |
| 11 | 1.831 | | | | | 7.66 | | | | 1.989 | | | | | |
| 12 | 1.886 | | | | | 7.62 | | | | 1.926 | | | | | |
| 13 | 2.032 | | | | | 7.66 | | | | 2.061 | | | | | |
| 14 | 1.983 | 114 | 1885 | 116 | 1918 | 7.65 | 45.9 | | | 2.009 | 11 | 90 | 184 | 5 | 96 |
| 15 | 1.969 | 109 | 1499 | 124 | 2036 | 8.05 | 46.5 | | | 2.055 | 4 | 96 | 69 | 13 | 90 |
| 16 | 2.035 | 141 | 2393 | 153 | 2285 | 7.53 | 46.6 | | | 2.143 | 7.5 | 95 | 134 | 4 | 97 |
| 17 | 1.955 | 119 | 1940 | 153 | 2495 | 7.50 | 47.9 | | | 2.070 | 4 | 97 | 69 | 3 | 98 |
| 18 | 1.896 | | | | | 7.13 | | | | 1.979 | | | | | |
| 19 | 2.296 | | | | | 7.37 | | | | 2.276 | | | | | |
| 20 | 2.218 | | | | | 7.15 | | | | 2.168 | | | | | |
| 21 | 2.071 | 161 | 2780 | 200 | 3454 | 7.24 | 51.3 | | | 2.086 | 11 | 93 | 194 | 6 | 97 |
| 22 | 2.053 | 142 | 2431 | 150 | 2568 | 7.24 | 39.2 | | | 2.244 | 5 | 96 | 94 | 2 | 99 |
| 23 | 2.012 | 180 | 3020 | 322 | 5403 | 7.74 | 46.5 | | | 2.051 | 4 | 98 | 68 | 1 | 99 |
| 24 | 1.989 | 140 | 2322 | 192 | 3184 | 6.83 | 53 | | | 2.053 | 2 | 99 | 34 | 5 | 97 |
| 25 | 1.979 | | | | | 6.16 | | | | 2.166 | | | | | |
| 26 | 4.443 | | | | | 6.43 | | | | 4.499 | | | | | |
| 27 | 4.727 | | | | | 6.56 | | | | 4.805 | | | | | |
| 28 | 4.700 | 56 | 2195 | 60 | 2351 | 6.38 | 19.9 | | | 4.796 | 14 | 75 | 560 | 5 | 92 |
| 29 | 3.587 | 69 | 2064 | 89 | 2662 | 5.96 | 25.1 | | | 3.646 | 6 | 91 | 182 | 4 | 96 |
| 30 | 2.920 | 77 | 1875 | 69 | 1680 | 6.23 | 33.4 | | | 2.988 | 9 | 88 | 224 | 9 | 87 |
| 31 | 2.606 | 75 | 1630 | 103 | 2239 | 6.31 | 30.6 | | | 2.793 | 5 | 93 | 114 | 6 | 94 |
| Total | | | | | | | | | | | | | | | |
| | AVG 2.346 | AVG 116 | AVG 2092 | AVG 148 | AVG 2636 | MIN 6.16 | AVG 43.4 | AVG | AVG | AVG 2.420 | AVG 7.2 | AVG 93 | AVG 151 | AVG 4.89 | AVG 95.6 |
| Permit | 6.1 | | 5616 | | 6405 | | | | | | 20 | 70 | 1017 | 20 | 78 |
| | MAX 4.727 | MAX 180 | MAX 3020 | MAX 322 | MAX 4097 | MAX 8.05 | MAX 53.6 | | | MAX 4.805 | AVW 8.6 | | AVW 270 | AVW 6.25 | |
| Limits | | | | | | | | | | | 30 | | 1525 | 30 | |

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=highest 7-day Geometric Mean

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month April | Year 2005

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection | Population 14 500

| | INFLUENT | | | | | | | | | EFFLUENT | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK | CONT | 4/WEEK | 4/YR | 4/YR | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK |
| Date | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY LBS/DAY | TSS MG/L | TSS LBS/DAY | pH STANDARD UNITS | AMMONIA MG/L | OIL & GREASE MG/L | CYANIDE UG/L | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY % REMOVAL | BOD 5-DAY LBS/DAY | TSS MG/L | TSS % REMOVAL |
| 1 | 2.468 | | | | | 6.03 | | | | 2.498 | | | | | |
| 2 | 2.337 | | | | | 7.24 | | | | 2.447 | | | | | |
| 3 | 2.706 | | | | | 7.14 | | | | 2.896 | | | | | |
| 4 | 2.552 | 140 | 2980 | 182 | 3874 | 6.77 | 37.4 | | | 2.623 | 17 | 88 | 388 | 6 | 97 |
| 5 | 1.452 | 57 | 690 | 85 | 1029 | 6.38 | 57.0 | | | 1.503 | 7 | 88 | 88 | 1 | 99 |
| 6 | 1.377 | 101 | 1160 | 70 | 804 | 7.04 | 55.1 | | | 1.476 | 10 | 90 | 123 | 6 | 91 |
| 7 | 1.438 | 65 | 780 | 56 | 672 | 7.13 | 58.0 | | | 1.402 | 15 | 77 | 175 | 7 | 87.5 |
| 8 | 1.381 | | | | | 7.33 | | | | 1.362 | | | | | |
| 9 | 1.370 | | | | | 6.69 | | | | 1.355 | | | | | |
| 10 | 1.492 | | | | | 6.41 | | | | 1.467 | | | | | |
| 11 | 1.538 | 91 | 1167 | 72 | 924 | 6.10 | 50 | | | 1.53 | 8 | 91 | 102 | 6 | 92 |
| 12 | 1.493 | 54 | 672 | 62 | 772 | 6.10 | 49.8 | | | 1.457 | 7 | 87 | 85 | 9 | 85 |
| 13 | 1.455 | 83 | 1007 | 151 | 1832 | 7.38 | 51.6 | | | 1.527 | 12 | 86 | 153 | 9 | 94 |
| 14 | 1.406 | 107 | 1255 | 101 | 1184 | 7.53 | 52.7 | | | 1.502 | 9 | 92 | 113 | 8 | 92 |
| 15 | 1.734 | | | | | 7.11 | | | | 1.775 | | | | | |
| 16 | 3.285 | | | | | 7.15 | | | | 3.411 | | | | | |
| 17 | 3.170 | | | | | 6.78 | | | | 3.239 | | | | | |
| 18 | 2.899 | 93 | 2249 | 106 | 2563 | 5.94 | 35.6 | | | 2.981 | 8 | 91 | 199 | 7 | 93 |
| 19 | 2.567 | 116 | 2483 | 133 | 2847 | 6.61 | 34.6 | | | 2.659 | 9 | 92 | 200 | 5 | 96 |
| 20 | 2.366 | 98 | 1934 | 186 | 3670 | 6.61 | 37.0 | | | 2.476 | 6 | 94 | 124 | 3 | 97 |
| 21 | 2.315 | 113 | 2182 | 160 | 3089 | 5.95 | 37.2 | | | 2.452 | 12 | 89 | 245 | 2 | 99 |
| 22 | 2.241 | | | | | 5.78 | | | | 2.332 | | | | | |
| 23 | 2.581 | | | | | 5.69 | | | | 2.665 | | | | | |
| 24 | 2.581 | | | | | 5.67 | | | | 2.639 | | | | | |
| 25 | 3.073 | 94 | 2409 | 106 | 2717 | 5.65 | 32.4 | | | 3.135 | 14 | 79 | 366 | 5 | 95 |
| 26 | 2.575 | 78 | 1675 | 76 | 1632 | 5.45 | 30 | | | 2.650 | 6 | 92 | 133 | 3 | 96 |
| 27 | 2.360 | 81 | 1594 | 98 | 1929 | 7.15 | 44.6 | | | 2.458 | 6 | 93 | 123 | 4 | 96 |
| 28 | 2.234 | 90 | 1677 | 124 | 2310 | 6.7 | 40.4 | | | 2.366 | 10 | 89 | 197 | 5 | 96 |
| 29 | 2.098 | | | | | 6.38 | | | | 2.117 | | | | | |
| 30 | 2.130 | | | | | 6.27 | | | | 2.199 | | | | | |
| 31 | | | | | | | | | | | | | | | |
| Total | 64.674 | | | | | | | | | | | | | | |
| | AVG 2.156 | AVG 91 | AVG 1620 | AVG 111 | AVG 1991 | MIN 5.45 | AVG 43.96 | AVG | AVG | AVG 2.220 | AVG 9.75 | AVG 88.6 | AVG 176 | AVG 5.38 | AVG 94.1 |
| Permit | 6.1 | | 5616 | | 6405 | | | | | | 20 | 70 | 1017 | 20 | 78 |
| | MAX 3.285 | MAX 140 | MAX 2980 | MAX 186 | MAX 3874 | MAX 7.53 | MAX 58.0 | | | MAX 3.411 | AVW 12.25 | | AVW 205 | AVW 8 | |
| Limits | | | | | | | | | | | 30 | | 1526 | 30 | |

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=highest 7-day Geometric Mean

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month APRIL | Year 2005

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection | Population 14500

EFFLUENT CONT.

| Frequency | 4/WEEK | CONT | CONT | 4/WEEK | 4/WEEK | DAILY | 4/YR | 4/YR | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | TSS LBS/DAY | pH STANDARD UNITS | TEMPERATURE DEG C | AMMONIA MG/L (WINTER) | AMMONIA MG/L (SUMMER) | FECAL COLIFORM #/100 ML | OIL & GREASE UG/L | CYANIDE UG/L | pH MINIMUM | | | | | | RAIN (IN) |
| 1 | | 7.88 | 15.91 | | | <1 | | | 7.15 | | | | | | 0.07 |
| 2 | | 9.07 | 15.91 | | | <1 | | | 7.91 | | | | | | .16 |
| 3 | | 9.05 | 15.71 | | | 2 | | | 7.16 | | | | | | .40 |
| 4 | 131 | 7.16 | 15.71 | | 16.4 | 4 | | | 7.03 | | | | | | .01 |
| 5 | 12.5 | 7.05 | 15.91 | | 12.5 | <1 | | | 6.99 | | | | | | .01 |
| 6 | 74 | 7.14 | 16.31 | | 9.2 | <1 | | | 6.99 | | | | | | .03 |
| 7 | 82 | 7.13 | 16.71 | | 10.3 | <1 | | | 7.05 | | | | | | .45 |
| 8 | | 7.07 | 17.11 | | | <1 | | | 6.99 | | | | | | .46 |
| 9 | | 7.07 | 17.31 | | | <1 | | | 6.96 | | | | | | .02 |
| 10 | | 6.99 | 17.31 | | | <1 | | | 6.92 | | | | | | .46 |
| 11 | 77 | 7.09 | 17.31 | | 6.7 | <1 | | | 7.01 | | | | | | .04 |
| 12 | 109 | 7.12 | 17.31 | | 4.4 | <1 | | | 7.01 | | | | | | .04 |
| 13 | 114 | 7.12 | 17.31 | | 6.8 | <1 | | | 7.05 | | | | | | .60 |
| 14 | 100 | 7.12 | 17.31 | | 6.3 | <1 | | | 7.05 | | | | | | .01 |
| 15 | | 7.29 | 16.71 | | | <1 | | | 6.87 | | | | | | .49 |
| 16 | | 7.29 | 16.71 | | | 2 | | | 6.87 | | | | | | .11 |
| 17 | | 7.33 | 16.71 | | | <1 | | | 7.09 | | | | | | .38 |
| 18 | 174 | 7.34 | 15.91 | | 13.3 | <1 | | | 6.58 | | | | | | .01 |
| 19 | 111 | 7.67 | 16.31 | | 13.6 | 5 | | | 6.93 | | | | | | ~~0~~ |
| 20 | 62 | 7.67 | 16.71 | | 15.5 | <1 | | | 6.93 | | | | | | ~~0~~ |
| 21 | 41 | 7.08 | 16.71 | | 15.4 | <1 | | | 7.03 | | | | | | ~~0~~ |
| 22 | | 7.06 | 17.51 | | | <1 | | | 6.99 | | | | | | .27 |
| 23 | | 7.01 | 16.91 | | | <1 | | | 6.97 | | | | | | .36 |
| 24 | | 6.99 | 16.91 | | | <1 | | | 6.97 | | | | | | .46 |
| 25 | 131 | 7.01 | 16.71 | | 16.5 | <1 | | | 6.97 | | | | | | .07 |
| 26 | 66 | 7.03 | 17.11 | | 10.47 | 1 | | | 6.96 | | | | | | ~~0~~ |
| 27 | 82 | 7.13 | 17.51 | | 17.65 | <1 | | | 7.0 | | | | | | ~~0~~ |
| 28 | 99 | 7.39 | 17.51 | | 14.5 | <1 | | | 7.0 | | | | | | ~~0~~ |
| 29 | | 7.43 | 17.31 | | | 11.5 | | | 7.39 | | | | | | .01 |
| 30 | | 7.41 | 18.10 | | | | | | 7.32 | | | | | | ~~0~~ |
| 31 | | | | | | | | | | | | | | | |
| Total | | | | | | | | | | | | | | | 4.92 |
| | AVG 99 | AVG 6.99 | | AVG 11.8 | AVG | GEM 5.48 | AVG | AVG | 6.58 | | | | | | |
| Permit | 1037 | 6 | | 7 | 20 | 200 | | | | | | | | | |
| | AVW 103 | MAX 9.07 | MAX 18.1 | MAX 17.65 | MAX | GM7 3.4 | | | 7.91 | | | | | | |
| Limits | 1525 | 9 | | 15 | 41 | 400 | | | | | | | | | |

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=highest 7-day Geometric Mean

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month May | Year 2005

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection | Population 14 500

| | INFLUENT | | | | | | | | | EFFLUENT | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | CONT. | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK | CONT. | 4/WEEK | 4/YR. | 4/YR. | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK |
| Date | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY LBS/DAY | TSS MG/L | TSS LBS/DAY | PH STANDARD UNITS | AMMONIA MG/L | OIL & GREASE MG/L | CYANIDE MG/L | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY % REMOVAL | BOD 5-DAY LBS/DAY | TSS MG/L | TSS % REMOVAL |
| 1 | 2.220 | | | | | 6.36 | | | | 2.345 | | | | | |
| 2 | 2.148 | 112 | 2006 | 97 | 1738 | 6.28 | 51.6 | | | 2.435 | 12 | 89 | 244 | 4 | 96 |
| 3 | 2.112 | 81 | 1427 | 136 | 2396 | 6.37 | 46 | | | 2.702 | 8 | 90 | 180 | 10 | 93 |
| 4 | 2.192 | 155 | 2839 | 154 | 2815 | 6.8 | 40 | | | 2.515 | 18 | 88 | 378 | 6 | 96 |
| 5 | 2.152 | 116 | 2082 | 101 | 1813 | 6.0 | 47.9 | | | 2.215 | 18 | 84 | 333 | 5 | 95 |
| 6 | 2.039 | | | | | 5.63 | | | | 2.139 | | | | | |
| 7 | 2.084 | | | | | 5.52 | | | | 2.178 | | | | | |
| 8 | 2.302 | | | | | 5.59 | | | | 2.388 | | | | | |
| 9 | 3.269 | 133 | 3626 | 242 | 6747 | 7.19 | 42.1 | | | 3.343 | 35 | 74 | 976 | 16 | 93 |
| 10 | 3.612 | 57 | 1717 | 87 | 2621 | 7.02 | 33.3 | | | 3.716 | 12 | 79 | 372 | 3 | 97 |
| 11 | 2.878 | 64 | 1536 | 158 | 3792 | 6.90 | 30.6 | | | 2.942 | 7 | 89 | 172 | 6 | 96 |
| 12 | 2.486 | 75 | 1555 | 100 | 2073 | 6.79 | 40.0 | | | 2.593 | 17 | 77 | 368 | ~~105~~ | ~~895~~ JD |
| 13 | 2.367 | | | | | 6.83 | | | | 2.464 | | | | | |
| 14 | 2.394 | | | | | 6.99 | | | | 2.486 | | | | | |
| 15 | 2.843 | | | | | 6.78 | | | | 2.938 | | | | | |
| 16 | 3.740 | 90 | 2807 | 218 | 6800 | 6.82 | 22.8 | | | 3.813 | 45 | 50 | 1240 | 45 | 79 |
| 17 | 3.429 | 94 | 2688 | 152 | 4347 | 6.82 | 25.7 | | | 3.470 | 52 | 45 | 1505 | 27 | 82 |
| 18 | 3.601 | 83 | 2493 | 97 | 2913 | 6.58 | 23.4 | | | 3.649 | 33 | 60 | 1004 | 27 | 72 |
| 19 | 3.468 | 82.5 | 2386 | 126 | 3644 | 6.60 | 25.1 | | | 3.549 | 36 | 55 | 1087 | 11 | 91 |
| 20 | 3.404 | | | | | 5.77 | | | | 3.490 | | | | | |
| 21 | 3.175 | | | | | 5.20 | | | | 3.201 | | | | | |
| 22 | 2.965 | | | | | 4.87 | | | | 2.974 | | | | | |
| 23 | 2.588 | 135 | 2914 | 133 | 2871 | 4.93 | 28.0 | | | 2.601 | 19 | 86 | 412 | 7 | 95 |
| 24 | 2.411 | 93 | 1870 | 71 | 1428 | 5.11 | 38.3 | | | 2.442 | 31 | 66 | 631 | 45 | 38 |
| 25 | 2.275 | 119 | 2258 | 80 | 1517 | 6.57 | 34 | | | 2.301 | 48 | 60 | 921 | 18 | 78 |
| 26 | 2.274 | 115 | 2181 | 90 | 1706 | 6.26 | 38 | | | 2.274 | 40 | 65 | 759 | 16 | 82 |
| 27 | 2.082 | | | | | 6.06 | | | | 2.232 | | | | | |
| 28 | 1.968 | | | | | 5.83 | | | | 2.064 | | | | | |
| 29 | 1.977 | | | | | 6.34 | | | | 1.993 | | | | | |
| 30 | 2.085 | 124 | 2156 | 130 | 2261 | 6.34 | 41.4 | | | 2.13 | 22 | 82 | 391 | 2 | 98 |
| 31 | 2.291 | 116 | 2216 | 127 | 2427 | 6.98 | 41.9 | | | 2.316 | 16 | 86 | 309 | 1 | 99 |
| Total | | | | | | | | | | | | | | | |
| | AVG 2.607 | AVG 102 | AVG 2264 | AVG 128 | AVG 2995 | MIN 4.87 | AVG 36.1 | AVG | AVG | AVG 2.706 | AVG 26 | AVG 74 | AVG 927 | AVG 14 | AVG 87 |
| Permit | 6.3 | | 5615 | | 6406 | | | | | | 20 | 70 | 1017 | 20 | 78 |
| | MAX 3.74 | MAX 155 | MAX 3626 | MAX 242 | MAX 6800 | MAX 7.19 | MAX 51.6 | | | MAX 3.813 | MAX 42 | | MAX 1209 | MAX 28 | |
| Limits | | | | | | | | | | | 30 | | 1525 | 30 | |

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

AVG=Average AVW=Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=Highest 7-day Geometric Mean

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Name and Title

Signature

WASTEWATER TREATMENT PLANT MONITORING

Permit No. WA0020249 | Month May | Year 2005

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection | Population 14500

| Frequency | 4/WEEK | CONT | CONT | 4/WEEK | 4/WEEK | DAILY | 4/YR | 4/YR | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | TSS LBS/DAY | pH STANDARD UNITS | EFFLUENT CONT TEMPERATURE DEG C | AMMONIA MG/L (WINTER) | AMMONIA MG/L (SUMMER) | FECAL COLIFORM #/100 ML | OIL & GREASE UG/L | CYANIDE UG/L | pH MINIMUM | | | | | | Cl-2R |
| 1 | | 7.41 | 18.11 | | | 4 | | | 7.32 | | | | | | 0.8 |
| 2 | 81 | 7.37 | 18.11 | | ←16.10 | 60 | | | 7.30 | | | | | | .08 |
| 3 | 225 | 7.84 | 18.71 | | ←21.9 | <1 | | | 7.34 | | | | | | .19 |
| 4 | 1260 | 7.84 | 18.71 | | ←21.1 | <1 | | | 7.34 | | | | | | .14 |
| 5 | 92 | 7.82 | 18.30 | | ←24.6 | <1 | | | 7.60 | | | | | | .03 |
| 6 | | 7.83 | 18.50 | | | <1 | | | 7.89 | | | | | | .01 |
| 7 | | 8.04 | 18.51 | | | <1 | | | 7.83 | | | | | | .08 |
| 8 | | 8.18 | 18.22 | | | 8 | | | 7.79 | | | | | | .41 |
| 9 | 446 | 7.83 | 18.82 | | ←30.7 | 60 | | | 7.66 | | | | | | .74 |
| 10 | 93 | 8.14 | 18.22 | | ←18.6 | <1 | | | 7.24 | | | | | | .35 |
| 11 | 147 | 8.16 | 17.01 | | ←22.0 | <1 | | | 7.24 | | | | | | Θ |
| JD/08 12 | ~~903~~ | 8.34 | 17.81 | | ←22.0 | <1 | | | 7.62 | | | | | | Θ |
| 13 | | 7.84 | 18.21 | | | <1 | | | 7.62 | | | | | | .22 |
| 14 | | 8.03 | 18.41 | | | 1 | | | 7.84 | | | | | | .03 |
| 15 | | 8.12 | 18.41 | | | TNTC | | | 7.75 | | | | | | .40 |
| 16 | 1431 | 8.12 | 18.41 | 15.7 | | <1 | | | 7.62 | | | | | | .47 |
| 17 | 781 | 8.10 | 18.01 | 15.2 | | <1 | | | 7.48 | | | | | | .61 |
| 18 | 822 | 7.59 | 17.21 | 14.3 | | <1 | | | 7.29 | | | | | | .07 |
| 19 | 325 | 7.38 | 17.20 | 14.3 | | <1 | | | 7.27 | | | | | | .48 |
| 20 | | 7.38 | 17.01 | | | <1 | | | 7.23 | | | | | | .28 |
| 21 | | 7.34 | 16.81 | | | <1 | | | 7.23 | | | | | | .26 |
| 22 | | 7.31 | 17.01 | | | <1 | | | 7.22 | | | | | | .04 |
| 23 | 152 | 7.35 | 17.81 | 13.8 | | <1 | | | 7.22 | | | | | | Θ |
| 24 | 916 | 7.37 | 18.41 | 17.17 | | 2 | | | 7.37 | | | | | | Θ |
| 25 | 345 | 7.46 | 18.82 | 22.9 | | 10 | | | 7.37 | | | | | | Θ |
| 26 | 303 | 7.55 | 19.41 | 22 | | <1 | | | 7.44 | | | | | | Θ |
| 27 | | 7.61 | 19.80 | | | <1 | | | 7.48 | | | | | | Θ |
| 28 | | 7.55 | 19.81 | | | <1 | | | 7.51 | | | | | | Θ |
| 29 | | 7.61 | 19.41 | | | <1 | | | 7.48 | | | | | | .05 |
| 30 | ~~136~~ | 7.48 | 19.58 | 21.5 | | <1 | | | 7.44 | | | | | | Θ |
| 31 | 19 | 7.51 | 18.94 | 19.7 | | <1 | | | 6.66 | | | | | | .40 |
| Total | | | | | | | | | | | | | | | |
| | AVG 358 | MIN 7.31 | | AVG 19.6 | AVG | GEM 2 | AVG | AVG | 6.66 | | | | | | 6.14 |
| Permit | 1017 | 5 | | 7 | 20 | 200 | | | | | | | | | |
| | AVW 837 | MAX 8.34 | MAX 19.81 | MAX 30.7 | MAX | GM7 3 | | | 7.89 | | | | | | |
| Limits | 1525 | 9 | | 15 | 41 | 400 | | | | | | | | | |

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AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

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Name and Title

Signature

WASTEWATER TREATMENT PLANT REPORT

Permit No. WA0020249 | Month JUNE | Year 2005

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection | Population 14500

| Frequency | 4/WEEK | CONT | CONT | 4/WEEK | 4/WEEK | DAILY | 4/YR | 4/YR | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | TSS LBS/DAY | pH STANDARD UNITS | EFFLUENT CONT TEMPERATURE DEG C | AMMONIA MG/L (WINTER) | AMMONIA MG/L (SUMMER) | FECAL COLIFORM #/100 ML | OIL & GREASE UG/L | CYANIDE UG/L | pH MINIMUM | | | | | | RAIN |
| 1 | 38 | 7.51 | 19.2 | | 30.4 | <1 | | | 6.66 | | | | | | 0.23 |
| 2 | 18 | 7.40 | 18.73 | | 24.7 | <1 | | | 7.36 | | | | | | 0.01 |
| 3 | | 7.38 | 19.16 | | | <1 | | | 7.36 | | | | | | 0 |
| 4 | | 7.36 | 19.4 | | | <1 | | | 7.34 | | | | | | .18 |
| 5 | | 7.38 | 18.98 | | | <1 | | | 7.32 | | | | | | .36 |
| 6 | 40 | 7.36 | 18.56 | | 20.1 | 2 | | | 7.30 | | | | | | .17 |
| 7 | 19 | 7.32 | 18.59 | | 22.4 | <1 | | | 7.27 | | | | | | .06 |
| 8 | 18 | 7.29 | 19.61 | | 23.6 | <1 | | | 7.25 | | | | | | 0 |
| 9 | 53 | 7.27 | 19.6 | | 19.9 | <1 | | | 7.19 | | | | | | 0 |
| 10 | | 7.26 | 19.4 | | | <1 | | | 7.24 | | | | | | .15 |
| 11 | | 7.31 | 19.35 | | | <1 | | | 7.26 | | | | | | .23 |
| 12 | | 7.31 | 19.61 | | | <1 | | | 7.22 | | | | | | .02 |
| 13 | 17 | 7.26 | 19.81 | | 19.7 | <1 | | | 7.22 | | | | | | 0 |
| 14 | 32 | 7.24 | 19.61 | | 23.8 | <1 | | | 7.22 | | | | | | .01 |
| 15 | 35 | 7.24 | 20.0 | | 22.8 | <1 | | | 7.20 | | | | | | 0 |
| 16 | 22 | 7.22 | 19.81 | | 21.4 | <1 | | | 7.20 | | | | | | .88 |
| 17 | | 7.31 | 19.05 | | | <1 | | | 7.20 | | | | | | .02 |
| 18 | | 7.31 | 19.7 | | | <1 | | | 7.26 | | | | | | .01 |
| 19 | | 7.28 | 20.13 | | | <1 | | | 7.22 | | | | | | .20 |
| 20 | 19 | 7.24 | 20.61 | | 19.3 | <1 | | | 7.17 | | | | | | 0 |
| 21 | 36 | 7.20 | 20.21 | | 18.4 | <1 | | | 7.17 | | | | | | .07 |
| 22 | 57 | 7.20 | 20.41 | | 21.1 | <1 | | | 7.15 | | | | | | .11 |
| 23 | 70 | 7.22 | 20.62 | | 20 | <1 | | | 7.15 | | | | | | 0 |
| 24 | | 7.30 | 20.81 | | | <1 | | | 7.22 | | | | | | 0 |
| 25 | | 7.30 | 20.81 | | | <1 | | | 7.28 | | | | | | 0 |
| 26 | | 7.28 | 20.61 | | | <1 | | | 7.26 | | | | | | .26 |
| 27 | 41 | 7.30 | 20.21 | | 18.7 | <1 | | | 7.28 | | | | | | .25 |
| 28 | 53 | 7.30 | 19.81 | | 18.4 | <1 | | | 7.21 | | | | | | 0 |
| 29 | 71 | 7.30 | 20.8 | | 18.7 | <1 | | | 7.17 | | | | | | 0 |
| 30 | 89 | 7.26 | 21.21 | | 23.5 | <1 | | | 7.15 | | | | | | 0 |
| 31 | | | | | | | | | | | | | | | |
| Total | | | | | | | | | | | | | | | |
| | AVG 33 | MIN 7.2 | | AVG | AVG 21.5 | GEM 2 | AVG | AVG | 6.66 | | | | | | 3.22" |
| Permit | 1037 | 5 | | 7 | 20 | 200 | | | | | | | | | |
| | AVW 64 | MIN 7.51 | MAX 21.21 | MAX | MAX 30.4 | GM7 2 | | | 7.36 | | | | | | |
| Limits | 1625 | 9 | | 15 | 41 | 400 | | | | | | | | | |

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Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month JUNE | Year 2005

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection | Population 14 500

| | INFLUENT | | | | | | | | | EFFLUENT | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK | CONT | 4/WEEK | 4/YR | 4/YR | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK |
| Date | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY LBS/DAY | TSS MG/L | TSS LBS/DAY | pH STANDARD UNITS | AMMONIA MG/L | OIL & GREASE MG/L | CYANIDE UG/L | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY % REMOVAL | BOD 5-DAY LBS/DAY | TSS MG/L | TSS % REMOVAL |
| 1 | 2.218 | 102 | 1887 | 91 | 1683 | 7.23 | 31.7 | | | 2.255 | 2 | 98 | 40 | 2 | 98 |
| 2 | 2.124 | 84 | 1488 | 90 | 1594 | 6.07 | 38.7 | | | 2.158 | 1 | 99 | 18 | 1 | 99 |
| 3 | 1.949 | | | | | 5.92 | | | | 2.062 | | | | | |
| 4 | 1.966 | | | | | 6.39 | | | | 2.005 | | | | | |
| 5 | 2.359 | | | | | 5.93 | | | | 2.411 | | | | | |
| 6 | 2.206 | 177 | 3256 | 380 | 6991 | 7.36 | 43.3 | | | 2.395 | 21 | 88 | 419 | 2 | 99 |
| 7 | 2.26 | 158 | 2978 | 259 | 4882 | 7.86 | 38.4 | | | 2.323 | 13 | 92 | 252 | 1 | 99 |
| 8 | 2.076 | 104 | 1801 | 182 | 3151 | 7.22 | 38.5 | | | 2.129 | 8 | 92 | 142 | 1 | 99 |
| 9 | 1.987 | 116 | 1927 | 151 | 2502 | 7.21 | 38.9 | | | 2.138 | 24 | 79 | 427 | 3 | 98 |
| 10 | 1.992 | | | | | 7.31 | | | | 2.164 | | | | | |
| 11 | 1.978 | | | | | 7.31 | | | | 2.019 | | | | | |
| 12 | 2.066 | | | | | 7.18 | | | | 2.155 | | | | | |
| 13 | 1.99 | 123 | 2041 | 149 | 2473 | 7.24 | 37.4 | | | 2.062 | 3 | 98 | 52 | 1 | 99 |
| 14 | 1.967 | 127 | 2023 | 176 | 2803 | 7.25 | 45.7 | | | 1.967 | 4 | 97 | 66 | 2 | 99 |
| 15 | 1.963 | 104 | 1703 | 125 | 2046 | 7.28 | 44.5 | | | 2.088 | 7 | 93 | 122 | 2 | 98 |
| 16 | 2.529 | 105 | 3164 | 217 | 4577 | 7.31 | 33.6 | | | 2.676 | 10 | 93 | 223 | 1 | 99 |
| 17 | 2.198 | | | | | 7.31 | | | | 2.302 | | | | | |
| 18 | 2.037 | | | | | 7.16 | | | | 2.148 | | | | | |
| 19 | 2.162 | | | | | 7.15 | | | | 2.263 | | | | | |
| 20 | 2.115 | 142 | 2504 | 181 | 3175 | 7.17 | 37.8 | | | 2.243 | 13 | 91 | 244 | 1 | 99 |
| 21 | 2.046 | 143 | 2440 | 270 | 4607 | 7.17 | 38.5 | | | 2.162 | 8 | 94 | 144 | 2 | 99 |
| 22 | 2.105 | 144 | 2528 | 607 | 10656 | 7.39 | 39 | | | 2.265 | 12 | 92 | 226 | 3 | 100 |
| 23 | 1.996 | 83 | 1381 | 378 | 6292 | 7.10 | 42 | | | 2.093 | 5 | 93 | 87 | 4 | 99 |
| 24 | 1.857 | | | | | 7.18 | | | | 1.962 | | | | | |
| 25 | 1.855 | | | | | 7.58 | | | | 1.956 | | | | | |
| 26 | 2.018 | | | | | 7.18 | | | | 2.067 | | | | | |
| 27 | 2.392 | 102 | 2035 | 126 | 2514 | 7.43 | 39.0 | | | 2.446 | 5 | 95 | 102 | 2 | 98 |
| 28 | 2.084 | 121 | 2103 | 132 | 2294 | 7.21 | 42.5 | | | 2.147 | 2 | 98 | 36 | 3 | 98 |
| 29 | 2.047 | 91 | 1554 | 112 | 1912 | 7.21 | 48.8 | | | 2.134 | 3 | 97 | 53 | 4 | 96 |
| 30 | 1.954 | 91 | 1483 | 112 | 1825 | 7.25 | 48.5 | | | 2.138 | 15 | 84 | 267 | 5 | 89 |
| 31 | | | | | | | | | | | | | | | |
| Total | | | | | | | | | | | | | | | |
| | AVG 2.066 | AVG 118 | AVG 2128 | AVG 208 | AVG 3665 | MIN 5.92 | AVG 40.4 | AVG | AVG | AVG 2.176 | AVG 9 | AVG 93 | AVG 162 | AVG 2 | AVG 98 |
| Permit | 6.1 | | 5616 | | 6405 | | | | | | 20 | 70 | 1017 | 20 | 70 |
| | MAX 2.529 | MAX 144 | MAX 3256 | MAX 607 | MAX 10656 | MAX 7.86 | MAX 48.8 | | | MAX 2.676 | AVW 16.5 | | AVW 310 | AVW 7 | |
| Limits | | | | | | | | | | | 30 | | 1525 | 30 | |

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GM7=highest 7-day Geometric Mean

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# WASTEWATER TREATMENT PLANT MONITORING REPORT

( No. WA0020249 | Month JULY | Year 2005

ity Name City of Camas | County Clark

eceiving Water Columbia River | Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection | Population 14500

EFFLUENT CONT

| Frequency | 4/WEEK | CONT | CONT | 4/WEEK | 4/WEEK | DAILY | 4/YR | 4/YR | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | TSS LBS/DAY | pH STANDARD UNITS | TEMPERATURE DEG C | AMMONIA MG/L (WINTER) | AMMONIA MG/L (SUMMER) | FECAL COLIFORM #/100 ML | OIL & GREASE UG/L | CYANIDE UG/L | pH MINIMUM | | | | | | RAIN |
| 1 | | 7.28 | 21.01 | | | <1 | | | 7.24 | | | | | | Ø |
| 2 | | 7.26 | 20.81 | | | <1 | | | 7.22 | | | | | | Ø |
| 3 | | 7.25 | 21.22 | | | <1 | | | 7.18 | | | | | | Ø |
| 4 | 50 | 7.25 | 21.41 | 11.7 → | | <1 | | | 7.16 | | | | | | Ø |
| 5 | 18 | 7.23 | 21.42 | 11.9 → | | <1 | | | 7.14 | | | | | | .06 |
| 6 | 87 | 7.20 | 21.41 | 15.2 → | | <1 | | | 7.14 | | | | | | Ø |
| 7 | 88 | 7.23 | 21.61 | | 14.1 | <1 | | | 7.14 | | | | | | Ø |
| 8 | | 7.26 | 21.01 | | | <1 | | | 7.19 | | | | | | .48 |
| 9 | | 7.24 | 20.79 | | | <1 | | | 7.21 | | | | | | .05 |
| 10 | | 7.28 | 21.0 | | | <1 | | | 7.24 | | | | | | Ø |
| 11 | 17 | 7.26 | 21.41 | 10.9 → | | <1 | | | 7.24 | | | | | | Ø |
| 12 | 65 | 7.24 | 21.59 | 14.2 → | | <1 | | | 7.21 | | | | | | Ø |
| 13 | 84 | 7.24 | 21.59 | | 17.2 | <1 | | | 7.17 | | | | | | Ø |
| 14 | 102 | 7.21 | 22 | | 14.6 | <1 | | | 7.17 | | | | | | Ø |
| 15 | | 7.19 | 22.21 | | | <1 | | | 7.17 | | | | | | Ø |
| 16 | | 7.23 | 22.01 | | | <1 | | | 7.17 | | | | | | Ø |
| 17 | | 7.23 | 22.22 | | | <1 | | | 7.21 | | | | | | Ø |
| 18 | 17 | 7.25 | 22.61 | | 14.1 | <1 | | | 7.21 | | | | | | Ø |
| 19 | 67 | 7.26 | 22.61 | | 14.0 | <1 | | | 7.17 | | | | | | Ø |
| 20 | 69 | 7.26 | 22.6 | | 13.6 | <1 | | | 7.13 | | | | | | Ø |
| 21 | 104 | 7.18 | 22.62 | | 13.1 | 4 | | | 7.07 | | | | | | .11 |
| 22 | | 7.21 | 21.63 | | | <1 | | | 7.07 | | | | | | .01 |
| 23 | | 7.34 | 21.63 | | | 2 | | | 7.16 | | | | | | Ø |
| 24 | | 7.36 | 22.62 | | | <1 | | | 7.25 | | | | | | Ø |
| 25 | 66 | 7.31 | 22.62 | | 11.2 | 1 | | | 7.13 | | | | | | Ø |
| 26 | 116 | 7.31 | 22.8 | | 12.2 | 1 | | | 7.09 | | | | | | Ø |
| 27 | 131 | 7.17 | 23.21 | | 11.75 | <1 | | | 7.11 | | | | | | Ø |
| 28 | 104 | 7.17 | 23.21 | | 12.4 | <1 | | | 7.13 | | | | | | Ø |
| 29 | | 7.18 | 23.21 | | | <1 | | | 7.13 | | | | | | Ø |
| 30 | | 7.18 | 23.22 | | | 1 | | | 7.13 | | | | | | Ø |
| 31 | | 7.18 | 23.22 | | | <1 | | | 7.14 | | | | | | |
| Total | | | | | | | | | | | | | | | |
| | AVG 68 | AVG 7.17 | | AVG | AVG 13.3 | GEM 2 | AVG | AVG | 7.07 | | | | | | .71 |
| Permit | 1017 | 5 | | 7 | 20 | 200 | | | | | | | | | |
| | AVW 79 | MAX 7.36 | MAX 23.22 | MAX | MAX 17.2 | GM7 2 | | | 7.25 | | | | | | |
| Limits | 1625 | 9 | | 15 | 41 | 400 | | | | | | | | | |

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=highest 7-day Geometric Mean

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month JULY | Year 2005

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection | Population 14 500

| | INFLUENT | | | | | | | | | EFFLUENT | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | CONT. | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK | CONT. | 4/WEEK | 4/YR. | 4/YR. | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK |
| Date | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY LBS/DAY | TSS MG/L | TSS LBS/DAY | pH STANDARD UNITS | AMMONIA MG/L | OIL & GREASE MG/L | CYANIDE UG/L | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY % REMOVAL | BOD 5-DAY LBS/DAY | TSS MG/L | TSS % REMOVAL |
| 1 | 1.829 | | | | | 7.28 | | | | 1.987 | | | | | |
| 2 | 1.845 | | | | | 7.22 | | | | 1.941 | | | | | |
| 3 | 1.782 | | | | | 7.23 | | | | 1.903 | | | | | |
| 4 | 1.856 | 109 | 1681 | 141 | 2183 | 7.21 | 33.6 | | | 2.002 | 9 | 92 | 148 | 3 | 98 |
| 5 | 1.982 | 125 | 2066 | 153 | 2529 | 7.31 | 33.4 | | | 2.137 | 7 | 94 | 125 | 1 | 99 |
| 6 | 1.979 | 101 | 1667 | 165 | 2723 | 7.23 | 42.1 | | | 2.086 | 9 | 91 | 157 | 5 | 97 |
| 7 | 1.897 | 120 | 1000 | 169 | 2674 | 7.19 | 44.0 | | | 2.099 | 47 | 61 | 392 | 5 | 97 |
| 8 | 2.046 | | | | | 7.69 | | | | 2.128 | | | | | |
| 9 | 2.019 | | | | | 7.28 | | | | 2.138 | | | | | |
| 10 | 2.032 | | | | | 7.33 | | | | 2.118 | | | | | |
| 11 | 2.054 | 196 | 3340 | 237 | 4060 | 7.24 | 37.6 | | | 2.081 | 14 | 93 | 243 | 1 | 99 |
| 12 | 1.945 | 133 | 2157 | 252 | 4088 | 7.19 | 40.1 | | | 1.941 | 24 | 82 | 389 | 4 | 98 |
| 13 | 1.976 | 175 | 2884 | 446 | 7350 | 7.24 | 55.9 | | | 2.012 | 8 | 95 | 134 | 5 | 99 |
| 14 | 1.924 | 220 | 3530 | 330 | 5295 | 7.21 | 39.8 | | | 2.042 | 31 | 86 | 528 | 6 | 98 |
| 15 | 1.834 | | | | | 7.25 | | | | 1.975 | | | | | |
| 16 | 1.869 | | | | | 7.23 | | | | 1.982 | | | | | |
| 17 | 1.861 | | | | | 7.23 | | | | 1.966 | | | | | |
| 18 | 1.94 | 221 | 3576 | 418 | 6763 | 7.29 | 39.7 | | | 2.047 | 9 | 96 | 154 | 1 | 99 |
| 19 | 1.905 | 115 | 1827 | 212 | 3368 | 7.29 | 39.2 | | | 2.020 | 14 | 88 | 236 | 4 | 98 |
| 20 | 1.946 | 205 | 3327 | 376 | 6102 | 7.28 | 36.6 | | | 2.070 | 15 | 93 | 259 | 4 | 99 |
| 21 | 1.959 | 102 | 1666 | 235 | 3839 | 7.26 | 34.6 | | | 2.088 | 10 | 90 | 174 | 6 | 97 |
| 22 | 1.913 | | | | | 7.23 | | | | 1.947 | | | | | |
| 23 | 1.923 | | | | | 7.34 | | | | 1.943 | | | | | |
| 24 | 1.86 | | | | | 7.25 | | | | 1.895 | | | | | |
| 25 | 1.934 | 137 | 2210 | 168 | 2710 | 7.25 | 37.2 | | | 1.971 | 10 | 93 | 164 | 4 | 98 |
| 26 | 1.917 | 85 | 1359 | 110 | 1759 | 7.34 | 41.7 | | | 1.966 | 8 | 91 | 131 | 1 | 99 |
| 27 | 1.887 | 115 | 1810 | 157 | 2471 | 7.16 | 38.6 | | | 1.967 | 12 | 90 | 197 | 8 | 95 |
| 28 | 1.99 | 187 | 3104 | 306 | 5079 | 7.15 | 38.6 | | | 2.073 | 12 | 94 | 207 | 6 | 98 |
| 29 | 1.862 | | | | | 7.15 | | | | 1.919 | | | | | |
| 30 | 1.91 | | | | | 7.19 | | | | 1.998 | | | | | |
| 31 | 1.951 | | | | | 7.28 | | | | 2.076 | | | | | |
| Total | | | | | | | | | | | | | | | |
| | AVG 1.923 | AVG 147 | AVG 2325 | AVG 242 | AVG 3937 | MIN 7.15 | AVG 39.5 | AVG | AVG | AVG 1.95 | AVG 15 | AVG 89 | AVG 227 | AVG 4 | AVG 98 |
| Permit | 6.1 | | 5615 | | 6405 | | | | | | 20 | 70 | 1017 | 20 | 78 |
| | MAX 2.054 | MAX 181 | MAX 3576 | MAX 418 | MAX 7350 | MAX 7.69 | MAX 55.9 | | | MAX 2.138 | AVW 19 | | AVW 324 | AVW 4.75 | |
| Limits | | | | | | | | | | | 30 | | 1525 | 30 | |

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AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=highest 7-day Geometric Mean

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month AUGUST | Year 2005

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection | Population 14500

EFFLUENT CONT

| Frequency | 4/WEEK | CONT | CONT | 4/WEEK | 4/WEEK | DAILY | 4/YR | 4/YR | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | TSS LBS/DAY | pH STANDARD UNITS | TEMPERATURE DEG C | AMMONIA MGL (WINTER) | AMMONIA MGL (SUMMER) | FECAL COLIFORM #/100 ML | OIL & GREASE UG/L | CYANIDE UG/L | pH MINIMUM | | | | | | R-2-n |
| 1 | 51 | 7.22 | 22.6 | | 12.5 | <1 | | | 7.18 | | | | | | 0 |
| 2 | 84 | 7.22 | 22.87 | | 9.3 | <1 | | | 7.12 | | | | | | 0 |
| 3 | 17 | 7.17 | 23.1 | | 9.6 | <1 | | | 7.12 | | | | | | 0 |
| 4 | 32 | 7.17 | 22.3 | | 8.1 | <1 | | | 7.12 | | | | | | 0 |
| 5 | | 7.17 | 22.7 | | | <1 | | | 7.14 | | | | | | 0 |
| 6 | | 7.17 | 23.3 | | | <1 | | | 7.12 | | | | | | 0 |
| 7 | | 7.17 | 23.3 | | | <1 | | | 7.10 | | | | | | 0 |
| 8 | 51 | 7.36 | 23.3 | | 10.4 | <1 | | | 7.10 | | | | | | 0 |
| 9 | 83 | 7.28 | 23.3 | | 13.2 | 2 | | | 7.19 | | | | | | 0 |
| 10 | 84 | 7.24 | 22.9 | | 11.3 | 2 | | | 7.17 | | | | | | 0 |
| 11 | 136 | 7.17 | 22.7 | | 13.1 | 1 | | | 7.13 | | | | | | 0 |
| 12 | | 7.15 | 22.9 | | | <1 | | | 7.08 | | | | | | 0 |
| 13 | | 7.17 | 22.3 | | | <1 | | | 7.06 | | | | | | 0 |
| 14 | | 7.15 | 22.6 | | | 4 | | | 7.08 | | | | | | 0 |
| 15 | 153 | 7.18 | 23.6 | | 12.6 | <1 | | | 7.09 | | | | | | 0 |
| 16 | 67 | 7.18 | 23.5 | | 12.4 | <1 | | | 7.09 | | | | | | 0 |
| 17 | 138 | 7.14 | 22.7 | | 11.3 | <1 | | | 7.08 | | | | | | .06 |
| 18 | 101 | 7.17 | 22.3 | | 12.1 | 3 | | | 7.05 | | | | | | 0 |
| 19 | | 7.24 | 23.6 | | | <1 | | | 6.64 | | | | | | 0 |
| 20 | | 7.12 | 23.5 | | | 6 | | | 7.07 | | | | | | 0 |
| 21 | 135 | 7.14 | 23.5 | | | 2 | | | 7.07 | | | | | | 0 |
| 22 | 8 | 7.17 | 22.9 | | 8.3 | <1 | | | 7.09 | | | | | | 0 |
| 23 | 68 | 7.17 | 22.5 | | 8.9 | <1 | | | 7.13 | | | | | | 0 |
| 24 | 102 | 7.22 | 22.7 | | 12.3 | <1 | | | 7.14 | | | | | | 0 |
| 25 | 163 | 7.16 | 23.1 | | 13.7 | <1 | | | 7.04 | | | | | | 0 |
| 26 | | 7.06 | 23.3 | | | 8 | | | 7.00 | | | | | | 0 |
| 27 | | 7.16 | 23.3 | | | 8 | | | 6.99 | | | | | | 0 |
| 28 | | 7.08 | 23.2 | | | 1 | | | 6.99 | | | | | | 0 |
| 29 | 108 | 7.21 | 22.8 | | 11.9 | <1 | | | 7.01 | | | | | | .68 |
| 30 | 67 | 7.28 | 22.8 | | 14.2 | <1 | | | 7.03 | | | | | | 0 |
| 31 | 17 | 7.23 | 23.0 | | 15.4 | <1 | | | 7.15 | | | | | | 0 |
| Total | | | | | | | | | | | | | | | |
| | AVW 87 | AVW 7.06 | | AVG | AVG 11.6 | GEM 2 | AVG | AVG | 6.64 | | | | | | .74" |
| Permit | 1037 | 5 | | 7 | 20 | 200 | | | | | | | | | |
| | MAX 117 | MIN 7.36 | MAX 23.6 | MAX | MAX 15.4 | GM7 2 | | | 7.19 | | | | | | |
| Limits | 1625 | 9 | | 15 | 41 | 400 | | | | | | | | | |

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=highest 7-day Geometric Mean

Certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month August | Year 2005

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection | Population 14 500

| | INFLUENT | | | | | | | | | EFFLUENT | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | CONT. | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK | CONT. | 4/WEEK | 4/YR. | 4/YR. | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK |
| Date | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY LBS/DAY | TSS MG/L | TSS LBS/DAY | pH STANDARD UNITS | AMMONIA MG/L | CHLORINE RESIDUAL UG/L | CYANIDE UG/L | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY % REMOVAL | BOD 5-DAY LBS/DAY | TSS MG/L | TSS % REMOVAL |
| 1 | 1.964 | 138 | 2260 | 168 | 2752 | 7.26 | 35.5 | | | 2.039 | 9 | 93 | 153 | 3 | 98 |
| 2 | 1.897 | 93 | 1471 | 134 | 2120 | 7.26 | 40.4 | | | 2.004 | 7 | 92 | 117 | 5 | 96 |
| 3 | 1.931 | 121 | 1949 | 154 | 2408 | 7.17 | 35.3 | | | 2.064 | 15 | 88 | 258 | 1 | 99 |
| EST 4 | 1.845 | 173 | 2662 | 210 | 3231 | 7.18 | 40.6 | | | 1.957 | 7 | 96 | 114 | 2 | 99 |
| Est. 5 | 1.850 | | | | | 7.15 | | | | 1.945 | | | | | |
| 6 | 1.918 | | | | | 7.10 | | | | 1.971 | | | | | |
| 7 | 2.04 | | | | | 7.29 | | | | 2.07 | | | | | |
| 8 | 2.032 | 86 | 1459 | 192 | 3254 | 7.29 | 41.2 | | | 2.056 | 6 | 93 | 103 | 3 | 98 |
| 9 | 1.977 | 130 | 2142 | 178 | 2935 | 7.33 | 41.6 | | | 1.999 | 7 | 95 | 117 | 5 | 97 |
| 10 | 1.986 | 117 | 1938 | 131 | 2170 | 7.27 | 38.3 | | | 2.017 | 8 | 93 | 135 | 5 | 96 |
| 11 | 1.979 | 164 | 2707 | 306 | 5050 | 7.25 | 36.1 | | | 2.038 | 6 | 96 | 102 | 8 | 97 |
| 12 | 1.969 | | | | | 7.17 | | | | 1.999 | | | | | |
| 13 | 1.927 | | | | | 7.31 | | | | 1.952 | | | | | |
| 14 | 1.983 | | | | | 7.52 | | | | 2.038 | | | | | |
| 15 | 1.992 | 143 | 2376 | 264 | 4386 | 7.20 | 40.7 | | | 2.039 | 6 | 96 | 102 | 9 | 96 |
| 16 | 2.003 | 139 | 2322 | 202 | 3374 | 7.26 | 64.2 | | | 2.015 | 6 | 96 | 101 | 4 | 98 |
| 17 | 2.024 | 120 | 2026 | 202 | 3410 | 7.34 | 38.6 | | | 2.065 | 6 | 95 | 103 | 8 | 96 |
| 18 | 1.925 | 147 | 2360 | 238 | 3821 | 7.33 | 40.1 | | | 2.022 | 5 | 97 | 84 | 6 | 97 |
| 19 | 1.928 | | | | | 7.33 | | | | 2.020 | | | | | |
| 20 | 1.954 | | | | | 7.24 | | | | 2.011 | | | | | |
| 21 | 2.027 | | | | | 6.76 | | | | 2.045 | | | | | |
| 22 | 2.017 | 149 | 2510 | 250 | 4205 | 6.02 | 36.2 | | | 2.025 | 9 | 94 | 155 | 8 | 97 |
| 23 | 2.024 | 151 | 2549 | 300 | 5064 | 5.80 | 39.6 | | | 2.026 | 5 | 97 | 84 | 4 | 99 |
| 24 | 1.995 | 96 | 1597 | 148 | 2462 | 5.82 | 39.3 | | | 2.050 | 5 | 95 | 85 | 6 | 96 |
| 25 | 2.054 | 95 | 1627 | 117 | 2004 | 7.57 | 38.5 | | | 2.167 | 9 | 91 | 163 | 9 | 92 |
| 26 | 1.886 | | | | | 5.86 | | | | 1.950 | | | | | |
| 27 | 1.903 | | | | | 6.92 | | | | 1.918 | | | | | |
| 28 | 2.202 | | | | | 6.89 | | | | 2.197 | | | | | |
| 29 | 2.155 | 107 | 1923 | 181 | 3253 | 6.29 | 39.4 | | | 2.164 | 6 | 94 | 108 | 6 | 97 |
| 30 | 1.997 | 96 | 1599 | 134 | 2232 | 7.04 | 38.5 | | | 2.023 | 4 | 96 | 67 | 4 | 97 |
| 31 | 2.017 | 76 | 1278 | 32 | 538 | 6.11 | 38.2 | | | 2.055 | 6 | 92 | 103 | 1 | 97 |
| Total | | | | | | | | | | | | | | | |
| | AVG 1.981 | AVG 123 | AVG 2040 | AVG 186 | AVG 3088 | MIN 5.8 | AVG 40.1 | AVG | AVG | AVG 2.030 | AVG 6.8 | AVG 94 | AVG 118 | AVG 5.1 | AVG 97 |
| Permit | 6.5 | | 5635 | | 6405 | | | | | | 20 | 70 | 1017 | 20 | 78 |
| | MAX 2.155 | MAX 173 | MAX 2707 | MAX 306 | MAX 5064 | MAX 7.57 | MAX 64.2 | | | MAX 2.197 | AVW 10 | | AVW 161 | AVW 6.75 | |
| Limits | | | | | | | | | | | 30 | | 1525 | 30 | |

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

AVG=Average AVW=Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=highest 7-day Geometric Mean

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month Sept | Year 2005

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator J. Dickinson

Plant Type Activated Sludge w/UV Disinfection | Population 15360

| | INFLUENT | | | | | | | | | | EFFLUENT | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK | CONT | CONT | 4/WEEK | 4/YR | 4/YR | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK |
| Date | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY LBS/DAY | TSS MG/L | TSS LBS/DAY | pH (DAILY MIN) STANDARD UNITS | pH (DAILY MAX) STANDARD UNITS | AMMONIA MG/L | OIL & GREASE MG/L | CYANIDE MG/L | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY % REMOVAL | BOD 5-DAY LBS/DAY | TSS MG/L |
| 1 | 1.994 | 106 | 1763 | 224 | 3725 | 5.88 | 5.97 | 40 | | | 2.07 | 4 | 96 | 69 | 6 |
| 2 | 1.983 | | | | | 5.90 | 7.04 | | | | 1.991 | | | | |
| 3 | 2.017 | | | | | 6.34 | 6.60 | | | | 2.038 | | | | |
| 4 | 1.929 | | | | | 6.23 | 6.94 | | | | 1.946 | | | | |
| 5 | 2.155 | 183 | 3289 | 218 | 3918 | 6.23 | 7.16 | 48.6 | | | 2.182 | 7 | 96 | 127 | 3 |
| 6 | 2.028 | 134 | 2266 | 192 | 3247 | 6.24 | 7.16 | 38.4 | | | 2.12 | 11 | 92 | 194 | 4 |
| 7 | 1.961 | 121 | 1979 | 170 | 2780 | 6.04 | 6.64 | 41.2 | | | 2.007 | 18 | 85 | 301 | 6 |
| 8 | 1.986 | 139 | 2302 | 182 | 3014 | 6.59 | 7.32 | 37 | | | 2.022 | 9 | 94 | 152 | 7 |
| 9 | 1.899 | | | | | 6.85 | 7.39 | | | | 1.901 | | | | |
| 10 | 1.983 | | | | | 6.84 | 7.17 | | | | 1.975 | | | | |
| 11 | 2.098 | 84 ? | 1352 ? | | | 5.91 | 7.29 | | | | 2.111 | 7 ? | 92 ? | 116 ? | |
| 12 | 1.973 | | | 123 | 2024 | 5.73 | 7.29 | 34.4 | | | 1.995 | | | | 8 |
| 13 | 1.995 | 117 | 1947 | 199 | 3311 | 6.71 | 7.17 | 43.0 | | | 1.994 | 5 | 96 | 83 | 3 |
| 14 | 1.957 | 211 | 3444 | 338 | 5516 | 6.59 | 7.17 | 42 | | | 1.963 | 9 | 96 | 147 | 9 |
| 15 | 1.991 | 93 | 1544 | 100 | 1660 | 6.36 | 7.17 | 47.6 | | | 2.049 | 6 | 94 | 104 | 6 |
| 16 | 1.992 | | | | | 6.25 | 7.03 | | | | 1.958 | | | | |
| 17 | 1951 | | | | | 6.45 | 7.14 | | | | 1.964 | | | | |
| 18 | 2.135 | | | | | 6.69 | 7.19 | | | | 2.134 | | | | |
| 19 | 2.069 | 141 | 2433 | 228 | 3934 | 3.84 | 7.22 | 43.2 | | | 2.07 | 3 | 98 | 52 | 5 |
| 20 | 1.983 | 104 | 1720 | 91 | 1505 | 6.28 | 7.13 | 43.6 | | | 1.972 | 5 | 95 | 82 | 20 |
| 21 | 1.962 | 105 | 1718 | 188 | 3076 | 6.28 | 7.18 | 48.7 | | | 1.972 | 3 | 97 | 49 | 8 |
| 22 | 1.954 | 128 | 2085 | 428 | 6974 | 5.52 | 7.38 | 46 | | | 2.034 | 7 | 95 | 118 | 5 |
| 23 | 1.832 | | | | | 6.76 | 7.15 | | | | 1.939 | | | | |
| 24 | 1.906 | | | | | 6.66 | 7.11 | | | | 1.943 | | | | |
| 25 | 2.053 | | | | | 6.55 | 7.18 | | | | 2.086 | | | | |
| 26 | 1.933 | 212 | 3417 | 302 | 4869 | 5.95 | 7.54 | 46.3 | | | 1.965 | 8 | 96 | 131 | 3 |
| 27 | 1.948 | 134 | 2177 | 222 | 3610 | 6.01 | 7.25 | 39 | | | 1.950 | 1 | 99 | 16 | 5 |
| 28 | 1.912 | 96 | 1531 | 118 | 1881 | 6.75 | 7.15 | 40 | | | 1.947 | 7 | 93 | 114 | 2 |
| 29 | 2.005 | 109 | 1657 | 292 | 4883 | 6.66 | 7.32 | 39.8 | | | 2.029 | 7 | 94 | 121 | 5 |
| 30 | 3.341 | | | | | 6.54 | 7.32 | | | | 3.383 | | | | |
| 31 | | | | | | | | | | | | | | | |
| Total | | | | | | | | | | | | | | | |
| | AVG 2.030 | AVG 130 | AVG 2156 | AVG 213 | AVG 3525 | MIN 3.84 | | AVG 42.3 | AVG | AVG | AVG 2.057 | AVG 7 | AVG 95 | AVG 116 | AVG 6.18 |
| Permit | 6.1 | | 5616 | | 6405 | | | | | | | 20 | 70 | 1017 | 20 |
| | MAX 3.341 | MAX 212 | MAX 3444 | MAX 428 | MAX 6974 | | MAX 7.54 | MAX 48.7 | | | MAX 3.383 | AVW 11 | | AVW 194 | AVW 9.5 |
| Limits | | | | | | | | | | | | 30 | | 1525 | 30 |

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Oly

AVG=Average AVW =Highest Weekly Average GEM=Geometric Me

M7=highest 7-day Geometric Mean

No, inflight

I certify under penalty of law, that this document and all attachments were prepared under ... em designed to assure that qualified personnel properly gathered and evaluated the informatic ... rsons who manage the system or those persons directly responsible for gathering information, th ... ge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting ... mprisonment for knowing violations.

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month Sept | Year 2005

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator J. Dickinson

Plant Type Activated Sludge w/UV Disinfection | Population 15360

EFFLUENT CONT.

| Frequency | 4/WEEK | 4/WEEK | CONT | CONT | CONT | 4/WEEK | 4/WEEK | DAILY | 4/YR | 4/YR | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | TSS % REMOVAL | TSS LBS/DAY | pH (DAILY MIN) STANDARD UNITS | pH (DAILY MAX) STANDARD UNITS | TEMPERATURE DEG C | AMMONIA MG/L (WINTER) | AMMONIA MG/L (SUMMER) | FECAL COLIFORM #/100 ML | OIL & GREASE UG/L | CYANIDE UG/L | | | | | N-O-R |
| 1 | 97 | 104 | 7.06 | 7.19 | 23.2 | 16.2 → | | <1 | | | | | | | ⊖ |
| 2 | | | 6.34 | 7.35 | 23.0 | | | <1 | | | | | | | ⊖ |
| 3 | | | 7.09 | 7.18 | 23 | | | <1 | | | | | | | / |
| 4 | | | 7.11 | 7.20 | 23 | | | | | | | | | | ⊖ |
| 5 | 99 | 55 | 7.1 | 7.20 | 23 | | 19.7 | <1 | | | | | | | ⊖ |
| 6 | 98 | 71 | 7.13 | 7.22 | 22.6 | | 16.7 | <1 | | | | | | | ⊖ |
| 7 | 96 | 100 | 7.19 | 7.25 | 22.9 | | 18.3 | <1 | | | | | | | ⊖ |
| 8 | 96 | 118 | 6.17 | 7.34 | 22.9 | | 20 | <1 | | | | | | | ⊖ |
| 9 | | | 7.14 | 7.21 | 22.3 | | | <1 | | | | | | | ⊖ |
| 10 | | | 7.10 | 7.21 | 22.3 | | | <1 | | | | | | | .01 |
| 11 | | | 7.02 | 7.10 | 22.3 | | | <1 | | | | | | | ⊖ |
| 12 | 93 | 133 | 6.25 | 7.16 | 22.3 | | 19.4 | <1 | | | | | | | ⊖ |
| 13 | 98 | 50 | 7.09 | 7.18 | 22.5 | | 20.4 | <1 | | | | | | | ⊖ |
| 14 | 97 | 146 | 7.10 | 7.23 | 21.9 | | 22 | <1 | | | | | | | ⊖ |
| 15 | 94 | 103 | 7.09 | 7.23 | 22.5 | | 26.2 | <1 | | | | | | | ⊖ |
| 16 | | | 7.10 | 7.17 | 21.9 | | | <1 | | | | | | | ⊖ |
| 17 | | | 7.02 | 7.13 | 22.12 | | | <1 | | | | | | | ⊖ |
| 18 | | | 7.00 | 7.06 | 21.9 | | | <1 | | | | | | | ⊖ |
| 19 | 98 | 86 | 6.54 | 7.46 | 21.9 | | 22.5 | <1 | | | | | | | ⊖ |
| 20 | 78 | 329 | 7.01 | 7.07 | 22.1 | | 25.1 | <1 | | | | | | | ⊖ |
| 21 | 96 | 132 | 6.52 | 7.16 | 22.1 | | 26.6 | <1 | | | | | | | ⊖ |
| 22 | 99 | 85 | 6.52 | 7.15 | 21.7 | | 21.7 | <1 | | | | | | | ⊖ |
| 23 | | | 7.01 | 7.10 | 21.7 | | | <1 | | | | | | | ⊖ |
| 24 | | | 7.06 | 7.10 | 21.3 | | | <1 | | | | | | | ⊖ |
| 25 | | | 7.06 | 7.12 | 21.5 | | | <1 | | | | | | | ⊖ |
| 26 | 99 | 49 | 7.06 | 7.13 | 21.7 | | 25.5 | <1 | | | | | | | ⊖ |
| 27 | 98 | 81 | 7.20 | 7.20 | 21.7 | | 22 | <1 | | | | | | | ⊖ |
| 28 | 98 | 32 | 6.69 | 7.19 | 21.7 | | 25 | <1 | | | | | | | ⊖ |
| 29 | 98 | 85 | 7.02 | 7.15 | 21.3 | | 25.4 | <1 | | | | | | | ⊖ |
| 30 | | | 6.93 | 7.13 | 21.5 | | | 12 | | | | | | | 2.36 |
| 31 | | | | | | | | | | | | | | | |
| Total | | | | | | | | | | | | | | | |
| | AVG 96 | AVG 103.5 | MIN 6.25 | | | AVG | AVG 21.9 | GEM 2 | AVG | AVG | | | | | 2.37 |
| Permit | 70 | 1017 | 6 | | | 7 | 20 | 200 | | | | | | | |
| | | AVW 158 | | MAX 7.46 | MXD 23.2 | MXD | MXD 26.6 | GM7 2 | | | | | | | |
| Limits | | 1525 | | 9 | | 15 | 41 | 400 | | | | | | | |

**Please Circle ALL Permit Violations** **Mail to P.O. Box 47775, Olympia WA 98504-7775**

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=highest 7-day Geometric Mean

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month October | Year 2005

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator J. Dickinson

Plant Type Activated Sludge w/UV Disinfection | Population 15360

| | INFLUENT | | | | | | | | | | EFFLUENT | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK | CONT | CONT | 4/WEEK | 4/YR | 4/YR | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK |
| Date | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY LBS/DAY | TSS MG/L | TSS LBS/DAY | pH (DAILY MIN) STANDARD UNITS | pH (DAILY MAX) STANDARD UNITS | AMMONIA MG/L | OIL & GREASE µG/L | CYANIDE µG/L | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY % REMOVAL | BOD 5-DAY LBS/DAY | TSS MG/L |
| 1 | 2.293 | | | | | 6.49 | 7.17 | | | | 2.312 | | | | |
| 2 | 2.403 | | | | | 6.52 | 6.96 | | | | 2.372 | | | | |
| 3 | 2.345 | 190 | 3716 | 414 | 8097 | 6.42 | 7.19 | 42.4 | | | 2.453 | 3 | 98 | 61 | 4 |
| 4 | 2.104 | 92 | 1614 | 232 | 4071 | 6.42 | 7.19 | 43 | | | 2.24 | 4 | 96 | 75 | 5 |
| 5 | 2.071 | 98 | 1693 | 157 | 2712 | 6.71 | 7.19 | 38.7 | | | 2.025 | 4 | 96 | 68 | 5 |
| 6 | 2.103 | 106 | 1859 | 224 | 3929 | 6.64 | 7.22 | 43.1 | | | 2.076 | 5 | 95 | 87 | 3 |
| 7 | 1.952 | | | | | 6.38 | 7.23 | | | | 1.911 | | | | |
| 8 | 2.084 | | | | | 6.42 | 7.10 | | | | 2.021 | | | | |
| 9 | 2.142 | | | | | 5.85 | 7.21 | | | | 2.079 | | | | |
| 10 | 2.076 | 219 | 3792 | 510 | 8830 | 6.45 | 6.87 | 40.6 | | | 2.013 | 10 | 95 | 168 | 3 |
| 11 | 2.033 | 220 | 3730 | 172 | 2916 | 6.48 | 6.90 | 35.2 | | | 1.971 | 6 | 97 | 99 | 1 |
| 12 | 2.104 | 108 | 1895 | 258 | 4527 | 6.45 | 7.31 | 50.1 | | | 2.049 | 6 | 94 | 103 | 1 |
| 13 | 2.177 | 142 | 2578 | 216 | 3922 | 6.54 | 7.02 | 37.7 | | | 2.176 | 7 | 95 | 127 | 1 |
| 14 | 2.076 | | | | | 6.41 | 6.92 | | | | 2.072 | | | | |
| 15 | 2.113 | | | | | 6.57 | 6.94 | | | | 2.085 | | | | |
| 16 | 2.247 | | | | | 6.57 | 7.06 | | | | 2.196 | | | | |
| 17 | 2.175 | 189 | 3437 | 282 | 5115 | 6.41 | 7.14 | 43.8 | | | 2.175 | 10 | 94 | 181 | 3 |
| 18 | 2.127 | 159 | 2821 | 208 | 3690 | 5.92 | 6.83 | 42 | | | 2.116 | 4 | 97 | 71 | 5 |
| 19 | 2.173 | 107 | 1939 | 168 | 3045 | 5.38 | 7.11 | 51.3 | | | 2.158 | 6 | 97 | 114 | 6 |
| 20 | 2.152 | 202 | 3623 | 354 | 6353 | 5.38 | 7.36 | 41.2 | | | 2.163 | 3 | 97 | 54 | 1 |
| 21 | 1.961 | | | | | 6.28 | 6.79 | | | | 1.977 | | | | |
| 22 | 2.009 | | | | | 6.54 | 6.92 | | | | 2.014 | | | | |
| 23 | 2.112 | | | | | 6.41 | 6.91 | | | | 2.083 | | | | |
| 24 | 2.028 | 107 | 1811 | 188 | 3180 | 6.3 | 6.92 | 41 | | | 2.028 | 8 | 93 | 135 | 2 |
| 25 | 2.073 | 102 | 1763 | 110 | 1902 | 6.5 | 6.88 | 37.3 | | | 2.046 | 4 | 96 | 68 | 4 |
| 26 | 2.049 | 81 | 1384 | 150 | 2563 | 6.3 | 6.92 | 46.9 | | | 2.02 | 7 | 91 | 118 | 3 |
| 27 | 2.174 | 134 | 2430 | 234 | 4243 | 6.49 | 7.08 | 36.4 | | | 2.183 | 6 | 96 | 109 | 1 |
| 28 | 2.177 | | | | | 6.51 | 7.10 | | | | 2.12 | | | | |
| 29 | 2.254 | | | | | 5.93 | 6.97 | | | | 2.186 | | | | |
| 30 | 2.469 | | | | | 6.09 | 6.89 | | | | 2.414 | | | | |
| 31 | 4.329 | 81 | 2924 | 126 | 4549 | 6.26 | 6.81 | 22.4 | | | 4.547 | 12 | 85 | 455 | 3 |
| Total | | | | | | | | | | | | | | | |
| | AVG 2.212 | AVG 137.5 | AVG 2530 | AVG 235 | AVG 4332 | MIN 5.38 | | AVG 40.7 | AVG | AVG | AVG 2.202 | AVG 6 | AVG 95 | AVG 123 | AVG 3 |
| Permit | 6.1 | | 5616 | | 6405 | | | | | | | 20 | 70 | 1017 | 20 |
| | MAX 4.329 | MAX 220 | MAX 3792 | MAX 510 | MAX 8830 | | MAX 7.36 | MAX 51.3 | | | MAX 4.547 | AVW 7.3 | | AVW 128 | AVG 4.25 |
| Limits | | | | | | | | | | | | 30 | | 1525 | 30 |

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=highest 7-day Geometric Mean

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 — Month October — Year 2005

Facility Name City of Camas — County Clark

Receiving Water Columbia River — Plant Operator J. Dickinson

Plant Type Activated Sludge w/UV Disinfection — Population 15360

EFFLUENT CONT.

| Frequency | 4/WEEK | 4/WEEK | CONT | CONT | CONT | 4/WEEK | 4/WEEK | DAILY | 4/YR | 4/YR | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | TSS % REMOVAL | TSS LBS/DAY | pH (DAILY MIN) STANDARD UNITS | pH (DAILY MAX) STANDARD UNITS | TEMPERATURE DEG C | AMMONIA MG/L (WINTER) | AMMONIA MG/L (SUMMER) | FECAL COLIFORM #/100 ML | OIL & GREASE UG/L | CYANIDE UG/L | | | | | Nitrate |
| 1 | | | 6.91 | 7.02 | 20.3 | | | <1 | | | | | | | .24 |
| 2 | | | 7.00 | 7.09 | 20.3 | | | <1 | | | | | | | .31 |
| 3 | 99 | 82 | 6.22 | 7.13 | 20.5 | 17.9 | | <1 | | | | | | | .23 |
| 4 | 93 | 93 | 7.05 | 7.11 | 20.1 | 22 | | <1 | | | | | | | ⊖ |
| 5 | 97 | 84 | 7.09 | 7.18 | 20.3 | 24 | | <1 | | | | | | | ⊖ |
| 6 | 99 | 52 | 7.12 | 7.18 | 20.7 | 27.1 | | <1 | | | | | | | .13 |
| 7 | | | 7.08 | 7.14 | 20.9 | | | <1 | | | | | | | 0 |
| 8 | | | 7.06 | 7.13 | 20.7 | | | <1 | | | | | | | .20 |
| 9 | | | 7.08 | 7.15 | 20.9 | | | <1 | | | | | | | .01 |
| 10 | 99 | 50 | 7.17 | 7.37 | 20.6 | 25 | | <1 | | | | | | | .01 |
| 11 | 99 | 16 | 7.00 | 7.33 | 20.8 | 24 | | <1 | | | | | | | .01 |
| 12 | 99 | 17 | 7.00 | 7.37 | 20.8 | 27.4 | | <1 | | | | | | | .24 |
| 13 | 99 | 18 | 7.10 | 7.27 | 20.4 | 28.7 | | <1 | | | | | | | .05 |
| 14 | | | 7.10 | 7.30 | 20.4 | | | <1 | | | | | | | .14 |
| 15 | | | 7.03 | 7.15 | 20.6 | | | 2 | | | | | | | .13 |
| 16 | | | 6.97 | 7.07 | 20.6 | | | <1 | | | | | | | .01 |
| 17 | 99 | 54 | 7.01 | 7.14 | 20.8 | 24.1 | | <1 | | | | | | | ⊖ |
| 18 | 97 | 88 | 7.10 | 7.18 | 20.8 | 26 | | <1 | | | | | | | .15 |
| 19 | 96 | 95 | 7.01 | 7.18 | 20.8 | 25.1 | | <1 | | | | | | | .20 |
| 20 | 99 | 18 | 6.52 | 7.25 | 20.4 | 22 | | <1 | | | | | | | .01 |
| 21 | | | 7.06 | 7.19 | 20.4 | | | <1 | | | | | | | ⊖ |
| 22 | | | 7.17 | 7.22 | 20.6 | | | <1 | | | | | | | ⊖ |
| 23 | | | 7.13 | 7.22 | 20.6 | | | 3 | | | | | | | ⊖ |
| 24 | 99 | 34 | 7.12 | 7.2 | 20.6 | 21 | | <1 | | | | | | | ⊖ |
| 25 | 96 | 68 | 7.12 | 7.18 | 20.6 | 21.7 | | <1 | | | | | | | .27 |
| 26 | 98 | 51 | 7.12 | 7.2 | 20.6 | 22.9 | | <1 | | | | | | | ⊖ |
| 27 | 99 | 18 | 7.10 | 7.19 | 19.8 | 23.4 | | <1 | | | | | | | .44 |
| 28 | | | 7.00 | 7.22 | 19.8 | | | <1 | | | | | | | .09 |
| 29 | | | 6.83 | 7.0 | 19.8 | | | <1 | | | | | | | .10 |
| 30 | | | 7.00 | 7.04 | 19.8 | | | <1 | | | | | | | .85 |
| 31 | 98 | 118 | 6.58 | 7.41 | 19.6 | 16.6 | | <1 | | | | | | | 1.2 |
| Total | | | | | | | | | | | | | | | |
| | AVG 98 | AVG 52 | MIN 6.22 | | | AVG 23.5 | AVG | GEM 2 | AVG | AVG | | | | | 5.02 |
| Permit | 70 | 1017 | 6 | | | 7 | 20 | 200 | | | | | | | |
| | | AVW 78 | | MAX 7.41 | MXD 20.9 | MXD 28.7 | MXD | GM7 2 | | | | | | | |
| Limits | | 1525 | | 9 | | 15 | 41 | 400 | | | | | | | |

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=highest 7-day Geometric Mean

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations

Added by JLS to binder.

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month November | Year 2005

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator J. Dickinson

Plant Type Activated Sludge w/UV Disinfection | Population 15360

| | INFLUENT | | | | | | | | | | EFFLUENT | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK | CONT | CONT | 4/WEEK | 4/YR | 4/YR | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK |
| Date | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY LBS/DAY | TSS MG/L | TSS LBS/DAY | pH (DAILY MIN) STANDARD UNITS | pH (DAILY MAX) STANDARD UNITS | AMMONIA MG/L | OIL & GREASE UG/L | CYANIDE UG/L | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY % REMOVAL | BOD 5-DAY LBS/DAY | TSS MG/L |
| 1 | 4.922 | 78 | 3202 | 109 | 4474 | 6.22 | 6.69 | 17.8 | | | 4.893 | 4 | 95 | 163 | 4 |
| 2 | 2.736 | 69 | 1574 | 108 | 2464 | 6.22 | 6.81 | 26.3 | | | 2.750 | 2.5 | 96 | 57 | 3 |
| 3 | 3.414 | 97 | 2742 | 126 | 3587 | 6.38 | 6.71 | 22 | | | 3.393 | 5 | 95 | 83 | 10 |
| 4 | 3.179 | | | | | 6.23 | 6.65 | | | | 3.192 | | | | |
| 5 | 3.624 | | | | | 6.30 | 6.78 | | | | 3.598 | | | | |
| 6 | 3.212 | | | | | 6.39 | 6.70 | | | | 3.197 | | | | |
| 7 | 2.813 | 76 | 1791 | 104 | 2440 | 6.41 | 6.76 | 24.8 | | | 2.714 | 10 | 87 | 226 | 3 |
| 8 | 2.526 | 77 | 1622 | 114 | 2401 | 6.37 | 6.76 | 33 | | | 2.426 | 4 | 95 | 81 | 10 |
| 9 | 2.370 | 111 | 2194 | 130 | 2569 | 6.45 | 6.92 | 47 | | | 2.337 | 7 | 94 | 136 | 11 |
| 10 | 2.313 | 149 | 2874 | 228 | 4398 | 6.42 | 6.88 | 38 | | | 2.278 | 6 | 96 | 114 | 7 |
| 11 | 2.675 | | | | | 5.26 | 6.96 | | | | 2.578 | | | | |
| 12 | 3.095 | | | | | 6.26 | 6.85 | | | | 2.994 | | | | |
| 13 | 3.265 | | | | | 6.06 | 6.77 | | | | 3.193 | | | | |
| 14 | 2.625 | 102 | 2233 | 161 | 3525 | 6.48 | 7.70 | 54.2 | | | 2.751 | 7 | 93 | 161 | 3 |
| 15 | 2.384 | 67 | 1332 | 104 | 2068 | 6.06 | 7.70 | 36.8 | | | 2.446 | 5 | 96 | 93 | 5 |
| 16 | 2.333 | 108 | 2101 | 132 | 2576 | 6.48 | 6.92 | 44.4 | | | 2.340 | 7 | 94 | 137 | 4 |
| 17 | 2.316 | 145.5 | 2810 | 204 | 3940 | 6.56 | 6.85 | 63.7 | | | 2.258 | 8.3 | 94 | 156.3 | 6 |
| 18 | 2.142 | | | | | 6.49 | 7.06 | | | | 2.062 | | | | |
| 19 | 2.151 | | | | | 6.53 | 7.01 | | | | 2.070 | | | | |
| 20 | 2.226 | | | | | 6.57 | 6.90 | | | | 2.125 | | | | |
| 21 | 2.223 | 106.5 | 1974 | 220 | 4079 | 6.47 | 7.01 | 37.5 | | | 2.137 | 8.85 | 92 | 158 | 6 |
| 22 | 2.102 | 120 | 2104 | 200 | 3506 | 6.31 | 6.83 | 41.1 | | | 2.028 | 5 | 96 | 85 | 6 |
| 23 | 2.146 | 199 | 3562 | 396 | 7087 | 6.31 | 6.87 | 45.2 | | | 2.121 | 7 | 96 | 124 | 3 |
| 24 | 2.234 | 145 | 2702 | 330 | 6148 | 6.42 | 6.86 | 43.0 | | | 2.174 | 9 | 94 | 163 | 5 |
| 25 | 2.671 | | | | | 6.42 | 6.83 | | | | 2.609 | | | | |
| 26 | 2.546 | | | | | 6.50 | 7.00 | | | | 2.495 | | | | |
| 27 | 2.556 | | | 115 | 2367 | 6.52 | 6.92 | 35.4 | | | 2.503 | | | | |
| 28 | 2.468 | 174 | 3585 | | | 6.40 | 7.02 | | | | 2.362 | 5 | 97 | 98 | 5 |
| 29 | 2.435 | 134 | 2721 | 171 | 3473 | 6.43 | 6.87 | 41.3 | | | 2.331 | 16 | 88 | 311 | 5 |
| 30 | 2.285 | 167 | 3183 | 278 | 5298 | 6.49 | 6.82 | 39.3 | | | 2.237 | 8 | 95 | 149 | 4 |
| 31 | | | | | | | | | | | | | | | |
| Total | | | | | | | | | | | | | | | |
| | AVG 2.666 | AVG 118 | AVG 2461 | AVG 179 | AVG 3689 | MIN 5.26 | | AVG 38.4 | AVG | AVG | AVG 2.621 | AVG 7 | AVG 94 | AVG 139 | AVG 5.6 |
| Permit | 6.1 | | 5616 | | 6405 | | | | | | | 20 | 70 | 1017 | 20 |
| | MAX 4.922 | MAX 199 | MAX 3585 | MAX 396 | MAX 7087 | | MAX 7.70 | MAX 63.7 | | | MAX 4.893 | AVW 7.5 | | AVW 186 | AVW 7.75 |
| Limits | | | | | | | | | | | | 30 | | 1525 | 30 |

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

M7=highest 7-day Geometric Mean

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 — Month November Year 2005

Facility Name City of Camas — County Clark

Receiving Water Columbia River — Plant Operator J. Dickinson

Plant Type Activated Sludge w/UV Disinfection — Population 15360

EFFLUENT CONT.

| Frequency | 4/WEEK | 4/WEEK | CONT | CONT | CONT | 4/WEEK | 4/WEEK | DAILY | 4/YR | 4/YR | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | TSS % REMOVAL | TSS LBS/DAY | pH (DAILY MIN) STANDARD UNITS | pH (DAILY MAX) STANDARD UNITS | TEMPERATURE DEG C | AMMONIA MG/L (WINTER) | AMMONIA MG/L (SUMMER) | FECAL COLIFORM #/100 ML | OIL & GREASE UG/L | CYANIDE UG/L | | | | | S-UR |
| 1 | 96 | 163 | 7.09 | 7.56 | 18.4 | 7.8 | | <1 | | | | | | | .58 |
| 2 | 97 | 69 | 6.58 | 7.56 | 19.6 | 12.0 | | <1 | | | | | | | .15 |
| 3 | 92 | 283 | 7.24 | 7.28 | 18.21 | 11.5 | | <1 | | | | | | | .50 |
| 4 | | | 7.15 | 7.30 | 18.21 | | | <1 | | | | | | | .29 |
| 5 | | | 7.02 | 7.20 | 18.01 | | | <1 | | | | | | | .57 |
| 6 | | | 7.02 | 7.07 | 17.8 | | | <1 | | | | | | | .41 |
| 7 | 97 | 68 | 6.74 | 7.18 | 18.01 | 10.28 | | <1 | | | | | | | .01 |
| 8 | 91 | 83 | 7.18 | 7.28 | 18.01 | 15.3 | | <1 | | | | | | | Ø |
| 9 | 92 | 214 | 7.28 | 7.38 | 18.01 | 20 | | <1 | | | | | | | Ø |
| 10 | 96 | 133 | 7.29 | 7.40 | 18.21 | 18 | | <1 | | | | | | | .21 |
| 11 | | | 7.18 | 7.33 | 18.21 | | | <1 | | | | | | | .40 |
| 12 | | | 7.09 | 7.25 | 18.01 | | | <1 | | | | | | | .52 |
| 13 | | | 6.99 | 7.09 | 18.0 | | | <1 | | | | | | | Ø |
| 14 | 98 | 69 | 6.43 | 7.18 | 17.8 | 18.3 | | <1 | | | | | | | Ø |
| 15 | 95 | 102 | 6.99 | 7.22 | 17.8 | 12.3 | | <1 | | | | | | | Ø |
| 16 | 97 | 78 | 7.01 | 7.22 | 17.8 | 14.2 | | <1 | | | | | | | Ø |
| 17 | 97 | 113 | 7.06 | 7.15 | 17.8 | 17.6 | | <1 | | | | | | | Ø |
| 18 | | | 7.06 | 7.11 | 17.8 | | | <1 | | | | | | | Ø |
| 19 | | | 7.09 | 7.18 | 17.61 | | | <1 | | | | | | | Ø |
| 20 | | | 7.14 | 7.21 | 17.61 | | | <1 | | | | | | | Ø |
| 21 | 97 | 107 | 7.05 | 7.21 | 17.6 | 16.4 | | <1 | | | | | | | Ø |
| 22 | 97 | 101 | 6.51 | 7.32 | 17.5 | 16.5 | | <1 | | | | | | | Ø |
| 23 | 99 | 53 | 7.09 | 7.17 | 17.2 | 15.6 | | <1 | | | | | | | Ø |
| 24 | 98 | 91 | 7.09 | 7.19 | 17.2 | 14.8 | | <1 | | | | | | | .59 |
| 25 | | | 7.15 | 7.19 | 17.2 | | | <1 | | | | | | | .47 |
| 26 | | | 7.13 | 7.19 | 17.1 | | | <1 | | | | | | | .13 |
| 27 | 96 | .98 | 7.13 | 7.17 | 17 | 19.4 | | <1 | | | | | | | Ø |
| 28 | | | 6.68 | 7.27 | 16.8 | | | <1 | | | | | | | .12 |
| 29 | 97 | 97 | 7.25 | 7.33 | 16.61 | 24.8 | | 12 | | | | | | | .14 |
| 30 | 99 | 75 | 7.12 | 7.31 | 16.6 | 27.9 | | 3 | | | | | | | .01 |
| 31 | | | | | | | | | | | | | | | |
| Total | | | | | | | | | | | | | | | |
| | AVG 96 | AVG 111 | MIN 6.43 | | | AVG 16.3 | AVG | GEM 2 | AVG | AVG | | | | | 5.1" |
| Permit | 70 | 1017 | 5 | | | 7 | 20 | 200 | | | | | | | |
| | | AVW 125 | | MAX 7.56 | MXD 19.6 | MXD 27.9 | MXD | GM7 2 | | | | | | | |
| Limits | | 1525 | | 9 | | 15 | 41 | 400 | | | | | | | |

**Please Circle ALL Permit Violations** **Mail to P.O. Box 47775, Olympia WA 98504-7775**

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

M7=highest 7-day Geometric Mean

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month DEC. | Year 2005

...lity Name City of Camas | County Clark

...ceiving Water Columbia River | Plant Operator J. DICKINSON

Plant Type Activated Sludge w/UV Disinfection | Population 153600

| | INFLUENT | | | | | | | | | | EFFLUENT | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK | CONT | CONT | 4/WEEK | 4/YR | 4/YR | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK |
| Date | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY LBS/DAY | TSS MG/L | TSS LBS/DAY | pH (DAILY MIN) STANDARD UNITS | pH (DAILY MAX) STANDARD UNITS | AMMONIA MG/L | OIL & GREASE UG/L | CYANIDE UG/L | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY % REMOVAL | BOD 5-DAY LBS/DAY | TSS MG/L |
| 1 | 2.845 | 144 | 3411 | 178 | 4223 | 6.39 | 6.81 | 40.2 | | | 2.746 | 7 | 95 | 98 | 7 |
| 2 | 3.532 | | | | | 6.38 | 6.78 | | | | 3.456 | | | | |
| 3 | 3.232 | | | | | 6.48 | 7.63 | | | | 3.174 | | | | |
| 4 | 2.851 | | | | | 6.47 | 6.79 | | | | 2.879 | | | | |
| 5 | 2.55 | 183 | 3882 | 154 | 3275 | 5.83 | 6.89 | 43.8 | | | 2.518 | 5 | 97 | 105 | 2 |
| 6 | 2.40 | 142 | 2834 | 196 | 3923 | 6.40 | 7.80 | 38 | | | 2.34 | 1 | 99 | 20 | 5 |
| 7 | 2.346 | 81 | 1585 | 92 | 1800 | 6.21 | 6.99 | 47 | | | 2.312 | 6 | 93 | 116 | 7 |
| 8 | 2.305 | 147 | 2832 | 292 | 5613 | 6.52 | 6.81 | 45.8 | | | 2.25 | 4 | 97 | 75 | 4 |
| 9 | 2.074 | | | | | 6.53 | 6.88 | | | | 2.005 | | | | |
| 10 | 2.178 | | | NX | | 6.57 | 6.88 | | | | 2.112 | | | | |
| 11 | 2.202 | | | | | 6.46 | 7.05 | | | | 2.152 | | | | |
| 12 | 2.174 | 162 | 2937 | 121 | 2194 | 5.36 | 6.99 | 46.5 | | | 2.138 | 3 | 98 | 53 | 4.25 |
| 13 | 2.080 | 116 | 2012 | 142 | 2463 | 6.63 | 7.06 | 45.2 | | | 2.082 | 6 | 95 | 104 | 1 |
| 14 | 2.053 | 185 | 3209 | 132 | 2260 | 6.56 | 7.00 | 44.5 | | | 2.065 | 8 | 96 | 138 | 12 |
| 15 | 2.105 | 139 | 2440 | 356 | 6249 | 6.09 | 6.94 | 57.9 | | | 2.141 | 3 | 98 | 54 | 4 |
| 16 | 2.028 | | | | | 6.44 | 6.90 | | | | 2.054 | | | | |
| 17 | 2.168 | | | | | 6.57 | 6.93 | | | | 2.144 | | | | |
| 18 | 2.11 | | | | | 6.63 | 6.97 | | | | 2.092 | | | | |
| 19 | 2.3 | 126 | 2417 | 200 | 3836 | 6.51 | 6.92 | 46.2 | | | 2.379 | 7 | 94 | 139 | 4 |
| 20 | 2.69 | 130 | 2921 | 242 | 5429 | 6.31 | 6.93 | 37.2 | | | 2.694 | 16 | 87 | 359 | 5 |
| 21 | 3.931 | 80 | 2623 | 176 | 5770 | 5.76 | 6.87 | 34.6 | | | 3.941 | 16 | 80 | 526 | 14 |
| 22 | 5.41 | 64.35 | 2903 | 106 | 4783 | 6.00 | 6.67 | 21.2 | | | 5.45 | 18.4 | 71 | 836 | 44 |
| 23 | 3.332 | | | | | 6.00 | 6.89 | | | | 3.473 | | | | |
| 24 | 2.899 | | | | | 6.06 | 6.85 | | | | 2.995 | | | | |
| 25 | 2.677 | 95 | 3571 | | | 5.66 | 6.06 | | | | 2.771 | 56 | 41 | 2175 | |
| 26 | 3.043 | 93 | 2360 | 62 | 1573 | 5.85 | 6.32 | 34.1 | | | 3.143 | 4 | 96 | 105 | 6 |
| 27 | 4.507 | ~~228~~ RS | ~~8940~~ RS | 74 | 2781 | 6.01 | 7.44 | 17.5 | | | 4.657 | ~~8~~ RS | ~~97~~ | ~~317~~ | 57 |
| 28 | 5.023 | 62 | 2597 | 90 | 3770 | 6.08 | 6.49 | 17.92 | | | 5.268 | 35 | 44 | 1538 | 20 |
| 29 | 4.871 | 63 | 2559 | 104 | 4225 | 6.08 | 6.54 | 20.8 | | | 5.149 | 26 | 59 | 1117 | 15 |
| 30 | 7.034 | | | | | 6.02 | 6.47 | | | | 7.774 | | | | |
| 31 | 4.90 | | | | | 6.18 | 6.61 | | | | 5.095 | | | | |
| Total | | | | | | | | | | | | | | | |
| | AVG 3.091 | AVG 118 | AVG 2770 | AVG 160 | AVG 3669 | MIN 5.36 | | AVG 37.5 | AVG | AVG | AVG 3.143 | AVG 13 | AVG 85 | AVG 445 | AVG 12.4 |
| Permit | 6.1 | | 5616 | | 6405 | | | | | | | 20 | 70 | 1017 | 20 |
| | MAX 7.034 | MAX 185 | MAX 3882 | MAX 356 | MAX 6249 | | MAX 7.80 | MAX 57.9 | | | MAX 7.774 | AVW 30 | | AVW 1234 | AVW 24.5 |
| Limits | | | | | | | | | | | | 30 | | 1525 | 30 |

...se Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

... G=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=highest 7-day Geometric Mean

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations

CH2M HILL OSBORNE, INC.
REC'D - SEATTLE
JAN 13 2006
JOB #

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month DEC. | Year 2005

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator J. DICKINSON

Plant Type Activated Sludge w/UV Disinfection | Population 15360

EFFLUENT CONT.

| Frequency | 4/WEEK | 4/WEEK | CONT | CONT | CONT | 4/WEEK | 4/WEEK | DAILY | 4/YR | 4/YR | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | TSS % REMOVAL | TSS LBS/DAY | pH (DAILY MIN) STANDARD UNITS | pH (DAILY MAX) STANDARD UNITS | TEMPERATURE DEG C | AMMONIA MG/L (WINTER) | AMMONIA MG/L (SUMMER) | FECAL COLIFORM #/100 ML | OIL & GREASE UG/L | CYANIDE UG/L | | | | | rain |
| 1 | 96 | 160 | 6.93 | 7.27 | 16.6 | 25.0 | | <1 | | | | | | | .55 |
| 2 | | | 6.78 | 6.96 | 16.4 | | | <1 | | | | | | | .56 |
| 3 | | | 6.72 | 7.05 | 15.81 | | | 6 | | | | | | | .11 |
| 4 | | | 6.92 | 7.09 | 16 | | | <1 | | | | | | | Ø |
| 5 | 99 | 42 | 6.41 | 7.09 | 16 | 24.5 | | <1 | | | | | | | Ø |
| 6 | 97 | 98 | 6.99 | 7.17 | 16.2 | 24.7 | | <1 | | | | | | | Ø |
| 7 | 92 | 135 | 7.12 | 7.23 | 15.8 | 26.7 | | <1 | | | | | | | Ø |
| 8 | 99 | 75 | 7.10 | 7.16 | 15.4 | 32.1 | | <1 | | | | | | | Ø |
| 9 | | | 7.14 | 7.23 | 15.8 | | | <1 | | | | | | | Ø |
| 10 | | | 7.19 | 7.25 | 15.61 | | | <1 | | | | | | | Ø |
| 11 | | | 7.21 | 7.27 | 15.4 | | | <1 | | | | | | | Ø |
| 12 | 96 | 76 | 7.24 | 7.29 | 15.80 | 32.3 | | <1 | | | | | | | .01 |
| 13 | 99 | 17 | 6.60 | 7.38 | 16.0 | 33.0 | | <1 | | | | | | | Ø |
| 14 | 91 | 206 | 6.60 | 7.32 | 15.60 | 34.2 | | <1 | | | | | | | Ø |
| 15 | 98 | 71 | 7.12 | 7.51 | 14.80 | 35.2 | | <1 | | | | | | | Ø |
| 16 | | | 7.21 | 7.62 | 14.80 | | | <1 | | | | | | | Ø |
| 17 | | | 7.09 | 7.21 | 14.40 | | | 3 | | | | | | | Ø |
| 18 | | | 7.05 | 7.14 | 14.2 | | | <1 | | | | | | | .28 |
| 19 | 98 | 79 | 6.63 | 7.3 | 14.4 | 33.9 | | <1 | | | | | | | .12 |
| 20 | 98 | 112 | 7.08 | 7.16 | 14.8 | 31.5 | | <1 | | | | | | | .72 |
| 21 | 92 | 460 | 7.01 | 7.14 | 15.0 | 28.2 | | <1 | | | | | | | 1.18 |
| 22 | 58 | 1999 | 7.03 | 7.18 | 14.4 | 20 | | <1 | | | | | | | .70 |
| 23 | | | 7.01 | 7.29 | 15.0 | | | <1 | | | | | | | .05 |
| 24 | | | 7.18 | 7.29 | 14.81 | | | <1 | | | | | | | .03 |
| 25 | | | 7.18 | 7.25 | 15.01 | | | 2 | | | | | | | .31 |
| 26 | 90 | 157 | 7.19 | 7.23 | 15.21 | 24.8 | | <1 | | | | | | | .43 |
| 27 | 23 | 2213 | 7.00 | 7.19 | 15.21 | 19.31 | | <1 | | | | | | | 1.22 |
| 28 | 78 | 878 | 6.95 | 7.21 | 14.20 | 12.62 | | <1 | | | | | | | .24 |
| 29 | 86 | 644 | 7.21 | 7.37 | 14.2 | 16.8 | | <1 | | | | | | | 1.30 |
| 30 | | | 6.64 | 7.37 | 13.6 | | | <1 | | | | | | | .82 |
| 31 | | | 7.09 | 7.40 | 13.6 | | | <1 | | | | | | | .25 |
| Total | | | | | | | | | | | | | | | |
| | AVG 88 | AVG 437 | MIN 6.41 | | | AVG 26.7 | AVG | GEM 2 | AVG | AVG | | | | | 8.88 |
| Permit | 70 | 1017 | 6 | | | 7 | 20 | 200 | | | | | | | |
| | | AVW 973 | | MAX 7.62 | MXD 16.6 | MXD 35.2 | MXD | GM7 2 | | | | | | | |
| Limits | | 1525 | | 9 | | 16 | 41 | 400 | | | | | | | |

Use Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 Month JAN. Year 2006

Facility Name City of Camas County Clark

Receiving Water Columbia River Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection Population 15360

| | INFLUENT | | | | | | | | | | EFFLUENT | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK | CONT | CONT | 4/WEEK | 4/YR | 4/YR | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK |
| Date | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY LBS/DAY | TSS MG/L | TSS LBS/DAY | pH DAILY MIN STANDARD UNITS | pH DAILY MAX STANDARD UNITS | AMMONIA MG/L | OIL & GREASE MG/L | CYANIDE UG/L | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY % REMOVAL | BOD 5-DAY LBS/DAY | TSS MG/L |
| 1 | 3.789 | | | | | 6.3 | 6.64 | | | | 4.075 | | | | |
| 2 | 3.921 | 97 | 3179 | 130 | 4251 | 6.17 | 6.6 | 28.1 | | | 4.054 | 17 | 82 | 575 | 7 |
| 3 | 3.546 | 94 | 2780 | 66 | 1952 | 6.17 | 6.63 | 30.7 | | | 3.646 | 8 | 91 | 243 | 8 |
| 4 | 3.159 | 80 | 2108 | 66 | 1739 | 5.99 | 6.63 | 21.7 | | | 3.311 | 6 | 92 | 166 | 5 |
| 5 | 2.871 | 76 | 1820 | 140 | 3352 | 5.66 | 6.5 | 27.7 | | | 3.008 | 6 | 92 | 151 | 2 |
| 6 | 4.238 | | | | | 5.85 | 6.42 | | | | 4.343 | | | | |
| 7 | 4.381 | | | | | 5.26 | 6.16 | | | | 4.468 | | | | |
| 8 | 3.852 | | | | | 5.07 | 5.78 | | | | 3.904 | | | | |
| 9 | 4.982 | 79 | 3282 | 144 | 5983 | 5.07 | 5.9 | 21.8 | | | 5.035 | 29 | 63 | 1218 | 26 |
| 10 | 6.208 | 80 | 4142 | 80 | 4142 | 5.4 | 6.5 | 16.9 | | | 5.669 | 14 | 83 | 662 | 7 |
| 11 | 4.758 | 33 | 1317 | 67 | 2659 | 6.14 | 6.5 | 17.0 | | | 4.898 | 4 | 88 | 163 | 2 |
| 12 | 5.092 | 49 | 2081 | 78 | 3312 | 6.12 | 6.5 | 17.3 | | | 5.244 | 13 | 73 | 2081 | 12 |
| 13 | 5.086 | | | | | 6.11 | 6.8 | | | | 5.269 | | | | |
| 14 | 4.219 | | | | | 6.20 | 6.48 | | | | 4.368 | | | | |
| 15 | 3.508 | | | | | 6.26 | 6.6 | | | | 3.531 | | | | |
| 16 | 4.623 | 66 | 2945 | 93 | 3586 | 6.07 | 6.6 | 21.8 | | | 4.699 | 11 | 83 | 431 | 7 |
| 17 | 5.4 | 80 | 3603 | 182 | 8197 | 6.05 | 6.47 | 14.2 | | | 5.589 | 7.5 | 91 | 350 | 8 |
| 18 | 4.438 | 81 | 2998 | 120 | 4442 | 6.10 | 6.69 | 15.9 | | | 4.545 | 8 | 90 | 303 | 5 |
| 19 | 3.648 | 65 | 1978 | 90 | 2738 | 6.05 | 6.8 | 23.4 | | | 3.714 | 5 | 92 | 155 | 6 |
| 20 | 4.059 | | | | | 6.11 | 6.7 | | | | 4.148 | | | | |
| 21 | 3.351 | | | | | 6.42 | 6.98 | | | | 3.413 | | | | |
| 22 | 3.038 | | | | | 6.42 | 6.66 | | | | 3.076 | | | | |
| 23 | 2.832 | 117 | 2763 | 169 | 3992 | 6.48 | 7.46 | 37.5 | | | 2.860 | 19 | 84 | 453 | 8 |
| 24 | 2.667 | 91 | 2024 | 81 | 1802 | 7.08 | 7.53 | 33.7 | | | 2.708 | 9 | 90 | 203 | 7 |
| 25 | 2.688 | 101 | 2264 | 154 | 3452 | 7.14 | 7.67 | 29.6 | | | 2.764 | 16 | 84 | 369 | 11 |
| 26 | 2.63 | 95 | 2084 | 156 | 3422 | 7.31 | 7.71 | 37.7 | | | 2.693 | 13 | 86 | 292 | 7 |
| 27 | 2.868 | | | | | 7.07 | 7.71 | | | | 2.888 | | | | |
| 28 | 3.455 | | | | | 7.22 | 7.57 | | | | 3.590 | | | | |
| 29 | 5.482 | | | | | 6.93 | 7.49 | | | | 5.753 | | | | |
| 30 | 5.088 | 33 | 1400 | 70 | 2970 | 7.02 | 7.52 | 63.3 | | | 5.389 | 10 | 70 | 449 | 8 |
| 31 | 4.676 | 103 | 4017 | 123 | 4796 | 6.9 | 7.62 | 16.3 | | | 4.901 | 9 | 91 | 368 | 6 |
| Total | | | | | | | | | | | | | | | |
| | AVG 4.017 | AVG 79 | AVG 2573 | AVG 112 | AVG 3710 | MIN 5.07 | | AVG 26.4 | AVG | AVG | AVG 4.113 | AVG 11 | AVG 85 | AVG 476 | AVG 7.8 |
| Permit | 6.1 | | 5616 | | 6405 | | | | | | | 20 | 70 | 1017 | 20 |
| | MAX 6.208 | MAX 117 | MAX 4142 | MAX 182 | MAX 8197 | | MAX 7.71 | MAX 63.3 | | | MAX 5.753 | AVW 15 | | AVW 1031 | AVW 11.75 |
| Limits | | | | | | | | | | | | 30 | | 1525 | 30 |

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=highest 7-day Geometric Mean

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month JAN. | Year 2006

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection | Population 153600

| Frequency | 4/WEEK | 4/WEEK | CONT | CONT | CONT | 4/WEEK | 4/WEEK | DAILY | 4/YR | 4/YR | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | EFFLUENT CONT | | | | | | | | | | | | | | |
| Date | TSS % REMOVAL | TSS LBS/DAY | pH (DAILY MIN) STANDARD UNITS | pH (DAILY MAX) STANDARD UNITS | TEMPERATURE DEG C | AMMONIA MG/L (WINTER) | AMMONIA MG/L (SUMMER) | FECAL COLIFORM #/100 ML | OIL & GREASE UG/L | CYANIDE UG/L | | | | | RAIN |
| 1 | | | 7.40 | 7.53 | 13.8 | | | <1 | | | | | | | .38 |
| 2 | 95 | 237 | 7.45 | 7.58 | 14 | 23.2 | | <1 | | | | | | | .10 |
| 3 | 88 | 243 | 7.19 | 7.51 | 14.2 | 23.3 | | <1 | | | | | | | .25 |
| 4 | 92 | 138 | 7.15 | 7.23 | 14.4 | 16.1 | | <1 | | | | | | | Θ |
| 5 | 99 | 50 | 6.49 | 7.29 | 14.6 | 18.7 | | <1 | | | | | | | .45 |
| 6 | | | 7.17 | 7.23 | 14.8 | | | <1 | | | | | | | .57 |
| 7 | | | 7.10 | 7.23 | 14.2 | | | <1 | | | | | | | .36 |
| 8 | | | 7.12 | 7.19 | 14.4 | | | <1 | | | | | | | .34 |
| 9 | 82 | 1092 | 7.06 | 7.17 | 14.4 | 17.3 | | <1 | | | | | | | .67 |
| 10 | 91 | 331 | 6.98 | 7.43 | 14 | 10.3 | | <1 | | | | | | | .87 |
| 11 | 97 | 82 | 6.96 | 7.51 | 13.6 | 7.0 | | <1 | | | | | | | .25 |
| 12 | 88 | 524 | 6.91 | 7.19 | 13.7 | 5.9 | | <1 | | | | | | | .75 |
| 13 | | | 7.04 | 7.19 | 13.7 | 4.6 | | <1 | | | | | | | .50 |
| 14 | | | 7.00 | 7.04 | 13.77 | 3.14 | | 6 | | | | | | | .11 |
| 15 | | | 7.02 | 7.3 | 14 | 1.47 | | <1 | | | | | | | .21 |
| 16 | 92 | 274 | 7.0 | 7.5 | 14.19 | 2.4 | | <1 | | | | | | | .84 |
| 17 | 96 | 373 | 6.36 | 7.29 | 14.2 | 1.8 | | <1 | | | | | | | .74 |
| 18 | 96 | 190 | 7.17 | 7.23 | 13.8 | .82 | | <1 | | | | | | | .07 |
| 19 | 93 | 186 | 7.16 | 7.32 | 14.2 | 1.8 | | <1 | | | | | | | .51 |
| 20 | | | 7.15 | 7.25 | 14.8 | 4.15 | | <1 | | | | | | | .06 |
| 21 | | | 7.13 | 7.17 | 14.18 | 2.40 | | 12 | | | | | | | .14 |
| 22 | | | 7.17 | 7.24 | 14.6 | 2.5 | | <1 | | | | | | | Θ |
| 23 | 95 | 189 | 6.63 | 7.64 | 15.6 | 5.07 | | <1 | | | | | | | Θ |
| 24 | 91 | 158 | 7.14 | 7.41 | 14.8 | 5.54 | | 4 | | | | | | | Ø |
| 25 | 93 | 253 | 7.04 | 7.61 | 14.8 | 5.2 | | <1 | | | | | | | .22 |
| 26 | 96 | 157 | 7.18 | 7.24 | 14.8 | 3.28 | | <1 | | | | | | | .15 |
| 27 | | | 7.20 | 7.24 | 14.8 | | | <1 | | | | | | | .59 |
| 28 | | | 7.16 | 7.22 | 14.8 | | | <1 | | | | | | | .16 |
| 29 | | | 7.12 | 7.22 | 14.2 | 4.03 | | <1 | | | | | | | 1.18 |
| 30 | 89 | 360 | 6.92 | 7.39 | 13.4 | 2.84 | | 3 | | | | | | | .30 |
| 31 | 95 | 245 | 7.14 | 7.28 | 13.6 | 1.33 | | <1 | | | | | | | .58 |
| Total | | | | | | | | | | | | | | | |
| | AVG 93 | AVG 283 | MIN 6.36 | | | AVG 6.96 | AVG | GEM 2 | AVG | AVG | | | | | 11.35" |
| Permit | 70 | 1017 | 6 | | | 7 | 20 | 200 | | | | | | | |
| | | AVW 507 | | MAX 7.64 | MXD 15.6 | MXD 23.3 | MXD | GM7 2 | | | | | | | |
| Limits | | 1526 | | 9 | | 16 | 41 | 400 | | | | | | | |

**Please Circle ALL Permit Violations** **Mail to P.O. Box 47775, Olympia WA 98504-7775**

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month FEB | Year 2006

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection | Population 15360

| | INFLUENT | | | | | | | | | | EFFLUENT | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK | CONT | CONT | 4/WEEK | 4/YR | 4/YR | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK |
| Date | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY LBS/DAY | TSS MG/L | TSS LBS/DAY | pH DAILY MIN STANDARD UNITS | pH DAILY MAX STANDARD UNITS | AMMONIA MG/L | OIL & GREASE MG/L | CYANIDE MG/L | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY % REMOVAL | BOD 5-DAY LBS/DAY | TSS MG/L |
| 1 | 3.838 | 46 | 1472 | 70 | 2240 | 7.08 | 7.48 | 20 | | | 3.974 | 8 | 83 | 265 | 9 |
| 2 | 3.46 | 79 | 2280 | 127 | 3654 | 6.87 | 7.59 | 24.1 | | | 3.598 | 8 | 90 | 240 | 6 |
| 3 | 3.254 | | | | | 6.82 | 7.00 | | | | 3.361 | | | | |
| 4 | 3.343 | | | | | 6.46 | 6.82 | | | | 3.427 | | | | |
| 5 | 3.061 | | | | | 6.24 | 6.46 | | | | 3.132 | | | | |
| 6 | 2.747 | 121 | 2772 | 116 | 2733 | 6.11 | 6.24 | 30.1 | | | 2.825 | 12 | 90 | 283 | 14 |
| 7 | 2.618 | 109 | 2380 | 170 | 3712 | 6.00 | 6.11 | 32.2 | | | 2.757 | 8 | 93 | 184 | 15 |
| 8 | 2.531 | 93 | 1963 | 128 | 2702 | 6.12 | 6.6 | 25.1 | | | 2.66 | 7 | 92 | 155 | 10 |
| 9 | 2.423 | 77 | 1556 | 192 | 3880 | 6.23 | 7.77 | 40.2 | | | 2.456 | 5 | 94 | 102 | 9 |
| 10 | 2.306 | | | | | 7.31 | 7.77 | | | | 2.377 | | | | |
| 11 | 2.326 | | | | | 6.72 | 7.76 | | | | 2.358 | | | | |
| 12 | 2.40 | | | | | 6.71 | 6.9 | | | | 2.412 | | | | |
| 13 | 2.349 | 135 | 2645 | 238 | 4663 | 6.69 | 7.52 | 38.8 | | | 2.356 | 9 | 93 | 177 | 14 |
| 14 | 2.399 | 98 | 1961 | 228 | 4562 | 6.43 | 7.57 | 37.4 | | | 2.428 | 14 | 86 | 283 | 14 |
| 15 | 2.309 | 174 | 3351 | 260 | 5007 | 6.16 | 6.5 | 39.6 | | | 2.394 | 7 | 96 | 140 | 12 |
| 16 | 2.245 | 127 | 2378 | 254 | 4756 | 6.95 | 7.53 | 50.4 | | | 2.256 | 5 | 96 | 94 | 12 |
| 17 | 2.195 | | | | | 7.21 | 7.74 | | | | 2.22 | | | | |
| 18 | 2.157 | | | | | 7.36 | 7.82 | | | | 2.145 | | | | |
| 19 | 2.205 | | | | | 7.11 | 7.76 | | | | 2.198 | | | | |
| 20 | 2.294 | 112 | 2142 | 260 | 4974 | 6.92 | 7.69 | 49.8 | | | 2.258 | 16.8 | 85 | 316 | 8 |
| 21 | 2.25 | 108 | 2027 | 129 | 2421 | 7.01 | 7.62 | 48.5 | | | 2.255 | 6 | 94 | 113 | 9 |
| 22 | 2.2 | 91 | 1670 | 142 | 2605 | 6.93 | 7.43 | 41.4 | | | 2.239 | 7 | 92 | 131 | 12 |
| 23 | 2.35 | 150 | 2940 | 172 | 3371 | 6.27 | 7.51 | 31.5 | | | 2.434 | 8 | 95 | 162 | 15 |
| 24 | 2.142 | | | | | 5.85 | 7.51 | | | | 2.154 | | | | |
| 25 | 2.222 | | | | | 6.98 | 7.70 | | | | 2.234 | | | | |
| 26 | 2.331 | | | | | 6.77 | 7.74 | | | | 2.333 | | | | |
| 27 | 2.644 | 129 | 2848 | 424 | 9350 | 6.77 | 7.54 | 38.1 | | | 2.643 | 7 | 95 | 154 | 8 |
| 28 | 3.741 | 96 | 2995 | 124 | 3869 | 7.07 | 7.5 | 18.5 | | | 3.793 | 7 | 93 | 221 | 17 |
| 29 | | | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | | | |
| 31 | | | | | | | | | | | | | | | |
| Total | | | | | | | | | | | | | | | |
| | AVG 2.567 | AVG 109 | AVG 2336 | AVG 190 | AVG 4031 | MIN 5.85 | | AVG 35 | AVG | AVG | AVG 2.631 | AVG 8.4 | AVG 92 | AVG 189 | AVG 12 |
| Permit | 6.1 | | 5616 | | 6406 | | | | | | | 20 | 70 | 1017 | 20 |
| | MAX 3.838 | MAX 174 | MAX 3351 | MAX 424 | MAX 9350 | | MAX 7.82 | MAX 50.4 | | | MAX 3.974 | AVW 9.5 | | AVW 181 | AVW 13 |
| Limits | | | | | | | | | | | | 30 | | 1525 | 30 |

**Please Circle ALL Permit Violations** Mail to P.O. Box 47775, Olympia WA 98504-7775

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=highest 7-day Geometric Mean

rtify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system gned to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 Month FEB Year 2006

Facility Name City of Camas County Clark

Receiving Water Columbia River Plant Operator JIM DICKINSON

ant Type Activated Sludge w/UV Disinfection Population 15360

EFFLUENT CONT.

| Frequency | 4/WEEK | 4/WEEK | CONT | CONT | CONT | 4/WEEK | 4/WEEK | DAILY | 4/YR | 4/YR | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | TSS % REMOVAL | TSS LBS/DAY | pH (DAILY MIN) STANDARD UNITS | pH (DAILY MAX) STANDARD UNITS | TEMPERATURE DEG C | AMMONIA MG/L (WINTER) | AMMONIA MG/L (SUMMER) | FECAL COLIFORM #/100 ML | OIL & GREASE UG/L | CYANIDE UG/L | | | | | RAIN |
| 1 | 87 | 298 | 7.21 | 7.29 | 13.8 | 0 | | <1 | | | | | | | .12 |
| 2 | 95 | 180 | 7.23 | 7.29 | 14.2 | 1.1 | | <1 | | | | | | | .21 |
| 3 | | | 7.27 | 7.36 | 14.4 | | | <1 | | | | | | | .37 |
| 4 | | | 7.36 | 7.42 | 14.2 | | | <1 | | | | | | | .12 |
| 5 | | | 7.32 | 7.40 | 14.4 | | | <1 | | | | | | | 0 |
| 6 | 88 | 330 | 7.32 | 7.38 | 14.6 | 3.6 | | <1 | | | | | | | 0 |
| 7 | 91 | 345 | 7.30 | 7.34 | 14.8 | 5.3 | | <1 | | | | | | | 0 |
| 8 | 92 | 222 | 7.26 | 7.37 | 15.2 | 5.8 | | <1 | | | | | | | 0 |
| 9 | 95 | 184 | 7.27 | 7.31 | 15.2 | 9.8 | | <1 | | | | | | | 0 |
| 10 | | | 7.23 | 7.38 | 14.6 | | | <1 | | | | | | | 0 |
| 11 | | | 7.27 | 7.40 | 14.61 | | | 4 | | | | | | | 0 |
| 12 | | | 7.19 | 7.27 | 15.2 | | | <1 | | | | | | | .01 |
| 13 | 94 | 275 | 7.15 | 7.29 | 15.4 | 6.6 | | <1 | | | | | | | .20 |
| 14 | 94 | 283 | 7.15 | 7.23 | 15.4 | 4.1 | | <1 | | | | | | | .14 |
| 15 | 95 | 240 | 7.17 | 7.22 | 15 | 4.1 | | <1 | | | | | | | 0 |
| 16 | 95 | 226 | 6.97 | 7.75 | 15 | 6.2 | | <1 | | | | | | | 0 |
| 17 | | | 7.15 | 7.24 | 14.3 | | | <1 | | | | | | | 0 |
| 18 | | | 7.12 | 7.18 | 13.7 | | | <1 | | | | | | | 0 |
| 19 | | | 7.08 | 7.18 | 14.1 | | | <1 | | | | | | | 0 |
| 20 | 97 | 151 | 7.09 | 7.18 | 14.3 | 4.1 | | <1 | | | | | | | .07 |
| 21 | 93 | 169 | 6.31 | 7.48 | 14.7 | 4.6 | | <1 | | | | | | | .08 |
| 22 | 92 | 224 | 7.10 | 7.17 | 14.9 | 2.2 | | <1 | | | | | | | .04 |
| 23 | 91 | 304 | 7.13 | 7.19 | 14.9 | 2.3 | | <1 | | | | | | | .28 |
| 24 | | | 7.12 | 7.20 | 14.9 | | | <1 | | | | | | | .01 |
| 25 | | | 7.13 | 7.20 | 14.7 | | | <1 | | | | | | | 0 |
| 26 | | | 7.12 | 7.21 | 14.5 | | | <1 | | | | | | | .09 |
| 27 | 98 | 176 | 6.83 | 7.50 | 14.9 | 4.9 | | <1 | | | | | | | .75 |
| 28 | 86 | 538 | 7.07 | 7.16 | 14.9 | 4.4 | | <1 | | | | | | | .43 |
| 29 | | | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | | | |
| 31 | | | | | | | | | | | | | | | |
| Total | | | | | | | | | | | | | | | |
| | AVG 93 | AVG 259 | MIN 6.31 | | | AVG 4.3 | AVG | GEM 2 | AVG | AVG | | | | | 2.92" |
| Permit | 70 | 1017 | 6 | | | 7 | 20 | 200 | | | | | | | |
| | | AVW 270 | | MAX 7.75 | MXD 15.4 | MXD 9.8 | MXE | GMT 2 | | | | | | | |
| Limits | | 1525 | | 9 | | 15 | 41 | 400 | | | | | | | |

**Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775**

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=highest 7-day Geometric Mean

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system gned to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 Month MARCH Year 2006

Facility Name City of Camas County Clark

Receiving Water Columbia River Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection Population 15360

| | INFLUENT | | | | | | | | | | EFFLUENT | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK | CONT | CONT | 4/WEEK | 4/YR | 4/YR | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK |
| Date | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY LBS/DAY | TSS MG/L | TSS LBS/DAY | pH DAILY MIN STANDARD UNITS | pH DAILY MAX STANDARD UNITS | AMMONIA MG/L | OIL & GREASE MG/L | CYANIDE MG/L | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY % REMOVAL | BOD 5-DAY LBS/DAY | TSS MG/L |
| 1 | 2.912 | 84 | 2040 | 104 | 2525 | 6.92 | 7.77 | 28 | | | 2.97 | 4 | 95 | 99 | 9 |
| 2 | 2.622 | 102 | 2230 | 124 | 2712 | 7.25 | 7.65 | 42.4 | | | 2.698 | 7 | 94 | 146 | 5 |
| 3 | 2.399 | | | | | 7.29 | 7.73 | | | | 2.420 | | | | |
| 4 | 2.445 | | | | | 7.26 | 7.46 | | | | 2.477 | | | | |
| 5 | 2.52 | | | | | 6.49 | 8.06 | | | | 2.497 | | | | |
| 6 | 2.403 | 109 | 2185 | 140 | 2806 | 6.9 | 7.72 | 48.2 | | | 2.399 | 8 | 93 | 160 | 8 |
| 7 | 2.726 | 102 | 2319 | 168 | 2318 | 6.6 | 7.30 | 30.6 | | | 2.726 | 6 | 94 | 136 | 21 |
| 8 | 3.044 | 104 | 2640 | 148 | 3757 | 7.08 | 7.82 | 32.2 | | | 3.102 | 9 | 91 | 233 | 10 |
| 9 | 3.398 | 87 | 2466 | 164 | 4648 | 7.08 | 7.75 | 30.7 | | | 3.411 | 7 | 92 | 199 | 13 |
| 10 | 2.922 | | | | | 7.01 | 7.55 | | | | 3.055 | | | | |
| 11 | 2.6216 | | | | | 6.49 | 7.57 | | | | 2.965 | | | | |
| 12 | 2.813 | | | | | 6.33 | 6.66 | 43.9 | | | 2.867 | | | | |
| 13 | 2.603 | 117 | 2608 | 99 | 2207 | 6.55 | 6.84 | 47.2 | | | 2.688 | 15 | 87 | 336 | 8 |
| 14 | 2.483 | 91 | 1884 | 68 | 1408 | 6.39 | 6.88 | | | | 2.993 | 8 | 91 | 173 | 6 |
| 15 | 2.466 | 122 | 2509 | 230 | 4730 | 6.2 | 6.88 | 41.7 | | | 2.557 | 7 | 94 | 149 | 7 |
| 16 | 2.495 | 146 | 3038 | 348 | 7241 | 6.13 | 6.34 | 45.1 | | | 2.641 | 2 | 99 | 44 | 4 |
| 17 | 2.557 | | | | | 6.01 | 6.18 | | | | 2.706 | | | | |
| 18 | 2.514 | | | | | 6.00 | 6.09 | | | | 2.687 | | | | |
| 19 | 2.564 | | | | | 5.98 | 6.15 | | | | 2.75 | | | | |
| 20 | 2.416 | 115 | 2317 | 125 | 2519 | 5.83 | 8.03 | 28.2 | | | 2.551 | 7 | 94 | 149 | 2 |
| 21 | 2.411 | 94 | 1890 | 114 | 2292 | 7.40 | 7.74 | 30.2 | | | 2.507 | 4 | 96 | 84 | 6 |
| 22 | 2.308 | 122 | 2348 | 140 | 2695 | 7.32 | 7.78 | 22.8 | | | 2.46 | 6 | 95 | 123 | 6 |
| 23 | 2.54 | 177 | 3561 | 160 | 3218 | 6.72 | 7.90 | 41 | | | 2.412 | 5 | 97 | 106 | 3 |
| 24 | 2.377 | | | | | 7.13 | 7.24 | | | | 2.481 | | | | |
| 25 | 2.485 | | | | | 7.38 | 7.87 | | | | 2.58 | | | | |
| 26 | 2.419 | | | | | 7.28 | 7.71 | | | | 2.525 | | | | |
| 27 | 2.443 | 145 | 2955 | 171 | 3484 | 7.2 | 7.74 | 53.7 | | | 2.538 | 5 | 97 | 106 | 3 |
| 28 | 2.388 | 125 | 2400 | 181 | 3484 | 7.26 | 7.87 | 49.6 | | | 2.388 | 6 | 95 | 119 | 8 |
| 29 | 2.468 | 152 | 3040 | 312 | 6240 | 6.63 | 7.90 | 49.2 | | | 2.398 | 1 | 99 | 21 | 3 |
| 30 | 2.279 | 164 | 3117 | 280 | 5322 | 7.36 | 7.77 | 53.7 | | | 2.392 | 8 | 95 | 160 | 4 |
| 31 | 2.457 | | | | | 7.30 | 7.72 | | | | 2.549 | | | | |
| Total | | | | | | | | | | | | | | | |
| | AVG 2.573 | AVG 120 | AVG 2530 | AVG 171 | AVG 3534 | MIN 5.83 | | AVG 39.9 | AVG | AVG | AVG 2.645 | AVG 6.4 | AVG 94 | AVG 141 | AVG 7 |
| Permit | 6.1 | | 5816 | | 6305 | | | | | | | 20 | 70 | 1017 | 20 |
| | MAX 3.398 | MAX 177 | MAX 3561 | MAX 348 | MAX 7241 | | MAX 8.06 | MAX 53.7 | | | MAX 3.411 | AVW 8 | | AVW 182 | AVW 13 |
| Limits | | | | | | | | | | | | 30 | | 1525 | 30 |

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=highest 7-day Geometric Mean

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Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 Month MARCH Year 2006

Facility Name City of Camas County Clark

Receiving Water Columbia River Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection Population 15360

EFFLUENT CONT.

| Frequency | 4/WEEK | 4/WEEK | CONT | CONT | CONT | 4/WEEK | 4/WEEK | DAILY | 4/YR | 4/YR | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | TSS % REMOVAL | TSS LBS/DAY | pH (DAILY MIN) STANDARD UNITS | pH (DAILY MAX) STANDARD UNITS | TEMPERATURE DEG C | AMMONIA MG/L (WINTER) | AMMONIA MG/L (SUMMER) | FECAL COLIFORM #/100 ML | OIL & GREASE UG/L | CYANIDE UG/L | | | | | RAIN |
| 1 | 91 | 222 | 6.58 | 7.26 | 14.3 | 2 | | <1 | | | | | | | .01 |
| 2 | 96 | 113 | 7.2 | 7.32 | 14.5 | 2.5 | | <1 | | | | | | | Θ |
| 3 | | | 7.18 | 7.22 | 14.9 | | | <1 | | | | | | | Θ |
| 4 | | | 7.16 | 7.22 | 15.3 | | | <1 | | | | | | | .29 |
| 5 | | | 7.2 | 7.26 | 15.1 | | | <1 | | | | | | | Θ |
| 6 | 94 | 160 | 5.8 | 7.29 | 15.1 | 6.8 | | <1 | | | | | | | .09 |
| 7 | 88 | 477 | 7.2 | 7.2 | 15.3 | 8.8 | | <1 | | | | | | | .43 |
| 8 | 93 | 259 | 7.08 | 7.82 | 15.3 | 7.6 | | <1 | | | | | | | .30 |
| 9 | 92 | 370 | 7.22 | 7.37 | 14.3 | 6.1 | | <1 | | | | | | | .23 |
| 10 | | | 7.33 | 7.39 | 14.1 | | | <1 | | | | | | | .05 |
| 11 | | | 7.31 | 7.44 | 13.91 | | | <1 | | | | | | | .25 |
| 12 | | | 7.39 | 7.48 | 14.1 | | | 2 | | | | | | | .01 |
| 13 | 92 | 179 | 7.37 | 7.43 | 14.51 | 6.3 | | <1 | | | | | | | .02 |
| 14 | 91 | 130 | 7.26 | 7.39 | 14.71 | 6.78 | | <1 | | | | | | | .04 |
| 15 | 97 | 149 | 7.24 | 7.43 | 14.8 | 4.8 | | <1 | | | | | | | .20 |
| 16 | 99 | 88 | 7.24 | 7.3 | 14.8 | 6.8 | | <1 | | | | | | | .02 |
| 17 | | | 7.18 | 7.24 | 15.1 | | | <1 | | | | | | | .045 |
| 18 | | | 7.11 | 7.18 | 14.81 | | | <1 | | | | | | | Θ |
| 19 | | | 7.1 | 7.14 | 15.2 | | | <1 | | | | | | | Θ |
| 20 | 98 | 43 | 6.09 | 7.29 | 15.4 | 1.5 | | <1 | | | | | | | .12 |
| 21 | 95 | 125 | 7.19 | 7.24 | 15.2 | 1.1 | | <1 | | | | | | | .05 |
| 22 | 96 | 123 | 7.21 | 7.24 | 15.4 | .82 | | <1 | | | | | | | Θ |
| 23 | 98 | 64 | 7.19 | 7.24 | 15.6 | 2.0 | | <1 | | | | | | | .18 |
| 24 | | | 7.35 | 7.84 | 15.8 | | | <1 | | | | | | | .19 |
| 25 | | | 7.15 | 7.22 | 15.6 | | | <1 | | | | | | | .21 |
| 26 | | | 7.15 | 7.22 | 15.6 | | | <1 | | | | | | | Θ |
| 27 | 98 | 64 | 7.17 | 7.22 | 15.6 | 3.4 | | <1 | | | | | | | Θ |
| 28 | 96 | 159 | 7.15 | 7.26 | 16 | 3.6 | | <1 | | | | | | | .02 |
| 29 | 99 | 62 | 7.15 | 7.21 | 16.01 | 2.24 | | <1 | | | | | | | .21 |
| 30 | 99 | 80 | 7.10 | 7.15 | 16.2 | 2.0 | | <1 | | | | | | | .11 |
| 31 | | | 7.13 | 7.19 | 16.4 | | | <1 | | | | | | | .38 |
| Total | | | | | | | | | | | | | | | |
| | AVG 95 | AVG 159 | MIN 5.8 | | | AVG 4.17 | AVG | GEM 2 | AVG | AVG | | | | | 3.86 |
| Permit | 70 | 1017 | 6 | | | 7 | 20 | 200 | | | | | | | |
| | | AVW 317 | | MAX 7.84 | MXD 16.4 | MXD 8.8 | MXD | GM7 2 | | | | | | | |
| Limits | | 1526 | | 9 | | 16 | 41 | 400 | | | | | | | |

**Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775**

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=highest 7-day Geometric Mean

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Name and Title

Signature

Permit No. WA0020249 | Month MARCH | Year 2006

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection | Population 153600

EFFLUENT CONT.

| Frequency | 4/WEEK | 4/WEEK | CONT | CONT | CONT | 4/WEEK | 4/WEEK | DAILY | 4/YR | 4/YR | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | TSS % REMOVAL | TSS LBS/DAY | pH (DAILY MIN) STANDARD UNITS | pH (DAILY MAX) STANDARD UNITS | TEMPERATURE DEG C | AMMONIA MG/L (WINTER) | AMMONIA MG/L (SUMMER) | FECAL COLIFORM #/100 ML | OIL & GREASE UG/L | CYANIDE UG/L | | | | | RAIN |
| 1 | 91 | 222 | 6.58 | 7.26 | 14.3 | 2 | | <1 | | | | | | | .01 |
| 2 | 96 | 113 | 7.2 | 7.32 | 14.9 | 2.5 | | <1 | | | | | | | 0 |
| 3 | | | 7.18 | 7.22 | 14.9 | | | <1 | | | | | | | 0 |
| 4 | | | 7.16 | 7.22 | 15.3 | | | <1 | | | | | | | .29 |
| 5 | | | 7.2 | 7.26 | 15.1 | | | <1 | | | | | | | 0 |
| 6 | 94 | 160 | 5.8 | 7.29 | 15.1 | 6.8 | | <1 | | | | | | | .09 |
| 7 | 88 | 477 | 7.2 | 7.2 | 15.3 | 8.8 | | <1 | | | | | | | .43 |
| 8 | 93 | 259 | 7.08 | 7.82 | 15.3 | 7.6 | | <1 | | | | | | | .30 |
| 9 | 92 | 370 | 7.22 | 7.37 | 14.3 | 6.1 | | <1 | | | | | | | .23 |
| 10 | | | 7.33 | 7.39 | 14.1 | | | <1 | | | | | | | .05 |
| 11 | | | 7.31 | 7.44 | 13.91 | | | <1 | | | | | | | .25 |
| 12 | | | 7.39 | 7.48 | 14.1 | | | 2 | | | | | | | .01 |
| 13 | 92 | 179 | 7.37 | 7.43 | 14.51 | 6.3 | | <1 | | | | | | | .02 |
| 14 | 91 | 130 | 7.26 | 7.39 | 14.71 | 6.78 | | <1 | | | | | | | .04 |
| 15 | 97 | 149 | 7.24 | 7.43 | 14.8 | 4.8 | | <1 | | | | | | | .20 |
| 16 | 99 | 88 | 7.24 | 7.3 | 14.8 | 6.8 | | <1 | | | | | | | .02 |
| 17 | | | 7.18 | 7.24 | 15.1 | | | <1 | | | | | | | .045 |
| 18 | | | 7.11 | 7.18 | 14.81 | | | <1 | | | | | | | 0 |
| 19 | | | 7.1 | 7.14 | 15.2 | | | <1 | | | | | | | 0 |
| 20 | 98 | 43 | 6.09 | 7.29 | 15.4 | 1.5 | | <1 | | | | | | | .12 |
| 21 | 95 | 125 | 7.19 | 7.24 | 15.2 | 1.1 | | <1 | | | | | | | .05 |
| 22 | 96 | 123 | 7.21 | 7.24 | 15.4 | .82 | | <1 | | | | | | | 0 |
| 23 | 98 | 64 | 7.19 | 7.24 | 15.6 | 2.0 | | <1 | | | | | | | .18 |
| 24 | | | 7.35 | 7.84 | 15.8 | | | <1 | | | | | | | .19 |
| 25 | | | 7.15 | 7.22 | 15.6 | | | <1 | | | | | | | .21 |
| 26 | | | 7.15 | 7.22 | 15.6 | | | <1 | | | | | | | 0 |
| 27 | 98 | 64 | 7.17 | 7.22 | 15.6 | 3.4 | | <1 | | | | | | | 0 |
| 28 | 96 | 159 | 7.15 | 7.26 | 16 | 3.6 | | <1 | | | | | | | .02 |
| 29 | 99 | 62 | 7.15 | 7.21 | 16.01 | 2.24 | | <1 | | | | | | | .21 |
| 30 | 99 | 80 | 7.10 | 7.15 | 16.2 | 2.0 | | <1 | | | | | | | .11 |
| 31 | | | 7.13 | 7.19 | 16.4 | | | <1 | | | | | | | .38 |
| Total | | | | | | | | | | | | | | | |
| | AVG 95 | AVG 159 | MIN 5.8 | | | AVG 4.17 | AVG | GEM 2 | AVG | AVG | | | | | 3.86 |
| Permit | 70 | 1017 | 6 | | | 7 | 20 | 200 | | | | | | | |
| | | AVW 317 | | MAX 7.84 | MOD 16.4 | MOD 8.8 | MOD | GM7 2 | | | | | | | |
| Limits | | 1526 | | 9 | | 15 | 41 | 400 | | | | | | | |

**Please Circle ALL Permit Violations** **Mail to P.O. Box 47775, Olympia WA 98504-7775**

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=highest 7-day Geometric Mean

I, under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month April | Year 2006

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator J. Dickinson

Type Activated Sludge w/UV Disinfection | Population 15360

| | INFLUENT | | | | | | | | | | EFFLUENT | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK | CONT | CONT | 4/WEEK | 4/YR | 4/YR | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK |
| Date | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY LBS/DAY | TSS MG/L | TSS LBS/DAY | RECORDER MIN | RECORDER MAX | STATE STD | AMMONIA MG/L | OIL & GREASE BOD | CYANIDE TSS | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY % REMOVAL | BOD 5-DAY LBS/DAY | TSS MG/L |
| 1 | 2.545 | | | | | 7.39 | 7.69 | | | | | 2.638 | | | | |
| 2 | 2.595 | | | | | 7.2 | 7.76 | | | | | 2.712 | | | | |
| 3 | 2.393 | 99 | 1976 | 72 | 1427 | 7.36 | 7.72 | 31.6 | | | | 2.416 | 15 | 85 | 302 | 3 |
| 4 | 2.216 | 125 | 2310 | 138 | 2550 | 7.32 | 7.76 | 24.4 | | | | 2.268 | 5 | 96 | 95 | 2 |
| 5 | 2.315 | 70 | 1351 | 78 | 1506 | 7.39 | 7.76 | 38.1 | | | | 2.408 | 6 | 91 | 120 | 3 |
| 6 | 2.148 | | | 92 | 1648 | 7.34 | 7.73 | 40.2 | | | | 2.247 | | | | 3 |
| 7 | 2.128 | | | | | 6.50 | 7.73 | | | | | 2.200 | | | | |
| 8 | 2.466 | | | | | 6.3 | 6.9 | | | | | 2.533 | | | | |
| 9 | 2.575 | | | | | 6.1 | 6.5 | | | | | 2.664 | | | 100 | |
| 10 | 2.886 | 129 | 3105 | 264 | 6354 | 6.78 | 7.14 | 33.3 | | | | 2.992 | 4 | 97 | XXXX | 10 |
| 11 | 2.506 | 77 | 1609 | 100 | 2090 | 6.58 | 6.98 | 33.9 | | | | 2.632 | 5 | 94 | 110 | 5 |
| 12 | 2.355 | 89 | 1748 | 143 | 2809 | 6.24 | 6.98 | 37.2 | | | | 2.482 | 3 | 97 | 62 | 2 |
| 13 | 2.393 | 133 | 2654 | 214 | 4271 | 6.21 | 6.73 | 45.6 | | | | 2.51 | 5 | 96 | 105 | 1 |
| 14 | 3.024 | | | | | 6.34 | 6.73 | | | | | 3.079 | | | | |
| 15 | 3.519 | | | | | 5.99 | 6.53 | | | | | 3.657 | | | | |
| 16 | 2.973 | | | | | 5.73 | 6.3 | | | | | 3.101 | | | | |
| 17 | 2.655 | 103 | 2281 | 121 | 2679 | 5.67 | 7.67 | 49.7 | | | | 2.714 | 3.5 | 97 | 79 | 2 |
| 18 | 2.413 | 96 | 1932 | 108 | 2173 | 6.78 | 7.21 | 50.2 | | | | 2.5 | 5 | 95 | 104 | 6 |
| 19 | 2.311 | 81 | 1554 | 108 | 2071 | 6.8 | 7.28 | 39.5 | | | | 2.4 | 11 | 86 | 220 | 3 |
| 20 | 2.312 | 69 | 1330 | 90 | 1735 | 6.78 | 7.30 | 40.5 | | | | 2.457 | 4 | 94 | 82 | 1 |
| 21 | 2.227 | | | | | 6.88 | 7.21 | | | | | 2.281 | | | | |
| 22 | 2.222 | | | | | 6.12 | 6.7 | | | | | 2.34 | | | | |
| 23 | 2.285 | | | | | 6.12 | 7.3 | | | | | 2.496 | | | | |
| 24 | 2.159 | 142 | 2657 | 192 | 3457 | 6.84 | 7.28 | 54.3 | | | | 2.316 | 2 | 99 | 39 | 4 |
| 25 | 2.135 | 127 | 2261 | 166 | 2956 | 6.15 | 7.18 | 62.3 | | | | 2.206 | 6 | 95 | 110 | 10 |
| 26 | 2.155 | 107 | 1923 | 146 | 2624 | 7.00 | 7.35 | 44.5 | | | | 2.215 | 10 | 91 | 185 | 7 |
| 27 | 2.096 | 113 | 1975 | 154 | 2692 | 6.03 | 6.6 | 43.2 | | | | 2.198 | 12 | 89 | 220 | 5 |
| 28 | 2.042 | | | | | 6.03 | 7.0 | | | | | 2.116 | | | | |
| 29 | 2.103 | | | | | 5.57 | 5.91 | | | | | 2.135 | | | | |
| 30 | 2.145 | | | | | 5.47 | 5.77 | | | | | 2.2 | | | | |
| 31 | | | | | | | | | | | | | | | | |
| Total | | | | | | | | | | | | | | | | |
| | AVG 2.410 | AVG | AVG | AVG 137 | AVG 2690 | MIN 5.47 | | AVG 41.8 | AVG | AVG | AVG 2.504 | AVG | AVG | AVG | AVG 4.2 |
| Permit | 6.1 | | 5016 | | 6405 | | | | | | | 20 | 70 | 1017 | 20 |
| | MAX 3.519 | MAX | MAX | MAX 264 | MAX 6354 | | MAX 7.76 | MAX 62.3 | | | MAX 3.657 | AVW | | AVW | AVG 6.5 |
| Limits | | | | | | | | | | | | 30 | | 1525 | 30 |

**Please Circle ALL Permit Violations** **Mail to P.O. Box 47775, Olympia WA 98504-7775**

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=highest 7-day Geometric Mean

I c[illegible]er penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month April | Year 2006

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator J. Dickinson

Plant Type Activated Sludge w/UV Disinfection | Population 15360

EFFLUENT CONT.

| Frequency | 4/WEEK | 4/WEEK | CONT | CONT | CONT | 4/WEEK | 4/WEEK | DAILY | 4/YR | 4/YR | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | TSS % REMOVAL | TSS LBS/DAY | pH (DAILY MIN) STANDARD UNITS | pH (DAILY MAX) STANDARD UNITS | TEMPERATURE DEG C | AMMONIA MG/L (WINTER) | AMMONIA MG/L (SUMMER) | FECAL COLIFORM #/100 ML | OIL & GREASE UG/L | CYANIDE UG/L | | | | | RAIN |
| 1 | | | 7.13 | 7.19 | 16.2 | | | <1 | | | | | | | .01 |
| 2 | | | 7.12 | 7.17 | 16.1 | | | <1 | | | | | | | .03 |
| 3 | 96 | 60 | 7.12 | 7.21 | 16.11 | 1 | | <1 | | | | | | | .10 |
| 4 | 99 | 38 | 7.15 | 7.21 | 16.5 | .85 | | <1 | | | | | | | 0 |
| 5 | 96 | 60 | 7.15 | 7.19 | 16.71 | 1.60 | | <1 | | | | | | | .27 |
| 6 | 97 | 76 | 7.15 | 7.19 | 16.71 | 2.5 | | <1 | | | | | | | 0 |
| 7 | | 7.14 | ~~5.00~~ | 7.17 | 16.6 | | | <1 | | | | | | | .22 |
| 8 | | JD | 7.14 | 7.19 | 16.6 | | | <1 | | | | | | | .23 |
| 9 | | | 7.14 | 7.19 | 16.4 | | | <1 | | | | | | | .43 |
| 10 | 96 | 250 | 6.86 | 6.94 | 16.6 | 6.7 | | <1 | | | | | | | .02 |
| 11 | 95 | 110 | 6.87 | 6.91 | 16.3 | 5.2 | | <1 | | | | | | | .09 |
| 12 | 99 | 41 | 6.82 | 6.87 | 16.88 | 4.64 | | <1 | | | | | | | .01 |
| 13 | 99 | 21 | 7.0 | 7.0 | 16.6 | 6.7 | | <1 | | | | | | | .22 |
| 14 | | | 7.0 | 7.02 | 16.6 | | | <1 | | | | | | | .59 |
| 15 | | | 6.95 | 7.00 | 16.02 | | | <1 | | | | | | | .28 |
| 16 | | | 6.95 | 7.06 | 15.4 | | | <1 | | | | | | | 0 |
| 17 | 98 | 45 | 7.04 | 7.11 | 15.8 | 3.8 | | <1 | | | | | | | .07 |
| 18 | 94 | 125 | 7.0 | 7.07 | 16.4 | 3.4 | | <1 | | | | | | | 0 |
| 19 | 97 | 60 | 7.0 | 7.0 | 16.4 | 2.2 | | <1 | | | | | | | 0 |
| 20 | 99 | 20 | 6.98 | 7.04 | 17.2 | 2.2 | | <1 | | | | | | | .09 |
| 21 | | | 6.98 | 7.02 | 17.2 | | | <1 | | | | | | | 0 |
| 22 | | | 7.0 | 7.02 | 17.2 | | | <1 | | | | | | | 0 |
| 23 | | | 7.0 | 7.02 | 17.2 | | | <1 | | | | | | | 0 |
| 24 | 98 | 77 | 7.02 | 7.07 | 17.4 | 1.8 | | <1 | | | | | | | 0 |
| 25 | 94 | 184 | 6.15 | 7.18 | 17.8 | 2.4 | | <1 | | | | | | | 0 |
| 26 | 95 | 129 | 7.0 | 7.18 | 17.8 | 4.2 | | <1 | | | | | | | 0 |
| 27 | 97 | 92 | 7.01 | 7.09 | 18.2 | 2.8 | | 528 | | | | | | | 0 |
| 28 | | | 6.99 | 7.05 | 18.2 | | | 4 | | | | | | | 0 |
| 29 | | | 7.08 | 7.14 | 18.6 | | | <1 | | | | | | | .19 |
| 30 | | | 7.06 | 7.14 | 18.2 | | | <1 | | | | | | | 0 |
| 31 | | | | | | | | | | | | | | | |
| Total | | | 6.15 | JD | | | | | | | | | | | |
| | AVG 97 | AVG 868 | MIN ~~5.00~~ | | | AVG 3.25 | AVG | GEM 2 | AVG | AVG | | | | | 2.85 |
| Permit | 70 | 1017 | 6 | | | 7 | 20 | 200 | | | | | | | |
| | | AVW 106 | | MAX 7.21 | MXD 18.6 | MXD 6.7 | MXD | GM7 3 | | | | | | | |
| Limits | | 1626 | | 8 | | 15 | 41 | 400 | | | | | | | |

**Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775**

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=highest 7-day Geometric Mean

I, under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name and Title _____ Signature _____

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month MAY | Year 2006

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator J. DICKINSON

Type Activated Sludge w/UV Disinfection | Population 153600

| | INFLUENT | | | | | | | | | | EFFLUENT | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK | CONT | CONT | 4/WEEK | 4/YR | 4/YR | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK |
| Date | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY LBS/DAY | TSS MG/L | TSS LBS/DAY | PH DAILY MIN STANDARD UNITS | PH DAILY MAX STANDARD UNITS | AMMONIA MG/L | OIL & GREASE MG/L | CYANIDE UG/L | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY % REMOVAL | BOD 5-DAY LBS/DAY | TSS MG/L |
| 1 | 2.124 | 106 | 1877 | 134 | 1256 | 5.47 | 7.36 | 80.8 | | | 2.153 | 5 | 95 | 90 | 10 |
| 2 | 2.058 | 104 | 1785 | 146 | 2506 | 6.77 | 7.36 | 70 | | | 2.131 | 1 | 99 | 18 | 5 |
| 3 | 2.138 | 90 | 1605 | 70 | 1248 | 6.77 | 7.36 | 52.5 | | | 2.218 | 4 | 96 | 74 | 2 |
| 4 | 2.178 | 134 | 2434 | 140 | 2543 | 6.39 | 7.32 | 39.2 | | | 2.32 | 5 | 96 | 97 | 5 |
| 5 | 1.916 | | | | | 5.73 | 7.25 | | | | 1.989 | | | | |
| 6 | 2.034 | | | | | 5.73 | 7.48 | | | | 2.078 | | | | |
| 7 | 2.462 | | | | | 5.90 | 7.40 | | | | 2.484 | | | | |
| 8 | 2.133 | 95 | 1689 | 97 | 1726 | 6.76 | 7.34 | 34.2 | | | 2.187 | 8 | 92 | 146 | 10 |
| 9 | 2.095 | 124 | 2167 | 318 | 5556 | 6.76 | 7.34 | 44.2 | | | 2.187 | 7 | 94 | 128 | 2 |
| 10 | 2.040 | 84 | 1429 | 90 | 1531 | 6.48 | 7.34 | 43.7 | | | 2.158 | 4.5 | 95 | 81 | 4 |
| 11 | 2.065 | 139 | 2394 | 136 | 2342 | 6.78 | 7.38 | 42.0 | | | 2.215 | 3 | 98 | 55 | 12 |
| 12 | 2.000 | | | | | 6.53 | 7.38 | | | | 2.165 | | | | |
| 13 | 1.964 | | | | | 6.48 | 7.38 | | | | 2.107 | | | | |
| 14 | 2.115 | | | | | 5.74 | 6.21 | | | | 2.295 | | | | |
| 15 | 2.041 | 201 | 3510 | 288 | 5030 | 6.89 | 7.34 | 46.7 | | | 2.200 | 5 | 98 | 92 | 3 |
| 16 | 2.141 | 185 | 3303 | 350 | 6249 | 6.89 | 7.32 | 43.5 | | | 1.998 | 2.5 | 99 | 42 | 3 |
| 17 | 2.068 | 145 | 2501 | 142 | 2449 | 6.84 | 7.37 | 51.5 | | | 2.226 | 1 | 99 | 19 | 3 |
| 18 | 2.008 | 123 | 2060 | 266 | 4455 | 6.68 | 7.49 | 52.7 | | | 2.185 | 2 | 98 | 36 | 6 |
| 19 | 1.994 | | | | | 6.68 | 7.49 | | | | 2.087 | | | | |
| 20 | 2.028 | | | | | 6.21 | 7.42 | | | | 2.183 | | | | |
| 21 | 2.172 | | | | | 6.21 | 7.38 | | | | 2.314 | | | | |
| 22 | 2.25 | 139 | 2608 | 174 | 3265 | 6.49 | 7.52 | 50.3 | | | 2.321 | 4 | 97 | 77 | 3 |
| 23 | 2.364 | 163 | 3214 | 172 | 3391 | 6.76 | 7.41 | 48.2 | | | 2.396 | 9 | 94 | 180 | 3 |
| 24 | 2.531 | 101 | 2132 | 96 | 2026 | 6.75 | 7.42 | 36.5 | | | 2.622 | 3 | 97 | 66 | 1 |
| 25 | 2.289 | 81 | 1537 | 136 | 2596 | 6.51 | 7.42 | 41 | | | 2.426 | 2 | 98 | 40 | 3 |
| 26 | 2.318 | | | | | 6.18 | 6.93 | | | | 2.379 | | | | |
| 27 | 2.702 | | | | | 6.00 | 6.76 | | | | 2.780 | | | | |
| 28 | 2.420 | | | | | 5.90 | 6.41 | | | | 2.544 | | | | |
| 29 | 2.346 | 118 | 2309 | 111 | 2172 | 6.44 | 7.49 | 48.1 | | | 2.456 | 4 | 97 | 82 | 5 |
| 30 | 2.266 | 111 | 2098 | 162 | 3061 | 6.89 | 7.49 | 37.0 | | | 2.429 | 4 | 96 | 81 | 4 |
| 31 | 2.187 | 168 | 3064 | 282 | 5431 | 6.86 | 6.92 | 40 | | | 2.406 | 3 | 98 | 60 | 5 |
| Total | | | | | | | | | | | | | | | |
| | AVG 2.177 | AVG 127 | AVG 2301 | AVG 174 | AVG 2939 | MIN 5.73 | | AVG 47.5 | AVG | AVG | AVG 2.276 | AVG 4 | AVG 97 | AVG 77 | AVG 4.5 |
| Permit | 6.1 | | 5515 | | 6405 | | | | | | | 20 | 70 | 1017 | 20 |
| | MAX 2.702 | MAX 201 | MAX 3510 | MAX 350 | MAX 6249 | | MAX 7.52 | MAX 80.8 | | | MAX 2.780 | AVW 6 | | AVW 103 | AVW 6 |
| Limits | | | | | | | | | | | | 30 | | 1525 | 30 |

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7 =highest 7-day Geometric Mean

I declare under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name and Title _____ Signature _____

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month MAY | Year 2006

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator J. PICKINSON

Type Activated Sludge w/UV Disinfection | Population 153600

EFFLUENT CONT.

| Frequency | 4/WEEK | 4/WEEK | CONT | CONT | CONT | 4/WEEK | 4/WEEK | DAILY | 4/YR | 4/YR | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | TSS % REMOVAL | TSS LBS/DAY | pH (DAILY MIN) STANDARD UNITS | pH (DAILY MAX) STANDARD UNITS | TEMPERATURE DEG C | AMMONIA MG/L (WINTER) | AMMONIA MG/L (SUMMER) | FECAL COLIFORM #/100 ML | OIL & GREASE UG/L | CYANIDE UG/L | | | | | RAIN |
| 1 | 93 | 180 | 7.05 | 7.14 | 17.8 | 6.2 | | 26 | | | | | | | Ø |
| 2 | 97 | 89 | 6.84 | 7.25 | 18.4 | 4.63 | 4.63 | <1 | | | | | | | Ø |
| 3 | 97 | 37 | 7.02 | 7.17 | 18.0 | 1.90 | 1.90 | <1 | | | | | | | Ø |
| 4 | 96 | 97 | 6.84 | 7.25 | 18.6 | 1.7 | | 2 | | | | | | | Ø |
| 5 | | | 6.70 | 7.25 | 18.6 | | | 4 | | | | | | | Ø |
| 6 | | | 7.0 | 7.25 | 19.0 | | | <1 | | | | | | | .06 |
| 7 | | | 7.04 | 7.10 | 18.42 | | | 2 | | | | | | | .43 |
| 8 | 94 | 109 | 7.06 | 7.13 | 18.21 | .520 | | <1 | | | | | | | Ø |
| 9 | 99 | 35 | 7.06 | 7.13 | 18.2 | .85 | | <1 | | | | | | | Ø |
| 10 | 95 | 72 | 7.02 | 7.13 | 18.6 | 1.2 | | <1 | | | | | | | Ø |
| 11 | 91 | 221 | 7.00 | 7.09 | 18.2 | 1.5 | | <1 | | | | | | | Ø |
| 12 | | | 7.00 | 7.09 | 18.2 | | | <1 | | | | | | | Ø |
| 13 | | | 7.0 | 7.10 | 19.0 | | | <1 | | | | | | | Ø |
| 14 | | | 7.04 | 7.09 | 19.42 | | | <1 | | | | | | | Ø |
| 15 | 99 | 55 | 7.06 | 7.11 | 19.62 | 1.6 | | <1 | | | | | | | Ø |
| 16 | 99 | 50 | 7.06 | 7.11 | 19.6 | <2.0 | | <1 | | | | | | | Ø |
| 17 | 98 | 56 | 7.05 | 7.11 | 20.61 | 1.6 | | <1 | | | | | | | Ø |
| 18 | 98 | 109 | 7.02 | 7.11 | 19.7 | 0.5 | | <1 | | | | | | | Ø |
| 19 | | | 7.02 | 7.17 | 20.61 | | | 14 | | | | | | | .06 |
| 20 | | | 7.11 | 7.22 | 20.4 | | | <1 | | | | | | | .06 |
| 21 | | | 7.09 | 7.18 | 20.2 | | | <1 | | | | | | | .35 |
| 22 | 98 | 58 | 7.05 | 7.16 | 20 | 1.3 | | 408 | | | | | | | .20 |
| 23 | 98 | 60 | 7.03 | 7.13 | 19.8 | .75 | | <1 | | | | | | | .33 |
| 24 | 99 | 22 | 6.93 | 7.03 | 19.5 | .89 | | <1 | | | | | | | .42 |
| 25 | 98 | 61 | 6.89 | 6.97 | 19.3 | .67 | | <1 | | | | | | | .19 |
| 26 | | | 6.89 | 6.97 | 19.3 | | | <1 | | | | | | | .23 |
| 27 | | | 6.91 | 7.00 | 18.91 | | | <1 | | | | | | | .57 |
| 28 | | | 6.83 | 6.95 | 18.51 | | | 2 | | | | | | | .02 |
| 29 | 95 | 102 | 6.85 | 6.91 | 18.9 | 1.5 | | <1 | | | | | | | Ø |
| 30 | 98 | 81 | 6.86 | 6.92 | 19.5 | .68 | | <1 | | | | | | | Ø |
| 31 | 98 | 100 | 6.86 | 6.92 | 19.7 | .73 | | <1 | | | | | | | .02 |
| Total | | | | | | | | | | | | | | | |
| | AVG 97 | AVG 84 | MIN 6.70 | | | AVG 1.6 | AVG | GEM 2 | AVG | AVG | | | | | 2.88" |
| Permit | 70 | 1017 | 6 | | | 7 | 20 | 200 | | | | | | | |
| | | AVW 109 | | MAX 7.25 | MAX 20.6 | MXD | MXD | GM7 33 | | | | | | | |
| Limits | | 1526 | | 9 | | 15 | 41 | 400 | | | | | | | |

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=highest 7-day Geometric Mean

Under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month JUNE | Year 2006

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator JIM DICKINSON

Type Activated Sludge w/UV Disinfection | Population 15360

| Frequency | INFLUENT CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK | CONT | CONT | 4/WEEK | 4/YR | 4/YR | EFFLUENT CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY LBS/DAY | TSS MG/L | TSS LBS/DAY | pH CONTINUOUS STANDARD UNITS | pH CONTINUOUS STANDARD UNITS | AMMONIA MG/L | OIL & GREASE MG/L | CYANIDE MG/L | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY % REMOVAL | BOD 5-DAY LBS/DAY | TSS MG/L |
| 1 | 2.598 | 176 | 3813 | 272 | 5894 | 6.67 | 6.73 | 59.7 | | | 2.761 | 4.5 | 97 | 103 | 3 |
| 2 | 2.252 | | | | | 6.17 | 7.34 | | | | 2.378 | | | | |
| 3 | 2.203 | | | | | 6.25 | 7.09 | | | | 2.385 | | | | |
| 4 | 2.34 | | | | | 6.45 | 7.31 | | | | 2.456 | | | | |
| 5 | 2.182 | 190 | 3708 | 240 | 4367 | 6.59 | 7.42 | 43 | | | 2.30 | 4 | 98 | 82 | 4 |
| 6 | 2.172 | 140 | 2536 | 290 | 5253 | 6.42 | 7.46 | 39 | | | 2.264 | 5 | 96 | 94 | 5 |
| 7 | 2.106 | 108 | 1897 | 88 | 1546 | 6.41 | 7.16 | 49 | | | 2.252 | 7 | 94 | 131 | 2 |
| 8 | 2.125 | 134 | 2375 | 125 | 2215 | 6.46 | 7.8 | 41.3 | | | 2.228 | 1 | 99 | 19 | 3 |
| 9 | 2.027 | | | | | 6.60 | 7.7 | | | | 2.063 | | | | |
| 10 | 1.988 | | | | | 6.16 | 7.26 | | | | 2.082 | | | | |
| 11 | 2.133 | | | | | 6.24 | 7.46 | | | | 2.234 | | | | |
| 12 | 2.16 | 144 | 2594 | 228 | 4108 | 6.57 | 7.53 | 15.8 | | | 2.213 | 5 | 97 | 92 | 2 |
| 13 | 2.049 | 136 | 2324 | 132 | 2256 | 6.30 | 7.49 | 1 | | | 2.135 | 1 | 99 | 18 | 3 |
| 14 | 2.207 | 106 | 1951 | 208 | 3826 | 6.55 | 7.31 | 46.7 | | | 2.114 | 6 | 94 | 106 | 5 |
| 15 | 2.086 | 134 | 2331 | 146 | 2540 | 6.48 | 7.67 | 81.5 | | | 2.191 | 5 | 96 | 91 | 5 |
| 16 | 2.055 | | | | | 6.76 | 7.70 | | | | 2.111 | | | | |
| 17 | 1.985 | | | | | 6.10 | 7.25 | | | | 2.087 | | | | |
| 18 | 2.094 | | | | | 6.58 | 7.41 | | | | 2.152 | | | | |
| 19 | 2.075 | 123 | 2129 | 164 | 2838 | 6.8 | 7.57 | 45.5 | | | 2.642 | 3 | 98 | 66 | 14 |
| 20 | 2.004 | 149 | 2423 | 172 | 2874 | 6.6 | 7.7 | 46.6 | | | 2.3 | 2 | 99 | 38 | 9 |
| 21 | 1.973 | 114 | 1878 | 100 | 1647 | 6.6 | 7.30 | 40.4 | | | 2.120 | 6 | 95 | 106 | 5 |
| 22 | 2.028 | 134 | 2266 | 124 | 2097 | 6.6 | 7.53 | 36.2 | | | 2.095 | 4 | 97 | 70 | 2 |
| 23 | 1.959 | | | | | 6.3 | 7.0 | | | | 2.061 | | | | |
| 24 | 1.966 | | | | | 5.9 | 6.83 | | | | 2.101 | | | | |
| 25 | 2.035 | | | | | 5.73 | 6.69 | | | | 2.18 | | | | |
| 26 | 2.096 | 129 | 2255 | 132 | 2307 | 5.98 | 7.94 | 45.6 | | | 2.22 | 3 | 98 | 56 | 5 |
| 27 | 2.057 | 88 | 1510 | 109 | 1870 | 6.63 | 7.66 | 45.0 | | | 2.175 | 4 | 95 | 73 | 3 |
| 28 | 1.990 | 129 | 2141 | 246 | 4082 | 6.98 | 6.83 | 43.4 | | | 2.105 | 3 | 98 | 53 | 4 |
| 29 | 1.938 | 88 | 1422 | 143 | 2311 | 6.67 | 7.48 | 40.8 | | | 2.124 | 3 | ~~53~~ | 53 | 3 |
| 30 | 1.971 | | | | | 6.56 | 7.63 | | | | 2.17 | | 97 | | |
| 31 | | | | | | | | | | | | | TR | | |
| Total | | | | | | | | | | | | | | | |
| | AVG 2.095 | AVG 130 | AVG 2327 | AVG 172 | AVG 3061 | MIN 5.73 | | AVG 42.4 | AVG | AVG | AVG 2.22 | AVG 3.9 | AVG 97 | AVG 74 | AVG 4.5 |
| Permit | 6.1 | | 5616 | | 6405 | | | | | | | 20 | 70 | 1017 | 20 |
| | MAX 2.598 | MAX 190 | MAX 3813 | MAX 272 | MAX 5894 | | MAX 7.94 | MAX 81.5 | | | MAX 2.761 | MAW 4.25 | | MAW 82 | MAW 7.5 |
| Limits | | | | | | | | | | | | 30 | | 1525 | 30 |

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AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=highest 7-day Geometric Mean

I c[illegible]der penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month JUNE | Year 2006

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection | Population 15360

EFFLUENT CONT.

| Frequency | 4/WEEK | 4/WEEK | CONT | CONT | CONT | 4/WEEK | 4/WEEK | DAILY | 4/YR | 4/YR | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | TSS % REMOVAL | TSS LBS/DAY | pH (DAILY MIN) STANDARD UNITS | pH (DAILY MAX) STANDARD UNITS | TEMPERATURE DEG C | AMMONIA MG/L (WINTER) | AMMONIA MG/L (SUMMER) | FECAL COLIFORM #/100 ML | OIL & GREASE UG/L | CYANIDE UG/L | | | | | RAIN |
| 1 | 99 | 69 | 6.90 | 6.92 | 19.9 | | 2.4 | 3 | | | | | | | .59 |
| 2 | | | 6.86 | 6.92 | 19.9 | | | <1 | | | | | | | 0 |
| 3 | | | 6.84 | 6.95 | 19.9 | | | 3 | | | | | | | .21 |
| 4 | | | 6.86 | 6.92 | 19.9 | | | <1 | | | | | | | .05 |
| 5 | 98 | 77 | 6.86 | 6.9 | 20.3 | | 1.8 | <1 | | | | | | | 0 |
| 6 | 98 | 94 | 6.88 | 6.95 | 20.5 | | 2.7 | <1 | | | | | | | 0 |
| 7 | 97 | 37 | 6.95 | 7.01 | 20.5 | | 5.9 | <1 | | | | | | | 0 |
| 8 | 98 | 56 | 6.99 | 7.10 | 20.1 | | 3.1 | <1 | | | | | | | 0 |
| 9 | | | 7.06 | 7.10 | 20.0 | | | <1 | | | | | | | 0 |
| 10 | | | 7.02 | 7.08 | 20.5 | | | 8 | | | | | | | 0 |
| 11 | | | 7.02 | 7.04 | 20.7 | | | <1 | | | | | | | .04 |
| 12 | 99 | 37 | 7.02 | 7.06 | 20.5 | | .82 | 6 | | | | | | | .20 |
| 13 | 98 | 53 | 7.02 | 7.06 | 20.52 | | .41 | <1 | | | | | | | 0 |
| 14 | 98 | 88 | 6.98 | 7.02 | 20.3 | | 16.7 | <1 | | | | | | | .06 |
| 15 | 97 | 91 | 6.96 | 7.0 | 20.3 | | 19.6 | 4 | | | | | | | .06 |
| 16 | | | 6.94 | 7.0 | 20.5 | | | <1 | | | | | | | .03 |
| 17 | | | 6.85 | 6.94 | 20.9 | | | <1 | | | | | | | 0 |
| 18 | | | 6.81 | 6.85 | 20.5 | | | <1 | | | | | | | 0 |
| 19 | 91 | 308 | 6.79 | 7.13 | 20.5 | | 9.3 | <1 | | | | | | | 0 |
| 20 | 95 | 172 | 6.97 | 7.07 | 20.2 | | 10.9 | <1 | | | | | | | 0 |
| 21 | 95 | 88 | 6.92 | 7.03 | 20.9 | | 8.4 | 36 | | | | | | | 0 |
| 22 | 98 | 35 | 7.01 | 7.10 | 20.1 | | 8.2 | <1 | | | | | | | 0 |
| 23 | | | 6.98 | 7.06 | 21.3 | | | <1 | | | | | | | 0 |
| 24 | | | 6.93 | 7.00 | 21.7 | | | <1 | | | | | | | 0 |
| 25 | | | 6.91 | 6.98 | 22.1 | | | <1 | | | | | | | 0 |
| 26 | 96 | 93 | 6.05 | 6.95 | 22.3 | | 14.3 | <1 | | | | | | | 0 |
| 27 | 97 | 54 | 6.92 | 6.99 | 22.7 | | 6.63 | <1 | | | | | | | 0 |
| 28 | 98 | 70 | 6.99 | 7.06 | 22.1 | | 7.9 | <1 | | | | | | | 0 |
| 29 | 98 | 53 | 7.08 | 7.12 | 21.3 | | 7.9 | <1 | | | | | | | 0 |
| 30 | | | 6.39 | 7.11 | 22.1 | | | | | | | | | | 0 |
| 31 | | | | | | | | | | | | | | | |
| Total | | | | | | | | | | | | | | | |
| | AVG 97 | AVG 86.7 | MIN 6.05 | | | AVG | AVG 7.46 | GEM 2 | AVG | AVG | | | | | 1.24" |
| Permit | 70 | 1017 | 6 | | | 7 | 20 | 200 | | | | | | | |
| | | AVW 150.7 | | MAX 7.13 | MXD 22.7 | MXD | MXD 19.6 | SMT 3 | | | | | | | |
| Limits | | 1526 | | 9 | | 15 | 41 | 400 | | | | | | | |

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AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

SMT=Highest 7-day Geometric Mean

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Permit No. WA0020249 | Month July | Year 2006

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator J. Dickinson

Plant Type Activated Sludge w/UV Disinfection | Population 16670

| | INFLUENT | | | | | | | | | | EFFLUENT | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK | CONT | CONT | 4/WEEK | 4/YR | 4/YR | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK |
| Date | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY LBS/DAY | TSS MG/L | TSS LBS/DAY | PH DAILY MIN STANDARD UNITS | PH DAILY MAX STANDARD UNITS | AMMONIA MG/L | OIL & GREASE MG/L | CYANIDE MG/L | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY % REMOVAL | BOD 5-DAY LBS/DAY | TSS MG/L |
| 1 | 1.952 | | | | | 6.07 | 7.28 | | | | 2.097 | | | | |
| 2 | 1.949 | | | | | 6.48 | 7.45 | | | | 2.07 | | | | |
| 3 | 1.978 | 141 | 2326 | 186 | 3068 | 6.51 | 8.55 | 51.6 | | | 2.089 | 6 | 96 | 105 | 6 |
| 4 | 1.987 | 72 | 1242 | 94 | 1621 | 6.44 | 7.59 | 43 | | | 2.068 | 6 | 92 | 99 | 6 |
| 5 | 2.035 | 97 | 1646 | 172 | 2619 | 7.01 | 7.66 | 42.9 | | | 2.07 | 4 | 96 | 69 | 5 |
| 6 | 2.053 | 121 | 2071 | 186 | 3185 | 6.69 | 7.66 | 39.4 | | | 2.141 | 11 | 94 | 191 | 5 |
| 7 | 1.919 | | | | | 6.69 | 7.5 | | | | 2.022 | | | | |
| 8 | 1.958 | | | | | 6.68 | 7.42 | | | | 2.07 | | | | |
| 9 | 1.986 | | | | | 6.68 | 7.33 | | | | 2.083 | | | | |
| 10 | 2.037 | 130 | 2209 | 200 | 3398 | 6.7 | 7.42 | 57.2 | | | 2.106 | 10 | 92 | 176 | 12 |
| 11 | 1.993 | 120 | 2002 | 174 | 2893 | 6.4 | 7.0 | 38 | | | 2.086 | 12 | 90 | 210 | 11 |
| 12 | 2.007 | 110 | 1841 | 136 | 2276 | 5.95 | 7.0 | 48 | | | 2.150 | 9 | 92 | 161 | 13 |
| 13 | 2.088 | 104 | 1811 | 206 | 3587 | 6.51 | 7.2 | 68 | | | 2.213 | 4 | 96 | 74 | 9 |
| 14 | 1.969 | | | | | 6.76 | 7.17 | | | | 2.054 | | | | |
| 15 | 1.983 | | | | | 6.73 | 7.23 | | | | 2.039 | | | | |
| 16 | 2.068 | | | | | 6.36 | 7.26 | | | | 2.138 | | | | |
| 17 | 2.04 | 101 | 1718 | 137 | 2331 | 6.82 | 7.26 | 34.2 | | | 2.063 | 9 | 91 | 155 | 6 |
| 18 | 1.996 | 111 | 1848 | 166 | 2763 | 6.75 | 7.29 | 12.6 | | | 2.032 | 8 | 93 | 136 | 4 |
| 19 | 2.039 | 80 | 1360 | 112 | 1904 | 6.75 | 7.22 | 43 | | | 2.1 | 6 | 93 | 105 | 7 |
| 20 | 2.057 | 137 | 2350 | 94 | 1613 | 6.87 | 7.40 | 39.4 | | | 2.124 | 11 | 92 | 195 | 3 |
| 21 | 2.021 | | | | | 6.68 | 7.40 | | | | 2.086 | | | | |
| 22 | 2.104 | | | | | 5.97 | 7.10 | | | | 2.123 | | | | |
| 23 | 2.071 | | | | | 6.04 | 7.13 | | | | 2.122 | | | | |
| 24 | 2.130 | 92 | 1634 | 110 | 2061 | 5.88 | 7.26 | 39.6 | | | 2.168 | 11 | 88 | 199 | 4 |
| 25 | 2.104 | 138 | 2422 | 194 | 3404 | 6.77 | 7.19 | 43 | | | 2.111 | 12 | 91 | 211 | 6 |
| 26 | 2.091 | 168 | 2930 | 241 | 3505 | 6.36 | 7.21 | 35.5 | | | 2.120 | 8 | 95 | 141 | 4 |
| 27 | 2.06 | 141 | 2422 | 256 | 4398 | 6.54 | 7.36 | 51.6 | | | 2.122 | 6 | 96 | 106 | 7 |
| 28 | 1.973 | | | | | 6.86 | 7.33 | | | | 1.991 | | | | |
| 29 | 1.978 | | | | | 6.18 | 7.37 | | | | 2.010 | | | | |
| 30 | 2.054 | | | | | 6.70 | 7.25 | | | | 2.065 | | | | |
| 31 | 2.018 | 145 | 2440 | 258 | 4342 | 6.4 | 7.25 | 52.6 | | | 2.049 | 4 | 97 | 68 | 7 |
| Total | | | | | | | | | | | | | | | |
| | AVG 2.023 | AVG 118 | AVG 2016 | AVG 170 | AVG 2880 | MIN 5.88 | | AVG 43.5 | AVG | AVG | AVG 2.089 | AVG 8 | AVG 93 | AVG 141 | AVG 7 |
| Permit | 6.1 | | 6616 | | 5405 | | | | | | | 20 | 70 | 1017 | 20 |
| | MAX 2.13 | MAX 145 | MAX 2930 | MAX 258 | MAX 4398 | | MAX 8.55 | MAX 68 | | | MAX 2.168 | AVW 9 | | AVW 164 | AVW 11 |
| Limits | | | | | | | | | | | | 30 | | 1525 | 30 |

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

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GM7=highest 7-day Geometric Mean

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Name and Title

Signature

Facility Name City of Camas
Receiving Water Columbia River
Plant Type Activated Sludge w/UV Disinfection

Month July Year 2006
County Clark
Plant Operator J. Dickinson
Population 116670

EFFLUENT CONT.

| Date | TSS | % REMOVAL | TSS | LBS/DAY | pH (DAILY MIN) STANDARD UNITS | pH (DAILY MAX) STANDARD UNITS | TEMPERATURE DEG C | AMMONIA MG/L (WINTER) | AMMONIA MG/L (SUMMER) | FECAL COLIFORM #/100 ML | OIL & GREASE UG/L | CYANIDE UG/L | | | | | RAIN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 4/WEEK | 4/WEEK | CONT | | CONT | | CONT | 4/WEEK | 4/WEEK | DAILY | 4/YR | 4/YR | | | | | |
| 1 | | | 7.0 | | 7.07 | | 21.3 | | | <1 | | | | | | | Ø |
| 2 | | | 7.0 | | 7.0 | | 22.1 | | | <1 | | | | | | | Ø |
| 3 | 97 | 105 | 7.0 | | 7.16 | | 22.5 | | 8.6 | <1 | | | | | | | .51 |
| 4 | 94 | 99 | 7.1 | | 7.13 | | 22.5 | | 8.5 | <1 | | | | | | | Ø |
| 5 | 97 | 86 | 7.08 | | 7.13 | | 21.3 | | 10.9 | <1 | | | | | | | Ø |
| 6 | 97 | 89 | 7.08 | | 7.16 | | 21.3 | | 14.1 | <1 | | | | | | | Ø |
| 7 | | | 7.01 | | 7.11 | | 22.1 | | | <1 | | | | | | | Ø |
| 8 | | | 6.95 | | 7.03 | | 22.3 | | | 34 | | | | | | | Ø |
| 9 | | | 6.93 | | 7.0 | | 22.8 | | | 18 | | | | | | | Ø |
| 10 | 94 | 211 | 6.95 | | 7.1 | | 22.4 | | 10.7 | 172 | | | | | | | Ø |
| 11 | 94 | 191 | 6.84 | | 7.2 | | 22.4 | | 12.7 | 92 | | | | | | | Ø |
| 12 | 90 | 233 | 7.13 | | 7.2 | | 21.7 | | 17.7 | 60 | | | | | | | .14 |
| 13 | 96 | 166 | 6.12 | | 7.0 | | 22.4 | | 15.7 | 164 | | | | | | | Ø |
| 14 | | | 7.0 | | 7.4 | | 22.3 | | | 9 | | | | | | | Ø |
| 15 | | | 6.98 | | 7.02 | | 22.7 | | | 12 | | | | | | | Ø |
| 16 | | | 6.98 | | 7.15 | | 23.1 | | | 4 | | | | | | | Ø |
| 17 | 96 | 103 | 7.02 | | 7.21 | | 22.7 | | 1.85 | 304 | | | | | | | Ø |
| 18 | 98 | 68 | 6.97 | | 7.05 | | 22.7 | | .53 | 6 | | | | | | | Ø |
| 19 | 94 | 123 | 6.95 | | 7.0 | | 22.7 | | 11.4 | 24 | | | | | | | Ø |
| 20 | 97 | 53 | 6.89 | | 6.98 | | 23.1 | | 10.3 | <1 | | | | | | | Ø |
| 21 | | | 6.93 | | 7.0 | | 23.5 | | | <1 | | | | | | | Ø |
| 22 | | | 6.87 | | 6.96 | | 23.3 | | | 6 | | | | | | | Ø |
| 23 | | | 6.87 | | 7.04 | | 24.1 | | | 2 | | | | | | | Ø |
| 24 | 96 | 72 | 6.96 | | 7.04 | | 24.19 | | 3.54 | 6 | | | | | | | Ø |
| 25 | 97 | 106 | 6.99 | | 7.09 | | 23.8 | | 5.4 | 3 | | | | | | | Ø |
| 26 | 98 | 71 | 7.06 | | 7.13 | | 23.79 | | 3.30 | 3 | | | | | | | Ø |
| 27 | 97 | 124 | 7.03 | | 7.11 | | 23.6 | | 4.1 | 3 | | | | | | | Ø |
| 28 | | | 7.01 | | 7.09 | | 23.1 | | | 43 | | | | | | | Ø |
| 29 | | | 7.02 | | 7.13 | | 23.12 | | | 3 | | | | | | | .01 |
| 30 | | | 7.17 | | 7.19 | | 22.7 | | | 3 | | | | | | | .01 |
| 31 | 97 | 120 | 7.07 | | 7.19 | | 22.9 | | 9.3 | 1 | | | | | | | Ø |
| Total | | | | | | | | | | | | | | | | | |
| | AVG 96 | AVG 119 | MIN 6.12 | | | | AVG | AVG 8.7 | | GEM 6 | AVG | AVG | | | | | .67 |
| Permit | 70 | 1017 | 6 | | | | 7 | 29 | | 200 | | | | | | | |
| | | AVW 200 | | | MAX 7.4 | | MAX 24.2 | MAX | MAX 17.7 | GM7 37 | | | | | | | |
| Limits | | 1526 | | | 9 | | | 15 | 41 | 400 | | | | | | | |

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775
AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name and Title

Signature

Permit No. WA0020249 | Month August | Year 2006

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator Jim Dickinson

Plant Type Activated Sludge w/UV Disinfection | Population 16670

| | INFLUENT | | | | | | | | | | EFFLUENT | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK | CONT | CONT | 4/WEEK | 4/YR | 4/YR | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK |
| Date | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY LBS/DAY | TSS MG/L | TSS LBS/DAY | PH DAILY MIN | PH DAILY MAX | AMMONIA MG/L | OIL & GREASE MG/L | CYANIDE MG/L | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY % REMOVAL | BOD 5-DAY LBS/DAY | TSS MG/L |
| 1 | 2.139 | 140 | 2497 | 270 | 4817 | 6.31 | 7.27 | 42.5 | | | 2.151 | 10 | 93 | 179 | 8 |
| 2 | 2.092 | 109 | 1902 | 136 | 2373 | 6.55 | 7.20 | 54.1 | | | 2.119 | 11 | 90 | 194 | 4 |
| 3 | 2.062 | 108 | 1857 | 143 | 2459 | 6.09 | 7.13 | 39 | | | 2.127 | 19 | 82 | 337 | 5 |
| 4 | 1.999 | | | | | 6.09 | 7.46 | | | | 1.984 | | | | |
| 5 | 1.925 | | | | | 5.81 | 7.05 | | | | 1.961 | | | | |
| 6 | 2.027 | | | | | 5.78 | 7.26 | | | | 2.052 | | | | |
| 7 | 2.038 | 135 | 2295 | 208 | 3535 | 6.66 | 7.18 | 35.3 | | | 2.041 | 6 | 96 | 102 | 2 |
| 8 | 2.034 | 86 | 1459 | 70 | 1187 | 6.39 | 7.17 | 40.0 | | | 2.001 | 15 | 83 | 250 | 7 |
| 9 | 2.018 | 92 | 1548 | 106 | 1784 | 6.39 | 7.18 | 45.2 | | | 2.000 | 22 | 76 | 367 | 9 |
| 10 | 2.041 | 124 | 2111 | 262 | 4460 | 6.36 | 7.2 | 75 | | | 2.065 | 7 | 94 | 121 | 6 |
| 11 | 2.063 | | | | | 6.20 | 7.13 | | | | 1.995 | | | | |
| 12 | 2.019 | | | | | 5.77 | 7.02 | | | | 2.039 | | | | |
| 13 | 2.066 | | | | | 6.36 | 7.22 | | | | 2.091 | | | | |
| 14 | 2.078 | 99 | 1715 | 200 | 34666 | 6.43 | 7.18 | 42.5 | | | 2.078 | 6 | 94 | 105 | 8 |
| 15 | 2.079 | 127 | 2202 | 176 | 3052 | 6.33 | 7.18 | 78 | | | 2.062 | 6 | 95 | 103 | 5 |
| 16 | 2.05 | 72 | 1231 | 190 | 3248 | 6.33 | 7.31 | 43.8 | | | 2.027 | 7 | 90 | 118 | 8 |
| 17 | 2.081 | 133 | 2308 | 242 | 4200 | 6.48 | 7.25 | 42.3 | | | 2.118 | 17.7 | 87 | 309 | 8 |
| 18 | 1.940 | | | | | 6.50 | 7.25 | | | | 1.959 | | | | |
| 19 | 2.030 | | | | | 5.78 | 6.84 | | | | 2.053 | | | | |
| 20 | 2.032 | | | | | 5.69 | 7.15 | | | | 2.030 | | | | |
| 21 | 2.063 | 133 | 2289 | 195 | 3355 | 6.25 | 7.13 | 40.8 | | | 2.024 | 8 | 94 | 135 | 6 |
| 22 | 2.041 | 116 | 1975 | 236 | 4017 | 6.20 | 7.13 | 50.0 | | | 1.990 | 16 | 86 | 266 | 7 |
| 23 | 2.069 | 119 | 2053 | 185 | 3192 | 6.30 | 7.28 | 36.8 | | | 2.029 | 8 | 93 | 135 | 6 |
| 24 | 2.072 | 147 | 2540 | 157 | 2713 | 6.27 | 7.18 | 40.5 | | | 1.999 | 19 | 87 | 317 | 4 |
| 25 | 2.017 | | | | | 6.10 | 7.17 | | | | 2.008 | | | | |
| 26 | 1.965 | | | | | 5.59 | 6.86 | | | | 1.979 | | | | |
| 27 | 2.205 | | | | | 5.32 | 6.62 | | | | 2.211 | | | | |
| 28 | 2.068 | 100 | 1725 | 153 | 2639 | 5.7 | 7.0 | 16.8 | | | 2.082 | 5 | 95 | 87 | 6 |
| 29 | 2.091 | 68 | 1186 | 90 | 1570 | 5.74 | 7.13 | .1766 | | | 2.059 | 8 | 88 | 17 | 4 |
| 30 | 2.161 | 60 | 1081 | 78 | 1405 | 6.07 | 7.18 | 46.5 | | | 2.192 | 4 | 93 | 73 | 3 |
| 31 | 2.021 | 116 | 1955 | 228 | 3843 | 6.34 | 7.39 | 41.6 | | | 2.081 | 4 | 97 | 69 | 3 |
| Total | | | | | | | | | | | | | | | |
| | AVG 2.048 | AVG 110 | AVG 1891 | AVG 175 | AVG 3017 | MIN 5.32 | | AVG 42.7 | AVG | AVG | AVG 2.05 | AVG 10 | AVG 90 | AVG 173 | AVG 6 |
| Permit | 6.1 | | 6616 | | 6605 | | | | | | | 20 | 70 | 1017 | 20 |
| | MAX 2.205 | MAX 147 | MAX 2540 | MAX 270 | MAX 4817 | | MAX 7.46 | MAX 78 | | | MAX 2.192 | AVW 13 | | AVW 213 | AVW 7 |
| Limits | | | | | | | | | | | | 30 | | 1525 | 30 |

Please Circle ALL Permit Violations **Mail to P.O. Box 47775, Olympia WA 98504-7775**

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=highest 7-day Geometric Mean

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month August | Year 2006

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator Jim Dickinson

Plant Type Activated Sludge w/UV Disinfection | Population 16670

EFFLUENT CONT.

| Frequency | 4/WEEK | 4/WEEK | CONT | CONT | CONT | 4/WEEK | 4/WEEK | DAILY | 4/YR | 4/YR | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | TSS | % REMOVAL | TSS | LBS/DAY | pH (DAILY MIN) STANDARD UNITS | pH (DAILY MAX) STANDARD UNITS | TEMPERATURE DEG C | AMMONIA MG/L (WINTER) | AMMONIA MG/L (SUMMER) | FECAL COLIFORM #/100 ML | OIL & GREASE UG/L | CYANIDE UG/L | | | | | N-DRU |
| 1 | 97 | | 142 | | 7.01 | 7.09 | 22.7 | | 11.1 | 3 | | | | | | | Ø |
| 2 | 97 | | 71 | | 6.97 | 7.01 | 23 | | 10.9 | 86 | | | | | | | Ø |
| 3 | 97 | | 89 | | 6.95 | 7.0 | 23.1 | | 8.2 | <1 | | | | | | | Ø |
| 4 | | | | | 6.99 | 7.06 | 23.1 | | | 56 | | | | | | | Ø |
| 5 | | | | | 6.09 | 7.03 | 23.3 | | | 6 | | | | | | | Ø |
| 6 | | | | | 6.99 | 7.05 | 23.5 | | | 286 | | | | | | | Ø |
| 7 | 99 | | 34 | | 6.99 | 7.07 | 23.7 | | 6.5 | 252 | | | | | | | Ø |
| 8 | 90 | | 117 | | 6.99 | 7.06 | 23.3 | | 5.8 | 600 | | | | | | | Ø |
| 9 | 91 | | 156 | | 7.01 | 7.09 | 23.5 | | 8.8 | <1 | | | | | | | Ø |
| 10 | 98 | | 103 | | 7.01 | 7.07 | 23.1 | | 14 | 16 | | | | | | | Ø |
| 11 | | | | | 6.93 | 7.01 | 22.9 | | | 220 | | | | | | | Ø |
| 12 | | | | | 6.89 | 6.95 | 23.1 | | | 4 | | | | | | | Ø |
| 13 | | | | | 6.92 | 6.97 | 23.3 | | | <1 | | | | | | | Ø |
| 14 | 96 | | 140 | | 6.90 | 6.97 | 23.3 | | 6.1 | 4 | | | | | | | Ø |
| 15 | 97 | | 86 | | 6.90 | 6.97 | 23.1 | | 9.8 | 8 | | | | | | | Ø |
| 16 | 96 | | 135 | | 6.92 | 6.98 | 22.4 | | 3.2 | <1 | | | | | | | Ø |
| 17 | 97 | | 141 | | 6.92 | 6.97 | 22.6 | | 3.4 | 5 | | | | | | | Ø |
| 18 | | | | | 6.92 | 6.98 | 23.7 | | | 18 | | | | | | | Ø |
| 19 | | | | | 6.93 | 6.98 | 23.2 | | | 4 | | | | | | | Ø |
| 20 | | | | | 6.86 | 6.96 | 23.5 | | | 21 | | | | | | | Ø |
| 21 | 97 | | 101 | | 6.84 | 7.02 | 23.3 | | 4.4 | 25 | | | | | | | Ø |
| 22 | 97 | | 116 | | 7.00 | 7.07 | 23.1 | | 7.9 | 2 | | | | | | | Ø |
| 23 | 97 | | 102 | | 7.00 | 7.10 | 22.71 | | 4.79 | 46 | | | | | | | .02 |
| 24 | 97 | | 67 | | 7.05 | 7.12 | 22.3 | | 4.7 | 2 | | | | | | | Ø |
| 25 | | | | | 7.08 | 7.12 | 23. | | | 12 | | | | | | | Ø |
| 26 | | | | | 7.03 | 7.12 | 23.31 | | | 3 | | | | | | | Ø |
| 27 | | | | | 7.05 | 7.12 | 23.3 | | | 186 | | | | | | | Ø |
| 28 | 96 | | 104 | | 7.08 | 7.12 | 23.9 | | .47 | 29 | | | | | | | Ø |
| 29 | 96 | | 69 | | 7.09 | 7.20 | 22.9 | | .06 | 10 | | | | | | | Ø |
| 30 | 96 | | 55 | | 7.04 | 7.11 | 22.4 | | 17.5 | 13 | | | | | | | Ø |
| 31 | 99 | | 52 | | 7.01 | 7.10 | 22.4 | | 16.6 | 11 | | | | | | | Ø |
| Total | | | | | | | | | | | | | | | | | |
| | AVG 96 | | AVG 989 | | MIN 6.09 | | | AVG | AVG 7.6 | GEM 13 | AVG | AVG | | | | | .02 |
| Permit | 70 | | 1017 | | 6 | | | 7 | 20 | 200 | | | | | | | |
| | | | AVW 125.5 | | | MAX 7.2 | MXD 23.9 | MXD | MXD 17.5 | GMT 25 | | | | | | | |
| Limits | | | 1525 | | | 9 | | 15 | 41 | 400 | | | | | | | |

**Please Circle ALL Permit Violations** **Mail to P.O. Box 47775, Olympia WA 98504-7775**

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=highest 7-day Geometric Mean

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name and Title

Signature

Permit No. WA0020249 | Month September Year 2006

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator Jim Dickinson

Plant Type Activated Sludge w/UV Disinfection | Population 16670

| | INFLUENT | | | | | | | | | | EFFLUENT | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK | CONT | CONT | 4/WEEK | 4/YR | 4/YR | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK |
| Date | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY LBS/DAY | TSS MG/L | TSS LBS/DAY | pH (DAILY MIN) STANDARD UNITS | pH (DAILY MAX) STANDARD UNITS | MANGANESE MG/L | OIL & GREASE MG/L | CYANIDE MG/L | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY % REMOVAL | BOD 5-DAY LBS/DAY | TSS MG/L |
| 1 | 1.988 | | | | | 6.43 | 7.39 | | | | 1.992 | | | | |
| 2 | 1.958 | | | | | 5.94 | 7.44 | | | | 1.944 | | | | |
| 3 | 1.927 | | | | | 5.73 | 5.94 | | | | 1.941 | | | | |
| 4 | 2.171 | 177 | 3212 | 276 | 4997 | 6.08 | 7.18 | 39.6 | | | 2.17 | 4 | 98 | 72 | 7 |
| 5 | 2.075 | 93 | 1609 | 174 | 3011 | 6.3 | 7.34 | 44.8 | | | 2.08 | 8 | 93 | 141 | 8 |
| 6 | 2.150 | 193 | 3461 | 244 | 4375 | 6.31 | 7.14 | 47.0 | | | 2.175 | 5 | 97 | 91 | 3 |
| 7 | 2.160 | 88 | 1585 | 220 | 3963 | 6.37 | 7.10 | 46.5 | | | 2.208 | 2 | 98 | 37 | 3 |
| 8 | 2.004 | | | | | 6.49 | 7.17 | | | | 2.011 | | | | |
| 9 | 2.052 | | | | | 6.22 | 7.43 | | | | 2.052 | | | | |
| 10 | 2.085 | | | | | 5.66 | 7.21 | | | | 2.104 | | | | |
| 11 | 2.080 | 88 | 1518 | 334 | 5794 | 6.43 | 7.21 | 45.0 | | | 2.097 | 3 | 97 | 45 | 2 |
| 12 | 2.044 | 105 | 1790 | 224 | 3819 | 6.38 | 7.28 | 47.5 | | | 2.061 | 3 | 97 | 52 | 5 |
| 13 | 2.034 | 118 | 2002 | 190 | 3223 | 6.78 | 7.52 | 45.4 | | | 2.023 | 2 | 98 | 34 | 8 |
| 14 | 2.217 | 107 | 1978 | 156 | 2884 | 6.45 | 7.30 | 41.9 | | | 2.255 | 5 | 95 | 94 | 10 |
| 15 | 2.092 | | | | | 6.48 | 7.36 | | | | 2.092 | | | | |
| 16 | 2.081 | | | | | 5.99 | 6.68 | | | | 2.079 | | | | |
| 17 | 2.12 | | | | | 5.51 | 7.14 | | | | 2.125 | | | | |
| 18 | 2.451 | 92 | 1881 | 244 | 4988 | 6.57 | 7.25 | 37.8 | | | 2.401 | 5 | 95 | 100 | 7 |
| 19 | 2.2 | 121 | 2220 | 128 | 2348 | 6.61 | 7.13 | 39.5 | | | 2.148 | 4 | 97 | 72 | 9 |
| 20 | 2.5 | 98 | 2043 | 216 | 4503 | 6.37 | 7.11 | 36.3 | | | 2.496 | 7 | 93 | 146 | 9 |
| 21 | 2.278 | 106 | 2014 | 158 | 3002 | 6.49 | 7.1 | 41.2 | | | 2.293 | 4 | 96 | 76 | 8 |
| 22 | 2.067 | | | | | 6.53 | 7.9 | | | | 2.047 | | | | |
| 23 | 2.045 | | | | | 6.29 | 7.11 | | | | 2.052 | | | | |
| 24 | 2.089 | | | | | 5.73 | 6.73 | | | | 2.086 | | | | |
| 25 | 2.030 | 93 | 1575 | 195 | 3301 | 6.08 | 7.09 | 39.1 | | | 2.059 | 5 | 95 | 86 | 7 |
| 26 | 1.984 | 143 | 2366 | 208 | 3442 | 6.4 | 7.17 | 48.9 | | | 2.026 | 3 | 98 | 51 | 3 |
| 27 | 1.974 | 78 | 1284 | 224 | 3688 | 6.25 | 7.26 | 44.5 | | | 2.041 | 3 | 96 | 51 | 7 |
| 28 | 1.939 | 113 | 1821 | 156 | 2523 | 6.25 | 7.26 | 49.8 | | | 2.049 | 5 | 96 | 82 | 5 |
| 29 | 1.897 | | | | | 6.29 | 7.26 | | | | 1.955 | | | | |
| 30 | 1.915 | | | | | 6.32 | 7.37 | | | | 1.951 | | | | |
| 31 | | | | | | | | | | | | | | | |
| Total | | | | | | | | | | | | | | | |
| | AVG 2.087 | AVG 113 | AVG 2022 | AVG 209 | AVG 3741 | MIN 5.51 | | AVG 43.4 | AVG | AVG | AVG 2.100 | AVG 4.25 | AVG 96 | AVG 77 | AVG 6.3 |
| Permit | 6.1 | | 5616 | | 5408 | | | | | | | 20 | 70 | 1017 | 20 |
| | MAX 2.5 | MAX 138 | MAX 3461 | MAX 334 | MAX 5794 | | MAX 7.9 | MAX 49.8 | | | MAX 2.496 | AVW 5 | | AVW 99 | AVW 8.25 |
| Limits | | | | | | | | | | | | 30 | | 1525 | 30 |

Please Circle ALL Permit Violations **Mail to P.O. Box 47775, Olympia WA 98504-7775**

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=highest 7-day Geometric Mean

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name and Title

Signature

Permit No. WA0020249 | Month September Year 2006

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator Jim Dickinson

Plant Type Activated Sludge w/UV Disinfection | Population 16670

EFFLUENT CONT.

| Frequency | 4/WEEK | 4/WEEK | CONT | CONT | CONT | 4/WEEK | 4/WEEK | DAILY | 4/YR | 4/YR | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | TSS % REMOVAL | TSS LBS/DAY | pH (DAILY MIN) STANDARD UNITS | pH (DAILY MAX) STANDARD UNITS | TEMPERATURE DEG C | AMMONIA MG/L (WINTER) | AMMONIA MG/L (SUMMER) | FECAL COLIFORM #/100 ML | OIL & GREASE UG/L | CYANIDE UG/L | | | | | NBR |
| 1 | | | 7.06 | 7.18 | 22.2 | | | 24 | | | | | | | Ø |
| 2 | | | 7.11 | 7.36 | 22.86 | | | 6 | | | | | | | Ø |
| 3 | | | 7.19 | 7.38 | 23.22 | | | 22 | | | | | | | .02 |
| 4 | 97 | 127 | 7.2 | 7.35 | 23.2 | | 17.8 | 1 | | | | | | | Ø |
| 5 | 95 | 139 | 7.01 | 7.24 | 23.2 | | 18.9 | 12 | | | | | | | Ø |
| 6 | 99 | 54 | 7.06 | 7.07 | 23.1 | | 13.3 | <1 | | | | | | | Ø |
| 7 | 99 | 55 | 6.96 | 7.07 | 22.7 | | 15.6 | 2 | | | | | | | Ø |
| 8 | | | 6.96 | 7.00 | 22.9 | | | 2 | | | | | | | .08 |
| 9 | | | 6.93 | 7.02 | 22.9 | | | 2 | | | | | | | .01 |
| 10 | | | 6.91 | 7.0 | 22.7 | | | 5 | | | | | | | Ø |
| 11 | 99 | 35 | 6.93 | 7.01 | 22.9 | | 7.0 | 58 | | | | | | | Ø |
| 12 | 98 | 86 | 6.99 | 7.04 | 23.1 | | 10.1 | 4 | | | | | | | Ø |
| 13 | 96 | 135 | 6.99 | 7.04 | 22.7 | | 8.3 | 8 | | | | | | | Ø |
| 14 | 94 | 188 | 6.99 | 7.08 | 22.1 | | 10.1 | 4 | | | | | | | .50 |
| 15 | | | 6.99 | 7.03 | 22.0 | | | 46 | | | | | | | .39 |
| 16 | | | 6.90 | 6.99 | 21.9 | | | 2 | | | | | | | Ø |
| 17 | | | 6.49 | 6.94 | 22.1 | | | 66 | | | | | | | .03 |
| 18 | 97 | 140 | 6.85 | 6.94 | 22.1 | | 4.1 | 16 | | | | | | | .68 |
| 19 | 93 | 161 | 6.89 | 6.99 | 22.1 | | 6.5 | 16 | | | | | | | .02 |
| 20 | 96 | 185 | 6.92 | 7.0 | 21.6 | | 5.1 | 122 | | | | | | | .59 |
| 21 | 95 | 153 | 6.9 | 6.99 | 21.2 | | 4.3 | 163 | | | | | | | .01 |
| 22 | | | 6.90 | 6.97 | 21.6 | | | 10 | | | | | | | Ø |
| 23 | | | 6.90 | 6.95 | 21.82 | | | 2 | | | | | | | Ø |
| 24 | | | 6.95 | 7.01 | 22 | | | 6 | | | | | | | Ø |
| 25 | 96 | 120 | 6.98 | 7.17 | 21.93 | | 6.04 | 16 | | | | | | | Ø |
| 26 | 99 | 51 | 6.91 | 6.98 | 22.4 | | 12.1 | 2 | | | | | | | Ø |
| 27 | 97 | 119 | 6.89 | 7.01 | 22.4 | | 7.7 | 2 | | | | | | | Ø |
| 28 | 97 | 85 | 6.89 | 7.08 | 22.4 | | 11.2 | 6 | | | | | | | Ø |
| 29 | | | 6.99 | 7.08 | 22.4 | | | 2 | | | | | | | Ø |
| 30 | | | 6.97 | 7.05 | 22.21 | | | 4 | | | | | | | .02 |
| 31 | | | | | | | | | | | | | | | |
| Total | | | | | | | | | | | | | | | |
| | AVG 97 | AVG 115 | MIN 6.49 | | | AVG | AVG 9.9 | GEM 8 | AVG | AVG | | | | | 2.35" |
| Permit | 70 | 1017 | 6 | | | 7 | 20 | 200 | | | | | | | |
| | | AVW 160 | | MAX 7.38 | MXD 23.22 | MXD | MXD 18.9 | GMT 32 | | | | | | | |
| Limits | | 1626 | | 9 | | 15 | 41 | 400 | | | | | | | |

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=highest 7-day Geometric Mean

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name and Title

Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month Oct | Year 2006

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator J. Dickinson

Plant Type Activated Sludge w/UV Disinfection | Population 16670

| | INFLUENT | | | | | | | | | | EFFLUENT | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK | CONT | CONT | 4/WEEK | 4/YR | 4/YR | CONT | 4/WEEK | 4/WEEK | 4/WEEK | 4/WEEK |
| Date | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY LBS/DAY | TSS MG/L | TSS LBS/DAY | pH (DAILY MIN) STANDARD UNITS | pH (DAILY MAX) STANDARD UNITS | AMMONIA MG/L | OIL & GREASE MG/L | CYANIDE MG/L | FLOW MGD | BOD 5-DAY MG/L | BOD 5-DAY % REMOVAL | BOD 5-DAY LBS/DAY | TSS MG/L |
| 1 | 2.056 | | | | | 5.74 | 7.17 | | | | 2.096 | | | | |
| 2 | 1.976 | 106 | 1748 | 208 | 3428 | 6.44 | 7.34 | 51 | | | 1.84 | 7 | 93 | 109 | 7 |
| 3 | 1.961 | 80 | 1308 | 178 | 2911 | 6.30 | 7.41 | 50.3 | | | 1.404 | 8 | 90 | 94 | 6 |
| 4 | 2.002 | 96 | 1603 | 124 | 2108 | 6.16 | 7.05 | 45.2 | | | 2.038 | 4 | 96 | 68 | 7 |
| 5 | 1.928 | 105 | 1688 | 158 | 2540 | 6.25 | 7.11 | 48 | | | 2.041 | 6 | 94 | 102 | 2 |
| 6 | 1.883 | | | | | 6.67 | 7.14 | | | | 1.915 | | | | |
| 7 | 1.972 | | | | | 6.26 | 7.33 | | | | 2.006 | | | | |
| 8 | 2.094 | | | | | 6.3 | 7.34 | | | | 2.098 | | | | |
| 9 | 2.025 | 130 | 2196 | 190 | 3209 | 6.02 | 7.53 | 57.6 | | | 2.039 | 8 | 94 | 136 | 4 |
| 10 | 1.993 | 148 | 2460 | 216 | 3590 | 6.5 | 7.27 | 76.3 | | | 2.024 | 3 | 98 | 51 | 5 |
| 11 | 1.953 | 129 | 2101 | 348 | 5668 | 6.2 | 7.27 | 42.7 | | | 2.009 | 5.4 | 96 | 90 | 6 |
| 12 | 1.979 | 85 | 1403 | 188 | 3102 | 6.1 | 7.12 | 40.1 | | | 2.091 | 12 | 86 | 209 | 5 |
| 13 | 1.924 | | | | | 6.63 | 7.24 | | | | 1.978 | | | | |
| 14 | 1.907 | | | | | 6.74 | 7.35 | | | | 1.933 | | | | |
| 15 | 2.669 | | | | | 6.08 | 7.3 | | | | 2.686 | | | | |
| 16 | 2.259 | 104 | 1989 | 222 | 4182 | 6.4 | 7.2 | 41 | | | 2.269 | 6 | 94 | 114 | 7 |
| 17 | 2.045 | 131 | 2234 | 252 | 4298 | 6.63 | 7.26 | 39.6 | | | 2.061 | 6 | 95 | 103 | 10 |
| 18 | 2.374 | 128 | 2534 | 141 | 2792 | 6.20 | 7.19 | 45 | | | 2.396 | 13 | 90 | 260 | 12 |
| 19 | 2.532 | 159 | 3357 | 280 | 5913 | 6.21 | 7.15 | 58.2 | | | 2.595 | 6 | 96 | 130 | 7 |
| 20 | 2.137 | | | | | 6.42 | 7.13 | | | | 2.142 | | | | |
| 21 | 2.104 | | | | | 6.06 | 6.96 | | | | 1.926 | | | | |
| 22 | 2.169 | | | | | 6.0 | 6.84 | | | | 2.143 | | | | |
| 23 | 2.112 | 177 | 3118 | 360 | 6341 | 6.09 | 7.17 | 49.9 | | | 2.115 | 3 | 98 | 53 | 3 |
| 24 | 2.179 | 131 | 2381 | 166 | 3016 | 6.19 | 7.14 | 50.1 | | | 2.164 | 6 | 95 | 108 | 8 |
| 25 | 2.102 | 110 | 1928 | 338 | 5925 | 6.09 | 7.19 | 44.6 | | | 2.143 | 1 | 99 | 18 | 6 |
| 26 | 2.103 | 129 | 2262 | 132 | 2315 | 6.22 | 7.04 | 63.6 | | | 2.125 | 2 | 98 | 35 | 3 |
| 27 | 2.022 | | | | | 6.14 | 7.09 | | | | 1.996 | | | | |
| 28 | 2.032 | | | | | 5.48 | 6.93 | | | | 2.062 | | | | |
| 29 | 2.173 | | | | | 5.29 | 7.08 | | | | 2.11 | | | | |
| 30 | 2.356 | 101 | 1985 | 264 | 5187 | 6.32 | 7.21 | 34.8 | | | 2.287 | 3 | 97 | 57 | 2 |
| 31 | 2.104 | 56 | 983 | 168 | 2947 | 6.49 | 7.25 | 49 | | | 2.038 | 3 | 95 | 51 | 4 |
| Total | | | | | | | | | | | | | | | |
| | AVG 2.100 | AVG 117 | AVG 2012 | AVG 219 | AVG 3704 | MIN 5.29 | | AVG 49.3 | AVG | AVG | AVG 2.089 | AVG 6 | AVG 95 | AVG 95 | AVG 6 |
| Permit | 6.1 | | 5816 | | 6405 | | | | | | | 20 | 70 | 1017 | 20 |
| | MAX 2.532 | MAX 177 | MAX 3357 | MAX 360 | MAX 6341 | | MAX 7.53 | MAX 76.3 | | | MAX 2.686 | AVW 7.75 | | AVW 152 | AVW 6 |
| Limits | | | | | | | | | | | | 30 | | 3525 | 30 |

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AVG=Average AVW=Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=Highest 7-day Geometric Mean

certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information the information submitted is, to the best of my knowledge and belief, true accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Jim Dickinson - Op. Supr.
Name and Title

Jim Dickinson
Signature

# WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month Oct | Year 2006

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator J. Dickinson

Type Activated Sludge w/UV Disinfection | Population 16670

| Date | TSS % REMOVAL | TSS LBS/DAY | pH (DAILY MIN) STANDARD UNITS | pH (DAILY MAX) STANDARD UNITS | TEMPERATURE DEG C | AMMONIA MG/L (WINTER) | AMMONIA MG/L (SUMMER) | FECAL COLIFORM #/100 ML | OIL & GREASE UG/L | CYANIDE UG/L | | | | | Rain |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 4/WEEK | 4/WEEK | CONT | CONT | CONT | 4/WEEK | 4/WEEK | DAILY | 4/YR | 4/YR | | | | | |
| | | | EFFLUENT CONT. | | | | | | | | | | | | |
| 1 | | | 6.89 | 6.99 | 22 | | | 3 | | | | | | | Ø |
| 2 | 97 | 107 | 6.92 | 7.03 | 21.8 | 9.4 | | 4 | | | | | | | Ø |
| 3 | 97 | 70 | 6.91 | 7.14 | 21.6 | 9 | | 4 | | | | | | | .01 |
| 4 | 94 | 117 | 6.83 | 6.95 | 21.4 | 3.37 | | 536 | | | | | | | .06 |
| 5 | 99 | 34 | 6.90 | 7.02 | 21.6 | 5.5 | | 110 | | | | | | | Ø |
| 6 | | | 6.94 | 7.03 | 21.4 | | | 26 | | | | | | | .02 |
| 7 | | | 6.92 | 6.99 | 21.4 | | | 13 | | | | | | | .02 |
| 8 | | | 6.92 | 7.0 | 21.2 | | | 5 | | | | | | | .03 |
| 9 | 98 | 68 | 6.93 | 7.01 | 21.2 | 10.5 | | 10 | | | | | | | Ø |
| 10 | 98 | 84 | 6.65 | 7.24 | 21.2 | 11.2 | | 16 | | | | | | | Ø |
| 11 | 98 | 101 | 6.86 | 6.95 | 21.2 | 0.6 | | 18 | | | | | | | Ø |
| 12 | 97 | 87 | 6.88 | 6.95 | 21.2 | 0.0 | | 6 | | | | | | | Ø |
| 13 | | | 6.91 | 7.35 | 21.4 | | | 34 | | | | | | | Ø |
| 14 | | | 7.09 | 7.26 | 21.21 | | | 6 | | | | | | | .07 |
| 15 | | | 6.96 | 7.11 | 20.8 | | | 3 | | | | | | | 1.15 |
| 16 | 97 | 117 | 6.90 | 6.96 | 20.6 | .20 | | 8 | | | | | | | .05 |
| 17 | 96 | 354 | 6.96 | 7.05 | 20.6 | 0.0 | | Ø | | | | | | | Ø |
| 18 | 91 | 240 | 6.97 | 7.09 | 20.61 | 1 | | 214 | | | | | | | .58 |
| 19 | 98 | 151 | 6.92 | 7.03 | 20.6 | 3.3 | | 96 | | | | | | | .06 |
| 20 | | | 6.57 | 7.13 | 20.62 | | | 28 | | | | | | | .01 |
| 21 | | | 7.11 | 7.28 | 20.41 | | | 13 | | | | | | | Ø |
| 22 | | | 7.24 | 7.35 | 20.2 | | | 19 | | | | | | | Ø |
| 23 | 99 | 53 | 7.07 | 7.26 | 20.2 | 0.3 | | 24 | | | | | | | Ø |
| 24 | 95 | 144 | 6.98 | 7.09 | 20.1 | 0.8 | | 8 | | | | | | | .26 |
| 25 | 98 | 107 | 6.98 | 7.05 | 20 | 0.2 | | 9 | | | | | | | .01 |
| 26 | 98 | 53 | 6.98 | 7.07 | 19.81 | 0.3 | | 34 | | | | | | | Ø |
| 27 | | | 6.22 | 7.05 | 19.81 | | | 44 | | | | | | | Ø |
| 28 | | | 6.93 | 7.00 | 19.82 | | | 1 | | | | | | | .08 |
| 29 | | | 6.94 | 7.12 | 19.8 | | | 4 | | | | | | | .03 |
| 30 | 99 | 38 | 7.08 | 7.18 | 19.4 | 1 | | 16 | | | | | | | Ø |
| 31 | 98 | 68 | 7.01 | 7.10 | 19 | 2.5 | | 1 | | | | | | | Ø |
| Total | | | | | | | | | | | | | | | |
| | AVG 97 | AVG 111 | MIN 6.22 | | | AVG 3.25 | AVG | GEM 13 | AVG | AVG | | | | | 2.44" |
| Permit | 79 | 1017 | 6 | | | 7 | 20 | 200 | | | | | | | |
| | | AVW 216 | | MAX 7.35 | MXD 21.8 | MXD 11.2 | MXD | GM7 20 | | | | | | | |
| Limits | | 1525 | | 9 | | 16 | 41 | 400 | | | | | | | |

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AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=highest 7-day Geometric Mean

...der penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system ... to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Jim Dickinson - Op. Supr.
Name and Title

Jim Dickinson
Signature

# APPENDIX E

# WATER CONSUMPTION SUMMARY

| | 2001-2002 | 2002-2003 | 2003-2004 | 2004-2005 |
|---|---|---|---|---|
| Single Family Residential | 848,943 | 865,842 | 955,383 | 982,766 |
| Multi-family Residential | 115,068 | 107,550 | 122,111 | 127,784 |
| Commercial | 93,052 | 98,356 | 125,191 | 114,338 |
| Industrial | 949,574 | 954,909 | 1,119,607 | 1,091,096 |
| City | 27,851 | 6,152 | 4,039 | 9,095 |
| TOTAL | 2,034,486 | 2,032,808 | 2,326,330 | 2,325,078 |

| | 2001-2002 | 2002-2003 | 2003-2004 | 2004-2005 |
|---|---|---|---|---|
| | 0.849 | 0.866 | 0.955 | 0.983 |
| | 0.115 | 0.108 | 0.122 | 0.128 |
| | 0.093 | 0.098 | 0.125 | 0.114 |
| | 0.950 | 0.955 | 1.120 | 1.091 |
| | 0.028 | 0.006 | 0.004 | 0.009 |
| | 2.034 | 2.033 | 2.326 | 2.325 |

| | 2001-2002 | 2002-2003 | 2003-2004 | 2004-2005 |
|---|---|---|---|---|
| Single Family Residential | 848,943 | 865,842 | 955,383 | 982,766 |
| # of Connctns | 4,631 | 5,066 | 5,407 | 5,613 |
| | 183.3 | 170.9 | 176.7 | 175.1 |

| | | Jan-02 Nov-16-Jan 15 | | | | Mar-02 Jan16-Mar15 | | | | Jan-03 Nov-16-Jan 15 | | | | Mar-03 Jan16-Mar15 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Billing | # of Connctns | Water Consmptn (100 cu. Ft.) | Water Consmptn (gpd)) | Water Consmptn per Connectn | # of Connctns | Water Consmptn (100 cu. Ft.) | Water Consmptn (gpd)) | Water Consmptn per Connectn | # of Connctns | Water Consmptn (100 cu. Ft.) | Water Consmptn (gpd)) | Water Consmptn per Connectn | # of Connctns | Water Consmptn (100 cu. Ft.) | Water Consmptn (gpd)) | Water Consmptn per Connectn |
| | Single Family Residential | Bi-monthly | 4,607 | 70,476 | 878,601 | 191 | 4,655 | 65,718 | 819,284 | 176 | 5,026 | 71,350 | 889,497 | 177 | 5,105 | 67,555 | 842,186 | 165 |
| | Multi-family Residential | Bi-monthly | 290 | 9,375 | 116,875 | 403 | 291 | 9,085 | 113,260 | 389 | 306 | 8,850 | 110,330 | 361 | 313 | 8,404 | 104,770 | 335 |
| | Commercial | Bi-monthly | 181 | 6,923 | 86,307 | 477 | 179 | 8,005 | 99,796 | 558 | 187 | 7,102 | 88,538 | 473 | 190 | 8,677 | 108,173 | 569 |
| | Industrial | Monthly | 30 | 42,162 | 1,051,239 | 17,521 | 30 | 34,007 | 847,908 | 14,132 | 29 | 40,225 | 1,002,943 | 17,292 | 29 | 36,372 | 906,875 | 15,636 |
| | City | Bi-monthly | 28 | 843 | 10,509 | 375 | 29 | 3625 | 45,192 | 1,558 | 30 | 461 | 5,747 | 192 | 30 | 526 | 6,557 | 219 |
| 1 | 5/8" Residential | | 4,141 | 63,529 | | | 4,186 | 59,143 | | | 4,505 | 63,622 | | | 4,581 | 60,748 | | |
| 2 | 1" Residential | | 161 | 5,120 | | | 162 | 4,940 | | | 173 | 4,253 | | | 178 | 4,068 | | |
| 4 | 1 1/2" Residential | | 24 | 1,434 | | | 24 | 1,622 | | | 24 | 1,318 | | | 25 | 1,309 | | |
| 5 | 2" Residential | | 8 | 1,000 | | | 8 | 939 | | | 8 | 1,455 | | | 8 | 1,284 | | |
| 6 | 3" Residential | | 2 | 433 | | | 2 | 419 | | | 2 | 440 | | | 2 | 426 | | |
| 10 | 3/4" Residential | | 84 | 1,388 | | | 84 | 1,165 | | | 87 | 1,384 | | | 87 | 1,317 | | |
| 11 | 5/8" Commercial | | 92 | 1,709 | | | 89 | 2,175 | | | 94 | 1,530 | | | 95 | 1,750 | | |
| 12 | 1" Commercial | | 50 | 1,519 | | | 50 | 1,755 | | | 51 | 1,978 | | | 52 | 3,168 | | |
| 14 | 1 1/2" Commercial | | 9 | 777 | | | 9 | 561 | | | 10 | 629 | | | 11 | 998 | | |
| 15 | 2" Commercial | | 12 | 1,508 | | | 12 | 1,498 | | | 13 | 1,466 | | | 13 | 1,530 | | |
| 16 | 3" Commercial | | 5 | 386 | | | 6 | 563 | | | 6 | 428 | | | 6 | 496 | | |
| 17 | 4" Commercial | | 4 | 813 | | | 4 | 1,134 | | | 4 | 736 | | | 4 | 429 | | |
| 18 | 3" Resident-No Base | | | | | | | | | | | | | | 1 | 0 | | |
| 20 | 3/4" Commercial | | 2 | 132 | | | 2 | 128 | | | 2 | 97 | | | 2 | 96 | | |
| 21 | 5/8" Industrial | | 3 | 63 | | | 3 | 118 | | | 3 | 49 | | | 3 | 30 | | |
| 22 | 1" Industrial | | 1 | 0 | | | 1 | 0 | | | 1 | 0 | | | 1 | 0 | | |
| 24 | 1 1/2" Industrial | | 3 | 311 | | | 3 | 335 | | | 3 | 259 | | | 3 | 264 | | |
| 25 | 2" Industrial | | 12 | 9,384 | | | 12 | 6,750 | | | 12 | 7,657 | | | 12 | 6,268 | | |
| 26 | 3" Industrial | | 4 | 657 | | | 4 | 553 | | | 4 | 384 | | | 4 | 405 | | |
| 27 | 4" Industrial | | 3 | 9,800 | | | 3 | 8,467 | | | 3 | 10,835 | | | 3 | 11,048 | | |
| 29 | 6" Industrial | | 1 | 20,314 | | | 1 | 15,317 | | | 1 | 19,797 | | | 1 | 16,824 | | |
| 31 | 5/8" City | | 10 | 67 | | | 10 | 584 | | | 10 | 6 | | | 10 | 7 | | |
| 32 | 1" City | | 5 | 13 | | | 5 | 0 | | | 5 | 37 | | | 5 | 123 | | |
| 33 | 1 1/4" City | | 1 | 0 | | | 1 | 0 | | | 1 | 0 | | | 1 | 0 | | |
| 34 | 1 1/2" City | | | | | | | | | | 1 | 0 | | | 1 | 0 | | |
| 35 | 2" City | | 9 | 763 | | | 10 | 715 | | | 10 | 415 | | | 10 | 370 | | |
| 47 | 4" Cemetery | | 1 | 0 | | | 1 | 590 | | | 1 | 2 | | | 1 | 123 | | |
| 57 | $99 Allowance | | | | | | | | | | | | | | | | | |
| 58 | 13 Hcf Allowance | | | | | | | | | | | | | | | | | |
| 59 | 40 Hcf Water Allowan | | | | | | | | | | | | | | | | | |
| 61 | 5/8" Irrigation | | 47 | 330 | | | 48 | 58 | | | 49 | 89 | | | 51 | 38 | | |
| 62 | 1" Irrigation | | 24 | 655 | | | 24 | 4 | | | 27 | 29 | | | 27 | 337 | | |
| 64 | 1 1/2" Irrigation | | 9 | 366 | | | 9 | 67 | | | 9 | 145 | | | 9 | 92 | | |
| 65 | 2" Irrigation | | 11 | 227 | | | 11 | 121 | | | 11 | 387 | | | 11 | 397 | | |
| 66 | 3" Irrigation | | 5 | 548 | | | 6 | 0 | | | 6 | 64 | | | 6 | 2 | | |
| 67 | 4" Irrigation | | 1 | 615 | | | 1 | 36 | | | 1 | 98 | | | 1 | 0 | | |
| 68 | 3/4" Irrigation | | | | | | | | | | 1 | 0 | | | 1 | 0 | | |
| C01 | 5/8" Residential - O | | 466 | 6,947 | | | 469 | 6,575 | | | 521 | 7,728 | | | 524 | 6,807 | | |
| C02 | 1" Residential - Out | | 10 | 130 | | | 10 | 189 | | | 11 | 227 | | | 12 | 205 | | |
| C04 | 1 1/2" Residential - | | | | | | | | | | | | | | | | | |
| C10 | 3/4" Residential - O | | 1 | 4 | | | 1 | 6 | | | 1 | 3 | | | 1 | 4 | | |
| C12 | 1" Commercial - Outs | | 3 | 20 | | | 3 | 35 | | | 2 | 30 | | | 2 | 29 | | |
| C14 | 1 1/2" Commercial - | | 2 | 14 | | | 2 | 26 | | | 2 | 30 | | | 2 | 24 | | |
| C16 | 3" Commercial - Outs | | 2 | 45 | | | 2 | 130 | | | 3 | 178 | | | 2 | 157 | | |
| C27 | 4" Industrial - Outs | | 3 | 1,633 | | | 2 | 1,647 | | | 1 | 755 | | | 1 | 936 | | |
| C28 | 4" Indust Out-No Bas | | | | | | 1 | 820 | | | 1 | 489 | | | 1 | 597 | | |
| C31 | 5/8" City - Outside | | 3 | 0 | | | 3 | 2,326 | | | 3 | 3 | | | 3 | 26 | | |
| C41 | 5/8" Cemetery Outsid | | | | | | | | | | 1 | 42 | | | 1 | 28 | | |
| C57 | $99 Water Allowance | | 1 | 54 | | | 1 | 54 | | | 3 | 28 | | | 3 | 23 | | |

| | | Jan-04 Nov-16-Jan 15 | | | | Mar-04 Jan16-Mar15 | | | | Jan-05 Nov-16-Jan 15 | | | | Mar-05 Jan16-Mar15 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Consmptn | | | | | | |
| | | # of Connctns | Water Consmptn (100 cu. Ft.) | Water Consmptn (gpd)) | Water Consmptn per Connectn | # of Connctns | Water Consmptn (100 cu. Ft.) | Water Consmptn (gpd)) | Water Consmptn per Connectn | # of Connctns | Water Consmptn (100 cu. Ft.) | Water Consmptn (gpd)) | Water Consmptn per Connectn | # of Connctns | Water Consmptn (100 cu. Ft.) | Water Consmptn (gpd)) | Water Consmptn per Connectn |
| | Single Family Residential | 5,383 | 92,651 | 1,155,049 | 215 | 5,407 | 60,619 | 755,717 | 140 | 5,594 | 85,637 | 1,067,608 | 191 | 5,613 | 72,026 | 897,924 | 160 |
| | Multi-family Residential | 360 | 12,479 | 155,572 | 432 | 360 | 7,111 | 88,650 | 246 | 393 | 11,459 | 142,856 | 364 | 414 | 9,041 | 112,711 | 272 |
| | Commercial | 189 | 11,755 | 146,546 | 775 | 203 | 8,329 | 103,835 | 512 | 207 | 10,048 | 125,265 | 605 | 208 | 8,295 | 103,411 | 497 |
| | Industrial | 29 | 48,072 | 1,198,595 | 20,665 | 31 | 41,736 | 1,040,618 | 16,784 | 28 | 41,674 | 1,039,072 | 18,555 | 30 | 45,847 | 1,143,119 | 19,052 |
| | City | 32 | 335 | 4,176 | 131 | 29 | 313 | 3,902 | 135 | 31 | 590 | 7,355 | 237 | 31 | 869 | 10,834 | 349 |
| 1 | 5/8" Residential | 5,001 | 85,702 | | 214 | 5,032 | 56,760 | | 141 | 5,209 | 79,297 | | 190 | 5,227 | 67,306 | | 161 |
| 2 | 1" Residential | 221 | 7,268 | | 411 | 223 | 3,898 | | 218 | 246 | 6,808 | | 346 | 252 | 4,892 | | 243 |
| 4 | 1 1/2" Residential | 25 | 1,746 | | 873 | 23 | 1,108 | | 602 | 22 | 1,291 | | 734 | 22 | 1,079 | | 613 |
| 5 | 2" Residential | 8 | 1,325 | | 2,070 | 7 | 749 | | 1,338 | 8 | 1,139 | | 1,780 | 7 | 886 | | 1,582 |
| 6 | 3" Residential | 1 | 467 | | 5,838 | 1 | 371 | | 4,638 | 1 | 523 | | 6,538 | 1 | 648 | | 8,100 |
| 10 | 3/4" Residential | 89 | 1,673 | | 235 | 90 | 985 | | 137 | 100 | 1,698 | | 212 | 115 | 1,536 | | 167 |
| 11 | 5/8" Commercial | 93 | 2,205 | | 296 | 96 | 1,447 | | 188 | 100 | 2,146 | | 268 | 101 | 2,085 | | 258 |
| 12 | 1" Commercial | 51 | 1,734 | | 425 | 60 | 1,555 | | 324 | 57 | 2,517 | | 552 | 57 | 1,810 | | 397 |
| 14 | 1 1/2" Commercial | 11 | 1,321 | | 1,501 | 13 | 819 | | 788 | 14 | 2,426 | | 2,166 | 14 | 1,355 | | 1,210 |
| 15 | 2" Commercial | 13 | 1,416 | | 1,362 | 15 | 1,178 | | 982 | 15 | 1,336 | | 1,113 | 15 | 1,349 | | 1,124 |
| 16 | 3" Commercial | 6 | 354 | | 738 | 6 | 354 | | 738 | 6 | 533 | | 1,110 | 6 | 575 | | 1,198 |
| 17 | 4" Commercial | 5 | 1,507 | | 3,768 | 5 | 333 | | 833 | 5 | 614 | | 1,535 | 5 | 613 | | 1,533 |
| 18 | 3" Resident-No Base | 1 | 0 | | 0 | 1 | 0 | | 0 | 1 | 0 | | 0 | 1 | 0 | | 0 |
| 20 | 3/4" Commercial | 3 | 173 | | 721 | 3 | 117 | | 488 | 4 | 130 | | 406 | 4 | 117 | | 366 |
| 21 | 5/8" Industrial | 3 | 80 | | 333 | 3 | 134 | | 558 | 3 | 48 | | 200 | 3 | 51 | | 213 |
| 22 | 1" Industrial | 1 | 1 | | 13 | 1 | 0 | | 0 | 1 | 0 | | 0 | 1 | 0 | | 0 |
| 24 | 1 1/2" Industrial | 3 | 968 | | 4,033 | 3 | 528 | | 2,200 | 2 | 566 | | 3,538 | 3 | 608 | | 2,533 |
| 25 | 2" Industrial | 12 | 9,280 | | 9,667 | 12 | 7,987 | | 8,320 | 12 | 6,899 | | 7,186 | 12 | 6,794 | | 7,077 |
| 26 | 3" Industrial | 4 | 535 | | 1,672 | 4 | 529 | | 1,653 | 4 | 535 | | 1,672 | 4 | 744 | | 2,325 |
| 27 | 4" Industrial | 3 | 11,298 | | 47,075 | 3 | 10,543 | | 43,929 | 3 | 12,051 | | 50,213 | 4 | 14,167 | | 44,272 |
| 29 | 6" Industrial | 1 | 22,421 | | 280,263 | 1 | 21,378 | | 267,225 | 1 | 20,098 | | 251,225 | 1 | 21,582 | | 269,775 |
| 31 | 5/8" City | 12 | 8 | | 8 | 11 | 14 | | 16 | 11 | 7 | | 8 | 11 | 131 | | 149 |
| 32 | 1" City | 5 | 0 | | 0 | 5 | 3 | | 8 | 5 | 1 | | 3 | 5 | 0 | | 0 |
| 33 | 1 1/4" City | 1 | 0 | | 0 | 1 | 0 | | 0 | 1 | 0 | | 0 | 1 | 0 | | 0 |
| 34 | 1 1/2" City | 1 | 3 | | 38 | 1 | 6 | | 75 | 1 | 2 | | 25 | 1 | 5 | | 63 |
| 35 | 2" City | 10 | 324 | | 405 | 10 | 290 | | 363 | 10 | 580 | | 725 | 10 | 716 | | 895 |
| 47 | 4" Cemetery | 2 | 10 | | 63 | 1 | 208 | | 2,600 | 1 | 161 | | 2,013 | 1 | 142 | | 1,775 |
| 57 | $99 Allowance | 2 | 76 | | 475 | 2 | 58 | | 363 | 2 | 114 | | 713 | 2 | 116 | | 725 |
| 58 | 13 Hcf Allowance | 1 | 10 | | 125 | 1 | 10 | | 125 | 1 | 10 | | 125 | 1 | 100 | | 1,250 |
| 59 | 40 Hcf Water Allowan | 1 | 10 | | 125 | 1 | 10 | | 125 | 1 | 10 | | 125 | 1 | 100 | | 1,250 |
| 61 | 5/8" Irrigation | 60 | 38 | | 8 | 60 | 167 | | 35 | 65 | 219 | | 42 | 64 | 100 | | 20 |
| 62 | 1" Irrigation | 32 | 10 | | 4 | 32 | 263 | | 103 | 30 | 65 | | 27 | 30 | 217 | | 90 |
| 64 | 1 1/2" Irrigation | 8 | 165 | | 258 | 8 | 205 | | 320 | 7 | 0 | | 0 | 7 | 91 | | 163 |
| 65 | 2" Irrigation | 13 | 479 | | 461 | 13 | 631 | | 607 | 15 | 413 | | 344 | 15 | 291 | | 243 |
| 66 | 3" Irrigation | 6 | 0 | | 0 | 6 | 43 | | 90 | 6 | 279 | | 581 | 6 | 64 | | 133 |
| 67 | 4" Irrigation | 1 | 48 | | 600 | 1 | 39 | | 488 | 1 | 44 | | 550 | 1 | 86 | | 1,075 |
| 68 | 3/4" Irrigation | 1 | 0 | | 0 | 1 | 0 | | 0 | 1 | 0 | | 0 | 1 | 0 | | 0 |
| C01 | 5/8" Residential - O | 382 | 6,949 | | 227 | 375 | 3,859 | | 129 | 385 | 6,340 | | 206 | 386 | 4,720 | | 153 |
| C02 | 1" Residential - Out | 13 | 341 | | 328 | 13 | 220 | | 212 | 14 | 153 | | 137 | 15 | 132 | | 110 |
| C04 | 1 1/2" Residential - | 1 | 18 | | 225 | 1 | 0 | | 0 | 1 | 20 | | 250 | 1 | 10 | | 125 |
| C10 | 3/4" Residential - O | 2 | 168 | | 1,050 | 2 | 78 | | 488 | 1 | 31 | | 388 | 1 | 433 | | 5,413 |
| C12 | 1" Commercial - Outs | 2 | 80 | | 500 | 1 | 6 | | 75 | 2 | 157 | | 981 | 2 | 136 | | 850 |
| C14 | 1 1/2" Commercial - | 1 | 13 | | 163 | 2 | 1,359 | | 8,494 | 1 | 37 | | 463 | 1 | 12 | | 150 |
| C16 | 3" Commercial - Outs | 3 | 2,952 | | 12,300 | 1 | 1,161 | | 14,513 | 2 | 152 | | 950 | 2 | 243 | | 1,519 |
| C27 | 4" Industrial - Outs | 1 | 2,963 | | 37,038 | 1 | 637 | | 7,963 | 1 | 1,014 | | 12,675 | 1 | 1,192 | | 14,900 |
| C28 | 4" Indust Out-No Bas | 1 | 526 | | 6,575 | 3 | 0 | | 0 | 1 | 463 | | 5,788 | 1 | 709 | | 8,863 |
| C31 | 5/8" City - Outside | 3 | 0 | | 0 | 1 | 0 | | 0 | 3 | 0 | | 0 | 3 | 17 | | 71 |
| C41 | 5/8" Cemetery Outsid | 2 | 10 | | 63 | 3 | 19 | | 79 | 1 | 1 | | 13 | 1 | 0 | | 0 |
| C57 | $99 Water Allowance | 3 | 34 | | 142 | 1 | 0 | | 0 | 1 | 10 | | 125 | 1 | 100 | | 1,250 |

# APPENDIX F

# HYDRAULIC MODELING REPORT

# APPENDIX F

# SEWER SYSTEM HYDRAULIC MODEL

## MODEL DEVELOPMENT

The primary goal in the development of the City's hydraulic model was to create a model that realistically represents the physical structure of the main trunk lines of the current wastewater collection system and to determine system deficiencies as the City grows over the next 20 years.

The hydraulic model chosen to accomplish this goal was MOUSE hydraulic modeling software by DHI, Inc. MOUSE modeling software is configured with a graphical user interface. Each model element, including pipes, manholes, force mains, lift stations, catchments, and discharge locations is assigned a unique graphical representation within the program. Each element is also assigned a number of attributes specific to its function and representation. Element attributes include spatial coordinates, rim elevation, invert elevation, diameter, slope, and assigned flows, as well as pump characteristics. Model input is accomplished through the creation and manipulation of these objects and their attributes. The results for a simulation can be given graphically in plan or profile view or in tabular report format to indicate flow, depth of sewer flow, hydraulic grade, and wet well levels for various system elements.

The MOUSE software operates using ESRI's ArcView GIS software program as a platform. GIS files for sewer system manholes, pipes, parcels, basins, etc. are imported into the model and the MOUSE software performs the hydraulic calculations. Microsoft Excel and access are usedto view and display tabular data and for some data manipulation.

The model consists of two layers: the network layer and the catchment layer. The network layer contains all of the information pertaining to the physical structures of the network including manhole location (X,Y coordinates), pipe size, invert elevations, slopes, pipe material, etc. Information to create the network layer was provided by the City in GIS shape files and Autocad as-built files. Known datum inconsistencies were corrected for. Additional information was provided through survey of selected lines. Where specific pipe inverts were not known, elevations were determined through linear interpolation between known upstream and downstream inverts. Additionally, where specific pipe lengths were not given, the length was determined based on the GIS coordinates of the upstream and downstream manholes.

The Camas network is comprised of gravity sewer, STEP (septic tank effluent pump) and force main systems. The model did not include the network components of the STEP systems within the City.

The catchment layer contains all data pertaining to flows within the system. 15 Basins (catchments) were created based on the natural drainage patterns of the City's service area. The basins were further sub-divided into smaller sub-basins. Flows for each sub basin were determined based on the number and zoning of the parcels within the sub-basin. Parcel information was provided in the "camparc" parcels shape file supplied by the City. All developed parcels zoned residential within the basin were considered to be single ERUs and ascribed a flow of 149 gallons per day, the average daily flow per ERU as developed in Chapter 6 of the DRAFT *General Sewer / Wastewater Facility Plan.*

A peaking factor was used to determine the peak hour flow. The peaking factor for residential flows was calculated using an equation provided by the *1998 Department Of Ecology Criteria for Sewage Works Design* (Orange Book). The equation calculates a peaking factor based on population. As population increases, the peaking factor decreases to account for greater attenuation of flows in the presumed larger system.

$$PeakingFactor = \left(18 + \sqrt{Population/1000}\right) / \left(4 + \sqrt{Population/1000}\right)$$

The portions of the network serviced by STEP systems were modeled based on the assumption that the system behaved essentially as a gravity system. This assumption is valid due to the similarity in flow patterns of gravity flow to that from a large number of STEP tanks.

In addition to residentially zoned parcels, flows were also ascribed to parcels zoned commercial, industrial, and other (school/church). Parcels zoned commercial were ascribed a flow rate of 3,000 gallons per acre per day. Industrial flow rates were based on the water consumption of the individual industry as described in Chapter 6 of the *General Sewer / Wastewater Facility Plan*. School and church parcels were ascribed a flow rate based on attending populations. The Department of Ecology ascribes a base flow of 10 gallons per day per student for schools with cafeterias but no showers, and 15 gallons per day per student with for schools with cafeterias and showers, including infiltration. School flows were peaked by a factor of three, assuming an 8-hour school day. This was considered a conservative estimate of the flows as infiltration within the school system is also peaked.

Infiltration and inflow (I&I) was added to the remainder of the basin based on the developed service area. Peak infiltration rates were developed based on adjusted average I&I rates established in the *1998 I/I Study*. Rates from this study were adjusted to account for recent development within the basins, as well as "peaked" to a peak hour I/I rate. To calibrate the model I/I rates were adjusted further to match model results to the known historic peak of 8.8 mgd observed at the treatment plant in December, 2005.

The flow developed for each sub-basin was "dumped" into the network system at the input nodes. The input nodes were generally located at the top of the network system of each sub-basin to provide a level of conservation in the flows within each sub-basin.

Future flows for residential parcels in the basins were developed utilizing the same 149 gallons per ERU. Undeveloped parcels within the basin were ascribed a number of ERU's based on the size and established zone of the parcel. Basins were assumed to grow at the growth rates established in Chapter 6 over the ten and twenty year period.

If a basin reached theoretical build-out prior to accepting the allotted number of ERUs base on the growth rate, these ERUs were transferred to basins with available parcels to handle the growth. The transference of ERUs to other basins was in part based on discussions with the City regarding known developments within the basins.

Commercial flows were similarly "grown" based on available commercial acreage. I&I rates were increased at the rate of increase of additional acreage of service area.

The model looked at flows generated in the years 2005, 2015, and 2025.

Two separate models were created to determine the adequacy of the City's current system. The first model was restricted to the force main running from Brady Rd. to Joy Street. A summary of the basin input information is in Table F-1, and the basins and flow input locations are shown in Figure F-1. The hydraulic grid line resulting from the force main model is shown in Figures F-1 to F-9.

The second system modeled included the main trunk lines of the gravity system. Flows from the force main model were input at the receiving manhole on Joy Street. A summary of the input information is shown in Table F-2, and the basins and flow input locations are shown in Figures G-1 to G-11.

## GRAVITY MODEL RESULTS:

The model results show a number of areas with capacity issues within the City's system. The majority of the problems identified were within Basins 1, 2 and 3n. Many of these areas, particularly those identified in Basins 1 and 2 are a result of high inflow and infiltration flows.

Table F-3 shows the results of a model run at 2005 conditions.

A pipe was determined to be under-capacity if the flow through the pipe, as determined by the model, was greater than the theoretical maximum flow the pipe could effectively convey. Pipes were re-sized based on this parameter ($Q_{max}/Q_f$) through an iterative process, increasing pipe size until all deficiencies were eliminated, as seen in Table F-4. Shaded cells in Table F-4 identify pipes where the $Q_{max}/Q_f$ was greater than 1 for each iteration.

Table F-5 summarizes the results of the final iteration. All deficiencies based on the $Q_{max}/Q_f$ criterion have been eliminated and the resulting pipe sizes are included in the table. Also included in the table is a column showing surcharge. This was developed from the $H_{max}/D$ column of the table. $H_{max}$ represents the maximum peak elevation of the

energy grid line. *D* is the diameter of the pipe. Pipes with an $H_{max}$/D greater than 1 are surcharged. The amount of surcharge during the peak hour flow in the year of 2025, as measured from the top of the pipe, is quantified in the surcharge column of the table.

TABLE F-1
STEP Main Model Basin Summary

**Input #1 (Station 42+00)**

| | Pop | ERU | Inf Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Peak Hr (gpd) | School/Other (gpd) | Com/Indus (gpd) | I&I (gpad) | I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Current | 37 | 13 | 11.9 | 149 | 1937 | 1.90 | 3680.300 | | | 256.52 | 3052.588 | 0.0067 | 0.010417 |
| 2015 | 37 | 13 | 11.9 | 149 | 1937 | 1.90 | 3680.300 | | | 256.52 | 3052.588 | 0.0067 | 0.010417 |
| 2025 | 37 | 13 | 11.9 | 149 | 1937 | 1.90 | 3680.300 | | | 256.52 | 3052.588 | 0.0067 | 0.010417 |

**Input #2 (Station 57+00)**

| | Pop | ERU | Inf Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Peak Hr (gpd) | School/Other (gpd) | Com/Indus (gpd) | I&I (gpad) | I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Current | 733 | 259 | 139.4 | 149 | 38591 | 1.90 | 73322.900 | 25000 | 1440 | 256.52 | 35758.89 | 0.1355 | 0.20967 |
| 2015 | 1092 | 386 | 139.4 | 149 | 57501 | 1.90 | 109251.121 | 25000 | 2146 | 256.52 | 35758.89 | 0.1722 | 0.266347 |
| 2025 | 1202 | 425 | 139.4 | 149 | 63289 | 1.90 | 120249.556 | 25000 | 2362 | 256.52 | 35758.89 | 0.1834 | 0.283697 |

**Input #3 (Station 84+00)**

| | Pop | ERU | Inf Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Peak Hr (gpd) | School/Other (gpd) | Com/Indus (gpd) | I&I (gpad) | I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Current | 184 | 65 | 25 | 149 | 9685 | 1.90 | 18401.500 | | | 256.52 | 6413 | 0.02 | 0.038391 |
| 2015 | 274 | 97 | 25 | 149 | 14430.65 | 1.90 | 27418.235 | | | 256.52 | 6413 | 0.03 | 0.052341 |
| 2025 | 302 | 107 | 25 | 149 | 15883.4 | 1.90 | 30178.460 | | | 256.52 | 6413 | 0.04 | 0.056612 |

**Input #4 (Station 111+00)**

| | Pop | ERU | Inf Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Peak Hr (gpd) | School/Other (gpd) | Com/Indus (gpd) | I&I (gpad) | I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Current | 546 | 193 | 82.0 | 149 | 28757 | 1.90 | 54638.300 | | | 256.52 | 21034.64 | 0.08 | 0.117076 |
| 2015 | 814 | 288 | 82.0 | 149 | 42848 | 1.90 | 81411.067 | | | 256.52 | 21034.64 | 0.10 | 0.158497 |
| 2025 | 896 | 317 | 82.0 | 149 | 47161 | 1.90 | 89606.812 | | | 256.52 | 21034.64 | 0.11 | 0.171177 |

**Input #5 (Station 119+00)**

| | Pop | ERU | Inf Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Peak Hr (gpd) | School/Other (gpd) | Com/Indus (gpd) | I&I (gpad) | I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Current | 23 | 8 | 2.6 | 149 | 1192 | 1.90 | 2264.800 | | | 256.52 | 666.952 | 0.00 | 0.004536 |
| 2015 | 34 | 12 | 2.6 | 149 | 1776.08 | 1.90 | 3374.552 | | | 256.52 | 666.952 | 0.00 | 0.006253 |
| 2025 | 55 | 20 | 2.6 | 149 | 2912.771 | 1.90 | 5534.265 | | | 256.52 | 666.952 | 0.01 | 0.009594 |

**Input #6 (Station 122+00)**

| | Pop | ERU | Inf Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Peak Hr (gpd) | School/Other (gpd) | Com/Indus (gpd) | I&I (gpad) | I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Current | 130 | 46 | 12.5 | 149 | 6854 | 1.90 | 13022.600 | | | 256.52 | 3206.5 | 0.02 | 0.025109 |
| 2015 | 194 | 69 | 12.5 | 149 | 10212.46 | 1.90 | 19403.674 | | | 256.52 | 3206.5 | 0.02 | 0.034981 |
| 2025 | 213 | 75 | 12.5 | 149 | 11240.56 | 1.90 | 21357.064 | | | 256.52 | 3206.5 | 0.02 | 0.038003 |

TABLE F-1
STEP Main Model Basin Summary

**Input #7 (Station 128+00)**

| | Pop | ERU | Inf Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Peak Hr (gpd) | School/Other (gpd) | Com/Indus (gpd) | I&I (gpad) | I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Current | 2168 | 766 | 226.9 | 149 | 114134 | 1.90 | 216854.600 | | | 256.52 | 58204.39 | 0.28 | 0.425552 |
| 2015 | 3230 | 1141 | 226.9 | 149 | 170060 | 1.90 | 323113.354 | | | 256.52 | 58204.39 | 0.38 | 0.589948 |
| 2025 | 4121 | 1456 | 226.9 | 149 | 216980 | 1.90 | 412261.544 | | | 256.52 | 58204.39 | 0.47 | 0.727872 |

**Input #8 & #9 (Station 148+00)**

| | Pop | ERU | Inf Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Peak Hr (gpd) | School/Other (gpd) | Com/Indus (gpd) | I&I (gpad) | I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Current | 119 | 42 | 61.7 | 149 | 6258 | 1.90 | 11890.200 | 25000 | 10194 | 329.12 | 20306.7 | 0.07 | 0.104262 |
| 2015 | 842 | 298 | 61.7 | 149 | 44339 | 1.90 | 84244.898 | 25000 | 13128 | 329.12 | 20306.7 | 0.14 | 0.220744 |
| 2025 | 860 | 304 | 61.7 | 149 | 45278 | 1.90 | 86028.428 | 25000 | 18000 | 329.12 | 20306.7 | 0.15 | 0.231041 |

**Input #10 (Station 176+00)**

| | Pop | ERU | Inf Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Peak Hr (gpd) | School/Other (gpd) | Com/Indus (gpd) | I&I (gpad) | I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Current | 139 | 49 | 11.8 | 149 | 7301 | 1.90 | 13871.900 | | | 329.12 | 3883.616 | 0.02 | 0.02747 |
| 2015 | 207 | 73 | 11.8 | 149 | 10878.49 | 1.90 | 20669.131 | | | 329.12 | 3883.616 | 0.02 | 0.037986 |
| 2025 | 227 | 80 | 11.8 | 149 | 11973.64 | 1.90 | 22749.916 | | | 329.12 | 3883.616 | 0.03 | 0.041206 |

**Input #11, 12, 13 (Station 192+00)**

| | Pop | ERU | Inf Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Peak Hr (gpd) | School/Other (gpd) | Com/Indus (gpd) | I&I (gpad) | I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Current | 181 | 64 | 435.3 | 149 | 9536 | 1.90 | 18118.400 | 25000 | 884465 | 329.12 | 143265.9 | 1.07 | 1.656742 |
| 2015 | 836 | 295 | 435.3 | 149 | 44009 | 1.90 | 83616.416 | 25000 | 1282022 | 329.12 | 143265.9 | 1.53 | 2.373148 |
| 2025 | 297 | 105 | 435.3 | 149 | 15639 | 1.90 | 29714.176 | 25000 | 1725000 | 329.12 | 143265.9 | 1.92 | 2.975099 |

**Input #14, 15 (Station 255+00)**

| | Pop | ERU | Inf Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Peak Hr (gpd) | School/Other (gpd) | Com/Indus (gpd) | I&I (gpad) | I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Current | 1288 | 455 | 101.5 | 149 | 67795 | 1.90 | 128810.500 | | | 329.12 | 33405.68 | 0.16 | 0.250969 |
| 2015 | 1919 | 678 | 101.5 | 149 | 101015 | 1.90 | 191927.645 | | 15 | 329.12 | 33405.68 | 0.23 | 0.348643 |
| 2025 | 2112 | 746 | 101.5 | 149 | 111184 | 1.90 | 211249.220 | | 22.5 | 329.12 | 33405.68 | 0.24 | 0.378548 |

**Input #16 (Station 272+00)**

| | Pop | ERU | Inf Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Peak Hr (gpd) | School/Other (gpd) | Com/Indus (gpd) | I&I (gpad) | I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Current | 487 | 172 | 148.0 | 149 | 25628 | 1.90 | 48693.200 | | 484700 | 329.12 | 48709.76 | 0.58 | 0.900589 |
| 2015 | 725 | 256 | 148.0 | 149 | 38186 | 1.90 | 72552.868 | | 923427 | 329.12 | 48709.76 | 1.04 | 1.61627 |
| 2025 | 798 | 282 | 148.0 | 149 | 42030 | 1.90 | 79856.848 | | 1250400 | 329.12 | 48709.76 | 1.38 | 2.13344 |

TABLE F-1
STEP Main Model Basin Summary

**Input #17 & #18 (Station 272+00)**

| | Pop | ERU | Inf Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Peak Hr (gpd) | School/Other (gpd) | Com/Indus (gpd) | I&I (gpad) | I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Current | 144 | 51 | 17.0 | 149 | 7599 | 1.90 | 14438.100 | | | 256.52 | 4360.84 | 0.02 | 0.029084 |
| 2015 | 215 | 76 | 17.0 | 149 | 11323 | 1.90 | 21512.769 | | | 256.52 | 4360.84 | 0.03 | 0.04003 |
| 2025 | 237 | 84 | 17.0 | 149 | 12462 | 1.90 | 23678.484 | | | 256.52 | 4360.84 | 0.03 | 0.04338 |

**Input #19 (Station 333+00)**

| | Pop | ERU | Inf Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Peak Hr (gpd) | School/Other (gpd) | Com/Indus (gpd) | I&I (gpad) | I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Current | 1710 | 606 | 275.0 | 149 | 90294 | 1.90 | 171558.600 | 18000 | | 256.52 | 70543 | 0.26 | 0.402411 |
| 2015 | 2550 | 903 | 275.0 | 149 | 134538 | 1.90 | 255622.314 | 18000 | | 256.52 | 70543 | 0.34 | 0.532468 |
| 2025 | 3565 | 994 | 275.0 | 149 | 148082 | 1.90 | 281356.104 | 18000 | | 256.52 | 70543 | 0.37 | 0.572282 |

**Totals**

| | Pop | ERU | Inf Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Peak Hr (gpd) | School/Other (gpd) | Com/Indus (gpd) | | I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Current | 7,888 | 2789 | 1,551 | | 415,561 | | 0.790 | 0.093 | 1.381 | | 0.453 | 2.72 | 4.202 |
| 2015 | 12,968 | 4584 | 1,551 | | 683,052 | | 1.298 | 0.093 | 2.221 | | 0.453 | 4.06 | 6.288 |
| 2025 | 14,922 | 5007 | 1,551 | | 746,053 | | 1.418 | 0.093 | 2.996 | | 0.453 | 4.96 | 7.672 |

# TABLE F-2
## Gravity Model Basin Summary

**Basin 1-A** **1-2-8**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hr I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 27 | 81.27 | 23.77 | 149 | 4023 | 1.90 | 7643.700 | 0 | 0 | 15029.41 | 357249 | 0.365 | 0.565 |
| **2015** | 40 | 81.27 | 23.77 | 149 | 5994.27 | 1.90 | 11389.113 | 0 | 0 | 15029.41 | 357249 | 0.369 | 0.570 |
| **2025** | 44 | 81.27 | 23.77 | 149 | 6597.72 | 1.90 | 12535.668 | 0 | 0 | 15029.41 | 357249 | 0.370 | 0.572 |

**Basin 1-B** **1-1-10**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 27 | 37.28 | 29.54 | 149 | 4023 | 1.90 | 7643.7 | 0 | 0 | 15029.41 | 443969 | 0.452 | 0.699 |
| **2015** | 40 | 37.28 | 29.54 | 149 | 5994.27 | 1.90 | 11389.113 | 0 | 0 | 15029.41 | 443969 | 0.455 | 0.704 |
| **2025** | 44 | 37.28 | 29.54 | 149 | 6597.72 | 1.90 | 12535.668 | 0 | 0 | 15029.41 | 443969 | 0.457 | 0.706 |

**Basin 1-C** **1-3-13**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 85 | 27.43 | 26.11 | 149 | 12665 | 1.90 | 24063.5 | 0 | 0 | 15029.41 | 392418 | 0.416 | 0.644 |
| **2015** | 92 | 27.43 | 26.11 | 149 | 13708 | 1.90 | 26045.2 | 0 | 0 | 15029.41 | 392418 | 0.418 | 0.647 |
| **2025** | 92 | 27.43 | 26.11 | 149 | 13708 | 1.90 | 26045.2 | 0 | 0 | 15029.41 | 392418 | 0.418 | 0.647 |

**Basin 1-D** **1-2-5**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 96 | 31.52 | 26.02 | 149 | 14304 | 1.90 | 27177.6 | 0 | 0 | 15029.41 | 391116 | 0.418 | 0.647 |
| **2015** | 143 | 31.52 | 26.02 | 149 | 21312.96 | 1.90 | 40494.624 | 0 | 0 | 15029.41 | 391116 | 0.432 | 0.668 |
| **2025** | 157 | 31.52 | 26.02 | 149 | 23458.56 | 1.90 | 44571.264 | 0 | 0 | 15029.41 | 391116 | 0.436 | 0.674 |

**Basin 1-E** **10-1-1**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 22 | 18.04 | 7.57 | 149 | 3278 | 1.90 | 6228.2 | 0 | 0 | 15029.41 | 113844 | 0.120 | 0.186 |
| **2015** | 33 | 18.04 | 7.57 | 149 | 4884.22 | 1.90 | 9280.018 | 0 | 0 | 15029.41 | 113844 | 0.123 | 0.190 |
| **2025** | 36 | 18.04 | 7.57 | 149 | 5375.92 | 1.90 | 10214.248 | 0 | 0 | 15029.41 | 113844 | 0.124 | 0.192 |

**Basin 2-A** **2-3-1**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

# TABLE F-2
## Gravity Model Basin Summary

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 146 | 37.70 | 28.64 | 149 | 21754 | 1.90 | 41332.6 | 25000 | 3270 | 10074.46 | 288511 | 0.358 | 0.554 |
| **2015** | 213 | 37.70 | 28.64 | 149 | 31737 | 1.90 | 60300.3 | 25000 | 3270 | 10074.46 | 288511 | 0.377 | 0.583 |
| **2025** | 213 | 37.70 | 28.64 | 149 | 31737 | 1.90 | 60300.3 | 25000 | 3270 | 10074.46 | 288511 | 0.377 | 0.583 |

**Basin 2-B** **2-1-11**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 120 | 49.11 | 38.12 | 149 | 17880 | 1.90 | 33972 | 0 | 0 | 10074.46 | 384078 | 0.418 | 0.647 |
| **2015** | 179 | 49.11 | 38.12 | 149 | 26641.2 | 1.90 | 50618.28 | 0 | 0 | 10074.46 | 384078 | 0.435 | 0.673 |
| **2025** | 187 | 49.11 | 38.12 | 149 | 27863 | 1.90 | 52939.7 | 0 | 0 | 10074.46 | 384078 | 0.437 | 0.676 |

**Basin 3n-A** **3-19A-1**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 39 | 12.53 | 9.53 | 149 | 5811 | 1.90 | 11040.9 | 0 | 0 | 6352.5 | 60527 | 0.072 | 0.111 |
| **2015** | 51 | 12.53 | 9.53 | 149 | 7599 | 1.90 | 14438.1 | 0 | 0 | 6352.5 | 60527 | 0.075 | 0.116 |
| **2025** | 51 | 12.53 | 9.53 | 149 | 7599 | 1.90 | 14438.1 | 0 | 0 | 6352.5 | 60527 | 0.075 | 0.116 |

**Basin 3n-B** **3-1-32**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 5 | 59.23 | 2.07 | 149 | 745 | 1.90 | 1415.5 | 0 | 0 | 6352.5 | 13165 | 0.015 | 0.023 |
| **2015** | 7 | 59.23 | 2.07 | 149 | 1110.05 | 1.90 | 2109.095 | 0 | 0 | 6352.5 | 13165 | 0.015 | 0.024 |
| **2025** | 208 | 59.23 | 2.07 | 149 | 31021.8 | 1.90 | 58941.42 | 0 | 0 | 6352.5 | 13165 | 0.072 | 0.112 |

**Basin 3n-C** **3-16-6**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 191 | 66.10 | 64.24 | 149 | 28459 | 1.90 | 54072.1 | 25000 | 0 | 6352.5 | 408101 | 0.487 | 0.754 |
| **2015** | 202 | 66.10 | 64.24 | 149 | 30098 | 1.90 | 57186.2 | 25000 | 0 | 6352.5 | 408101 | 0.490 | 0.759 |
| **2025** | 202 | 66.10 | 64.24 | 149 | 30098 | 1.90 | 57186.2 | 25000 | 0 | 6352.5 | 408101 | 0.490 | 0.759 |

**Basin 3n-D** **3-1-29**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 8 | 12.90 | 9.24 | 149 | 1192 | 1.90 | 2264.8 | 0 | 0 | 6352.5 | 58711 | 0.061 | 0.094 |
| **2015** | 12 | 12.90 | 9.24 | 149 | 1776.08 | 1.90 | 3374.552 | 0 | 0 | 6352.5 | 58711 | 0.062 | 0.096 |
| **2025** | 13 | 12.90 | 9.24 | 149 | 1954.88 | 1.90 | 3714.272 | 0 | 0 | 6352.5 | 58711 | 0.062 | 0.097 |

# TABLE F-2
## Gravity Model Basin Summary

**Basin 3n-E** **3-1-24**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 97 | 100.61 | 31.79 | 149 | 14453 | 1.90 | 27460.7 | 0 | 0 | 6352.5 | 201932 | 0.229 | 0.355 |
| **2015** | 145 | 100.61 | 31.79 | 149 | 21534.97 | 1.90 | 40916.443 | 0 | 0 | 6352.5 | 201932 | 0.243 | 0.376 |
| **2025** | 159 | 100.61 | 31.79 | 149 | 23702.92 | 1.90 | 45035.548 | 0 | 0 | 6352.5 | 201932 | 0.247 | 0.382 |

**Basin 3n-F** **3-1-14**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 56 | 18.11 | 10.59 | 149 | 8344 | 1.90 | 15853.6 | 0 | 0 | 6352.5 | 67260 | 0.083 | 0.129 |
| **2015** | 83 | 18.11 | 10.59 | 149 | 12432.56 | 1.90 | 23621.864 | 0 | 0 | 6352.5 | 67260 | 0.091 | 0.141 |
| **2025** | 92 | 18.11 | 10.59 | 149 | 13684.16 | 1.90 | 25999.904 | 0 | 0 | 6352.5 | 67260 | 0.093 | 0.144 |

**Basin 3n-G** **3-1-18**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 28 | 98.02 | 51.15 | 149 | 4172 | 1.90 | 7926.8 | 0 | 0 | 6352.5 | 324952 | 0.333 | 0.515 |
| **2015** | 42 | 98.02 | 51.15 | 149 | 6216.28 | 1.90 | 11810.932 | 0 | 0 | 6352.5 | 324952 | 0.337 | 0.521 |
| **2025** | 46 | 98.02 | 51.15 | 149 | 6842.08 | 1.90 | 12999.952 | 0 | 0 | 6352.5 | 324952 | 0.338 | 0.523 |

**Basin 3n-H** **3-1-39**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 256 | 80.33 | 76.55 | 149 | 38144 | 1.90 | 72473.6 | 0 | 4650 | 6352.5 | 486267 | 0.563 | 0.872 |
| **2015** | 275 | 80.33 | 76.55 | 149 | 40975 | 1.90 | 77852.5 | 0 | 4650 | 6352.5 | 486267 | 0.569 | 0.880 |
| **2025** | 275 | 80.33 | 76.55 | 149 | 40975 | 1.90 | 77852.5 | 0 | 4650 | 6352.5 | 486267 | 0.569 | 0.880 |

**Basin 3s-A** **3-1-10**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 135 | 18.12 | 17.73 | 149 | 20115 | 1.90 | 38218.5 | 0 | 0 | 4483.05 | 79502 | 0.118 | 0.182 |
| **2015** | 137 | 18.12 | 17.73 | 149 | 20413 | 1.90 | 38784.7 | 0 | 0 | 4483.05 | 79502 | 0.118 | 0.183 |
| **2025** | 137 | 18.12 | 17.73 | 149 | 20413 | 1.90 | 38784.7 | 0 | 0 | 4483.05 | 79502 | 0.118 | 0.183 |

**Basin 3s-B** **3-2-2**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

# TABLE F-2
## Gravity Model Basin Summary

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 98 | 14.65 | 13.41 | 149 | 14602 | 1.90 | 27743.8 | 25000 | 0 | 4483.05 | 60121 | 0.113 | 0.175 |
| **2015** | 105 | 14.65 | 13.41 | 149 | 15645 | 1.90 | 29725.5 | 25000 | 0 | 4483.05 | 60121 | 0.115 | 0.178 |
| **2025** | 105 | 14.65 | 13.41 | 149 | 15645 | 1.90 | 29725.5 | 25000 | 0 | 4483.05 | 60121 | 0.115 | 0.178 |

**Basin 3s-C** **3-1-2**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 122 | 22.12 | 18.54 | 149 | 18178 | 1.90 | 34538.2 | 0 | 0 | 4483.05 | 83133 | 0.118 | 0.182 |
| **2015** | 142 | 22.12 | 18.54 | 149 | 21158 | 1.90 | 40200.2 | 0 | 0 | 4483.05 | 83133 | 0.123 | 0.191 |
| **2025** | 142 | 22.12 | 18.54 | 149 | 21158 | 1.90 | 40200.2 | 0 | 0 | 4483.05 | 83133 | 0.123 | 0.191 |

**Basin 4-A** **4-1-8**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 79 | 26.35 | 25.98 | 149 | 11771 | 1.90 | 22364.9 | 25000 | 0 | 10755.69 | 279387 | 0.327 | 0.506 |
| **2015** | 81 | 26.35 | 25.98 | 149 | 12069 | 1.90 | 22931.1 | 25000 | 0 | 10755.69 | 279387 | 0.327 | 0.506 |
| **2025** | 81 | 26.35 | 25.98 | 149 | 12069 | 1.90 | 22931.1 | 25000 | 0 | 10755.69 | 279387 | 0.327 | 0.506 |

**Basin 4-B** **4-1-7**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 99 | 24.37 | 23.50 | 149 | 14751 | 1.90 | 28026.9 | 0 | 0 | 10755.69 | 252742 | 0.281 | 0.434 |
| **2015** | 104 | 24.37 | 23.50 | 149 | 15496 | 1.90 | 29442.4 | 0 | 0 | 10755.69 | 252742 | 0.282 | 0.437 |
| **2025** | 104 | 24.37 | 23.50 | 149 | 15496 | 1.90 | 29442.4 | 0 | 0 | 10755.69 | 252742 | 0.282 | 0.437 |

**Basin 4-C** **4-1-4**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 68 | 19.28 | 18.05 | 149 | 10132 | 1.90 | 19250.8 | 25000 | 1380 | 10755.69 | 194152 | 0.240 | 0.371 |
| **2015** | 75 | 19.28 | 18.05 | 149 | 11175 | 1.90 | 21232.5 | 25000 | 1380 | 10755.69 | 194152 | 0.242 | 0.374 |
| **2025** | 75 | 19.28 | 18.05 | 149 | 11175 | 1.90 | 21232.5 | 25000 | 1380 | 10755.69 | 194152 | 0.242 | 0.374 |

**Basin 4-D** **4-2A-2**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 23 | 4.58 | 4.37 | 149 | 3427 | 1.90 | 6511.3 | 25000 | 0 | 10755.69 | 47013 | 0.079 | 0.121 |
| **2015** | 24 | 4.58 | 4.37 | 149 | 3576 | 1.90 | 6794.4 | 25000 | 0 | 10755.69 | 47013 | 0.079 | 0.122 |
| **2025** | 24 | 4.58 | 4.37 | 149 | 3576 | 1.90 | 6794.4 | 25000 | 0 | 10755.69 | 47013 | 0.079 | 0.122 |

# TABLE F-2
## Gravity Model Basin Summary

**Basin 5-A** **5-1-22**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 117 | 30.00 | 25.90 | 149 | 17433 | 1.90 | 33122.7 | 25000 | 14280 | 1516.13 | 39268 | 0.112 | 0.173 |
| **2015** | 174 | 30.00 | 25.90 | 149 | 25975.17 | 1.90 | 49352.823 | 25000 | 14280 | 1516.13 | 39268 | 0.128 | 0.198 |
| **2025** | 185 | 30.00 | 25.90 | 149 | 27565 | 1.90 | 52373.5 | 25000 | 14280 | 1516.13 | 39268 | 0.131 | 0.203 |

**Basin 5-B** **5-1-11**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 55 | 20.95 | 20.31 | 149 | 8195 | 1.90 | 15570.5 | 25000 | 37860 | 1516.13 | 30798 | 0.109 | 0.169 |
| **2015** | 59 | 20.95 | 20.31 | 149 | 8791 | 1.90 | 16702.9 | 25000 | 37860 | 1516.13 | 30798 | 0.110 | 0.171 |
| **2025** | 59 | 20.95 | 20.31 | 149 | 8791 | 1.90 | 16702.9 | 25000 | 37860 | 1516.13 | 30798 | 0.110 | 0.171 |

**Basin 6-A** **6-7-8**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 181 | 49.74 | 48.46 | 149 | 26969 | 1.90 | 51241.1 | 25000 | 14280 | 2689.83 | 130343 | 0.221 | 0.342 |
| **2015** | 188 | 49.74 | 48.46 | 149 | 28012 | 1.90 | 53222.8 | 25000 | 14280 | 2689.83 | 130343 | 0.223 | 0.345 |
| **2025** | 188 | 49.74 | 48.46 | 149 | 28012 | 1.90 | 53222.8 | 25000 | 14280 | 2689.83 | 130343 | 0.223 | 0.345 |

**Basin 6-B** **6-1-5**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 97 | 18.38 | 18.38 | 149 | 14453 | 1.90 | 27460.7 | 25000 | 21330 | 2689.83 | 49431 | 0.123 | 0.191 |
| **2015** | 97 | 18.38 | 18.38 | 149 | 14453 | 1.90 | 27460.7 | 25000 | 21330 | 2689.83 | 49431 | 0.123 | 0.191 |
| **2025** | 97 | 18.38 | 18.38 | 149 | 14453 | 1.90 | 27460.7 | 25000 | 21330 | 2689.83 | 49431 | 0.123 | 0.191 |

**Basin 7-A** **7-3-5**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 24 | 16.58 | 12.93 | 149 | 3576 | 1.90 | 6794.4 | 0 | 1500 | 2357.08 | 30487 | 0.039 | 0.060 |
| **2015** | 35 | 16.58 | 12.93 | 149 | 5215 | 1.90 | 9908.5 | 0 | 1500 | 2357.08 | 30487 | 0.042 | 0.065 |
| **2025** | 35 | 16.58 | 12.93 | 149 | 5215 | 1.90 | 9908.5 | 0 | 1500 | 2357.08 | 30487 | 0.042 | 0.065 |

**Basin 7-B** **7-1-6**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

# TABLE F-2
## Gravity Model Basin Summary

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 95 | 159.19 | 80.71 | 149 | 14155 | 1.90 | 26894.5 | 0 | 126300 | 2357.08 | 190245 | 0.343 | 0.531 |
| **2015** | 467 | 159.19 | 80.71 | 149 | 69515.95 | 1.90 | 132080.305 | 0 | 126300 | 2357.08 | 190245 | 0.449 | 0.694 |
| **2025** | 606 | 159.19 | 80.71 | 149 | 90264.2 | 1.90 | 171501.98 | 0 | 126300 | 2357.08 | 190245 | 0.488 | 0.755 |

**Basin 7-C** **7-2-1**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 48 | 5.59 | 4.31 | 149 | 7152 | 1.90 | 13588.8 | 25000 | 750 | 2357.08 | 10162 | 0.050 | 0.077 |
| **2015** | 72 | 5.59 | 4.31 | 149 | 10656.48 | 1.90 | 20247.312 | 25000 | 750 | 2357.08 | 10162 | 0.056 | 0.087 |
| **2025** | 79 | 5.59 | 4.31 | 149 | 11729.28 | 1.90 | 22285.632 | 25000 | 750 | 2357.08 | 10162 | 0.058 | 0.090 |

**Basin 8-A** **8-1-5**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 188 | 54.74 | 51.67 | 149 | 28012 | 1.90 | 53222.8 | 25000 | 66390 | 344.85 | 17817 | 0.162 | 0.251 |
| **2015** | 280 | 54.74 | 51.67 | 149 | 41737.88 | 1.90 | 79301.972 | 25000 | 66390 | 344.85 | 17817 | 0.189 | 0.292 |
| **2025** | 308 | 54.74 | 51.67 | 149 | 45939.68 | 1.90 | 87285.392 | 25000 | 66390 | 344.85 | 17817 | 0.196 | 0.304 |

**Basin 8-B**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 49 | 76.13 | 65.77 | 149 | 7301 | 1.90 | 13871.9 | 0 | 126300 | 344.85 | 22679 | 0.163 | 0.252 |
| **2015** | 73 | 76.13 | 65.77 | 149 | 10878.49 | 1.90 | 20669.131 | 0 | 126300 | 344.85 | 22679 | 0.170 | 0.262 |
| **2025** | 80 | 76.13 | 65.77 | 149 | 11973.64 | 1.90 | 22749.916 | 0 | 126300 | 344.85 | 22679 | 0.172 | 0.266 |

**Basin 9-A** **9-1-5**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 181 | 72.79 | 71.77 | 149 | 26969 | 1.90 | 51241.1 | 0 | 53370 | 303.71 | 21796 | 0.126 | 0.196 |
| **2015** | 188 | 72.79 | 71.77 | 149 | 28012 | 1.90 | 53222.8 | 0 | 53370 | 303.71 | 21796 | 0.128 | 0.199 |
| **2025** | 188 | 72.79 | 71.77 | 149 | 28012 | 1.90 | 53222.8 | 0 | 53370 | 303.71 | 21796 | 0.128 | 0.199 |

**Basin 9-B** **9-1-2**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 50 | 14.63 | 14.63 | 149 | 7450 | 1.90 | 14155 | 0 | 0 | 303.71 | 4442 | 0.019 | 0.029 |
| **2015** | 50 | 14.63 | 14.63 | 149 | 7450 | 1.90 | 14155 | 0 | 0 | 303.71 | 4442 | 0.019 | 0.029 |
| **2025** | 50 | 14.63 | 14.63 | 149 | 7450 | 1.90 | 14155 | 0 | 0 | 303.71 | 4442 | 0.019 | 0.029 |

# TABLE F-2
## Gravity Model Basin Summary

**Basin 10-A** **10-6-4**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 66 | 196.57 | 149.57 | 149 | 9834 | 1.90 | 18684.6 | 0 | 0 | 3172.62 | 474515 | 0.493 | 0.763 |
| **2015** | 98 | 196.57 | 149.57 | 149 | 14652.66 | 1.90 | 27840.054 | 0 | 0 | 3172.62 | 474515 | 0.502 | 0.777 |
| **2025** | 108 | 196.57 | 149.57 | 149 | 16127.76 | 1.90 | 30642.744 | 0 | 0 | 3172.62 | 474515 | 0.505 | 0.782 |

**Basin 10-B** **10-1-20**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 30 | 31.88 | 25.32 | 149 | 4470 | 1.90 | 8493 | 0 | 0 | 3172.62 | 80333 | 0.089 | 0.137 |
| **2015** | 45 | 31.88 | 25.32 | 149 | 6660.3 | 1.90 | 12654.57 | 0 | 0 | 3172.62 | 80333 | 0.093 | 0.144 |
| **2025** | 49 | 31.88 | 25.32 | 149 | 7330.8 | 1.90 | 13928.52 | 0 | 0 | 3172.62 | 80333 | 0.094 | 0.146 |

**Basin 10-C** **10-1-23**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 55 | 36.10 | 21.56 | 149 | 8195 | 1.90 | 15570.5 | 0 | 0 | 3172.62 | 68392 | 0.084 | 0.130 |
| **2015** | 82 | 36.10 | 21.56 | 149 | 12210.55 | 1.90 | 23200.045 | 0 | 0 | 3172.62 | 68392 | 0.092 | 0.142 |
| **2025** | 90 | 36.10 | 21.56 | 149 | 13439.8 | 1.90 | 25535.62 | 0 | 0 | 3172.62 | 68392 | 0.094 | 0.145 |

**Basin 10-D** **10-10-12**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 29 | 63.02 | 40.79 | 149 | 4321 | 1.90 | 8209.9 | 0 | 930 | 3172.62 | 129418 | 0.139 | 0.214 |
| **2015** | 43 | 63.02 | 40.79 | 149 | 6438.29 | 1.90 | 12232.751 | 0 | 930 | 3172.62 | 129418 | 0.143 | 0.221 |
| **2025** | 48 | 63.02 | 40.79 | 149 | 7086.44 | 1.90 | 13464.236 | 0 | 930 | 3172.62 | 129418 | 0.144 | 0.222 |

**Basin 10-E** **10-10B-1**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 70 | 59.93 | 31.08 | 149 | 10430 | 1.90 | 19817 | 0 | 30 | 3172.62 | 98615 | 0.118 | 0.183 |
| **2015** | 104 | 59.93 | 31.08 | 149 | 15540.7 | 1.90 | 29527.33 | 0 | 30 | 3172.62 | 98615 | 0.128 | 0.198 |
| **2025** | 115 | 59.93 | 31.08 | 149 | 17105.2 | 1.90 | 32499.88 | 0 | 30 | 3172.62 | 98615 | 0.131 | 0.203 |

**Basin 10-F** **10-1-3**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

# TABLE F-2
## Gravity Model Basin Summary

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 39 | 47.61 | 21.52 | 149 | 5811 | 1.90 | 11040.9 | 0 | 0 | 3172.62 | 68279 | 0.079 | 0.123 |
| **2015** | 58 | 47.61 | 21.52 | 149 | 8658.39 | 1.90 | 16450.941 | 0 | 0 | 3172.62 | 68279 | 0.085 | 0.131 |
| **2025** | 64 | 47.61 | 21.52 | 149 | 9530.04 | 1.90 | 18107.076 | 0 | 0 | 3172.62 | 68279 | 0.086 | 0.134 |

**Basin 10-G** **10-1-3**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 144 | 62.20 | 50.18 | 149 | 21456 | 1.90 | 40766.4 | 0 | 0 | 3172.62 | 159192 | 0.200 | 0.309 |
| **2015** | 215 | 62.20 | 50.18 | 149 | 31969.44 | 1.90 | 60741.936 | 0 | 0 | 3172.62 | 159192 | 0.220 | 0.340 |
| **2025** | 231 | 62.20 | 50.18 | 149 | 34383.24 | 1.90 | 65328.156 | 0 | 0 | 3172.62 | 159192 | 0.225 | 0.347 |

**Basin 12-A** **10-10-12**

| | ERU's | Total Area | Dev Area | Flow/ERU (gpd) | Ave Day (gpd) | Peak Factor | Pk Hour (gpd) | School /Other (gpd) | Com/ Indus (gpd) | I&I (gpad) | Pk Hour I&I (gpd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Current** | 414 | 214.38 | 165.84 | 149 | 61686.00 | 1.90 | 117203.4 | 0 | 18330 | 358.16 | 59395 | 0.195 | 0.302 |
| **2015** | 617 | 214.38 | 165.84 | 149 | 91912.14 | 1.90 | 174633.066 | 0 | 18330 | 358.16 | 59395 | 0.252 | 0.390 |
| **2025** | 626 | 214.38 | 165.84 | 149 | 93274.00 | 1.90 | 177220.6 | 0 | 18330 | 358.16 | 59395 | 0.255 | 0.394 |

| **Totals** | ERU's | Pk Hour (mgd) | School /Other (mgd) | Com/ Indus (mgd) | Total Peak I&I (mgd) | Total Peak Hr (mgd) | Total Peak Hr (cfs) |
|---|---|---|---|---|---|---|---|
| **Current** | 3503.00 | 0.992 | 0.300 | 0.49 | 6.187 | 7.965 | 12.324 |
| **2015** | 4894.70 | 1.386 | 0.300 | 0.49 | 6.187 | 8.359 | 12.933 |
| **2025** | 5419.16 | 1.534 | 0.300 | 0.49 | 6.187 | 8.508 | 13.163 |

TABLE F-3
Current Model Results

| LinkID | Up Stream MH | Down Stream MH | Up - Invert Level | Down - Invert Level | Length | Slope % | Pipe Diameter | Qmax | Hmax/D | Qmax/Qf | Capacity |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2-3-1l1 | 2-3-1 | 2-1-6 | 124.49 | 114.84 | 156.08 | 6.1827 | 10 | 0.554 | 0.785 | 0.104 | |
| 1-3-14l1 | 1-3-14 | 1-3-13 | 330.43 | 313 | 152.87 | 11.4018 | 8 | 0 | 0.58 | 0 | |
| 1-3-13l1 | 1-3-13 | 1-3-12 | 313 | 289.73 | 262.09 | 8.8786 | 8 | 0.644 | 0.29 | 0.184 | |
| 1-3-12l1 | 1-3-12 | 1-3-11 | 289.48 | 262 | 201.31 | 13.6506 | 8 | 0.644 | 0.586 | 0.148 | |
| 1-3-11l1 | 1-3-11 | 1-3-10 | 262 | 235.54 | 308.84 | 8.5675 | 8 | 0.644 | 0.336 | 0.187 | |
| 1-3-10l1 | 1-3-10 | 1-3-9 | 235.34 | 226 | 146.25 | 6.3863 | 8 | 0.644 | 0.669 | 0.217 | |
| 1-3-9l1 | 1-3-9 | 1-3-8 | 226 | 217.87 | 157.97 | 5.1465 | 8 | 0.644 | 0.334 | 0.241 | |
| 1-3-8l1 | 1-3-8 | 1-3-7 | 217.57 | 206 | 209.07 | 5.534 | 8 | 0.644 | 0.696 | 0.233 | |
| 1-3-7l1 | 1-3-7 | 1-3-6 | 206 | 199.67 | 141.42 | 4.476 | 8 | 0.644 | 0.432 | 0.259 | |
| 1-3-6l1 | 1-3-6 | 1-3-5 | 199.52 | 192 | 132.65 | 5.6691 | 8 | 0.644 | 0.667 | 0.23 | |
| 1-3-5l1 | 1-3-5 | 1-3-4 | 192 | 185.33 | 123.75 | 5.3899 | 8 | 0.644 | 0.667 | 0.236 | |
| 1-3-4l1 | 1-3-4 | 1-3-3 | 185.23 | 182.7 | 89.04 | 2.8414 | 8 | 0.644 | 0.935 | 0.325 | |
| 1-3-3l1 | 1-3-3 | 1-3-2 | 182.7 | 179.47 | 214.38 | 1.5067 | 8 | 0.644 | 0.468 | 0.446 | |
| 1-3-2l1 | 1-3-2 | 1-3-1 | 179.22 | 161.8 | 221.38 | 7.8688 | 8 | 0.645 | 2.086 | 0.195 | |
| 1-3-1l1 | 1-3-1 | 1-1-10 | 161.9 | 161.33 | 221.38 | 0.2575 | 8 | 0.646 | 1.819 | 1.081 | NO |
| 1-1-10l1 | 1-1-10 | 1-1-9 | 161.05 | 154.6 | 110.72 | 5.8255 | 12 | 3.776 | 5.555 | 0.451 | |
| 1-1-9l1 | 1-1-9 | 1-1-8 | 154.6 | 153.35 | 111.55 | 1.1206 | 12 | 3.234 | 5.889 | 0.88 | |
| 1-1-8l1 | 1-1-8 | 1-1-7 | 153.35 | 149.17 | 88.49 | 4.7237 | 12 | 3.219 | 9.507 | 0.427 | |
| 1-1-7l1 | 1-1-7 | 1-1-6 | 149.17 | 148.49 | 425.2 | 0.1599 | 12 | 2.132 | 9.373 | 1.536 | NO |
| 1-1-6l1 | 1-1-6 | 1-1-5 | 148.49 | 148.44 | 56.87 | 0.0879 | 12 | 2.117 | 8.237 | 2.057 | NO |
| 1-1-5l1 | 1-1-5 | 1-1-4 | 148.44 | 147.9 | 463.05 | 0.1166 | 12 | 2.118 | 7.846 | 1.786 | NO |
| 1-1-4l1 | 1-1-4 | 1-1-3 | 147.9 | 147.6 | 204.27 | 0.1469 | 12 | 2.426 | 6.524 | 1.824 | NO |
| 1-1-3l1 | 1-1-3 | 1-1-2 | 147.6 | 147.33 | 141.95 | 0.1902 | 12 | 2.437 | 6.124 | 1.61 | NO |
| 1-1-2l1 | 1-1-2 | 1-1-1 | 147.33 | 147.3 | 48.85 | 0.0614 | 12 | 2.66 | 5.827 | 3.092 | NO |
| 1-1-1l1 | 1-1-1 | 2-1-11 | 147 | 145.77 | 372.51 | 0.3302 | 12 | 2.661 | 5.535 | 1.334 | NO |
| 2-1-11l1 | 2-1-11 | 2-1-10 | 145.77 | 144.56 | 413.58 | 0.2926 | 12 | 3.165 | 4.462 | 1.686 | NO |
| 2-1-10l1 | 2-1-10 | 2-1-9 | 144.56 | 144 | 178.13 | 0.3144 | 12 | 3.165 | 1.852 | 1.626 | NO |
| 2-1-9l1 | 2-1-9 | 2-1-8 | 144 | 128.5 | 366.34 | 4.231 | 12 | 3.165 | 1.802 | 0.443 | |
| 2-1-8l1 | 2-1-8 | 2-1-7B | 128.5 | 126.5 | 305.36 | 0.655 | 12 | 3.165 | 1.455 | 1.127 | NO |
| 2-1-7Bl1 | 2-1-7B | 2-1-7 | 126.14 | 124.99 | 64.67 | 1.7783 | 12 | 3.165 | 0.803 | 0.684 | |
| 2-1-7l1 | 2-1-7 | 2-1-6 | 124.85 | 114.84 | 246.23 | 4.0653 | 12 | 3.165 | 0.655 | 0.452 | |
| 2-1-6l1 | 2-1-6 | 2-1-5 | 114.64 | 106.81 | 92.85 | 8.433 | 12 | 3.718 | 0.878 | 0.369 | |
| 2-1-5l1 | 2-1-5 | 2-1-4 | 106.61 | 101.76 | 131 | 3.7023 | 12 | 3.718 | 0.72 | 0.557 | |

TABLE F-3
Current Model Results

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2-1-4I1 | 2-1-4 | 2-1-3 | 101.56 | 73.34 | 461.91 | 6.1094 | 12 | 3.718 | 0.977 | 0.433 | |
| 2-1-3I1 | 2-1-3 | 2-1-2B | 73.14 | 66.45 | 246.84 | 2.7103 | 12 | 3.718 | 0.958 | 0.651 | |
| 2-1-2BI1 | 2-1-2B | 2-1-2A | 66.31 | 64.36 | 49 | 3.9796 | 12 | 3.718 | 0.85 | 0.537 | |
| 2-1-2AI1 | 2-1-2A | 2-1-2 | 64.2 | 62.25 | 32.81 | 5.9436 | 12 | 3.718 | 1.003 | 0.439 | |
| 2-1-2I1 | 2-1-2 | 2-1-1 | 62.12 | 60.16 | 465.18 | 0.4213 | 18 | 3.718 | 0.535 | 0.56 | |
| 2-1-1I1 | 2-1-1 | 5-1-12 | 56.78 | 52.47 | 401 | 1.0748 | 12 | 3.718 | 1.59 | 1.033 | NO |
| | | | | | | | | | | | |
| 1-2-8I1 | 1-2-8 | 1-2-7 | 226.12 | 204.5 | 303.65 | 7.12 | 8 | 0.565 | 0.587 | 0.18 | |
| 1-2-7I1 | 1-2-7 | 1-2-6 | 204.5 | 181.39 | 354.81 | 6.5133 | 8 | 0.565 | 0.635 | 0.188 | |
| 1-2-6I1 | 1-2-6 | 1-2-5 | 181.34 | 175.5 | 175.43 | 3.329 | 8 | 0.565 | 0.816 | 0.263 | |
| 1-2-5I1 | 1-2-5 | 1-2-4 | 175.45 | 170 | 80.81 | 6.7442 | 8 | 1.212 | 0.952 | 0.396 | |
| 1-2-4I1 | 1-2-4 | 1-2-3 | 170 | 166.39 | 68.18 | 5.2948 | 8 | 1.212 | 0.758 | 0.447 | |
| 1-2-3I1 | 1-2-3 | 1-2-2 | 166.24 | 160 | 130.65 | 4.7761 | 8 | 1.212 | 1.051 | 0.471 | |
| 1-2-2I1 | 1-2-2 | 1-2-1 | 160 | 155.3 | 117.35 | 4.0051 | 8 | 1.212 | 1.263 | 0.514 | |
| 1-2-1I1 | 1-2-1 | 1-1-2 | 155.2 | 147.33 | 152.69 | 5.1542 | 8 | 1.212 | 9.169 | 0.453 | |
| | | | | | | | | | | | |
| 5-1-25I1 | 5-1-25 | 5-1-24 | 179.15 | 175.8 | 170.03 | 1.9702 | 8 | 0 | 0.01 | 0 | |
| 5-1-24I1 | 5-1-24 | 5-1-23 | 175.8 | 158.25 | 97.27 | 18.0426 | 8 | 0 | 0.011 | 0 | |
| 5-1-23I1 | 5-1-23 | 5-1-22 | 158.25 | 146.53 | 112.21 | 10.4447 | 8 | 0 | 0.361 | 0 | |
| 5-1-22I1 | 5-1-22 | 5-1-21 | 146.53 | 135 | 271.78 | 4.2424 | 8 | 0.173 | 0.374 | 0.071 | |
| 5-1-21I1 | 5-1-21 | 5-1-20 | 135 | 125 | 272.09 | 3.6753 | 8 | 0.173 | 0.353 | 0.077 | |
| 5-1-20I1 | 5-1-20 | 5-1-19 | 125 | 112.43 | 268.1 | 4.6885 | 8 | 0.173 | 0.197 | 0.068 | |
| 5-1-19I1 | 5-1-19 | 5-1-18 | 112.33 | 100 | 246.71 | 4.9978 | 8 | 0.173 | 0.374 | 0.066 | |
| 5-1-18I1 | 5-1-18 | 5-1-17 | 100 | 90 | 271.63 | 3.6815 | 8 | 0.173 | 0.372 | 0.077 | |
| 5-1-17I1 | 5-1-17 | 5-1-16 | 90 | 79.7 | 272.88 | 3.7746 | 8 | 0.173 | 0.237 | 0.076 | |
| 5-1-16I1 | 5-1-16 | 5-1-15 | 79.6 | 71 | 267.08 | 3.22 | 8 | 0.173 | 0.384 | 0.082 | |
| 5-1-15I1 | 5-1-15 | 5-1-14 | 71 | 66.21 | 143.92 | 3.3282 | 8 | 0.173 | 0.207 | 0.081 | |
| 5-1-14I1 | 5-1-14 | 5-1-13 | 66.11 | 60.5 | 122.75 | 4.5703 | 8 | 0.173 | 0.399 | 0.069 | |
| 5-1-13I1 | 5-1-13 | 5-1-12 | 60.5 | 52.47 | 280.67 | 2.861 | 8 | 0.173 | 1.956 | 0.087 | |
| 5-1-12I1 | 5-1-12 | 5-1-11 | 52.47 | 43.93 | 272 | 3.1397 | 21 | 8.049 | 0.943 | 0.294 | |
| 5-1-11I1 | 5-1-11 | 5-1-10 | 43.93 | 40.07 | 274.19 | 1.4078 | 21 | 8.217 | 0.644 | 0.449 | |
| 5-1-10I1 | 5-1-10 | 5-1-9 | 39.62 | 37.5 | 245.69 | 0.8629 | 24 | 8.217 | 0.841 | 0.401 | |
| 5-1-9I1 | 5-1-9 | 5-1-8 | 37.5 | 36.52 | 551.39 | 0.1777 | 24 | 8.217 | 0.788 | 0.884 | |
| 5-1-8I1 | 5-1-8 | 5-1-7 | 36.52 | 35 | 130.28 | 1.1667 | 24 | 8.217 | 0.853 | 0.345 | |
| 5-1-7I1 | 5-1-7 | 5-1-6 | 35 | 33 | 226.78 | 0.8819 | 21 | 8.217 | 0.758 | 0.567 | |
| 5-1-6I1 | 5-1-6 | 5-1-5 | 33 | 28 | 121.91 | 4.1014 | 21 | 8.217 | 1.123 | 0.263 | |
| 5-1-5I1 | 5-1-5 | 5-1-4 | 28 | 26.22 | 240 | 0.7417 | 21 | 8.217 | 1.406 | 0.618 | |

TABLE F-3
Current Model Results

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5-1-4I1 | 5-1-4 | 5-1-3 | 26.22 | 25.93 | 289.28 | 0.1002 | 21 | 8.217 | 1.275 | 1.681 | NO |
| 5-1-3I1 | 5-1-3 | 5-1-2 | 25.93 | 24.9 | 240 | 0.4292 | 21 | 8.217 | 0.962 | 0.812 | |
| 5-1-2I1 | 5-1-2 | 5-1-1 | 24.9 | 24.41 | 34 | 1.4412 | 24 | 8.217 | 0.902 | 0.31 | |
| 5-1-1I1 | 5-1-1 | Main_LS | 24.41 | 22 | 142 | 1.6972 | 24 | 13.619 | 0.451 | 0.418 | |
| | | | | | | | | | | | |
| 9-1-5I1 | 9-1-5 | 9-1-4 | 33.75 | 32.91 | 226.74 | 0.3705 | 8 | 0.196 | 0.358 | 0.273 | |
| 9-1-4I1 | 9-1-4 | 9-1-3 | 26.95 | 25.22 | 436.41 | 0.3964 | 8 | 0.196 | 0.571 | 0.264 | |
| 9-1-3I1 | 9-1-3 | 9-1-2 | 25.22 | 24.95 | 337.85 | 0.0799 | 8 | 0.196 | 0.536 | 0.588 | |
| 9-1-2I1 | 9-1-2 | 9-1-1 | 23.85 | 23.61 | 65.8 | 0.3647 | 8 | 0.224 | 0.374 | 0.316 | |
| 9-1-1I1 | 9-1-1 | One Stp LS | 23.51 | 22.5 | 32.81 | 3.0785 | 12 | 0.224 | 0.123 | 0.032 | |
| | | | | | | | | | | | |
| 4-2A-2I1 | 4-2A-2 | 4-2A-Q | 213.76 | 209 | 281.8 | 1.6891 | 8 | 0.121 | 0.347 | 0.079 | |
| 4-2A-QI1 | 4-2A-Q | 4-2A-1 | 209 | 206 | 115 | 2.6087 | 8 | 0.121 | 0.397 | 0.064 | |
| 4-2A-1I1 | 4-2A-1 | 4-2-3 | 206 | 200.12 | 462.56 | 1.2712 | 8 | 0.121 | 0.362 | 0.091 | |
| 4-2-3I1 | 4-2-3 | 4-2-2 | 200.12 | 198.99 | 374.83 | 0.3015 | 8 | 0.121 | 0.295 | 0.188 | |
| 4-2-2I1 | 4-2-2 | 4-2-1 | 198.89 | 190.96 | 358.22 | 2.2137 | 8 | 0.121 | 0.416 | 0.069 | |
| 4-2-1I1 | 4-2-1 | 4-1-2 | 190.96 | 190.15 | 256.41 | 0.3159 | 8 | 0.122 | 1.117 | 0.184 | |
| | | | | | | | | | | | |
| 4-8-2I1 | 4-8-2 | 4-8-1 | 203.25 | 201.98 | 172.2 | 0.7375 | 10 | 0 | 0.008 | 0 | |
| 4-8-1I1 | **4-8-1** | 4-1-8 | 201.98 | 200.95 | 441.72 | 0.2332 | 10 | 0.002 | 0.581 | 0.001 | |
| 4-1-8I1 | 4-1-8 | 4-1-7 | 200.95 | 199.6 | 468.84 | 0.2879 | 10 | 0.506 | 0.8 | 0.442 | |
| 4-1-7I1 | 4-1-7 | 4-1-6 | 199.6 | 199.3 | 88.8 | 0.3378 | 12 | 0.941 | 0.711 | 0.466 | |
| 4-1-6I1 | 4-1-6 | 4-1-5 | 199.3 | 199 | 70.52 | 0.4254 | 12 | 0.941 | 0.633 | 0.415 | |
| 4-1-5I1 | 4-1-5 | 4-1-4 | 199 | 198.2 | 289.47 | 0.2764 | 12 | 0.941 | 0.866 | 0.516 | |
| 4-1-4I1 | 4-1-4 | 4-1-3 | 198.2 | 197.37 | 315.9 | 0.2627 | 12 | 1.312 | 0.734 | 0.737 | |
| 4-1-3I1 | 4-1-3 | 4-1-2 | 197.37 | 190.15 | 418.58 | 1.7249 | 12 | 1.312 | 0.745 | 0.288 | |
| 4-1-2I1 | 4-1-2 | 4-1-1 | 190.15 | 189.6 | 246.78 | 0.2229 | 15 | 1.433 | 0.581 | 0.482 | |
| 4-1-1I1 | 4-1-1 | 3-2-6 | 189.6 | 189.02 | 158.24 | 0.3665 | 15 | 1.433 | 0.629 | 0.376 | |
| 3-2-6I1 | 3-2-6 | 3-2-5 | 189.02 | 188.29 | 224.99 | 0.3245 | 15 | 1.433 | 0.633 | 0.4 | |
| 3-2-5I1 | 3-2-5 | 3-2-4 | 188.29 | 188.06 | 122.43 | 0.1879 | 15 | 1.433 | 0.58 | 0.525 | |
| 3-2-4I1 | 3-2-4 | 3-2-3 | 188.06 | 184 | 261.61 | 1.5519 | 15 | 1.433 | 0.58 | 0.183 | |
| 3-2-3I1 | 3-2-3 | 3-2-2 | 184 | 181.71 | 123.56 | 1.8534 | 15 | 1.433 | 0.599 | 0.167 | |
| 3-2-2I1 | 3-2-2 | 3-2-1 | 181.71 | 175.84 | 342.51 | 1.7138 | 15 | 1.608 | 0.362 | 0.195 | |
| 3-2-1I1 | 3-2-1 | 3-1-1 | 175.59 | 168.9 | 304.81 | 2.1948 | 15 | 1.608 | 0.492 | 0.172 | |
| | | | | | | | | | | | |
| 6-7-9I1 | 6-7-9 | 6-1-17 | 158.05 | 149.01 | 334.17 | 2.7052 | 8 | 0 | 0.007 | 0 | |
| 6-1-17I1 | 6-1-17 | 6-1-16 | 149.01 | 141.48 | 280.07 | 2.6886 | 8 | 0 | 0.008 | 0 | |

TABLE F-3
Current Model Results

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 6-1-16I1 | 6-1-16 | 6-1-15 | 141.48 | 135.98 | 144.02 | 3.8189 | 8 | 0 | 0.009 | 0 |
| 6-1-15I1 | 6-1-15 | 6-1-14 | 135.98 | 133.05 | 301.36 | 0.9723 | 8 | 0 | 0.007 | 0 |
| 6-1-14I1 | 6-1-14 | 6-1-13 | 132.83 | 131.59 | 95.32 | 1.3009 | 12 | 0 | 0.01 | 0 |
| 6-1-13I1 | 6-1-13 | 6-1-13B | 131.59 | 127.94 | 32.81 | 11.1252 | 12 | 0 | 0.799 | 0 |
| 6-1-13BI1 | 6-1-13B | 6-1-12 | 127.94 | 115.03 | 136.35 | 9.4683 | 15 | 4.203 | 0.736 | 0.217 |
| 6-1-12I1 | 6-1-12 | 6-1-11 | 115.03 | 95 | 256.6 | 7.8059 | 12 | 4.203 | 0.869 | 0.433 |
| 6-1-11I1 | 6-1-11 | 6-1-10 | 95 | 71.35 | 247.14 | 9.5695 | 12 | 4.203 | 0.957 | 0.391 |
| 6-1-10I1 | 6-1-10 | 6-1-9 | 71.35 | 59.76 | 284.88 | 4.0684 | 18 | 4.544 | 1.058 | 0.22 |
| 6-1-9I1 | 6-1-9 | 6-1-8 | 59.76 | 57.85 | 276.65 | 0.6904 | 18 | 4.544 | 0.758 | 0.534 |
| 6-1-8I1 | 6-1-8 | 6-1-7 | 57.85 | 52.04 | 269.02 | 2.1597 | 18 | 4.544 | 1.032 | 0.302 |
| 6-1-7I1 | 6-1-7 | 6-1-6 | 52.04 | 49.84 | 256.12 | 0.859 | 18 | 4.544 | 1.146 | 0.479 |
| 6-1-6I1 | 6-1-6 | 6-1-5 | 49.84 | 47.68 | 279.68 | 0.7723 | 18 | 5.212 | 1.146 | 0.579 |
| 6-1-5I1 | 6-1-5 | 6-1-4 | 47.68 | 45.48 | 278.91 | 0.7888 | 18 | 5.403 | 0.95 | 0.594 |
| 6-1-4I1 | 6-1-4 | 6-1-3 | 45.48 | 43.32 | 265.09 | 0.8148 | 18 | 5.403 | 1.103 | 0.585 |
| 6-1-3I1 | 6-1-3 | 6-1-2 | 43.32 | 41.16 | 268.64 | 0.8041 | 18 | 5.403 | 0.552 | 0.589 |
| 6-1-2I1 | 6-1-2 | 6-1-1 | 37.5 | 35.44 | 251.4 | 0.8194 | 18 | 5.403 | 0.933 | 0.583 |
| 6-1-1I1 | 6-1-1 | 5-2-3 | 35.44 | 32.47 | 265.6 | 1.1182 | 21 | 5.403 | 0.645 | 0.331 |
| 5-2-3I1 | 5-2-3 | 5-2-2 | 32.47 | 29.6 | 75.16 | 3.8185 | 18 | 5.403 | 0.749 | 0.27 |
| 5-2-2I1 | 5-2-2 | 5-2-1 | 29.5 | 27.1 | 79.87 | 3.0049 | 18 | 5.403 | 0.793 | 0.304 |
| 5-2-1I1 | 5-2-1 | 5-1-1 | 27 | 24.41 | 75.8 | 3.4169 | 18 | 5.403 | 1.203 | 0.286 |
| | | | | | | | | | | |
| 6-7-8I1 | 6-7-8 | 6-7-7 | 129.5 | 120.8 | 267.66 | 3.2504 | 8 | 0.342 | 0.455 | 0.161 |
| 6-7-7I1 | 6-7-7 | 6-7-6 | 120.8 | 100 | 319 | 6.5204 | 8 | 0.342 | 0.544 | 0.114 |
| 6-7-6I1 | 6-7-6 | 6-7-5 | 100 | 90.21 | 303.36 | 3.2272 | 8 | 0.342 | 0.601 | 0.162 |
| 6-7-5I1 | 6-7-5 | 6-7-4 | 90.21 | 82.72 | 344.71 | 2.1728 | 8 | 0.342 | 0.527 | 0.197 |
| 6-7-4I1 | 6-7-4 | 6-7-3 | 82.72 | 80.3 | 103.15 | 2.3461 | 12 | 0.342 | 0.39 | 0.064 |
| 6-7-3I1 | 6-7-3 | 6-7-2 | 80.3 | 77.76 | 267.1 | 0.951 | 12 | 0.342 | 0.387 | 0.101 |
| 6-7-2I1 | 6-7-2 | 6-7-1 | 77.76 | 73.87 | 417.65 | 0.9314 | 12 | 0.342 | 0.392 | 0.102 |
| 6-7-1I1 | 6-7-1 | 6-1-10 | 73.87 | 71.35 | 189.34 | 1.3309 | 12 | 0.342 | 0.957 | 0.085 |
| | | | | | | | | | | |
| 6-5-2I1 | 6-5-2 | 6-5-1 | 59.47 | 58.27 | 380.57 | 0.3153 | 8 | 0 | 0.007 | 0 |
| 6-5-1I1 | 6-5-1 | 6-1-6 | 58.27 | 49.84 | 421.07 | 2.002 | 8 | 0 | 2.578 | 0 |
| | | | | | | | | | | |
| 3-1-39I1 | 3-1-39 | 3-1-38 | 548.87 | 530 | 167.36 | 11.2751 | 8 | 0.872 | 0.319 | 0.221 |
| 3-1-38I1 | 3-1-38 | 3-1-37 | 527.99 | 521 | 215.05 | 3.2504 | 8 | 0.872 | 0.607 | 0.411 |
| 3-1-37I1 | 3-1-37 | Crown LS | 521 | 519 | 32.81 | 6.096 | 12 | 0.872 | 0.202 | 0.09 |

TABLE F-3
Current Model Results

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3-16-6I1 | 3-16-6 | 3-16-4 | 625.42 | 594.25 | 396.42 | 7.8629 | 8 | 0.754 | 0.624 | 0.228 | |
| 3-16-4I1 | 3-16-4 | 3-16-3 | 594.25 | 581 | 141.91 | 9.3369 | 8 | 0.754 | 0.684 | 0.21 | |
| 3-16-3I1 | 3-16-3 | 3-16-2 | 581 | 563.08 | 277.87 | 6.449 | 8 | 0.754 | 0.774 | 0.252 | |
| 3-16-2I1 | 3-16-2 | 3-16-1 | 563.08 | 554.01 | 222.76 | 4.0716 | 8 | 0.754 | 0.81 | 0.317 | |
| 3-16-1I1 | 3-16-1 | 3-1-27 | 554.01 | 543.48 | 297.16 | 3.5435 | 8 | 0.754 | 6.686 | 0.34 | |
| | | | | | | | | | | | |
| 3-19A-1I1 | 3-19A-1 | 3-19B-1 | 690.67 | 685 | 467.84 | 1.212 | 8 | 0.111 | 0.382 | 0.085 | |
| 3-19B-1I1 | 3-19B-1 | 3-19-6 | 685 | 678.77 | 467.84 | 1.3317 | 8 | 0.111 | 0.193 | 0.082 | |
| 3-19-6I1 | 3-19-6 | 3-19-5 | 678.57 | 675.28 | 361.39 | 0.9104 | 8 | 0.111 | 0.212 | 0.099 | |
| 3-19-5I1 | 3-19-5 | 3-19-4 | 675.16 | 671.11 | 334.48 | 1.2108 | 8 | 0.111 | 0.37 | 0.085 | |
| 3-19-4I1 | 3-19-4 | 3-19-3 | 671.11 | 667.05 | 255.81 | 1.5871 | 8 | 0.111 | 0.271 | 0.075 | |
| 3-19-3I1 | 3-19-3 | 3-19-2 | 667.05 | 664 | 51.5 | 5.9223 | 8 | 0.111 | 0.286 | 0.039 | |
| 3-19-2I1 | 3-19-2 | 3-19-1 | 664 | 645.19 | 415.02 | 4.5323 | 8 | 0.111 | 0.143 | 0.044 | |
| 3-19-1I1 | 3-19-1 | 3-1-36 | 645.09 | 627.12 | 269.24 | 6.6743 | 8 | 0.111 | 0.865 | 0.036 | |
| 3-1-36I1 | 3-1-36 | 3-1-35 | 627.12 | 620.08 | 150.2 | 4.6871 | 8 | 0.982 | 0.59 | 0.385 | |
| 3-1-35I1 | 3-1-35 | 3-1-34 | 619.88 | 605.44 | 345.62 | 4.178 | 8 | 0.982 | 0.508 | 0.408 | |
| 3-1-34I1 | 3-1-34 | 3-1-33 | 605.24 | 589.5 | 267 | 5.8951 | 8 | 0.982 | 0.875 | 0.344 | |
| 3-1-33I1 | 3-1-33 | 3-1-32 | 589.5 | 573.8 | 354.48 | 4.429 | 8 | 0.982 | 0.438 | 0.397 | |
| 3-1-32I1 | 3-1-32 | 3-1-31 | 572.42 | 561.9 | 126.18 | 8.3373 | 8 | 1.005 | 1.112 | 0.296 | |
| 3-1-31I1 | 3-1-31 | 3-1-30 | 561.9 | 558.52 | 154.4 | 2.1891 | 8 | 1.005 | 0.88 | 0.577 | |
| 3-1-30I1 | 3-1-30 | 3-1-29 | 558.52 | 554.39 | 83.71 | 4.9337 | 8 | 1.005 | 0.941 | 0.384 | |
| 3-1-29I1 | 3-1-29 | 3-1-28 | 554.39 | 548.82 | 116.48 | 4.7819 | 8 | 1.099 | 1.337 | 0.427 | |
| 3-1-28I1 | 3-1-28 | 3-1-27 | 548.82 | 543.48 | 100.57 | 5.3097 | 8 | 1.1 | 6.686 | 0.405 | |
| 3-1-27I1 | 3-1-27 | 3-1-26 | 543.48 | 533.98 | 143.24 | 6.6322 | 8 | 1.851 | 14.65 | 0.61 | |
| 3-1-26I1 | 3-1-26 | 3-1-25 | 533.98 | 530.74 | 150.68 | 2.1503 | 8 | 1.838 | 13.949 | 1.065 | NO |
| 3-1-25I1 | 3-1-25 | 3-1-24 | 530.74 | 527.7 | 296.49 | 1.0253 | 8 | 1.836 | 12.602 | 1.54 | NO |
| 3-1-24I1 | 3-1-24 | 3-1-23 | 527.7 | 517.67 | 297 | 3.3771 | 8 | 2.182 | 5.154 | 1.008 | NO |
| 3-1-23I1 | 3-1-23 | 3-1-22 | 517.67 | 510.51 | 263.25 | 2.7198 | 8 | 2.182 | 3.691 | 1.124 | NO |
| 3-1-22I1 | 3-1-22 | 3-1-21 | 510.29 | 488.8 | 285.69 | 7.5221 | 8 | 2.182 | 1.486 | 0.676 | |
| 3-1-21I1 | 3-1-21 | 3-1-20B | 488.8 | 480.5 | 191.92 | 4.3247 | 8 | 2.182 | 1.048 | 0.891 | |
| 3-1-20BI1 | 3-1-20B | 3-1-20 | 480.5 | 464 | 137.81 | 11.973 | 8 | 2.182 | 1.03 | 0.536 | |
| 3-1-20I1 | 3-1-20 | 3-1-19 | 464 | 451 | 101.75 | 12.7764 | 8 | 2.182 | 1.031 | 0.518 | |
| 3-1-19I1 | 3-1-19 | 3-1-18 | 451 | 422 | 234.31 | 12.3768 | 8 | 2.182 | 1.435 | 0.527 | |
| 3-1-18I1 | 3-1-18 | 3-1-17 | 422 | 413.73 | 117.92 | 7.0132 | 8 | 2.695 | 0.717 | 0.865 | |
| 3-1-17I1 | 3-1-17 | 3-1-16 | 412.3 | 395.63 | 285.81 | 5.8325 | 8 | 2.695 | 1.306 | 0.948 | |
| 3-1-16I1 | 3-1-16 | 3-1-15 | 395.63 | 371 | 272.7 | 9.0319 | 8 | 2.695 | 0.653 | 0.762 | |
| 3-1-15I1 | 3-1-15 | 3-1-14 | 370 | 361 | 109.1 | 8.2493 | 8 | 2.695 | 1.145 | 0.797 | |

TABLE F-3
Current Model Results

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3-1-14I1 | 3-1-14 | 3-1-13 | 361 | 324.63 | 246.6 | 14.7486 | 8 | 2.824 | 1.568 | 0.625 | |
| 3-1-13I1 | 3-1-13 | 3-1-12 | 324.63 | 304.37 | 323 | 6.2724 | 8 | 2.824 | 1.345 | 0.958 | |
| 3-1-12I1 | 3-1-12 | 3-1-11 | 304.27 | 282 | 244.65 | 9.1028 | 8 | 2.824 | 10.985 | 0.795 | |
| 3-1-11I1 | 3-1-11 | 3-1-10 | 282 | 262.19 | 287.26 | 6.8962 | 8 | 2.791 | 15.139 | 0.903 | |
| 3-1-10I1 | 3-1-10 | 3-1-9 | 261.79 | 259.99 | 230.46 | 0.781 | 8 | 2.374 | 13.518 | 2.281 | NO |
| 3-1-9I1 | 3-1-9 | 3-1-8 | 259.89 | 255.71 | 35.63 | 11.7317 | 8 | 2.373 | 5.206 | 0.588 | |
| 3-1-8I1 | 3-1-8 | 3-1-7 | 255.71 | 247.51 | 206.38 | 3.9733 | 8 | 2.373 | 3.742 | 1.011 | NO |
| 3-1-7I1 | 3-1-7 | 3-1-6 | 246.66 | 231.4 | 242.11 | 6.3029 | 8 | 2.373 | 10.616 | 0.803 | |
| 3-1-6I1 | 3-1-6 | 3-1-5 | 231.4 | 226.54 | 256.56 | 1.8943 | 8 | 2.373 | 9.33 | 1.464 | NO |
| 3-1-5I1 | 3-1-5 | 3-1-4 | 226.24 | 210 | 262.89 | 6.1775 | 8 | 2.373 | 1.392 | 0.811 | |
| 3-1-4I1 | 3-1-4 | 3-1-3 | 210 | 194.73 | 259.92 | 5.8749 | 8 | 2.373 | 1.092 | 0.831 | |
| 3-1-3I1 | 3-1-3 | 3-1-2 | 194.63 | 173.42 | 262.16 | 8.0905 | 8 | 2.373 | 0.623 | 0.709 | |
| 3-1-2I1 | 3-1-2 | 3-1-1 | 172.82 | 169.05 | 276.02 | 1.3658 | 15 | 2.551 | 0.406 | 0.347 | |
| 3-1-1I1 | 3-1-1 | 5-8-1 | 168.9 | 83.11 | 442.05 | 19.4073 | 18 | 4.159 | 0.213 | 0.092 | |
| 5-8-1I1 | 5-8-1 | 5-1-12 | 82.76 | 52.47 | 259.11 | 11.69 | 21 | 4.159 | 0.745 | 0.079 | |
| | | | | | | | | | | | |
| 7-3-5I1 | 7-3-5 | 7-3-4 | 71.5 | 64.31 | 121.17 | 5.9338 | 8 | 0.06 | 0.1 | 0.021 | |
| 7-3-4I1 | 7-3-4 | 7-3-3 | 64.26 | 41.81 | 193.99 | 11.5728 | 8 | 0.06 | 0.203 | 0.015 | |
| 7-3-3I1 | 7-3-3 | 7-3-2 | 41.76 | 39.51 | 150.63 | 1.4937 | 8 | 0.06 | 0.139 | 0.042 | |
| 7-3-2I1 | 7-3-2 | 7-3-1 | 39.46 | 26.94 | 118.27 | 10.5859 | 8 | 0.06 | 0.133 | 0.016 | |
| 7-3-1I1 | 7-3-1 | 7-1-1 | 26.89 | 16.91 | 190.47 | 5.2397 | 8 | 0.06 | 0.611 | 0.022 | |
| | | | | | | | | | | | |
| 7-1-6I1 | 7-1-6 | 7-1-5 | 23.7 | 22.21 | 286.97 | 0.5192 | 8 | 0.531 | 0.82 | 0.626 | |
| 7-1-5I1 | 7-1-5 | 7-1-4 | 22.21 | 21.45 | 213.44 | 0.3561 | 8 | 0.531 | 0.733 | 0.756 | |
| 7-1-4I1 | 7-1-4 | 7-1-3 | 21.45 | 19.75 | 57.12 | 2.9762 | 8 | 0.531 | 0.8 | 0.262 | |
| 7-1-3I1 | 7-1-3 | 7-1-2 | 19.75 | 17.5 | 455.94 | 0.4935 | 8 | 0.531 | 0.814 | 0.642 | |
| 7-1-2I1 | 7-1-2 | 7-1-1 | 17.5 | 16.86 | 163.94 | 0.3904 | 8 | 0.531 | 0.686 | 0.722 | |
| 7-1-1I1 | 7-1-1 | L C LS | 16.86 | 9.62 | 328.36 | 2.2049 | 10 | 0.591 | 0.274 | 0.165 | |
| | | | | | | | | | | | |
| 7-2-1I1 | 7-2-1 | L C LS | 12 | 9.62 | 101 | 2.3564 | 12 | 0.077 | 0.084 | 0.014 | |
| | | | | | | | | | | | |
| 8-1-9I1 | 8-1-9 | 8-1-8 | 30.84 | 29.83 | 441.23 | 0.2289 | 10 | 0.225 | 0.367 | 0.22 | |
| 8-1-8I1 | 8-1-8 | 8-1-7 | 29.83 | 28.67 | 335.14 | 0.3461 | 10 | 0.224 | 0.368 | 0.179 | |
| 8-1-7I1 | 8-1-7 | 8-1-6 | 28.67 | 27.14 | 281.54 | 0.5434 | 10 | 0.224 | 0.378 | 0.143 | |
| 8-1-6I1 | 8-1-6 | 8-1-5 | 27.14 | 25.16 | 266.48 | 0.743 | 10 | 0.224 | 0.516 | 0.122 | |
| 8-1-5I1 | 8-1-5 | 8-1-4 | 25.16 | 24.22 | 272.21 | 0.3453 | 12 | 0.476 | 0.447 | 0.233 | |
| 8-1-4I1 | 8-1-4 | 8-1-3 | 24.22 | 21.83 | 304.05 | 0.7861 | 12 | 0.476 | 0.436 | 0.155 | |

TABLE F-3
Current Model Results

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 8-1-3I1 | 8-1-3 | 8-1-2 | 21.83 | 21.07 | 310.28 | 0.2449 | 12 | 0.476 | 0.467 | 0.277 |
| 8-1-2I1 | 8-1-2 | 8-1-1 | 21.07 | 20.95 | 41.2 | 0.2913 | 12 | 0.476 | 0.322 | 0.254 |
| 8-1-1I1 | 8-1-1 | Oaks LS | 20.7 | 17 | 250 | 1.48 | 12 | 0.476 | 0.213 | 0.099 |
| | | | | | | | | | | |
| 10-1-23I1 | 10-1-23 | 10-1-24 | 586.24 | 582.57 | 246.52 | 1.4887 | 8 | 0.13 | 0.409 | 0.09 |
| 10-1-24I1 | 10-1-24 | 10-1-25 | 582.57 | 578.65 | 271.62 | 1.4432 | 8 | 0.13 | 0.205 | 0.092 |
| 10-1-25I1 | 10-1-25 | 10-1-26 | 578.46 | 573.76 | 73.84 | 6.3651 | 8 | 0.13 | 0.142 | 0.044 |
| 10-1-26I1 | 10-1-26 | 10-10B-1 | 573.52 | 565 | 71.95 | 11.8416 | 8 | 0.13 | 0.123 | 0.032 |
| | | | | | | | | | | |
| 10-1-20I1 | 10-1-20 | 10-1-19 | 560.33 | 558.74 | 222.19 | 0.7156 | 10 | 0.137 | 0.256 | 0.076 |
| 10-1-19I1 | 10-1-19 | 10-1-18 | 558.7 | 557.34 | 180 | 0.7556 | 10 | 0.137 | 0.187 | 0.065 |
| 10-11-8I1 | 10-1-18 | 10-1-17 | 529.03 | 512.56 | 172.89 | 9.5263 | 8 | 0.829 | 0.719 | 0.228 |
| 10-11-7I1 | 10-1-17 | 10-1-16 | 512.51 | 504.76 | 172.89 | 4.4826 | 8 | 0.829 | 0.397 | 0.333 |
| 10-11-6I1 | 10-1-16 | 10-1-15 | 504.29 | 496.36 | 122.58 | 6.4692 | 8 | 0.829 | 0.712 | 0.277 |
| 10-11-5I1 | 10-1-15 | 10-1-14 | 496.36 | 489.35 | 99.68 | 7.0325 | 8 | 0.829 | 0.829 | 0.266 |
| 10-11-4I1 | 10-1-14 | 10-1-13 | 489.35 | 486.23 | 79.73 | 3.9132 | 8 | 0.829 | 0.52 | 0.356 |
| 10-11-3I1 | 10-1-13 | 10-1-12 | 485.94 | 481.23 | 202.93 | 2.321 | 8 | 0.829 | 0.477 | 0.462 |
| 10-11-2I1 | 10-1-12 | 10-1-11 | 480.56 | 456.89 | 276.46 | 8.5618 | 8 | 0.829 | 0.334 | 0.241 |
| 10-11-1I1 | 10-1-11 | 10-1-10 | 456.17 | 437.78 | 149.06 | 12.3373 | 8 | 0.829 | 0.304 | 0.201 |
| | | | | | | | | | | |
| 10-6-4I1 | 10-6-4 | 10-6-3 | 475.28 | 471.48 | 200.3 | 1.8972 | 8 | 0.763 | 0.674 | 0.471 |
| 10-6-3I1 | 10-6-3 | 10-6-2 | 471.48 | 445.39 | 371.61 | 7.0208 | 8 | 0.763 | 0.658 | 0.245 |
| 10-6-2I1 | 10-6-2 | 10-6-1 | 445.39 | 424.43 | 273.95 | 7.651 | 8 | 0.763 | 0.848 | 0.234 |
| 10-6-1I1 | 10-6-1 | 10-1A-12 | 424.43 | 417.32 | 238.32 | 2.9834 | 8 | 0.763 | 0.424 | 0.375 |
| 10-1A-12I1 | 10-1A-12 | 10-1-12 | 417.18 | 411.61 | 32.81 | 16.9774 | 8 | 0.763 | 0.268 | 0.157 |
| | | | | | | | | | | |
| 10-10-12I1 | 10-10-12 | 10-10-11 | 729.37 | 719.72 | 316.82 | 3.0459 | 8 | 0.516 | 0.687 | 0.251 |
| 10-10-11I1 | 10-10-11 | 10-10-10 | 719.72 | 713.46 | 209.66 | 2.9858 | 8 | 0.516 | 0.347 | 0.254 |
| 10-10-10I1 | 10-10-10 | 10-10-9 | 713.35 | 700 | 141.84 | 9.412 | 8 | 0.516 | 0.491 | 0.143 |
| 10-10-9I1 | 10-10-9 | 10-10-9A | 700 | 690.71 | 83 | 11.1928 | 8 | 0.516 | 0.474 | 0.131 |
| 10-10-9AI1 | 10-10-9A | 10-10-8 | 690.71 | 673.37 | 136.92 | 12.6643 | 8 | 0.516 | 0.237 | 0.123 |
| 10-10-8I1 | 10-10-8 | 10-10-7 | 672.92 | 665.34 | 144.41 | 5.2489 | 8 | 0.516 | 0.296 | 0.191 |
| 10-10-7I1 | 10-10-7 | 10-10-6 | 664.94 | 650.23 | 168.4 | 8.7352 | 8 | 0.516 | 0.26 | 0.148 |
| 10-10-6I1 | 10-10-6 | 10-10-5 | 649.67 | 645.94 | 62.14 | 6.0026 | 8 | 0.516 | 0.286 | 0.179 |
| 10-10-5I1 | 10-10-5 | 10-10-4 | 645.64 | 617 | 347.43 | 8.2434 | 8 | 0.516 | 0.264 | 0.153 |
| 10-10-4I1 | 10-10-4 | 10-10-3 | 615.26 | 611.74 | 127.96 | 2.7509 | 8 | 0.516 | 0.351 | 0.264 |
| 10-10-3I1 | 10-10-3 | 10-10-2 | 611.07 | 595 | 101.85 | 15.7781 | 8 | 0.516 | 0.411 | 0.11 |

TABLE F-3
Current Model Results

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10-10-2I1 | 10-10-2 | 10-10-1 | 595 | 579.91 | 67.04 | 22.5089 | 8 | 0.516 | 0.205 | 0.092 | |
| 10-10-1I1 | 10-10-1 | 10-10B-1 | 579.48 | 552.57 | 204.62 | 13.1512 | 8 | 0.516 | 0.235 | 0.121 | |
| 10-10B-1I1 | 10-10B-1 | 10-11-8 | 552.32 | 529.58 | 113.51 | 20.0335 | 8 | 0.829 | 0.268 | 0.157 | |
| 10-1-18I1 | 10-11-8 | 10-11-7 | 557.34 | 528.08 | 178.24 | 16.4161 | 8 | 0.137 | 0.117 | 0.029 | |
| 10-1-17I1 | 10-11-7 | 10-11-6 | 527.27 | 510.29 | 82.16 | 20.667 | 8 | 0.137 | 0.11 | 0.026 | |
| 10-1-16I1 | 10-11-6 | 10-11-5 | 509.25 | 487.05 | 64.52 | 34.4079 | 8 | 0.137 | 0.098 | 0.02 | |
| 10-1-15I1 | 10-11-5 | 10-11-4 | 486.88 | 461.89 | 227.99 | 10.961 | 8 | 0.137 | 0.427 | 0.035 | |
| 10-1-14I1 | 10-11-4 | 10-11-3 | 461.89 | 461.44 | 33 | 1.3636 | 8 | 0.137 | 0.213 | 0.1 | |
| 10-1-13I1 | 10-11-3 | 10-11-2 | 461.44 | 411.61 | 153.23 | 32.5197 | 8 | 0.137 | 0.099 | 0.02 | |
| 10-1-12I1 | 10-11-2 | 10-11-1 | 410.71 | 388 | 158.82 | 14.2992 | 8 | 0.9 | 0.305 | 0.202 | |
| 10-1-11I1 | 10-11-1 | 10-4-4 | 382.41 | 380.71 | 187.51 | 0.9066 | 8 | 0.9 | 0.677 | 0.803 | |
| 10-4-4I1 | 10-4-4 | 10-4-3 | 437.47 | 431.39 | 77.5 | 7.8452 | 8 | 0.829 | 0.397 | 0.251 | |
| 10-4-3I1 | 10-4-3 | 10-4-2 | 431.2 | 422.61 | 105.27 | 8.16 | 8 | 0.829 | 0.721 | 0.247 | |
| 10-4-2I1 | 10-4-2 | 10-4-1 | 422.31 | 421.65 | 63.07 | 1.0465 | 8 | 0.829 | 0.609 | 0.688 | |
| 10-4-1I1 | 10-4-1 | 10-1-10 | 421.53 | 377.51 | 189.32 | 23.2516 | 8 | 0.829 | 0.258 | 0.146 | |
| 10-1-10I1 | 10-1-10 | 10-1-9 | 375.1 | 170.58 | 281.66 | 72.6124 | 8 | 1.73 | 1.96 | 0.172 | |
| 10-1-9I1 | 10-1-9 | 10-1-8 | 171.3 | 159.26 | 89.57 | 13.442 | 8 | 1.73 | 0.44 | 0.401 | |
| 10-1-8I1 | 10-1-8 | 10-1-7 | 154.04 | 151.99 | 186.15 | 1.1013 | 8 | 1.73 | 3.856 | 1.4 | NO |
| 10-1-7I1 | 10-1-7 | 10-1-6 | 151.69 | 145.35 | 182.68 | 3.4705 | 8 | 1.73 | 1.152 | 0.789 | |
| 10-1-6I1 | 10-1-6 | 10-1-5 | 145.15 | 138.94 | 215.3 | 2.8843 | 8 | 1.73 | 0.995 | 0.865 | |
| 10-1-5I1 | 10-1-5 | S P Hill LS | 138.94 | 137.5 | 32.81 | 4.3891 | 12 | 1.73 | 0.332 | 0.238 | |
| | | | | | | | | | | | |
| 10-1-3I1 | 10-1-3 | 10-1-2 | 146.7 | 132 | 255.96 | 5.7431 | 8 | 2.162 | 1.355 | 0.766 | |
| 10-1-2I1 | 10-1-2 | 10-1-1 | 132 | 122.59 | 300 | 3.1367 | 10 | 2.162 | 0.913 | 0.572 | |
| 10-1-1I1 | 10-1-1 | W C LS | 122.59 | 121 | 32.81 | 4.8463 | 12 | 2.347 | 0.38 | 0.307 | |

TABLE F-4
2025 Gravity Model Iterations

| LinkID | Up Stream MH | Down Stream MH | Up - Invert Level | Down - Invert Level | Length | Slope % | *First Iteration / Original Pipe Sizes* Pipe Diameter | Hmax/D | Qmax/Qf | | *Second Iteration* Pipe Diameter | Hmax/D | Qmax/Qf | | *Third Iteration* Pipe Diameter | Hmax/D | Qmax/Qf | | *Fourth Iteration* Pipe Diameter | Hmax/D | Qmax/Qf | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2-3-1I1 | 2-3-1 | 2-1-6 | 124.49 | 114.84 | 156.08 | 6.1827 | 10 | 0.795 | 0.11 | | 10 | 1.061 | 0.11 | | 10 | 1.202 | 0.11 | | 10 | 1.202 | 0.11 | |
| 1-3-14I1 | 1-3-14 | 1-3-13 | 330.43 | 313 | 152.87 | 11.4018 | 8 | 0.582 | 0 | | 8 | 0.582 | 0 | | 8 | 0.582 | 0 | | 8 | 0.582 | 0 | |
| 1-3-13I1 | 1-3-13 | 1-3-12 | 313 | 289.73 | 262.09 | 8.8786 | 8 | 0.291 | 0.185 | | 8 | 0.291 | 0.185 | | 8 | 0.291 | 0.185 | | 8 | 0.291 | 0.185 | |
| 1-3-12I1 | 1-3-12 | 1-3-11 | 289.48 | 262 | 201.31 | 13.6506 | 8 | 0.587 | 0.149 | | 8 | 0.587 | 0.149 | | 8 | 0.587 | 0.149 | | 8 | 0.587 | 0.149 | |
| 1-3-11I1 | 1-3-11 | 1-3-10 | 262 | 235.54 | 308.84 | 8.5675 | 8 | 0.338 | 0.188 | | 8 | 0.338 | 0.188 | | 8 | 0.338 | 0.188 | | 8 | 0.338 | 0.188 | |
| 1-3-10I1 | 1-3-10 | 1-3-9 | 235.34 | 226 | 146.25 | 6.3863 | 8 | 0.67 | 0.218 | | 8 | 0.67 | 0.218 | | 8 | 0.67 | 0.218 | | 8 | 0.67 | 0.218 | |
| 1-3-9I1 | 1-3-9 | 1-3-8 | 226 | 217.87 | 157.97 | 5.1465 | 8 | 0.335 | 0.242 | | 8 | 0.335 | 0.242 | | 8 | 0.335 | 0.242 | | 8 | 0.335 | 0.242 | |
| 1-3-8I1 | 1-3-8 | 1-3-7 | 217.57 | 206 | 209.07 | 5.534 | 8 | 0.697 | 0.234 | | 8 | 0.697 | 0.234 | | 8 | 0.697 | 0.234 | | 8 | 0.697 | 0.234 | |
| 1-3-7I1 | 1-3-7 | 1-3-6 | 206 | 199.67 | 141.42 | 4.476 | 8 | 0.434 | 0.26 | | 8 | 0.434 | 0.26 | | 8 | 0.434 | 0.26 | | 8 | 0.434 | 0.26 | |
| 1-3-6I1 | 1-3-6 | 1-3-5 | 199.52 | 192 | 132.65 | 5.6691 | 8 | 0.668 | 0.231 | | 8 | 0.668 | 0.231 | | 8 | 0.668 | 0.231 | | 8 | 0.668 | 0.231 | |
| 1-3-5I1 | 1-3-5 | 1-3-4 | 192 | 185.33 | 123.75 | 5.3899 | 8 | 0.669 | 0.237 | | 8 | 0.669 | 0.237 | | 8 | 0.669 | 0.237 | | 8 | 0.669 | 0.237 | |
| 1-3-4I1 | 1-3-4 | 1-3-3 | 185.23 | 182.7 | 89.04 | 2.8414 | 8 | 0.938 | 0.326 | | 8 | 0.938 | 0.326 | | 8 | 0.938 | 0.326 | | 8 | 0.938 | 0.326 | |
| 1-3-3I1 | 1-3-3 | 1-3-2 | 182.7 | 179.47 | 214.38 | 1.5067 | 8 | 0.469 | 0.448 | | 8 | 0.469 | 0.448 | | 8 | 0.469 | 0.448 | | 8 | 0.469 | 0.448 | |
| 1-3-2I1 | 1-3-2 | 1-3-1 | 179.22 | 161.8 | 221.38 | 7.8688 | 8 | 2.282 | 0.196 | | 8 | 1.246 | 0.196 | | 8 | 1.055 | 0.196 | | 8 | 1.055 | 0.196 | |
| 1-3-1I1 | 1-3-1 | 1-1-10 | 161.9 | 161.33 | 221.38 | 0.2575 | 8 | 2.015 | 1.084 | NO | 10 | 1.306 | 0.598 | | 10 | 0.862 | 0.598 | | 10 | 0.864 | 0.598 | |
| 1-1-10I1 | 1-1-10 | 1-1-9 | 161.05 | 154.6 | 110.72 | 5.8255 | 12 | 5.829 | 0.477 | | 12 | 5.045 | 0.478 | | 12 | 1.281 | 0.468 | | 12 | 1.304 | 0.468 | |
| 1-1-9I1 | 1-1-9 | 1-1-8 | 154.6 | 153.35 | 111.55 | 1.1206 | 12 | 6.169 | 0.891 | | 12 | 4.617 | 1.009 | NO | 15 | 1.03 | 0.588 | | 15 | 0.899 | 0.588 | |
| 1-1-8I1 | 1-1-8 | 1-1-7 | 153.35 | 149.17 | 88.49 | 4.7237 | 12 | 9.791 | 0.431 | | 12 | 7.473 | 0.491 | | 12 | 2.799 | 0.519 | | 12 | 1.677 | 0.519 | |
| 1-1-7I1 | 1-1-7 | 1-1-6 | 149.17 | 148.49 | 425.2 | 0.1599 | 12 | 9.653 | 1.565 | NO | 15 | 5.866 | 1.308 | NO | 18 | 1.836 | 0.957 | | 18 | 1.091 | 0.957 | |
| 1-1-6I1 | 1-1-6 | 1-1-5 | 148.49 | 148.44 | 56.87 | 0.0879 | 12 | 8.451 | 2.095 | NO | 15 | 5.295 | 1.765 | NO | 18 | 1.723 | 1.291 | NO | 21 | 0.885 | 0.856 | |
| 1-1-5I1 | 1-1-5 | 1-1-4 | 148.44 | 147.9 | 463.05 | 0.1166 | 12 | 8.046 | 1.82 | NO | 15 | 5.02 | 1.533 | NO | 18 | 1.585 | 1.121 | NO | 21 | 0.967 | 0.743 | |
| 1-1-4I1 | 1-1-4 | 1-1-3 | 147.9 | 147.6 | 204.27 | 0.1469 | 12 | 6.668 | 1.841 | NO | 15 | 4.338 | 1.456 | NO | 18 | 1.427 | 0.999 | | 18 | 1.064 | 0.999 | |
| 1-1-3I1 | 1-1-3 | 1-1-2 | 147.6 | 147.33 | 141.95 | 0.1902 | 12 | 6.256 | 1.627 | NO | 15 | 4.049 | 1.282 | NO | 18 | 1.402 | 0.878 | | 18 | 1.039 | 0.878 | |
| 1-1-2I1 | 1-1-2 | 1-1-1 | 147.33 | 147.3 | 48.85 | 0.0614 | 12 | 5.955 | 3.114 | NO | 15 | 3.689 | 2.761 | NO | 18 | 1.222 | 2.036 | NO | 21 | 0.772 | 1.35 | NO |
| 1-1-1I1 | 1-1-1 | 2-1-11 | 147 | 145.77 | 372.51 | 0.3302 | 12 | 5.66 | 1.344 | NO | 15 | 3.425 | 1.191 | NO | 18 | 1.343 | 0.878 | | 18 | 0.919 | 0.878 | |
| 2-1-11I1 | 2-1-11 | 2-1-10 | 145.77 | 144.56 | 413.58 | 0.2926 | 12 | 4.575 | 1.703 | NO | 15 | 2.768 | 1.449 | NO | 18 | 1.194 | 1.055 | NO | 21 | 0.82 | 0.699 | |
| 2-1-10I1 | 2-1-10 | 2-1-9 | 144.56 | 144 | 178.13 | 0.3144 | 12 | 1.888 | 1.642 | NO | 15 | 1.407 | 1.398 | NO | 18 | 0.933 | 1.018 | NO | 21 | 0.787 | 0.675 | |
| 2-1-9I1 | 2-1-9 | 2-1-8 | 144 | 128.5 | 366.34 | 4.231 | 12 | 1.87 | 0.448 | | 12 | 2.173 | 0.691 | | 12 | 2.514 | 0.818 | | 12 | 1.467 | 0.818 | |
| 2-1-8I1 | 2-1-8 | 2-1-7B | 128.5 | 126.5 | 305.36 | 0.655 | 12 | 1.516 | 1.138 | NO | 15 | 1.567 | 0.969 | | 15 | 1.628 | 1.147 | NO | 18 | 0.937 | 0.705 | |
| 2-1-7BI1 | 2-1-7B | 2-1-7 | 126.14 | 124.99 | 64.67 | 1.7783 | 12 | 0.809 | 0.691 | | 12 | 1.255 | 1.066 | NO | 15 | 1.006 | 0.696 | | 15 | 1.006 | 0.696 | |
| 2-1-7I1 | 2-1-7 | 2-1-6 | 124.85 | 114.84 | 246.23 | 4.0653 | 12 | 0.663 | 0.457 | | 12 | 0.884 | 0.705 | | 12 | 1.002 | 0.835 | | 12 | 1.002 | 0.835 | |
| 2-1-6I1 | 2-1-6 | 2-1-5 | 114.64 | 106.81 | 92.85 | 8.433 | 12 | 0.889 | 0.375 | | 12 | 1.214 | 0.547 | | 12 | 1.422 | 0.637 | | 12 | 1.422 | 0.637 | |
| 2-1-5I1 | 2-1-5 | 2-1-4 | 106.61 | 101.76 | 131 | 3.7023 | 12 | 0.729 | 0.566 | | 12 | 0.966 | 0.826 | | 12 | 1.091 | 0.962 | | 12 | 1.09 | 0.962 | |
| 2-1-4I1 | 2-1-4 | 2-1-3 | 101.56 | 73.34 | 461.91 | 6.1094 | 12 | 0.99 | 0.44 | | 12 | 1.567 | 0.643 | | 12 | 5.094 | 0.749 | | 12 | 1.24 | 0.749 | |
| 2-1-3I1 | 2-1-3 | 2-1-2B | 73.14 | 66.45 | 246.84 | 2.7103 | 12 | 0.97 | 0.661 | | 12 | 1.349 | 0.965 | | 12 | 3.848 | 1.124 | NO | 15 | 1.663 | 0.62 | |
| 2-1-2BI1 | 2-1-2B | 2-1-2A | 66.31 | 64.36 | 49 | 3.9796 | 12 | 0.861 | 0.546 | | 12 | 1.183 | 0.796 | | 12 | 1.383 | 0.928 | | 12 | 1.383 | 0.928 | |
| 2-1-2AI1 | 2-1-2A | 2-1-2 | 64.2 | 62.25 | 32.81 | 5.9436 | 12 | 1.014 | 0.447 | | 12 | 1.3 | 0.652 | | 12 | 1.455 | 0.759 | | 12 | 1.455 | 0.759 | |
| 2-1-2I1 | 2-1-2 | 2-1-1 | 62.12 | 60.16 | 465.18 | 0.4213 | 18 | 0.54 | 0.569 | | 18 | 0.694 | 0.83 | | 18 | 0.785 | 0.967 | | 18 | 0.785 | 0.967 | |
| 2-1-1I1 | 2-1-1 | 5-1-12 | 56.78 | 52.47 | 401 | 1.0748 | 12 | 1.753 | 1.05 | NO | 15 | 1.208 | 0.845 | | 15 | 1.281 | 0.985 | | 15 | 1.281 | 0.985 | |
| 1-2-8I1 | 1-2-8 | 1-2-7 | 226.12 | 204.5 | 303.65 | 7.12 | 8 | 0.591 | 0.182 | | 8 | 0.591 | 0.182 | | 8 | 0.591 | 0.182 | | 8 | 0.591 | 0.182 | |
| 1-2-7I1 | 1-2-7 | 1-2-6 | 204.5 | 181.39 | 354.81 | 6.5133 | 8 | 0.64 | 0.19 | | 8 | 0.64 | 0.19 | | 8 | 0.64 | 0.19 | | 8 | 0.64 | 0.19 | |
| 1-2-6I1 | 1-2-6 | 1-2-5 | 181.34 | 175.5 | 175.43 | 3.329 | 8 | 0.83 | 0.266 | | 8 | 0.83 | 0.266 | | 8 | 0.83 | 0.266 | | 8 | 0.83 | 0.266 | |
| 1-2-5I1 | 1-2-5 | 1-2-4 | 175.45 | 170 | 80.81 | 6.7442 | 8 | 0.968 | 0.408 | | 8 | 0.968 | 0.408 | | 8 | 0.968 | 0.408 | | 8 | 0.968 | 0.408 | |
| 1-2-4I1 | 1-2-4 | 1-2-3 | 170 | 166.39 | 68.18 | 5.2948 | 8 | 0.774 | 0.46 | | 8 | 0.774 | 0.46 | | 8 | 0.774 | 0.46 | | 8 | 0.774 | 0.46 | |
| 1-2-3I1 | 1-2-3 | 1-2-2 | 166.24 | 160 | 130.65 | 4.7761 | 8 | 1.07 | 0.484 | | 8 | 1.06 | 0.484 | | 8 | 1.05 | 0.484 | | 8 | 1.049 | 0.484 | |
| 1-2-2I1 | 1-2-2 | 1-2-1 | 160 | 155.3 | 117.35 | 4.0051 | 8 | 1.303 | 0.529 | | 8 | 1.104 | 0.529 | | 8 | 0.884 | 0.529 | | 8 | 0.858 | 0.529 | |
| 1-2-1I1 | 1-2-1 | 1-1-2 | 155.2 | 147.33 | 152.69 | 5.1542 | 8 | 9.364 | 0.466 | | 8 | 7.478 | 0.466 | | 8 | 3.154 | 0.466 | | 8 | 2.339 | 0.466 | |
| 5-1-25I1 | 5-1-25 | 5-1-24 | 179.15 | 175.8 | 170.03 | 1.9702 | 8 | 0.01 | 0 | | 8 | 0.01 | 0 | | 8 | 0.01 | 0 | | 8 | 0.01 | 0 | |
| 5-1-24I1 | 5-1-24 | 5-1-23 | 175.8 | 158.25 | 97.27 | 18.0426 | 8 | 0.011 | 0 | | 8 | 0.011 | 0 | | 8 | 0.011 | 0 | | 8 | 0.011 | 0 | |

TABLE F-4
2025 Gravity Model Iterations

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5-1-23I1 | 5-1-23 | 5-1-22 | 158.25 | 146.53 | 112.21 | 10.4447 | 8 | 0.391 | 0 | | 8 | 0.391 | 0 | | 8 | 0.391 | 0 | | 8 | 0.391 | 0 |
| 5-1-22I1 | 5-1-22 | 5-1-21 | 146.53 | 135 | 271.78 | 4.2424 | 8 | 0.405 | 0.084 | | 8 | 0.405 | 0.084 | | 8 | 0.405 | 0.084 | | 8 | 0.405 | 0.084 |
| 5-1-21I1 | 5-1-21 | 5-1-20 | 135 | 125 | 272.09 | 3.6753 | 8 | 0.381 | 0.09 | | 8 | 0.381 | 0.09 | | 8 | 0.381 | 0.09 | | 8 | 0.381 | 0.09 |
| 5-1-20I1 | 5-1-20 | 5-1-19 | 125 | 112.43 | 268.1 | 4.6885 | 8 | 0.225 | 0.08 | | 8 | 0.225 | 0.08 | | 8 | 0.225 | 0.08 | | 8 | 0.225 | 0.08 |
| 5-1-19I1 | 5-1-19 | 5-1-18 | 112.33 | 100 | 246.71 | 4.9978 | 8 | 0.405 | 0.077 | | 8 | 0.405 | 0.077 | | 8 | 0.405 | 0.077 | | 8 | 0.405 | 0.077 |
| 5-1-18I1 | 5-1-18 | 5-1-17 | 100 | 90 | 271.63 | 3.6815 | 8 | 0.402 | 0.09 | | 8 | 0.402 | 0.09 | | 8 | 0.402 | 0.09 | | 8 | 0.402 | 0.09 |
| 5-1-17I1 | 5-1-17 | 5-1-16 | 90 | 79.7 | 272.88 | 3.7746 | 8 | 0.268 | 0.089 | | 8 | 0.268 | 0.089 | | 8 | 0.268 | 0.089 | | 8 | 0.268 | 0.089 |
| 5-1-16I1 | 5-1-16 | 5-1-15 | 79.6 | 71 | 267.08 | 3.22 | 8 | 0.415 | 0.096 | | 8 | 0.415 | 0.096 | | 8 | 0.415 | 0.096 | | 8 | 0.415 | 0.096 |
| 5-1-15I1 | 5-1-15 | 5-1-14 | 71 | 66.21 | 143.92 | 3.3282 | 8 | 0.236 | 0.094 | | 8 | 0.236 | 0.094 | | 8 | 0.236 | 0.094 | | 8 | 0.236 | 0.094 |
| 5-1-14I1 | 5-1-14 | 5-1-13 | 66.11 | 60.5 | 122.75 | 4.5703 | 8 | 0.431 | 0.081 | | 8 | 0.431 | 0.081 | | 8 | 0.431 | 0.081 | | 8 | 0.431 | 0.081 |
| 5-1-13I1 | 5-1-13 | 5-1-12 | 60.5 | 52.47 | 280.67 | 2.861 | 8 | 1.971 | 0.102 | | 8 | 2.264 | 0.102 | | 8 | 2.402 | 0.102 | | 8 | 2.402 | 0.102 |
| 5-1-12I1 | 5-1-12 | 5-1-11 | 52.47 | 43.93 | 272 | 3.1397 | 21 | 0.951 | 0.298 | | 21 | 1.104 | 0.383 | | 21 | 1.181 | 0.425 | | 21 | 1.181 | 0.425 |
| 5-1-11I1 | 5-1-11 | 5-1-10 | 43.93 | 40.07 | 274.19 | 1.4078 | 21 | 0.65 | 0.455 | | 21 | 0.763 | 0.582 | | 21 | 0.851 | 0.644 | | 21 | 0.851 | 0.644 |
| 5-1-10I1 | 5-1-10 | 5-1-9 | 39.62 | 37.5 | 245.69 | 0.8629 | 24 | 0.85 | 0.407 | | 24 | 1.167 | 0.521 | | 24 | 0.908 | 0.576 | | 24 | 0.908 | 0.576 |
| 5-1-9I1 | 5-1-9 | 5-1-8 | 37.5 | 36.52 | 551.39 | 0.1777 | 24 | 0.794 | 0.896 | | 24 | 1.061 | 1.147 | NO | 30 | 0.761 | 0.7 | | 30 | 0.761 | 0.7 |
| 5-1-8I1 | 5-1-8 | 5-1-7 | 36.52 | 35 | 130.28 | 1.1667 | 24 | 0.859 | 0.35 | | 24 | 0.976 | 0.448 | | 24 | 1.042 | 0.496 | | 24 | 1.042 | 0.496 |
| 5-1-7I1 | 5-1-7 | 5-1-6 | 35 | 33 | 226.78 | 0.8819 | 21 | 0.766 | 0.574 | | 21 | 0.974 | 0.735 | | 21 | 0.975 | 0.814 | | 21 | 0.975 | 0.814 |
| 5-1-6I1 | 5-1-6 | 5-1-5 | 33 | 28 | 121.91 | 4.1014 | 21 | 1.15 | 0.266 | | 21 | 1.889 | 0.341 | | 21 | 1.569 | 0.377 | | 21 | 1.569 | 0.377 |
| 5-1-5I1 | 5-1-5 | 5-1-4 | 28 | 26.22 | 240 | 0.7417 | 21 | 1.477 | 0.626 | | 21 | 1.857 | 0.802 | | 21 | 1.299 | 0.887 | | 21 | 1.299 | 0.887 |
| 5-1-4I1 | 5-1-4 | 5-1-3 | 26.22 | 25.93 | 289.28 | 0.1002 | 21 | 1.342 | 1.704 | NO | 24 | 1.512 | 1.527 | NO | 30 | 0.883 | 0.932 | | 30 | 0.883 | 0.932 |
| 5-1-3I1 | 5-1-3 | 5-1-2 | 25.93 | 24.9 | 240 | 0.4292 | 21 | 1.06 | 0.824 | | 21 | 1.284 | 1.054 | NO | 24 | 1.141 | 0.817 | | 24 | 1.141 | 0.817 |
| 5-1-2I1 | 5-1-2 | 5-1-1 | 24.9 | 24.41 | 34 | 1.4412 | 24 | 1.042 | 0.315 | | 24 | 1.125 | 0.403 | | 24 | 1.166 | 0.446 | | 24 | 1.166 | 0.446 |
| 5-1-1I1 | 5-1-1 | Main_LS | 24.41 | 22 | 142 | 1.6972 | 24 | 0.521 | 0.536 | | 24 | 0.563 | 0.607 | | 24 | 0.583 | 0.643 | | 24 | 0.583 | 0.643 |
| | | | | | | | | | | | | | | | | | | | | | |
| 9-1-5I1 | 9-1-5 | 9-1-4 | 33.75 | 32.91 | 226.74 | 0.3705 | 8 | 0.361 | 0.277 | | 8 | 0.361 | 0.277 | | 8 | 0.361 | 0.277 | | 8 | 0.361 | 0.277 |
| 9-1-4I1 | 9-1-4 | 9-1-3 | 26.95 | 25.22 | 436.41 | 0.3964 | 8 | 0.575 | 0.268 | | 8 | 0.575 | 0.268 | | 8 | 0.575 | 0.268 | | 8 | 0.575 | 0.268 |
| 9-1-3I1 | 9-1-3 | 9-1-2 | 25.22 | 24.95 | 337.85 | 0.0799 | 8 | 0.54 | 0.597 | | 8 | 0.54 | 0.597 | | 8 | 0.54 | 0.597 | | 8 | 0.54 | 0.597 |
| 9-1-2I1 | 9-1-2 | 9-1-1 | 23.85 | 23.61 | 65.8 | 0.3647 | 8 | 0.377 | 0.32 | | 8 | 0.377 | 0.32 | | 8 | 0.377 | 0.32 | | 8 | 0.377 | 0.32 |
| 9-1-1I1 | 9-1-1 | One Stp LS | 23.51 | 22.5 | 32.81 | 3.0785 | 12 | 0.124 | 0.033 | | 12 | 0.124 | 0.033 | | 12 | 0.124 | 0.033 | | 12 | 0.124 | 0.033 |
| | | | | | | | | | | | | | | | | | | | | | |
| 4-2A-2I1 | 4-2A-2 | 4-2A-Q | 213.76 | 209 | 281.8 | 1.6891 | 8 | 0.347 | 0.08 | | 8 | 0.347 | 0.08 | | 8 | 0.347 | 0.08 | | 8 | 0.347 | 0.08 |
| 4-2A-QI1 | 4-2A-Q | 4-2A-1 | 209 | 206 | 115 | 2.6087 | 8 | 0.398 | 0.064 | | 8 | 0.398 | 0.064 | | 8 | 0.398 | 0.064 | | 8 | 0.398 | 0.064 |
| 4-2A-1I1 | 4-2A-1 | 4-2-3 | 206 | 200.12 | 462.56 | 1.2712 | 8 | 0.363 | 0.092 | | 8 | 0.363 | 0.092 | | 8 | 0.363 | 0.092 | | 8 | 0.363 | 0.092 |
| 4-2-3I1 | 4-2-3 | 4-2-2 | 200.12 | 198.99 | 374.83 | 0.3015 | 8 | 0.295 | 0.189 | | 8 | 0.295 | 0.189 | | 8 | 0.295 | 0.189 | | 8 | 0.295 | 0.189 |
| 4-2-2I1 | 4-2-2 | 4-2-1 | 198.89 | 190.96 | 358.22 | 2.2137 | 8 | 0.417 | 0.07 | | 8 | 0.417 | 0.07 | | 8 | 0.417 | 0.07 | | 8 | 0.417 | 0.07 |
| 4-2-1I1 | 4-2-1 | 4-1-2 | 190.96 | 190.15 | 256.41 | 0.3159 | 8 | 1.12 | 0.185 | | 8 | 1.12 | 0.185 | | 8 | 1.12 | 0.185 | | 8 | 1.12 | 0.185 |
| | | | | | | | | | | | | | | | | | | | | | |
| 4-8-2I1 | 4-8-2 | 4-8-1 | 203.25 | 201.98 | 172.2 | 0.7375 | 10 | 0.008 | 0 | | 10 | 0.008 | 0 | | 10 | 0.008 | 0 | | 10 | 0.008 | 0 |
| 4-8-1I1 | **4-8-1** | 4-1-8 | 201.98 | 200.95 | 441.72 | 0.2332 | 10 | 0.582 | 0.001 | | 10 | 0.582 | 0.001 | | 10 | 0.582 | 0.001 | | 10 | 0.582 | 0.001 |
| 4-1-8I1 | 4-1-8 | 4-1-7 | 200.95 | 199.6 | 468.84 | 0.2879 | 10 | 0.801 | 0.443 | | 10 | 0.801 | 0.443 | | 10 | 0.801 | 0.443 | | 10 | 0.801 | 0.443 |
| 4-1-7I1 | 4-1-7 | 4-1-6 | 199.6 | 199.3 | 88.8 | 0.3378 | 12 | 0.713 | 0.468 | | 12 | 0.713 | 0.468 | | 12 | 0.713 | 0.468 | | 12 | 0.713 | 0.468 |
| 4-1-6I1 | 4-1-6 | 4-1-5 | 199.3 | 199 | 70.52 | 0.4254 | 12 | 0.634 | 0.417 | | 12 | 0.634 | 0.417 | | 12 | 0.634 | 0.417 | | 12 | 0.634 | 0.417 |
| 4-1-5I1 | 4-1-5 | 4-1-4 | 199 | 198.2 | 289.47 | 0.2764 | 12 | 0.868 | 0.517 | | 12 | 0.868 | 0.517 | | 12 | 0.868 | 0.517 | | 12 | 0.868 | 0.517 |
| 4-1-4I1 | 4-1-4 | 4-1-3 | 198.2 | 197.37 | 315.9 | 0.2627 | 12 | 0.736 | 0.741 | | 12 | 0.736 | 0.741 | | 12 | 0.736 | 0.741 | | 12 | 0.736 | 0.741 |
| 4-1-3I1 | 4-1-3 | 4-1-2 | 197.37 | 190.15 | 418.58 | 1.7249 | 12 | 0.747 | 0.289 | | 12 | 0.747 | 0.289 | | 12 | 0.747 | 0.289 | | 12 | 0.747 | 0.289 |
| 4-1-2I1 | 4-1-2 | 4-1-1 | 190.15 | 189.6 | 246.78 | 0.2229 | 15 | 0.582 | 0.484 | | 15 | 0.582 | 0.484 | | 15 | 0.582 | 0.484 | | 15 | 0.582 | 0.484 |
| 4-1-1I1 | 4-1-1 | 3-2-6 | 189.6 | 189.02 | 158.24 | 0.3665 | 15 | 0.63 | 0.378 | | 15 | 0.63 | 0.378 | | 15 | 0.63 | 0.378 | | 15 | 0.63 | 0.378 |
| 3-2-6I1 | 3-2-6 | 3-2-5 | 189.02 | 188.29 | 224.99 | 0.3245 | 15 | 0.634 | 0.402 | | 15 | 0.634 | 0.402 | | 15 | 0.634 | 0.402 | | 15 | 0.634 | 0.402 |
| 3-2-5I1 | 3-2-5 | 3-2-4 | 188.29 | 188.06 | 122.43 | 0.1879 | 15 | 0.582 | 0.528 | | 15 | 0.582 | 0.528 | | 15 | 0.582 | 0.528 | | 15 | 0.582 | 0.528 |
| 3-2-4I1 | 3-2-4 | 3-2-3 | 188.06 | 184 | 261.61 | 1.5519 | 15 | 0.581 | 0.184 | | 15 | 0.581 | 0.184 | | 15 | 0.581 | 0.184 | | 15 | 0.581 | 0.184 |
| 3-2-3I1 | 3-2-3 | 3-2-2 | 184 | 181.71 | 123.56 | 1.8534 | 15 | 0.601 | 0.168 | | 15 | 0.601 | 0.168 | | 15 | 0.601 | 0.168 | | 15 | 0.601 | 0.168 |
| 3-2-2I1 | 3-2-2 | 3-2-1 | 181.71 | 175.84 | 342.51 | 1.7138 | 15 | 0.364 | 0.196 | | 15 | 0.364 | 0.196 | | 15 | 0.364 | 0.196 | | 15 | 0.364 | 0.196 |
| 3-2-1I1 | 3-2-1 | 3-1-1 | 175.59 | 168.9 | 304.81 | 2.1948 | 15 | 0.493 | 0.173 | | 15 | 0.527 | 0.173 | | 15 | 0.54 | 0.173 | | 15 | 0.54 | 0.173 |
| | | | | | | | | | | | | | | | | | | | | | |
| 6-7-9I1 | 6-7-9 | 6-1-17 | 158.05 | 149.01 | 334.17 | 2.7052 | 8 | 0.007 | 0 | | 8 | 0.007 | 0 | | 8 | 0.007 | 0 | | 8 | 0.007 | 0 |
| 6-1-17I1 | 6-1-17 | 6-1-16 | 149.01 | 141.48 | 280.07 | 2.6886 | 8 | 0.008 | 0 | | 8 | 0.008 | 0 | | 8 | 0.008 | 0 | | 8 | 0.008 | 0 |

TABLE F-4
2025 Gravity Model Iterations

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6-1-16I1 | 6-1-16 | 6-1-15 | 141.48 | 135.98 | 144.02 | 3.8189 | 8 | 0.009 | 0 | 8 | 0.009 | 0 | 8 | 0.009 | 0 | 8 | 0.009 | 0 |
| 6-1-15I1 | 6-1-15 | 6-1-14 | 135.98 | 133.05 | 301.36 | 0.9723 | 8 | 0.007 | 0 | 8 | 0.007 | 0 | 8 | 0.007 | 0 | 8 | 0.007 | 0 |
| 6-1-14I1 | 6-1-14 | 6-1-13 | 132.83 | 131.59 | 95.32 | 1.3009 | 12 | 0.01 | 0 | 12 | 0.01 | 0 | 12 | 0.01 | 0 | 12 | 0.01 | 0 |
| 6-1-13I1 | 6-1-13 | 6-1-13B | 131.59 | 127.94 | 32.81 | 11.1252 | 12 | 1.113 | 0 | 12 | 1.113 | 0 | 12 | 1.113 | 0 | 12 | 1.113 | 0 |
| 6-1-13BI1 | 6-1-13B | 6-1-12 | 127.94 | 115.03 | 136.35 | 9.4683 | 15 | 1.074 | 0.396 | 15 | 1.074 | 0.396 | 15 | 1.074 | 0.396 | 15 | 1.074 | 0.396 |
| 6-1-12I1 | 6-1-12 | 6-1-11 | 115.03 | 95 | 256.6 | 7.8059 | 12 | 1.25 | 0.791 | 12 | 1.25 | 0.791 | 12 | 1.25 | 0.791 | 12 | 1.25 | 0.791 |
| 6-1-11I1 | 6-1-11 | 6-1-10 | 95 | 71.35 | 247.14 | 9.5695 | 12 | 1.302 | 0.715 | 12 | 1.301 | 0.715 | 12 | 1.301 | 0.715 | 12 | 1.301 | 0.715 |
| 6-1-10I1 | 6-1-10 | 6-1-9 | 71.35 | 59.76 | 284.88 | 4.0684 | 18 | 1.616 | 0.388 | 18 | 1.447 | 0.388 | 18 | 1.447 | 0.388 | 18 | 1.447 | 0.388 |
| 6-1-9I1 | 6-1-9 | 6-1-8 | 59.76 | 57.85 | 276.65 | 0.6904 | 18 | 1.287 | 0.943 | 18 | 1.081 | 0.943 | 18 | 1.081 | 0.943 | 18 | 1.081 | 0.943 |
| 6-1-8I1 | 6-1-8 | 6-1-7 | 57.85 | 52.04 | 269.02 | 2.1597 | 18 | 3.229 | 0.533 | 18 | 2.112 | 0.533 | 18 | 2.112 | 0.533 | 18 | 2.112 | 0.533 |
| 6-1-7I1 | 6-1-7 | 6-1-6 | 52.04 | 49.84 | 256.12 | 0.859 | 18 | 3.167 | 0.845 | 18 | 2.043 | 0.845 | 18 | 2.043 | 0.845 | 18 | 2.043 | 0.845 |
| 6-1-6I1 | 6-1-6 | 6-1-5 | 49.84 | 47.68 | 279.68 | 0.7723 | 18 | 2.591 | 0.993 | 18 | 1.461 | 0.992 | 18 | 1.461 | 0.992 | 18 | 1.461 | 0.992 |
| 6-1-5I1 | 6-1-5 | 6-1-4 | 47.68 | 45.48 | 278.91 | 0.7888 | 18 | 1.959 | 1.004 | NO | 21 | 1.667 | 0.665 | 21 | 1.667 | 0.665 | 21 | 1.667 | 0.665 |
| 6-1-4I1 | 6-1-4 | 6-1-3 | 45.48 | 43.32 | 265.09 | 0.8148 | 18 | 1.616 | 0.988 | | 18 | 1.615 | 0.987 | 18 | 1.615 | 0.987 | 18 | 1.615 | 0.987 |
| 6-1-3I1 | 6-1-3 | 6-1-2 | 43.32 | 41.16 | 268.64 | 0.8041 | 18 | 0.808 | 0.994 | | 18 | 0.807 | 0.993 | 18 | 0.807 | 0.993 | 18 | 0.807 | 0.993 |
| 6-1-2I1 | 6-1-2 | 6-1-1 | 37.5 | 35.44 | 251.4 | 0.8194 | 18 | 1.276 | 0.985 | | 18 | 1.276 | 0.984 | 18 | 1.276 | 0.984 | 18 | 1.276 | 0.984 |
| 6-1-1I1 | 6-1-1 | 5-2-3 | 35.44 | 32.47 | 265.6 | 1.1182 | 21 | 0.9 | 0.559 | | 21 | 0.902 | 0.558 | 21 | 0.903 | 0.558 | 21 | 0.903 | 0.558 |
| 5-2-3I1 | 5-2-3 | 5-2-2 | 32.47 | 29.6 | 75.16 | 3.8185 | 18 | 1.086 | 0.456 | | 18 | 1.098 | 0.456 | 18 | 1.105 | 0.456 | 18 | 1.105 | 0.456 |
| 5-2-2I1 | 5-2-2 | 5-2-1 | 29.5 | 27.1 | 79.87 | 3.0049 | 18 | 1.116 | 0.514 | | 18 | 1.156 | 0.514 | 18 | 1.178 | 0.514 | 18 | 1.178 | 0.514 |
| 5-2-1I1 | 5-2-1 | 5-1-1 | 27 | 24.41 | 75.8 | 3.4169 | 18 | 1.39 | 0.482 | | 18 | 1.5 | 0.482 | 18 | 1.554 | 0.482 | 18 | 1.554 | 0.482 |
| | | | | | | | | | | | | | | | | | | |
| 6-7-8I1 | 6-7-8 | 6-7-7 | 129.5 | 120.8 | 267.66 | 3.2504 | 8 | 0.457 | 0.162 | 8 | 0.457 | 0.162 | 8 | 0.457 | 0.162 | 8 | 0.457 | 0.162 |
| 6-7-7I1 | 6-7-7 | 6-7-6 | 120.8 | 100 | 319 | 6.5204 | 8 | 0.546 | 0.115 | 8 | 0.546 | 0.115 | 8 | 0.546 | 0.115 | 8 | 0.546 | 0.115 |
| 6-7-6I1 | 6-7-6 | 6-7-5 | 100 | 90.21 | 303.36 | 3.2272 | 8 | 0.604 | 0.163 | 8 | 0.604 | 0.163 | 8 | 0.604 | 0.163 | 8 | 0.604 | 0.163 |
| 6-7-5I1 | 6-7-5 | 6-7-4 | 90.21 | 82.72 | 344.71 | 2.1728 | 8 | 0.529 | 0.198 | 8 | 0.529 | 0.198 | 8 | 0.529 | 0.198 | 8 | 0.529 | 0.198 |
| 6-7-4I1 | 6-7-4 | 6-7-3 | 82.72 | 80.3 | 103.15 | 2.3461 | 12 | 0.392 | 0.065 | 12 | 0.392 | 0.065 | 12 | 0.392 | 0.065 | 12 | 0.392 | 0.065 |
| 6-7-3I1 | 6-7-3 | 6-7-2 | 80.3 | 77.76 | 267.1 | 0.951 | 12 | 0.389 | 0.102 | 12 | 0.389 | 0.102 | 12 | 0.389 | 0.102 | 12 | 0.389 | 0.102 |
| 6-7-2I1 | 6-7-2 | 6-7-1 | 77.76 | 73.87 | 417.65 | 0.9314 | 12 | 0.38 | 0.103 | 12 | 0.38 | 0.103 | 12 | 0.38 | 0.103 | 12 | 0.38 | 0.103 |
| 6-7-1I1 | 6-7-1 | 6-1-10 | 73.87 | 71.35 | 189.34 | 1.3309 | 12 | 1.302 | 0.086 | 12 | 1.301 | 0.086 | 12 | 1.301 | 0.086 | 12 | 1.301 | 0.086 |
| | | | | | | | | | | | | | | | | | | |
| 6-5-2I1 | 6-5-2 | 6-5-1 | 59.47 | 58.27 | 380.57 | 0.3153 | 8 | 0.007 | 0 | 8 | 0.007 | 0 | 8 | 0.007 | 0 | 8 | 0.007 | 0 |
| 6-5-1I1 | 6-5-1 | 6-1-6 | 58.27 | 49.84 | 421.07 | 2.002 | 8 | 7.125 | 0.016 | 8 | 4.596 | 0.009 | 8 | 4.596 | 0.009 | 8 | 4.596 | 0.009 |
| | | | | | | | | | | | | | | | | | | |
| 3-1-39I1 | 3-1-39 | 3-1-38 | 548.87 | 530 | 167.36 | 11.2751 | 8 | 0.321 | 0.223 | 8 | 0.321 | 0.223 | 8 | 0.321 | 0.223 | 8 | 0.321 | 0.223 |
| 3-1-38I1 | 3-1-38 | 3-1-37 | 527.99 | 521 | 215.05 | 3.2504 | 8 | 0.61 | 0.415 | 8 | 0.61 | 0.415 | 8 | 0.61 | 0.415 | 8 | 0.61 | 0.415 |
| 3-1-37I1 | 3-1-37 | Crown LS | 521 | 519 | 32.81 | 6.096 | 12 | 0.203 | 0.091 | 12 | 0.203 | 0.091 | 12 | 0.203 | 0.091 | 12 | 0.203 | 0.091 |
| | | | | | | | | | | | | | | | | | | |
| 3-16-6I1 | 3-16-6 | 3-16-4 | 625.42 | 594.25 | 396.42 | 7.8629 | 8 | 0.626 | 0.23 | 8 | 0.626 | 0.23 | 8 | 0.626 | 0.23 | 8 | 0.626 | 0.23 |
| 3-16-4I1 | 3-16-4 | 3-16-3 | 594.25 | 581 | 141.91 | 9.3369 | 8 | 0.687 | 0.211 | 8 | 0.687 | 0.211 | 8 | 0.687 | 0.211 | 8 | 0.687 | 0.211 |
| 3-16-3I1 | 3-16-3 | 3-16-2 | 581 | 563.08 | 277.87 | 6.449 | 8 | 0.777 | 0.254 | 8 | 0.777 | 0.254 | 8 | 0.777 | 0.254 | 8 | 0.777 | 0.254 |
| 3-16-2I1 | 3-16-2 | 3-16-1 | 563.08 | 554.01 | 222.76 | 4.0716 | 8 | 0.848 | 0.319 | 8 | 0.807 | 0.319 | 8 | 0.807 | 0.319 | 8 | 0.807 | 0.319 |
| 3-16-1I1 | 3-16-1 | 3-1-27 | 554.01 | 543.48 | 297.16 | 3.5435 | 8 | 8.766 | 0.355 | 8 | 1.197 | 0.342 | 8 | 1.197 | 0.342 | 8 | 1.197 | 0.342 |
| | | | | | | | | | | | | | | | | | | |
| 3-19A-1I1 | 3-19A-1 | 3-19B-1 | 690.67 | 685 | 467.84 | 1.212 | 8 | 0.392 | 0.089 | 8 | 0.392 | 0.089 | 8 | 0.392 | 0.089 | 8 | 0.392 | 0.089 |
| 3-19B-1I1 | 3-19B-1 | 3-19-6 | 685 | 678.77 | 467.84 | 1.3317 | 8 | 0.197 | 0.085 | 8 | 0.197 | 0.085 | 8 | 0.197 | 0.085 | 8 | 0.197 | 0.085 |
| 3-19-6I1 | 3-19-6 | 3-19-5 | 678.57 | 675.28 | 361.39 | 0.9104 | 8 | 0.217 | 0.103 | 8 | 0.217 | 0.103 | 8 | 0.217 | 0.103 | 8 | 0.217 | 0.103 |
| 3-19-5I1 | 3-19-5 | 3-19-4 | 675.16 | 671.11 | 334.48 | 1.2108 | 8 | 0.378 | 0.09 | 8 | 0.378 | 0.09 | 8 | 0.378 | 0.09 | 8 | 0.378 | 0.09 |
| 3-19-4I1 | 3-19-4 | 3-19-3 | 671.11 | 667.05 | 255.81 | 1.5871 | 8 | 0.277 | 0.078 | 8 | 0.277 | 0.078 | 8 | 0.277 | 0.078 | 8 | 0.277 | 0.078 |
| 3-19-3I1 | 3-19-3 | 3-19-2 | 667.05 | 664 | 51.5 | 5.9223 | 8 | 0.293 | 0.04 | 8 | 0.293 | 0.04 | 8 | 0.293 | 0.04 | 8 | 0.293 | 0.04 |
| 3-19-2I1 | 3-19-2 | 3-19-1 | 664 | 645.19 | 415.02 | 4.5323 | 8 | 0.146 | 0.046 | 8 | 0.146 | 0.046 | 8 | 0.146 | 0.046 | 8 | 0.146 | 0.046 |
| 3-19-1I1 | 3-19-1 | 3-1-36 | 645.09 | 627.12 | 269.24 | 6.6743 | 8 | 0.872 | 0.038 | 8 | 0.872 | 0.038 | 8 | 0.872 | 0.038 | 8 | 0.872 | 0.038 |
| 3-1-36I1 | 3-1-36 | 3-1-35 | 627.12 | 620.08 | 150.2 | 4.6871 | 8 | 0.596 | 0.391 | 8 | 0.596 | 0.391 | 8 | 0.596 | 0.391 | 8 | 0.596 | 0.391 |
| 3-1-35I1 | 3-1-35 | 3-1-34 | 619.88 | 605.44 | 345.62 | 4.178 | 8 | 0.515 | 0.414 | 8 | 0.515 | 0.414 | 8 | 0.515 | 0.414 | 8 | 0.515 | 0.414 |
| 3-1-34I1 | 3-1-34 | 3-1-33 | 605.24 | 589.5 | 267 | 5.8951 | 8 | 0.882 | 0.348 | 8 | 0.882 | 0.348 | 8 | 0.882 | 0.348 | 8 | 0.882 | 0.348 |
| 3-1-33I1 | 3-1-33 | 3-1-32 | 589.5 | 573.8 | 354.48 | 4.429 | 8 | 0.441 | 0.402 | 8 | 0.441 | 0.402 | 8 | 0.441 | 0.402 | 8 | 0.441 | 0.402 |
| 3-1-32I1 | 3-1-32 | 3-1-31 | 572.42 | 561.9 | 126.18 | 8.3373 | 8 | 1.184 | 0.326 | 8 | 1.184 | 0.326 | 8 | 1.184 | 0.326 | 8 | 1.184 | 0.326 |

TABLE F-4
2025 Gravity Model Iterations

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3-1-31I1 | 3-1-31 | 3-1-30 | 561.9 | 558.52 | 154.4 | 2.1891 | 8 | 0.934 | 0.636 | | 8 | 0.931 | 0.636 | | 8 | 0.931 | 0.636 | | 8 | 0.931 | 0.636 |
| 3-1-30I1 | 3-1-30 | 3-1-29 | 558.52 | 554.39 | 83.71 | 4.9337 | 8 | 1.051 | 0.424 | | 8 | 0.978 | 0.424 | | 8 | 0.978 | 0.424 | | 8 | 0.978 | 0.424 |
| 3-1-29I1 | 3-1-29 | 3-1-28 | 554.39 | 548.82 | 116.48 | 4.7819 | 8 | 2.708 | 0.468 | | 8 | 0.958 | 0.468 | | 8 | 0.958 | 0.468 | | 8 | 0.958 | 0.468 |
| 3-1-28I1 | 3-1-28 | 3-1-27 | 548.82 | 543.48 | 100.57 | 5.3097 | 8 | 8.766 | 0.443 | | 8 | 1.197 | 0.444 | | 8 | 1.197 | 0.444 | | 8 | 1.197 | 0.444 |
| 3-1-27I1 | 3-1-27 | 3-1-26 | 543.48 | 533.98 | 143.24 | 6.6322 | 8 | 16.126 | 0.646 | | 8 | 1.525 | 0.647 | | 8 | 1.525 | 0.647 | | 8 | 1.525 | 0.647 |
| 3-1-26I1 | 3-1-26 | 3-1-25 | 533.98 | 530.74 | 150.68 | 2.1503 | 8 | 15.42 | 1.087 | NO | 10 | 1.284 | 0.627 | | 10 | 1.284 | 0.627 | | 10 | 1.284 | 0.627 |
| 3-1-25I1 | 3-1-25 | 3-1-24 | 530.74 | 527.7 | 296.49 | 1.0253 | 8 | 13.868 | 1.574 | NO | 10 | 1.115 | 0.908 | | 10 | 1.115 | 0.908 | | 10 | 1.115 | 0.908 |
| 3-1-24I1 | 3-1-24 | 3-1-23 | 527.7 | 517.67 | 297 | 3.3771 | 8 | 6.173 | 1.025 | NO | 10 | 1.193 | 0.598 | | 10 | 1.193 | 0.598 | | 10 | 1.193 | 0.598 |
| 3-1-23I1 | 3-1-23 | 3-1-22 | 517.67 | 510.51 | 263.25 | 2.7198 | 8 | 4.164 | 1.142 | NO | 10 | 0.747 | 0.666 | | 10 | 0.747 | 0.666 | | 10 | 0.747 | 0.666 |
| 3-1-22I1 | 3-1-22 | 3-1-21 | 510.29 | 488.8 | 285.69 | 7.5221 | 8 | 1.507 | 0.687 | | 8 | 1.586 | 0.726 | | 8 | 1.586 | 0.726 | | 8 | 1.586 | 0.726 |
| 3-1-21I1 | 3-1-21 | 3-1-20B | 488.8 | 480.5 | 191.92 | 4.3247 | 8 | 1.058 | 0.906 | | 8 | 1.095 | 0.958 | | 8 | 1.095 | 0.958 | | 8 | 1.095 | 0.958 |
| 3-1-20BI1 | 3-1-20B | 3-1-20 | 480.5 | 464 | 137.81 | 11.973 | 8 | 1.04 | 0.544 | | 8 | 1.076 | 0.576 | | 8 | 1.076 | 0.576 | | 8 | 1.076 | 0.576 |
| 3-1-20I1 | 3-1-20 | 3-1-19 | 464 | 451 | 101.75 | 12.7764 | 8 | 1.041 | 0.527 | | 8 | 1.077 | 0.557 | | 8 | 1.077 | 0.557 | | 8 | 1.077 | 0.557 |
| 3-1-19I1 | 3-1-19 | 3-1-18 | 451 | 422 | 234.31 | 12.3768 | 8 | 1.454 | 0.536 | | 8 | 1.544 | 0.566 | | 8 | 1.511 | 0.566 | | 8 | 1.511 | 0.566 |
| 3-1-18I1 | 3-1-18 | 3-1-17 | 422 | 413.73 | 117.92 | 7.0132 | 8 | 0.727 | 0.879 | | 8 | 1.37 | 0.92 | | 8 | 0.755 | 0.92 | | 8 | 0.755 | 0.92 |
| 3-1-17I1 | 3-1-17 | 3-1-16 | 412.3 | 395.63 | 285.81 | 5.8325 | 8 | 1.321 | 0.964 | | 8 | 1.757 | 1.008 | NO | 10 | 1.093 | 0.556 | | 10 | 1.093 | 0.556 |
| 3-1-16I1 | 3-1-16 | 3-1-15 | 395.63 | 371 | 272.7 | 9.0319 | 8 | 0.661 | 0.774 | | 8 | 0.683 | 0.81 | | 8 | 0.683 | 0.811 | | 8 | 0.683 | 0.811 |
| 3-1-15I1 | 3-1-15 | 3-1-14 | 370 | 361 | 109.1 | 8.2493 | 8 | 1.16 | 0.81 | | 8 | 1.194 | 0.848 | | 8 | 1.193 | 0.848 | | 8 | 1.193 | 0.848 |
| 3-1-14I1 | 3-1-14 | 3-1-13 | 361 | 324.63 | 246.6 | 14.7486 | 8 | 1.601 | 0.638 | | 8 | 6.404 | 0.666 | | 8 | 1.342 | 0.666 | | 8 | 1.342 | 0.666 |
| 3-1-13I1 | 3-1-13 | 3-1-12 | 324.63 | 304.37 | 323 | 6.2724 | 8 | 1.435 | 0.978 | | 8 | 4.092 | 1.02 | NO | 10 | 1.011 | 0.563 | | 10 | 1.011 | 0.563 |
| 3-1-12I1 | 3-1-12 | 3-1-11 | 304.27 | 282 | 244.65 | 9.1028 | 8 | 11.687 | 0.812 | | 8 | 11.361 | 0.845 | | 8 | 1.609 | 0.848 | | 8 | 1.595 | 0.848 |
| 3-1-11I1 | 3-1-11 | 3-1-10 | 282 | 262.19 | 287.26 | 6.8962 | 8 | 15.494 | 0.912 | | 8 | 12.365 | 0.952 | | 8 | 1.847 | 0.974 | | 8 | 1.493 | 0.974 |
| 3-1-10I1 | 3-1-10 | 3-1-9 | 261.79 | 259.99 | 230.46 | 0.781 | 8 | 13.886 | 2.284 | NO | 10 | 9.105 | 1.64 | NO | 12 | 1 | 1.041 | NO | 15 | 0.68 | 0.574 |
| 3-1-9I1 | 3-1-9 | 3-1-8 | 259.89 | 255.71 | 35.63 | 11.7317 | 8 | 5.376 | 0.589 | | 8 | 7.072 | 0.767 | | 8 | 1.616 | 0.792 | | 8 | 1.616 | 0.792 |
| 3-1-8I1 | 3-1-8 | 3-1-7 | 255.71 | 247.51 | 206.38 | 3.9733 | 8 | 3.915 | 1.012 | NO | 10 | 9.609 | 0.727 | | 10 | 0.646 | 0.751 | | 10 | 0.646 | 0.751 |
| 3-1-7I1 | 3-1-7 | 3-1-6 | 246.66 | 231.4 | 242.11 | 6.3029 | 8 | 10.654 | 0.804 | | 8 | 9.958 | 1.008 | NO | 10 | 1.436 | 0.596 | | 10 | 1.436 | 0.596 |
| 3-1-6I1 | 3-1-6 | 3-1-5 | 231.4 | 226.54 | 256.56 | 1.8943 | 8 | 9.366 | 1.466 | NO | 10 | 7.005 | 1.014 | NO | 12 | 0.633 | 0.669 | | 12 | 0.633 | 0.669 |
| 3-1-5I1 | 3-1-5 | 3-1-4 | 226.24 | 210 | 262.89 | 6.1775 | 8 | 1.393 | 0.812 | | 8 | 6.496 | 1.018 | NO | 10 | 1.137 | 0.602 | | 10 | 1.137 | 0.602 |
| 3-1-4I1 | 3-1-4 | 3-1-3 | 210 | 194.73 | 259.92 | 5.8749 | 8 | 1.093 | 0.832 | | 8 | 3.331 | 1.044 | NO | 10 | 1.129 | 0.617 | | 10 | 1.129 | 0.617 |
| 3-1-3I1 | 3-1-3 | 3-1-2 | 194.63 | 173.42 | 262.16 | 8.0905 | 8 | 0.627 | 0.709 | | 8 | 0.816 | 0.889 | | 8 | 0.886 | 0.954 | | 8 | 0.886 | 0.954 |
| 3-1-2I1 | 3-1-2 | 3-1-1 | 172.82 | 169.05 | 276.02 | 1.3658 | 15 | 0.407 | 0.348 | | 15 | 0.458 | 0.429 | | 15 | 0.476 | 0.46 | | 15 | 0.476 | 0.46 |
| 3-1-1I1 | 3-1-1 | 5-8-1 | 168.9 | 83.11 | 442.05 | 19.4073 | 18 | 0.214 | 0.093 | | 18 | 0.245 | 0.106 | | 18 | 0.257 | 0.111 | | 18 | 0.257 | 0.111 |
| 5-8-1I1 | 5-8-1 | 5-1-12 | 82.76 | 52.47 | 259.11 | 11.69 | 21 | 0.751 | 0.079 | | 21 | 0.863 | 0.09 | | 21 | 0.915 | 0.095 | | 21 | 0.915 | 0.095 |
| | | | | | | | | | | | | | | | | | | | | |
| 7-3-5I1 | 7-3-5 | 7-3-4 | 71.5 | 64.31 | 121.17 | 5.9338 | 8 | 0.104 | 0.023 | | 8 | 0.104 | 0.023 | | 8 | 0.104 | 0.023 | | 8 | 0.104 | 0.023 |
| 7-3-4I1 | 7-3-4 | 7-3-3 | 64.26 | 41.81 | 193.99 | 11.5728 | 8 | 0.214 | 0.016 | | 8 | 0.214 | 0.016 | | 8 | 0.214 | 0.016 | | 8 | 0.214 | 0.016 |
| 7-3-3I1 | 7-3-3 | 7-3-2 | 41.76 | 39.51 | 150.63 | 1.4937 | 8 | 0.145 | 0.045 | | 8 | 0.145 | 0.045 | | 8 | 0.145 | 0.045 | | 8 | 0.145 | 0.045 |
| 7-3-2I1 | 7-3-2 | 7-3-1 | 39.46 | 26.94 | 118.27 | 10.5859 | 8 | 0.141 | 0.017 | | 8 | 0.141 | 0.017 | | 8 | 0.141 | 0.017 | | 8 | 0.141 | 0.017 |
| 7-3-1I1 | 7-3-1 | 7-1-1 | 26.89 | 16.91 | 190.47 | 5.2397 | 8 | 0.737 | 0.024 | | 8 | 0.737 | 0.024 | | 8 | 0.737 | 0.024 | | 8 | 0.737 | 0.024 |
| | | | | | | | | | | | | | | | | | | | | |
| 7-1-6I1 | 7-1-6 | 7-1-5 | 23.7 | 22.21 | 286.97 | 0.5192 | 8 | 1.231 | 0.89 | | 8 | 0.901 | 0.89 | | 8 | 0.901 | 0.89 | | 8 | 0.901 | 0.89 |
| 7-1-5I1 | 7-1-5 | 7-1-4 | 22.21 | 21.45 | 213.44 | 0.3561 | 8 | 1.078 | 1.075 | NO | 10 | 0.722 | 0.593 | | 10 | 0.722 | 0.593 | | 10 | 0.722 | 0.593 |
| 7-1-4I1 | 7-1-4 | 7-1-3 | 21.45 | 19.75 | 57.12 | 2.9762 | 8 | 0.997 | 0.372 | | 8 | 0.997 | 0.372 | | 8 | 0.997 | 0.372 | | 8 | 0.997 | 0.372 |
| 7-1-3I1 | 7-1-3 | 7-1-2 | 19.75 | 17.5 | 455.94 | 0.4935 | 8 | 1.052 | 0.913 | | 8 | 0.895 | 0.913 | | 8 | 0.895 | 0.913 | | 8 | 0.895 | 0.913 |
| 7-1-2I1 | 7-1-2 | 7-1-1 | 17.5 | 16.86 | 163.94 | 0.3904 | 8 | 0.862 | 1.026 | NO | 10 | 0.65 | 0.566 | | 10 | 0.65 | 0.566 | | 10 | 0.65 | 0.566 |
| 7-1-1I1 | 7-1-1 | L C LS | 16.86 | 9.62 | 328.36 | 2.2049 | 10 | 0.325 | 0.228 | | 10 | 0.325 | 0.228 | | 10 | 0.325 | 0.228 | | 10 | 0.325 | 0.228 |
| | | | | | | | | | | | | | | | | | | | | |
| 7-2-1I1 | 7-2-1 | L C LS | 12 | 9.62 | 101 | 2.3564 | 12 | 0.09 | 0.017 | | 12 | 0.09 | 0.017 | | 12 | 0.09 | 0.017 | | 12 | 0.09 | 0.017 |
| | | | | | | | | | | | | | | | | | | | | |
| 8-1-9I1 | 8-1-9 | 8-1-8 | 30.84 | 29.83 | 441.23 | 0.2289 | 10 | 0.37 | 0.223 | | 10 | 0.37 | 0.223 | | 10 | 0.37 | 0.223 | | 10 | 0.37 | 0.223 |
| 8-1-8I1 | 8-1-8 | 8-1-7 | 29.83 | 28.67 | 335.14 | 0.3461 | 10 | 0.371 | 0.181 | | 10 | 0.371 | 0.181 | | 10 | 0.371 | 0.181 | | 10 | 0.371 | 0.181 |
| 8-1-7I1 | 8-1-7 | 8-1-6 | 28.67 | 27.14 | 281.54 | 0.5434 | 10 | 0.38 | 0.145 | | 10 | 0.38 | 0.145 | | 10 | 0.38 | 0.145 | | 10 | 0.38 | 0.145 |
| 8-1-6I1 | 8-1-6 | 8-1-5 | 27.14 | 25.16 | 266.48 | 0.743 | 10 | 0.548 | 0.124 | | 10 | 0.548 | 0.124 | | 10 | 0.548 | 0.124 | | 10 | 0.548 | 0.124 |
| 8-1-5I1 | 8-1-5 | 8-1-4 | 25.16 | 24.22 | 272.21 | 0.3453 | 12 | 0.474 | 0.261 | | 12 | 0.474 | 0.261 | | 12 | 0.474 | 0.261 | | 12 | 0.474 | 0.261 |
| 8-1-4I1 | 8-1-4 | 8-1-3 | 24.22 | 21.83 | 304.05 | 0.7861 | 12 | 0.462 | 0.173 | | 12 | 0.462 | 0.173 | | 12 | 0.462 | 0.173 | | 12 | 0.462 | 0.173 |
| 8-1-3I1 | 8-1-3 | 8-1-2 | 21.83 | 21.07 | 310.28 | 0.2449 | 12 | 0.496 | 0.309 | | 12 | 0.496 | 0.309 | | 12 | 0.496 | 0.309 | | 12 | 0.496 | 0.309 |

TABLE F-4
2025 Gravity Model Iterations

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8-1-2I1 | 8-1-2 | 8-1-1 | 21.07 | 20.95 | 41.2 | 0.2913 | 12 | 0.341 | 0.284 | 12 | 0.341 | 0.284 | 12 | 0.341 | 0.284 | 12 | 0.341 | 0.284 |
| 8-1-1I1 | 8-1-1 | Oaks LS | 20.7 | 17 | 250 | 1.48 | 12 | 0.225 | 0.111 | 12 | 0.225 | 0.111 | 12 | 0.225 | 0.111 | 12 | 0.225 | 0.111 |
| | | | | | | | | | | | | | | | | | | |
| 10-1-23I1 | 10-1-23 | 10-1-24 | 586.24 | 582.57 | 246.52 | 1.4887 | 8 | 0.433 | 0.101 | 8 | 0.433 | 0.101 | 8 | 0.433 | 0.101 | 8 | 0.433 | 0.101 |
| 10-1-24I1 | 10-1-24 | 10-1-25 | 582.57 | 578.65 | 271.62 | 1.4432 | 8 | 0.216 | 0.103 | 8 | 0.216 | 0.103 | 8 | 0.216 | 0.103 | 8 | 0.216 | 0.103 |
| 10-1-25I1 | 10-1-25 | 10-1-26 | 578.46 | 573.76 | 73.84 | 6.3651 | 8 | 0.15 | 0.049 | 8 | 0.15 | 0.049 | 8 | 0.15 | 0.049 | 8 | 0.15 | 0.049 |
| 10-1-26I1 | 10-1-26 | 10-10B-1 | 573.52 | 565 | 71.95 | 11.8416 | 8 | 0.13 | 0.036 | 8 | 0.13 | 0.036 | 8 | 0.13 | 0.036 | 8 | 0.13 | 0.036 |
| | | | | | | | | | | | | | | | | | | |
| 10-1-20I1 | 10-1-20 | 10-1-19 | 560.33 | 558.74 | 222.19 | 0.7156 | 10 | 0.266 | 0.081 | 10 | 0.266 | 0.081 | 10 | 0.266 | 0.081 | 10 | 0.266 | 0.081 |
| 10-1-19I1 | 10-1-19 | 10-1-18 | 558.7 | 557.34 | 180 | 0.7556 | 10 | 0.192 | 0.069 | 10 | 0.192 | 0.069 | 10 | 0.192 | 0.069 | 10 | 0.192 | 0.069 |
| 10-11-8I1 | 10-1-18 | 10-1-17 | 529.03 | 512.56 | 172.89 | 9.5263 | 8 | 0.789 | 0.266 | 8 | 0.789 | 0.266 | 8 | 0.789 | 0.266 | 8 | 0.789 | 0.266 |
| 10-11-7I1 | 10-1-17 | 10-1-16 | 512.51 | 504.76 | 172.89 | 4.4826 | 8 | 0.432 | 0.387 | 8 | 0.432 | 0.387 | 8 | 0.432 | 0.387 | 8 | 0.432 | 0.387 |
| 10-11-6I1 | 10-1-16 | 10-1-15 | 504.29 | 496.36 | 122.58 | 6.4692 | 8 | 0.774 | 0.322 | 8 | 0.774 | 0.322 | 8 | 0.774 | 0.322 | 8 | 0.774 | 0.322 |
| 10-11-5I1 | 10-1-15 | 10-1-14 | 496.36 | 489.35 | 99.68 | 7.0325 | 8 | 0.906 | 0.309 | 8 | 0.906 | 0.309 | 8 | 0.906 | 0.309 | 8 | 0.906 | 0.309 |
| 10-11-4I1 | 10-1-14 | 10-1-13 | 489.35 | 486.23 | 79.73 | 3.9132 | 8 | 0.609 | 0.414 | 8 | 0.609 | 0.414 | 8 | 0.609 | 0.414 | 8 | 0.609 | 0.414 |
| 10-11-3I1 | 10-1-13 | 10-1-12 | 485.94 | 481.23 | 202.93 | 2.321 | 8 | 0.522 | 0.538 | 8 | 0.522 | 0.538 | 8 | 0.522 | 0.538 | 8 | 0.522 | 0.538 |
| 10-11-2I1 | 10-1-12 | 10-1-11 | 480.56 | 456.89 | 276.46 | 8.5618 | 8 | 0.362 | 0.28 | 8 | 0.362 | 0.28 | 8 | 0.362 | 0.28 | 8 | 0.362 | 0.28 |
| 10-11-1I1 | 10-1-11 | 10-1-10 | 456.17 | 437.78 | 149.06 | 12.3373 | 8 | 0.329 | 0.233 | 8 | 0.329 | 0.233 | 8 | 0.329 | 0.233 | 8 | 0.329 | 0.233 |
| | | | | | | | | | | | | | | | | | | |
| 10-6-4I1 | 10-6-4 | 10-6-3 | 475.28 | 471.48 | 200.3 | 1.8972 | 8 | 0.682 | 0.482 | 8 | 0.682 | 0.482 | 8 | 0.682 | 0.482 | 8 | 0.682 | 0.482 |
| 10-6-3I1 | 10-6-3 | 10-6-2 | 471.48 | 445.39 | 371.61 | 7.0208 | 8 | 0.667 | 0.251 | 8 | 0.667 | 0.251 | 8 | 0.667 | 0.251 | 8 | 0.667 | 0.251 |
| 10-6-2I1 | 10-6-2 | 10-6-1 | 445.39 | 424.43 | 273.95 | 7.651 | 8 | 0.859 | 0.24 | 8 | 0.859 | 0.24 | 8 | 0.859 | 0.24 | 8 | 0.859 | 0.24 |
| 10-6-1I1 | 10-6-1 | 10-1A-12 | 424.43 | 417.32 | 238.32 | 2.9834 | 8 | 0.43 | 0.384 | 8 | 0.43 | 0.384 | 8 | 0.43 | 0.384 | 8 | 0.43 | 0.384 |
| 10-1A-12I1 | 10-1A-12 | 10-1-12 | 417.18 | 411.61 | 32.81 | 16.9774 | 8 | 0.271 | 0.161 | 8 | 0.271 | 0.161 | 8 | 0.271 | 0.161 | 8 | 0.271 | 0.161 |
| | | | | | | | | | | | | | | | | | | |
| 10-10-12I1 | 10-10-12 | 10-10-11 | 729.37 | 719.72 | 316.82 | 3.0459 | 8 | 0.756 | 0.3 | 8 | 0.756 | 0.3 | 8 | 0.756 | 0.3 | 8 | 0.756 | 0.3 |
| 10-10-11I1 | 10-10-11 | 10-10-10 | 719.72 | 713.46 | 209.66 | 2.9858 | 8 | 0.396 | 0.303 | 8 | 0.396 | 0.303 | 8 | 0.396 | 0.303 | 8 | 0.396 | 0.303 |
| 10-10-10I1 | 10-10-10 | 10-10-9 | 713.35 | 700 | 141.84 | 9.412 | 8 | 0.537 | 0.171 | 8 | 0.537 | 0.171 | 8 | 0.537 | 0.171 | 8 | 0.537 | 0.171 |
| 10-10-9I1 | 10-10-9 | 10-10-9A | 700 | 690.71 | 83 | 11.1928 | 8 | 0.518 | 0.157 | 8 | 0.518 | 0.157 | 8 | 0.518 | 0.157 | 8 | 0.518 | 0.157 |
| 10-10-9AI1 | 10-10-9A | 10-10-8 | 690.71 | 673.37 | 136.92 | 12.6643 | 8 | 0.259 | 0.147 | 8 | 0.259 | 0.147 | 8 | 0.259 | 0.147 | 8 | 0.259 | 0.147 |
| 10-10-8I1 | 10-10-8 | 10-10-7 | 672.92 | 665.34 | 144.41 | 5.2489 | 8 | 0.325 | 0.229 | 8 | 0.325 | 0.229 | 8 | 0.325 | 0.229 | 8 | 0.325 | 0.229 |
| 10-10-7I1 | 10-10-7 | 10-10-6 | 664.94 | 650.23 | 168.4 | 8.7352 | 8 | 0.285 | 0.177 | 8 | 0.285 | 0.177 | 8 | 0.285 | 0.177 | 8 | 0.285 | 0.177 |
| 10-10-6I1 | 10-10-6 | 10-10-5 | 649.67 | 645.94 | 62.14 | 6.0026 | 8 | 0.314 | 0.214 | 8 | 0.314 | 0.214 | 8 | 0.314 | 0.214 | 8 | 0.314 | 0.214 |
| 10-10-5I1 | 10-10-5 | 10-10-4 | 645.64 | 617 | 347.43 | 8.2434 | 8 | 0.289 | 0.183 | 8 | 0.289 | 0.183 | 8 | 0.289 | 0.183 | 8 | 0.289 | 0.183 |
| 10-10-4I1 | 10-10-4 | 10-10-3 | 615.26 | 611.74 | 127.96 | 2.7509 | 8 | 0.386 | 0.316 | 8 | 0.386 | 0.316 | 8 | 0.386 | 0.316 | 8 | 0.386 | 0.316 |
| 10-10-3I1 | 10-10-3 | 10-10-2 | 611.07 | 595 | 101.85 | 15.7781 | 8 | 0.449 | 0.132 | 8 | 0.449 | 0.132 | 8 | 0.449 | 0.132 | 8 | 0.449 | 0.132 |
| 10-10-2I1 | 10-10-2 | 10-10-1 | 595 | 579.91 | 67.04 | 22.5089 | 8 | 0.224 | 0.11 | 8 | 0.224 | 0.11 | 8 | 0.224 | 0.11 | 8 | 0.224 | 0.11 |
| 10-10-1I1 | 10-10-1 | 10-10B-1 | 579.48 | 552.57 | 204.62 | 13.1512 | 8 | 0.257 | 0.145 | 8 | 0.257 | 0.145 | 8 | 0.257 | 0.145 | 8 | 0.257 | 0.145 |
| 10-10B-1I1 | 10-10B-1 | 10-11-8 | 552.32 | 529.58 | 113.51 | 20.0335 | 8 | 0.29 | 0.183 | 8 | 0.29 | 0.183 | 8 | 0.29 | 0.183 | 8 | 0.29 | 0.183 |
| 10-1-18I1 | 10-11-8 | 10-11-7 | 557.34 | 528.08 | 178.24 | 16.4161 | 8 | 0.12 | 0.031 | 8 | 0.12 | 0.031 | 8 | 0.12 | 0.031 | 8 | 0.12 | 0.031 |
| 10-1-17I1 | 10-11-7 | 10-11-6 | 527.27 | 510.29 | 82.16 | 20.667 | 8 | 0.113 | 0.027 | 8 | 0.113 | 0.027 | 8 | 0.113 | 0.027 | 8 | 0.113 | 0.027 |
| 10-1-16I1 | 10-11-6 | 10-11-5 | 509.25 | 487.05 | 64.52 | 34.4079 | 8 | 0.101 | 0.021 | 8 | 0.101 | 0.021 | 8 | 0.101 | 0.021 | 8 | 0.101 | 0.021 |
| 10-1-15I1 | 10-11-5 | 10-11-4 | 486.88 | 461.89 | 227.99 | 10.961 | 8 | 0.44 | 0.037 | 8 | 0.44 | 0.037 | 8 | 0.44 | 0.037 | 8 | 0.44 | 0.037 |
| 10-1-14I1 | 10-11-4 | 10-11-3 | 461.89 | 461.44 | 33 | 1.3636 | 8 | 0.22 | 0.106 | 8 | 0.22 | 0.106 | 8 | 0.22 | 0.106 | 8 | 0.22 | 0.106 |
| 10-1-13I1 | 10-11-3 | 10-11-2 | 461.44 | 411.61 | 153.23 | 32.5197 | 8 | 0.102 | 0.022 | 8 | 0.102 | 0.022 | 8 | 0.102 | 0.022 | 8 | 0.102 | 0.022 |
| 10-1-12I1 | 10-11-2 | 10-11-1 | 410.71 | 388 | 158.82 | 14.2992 | 8 | 0.31 | 0.208 | 8 | 0.31 | 0.208 | 8 | 0.31 | 0.208 | 8 | 0.31 | 0.208 |
| 10-1-11I1 | 10-11-1 | 10-4-4 | 382.41 | 380.71 | 187.51 | 0.9066 | 8 | 0.691 | 0.827 | 8 | 0.691 | 0.827 | 8 | 0.691 | 0.827 | 8 | 0.691 | 0.827 |
| 10-4-4I1 | 10-4-4 | 10-4-3 | 437.47 | 431.39 | 77.5 | 7.8452 | 8 | 0.455 | 0.293 | 8 | 0.455 | 0.293 | 8 | 0.455 | 0.293 | 8 | 0.455 | 0.293 |
| 10-4-3I1 | 10-4-3 | 10-4-2 | 431.2 | 422.61 | 105.27 | 8.16 | 8 | 0.823 | 0.287 | 8 | 0.823 | 0.287 | 8 | 0.823 | 0.287 | 8 | 0.823 | 0.287 |
| 10-4-2I1 | 10-4-2 | 10-4-1 | 422.31 | 421.65 | 63.07 | 1.0465 | 8 | 0.677 | 0.801 | 8 | 0.677 | 0.801 | 8 | 0.677 | 0.801 | 8 | 0.677 | 0.801 |
| 10-4-1I1 | 10-4-1 | 10-1-10 | 421.53 | 377.51 | 189.32 | 23.2516 | 8 | 0.279 | 0.17 | 8 | 0.279 | 0.17 | 8 | 0.279 | 0.17 | 8 | 0.279 | 0.17 |
| 10-1-10I1 | 10-1-10 | 10-1-9 | 375.1 | 170.58 | 281.66 | 72.6124 | 8 | 2.006 | 0.189 | 8 | 2.006 | 0.189 | 8 | 2.006 | 0.189 | 8 | 2.006 | 0.189 |
| 10-1-9I1 | 10-1-9 | 10-1-8 | 171.3 | 159.26 | 89.57 | 13.442 | 8 | 0.463 | 0.438 | 8 | 0.463 | 0.438 | 8 | 0.463 | 0.438 | 8 | 0.463 | 0.438 |
| 10-1-8I1 | 10-1-8 | 10-1-7 | 154.04 | 151.99 | 186.15 | 1.1013 | 8 | 5.146 | 1.532 | NO | 10 | 0.813 | 0.845 | 10 | 0.813 | 0.845 | 10 | 0.813 | 0.845 |
| 10-1-7I1 | 10-1-7 | 10-1-6 | 151.69 | 145.35 | 182.68 | 3.4705 | 8 | 1.271 | 0.863 | | 8 | 1.271 | 0.863 | 8 | 1.271 | 0.863 | 8 | 1.271 | 0.863 |
| 10-1-6I1 | 10-1-6 | 10-1-5 | 145.15 | 138.94 | 215.3 | 2.8843 | 8 | 1.044 | 0.946 | | 8 | 1.044 | 0.946 | 8 | 1.044 | 0.946 | 8 | 1.044 | 0.946 |

TABLE F-4
2025 Gravity Model Iterations

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10-1-5I1 | 10-1-5 | S P Hill LS | 138.94 | 137.5 | 32.81 | 4.3891 | 12 | 0.348 | 0.26 | 12 | 0.348 | 0.26 | 12 | 0.348 | 0.26 | 12 | 0.348 | 0.26 |
| 10-1-3I1 | 10-1-3 | 10-1-2 | 146.7 | 132 | 255.96 | 5.7431 | 8 | 1.437 | 0.841 | 8 | 1.437 | 0.841 | 8 | 1.437 | 0.841 | 8 | 1.437 | 0.841 |
| 10-1-2I1 | 10-1-2 | 10-1-1 | 132 | 122.59 | 300 | 3.1367 | 10 | 0.958 | 0.628 | 10 | 0.958 | 0.628 | 10 | 0.958 | 0.628 | 10 | 0.958 | 0.628 |
| 10-1-1I1 | 10-1-1 | W C LS | 122.59 | 121 | 32.81 | 4.8463 | 12 | 0.399 | 0.336 | 12 | 0.399 | 0.336 | 12 | 0.399 | 0.336 | 12 | 0.399 | 0.336 |

TABLE F-5
2025 Gravity Model Final Pipe Sizes

| LinkID | Up Stream MH | Down Stream MH | Up - Invert Level | Down - Invert Level | Length | Slope % | Pipe Diameter | Qf | Hmax | Qmax (cfs) | Hmax/D | Qmax/Qf |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2-3-1I1 | 2-3-1 | 2-1-6 | 124.49 | 114.84 | 156.08 | 6.1827 | 10 | 5.308 | 124.68 | 0.583 | 1.202 | 0.11 |
| 1-3-14I1 | 1-3-14 | 1-3-13 | 330.43 | 313 | 152.87 | 11.4018 | 8 | 3.975 | 330.43 | 0 | 0.582 | 0 |
| 1-3-13I1 | 1-3-13 | 1-3-12 | 313 | 289.73 | 262.09 | 8.8786 | 8 | 3.508 | 313.19 | 0.648 | 0.291 | 0.185 |
| 1-3-12I1 | 1-3-12 | 1-3-11 | 289.48 | 262 | 201.31 | 13.6506 | 8 | 4.35 | 289.65 | 0.648 | 0.587 | 0.149 |
| 1-3-11I1 | 1-3-11 | 1-3-10 | 262 | 235.54 | 308.84 | 8.5675 | 8 | 3.446 | 262.2 | 0.648 | 0.338 | 0.188 |
| 1-3-10I1 | 1-3-10 | 1-3-9 | 235.34 | 226 | 146.25 | 6.3863 | 8 | 2.975 | 235.55 | 0.648 | 0.67 | 0.218 |
| 1-3-9I1 | 1-3-9 | 1-3-8 | 226 | 217.87 | 157.97 | 5.1465 | 8 | 2.671 | 226.22 | 0.648 | 0.335 | 0.242 |
| 1-3-8I1 | 1-3-8 | 1-3-7 | 217.57 | 206 | 209.07 | 5.534 | 8 | 2.769 | 217.79 | 0.648 | 0.697 | 0.234 |
| 1-3-7I1 | 1-3-7 | 1-3-6 | 206 | 199.67 | 141.42 | 4.476 | 8 | 2.491 | 206.23 | 0.648 | 0.434 | 0.26 |
| 1-3-6I1 | 1-3-6 | 1-3-5 | 199.52 | 192 | 132.65 | 5.6691 | 8 | 2.803 | 199.74 | 0.648 | 0.668 | 0.231 |
| 1-3-5I1 | 1-3-5 | 1-3-4 | 192 | 185.33 | 123.75 | 5.3899 | 8 | 2.733 | 192.22 | 0.648 | 0.669 | 0.237 |
| 1-3-4I1 | 1-3-4 | 1-3-3 | 185.23 | 182.7 | 89.04 | 2.8414 | 8 | 1.984 | 185.5 | 0.648 | 0.938 | 0.326 |
| 1-3-3I1 | 1-3-3 | 1-3-2 | 182.7 | 179.47 | 214.38 | 1.5067 | 8 | 1.445 | 183.01 | 0.648 | 0.469 | 0.448 |
| 1-3-2I1 | 1-3-2 | 1-3-1 | 179.22 | 161.8 | 221.38 | 7.8688 | 8 | 3.302 | 179.42 | 0.648 | 1.055 | 0.196 |
| 1-3-1I1 | 1-3-1 | 1-1-10 | 161.9 | 161.33 | 221.38 | 0.2575 | 10 | 1.083 | 162.43 | 0.648 | 0.864 | 0.598 |
| 1-1-10I1 | 1-1-10 | 1-1-9 | 161.05 | 154.6 | 110.72 | 5.8255 | 12 | 8.379 | 161.55 | 3.919 | 1.305 | 0.468 |
| 1-1-9I1 | 1-1-9 | 1-1-8 | 154.6 | 153.35 | 111.55 | 1.1206 | 15 | 6.663 | 155.37 | 3.919 | 0.895 | 0.588 |
| 1-1-8I1 | 1-1-8 | 1-1-7 | 153.35 | 149.17 | 88.49 | 4.7237 | 12 | 7.545 | 153.91 | 3.919 | 1.634 | 0.519 |
| 1-1-7I1 | 1-1-7 | 1-1-6 | 149.17 | 148.49 | 425.2 | 0.1599 | 18 | 4.094 | 150.71 | 3.919 | 1.063 | 0.957 |
| 1-1-6I1 | 1-1-6 | 1-1-5 | 148.49 | 148.44 | 56.87 | 0.0879 | 21 | 4.579 | 149.98 | 3.919 | 0.857 | 0.856 |
| 1-1-5I1 | 1-1-5 | 1-1-4 | 148.44 | 147.9 | 463.05 | 0.1166 | 21 | 5.273 | 149.81 | 3.919 | 0.933 | 0.743 |
| 1-1-4I1 | 1-1-4 | 1-1-3 | 147.9 | 147.6 | 204.27 | 0.1469 | 18 | 3.923 | 149.44 | 3.919 | 1.024 | 0.999 |
| 1-1-3I1 | 1-1-3 | 1-1-2 | 147.6 | 147.33 | 141.95 | 0.1902 | 18 | 4.464 | 149.04 | 3.919 | 0.998 | 0.878 |
| 1-1-2I1 | 1-1-2 | 1-1-1 | 147.33 | 147.3 | 48.85 | 0.0614 | 24 | 5.464 | 148.67 | 5.165 | 0.668 | 0.945 |
| 1-1-1I1 | 1-1-1 | 2-1-11 | 147 | 145.77 | 372.51 | 0.3302 | 18 | 5.882 | 148.13 | 5.166 | 0.918 | 0.878 |
| 2-1-11I1 | 2-1-11 | 2-1-10 | 145.77 | 144.56 | 413.58 | 0.2926 | 21 | 8.352 | 146.88 | 5.841 | 0.82 | 0.699 |
| 2-1-10I1 | 2-1-10 | 2-1-9 | 144.56 | 144 | 178.13 | 0.3144 | 21 | 8.658 | 145.76 | 5.841 | 0.787 | 0.675 |
| 2-1-9I1 | 2-1-9 | 2-1-8 | 144 | 128.5 | 366.34 | 4.231 | 12 | 7.14 | 144.69 | 5.841 | 1.467 | 0.818 |
| 2-1-8I1 | 2-1-8 | 2-1-7B | 128.5 | 126.5 | 305.36 | 0.655 | 18 | 8.284 | 129.45 | 5.841 | 0.937 | 0.705 |
| 2-1-7BI1 | 2-1-7B | 2-1-7 | 126.14 | 124.99 | 64.67 | 1.7783 | 15 | 8.394 | 127.02 | 5.841 | 1.006 | 0.696 |
| 2-1-7I1 | 2-1-7 | 2-1-6 | 124.85 | 114.84 | 246.23 | 4.0653 | 12 | 6.999 | 125.55 | 5.841 | 1.002 | 0.835 |
| 2-1-6I1 | 2-1-6 | 2-1-5 | 114.64 | 106.81 | 92.85 | 8.433 | 12 | 10.081 | 115.24 | 6.425 | 1.422 | 0.637 |
| 2-1-5I1 | 2-1-5 | 2-1-4 | 106.61 | 101.76 | 131 | 3.7023 | 12 | 6.679 | 107.42 | 6.425 | 1.09 | 0.962 |
| 2-1-4I1 | 2-1-4 | 2-1-3 | 101.56 | 73.34 | 461.91 | 6.1094 | 12 | 8.58 | 102.21 | 6.425 | 1.24 | 0.749 |
| 2-1-3I1 | 2-1-3 | 2-1-2B | 73.14 | 66.45 | 246.84 | 2.7103 | 15 | 10.363 | 73.86 | 6.425 | 1.663 | 0.62 |

TABLE F-5
2025 Gravity Model Final Pipe Sizes

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2-1-2BI1 | 2-1-2B | 2-1-2A | 66.31 | 64.36 | 49 | 3.9796 | 12 | 6.925 | 67.42 | 6.425 | 1.383 | 0.928 |
| 2-1-2AI1 | 2-1-2A | 2-1-2 | 64.2 | 62.25 | 32.81 | 5.9436 | 12 | 8.463 | 64.97 | 6.425 | 1.454 | 0.759 |
| 2-1-2I1 | 2-1-2 | 2-1-1 | 62.12 | 60.16 | 465.18 | 0.4213 | 18 | 6.644 | 63.3 | 6.425 | 0.785 | 0.967 |
| 2-1-1I1 | 2-1-1 | 5-1-12 | 56.78 | 52.47 | 401 | 1.0748 | 15 | 6.526 | 58.24 | 6.424 | 1.281 | 0.984 |
| | | | | | | | | | | | | |
| 1-2-8I1 | 1-2-8 | 1-2-7 | 226.12 | 204.5 | 303.65 | 7.12 | 8 | 3.141 | 226.31 | 0.572 | 0.591 | 0.182 |
| 1-2-7I1 | 1-2-7 | 1-2-6 | 204.5 | 181.39 | 354.81 | 6.5133 | 8 | 3.004 | 204.7 | 0.572 | 0.64 | 0.19 |
| 1-2-6I1 | 1-2-6 | 1-2-5 | 181.34 | 175.5 | 175.43 | 3.329 | 8 | 2.148 | 181.58 | 0.572 | 0.83 | 0.266 |
| 1-2-5I1 | 1-2-5 | 1-2-4 | 175.45 | 170 | 80.81 | 6.7442 | 8 | 3.057 | 175.75 | 1.246 | 0.968 | 0.408 |
| 1-2-4I1 | 1-2-4 | 1-2-3 | 170 | 166.39 | 68.18 | 5.2948 | 8 | 2.709 | 170.32 | 1.246 | 0.774 | 0.46 |
| 1-2-3I1 | 1-2-3 | 1-2-2 | 166.24 | 160 | 130.65 | 4.7761 | 8 | 2.573 | 166.57 | 1.246 | 1.049 | 0.484 |
| 1-2-2I1 | 1-2-2 | 1-2-1 | 160 | 155.3 | 117.35 | 4.0051 | 8 | 2.356 | 160.35 | 1.246 | 0.856 | 0.529 |
| 1-2-1I1 | 1-2-1 | 1-1-2 | 155.2 | 147.33 | 152.69 | 5.1542 | 8 | 2.673 | 155.54 | 1.246 | 2.246 | 0.466 |
| | | | | | | | | | | | | |
| 5-1-25I1 | 5-1-25 | 5-1-24 | 179.15 | 175.8 | 170.03 | 1.9702 | 8 | 1.652 | 179.15 | 0 | 0.01 | 0 |
| 5-1-24I1 | 5-1-24 | 5-1-23 | 175.8 | 158.25 | 97.27 | 18.0426 | 8 | 5.001 | 175.8 | 0 | 0.011 | 0 |
| 5-1-23I1 | 5-1-23 | 5-1-22 | 158.25 | 146.53 | 112.21 | 10.4447 | 8 | 3.805 | 158.25 | 0 | 0.391 | 0 |
| 5-1-22I1 | 5-1-22 | 5-1-21 | 146.53 | 135 | 271.78 | 4.2424 | 8 | 2.425 | 146.66 | 0.203 | 0.405 | 0.084 |
| 5-1-21I1 | 5-1-21 | 5-1-20 | 135 | 125 | 272.09 | 3.6753 | 8 | 2.257 | 135.13 | 0.203 | 0.381 | 0.09 |
| 5-1-20I1 | 5-1-20 | 5-1-19 | 125 | 112.43 | 268.1 | 4.6885 | 8 | 2.549 | 125.13 | 0.203 | 0.225 | 0.08 |
| 5-1-19I1 | 5-1-19 | 5-1-18 | 112.33 | 100 | 246.71 | 4.9978 | 8 | 2.632 | 112.46 | 0.203 | 0.405 | 0.077 |
| 5-1-18I1 | 5-1-18 | 5-1-17 | 100 | 90 | 271.63 | 3.6815 | 8 | 2.259 | 100.13 | 0.203 | 0.402 | 0.09 |
| 5-1-17I1 | 5-1-17 | 5-1-16 | 90 | 79.7 | 272.88 | 3.7746 | 8 | 2.287 | 90.13 | 0.203 | 0.268 | 0.089 |
| 5-1-16I1 | 5-1-16 | 5-1-15 | 79.6 | 71 | 267.08 | 3.22 | 8 | 2.112 | 79.74 | 0.203 | 0.415 | 0.096 |
| 5-1-15I1 | 5-1-15 | 5-1-14 | 71 | 66.21 | 143.92 | 3.3282 | 8 | 2.148 | 71.14 | 0.203 | 0.236 | 0.094 |
| 5-1-14I1 | 5-1-14 | 5-1-13 | 66.11 | 60.5 | 122.75 | 4.5703 | 8 | 2.517 | 66.24 | 0.203 | 0.431 | 0.081 |
| 5-1-13I1 | 5-1-13 | 5-1-12 | 60.5 | 52.47 | 280.67 | 2.861 | 8 | 1.991 | 60.64 | 0.203 | 2.401 | 0.102 |
| 5-1-12I1 | 5-1-12 | 5-1-11 | 52.47 | 43.93 | 272 | 3.1397 | 21 | 27.361 | 53.27 | 11.63 | 1.181 | 0.425 |
| 5-1-11I1 | 5-1-11 | 5-1-10 | 43.93 | 40.07 | 274.19 | 1.4078 | 21 | 18.321 | 44.96 | 11.801 | 0.851 | 0.644 |
| 5-1-10I1 | 5-1-10 | 5-1-9 | 39.62 | 37.5 | 245.69 | 0.8629 | 24 | 20.48 | 40.83 | 11.801 | 0.908 | 0.576 |
| 5-1-9I1 | 5-1-9 | 5-1-8 | 37.5 | 36.52 | 551.39 | 0.1777 | 30 | 16.854 | 39.11 | 11.801 | 0.761 | 0.7 |
| 5-1-8I1 | 5-1-8 | 5-1-7 | 36.52 | 35 | 130.28 | 1.1667 | 24 | 23.814 | 37.79 | 11.801 | 1.042 | 0.496 |
| 5-1-7I1 | 5-1-7 | 5-1-6 | 35 | 33 | 226.78 | 0.8819 | 21 | 14.501 | 36.31 | 11.801 | 0.975 | 0.814 |
| 5-1-6I1 | 5-1-6 | 5-1-5 | 33 | 28 | 121.91 | 4.1014 | 21 | 31.272 | 33.85 | 11.801 | 1.569 | 0.377 |
| 5-1-5I1 | 5-1-5 | 5-1-4 | 28 | 26.22 | 240 | 0.7417 | 21 | 13.298 | 29.89 | 11.801 | 1.299 | 0.887 |
| 5-1-4I1 | 5-1-4 | 5-1-3 | 26.22 | 25.93 | 289.28 | 0.1002 | 30 | 12.657 | 28.39 | 11.801 | 0.883 | 0.932 |
| 5-1-3I1 | 5-1-3 | 5-1-2 | 25.93 | 24.9 | 240 | 0.4292 | 24 | 14.443 | 27.87 | 11.802 | 1.141 | 0.817 |
| 5-1-2I1 | 5-1-2 | 5-1-1 | 24.9 | 24.41 | 34 | 1.4412 | 24 | 26.467 | 26.84 | 11.802 | 1.166 | 0.446 |
| 5-1-1I1 | 5-1-1 | Main_LS | 24.41 | 22 | 142 | 1.6972 | 24 | 32.551 | 25.58 | 20.918 | 0.583 | 0.643 |

TABLE F-5
2025 Gravity Model Final Pipe Sizes

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9-1-5I1 | 9-1-5 | 9-1-4 | 33.75 | 32.91 | 226.74 | 0.3705 | 8 | 0.717 | 33.99 | 0.199 | 0.361 | 0.277 |
| 9-1-4I1 | 9-1-4 | 9-1-3 | 26.95 | 25.22 | 436.41 | 0.3964 | 8 | 0.741 | 27.19 | 0.199 | 0.575 | 0.268 |
| 9-1-3I1 | 9-1-3 | 9-1-2 | 25.22 | 24.95 | 337.85 | 0.0799 | 8 | 0.333 | 25.58 | 0.199 | 0.54 | 0.597 |
| 9-1-2I1 | 9-1-2 | 9-1-1 | 23.85 | 23.61 | 65.8 | 0.3647 | 8 | 0.711 | 24.1 | 0.227 | 0.377 | 0.32 |
| 9-1-1I1 | 9-1-1 | One Stp LS | 23.51 | 22.5 | 32.81 | 3.0785 | 12 | 6.903 | 23.63 | 0.227 | 0.124 | 0.033 |
| | | | | | | | | | | | | |
| 4-2A-2I1 | 4-2A-2 | 4-2A-Q | 213.76 | 209 | 281.8 | 1.6891 | 8 | 1.53 | 213.89 | 0.122 | 0.347 | 0.08 |
| 4-2A-QI1 | 4-2A-Q | 4-2A-1 | 209 | 206 | 115 | 2.6087 | 8 | 1.904 | 209.12 | 0.122 | 0.398 | 0.064 |
| 4-2A-1I1 | 4-2A-1 | 4-2-3 | 206 | 200.12 | 462.56 | 1.2712 | 8 | 1.329 | 206.14 | 0.122 | 0.363 | 0.092 |
| 4-2-3I1 | 4-2-3 | 4-2-2 | 200.12 | 198.99 | 374.83 | 0.3015 | 8 | 0.646 | 200.32 | 0.122 | 0.295 | 0.189 |
| 4-2-2I1 | 4-2-2 | 4-2-1 | 198.89 | 190.96 | 358.22 | 2.2137 | 8 | 1.752 | 199.01 | 0.122 | 0.417 | 0.07 |
| 4-2-1I1 | 4-2-1 | 4-1-2 | 190.96 | 190.15 | 256.41 | 0.3159 | 8 | 0.662 | 191.14 | 0.122 | 1.12 | 0.185 |
| | | | | | | | | | | | | |
| 4-8-2I1 | 4-8-2 | 4-8-1 | 203.25 | 201.98 | 172.2 | 0.7375 | 10 | 1.833 | 203.25 | 0 | 0.008 | 0 |
| 4-8-1I1 | 4-8-1 | 4-1-8 | 201.98 | 200.95 | 441.72 | 0.2332 | 10 | 1.031 | 201.99 | 0.002 | 0.582 | 0.001 |
| 4-1-8I1 | 4-1-8 | 4-1-7 | 200.95 | 199.6 | 468.84 | 0.2879 | 10 | 1.145 | 201.34 | 0.507 | 0.801 | 0.443 |
| 4-1-7I1 | 4-1-7 | 4-1-6 | 199.6 | 199.3 | 88.8 | 0.3378 | 12 | 2.018 | 200.18 | 0.944 | 0.713 | 0.468 |
| 4-1-6I1 | 4-1-6 | 4-1-5 | 199.3 | 199 | 70.52 | 0.4254 | 12 | 2.264 | 199.82 | 0.944 | 0.634 | 0.417 |
| 4-1-5I1 | 4-1-5 | 4-1-4 | 199 | 198.2 | 289.47 | 0.2764 | 12 | 1.825 | 199.52 | 0.944 | 0.868 | 0.517 |
| 4-1-4I1 | 4-1-4 | 4-1-3 | 198.2 | 197.37 | 315.9 | 0.2627 | 12 | 1.779 | 198.85 | 1.318 | 0.736 | 0.741 |
| 4-1-3I1 | 4-1-3 | 4-1-2 | 197.37 | 190.15 | 418.58 | 1.7249 | 12 | 4.559 | 197.74 | 1.318 | 0.747 | 0.289 |
| 4-1-2I1 | 4-1-2 | 4-1-1 | 190.15 | 189.6 | 246.78 | 0.2229 | 15 | 2.972 | 190.77 | 1.44 | 0.582 | 0.484 |
| 4-1-1I1 | 4-1-1 | 3-2-6 | 189.6 | 189.02 | 158.24 | 0.3665 | 15 | 3.811 | 190.2 | 1.44 | 0.63 | 0.378 |
| 3-2-6I1 | 3-2-6 | 3-2-5 | 189.02 | 188.29 | 224.99 | 0.3245 | 15 | 3.585 | 189.62 | 1.44 | 0.634 | 0.402 |
| 3-2-5I1 | 3-2-5 | 3-2-4 | 188.29 | 188.06 | 122.43 | 0.1879 | 15 | 2.728 | 188.98 | 1.44 | 0.582 | 0.528 |
| 3-2-4I1 | 3-2-4 | 3-2-3 | 188.06 | 184 | 261.61 | 1.5519 | 15 | 7.841 | 188.42 | 1.44 | 0.581 | 0.184 |
| 3-2-3I1 | 3-2-3 | 3-2-2 | 184 | 181.71 | 123.56 | 1.8534 | 15 | 8.569 | 184.36 | 1.44 | 0.601 | 0.168 |
| 3-2-2I1 | 3-2-2 | 3-2-1 | 181.71 | 175.84 | 342.51 | 1.7138 | 15 | 8.24 | 182.09 | 1.617 | 0.364 | 0.196 |
| 3-2-1I1 | 3-2-1 | 3-1-1 | 175.59 | 168.9 | 304.81 | 2.1948 | 15 | 9.325 | 175.94 | 1.617 | 0.54 | 0.173 |
| | | | | | | | | | | | | |
| 6-7-9I1 | 6-7-9 | 6-1-17 | 158.05 | 149.01 | 334.17 | 2.7052 | 8 | 1.936 | 158.05 | 0 | 0.007 | 0 |
| 6-1-17I1 | 6-1-17 | 6-1-16 | 149.01 | 141.48 | 280.07 | 2.6886 | 8 | 1.93 | 149.01 | 0 | 0.008 | 0 |
| 6-1-16I1 | 6-1-16 | 6-1-15 | 141.48 | 135.98 | 144.02 | 3.8189 | 8 | 2.301 | 141.48 | 0 | 0.009 | 0 |
| 6-1-15I1 | 6-1-15 | 6-1-14 | 135.98 | 133.05 | 301.36 | 0.9723 | 8 | 1.161 | 135.98 | 0 | 0.007 | 0 |
| 6-1-14I1 | 6-1-14 | 6-1-13 | 132.83 | 131.59 | 95.32 | 1.3009 | 12 | 3.959 | 132.83 | 0 | 0.01 | 0 |
| 6-1-13I1 | 6-1-13 | 6-1-13B | 131.59 | 127.94 | 32.81 | 11.1252 | 12 | 11.579 | 131.59 | 0 | 1.113 | 0 |
| 6-1-13BI1 | 6-1-13B | 6-1-12 | 127.94 | 115.03 | 136.35 | 9.4683 | 15 | 19.369 | 128.5 | 7.673 | 1.074 | 0.396 |
| 6-1-12I1 | 6-1-12 | 6-1-11 | 115.03 | 95 | 256.6 | 7.8059 | 12 | 9.699 | 115.7 | 7.673 | 1.25 | 0.791 |

TABLE F-5
2025 Gravity Model Final Pipe Sizes

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6-1-11I1 | 6-1-11 | 6-1-10 | 95 | 71.35 | 247.14 | 9.5695 | 12 | 10.739 | 95.63 | 7.673 | 1.301 | 0.715 |
| 6-1-10I1 | 6-1-10 | 6-1-9 | 71.35 | 59.76 | 284.88 | 4.0684 | 18 | 20.647 | 72 | 8.017 | 1.447 | 0.388 |
| 6-1-9I1 | 6-1-9 | 6-1-8 | 59.76 | 57.85 | 276.65 | 0.6904 | 18 | 8.505 | 61.15 | 8.017 | 1.081 | 0.943 |
| 6-1-8I1 | 6-1-8 | 6-1-7 | 57.85 | 52.04 | 269.02 | 2.1597 | 18 | 15.043 | 58.66 | 8.017 | 2.112 | 0.533 |
| 6-1-7I1 | 6-1-7 | 6-1-6 | 52.04 | 49.84 | 256.12 | 0.859 | 18 | 9.487 | 54.47 | 8.018 | 2.043 | 0.845 |
| 6-1-6I1 | 6-1-6 | 6-1-5 | 49.84 | 47.68 | 279.68 | 0.7723 | 18 | 8.996 | 52 | 8.928 | 1.461 | 0.992 |
| 6-1-5I1 | 6-1-5 | 6-1-4 | 47.68 | 45.48 | 278.91 | 0.7888 | 21 | 13.714 | 49.34 | 9.118 | 1.667 | 0.665 |
| 6-1-4I1 | 6-1-4 | 6-1-3 | 45.48 | 43.32 | 265.09 | 0.8148 | 18 | 9.24 | 47.84 | 9.118 | 1.615 | 0.987 |
| 6-1-3I1 | 6-1-3 | 6-1-2 | 43.32 | 41.16 | 268.64 | 0.8041 | 18 | 9.179 | 44.53 | 9.118 | 0.807 | 0.993 |
| 6-1-2I1 | 6-1-2 | 6-1-1 | 37.5 | 35.44 | 251.4 | 0.8194 | 18 | 9.266 | 39.35 | 9.118 | 1.276 | 0.984 |
| 6-1-1I1 | 6-1-1 | 5-2-3 | 35.44 | 32.47 | 265.6 | 1.1182 | 21 | 16.329 | 36.4 | 9.118 | 0.903 | 0.558 |
| 5-2-3I1 | 5-2-3 | 5-2-2 | 32.47 | 29.6 | 75.16 | 3.8185 | 18 | 20.003 | 33.26 | 9.118 | 1.105 | 0.456 |
| 5-2-2I1 | 5-2-2 | 5-2-1 | 29.5 | 27.1 | 79.87 | 3.0049 | 18 | 17.744 | 30.38 | 9.118 | 1.178 | 0.514 |
| 5-2-1I1 | 5-2-1 | 5-1-1 | 27 | 24.41 | 75.8 | 3.4169 | 18 | 18.921 | 27.93 | 9.118 | 1.554 | 0.482 |
| | | | | | | | | | | | | |
| 6-7-8I1 | 6-7-8 | 6-7-7 | 129.5 | 120.8 | 267.66 | 3.2504 | 8 | 2.122 | 129.68 | 0.345 | 0.457 | 0.162 |
| 6-7-7I1 | 6-7-7 | 6-7-6 | 120.8 | 100 | 319 | 6.5204 | 8 | 3.006 | 120.95 | 0.345 | 0.546 | 0.115 |
| 6-7-6I1 | 6-7-6 | 6-7-5 | 100 | 90.21 | 303.36 | 3.2272 | 8 | 2.115 | 100.18 | 0.345 | 0.604 | 0.163 |
| 6-7-5I1 | 6-7-5 | 6-7-4 | 90.21 | 82.72 | 344.71 | 2.1728 | 8 | 1.738 | 90.41 | 0.345 | 0.529 | 0.198 |
| 6-7-4I1 | 6-7-4 | 6-7-3 | 82.72 | 80.3 | 103.15 | 2.3461 | 12 | 5.317 | 82.9 | 0.345 | 0.392 | 0.065 |
| 6-7-3I1 | 6-7-3 | 6-7-2 | 80.3 | 77.76 | 267.1 | 0.951 | 12 | 3.385 | 80.52 | 0.345 | 0.389 | 0.102 |
| 6-7-2I1 | 6-7-2 | 6-7-1 | 77.76 | 73.87 | 417.65 | 0.9314 | 12 | 3.35 | 77.98 | 0.345 | 0.38 | 0.103 |
| 6-7-1I1 | 6-7-1 | 6-1-10 | 73.87 | 71.35 | 189.34 | 1.3309 | 12 | 4.005 | 74.1 | 0.345 | 1.301 | 0.086 |
| | | | | | | | | | | | | |
| 6-5-2I1 | 6-5-2 | 6-5-1 | 59.47 | 58.27 | 380.57 | 0.3153 | 8 | 0.661 | 59.47 | 0 | 0.007 | 0 |
| 6-5-1I1 | 6-5-1 | 6-1-6 | 58.27 | 49.84 | 421.07 | 2.002 | 8 | 1.666 | 58.27 | 0.015 | 4.596 | 0.009 |
| | | | | | | | | | | | | |
| 3-1-39I1 | 3-1-39 | 3-1-38 | 548.87 | 530 | 167.36 | 11.2751 | 8 | 3.953 | 549.08 | 0.88 | 0.321 | 0.223 |
| 3-1-38I1 | 3-1-38 | 3-1-37 | 527.99 | 521 | 215.05 | 3.2504 | 8 | 2.122 | 528.29 | 0.88 | 0.61 | 0.415 |
| 3-1-37I1 | 3-1-37 | Crown LS | 521 | 519 | 32.81 | 6.096 | 12 | 9.714 | 521.2 | 0.88 | 0.203 | 0.091 |
| | | | | | | | | | | | | |
| 3-16-6I1 | 3-16-6 | 3-16-4 | 625.42 | 594.25 | 396.42 | 7.8629 | 8 | 3.302 | 625.64 | 0.759 | 0.626 | 0.23 |
| 3-16-4I1 | 3-16-4 | 3-16-3 | 594.25 | 581 | 141.91 | 9.3369 | 8 | 3.597 | 594.46 | 0.759 | 0.687 | 0.211 |
| 3-16-3I1 | 3-16-3 | 3-16-2 | 581 | 563.08 | 277.87 | 6.449 | 8 | 2.99 | 581.23 | 0.759 | 0.777 | 0.254 |
| 3-16-2I1 | 3-16-2 | 3-16-1 | 563.08 | 554.01 | 222.76 | 4.0716 | 8 | 2.375 | 563.34 | 0.759 | 0.807 | 0.319 |
| 3-16-1I1 | 3-16-1 | 3-1-27 | 554.01 | 543.48 | 297.16 | 3.5435 | 8 | 2.216 | 554.28 | 0.759 | 1.197 | 0.342 |
| | | | | | | | | | | | | |
| 3-19A-1I1 | 3-19A-1 | 3-19B-1 | 690.67 | 685 | 467.84 | 1.212 | 8 | 1.296 | 690.8 | 0.116 | 0.392 | 0.089 |
| 3-19B-1I1 | 3-19B-1 | 3-19-6 | 685 | 678.77 | 467.84 | 1.3317 | 8 | 1.359 | 685.13 | 0.116 | 0.197 | 0.085 |

TABLE F-5
2025 Gravity Model Final Pipe Sizes

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3-19-6I1 | 3-19-6 | 3-19-5 | 678.57 | 675.28 | 361.39 | 0.9104 | 8 | 1.123 | 678.71 | 0.116 | 0.217 | 0.103 |
| 3-19-5I1 | 3-19-5 | 3-19-4 | 675.16 | 671.11 | 334.48 | 1.2108 | 8 | 1.295 | 675.29 | 0.116 | 0.378 | 0.09 |
| 3-19-4I1 | 3-19-4 | 3-19-3 | 671.11 | 667.05 | 255.81 | 1.5871 | 8 | 1.483 | 671.24 | 0.116 | 0.277 | 0.078 |
| 3-19-3I1 | 3-19-3 | 3-19-2 | 667.05 | 664 | 51.5 | 5.9223 | 8 | 2.865 | 667.14 | 0.116 | 0.293 | 0.04 |
| 3-19-2I1 | 3-19-2 | 3-19-1 | 664 | 645.19 | 415.02 | 4.5323 | 8 | 2.506 | 664.1 | 0.116 | 0.146 | 0.046 |
| 3-19-1I1 | 3-19-1 | 3-1-36 | 645.09 | 627.12 | 269.24 | 6.6743 | 8 | 3.041 | 645.18 | 0.116 | 0.872 | 0.038 |
| 3-1-36I1 | 3-1-36 | 3-1-35 | 627.12 | 620.08 | 150.2 | 4.6871 | 8 | 2.549 | 627.41 | 0.996 | 0.596 | 0.391 |
| 3-1-35I1 | 3-1-35 | 3-1-34 | 619.88 | 605.44 | 345.62 | 4.178 | 8 | 2.406 | 620.18 | 0.996 | 0.515 | 0.414 |
| 3-1-34I1 | 3-1-34 | 3-1-33 | 605.24 | 589.5 | 267 | 5.8951 | 8 | 2.858 | 605.51 | 0.996 | 0.882 | 0.348 |
| 3-1-33I1 | 3-1-33 | 3-1-32 | 589.5 | 573.8 | 354.48 | 4.429 | 8 | 2.478 | 589.79 | 0.996 | 0.441 | 0.402 |
| 3-1-32I1 | 3-1-32 | 3-1-31 | 572.42 | 561.9 | 126.18 | 8.3373 | 8 | 3.399 | 572.69 | 1.107 | 1.184 | 0.326 |
| 3-1-31I1 | 3-1-31 | 3-1-30 | 561.9 | 558.52 | 154.4 | 2.1891 | 8 | 1.742 | 562.29 | 1.107 | 0.931 | 0.636 |
| 3-1-30I1 | 3-1-30 | 3-1-29 | 558.52 | 554.39 | 83.71 | 4.9337 | 8 | 2.615 | 558.83 | 1.107 | 0.978 | 0.424 |
| 3-1-29I1 | 3-1-29 | 3-1-28 | 554.39 | 548.82 | 116.48 | 4.7819 | 8 | 2.574 | 554.72 | 1.204 | 0.958 | 0.468 |
| 3-1-28I1 | 3-1-28 | 3-1-27 | 548.82 | 543.48 | 100.57 | 5.3097 | 8 | 2.713 | 549.14 | 1.204 | 1.197 | 0.444 |
| 3-1-27I1 | 3-1-27 | 3-1-26 | 543.48 | 533.98 | 143.24 | 6.6322 | 8 | 3.032 | 543.88 | 1.963 | 1.525 | 0.647 |
| 3-1-26I1 | 3-1-26 | 3-1-25 | 533.98 | 530.74 | 150.68 | 2.1503 | 10 | 3.13 | 534.49 | 1.963 | 1.284 | 0.627 |
| 3-1-25I1 | 3-1-25 | 3-1-24 | 530.74 | 527.7 | 296.49 | 1.0253 | 10 | 2.161 | 531.37 | 1.963 | 1.115 | 0.908 |
| 3-1-24I1 | 3-1-24 | 3-1-23 | 527.7 | 517.67 | 297 | 3.3771 | 10 | 3.923 | 528.16 | 2.345 | 1.193 | 0.598 |
| 3-1-23I1 | 3-1-23 | 3-1-22 | 517.67 | 510.51 | 263.25 | 2.7198 | 10 | 3.52 | 518.17 | 2.345 | 0.747 | 0.666 |
| 3-1-22I1 | 3-1-22 | 3-1-21 | 510.29 | 488.8 | 285.69 | 7.5221 | 8 | 3.229 | 510.71 | 2.345 | 1.586 | 0.726 |
| 3-1-21I1 | 3-1-21 | 3-1-20B | 488.8 | 480.5 | 191.92 | 4.3247 | 8 | 2.448 | 489.33 | 2.345 | 1.095 | 0.958 |
| 3-1-20BI1 | 3-1-20B | 3-1-20 | 480.5 | 464 | 137.81 | 11.973 | 8 | 4.074 | 480.87 | 2.345 | 1.076 | 0.576 |
| 3-1-20I1 | 3-1-20 | 3-1-19 | 464 | 451 | 101.75 | 12.7764 | 8 | 4.208 | 464.36 | 2.345 | 1.077 | 0.557 |
| 3-1-19I1 | 3-1-19 | 3-1-18 | 451 | 422 | 234.31 | 12.3768 | 8 | 4.142 | 451.36 | 2.345 | 1.511 | 0.566 |
| 3-1-18I1 | 3-1-18 | 3-1-17 | 422 | 413.73 | 117.92 | 7.0132 | 8 | 3.118 | 422.5 | 2.868 | 0.755 | 0.92 |
| 3-1-17I1 | 3-1-17 | 3-1-16 | 412.3 | 395.63 | 285.81 | 5.8325 | 10 | 5.155 | 412.74 | 2.868 | 1.093 | 0.556 |
| 3-1-16I1 | 3-1-16 | 3-1-15 | 395.63 | 371 | 272.7 | 9.0319 | 8 | 3.538 | 396.09 | 2.868 | 0.683 | 0.811 |
| 3-1-15I1 | 3-1-15 | 3-1-14 | 370 | 361 | 109.1 | 8.2493 | 8 | 3.381 | 370.48 | 2.868 | 1.193 | 0.848 |
| 3-1-14I1 | 3-1-14 | 3-1-13 | 361 | 324.63 | 246.6 | 14.7486 | 8 | 4.521 | 361.4 | 3.012 | 1.342 | 0.666 |
| 3-1-13I1 | 3-1-13 | 3-1-12 | 324.63 | 304.37 | 323 | 6.2724 | 10 | 5.346 | 325.08 | 3.012 | 1.011 | 0.563 |
| 3-1-12I1 | 3-1-12 | 3-1-11 | 304.27 | 282 | 244.65 | 9.1028 | 8 | 3.552 | 304.74 | 3.012 | 1.595 | 0.848 |
| 3-1-11I1 | 3-1-11 | 3-1-10 | 282 | 262.19 | 287.26 | 6.8962 | 8 | 3.092 | 282.53 | 3.012 | 1.493 | 0.974 |
| 3-1-10I1 | 3-1-10 | 3-1-9 | 261.79 | 259.99 | 230.46 | 0.781 | 15 | 5.563 | 262.49 | 3.195 | 0.68 | 0.574 |
| 3-1-9I1 | 3-1-9 | 3-1-8 | 259.89 | 255.71 | 35.63 | 11.7317 | 8 | 4.032 | 260.36 | 3.195 | 1.616 | 0.792 |
| 3-1-8I1 | 3-1-8 | 3-1-7 | 255.71 | 247.51 | 206.38 | 3.9733 | 10 | 4.255 | 256.25 | 3.195 | 0.646 | 0.751 |
| 3-1-7I1 | 3-1-7 | 3-1-6 | 246.66 | 231.4 | 242.11 | 6.3029 | 10 | 5.359 | 247.12 | 3.195 | 1.436 | 0.596 |
| 3-1-6I1 | 3-1-6 | 3-1-5 | 231.4 | 226.54 | 256.56 | 1.8943 | 12 | 4.778 | 232 | 3.195 | 0.633 | 0.669 |
| 3-1-5I1 | 3-1-5 | 3-1-4 | 226.24 | 210 | 262.89 | 6.1775 | 10 | 5.306 | 226.71 | 3.195 | 1.137 | 0.602 |

TABLE F-5
2025 Gravity Model Final Pipe Sizes

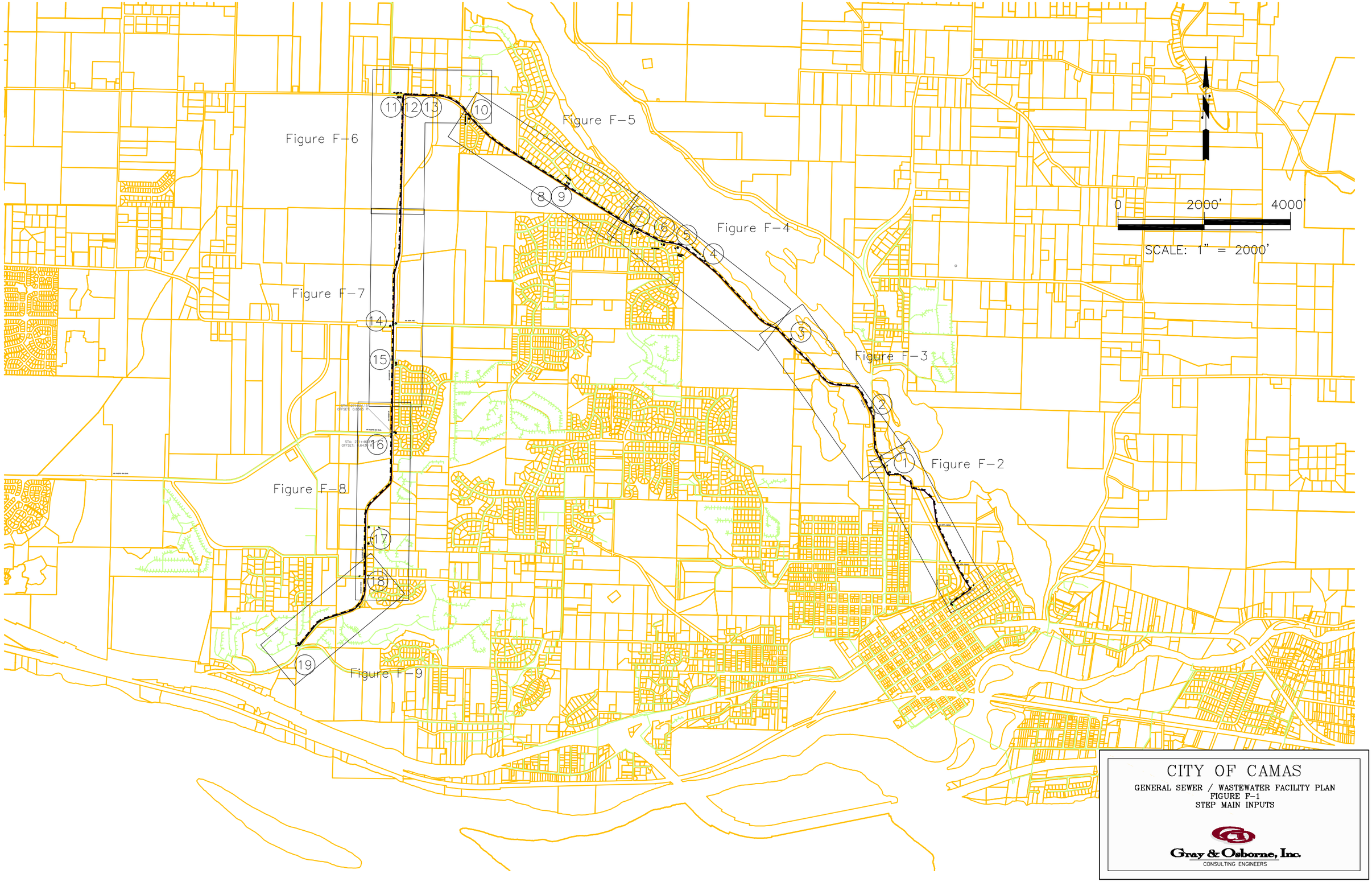
| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3-1-4I1 | 3-1-4 | 3-1-3 | 210 | 194.73 | 259.92 | 5.8749 | 10 | 5.174 | 210.47 | 3.195 | 1.129 | 0.617 |
| 3-1-3I1 | 3-1-3 | 3-1-2 | 194.63 | 173.42 | 262.16 | 8.0905 | 8 | 3.349 | 195.15 | 3.195 | 0.886 | 0.954 |
| 3-1-2I1 | 3-1-2 | 3-1-1 | 172.82 | 169.05 | 276.02 | 1.3658 | 15 | 7.356 | 173.42 | 3.386 | 0.476 | 0.46 |
| 3-1-1I1 | 3-1-1 | 5-8-1 | 168.9 | 83.11 | 442.05 | 19.4073 | 18 | 45.094 | 169.24 | 5.003 | 0.257 | 0.111 |
| 5-8-1I1 | 5-8-1 | 5-1-12 | 82.76 | 52.47 | 259.11 | 11.69 | 21 | 52.795 | 83.13 | 5.003 | 0.915 | 0.095 |
| | | | | | | | | | | | | |
| 7-3-5I1 | 7-3-5 | 7-3-4 | 71.5 | 64.31 | 121.17 | 5.9338 | 8 | 2.868 | 71.57 | 0.065 | 0.104 | 0.023 |
| 7-3-4I1 | 7-3-4 | 7-3-3 | 64.26 | 41.81 | 193.99 | 11.5728 | 8 | 4.005 | 64.32 | 0.065 | 0.214 | 0.016 |
| 7-3-3I1 | 7-3-3 | 7-3-2 | 41.76 | 39.51 | 150.63 | 1.4937 | 8 | 1.439 | 41.86 | 0.065 | 0.145 | 0.045 |
| 7-3-2I1 | 7-3-2 | 7-3-1 | 39.46 | 26.94 | 118.27 | 10.5859 | 8 | 3.83 | 39.52 | 0.065 | 0.141 | 0.017 |
| 7-3-1I1 | 7-3-1 | 7-1-1 | 26.89 | 16.91 | 190.47 | 5.2397 | 8 | 2.695 | 26.96 | 0.065 | 0.737 | 0.024 |
| | | | | | | | | | | | | |
| 7-1-6I1 | 7-1-6 | 7-1-5 | 23.7 | 22.21 | 286.97 | 0.5192 | 8 | 0.848 | 24.19 | 0.755 | 0.901 | 0.89 |
| 7-1-5I1 | 7-1-5 | 7-1-4 | 22.21 | 21.45 | 213.44 | 0.3561 | 10 | 1.274 | 22.7 | 0.755 | 0.722 | 0.593 |
| 7-1-4I1 | 7-1-4 | 7-1-3 | 21.45 | 19.75 | 57.12 | 2.9762 | 8 | 2.031 | 21.75 | 0.755 | 0.997 | 0.372 |
| 7-1-3I1 | 7-1-3 | 7-1-2 | 19.75 | 17.5 | 455.94 | 0.4935 | 8 | 0.827 | 20.25 | 0.755 | 0.895 | 0.913 |
| 7-1-2I1 | 7-1-2 | 7-1-1 | 17.5 | 16.86 | 163.94 | 0.3904 | 10 | 1.334 | 17.97 | 0.755 | 0.65 | 0.566 |
| 7-1-1I1 | 7-1-1 | L C LS | 16.86 | 9.62 | 328.36 | 2.2049 | 10 | 3.592 | 17.13 | 0.82 | 0.325 | 0.228 |
| | | | | | | | | | | | | |
| 7-2-1I1 | 7-2-1 | L C LS | 12 | 9.62 | 101 | 2.3564 | 12 | 5.329 | 12.09 | 0.09 | 0.09 | 0.017 |
| | | | | | | | | | | | | |
| 8-1-9I1 | 8-1-9 | 8-1-8 | 30.84 | 29.83 | 441.23 | 0.2289 | 10 | 1.021 | 31.11 | 0.228 | 0.37 | 0.223 |
| 8-1-8I1 | 8-1-8 | 8-1-7 | 29.83 | 28.67 | 335.14 | 0.3461 | 10 | 1.256 | 30.07 | 0.227 | 0.371 | 0.181 |
| 8-1-7I1 | 8-1-7 | 8-1-6 | 28.67 | 27.14 | 281.54 | 0.5434 | 10 | 1.574 | 28.88 | 0.227 | 0.38 | 0.145 |
| 8-1-6I1 | 8-1-6 | 8-1-5 | 27.14 | 25.16 | 266.48 | 0.743 | 10 | 1.84 | 27.34 | 0.227 | 0.548 | 0.124 |
| 8-1-5I1 | 8-1-5 | 8-1-4 | 25.16 | 24.22 | 272.21 | 0.3453 | 12 | 2.04 | 25.51 | 0.531 | 0.474 | 0.261 |
| 8-1-4I1 | 8-1-4 | 8-1-3 | 24.22 | 21.83 | 304.05 | 0.7861 | 12 | 3.078 | 24.5 | 0.531 | 0.462 | 0.173 |
| 8-1-3I1 | 8-1-3 | 8-1-2 | 21.83 | 21.07 | 310.28 | 0.2449 | 12 | 1.718 | 22.21 | 0.531 | 0.496 | 0.309 |
| 8-1-2I1 | 8-1-2 | 8-1-1 | 21.07 | 20.95 | 41.2 | 0.2913 | 12 | 1.873 | 21.41 | 0.531 | 0.341 | 0.284 |
| 8-1-1I1 | 8-1-1 | Oaks LS | 20.7 | 17 | 250 | 1.48 | 12 | 4.786 | 20.92 | 0.531 | 0.225 | 0.111 |
| | | | | | | | | | | | | |
| 10-1-23I1 | 10-1-23 | 10-1-24 | 586.24 | 582.57 | 246.52 | 1.4887 | 8 | 1.436 | 586.38 | 0.145 | 0.433 | 0.101 |
| 10-1-24I1 | 10-1-24 | 10-1-25 | 582.57 | 578.65 | 271.62 | 1.4432 | 8 | 1.414 | 582.71 | 0.145 | 0.216 | 0.103 |
| 10-1-25I1 | 10-1-25 | 10-1-26 | 578.46 | 573.76 | 73.84 | 6.3651 | 8 | 2.97 | 578.56 | 0.145 | 0.15 | 0.049 |
| 10-1-26I1 | 10-1-26 | 10-10B-1 | 573.52 | 565 | 71.95 | 11.8416 | 8 | 4.051 | 573.61 | 0.145 | 0.13 | 0.036 |
| | | | | | | | | | | | | |
| 10-1-20I1 | 10-1-20 | 10-1-19 | 560.33 | 558.74 | 222.19 | 0.7156 | 10 | 1.806 | 560.49 | 0.146 | 0.266 | 0.081 |
| 10-1-19I1 | 10-1-19 | 10-1-18 | 558.7 | 557.34 | 180 | 0.7556 | 10 | 2.103 | 558.85 | 0.146 | 0.192 | 0.069 |
| 10-11-8I1 | 10-1-18 | 10-1-17 | 529.03 | 512.56 | 172.89 | 9.5263 | 8 | 3.634 | 529.27 | 0.965 | 0.789 | 0.266 |

TABLE F-5
2025 Gravity Model Final Pipe Sizes

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10-11-7I1 | 10-1-17 | 10-1-16 | 512.51 | 504.76 | 172.89 | 4.4826 | 8 | 2.492 | 512.8 | 0.965 | 0.432 | 0.387 |
| 10-11-6I1 | 10-1-16 | 10-1-15 | 504.29 | 496.36 | 122.58 | 6.4692 | 8 | 2.994 | 504.55 | 0.965 | 0.774 | 0.322 |
| 10-11-5I1 | 10-1-15 | 10-1-14 | 496.36 | 489.35 | 99.68 | 7.0325 | 8 | 3.122 | 496.62 | 0.965 | 0.906 | 0.309 |
| 10-11-4I1 | 10-1-14 | 10-1-13 | 489.35 | 486.23 | 79.73 | 3.9132 | 8 | 2.329 | 489.65 | 0.965 | 0.609 | 0.414 |
| 10-11-3I1 | 10-1-13 | 10-1-12 | 485.94 | 481.23 | 202.93 | 2.321 | 8 | 1.794 | 486.29 | 0.965 | 0.522 | 0.538 |
| 10-11-2I1 | 10-1-12 | 10-1-11 | 480.56 | 456.89 | 276.46 | 8.5618 | 8 | 3.445 | 480.8 | 0.965 | 0.362 | 0.28 |
| 10-11-1I1 | 10-1-11 | 10-1-10 | 456.17 | 437.78 | 149.06 | 12.3373 | 8 | 4.135 | 456.39 | 0.965 | 0.329 | 0.233 |
| | | | | | | | | | | | | |
| 10-6-4I1 | 10-6-4 | 10-6-3 | 475.28 | 471.48 | 200.3 | 1.8972 | 8 | 1.622 | 475.61 | 0.782 | 0.682 | 0.482 |
| 10-6-3I1 | 10-6-3 | 10-6-2 | 471.48 | 445.39 | 371.61 | 7.0208 | 8 | 3.119 | 471.71 | 0.782 | 0.667 | 0.251 |
| 10-6-2I1 | 10-6-2 | 10-6-1 | 445.39 | 424.43 | 273.95 | 7.651 | 8 | 3.261 | 445.61 | 0.782 | 0.859 | 0.24 |
| 10-6-1I1 | 10-6-1 | 10-1A-12 | 424.43 | 417.32 | 238.32 | 2.9834 | 8 | 2.036 | 424.72 | 0.782 | 0.43 | 0.384 |
| 10-1A-12I1 | 10-1A-12 | 10-1-12 | 417.18 | 411.61 | 32.81 | 16.9774 | 8 | 4.851 | 417.36 | 0.782 | 0.271 | 0.161 |
| | | | | | | | | | | | | |
| 10-10-12I1 | 10-10-12 | 10-10-11 | 729.37 | 719.72 | 316.82 | 3.0459 | 8 | 2.055 | 729.62 | 0.617 | 0.756 | 0.3 |
| 10-10-11I1 | 10-10-11 | 10-10-10 | 719.72 | 713.46 | 209.66 | 2.9858 | 8 | 2.034 | 719.97 | 0.617 | 0.396 | 0.303 |
| 10-10-10I1 | 10-10-10 | 10-10-9 | 713.35 | 700 | 141.84 | 9.412 | 8 | 3.612 | 713.54 | 0.617 | 0.537 | 0.171 |
| 10-10-9I1 | 10-10-9 | 10-10-9A | 700 | 690.71 | 83 | 11.1928 | 8 | 3.939 | 700.18 | 0.617 | 0.518 | 0.157 |
| 10-10-9AI1 | 10-10-9A | 10-10-8 | 690.71 | 673.37 | 136.92 | 12.6643 | 8 | 4.189 | 690.88 | 0.617 | 0.259 | 0.147 |
| 10-10-8I1 | 10-10-8 | 10-10-7 | 672.92 | 665.34 | 144.41 | 5.2489 | 8 | 2.697 | 673.14 | 0.617 | 0.325 | 0.229 |
| 10-10-7I1 | 10-10-7 | 10-10-6 | 664.94 | 650.23 | 168.4 | 8.7352 | 8 | 3.479 | 665.13 | 0.617 | 0.285 | 0.177 |
| 10-10-6I1 | 10-10-6 | 10-10-5 | 649.67 | 645.94 | 62.14 | 6.0026 | 8 | 2.884 | 649.88 | 0.617 | 0.314 | 0.214 |
| 10-10-5I1 | 10-10-5 | 10-10-4 | 645.64 | 617 | 347.43 | 8.2434 | 8 | 3.38 | 645.83 | 0.617 | 0.289 | 0.183 |
| 10-10-4I1 | 10-10-4 | 10-10-3 | 615.26 | 611.74 | 127.96 | 2.7509 | 8 | 1.953 | 615.52 | 0.617 | 0.386 | 0.316 |
| 10-10-3I1 | 10-10-3 | 10-10-2 | 611.07 | 595 | 101.85 | 15.7781 | 8 | 4.676 | 611.23 | 0.617 | 0.449 | 0.132 |
| 10-10-2I1 | 10-10-2 | 10-10-1 | 595 | 579.91 | 67.04 | 22.5089 | 8 | 5.585 | 595.15 | 0.617 | 0.224 | 0.11 |
| 10-10-1I1 | 10-10-1 | 10-10B-1 | 579.48 | 552.57 | 204.62 | 13.1512 | 8 | 4.269 | 579.65 | 0.617 | 0.257 | 0.145 |
| 10-10B-1I1 | 10-10B-1 | 10-11-8 | 552.32 | 529.58 | 113.51 | 20.0335 | 8 | 5.269 | 552.51 | 0.965 | 0.29 | 0.183 |
| 10-1-18I1 | 10-11-8 | 10-11-7 | 557.34 | 528.08 | 178.24 | 16.4161 | 8 | 4.77 | 557.42 | 0.146 | 0.12 | 0.031 |
| 10-1-17I1 | 10-11-7 | 10-11-6 | 527.27 | 510.29 | 82.16 | 20.667 | 8 | 5.352 | 527.35 | 0.146 | 0.113 | 0.027 |
| 10-1-16I1 | 10-11-6 | 10-11-5 | 509.25 | 487.05 | 64.52 | 34.4079 | 8 | 6.906 | 509.32 | 0.146 | 0.101 | 0.021 |
| 10-1-15I1 | 10-11-5 | 10-11-4 | 486.88 | 461.89 | 227.99 | 10.961 | 8 | 3.903 | 486.97 | 0.146 | 0.44 | 0.037 |
| 10-1-14I1 | 10-11-4 | 10-11-3 | 461.89 | 461.44 | 33 | 1.3636 | 8 | 1.375 | 462.04 | 0.146 | 0.22 | 0.106 |
| 10-1-13I1 | 10-11-3 | 10-11-2 | 461.44 | 411.61 | 153.23 | 32.5197 | 8 | 6.713 | 461.51 | 0.146 | 0.102 | 0.022 |
| 10-1-12I1 | 10-11-2 | 10-11-1 | 410.71 | 388 | 158.82 | 14.2992 | 8 | 4.452 | 410.92 | 0.927 | 0.31 | 0.208 |
| 10-1-11I1 | 10-11-1 | 10-4-4 | 382.41 | 380.71 | 187.51 | 0.9066 | 8 | 1.121 | 382.87 | 0.927 | 0.691 | 0.827 |
| 10-4-4I1 | 10-4-4 | 10-4-3 | 437.47 | 431.39 | 77.5 | 7.8452 | 8 | 3.297 | 437.72 | 0.965 | 0.455 | 0.293 |
| 10-4-3I1 | 10-4-3 | 10-4-2 | 431.2 | 422.61 | 105.27 | 8.16 | 8 | 3.363 | 431.45 | 0.965 | 0.823 | 0.287 |
| 10-4-2I1 | 10-4-2 | 10-4-1 | 422.31 | 421.65 | 63.07 | 1.0465 | 8 | 1.204 | 422.76 | 0.965 | 0.677 | 0.801 |

TABLE F-5
2025 Gravity Model Final Pipe Sizes

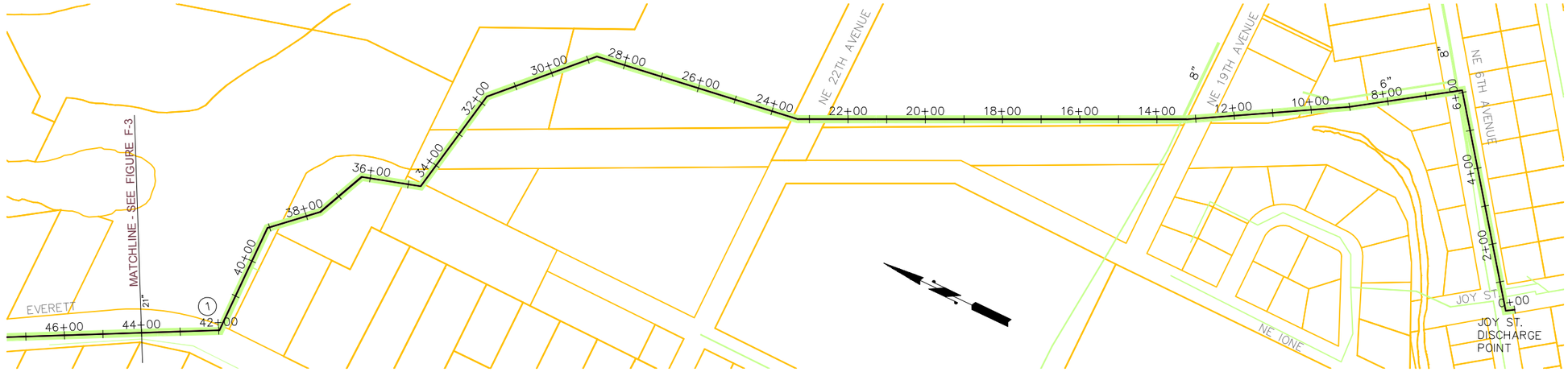
| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10-4-1l1 | 10-4-1 | 10-1-10 | 421.53 | 377.51 | 189.32 | 23.2516 | 8 | 5.677 | 421.72 | 0.965 | 0.279 | 0.17 |
| 10-1-10l1 | 10-1-10 | 10-1-9 | 375.1 | 170.58 | 281.66 | 72.6124 | 8 | 10.032 | 375.3 | 1.893 | 2.006 | 0.189 |
| 10-1-9l1 | 10-1-9 | 10-1-8 | 171.3 | 159.26 | 89.57 | 13.442 | 8 | 4.316 | 171.61 | 1.893 | 0.463 | 0.438 |
| 10-1-8l1 | 10-1-8 | 10-1-7 | 154.04 | 151.99 | 186.15 | 1.1013 | 10 | 2.24 | 154.64 | 1.893 | 0.813 | 0.845 |
| 10-1-7l1 | 10-1-7 | 10-1-6 | 151.69 | 145.35 | 182.68 | 3.4705 | 8 | 2.193 | 152.18 | 1.893 | 1.271 | 0.863 |
| 10-1-6l1 | 10-1-6 | 10-1-5 | 145.15 | 138.94 | 215.3 | 2.8843 | 8 | 2 | 145.67 | 1.893 | 1.044 | 0.946 |
| 10-1-5l1 | 10-1-5 | S P Hill LS | 138.94 | 137.5 | 32.81 | 4.3891 | 12 | 7.273 | 139.29 | 1.893 | 0.348 | 0.26 |
| | | | | | | | | | | | | |
| 10-1-3l1 | 10-1-3 | 10-1-2 | 146.7 | 132 | 255.96 | 5.7431 | 8 | 2.821 | 147.17 | 2.374 | 1.437 | 0.841 |
| 10-1-2l1 | 10-1-2 | 10-1-1 | 132 | 122.59 | 300 | 3.1367 | 10 | 3.78 | 132.48 | 2.374 | 0.958 | 0.628 |
| 10-1-1l1 | 10-1-1 | W C LS | 122.59 | 121 | 32.81 | 4.8463 | 12 | 7.642 | 122.99 | 2.565 | 0.399 | 0.336 |




CITY OF CAMAS

GENERAL SEWER / WASTEWATER FACILITY PLAN
FIGURE F-1
STEP MAIN INPUTS

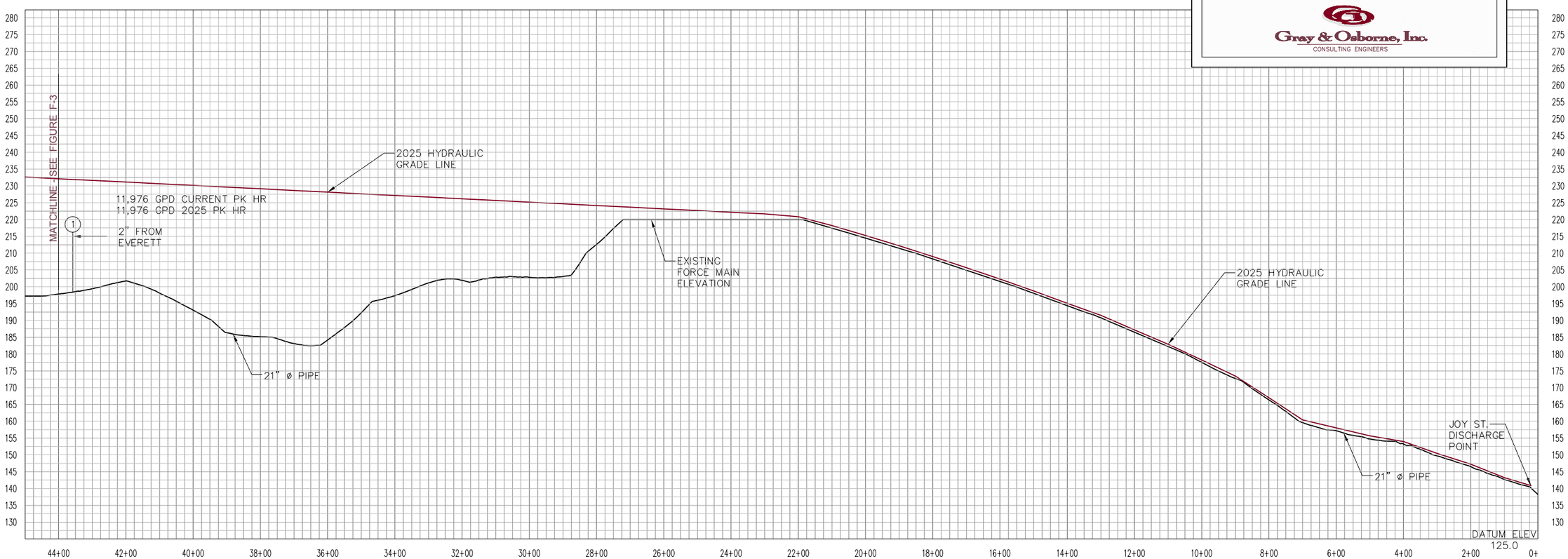
Gray & Osborne, Inc.
CONSULTING ENGINEERS

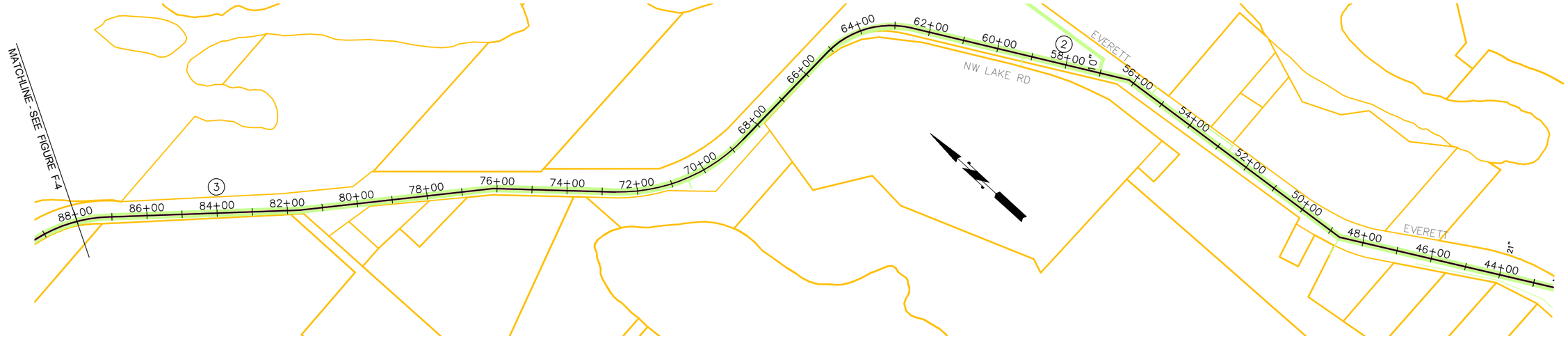


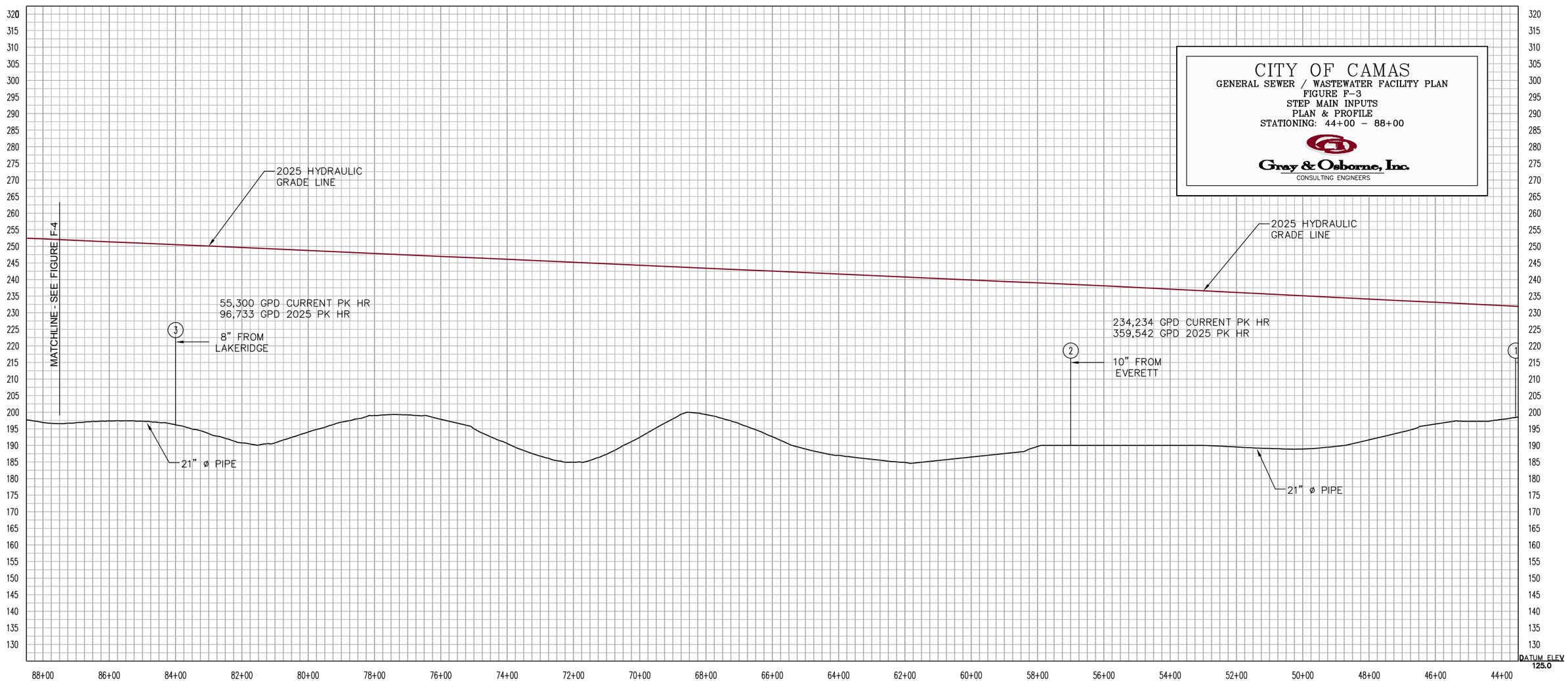

# CITY OF CAMAS

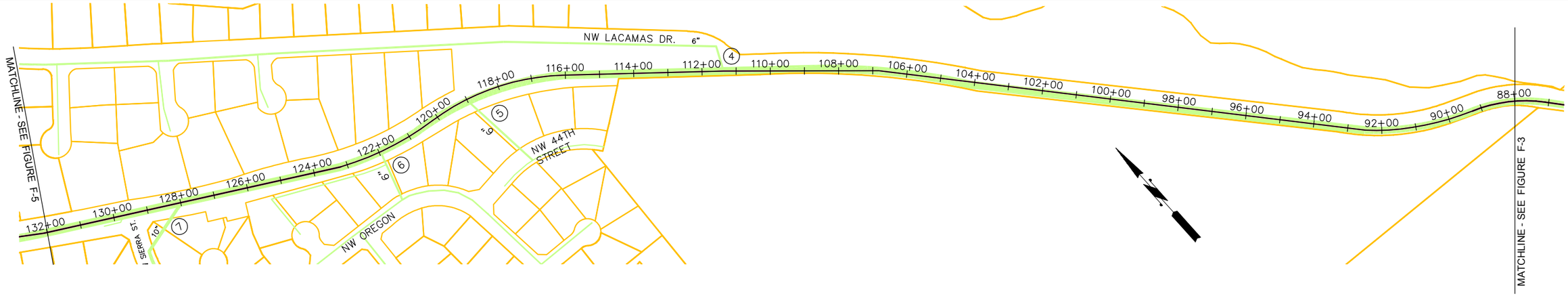
GENERAL SEWER / WASTEWATER FACILITY PLAN
FIGURE F-2
STEP MAIN INPUTS
PLAN & PROFILE
STATIONING: 0+00-44+00

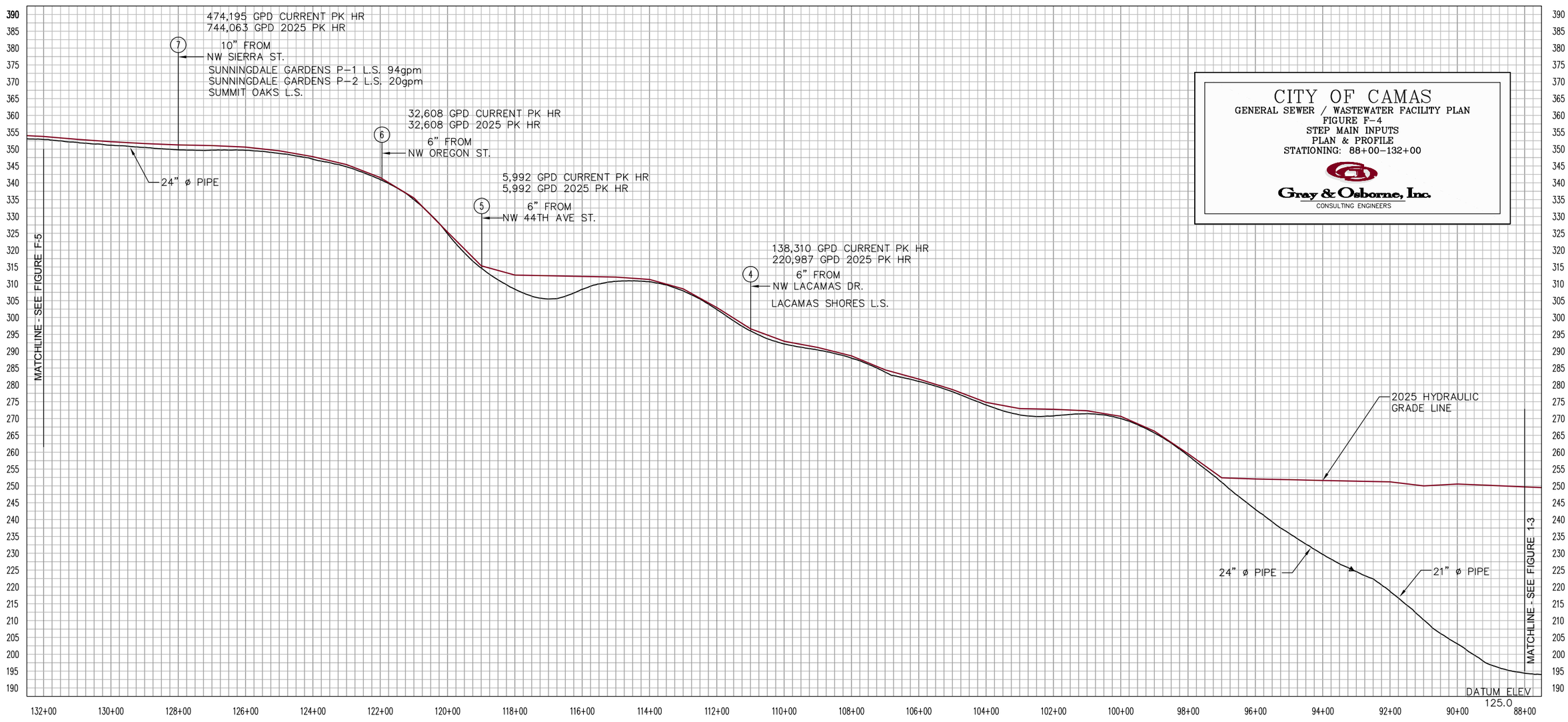
Gray & Osborne, Inc.
CONSULTING ENGINEERS



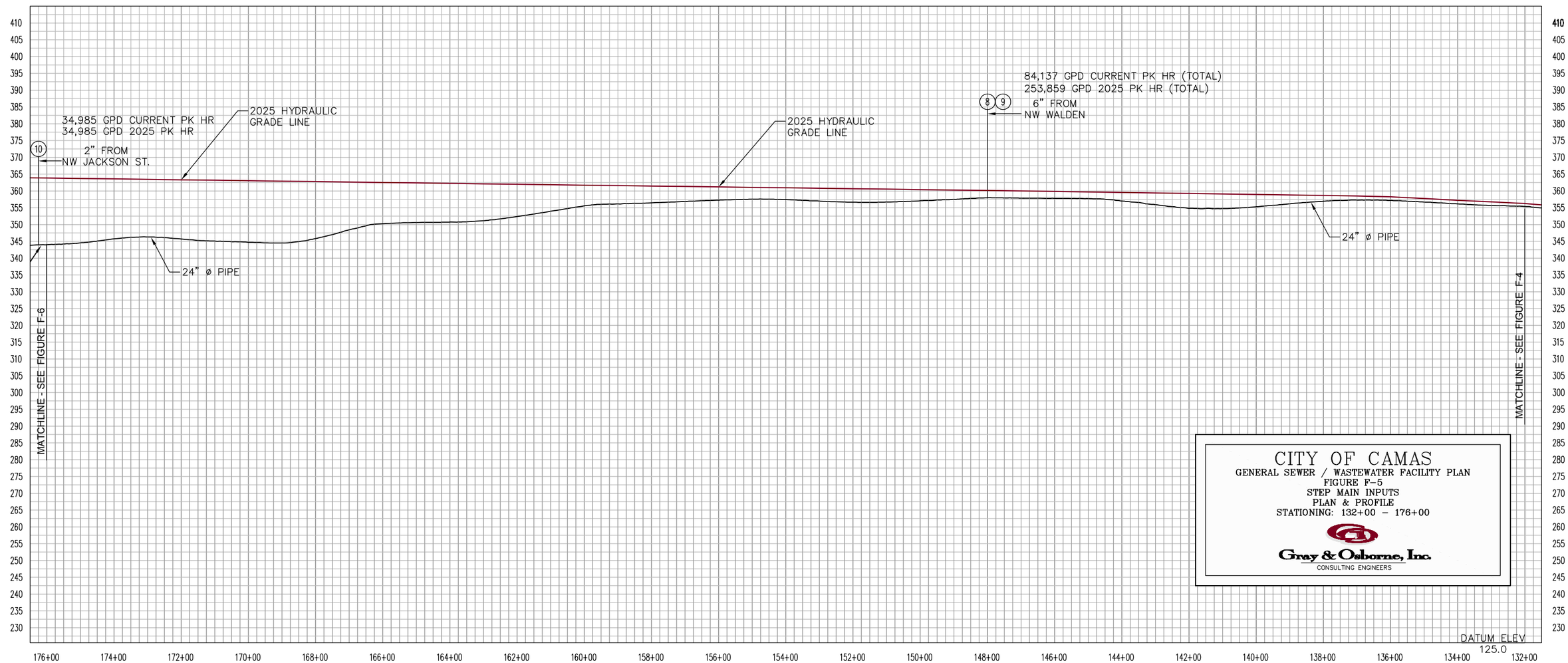

MATCHLINE - SEE FIGURE F-4
88+00
86+00
84+00
82+00
80+00
78+00
76+00
74+00
72+00
70+00
68+00
66+00
64+00
62+00
60+00
58+00
56+00
54+00
52+00
50+00
48+00
46+00
44+00
3
2
1
NW LAKE RD
EVERETT
EVERETT
10"
21"

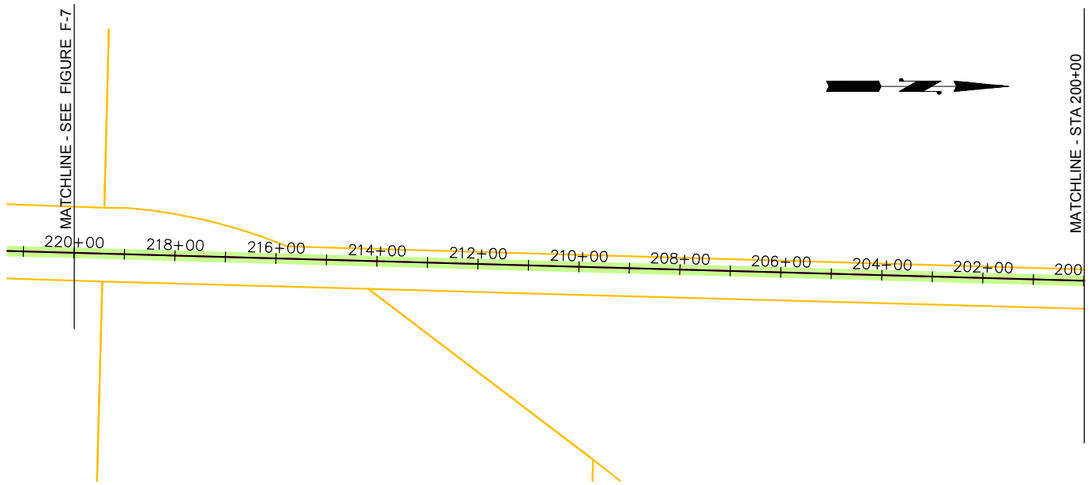

CITY OF CAMAS
GENERAL SEWER / WASTEWATER FACILITY PLAN
FIGURE F-3
STEP MAIN INPUTS
PLAN & PROFILE
STATIONING: 44+00 - 88+00
Gray & Osborne, Inc.
CONSULTING ENGINEERS
2025 HYDRAULIC GRADE LINE
2025 HYDRAULIC GRADE LINE
MATCHLINE - SEE FIGURE F-4
55,300 GPD CURRENT PK HR
96,733 GPD 2025 PK HR
8" FROM LAKERIDGE
234,234 GPD CURRENT PK HR
359,542 GPD 2025 PK HR
10" FROM EVERETT
21" ø PIPE
21" ø PIPE
DATUM ELEV 125.0
320
315
310
305
300
295
290
285
280
275
270
265
260
255
250
245
240
235
230
225
220
215
210
205
200
195
190
185
180
175
170
165
160
155
150
145
140
135
130
88+00
86+00
84+00
82+00
80+00
78+00
76+00
74+00
72+00
70+00
68+00
66+00
64+00
62+00
60+00
58+00
56+00
54+00
52+00
50+00
48+00
46+00
44+00

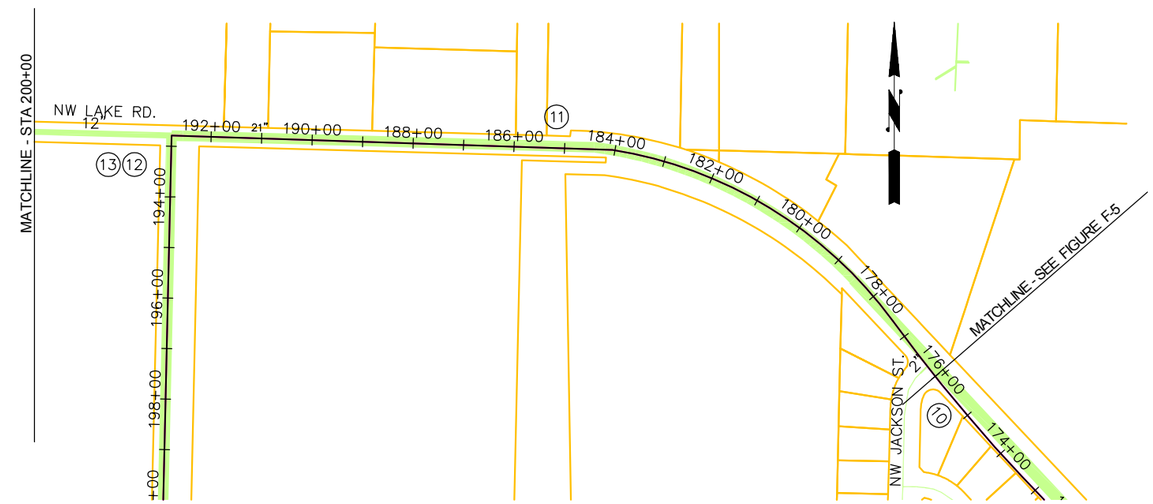

NW LACAMAS DR.
6"
MATCHLINE - SEE FIGURE F-5
MATCHLINE - SEE FIGURE F-3
NW 44TH STREET
NW OREGON
NW SIERRA ST.
10"
6"
132+00
130+00
128+00
126+00
124+00
122+00
120+00
118+00
116+00
114+00
112+00
110+00
108+00
106+00
104+00
102+00
100+00
98+00
96+00
94+00
92+00
90+00
88+00

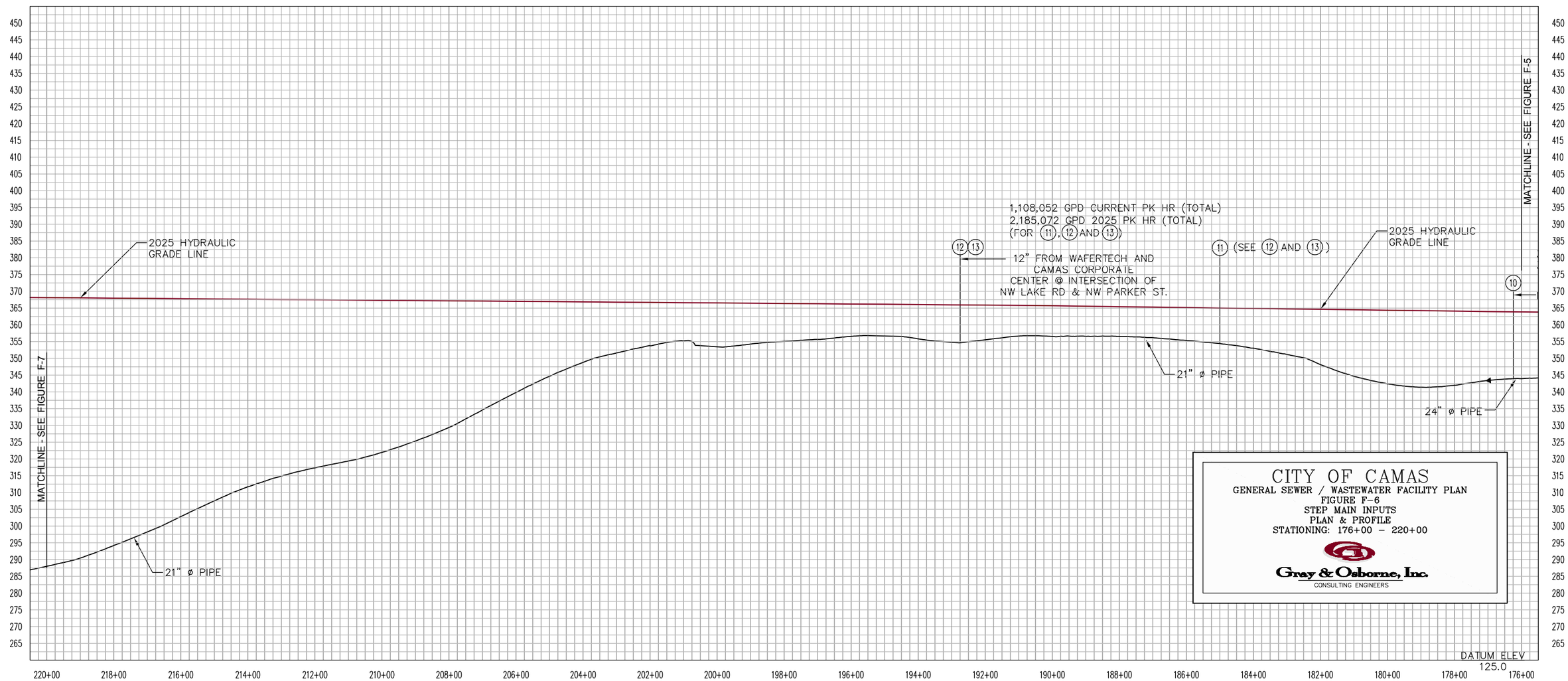

474,195 GPD CURRENT PK HR
744,063 GPD 2025 PK HR
10" FROM
NW SIERRA ST.
SUNNINGDALE GARDENS P-1 L.S. 94gpm
SUNNINGDALE GARDENS P-2 L.S. 20gpm
SUMMIT OAKS L.S.
32,608 GPD CURRENT PK HR
32,608 GPD 2025 PK HR
6" FROM
NW OREGON ST.
24" ø PIPE
5,992 GPD CURRENT PK HR
5,992 GPD 2025 PK HR
6" FROM
NW 44TH AVE ST.
138,310 GPD CURRENT PK HR
220,987 GPD 2025 PK HR
6" FROM
NW LACAMAS DR.
LACAMAS SHORES L.S.
2025 HYDRAULIC GRADE LINE
24" ø PIPE
21" ø PIPE
MATCHLINE - SEE FIGURE F-5
MATCHLINE - SEE FIGURE 1-3
DATUM ELEV
125.0
CITY OF CAMAS
GENERAL SEWER / WASTEWATER FACILITY PLAN
FIGURE F-4
STEP MAIN INPUTS
PLAN & PROFILE
STATIONING: 88+00-132+00
Gray & Osborne, Inc.
CONSULTING ENGINEERS

MATCHLINE - SEE FIGURE F-6
NW JACKSON ST.
NW WALDEN
MATCHLINE - SEE FIGURE F-4
176+00
174+00
172+00
170+00
168+00
166+00
164+00
162+00
160+00
158+00
156+00
154+00
152+00
150+00
148+00
146+00
144+00
142+00
140+00
138+00
136+00
134+00
132+00
10
9
8


34,985 GPD CURRENT PK HR
34,985 GPD 2025 PK HR
2" FROM
NW JACKSON ST.
2025 HYDRAULIC
GRADE LINE
2025 HYDRAULIC
GRADE LINE
84,137 GPD CURRENT PK HR (TOTAL)
253,859 GPD 2025 PK HR (TOTAL)
6" FROM
NW WALDEN
24" ø PIPE
24" ø PIPE
MATCHLINE - SEE FIGURE F-6
MATCHLINE - SEE FIGURE F-4
DATUM ELEV
125.0
CITY OF CAMAS
GENERAL SEWER / WASTEWATER FACILITY PLAN
FIGURE F-5
STEP MAIN INPUTS
PLAN & PROFILE
STATIONING: 132+00 – 176+00
Gray & Osborne, Inc.
CONSULTING ENGINEERS



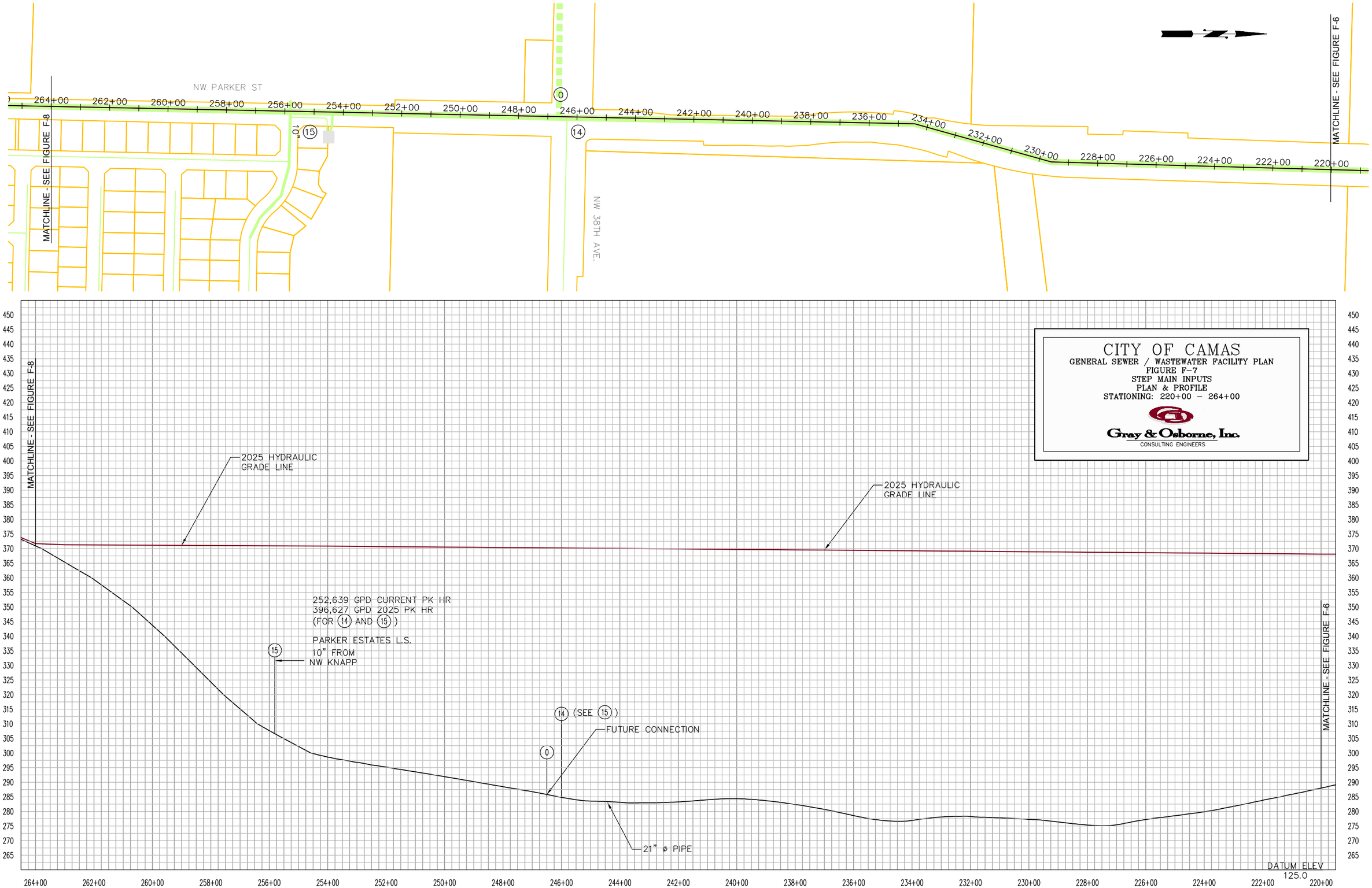



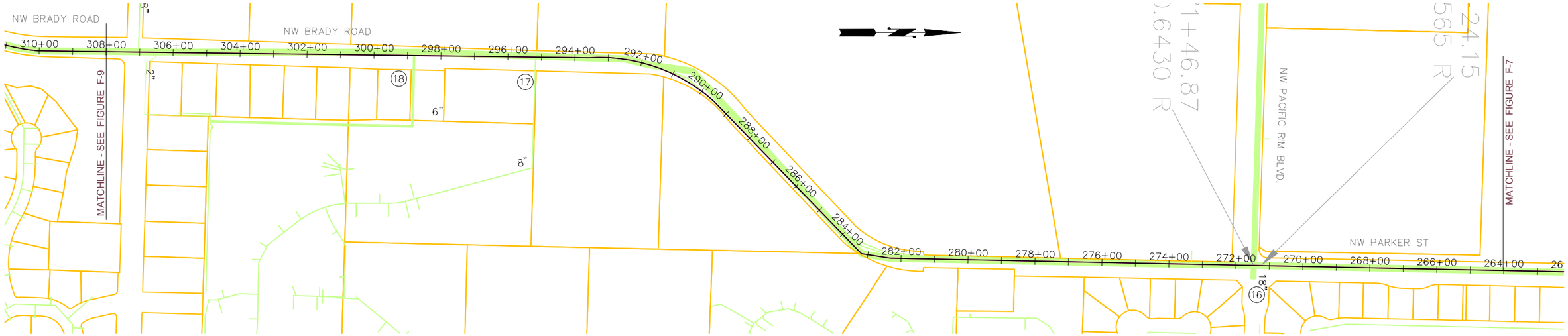

CITY OF CAMAS
GENERAL SEWER / WASTEWATER FACILITY PLAN
FIGURE F-6
STEP MAIN INPUTS
PLAN & PROFILE
STATIONING: 176+00 – 220+00

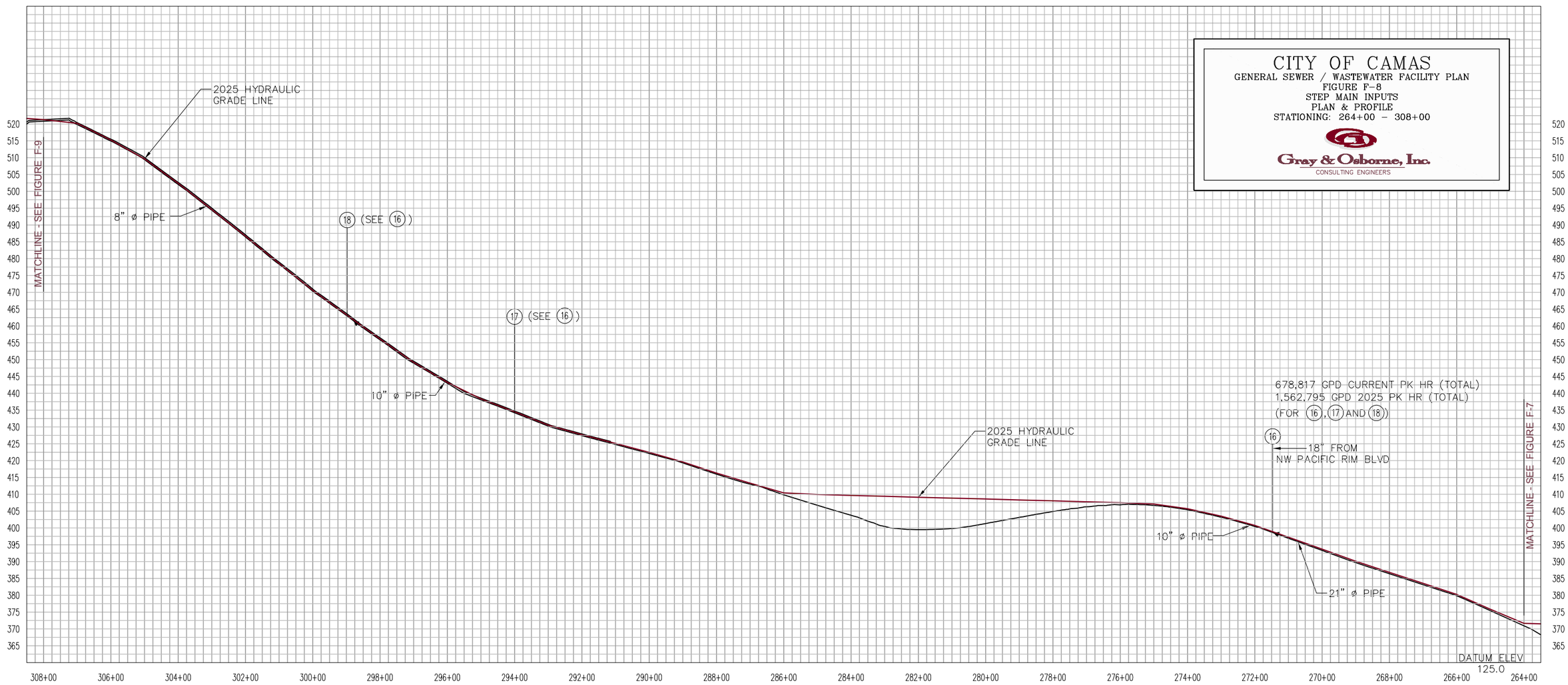
Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\05471 WW FAC PLAN\PLANSET\H-GRADEPROFILE.DWG, FIGURE 6, 7/21/2006 9:50:07 AM, I:I, BY: M SEIDEL




L:\CAMAS\05471 WW Fac Plan\Planset\H-GRADEPROFILE.DWG, FIGURE 7, 7/21/2006 9:51:52 AM, 1:1, BY: M SEIDEL

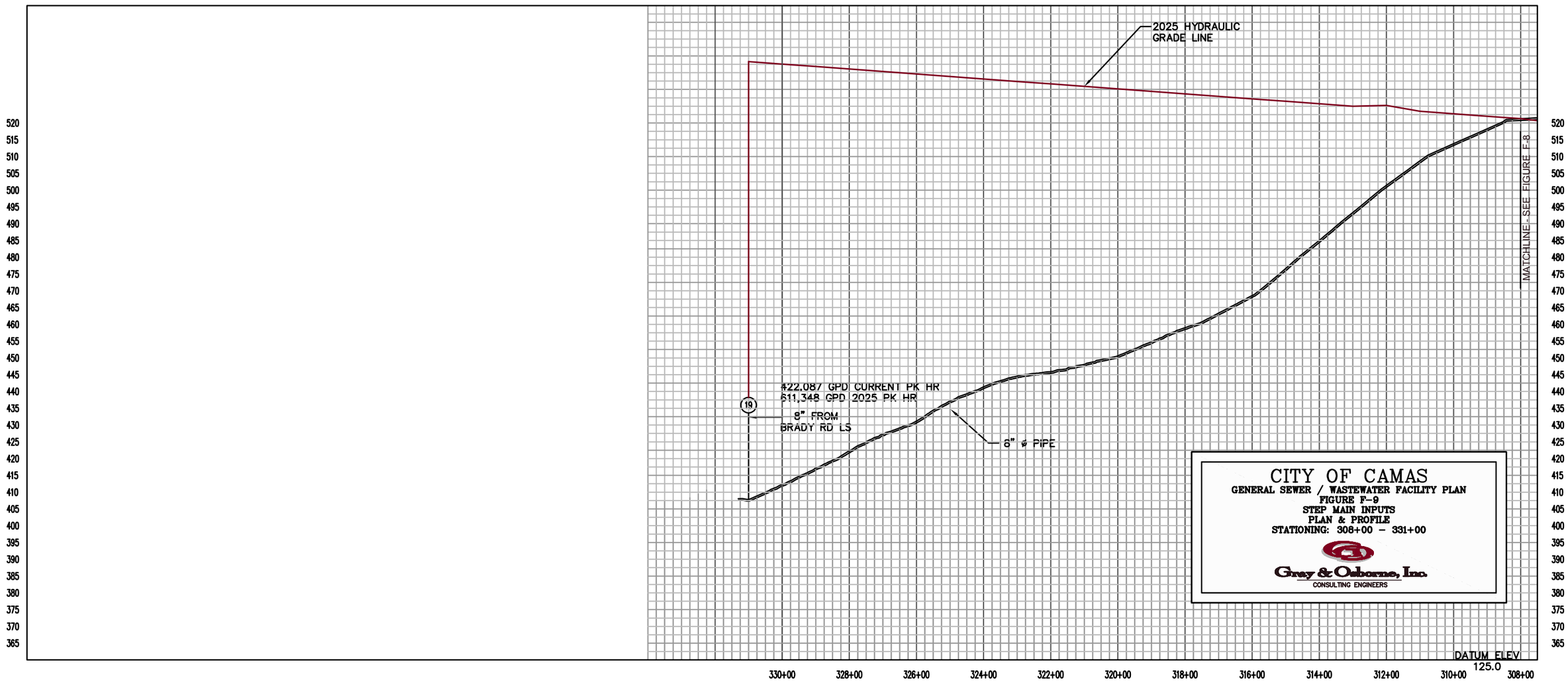



# CITY OF CAMAS

GENERAL SEWER / WASTEWATER FACILITY PLAN
FIGURE F-8
STEP MAIN INPUTS
PLAN & PROFILE
STATIONING: 264+00 – 308+00

Gray & Osborne, Inc.
CONSULTING ENGINEERS

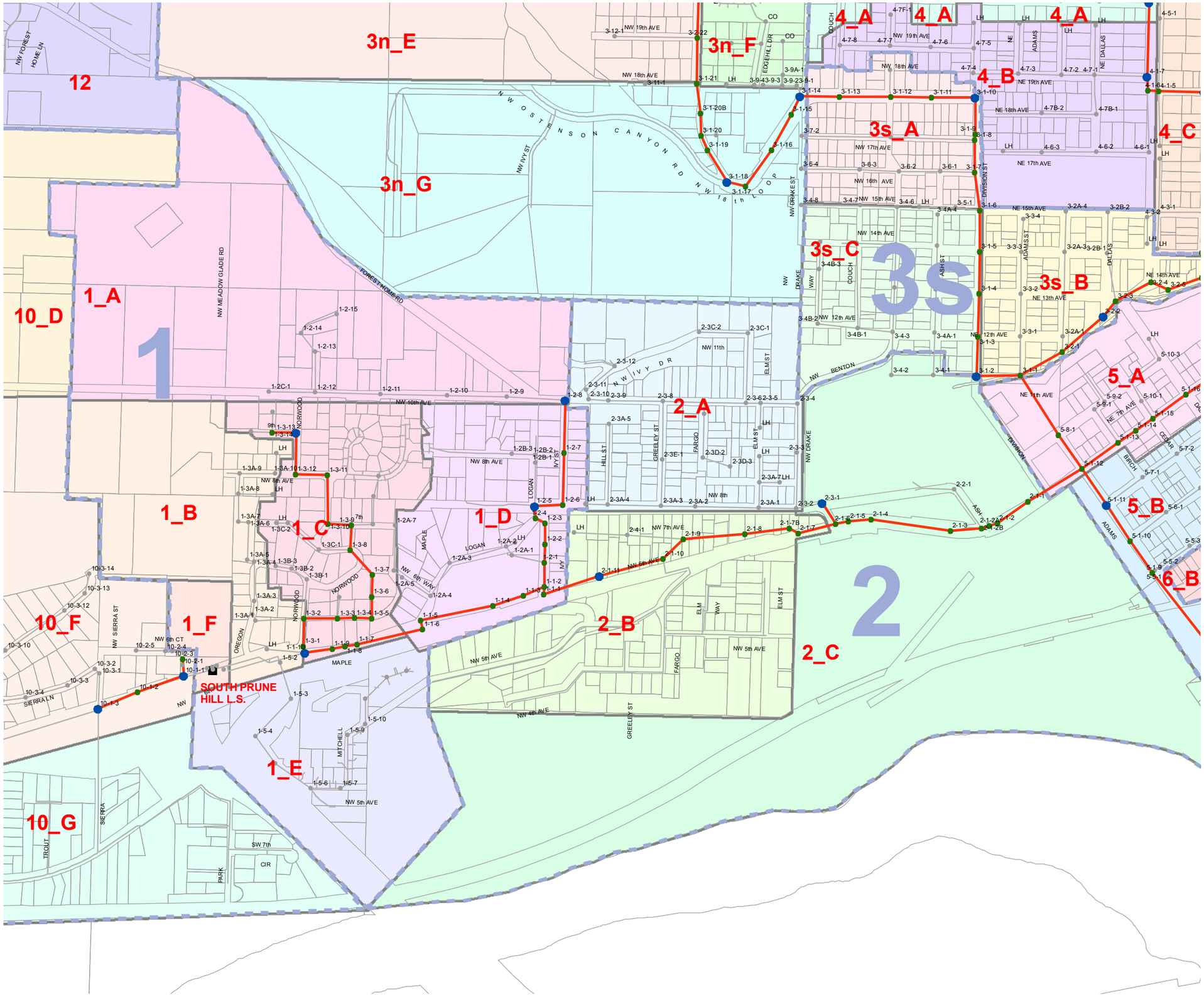



CITY OF CAMAS
GENERAL SEWER / WASTEWATER FACILITY PLAN
FIGURE F-9
STEP MAIN INPUTS
PLAN & PROFILE
STATIONING: 308+00 – 331+00

Gray & Osborne, Inc.
CONSULTING ENGINEERS

# APPENDIX G

# SUBBASINS FOR HYDRAULIC MODEL DEVELOPMENT




**LEGEND:**

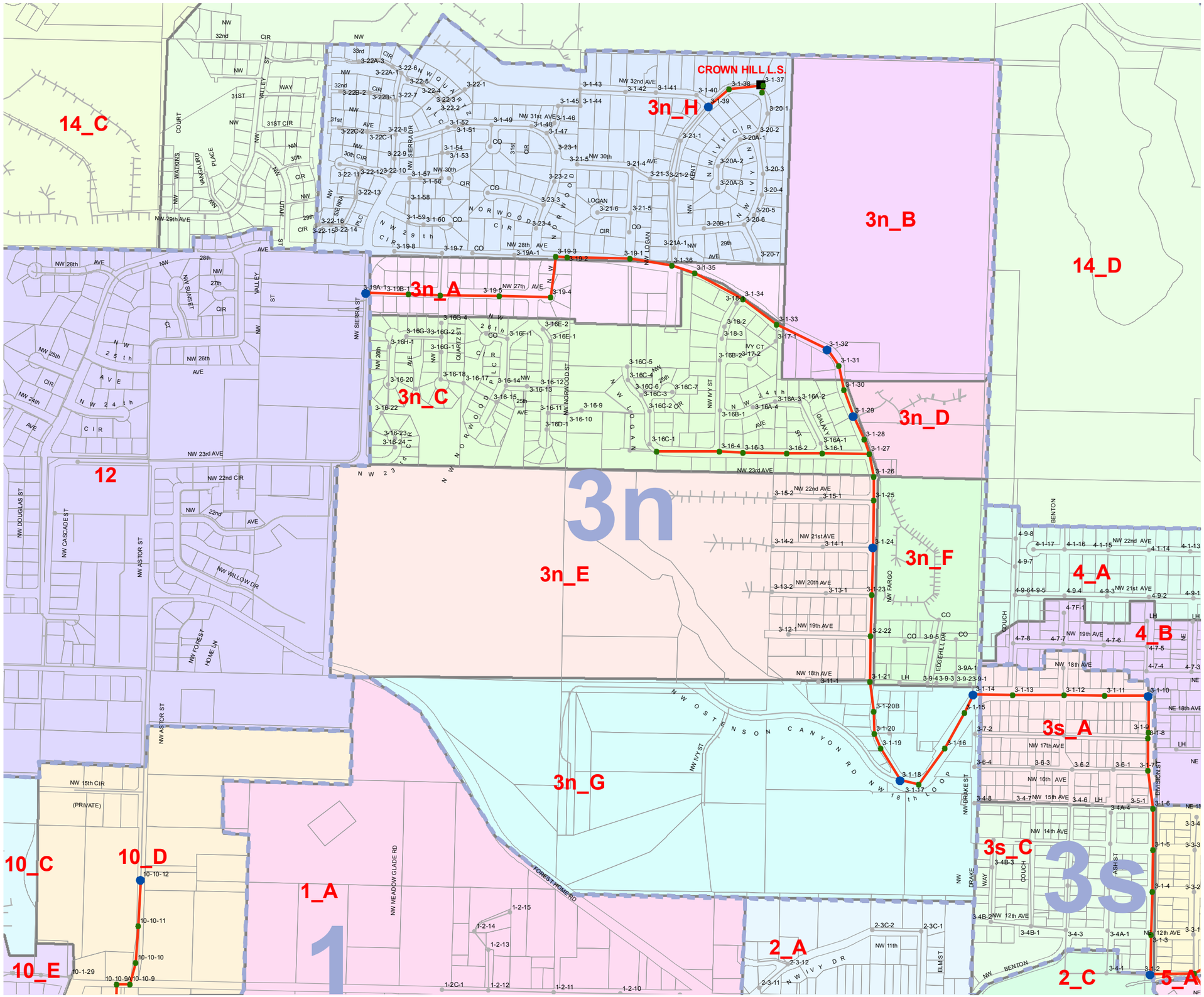
- CITY LIMITS
- URBAN GROWTH BOUNDARY
- URBAN RESERVE
- SEWER BASINS
- PARCELS
- SEWER PIPELINES:
- SEWER MANHOLES
- INPUT MANHOLES
- MODELED MANHOLES
- MODELED PIPES
- SUB-BASINS

# CITY OF CAMAS

GENERAL SEWER / WASTEWATER FACILITY PLAN
MODEL DEVELOPMENT
FIGURE G-1

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\05471\GIS\MODEL_DEVELOPMENT_FIGURES\FIG_G-1.MXD




N

0 600 1,200 Feet

**LEGEND:**

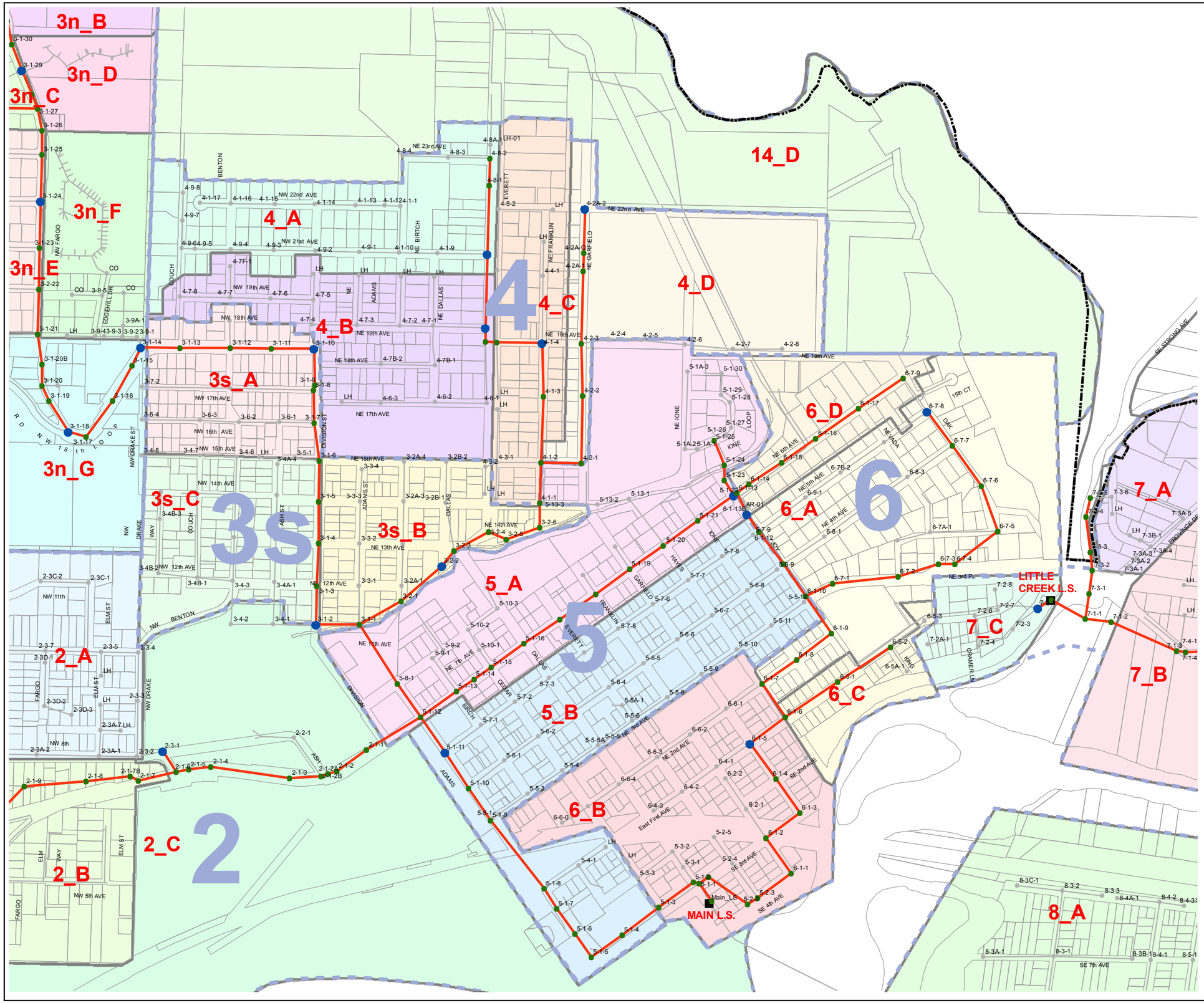
- CITY LIMITS
- URBAN GROWTH BOUNDARY
- URBAN RESERVE
- SEWER BASINS
- SEWER MANHOLES
- PARCELS
- SEWER PIPELINES:
- INPUT MANHOLES
- MODELED MANHOLES
- MODELED PIPES
- SUB-BASINS

# CITY OF CAMAS

GENERAL SEWER / WASTEWATER FACILITY PLAN
MODEL DEVELOPMENT
FIGURE G-2

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\05471\GIS\MODEL_DEVELOPMENT_FIGURES\FIG_G-2.MXD




N

0 600 1,200 Feet

**LEGEND:**

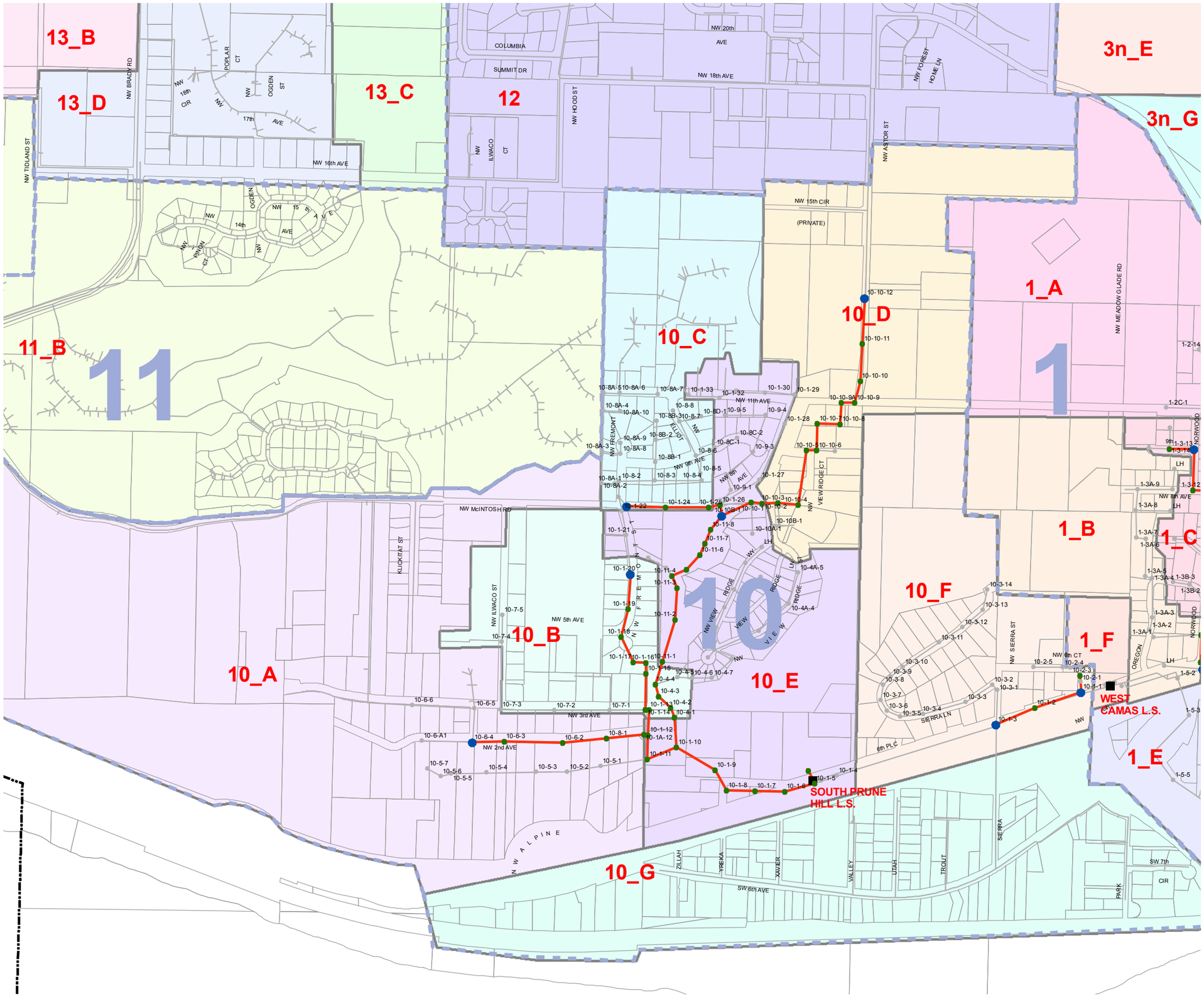
- CITY LIMITS
- URBAN GROWTH BOUNDARY
- URBAN RESERVE
- SEWER BASINS
- SEWER MANHOLES
- PARCELS
- SEWER PIPELINES:
- INPUT MANHOLES
- MODELED MANHOLES
- MODELED PIPES
- SUB-BASINS

# CITY OF CAMAS

GENERAL SEWER / WASTEWATER FACILITY PLAN
MODEL DEVELOPMENT
FIGURE G-3

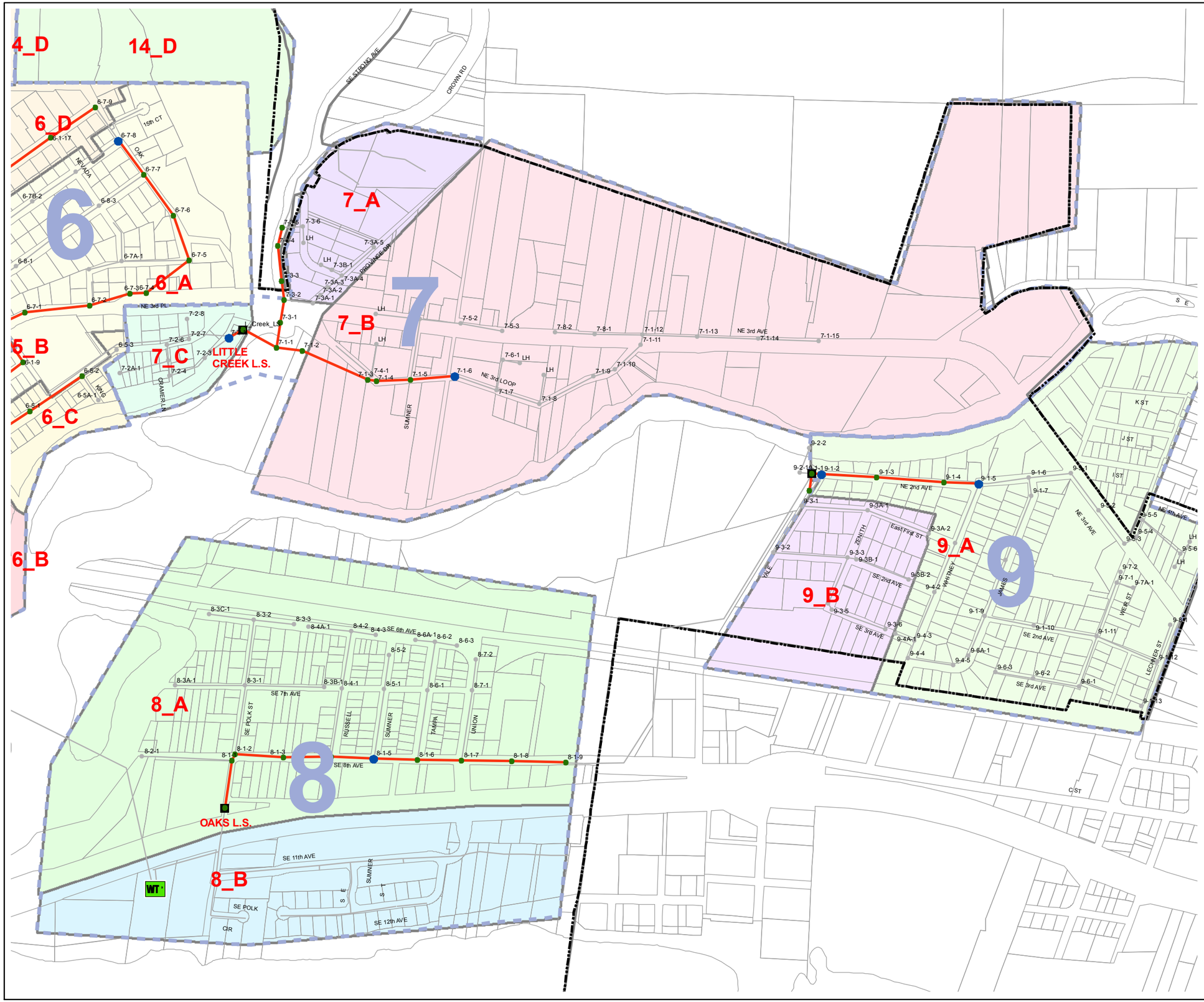
Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\05471\GIS\MODEL_DEVELOPMENT_FIGURES\FIG_G-3.MXD




CITY OF CAMAS

GENERAL SEWER / WASTEWATER FACILITY PLAN
MODEL DEVELOPMENT
FIGURE G-4




**LEGEND:**

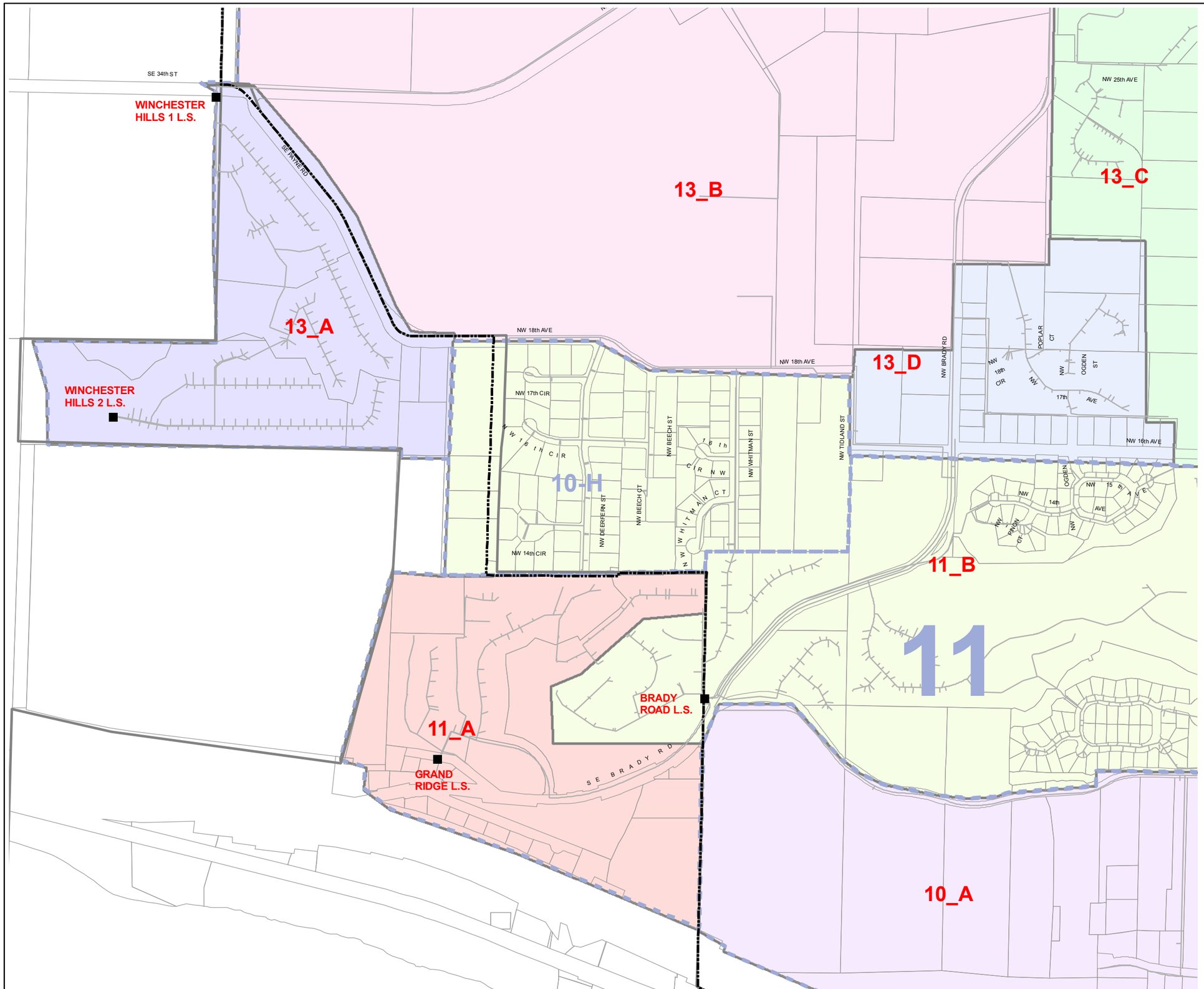
- CITY LIMITS
- URBAN GROWTH BOUNDARY
- URBAN RESERVE
- SEWER BASINS
- SEWER MANHOLES
- PARCELS
- SEWER PIPELINES:
- INPUT MANHOLES
- MODELED MANHOLES
- MODELED PIPES
- SUB-BASINS

# CITY OF CAMAS

GENERAL SEWER / WASTEWATER FACILITY PLAN
MODEL DEVELOPMENT
FIGURE G-5

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\05471\GIS\MODEL_DEVELOPMENT_FIGURES\FIG_G-5.MXD




**LEGEND:**

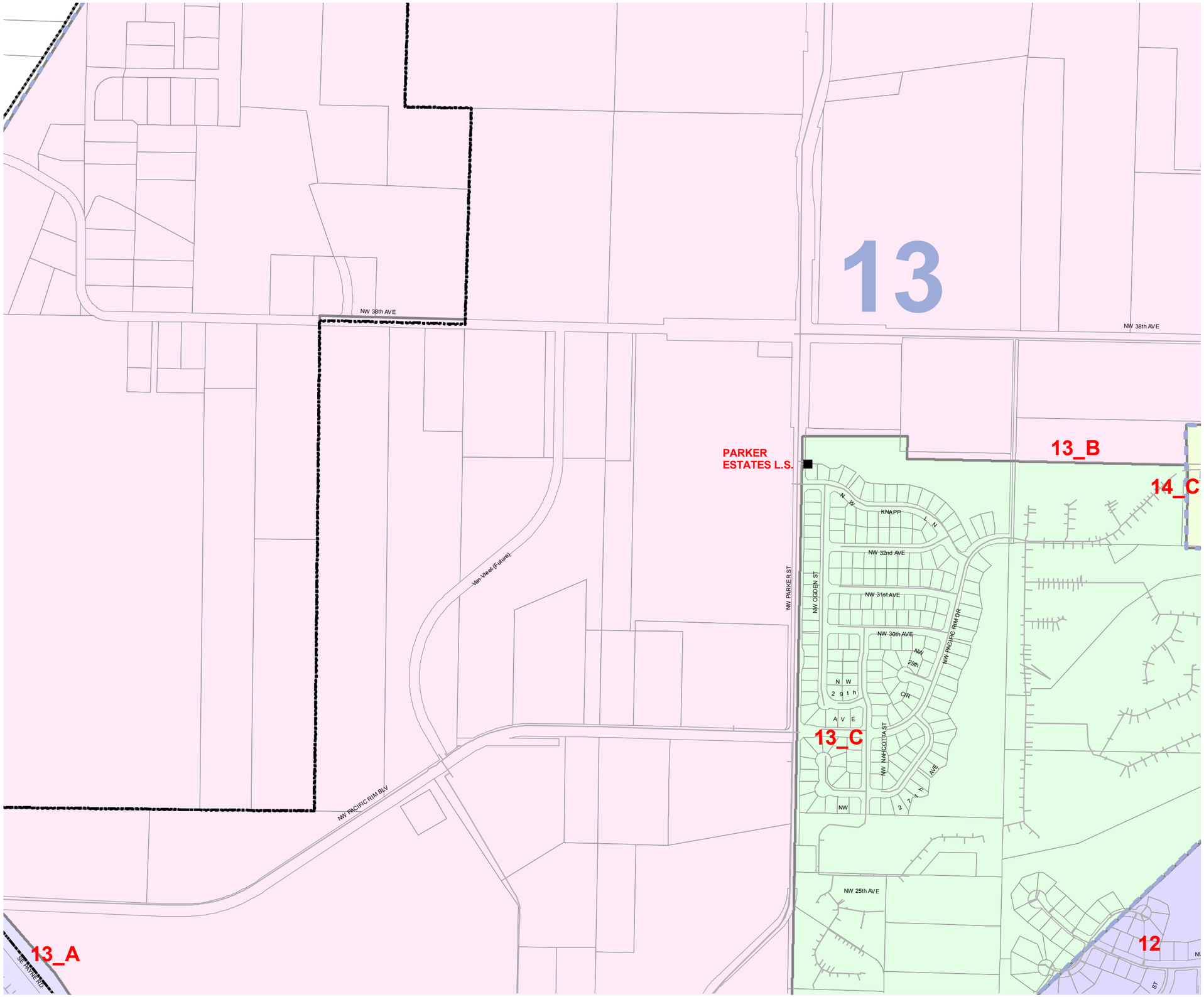
- CITY LIMITS
- URBAN GROWTH BOUNDARY
- URBAN RESERVE
- SEWER BASINS
- SEWER MANHOLES
- PARCELS
- SEWER PIPELINES:
- INPUT MANHOLES
- MODELED MANHOLES
- MODELED PIPES
- SUB-BASINS

# CITY OF CAMAS

GENERAL SEWER / WASTEWATER FACILITY PLAN
MODEL DEVELOPMENT
FIGURE G-6

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\05471\GIS\MODEL_DEVELOPMENT_FIGURES\FIG_G-6.MXD




N

0 600 1,200 Feet

**LEGEND:**

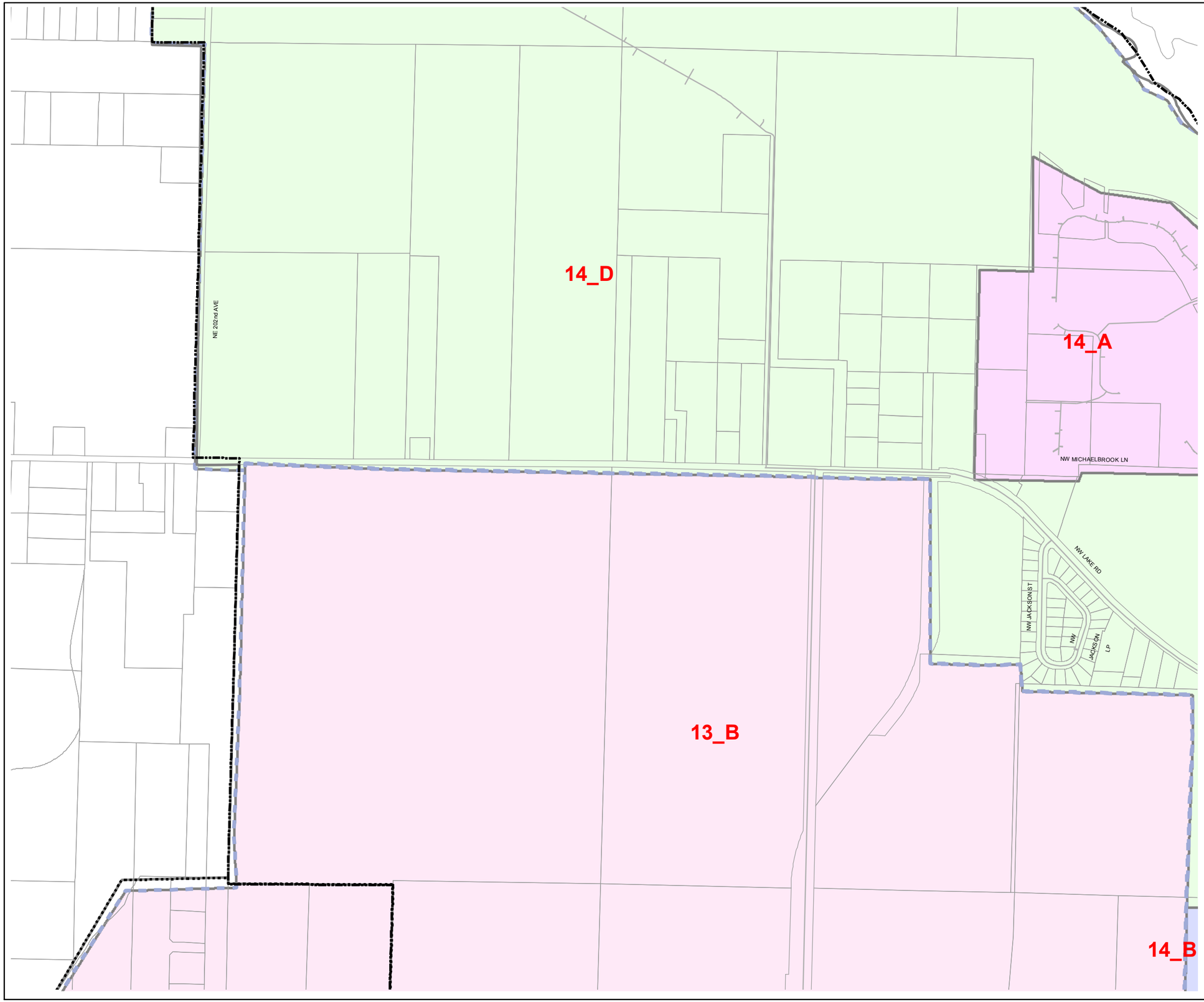
- CITY LIMITS
- URBAN GROWTH BOUNDARY
- URBAN RESERVE
- SEWER BASINS
- SEWER MANHOLES
- PARCELS
- SEWER PIPELINES:
- INPUT MANHOLES
- MODELED MANHOLES
- MODELED PIPES
- SUB-BASINS

# CITY OF CAMAS

GENERAL SEWER / WASTEWATER FACILITY PLAN
MODEL DEVELOPMENT
FIGURE G-7

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\05471\GIS\MODEL_DEVELOPMENT_FIGURES\FIG_G-7.MXD




**LEGEND:**

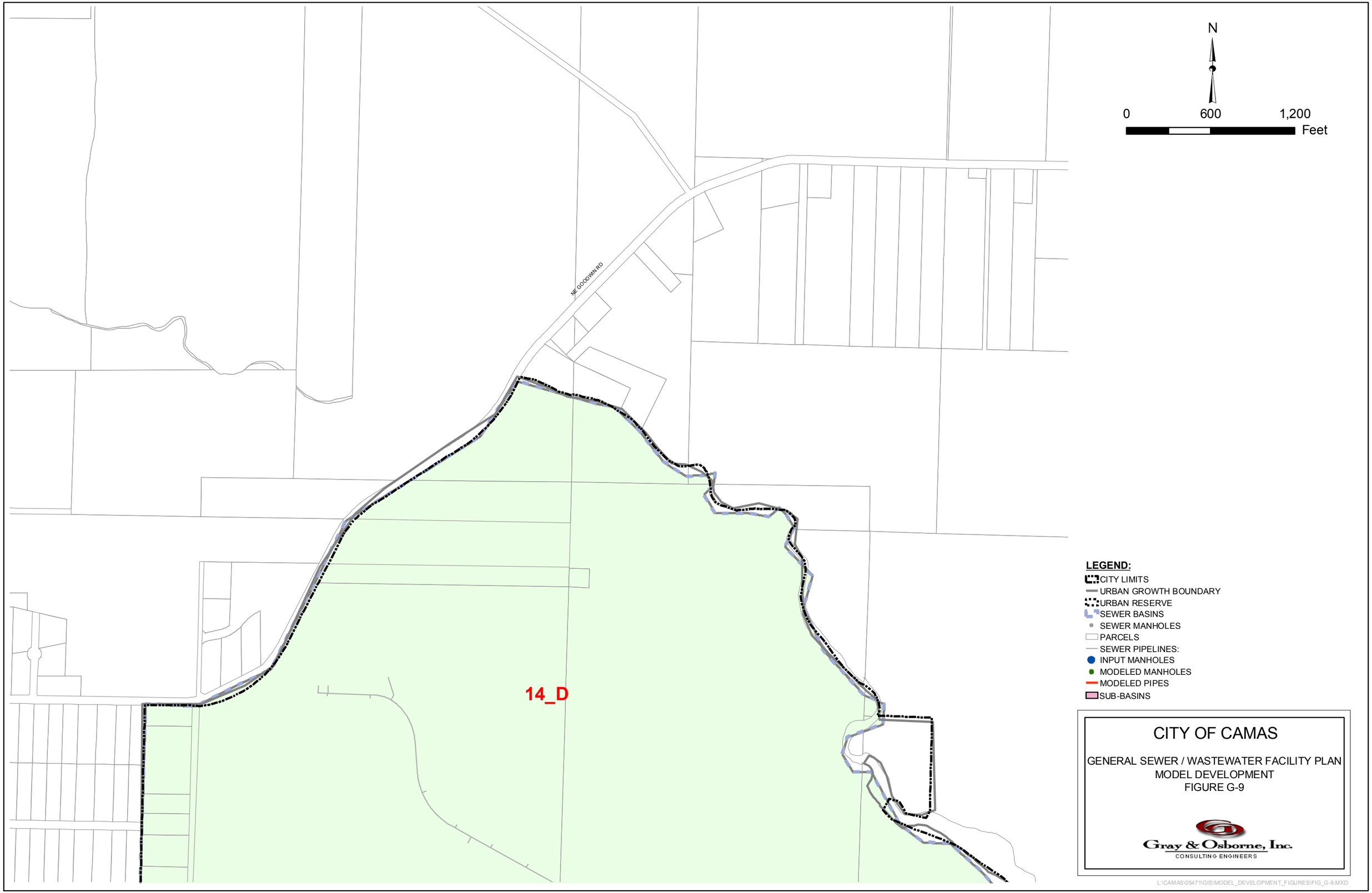
- CITY LIMITS
- URBAN GROWTH BOUNDARY
- URBAN RESERVE
- SEWER BASINS
- SEWER MANHOLES
- PARCELS
- SEWER PIPELINES:
- INPUT MANHOLES
- MODELED MANHOLES
- MODELED PIPES
- SUB-BASINS

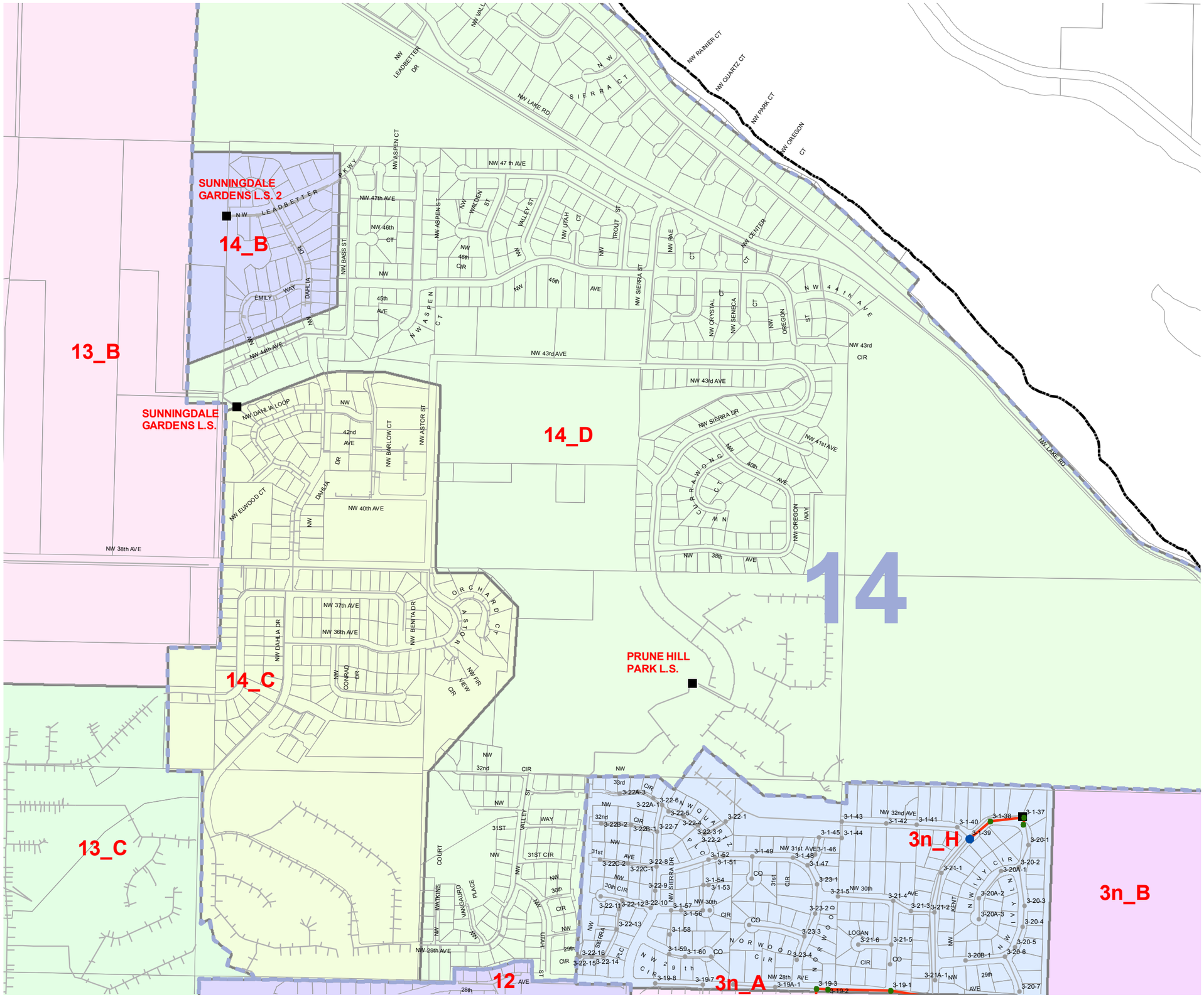
# CITY OF CAMAS

GENERAL SEWER / WASTEWATER FACILITY PLAN
MODEL DEVELOPMENT
FIGURE G-8

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\05471\GIS\MODEL_DEVELOPMENT_FIGURES\FIG_G-8.MXD


N
0
600
1,200
Feet
NE GOODWIN RD
14_D
LEGEND:
CITY LIMITS
URBAN GROWTH BOUNDARY
URBAN RESERVE
SEWER BASINS
SEWER MANHOLES
PARCELS
SEWER PIPELINES:
INPUT MANHOLES
MODELED MANHOLES
MODELED PIPES
SUB-BASINS
CITY OF CAMAS
GENERAL SEWER / WASTEWATER FACILITY PLAN
MODEL DEVELOPMENT
FIGURE G-9
Gray & Osborne, Inc.
CONSULTING ENGINEERS
L:\CAMAS\05471\GIS\MODEL_DEVELOPMENT_FIGURES\FIG_G-9.MXD




**LEGEND:**

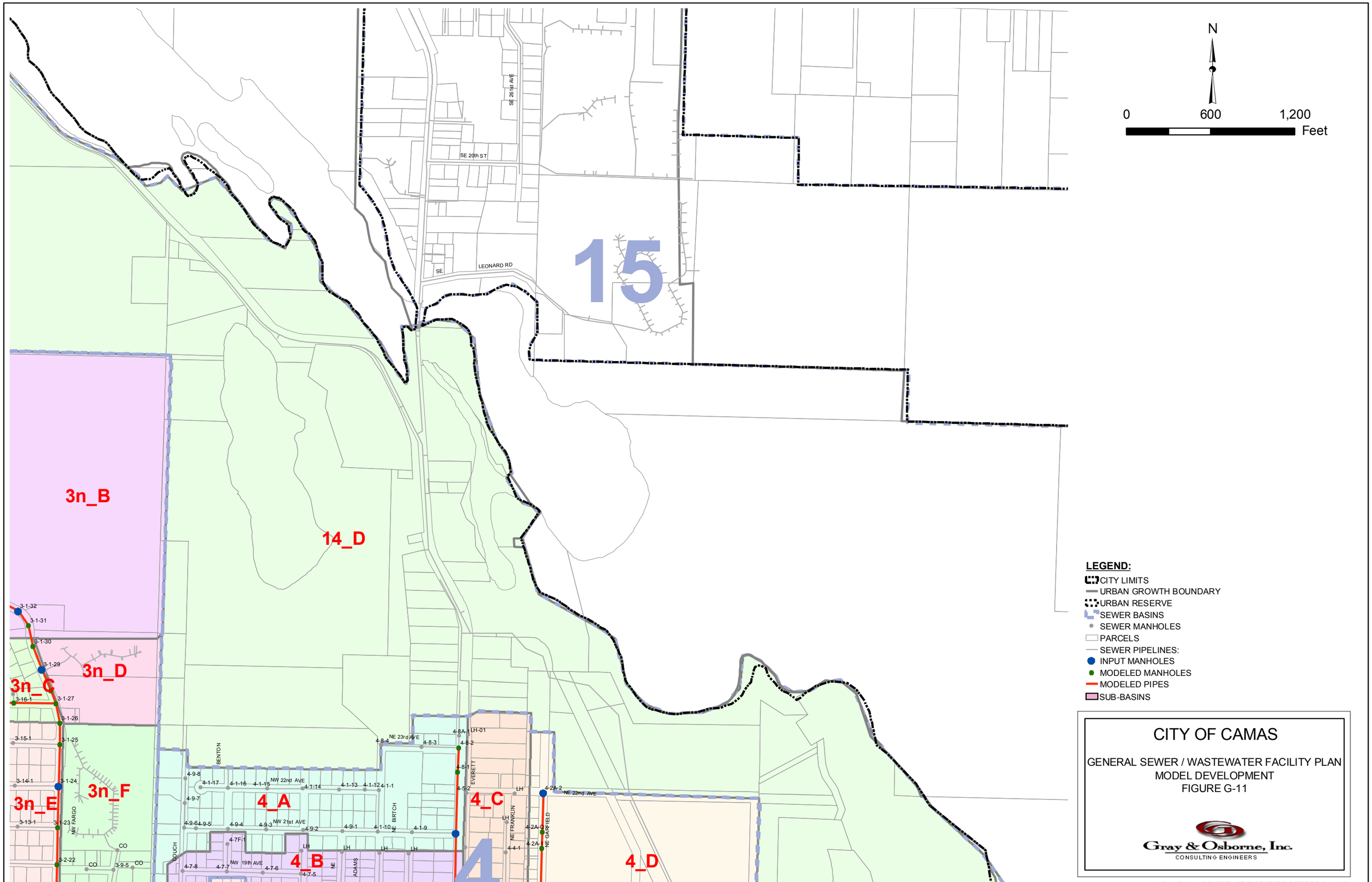
- CITY LIMITS
- URBAN GROWTH BOUNDARY
- URBAN RESERVE
- SEWER BASINS
- SEWER MANHOLES
- PARCELS
- SEWER PIPELINES:
- INPUT MANHOLES
- MODELED MANHOLES
- MODELED PIPES
- SUB-BASINS

# CITY OF CAMAS

GENERAL SEWER / WASTEWATER FACILITY PLAN
MODEL DEVELOPMENT
FIGURE G-10

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\05471\GIS\MODEL_DEVELOPMENT_FIGURES\FIG_G-10.MXD


N
0
600
1,200
Feet
SE 26th AVE
SE 20th ST
SE
LEONARD RD
15
3n_B
14_D
3n_D
3n_C
3n_F
3n_E
4_A
4_B
4_C
4_D
4
NW 22nd AVE
NW 21st AVE
NW 19th AVE
NE 23rd AVE
NE 22nd AVE
BENTON
BOUCH
NW FARGO
NE BIRTCH
ADAMS
EVERETT
NE FRANKLIN
NE GARFIELD
LEGEND:
CITY LIMITS
URBAN GROWTH BOUNDARY
URBAN RESERVE
SEWER BASINS
SEWER MANHOLES
PARCELS
SEWER PIPELINES:
INPUT MANHOLES
MODELED MANHOLES
MODELED PIPES
SUB-BASINS
CITY OF CAMAS
GENERAL SEWER / WASTEWATER FACILITY PLAN
MODEL DEVELOPMENT
FIGURE G-11
Gray & Osborne, Inc.
CONSULTING ENGINEERS
L:\CAMAS\05471\GIS\MODEL_DEVELOPMENT_FIGURES\FIG_G-11.MXD

# APPENDIX H

# 304 STAINLESS STEEL SADDLE FAILURE ANALYSIS REPORT

CITY OF CAMAS
616 Northeast Fourth Avenue
P.O. Box 1055
Camas, Washington 98607
http://www.ci.camas.wa.us

DEPARTMENT OF PUBLIC WORKS

June 25, 2001

Mr. Cline Reese
Romac Industries, Inc.
21919 20th Ave SE, Suite 100
Bothell, WA 98021

SUBJECT: *RMA # 55857*
***4" x 1" 304 Stainless Saddle***

Dear Mr. Reese:

Please find enclosed (1) Romac 304 Stainless Saddle as described above and per our telephone conversation of Friday, June 22, 2001. The subject saddle was installed in September of 1994 in the Prune Hill Estates Subdivision in Camas by Wubbin Brothers, Inc. of Vancouver, Washington. This type of saddle has been the typical product installed for a 1" diameter Schedule 40 PVC S.T.E.P. sanitary sewer service in the City of Camas for approximately 10 years. The supplier of the saddle was most likely US Filter of Vancouver, Washington.

The City investigated a complaint of a sewer leak on NW Douglas Street in Camas on June 20, 2001. A City maintenance crew excavated and exposed (2) saddles and found both of them to be pitted and leaking around the weld between the threaded nipple and the body of the saddle. The saddles were connected to a 4" diameter Class 200 PVC pressure sewer main which was bedded and backfilled entirely with imported granular material. The saddles were located in an area of the main that was only partially full of liquid. Both saddles were removed and replaced with similar new ones by a City maintenance crew.

We would greatly appreciate your assistance in determining the nature and cause of the corrosion that lead to the failure of these saddles. Please inspect the saddle and advise us in writing of your findings as soon as possible. Please call me if you have any comments or questions. I can be reached at 360-834-3451.

Sincerely,

James M. Hodges

James Hodges
Engineer III

Enclosure

CC: Mark Wubben
US Filter
Jim Anderson
Monte Brachmann

Recd 12/31/01

MDE Engineers, Inc.

December 5, 2001

Mr. Cline Reese
Quality Assurance Manager
Romac Industries
21919 - 20th Avenue S.E., Suite 100
Bothell, WA 98021-4404

Re: 304 Stainless Steel Service Saddle Failure Analysis Report
City of Camas, Jim Hodges
Job: # 12001

Dear Mr. Reese:

In our last conversation, you asked for a report on the investigation of the referenced saddle failure. You indicated the part was returned on a pvc pipe which was removed from a step sewer system in Camas, Washington. The part was returned to you for analysis, where in you sent it to us for a third party investigation of the cause or determination of the source of degradation.

Our investigation included initially evaluating the surfaces for the failure mechanism and process. Then we evaluated the media and manufacturing to determine if they influenced the process in any way. A stereomicroscope and compound microscope were utilized to perform the investigation, while long-term microbiological tests were performed to determine if any microbes were present in the corrosion product/media.

The part was designed and shown to fit a pipe 4.50"-4.80" and was manufactured and QC stamped on 8/6/94. The chemical passivation of the part appeared to be proper as shown by the surface structure at 10X. The GTAW welding of the tapped outlet showed no obvious defects. Testing of the weld microstructure was not performed due to the degradation being outside the HAZ(heat affected zone).

The degradation occurred primarily on the internal surface between the gasket and ½ coupling. Though corrosion of stainless steel can burrough it's way from the outside inward, there was no indication of a corrosion process on the exterior surface, indicating the source of the failure was inside the saddle and piping system. Corrosion product was removed and cultured for one week to determine if microbiologically influenced corrosion (MIC) played any part in the degradation.

The MIC tests were found positive for aerobic bacteria, iron reducing bacteria, and sulfate reducing bacteria (SRB). The short rods, some forming chains along debris from the innoculum or small groups of cells are the growth of the SRB. These are shown in the attached photographs.

*700 South Industrial Way* *Seattle, Washington 98108-5231* *206/622-2007 • Fax 206/622-2248*

This MIC corrosion mechanism appears to be the cause of this failure. Other mechanisms, such as; work hardening from overbending or overtorque causing anodic regions, crevices producing stagnant conditions and/or stress corrosion cracking may have influenced or accelerated the process, but it appears the MIC was predominate in the degradation mode. The microbes causing MIC can be found is some sewer systems.

If you would like to discuss these results further, please call me anytime.

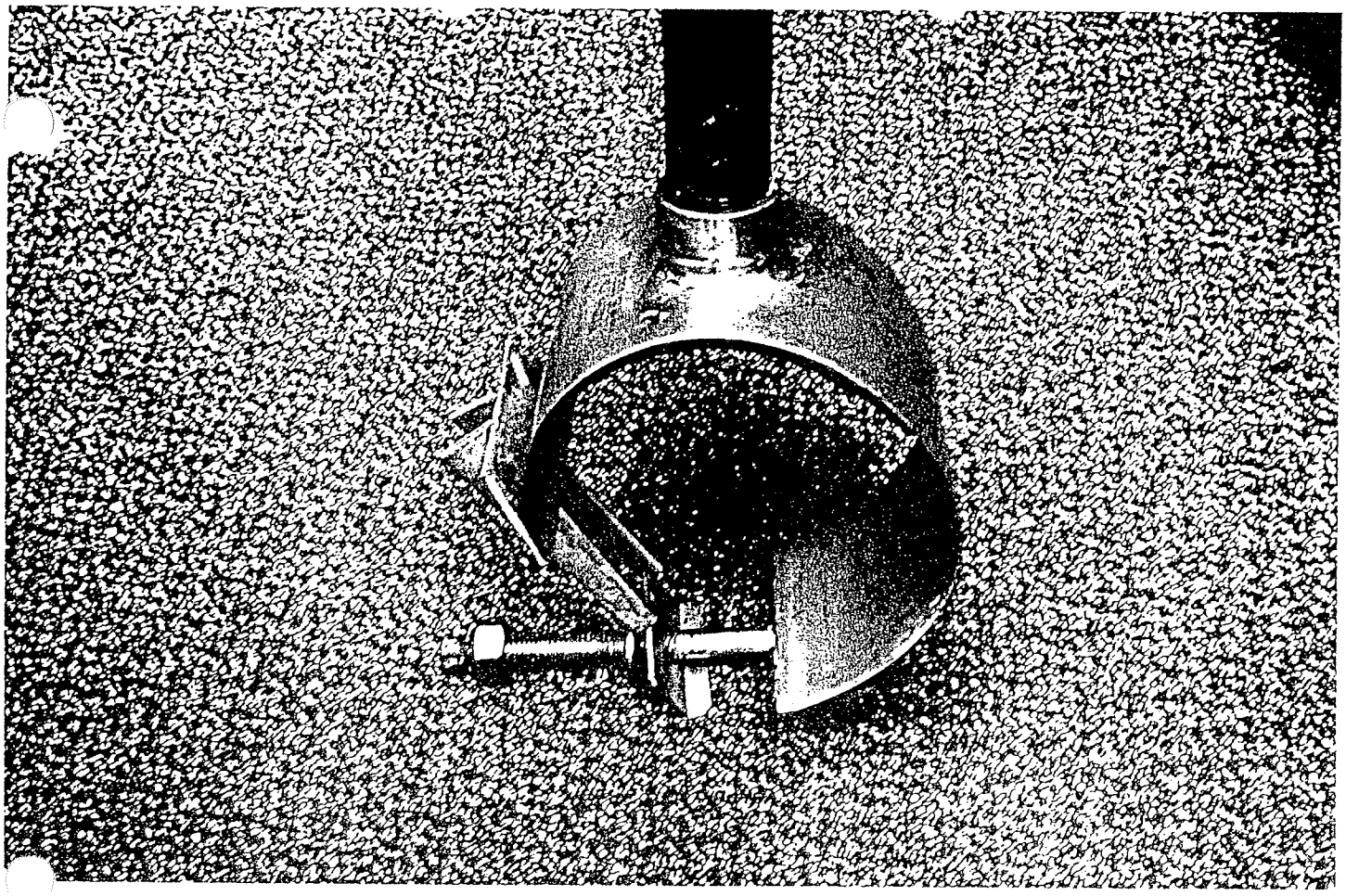
Sincerely,
***MDE*** Engineers, Inc.

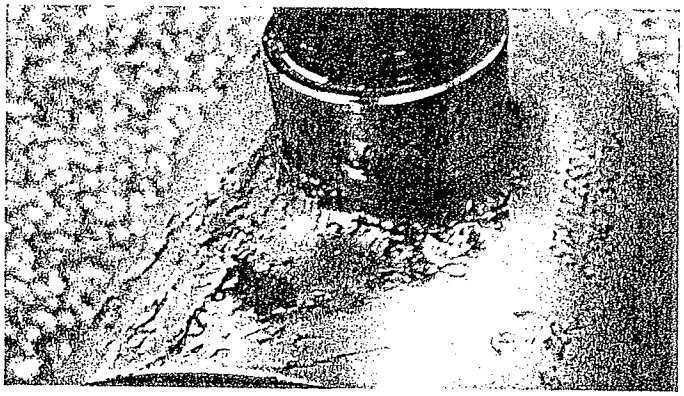
Randy K. Kent, P.E.
Vice-President/Metallurgical Engineer
*e-mail:* kent@mde.com

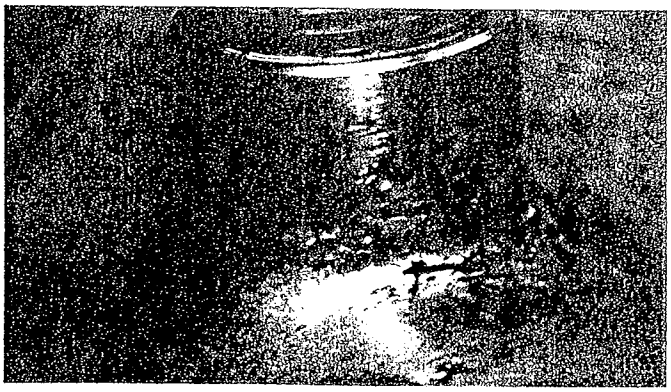
EXPIRES: 11/07/03

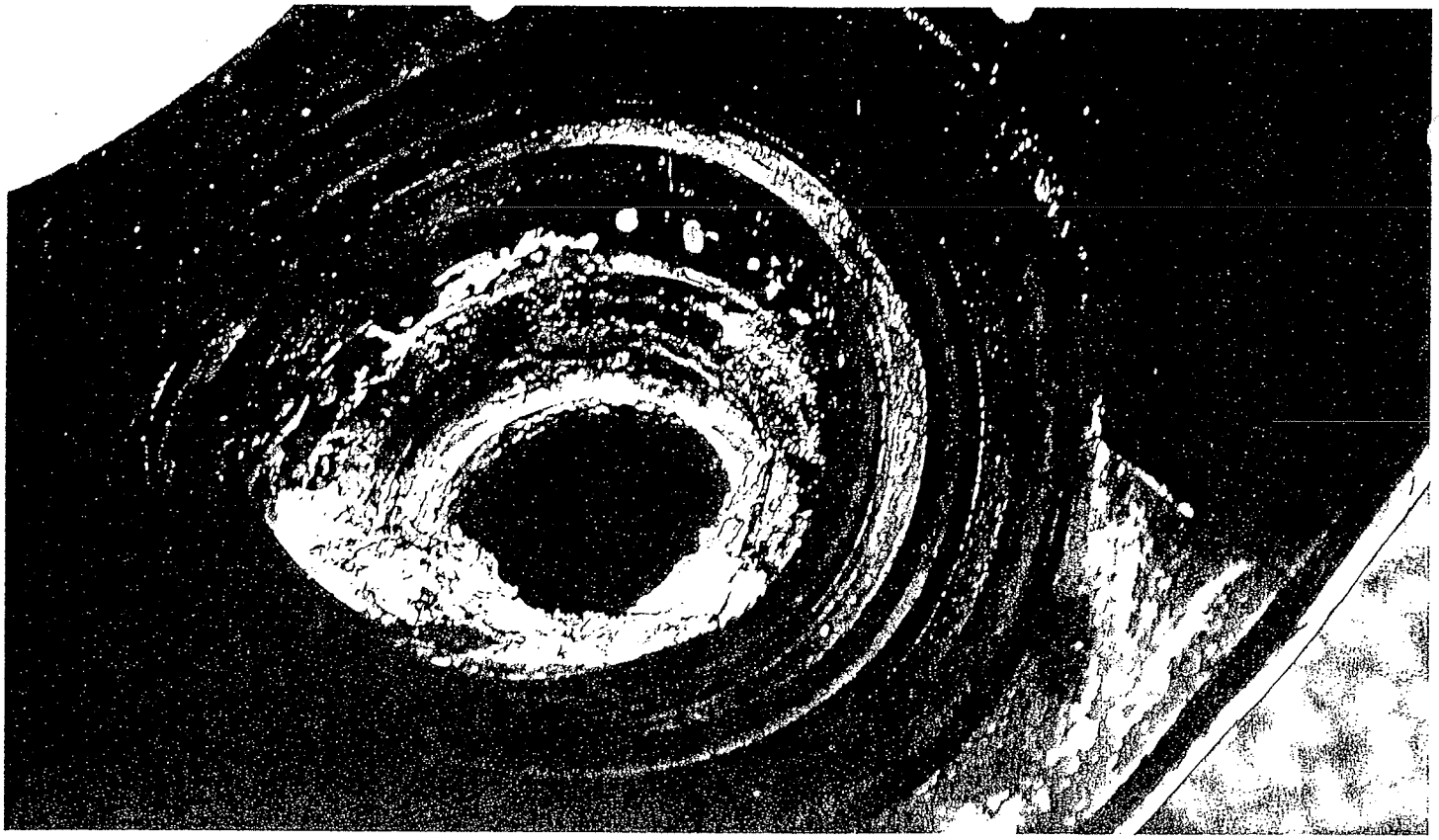
*attachments:* *Photographs and Photomicrographs (4)*

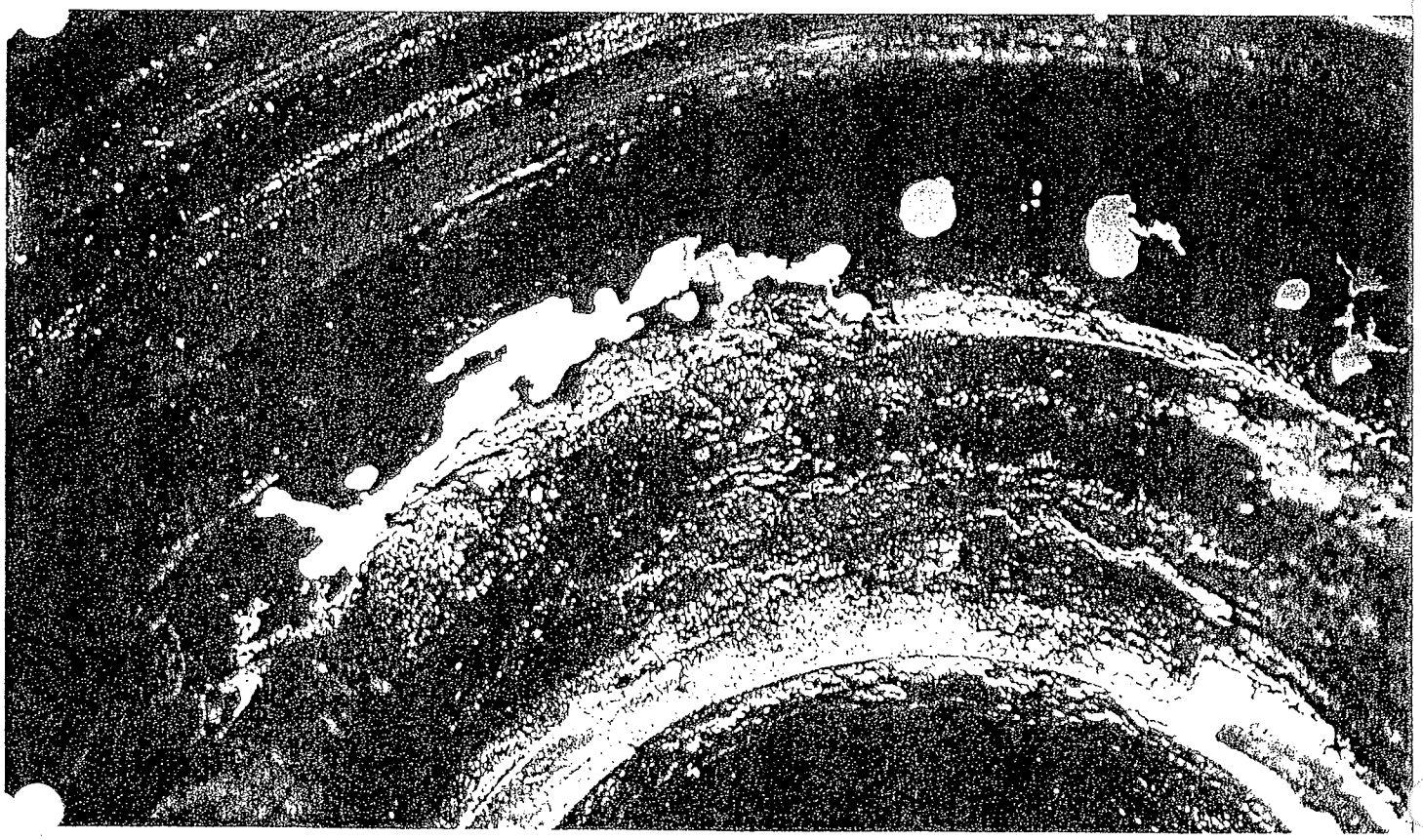
12/6/01
*Reviewed by*

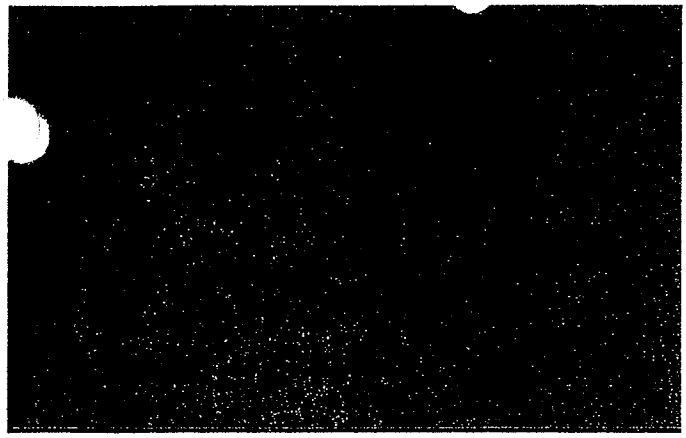


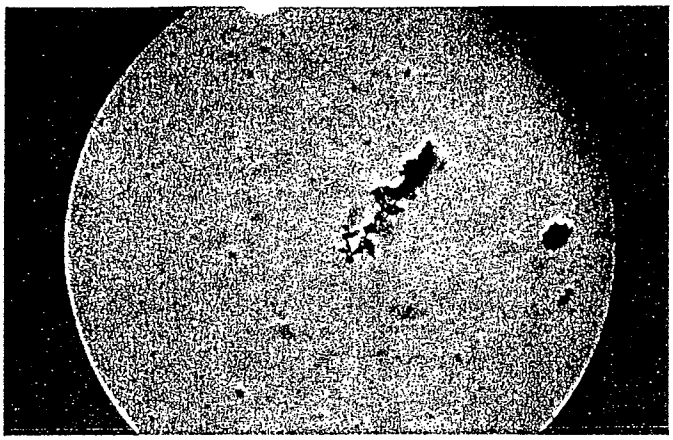


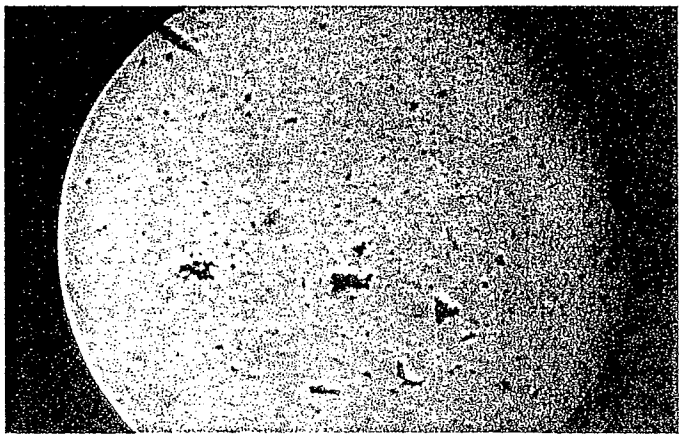


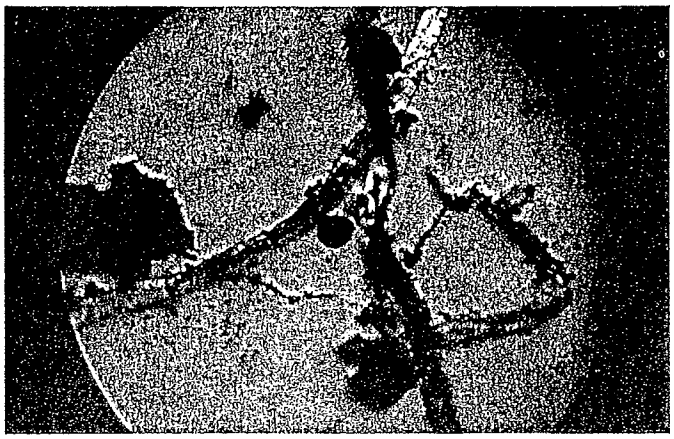


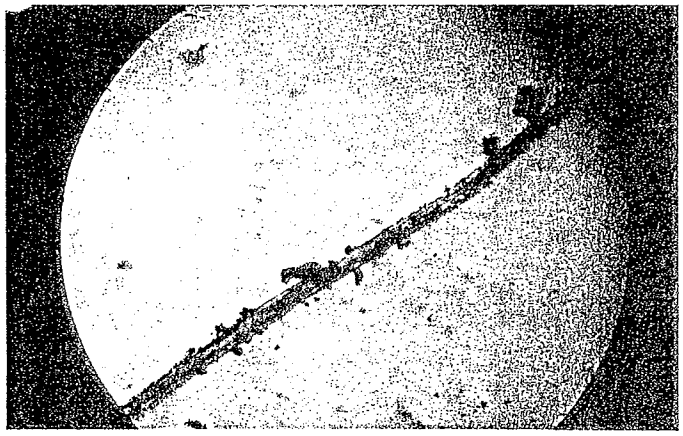


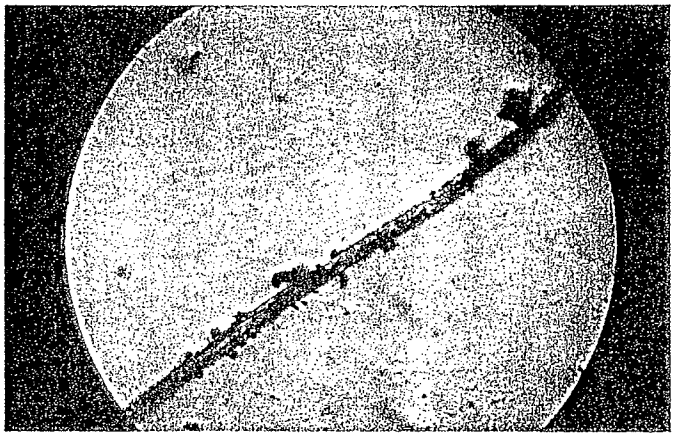


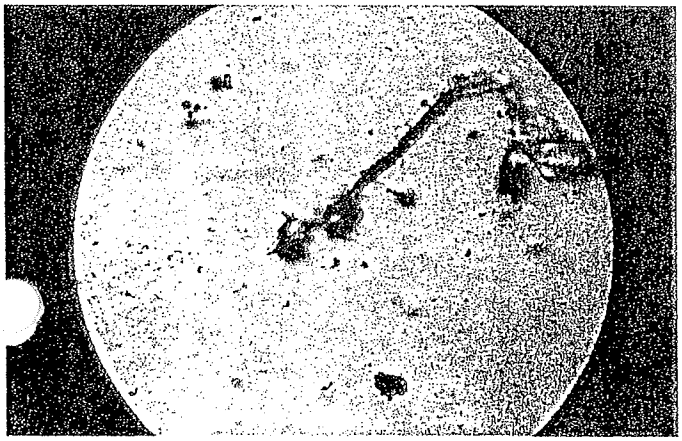


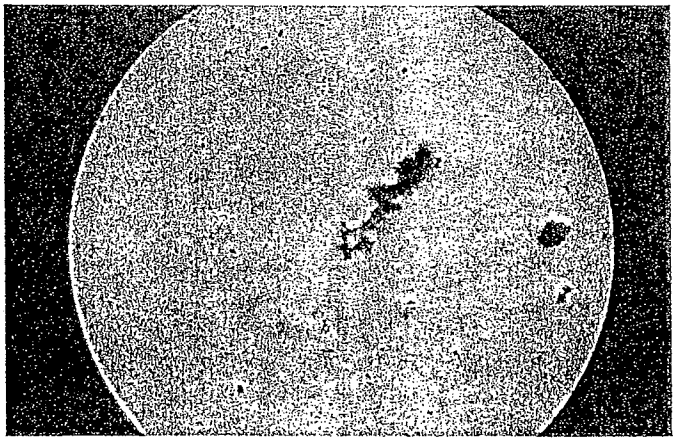


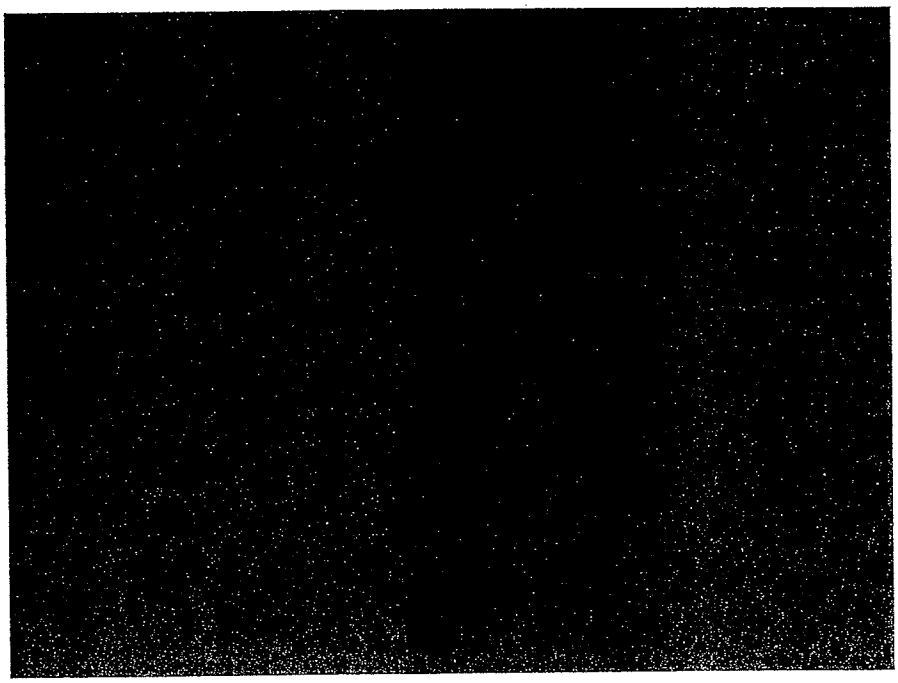


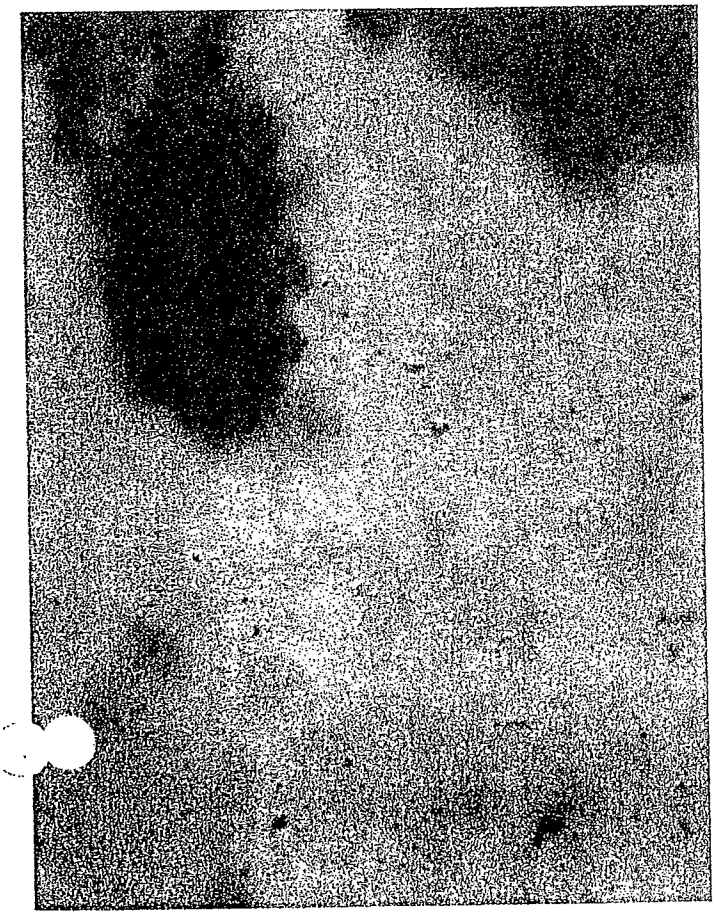


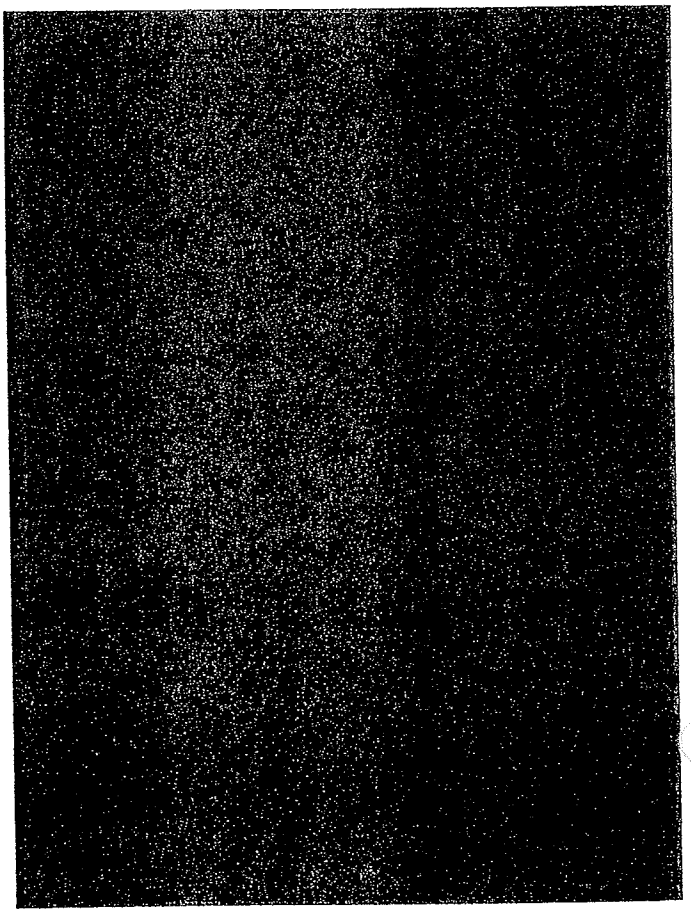


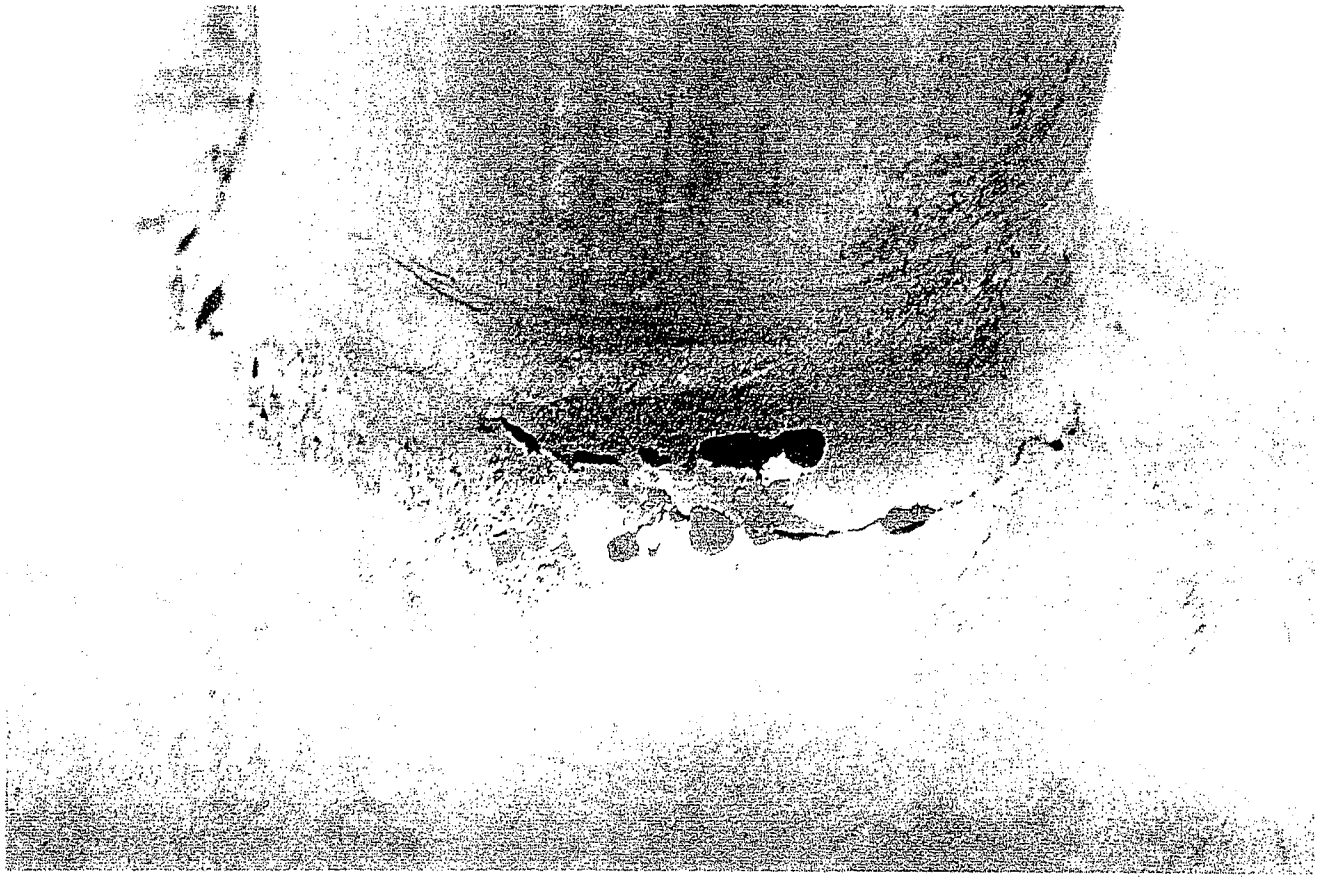












ROMAC
INDUSTRIES,
INC.

21919 20th Ave. SE Suite 100
Bothell, Washington 98021-4404

Hays fluid controls

Transmate
a Division of Romac Industries, Inc.

# *RMA QA Report*

*Customer* **City of Camus**

Camus , Washington

*RMA Number* 55857 *QA Number* 710-10

*Number PartsReturned* 1

*Product Descriptions* 304 4.80 x 1" IP Saddle

---

*QA Report Analysis*

*QA Report Conclusion*

Please see the attached report from the 3rd party lab analysis.

C. Reese
*QA Technician*

*Cline M. Reese - QA Manager*

*Wednesday, December 19, 2001*



PHONE (425) 951-6200 • TOLL FREE 1-800-426-9341 • FAX NUMBER (425) 951-6201

MDE Engineers, Inc.

December 5, 2001

Mr. Cline Reese
Quality Assurance Manager
Romac Industries
21919 - 20th Avenue S.E., Suite 100
Bothell, WA 98021-4404

Re: 304 Stainless Steel Service Saddle Failure Analysis Report
City of Camas, Jim Hodges
Job: # 12001

Dear Mr. Reese:

In our last conversation, you asked for a report on the investigation of the referenced saddle failure. You indicated the part was returned on a pvc pipe which was removed from a step sewer system in Camas, Washington. The part was returned to you for analysis, where in you sent it to us for a third party investigation of the cause or determination of the source of degradation.

Our investigation included initially evaluating the surfaces for the failure mechanism and process. Then we evaluated the media and manufacturing to determine if they influenced the process in any way. A stereomicroscope and compound microscope were utilized to perform the investigation, while long-term microbiological tests were performed to determine if any microbes were present in the corrosion product/media.

The part was designed and shown to fit a pipe 4.50"-4.80" and was manufactured and QC stamped on 8/6/94. The chemical passivation of the part appeared to be proper as shown by the surface structure at 10X. The GTAW welding of the tapped outlet showed no obvious defects. Testing of the weld microstructure was not performed due to the degradation being outside the HAZ(heat affected zone).

The degradation occurred primarily on the internal surface between the gasket and ½ coupling. Though corrosion of stainless steel can burrough it's way from the outside inward, there was no indication of a corrosion process on the exterior surface, indicating the source of the failure was inside the saddle and piping system. Corrosion product was removed and cultured for one week to determine if microbiologically influenced corrosion (MIC) played any part in the degradation.

The MIC tests were found positive for aerobic bacteria, iron reducing bacteria, and sulfate reducing bacteria (SRB). The short rods, some forming chains along debris from the innoculum or small groups of cells are the growth of the SRB. These are shown in the attached photographs.

*700 South Industrial Way Seattle, Washington 98108-5231 206/622-2007 • Fax 206/622-2248*

This MIC corrosion mechanism appears to be the cause of this failure. Other mechanisms, such as; work hardening from overbending or overtorque causing anodic regions, crevices producing stagnant conditions and/or stress corrosion cracking may have influenced or accelerated the process, but it appears the MIC was predominate in the degradation mode. The microbes causing MIC can be found is some sewer systems.

If you would like to discuss these results further, please call me anytime.

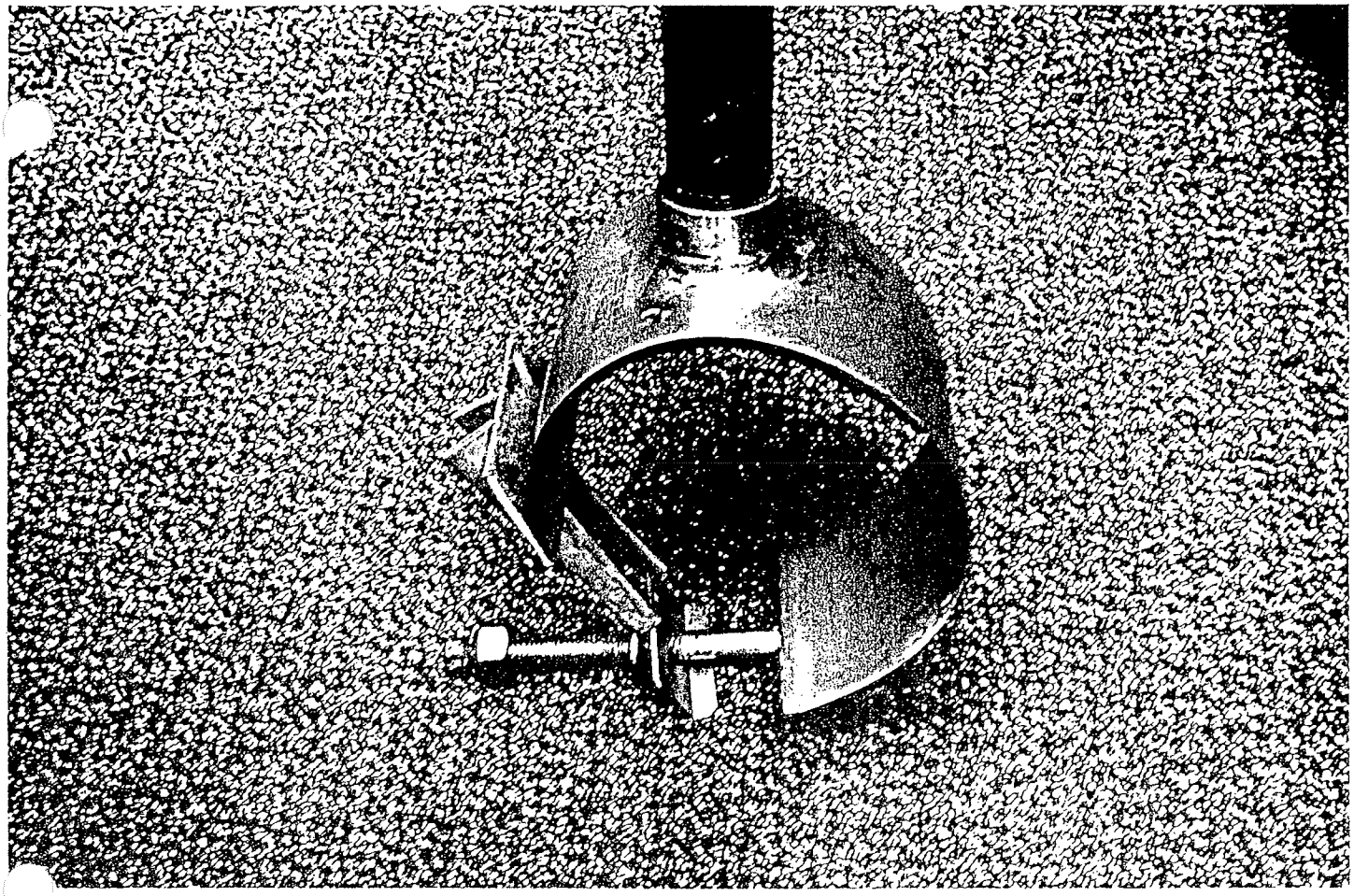
Sincerely,
*MDE* Engineers, Inc.

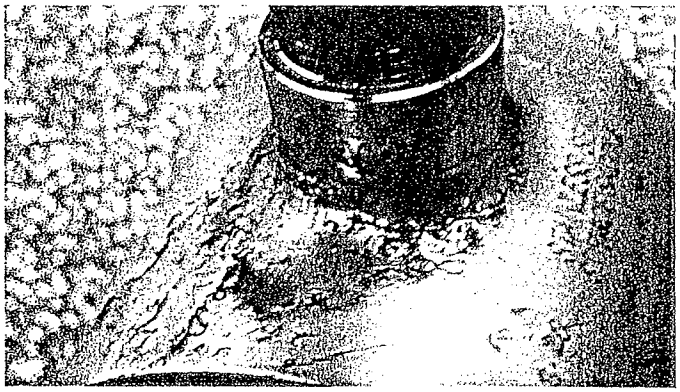
Randy K. Kent, P.E.
Vice-President/Metallurgical Engineer
*e-mail:* kent@mde.com

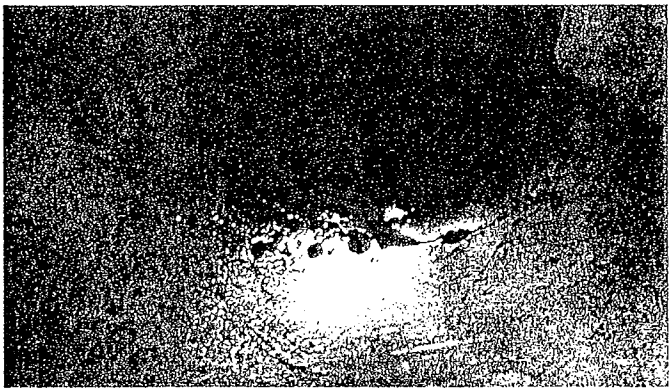
EXPIRES: 11/01/03

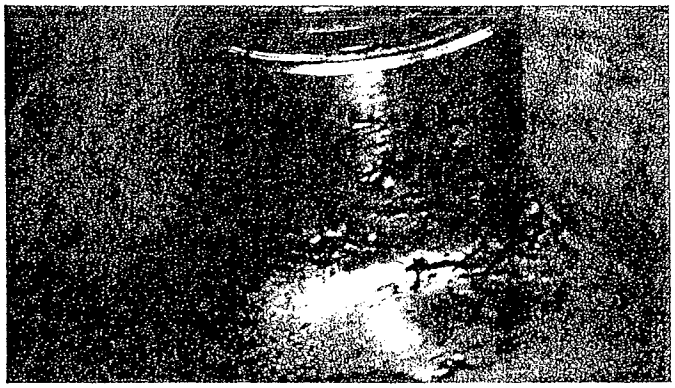
*attachments:* *Photographs and Photomicrographs (4)*

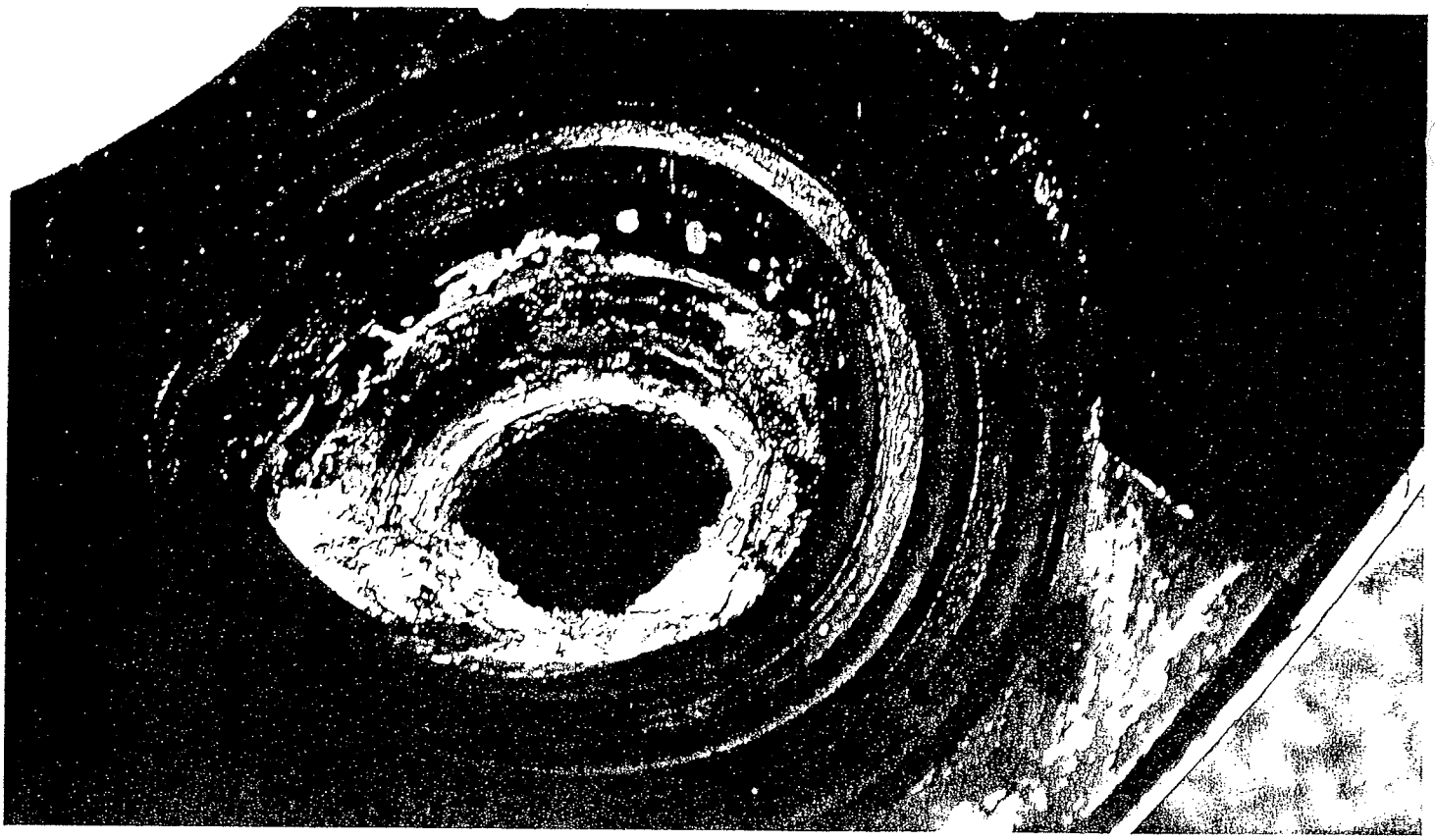
12/6/01
*Reviewed by*

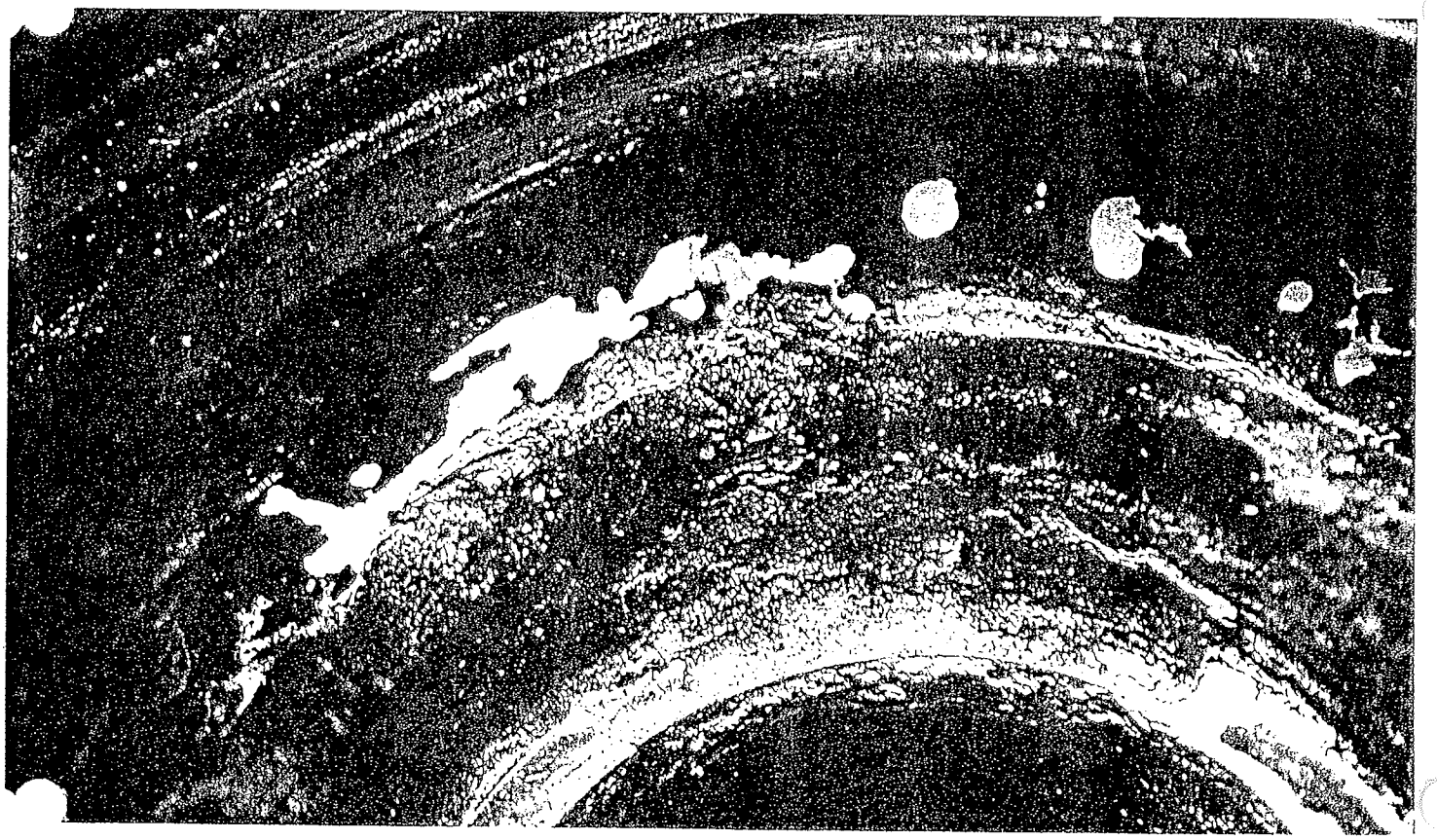


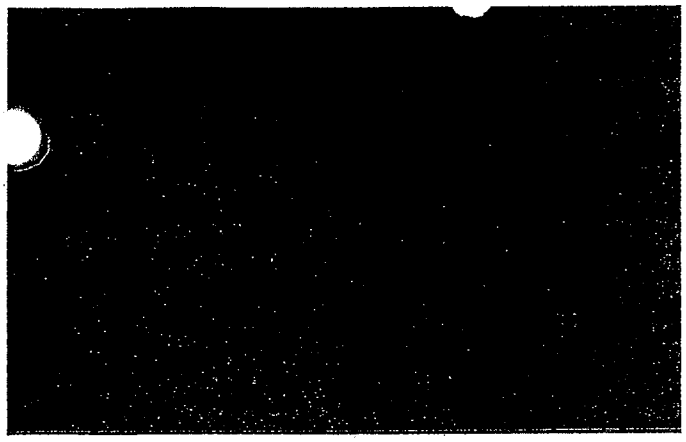


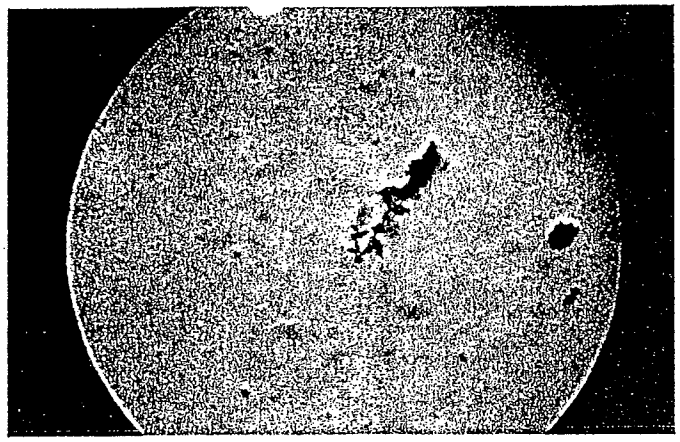


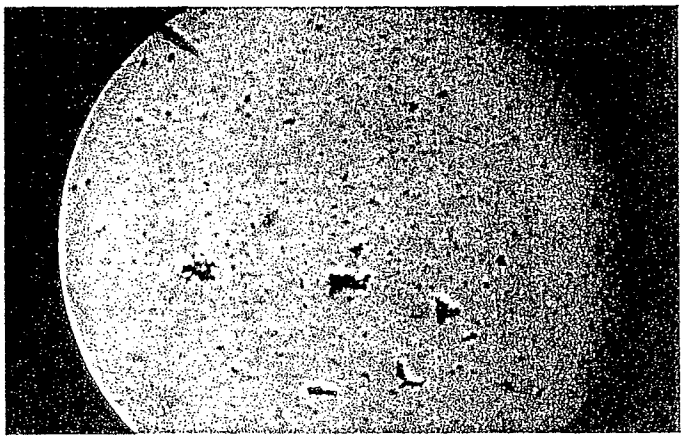


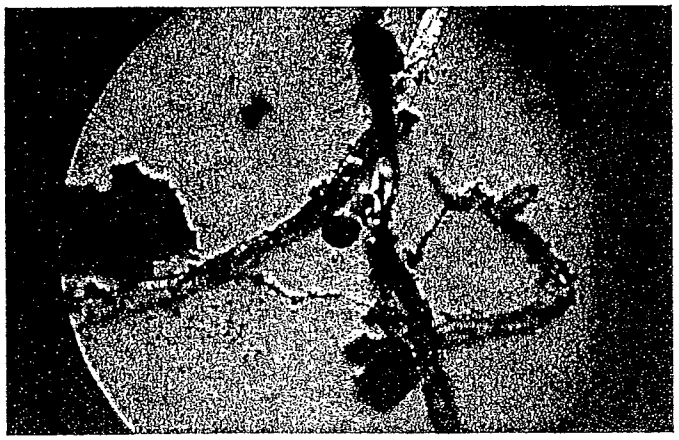


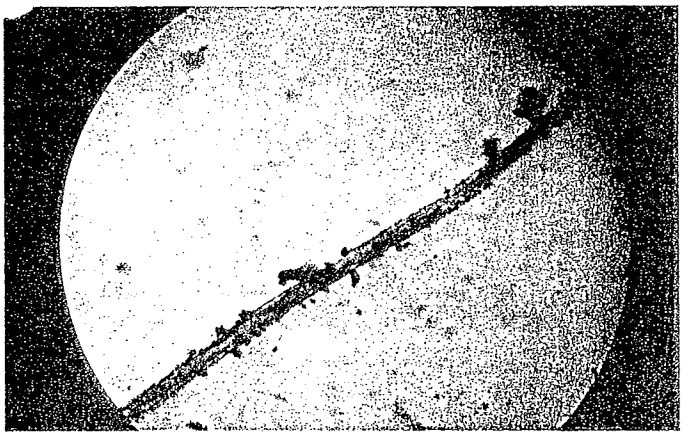


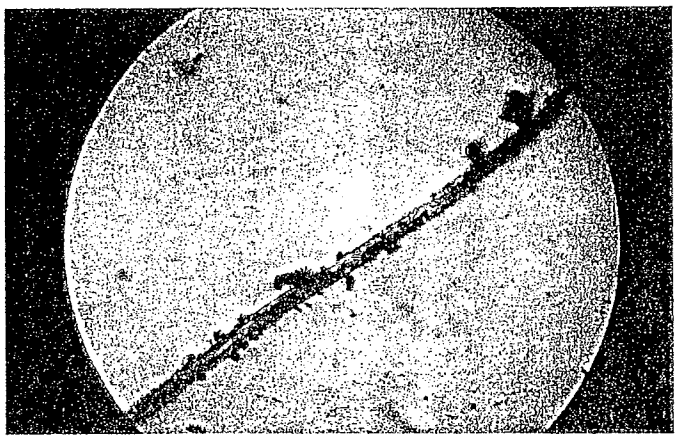


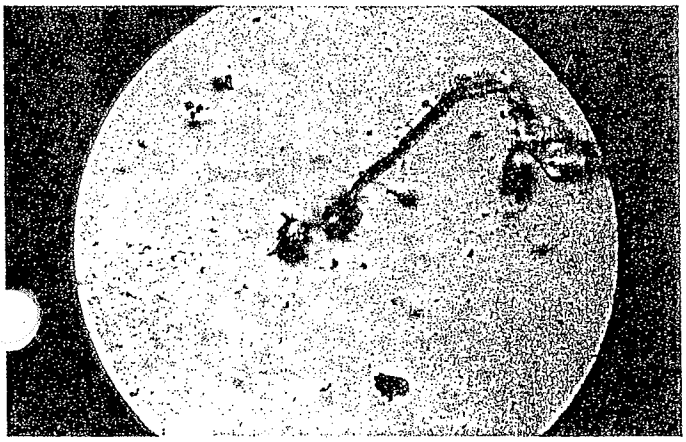


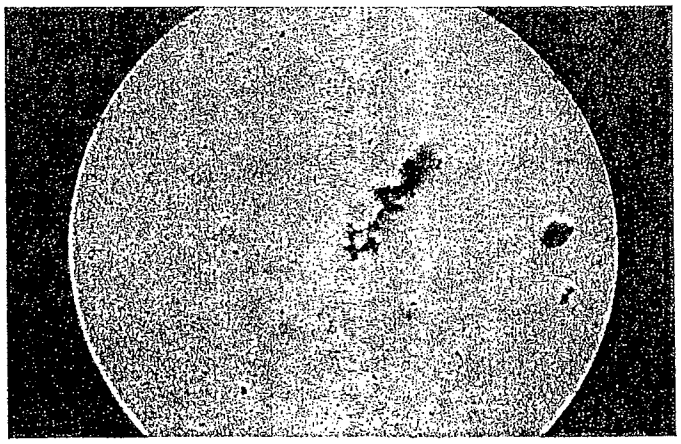


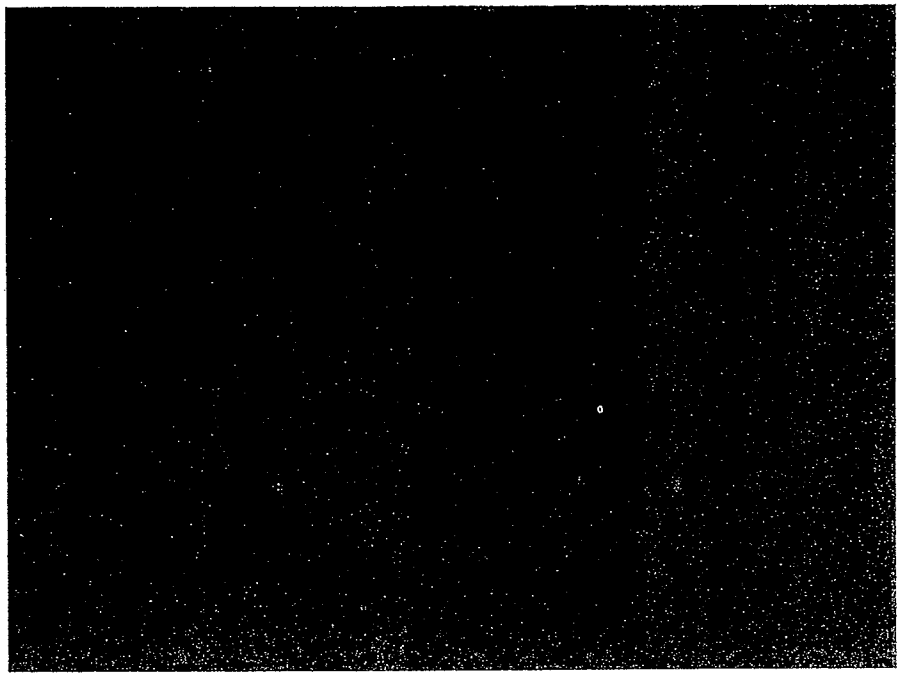


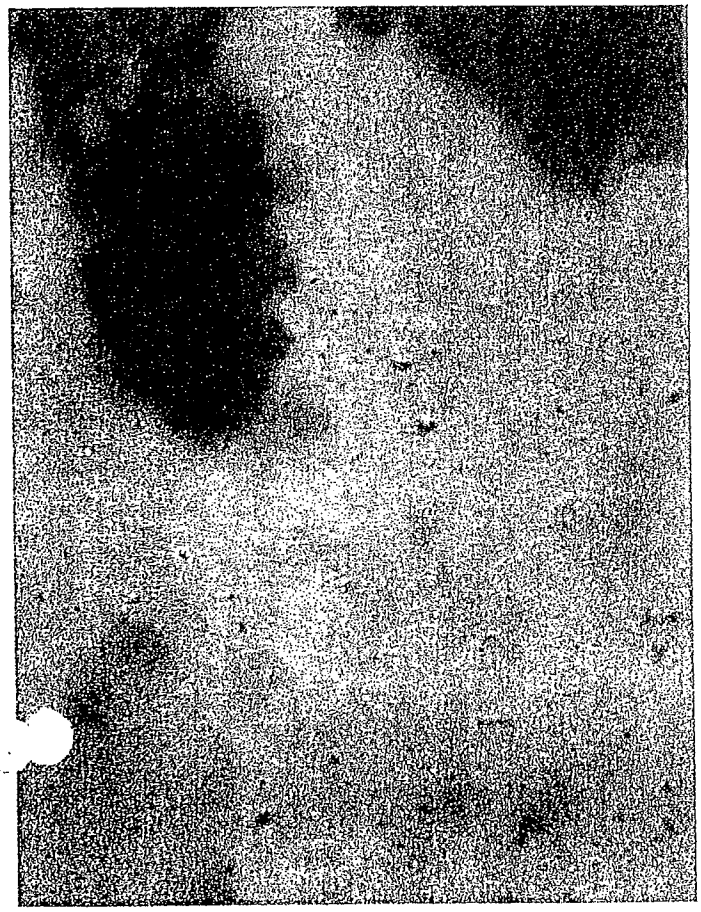


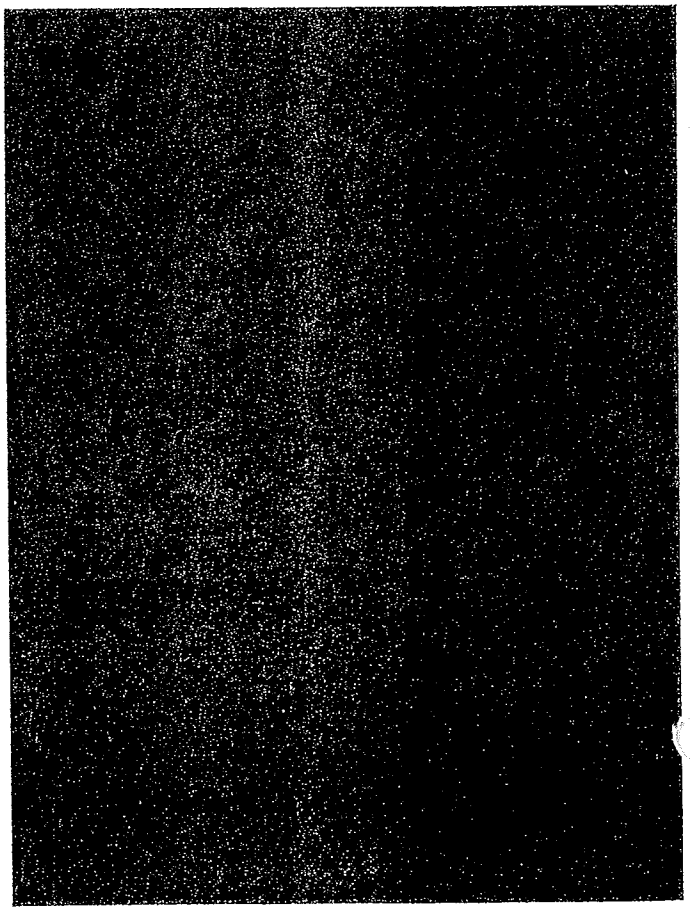












**From:** Jim Hodges
**To:** kent@mde.com
**Date:** 1/2/02 9:50AM
**Subject:** Job # 12001

To Randy Kent, P.E.

Dear Mr. Kent:

I just received a copy of your company's analysis of a 304 SS saddle that we returned to Romac for evaluation. The City of Camas currently has a few thousand of these saddles in use on our STEP sewer collection system. The saddle that you received for analysis is one of 4 that have failed in recent months. To my knowledge, we have not had this type of failure before All four of the failures have occurred in an isolated area. The HGL of the affected STEP main has recently been increased by some piping changes. Prior to the increased HGL, we believe that the main was only partially full of liquid in the area of the failures. The increased pressure in the main caused leaks to develop, which were investigated, revealing the failed saddles. Based on this scenario, can you answer the following questions?

1) In your report you note the presence of aerobic bacteria, iron reducing bacteria, and sulfate reducing bacteria; and cite this as the corrosion mechanism. Will the presence of trapped air in a system produce conditions favorable for their growth?

2) Can they grow in an anaerobic environment?

3) Do they spread easily? Should we expect similar failures in other parts of our system?

4) How difficult is it to test for these types of conditions in our system?

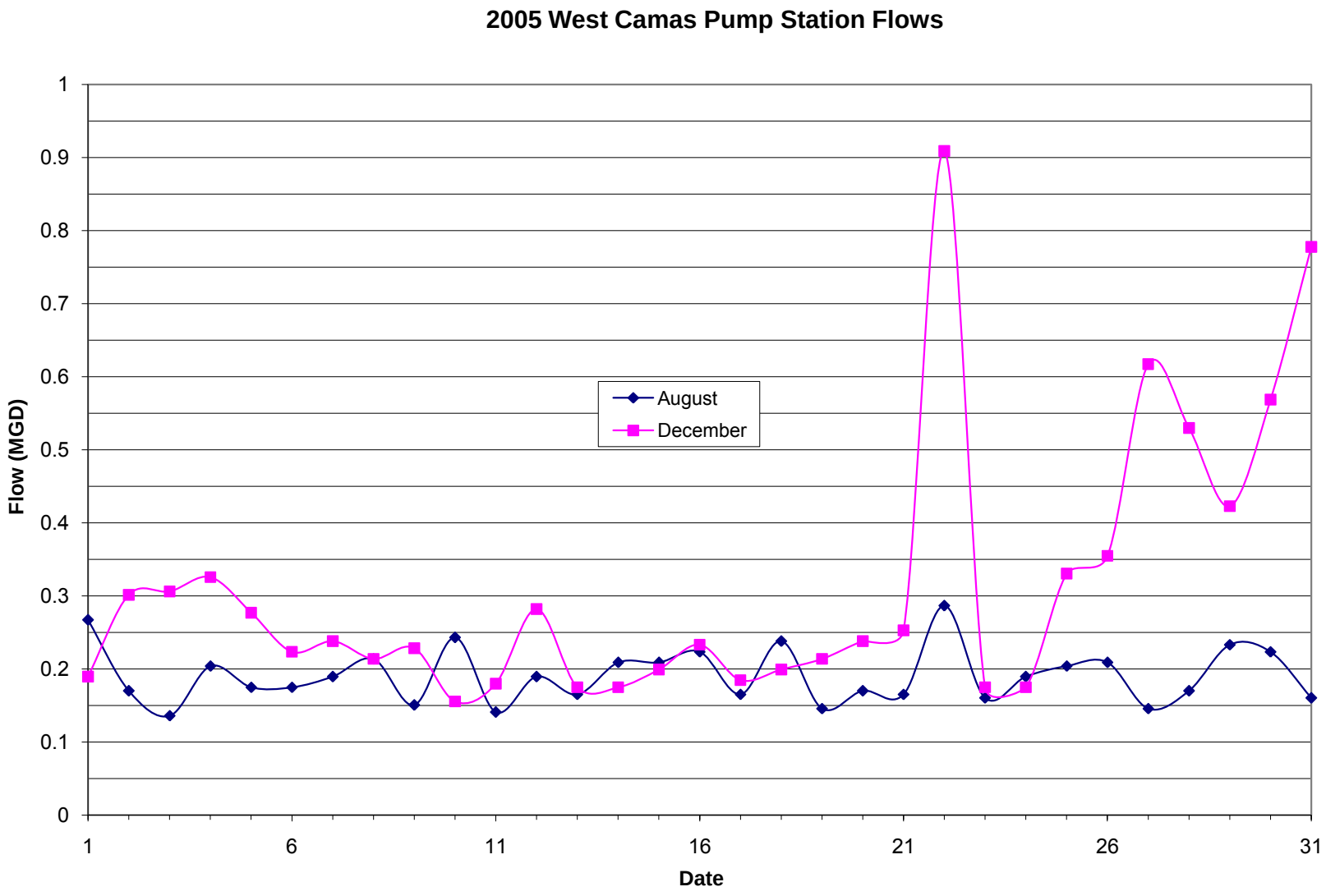
5) Is it feasible for the City staff to collect samples for evaluation, submit them to a company similar to yours, and obtain information useful in predicting potential future problems?

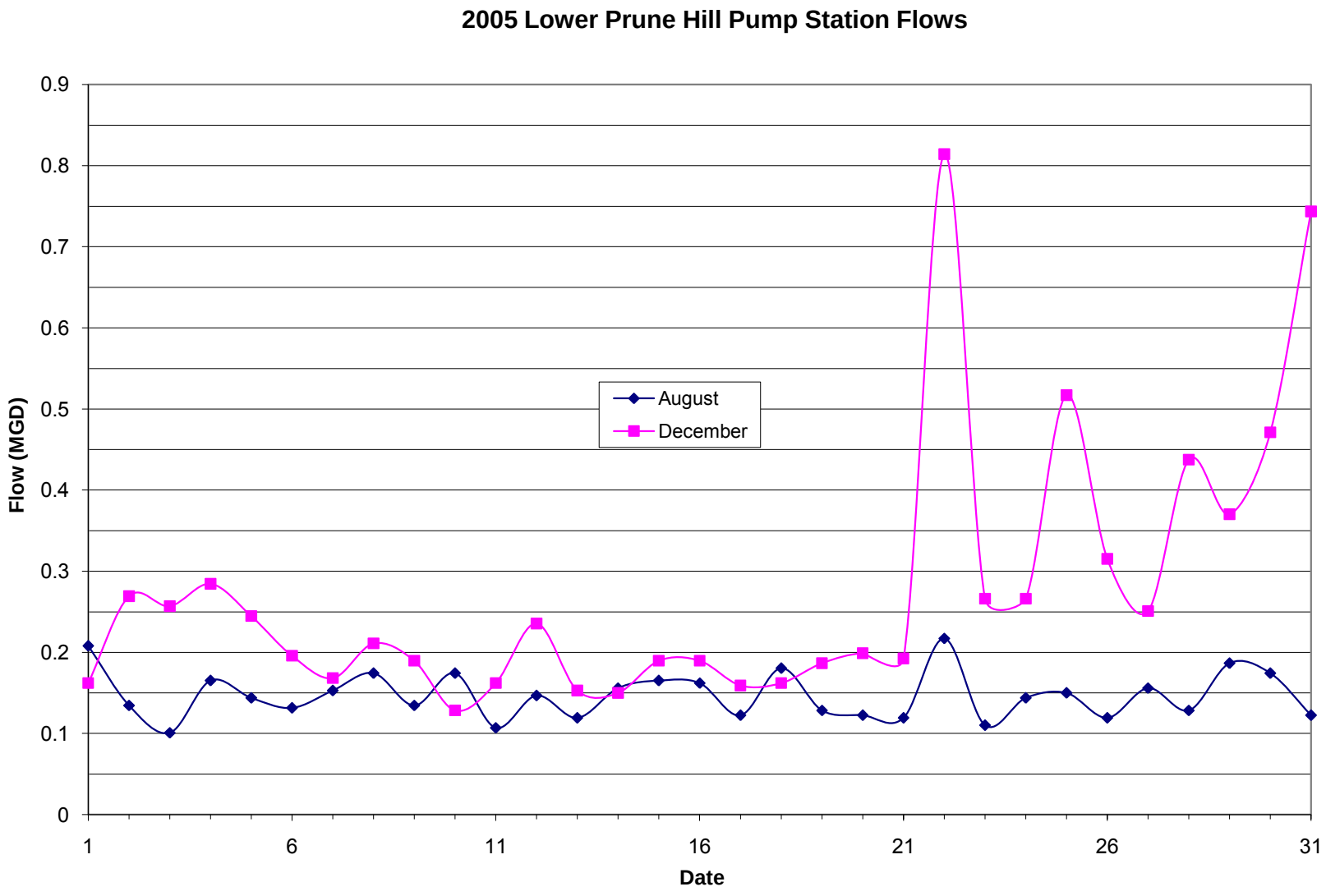
6) Is there an easy solution to restricting the growth of these organisms in a closed sewage collection system?

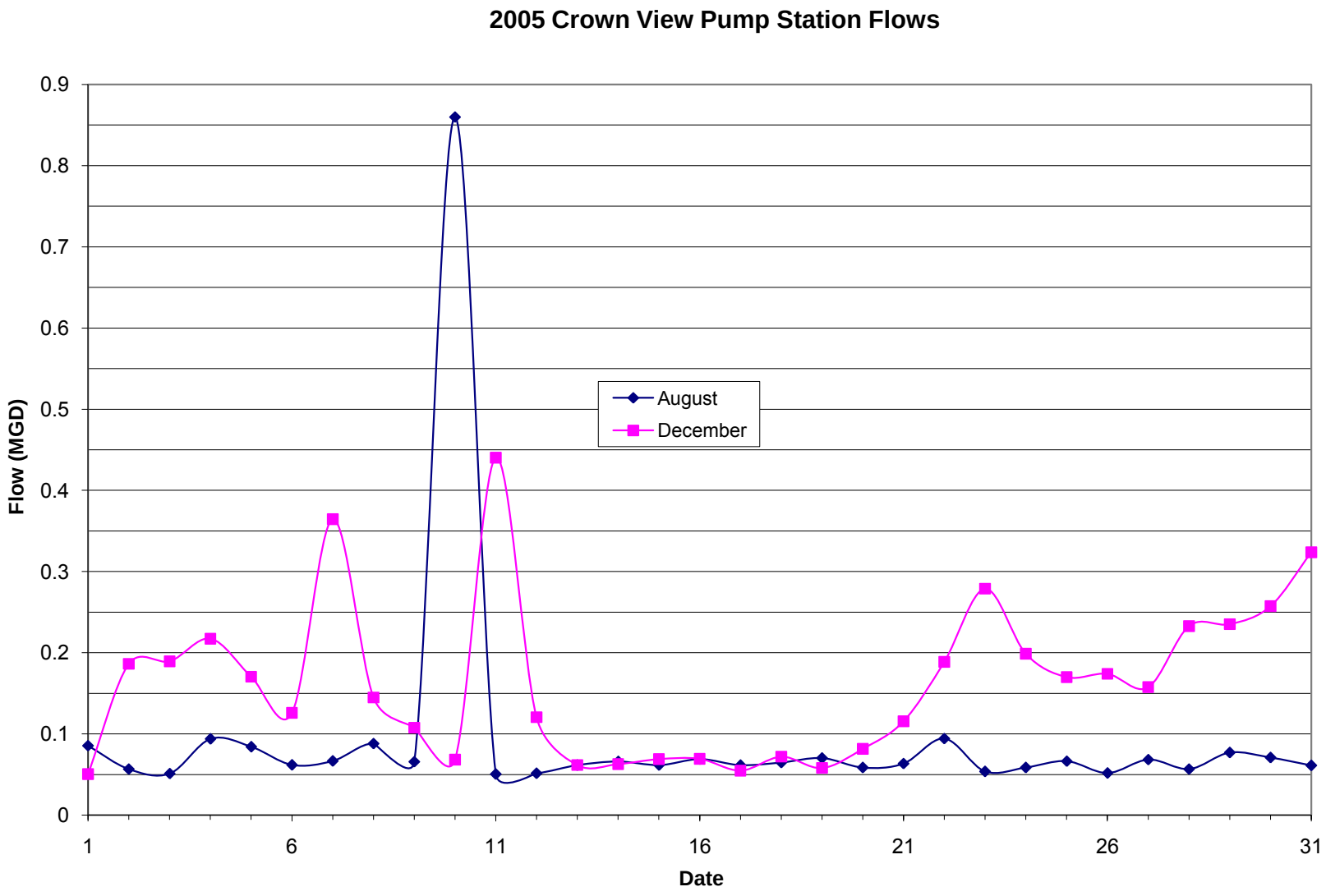
Any information you can give me will be appreciated. Thanks for your time. Please call me if it will aid in your response, or if you have any questions.

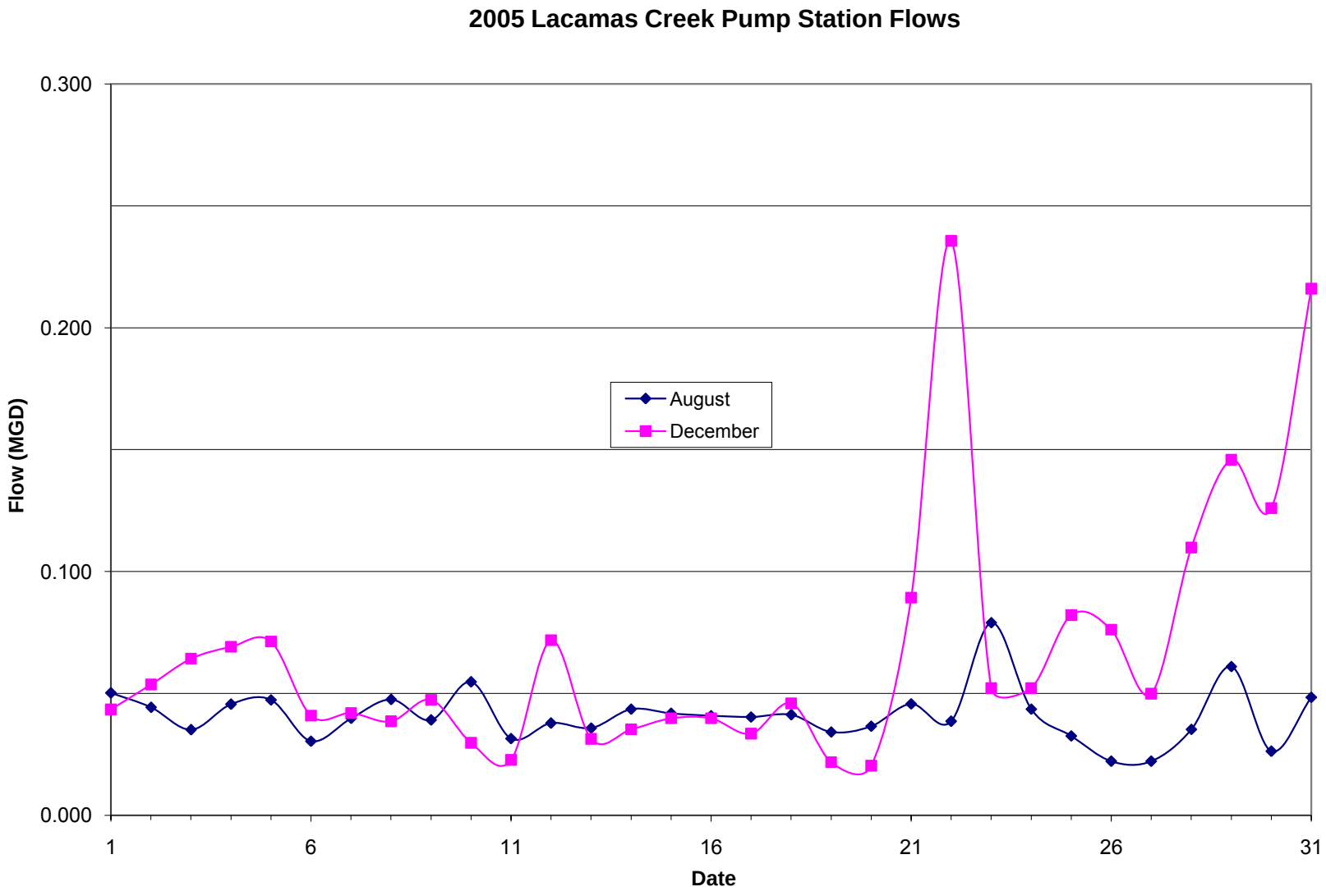
# APPENDIX I

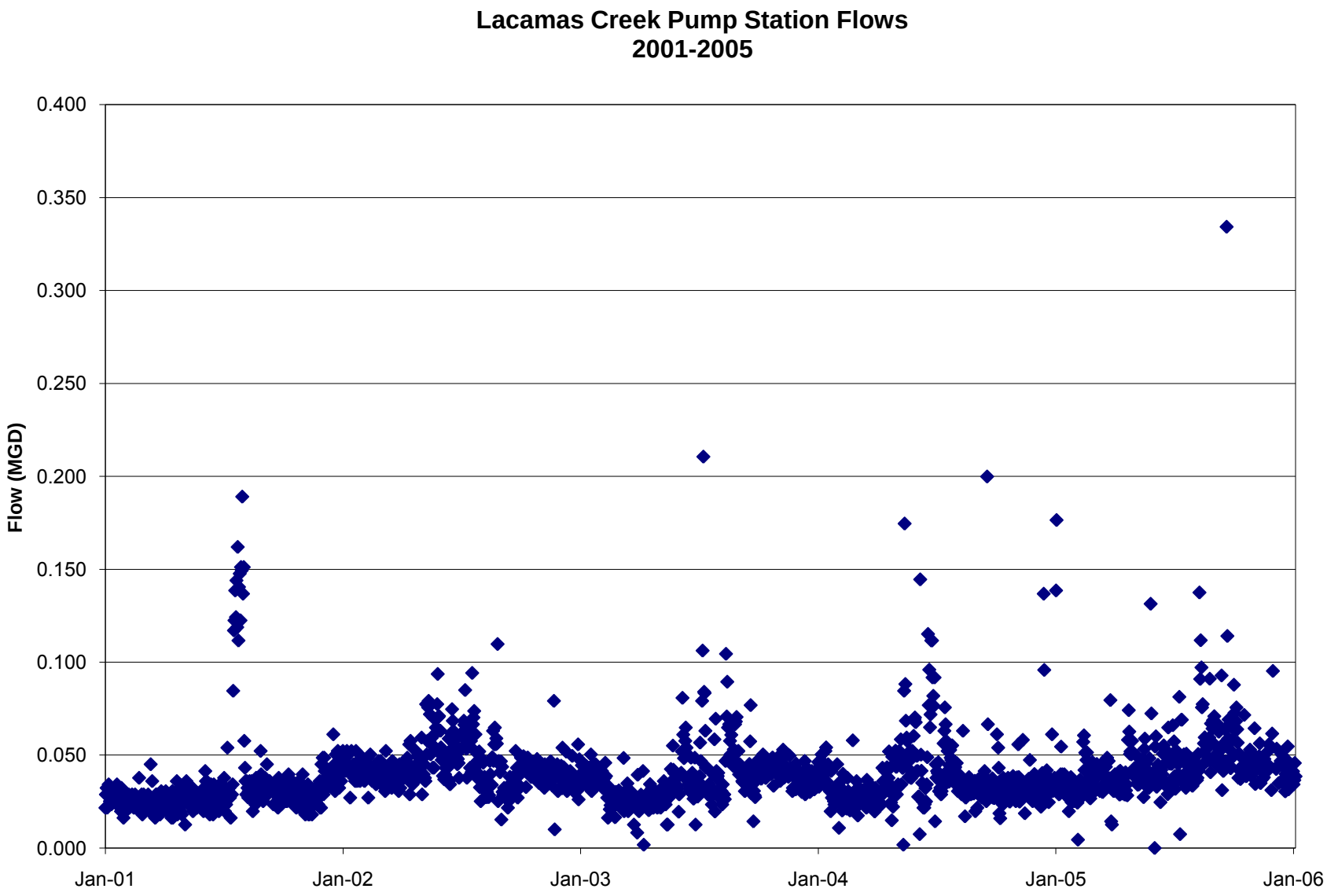
# PUMP STATION RUN-TIME DATA


2005 West Camas Pump Station Flows
Flow (MGD)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1
6
11
16
21
26
31
Date
August
December


2005 Lower Prune Hill Pump Station Flows
Flow (MGD)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1
6
11
16
21
26
31
Date
August
December


2005 Crown View Pump Station Flows
Flow (MGD)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1
6
11
16
21
26
31
Date
August
December


2005 Lacamas Creek Pump Station Flows
0.300
0.200
0.100
0.000
Flow (MGD)
August
December
1
6
11
16
21
26
31
Date


Lacamas Creek Pump Station Flows
2001-2005
Flow (MGD)
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06

# APPENDIX J

# BASIN 11 FLOW PROJECTIONS – BRADY ROAD PUMP STATION

**TECHNICAL MEMORANDUM**

**City of Camas**
**Basin 11 Flow Projections**
**Brady Road Pump Station**

| | |
|---|---|
| TO: | Monte Brachmann, Jim Hodges & Eric Levison, City of Camas |
| FROM: | Thomas Zerkel, P.E. & Jay Swift, P.E. |
| DATE: | June 30, 2006 |
| SUBJECT: | Basin 11 Flow Projections<br>Brady Road Pump Station |
| G&O # | 05471 |

---

The Brady Road Pump Station serves Basin 11 in the southwest corner of Camas. The Brady Road Pump Station accepts STEP effluent from the Grand Ridge Pump Station to the southwest and individual STEP systems throughout Basin 11, and pumps the combined flows up Brady Road to NW Parker Street. Basin 11 excludes the area south of NW 18th Avenue and west of NW Beech Street; sewage from this area is conveyed into the Sharp Bypass Line that drains to Basin 10 to the Southeast. Basin 11 consists of approximately 411 acres, of which approximately 127 acres is developed, 73 acres is undeveloped and 211 acres is open space or undevelopable (including right of way). The means of conveyance within Basin 11 consist primarily of STEP, STEF and STEG systems consisting of 2-inch, 6-inch and 8-inch pipe. Although the system is primarily STEP, STEF and STEG, flow rates were developed assuming that the system behaved essentially as a gravity system. This assumption is based on the similarity in flow pattern of gravity flow to that from a large number of STEP tanks. The attached figure shows the basin.

The flows for the 60-acre "New R-10" area in the northwest corner of Basin 10 are projected assuming R-10 zoning, a minimum of 10,000 square feet per lot, resulting in a maximum of 261 lots. Flows from Basin 11 to the Brady Road Pump Station were projected for 2025, with and without the New R-10 area, using the "camparc" parcels shape file supplied by the City. All developed parcels within the basin were considered to be single ERUs and ascribed a flow of 149 gallons per day, the average daily flow per ERU as developed in Chapter 6 of the DRAFT *General Sewer / Wastewater Facility Plan.*

A peaking factor was used to determine the peak hour flow. The peaking factor for residential flows was calculated using an equation provided by the *1998 Department Of Ecology Criteria for Sewage Works Design* (Orange Book). The equation calculates a peaking factor based on population. As population increases, the peaking factor decreases to account for greater attenuation of flows in the presumed larger system.

$$PeakingFactor = \left(18 + \sqrt{Population/1000}\right) / \left(4 + \sqrt{Population/1000}\right)$$

Prune Hill Elementary School is located within the basin. The Department of Ecology ascribes a base flow of 10 gpd per student for schools with cafeterias but no showers, including infiltration. The school has a population of approximately 600 students. Assuming an 8-hour school day the flow was peaked by a factor of three. This is a conservative estimate of the flows as normal infiltration within the school system is also peaked.

Infiltration was added to the remainder of the basin based on the developed service area at a rate of 500 gallons per developed acre per day. This value is a conservative estimate based on the average I/I rate calculated for STEP areas in the *1998 I/I Study* adjusted to establish a peak hour I/I rate.

Future flows in the basin were developed utilizing the same 149 gallons per ERU. Undeveloped parcels within the basin were added to the service area assuming R-10 and R-12 zoning.

Table 1 summarizes the input data for the analysis, the resulting flows to the Brady Road Lift Station with and without the New R-10 area. Infiltration rates remain at 275 gallons per developed acre per day for the future flows.

**TABLE 1**
**Brady Road Pump Station**
**Basin 11 Flow Projections**

| | **Current** | **R-10 Area** | **2025 w/ New R-10 Area** | **2025 w/o New R-10 Area** |
|---|---|---|---|---|
| Pop | 1,388 | 706 | 2,982 | 2,276 |
| Total Area | 411[1] | 60 | 461 | 411[1] |
| Developed Area (acres) | 127 | 60 | 254 | 240 |
| Residential Area (acres) | 119 | 60 | 252 | 232 |
| ERUs | 514 | 261 | 1,104 | 910 |
| Flow/ERU (gpd) | 149 | 149 | 149 | 149 |
| Ave Day Residential Flow (gpd) | 77,000 | 39,000 | 165,000 | 126,000 |
| Peak Factor | 3.70 | NA | 3.44 | 3.54 |
| Peak Hour Residential Flow (gpd) | 286,000 | NA | 569,000 | 447,000 |
| Peak Hour School (gpd) | 18,000 | NA | 18,000 | 18,000 |
| Peak Hour I/I (gpad) | 500 | NA | 500 | 500 |
| Peak Hour I/I (gpd) | 63,700 | NA | 127,200 | 100,200 |
| Total Peak Hour Flow (gpd) | 368,000 | NA | 715,000 | 566,000 |
| Total Peak Hour Flow (gpm) | 256 | NA | 497 | 393 |
| Total Dynamic Head [(2)] (ft) | 133 | NA | 154 | 144 |

1. Includes right of ways.
2. Assumes 15 ft of station losses.

The Brady Road Pump Station is located at SE Brady Rd. and NW MacIntosh Rd. The pump station houses two (2) twenty horsepower effluent style pumps. Documentation of existing pump capacity was not available when this memo was prepared. Total dynamic head in the system at 2025, as provided in Table 1, is 154 feet including the "New R-10 area" in the analysis, and 144 feet not including the New R-10 area. It is projected that this basin will be built out prior to 2025.

# APPENDIX K

# COST ESTIMATES

| | | | | | | |
|---|---|---|---|---|---|---|
| Basin No. | 1 | | | | | |
| Proj. No. | 1 | | | | | |
| Pipe Size | | 8 | 10 | 15 | 21 | 24 |
| Segment Length = | | | 221 | 112 | 1081 | |
| No of Side Sewers (Parcels) = | | | 0 | 1 | 4 | 1 |
| | | | | | | |
| | | | | UNIT | | AMOUNT |
| NO. | ITEM | QUANTITY | | PRICE | | |
| | | | | | | |
| 1 | Mobilization and Demobilization | LUMP SUM | | $ 34,200 | | $ 34,200 |
| 2 | Trench Safety Systems | LUMP SUM | | $ 12,500 | | $ 12,500 |
| 3 | Locate Existing Utilities | LUMP SUM | | $ 8,200 | | $ 8,200 |
| 4 | Erosion Control | LUMP SUM | | $ 8,000 | | $ 8,000 |
| 5 | Dewatering | LUMP SUM | | $ 19,000 | | $ 19,000 |
| 6 | Bypass Pumping | LUMP SUM | | $ 18,100 | | $ 18,100 |
| | | | | | | |
| 7 | Sawcutting | 2828 | LF | $ 2 | | $ 5,656 |
| 8 | Traffic Control | 230 | HR | $ 30 | | $ 6,900 |
| 9a | 8" Gravity Sewer Main | 0 | LF | $ 70 | | $ - |
| 9b | 10" Gravity Sewer Main | 221 | LF | $ 80 | | $ 17,680 |
| 9c | 15" Gravity Sewer Main | 112 | LF | $ 120 | | $ 13,440 |
| 9d | 21" Gravity Sewer Main | 1081 | LF | $ 155 | | $ 167,555 |
| 9e | 24" Gravity Sewer Main | 0 | LF | $ 190 | | $ - |
| 9f | 30" Gravity Sewer Main | | LF | $ 236 | | |
| 10 | Side Sewer | 6 | EA | $ 1,000 | | $ 6,000 |
| 11 | 48" Manhole | 6 | EA | $ 4,500 | | $ 27,000 |
| 12 | Asphalt | 400 | TN | $ 110 | | $ 44,000 |
| 13a | Gravel Backfill (8") | 0 | CY | $ 15 | | |
| 13b | Gravel Backfill (10") | 100 | CY | $ 15 | | $ 1,500 |
| 13c | Gravel Backfill (15") | 60 | CY | $ 15 | | $ 900 |
| 13d | Gravel Backfill (21") | 650 | CY | $ 15 | | $ 9,750 |
| 13e | Gravel Backfill (24") | 0 | CY | $ 15 | | $ - |
| 13f | Gravel Backfill (30") | 0 | CY | $ 15 | | $ - |
| 14a | CDF (8") | 0 | CY | $ 75 | | $ - |
| 14b | CDF (10") | 100 | CY | $ 75 | | $ 7,500 |
| 14c | CDF (15") | 60 | CY | $ 75 | | $ 4,500 |
| 14d | CDF (21") | 650 | CY | $ 75 | | $ 48,750 |
| 14e | CDF (24") | 0 | CY | $ 75 | | $ - |
| 14f | CDF (30") | 0 | CY | $ 75 | | $ - |
| | Subtotal | | | | | $ 461,131 |
| | Tax @ | 7.9 | % | | | $ 36,429 |
| | | | | | | |
| | Subtotal | | | | | $ 497,560 |
| | Contingency (20%)…… | | | | | $ 99,512 |
| | | | | | | |
| | TOTAL ESTIMATED CONSTRUCTION COST:..... | | | | | $ 597,072 |
| | | | | | | |
| | Engineering and Administrative Costs (30%):..... | | | | | $ 179,122 |
| | | | | | | |
| | TOTAL ESTIMATED PROJECT COST:..... | | | | | $ 776,194 |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Basin No. | 1 | | | | | |
| Proj. No. | 2 | | | | | |
| Pipe Size | | 6 | 8 | 10 | 12 | 15 |
| Segment Length = | | | 1062 | | | |
| No of Side Sewers (Parcels) = | | | 21 | | | |
| | | | | | | |
| | | | | UNIT | | AMOUNT |
| NO. | ITEM | QUANTITY | | PRICE | | |
| | | | | | | |
| 1 | Mobilization and Demobilization | LUMP SUM | | $ 19,300 | | $ 19,300 |
| 2 | Trench Safety Systems | LUMP SUM | | $ 7,100 | | $ 7,100 |
| 3 | Locate Existing Utilities | LUMP SUM | | $ 4,600 | | $ 4,600 |
| 4 | Erosion Control | LUMP SUM | | $ 4,500 | | $ 4,500 |
| 5 | Dewatering | LUMP SUM | | $ 10,700 | | $ 10,700 |
| 6 | Bypass Pumping | LUMP SUM | | $ 10,200 | | $ 10,200 |
| | | | | | | |
| 7 | Sawcutting | 2124 | LF | $ 2 | | $ 4,248 |
| | | | | | | |
| 8 | Traffic Control | 170 | HR | $ 30 | | $ 5,100 |
| 9a | 6" Gravity Sewer Main | 0 | LF | $ 40 | | $ - |
| 9b | 8" Gravity Sewer Main | 1062 | LF | $ 70 | | $ 74,340 |
| 9c | 10" Gravity Sewer Main | 0 | LF | $ 80 | | $ - |
| 9d | 12" Gravity Sewer Main | 0 | LF | $ 100 | | $ - |
| 9e | 15" Gravity Sewer Main | 0 | LF | $ 120 | | $ - |
| | | | | | | |
| 10 | Side Sewer | 21 | EA | $ 1,000 | | $ 21,000 |
| | | | | | | |
| 11 | 48" Manhole | 5 | EA | $ 4,500 | | $ 22,500 |
| | | | | | | |
| 12 | Asphalt | 300 | TN | $ 110 | | $ 33,000 |
| 13a | Gravel Backfill (6") | 0 | CY | $ 15 | | |
| 13b | Gravel Backfill (8") | 480 | CY | $ 15 | | $ 7,200 |
| 13c | Gravel Backfill (10") | 0 | CY | $ 15 | | $ - |
| 13d | Gravel Backfill (12") | 0 | CY | $ 15 | | $ - |
| 13e | Gravel Backfill (15") | 0 | CY | $ 15 | | $ - |
| 14a | CDF (6") | 0 | CY | $ 75 | | $ - |
| 14b | CDF (8") | 480 | CY | $ 75 | | $ 36,000 |
| 14c | CDF (10") | 0 | CY | $ 75 | | $ - |
| 14d | CDF (12") | 0 | CY | $ 75 | | $ - |
| 14e | CDF (15") | 0 | CY | $ 75 | | $ - |
| | Subtotal | | | | | $ 259,788 |
| | Tax @ | 7.9 | % | | | $ 20,523 |
| | | | | | | |
| | Subtotal | | | | | $ 280,311 |
| | Contingency (20%)…… | | | | | $ 56,062 |
| | | | | | | |
| | TOTAL ESTIMATED CONSTRUCTION COST:..... | | | | | $ 336,373 |
| | | | | | | |
| | Engineering and Administrative Costs (30%):..... | | | | | $ 100,912 |
| | | | | | | |
| | TOTAL ESTIMATED PROJECT COST:..... | | | | | $ 437,285 |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Basin No. | 1 | | | | | |
| Proj. No. | 3 | | | | | |
| Pipe Size | | 6 | 8 | 10 | 12 | 15 |
| Segment Length = | | 34 | 1093 | | | |
| No of Side Sewers (Parcels) = | | 0 | 28 | | | |
| | | | | | | |
| | | | | UNIT | | AMOUNT |
| NO. | ITEM | QUANTITY | | PRICE | | |
| | | | | | | |
| 1 | Mobilization and Demobilization | LUMP SUM | | $ 20,600 | | $ 20,600 |
| 2 | Trench Safety Systems | LUMP SUM | | $ 7,500 | | $ 7,500 |
| 3 | Locate Existing Utilities | LUMP SUM | | $ 4,900 | | $ 4,900 |
| 4 | Erosion Control | LUMP SUM | | $ 4,800 | | $ 4,800 |
| 5 | Dewatering | LUMP SUM | | $ 11,400 | | $ 11,400 |
| 6 | Bypass Pumping | LUMP SUM | | $ 10,900 | | $ 10,900 |
| | | | | | | |
| 7 | Sawcutting | 2186 | LF | $ 2 | | $ 4,372 |
| | | | | | | |
| 8 | Traffic Control | 190 | HR | $ 30 | | $ 5,700 |
| 9a | 6" Gravity Sewer Main | 34 | LF | $ 40 | | $ 1,360 |
| 9b | 8" Gravity Sewer Main | 1093 | LF | $ 70 | | $ 76,510 |
| 9c | 10" Gravity Sewer Main | 0 | LF | $ 80 | | $ - |
| 9d | 12" Gravity Sewer Main | 0 | LF | $ 100 | | $ - |
| 9e | 15" Gravity Sewer Main | 0 | LF | $ 120 | | $ - |
| | | | | | | |
| 10 | Side Sewer | 28 | EA | $ 1,000 | | $ 28,000 |
| | | | | | | |
| 11 | 48" Manhole | 5 | EA | $ 4,500 | | $ 22,500 |
| | | | | | | |
| 12 | Asphalt | 300 | TN | $ 110 | | $ 33,000 |
| 13a | Gravel Backfill (6") | 20 | CY | $ 15 | | |
| 13b | Gravel Backfill (8") | 490 | CY | $ 15 | | $ 7,350 |
| 13c | Gravel Backfill (10") | 0 | CY | $ 15 | | $ - |
| 13d | Gravel Backfill (12") | 0 | CY | $ 15 | | $ - |
| 13e | Gravel Backfill (15") | 0 | CY | $ 15 | | $ - |
| 14a | CDF (6") | 20 | CY | $ 75 | | $ 1,500 |
| 14b | CDF (8") | 490 | CY | $ 75 | | $ 36,750 |
| 14c | CDF (10") | 0 | CY | $ 75 | | $ - |
| 14d | CDF (12") | 0 | CY | $ 75 | | $ - |
| 14e | CDF (15") | 0 | CY | $ 75 | | $ - |
| | Subtotal | | | | | $ 277,142 |
| | Tax @ | 7.9 | % | | | $ 21,894 |
| | | | | | | |
| | Subtotal | | | | | $ 299,036 |
| | Contingency (20%)…… | | | | | $ 59,807 |
| | | | | | | |
| | TOTAL ESTIMATED CONSTRUCTION COST:..... | | | | | $ 358,843 |
| | | | | | | |
| | Engineering and Administrative Costs (30%):..... | | | | | $ 107,653 |
| | | | | | | |
| | TOTAL ESTIMATED PROJECT COST:..... | | | | | $ 466,496 |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Basin No. | 1 | | | | | |
| Proj. No. | 4 | | | | | |
| Pipe Size | | 6 | 8 | 10 | 12 | 15 |
| Segment Length = | | | 845 | | | |
| No of Side Sewers (Parcels) = | | | 18 | | | |
| | | | | | | |
| | | | | UNIT | | AMOUNT |
| NO. | ITEM | QUANTITY | | PRICE | | |
| | | | | | | |
| 1 | Mobilization and Demobilization | LUMP SUM | | $ 15,100 | | $ 15,100 |
| 2 | Trench Safety Systems | LUMP SUM | | $ 5,500 | | $ 5,500 |
| 3 | Locate Existing Utilities | LUMP SUM | | $ 3,600 | | $ 3,600 |
| 4 | Erosion Control | LUMP SUM | | $ 3,600 | | $ 3,600 |
| 5 | Dewatering | LUMP SUM | | $ 8,400 | | $ 8,400 |
| 6 | Bypass Pumping | LUMP SUM | | $ 8,000 | | $ 8,000 |
| | | | | | | |
| 7 | Sawcutting | 1690 | LF | $ 2 | | $ 3,380 |
| | | | | | | |
| 8 | Traffic Control | 140 | HR | $ 30 | | $ 4,200 |
| 9a | 6" Gravity Sewer Main | 0 | LF | $ 40 | | $ - |
| 9b | 8" Gravity Sewer Main | 845 | LF | $ 70 | | $ 59,150 |
| 9c | 10" Gravity Sewer Main | 0 | LF | $ 80 | | $ - |
| 9d | 12" Gravity Sewer Main | 0 | LF | $ 100 | | $ - |
| 9e | 15" Gravity Sewer Main | 0 | LF | $ 120 | | $ - |
| | | | | | | |
| 10 | Side Sewer | 18 | EA | $ 1,000 | | $ 18,000 |
| | | | | | | |
| 11 | 48" Manhole | 4 | EA | $ 4,500 | | $ 18,000 |
| | | | | | | |
| 12 | Asphalt | 200 | TN | $ 110 | | $ 22,000 |
| 13a | Gravel Backfill (6") | 0 | CY | $ 15 | | |
| 13b | Gravel Backfill (8") | 380 | CY | $ 15 | | $ 5,700 |
| 13c | Gravel Backfill (10") | 0 | CY | $ 15 | | $ - |
| 13d | Gravel Backfill (12") | 0 | CY | $ 15 | | $ - |
| 13e | Gravel Backfill (15") | 0 | CY | $ 15 | | $ - |
| 14a | CDF (6") | 0 | CY | $ 75 | | $ - |
| 14b | CDF (8") | 380 | CY | $ 75 | | $ 28,500 |
| 14c | CDF (10") | 0 | CY | $ 75 | | $ - |
| 14d | CDF (12") | 0 | CY | $ 75 | | $ - |
| 14e | CDF (15") | 0 | CY | $ 75 | | $ - |
| | Subtotal | | | | | $ 203,130 |
| | Tax @ | 7.9 | % | | | $ 16,047 |
| | | | | | | |
| | Subtotal | | | | | $ 219,177 |
| | Contingency (20%)…… | | | | | $ 43,835 |
| | | | | | | |
| | TOTAL ESTIMATED CONSTRUCTION COST:..... | | | | | $ 263,012 |
| | | | | | | |
| | Engineering and Administrative Costs (30%):..... | | | | | $ 78,904 |
| | | | | | | |
| | TOTAL ESTIMATED PROJECT COST:..... | | | | | $ 341,916 |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Basin No. | 1 | | | | | |
| Proj. No. | 5 | | | | | |
| Pipe Size | | 6 | 8 | 10 | 12 | 15 |
| Segment Length = | | | 891 | | | |
| No of Side Sewers (Parcels) = | | | 15 | | | |
| | | | | | | |
| | | | | UNIT | | AMOUNT |
| NO. | ITEM | QUANTITY | | PRICE | | |
| | | | | | | |
| 1 | Mobilization and Demobilization | LUMP SUM | | $ 15,300 | | $ 15,300 |
| 2 | Trench Safety Systems | LUMP SUM | | $ 5,600 | | $ 5,600 |
| 3 | Locate Existing Utilities | LUMP SUM | | $ 3,700 | | $ 3,700 |
| 4 | Erosion Control | LUMP SUM | | $ 3,600 | | $ 3,600 |
| 5 | Dewatering | LUMP SUM | | $ 8,500 | | $ 8,500 |
| 6 | Bypass Pumping | LUMP SUM | | $ 8,100 | | $ 8,100 |
| | | | | | | |
| 7 | Sawcutting | 1782 | LF | $ 2 | | $ 3,564 |
| | | | | | | |
| 8 | Traffic Control | 150 | HR | $ 30 | | $ 4,500 |
| 9a | 6" Gravity Sewer Main | 0 | LF | $ 40 | | $ - |
| 9b | 8" Gravity Sewer Main | 891 | LF | $ 70 | | $ 62,370 |
| 9c | 10" Gravity Sewer Main | 0 | LF | $ 80 | | $ - |
| 9d | 12" Gravity Sewer Main | 0 | LF | $ 100 | | $ - |
| 9e | 15" Gravity Sewer Main | 0 | LF | $ 120 | | $ - |
| | | | | | | |
| 10 | Side Sewer | 15 | EA | $ 1,000 | | $ 15,000 |
| | | | | | | |
| 11 | 48" Manhole | 4 | EA | $ 4,500 | | $ 18,000 |
| | | | | | | |
| 12 | Asphalt | 200 | TN | $ 110 | | $ 22,000 |
| 13a | Gravel Backfill (6") | 0 | CY | $ 15 | | |
| 13b | Gravel Backfill (8") | 400 | CY | $ 15 | | $ 6,000 |
| 13c | Gravel Backfill (10") | 0 | CY | $ 15 | | $ - |
| 13d | Gravel Backfill (12") | 0 | CY | $ 15 | | $ - |
| 13e | Gravel Backfill (15") | 0 | CY | $ 15 | | $ - |
| 14a | CDF (6") | 0 | CY | $ 75 | | $ - |
| 14b | CDF (8") | 400 | CY | $ 75 | | $ 30,000 |
| 14c | CDF (10") | 0 | CY | $ 75 | | $ - |
| 14d | CDF (12") | 0 | CY | $ 75 | | $ - |
| 14e | CDF (15") | 0 | CY | $ 75 | | $ - |
| | Subtotal | | | | | $ 206,234 |
| | Tax @ | 7.9 | % | | | $ 16,292 |
| | | | | | | |
| | Subtotal | | | | | $ 222,526 |
| | Contingency (20%)…… | | | | | $ 44,505 |
| | | | | | | |
| | TOTAL ESTIMATED CONSTRUCTION COST:..... | | | | | $ 267,031 |
| | | | | | | |
| | Engineering and Administrative Costs (30%):..... | | | | | $ 80,109 |
| | | | | | | |
| | TOTAL ESTIMATED PROJECT COST:..... | | | | | $ 347,140 |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Basin No. | 2 | | | | | |
| Proj. No. | 1 | | | | | |
| Pipe Size | | 8 | 12 | 15 | 21 | 30 |
| Segment Length = | | | 388 | | 863 | |
| No of Side Sewers (Parcels) = | | | 0 | | 20 | |
| | | | | | | |
| | | | | UNIT | | AMOUNT |
| NO. | ITEM | QUANTITY | | PRICE | | |
| | | | | | | |
| 1 | Mobilization and Demobilization | LUMP SUM | | $ 30,500 | | $ 30,500 |
| 2 | Trench Safety Systems | LUMP SUM | | $ 11,100 | | $ 11,100 |
| 3 | Locate Existing Utilities | LUMP SUM | | $ 7,300 | | $ 7,300 |
| 4 | Erosion Control | LUMP SUM | | $ 7,100 | | $ 7,100 |
| 5 | Dewatering | LUMP SUM | | $ 16,900 | | $ 16,900 |
| 6 | Bypass Pumping | LUMP SUM | | $ 16,100 | | $ 16,100 |
| | | | | | | |
| 7 | Sawcutting | 2502 | LF | $ 2 | | $ 5,004 |
| | | | | | | |
| 8 | Traffic Control | 210 | HR | $ 30 | | $ 6,300 |
| 9a | 8" Gravity Sewer Main | 0 | LF | $ 80 | | $ - |
| 9b | 12" Gravity Sewer Main | 388 | LF | $ 100 | | $ 38,800 |
| 9c | 15" Gravity Sewer Main | 0 | LF | $ 120 | | $ - |
| 9d | 21" Gravity Sewer Main | 863 | LF | $ 155 | | $ 133,765 |
| 9e | xx" Gravity Sewer Main | | LF | $ 155 | | $ - |
| 9f | 30" Gravity Sewer Main | 0 | LF | $ 236 | | $ - |
| 10 | Side Sewer | 20 | EA | $ 1,000 | | $ 20,000 |
| 11 | 48" Manhole | 6 | EA | $ 4,500 | | $ 27,000 |
| 12 | Asphalt | 300 | TN | $ 110 | | $ 33,000 |
| 13a | Gravel Backfill (8") | 0 | CY | $ 15 | | |
| 13b | Gravel Backfill (12") | 180 | CY | $ 15 | | $ 2,700 |
| 13c | Gravel Backfill (15") | 0 | CY | $ 15 | | $ - |
| 13d | Gravel Backfill (21") | 520 | CY | $ 15 | | $ 7,800 |
| 13e | Gravel Backfill (xx") | 0 | CY | $ 15 | | $ - |
| 13f | Gravel Backfill (30") | 0 | CY | $ 15 | | $ - |
| 14a | CDF (8") | 0 | CY | $ 75 | | $ - |
| 14b | CDF (12") | 180 | CY | $ 75 | | $ 13,500 |
| 14c | CDF (15") | 0 | CY | $ 75 | | $ - |
| 14d | CDF (21") | 450 | CY | $ 75 | | $ 33,750 |
| 14e | CDF (xx") | 0 | CY | $ 75 | | $ - |
| 14f | CDF (30") | 0 | CY | $ 75 | | $ - |
| | Subtotal | | | | | $ 410,619 |
| | Tax @ | 7.9 | % | | | $ 32,439 |
| | | | | | | |
| | Subtotal | | | | | $ 443,058 |
| | Contingency (20%)…….…...…….…….…… | | | | | $ 88,612 |
| | | | | | | |
| | TOTAL ESTIMATED CONSTRUCTION COST:..... | | | | | $ 531,670 |
| | | | | | | |
| | Engineering and Administrative Costs (30%):.....…..... | | | | | $ 159,501 |
| | | | | | | |
| | TOTAL ESTIMATED PROJECT COST:..... | | | | | $ 691,171 |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Basin No. | 2 | | | | | |
| Proj. No. | 2 | | | | | |
| Pipe Size | | 8 | 12 | 15 | 18 | 21 |
| Segment Length = | | | 354 | | 320 | |
| No of Side Sewers (Parcels) = | | | 12 | | 6 | |
| | | | | | | |
| | | | | UNIT | | AMOUNT |
| NO. | ITEM | QUANTITY | | PRICE | | |
| | | | | | | |
| 1 | Mobilization and Demobilization | LUMP SUM | | $ 16,700 | | $ 16,700 |
| 2 | Trench Safety Systems | LUMP SUM | | $ 6,100 | | $ 6,100 |
| 3 | Locate Existing Utilities | LUMP SUM | | $ 4,000 | | $ 4,000 |
| 4 | Erosion Control | LUMP SUM | | $ 3,900 | | $ 3,900 |
| 5 | Dewatering | LUMP SUM | | $ 9,300 | | $ 9,300 |
| 6 | Bypass Pumping | LUMP SUM | | $ 8,800 | | $ 8,800 |
| | | | | | | |
| 7 | Sawcutting | 1348 | LF | $ 2 | | $ 2,696 |
| 8 | Traffic Control | 120 | HR | $ 30 | | $ 3,600 |
| 9a | 8" Gravity Sewer Main | 0 | LF | $ 80 | | $ - |
| 9b | 12" Gravity Sewer Main | 354 | LF | $ 100 | | $ 35,400 |
| 9c | 15" Gravity Sewer Main | 0 | LF | $ 120 | | $ - |
| 9d | 18" Gravity Sewer Main | 320 | LF | $ 145 | | $ 46,400 |
| 9e | 21" Gravity Sewer Main | 0 | LF | $ 155 | | $ - |
| 9f | 24" Gravity Sewer Main | | LF | $ - | | |
| 10 | Side Sewer | 18 | EA | $ 1,000 | | $ 18,000 |
| 11 | 48" Manhole | 4 | EA | $ 4,500 | | $ 18,000 |
| 12 | Asphalt | 200 | TN | $ 110 | | $ 22,000 |
| 13a | Gravel Backfill (8") | 0 | CY | $ 15 | | |
| 13b | Gravel Backfill (12") | 160 | CY | $ 15 | | $ 2,400 |
| 13c | Gravel Backfill (15") | 0 | CY | $ 15 | | $ - |
| 13d | Gravel Backfill (18") | 170 | CY | $ 15 | | $ 2,550 |
| 13e | Gravel Backfill (21") | 0 | CY | $ 15 | | $ - |
| 13f | Gravel Backfill (24") | 0 | CY | $ 15 | | $ - |
| 14a | CDF (8") | 0 | CY | $ 75 | | $ - |
| 14b | CDF (12") | 160 | CY | $ 75 | | $ 12,000 |
| 14c | CDF (15") | 0 | CY | $ 75 | | $ - |
| 14d | CDF (18") | 170 | CY | $ 75 | | $ 12,750 |
| 14e | CDF (21") | 0 | CY | $ 75 | | $ - |
| 14f | CDF (24") | 0 | CY | $ 75 | | $ - |
| | Subtotal | | | | | $ 224,596 |
| | Tax @ | 7.9 | % | | | $ 17,743 |
| | | | | | | |
| | Subtotal | | | | | $ 242,339 |
| | Contingency (20%)…… | | | | | $ 48,468 |
| | | | | | | |
| | TOTAL ESTIMATED CONSTRUCTION COST:..... | | | | | $ 290,807 |
| | | | | | | |
| | Engineering and Administrative Costs (30%):..... | | | | | $ 87,242 |
| | | | | | | |
| | TOTAL ESTIMATED PROJECT COST:..... | | | | | $ 378,049 |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Basin No. | 3N | | | | | |
| Proj. No. | 1 | | | | | |
| Pipe Size | | 6 | 8 | 10 | 12 | 15 |
| Segment Length = | | | 2300 | | | |
| No of Side Sewers (Parcels) = | | | 32 | | | |
| | | | | | | |
| | | | | UNIT | | AMOUNT |
| NO. | ITEM | QUANTITY | | PRICE | | |
| | | | | | | |
| 1 | Mobilization and Demobilization | LUMP SUM | | $ 39,000 | | $ 39,000 |
| 2 | Trench Safety Systems | LUMP SUM | | $ 14,200 | | $ 14,200 |
| 3 | Locate Existing Utilities | LUMP SUM | | $ 9,300 | | $ 9,300 |
| 4 | Erosion Control | LUMP SUM | | $ 9,100 | | $ 9,100 |
| 5 | Dewatering | LUMP SUM | | $ 21,700 | | $ 21,700 |
| 6 | Bypass Pumping | LUMP SUM | | $ 20,700 | | $ 20,700 |
| | | | | | | |
| 7 | Sawcutting | 4600 | LF | $ 2 | | $ 9,200 |
| | | | | | | |
| 8 | Traffic Control | 370 | HR | $ 30 | | $ 11,100 |
| 9a | 6" Gravity Sewer Main | 0 | LF | $ 40 | | $ - |
| 9b | 8" Gravity Sewer Main | 2300 | LF | $ 70 | | $ 161,000 |
| 9c | 10" Gravity Sewer Main | 0 | LF | $ 80 | | $ - |
| 9d | 12" Gravity Sewer Main | 0 | LF | $ 100 | | $ - |
| 9e | 15" Gravity Sewer Main | 0 | LF | $ 120 | | $ - |
| | | | | | | |
| 10 | Side Sewer | 32 | EA | $ 1,000 | | $ 32,000 |
| | | | | | | |
| 11 | 48" Manhole | 9 | EA | $ 4,500 | | $ 40,500 |
| | | | | | | |
| 12 | Asphalt | 600 | TN | $ 110 | | $ 66,000 |
| 13a | Gravel Backfill (6") | 0 | CY | $ 15 | | |
| 13b | Gravel Backfill (8") | 1030 | CY | $ 15 | | $ 15,450 |
| 13c | Gravel Backfill (10") | 0 | CY | $ 15 | | $ - |
| 13d | Gravel Backfill (12") | 0 | CY | $ 15 | | $ - |
| 13e | Gravel Backfill (15") | 0 | CY | $ 15 | | $ - |
| 14a | CDF (6") | 0 | CY | $ 75 | | $ - |
| 14b | CDF (8") | 1030 | CY | $ 75 | | $ 77,250 |
| 14c | CDF (10") | 0 | CY | $ 75 | | $ - |
| 14d | CDF (12") | 0 | CY | $ 75 | | $ - |
| 14e | CDF (15") | 0 | CY | $ 75 | | $ - |
| | Subtotal | | | | | $ 526,500 |
| | Tax @ | 7.9 | % | | | $ 41,594 |
| | | | | | | |
| | Subtotal | | | | | $ 568,094 |
| | Contingency (20%)…… | | | | | $ 113,619 |
| | | | | | | |
| | TOTAL ESTIMATED CONSTRUCTION COST:..... | | | | | $ 681,713 |
| | | | | | | |
| | Engineering and Administrative Costs (30%):..... | | | | | $ 204,514 |
| | | | | | | |
| | TOTAL ESTIMATED PROJECT COST:..... | | | | | $ 886,227 |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Basin No. | 3N | | | | | |
| Proj. No. | 2 | | | | | |
| Pipe Size | | 6 | 8 | 10 | 12 | 15 |
| Segment Length = | | | 1432 | | | |
| No of Side Sewers (Parcels) = | | | 43 | | | |
| | | | | | | |
| | | | | UNIT | | AMOUNT |
| NO. | ITEM | QUANTITY | | PRICE | | |
| | | | | | | |
| 1 | Mobilization and Demobilization | LUMP SUM | | $ 27,000 | | $ 27,000 |
| 2 | Trench Safety Systems | LUMP SUM | | $ 9,800 | | $ 9,800 |
| 3 | Locate Existing Utilities | LUMP SUM | | $ 6,500 | | $ 6,500 |
| 4 | Erosion Control | LUMP SUM | | $ 6,300 | | $ 6,300 |
| 5 | Dewatering | LUMP SUM | | $ 15,000 | | $ 15,000 |
| 6 | Bypass Pumping | LUMP SUM | | $ 14,300 | | $ 14,300 |
| | | | | | | |
| 7 | Sawcutting | 2864 | LF | $ 2 | | $ 5,728 |
| | | | | | | |
| 8 | Traffic Control | 230 | HR | $ 30 | | $ 6,900 |
| 9a | 6" Gravity Sewer Main | 0 | LF | $ 40 | | $ - |
| 9b | 8" Gravity Sewer Main | 1432 | LF | $ 70 | | $ 100,240 |
| 9c | 10" Gravity Sewer Main | 0 | LF | $ 80 | | $ - |
| 9d | 12" Gravity Sewer Main | 0 | LF | $ 100 | | $ - |
| 9e | 15" Gravity Sewer Main | 0 | LF | $ 120 | | $ - |
| | | | | | | |
| 10 | Side Sewer | 43 | EA | $ 1,000 | | $ 43,000 |
| | | | | | | |
| 11 | 48" Manhole | 6 | EA | $ 4,500 | | $ 27,000 |
| | | | | | | |
| 12 | Asphalt | 400 | TN | $ 110 | | $ 44,000 |
| 13a | Gravel Backfill (6") | 0 | CY | $ 15 | | |
| 13b | Gravel Backfill (8") | 640 | CY | $ 15 | | $ 9,600 |
| 13c | Gravel Backfill (10") | 0 | CY | $ 15 | | $ - |
| 13d | Gravel Backfill (12") | 0 | CY | $ 15 | | $ - |
| 13e | Gravel Backfill (15") | 0 | CY | $ 15 | | $ - |
| 14a | CDF (6") | 0 | CY | $ 75 | | $ - |
| 14b | CDF (8") | 640 | CY | $ 75 | | $ 48,000 |
| 14c | CDF (10") | 0 | CY | $ 75 | | $ - |
| 14d | CDF (12") | 0 | CY | $ 75 | | $ - |
| 14e | CDF (15") | 0 | CY | $ 75 | | $ - |
| | Subtotal | | | | | $ 363,368 |
| | Tax @ | 7.9 | % | | | $ 28,706 |
| | | | | | | |
| | Subtotal | | | | | $ 392,074 |
| | Contingency (20%)…… | | | | | $ 78,415 |
| | | | | | | |
| | TOTAL ESTIMATED CONSTRUCTION COST:..... | | | | | $ 470,489 |
| | | | | | | |
| | Engineering and Administrative Costs (30%):..... | | | | | $ 141,147 |
| | | | | | | |
| | TOTAL ESTIMATED PROJECT COST:..... | | | | | $ 611,636 |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Basin No. | 3N | | | | | |
| Proj. No. | 3 | | | | | |
| Pipe Size | | 6 | 8 | 10 | 12 | 15 |
| Segment Length = | | | 1322 | | | |
| No of Side Sewers (Parcels) = | | | 36 | | | |
| | | | | | | |
| | | | | UNIT | | AMOUNT |
| NO. | ITEM | QUANTITY | | PRICE | | |
| | | | | | | |
| 1 | Mobilization and Demobilization | LUMP SUM | | $ 24,000 | | $ 24,000 |
| 2 | Trench Safety Systems | LUMP SUM | | $ 8,800 | | $ 8,800 |
| 3 | Locate Existing Utilities | LUMP SUM | | $ 5,800 | | $ 5,800 |
| 4 | Erosion Control | LUMP SUM | | $ 5,600 | | $ 5,600 |
| 5 | Dewatering | LUMP SUM | | $ 13,400 | | $ 13,400 |
| 6 | Bypass Pumping | LUMP SUM | | $ 12,700 | | $ 12,700 |
| | | | | | | |
| 7 | Sawcutting | 2644 | LF | $ 2 | | $ 5,288 |
| | | | | | | |
| 8 | Traffic Control | 220 | HR | $ 30 | | $ 6,600 |
| 9a | 6" Gravity Sewer Main | 0 | LF | $ 40 | | $ - |
| 9b | 8" Gravity Sewer Main | 1322 | LF | $ 70 | | $ 92,540 |
| 9c | 10" Gravity Sewer Main | 0 | LF | $ 80 | | $ - |
| 9d | 12" Gravity Sewer Main | 0 | LF | $ 100 | | $ - |
| 9e | 15" Gravity Sewer Main | 0 | LF | $ 120 | | $ - |
| | | | | | | |
| 10 | Side Sewer | 36 | EA | $ 1,000 | | $ 36,000 |
| | | | | | | |
| 11 | 48" Manhole | 6 | EA | $ 4,500 | | $ 27,000 |
| | | | | | | |
| 12 | Asphalt | 300 | TN | $ 110 | | $ 33,000 |
| 13a | Gravel Backfill (6") | 0 | CY | $ 15 | | |
| 13b | Gravel Backfill (8") | 590 | CY | $ 15 | | $ 8,850 |
| 13c | Gravel Backfill (10") | 0 | CY | $ 15 | | $ - |
| 13d | Gravel Backfill (12") | 0 | CY | $ 15 | | $ - |
| 13e | Gravel Backfill (15") | 0 | CY | $ 15 | | $ - |
| 14a | CDF (6") | 0 | CY | $ 75 | | $ - |
| 14b | CDF (8") | 590 | CY | $ 75 | | $ 44,250 |
| 14c | CDF (10") | 0 | CY | $ 75 | | $ - |
| 14d | CDF (12") | 0 | CY | $ 75 | | $ - |
| 14e | CDF (15") | 0 | CY | $ 75 | | $ - |
| | Subtotal | | | | | $ 323,828 |
| | Tax @ | 7.9 | % | | | $ 25,582 |
| | | | | | | |
| | Subtotal | | | | | $ 349,410 |
| | Contingency (20%)…… | | | | | $ 69,882 |
| | | | | | | |
| | TOTAL ESTIMATED CONSTRUCTION COST:..... | | | | | $ 419,292 |
| | | | | | | |
| | Engineering and Administrative Costs (30%):..... | | | | | $ 125,788 |
| | | | | | | |
| | TOTAL ESTIMATED PROJECT COST:..... | | | | | $ 545,080 |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Basin No. | 3N | | | | | |
| Proj. No. | 4 | | | | | |
| Pipe Size | | 6 | 8 | 10 | 12 | 15 |
| Segment Length = | | | 1087 | | | |
| No of Side Sewers (Parcels) = | | | 34 | | | |
| | | | | | | |
| | | | | UNIT | | AMOUNT |
| NO. | ITEM | QUANTITY | | PRICE | | |
| | | | | | | |
| 1 | Mobilization and Demobilization | LUMP SUM | | $ 20,800 | | $ 20,800 |
| 2 | Trench Safety Systems | LUMP SUM | | $ 7,600 | | $ 7,600 |
| 3 | Locate Existing Utilities | LUMP SUM | | $ 5,000 | | $ 5,000 |
| 4 | Erosion Control | LUMP SUM | | $ 4,900 | | $ 4,900 |
| 5 | Dewatering | LUMP SUM | | $ 11,600 | | $ 11,600 |
| 6 | Bypass Pumping | LUMP SUM | | $ 11,000 | | $ 11,000 |
| | | | | | | |
| 7 | Sawcutting | 2174 | LF | $ 2 | | $ 4,348 |
| | | | | | | |
| 8 | Traffic Control | 180 | HR | $ 30 | | $ 5,400 |
| 9a | 6" Gravity Sewer Main | 0 | LF | $ 40 | | $ - |
| 9b | 8" Gravity Sewer Main | 1087 | LF | $ 70 | | $ 76,090 |
| 9c | 10" Gravity Sewer Main | 0 | LF | $ 80 | | $ - |
| 9d | 12" Gravity Sewer Main | 0 | LF | $ 100 | | $ - |
| 9e | 15" Gravity Sewer Main | 0 | LF | $ 120 | | $ - |
| | | | | | | |
| 10 | Side Sewer | 34 | EA | $ 1,000 | | $ 34,000 |
| | | | | | | |
| 11 | 48" Manhole | 5 | EA | $ 4,500 | | $ 22,500 |
| | | | | | | |
| 12 | Asphalt | 300 | TN | $ 110 | | $ 33,000 |
| 13a | Gravel Backfill (6") | 0 | CY | $ 15 | | |
| 13b | Gravel Backfill (8") | 490 | CY | $ 15 | | $ 7,350 |
| 13c | Gravel Backfill (10") | 0 | CY | $ 15 | | $ - |
| 13d | Gravel Backfill (12") | 0 | CY | $ 15 | | $ - |
| 13e | Gravel Backfill (15") | 0 | CY | $ 15 | | $ - |
| 14a | CDF (6") | 0 | CY | $ 75 | | $ - |
| 14b | CDF (8") | 490 | CY | $ 75 | | $ 36,750 |
| 14c | CDF (10") | 0 | CY | $ 75 | | $ - |
| 14d | CDF (12") | 0 | CY | $ 75 | | $ - |
| 14e | CDF (15") | 0 | CY | $ 75 | | $ - |
| | Subtotal | | | | | $ 280,338 |
| | Tax @ | 7.9 | % | | | $ 22,147 |
| | | | | | | |
| | Subtotal | | | | | $ 302,485 |
| | Contingency (20%)…… | | | | | $ 60,497 |
| | | | | | | |
| | TOTAL ESTIMATED CONSTRUCTION COST:..... | | | | | $ 362,982 |
| | | | | | | |
| | Engineering and Administrative Costs (30%):..... | | | | | $ 108,895 |
| | | | | | | |
| | TOTAL ESTIMATED PROJECT COST:..... | | | | | $ 471,877 |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Basin No. | 3N | | | | | |
| Proj. No. | 5 | | | | | |
| Pipe Size | | 6 | 8 | 10 | 12 | 15 |
| Segment Length = | | | | 1680 | 296 | |
| No of Side Sewers (Parcels) = | | | | 21 | 5 | |
| | | | | | | |
| | | | | UNIT | | AMOUNT |
| NO. | ITEM | QUANTITY | | PRICE | | |
| | | | | | | |
| 1 | Mobilization and Demobilization | LUMP SUM | | $ 35,900 | | $ 35,900 |
| 2 | Trench Safety Systems | LUMP SUM | | $ 13,100 | | $ 13,100 |
| 3 | Locate Existing Utilities | LUMP SUM | | $ 8,600 | | $ 8,600 |
| 4 | Erosion Control | LUMP SUM | | $ 8,400 | | $ 8,400 |
| 5 | Dewatering | LUMP SUM | | $ 19,900 | | $ 19,900 |
| 6 | Bypass Pumping | LUMP SUM | | $ 19,000 | | $ 19,000 |
| | | | | | | |
| 7 | Sawcutting | 3952 | LF | $ 2 | | $ 7,904 |
| | | | | | | |
| 8 | Traffic Control | 320 | HR | $ 30 | | $ 9,600 |
| 9a | 6" Gravity Sewer Main | 0 | LF | $ 40 | | $ - |
| 9b | 8" Gravity Sewer Main | 0 | LF | $ 70 | | $ - |
| 9c | 10" Gravity Sewer Main | 1680 | LF | $ 80 | | $ 134,400 |
| 9d | 12" Gravity Sewer Main | 296 | LF | $ 100 | | $ 29,600 |
| 9e | 15" Gravity Sewer Main | 0 | LF | $ 120 | | $ - |
| | | | | | | |
| 10 | Side Sewer | 26 | EA | $ 1,000 | | $ 26,000 |
| | | | | | | |
| 11 | 48" Manhole | 8 | EA | $ 4,500 | | $ 36,000 |
| | | | | | | |
| 12 | Asphalt | 500 | TN | $ 110 | | $ 55,000 |
| 13a | Gravel Backfill (6") | 0 | CY | $ 15 | | |
| 13b | Gravel Backfill (8") | 0 | CY | $ 15 | | $ - |
| 13c | Gravel Backfill (10") | 750 | CY | $ 15 | | $ 11,250 |
| 13d | Gravel Backfill (12") | 140 | CY | $ 15 | | $ 2,100 |
| 13e | Gravel Backfill (15") | 0 | CY | $ 15 | | $ - |
| 14a | CDF (6") | 0 | CY | $ 75 | | $ - |
| 14b | CDF (8") | 0 | CY | $ 75 | | $ - |
| 14c | CDF (10") | 750 | CY | $ 75 | | $ 56,250 |
| 14d | CDF (12") | 140 | CY | $ 75 | | $ 10,500 |
| 14e | CDF (15") | 0 | CY | $ 75 | | $ - |
| | Subtotal | | | | | $ 483,504 |
| | Tax @ | 7.9 | % | | | $ 38,197 |
| | | | | | | |
| | Subtotal | | | | | $ 521,701 |
| | Contingency (20%)…… | | | | | $ 104,340 |
| | | | | | | |
| | TOTAL ESTIMATED CONSTRUCTION COST:..... | | | | | $ 626,041 |
| | | | | | | |
| | Engineering and Administrative Costs (30%):..... | | | | | $ 187,812 |
| | | | | | | |
| | TOTAL ESTIMATED PROJECT COST:..... | | | | | $ 813,853 |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Basin No. | 3S | | | | | |
| Proj. No. | 1 | | | | | |
| Pipe Size | | 6 | 8 | 10 | 12 | 15 |
| Segment Length = | | | 951 | | | |
| No of Side Sewers (Parcels) = | | | 51 | | | |
| | | | | | | |
| | | | | UNIT | | AMOUNT |
| NO. | ITEM | QUANTITY | | PRICE | | |
| | | | | | | |
| 1 | Mobilization and Demobilization | LUMP SUM | | $ 20,900 | | $ 20,900 |
| 2 | Trench Safety Systems | LUMP SUM | | $ 7,600 | | $ 7,600 |
| 3 | Locate Existing Utilities | LUMP SUM | | $ 5,000 | | $ 5,000 |
| 4 | Erosion Control | LUMP SUM | | $ 4,900 | | $ 4,900 |
| 5 | Dewatering | LUMP SUM | | $ 11,600 | | $ 11,600 |
| 6 | Bypass Pumping | LUMP SUM | | $ 11,100 | | $ 11,100 |
| | | | | | | |
| 7 | Sawcutting | 1902 | LF | $ 2 | | $ 3,804 |
| | | | | | | |
| 8 | Traffic Control | 160 | HR | $ 30 | | $ 4,800 |
| 9a | 6" Gravity Sewer Main | 0 | LF | $ 40 | | $ - |
| 9b | 8" Gravity Sewer Main | 951 | LF | $ 70 | | $ 66,570 |
| 9c | 10" Gravity Sewer Main | 0 | LF | $ 80 | | $ - |
| 9d | 12" Gravity Sewer Main | 0 | LF | $ 100 | | $ - |
| 9e | 15" Gravity Sewer Main | 0 | LF | $ 120 | | $ - |
| | | | | | | |
| 10 | Side Sewer | 51 | EA | $ 1,000 | | $ 51,000 |
| | | | | | | |
| 11 | 48" Manhole | 5 | EA | $ 4,500 | | $ 22,500 |
| | | | | | | |
| 12 | Asphalt | 300 | TN | $ 110 | | $ 33,000 |
| 13a | Gravel Backfill (6") | 0 | CY | $ 15 | | |
| 13b | Gravel Backfill (8") | 430 | CY | $ 15 | | $ 6,450 |
| 13c | Gravel Backfill (10") | 0 | CY | $ 15 | | $ - |
| 13d | Gravel Backfill (12") | 0 | CY | $ 15 | | $ - |
| 13e | Gravel Backfill (15") | 0 | CY | $ 15 | | $ - |
| 14a | CDF (6") | 0 | CY | $ 75 | | $ - |
| 14b | CDF (8") | 430 | CY | $ 75 | | $ 32,250 |
| 14c | CDF (10") | 0 | CY | $ 75 | | $ - |
| 14d | CDF (12") | 0 | CY | $ 75 | | $ - |
| 14e | CDF (15") | 0 | CY | $ 75 | | $ - |
| | Subtotal | | | | | $ 281,474 |
| | Tax @ | 7.9 | % | | | $ 22,236 |
| | | | | | | |
| | Subtotal | | | | | $ 303,710 |
| | Contingency (20%)…… | | | | | $ 60,742 |
| | | | | | | |
| | TOTAL ESTIMATED CONSTRUCTION COST:..... | | | | | $ 364,452 |
| | | | | | | |
| | Engineering and Administrative Costs (30%):..... | | | | | $ 109,336 |
| | | | | | | |
| | TOTAL ESTIMATED PROJECT COST:..... | | | | | $ 473,788 |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Basin No. | 3S | | | | | |
| Proj. No. | 2 | | | | | |
| Pipe Size | | 6 | 8 | 10 | 12 | 15 |
| Segment Length = | | | 1020 | | | 261 |
| No of Side Sewers (Parcels) = | | | 30 | | | 1 |
| | | | | | | |
| | | | | UNIT | | AMOUNT |
| NO. | ITEM | QUANTITY | | PRICE | | |
| | | | | | | |
| 1 | Mobilization and Demobilization | LUMP SUM | | $ 24,600 | | $ 24,600 |
| 2 | Trench Safety Systems | LUMP SUM | | $ 9,000 | | $ 9,000 |
| 3 | Locate Existing Utilities | LUMP SUM | | $ 5,900 | | $ 5,900 |
| 4 | Erosion Control | LUMP SUM | | $ 5,800 | | $ 5,800 |
| 5 | Dewatering | LUMP SUM | | $ 13,700 | | $ 13,700 |
| 6 | Bypass Pumping | LUMP SUM | | $ 13,000 | | $ 13,000 |
| | | | | | | |
| 7 | Sawcutting | 2562 | LF | $ 2 | | $ 5,124 |
| | | | | | | |
| 8 | Traffic Control | 210 | HR | $ 30 | | $ 6,300 |
| 9a | 6" Gravity Sewer Main | 0 | LF | $ 40 | | $ - |
| 9b | 8" Gravity Sewer Main | 1020 | LF | $ 70 | | $ 71,400 |
| 9c | 10" Gravity Sewer Main | 0 | LF | $ 80 | | $ - |
| 9d | 12" Gravity Sewer Main | 0 | LF | $ 100 | | $ - |
| 9e | 15" Gravity Sewer Main | 261 | LF | $ 120 | | $ 31,320 |
| | | | | | | |
| 10 | Side Sewer | 31 | EA | $ 1,000 | | $ 31,000 |
| | | | | | | |
| 11 | 48" Manhole | 6 | EA | $ 4,500 | | $ 27,000 |
| | | | | | | |
| 12 | Asphalt | 300 | TN | $ 110 | | $ 33,000 |
| 13a | Gravel Backfill (6") | 0 | CY | $ 15 | | |
| 13b | Gravel Backfill (8") | 460 | CY | $ 15 | | $ 6,900 |
| 13c | Gravel Backfill (10") | 0 | CY | $ 15 | | $ - |
| 13d | Gravel Backfill (12") | 0 | CY | $ 15 | | $ - |
| 13e | Gravel Backfill (15") | 140 | CY | $ 15 | | $ 2,100 |
| 14a | CDF (6") | 0 | CY | $ 75 | | $ - |
| 14b | CDF (8") | 460 | CY | $ 75 | | $ 34,500 |
| 14c | CDF (10") | 0 | CY | $ 75 | | $ - |
| 14d | CDF (12") | 0 | CY | $ 75 | | $ - |
| 14e | CDF (15") | 140 | CY | $ 75 | | $ 10,500 |
| | Subtotal | | | | | $ 331,144 |
| | Tax @ | 7.9 | % | | | $ 26,160 |
| | | | | | | |
| | Subtotal | | | | | $ 357,304 |
| | Contingency (20%)…… | | | | | $ 71,461 |
| | | | | | | |
| | TOTAL ESTIMATED CONSTRUCTION COST:..... | | | | | $ 428,765 |
| | | | | | | |
| | Engineering and Administrative Costs (30%):..... | | | | | $ 128,630 |
| | | | | | | |
| | TOTAL ESTIMATED PROJECT COST:..... | | | | | $ 557,395 |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Basin No. | 3S | | | | | |
| Proj. No. | 3 | | | | | |
| Pipe Size | | 6 | 8 | 10 | 12 | 15 |
| Segment Length = | | | 258 | 1057 | 258 | 261 |
| No of Side Sewers (Parcels) = | | | 7 | 28 | 7 | 2 |
| | | | | | | |
| | | | | UNIT | | AMOUNT |
| NO. | ITEM | QUANTITY | | PRICE | | |
| | | | | | | |
| 1 | Mobilization and Demobilization | LUMP SUM | | $ 36,700 | | $ 36,700 |
| 2 | Trench Safety Systems | LUMP SUM | | $ 13,400 | | $ 13,400 |
| 3 | Locate Existing Utilities | LUMP SUM | | $ 8,800 | | $ 8,800 |
| 4 | Erosion Control | LUMP SUM | | $ 8,600 | | $ 8,600 |
| 5 | Dewatering | LUMP SUM | | $ 20,400 | | $ 20,400 |
| 6 | Bypass Pumping | LUMP SUM | | $ 19,400 | | $ 19,400 |
| | | | | | | |
| 7 | Sawcutting | 3668 | LF | $ 2 | | $ 7,336 |
| | | | | | | |
| 8 | Traffic Control | 300 | HR | $ 30 | | $ 9,000 |
| 9a | 6" Gravity Sewer Main | 0 | LF | $ 40 | | $ - |
| 9b | 8" Gravity Sewer Main | 258 | LF | $ 70 | | $ 18,060 |
| 9c | 10" Gravity Sewer Main | 1057 | LF | $ 80 | | $ 84,560 |
| 9d | 12" Gravity Sewer Main | 258 | LF | $ 100 | | $ 25,800 |
| 9e | 15" Gravity Sewer Main | 261 | LF | $ 120 | | $ 31,320 |
| | | | | | | |
| 10 | Side Sewer | 44 | EA | $ 1,000 | | $ 44,000 |
| | | | | | | |
| 11 | 48" Manhole | 8 | EA | $ 4,500 | | $ 36,000 |
| | | | | | | |
| 12 | Asphalt | 500 | TN | $ 110 | | $ 55,000 |
| 13a | Gravel Backfill (6") | 0 | CY | $ 15 | | |
| 13b | Gravel Backfill (8") | 120 | CY | $ 15 | | $ 1,800 |
| 13c | Gravel Backfill (10") | 470 | CY | $ 15 | | $ 7,050 |
| 13d | Gravel Backfill (12") | 120 | CY | $ 15 | | $ 1,800 |
| 13e | Gravel Backfill (15") | 140 | CY | $ 15 | | $ 2,100 |
| 14a | CDF (6") | 0 | CY | $ 75 | | $ - |
| 14b | CDF (8") | 120 | CY | $ 75 | | $ 9,000 |
| 14c | CDF (10") | 470 | CY | $ 75 | | $ 35,250 |
| 14d | CDF (12") | 120 | CY | $ 75 | | $ 9,000 |
| 14e | CDF (15") | 140 | CY | $ 75 | | $ 10,500 |
| | Subtotal | | | | | $ 494,876 |
| | Tax @ | 7.9 | % | | | $ 39,095 |
| | | | | | | |
| | Subtotal | | | | | $ 533,971 |
| | Contingency (20%)…… | | | | | $ 106,794 |
| | | | | | | |
| | TOTAL ESTIMATED CONSTRUCTION COST:..... | | | | | $ 640,765 |
| | | | | | | |
| | Engineering and Administrative Costs (30%):..... | | | | | $ 192,230 |
| | | | | | | |
| | TOTAL ESTIMATED PROJECT COST:..... | | | | | $ 832,995 |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Basin No. | 3S | | | | | |
| Proj. No. | 4 | | | | | |
| Pipe Size | | 6 | 8 | 10 | 12 | 15 |
| Segment Length = | | | 1187 | | | 662 |
| No of Side Sewers (Parcels) = | | | 32 | | | 4 |
| | | | | | | |
| | | | | UNIT | | AMOUNT |
| NO. | ITEM | QUANTITY | | PRICE | | |
| | | | | | | |
| 1 | Mobilization and Demobilization | LUMP SUM | | $ 36,500 | | $ 36,500 |
| 2 | Trench Safety Systems | LUMP SUM | | $ 13,300 | | $ 13,300 |
| 3 | Locate Existing Utilities | LUMP SUM | | $ 8,700 | | $ 8,700 |
| 4 | Erosion Control | LUMP SUM | | $ 8,500 | | $ 8,500 |
| 5 | Dewatering | LUMP SUM | | $ 20,300 | | $ 20,300 |
| 6 | Bypass Pumping | LUMP SUM | | $ 19,300 | | $ 19,300 |
| | | | | | | |
| 7 | Sawcutting | 3698 | LF | $ 2 | | $ 7,396 |
| | | | | | | |
| 8 | Traffic Control | 300 | HR | $ 30 | | $ 9,000 |
| 9a | 6" Gravity Sewer Main | 0 | LF | $ 40 | | $ - |
| 9b | 8" Gravity Sewer Main | 1187 | LF | $ 70 | | $ 83,090 |
| 9c | 10" Gravity Sewer Main | 0 | LF | $ 80 | | $ - |
| 9d | 12" Gravity Sewer Main | 0 | LF | $ 100 | | $ - |
| 9e | 15" Gravity Sewer Main | 662 | LF | $ 120 | | $ 79,440 |
| | | | | | | |
| 10 | Side Sewer | 36 | EA | $ 1,000 | | $ 36,000 |
| | | | | | | |
| 11 | 48" Manhole | 8 | EA | $ 4,500 | | $ 36,000 |
| | | | | | | |
| 12 | Asphalt | 500 | TN | $ 110 | | $ 55,000 |
| 13a | Gravel Backfill (6") | 0 | CY | $ 15 | | |
| 13b | Gravel Backfill (8") | 530 | CY | $ 15 | | $ 7,950 |
| 13c | Gravel Backfill (10") | 0 | CY | $ 15 | | $ - |
| 13d | Gravel Backfill (12") | 0 | CY | $ 15 | | $ - |
| 13e | Gravel Backfill (15") | 350 | CY | $ 15 | | $ 5,250 |
| 14a | CDF (6") | 0 | CY | $ 75 | | $ - |
| 14b | CDF (8") | 530 | CY | $ 75 | | $ 39,750 |
| 14c | CDF (10") | 0 | CY | $ 75 | | $ - |
| 14d | CDF (12") | 0 | CY | $ 75 | | $ - |
| 14e | CDF (15") | 350 | CY | $ 75 | | $ 26,250 |
| | Subtotal | | | | | $ 491,726 |
| | Tax @ | 7.9 | % | | | $ 38,846 |
| | | | | | | |
| | Subtotal | | | | | $ 530,572 |
| | Contingency (20%)…… | | | | | $ 106,114 |
| | | | | | | |
| | TOTAL ESTIMATED CONSTRUCTION COST:..... | | | | | $ 636,686 |
| | | | | | | |
| | Engineering and Administrative Costs (30%):..... | | | | | $ 191,006 |
| | | | | | | |
| | TOTAL ESTIMATED PROJECT COST:..... | | | | | $ 827,692 |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Basin No. | 3S | | | | | |
| Proj. No. | 5 | | | | | |
| Pipe Size | | 6 | 8 | 10 | 12 | 15 |
| Segment Length = | | | 533 | | | 229 |
| No of Side Sewers (Parcels) = | | | 11 | | | 3 |
| | | | | | | |
| | | | | UNIT | | AMOUNT |
| NO. | ITEM | QUANTITY | | PRICE | | |
| | | | | | | |
| 1 | Mobilization and Demobilization | LUMP SUM | | $ 15,000 | | $ 15,000 |
| 2 | Trench Safety Systems | LUMP SUM | | $ 5,500 | | $ 5,500 |
| 3 | Locate Existing Utilities | LUMP SUM | | $ 3,600 | | $ 3,600 |
| 4 | Erosion Control | LUMP SUM | | $ 3,500 | | $ 3,500 |
| 5 | Dewatering | LUMP SUM | | $ 8,400 | | $ 8,400 |
| 6 | Bypass Pumping | LUMP SUM | | $ 8,000 | | $ 8,000 |
| | | | | | | |
| 7 | Sawcutting | 1524 | LF | $ 2 | | $ 3,048 |
| | | | | | | |
| 8 | Traffic Control | 130 | HR | $ 30 | | $ 3,900 |
| 9a | 6" Gravity Sewer Main | 0 | LF | $ 40 | | $ - |
| 9b | 8" Gravity Sewer Main | 533 | LF | $ 70 | | $ 37,310 |
| 9c | 10" Gravity Sewer Main | 0 | LF | $ 80 | | $ - |
| 9d | 12" Gravity Sewer Main | 0 | LF | $ 100 | | $ - |
| 9e | 15" Gravity Sewer Main | 229 | LF | $ 120 | | $ 27,480 |
| | | | | | | |
| 10 | Side Sewer | 14 | EA | $ 1,000 | | $ 14,000 |
| | | | | | | |
| 11 | 48" Manhole | 4 | EA | $ 4,500 | | $ 18,000 |
| | | | | | | |
| 12 | Asphalt | 200 | TN | $ 110 | | $ 22,000 |
| 13a | Gravel Backfill (6") | 0 | CY | $ 15 | | |
| 13b | Gravel Backfill (8") | 240 | CY | $ 15 | | $ 3,600 |
| 13c | Gravel Backfill (10") | 0 | CY | $ 15 | | $ - |
| 13d | Gravel Backfill (12") | 0 | CY | $ 15 | | $ - |
| 13e | Gravel Backfill (15") | 120 | CY | $ 15 | | $ 1,800 |
| 14a | CDF (6") | 0 | CY | $ 75 | | $ - |
| 14b | CDF (8") | 240 | CY | $ 75 | | $ 18,000 |
| 14c | CDF (10") | 0 | CY | $ 75 | | $ - |
| 14d | CDF (12") | 0 | CY | $ 75 | | $ - |
| 14e | CDF (15") | 120 | CY | $ 75 | | $ 9,000 |
| | Subtotal | | | | | $ 202,138 |
| | Tax @ | 7.9 | % | | | $ 15,969 |
| | | | | | | |
| | Subtotal | | | | | $ 218,107 |
| | Contingency (20%)…… | | | | | $ 43,621 |
| | | | | | | |
| | TOTAL ESTIMATED CONSTRUCTION COST:..... | | | | | $ 261,728 |
| | | | | | | |
| | Engineering and Administrative Costs (30%):..... | | | | | $ 78,518 |
| | | | | | | |
| | TOTAL ESTIMATED PROJECT COST:..... | | | | | $ 340,246 |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Basin No. | 3S | | | | | |
| Proj. No. | 6 | | | | | |
| Pipe Size | | 6 | 8 | | 10 | 15 |
| Segment Length = | | | 184 | | 866 | 242 |
| No of Side Sewers (Parcels) = | | | 5 | | 24 | 7 |
| | | | | | | |
| | | | | UNIT | | AMOUNT |
| NO. | ITEM | QUANTITY | | PRICE | | |
| | | | | | | |
| 1 | Mobilization and Demobilization | LUMP SUM | | $ 25,900 | | $ 25,900 |
| 2 | Trench Safety Systems | LUMP SUM | | $ 9,500 | | $ 9,500 |
| 3 | Locate Existing Utilities | LUMP SUM | | $ 6,200 | | $ 6,200 |
| 4 | Erosion Control | LUMP SUM | | $ 6,100 | | $ 6,100 |
| 5 | Dewatering | LUMP SUM | | $ 14,400 | | $ 14,400 |
| 6 | Bypass Pumping | LUMP SUM | | $ 13,700 | | $ 13,700 |
| | | | | | | |
| 7 | Sawcutting | 2584 | LF | $ 2 | | $ 5,168 |
| | | | | | | |
| 8 | Traffic Control | 210 | HR | $ 30 | | $ 6,300 |
| 9a | 6" Gravity Sewer Main | 0 | LF | $ 40 | | $ - |
| 9b | 8" Gravity Sewer Main | 184 | LF | $ 70 | | $ 12,880 |
| 9c | xx" Gravity Sewer Main | 0 | LF | $ 80 | | $ - |
| 9d | 10" Gravity Sewer Main | 866 | LF | $ 80 | | $ 69,280 |
| 9e | 15" Gravity Sewer Main | 242 | LF | $ 120 | | $ 29,040 |
| | | | | | | |
| 10 | Side Sewer | 36 | EA | $ 1,000 | | $ 36,000 |
| | | | | | | |
| 11 | 48" Manhole | 6 | EA | $ 4,500 | | $ 27,000 |
| | | | | | | |
| 12 | Asphalt | 300 | TN | $ 110 | | $ 33,000 |
| 13a | Gravel Backfill (6") | 0 | CY | $ 15 | | |
| 13b | Gravel Backfill (8") | 90 | CY | $ 15 | | $ 1,350 |
| 13c | Gravel Backfill (xx") | 0 | CY | $ 15 | | $ - |
| 13d | Gravel Backfill (10") | 390 | CY | $ 15 | | $ 5,850 |
| 13e | Gravel Backfill (15") | 130 | CY | $ 15 | | $ 1,950 |
| 14a | CDF (6") | 0 | CY | $ 75 | | $ - |
| 14b | CDF (8") | 90 | CY | $ 75 | | $ 6,750 |
| 14c | CDF (xx") | 0 | CY | $ 75 | | $ - |
| 14d | CDF (10") | 390 | CY | $ 75 | | $ 29,250 |
| 14e | CDF (15") | 130 | CY | $ 75 | | $ 9,750 |
| | Subtotal | | | | | $ 349,368 |
| | Tax @ | 7.9 | % | | | $ 27,600 |
| | | | | | | |
| | Subtotal | | | | | $ 376,968 |
| | Contingency (20%)…… | | | | | $ 75,394 |
| | | | | | | |
| | TOTAL ESTIMATED CONSTRUCTION COST:..... | | | | | $ 452,362 |
| | | | | | | |
| | Engineering and Administrative Costs (30%):..... | | | | | $ 135,709 |
| | | | | | | |
| | TOTAL ESTIMATED PROJECT COST:..... | | | | | $ 588,071 |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Basin No. | 4 | | | | | |
| Proj. No. | 1 | | | | | |
| Pipe Size | | 6 | 8 | 10 | 12 | 15 |
| Segment Length = | | | 1769 | | | |
| No of Side Sewers (Parcels) = | | | 46 | | | |
| | | | | | | |
| | | | | UNIT | | AMOUNT |
| NO. | ITEM | QUANTITY | | PRICE | | |
| | | | | | | |
| 1 | Mobilization and Demobilization | LUMP SUM | | $ 31,500 | | $ 31,500 |
| 2 | Trench Safety Systems | LUMP SUM | | $ 11,500 | | $ 11,500 |
| 3 | Locate Existing Utilities | LUMP SUM | | $ 7,500 | | $ 7,500 |
| 4 | Erosion Control | LUMP SUM | | $ 7,400 | | $ 7,400 |
| 5 | Dewatering | LUMP SUM | | $ 17,500 | | $ 17,500 |
| 6 | Bypass Pumping | LUMP SUM | | $ 16,700 | | $ 16,700 |
| | | | | | | |
| 7 | Sawcutting | 3538 | LF | $ 2 | | $ 7,076 |
| | | | | | | |
| 8 | Traffic Control | 290 | HR | $ 30 | | $ 8,700 |
| 9a | 6" Gravity Sewer Main | 0 | LF | $ 40 | | $ - |
| 9b | 8" Gravity Sewer Main | 1769 | LF | $ 70 | | $ 123,830 |
| 9c | 10" Gravity Sewer Main | 0 | LF | $ 80 | | $ - |
| 9d | 12" Gravity Sewer Main | 0 | LF | $ 100 | | $ - |
| 9e | 15" Gravity Sewer Main | 0 | LF | $ 120 | | $ - |
| | | | | | | |
| 10 | Side Sewer | 46 | EA | $ 1,000 | | $ 46,000 |
| | | | | | | |
| 11 | 48" Manhole | 7 | EA | $ 4,500 | | $ 31,500 |
| | | | | | | |
| 12 | Asphalt | 400 | TN | $ 110 | | $ 44,000 |
| 13a | Gravel Backfill (6") | 0 | CY | $ 15 | | |
| 13b | Gravel Backfill (8") | 790 | CY | $ 15 | | $ 11,850 |
| 13c | Gravel Backfill (10") | 0 | CY | $ 15 | | $ - |
| 13d | Gravel Backfill (12") | 0 | CY | $ 15 | | $ - |
| 13e | Gravel Backfill (15") | 0 | CY | $ 15 | | $ - |
| 14a | CDF (6") | 0 | CY | $ 75 | | $ - |
| 14b | CDF (8") | 790 | CY | $ 75 | | $ 59,250 |
| 14c | CDF (10") | 0 | CY | $ 75 | | $ - |
| 14d | CDF (12") | 0 | CY | $ 75 | | $ - |
| 14e | CDF (15") | 0 | CY | $ 75 | | $ - |
| | Subtotal | | | | | $ 424,306 |
| | Tax @ | 7.9 | % | | | $ 33,520 |
| | | | | | | |
| | Subtotal | | | | | $ 457,826 |
| | Contingency (20%)…… | | | | | $ 91,565 |
| | | | | | | |
| | TOTAL ESTIMATED CONSTRUCTION COST:..... | | | | | $ 549,391 |
| | | | | | | |
| | Engineering and Administrative Costs (30%):..... | | | | | $ 164,817 |
| | | | | | | |
| | TOTAL ESTIMATED PROJECT COST:..... | | | | | $ 714,208 |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Basin No. | 4 | | | | | |
| Proj. No. | 2 | | | | | |
| Pipe Size | | 6 | 8 | 10 | 12 | 15 |
| Segment Length = | | | 851 | 550 | | |
| No of Side Sewers (Parcels) = | | | 17 | 6 | | |
| | | | | | | |
| | | | | UNIT | | AMOUNT |
| NO. | ITEM | QUANTITY | | PRICE | | |
| | | | | | | |
| 1 | Mobilization and Demobilization | LUMP SUM | | $ 25,300 | | $ 25,300 |
| 2 | Trench Safety Systems | LUMP SUM | | $ 9,200 | | $ 9,200 |
| 3 | Locate Existing Utilities | LUMP SUM | | $ 6,100 | | $ 6,100 |
| 4 | Erosion Control | LUMP SUM | | $ 5,900 | | $ 5,900 |
| 5 | Dewatering | LUMP SUM | | $ 14,100 | | $ 14,100 |
| 6 | Bypass Pumping | LUMP SUM | | $ 13,400 | | $ 13,400 |
| | | | | | | |
| 7 | Sawcutting | 2802 | LF | $ 2 | | $ 5,604 |
| | | | | | | |
| 8 | Traffic Control | 230 | HR | $ 30 | | $ 6,900 |
| 9a | 6" Gravity Sewer Main | 0 | LF | $ 40 | | $ - |
| 9b | 8" Gravity Sewer Main | 851 | LF | $ 70 | | $ 59,570 |
| 9c | 10" Gravity Sewer Main | 550 | LF | $ 80 | | $ 44,000 |
| 9d | 12" Gravity Sewer Main | 0 | LF | $ 100 | | $ - |
| 9e | 15" Gravity Sewer Main | 0 | LF | $ 120 | | $ - |
| | | | | | | |
| 10 | Side Sewer | 23 | EA | $ 1,000 | | $ 23,000 |
| | | | | | | |
| 11 | 48" Manhole | 6 | EA | $ 4,500 | | $ 27,000 |
| | | | | | | |
| 12 | Asphalt | 400 | TN | $ 110 | | $ 44,000 |
| 13a | Gravel Backfill (6") | 0 | CY | $ 15 | | |
| 13b | Gravel Backfill (8") | 380 | CY | $ 15 | | $ 5,700 |
| 13c | Gravel Backfill (10") | 250 | CY | $ 15 | | $ 3,750 |
| 13d | Gravel Backfill (12") | 0 | CY | $ 15 | | $ - |
| 13e | Gravel Backfill (15") | 0 | CY | $ 15 | | $ - |
| 14a | CDF (6") | 0 | CY | $ 75 | | $ - |
| 14b | CDF (8") | 380 | CY | $ 75 | | $ 28,500 |
| 14c | CDF (10") | 250 | CY | $ 75 | | $ 18,750 |
| 14d | CDF (12") | 0 | CY | $ 75 | | $ - |
| 14e | CDF (15") | 0 | CY | $ 75 | | $ - |
| | Subtotal | | | | | $ 340,774 |
| | Tax @ | 7.9 | % | | | $ 26,921 |
| | | | | | | |
| | Subtotal | | | | | $ 367,695 |
| | Contingency (20%)…… | | | | | $ 73,539 |
| | | | | | | |
| | TOTAL ESTIMATED CONSTRUCTION COST:..... | | | | | $ 441,234 |
| | | | | | | |
| | Engineering and Administrative Costs (30%):..... | | | | | $ 132,370 |
| | | | | | | |
| | TOTAL ESTIMATED PROJECT COST:..... | | | | | $ 573,604 |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Basin No. | 4 | | | | | |
| Proj. No. | 3 | | | | | |
| Pipe Size | | 6 | 8 | 10 | 12 | 15 |
| Segment Length = | | | 1181 | | | |
| No of Side Sewers (Parcels) = | | | 13 | | | |
| | | | | | | |
| | | | | UNIT | | AMOUNT |
| NO. | ITEM | QUANTITY | | PRICE | | |
| | | | | | | |
| 1 | Mobilization and Demobilization | LUMP SUM | | $ 19,900 | | $ 19,900 |
| 2 | Trench Safety Systems | LUMP SUM | | $ 7,300 | | $ 7,300 |
| 3 | Locate Existing Utilities | LUMP SUM | | $ 4,800 | | $ 4,800 |
| 4 | Erosion Control | LUMP SUM | | $ 4,700 | | $ 4,700 |
| 5 | Dewatering | LUMP SUM | | $ 11,000 | | $ 11,000 |
| 6 | Bypass Pumping | LUMP SUM | | $ 10,500 | | $ 10,500 |
| | | | | | | |
| 7 | Sawcutting | 2362 | LF | $ 2 | | $ 4,724 |
| | | | | | | |
| 8 | Traffic Control | 190 | HR | $ 30 | | $ 5,700 |
| 9a | 6" Gravity Sewer Main | 0 | LF | $ 40 | | $ - |
| 9b | 8" Gravity Sewer Main | 1181 | LF | $ 70 | | $ 82,670 |
| 9c | 10" Gravity Sewer Main | 0 | LF | $ 80 | | $ - |
| 9d | 12" Gravity Sewer Main | 0 | LF | $ 100 | | $ - |
| 9e | 15" Gravity Sewer Main | 0 | LF | $ 120 | | $ - |
| | | | | | | |
| 10 | Side Sewer | 13 | EA | $ 1,000 | | $ 13,000 |
| | | | | | | |
| 11 | 48" Manhole | 5 | EA | $ 4,500 | | $ 22,500 |
| | | | | | | |
| 12 | Asphalt | 300 | TN | $ 110 | | $ 33,000 |
| 13a | Gravel Backfill (6") | 0 | CY | $ 15 | | |
| 13b | Gravel Backfill (8") | 530 | CY | $ 15 | | $ 7,950 |
| 13c | Gravel Backfill (10") | 0 | CY | $ 15 | | $ - |
| 13d | Gravel Backfill (12") | 0 | CY | $ 15 | | $ - |
| 13e | Gravel Backfill (15") | 0 | CY | $ 15 | | $ - |
| 14a | CDF (6") | 0 | CY | $ 75 | | $ - |
| 14b | CDF (8") | 530 | CY | $ 75 | | $ 39,750 |
| 14c | CDF (10") | 0 | CY | $ 75 | | $ - |
| 14d | CDF (12") | 0 | CY | $ 75 | | $ - |
| 14e | CDF (15") | 0 | CY | $ 75 | | $ - |
| | Subtotal | | | | | $ 267,494 |
| | Tax @ | 7.9 | % | | | $ 21,132 |
| | | | | | | |
| | Subtotal | | | | | $ 288,626 |
| | Contingency (20%)…… | | | | | $ 57,725 |
| | | | | | | |
| | TOTAL ESTIMATED CONSTRUCTION COST:..... | | | | | $ 346,351 |
| | | | | | | |
| | Engineering and Administrative Costs (30%):..... | | | | | $ 103,905 |
| | | | | | | |
| | TOTAL ESTIMATED PROJECT COST:..... | | | | | $ 450,256 |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Basin No. | 4 | | | | | |
| Proj. No. | 4 | | | | | |
| Pipe Size | | 6 | 8 | 10 | 12 | 15 |
| Segment Length = | | | 283 | | 1010 | 140 |
| No of Side Sewers (Parcels) = | | | 6 | | 30 | 3 |
| | | | | | | |
| | | | | UNIT | | AMOUNT |
| NO. | ITEM | QUANTITY | | PRICE | | |
| | | | | | | |
| 1 | Mobilization and Demobilization | LUMP SUM | | $ 30,300 | | $ 30,300 |
| 2 | Trench Safety Systems | LUMP SUM | | $ 11,100 | | $ 11,100 |
| 3 | Locate Existing Utilities | LUMP SUM | | $ 7,200 | | $ 7,200 |
| 4 | Erosion Control | LUMP SUM | | $ 7,100 | | $ 7,100 |
| 5 | Dewatering | LUMP SUM | | $ 16,800 | | $ 16,800 |
| 6 | Bypass Pumping | LUMP SUM | | $ 16,000 | | $ 16,000 |
| | | | | | | |
| 7 | Sawcutting | 2866 | LF | $ 2 | | $ 5,732 |
| | | | | | | |
| 8 | Traffic Control | 230 | HR | $ 30 | | $ 6,900 |
| 9a | 6" Gravity Sewer Main | 0 | LF | $ 40 | | $ - |
| 9b | 8" Gravity Sewer Main | 283 | LF | $ 70 | | $ 19,810 |
| 9c | 10" Gravity Sewer Main | 0 | LF | $ 80 | | $ - |
| 9d | 12" Gravity Sewer Main | 1010 | LF | $ 100 | | $ 101,000 |
| 9e | 15" Gravity Sewer Main | 140 | LF | $ 120 | | $ 16,800 |
| | | | | | | |
| 10 | Side Sewer | 39 | EA | $ 1,000 | | $ 39,000 |
| | | | | | | |
| 11 | 48" Manhole | 6 | EA | $ 4,500 | | $ 27,000 |
| | | | | | | |
| 12 | Asphalt | 400 | TN | $ 110 | | $ 44,000 |
| 13a | Gravel Backfill (6") | 0 | CY | $ 15 | | |
| 13b | Gravel Backfill (8") | 130 | CY | $ 15 | | $ 1,950 |
| 13c | Gravel Backfill (10") | 0 | CY | $ 15 | | $ - |
| 13d | Gravel Backfill (12") | 450 | CY | $ 15 | | $ 6,750 |
| 13e | Gravel Backfill (15") | 80 | CY | $ 15 | | $ 1,200 |
| 14a | CDF (6") | 0 | CY | $ 75 | | $ - |
| 14b | CDF (8") | 130 | CY | $ 75 | | $ 9,750 |
| 14c | CDF (10") | 0 | CY | $ 75 | | $ - |
| 14d | CDF (12") | 450 | CY | $ 75 | | $ 33,750 |
| 14e | CDF (15") | 80 | CY | $ 75 | | $ 6,000 |
| | Subtotal | | | | | $ 408,142 |
| | Tax @ | 7.9 | % | | | $ 32,243 |
| | | | | | | |
| | Subtotal | | | | | $ 440,385 |
| | Contingency (20%)…… | | | | | $ 88,077 |
| | | | | | | |
| | TOTAL ESTIMATED CONSTRUCTION COST:..... | | | | | $ 528,462 |
| | | | | | | |
| | Engineering and Administrative Costs (30%):..... | | | | | $ 158,539 |
| | | | | | | |
| | TOTAL ESTIMATED PROJECT COST:..... | | | | | $ 687,001 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Basin No. | 5 | | | | | |
| Proj. No. | 1 | | | | | |
| Pipe Size | | 6 | 8 | 21 | 24 | 30 |
| Segment Length = | | | | | | 551 |
| No of Side Sewers (Parcels) = | | | | | | 2 |
| | | | | | | |
| | | | | UNIT | | AMOUNT |
| NO. | ITEM | QUANTITY | | PRICE | | |
| | | | | | | |
| 1 | Mobilization and Demobilization | LUMP SUM | | $ 19,500 | | $ 19,500 |
| 2 | Trench Safety Systems | LUMP SUM | | $ 7,100 | | $ 7,100 |
| 3 | Locate Existing Utilities | LUMP SUM | | $ 4,700 | | $ 4,700 |
| 4 | Erosion Control | LUMP SUM | | $ 4,600 | | $ 4,600 |
| 5 | Dewatering | LUMP SUM | | $ 10,900 | | $ 10,900 |
| 6 | Bypass Pumping | LUMP SUM | | $ 10,300 | | $ 10,300 |
| | | | | | | |
| 7 | Sawcutting | 1102 | LF | $ 2 | | $ 2,204 |
| | | | | | | |
| 8 | Traffic Control | 90 | HR | $ 30 | | $ 2,700 |
| 9a | 6" Gravity Sewer Main | 0 | LF | $ 40 | | $ - |
| 9b | 8" Gravity Sewer Main | 0 | LF | $ 70 | | $ - |
| 9c | 21" Gravity Sewer Main | 0 | LF | $ 155 | | $ - |
| 9d | 24" Gravity Sewer Main | 0 | LF | $ 190 | | $ - |
| 9e | 30" Gravity Sewer Main | 551 | LF | $ 236 | | $ 130,036 |
| | | | | | | |
| 10 | Side Sewer | 2 | EA | $ 1,000 | | $ 2,000 |
| | | | | | | |
| 11 | 48" Manhole | 3 | EA | $ 4,500 | | $ 13,500 |
| | | | | | | |
| 12 | Asphalt | 200 | TN | $ 110 | | $ 22,000 |
| 13a | Gravel Backfill (6") | 0 | CY | $ 15 | | |
| 13b | Gravel Backfill (8") | 0 | CY | $ 15 | | $ - |
| 13c | Gravel Backfill (21") | 0 | CY | $ 15 | | $ - |
| 13d | Gravel Backfill (24") | 0 | CY | $ 15 | | $ - |
| 13e | Gravel Backfill (30") | 370 | CY | $ 15 | | $ 5,550 |
| 14a | CDF (6") | 0 | CY | $ 75 | | $ - |
| 14b | CDF (8") | 0 | CY | $ 75 | | $ - |
| 14c | CDF (21") | 0 | CY | $ 75 | | $ - |
| 14d | CDF (24") | 0 | CY | $ 75 | | $ - |
| 14e | CDF (30") | 370 | CY | $ 75 | | $ 27,750 |
| | Subtotal | | | | | $ 262,840 |
| | Tax @ | 7.9 | % | | | $ 20,764 |
| | | | | | | |
| | Subtotal | | | | | $ 283,604 |
| | Contingency (20%)…… | | | | | $ 56,721 |
| | | | | | | |
| | TOTAL ESTIMATED CONSTRUCTION COST:..... | | | | | $ 340,325 |
| | | | | | | |
| | Engineering and Administrative Costs (30%):..... | | | | | $ 102,098 |
| | | | | | | |
| | TOTAL ESTIMATED PROJECT COST:..... | | | | | $ 442,423 |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Basin No. | 5 | | | | | |
| Proj. No. | 2 | | | | | |
| Pipe Size | | 6 | 8 | 24 | 30 | 36 |
| Segment Length = | | | | 707 | 289 | |
| No of Side Sewers (Parcels) = | | | | 1 | 6 | |
| | | | | | | |
| | | | | UNIT | | AMOUNT |
| NO. | ITEM | QUANTITY | | PRICE | | |
| | | | | | | |
| 1 | Mobilization and Demobilization | LUMP SUM | | $ 31,200 | | $ 31,200 |
| 2 | Trench Safety Systems | LUMP SUM | | $ 11,400 | | $ 11,400 |
| 3 | Locate Existing Utilities | LUMP SUM | | $ 7,500 | | $ 7,500 |
| 4 | Erosion Control | LUMP SUM | | $ 7,300 | | $ 7,300 |
| 5 | Dewatering | LUMP SUM | | $ 17,400 | | $ 17,400 |
| 6 | Bypass Pumping | LUMP SUM | | $ 16,500 | | $ 16,500 |
| | | | | | | |
| 7 | Sawcutting | 1992 | LF | $ 2 | | $ 3,984 |
| | | | | | | |
| 8 | Traffic Control | 160 | HR | $ 30 | | $ 4,800 |
| 9a | 6" Gravity Sewer Main | 0 | LF | $ 40 | | $ - |
| 9b | 8" Gravity Sewer Main | 0 | LF | $ 70 | | $ - |
| 9c | 24" Gravity Sewer Main | 707 | LF | $ 190 | | $ 134,330 |
| 9d | 30" Gravity Sewer Main | 289 | LF | $ 236 | | $ 68,204 |
| 9e | 36" Gravity Sewer Main | 0 | LF | $ 285 | | $ - |
| | | | | | | |
| 10 | Side Sewer | 7 | EA | $ 1,000 | | $ 7,000 |
| | | | | | | |
| 11 | 48" Manhole | 5 | EA | $ 4,500 | | $ 22,500 |
| | | | | | | |
| 12 | Asphalt | 300 | TN | $ 110 | | $ 33,000 |
| 13a | Gravel Backfill (6") | 0 | CY | $ 15 | | |
| 13b | Gravel Backfill (8") | 0 | CY | $ 15 | | $ - |
| 13c | Gravel Backfill (24") | 420 | CY | $ 15 | | $ 6,300 |
| 13d | Gravel Backfill (30") | 200 | CY | $ 15 | | $ 3,000 |
| 13e | Gravel Backfill (36") | 0 | CY | $ 15 | | $ - |
| 14a | CDF (6") | 0 | CY | $ 75 | | $ - |
| 14b | CDF (8") | 0 | CY | $ 75 | | $ - |
| 14c | CDF (24") | 420 | CY | $ 75 | | $ 31,500 |
| 14d | CDF (30") | 200 | CY | $ 75 | | $ 15,000 |
| 14e | CDF (36") | 0 | CY | $ 75 | | $ - |
| | Subtotal | | | | | $ 420,918 |
| | Tax @ | 7.9 | % | | | $ 33,253 |
| | | | | | | |
| | Subtotal | | | | | $ 454,171 |
| | Contingency (20%)…… | | | | | $ 90,834 |
| | | | | | | |
| | TOTAL ESTIMATED CONSTRUCTION COST:..... | | | | | $ 545,005 |
| | | | | | | |
| | Engineering and Administrative Costs (30%):..... | | | | | $ 163,502 |
| | | | | | | |
| | TOTAL ESTIMATED PROJECT COST:..... | | | | | $ 708,507 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Basin No. | 6 | | | | | |
| Proj. No. | 1 | | | | | |
| Pipe Size | | 12 | 15 | 21 | 24 | 30 |
| Segment Length = | | | | 1051 | | |
| No of Side Sewers (Parcels) = | | | | 16 | | |
| | | | | | | |
| | | | | UNIT | | AMOUNT |
| NO. | ITEM | QUANTITY | | PRICE | | |
| | | | | | | |
| 1 | Mobilization and Demobilization | LUMP SUM | | $ 28,500 | | $ 28,500 |
| 2 | Trench Safety Systems | LUMP SUM | | $ 10,400 | | $ 10,400 |
| 3 | Locate Existing Utilities | LUMP SUM | | $ 6,800 | | $ 6,800 |
| 4 | Erosion Control | LUMP SUM | | $ 6,700 | | $ 6,700 |
| 5 | Dewatering | LUMP SUM | | $ 15,800 | | $ 15,800 |
| 6 | Bypass Pumping | LUMP SUM | | $ 15,100 | | $ 15,100 |
| | | | | | | |
| 7 | Sawcutting | 2102 | LF | $ 2 | | $ 4,204 |
| | | | | | | |
| 8 | Traffic Control | 170 | HR | $ 30 | | $ 5,100 |
| 9a | 12" Gravity Sewer Main | 0 | LF | $ 40 | | $ - |
| 9b | 15" Gravity Sewer Main | 0 | LF | $ 70 | | $ - |
| 9c | 21" Gravity Sewer Main | 1051 | LF | $ 155 | | $ 162,905 |
| 9d | 24" Gravity Sewer Main | 0 | LF | $ - | | $ - |
| 9e | 30" Gravity Sewer Main | 0 | LF | $ - | | $ - |
| | | | | | | |
| 10 | Side Sewer | 16 | EA | $ 1,000 | | $ 16,000 |
| | | | | | | |
| 11 | 48" Manhole | 5 | EA | $ 4,500 | | $ 22,500 |
| | | | | | | |
| 12 | Asphalt | 300 | TN | $ 110 | | $ 33,000 |
| 13a | Gravel Backfill 12") | 0 | CY | $ 15 | | |
| 13b | Gravel Backfill (15") | 0 | CY | $ 15 | | $ - |
| 13c | Gravel Backfill (21") | 630 | CY | $ 15 | | $ 9,450 |
| 13d | Gravel Backfill (24") | 0 | CY | $ 15 | | $ - |
| 13e | Gravel Backfill (30") | 0 | CY | $ 15 | | $ - |
| 14a | CDF (12") | 0 | CY | $ 75 | | $ - |
| 14b | CDF (15") | 0 | CY | $ 75 | | $ - |
| 14c | CDF (21") | 630 | CY | $ 75 | | $ 47,250 |
| 14d | CDF (24") | 0 | CY | $ 75 | | $ - |
| 14e | CDF (30") | 0 | CY | $ 75 | | $ - |
| | Subtotal | | | | | $ 383,709 |
| | Tax @ | 7.9 | % | | | $ 30,313 |
| | | | | | | |
| | Subtotal | | | | | $ 414,022 |
| | Contingency (20%)…… | | | | | $ 82,804 |
| | | | | | | |
| | TOTAL ESTIMATED CONSTRUCTION COST:..... | | | | | $ 496,826 |
| | | | | | | |
| | Engineering and Administrative Costs (30%):..... | | | | | $ 149,048 |
| | | | | | | |
| | TOTAL ESTIMATED PROJECT COST:..... | | | | | $ 645,874 |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Basin No. | 6 | | | | | |
| Proj. No. | 2 | | | | | |
| Pipe Size | | 12 | 15 | 21 | 24 | 30 |
| Segment Length = | | | | 815 | | |
| No of Side Sewers (Parcels) = | | | | 18 | | |
| | | | | | | |
| | | | | UNIT | | AMOUNT |
| NO. | ITEM | QUANTITY | | PRICE | | |
| | | | | | | |
| 1 | Mobilization and Demobilization | LUMP SUM | | $ 22,400 | | $ 22,400 |
| 2 | Trench Safety Systems | LUMP SUM | | $ 8,200 | | $ 8,200 |
| 3 | Locate Existing Utilities | LUMP SUM | | $ 5,400 | | $ 5,400 |
| 4 | Erosion Control | LUMP SUM | | $ 5,300 | | $ 5,300 |
| 5 | Dewatering | LUMP SUM | | $ 12,400 | | $ 12,400 |
| 6 | Bypass Pumping | LUMP SUM | | $ 11,800 | | $ 11,800 |
| | | | | | | |
| 7 | Sawcutting | 1630 | LF | $ 2 | | $ 3,260 |
| | | | | | | |
| 8 | Traffic Control | 140 | HR | $ 30 | | $ 4,200 |
| 9a | 12" Gravity Sewer Main | 0 | LF | $ 40 | | $ - |
| 9b | 15" Gravity Sewer Main | 0 | LF | $ 70 | | $ - |
| 9c | 21" Gravity Sewer Main | 815 | LF | $ 155 | | $ 126,325 |
| 9d | 24" Gravity Sewer Main | 0 | LF | $ - | | $ - |
| 9e | 30" Gravity Sewer Main | 0 | LF | $ - | | $ - |
| | | | | | | |
| 10 | Side Sewer | 18 | EA | $ 1,000 | | $ 18,000 |
| | | | | | | |
| 11 | 48" Manhole | 4 | EA | $ 4,500 | | $ 18,000 |
| | | | | | | |
| 12 | Asphalt | 200 | TN | $ 110 | | $ 22,000 |
| 13a | Gravel Backfill 12") | 0 | CY | $ 15 | | |
| 13b | Gravel Backfill (15") | 0 | CY | $ 15 | | $ - |
| 13c | Gravel Backfill (21") | 490 | CY | $ 15 | | $ 7,350 |
| 13d | Gravel Backfill (24") | 0 | CY | $ 15 | | $ - |
| 13e | Gravel Backfill (30") | 0 | CY | $ 15 | | $ - |
| 14a | CDF (12") | 0 | CY | $ 75 | | $ - |
| 14b | CDF (15") | 0 | CY | $ 75 | | $ - |
| 14c | CDF (21") | 490 | CY | $ 75 | | $ 36,750 |
| 14d | CDF (24") | 0 | CY | $ 75 | | $ - |
| 14e | CDF (30") | 0 | CY | $ 75 | | $ - |
| | Subtotal | | | | | $ 301,385 |
| | Tax @ | 7.9 | % | | | $ 23,809 |
| | | | | | | |
| | Subtotal | | | | | $ 325,194 |
| | Contingency (20%)…… | | | | | $ 65,039 |
| | | | | | | |
| | TOTAL ESTIMATED CONSTRUCTION COST:..... | | | | | $ 390,233 |
| | | | | | | |
| | Engineering and Administrative Costs (30%):..... | | | | | $ 117,070 |
| | | | | | | |
| | TOTAL ESTIMATED PROJECT COST:..... | | | | | $ 507,303 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Basin No. | 6 | | | | | |
| Proj. No. | 3 | | | | | |
| Pipe Size | | 12 | 15 | 21 | 24 | 30 |
| Segment Length = | | | 257 | 0 | | |
| No of Side Sewers (Parcels) = | | | 5 | 0 | | |
| | | | | | | |
| | | | | UNIT | | AMOUNT |
| NO. | ITEM | QUANTITY | | PRICE | | |
| | | | | | | |
| 1 | Mobilization and Demobilization | LUMP SUM | | $ 5,600 | | $ 5,600 |
| 2 | Trench Safety Systems | LUMP SUM | | $ 2,100 | | $ 2,100 |
| 3 | Locate Existing Utilities | LUMP SUM | | $ 1,400 | | $ 1,400 |
| 4 | Erosion Control | LUMP SUM | | $ 1,300 | | $ 1,300 |
| 5 | Dewatering | LUMP SUM | | $ 3,100 | | $ 3,100 |
| 6 | Bypass Pumping | LUMP SUM | | $ 3,000 | | $ 3,000 |
| | | | | | | |
| 7 | Sawcutting | 514 | LF | $ 2 | | $ 1,028 |
| | | | | | | |
| 8 | Traffic Control | 50 | HR | $ 30 | | $ 1,500 |
| 9a | 12" Gravity Sewer Main | 0 | LF | $ 40 | | $ - |
| 9b | 15" Gravity Sewer Main | 257 | LF | $ 70 | | $ 17,990 |
| 9c | 21" Gravity Sewer Main | 0 | LF | $ 155 | | $ - |
| 9d | 24" Gravity Sewer Main | 0 | LF | $ 110 | | $ - |
| 9e | 30" Gravity Sewer Main | 0 | LF | $ 30 | | $ - |
| | | | | | | |
| 10 | Side Sewer | 5 | EA | $ 1,000 | | $ 5,000 |
| | | | | | | |
| 11 | 48" Manhole | 2 | EA | $ 4,500 | | $ 9,000 |
| | | | | | | |
| 12 | Asphalt | 100 | TN | $ 110 | | $ 11,000 |
| 13a | Gravel Backfill 12") | 0 | CY | $ 15 | | |
| 13b | Gravel Backfill (15") | 140 | CY | $ 15 | | $ 2,100 |
| 13c | Gravel Backfill (21") | 0 | CY | $ 15 | | $ - |
| 13d | Gravel Backfill (24") | 0 | CY | $ 15 | | $ - |
| 13e | Gravel Backfill (30") | 0 | CY | $ 15 | | $ - |
| 14a | CDF (12") | 0 | CY | $ 75 | | $ - |
| 14b | CDF (15") | 140 | CY | $ 75 | | $ 10,500 |
| 14c | CDF (21") | 0 | CY | $ 75 | | $ - |
| 14d | CDF (24") | 0 | CY | $ 75 | | $ - |
| 14e | CDF (30") | 0 | CY | $ 75 | | $ - |
| | Subtotal | | | | | $ 74,618 |
| | Tax @ | 7.9 | % | | | $ 5,895 |
| | | | | | | |
| | Subtotal | | | | | $ 80,513 |
| | Contingency (20%)…… | | | | | $ 16,103 |
| | | | | | | |
| | TOTAL ESTIMATED CONSTRUCTION COST:..... | | | | | $ 96,616 |
| | | | | | | |
| | Engineering and Administrative Costs (30%):..... | | | | | $ 28,985 |
| | | | | | | |
| | TOTAL ESTIMATED PROJECT COST:..... | | | | | $ 125,601 |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Basin No. | 10 | | | | | |
| Proj. No. | 1 | | | | | |
| Pipe Size | | 10 | 12 | 21 | 24 | 30 |
| Segment Length = | | 1391 | | | | |
| No of Side Sewers (Parcels) = | | 7 | | | | |
| | | | | | | |
| | | | | UNIT | | AMOUNT |
| NO. | ITEM | QUANTITY | | PRICE | | |
| | | | | | | |
| 1 | Mobilization and Demobilization | LUMP SUM | | $ 18,600 | | $ 18,600 |
| 2 | Trench Safety Systems | LUMP SUM | | $ 6,800 | | $ 6,800 |
| 3 | Locate Existing Utilities | LUMP SUM | | $ 4,500 | | $ 4,500 |
| 4 | Erosion Control | LUMP SUM | | $ 4,400 | | $ 4,400 |
| 5 | Dewatering | LUMP SUM | | $ 10,400 | | $ 10,400 |
| 6 | Bypass Pumping | LUMP SUM | | $ 9,900 | | $ 9,900 |
| | | | | | | |
| 7 | Sawcutting | 0 | LF | $ 2 | | $ - |
| | | | | | | |
| 8 | Traffic Control | 230 | HR | $ 30 | | $ 6,900 |
| 9a | 10" Gravity Sewer Main | 1391 | LF | $ 40 | | $ 55,640 |
| 9b | 12" Gravity Sewer Main | 0 | LF | $ 70 | | $ - |
| 9c | 21" Gravity Sewer Main | 0 | LF | $ 155 | | $ - |
| 9d | 24" Gravity Sewer Main | 0 | LF | $ - | | $ - |
| 9e | 30" Gravity Sewer Main | 0 | LF | $ - | | $ - |
| | | | | | | |
| 10 | Side Sewer | 7 | EA | $ 1,000 | | $ 7,000 |
| | | | | | | |
| 11 | 48" Manhole | 6 | EA | $ 4,500 | | $ 27,000 |
| | | | | | | |
| 12 | Asphalt | 400 | TN | $ 110 | | $ 44,000 |
| 13a | Gravel Backfill 10") | 620 | CY | $ 15 | | $ 9,300 |
| 13b | Gravel Backfill (12") | 0 | CY | $ 15 | | $ - |
| 13c | Gravel Backfill (21") | 0 | CY | $ 15 | | $ - |
| 13d | Gravel Backfill (24") | 0 | CY | $ 15 | | $ - |
| 13e | Gravel Backfill (30") | 0 | CY | $ 15 | | $ - |
| 14a | CDF (10") | 620 | CY | $ 75 | | $ 46,500 |
| 14b | CDF (12") | 0 | CY | $ 75 | | $ - |
| 14c | CDF (21") | 0 | CY | $ 75 | | $ - |
| 14d | CDF (24") | 0 | CY | $ 75 | | $ - |
| 14e | CDF (30") | 0 | CY | $ 75 | | $ - |
| | Subtotal | | | | | $ 250,940 |
| | Tax @ | 7.9 | % | | | $ 19,824 |
| | | | | | | |
| | Subtotal | | | | | $ 270,764 |
| | Contingency (20%)……..…...……..……. | | | | | $ 54,153 |
| | | | | | | |
| | TOTAL ESTIMATED CONSTRUCTION COST:..... | | | | | $ 324,917 |
| | | | | | | |
| | Engineering and Administrative Costs (30%):.....…..... | | | | | $ 97,475 |
| | | | | | | |
| | TOTAL ESTIMATED PROJECT COST:..... | | | | | $ 422,392 |

# APPENDIX L

# GREGG SERVICE AREA – CROWN ROAD SEWER SERVICE MEMORANDUM

**DRAFT TECHNICAL MEMORANDUM**

# EVALUATION OF SEWER SERVICE TO THE GREGG RESERVOIR ANNEXATION DEVELOPMENT

| | |
|---|---|
| TO: | Monte Brachmann & Eric Levison, City of Camas |
| FROM: | Thomas Zerkel, P.E. & Jay Swift, P.E. |
| DATE: | October 7, 2005 |
| **SUBJECT:** | **Sewer System Improvements – Gregg Reservoir Annexation** |
| G&O # | 03689<br>City of Camas # WS 621 |

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Per discussion between the developer and the City on September 2, 2005, hydraulic model analyses were run to determine the improvements that were necessary to provide the *Gregg Reservoir Annexation* (formerly known as the Loyal Lands Development) with water and sewer service to serve approximately 700 houses. A companion memo has evaluated the improvements necessary for water service. This memo provides an analysis of sewer service requirements and improvements needed to serve the Gregg Reservoir Annexation.

Based on the topography of the Gregg Reservoir Annexation (GRA) area, it is proposed that approximately 50 acres (250 homes) in the northwest portion of the 700 home GRA development will be served by the existing STEP system on Leonard Road in Basin 15 (See Figure 1). The remaining estimated 90 acres (450 homes) are proposed to be served by a new gravity sewer line to the southeast of the GRA area along Crown Road.

## PROJECTED FLOWS

Previous studies have investigated the water system storage and pumping requirements to serve anticipated development in the Gregg Zone (*Gregg Service Area Analysis*, 2003) and more specifically to serve the 141-acre Gregg Reservoir Annexation (*Loyal Lands Annexation Analysis,* 2004).

Table 1 provides the projected sewage flows for the proposed 700-house GRA development. The *wastewater* ERU value is calculated based on *winter* water use (in order to exclude irrigation flows). For the City of Camas, it is estimated that 10% of the winter water consumption does not enter the wastewater collection system, so the wastewater ERU value is calculated by dividing the winter water use for single family residential (SFR) units by the number of single family units and multiplying by 0.90. Based on a review of 2004-2005 water use records, average winter single family residential water use is 177 gallons per SFR household. 90% of this value is 159 gallons per SFR household or ERU. Multiplying this by the projected number of GRA homes yields an estimated annual average sewage baseflow of 111,300 gpd.

Calculation of the peaking factor to determine the peak hour flow is performed by multiplying the dry weather flow by a population-based peaking factor (PF), given by the equation:

$$PF = (18 + \text{square root } (P))/(4 + \text{square root } (P))$$

where P = population, in thousands of people (*Department of Ecology Criteria for Sewage Works Design, 1998).* Gregg Annexation Reservoir Area population is estimated by multiplying the number of homes by the persons per household. Based on on OFM estimate of 5,153 housing units in Camas, and a 2002 City population of 13,450, the City has an average population of 2.6 persons per household (pph). This number is consistent with OFM estimates for Clark County at 2.645 pph for year 2005.) Use of the above equation with a GRA population of 1,820 (700 x 2.6 pph) yields a peak hour to annual average peaking factor of 3.62, for the projected 700 homes. Assuming no attenuation in the sewer system, multiplying this peaking factor by the projected residential daily average flows yields a projected peak hour flow of 402,900 gpd.

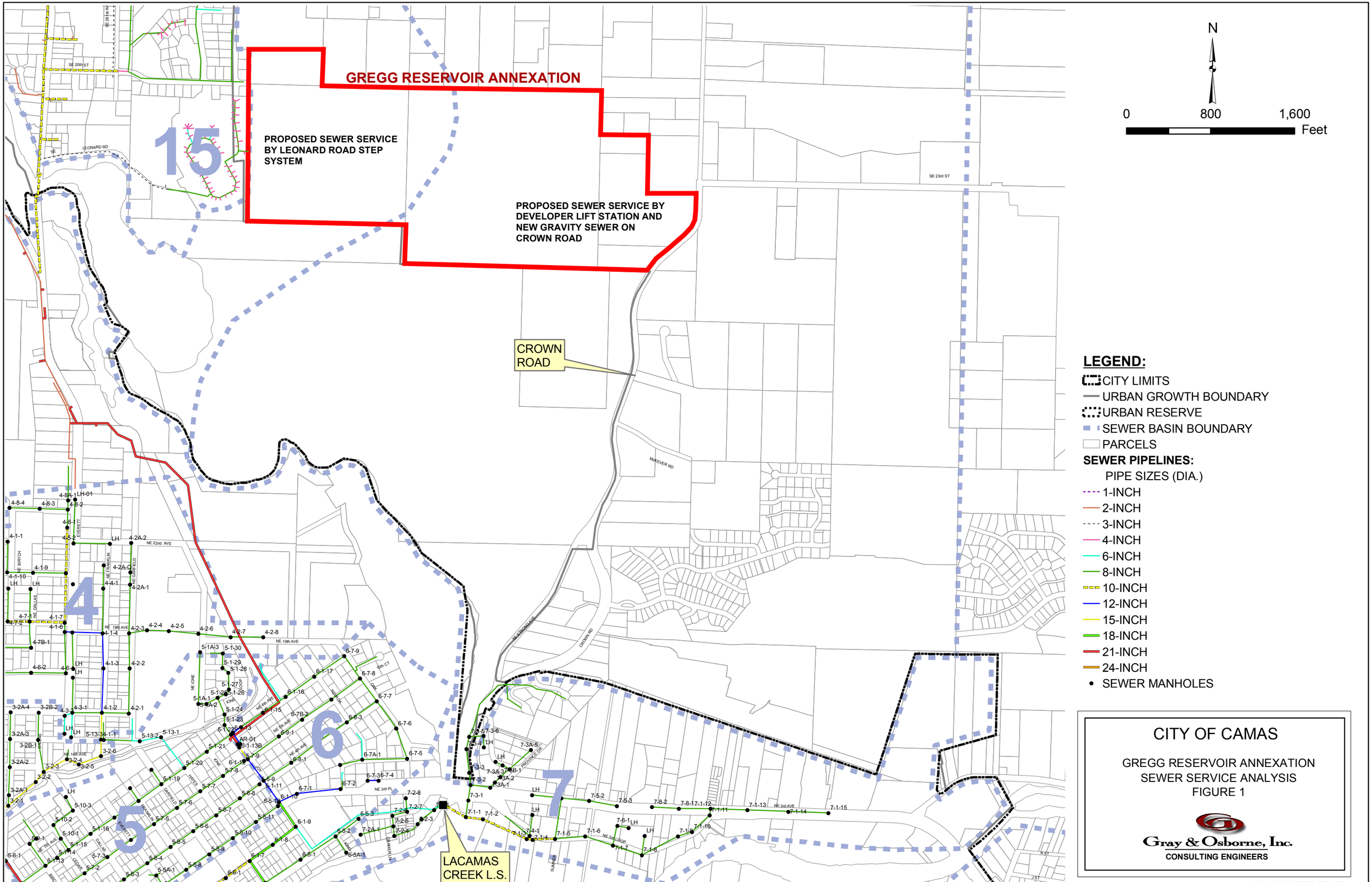
Total peak hour flow from the GRA will include both baseflow from commercial and domestic uses, and infiltration and inflow. In the *1998 City of Camas I/I Study*, I/I was found to range from about 300 to 11,000 gpad within the fifteen collection basins in the City. For *new* gravity sewer systems such as that which will serve the southeast portion of the GRA area, I/I is assumed to be essentially negligible immediately after construction. As the age of the system increases, I/I increases due to system deterioration. Following a standard adopted by a number of communities, peak hour I/I for a newly constructed gravity sewer system such as that serving the GRA area is assumed to increase linearly from zero to 1000 gallons per acre per day (gpad) over 50 years. Hence, for the estimated 90 acres to be served by gravity sewers in the GRA area, the estimated I/I in year 2055 is 90,000 gallons per day (90 acres x 1000 gpad). The northwest portion of the GRA area, since it is proposed to be served by a STEP system, is assumed to have negligible infiltration and inflow, even after 50 years.

**TABLE 1**
**Projected Sewage Flows**
**Gregg Reservoir Annexation**

| Criteria | Quantity | Unit |
|---|---|---|
| **Entire GRA Service Area** | | |
| Dwelling Units | 700 | DU |
| Equivalent Residential Unit (1) -Sewage Flow | 159 | gpd |
| Total Average Daily Sewage Baseflow | 111,300 | gpd |
| Peaking Factor | 3.62 | |
| Peak Hour Baseflow | 402,900 | gpd |
| Peak Hour I/I | 90,000 | gpd |
| Peak Hour Flow | 492,900 | gpd |
| **Northwest GRA Service Area (Served by STEP)** | | |
| Peak Hour Flow | 141,000 | gpd |
| **Southeast GRA Service Area (Served by Gravity)** | | |
| Peak Hour Flow | 351,900 | gpd |

(1) Calculated based on 90% of single family residential water use in the City of Camas.

As shown in Table 1, the year 2055 peak hour flow for the Northwest GRA Service Area (served by STEP) is projected to be 141,000 gpd, while the peak hour flow for the Southeast GRA Service Area (served by gravity on Crown Road) is projected to be 351,900 gpd.


GREGG RESERVOIR ANNEXATION
PROPOSED SEWER SERVICE BY LEONARD ROAD STEP SYSTEM
PROPOSED SEWER SERVICE BY DEVELOPER LIFT STATION AND NEW GRAVITY SEWER ON CROWN ROAD
CROWN ROAD
LACAMAS CREEK L.S.
15
4
5
6
7
SE 20th ST
LEONARD RD
SE 23rd ST
McKEVER RD
CROWN RD
NE 22nd AVE
NE 19th AVE
NE 14th AVE
NE 3rd PL
NE 3rd AVE
N
0
800
1,600
Feet
LEGEND:
CITY LIMITS
URBAN GROWTH BOUNDARY
URBAN RESERVE
SEWER BASIN BOUNDARY
PARCELS
SEWER PIPELINES:
PIPE SIZES (DIA.)
1-INCH
2-INCH
3-INCH
4-INCH
6-INCH
8-INCH
10-INCH
12-INCH
15-INCH
18-INCH
21-INCH
24-INCH
SEWER MANHOLES
CITY OF CAMAS
GREGG RESERVOIR ANNEXATION
SEWER SERVICE ANALYSIS
FIGURE 1
Gray & Osborne, Inc.
CONSULTING ENGINEERS
L:\CAMAS\05471\GIS\FIGURE1.MXD

The proposed new sewer line on Crown Road should be sized for the build-out population in the entire basin surrounding it. Depending on the projected ultimate annexation of areas within the City, the Crown Hill line should be built for the Southeast Gregg Service Area basin or the Draft Discussion Area shown in the 9/27/05 Comprehensive Growth Management Plan map, both shown in Figure 2. Table 2 indicates the total build-out flows expected from these potential service areas. Peak hour flows of either 4.07 MGD or 0.96 MGD are projected at build-out in the proposed Crown Road Sewer Line, depending on the ultimate annexation decisions.

**TABLE 2**
**Projected Build-out Sewage Flows**
**Crown Road Sewer Line**

| Criteria | Quantity | Unit | Quantity | Unit |
|---|---|---|---|---|
| | **Total Southeast Gregg Service Area Basin [2]** | | **Draft Discussion Area [2]** | |
| Area | 1480 | acres | 306 | acres |
| Projected Dwelling Units at 4 Units per Acre | 5920 | DU | 1224 | DU |
| Equivalent Residential Unit [(1)] - Sewage Flow | 159 | gpd | 159 | gpd |
| Total Average Daily Sewage Baseflow | 0.94 | MGD | 0.195 | MGD |
| Peaking Factor | 2.75 | | 3.42 | |
| Peak Hour Baseflow | 2.59 | MGD | 0.66 | MGD |
| Peak Hour I/I | 1.48 | MGD | 0.30 | MGD |
| Peak Hour Flow | 4.07 [1] | MGD | 0.96 | MGD |

1. 4.07 MGD includes the 0.352 MGD coming from the 450 homes in the eastern GRA area.
2. Proposed to be Served by the New Gravity Line on Crown Road.

## SEWER SYSTEM CAPACITY ANALYSIS

As previously described, it is proposed that approximately 250 homes in the northwest portion of the GRA development will be served by the existing STEP system on Leonard Road in Basin 15. The remaining estimated 450 homes are proposed to be served by a new gravity sewer line to be constructed along Crown Road to the southeast of the GRA area. In this section, the required Crown Road sewer line capacity is projected, the capacity of existing affected sewer facilities is evaluated, and required improvements are noted, both to serve the GRA development and the ultimate build-out population in the Southeast Gregg Service Area Basin.

Lift station run-time data and the distribution of population throughout the City were used to assist in estimating flows in the various portions of the sewer system. However, comprehensive sewer system flow monitoring has not been conducted since 1998, when it was performed for the *City of Camas Sewer System I/I Study*. Hence, a table from the 1998 I/I study is reprinted as Table 3 in this memo for reference. Table 3 shows a total City peak daily WWTP flow of 4.6 MGD during flow monitoring conducted in 1998.

The storm associated with that flow was estimated to have a 2-year return interval. Figure 3 shows WWTP influent flows for 2000-2004; five daily influent flows have exceeded the 4.6 MGD: 5.632, 5.337, 4.913, 4,796, 4.723 MGD. An analysis of WWTP diurnal flow records indicates that the peak hour flow on February 1, 2003 (when the peak day flow was 5.632 MGD) was 6.5 MGD. As described below, the infiltration rates for the various basins noted in Table 3 were used in constructing a hydraulic model for the Camas sewer system.

**Crown Hill Sewer and Downstream Impacts**

A new developer-financed lift station sited at the southern end of the east side of the GRA area could serve the entire eastern GRA. The lift station would convey the collected sewage approximately 900 feet to the proposed new Crown Hill Sewer line. The new Crown Hill Sewer line serving the Southeast Gregg Service Area would connect to existing Manhole 7-3-5 at Crown Road in Basin 7. (See Figure 4.) At Manhole 7-1-1, sewage from Crown Road mixes with flow from the rest of Basin 7. This combined flow is then conveyed to the Lacamas Creek Lift Station, where it is pumped to Manhole 6-1-9. At Manhole 6-1-9, the flow from Basin 7 merges with the flow from Basins 6, 11, 13, 14 and 15. At the Main Lift Station, this combined flow is combined with flow from Basins 1, 2, 3, 4, 5,10 and 12.

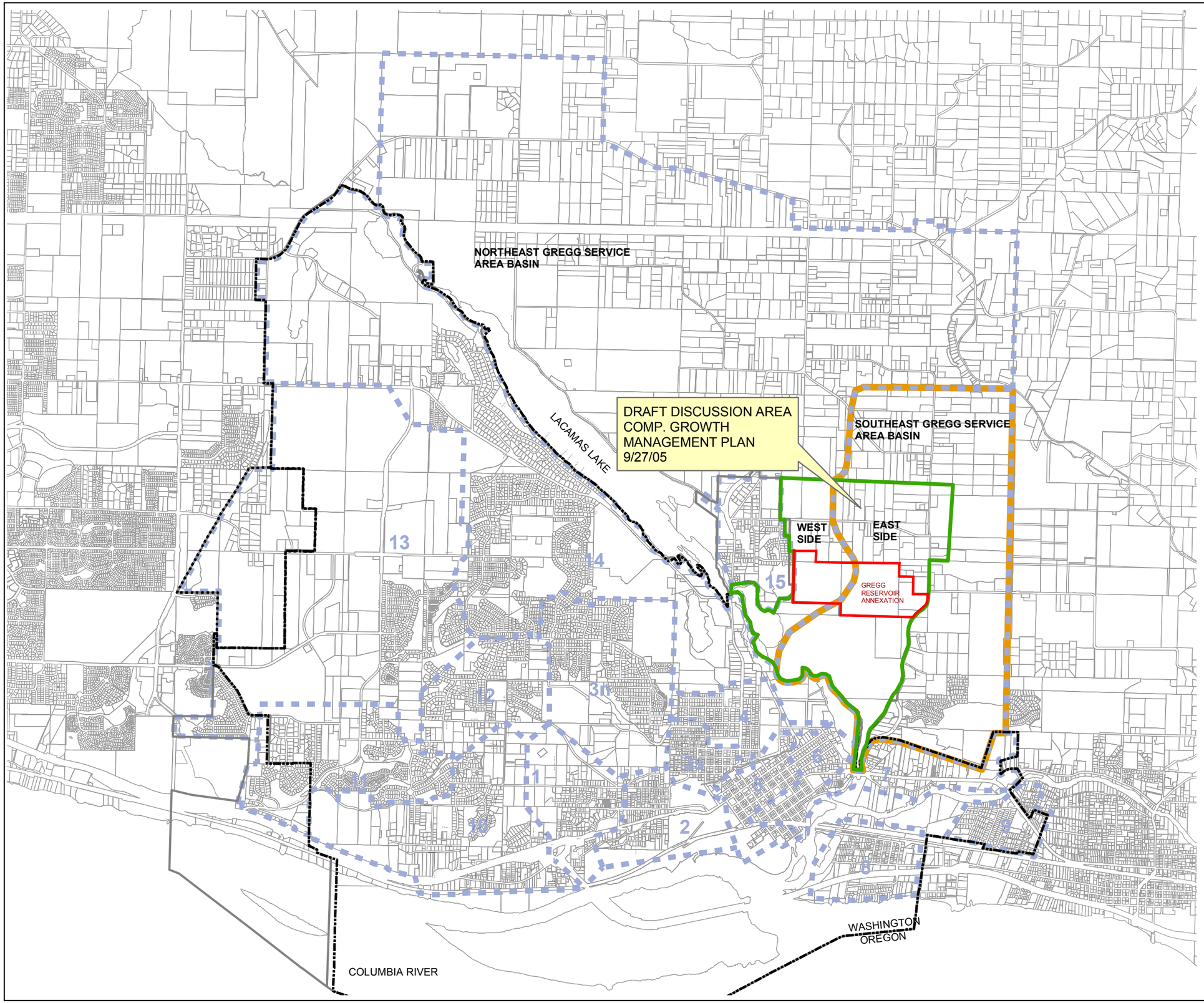
Pipe capacities and downstream impacts from the proposed development were determined using Mouse hydraulic modeling software developed by DHI, Inc. Modeling results are summarized in Appendix A.

To simplify the modeling effort it was assumed that the STEP systems and the basins conveyed to the Parker Estates Lift Station and the Lake Road STEP line drained by gravity to Manhole 6-1-9. The combined flow from the City's multitude of STEP lift stations in this area can be conservatively modeled as a gravity system.

Based on an evaluation of the topography along Crown Road, it was assumed that the minimum slope of the new system connecting the proposed development to the existing system would be 3%.

In order to construct the hydraulic model, the following assumptions were used:

- Basin-wide I/I rates from Table 3
- New estimates of baseflow based on current land use
- Industrial wastewater flows estimated to be 1,701,000 gallons per day (peak hour) based on data provided by the City and summarized in Table 4. It was assumed that all of the NPDES-permitted dischargers were discharging at their permitted capacity, and that the other industrial dischargers were discharging daily volumes equal to their average daily water consumption for 2004. A 10% peaking factor (peak hour to peak day) was applied to the overall total to calculate the 1,701,000 gallons per day peak hour flow.




N

0 3,000 6,000 Feet

**LEGEND:**

- CITY LIMITS
- URBAN GROWTH BOUNDARY
- URBAN RESERVE
- SEWER BASIN BOUNDARY
- PARCELS
- DRAFT DISCUSSION AREA 9/27/05 COMP. GROWTH MANAGEMENT PLAN

SOURCE: CITY OF CAMAS

CITY OF CAMAS

GREGG RESERVOIR ANNEXATION
SEWER SERVICE ANALYSIS
FIGURE 2

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\05471\GIS\FIGURE2.MXD

**FIGURE 3**
**City of Camas WWTP**
**Daily Influent Flows**

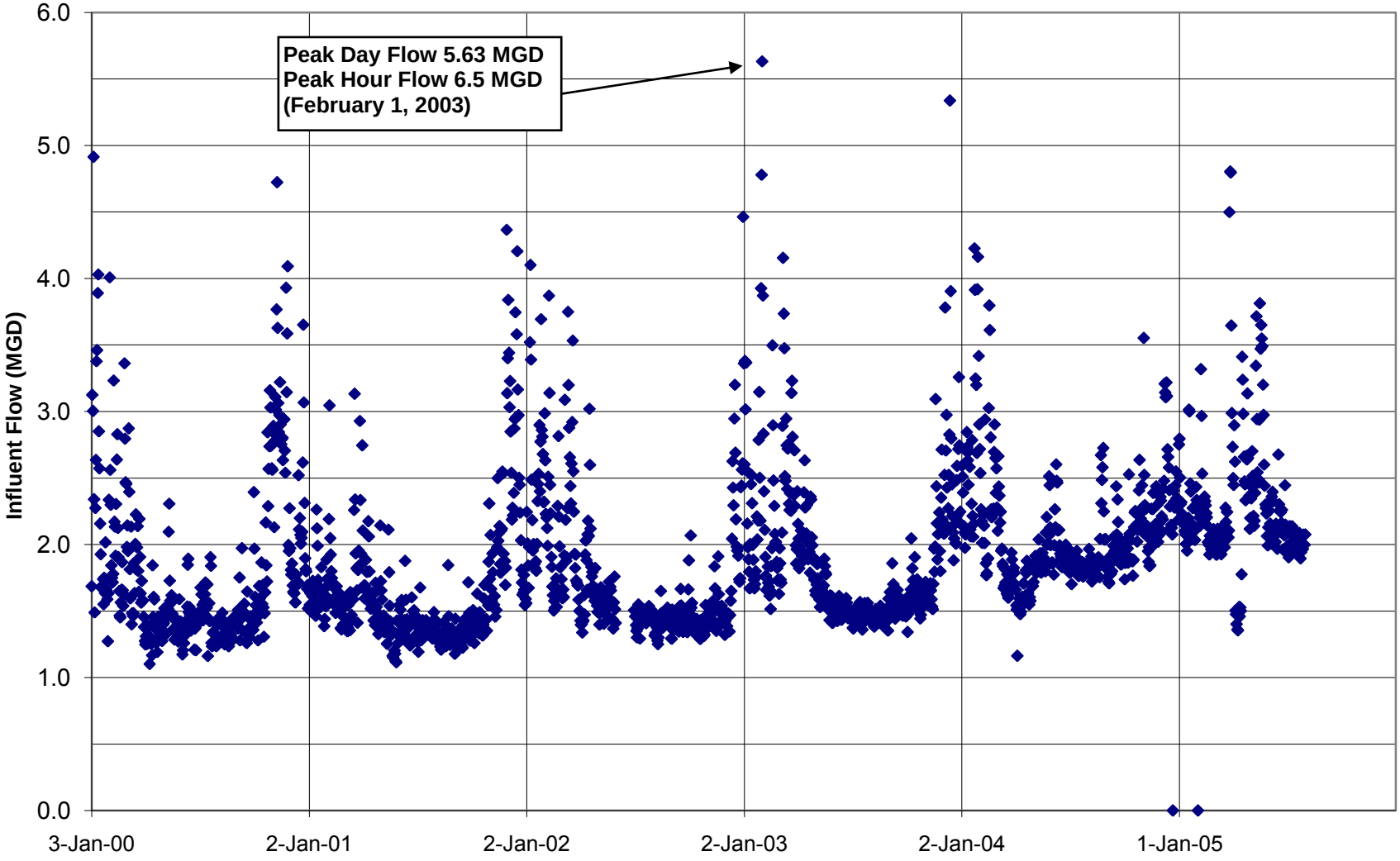


**TABLE 3**
**Estimated Peak Day I/I per Basin**
**1998 I/I Report**

| Basin | Developed Area | | Est. Pop. | Base Flow | Estimated I/I | | | | | | Total Flow | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (acres) | % of Total Dev. Area | Based on Dev. Area | (gpd) | Total I/I (gpd) | % | Infiltration (gpd) | % | Inflow (gpd) | % | (gpd) | (gpcd) | (gpad) |
| 1 | 56 | 3.34 | 375 | 40,000 | 600,000 | 17.6 | 60,000 | 14.9 | 540,000 | 18.0 | 640,000 | 1,706* | 11,467 |
| 2 | 79 | 4.75 | 534 | 70,000 | 500,000 | 14.7 | 50,000 | 12.4 | 450,000 | 15.0 | 570,000 | 1,067* | 7,170 |
| 3 South | 71 | 4.26 | 479 | 50,000 | 200,000 | 5.9 | 20,000 | 5.0 | 180,000 | 6.0 | 250,000 | 521* | 3,505 |
| 3 North | 213 | 12.73 | 1431 | 150,000 | 850,000 | 25.0 | 110,000 | 27.4 | 740,000 | 24.7 | 1,000,000 | 699* | 4,699 |
| 4 | 111 | 6.63 | 745 | 90,000 | 750,000 | 22.1 | 70,000 | 17.4 | 680,000 | 22.7 | 840,000 | 1,127* | 7,578 |
| 5 | 105 | 6.31 | 709 | 100,000 | 100,000 | 2.9 | 10,000 | 2.5 | 90,000 | 3.0 | 200,000 | 282* | 1,896 |
| 6 | 71 | 4.27 | 481 | 85,000 | 120,000 | 3.5 | 10,000 | 2.5 | 110,000 | 3.7 | 205,000 | 427* | 2,868 |
| 7 | 54 | 3.24 | 364 | 40,000 | 80,000 | 2.4 | 5,000 | 1.2 | 75,000 | 2.5 | 120,000 | 329* | 2,213 |
| 8 | 62 | 3.68 | 414 | 45,000 | 10,000 | 0.3 | 1,000 | 0.2 | 9,000 | 0.3 | 55,000 | 133 | 894 |
| 9 | 70 | 4.19 | 471 | 50,000 | 10,000 | 0.3 | 1,000 | 0.2 | 9,000 | 0.3 | 60,000 | 127 | 857 |
| 10 | 91 | 5.42 | 609 | 60,000 | 70,000 | 2.1 | 10,000 | 2.5 | 60,000 | 2.0 | 130,000 | 214 | 1,435 |
| 11 | 81 | 4.85 | 545 | 55,000 | 5,000 | 0.1 | 2,500 | 0.6 | 2,500 | 0.1 | 60,000 | 110 | 740 |
| 12 | 117 | 7.01 | 789 | 70,000 | 10,000 | 0.3 | 5,000 | 1.2 | 5,000 | 0.2 | 80,000 | 101 | 682 |
| 13 | 121 | 7.23 | 813 | 75,000 | 25,000 | 0.7 | 12,500 | 3.1 | 12,500 | 0.4 | 100,000 | 123 | 827 |
| 14 | 308 | 18.43 | 1036** | 200,000 | 50,000 | 1.5 | 25,000 | 6.2 | 25,000 | 0.8 | 250,000 | 241 | 811 |
| 15 | 61 | 3.66 | 206** | 20,000 | 20,000 | 0.6 | 10,000 | 2.5 | 10,000 | 0.3 | 40,000 | 194 | 653 |
| Total | 1672 | 100.0 | 10,000 | 1,200,000 | 3,400,000 | 100.0 | 400,000 | 100.0 | 3,000,000 | 100.0 | 4,600,000 | 460 | 2,750 |

New Crown Hill Sewer to Manhole 7-3-5

Modeling results show a pipe size of 8 inches connecting to the existing system would be sufficient to handle the flow generated from the 450 homes proposed from the new development.

The estimated cost for this new gravity line is $1.16 million dollars.

Manhole 7-3-5 to Lacamas Creek Lift Station

The existing system currently has enough excess capacity to convey the additional flows from the new development to the lift station.

Lacamas Creek Lift Station and Force Main to Manhole 6-1-9

Modeling results indicate that the Lacamas Creek Lift Station has insufficient excess capacity to pump the additional flows from the proposed 450 homes associated with the new development. Current excess capacity at the lift station could accommodate additional flows from only approximately 235 new homes based on our analysis. Lift station improvements would require a pump capacity of approximately 0.592 MGD (410 gpm) at the Lacamas Creek Lift Station in order to convey peak hour flows for the entire 450 homes. (Note: lift station capacities are noted with one pump on standby, as required by Department of Ecology criteria.)

The Lacamas Creek Lift Station could be relatively easily expanded to accommodate the peak hour flow of 0.592 MGD (410 gpm) anticipated from the combination of the entire 450 home development and existing flows by simply replacing the existing PACO pumps with larger pumps and providing a new electrical control panel. The estimated cost for this upgrade is $125,000. Cost estimates are attached to the back of the memo. PACO no longer manufactures or sells the pumps that are currently at the lift station. They are manufactured by ABS and marketed as Pumpex pumps by Pumptech in the northwest.

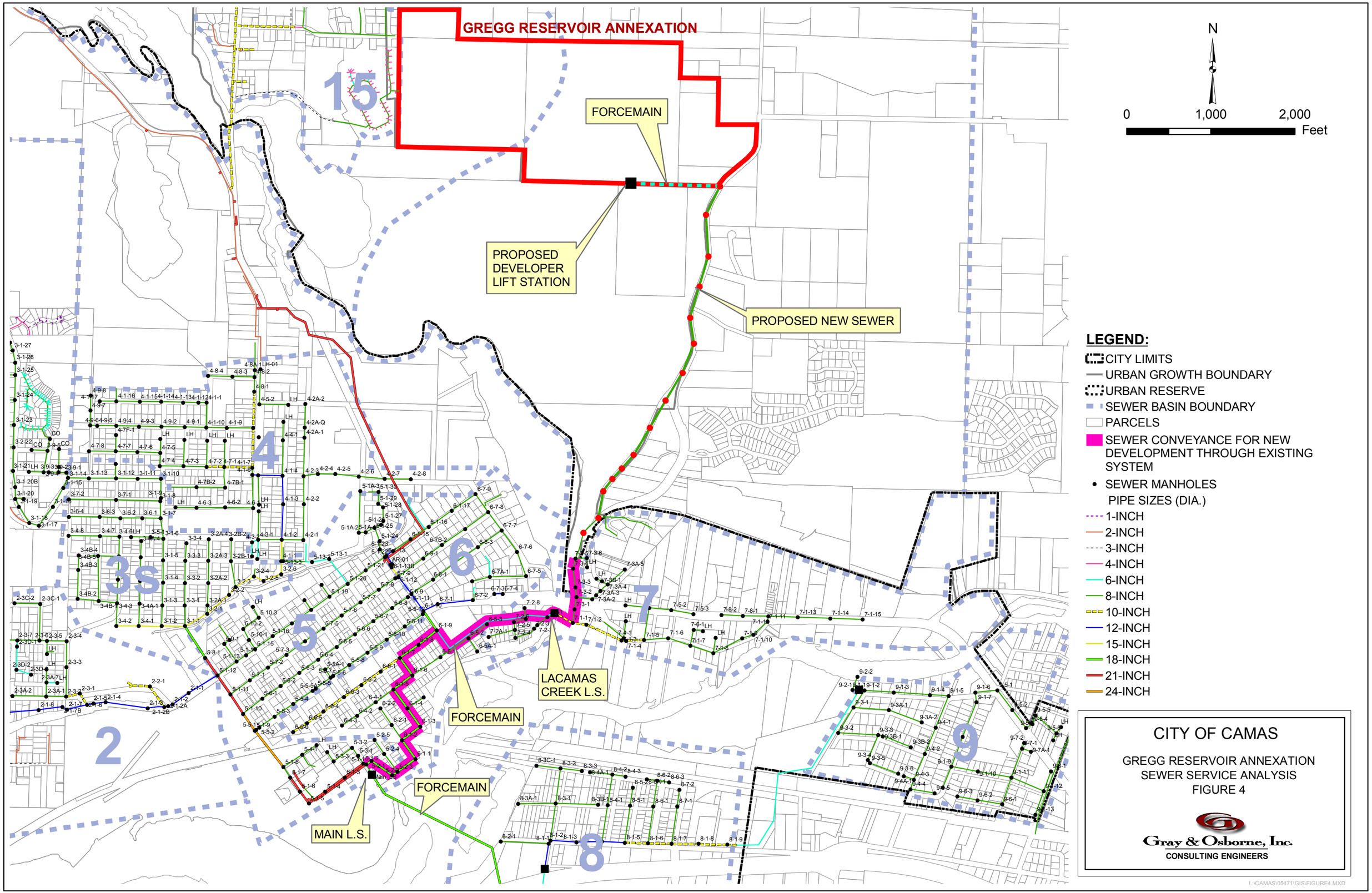
The lift station could be further expanded to as much as 550 gpm by replacing the existing pumps with new pumps; however, this would require major electrical upgrades to the lift station. Expanding beyond 550 gpm would require considerably more expense, including replacing the force main, use of a different pump family, and additional associated mechanical and electrical lift station modifications.

Gravity Sewer from Manhole 6-1-9 to the Main Lift Station

The results of the model indicate that the existing system has sufficient excess capacity to convey the additional flows resulting from the 700 homes in the proposed development.

# Table 4
# City of Camas
# Industrial Wastewater Flows

| Industry | Business Type | Modeled Flows | Annual Average Water Consumption (excluding Irrigation) | | | Wastewater Flow | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2004 | 2003 | 2002 | Noted in City's NPDES Permit Application | Industry State Waste Discharge Permit | Industry State Waste Discharge Permit | Industrial User Survey | Hours of Discharge | Maximum Noted |
| | | gpd | gpd | gpd | gpd | gpd | gpd Max Daily | gpd Ave Monthly | gpd | | |
| **Wafertech** | Semiconductor Manufacturing | 1,150,000 | 561,565 | 502,771 | 437,589 | 1,150,000 | 1,437,500 | 1,150,000 | 450,000 | Likely 24 h/d | 1,437,500 |
| | | - | | | | | | | | | |
| | | - | | | | | | | | | |
| | | - | | | | | | | | | |
| | | - | | | | | | | | | |
| **Linear** | Semiconductor Manufacturing | 299,000 | 186,419 | 175,052 | 186,146 | 299,000 | 299,000 | 334,000 | | Likely 24 h/d | 334,000 |
| | | - | | | | | | | | | |
| | | - | | | | | | | | | |
| **Sharp** | Semiconductors and LCD R&D | 13,000 | 19,595 | 16,564 | 15,633 | 13,000 | 48,000 | 35,500 | 16,745 | Likely 24 h/d | 48,000 |
| | | - | | | | | | | | | |
| | | - | | | | | | | | | |
| | | - | | | | | | | | | |
| **Landa** | Manufacturing Industrial Cleaning Systems / Metal Finishing | 43,000 | 5,860 | 5,669 | 7,301 | 43,000 | | | 9,500 | 16 hours /day | 43,000 |
| | | - | | | | | | | | | |
| **Underwriters Lab** | Electrical Product Testing | 6,473 | 6,473 | 6,526 | 4,777 | | | | | | |
| | | - | | | | | | | | | |
| **Heraeus Shin Etsu** | Quartz Glass Manufacturing | 35,000 | 11,733 | 12,166 | 12,871 | 35,000 | 35,000 | | | | 35,000 |
| | | - | | | | | | | | | |
| | | | | | - | | | | | | |
| Total Current Estimated Peak Day Flow | | 1,546,473 | 791,645 | 718,749 | 664,317 | | | | | | 1,897,500 |
| Peaking Factor | | 1.1 | 1.45 | | | | | | | | |
| **Total Current Estimated Peak Hour Flow** | | **1,701,120** | **1,150,000** | | | | | | | | |


GREGG RESERVOIR ANNEXATION
FORCEMAIN
PROPOSED DEVELOPER LIFT STATION
PROPOSED NEW SEWER
LACAMAS CREEK L.S.
FORCEMAIN
FORCEMAIN
MAIN L.S.
15
4
3s
6
5
7
2
8
9
N
0
1,000
2,000
Feet
LEGEND:
CITY LIMITS
URBAN GROWTH BOUNDARY
URBAN RESERVE
SEWER BASIN BOUNDARY
PARCELS
SEWER CONVEYANCE FOR NEW DEVELOPMENT THROUGH EXISTING SYSTEM
SEWER MANHOLES
PIPE SIZES (DIA.)
1-INCH
2-INCH
3-INCH
4-INCH
6-INCH
8-INCH
10-INCH
12-INCH
15-INCH
18-INCH
21-INCH
24-INCH
CITY OF CAMAS
GREGG RESERVOIR ANNEXATION
SEWER SERVICE ANALYSIS
FIGURE 4
Gray & Osborne, Inc.
CONSULTING ENGINEERS
L:\CAMAS\05471\GIS\FIGURE4.MXD

Main Lift Station to Treatment Plant

Analysis of the Main Lift Station shows an existing excess peak hour capacity of approximately 4.6 MGD based on flow metering data received from the City. Peak hour flows generated from the entire 700 proposed homes is estimated at 0.49 MGD. The Main Lift Station therefore has ample excess capacity to pump the additional flows associated with the development.

Cost Estimates

Table 5 summarized projected City costs to provide service to the GRA area. Actual cost estimates are attached to the back of this memo. Cost estimates are total project costs including tax, engineering and contingency. Developer costs, including the new developer lift station and force main, are not included.

**TABLE 5**
**Capital Costs to Provide Sewer Service to the GRA Area**

| ITEM | COST ESTIMATE |
|---|---|
| Crown Hill Sewer (8 " diameter) | $1,160,000 |
| Upgrade Lacamas Creek Lift Station to 410 gpm | $125,000 |
| **TOTAL** | **$1,285,000** |

**Future Needs**

Simplified models were also developed to determine the sewer facilities required to convey future build-out flows, for two scenarios:

1. the east side of the Draft Discussion Area north of and including the GRA area shown in the 9/27/05 Comprehensive Growth Management Plan map ("east side of Comp Plan Draft Discussion Area").

2. the entire built-out southeast Gregg Service Area Basin, including the GRA area, and

These two respective areas were shown in Figure 2. The areas that could be serviced by a new developer-financed lift station under each of these scenarios is shown in Figure 5.

East Side Of Comp Plan Draft Discussion Area

A summary of sewer system hydraulic modeling results for the East Side of the Draft Discussion Area is provided in Appendix B. To provide sufficient capacity for build-out flows from the Eastside of the Draft Discussion Area, the new Crown Hill sewer line would need to have a diameter of 10 inches, and the sewer line upstream of the Lacamas Creek Lift Station would also need to have a diameter of 10 inches (except the sewer pipe immediately upstream of the Lacamas Creek Lift Station, which would need to have a diameter of 12 inches). The sewer line downstream of the Lacamas Creek Lift Station

would not need to be replaced. Improvements required at the Lacamas Creek Lift Station in order to convey peak hour flows from this developed area under build-out conditions would include increasing pump capacity to approximately 1.22 MGD (847 gpm).

Table 6 summarized projected City costs to provide service to the East Side of the Draft Discussion Area, including the GRA. Actual cost estimates are attached to the back of this memo. Cost estimates are total project costs including tax, engineering and contingency. Developer costs, including the new developer lift station and force main, are not included.

**TABLE 6**
**Capital Costs to Provide Sewer Service to the East Side of the Comp Plan Draft Discussion Area**

| **ITEM** | **COST ESTIMATE** |
|---|---|
| Crown Hill Sewer (10”) | $1,280,000 |
| Replace Sewer Upstream of Lacamas Lift Station | $260,000 |
| Upgrade Lacamas Creek Lift Station to 1.22 MGD (847 gpm) | $700,000 |
| **TOTAL** | **$2,240,000** |

Entire Built-Out Southeast Gregg Service Area Basin

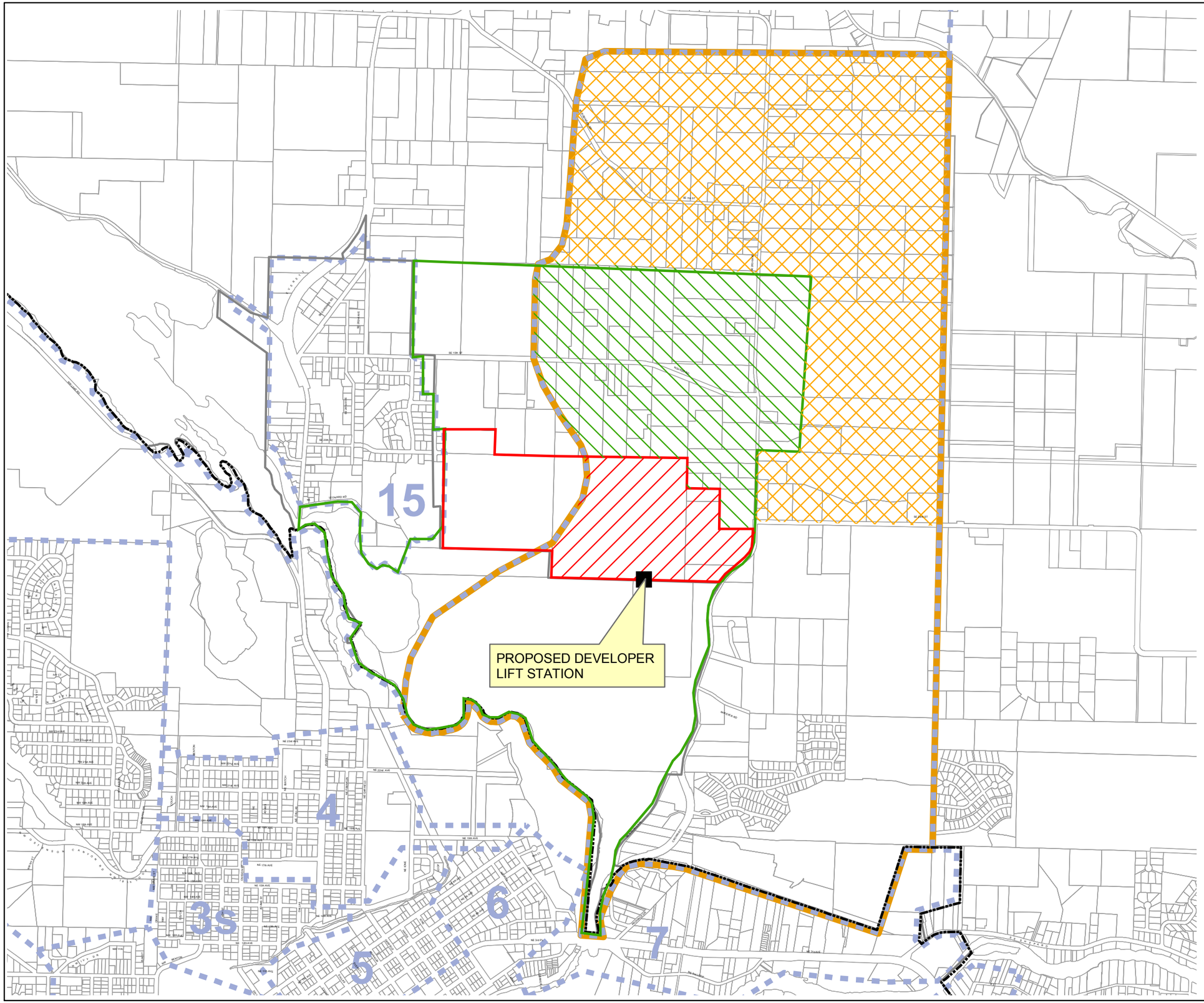
A summary of sewer system hydraulic modeling results for the Entire Built-Out Southeast Gregg Service Area Basin is provided in Appendix C. To provide sufficient capacity for build-out flows from the entire Southeast Gregg Service Area Basin, the new Crown Hill sewer line would need to have a diameter of 15 inches, and the sewer line upstream of the Lacamas Creek Lift Station would need to have a diameter of 15 inches (except the sewer pipe immediately upstream of the Lacamas Creek Lift Station, which would need to have a diameter of 18 inches). The gravity sewer line downstream of the Lacamas Creek Lift Station would need to be replaced with 24-inch diameter pipes.

Improvements required at the Lacamas Creek Lift Station in order to convey peak hour flows from this developed area under build-out conditions would include increasing pump capacity to approximately 5.24 MGD from 0.432 MGD. It is assumed that a new lift station would be built to provide this capacity. Full build-out of the Southwest Gregg Service Area might also require increasing the capacity of the Main Lift Station. The additional 4.8 MGD from the Lacamas Lift Station would increase peak hour flows to 11.3 MGD, just barely exceeding the capacity of the lift station (11.1 MGD). Table 7 summarizes the available connections at the Lacamas Creek and Main lift stations

.

**TABLE 7**
**Summary of Lift Station Analysis**

| Lift Station | Current Capacity (Peak Hour) | Current Peak Hour Flow | Excess Capacity (Peak Hour) | Connections Available |
|---|---|---|---|---|
| Lacamas Creek | 0.432 MGD | 0.250 MGD | 0.182 MGD | 235 |
| Main | 11.1 MGD | 6.5 MGD | 4.6 MGD | 5,900 |




N

0 1,300 2,600 Feet

**LEGEND:**

- CITY LIMITS
- URBAN GROWTH BOUNDARY
- URBAN RESERVE
- SEWER BASIN BOUNDARY
- PARCELS
- PROPOSED DEVELOPER LIFT STATION

POTENTIAL AREAS SERVED BY PROPOSED DEVELOPER LIFT STATION:

- SOUTH GREGG SERVICE AREA BASIN
- GREGG RESERVOIR ANNEXATION
- DRAFT DISCUSSION AREA COMP. GROWTH MANAGEMENT PLAN 9/27/05

CITY OF CAMAS

POTENTIAL AREA SERVED BY PROPOSED DEVELOPER LIFT STATION
FIGURE 5

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\05471\GIS\FIGURE5.MXD

**City of Camas**
**Evaluation of Sewer Service for the Gregg Reservoir Annexation**
**Preliminary Cost Estimate**
**Proposed Crown Road 8" Sewer**

| | Item | Quantity | | Unit Cost | Total |
|---|---|---|---|---|---|
| 1 | Mobilization/Demobilization | 1 | LS | $ 77,000.00 | $ 77,000 |
| 2 | Clearing and Grubbing | 1 | LS | $ - | $ - |
| 3 | Environmental Controls | 1 | LS | $ 11,000.00 | $ 11,000 |
| 4 | Trench Excavation Safety Systems | 1 | LS | $ 13,000.00 | $ 13,000 |
| 5 | Dewatering | 1 | LS | $ 31,000.00 | $ 31,000 |
| 6 | Locate Existing Utilities | 1 | LS | $ 8,000.00 | $ 8,000 |
| 7 | Removal of Structures and Obstructions | 1 | LS | $ 6,000.00 | $ 6,000 |
| 8 | Traffic Control | 1 | LS | $ 13,000.00 | $ 13,000 |
| 9 | 8" PVC Sewer Pipe (Including bedding) | 5,150 | LF | $ 50.00 | $ 257,500 |
| | 8" in ROW | 5,150 | | | |
| | 8" in unimp easmnt | | | | |
| 10 | 48" Precast Manhole (Basic to 8') | 13 | EA | $ 3,000.00 | $ 39,000 |
| 11 | 48" Precast Manhole (Height over 8') | 0 | LF | $ 200.00 | $ - |
| 12 | Connection to Existing Manhole | 1 | EA | $ 1,000.00 | $ 1,000 |
| 13 | 6" PVC Side Sewer Pipe (including bedding and tee) | | EA | $ 900.00 | $ - |
| 14 | Special Excavation of Unsuitable Material | 60 | CY | $ 35.00 | $ 2,100 |
| 15 | Foundation Gravel | 60 | TN | $ 15.00 | $ 900 |
| 16 | Gravel Base | 7,790 | TN | $ 12.00 | $ 93,480 |
| 17 | Crushed Surfacing Top Course | 970 | TN | $ 20.00 | $ 19,400 |
| 18 | Cold Mix Asphalt (temp repair) | 770 | TN | $ 50.00 | $ 38,500 |
| 19 | Asphalt Pavement Repair | 3,430 | SY | $ 20.00 | $ 68,600 |
| 20 | Hydroseeding | | SY | $ 2.00 | $ - |
| 21 | Saw Cutting | 20,600 | LF | $ 2.00 | $ 41,200 |
| | | Subtotal | | | $ 720,680 |
| | | Contingency (20%) | | | $ 144,136 |
| | | Subtotal | | | $ 864,816 |
| | | Sales Tax (7.7%) | | | $ 66,591 |
| | | Total | | | $ 931,407 |
| | | **Total Construction Cost (Rounded)** | | | **$ 931,000** |
| | | Engineering and Construction Administration (25%) | | | $ 233,000 |
| | | **Total Project Cost (Rounded)** | | | **$ 1,160,000** |

**City of Camas**
**Evaluation of Sewer Service for the Gregg Reservoir Annexation**
**Preliminary Cost Estimate**
**Lacamas Creek Pump Station - Increase in Capacity to 410 gpm**

| | Item | Quantity | | Unit Cost | Total |
|---|---|---|---|---|---|
| 1 | Mobilization/Demobilization | 1 | LS | $ 7,000.00 | $ 7,000 |
| 2 | Pumps | 2 | EA | $ 13,000.00 | $ 26,000 |
| 3 | Control Panel | 1 | EA | $ 34,000.00 | $ 34,000 |
| 4 | Power Supply Upgrade | 1 | LS | $ 10,000.00 | $ 10,000 |
| | | Subtotal | | | $ 77,000 |
| | | Contingency (20%) | | | $ 15,400 |
| | | Subtotal | | | $ 92,400 |
| | | Sales Tax (7.7%) | | | $ 7,115 |
| | | Total | | | $ 99,515 |
| | | **Total Construction Cost (Rounded)** | | | **$ 100,000** |
| | | Engineering and Construction Administration (25%) | | | $ 25,000 |
| | | **Total Project Cost (Rounded)** | | | **$ 125,000** |

**City of Camas**
**Evaluation of Sewer Service for the Gregg Reservoir Annexation**
**Preliminary Cost Estimate**
**Proposed Crown Road 10" Sewer**

| | Item | Quantity | | Unit Cost | Total |
|---|---|---|---|---|---|
| 1 | Mobilization/Demobilization | 1 | LS | $ 85,000.00 | $ 85,000 |
| 2 | Clearing and Grubbing | 1 | LS | $ - | $ - |
| 3 | Environmental Controls | 1 | LS | $ 11,000.00 | $ 11,000 |
| 4 | Trench Excavation Safety Systems | 1 | LS | $ 13,000.00 | $ 13,000 |
| 5 | Dewatering | 1 | LS | $ 31,000.00 | $ 31,000 |
| 6 | Locate Existing Utilities | 1 | LS | $ 8,000.00 | $ 8,000 |
| 7 | Removal of Structures and Obstructions | 1 | LS | $ 6,000.00 | $ 6,000 |
| 8 | Traffic Control | 1 | LS | $ 13,000.00 | $ 13,000 |
| 9 | 10" PVC Sewer Pipe (Including bedding) | 5,150 | LF | $ 62.00 | $ 319,300 |
| | 10" in ROW | 5,150 | | | |
| | 10" in unimp easmnt | 0 | | | |
| 10 | 48" Precast Manhole (Basic to 8') | 13 | EA | $ 3,000.00 | $ 39,000 |
| 11 | 48" Precast Manhole (Height over 8') | 0 | LF | $ 200.00 | $ - |
| 12 | Connection to Existing Manhole | 1 | EA | $ 1,000.00 | $ 1,000 |
| 13 | 6" PVC Side Sewer Pipe (including bedding | 0 | EA | $ 1,000.00 | $ - |
| 14 | Special Excavation of Unsuitable Material | 60 | CY | $ 35.00 | $ 2,100 |
| 15 | Foundation Gravel | 60 | TN | $ 15.00 | $ 900 |
| 16 | Gravel Base | 8,040 | TN | $ 12.00 | $ 96,480 |
| 17 | Crushed Surfacing Top Course | 970 | TN | $ 20.00 | $ 19,400 |
| 18 | Cold Mix Asphalt (temp repair) | 770 | TN | $ 50.00 | $ 38,500 |
| 19 | Asphalt Pavement Repair | 3,430 | SY | $ 20.00 | $ 68,600 |
| 20 | Hydroseeding | | SY | $ 2.00 | $ - |
| 21 | Saw Cutting | 20,600 | LF | $ 2.00 | $ 41,200 |
| | | Subtotal | | | $ 793,480 |
| | | Contingency (20%) | | | $ 158,696 |
| | | Subtotal | | | $ 952,176 |
| | | Sales Tax (7.7%) | | | $ 73,318 |
| | | Total | | | $ 1,025,494 |
| | | **Total Construction Cost (Rounded)** | | | **$ 1,025,000** |
| | | Engineering and Construction Administration (25%) | | | $ 256,000 |
| | | **Total Project Cost (Rounded)** | | | **$ 1,280,000** |

**City of Camas**
**Evaluation of Sewer Service for the Gregg Reservoir Annexation**
**Preliminary Cost Estimate**
**Replace Sewer Upstream of Lacamas Lift Station (w/10" Sewer)**

| | Item | Quantity | | Unit Cost | Total |
|---|---|---|---|---|---|
| 1 | Mobilization/Demobilization | 1 | LS | $ 20,000.00 | $ 20,000 |
| 2 | Clearing and Grubbing | 1 | LS | $ - | $ - |
| 3 | Environmental Controls | 1 | LS | $ 2,000.00 | $ 2,000 |
| 4 | Trench Excavation Safety Systems | 1 | LS | $ 3,000.00 | $ 3,000 |
| 5 | Dewatering | 1 | LS | $ 3,000.00 | $ 3,000 |
| 6 | Locate Existing Utilities | 1 | LS | $ 2,000.00 | $ 2,000 |
| 7 | Removal of Structures and Obstructions | 1 | LS | $ 1,000.00 | $ 1,000 |
| 8 | Traffic Control | 1 | LS | $ 3,000.00 | $ 3,000 |
| 9 | 10" PVC Sewer Pipe (Including bedding) | 950 | LF | $ 62.00 | $ 58,900 |
| | 10" in ROW | 950 | | | |
| | 10" in unimp easmnt | 0 | | | |
| 10 | 48" Precast Manhole (Basic to 8') | 6 | EA | $ 3,000.00 | $ 18,000 |
| 11 | 48" Precast Manhole (Height over 8') | 0 | LF | $ 200.00 | $ - |
| 12 | Connection to Existing Manhole | 1 | EA | $ 1,000.00 | $ 1,000 |
| 13 | 6" PVC Side Sewer Pipe (including bedding | 0 | EA | $ 1,000.00 | $ - |
| 14 | Special Excavation of Unsuitable Material | 10 | CY | $ 35.00 | $ 350 |
| 15 | Foundation Gravel | 10 | TN | $ 15.00 | $ 150 |
| 16 | Gravel Base | 1,440 | TN | $ 12.00 | $ 17,280 |
| 17 | Crushed Surfacing Top Course | 180 | TN | $ 20.00 | $ 3,600 |
| 18 | Cold Mix Asphalt (temp repair) | 140 | TN | $ 50.00 | $ 7,000 |
| 19 | Asphalt Pavement Repair | 630 | SY | $ 20.00 | $ 12,600 |
| 20 | Hydroseeding | | SY | $ 2.00 | $ - |
| 21 | Saw Cutting | 3,800 | LF | $ 2.00 | $ 7,600 |
| | | Subtotal | | | $ 160,480 |
| | | Contingency (20%) | | | $ 32,096 |
| | | Subtotal | | | $ 192,576 |
| | | Sales Tax (7.7%) | | | $ 14,828 |
| | | Total | | | $ 207,404 |
| | | **Total Construction Cost (Rounded)** | | | **$ 207,000** |
| | | Engineering and Construction Administration (25%) | | | $ 52,000 |
| | | **Total Project Cost (Rounded)** | | | **$ 260,000** |

# City of Camas
## Evaluation of Sewer Service for the Gregg Reservoir Annexation
## Preliminary Cost Estimate
## Lacamas Creek Pump Station and Force Main - Upgrade to 847 gpm

1600 LF 8" DI Force Main

| | Item | Quantity | | Unit Cost | Total |
|---|---|---|---|---|---|
| 1 | Mobil. & Demobil. | 1 | LS | $ 37,000.00 | $ 37,000 |
| 2 | 8" PVC Force Main | 1600 | LF | $ 40.00 | $ 64,000 |
| 3 | Locate Existing Utility | 1 | LS | $ 3,000.00 | $ 3,000 |
| 4 | Trench Safety Systems | 1 | LS | $ 5,000.00 | $ 5,000 |
| 5 | Trench Excavation, Backfill | 1 | LS | $ 25,000.00 | $ 25,000 |
| 6 | Traffic Control | 1 | LS | $ 5,000.00 | $ 5,000 |
| 7 | Erosion Control | 1 | LS | $ 4,000.00 | $ 4,000 |
| 8 | Foundation Gravel | 50 | CY | $ 30.00 | $ 1,500 |
| 9 | Gravel Base | 300 | CY | $ 30.00 | $ 9,000 |
| 10 | Crushed Top Course | 200 | CY | $ 30.00 | $ 6,000 |
| 11 | Asphalt Pavement Repair | 100 | TN | $ 100.00 | $ 10,000 |
| 12 | Sawcutting | 2000 | LF | $ 2.50 | $ 5,000 |
| 13 | Dry Pit Submersible pumps | 2 | EA | $ 30,000.00 | $ 60,000 |
| 14 | Electrical & Control | 1 | LS | $ 90,000.00 | $ 90,000 |
| 15 | Generator | 1 | LS | $ 42,000.00 | $ 42,000 |
| 16 | HVAC | 1 | LS | $ 20,000.00 | $ 20,000 |
| 17 | Piping at Pump Station | 1 | LS | $ 15,000.00 | $ 15,000 |
| 18 | Shoring and Dewatering | 1 | LS | $ 20,000.00 | $ 20,000 |
| 19 | Demolition | 1 | LS | $ 10,000.00 | $ 10,000 |
| | Subtotal | | | | $ 431,500 |
| | Contigency (20%) | | | | $ 86,300 |
| | Subtotal | | | | $ 517,800 |
| | Sales Tax (7.7%) | | | | $ 39,871 |
| | **Total Construction Cost** | | | | $ 557,671 |
| | Engineering and Administration(25%) | | | | $139,418 |
| | **Total Project Cost (Rounded)** | | | | $ 698,000 |

Appendix A

Hydraulic Modeling Results for Sewer Service for the Gregg Reservoir Annexation

| LinkID | From Node | To Node | Design Capacity | Qmax | Hmax/D | Qmax/ Capacity | Up - Invert Level | Down - Invert Level | Length | Required Diameter |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | (mgd) | (mgd) | | | [ft] | [ft] | [ft] | (inch) |
| Fut_8l1 | Fut_8 | Fut_7 | 1.408 | 0.337 | 0.517 | 0.24 | 235.35 | 218.91 | 548 | 8 |
| Fut_7l1 | Fut_7 | Fut_6 | 1.408 | 0.337 | 0.517 | 0.24 | 218.81 | 207.53 | 376 | 8 |
| Fut_6l1 | Fut_6 | Fut_5 | 1.408 | 0.337 | 0.517 | 0.24 | 207.43 | 190.39 | 568 | 8 |
| Fut_5l1 | Fut_5 | Fut_4 | 1.408 | 0.337 | 0.517 | 0.24 | 190.29 | 171.84 | 615 | 8 |
| Fut_4l1 | Fut_4 | Fut_3 | 1.408 | 0.337 | 0.517 | 0.24 | 171.74 | 157.94 | 460 | 8 |
| Fut_3l1 | Fut_3 | Fut_2 | 1.408 | 0.337 | 0.517 | 0.24 | 157.84 | 116.35 | 1383 | 8 |
| Fut_2l1 | Fut_2 | Fut_1 | 1.408 | 0.337 | 0.517 | 0.24 | 116.25 | 97.68 | 619 | 8 |
| Fut_1l1 | Fut_1 | 7-3-5 | 1.408 | 0.337 | 0.429 | 0.24 | 97.58 | 71.6 | 866 | 8 |
| 7-3-5l1 | 7-3-5 | 7-3-4 | 1.860 | 0.337 | 0.489 | 0.181 | 71.5 | 64.26 | 121.17 | 8 |
| 7-3-4l1 | 7-3-4 | 7-3-3 | 2.592 | 0.337 | 0.838 | 0.13 | 64.26 | 41.76 | 193.99 | 8 |
| 7-3-3l1 | 7-3-3 | 7-3-2 | 0.920 | 0.337 | 0.419 | 0.367 | 41.76 | 39.56 | 150.63 | 8 |
| 7-3-2l1 | 7-3-2 | 7-3-1 | 2.462 | 0.337 | 0.301 | 0.137 | 39.46 | 27.09 | 118.27 | 8 |
| 7-3-1l1 | 7-3-1 | 7-1-1 | 1.738 | 0.337 | 0.666 | 0.194 | 26.89 | 16.96 | 190.47 | 8 |
| 7-1-1l1 | 7-1-1 | L_Creek_LS | 2.048 | 0.476 | 0.651 | 0.232 | 16.86 | 9.62 | 328.36 | 10 |
| | | | | | | | | | | |
| 6-1-9l1 | 6-1-9 | 6-1-8 | 5.541 | 3.019 | 0.843 | 0.545 | 59.79 | 57.85 | 276.65 | 18 |
| 6-1-8l1 | 6-1-8 | 6-1-7 | 5.134 | 2.981 | 0.549 | 0.581 | 57.85 | 56.23 | 269.02 | 18 |
| 6-1-7l1 | 6-1-7 | 6-1-6 | 6.133 | 2.931 | 1.029 | 0.478 | 52.04 | 49.84 | 256.12 | 18 |
| 6-1-6l1 | 6-1-6 | 6-1-5 | 5.815 | 2.885 | 1 | 0.496 | 49.84 | 47.68 | 279.68 | 18 |
| 6-1-5l1 | 6-1-5 | 6-1-4 | 5.877 | 2.823 | 0.839 | 0.48 | 47.68 | 45.48 | 278.91 | 18 |
| 6-1-4l1 | 6-1-4 | 6-1-3 | 5.973 | 2.782 | 0.955 | 0.466 | 45.48 | 43.32 | 265.09 | 18 |
| 6-1-3l1 | 6-1-3 | 6-1-2 | 5.933 | 2.749 | 0.478 | 0.463 | 43.32 | 41.16 | 268.64 | 18 |
| 6-1-2l1 | 6-1-2 | 6-1-1 | 5.990 | 2.726 | 0.871 | 0.455 | 37.5 | 35.44 | 251.4 | 18 |
| 6-1-1l1 | 6-1-1 | 5-2-3 | 6.997 | 2.718 | 0.649 | 0.388 | 35.44 | 32.47 | 265.6 | 18 |
| 5-2-3l1 | 5-2-3 | 5-2-2 | 12.930 | 2.707 | 0.622 | 0.209 | 32.47 | 29.6 | 75.16 | 18 |
| 5-2-2l1 | 5-2-2 | 5-2-1 | 11.470 | 2.706 | 0.573 | 0.236 | 29.5 | 27.1 | 79.87 | 18 |
| 5-2-1l1 | 5-2-1 | 5-1-1 | 12.231 | 2.703 | 0.32 | 0.221 | 27 | 24.41 | 75.8 | 18 |

Appendix B

Hydraulic Modeling Results for Sewer Service for the East Side of the Comp Plan Draft Discussion Area

| LinkID | From Node | To Node | Design Capacity | Qmax | Hmax/D | Qmax/ Capacity | Up - Invert Level | Down - Invert Level | Length | Required Diameter |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | (mgd) | (mgd) | | | [ft] | [ft] | [ft] | (inch) |
| Fut_8l1 | Fut_8 | Fut_7 | 2.547 | 1.043 | 0.771 | 0.41 | 235.35 | 218.91 | 548 | 10 |
| Fut_7l1 | Fut_7 | Fut_6 | 2.547 | 1.043 | 0.771 | 0.41 | 218.81 | 207.53 | 376 | 10 |
| Fut_6l1 | Fut_6 | Fut_5 | 2.547 | 1.043 | 0.772 | 0.41 | 207.43 | 190.39 | 568 | 10 |
| Fut_5l1 | Fut_5 | Fut_4 | 2.547 | 1.044 | 0.772 | 0.41 | 190.29 | 171.84 | 615 | 10 |
| Fut_4l1 | Fut_4 | Fut_3 | 2.547 | 1.044 | 0.772 | 0.41 | 171.74 | 157.94 | 460 | 10 |
| Fut_3l1 | Fut_3 | Fut_2 | 2.547 | 1.045 | 0.772 | 0.41 | 157.84 | 116.35 | 1383 | 10 |
| Fut_2l1 | Fut_2 | Fut_1 | 2.547 | 1.044 | 0.772 | 0.41 | 116.25 | 97.68 | 619 | 10 |
| Fut_1l1 | Fut_1 | 7-3-5 | 2.547 | 1.044 | 0.65 | 0.41 | 97.58 | 71.6 | 866 | 10 |
| 7-3-5l1 | 7-3-5 | 7-3-4 | 3.369 | 1.044 | 0.646 | 0.31 | 71.5 | 64.26 | 121.17 | 10 |
| 7-3-4l1 | 7-3-4 | 7-3-3 | 4.694 | 1.044 | 1.147 | 0.222 | 64.26 | 41.76 | 193.99 | 10 |
| 7-3-3l1 | 7-3-3 | 7-3-2 | 1.666 | 1.043 | 0.574 | 0.626 | 41.76 | 39.56 | 150.63 | 10 |
| 7-3-2l1 | 7-3-2 | 7-3-1 | 4.458 | 1.043 | 0.561 | 0.234 | 39.46 | 27.09 | 118.27 | 10 |
| 7-3-1l1 | 7-3-1 | 7-1-1 | 3.147 | 1.043 | 0.866 | 0.332 | 26.89 | 16.96 | 190.47 | 10 |
| 7-1-1l1 | 7-1-1 | L_Creek_LS | 3.332 | 1.181 | 0.91 | 0.354 | 16.86 | 9.62 | 328.36 | 12 |
| | | | | | | | | | | |
| 6-1-9l1 | 6-1-9 | 6-1-8 | 5.541 | 3.385 | 0.918 | 0.611 | 59.79 | 57.85 | 276.65 | 18 |
| 6-1-8l1 | 6-1-8 | 6-1-7 | 5.134 | 3.385 | 0.592 | 0.659 | 57.85 | 56.23 | 269.02 | 18 |
| 6-1-7l1 | 6-1-7 | 6-1-6 | 6.133 | 3.385 | 1.147 | 0.552 | 52.04 | 49.84 | 256.12 | 18 |
| 6-1-6l1 | 6-1-6 | 6-1-5 | 5.815 | 3.389 | 1.123 | 0.583 | 49.84 | 47.68 | 279.68 | 18 |
| 6-1-5l1 | 6-1-5 | 6-1-4 | 5.877 | 3.402 | 0.934 | 0.579 | 47.68 | 45.48 | 278.91 | 18 |
| 6-1-4l1 | 6-1-4 | 6-1-3 | 5.973 | 3.411 | 1.09 | 0.571 | 45.48 | 43.32 | 265.09 | 18 |
| 6-1-3l1 | 6-1-3 | 6-1-2 | 5.933 | 3.411 | 0.546 | 0.575 | 43.32 | 41.16 | 268.64 | 18 |
| 6-1-2l1 | 6-1-2 | 6-1-1 | 5.990 | 3.408 | 0.996 | 0.569 | 37.5 | 35.44 | 251.4 | 18 |
| 6-1-1l1 | 6-1-1 | 5-2-3 | 6.997 | 3.405 | 0.739 | 0.487 | 35.44 | 32.47 | 265.6 | 18 |
| 5-2-3l1 | 5-2-3 | 5-2-2 | 12.930 | 3.405 | 0.718 | 0.263 | 32.47 | 29.6 | 75.16 | 18 |
| 5-2-2l1 | 5-2-2 | 5-2-1 | 11.470 | 3.403 | 0.657 | 0.297 | 29.5 | 27.1 | 79.87 | 18 |
| 5-2-1l1 | 5-2-1 | 5-1-1 | 12.231 | 3.401 | 0.362 | 0.278 | 27 | 24.41 | 75.8 | 18 |

Appendix C

Hydraulic Modeling Results for Sewer Service for the Entire Southeast Gregg Service Area

| LinkID | From Node | To Node | Design Capacity | Qmax | Hmax/D | Qmax/ Capacity | Up - Invert Level | Down - Invert Level | Length | Required Diameter |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | (mgd) | (mgd) | | | [ft] | [ft] | [ft] | (inch) |
| Fut_8l1 | Fut_8 | Fut_7 | 7.517 | 5.039 | 1.12 | 0.67 | 235.35 | 218.91 | 548 | 15 |
| Fut_7l1 | Fut_7 | Fut_6 | 7.517 | 5.039 | 1.118 | 0.67 | 218.81 | 207.53 | 376 | 15 |
| Fut_6l1 | Fut_6 | Fut_5 | 7.517 | 5.039 | 1.118 | 0.67 | 207.43 | 190.39 | 568 | 15 |
| Fut_5l1 | Fut_5 | Fut_4 | 7.517 | 5.039 | 1.118 | 0.67 | 190.29 | 171.84 | 615 | 15 |
| Fut_4l1 | Fut_4 | Fut_3 | 7.517 | 5.039 | 1.118 | 0.67 | 171.74 | 157.94 | 460 | 15 |
| Fut_3l1 | Fut_3 | Fut_2 | 7.517 | 5.039 | 1.118 | 0.67 | 157.84 | 116.35 | 1383 | 15 |
| Fut_2l1 | Fut_2 | Fut_1 | 7.517 | 5.039 | 1.118 | 0.67 | 116.25 | 97.68 | 619 | 15 |
| Fut_1l1 | Fut_1 | 7-3-5 | 7.517 | 5.039 | 0.946 | 0.67 | 97.58 | 71.6 | 866 | 15 |
| 7-3-5l1 | 7-3-5 | 7-3-4 | 9.946 | 5.039 | 0.851 | 0.507 | 71.5 | 64.26 | 121.17 | 15 |
| 7-3-4l1 | 7-3-4 | 7-3-3 | 13.857 | 5.039 | 1.694 | 0.364 | 64.26 | 41.76 | 193.99 | 15 |
| 7-3-3l1 | 7-3-3 | 7-3-2 | 4.917 | 5.039 | 0.907 | 1.025 | 41.76 | 39.56 | 150.63 | 15 |
| 7-3-2l1 | 7-3-2 | 7-3-1 | 13.159 | 5.039 | 0.916 | 0.383 | 39.46 | 27.09 | 118.27 | 15 |
| 7-3-1l1 | 7-3-1 | 7-1-1 | 9.290 | 5.039 | 1.157 | 0.542 | 26.89 | 16.96 | 190.47 | 15 |
| 7-1-1l1 | 7-1-1 | L_Creek_LS | 9.825 | 5.173 | 0.515 | 0.527 | 16.86 | 9.62 | 328.36 | 18 |
| 6-1-9l1 | 6-1-9 | 6-1-8 | 11.934 | 7.362 | 0.94 | 0.617 | 59.79 | 57.85 | 276.65 | 24 |
| 6-1-8l1 | 6-1-8 | 6-1-7 | 11.059 | 7.357 | 0.596 | 0.665 | 57.85 | 56.23 | 269.02 | 24 |
| 6-1-7l1 | 6-1-7 | 6-1-6 | 13.208 | 7.355 | 1.198 | 0.557 | 52.04 | 49.84 | 256.12 | 24 |
| 6-1-6l1 | 6-1-6 | 6-1-5 | 12.524 | 7.354 | 1.153 | 0.587 | 49.84 | 47.68 | 279.68 | 24 |
| 6-1-5l1 | 6-1-5 | 6-1-4 | 12.657 | 7.351 | 0.923 | 0.581 | 47.68 | 45.48 | 278.91 | 24 |
| 6-1-4l1 | 6-1-4 | 6-1-3 | 12.864 | 7.348 | 1.087 | 0.571 | 45.48 | 43.32 | 265.09 | 24 |
| 6-1-3l1 | 6-1-3 | 6-1-2 | 12.779 | 7.347 | 0.544 | 0.575 | 43.32 | 41.16 | 268.64 | 24 |
| 6-1-2l1 | 6-1-2 | 6-1-1 | 12.900 | 7.346 | 1.038 | 0.569 | 37.5 | 35.44 | 251.4 | 24 |
| 6-1-1l1 | 6-1-1 | 5-2-3 | 15.070 | 7.345 | 0.759 | 0.487 | 35.44 | 32.47 | 265.6 | 24 |
| 5-2-3l1 | 5-2-3 | 5-2-2 | 27.849 | 7.345 | 0.751 | 0.264 | 32.47 | 29.6 | 75.16 | 24 |
| 5-2-2l1 | 5-2-2 | 5-2-1 | 24.705 | 7.344 | 0.672 | 0.297 | 29.5 | 27.1 | 79.87 | 24 |
| 5-2-1l1 | 5-2-1 | 5-1-1 | 26.343 | 7.344 | 0.361 | 0.279 | 27 | 24.41 | 75.8 | 24 |

# APPENDIX M

# WWTF PERFORMANCE DATA

**Figure 1**
**City of Camas WWTP**
**Influent and Effluent BOD5 (mg/L)**

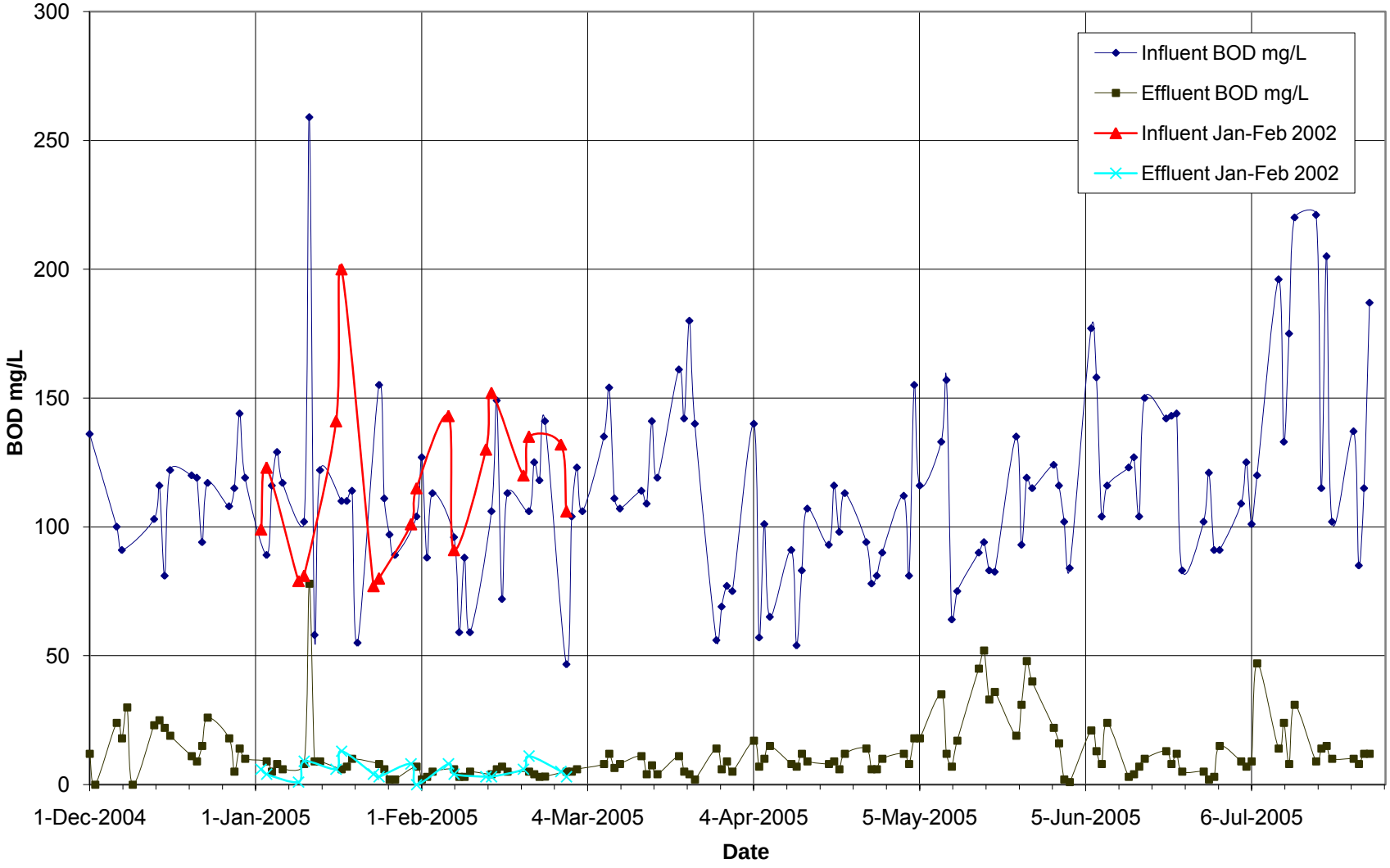


**Figure 2**
**City of Camas WWTP**
**Influent and Effluent TSS (mg/L)**

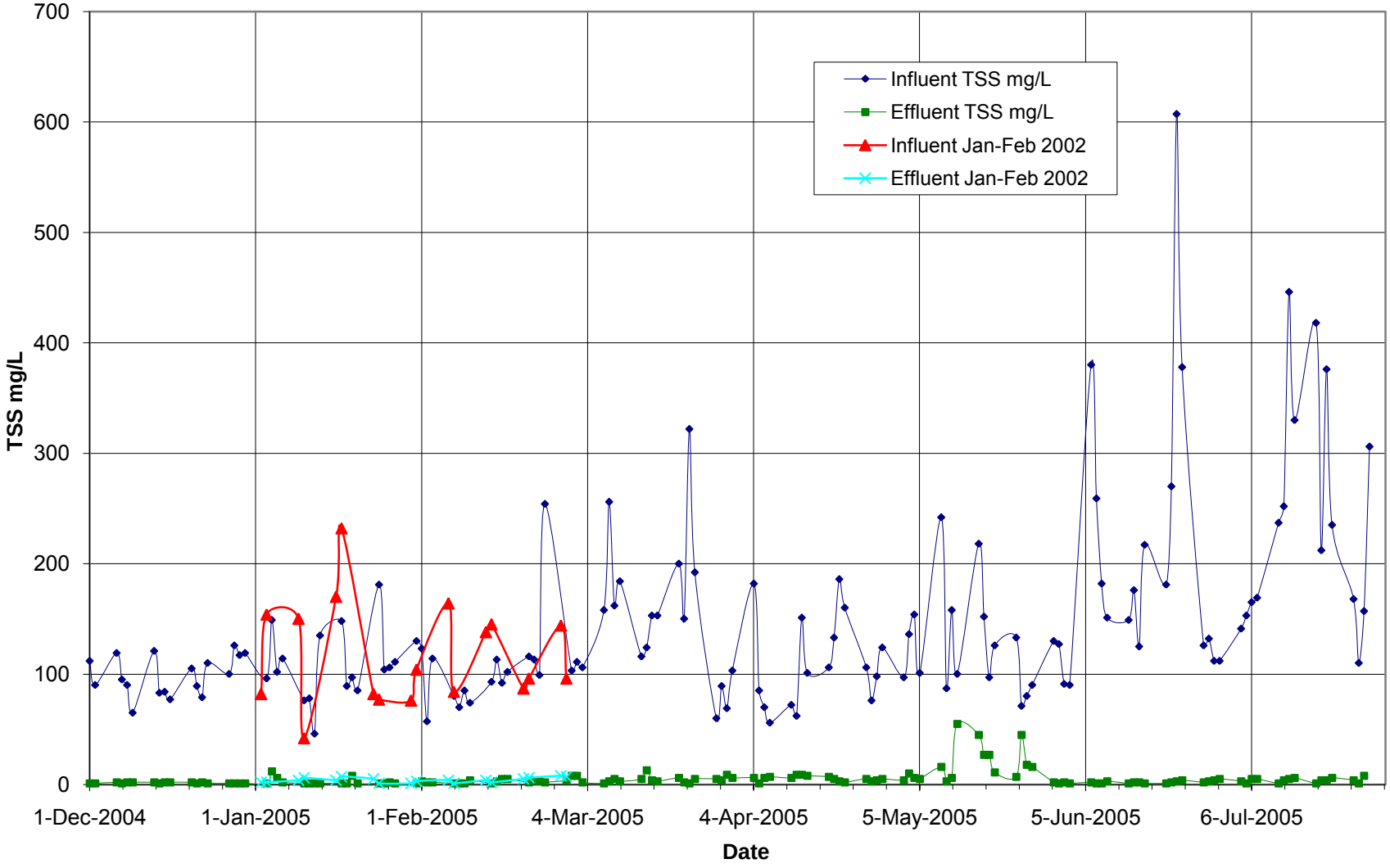


**Figure 3**
**City of Camas WWTP**
**Influent and Effluent Ammonia (mg/L)**

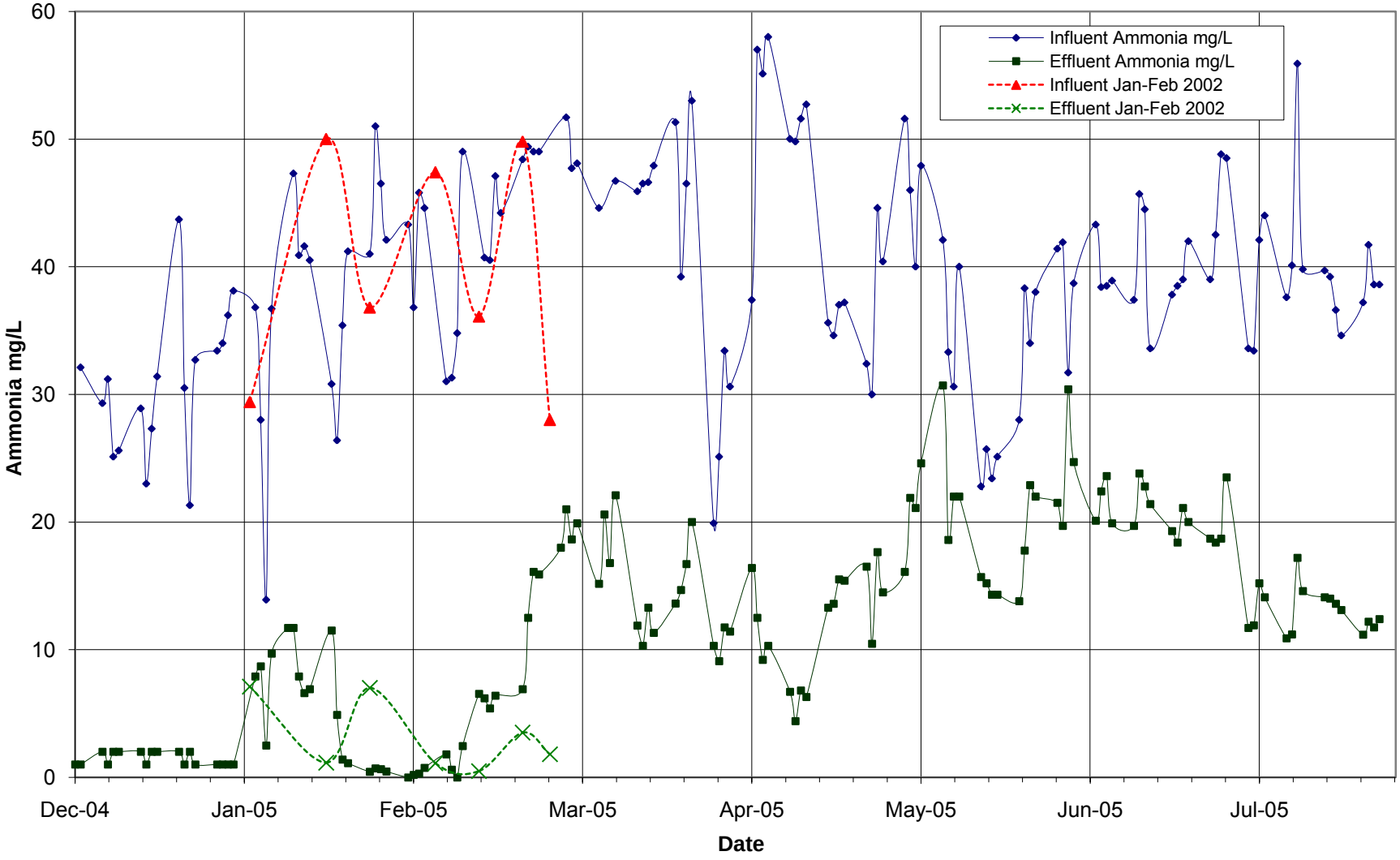


**Figure 4**
**City of Camas WWTP**
**Influent and Effluent Flow MGD**

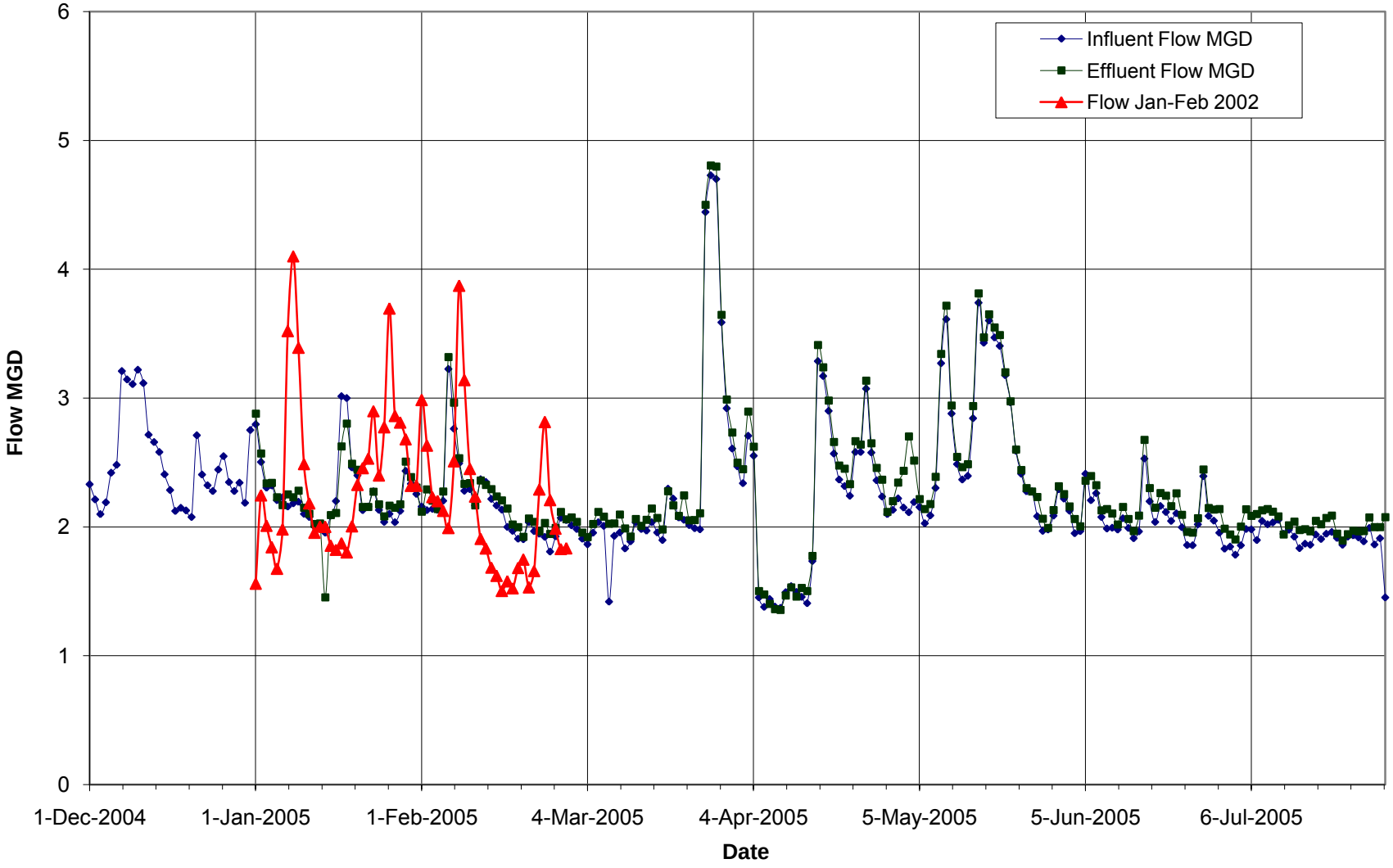


**Figure 5**
**City of Camas WWTP**
**Aeration Basin MLSS**

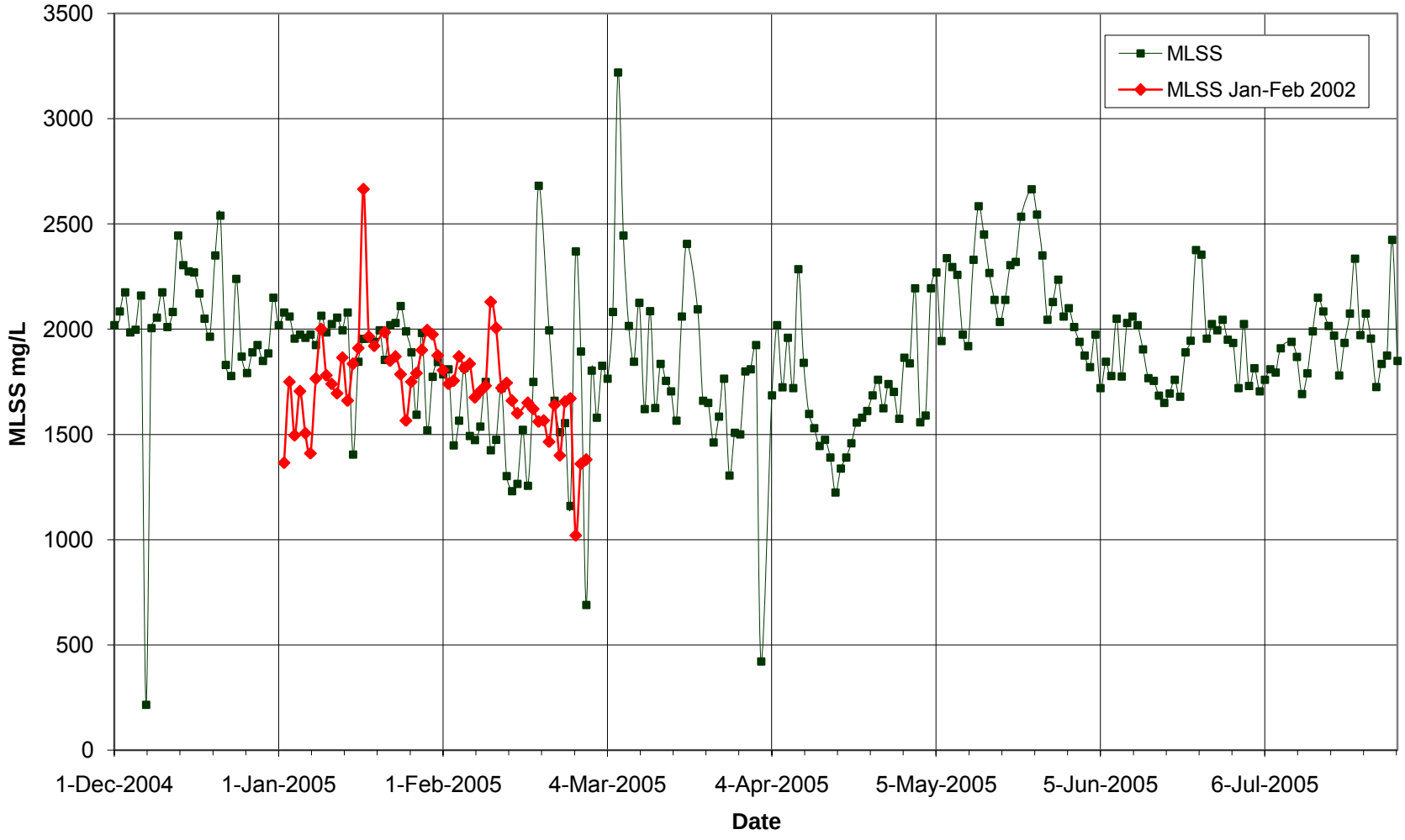


**Figure 6**
**City of Camas WWTP**
**F/M**
**Reported by WWTP Lab**

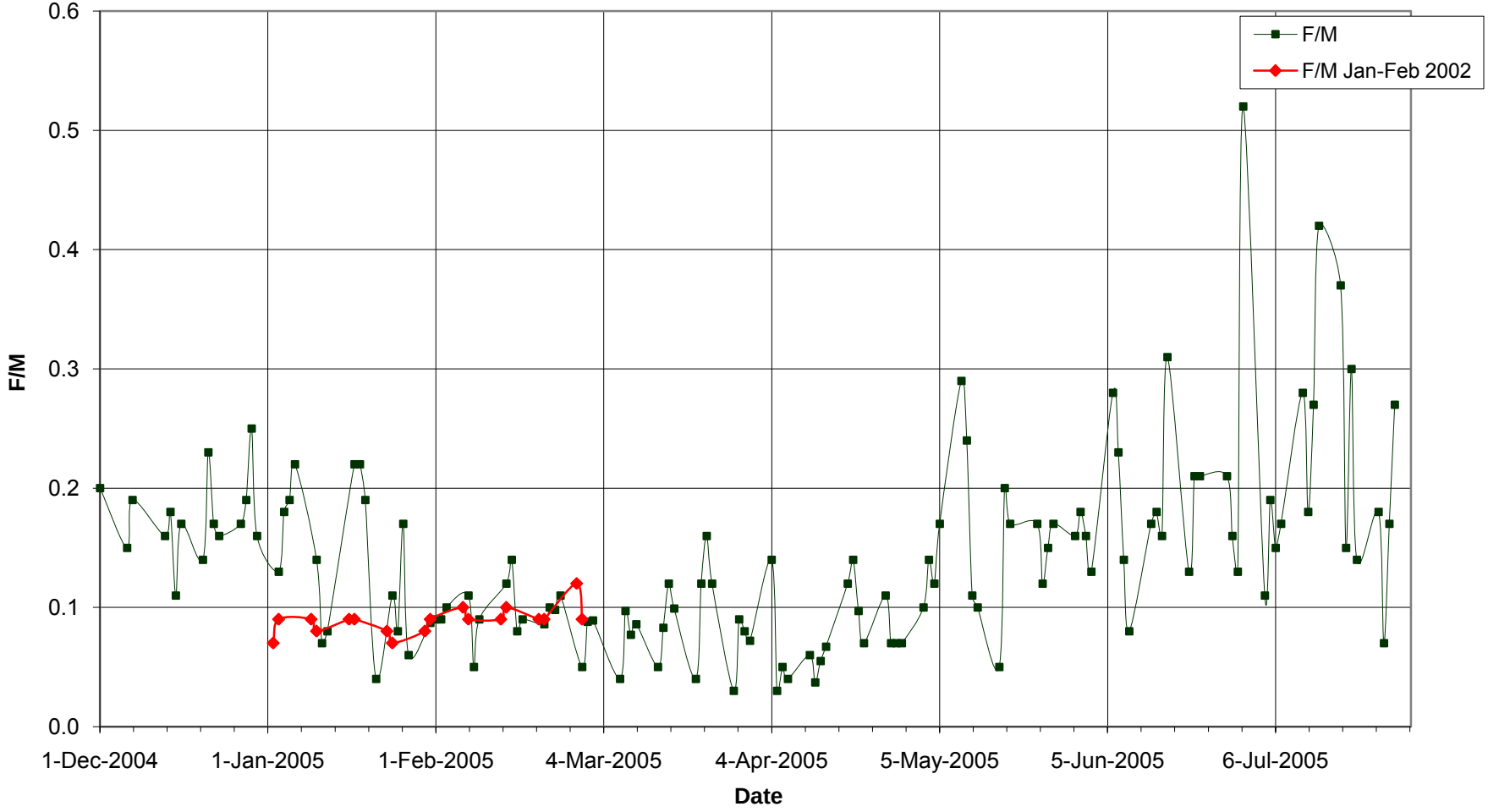


**Figure 7**
**City of Camas WWTP**
**Primary Effluent Suspended Solids mg/L**

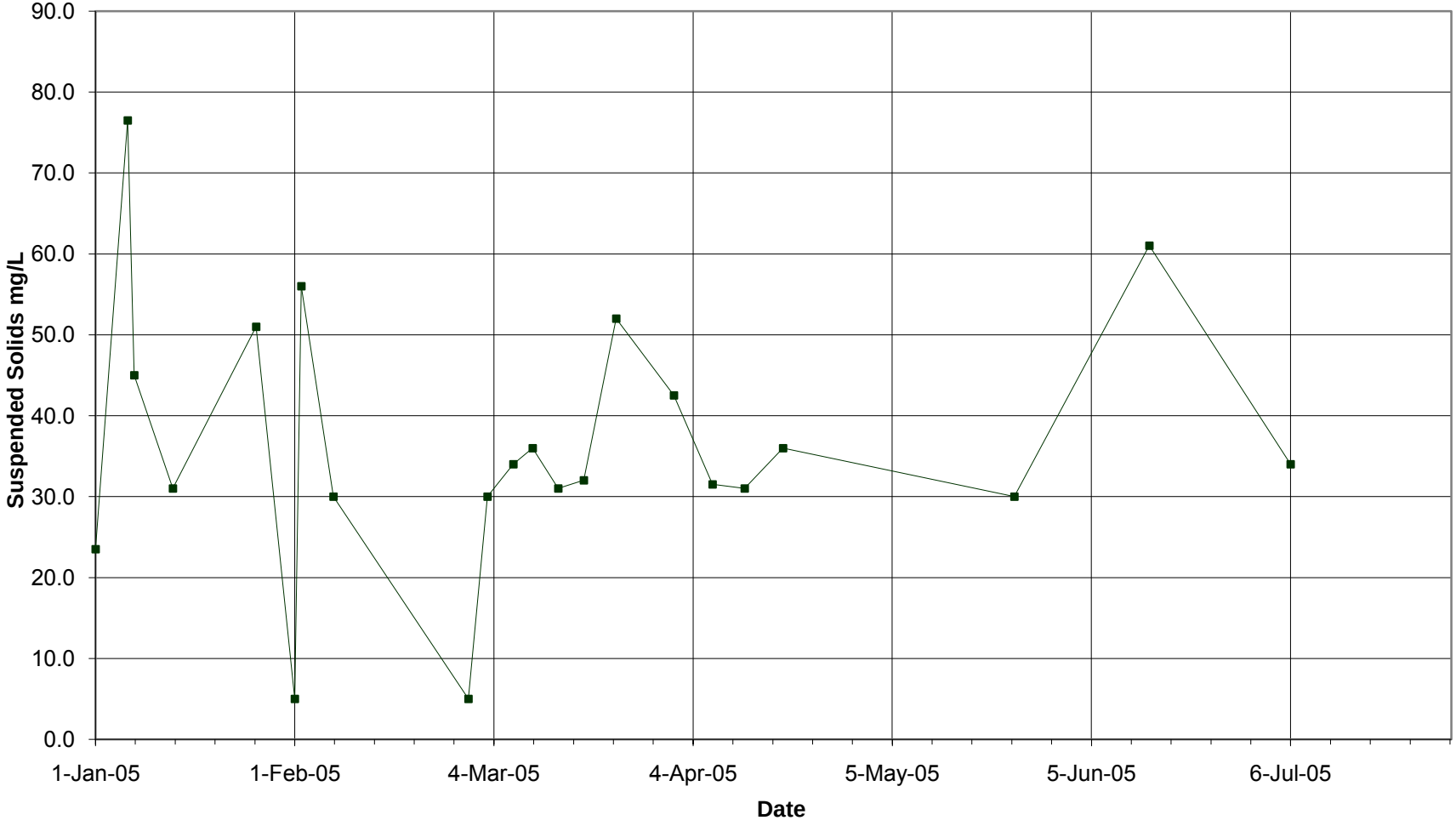


**Figure 8**
**City of Camas WWTP**
**Influent and Effluent pH**

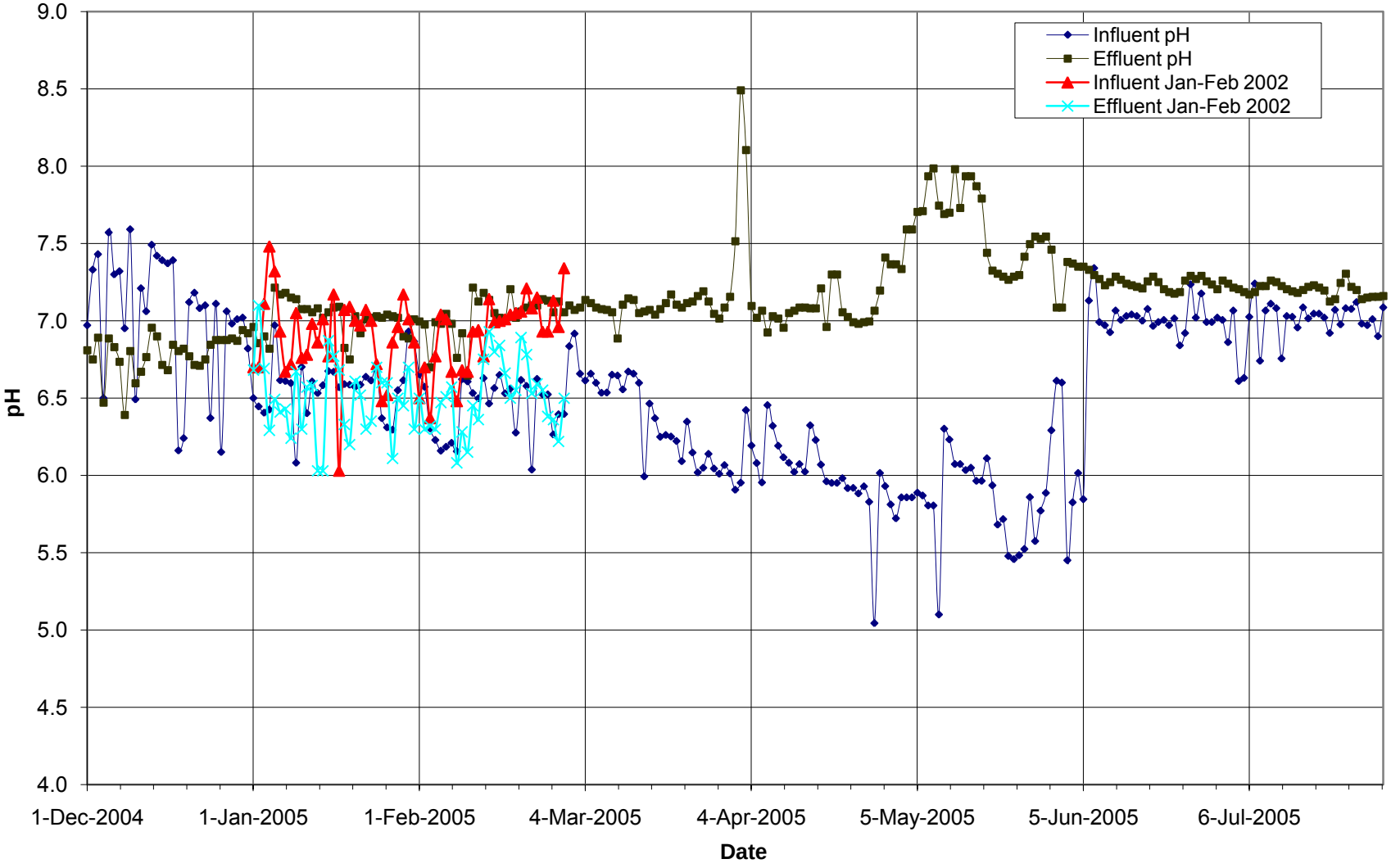


**Figure 9**
**City of Camas WWTP**
**Aeration Basin Alkalinity**

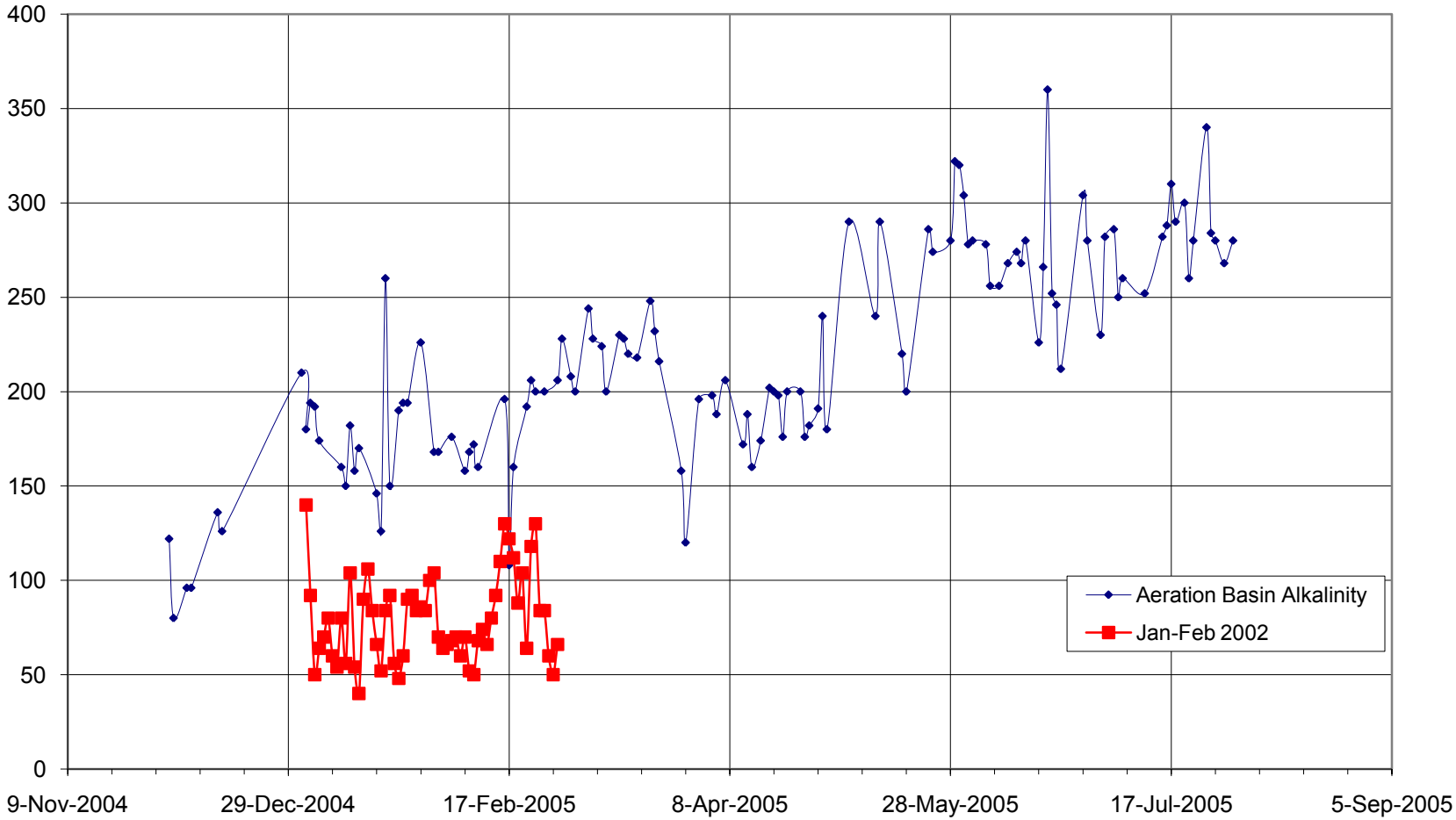
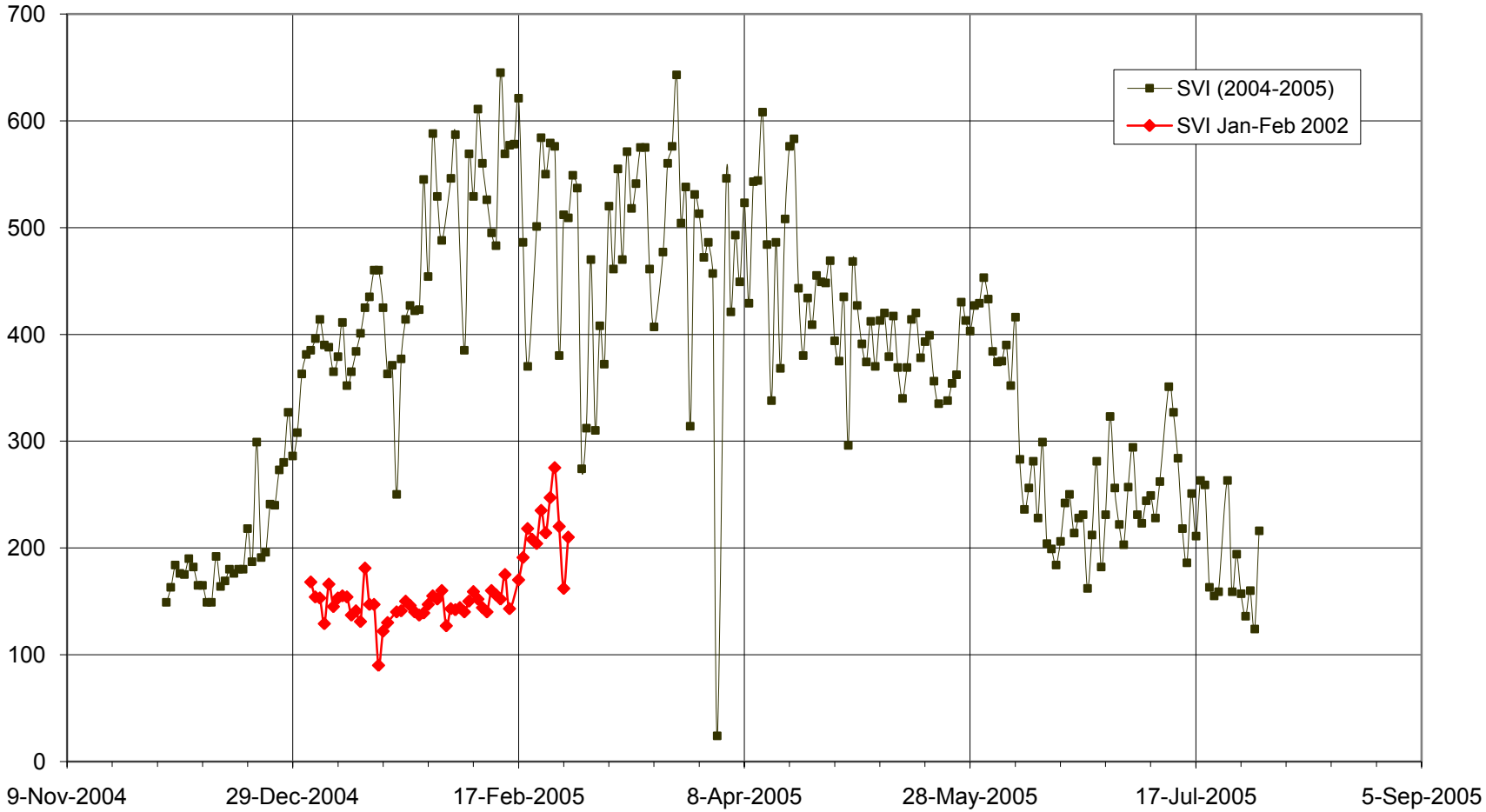


**Figure 10**
**Sludge Volume Index (SVI)**
**City of Camas WWTP**



# APPENDIX N

# EFFLUENT DYE STUDY AND MIXING ZONE EVALUATION

## City of Camas

# Final Dye Tracer and Mixing Zone Study

***Prepared for:***

Gray & Osborne, Inc.
701 Dexter Avenue North
Suite 200
Seattle, Washington 98109

***Prepared by:***

Cosmopolitan Engineering Group
117 South 8th Street
Tacoma, Washington 98402

December 2006
G&O016

# CERTIFICATE OF ENGINEER

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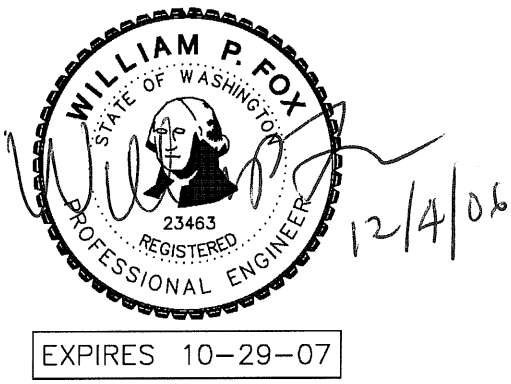


William P. Fox, P.E.
Cosmopolitan Engineering Group, Inc.

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# OVERVIEW

The purpose of this report is to present the results of the dye tracer studies for the City of Camas Wastewater Treatment Plant (WWTP) discharge to the Columbia River. The tracer studies and ancillary field measurements have been conducted to assess and calibrate the most appropriate mixing zone model to use for the City's NPDES permit and development of effluent limitations. This report of the methods and results of the field studies and model calibration is presented in three parts as follows:

## PART I

Dye tracer study No. 1 was completed on February 16, 2005. The February field study was selected to represent potential critical conditions for the winter season. Target conditions for the study included maximum potential plume buoyancy (largest difference between ambient river temperature and effluent temperature), relatively low river discharge, adverse tidal conditions (late flood tide) and high effluent flow. Tracer study results and model calibration parameters are presented in this section.

## PART II

Dye tracer study No. 2 was conducted on October 4, 2005. The October field study was selected to represent critical conditions for the late summer, early autumn season. Target conditions for the field study included annual low river discharge and adverse tidal conditions (late flood tide). Tracer study results and model calibration parameters from the second dye study are presented in this section.

## PART III

This section presents the model selection and calibration parameters that are recommended based on the results of the two dye tracer studies. The revised dilution modeling for the critical conditions established in the NPDES permit are presented in this section along with an assessment of the reasonable potential to exceed water quality standards.

## ECOLOGY COMMENTS AND RESPONSES

Ecology provided detailed comments to the January 2006 draft of this report in a letter dated May 5, 2006. This final report incorporates the revisions to the January 2006 report that resulted from the Ecology comments and Cosmopolitan's responses.

# PART I:
# DYE STUDY NO. 1

# PART I:
# DYE STUDY NO. 1

The outfall from the City of Camas WWTP is a 36-inch-diameter corrugated metal pipe (CMP) extending approximately 850 feet from the river bank to a depth of approximately 20 to 25 feet during normal river flows. The outfall terminates in a 150-foot diffuser section consisting of 16 6-inch-diameter ports. The ports extend vertically from the diffuser and include 90-degree bends pointing horizontally downstream. The first eight ports are currently capped off, and only the last eight are discharging effluent. Drawings of the outfall and diffuser are shown in Attachment I-1.

## WWTP DATA

### Dye Injection

Rhodamine WT dye was injected at a constant rate into the Camas WWTP effluent for approximately 4.4 hours on February 16, 2005. The liquid dye (23 percent solution) was injected at a rate of 27 mL/min. The dye solution was injected into the mixing vault at the outlet from the UV chamber. Effluent pumps and plant water recirculation pumps were shut down during the study.

### Effluent Monitoring

WWTP staff monitored effluent flow rate and temperature during the tracer study. They also collected effluent grab samples from the outfall manhole across the street from the WWTP. The grab samples were subsequently diluted by a factor of 100:1 in the Cosmopolitan laboratory and measured by the fluorometer. The results of the WWTP effluent monitoring are in Table I-1.

**Table III- 1 WWTP Effluent Monitoring During the Tracer Study**

| Date | Time | Effluent Flow (mgd) | Effluent Temp (C) | Tracer Conc (ppb) |
|---|---|---|---|---|
| 2/16/05 | 08:30 | 2.77 | 14.6 | 1,220 |
| 2/16/05 | 12:00 | 2.30 | 14.8 | 1,110 |
| 2/16/05 | 13:00 | 2.00 | 14.8 | 790 |
| 2/16/05 | 13:30 | 2.00 | 14.9 | 980 |
| | | | **AVERAGE** | 1,030 |

### Tracer Concentration

The tracer concentration data in Table I-1 are variable, suggesting that mixing in the outfall was incomplete during the estimated 2-minute travel time between the dye injection point and the effluent manhole. The actual mixed tracer concentration can be more reliably calculated from the known tracer concentration and injection rate. The dye pump was pre-calibrated to an injection rate of 27 mL/min, and at a calibrated concentration of 23 percent. The dye container was weighed before and after the dye injection, which confirmed the 27 mL/min injection rate.

15.5 lbs of 23 percent solution Rhodamine WT dye were discharged over a period of 263 minutes. The corresponding effluent flow during the tracer study field measurements averaged 2.15 mgd. Therefore, the average effluent tracer concentration during the study was the ratio of dye to effluent mass discharge, as shown below:

Tracer Mass Discharge = (0.23) (15.5) / (263) = 0.0135 lbs/min
Effluent Mass Discharge = (2,150,000) (8.34) / (1440) = 12,500 lbs/min
Effluent Tracer Conc = 0.00000108 = 1,080 ppb

## RIVER DATA

### River Discharge

River discharge data for the Bonneville Dam are available from the following website:

http://www.nwd-wc.usace.army.mil/perl/dataquery.pl?k=id:BON+record://BON/QR//IR-MONTH/HRXZZAZD/+psy:+psm:+psd:+pey:+pem:+ped:+pk:columbia+river+flow+bonneville

There is a time delay from variations in release at Bonneville to changes observed near Camas. The distance from Bonneville to the Camas WWTP is approximately 10.5 miles. The celerity of a gravity wave generated by an abrupt elevation change of one foot, similar to the flow increase on the morning of February 16, is as follows:

$$V = (2gh)^{1/2} = 8 \text{ ft/sec}$$

Therefore, abrupt changes in release at the Bonneville Dam takes approximately one to two hours to reach Camas.

### River Stage and Tidal Influence

River stage at Camas varies as a function of river discharge, and may be influenced by tides. It is known that tides influence river flow as far upstream as Vancouver, WA. However, no

predictions are provided by NOAA upstream of Vancouver. The tracer study was timed to occur during the period predicted to coincide with potential tidal slowing of the river current, which was high slack tide predicted at 12:30 PM in Vancouver.

Bonneville discharge data and predicted tides at Vancouver are plotted in Figure I-1. The duration of the effluent tracer field measurements is also shown as a yellow bar in the figure. The tracer measurements occurred during predicted slack tide at a time when river discharge was in the range of 155 to 160 kcfs.

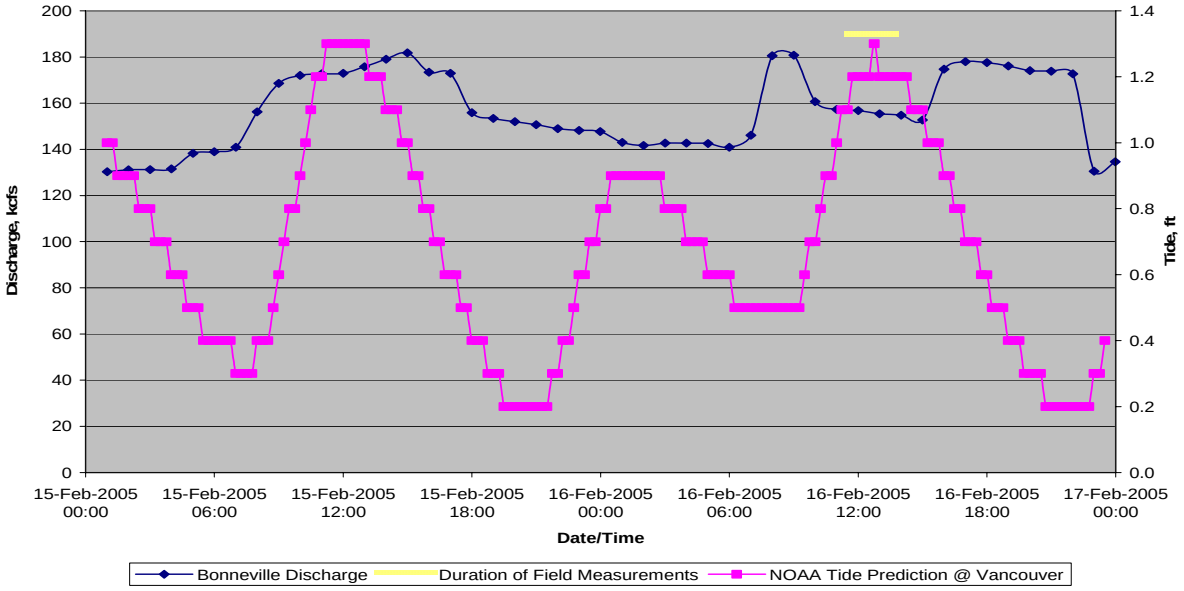



**Figure I-1. Bonneville Dam Discharge Data**

## River Velocity Measurements

Velocity measurements were obtained several times during and prior to the tracer study. These data are listed in Table I-2 with river stage data that were observed at the Port of Washougal. The results lead to no conclusions about tidal influence. The increase in river stage from morning to midday on February 16 could have been caused by either the tide or the unsteady flow caused by the release at Bonneville Dam earlier in the morning. The fact that current velocity rose slightly would suggest that the stage increase was produced by the Bonneville Dam release rather than tidal influence.

**Table I-2 River Stage and Velocity Data During the Tracer Study**

| Date | Time | River Stage (ft) | Current Speed (fps) |
|---|---|---|---|
| 2/15/05 | 13:50 | 4.5 | 1.65 |
| 2/15/05 | 15:50 | 4.5 | 1.65 |
| 2/16/05 | 07:15 | 3.0 | 1.40 |
| 2/16/05 | 11:00 | 3.8 | 1.54 |
| 2/16/05 | 13:00 | 3.9 | 1.54 |

### CTD Profiles

Conductivity, temperature, and depth profiles were measured three times during the tracer study. The results are presented in Table I-3. Temperature and salinity profiles conclusively show that the receiving water is well mixed, or unstratified.

**Table I-3 CTD Profiles During the Tracer Study**

| Depth (m) | 08:34 2/16/05 | | 13:00 2/16/05 | | 14:32 2/16/05 | |
|---|---|---|---|---|---|---|
| | Sal (ppt) | Temp (C) | Sal (ppt) | Temp (C) | Sal (ppt) | Temp (C) |
| 1 | 0.077 | 4.16 | 0.077 | 4.26 | 0.077 | 4.34 |
| 2 | 0.077 | 4.17 | 0.078 | 4.26 | 0.078 | 4.34 |
| 3 | 0.077 | 4.17 | 0.078 | 4.27 | 0.078 | 4.34 |
| 4 | 0.077 | 4.17 | 0.079 | 4.27 | 0.078 | 4.35 |
| 5 | 0.077 | 4.16 | 0.079 | 4.28 | 0.078 | 4.35 |
| 6 | 0.077 | 4.16 | 0.079 | 4.28 | 0.078 | 4.35 |

## TRACER STUDY RESULTS

### Overview

Dye injection began at 8:28 on February 16. The fluorometer was placed in the water and towed across the mixing zone boundary 320 feet downstream of the diffuser. The dye plume was quickly found and the research vessel was moored approximately 310 feet downstream. The mooring consisted of an anchor set approximately 50 feet upstream of the diffuser, with a 360-ft anchor line. Traverses across the downstream mixing zone boundary were conducted by swinging in an arc pattern from the main mooring. Lateral anchors were set to aid in cross-channel positioning along the downstream mixing zone boundary.

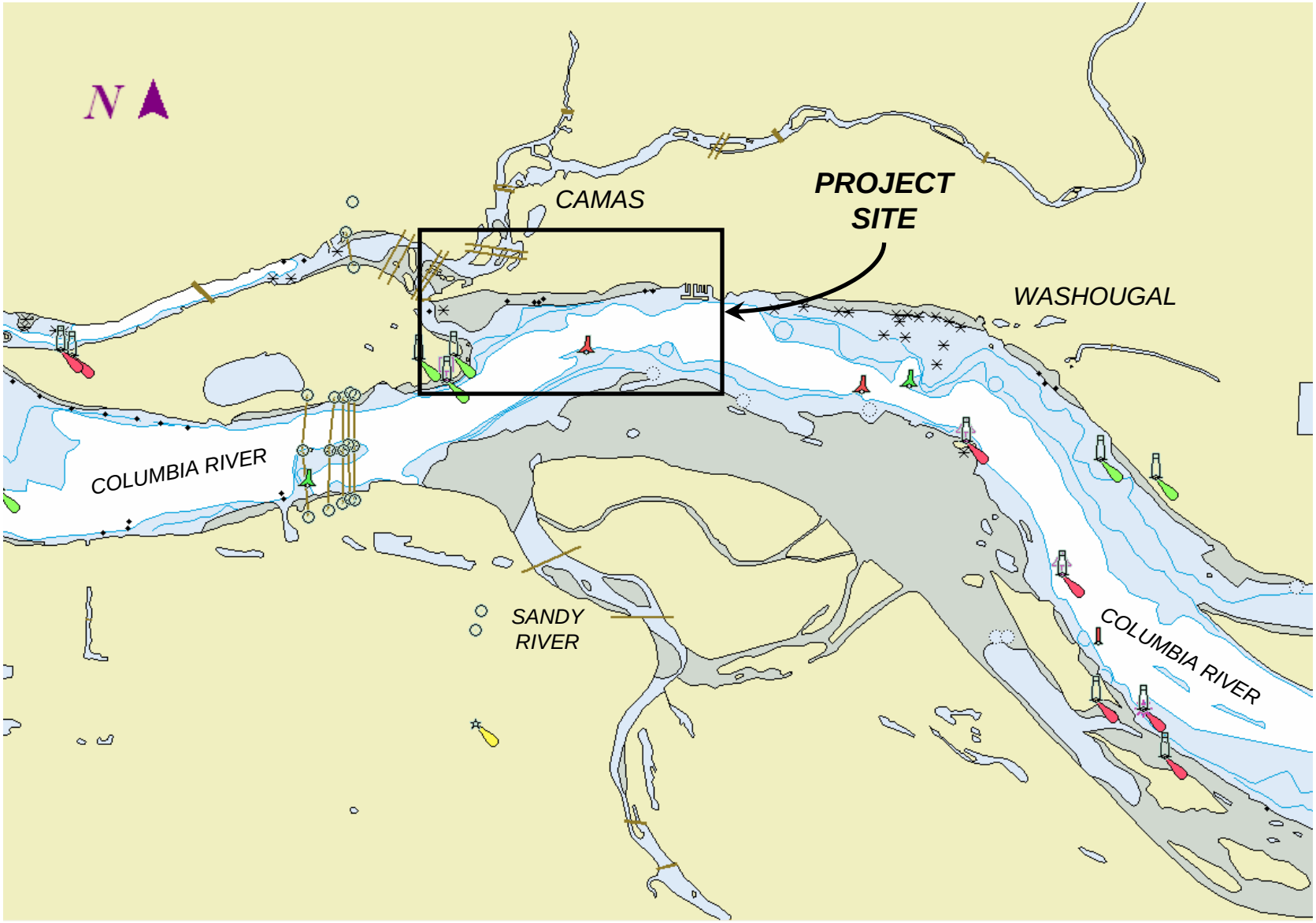
The general configuration of the diffuser, mixing zone boundary, mooring system and cross-channel stationing are illustrated in Figures I-2 through I-4. The river is conveniently oriented east-west, so the vessel's cross-channel positions along the downstream mixing zone boundary were recorded by the latitude reading from a dGPS system. The vessel's cross-channel positioning data were post-processed into a stationing system corresponding to the stationing on the 1971 outfall drawing (sheet 42). That is, the diffuser terminus is at station 12+40 on the drawing. In our reporting of dye study results, our station 12+40 is approximately 310 feet directly downstream of the diffuser terminus. The plume centerline is at approximately station 12+05 or latitude 45° 34.529', corresponding to the midpoint of the diffuser.

Shortly after the mooring system was completed, communications between the SCUFA fluorometer and on-board computer failed. The dye injection was shut off at 9:53. We returned to the Washougal marina and picked up a replacement laptop computer provided the WWTP operators. SCUFA communications were reestablished and the dye injection was restarted at 10:55 and continued through 13:53.

Comprehensive plume tracer concentration data were obtained at the mixing zone boundary between 11:23 and 13:40 on February 16, 2005. Measurements consisted of (1) vertical profiles measured at a fixed location, (2) horizontal transects measured from one edge of the mixing zone to the other at fixed depths, and (3) a final "sawtooth" pattern measured near the centerline of the plume and across depths of maximum plume concentration. The schedule of plume tracer measurements is provided in Table I-4.

**Table I-4 Schedule of Plume Tracer Concentration Measurements**

| Date | Time | Type |
|---|---|---|
| 2/16/05 | 11:23 – 11:27 | Profile #1 at station 11+80 |
| 2/16/05 | 11:50 – 11:59 | Profile #2 at station 12+20 |
| 2/16/05 | 12:10 – 12:17 | Transect #1 4 ft above bottom |
| 2/16/05 | 12:35 – 12:42 | Transect #2 8 ft above bottom |
| 2/16/05 | 12:49 – 13:03 | Profile #3 at station 12+05 |
| 2/16/05 | 13:32 – 13:41 | Sawtooth pattern |




FILE: G&O016/REPORTS/DYE TRACER & MIXING ZONE STUDY/FIG 2-3-4-5-6-7-15.PPT

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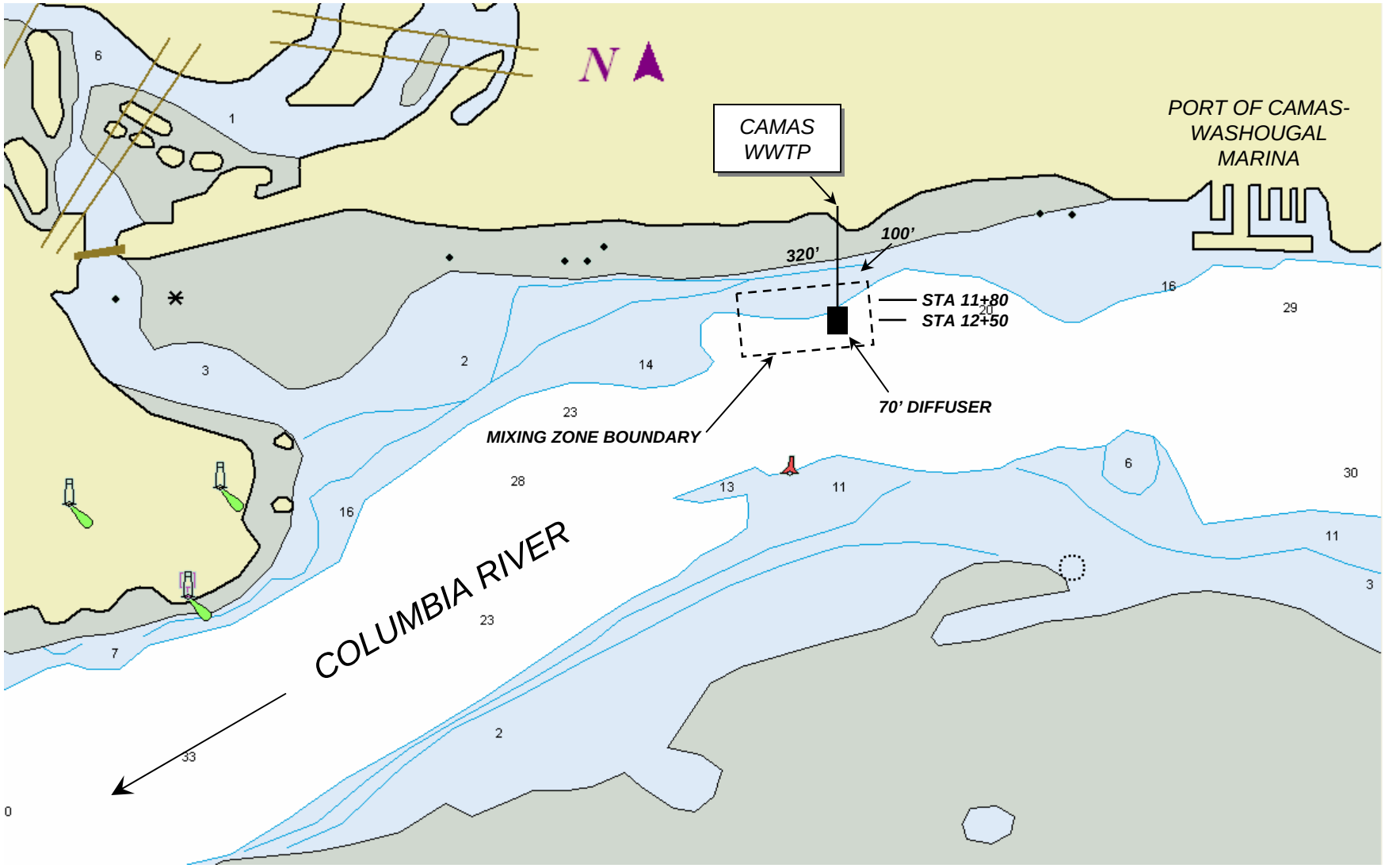
***NO SCALE***

**Figure I-2: PROJECT VICINITY MAP**




FILE: G&O016/REPORTS/DYE TRACER & MIXING ZONE STUDY/FIG 2-3-4-5-6-7-15.PPT

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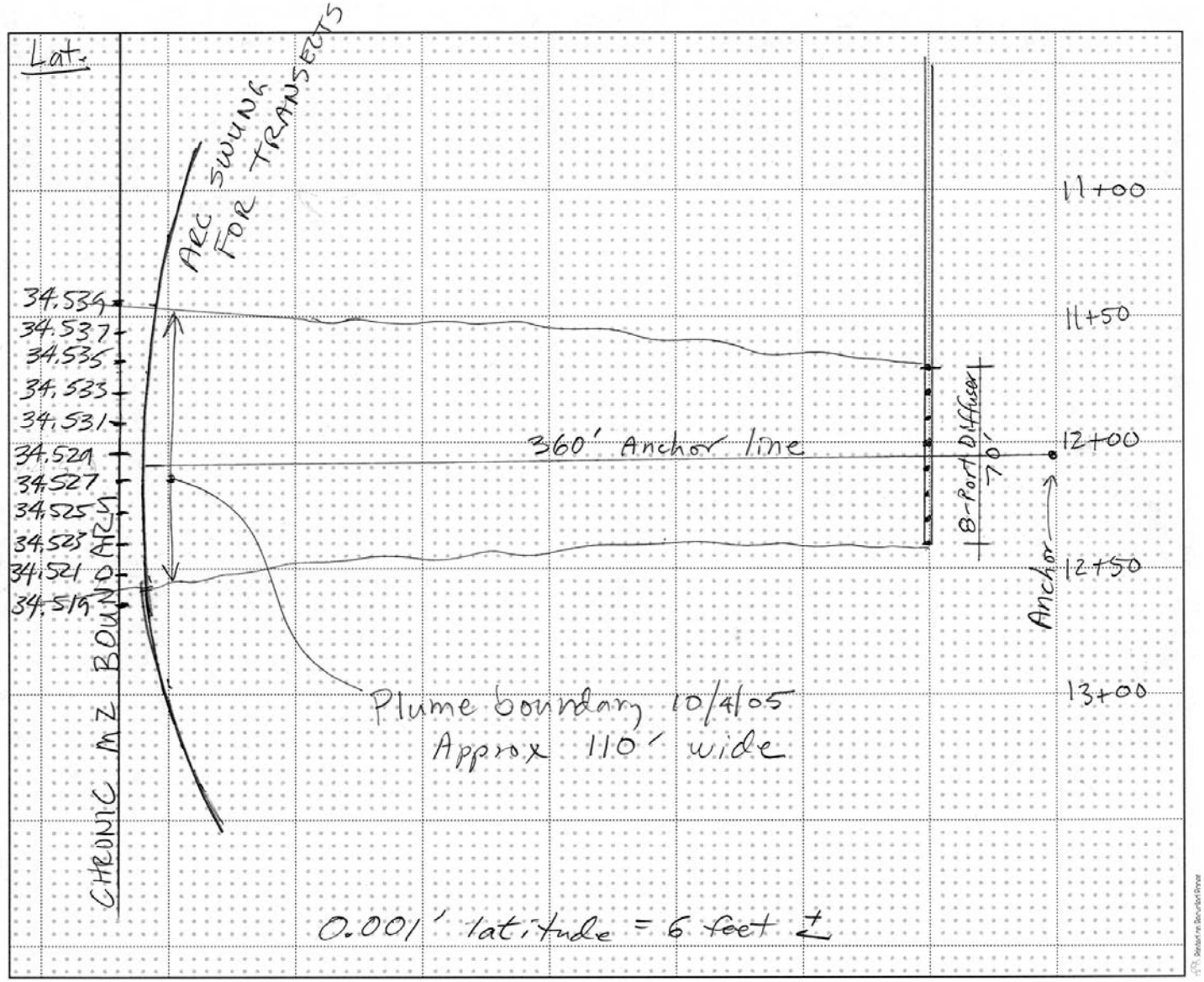
**NO SCALE**

**Figure I-3: TRACER STUDY SITE MAP**




FILE: G&O016/REPORTS/DYE TRACER & MIXING ZONE STUDY/FIG 2-3-4-5-6-7-15.PPT

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***NO SCALE***

**Figure I-4: MIXING ZONE TRANSECTS**

## Tabular Results

Effluent tracer concentration data are tabulated and are provided in Attachment I-1. The information on each table includes the date and time of measurement, fluorescence (i.e., the tracer concentration), turbidity (uncalibrated), height of the fluorometer above the river bottom, cross-channel stationing, effluent volume fraction, and dilution. Effluent volume fraction is the proportion of the measured parcel of ambient water consisting of effluent. For example, 0.3% effluent fraction would consist of 3 parts effluent to 997 parts ambient water. Dilution factor is merely the inverse of effluent volume fraction. Only dilution factors less than 1,000:1 are recorded in the tables.

## Graphical Results

The tracer concentration measurements are shown graphically for each set of measurements in Figures I-5 through I-10. The data shown are effluent volume fraction. The two principal observations from these graphs are (1) the depth of maximum effluent concentration is about 4 feet above the river bottom, and (2) the concentrations are relatively uniform across the width of the diffuser, with the maximum concentration occurring near the midpoint or a bit shoreward of that point.

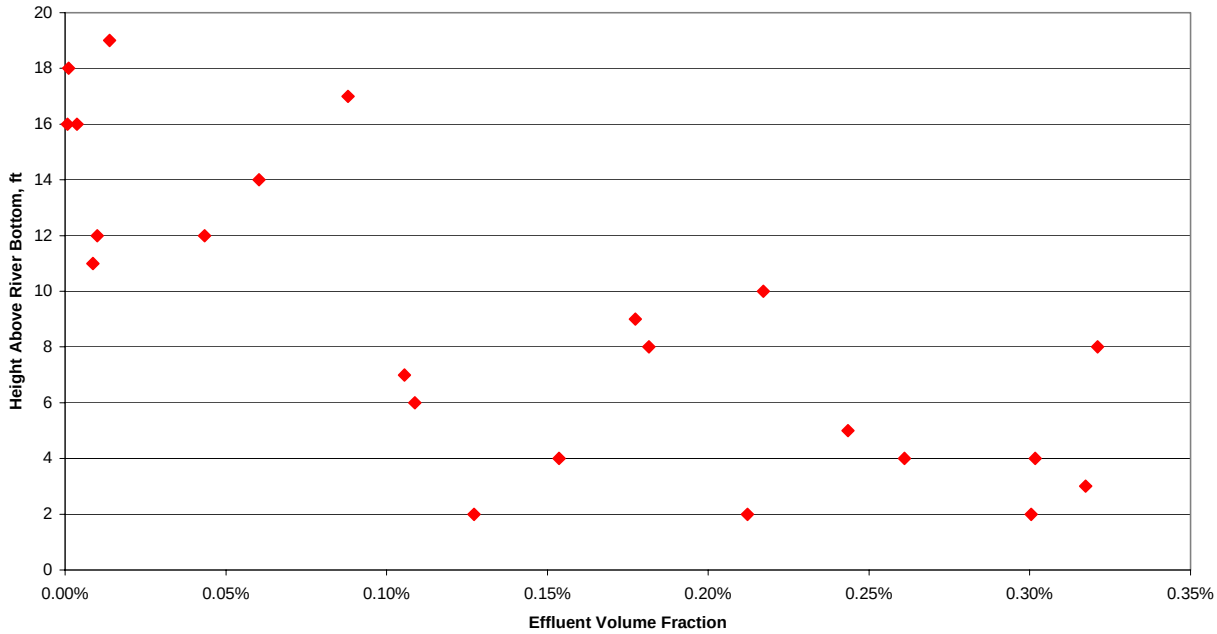



**Figure I-5. Profile #1 – Station 11+80**

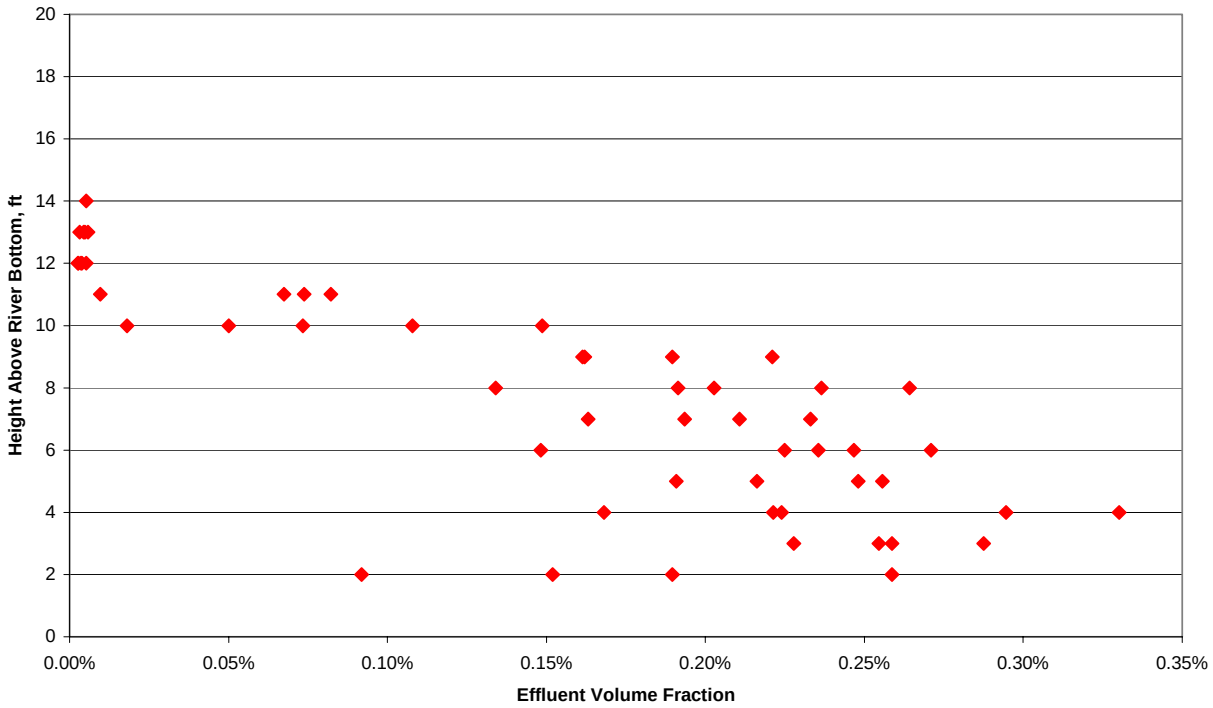



**Figure I-6. Profile #2 – Station 12+20**

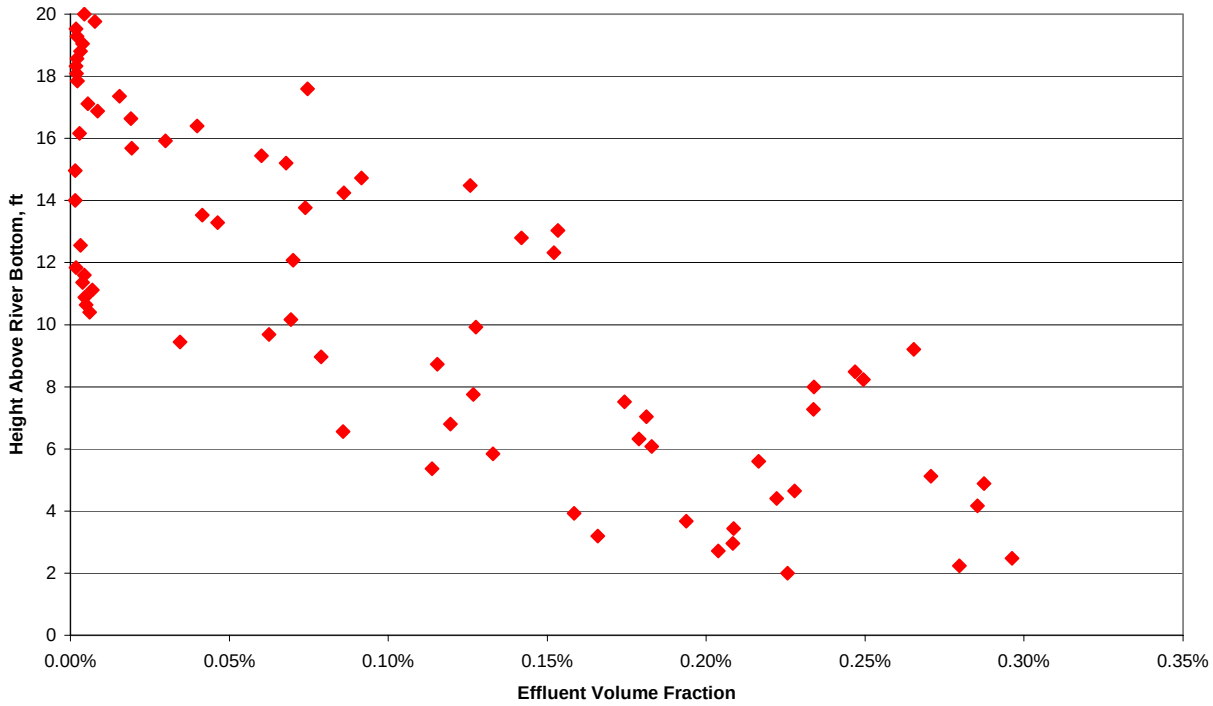



**Figure I-7. Profile #3 – Station 12+05**

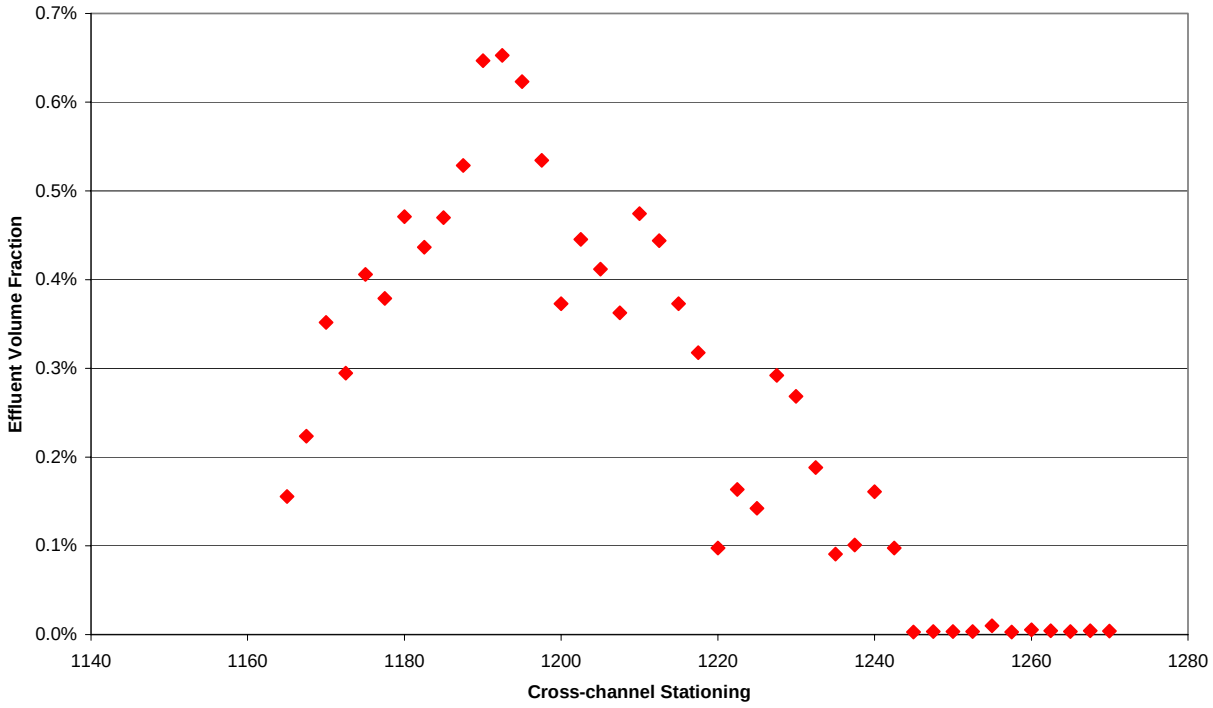



**Figure I-8. Transect #1 – 4 ft above bottom**

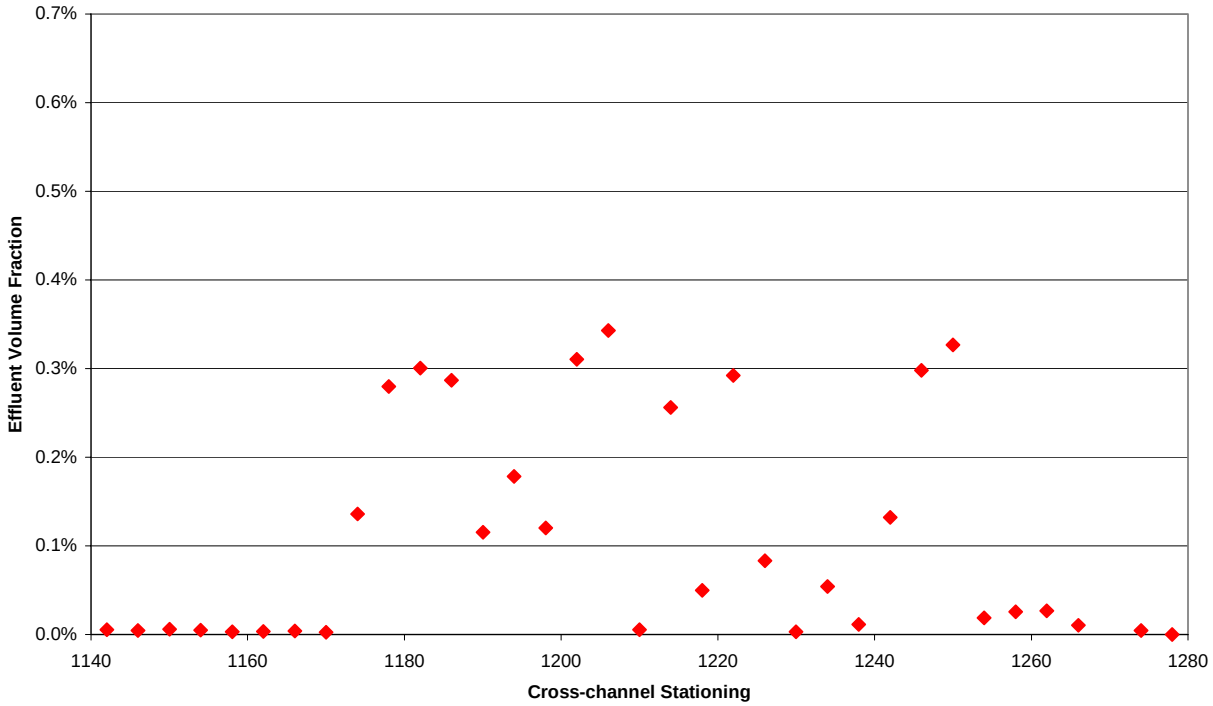



**Figure I-9. Transect #2 – 8 ft above bottom**

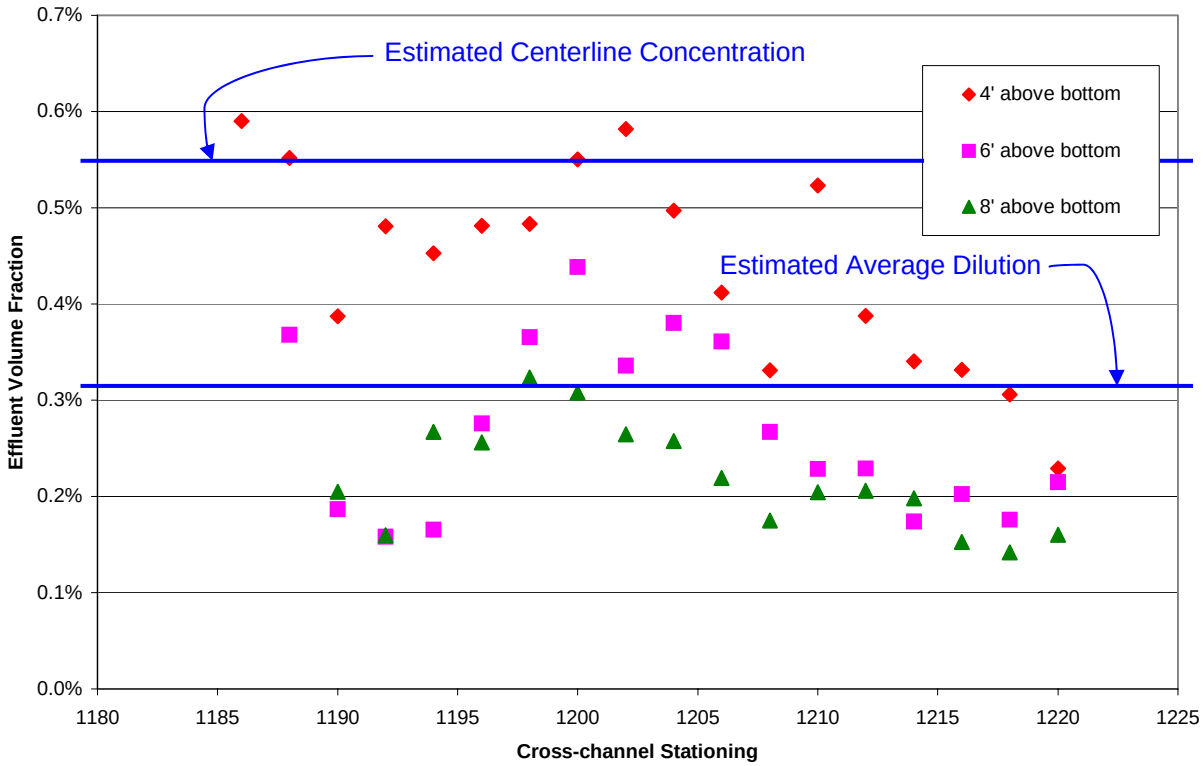



**Figure I-10. Sawtooth #1 – near plume midpoint**

### Observed Dilution Factors

Figures I-5 through I-9 depict effluent concentration sections through the effluent plume, both vertically and horizontally. Figure I-10 provides the best composite depiction of effluent concentrations in the plume, and is consistent with the earlier figures. The average effluent concentration from these data is 0.31% (dilution factor = 320). The 95$^{th}$ percentile effluent concentration is 0.55% (dilution factor = 180). These figures will be used to represent flux-average and centerline plume concentrations, respectively, in the comparison and calibration of dilution models, which follows.

## MODEL COMPARISONS

Model runs were made using CORMIX2, UM3 and DKHW for the effluent and ambient conditions measured during the tracer study. The results are provided in Table I-5. The results reveal that CORMIX2 overestimates dilution at the mixing zone boundary, and UM3 underestimates dilution factor. DKHW failed to produce reasonable results and will not be repeated unless the error is discovered.

**Table I-5 Summary of Dilution Model Results**

| Model Run | Flux-average Dilution | Centerline Dilution |
|---|---|---|
| CORMIX2 | 890 | N/A |
| UM3[(1)] | 97 | 25 |
| DKHW | 10,200 | N/A |
| UM3[(2)] | 277 | 71 |
| Observed (approx) | 320 | 180 |

(1) Using default aspiration entrainment coefficient = 0.1
(2) Using alternative aspiration entrainment coefficient = 1.3

The UM3 model significantly underestimates both flux-average and centerline dilution factors compared to observed data. The principal calibration parameter to adjust model predictions to observed data is the Aspiration Entrainment Coefficient (AEC). Additional UM3 model runs were made, adjusting the AEC from 0.1 to 2.0. The resulting dilution prediction at an AEC of 1.3 approaches the observed dilution values, suggesting that UM3 may be suitable for this project if properly calibrated.

Model output for the UM3 and DKHW runs, which use the Visual Plumes interface, are provided in Attachment I-2.

## CONCLUSIONS AND RECOMMENDATIONS

The dye study was successful at measuring dilution factors at the downstream mixing zone boundary. The observed dilution factors were approximately 320:1 for flux-average, and 180:1 for centerline. Neither CORMIX2, UM3 nor DKHW adequately simulate these dye study results. I expect that we will be able to calibrate UM3 using alternative aspiration entrainment coefficients or dispersion coefficients within the model.

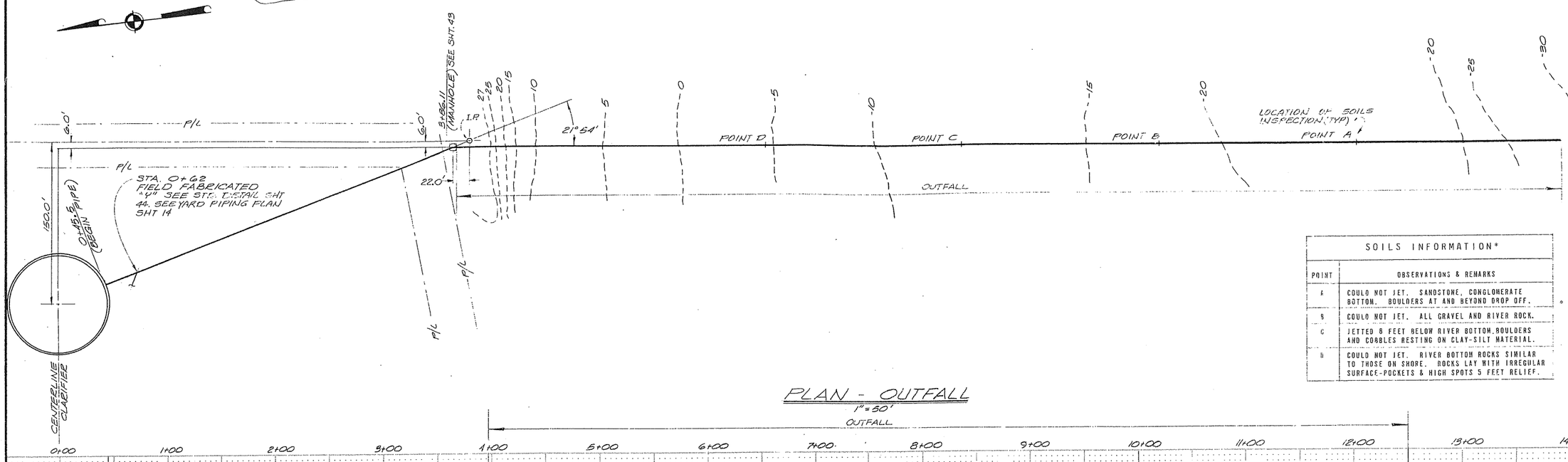
We recommend proceeding with the second dye study as planned for late summer or early autumn 2005. This next period will be more critical in terms of ambient current conditions, and will be designed to calibrate the UM3 model calibration.

In the February field studies, we were not able to precisely measure ambient current profiles or discern tidal effects (which was one of our project goals). We recommend that the second dye study include an ADCP current meter mooring upstream of the diffuser in order to provide precise current speed and water elevation data concurrent with the dye measurements. We will also modify the timing of the field measurements to better correspond to diurnal periods of reduced discharge from the Bonneville Dam.

After the final dye study and model calibration, we recommend analyzing diffuser modifications including opening of the eight nearshore ports and orienting the ports to discharge vertically, which would expose the diffuser jet to a current cross-flow.

# ATTACHMENT I-1:
# OUTFALL AND DIFFUSER DRAWINGS

BRG 353



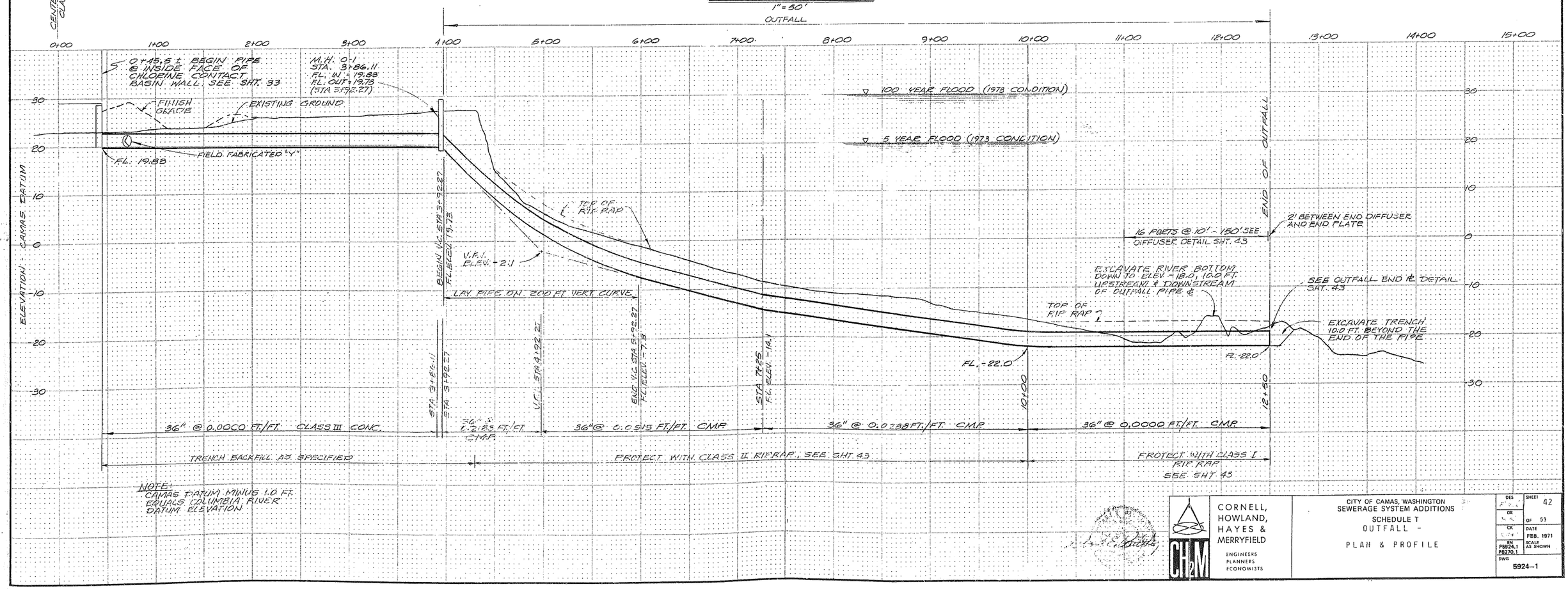

| SOILS INFORMATION* | |
|---|---|
| POINT | OBSERVATIONS & REMARKS |
| A | COULD NOT JET. SANDSTONE, CONGLOMERATE BOTTOM. BOULDERS AT AND BEYOND DROP OFF. |
| B | COULD NOT JET. ALL GRAVEL AND RIVER ROCK. |
| C | JETTED 6 FEET BELOW RIVER BOTTOM. BOULDERS AND COBBLES RESTING ON CLAY-SILT MATERIAL. |
| D | COULD NOT JET. RIVER BOTTOM ROCKS SIMILAR TO THOSE ON SHORE. ROCKS LAY WITH IRREGULAR SURFACE-POCKETS & HIGH SPOTS 5 FEET RELIEF. |

* NOTES: 1.. SOILS INFORMATION WAS OBTAINED FROM A DIVER, WHO INSPECTED THE RIVER BOTTOM ON 29 DEC. 1970. A 1½" JET PIPE WAS USED BY THE DIVER TO JET HOLES INTO RIVER BED.

2.. SEE NOTE UNDER TEST LOGS SHEET 6

## PLAN - OUTFALL

1" = 50'

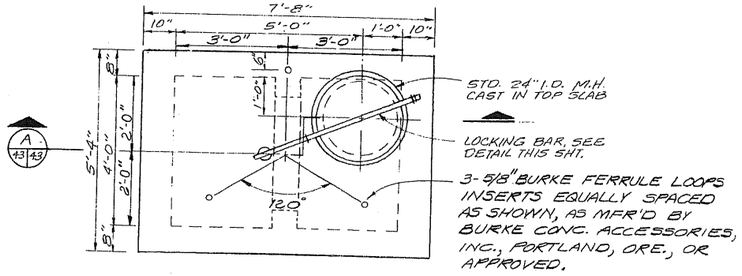



NOTE:
CAMAS DATUM MINUS 1.0 FT. EQUALS COLUMBIA RIVER DATUM ELEVATION

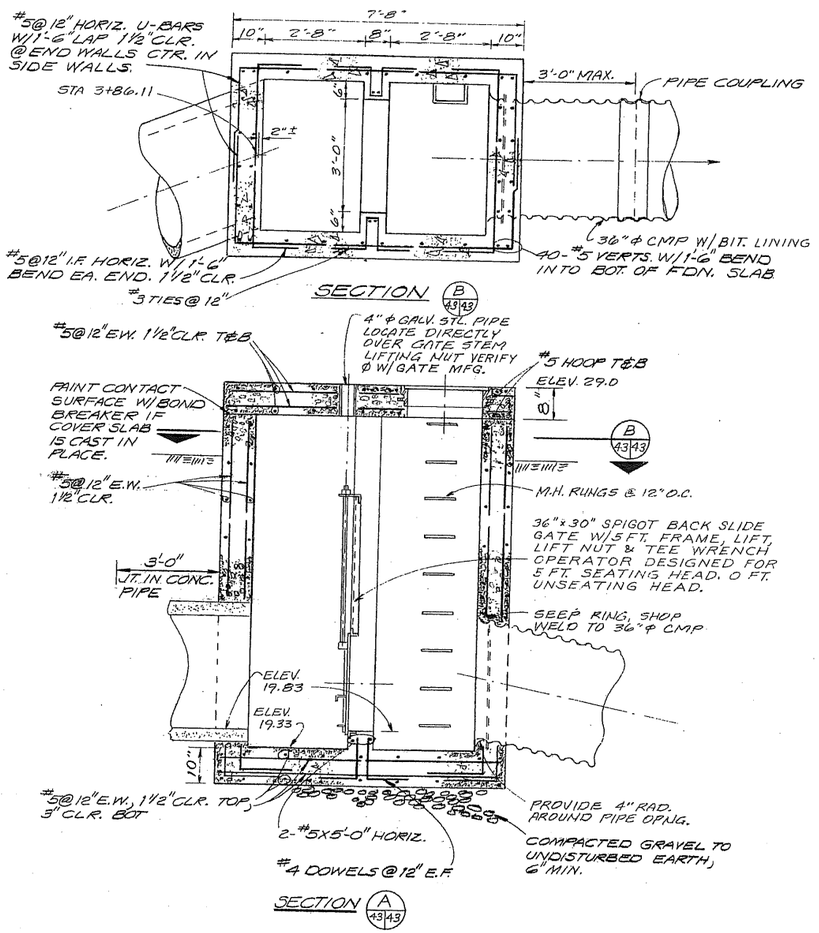
CORNELL, HOWLAND, HAYES & MERRYFIELD
ENGINEERS PLANNERS ECONOMISTS

CITY OF CAMAS, WASHINGTON
SEWERAGE SYSTEM ADDITIONS
SCHEDULE T
OUTFALL -
PLAN & PROFILE

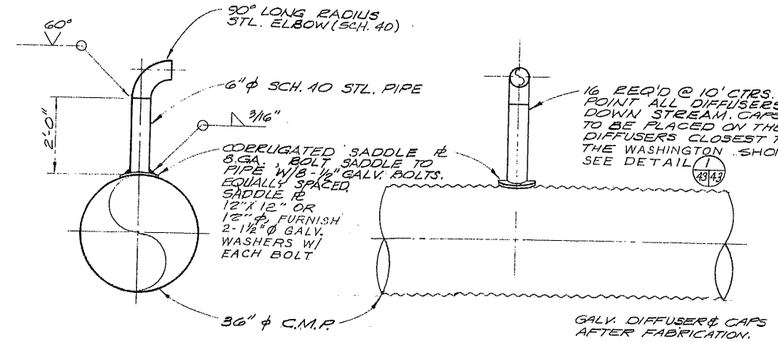
| | |
|---|---|
| DES | SHEET 42 |
| DR | OF 53 |
| CK | DATE FEB. 1971 |
| BN P5924.1 P8270.1 | SCALE AS SHOWN |
| DWG | 5924-1 |



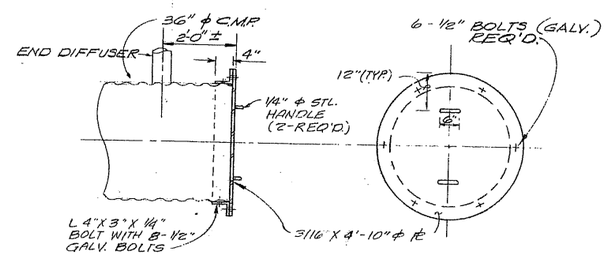

PLAN



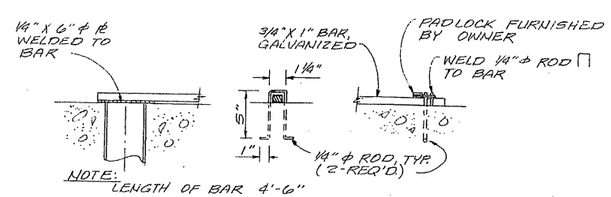

OUTFALL MANHOLE O-1
1/2" = 1'-0"



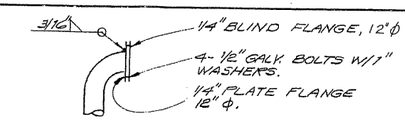

DETAIL OF DIFFUSER
1/2" = 1'-0"



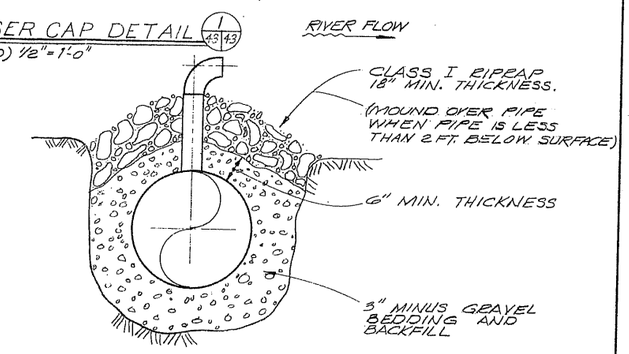

OUTFALL END ℄ DETAIL
1/2" = 1'-0"



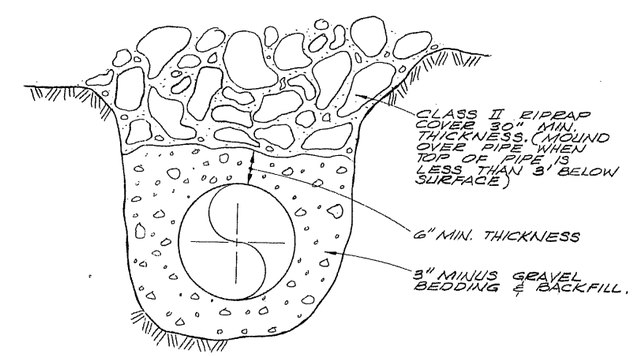

LOCKING BAR DETAIL
1 1/2" = 1'-0"




DIFFUSER CAP DETAIL 1 43 43
(8 REQ'D) 1/2" = 1'-0"




TYPICAL BACKFILL
STA. 10+00 TO 12+50
1/2" = 1'-0"




TYPICAL BACKFILL
STA. 4+30 TO 10+00
1/2" = 1'-0"

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SCHEDULE T

OUTFALL - DETAILS

| | |
|---|---|
| DES RWL | SHEET 43 |
| DR RJK | OF 53 |
| CK RSR | DATE FEB. 1971 |
| BN P5974.1 P6270.1 | SCALE AS SHOWN |
| DWG C 5924-1 | |

# ATTACHMENT I-2:
# TABULAR PLUME DATA FOR DYE STUDY NO. 1

**Effluent Concentration =** **1080 ppb**
**Background Concentration =** **1.1 ppb**

| **Profile 1** | **Station 11+80** | | | | | | **Effluent** | |
|---|---|---|---|---|---|---|---|---|
| **Entry #** | **Date** | **Time** | **Fluor** | **Turb** | **Height** | **Station** | **Fraction** | **Dilution** |
| 1 | 2005:02:16 | 11:22:50 | 2.474 | 1.389 | 2 | 1180 | 0.13% | 786 |
| 2 | 2005:02:16 | 11:23:01 | 4.528 | 1.283 | 3 | 1180 | 0.32% | 315 |
| 3 | 2005:02:16 | 11:23:11 | 2.759 | 1.284 | 4 | 1180 | 0.15% | 651 |
| 4 | 2005:02:16 | 11:23:21 | 3.73 | 1.287 | 5 | 1180 | 0.24% | 411 |
| 5 | 2005:02:16 | 11:23:31 | 2.274 | 1.303 | 6 | 1180 | 0.11% | 920 |
| 6 | 2005:02:16 | 11:23:41 | 2.24 | 1.313 | 7 | 1180 | 0.11% | 947 |
| 7 | 2005:02:16 | 11:23:51 | 3.061 | 1.327 | 8 | 1180 | 0.18% | 551 |
| 8 | 2005:02:16 | 11:24:01 | 3.015 | 1.289 | 9 | 1180 | 0.18% | 564 |
| 9 | 2005:02:16 | 11:24:11 | 3.445 | 1.254 | 10 | 1180 | 0.22% | 461 |
| 10 | 2005:02:16 | 11:24:21 | 1.194 | 1.293 | 11 | 1180 | 0.01% | |
| 11 | 2005:02:16 | 11:24:31 | 1.208 | 1.286 | 12 | 1180 | 0.01% | |
| 12 | 2005:02:16 | 11:24:41 | 1.096 | 1.285 | 13 | 1180 | 0.00% | |
| 13 | 2005:02:16 | 11:24:51 | 1.752 | 1.298 | 14 | 1180 | 0.06% | |
| 14 | 2005:02:16 | 11:25:01 | 1.087 | 1.245 | 15 | 1180 | 0.00% | |
| 15 | 2005:02:16 | 11:25:11 | 1.14 | 1.228 | 16 | 1180 | 0.00% | |
| 16 | 2005:02:16 | 11:25:21 | 2.051 | 1.268 | 17 | 1180 | 0.09% | |
| 17 | 2005:02:16 | 11:25:31 | 1.112 | 1.275 | 18 | 1180 | 0.00% | |
| 18 | 2005:02:16 | 11:25:41 | 1.25 | 1.35 | 19 | 1180 | 0.01% | |
| 19 | 2005:02:16 | 11:25:51 | 1.099 | 1.244 | 20 | 1180 | 0.00% | |
| 20 | 2005:02:16 | 11:26:01 | 1.108 | 1.28 | 16 | 1180 | 0.00% | |
| 21 | 2005:02:16 | 11:26:11 | 1.569 | 1.256 | 12 | 1180 | 0.04% | |
| 22 | 2005:02:16 | 11:26:21 | 4.568 | 1.29 | 8 | 1180 | 0.32% | 311 |
| 23 | 2005:02:16 | 11:26:31 | 3.919 | 1.371 | 4 | 1180 | 0.26% | 383 |
| 24 | 2005:02:16 | 11:26:40 | 4.345 | 1.39 | 2 | 1180 | 0.30% | 333 |
| 25 | 2005:02:16 | 11:27:00 | 3.392 | 1.278 | 2 | 1180 | 0.21% | 471 |
| 26 | 2005:02:16 | 11:27:10 | 4.358 | 1.274 | 4 | 1180 | 0.30% | 331 |

| **Profile 2** | **Station 12+20** | | | | | | **Effluent** | |
|---|---|---|---|---|---|---|---|---|
| **Entry #** | **Date** | **Time** | **Fluor** | **Turb** | **Height** | **Station** | **Fraction** | **Dilution** |
| 27 | 2005:02:16 | 11:50:13 | 2.741 | 1.224 | 2 | 1220 | 0.15% | 658 |
| 28 | 2005:02:16 | 11:50:23 | 3.148 | 1.27 | 2 | 1220 | 0.19% | 527 |
| 29 | 2005:02:16 | 11:50:33 | 2.092 | 1.301 | 2 | 1220 | 0.09% | |
| 30 | 2005:02:16 | 11:50:43 | 3.894 | 1.265 | 2 | 1220 | 0.26% | 387 |
| 31 | 2005:02:16 | 11:50:53 | 3.85 | 1.345 | 3 | 1220 | 0.25% | 393 |
| 32 | 2005:02:16 | 11:51:03 | 4.205 | 1.269 | 3 | 1220 | 0.29% | 348 |
| 33 | 2005:02:16 | 11:51:13 | 3.894 | 1.244 | 3 | 1220 | 0.26% | 387 |
| 34 | 2005:02:16 | 11:51:23 | 3.56 | 1.353 | 3 | 1220 | 0.23% | 439 |
| 35 | 2005:02:16 | 11:51:33 | 2.916 | 1.32 | 4 | 1220 | 0.17% | 595 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 36 | 2005:02:16 | 11:51:43 | 3.491 | 1.318 | 4 | 1220 | 0.22% | 452 |
| 37 | 2005:02:16 | 11:51:53 | 3.518 | 1.273 | 4 | 1220 | 0.22% | 447 |
| 38 | 2005:02:16 | 11:52:03 | 4.281 | 1.281 | 4 | 1220 | 0.29% | 340 |
| 39 | 2005:02:16 | 11:52:13 | 4.666 | 1.274 | 4 | 1220 | 0.33% | 303 |
| 40 | 2005:02:16 | 11:52:23 | 3.862 | 1.343 | 5 | 1220 | 0.26% | 391 |
| 41 | 2005:02:16 | 11:52:33 | 3.435 | 1.304 | 5 | 1220 | 0.22% | 463 |
| 42 | 2005:02:16 | 11:52:43 | 3.162 | 1.378 | 5 | 1220 | 0.19% | 524 |
| 43 | 2005:02:16 | 11:52:53 | 3.78 | 1.299 | 5 | 1220 | 0.25% | 403 |
| 44 | 2005:02:16 | 11:53:03 | 4.027 | 1.256 | 6 | 1220 | 0.27% | 369 |
| 45 | 2005:02:16 | 11:53:13 | 3.644 | 1.305 | 6 | 1220 | 0.24% | 425 |
| 46 | 2005:02:16 | 11:53:23 | 2.701 | 1.307 | 6 | 1220 | 0.15% | 675 |
| 47 | 2005:02:16 | 11:53:33 | 3.529 | 1.308 | 6 | 1220 | 0.22% | 445 |
| 48 | 2005:02:16 | 11:53:43 | 3.765 | 1.303 | 6 | 1220 | 0.25% | 405 |
| 49 | 2005:02:16 | 11:53:53 | 3.617 | 1.304 | 7 | 1220 | 0.23% | 429 |
| 50 | 2005:02:16 | 11:54:03 | 3.19 | 1.378 | 7 | 1220 | 0.19% | 517 |
| 51 | 2005:02:16 | 11:54:13 | 3.376 | 1.234 | 7 | 1220 | 0.21% | 475 |
| 52 | 2005:02:16 | 11:54:23 | 2.862 | 1.256 | 7 | 1220 | 0.16% | 613 |
| 53 | 2005:02:16 | 11:54:33 | 2.548 | 1.247 | 8 | 1220 | 0.13% | 746 |
| 54 | 2005:02:16 | 11:54:43 | 3.167 | 1.28 | 8 | 1220 | 0.19% | 522 |
| 55 | 2005:02:16 | 11:54:53 | 3.954 | 1.217 | 8 | 1220 | 0.26% | 378 |
| 56 | 2005:02:16 | 11:55:03 | 3.654 | 1.263 | 8 | 1220 | 0.24% | 423 |
| 57 | 2005:02:16 | 11:55:13 | 3.289 | 1.238 | 8 | 1220 | 0.20% | 493 |
| 58 | 2005:02:16 | 11:55:23 | 3.487 | 1.253 | 9 | 1220 | 0.22% | 452 |
| 59 | 2005:02:16 | 11:55:33 | 2.85 | 1.224 | 9 | 1220 | 0.16% | 617 |
| 60 | 2005:02:16 | 11:55:43 | 3.148 | 1.269 | 9 | 1220 | 0.19% | 527 |
| 61 | 2005:02:16 | 11:55:53 | 2.842 | 1.244 | 9 | 1220 | 0.16% | 620 |
| 62 | 2005:02:16 | 11:56:03 | 2.706 | 1.353 | 10 | 1220 | 0.15% | 672 |
| 63 | 2005:02:16 | 11:56:13 | 2.264 | 1.313 | 10 | 1220 | 0.11% | 928 |
| 64 | 2005:02:16 | 11:56:23 | 1.893 | 1.327 | 10 | 1220 | 0.07% | |
| 65 | 2005:02:16 | 11:56:33 | 1.64 | 1.289 | 10 | 1220 | 0.05% | |
| 66 | 2005:02:16 | 11:56:43 | 1.295 | 1.254 | 10 | 1220 | 0.02% | |
| 67 | 2005:02:16 | 11:56:53 | 1.987 | 1.293 | 11 | 1220 | 0.08% | |
| 68 | 2005:02:16 | 11:57:03 | 1.829 | 1.286 | 11 | 1220 | 0.07% | |
| 69 | 2005:02:16 | 11:57:13 | 1.897 | 1.285 | 11 | 1220 | 0.07% | |
| 70 | 2005:02:16 | 11:57:23 | 1.204 | 1.298 | 11 | 1220 | 0.01% | |
| 71 | 2005:02:16 | 11:57:33 | 1.13 | 1.245 | 12 | 1220 | 0.00% | |
| 72 | 2005:02:16 | 11:57:43 | 1.157 | 1.228 | 12 | 1220 | 0.01% | |
| 73 | 2005:02:16 | 11:57:53 | 1.128 | 1.268 | 12 | 1220 | 0.00% | |
| 74 | 2005:02:16 | 11:58:03 | 1.141 | 1.275 | 12 | 1220 | 0.00% | |
| 75 | 2005:02:16 | 11:58:13 | 1.139 | 1.305 | 12 | 1220 | 0.00% | |
| 76 | 2005:02:16 | 11:58:23 | 1.134 | 1.307 | 13 | 1220 | 0.00% | |
| 77 | 2005:02:16 | 11:58:33 | 1.152 | 1.308 | 13 | 1220 | 0.00% | |
| 78 | 2005:02:16 | 11:58:43 | 1.162 | 1.303 | 13 | 1220 | 0.01% | |
| 79 | 2005:02:16 | 11:58:53 | 1.147 | 1.304 | 13 | 1220 | 0.00% | |
| 80 | 2005:02:16 | 11:59:03 | 1.157 | 1.378 | 14 | 1220 | 0.01% | |

| Transect 1 | Height = 4' Above Bottom | | | | | | Effluent | |
|---|---|---|---|---|---|---|---|---|
| Entry # | Date | Time | Fluor | Turb | Fraction | Dilution | Fraction | Dilution |
| 9 | 2005:02:16 | 12:10:05 | 1.142 | 1.327 | 4 | 1270 | 0.00% | |
| 10 | 2005:02:16 | 12:10:15 | 1.147 | 1.289 | 4 | 1267.5 | 0.00% | |
| 11 | 2005:02:16 | 12:10:25 | 1.139 | 1.254 | 4 | 1265 | 0.00% | |
| 12 | 2005:02:16 | 12:10:35 | 1.147 | 1.293 | 4 | 1262.5 | 0.00% | |
| 13 | 2005:02:16 | 12:10:45 | 1.157 | 1.289 | 4 | 1260 | 0.01% | |
| 14 | 2005:02:16 | 12:10:55 | 1.13 | 1.254 | 4 | 1257.5 | 0.00% | |
| 15 | 2005:02:16 | 12:11:05 | 1.204 | 1.293 | 4 | 1255 | 0.01% | |
| 16 | 2005:02:16 | 12:11:15 | 1.139 | 1.286 | 4 | 1252.5 | 0.00% | |
| 17 | 2005:02:16 | 12:11:25 | 1.139 | 1.285 | 4 | 1250 | 0.00% | |
| 18 | 2005:02:16 | 12:11:35 | 1.139 | 1.298 | 4 | 1247.5 | 0.00% | |
| 19 | 2005:02:16 | 12:11:45 | 1.134 | 1.245 | 4 | 1245 | 0.00% | |
| 20 | 2005:02:16 | 12:11:55 | 2.152 | 1.228 | 4 | 1242.5 | 0.10% | |
| 21 | 2005:02:16 | 12:12:05 | 2.841 | 1.268 | 4 | 1240 | 0.16% | 620 |
| 22 | 2005:02:16 | 12:12:15 | 2.189 | 1.275 | 4 | 1237.5 | 0.10% | 992 |
| 23 | 2005:02:16 | 12:12:25 | 2.08 | 1.305 | 4 | 1235 | 0.09% | |
| 24 | 2005:02:16 | 12:12:35 | 3.134 | 1.307 | 4 | 1232.5 | 0.19% | 531 |
| 25 | 2005:02:16 | 12:12:45 | 3.998 | 1.308 | 4 | 1230 | 0.27% | 373 |
| 26 | 2005:02:16 | 12:12:55 | 4.255 | 1.303 | 4 | 1227.5 | 0.29% | 342 |
| 27 | 2005:02:16 | 12:13:05 | 2.636 | 1.285 | 4 | 1225 | 0.14% | 703 |
| 28 | 2005:02:16 | 12:13:15 | 2.868 | 1.298 | 4 | 1222.5 | 0.16% | 611 |
| 29 | 2005:02:16 | 12:13:25 | 2.156 | 1.245 | 4 | 1220 | 0.10% | |
| 30 | 2005:02:16 | 12:13:35 | 4.531 | 1.228 | 4 | 1217.5 | 0.32% | 315 |
| 31 | 2005:02:16 | 12:13:45 | 5.128 | 1.268 | 4 | 1215 | 0.37% | 268 |
| 32 | 2005:02:16 | 12:13:55 | 5.891 | 1.244 | 4 | 1212.5 | 0.44% | 225 |
| 33 | 2005:02:16 | 12:14:05 | 6.222 | 1.353 | 4 | 1210 | 0.47% | 211 |
| 34 | 2005:02:16 | 12:14:15 | 5.018 | 1.32 | 4 | 1207.5 | 0.36% | 276 |
| 35 | 2005:02:16 | 12:14:25 | 5.55 | 1.318 | 4 | 1205 | 0.41% | 243 |
| 36 | 2005:02:16 | 12:14:35 | 5.912 | 1.273 | 4 | 1202.5 | 0.45% | 224 |
| 37 | 2005:02:16 | 12:14:45 | 5.129 | 1.281 | 4 | 1200 | 0.37% | 268 |
| 38 | 2005:02:16 | 12:14:55 | 6.87 | 1.274 | 4 | 1197.5 | 0.53% | 187 |
| 39 | 2005:02:16 | 12:15:05 | 7.828 | 1.343 | 4 | 1195 | 0.62% | 161 |
| 40 | 2005:02:16 | 12:15:15 | 8.15 | 1.304 | 4 | 1192.5 | 0.65% | 153 |
| 41 | 2005:02:16 | 12:15:25 | 8.084 | 1.378 | 4 | 1190 | 0.65% | 155 |
| 42 | 2005:02:16 | 12:15:35 | 6.81 | 1.299 | 4 | 1187.5 | 0.53% | 189 |
| 43 | 2005:02:16 | 12:15:45 | 6.175 | 1.256 | 4 | 1185 | 0.47% | 213 |
| 44 | 2005:02:16 | 12:15:55 | 5.813 | 1.305 | 4 | 1182.5 | 0.44% | 229 |
| 45 | 2005:02:16 | 12:16:05 | 6.188 | 1.345 | 4 | 1180 | 0.47% | 212 |
| 46 | 2005:02:16 | 12:16:15 | 5.189 | 1.269 | 4 | 1177.5 | 0.38% | 264 |
| 47 | 2005:02:16 | 12:16:25 | 5.486 | 1.244 | 4 | 1175 | 0.41% | 246 |
| 48 | 2005:02:16 | 12:16:35 | 4.28 | 1.353 | 4 | 1172.5 | 0.29% | 340 |
| 49 | 2005:02:16 | 12:16:45 | 4.9 | 1.32 | 4 | 1170 | 0.35% | 284 |
| 50 | 2005:02:16 | 12:16:55 | 3.514 | 1.318 | 4 | 1167.5 | 0.22% | 447 |
| 51 | 2005:02:16 | 12:17:05 | 2.782 | 1.273 | 4 | 1165 | 0.16% | 642 |

| Transect 2 | Height = 8' Above Bottom | | | | | | Effluent | |
|---|---|---|---|---|---|---|---|---|
| Entry # | Date | Time | Fluor | Turb | Height | Station | Fraction | Dilution |
| 15 | 2005:02:16 | 12:34:50 | 1.142 | 1.249 | 8 | 1290 | 0.00% | |
| 16 | 2005:02:16 | 12:35:01 | 1.506 | 1.306 | 8 | 1286 | 0.04% | |
| 17 | 2005:02:16 | 12:35:11 | 1.184 | 1.27 | 8 | 1282 | 0.01% | |
| 18 | 2005:02:16 | 12:35:21 | 1.099 | 1.26 | 8 | 1278 | 0.00% | |
| 19 | 2005:02:16 | 12:35:31 | 1.146 | 1.234 | 8 | 1274 | 0.00% | |
| 20 | 2005:02:16 | 12:35:41 | 1.069 | 1.234 | 8 | 1270 | 0.00% | |
| 21 | 2005:02:16 | 12:35:51 | 1.21 | 1.256 | 8 | 1266 | 0.01% | |
| 22 | 2005:02:16 | 12:36:01 | 1.389 | 1.247 | 8 | 1262 | 0.03% | |
| 23 | 2005:02:16 | 12:36:10 | 1.375 | 1.28 | 8 | 1258 | 0.03% | |
| 24 | 2005:02:16 | 12:36:21 | 1.304 | 1.217 | 8 | 1254 | 0.02% | |
| 25 | 2005:02:16 | 12:36:31 | 4.629 | 1.263 | 8 | 1250 | 0.33% | 306 |
| 26 | 2005:02:16 | 12:36:41 | 4.317 | 1.238 | 8 | 1246 | 0.30% | 336 |
| 27 | 2005:02:16 | 12:36:51 | 2.524 | 1.253 | 8 | 1242 | 0.13% | 758 |
| 28 | 2005:02:16 | 12:37:01 | 1.221 | 1.224 | 8 | 1238 | 0.01% | |
| 29 | 2005:02:16 | 12:37:11 | 1.684 | 1.27 | 8 | 1234 | 0.05% | |
| 30 | 2005:02:16 | 12:37:21 | 1.134 | 1.301 | 8 | 1230 | 0.00% | |
| 31 | 2005:02:16 | 12:37:31 | 1.998 | 1.265 | 8 | 1226 | 0.08% | |
| 32 | 2005:02:16 | 12:37:41 | 4.255 | 1.345 | 8 | 1222 | 0.29% | 342 |
| 33 | 2005:02:16 | 12:37:51 | 1.636 | 1.269 | 8 | 1218 | 0.05% | |
| 34 | 2005:02:16 | 12:38:01 | 3.868 | 1.244 | 8 | 1214 | 0.26% | 390 |
| 35 | 2005:02:16 | 12:38:11 | 1.16 | 1.353 | 8 | 1210 | 0.01% | |
| 36 | 2005:02:16 | 12:38:20 | 4.802 | 1.32 | 8 | 1206 | 0.34% | 292 |
| 37 | 2005:02:16 | 12:38:31 | 4.451 | 1.318 | 8 | 1202 | 0.31% | 322 |
| 38 | 2005:02:16 | 12:38:41 | 2.397 | 1.273 | 8 | 1198 | 0.12% | 833 |
| 39 | 2005:02:16 | 12:38:50 | 3.025 | 1.281 | 8 | 1194 | 0.18% | 561 |
| 40 | 2005:02:16 | 12:39:01 | 2.347 | 1.274 | 8 | 1190 | 0.12% | 866 |
| 41 | 2005:02:16 | 12:39:11 | 4.194 | 1.343 | 8 | 1186 | 0.29% | 349 |
| 42 | 2005:02:16 | 12:39:21 | 4.343 | 1.304 | 8 | 1182 | 0.30% | 333 |
| 43 | 2005:02:16 | 12:39:31 | 4.122 | 1.378 | 8 | 1178 | 0.28% | 357 |
| 44 | 2005:02:16 | 12:39:41 | 2.567 | 1.299 | 8 | 1174 | 0.14% | 736 |
| 45 | 2005:02:16 | 12:39:51 | 1.128 | 1.256 | 8 | 1170 | 0.00% | |
| 46 | 2005:02:16 | 12:40:01 | 1.141 | 1.305 | 8 | 1166 | 0.00% | |
| 47 | 2005:02:16 | 12:40:11 | 1.139 | 1.307 | 8 | 1162 | 0.00% | |
| 48 | 2005:02:16 | 12:40:21 | 1.134 | 1.308 | 8 | 1158 | 0.00% | |
| 49 | 2005:02:16 | 12:40:31 | 1.152 | 1.303 | 8 | 1154 | 0.00% | |
| 50 | 2005:02:16 | 12:40:41 | 1.162 | 1.4 | 8 | 1150 | 0.01% | |
| 51 | 2005:02:16 | 12:40:51 | 1.147 | 1.325 | 8 | 1146 | 0.00% | |
| 52 | 2005:02:16 | 12:41:01 | 1.157 | 1.351 | 8 | 1142 | 0.01% | |
| 53 | 2005:02:16 | 12:41:11 | 1.168 | 1.418 | 8 | 1138 | 0.01% | |
| 54 | 2005:02:16 | 12:41:21 | 1.159 | 1.386 | 8 | 1134 | 0.01% | |
| 55 | 2005:02:16 | 12:41:30 | 1.163 | 1.39 | 8 | 1130 | 0.01% | |
| 56 | 2005:02:16 | 12:41:40 | 1.132 | 1.399 | 8 | 1126 | 0.00% | |
| 57 | 2005:02:16 | 12:41:50 | 1.13 | 1.348 | 8 | 1122 | 0.00% | |

| Profile 3 | Station 12+05 | | | | | | Effluent | |
|---|---|---|---|---|---|---|---|---|
| Entry # | Date | Time | Fluor | Turb | Height | Station | Fraction | Dilution |
| 59 | 2005:02:16 | 12:49:00 | 3.537 | 1.232 | 2 | 1205 | 0.23% | 443 |
| 60 | 2005:02:16 | 12:49:11 | 4.12 | 1.27 | 2.24 | 1205 | 0.28% | 358 |
| 61 | 2005:02:16 | 12:49:21 | 4.299 | 1.32 | 2.48 | 1205 | 0.30% | 338 |
| 62 | 2005:02:16 | 12:49:31 | 3.302 | 1.288 | 2.72 | 1205 | 0.20% | 490 |
| 63 | 2005:02:16 | 12:49:41 | 3.351 | 1.239 | 2.96 | 1205 | 0.21% | 480 |
| 64 | 2005:02:16 | 12:49:51 | 2.892 | 1.346 | 3.2 | 1205 | 0.17% | 603 |
| 65 | 2005:02:16 | 12:50:01 | 3.353 | 1.311 | 3.44 | 1205 | 0.21% | 479 |
| 66 | 2005:02:16 | 12:50:11 | 3.193 | 1.317 | 3.68 | 1205 | 0.19% | 516 |
| 67 | 2005:02:16 | 12:50:21 | 2.811 | 1.367 | 3.92 | 1205 | 0.16% | 631 |
| 68 | 2005:02:16 | 12:50:31 | 4.181 | 1.242 | 4.16 | 1205 | 0.29% | 351 |
| 69 | 2005:02:16 | 12:50:41 | 3.499 | 1.277 | 4.4 | 1205 | 0.22% | 450 |
| 70 | 2005:02:16 | 12:50:51 | 3.56 | 1.338 | 4.64 | 1205 | 0.23% | 439 |
| 71 | 2005:02:16 | 12:51:00 | 4.204 | 1.307 | 4.88 | 1205 | 0.29% | 348 |
| 84 | 2005:02:16 | 12:51:11 | 4.023 | 1.325 | 5.12 | 1205 | 0.27% | 369 |
| 85 | 2005:02:16 | 12:51:21 | 2.329 | 1.301 | 5.36 | 1205 | 0.11% | 879 |
| 86 | 2005:02:16 | 12:51:31 | 3.438 | 1.33 | 5.6 | 1205 | 0.22% | 462 |
| 87 | 2005:02:16 | 12:51:41 | 2.535 | 1.304 | 5.84 | 1205 | 0.13% | 753 |
| 88 | 2005:02:16 | 12:51:51 | 3.075 | 1.36 | 6.08 | 1205 | 0.18% | 547 |
| 89 | 2005:02:16 | 12:52:01 | 3.031 | 1.326 | 6.32 | 1205 | 0.18% | 559 |
| 90 | 2005:02:16 | 12:52:11 | 2.026 | 1.275 | 6.56 | 1205 | 0.09% | |
| 91 | 2005:02:16 | 12:52:21 | 2.391 | 1.303 | 6.8 | 1205 | 0.12% | 837 |
| 92 | 2005:02:16 | 12:52:31 | 3.057 | 1.326 | 7.04 | 1205 | 0.18% | 552 |
| 93 | 2005:02:16 | 12:52:41 | 3.624 | 1.297 | 7.28 | 1205 | 0.23% | 428 |
| 94 | 2005:02:16 | 12:52:51 | 2.982 | 1.276 | 7.52 | 1205 | 0.17% | 574 |
| 95 | 2005:02:16 | 12:53:01 | 2.469 | 1.328 | 7.76 | 1205 | 0.13% | 789 |
| 96 | 2005:02:16 | 12:53:11 | 3.626 | 1.338 | 8 | 1205 | 0.23% | 428 |
| 97 | 2005:02:16 | 12:53:21 | 3.795 | 1.291 | 8.24 | 1205 | 0.25% | 401 |
| 98 | 2005:02:16 | 12:53:31 | 3.766 | 1.309 | 8.48 | 1205 | 0.25% | 405 |
| 99 | 2005:02:16 | 12:53:41 | 2.346 | 1.344 | 8.72 | 1205 | 0.12% | 867 |
| 100 | 2005:02:16 | 12:53:51 | 1.952 | 1.328 | 8.96 | 1205 | 0.08% | |
| 101 | 2005:02:16 | 12:54:01 | 3.966 | 1.379 | 9.2 | 1205 | 0.27% | 377 |
| 102 | 2005:02:16 | 12:54:11 | 1.472 | 1.264 | 9.44 | 1205 | 0.03% | |
| 103 | 2005:02:16 | 12:54:21 | 1.774 | 1.269 | 9.68 | 1205 | 0.06% | |
| 104 | 2005:02:16 | 12:54:31 | 2.478 | 1.278 | 9.92 | 1205 | 0.13% | 784 |
| 105 | 2005:02:16 | 12:54:41 | 1.849 | 1.304 | 10.16 | 1205 | 0.07% | |
| 106 | 2005:02:16 | 12:54:51 | 1.166 | 1.293 | 10.4 | 1205 | 0.01% | |
| 107 | 2005:02:16 | 12:55:01 | 1.153 | 1.282 | 10.64 | 1205 | 0.00% | |
| 108 | 2005:02:16 | 12:55:11 | 1.149 | 1.313 | 10.88 | 1205 | 0.00% | |
| 109 | 2005:02:16 | 12:55:21 | 1.174 | 1.277 | 11.12 | 1205 | 0.01% | |
| 110 | 2005:02:16 | 12:55:31 | 1.142 | 1.358 | 11.36 | 1205 | 0.00% | |
| 111 | 2005:02:16 | 12:55:40 | 1.148 | 1.309 | 11.6 | 1205 | 0.00% | |
| 112 | 2005:02:16 | 12:55:51 | 1.12 | 1.336 | 11.84 | 1205 | 0.00% | |
| 113 | 2005:02:16 | 12:56:01 | 1.857 | 1.289 | 12.08 | 1205 | 0.07% | |
| 114 | 2005:02:16 | 12:56:11 | 2.743 | 1.263 | 12.32 | 1205 | 0.15% | 657 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 115 | 2005:02:16 | 12:56:21 | 1.134 | 1.314 | 12.56 | 1205 | 0.00% | |
| 116 | 2005:02:16 | 12:56:41 | 2.632 | 1.401 | 12.8 | 1205 | 0.14% | 705 |
| 117 | 2005:02:16 | 12:56:51 | 2.756 | 1.331 | 13.04 | 1205 | 0.15% | 652 |
| 118 | 2005:02:16 | 12:57:01 | 1.6 | 1.315 | 13.28 | 1205 | 0.05% | |
| 119 | 2005:02:16 | 12:57:11 | 1.548 | 1.372 | 13.52 | 1205 | 0.04% | |
| 120 | 2005:02:16 | 12:57:21 | 1.898 | 1.399 | 13.76 | 1205 | 0.07% | |
| 121 | 2005:02:16 | 12:57:31 | 1.117 | 1.275 | 14 | 1205 | 0.00% | |
| 122 | 2005:02:16 | 12:57:41 | 2.03 | 1.316 | 14.24 | 1205 | 0.09% | |
| 123 | 2005:02:16 | 12:57:51 | 2.458 | 1.339 | 14.48 | 1205 | 0.13% | 795 |
| 124 | 2005:02:16 | 12:58:01 | 2.089 | 1.325 | 14.72 | 1205 | 0.09% | |
| 125 | 2005:02:16 | 12:58:11 | 1.117 | 1.299 | 14.96 | 1205 | 0.00% | |
| 126 | 2005:02:16 | 12:58:21 | 1.833 | 1.357 | 15.2 | 1205 | 0.07% | |
| 127 | 2005:02:16 | 12:58:31 | 1.749 | 1.356 | 15.44 | 1205 | 0.06% | |
| 128 | 2005:02:16 | 12:58:41 | 1.308 | 1.326 | 15.68 | 1205 | 0.02% | |
| 129 | 2005:02:16 | 12:58:51 | 1.423 | 1.301 | 15.92 | 1205 | 0.03% | |
| 130 | 2005:02:16 | 12:59:01 | 1.131 | 1.278 | 16.16 | 1205 | 0.00% | |
| 131 | 2005:02:16 | 12:59:11 | 1.531 | 1.313 | 16.4 | 1205 | 0.04% | |
| 132 | 2005:02:16 | 12:59:21 | 1.305 | 1.34 | 16.64 | 1205 | 0.02% | |
| 133 | 2005:02:16 | 12:59:31 | 1.192 | 1.378 | 16.88 | 1205 | 0.01% | |
| 134 | 2005:02:16 | 12:59:41 | 1.159 | 1.292 | 17.12 | 1205 | 0.01% | |
| 135 | 2005:02:16 | 12:59:51 | 1.267 | 1.349 | 17.36 | 1205 | 0.02% | |
| 136 | 2005:02:16 | 13:00:01 | 1.906 | 1.341 | 17.6 | 1205 | 0.07% | |
| 137 | 2005:02:16 | 13:00:11 | 1.124 | 1.308 | 17.84 | 1205 | 0.00% | |
| 138 | 2005:02:16 | 13:00:21 | 1.121 | 1.32 | 18.08 | 1205 | 0.00% | |
| 139 | 2005:02:16 | 13:00:31 | 1.119 | 1.295 | 18.32 | 1205 | 0.00% | |
| 140 | 2005:02:16 | 13:00:41 | 1.123 | 1.301 | 18.56 | 1205 | 0.00% | |
| 141 | 2005:02:16 | 13:00:51 | 1.135 | 1.327 | 18.8 | 1205 | 0.00% | |
| 142 | 2005:02:16 | 13:01:01 | 1.142 | 1.321 | 19.04 | 1205 | 0.00% | |
| 143 | 2005:02:16 | 13:01:11 | 1.123 | 6.498 | 19.28 | 1205 | 0.00% | |
| 144 | 2005:02:16 | 13:01:21 | 1.119 | 1.385 | 19.52 | 1205 | 0.00% | |
| 145 | 2005:02:16 | 13:01:31 | 1.183 | 1.453 | 19.76 | 1205 | 0.01% | |
| 146 | 2005:02:16 | 13:01:41 | 1.147 | 1.36 | 20 | 1205 | 0.00% | |
| 147 | 2005:02:16 | 13:01:51 | 1.146 | 1.344 | 20.24 | 1205 | 0.00% | |
| 148 | 2005:02:16 | 13:02:01 | 1.129 | 1.384 | 20.48 | 1205 | 0.00% | |
| 149 | 2005:02:16 | 13:02:11 | 1.343 | 1.327 | 20.72 | 1205 | 0.02% | |
| 150 | 2005:02:16 | 13:02:21 | 1.166 | 1.338 | 20.96 | 1205 | 0.01% | |
| 151 | 2005:02:16 | 13:02:31 | 1.135 | 1.331 | 21.2 | 1205 | 0.00% | |
| 152 | 2005:02:16 | 13:02:41 | 1.137 | 1.337 | 21.44 | 1205 | 0.00% | |
| 153 | 2005:02:16 | 13:02:51 | 1.143 | 1.346 | 21.68 | 1205 | 0.00% | |

| **Sawtooth 1** | | | | | | | **Effluent** | |
|---|---|---|---|---|---|---|---|---|
| **Entry #** | **Date** | **Time** | **Fluor** | **Turb** | **Height** | **Station** | **Fraction** | **Dilution** |
| 159 | 2005:02:16 | 13:32:10 | 3.576 | 1.16 | 4 | 1220 | 0.23% | 436 |
| 160 | 2005:02:16 | 13:32:20 | 4.406 | 1.16 | 4 | 1218 | 0.31% | 327 |
| 161 | 2005:02:16 | 13:33:30 | 4.678 | 1.186 | 4 | 1216 | 0.33% | 302 |
| 162 | 2005:02:16 | 13:32:40 | 4.777 | 1.18 | 4 | 1214 | 0.34% | 294 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 163 | 2005:02:16 | 13:32:50 | 5.288 | 1.181 | 4 | 1212 | 0.39% | 258 |
| 164 | 2005:02:16 | 13:33:00 | 6.751 | 1.184 | 4 | 1210 | 0.52% | 191 |
| 165 | 2005:02:16 | 13:33:10 | 4.673 | 1.181 | 4 | 1208 | 0.33% | 302 |
| 166 | 2005:02:16 | 13:33:20 | 5.55 | 1.182 | 4 | 1206 | 0.41% | 243 |
| 167 | 2005:02:16 | 13:33:30 | 6.47 | 1.176 | 4 | 1204 | 0.50% | 201 |
| 168 | 2005:02:16 | 13:33:40 | 7.383 | 1.172 | 4 | 1202 | 0.58% | 172 |
| 169 | 2005:02:16 | 13:33:50 | 7.045 | 1.171 | 4 | 1200 | 0.55% | 182 |
| 170 | 2005:02:16 | 13:34:00 | 6.319 | 1.167 | 4 | 1198 | 0.48% | 207 |
| 171 | 2005:02:16 | 13:34:10 | 6.298 | 1.16 | 4 | 1196 | 0.48% | 208 |
| 172 | 2005:02:16 | 13:34:20 | 5.988 | 1.158 | 4 | 1194 | 0.45% | 221 |
| 173 | 2005:02:16 | 13:34:30 | 6.295 | 1.158 | 4 | 1192 | 0.48% | 208 |
| 174 | 2005:02:16 | 13:34:40 | 5.284 | 1.156 | 4 | 1190 | 0.39% | 258 |
| 175 | 2005:02:16 | 13:34:50 | 7.059 | 1.153 | 4 | 1188 | 0.55% | 181 |
| 176 | 2005:02:16 | 13:35:00 | 7.471 | 1.15 | 4 | 1186 | 0.59% | 170 |
| 177 | 2005:02:16 | 13:35:10 | 5.075 | 1.146 | 6 | 1188 | 0.37% | 272 |
| 178 | 2005:02:16 | 13:35:20 | 3.115 | 1.147 | 6 | 1190 | 0.19% | 536 |
| 179 | 2005:02:16 | 13:35:30 | 2.806 | 1.152 | 6 | 1192 | 0.16% | 633 |
| 180 | 2005:02:16 | 13:35:41 | 2.887 | 1.152 | 6 | 1194 | 0.17% | 604 |
| 181 | 2005:02:16 | 13:35:51 | 4.077 | 1.153 | 6 | 1196 | 0.28% | 363 |
| 182 | 2005:02:16 | 13:36:01 | 5.049 | 1.155 | 6 | 1198 | 0.37% | 273 |
| 183 | 2005:02:16 | 13:36:11 | 5.837 | 1.162 | 6 | 1200 | 0.44% | 228 |
| 184 | 2005:02:16 | 13:36:21 | 4.727 | 1.152 | 6 | 1202 | 0.34% | 298 |
| 185 | 2005:02:16 | 13:36:31 | 5.209 | 1.152 | 6 | 1204 | 0.38% | 263 |
| 186 | 2005:02:16 | 13:36:41 | 5.002 | 1.154 | 6 | 1206 | 0.36% | 277 |
| 187 | 2005:02:16 | 13:36:51 | 3.982 | 1.152 | 6 | 1208 | 0.27% | 375 |
| 188 | 2005:02:16 | 13:37:01 | 3.571 | 1.155 | 6 | 1210 | 0.23% | 437 |
| 189 | 2005:02:16 | 13:37:11 | 3.572 | 1.151 | 6 | 1212 | 0.23% | 437 |
| 190 | 2005:02:16 | 13:37:21 | 2.976 | 1.151 | 6 | 1214 | 0.17% | 576 |
| 191 | 2005:02:16 | 13:37:31 | 3.288 | 1.148 | 6 | 1216 | 0.20% | 494 |
| 192 | 2005:02:16 | 13:37:41 | 2.999 | 1.131 | 6 | 1218 | 0.18% | 569 |
| 193 | 2005:02:16 | 13:37:51 | 3.418 | 1.125 | 6 | 1220 | 0.21% | 466 |
| 194 | 2005:02:16 | 13:38:01 | 2.83 | 1.119 | 8 | 1218 | 0.16% | 624 |
| 195 | 2005:02:16 | 13:38:11 | 2.633 | 1.12 | 8 | 1216 | 0.14% | 705 |
| 196 | 2005:02:16 | 13:38:21 | 2.749 | 1.117 | 8 | 1214 | 0.15% | 655 |
| 197 | 2005:02:16 | 13:38:31 | 3.241 | 1.122 | 8 | 1212 | 0.20% | 504 |
| 198 | 2005:02:16 | 13:38:41 | 3.324 | 1.122 | 8 | 1210 | 0.21% | 486 |
| 199 | 2005:02:16 | 13:38:51 | 3.307 | 1.116 | 8 | 1208 | 0.20% | 489 |
| 200 | 2005:02:16 | 13:39:01 | 2.99 | 1.112 | 8 | 1206 | 0.18% | 571 |
| 201 | 2005:02:16 | 13:39:11 | 3.468 | 1.112 | 8 | 1204 | 0.22% | 456 |
| 202 | 2005:02:16 | 13:39:21 | 3.883 | 1.117 | 8 | 1202 | 0.26% | 388 |
| 203 | 2005:02:16 | 13:39:31 | 3.957 | 1.11 | 8 | 1200 | 0.26% | 378 |
| 204 | 2005:02:16 | 13:39:41 | 4.424 | 1.106 | 8 | 1198 | 0.31% | 325 |
| 205 | 2005:02:16 | 13:39:51 | 4.595 | 1.111 | 8 | 1196 | 0.32% | 309 |
| 206 | 2005:02:16 | 13:40:01 | 3.866 | 1.114 | 8 | 1194 | 0.26% | 390 |
| 207 | 2005:02:16 | 13:40:11 | 3.984 | 1.115 | 8 | 1192 | 0.27% | 374 |
| 208 | 2005:02:16 | 13:40:21 | 2.825 | 1.114 | 8 | 1190 | 0.16% | 626 |

# ATTACHMENT I-3:
# DILUTION MODEL OUTPUT FOR UM3 AND DKHW

## UM3 (default aspiration coefficient = 0.1)

Visual Plumes, Ver. 1.0; U.S. Environmental Protection Agency, ERD-Athens, ORD, 14 August 2001

File Edit Models Stop Run Help

Diffuser: Camas1.vpp.db | Ambient: C:\Plumes\Camas1.004.db | Special Settings | Text Output | Graphical Output

Clear text display | Clear + | Output options | Numerical only

```
/ UM3. 3/4/2005 2:16:21 PM
Case 1; ambient file C:\Plumes\Camas1.004.db; Diffuser table record 1: ----------------------------------

Ambient Table:
     Depth   Amb-cur   Amb-dir   Amb-sal   Amb-tem   Amb-pol      Decay   Far-spd   Far-dir   Disprsn   Density
         m       m/s       deg       psu         C     kg/kg        s-1       m/s       deg  m0.67/s2   sigma-T
       0.0      0.47     180.0     0.077       4.3       0.0        0.0      0.47     180.0     0.001    0.0994
       1.0      0.47     180.0     0.077       4.3       0.0        0.0      0.47     180.0     0.001    0.0994
       2.0      0.47     180.0     0.077       4.3       0.0        0.0      0.47     180.0     0.001    0.0994
       3.0      0.47     180.0     0.077       4.3       0.0        0.0      0.47     180.0     0.001    0.0994
       4.0      0.47     180.0     0.077       4.3       0.0        0.0      0.47     180.0     0.001    0.0994
       5.0      0.47     180.0     0.077       4.3       0.0        0.0      0.47     180.0     0.001    0.0994
       6.0      0.47     180.0     0.077       4.3       0.0        0.0      0.47     180.0     0.001    0.0994
       7.0      0.47     180.0     0.077       4.3       0.0        0.0      0.47     180.0     0.001    0.0994
      13.0      0.47     180.0     0.077       4.3       0.0        0.0      0.47     180.0     0.001    0.0994

Diffuser table:
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
    (in)    (ft)   (deg)   (deg)      ()    (ft)    (ft)    (ft)    (ft)   (MGD)   (psu)     (C) (kg/kg)
     6.0     4.0     0.0   180.0     8.0    10.0    32.0   322.0    20.0    2.15     0.0    14.8     1.0

Simulation:
Froude number:        20.0; effleunt density (sigma-T)    -0.806; effleunt velocity     0.717(m/s);
        Depth  Amb-cur    P-dia  Polutnt   Dilutn  CL-diln   x-posn   y-posn     Time
Step     (ft)    (m/s)     (in)  (kg/kg)       ()       ()     (ft)     (ft)      (s)
   0     20.0     0.47    5.692      1.0      1.0      1.0      0.0      0.0      0.0;
 100    19.85     0.47    18.25    0.138    7.238     1.99   -18.29      0.0    10.38;
 121    19.71     0.47    22.74   0.0911    10.97    2.953   -32.46      0.0    19.07; acute zone;
 200    18.37     0.47    50.66   0.0191    52.44    13.62   -184.1      0.0    115.5;
 231    17.32     0.47    69.02   0.0103    96.88    25.05   -327.6      0.0    207.9; chronic zone;
 287    14.17     0.47    120.4   0.0034    293.7    75.76   -857.4      0.0    550.4; merging;
 300     13.0     0.47    141.3  0.00263    379.9    105.9  -1083.1      0.0    696.6;
 328    9.189     0.47    221.9  0.00151    661.4    267.5  -1858.8      0.0   1199.1; surface;
Outside chronic zone
 ;
2:16:22 PM. amb fills: 2
```

Model runs output (Limited buffer size, for many runs output to file)

Start | Camas - Mic... | Minesweeper | C:\Docume... | M-swift 030... | Plumes | 2:17 PM

## DKHW

Visual Plumes, Ver. 1.0; U.S. Environmental Protection Agency, ERD-Athens, ORD, 14 August 2001

File Edit Models Stop Run Help

Diffuser: Camas1.vpp.db | Ambient: C:\Plumes\Camas1.004.db | Special Settings | Text Output | Graphical Output

Clear text display | Clear + | Output options | Numerical only

```
/ DKHW
Case 1; ambient file C:\Plumes\Camas1.004.db; Diffuser table record 1: ----------------------------------

Ambient Table:
     Depth    Amb-cur    Amb-dir    Amb-sal    Amb-tem    Amb-pol      Decay    Far-spd    Far-dir    Disprsn    Density
       m        m/s        deg        psu          C      kg/kg        s-1        m/s        deg   m0.67/s2    sigma-T
       0.0      0.47      180.0      0.077        4.3        0.0        0.0       0.47      180.0      0.001     0.0994
       1.0      0.47      180.0      0.077        4.3        0.0        0.0       0.47      180.0      0.001     0.0994
       2.0      0.47      180.0      0.077        4.3        0.0        0.0       0.47      180.0      0.001     0.0994
       3.0      0.47      180.0      0.077        4.3        0.0        0.0       0.47      180.0      0.001     0.0994
       4.0      0.47      180.0      0.077        4.3        0.0        0.0       0.47      180.0      0.001     0.0994
       5.0      0.47      180.0      0.077        4.3        0.0        0.0       0.47      180.0      0.001     0.0994
       6.0      0.47      180.0      0.077        4.3        0.0        0.0       0.47      180.0      0.001     0.0994
       7.0      0.47      180.0      0.077        4.3        0.0        0.0       0.47      180.0      0.001     0.0994
      13.0      0.47      180.0      0.077        4.3        0.0        0.0       0.47      180.0      0.001     0.0994

Diffuser table:
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
    (in)    (ft)   (deg)   (deg)      ()    (ft)    (ft)    (ft)    (ft)   (MGD)   (psu)     (C) (kg/kg)
     6.0     4.0     0.0   180.0     8.0    10.0    32.0   322.0    20.0    2.15     0.0    14.8     1.0

Simulation:
Froude number:       20.0; effleunt density (sigma-T)    -0.806; effleunt velocity     0.717(m/s);
        Depth  Amb-cur    P-dia  Polutnt   Dilutn  CL-diln   x-posn   y-posn     Time
Step     (ft)    (m/s)     (in)  (kg/kg)       ()       ()     (ft)     (ft)      (s)
   0     20.0     0.47    5.692      1.0      1.0      0.0      0.0      0.0      0.0;
   2    19.52     0.47    12.32      0.0    3.495    1.953   -17.84      0.0    7.587;
  44     19.4     0.47    15.67      0.0    5.402    3.018   -21.27      0.0    9.151;
  45    19.39     0.47    15.91      0.0    5.564    3.108   -21.58      0.0    9.298;
  58    19.23     0.47    19.92      0.0    8.503     4.75   -27.34      0.0    12.23;
Plumes not merged, Brooks method may be overly conservative.
Const Eddy Diffusivity.  Farfield dispersion based on wastefield width of      21.86 m
    conc  dilutn   width distnce    time
 (kg/kg)            (m)     (m)    (hrs) (kg/kg)   (s-1)   (m/s)(m0.67/s2)
     0.0 10240.6   27.51   98.15  0.0529     0.0     0.0    0.47   0.001
count: 1
 ;
```

Model runs output (Limited buffer size, for many runs output to file)

Start | Camas - Mic... | Minesweeper | C:\Docume... | M-swift 030... | Plumes | 2:15 PM

## UM3 (with alternate aspiration coefficient = 1.3)

Visual Plumes, Ver. 1.0; U.S. Environmental Protection Agency, ERD-Athens, ORD, 14 August 2001

File Edit Models Stop Run Help

Diffuser: Camas1.vpp.db | Ambient: C:\Plumes\Camas1.004.db | Special Settings | Text Output | Graphical Output

Clear text display | Clear + | Output options | Numerical only

```
/ UM3. 3/4/2005 2:23:19 PM
Case 1; ambient file C:\Plumes\Camas1.004.db; Diffuser table record 1: ----------------------------------

Ambient Table:
     Depth   Amb-cur   Amb-dir   Amb-sal   Amb-tem   Amb-pol      Decay   Far-spd   Far-dir   Disprsn   Density
         m       m/s       deg       psu         C     kg/kg        s-1       m/s       deg  m0.67/s2   sigma-T
       0.0      0.47     180.0     0.077       4.3       0.0        0.0      0.47     180.0     0.001    0.0994
       1.0      0.47     180.0     0.077       4.3       0.0        0.0      0.47     180.0     0.001    0.0994
       2.0      0.47     180.0     0.077       4.3       0.0        0.0      0.47     180.0     0.001    0.0994
       3.0      0.47     180.0     0.077       4.3       0.0        0.0      0.47     180.0     0.001    0.0994
       4.0      0.47     180.0     0.077       4.3       0.0        0.0      0.47     180.0     0.001    0.0994
       5.0      0.47     180.0     0.077       4.3       0.0        0.0      0.47     180.0     0.001    0.0994
       6.0      0.47     180.0     0.077       4.3       0.0        0.0      0.47     180.0     0.001    0.0994
       7.0      0.47     180.0     0.077       4.3       0.0        0.0      0.47     180.0     0.001    0.0994
      13.0      0.47     180.0     0.077       4.3       0.0        0.0      0.47     180.0     0.001    0.0994

Diffuser table:
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
    (in)    (ft)   (deg)   (deg)      ()    (ft)    (ft)    (ft)    (ft)   (MGD)   (psu)     (C) (kg/kg)
     6.0     4.0     0.0   180.0     8.0    10.0    32.0   322.0    20.0    2.15     0.0    14.8     1.0

Simulation:
Froude number:       20.0; effleunt density (sigma-T)    -0.806; effleunt velocity     0.717(m/s);
        Depth  Amb-cur    P-dia  Polutnt   Dilutn  CL-diln   x-posn   y-posn     Time
Step     (ft)    (m/s)     (in)  (kg/kg)       ()       ()     (ft)     (ft)      (s)
   0     20.0     0.47    5.692      1.0      1.0      1.0      0.0      0.0      0.0;
 100     20.0     0.47    18.25    0.138    7.238     1.99   -1.414      0.0    0.803;
 200    19.97     0.47    50.66   0.0191    52.44    13.62   -26.91      0.0    17.02;
 206    19.97     0.47    53.79   0.0169    59.05    15.32   -32.12      0.0    20.37; acute zone;
 273    19.66     0.47    104.8  0.00449    222.6    57.37   -233.2      0.0    150.3; bottom hit;
 284    19.49     0.47    116.9  0.00361    276.7     71.3   -323.0      0.0    208.4; chronic zone;
 287    19.43     0.47    120.4   0.0034    293.7    75.76   -353.1      0.0    227.8; merging;
 300    18.96     0.47    141.3  0.00263    379.9    105.9   -556.7      0.0    359.7;
 347    13.07     0.47    314.0  0.00104    963.5    433.7  -2287.2      0.0   1481.0; surface;
Outside chronic zone
 ;
2:23:21 PM. amb fills: 2
```

Model runs output (Limited buffer size, for many runs output to file)

Start | Camas - Mic... | Minesweeper | C:\Docume... | M-swift 030... | Plumes | 2:23 PM

# PART II:
# DYE STUDY NO. 2

# PART II:
# DYE STUDY NO. 2

Based on the results of the two dye tracer studies, the recommended mixing zone model for the City of Camas WWTP outfall is UM3, which was the same model used in the NPDES permit. However, the model has been calibrated to the dye studies, revealing that the dilution values cited in the NPDES permit are incorrect. The revised mixing zone modeling and appropriate NPDES permit modifications are presented in this report.

## WWTP DATA

### Dye Injection

Rhodamine WT dye was injected at a constant rate into the Camas WWTP effluent for 301 minutes (5.0 hours) on October 4, 2005. The liquid dye (23 percent solution) was injected at a rate of 28.4 mL/min. The dye solution was injected into the mixing vault at the outlet from the UV chamber.

### Effluent Monitoring

WWTP staff monitored effluent flow rate and temperature during the tracer study. They also collected effluent grab samples from the outfall manhole across the street from the WWTP. The grab samples were subsequently diluted by a factor of 100:1 in the Cosmopolitan laboratory and measured by the same Turner Designs SCUFA fluorometer used in the field study. The results of the WWTP effluent monitoring are in Table II-1.

**Table II-1 WWTP Effluent Monitoring During the Tracer Study**

| Date | Time | Effluent Flow (mgd) | Effluent Temp (C) | Tracer Conc Measured (ppb) | Tracer Conc Calculated (ppb) |
|---|---|---|---|---|---|
| 10/4/05 | 6:30 | 2.01 | 19.9 | | 1,207 |
| 10/4/05 | 7:00 | 2.42 | 19.9 | 1,180 | 1,003 |
| 10/4/05 | 7:30 | 2.78 | 20.0 | 1,000 | 872 |
| 10/4/05 | 8:00 | 3.85 | 20.0 | 680 | 630 |
| 10/4/05 | 8:30 | 3.65 | 20.0 | 770 | 665 |
| 10/4/05 | 9:00 | 3.24 | 20.0 | 710 | 749 |
| 10/4/05 | 9:45 | 2.93 | 20.1 | 730 | 828 |
| 10/4/05 | 10:30 | 2.88 | 20.1 | 940 | 842 |
| 10/4/05 | 11:15 | 2.70 | 20.2 | 980 | 899 |

### Tracer Concentration

The measured tracer concentration data in Table 1 are highly variable, in part due to the wide effluent flow swings typical in the morning. The monitoring during the first dye study in February, when effluent flow was much more stable, also suggested that mixing in the outfall was incomplete during the estimated 2-minute travel time between the dye injection point and the effluent manhole.

The actual mixed tracer concentration can be more reliably calculated from the known effluent flow rate, tracer concentration and injection rate, which are shown in the right-hand column of Table I-1. The dye pump was pre-calibrated to an injection rate of approximately 28 mL/min, and a concentration of 23 percent. The dye container was measured before and after the dye injection, which determined an actual injection rate of 28.4 mL/min.

## AMBIENT DATA AND CRITICAL CONDITIONS

The first field study in February revealed that river velocity and water surface elevation vary rapidly near the Camas outfall. The first study was unable to discern whether these changes resulted from abrupt changes in discharge at the Bonneville Dam, or tides, or a combination of both. Therefore, the field studies for the October event were modified and expanded to aid in this determination, as described below:

### River Discharge

River discharge data for the Bonneville Dam are available from the following website:

http://www.nwd-wc.usace.army.mil/perl/dataquery.pl?k=id:BON+record://BON/QR//IR-MONTH/HRXZZAZD/+psy:+psm:+psd:+pey:+pem:+ped:+pk:columbia+river+flow+bonneville

We contacted Mr. Paul Koski, Hydrologist at the Reservoir Control Center of the Corps of Engineers Portland District. Mr. Koski described BPA's planning and operating criteria for releases from the Bonneville Dam. Forecasts are prepared each Thursday and Monday for the following few days. Therefore, scheduling of the second dye study was made flexible to respond to the updated release forecasts at the latest possible opportunity. The field studies were eventually conducted on the morning of Tuesday, October 4, which had been forecasted by the Corps the previous day to be a period of low discharge.

River discharge from the Bonneville Dam during the October field study is shown in Figure II-1. Discharge data during the February study are also shown for comparison. The characteristic rapid variations from Bonneville are revealed in the figure. The durations of the field studies are

indicated by horizontal bars. The October 4 field study was successful at capturing the low discharge period. River discharge was at its seasonal, diurnal and weekly minimum (approximately 80 kcfs) for the first two hours of the field measurements (approximately 6:30 to 8:30 Tuesday morning).

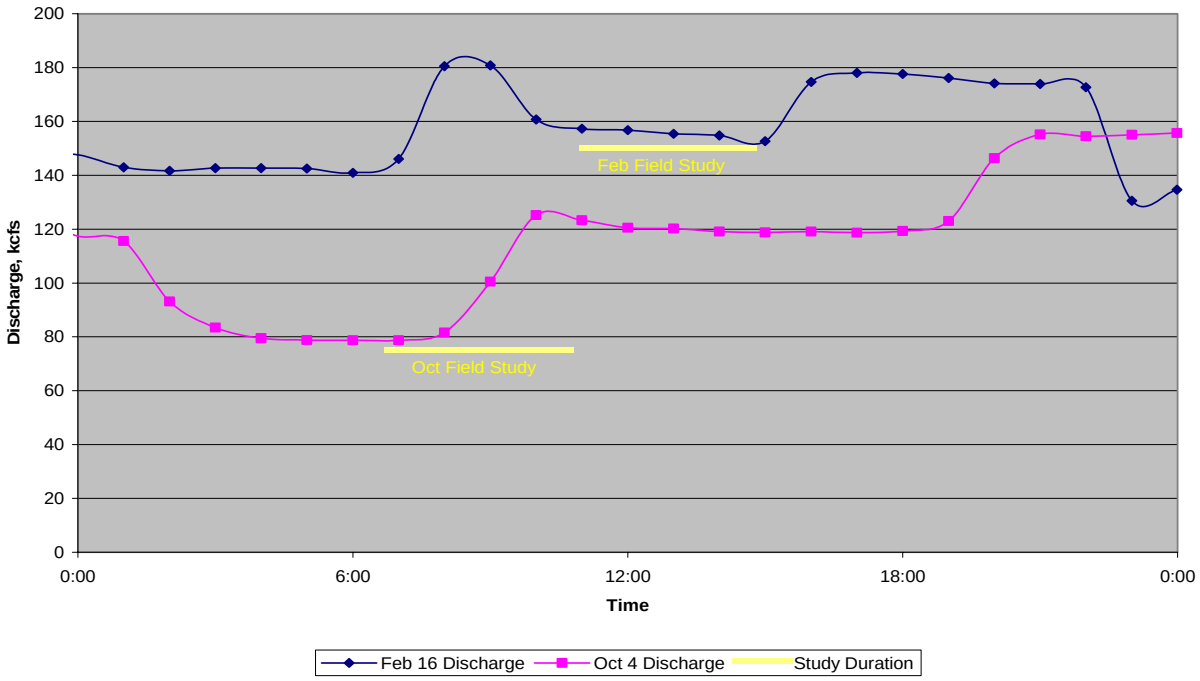



**Figure II-1. Bonneville Dam Discharge Data**

## Tidal Influence

The first dye study in February did not include adequate detail in the measurement of ambient velocity and water surface elevation to determine the separate effects of tide and Bonneville discharge. Therefore, an ADCP current meter was deployed approximately 100 feet upstream of the diffuser to provide continuous and precise measurement of velocity and water surface elevation.

It is known that tides influence river flow as far upstream as Vancouver, WA. However, no predictions are provided by NOAA upstream of Ellsworth, which is approximately 8 miles downstream of Camas. Therefore, the tracer study was timed to occur during the period predicted to coincide with potential tidal slowing of the river current, which was high slack tide predicted at in Vancouver.

The observed water surface elevation data from the ADCP are plotted with the predicted tide data for Ellsworth in Figure II-2. These data clearly confirm that there is a tidal influence at Camas. The observed tide range on October 3 and 4 was approximately 50 to 60 cm.

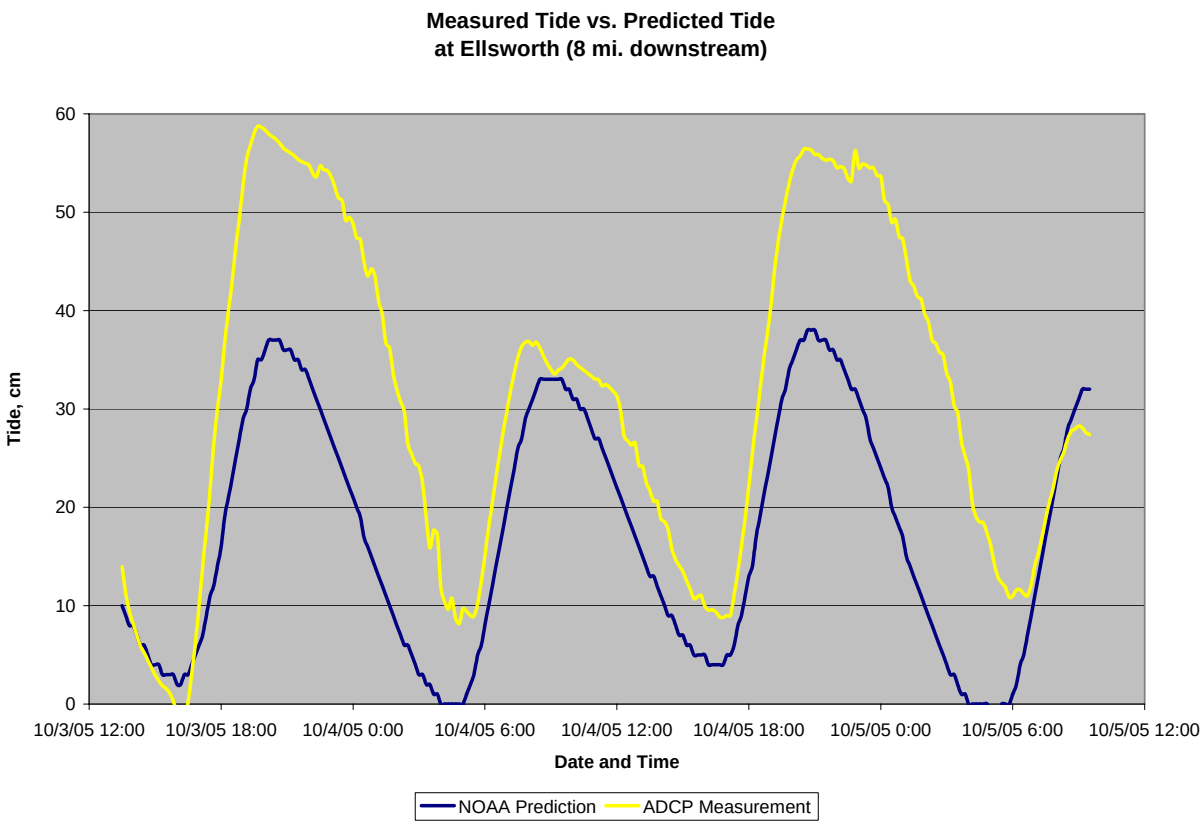



**Figure II-2. NOAA Predicted Tide and Observed Water Surface Elevation**

## River Velocity

The ADCP measured current velocity in 1-meter bins at 10-minute intervals for two days surrounding the dye study. The current speed results for four of the bins are shown in Figure II-3. As expected, current speed decreases from the water surface to the bottom. The direction of all measured currents was between 240 and 250 degrees true. Therefore, there was no reversal of current caused by the tidal influence.

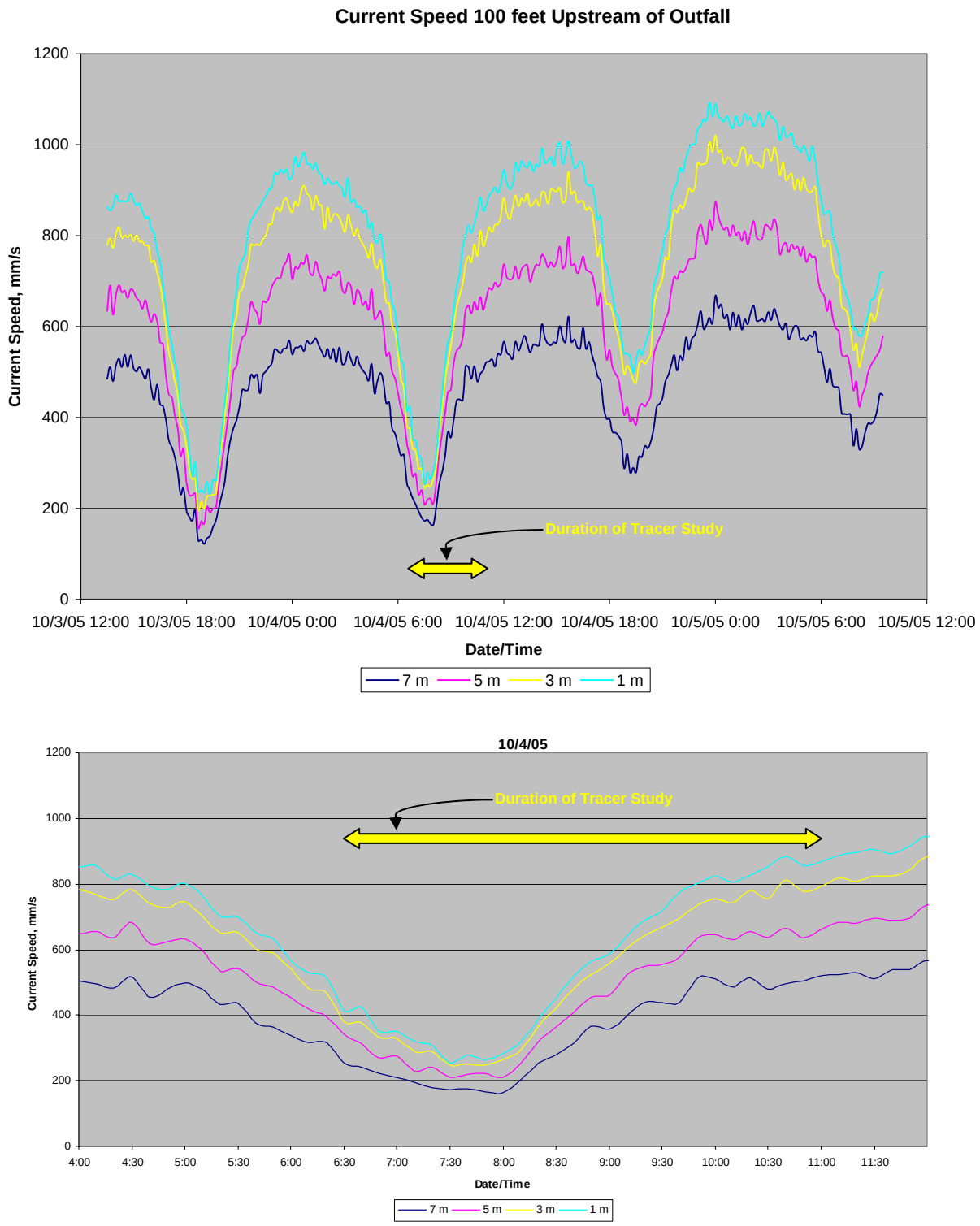



**Figure II-3. Current Speed Data Measured During the October Field Studies**

## Critical Conditions

The data from the Corps and the ADCP mooring combine to reveal that critical (i.e., lowest) current speed is a function of both Bonneville discharge and tidal influence. The average current speed measured during the October event is plotted with the Bonneville discharge and tide data in Figure II-4. The lowest current speed occurs just prior to high slack tide. The first portion of the October 4 tracer study (6:30 to 8:30) captured critical conditions for both tidal and Bonneville influences. The second portion of the tracer study (8:30 to 10:00) was at steadily increasing current speeds. The final portion of the tracer study (10:00 to 11:00) occurred during relatively stable, maximum current speeds.

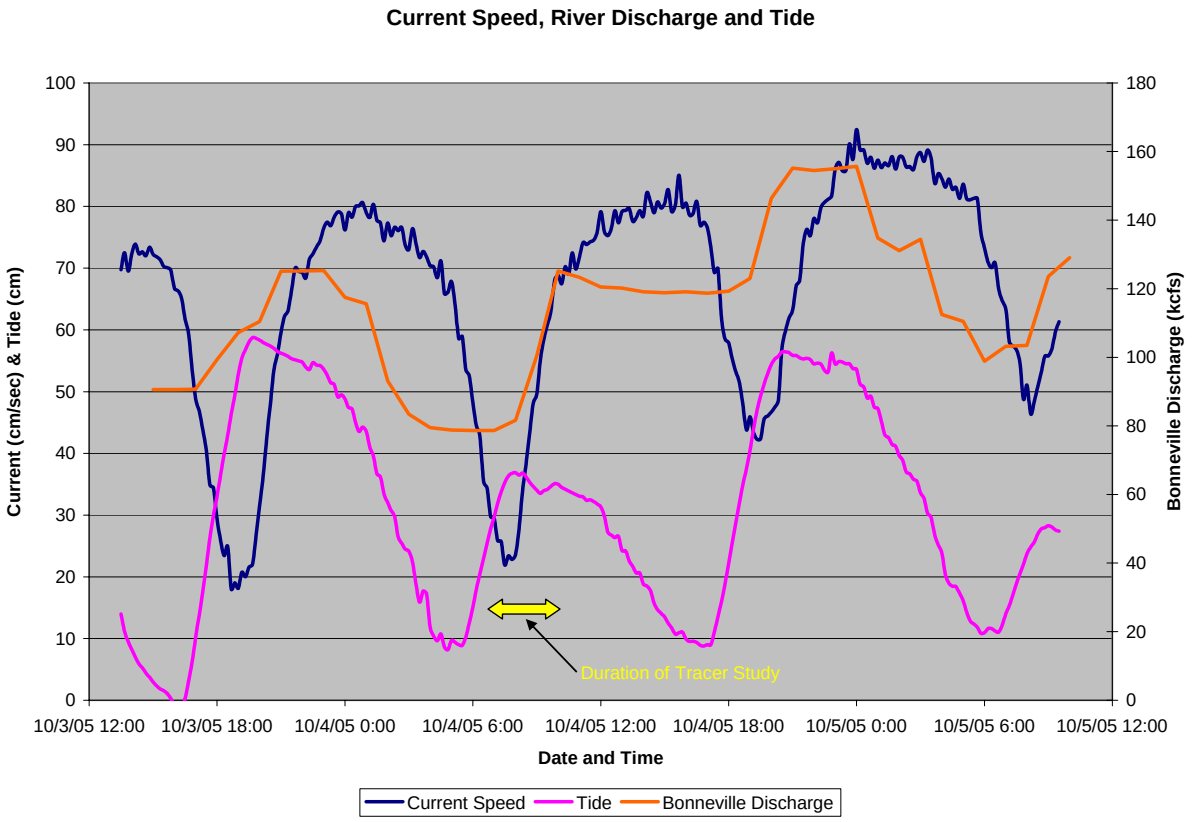



**Figure II-4. Critical Ambient Conditions During the October 4 Tracer Study**

## CTD Profiles

Conductivity, temperature, and depth profiles were measured three times during the October 4 tracer study. The results are presented in Table II-2. Temperature and salinity profiles show that the receiving water is well mixed, or unstratified. This lack of stratification was also observed during the February tracer study.

**Table II-2 CTD Profiles During the Tracer Study**

| Depth (m) | 7:23 10/04/05 | | 8:51 10/04/05 | | 11:01 10/04/05 | |
|---|---|---|---|---|---|---|
| | Sal (ppt) | Temp (C) | Sal (ppt) | Temp (C) | Sal (ppt) | Temp (C) |
| 1 | 0.072 | 17.08 | 0.072 | 17.09 | 0.071 | 17.12 |
| 2 | 0.073 | 17.08 | 0.072 | 17.09 | 0.071 | 17.12 |
| 3 | 0.074 | 17.08 | 0.073 | 17.09 | 0.071 | 17.12 |
| 4 | 0.077 | 17.08 | 0.075 | 17.09 | 0.071 | 17.11 |
| 5 | 0.077 | 17.08 | 0.075 | 17.09 | 0.072 | 17.11 |
| 6 | 0.077 | 17.08 | 0.075 | 17.09 | 0.072 | 17.11 |

## TRACER STUDY RESULTS

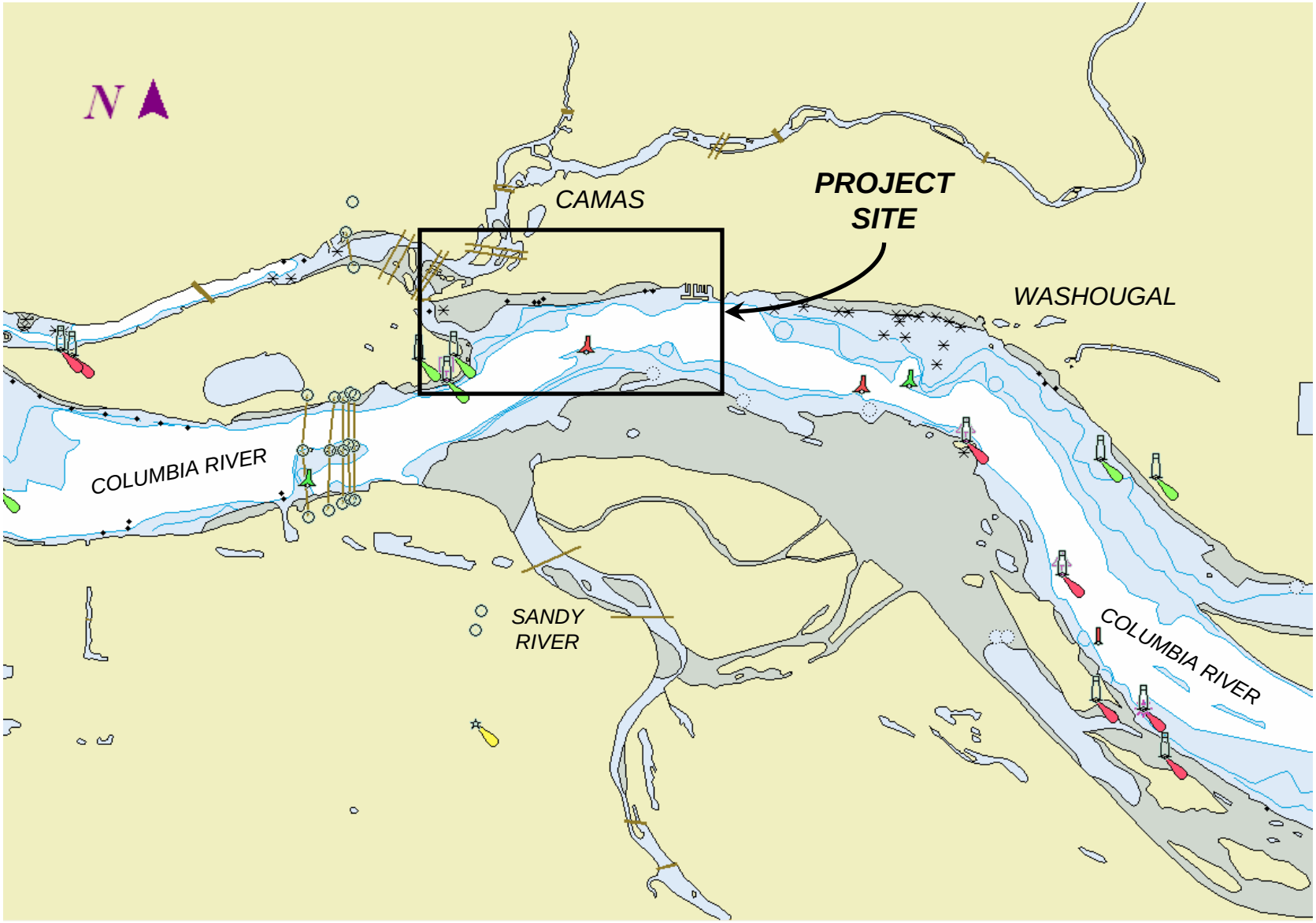
### Overview

Dye injection began at 6:19 a.m. on October 4, 2005 and continued until 11:20 a.m. Effluent concentrations were calculated from the known effluent flow rates and dye injection rate, as shown in Table II-1. There is a calculated lag of approximately 30 minutes from the WWTP to the downstream mixing zone, which has been included in the mixing zone plume calculations.

Beginning at approximately 6:45 a.m. and continuing through 11:00 a.m., the fluorometer was placed in the water and placed at various locations along the mixing zone boundary 314 feet downstream of the diffuser (based on dGPS coordinates). One transect was run 206 feet downstream. The mooring consisted of an anchor set approximately 50 feet upstream of the diffuser, with a 400-ft anchor line. Traverses across the downstream mixing zone boundary were conducted by swinging in an arc pattern from the main mooring. Lateral anchors were set to aid in cross-channel positioning along the downstream mixing zone boundary.

The general configuration of the diffuser, mixing zone boundary, mooring system and cross-channel stationing are illustrated in Figures II-5 through II-7. The river is conveniently oriented east-west, so the vessel's cross-channel positions along the downstream mixing zone boundary were recorded by the latitude reading from a dGPS system. The vessel's cross-channel positioning data were post-processed into a stationing system corresponding to the stationing on the 1971 outfall drawing (sheet 42). The diffuser terminus is at approximately station 12+40 on the drawing. In this study, station 12+40 is approximately 310 feet directly downstream of the diffuser terminus. The plume centerline is at approximately station 12+05 or latitude 45° 34.529', corresponding to the midpoint of the diffuser.

Comprehensive plume tracer concentration data were recorded at the mixing zone boundary. Measurements consisted of (1) vertical profiles measured at a fixed location, (2) horizontal transects measured from one edge of the mixing zone to the other at fixed depths, and (3) time series of effluent concentration at a fixed location believed to be centerline of the plume. The schedule of plume tracer measurements is provided in Table II-3.

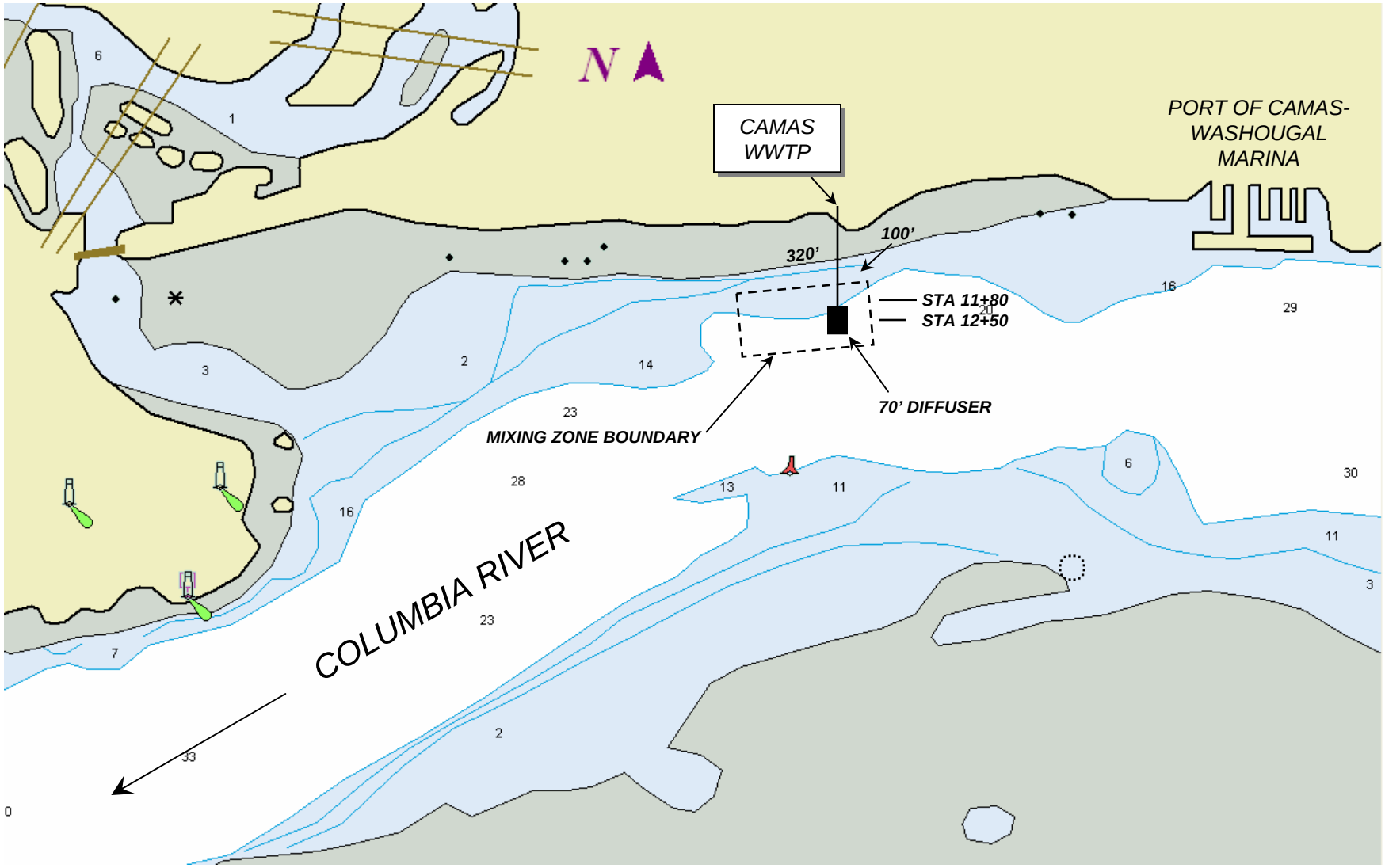



FILE: G&O016/REPORTS/DYE TRACER & MIXING ZONE STUDY/FIG 2-3-4-5-6-7-15.PPT

COSMOPOLITAN ENGINEERING GROUP
Civil, Environmental, and Recreational Consulting

***NO SCALE***

**Figure II-5: PROJECT VICINITY MAP**

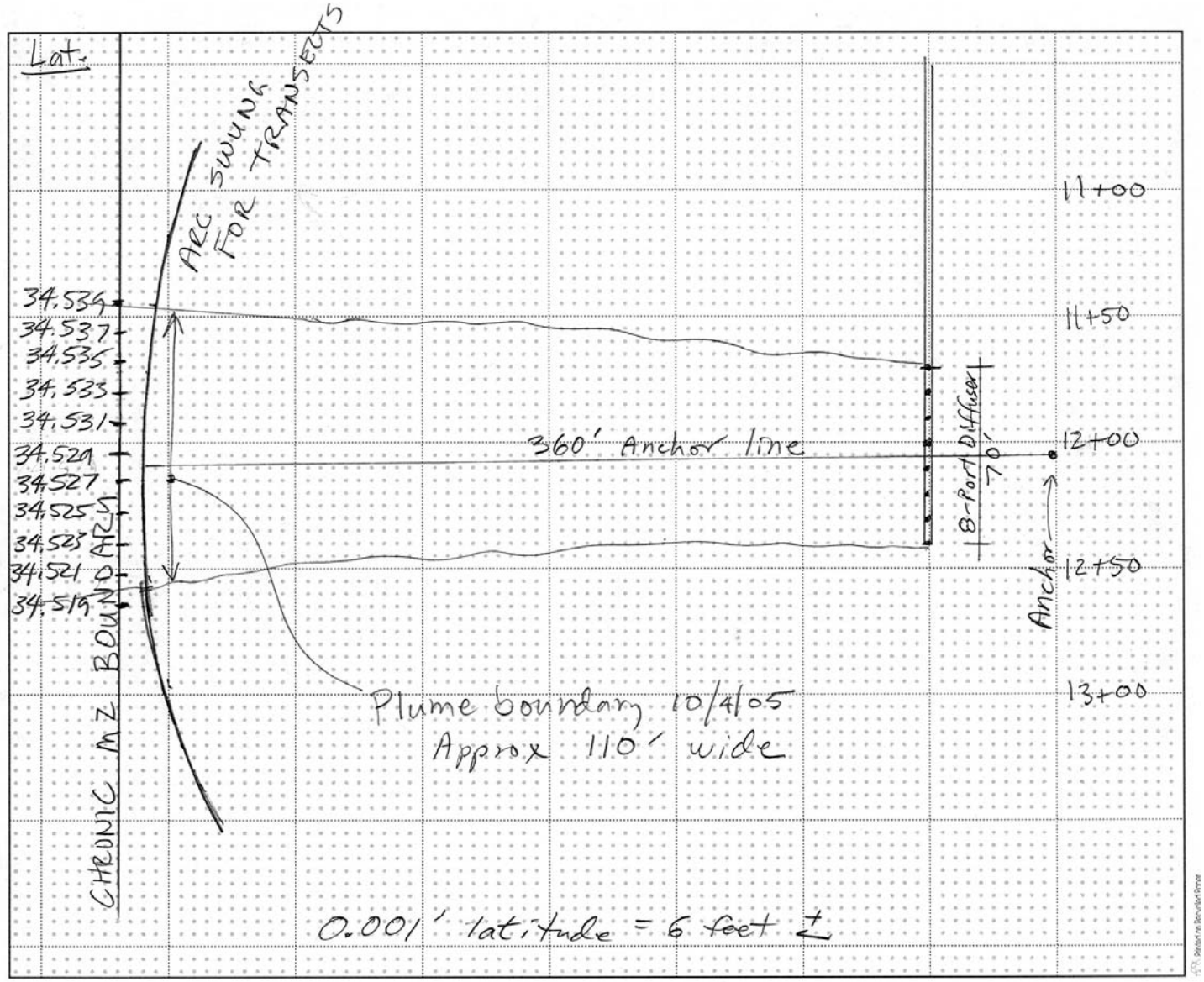



FILE: G&O016/REPORTS/DYE TRACER & MIXING ZONE STUDY/FIG 2-3-4-5-6-7-15.PPT

ENGINEERING GROUP
Civil, Environmental, and Recreational Consulting

**NO SCALE**

**Figure II-6: TRACER STUDY SITE MAP**




FILE: G&O016/REPORTS/DYE TRACER & MIXING ZONE STUDY/FIG 2-3-4-5-6-7-15.PPT

ENGINEERING GROUP
Civil, Environmental, and Recreational Consulting

***NO SCALE***

**Figure II-7: MIXING ZONE TRANSECTS**

**Table II-3 Schedule of Plume Tracer Concentration Measurements**

| Date | Time | Type |
|---|---|---|
| 10/04/05 | 6:44 – 6:50 | Profile #1 at station 12+00 |
| 10/04/05 | 6:52 – 6:59 | Transect #1 - 6 ft above bottom |
| 10/04/05 | 7:18 – 7:29 | Time series #1 - 6 ft above bottom at Sta 12+00 |
| 10/04/05 | 8:00 – 8:07 | Transect #2 - 5 ft above bottom |
| 10/04/05 | 8:24 – 8:29 | Profile #2 at station 12+05 |
| 10/04/05 | 8:34 – 8:58 | General time series – various centerline locations |
| 10/04/05 | 9:17 – 9:24 | Transect 206' downstream from diffuser |
| 10/04/05 | 10:01 – 10:59 | Time series #2 - 4 ft above bottom at Sta 12+00 |

## Tabular Results

Raw fluorometer data and calculated plume concentration data are tabulated and provided in Attachment II-1. The information on each table includes the date and time of measurement, fluorescence (i.e., the tracer concentration), height of the fluorometer above the river bottom, cross-channel stationing, effluent concentration, background concentration, calculated effluent volume fraction, and dilution. Effluent volume fraction is the proportion of the measured parcel of ambient water consisting of effluent. For example, 0.3% effluent fraction would consist of 3 parts effluent to 997 parts ambient water. Dilution factor is merely the inverse of effluent volume fraction.

## Graphical Results

The tracer concentration measurements (i.e., effluent volume fraction) are shown graphically in Figures II-8 through II-14. There were three characteristic periods for these measurements, as described below:

- Figures II-8 through II-11 reveal relatively stable plume conditions prior to 8:30 a.m., because ambient current speed was low (approximately 25 cm/sec) and relatively stable during this period. This was the slack tide period representing critical conditions.

- Current speed increased steadily and rapidly between 8:30 and 10:00 a.m., which is revealed in Figures II-12 through II-13. Effluent flows were also greater during this period.

- The time series in Figure II-14 was during relatively stable currents approximately three times higher than the early morning condition. Measurements were at plume centerline.

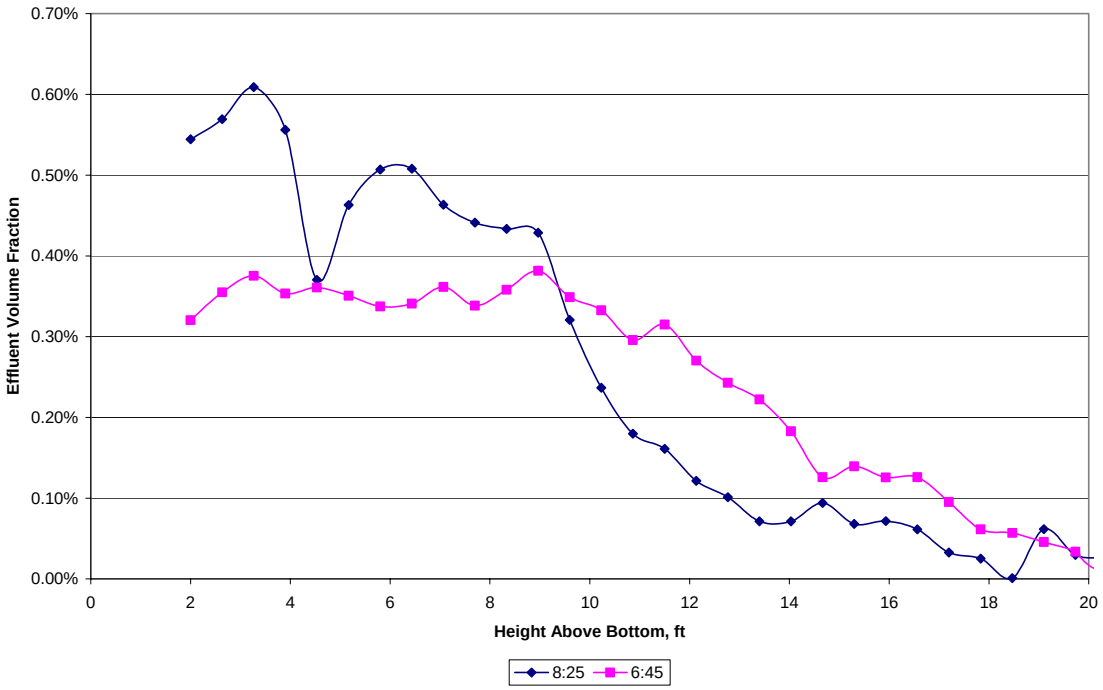



**Figure II-8. Slack Tide Profiles**

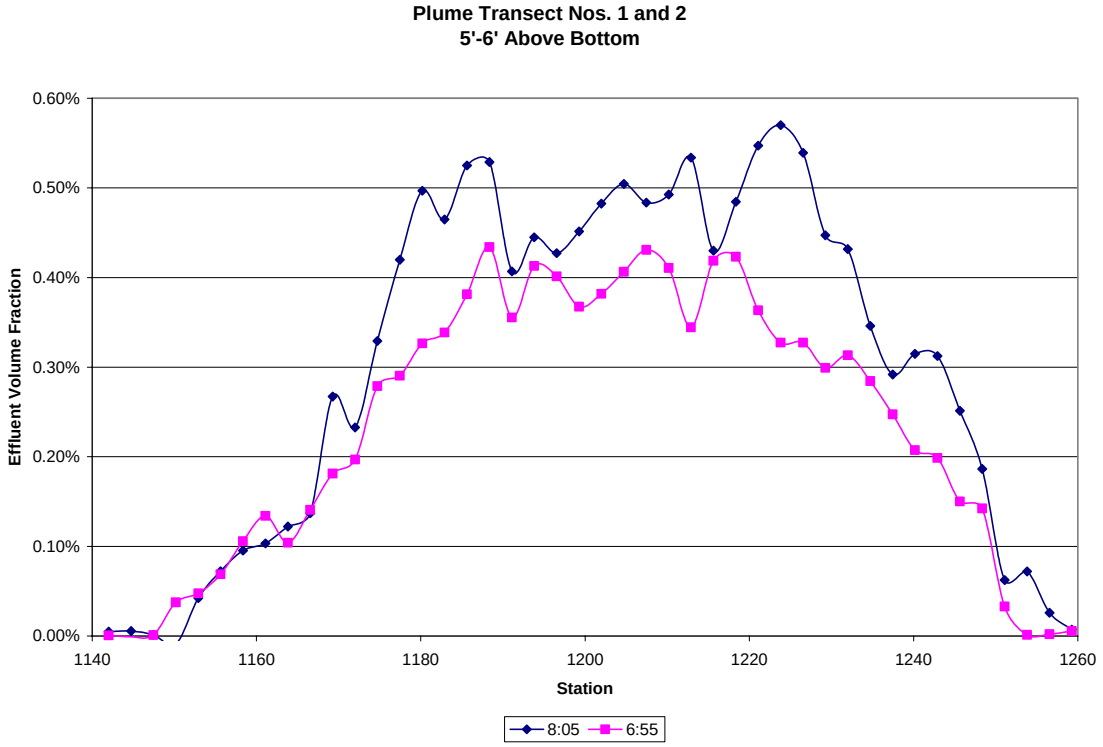



**Figure II-9. Slack Tide Transects**

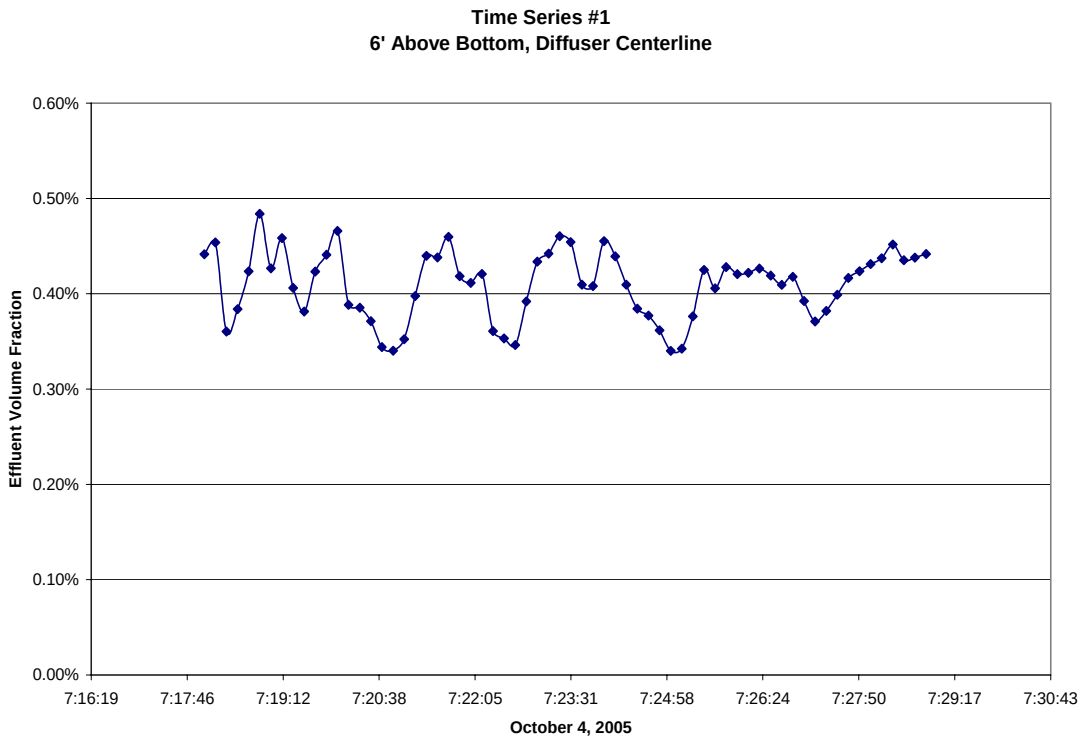



**Figure II-10. Slack Tide Time Series**

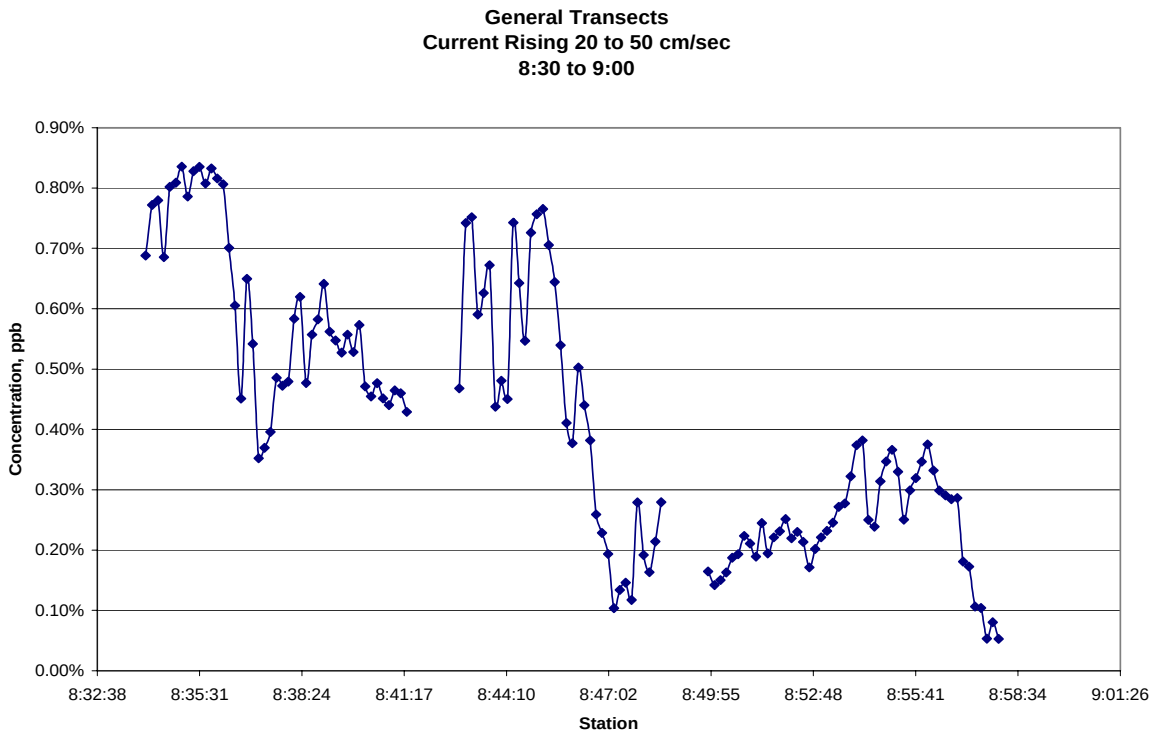



**Figure II-11. General Transects During Increasing Currents**

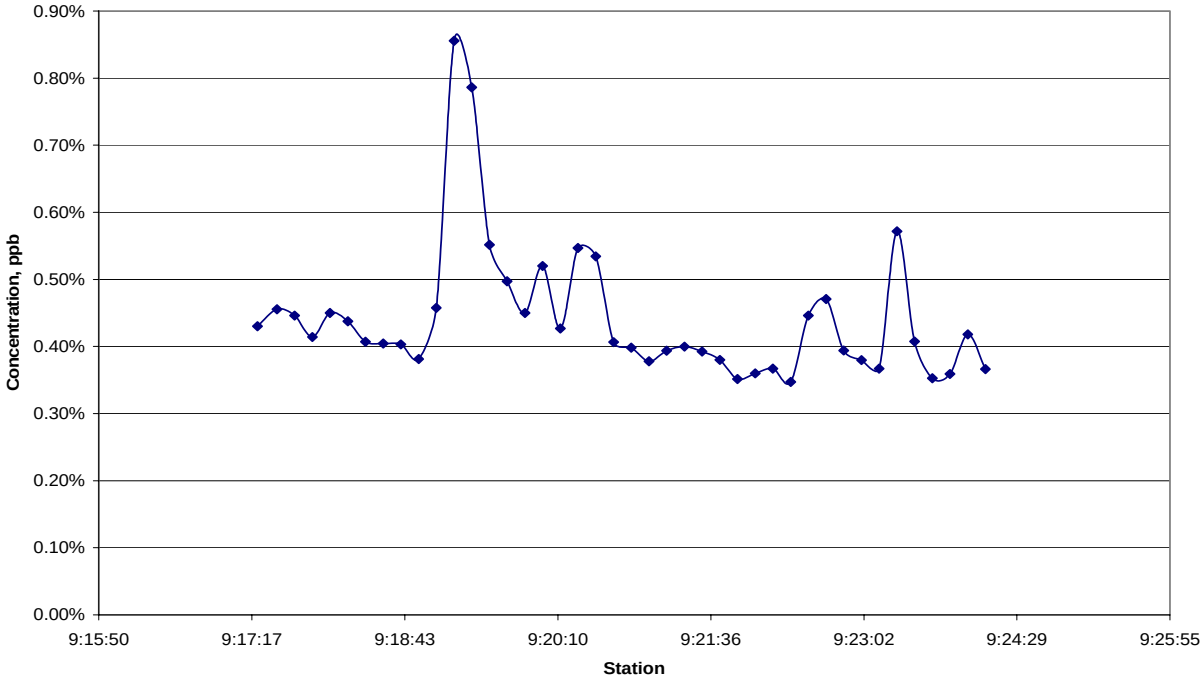



**Figure II-12. General Transect 206 Feet Downstream From Diffuser – Increasing Currents**

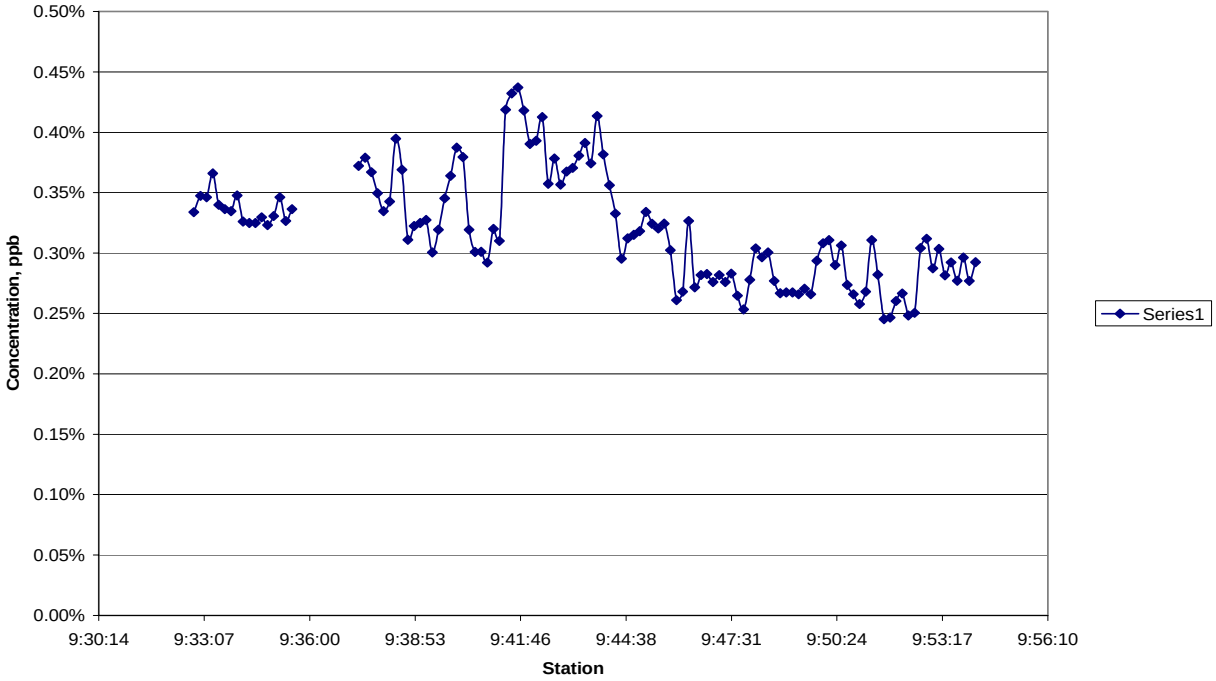



**Figure II-13. General Transects 314 Feet Downstream From Diffuser – Increasing Currents**

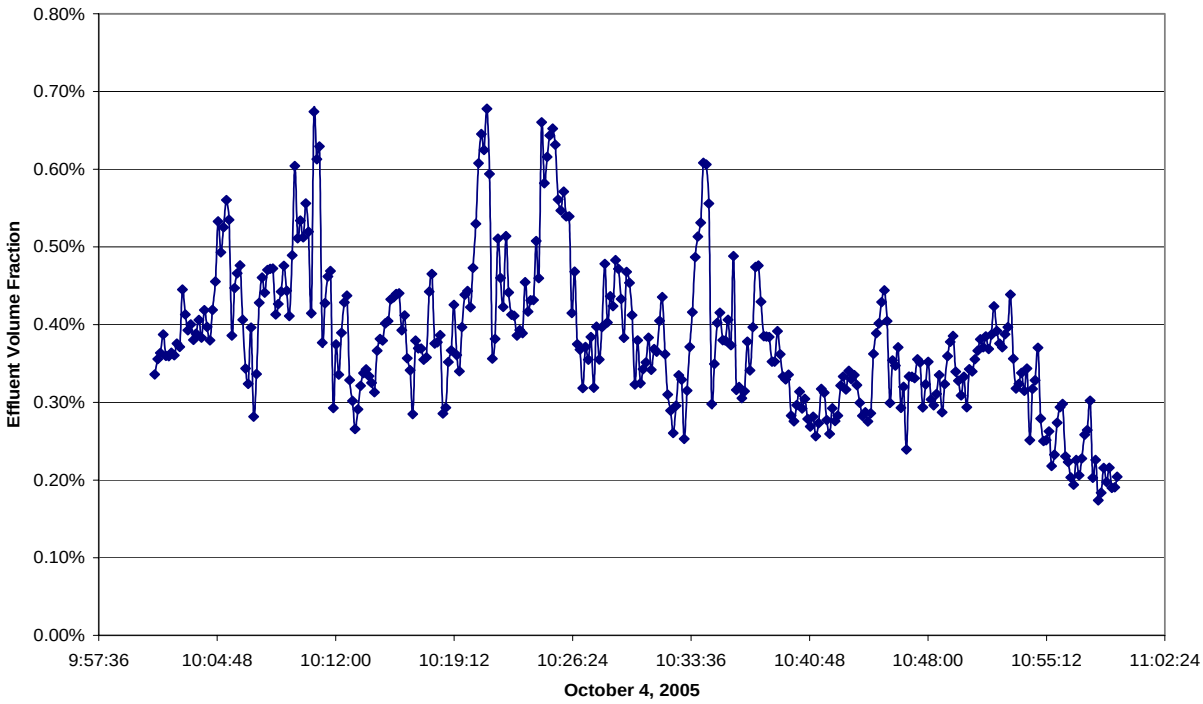



**Figure II-14. Maximum Current Time Series – Plume Centerline**

## Comprehensive Plume Cross-Section

Figures II-8 and II-9 provide the best 3-dimensional data of plume concentration during the critical ambient conditions at slack water (i.e., minimum current speed). These data were combined and extrapolated to simulate the comprehensive distribution of effluent concentration at the downstream mixing zone boundary. Figure II-15 provides a table of effluent volume fraction across the downstream boundary during the low current data (approximately 6:45 through 8:25 a.m.). Each cell is 0.67 ft high by 5.55 ft wide.

Enclosure 2 of Ecology's comments dated May 5, 2006 presented the following equation to quantify peak and average plume concentration:

$$\frac{C_{\max}}{C_{avg}} = \frac{C_{\max}\int_A vdA}{\int_A CvdA}$$

Where: v and C = velocity and concentration of the cross-sectional element dA

The data in Figure II-15 may be used in a finite element solution to the equation above. Elemental concentration data for each cell in the denominator are taken directly from

Figure II-15. The peak concentration ($C_{max}$ in the equation above) is taken as the 95$^{th}$ percentile value. It is critical to not use instantaneous peak concentrations, but to establish a time-averaged concentration at the plume centerline. The 95$^{th}$ percentile of all non-zero concentrations was selected for the peak time-averaged plume concentration.

The tables developed for this calculation are provided in Attachment II-2, and described below:

Table A. This is Table II-15. The data are the effluent concentration, in percent effluent, interpolated from transects and profiles between 6:40 and 7:00 a.m. and again between 8:00 and 8:30 a.m. (Figures II-8 and II-9).

Table B. This table includes the velocity profile for the period from 6:40 to 7:00 a.m. and 8:00 to 8:30 a.m. The data were determined from the ADCP current meter deployed upstream of the diffuser. Note that the current speed varies vertically, but is uniform horizontally at all depths.

Table C. This table is the current flux through each cell (v*dA). It is the product of the cell area and the velocity from Table B.

Table D. This table is the effluent flux through each cell (C*v*dA). It is the product of the cell area and Tables A and B. Note the integral of these cells is the total effluent flow, calculated at 2.32 mgd.

Table E. This table is effluent flux through each cell, with the cells less than 0.001 mgd deleted. The integral of this table of 824 cells is 2.19 mgd. The effluent mass flux through this control area is 95 percent of the total (i.e., 95 percent recovery).

Table F. This table is the current flux through the same 824 cell control area. The flux-average effluent concentration is the integral of Table E divided by the integral of Table F = 0.23 percent, or a dilution factor of 433.

Table G. This table has the same values as Table A for only the 824 cells in the control area. The 95$^{th}$ percentile concentration is 0.48 percent effluent, or a dilution factor of 210. The resulting peak-to-mean ratio is 0.48/0.23 = 2.1.

## CROSS-CHANNEL STATIONING, FT

**Table A. Effluent fraction cross section from transects and profiles 6:40 to 7:00 and 8:00 to 8:30**

| HEIGHT ABOVE BOTTOM, FT | 1152.9 | 1158.4 | 1163.8 | 1169.3 | 1174.7 | 1180.2 | 1185.6 | 1191.1 | 1196.5 | 1202.0 | 1207.5 | 1212.9 | 1218.4 | 1223.8 | 1229.3 | 1234.7 | 1240.2 | 1245.6 | 1251.1 | 1256.5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **21.33** | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | **0.00%** | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| **20.67** | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | **0.00%** | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| **20.00** | 0.00% | 0.00% | 0.00% | 0.01% | 0.01% | 0.02% | 0.02% | 0.02% | **0.02%** | 0.02% | 0.02% | 0.02% | 0.02% | 0.02% | 0.02% | 0.01% | 0.01% | 0.01% | 0.00% | 0.00% |
| **19.33** | 0.00% | 0.01% | 0.01% | 0.02% | 0.02% | 0.03% | 0.03% | 0.03% | **0.03%** | 0.03% | 0.03% | 0.03% | 0.03% | 0.03% | 0.03% | 0.02% | 0.02% | 0.02% | 0.00% | 0.00% |
| **18.67** | 0.01% | 0.01% | 0.01% | 0.03% | 0.04% | 0.05% | 0.06% | 0.05% | **0.05%** | 0.06% | 0.06% | 0.06% | 0.06% | 0.06% | 0.05% | 0.04% | 0.03% | 0.03% | 0.01% | 0.00% |
| **18.00** | 0.00% | 0.01% | 0.01% | 0.02% | 0.02% | 0.03% | 0.03% | 0.03% | **0.03%** | 0.03% | 0.03% | 0.03% | 0.03% | 0.03% | 0.03% | 0.02% | 0.02% | 0.01% | 0.00% | 0.00% |
| **17.33** | 0.00% | 0.01% | 0.01% | 0.02% | 0.03% | 0.04% | 0.05% | 0.04% | **0.04%** | 0.05% | 0.05% | 0.05% | 0.05% | 0.05% | 0.04% | 0.03% | 0.03% | 0.02% | 0.00% | 0.00% |
| **16.67** | 0.01% | 0.02% | 0.02% | 0.03% | 0.05% | 0.06% | 0.07% | 0.06% | **0.06%** | 0.07% | 0.07% | 0.07% | 0.07% | 0.07% | 0.06% | 0.05% | 0.04% | 0.03% | 0.01% | 0.00% |
| **16.00** | 0.01% | 0.02% | 0.03% | 0.05% | 0.07% | 0.09% | 0.10% | 0.09% | **0.09%** | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.08% | 0.07% | 0.06% | 0.05% | 0.01% | 0.00% |
| **15.33** | 0.01% | 0.02% | 0.03% | 0.05% | 0.07% | 0.10% | 0.11% | 0.09% | **0.10%** | 0.10% | 0.11% | 0.10% | 0.11% | 0.11% | 0.09% | 0.08% | 0.06% | 0.05% | 0.01% | 0.00% |
| **14.67** | 0.01% | 0.03% | 0.03% | 0.06% | 0.08% | 0.10% | 0.11% | 0.10% | **0.10%** | 0.11% | 0.11% | 0.11% | 0.11% | 0.11% | 0.09% | 0.08% | 0.07% | 0.05% | 0.01% | 0.00% |
| **14.00** | 0.01% | 0.03% | 0.03% | 0.06% | 0.08% | 0.11% | 0.12% | 0.10% | **0.11%** | 0.11% | 0.12% | 0.12% | 0.12% | 0.12% | 0.10% | 0.08% | 0.07% | 0.05% | 0.01% | 0.00% |
| **13.33** | 0.01% | 0.03% | 0.03% | 0.07% | 0.09% | 0.13% | 0.14% | 0.12% | **0.13%** | 0.13% | 0.14% | 0.13% | 0.14% | 0.14% | 0.11% | 0.10% | 0.08% | 0.06% | 0.01% | 0.00% |
| **12.67** | 0.02% | 0.04% | 0.04% | 0.08% | 0.11% | 0.15% | 0.16% | 0.13% | **0.15%** | 0.15% | 0.16% | 0.16% | 0.16% | 0.16% | 0.13% | 0.11% | 0.09% | 0.07% | 0.02% | 0.00% |
| **12.00** | 0.02% | 0.04% | 0.05% | 0.09% | 0.13% | 0.17% | 0.19% | 0.16% | **0.17%** | 0.18% | 0.19% | 0.18% | 0.19% | 0.19% | 0.16% | 0.13% | 0.11% | 0.08% | 0.02% | 0.01% |
| **11.33** | 0.02% | 0.05% | 0.05% | 0.11% | 0.14% | 0.19% | 0.21% | 0.18% | **0.20%** | 0.20% | 0.22% | 0.21% | 0.21% | 0.21% | 0.18% | 0.15% | 0.12% | 0.09% | 0.02% | 0.01% |
| **10.67** | 0.03% | 0.06% | 0.06% | 0.13% | 0.17% | 0.24% | 0.26% | 0.22% | **0.24%** | 0.25% | 0.26% | 0.25% | 0.26% | 0.26% | 0.21% | 0.18% | 0.15% | 0.12% | 0.03% | 0.01% |
| **10.00** | 0.03% | 0.06% | 0.06% | 0.13% | 0.17% | 0.24% | 0.26% | 0.22% | **0.24%** | 0.25% | 0.26% | 0.25% | 0.26% | 0.26% | 0.21% | 0.18% | 0.15% | 0.12% | 0.03% | 0.01% |
| **9.33** | 0.03% | 0.07% | 0.08% | 0.15% | 0.21% | 0.28% | 0.31% | 0.26% | **0.28%** | 0.30% | 0.31% | 0.30% | 0.31% | 0.31% | 0.26% | 0.22% | 0.18% | 0.14% | 0.03% | 0.01% |
| **8.67** | 0.04% | 0.08% | 0.09% | 0.18% | 0.25% | 0.33% | 0.37% | 0.31% | **0.33%** | 0.35% | 0.37% | 0.35% | 0.37% | 0.36% | 0.30% | 0.25% | 0.21% | 0.16% | 0.04% | 0.01% |
| **8.00** | 0.04% | 0.10% | 0.11% | 0.22% | 0.30% | 0.40% | 0.44% | 0.37% | **0.41%** | 0.42% | 0.45% | 0.43% | 0.44% | 0.44% | 0.37% | 0.31% | 0.26% | 0.20% | 0.05% | 0.01% |
| **7.33** | 0.04% | 0.10% | 0.11% | 0.21% | 0.29% | 0.39% | 0.43% | 0.36% | **0.40%** | 0.41% | 0.44% | 0.42% | 0.43% | 0.43% | 0.36% | 0.30% | 0.25% | 0.19% | 0.05% | 0.01% |
| **6.67** | 0.04% | 0.09% | 0.11% | 0.21% | 0.29% | 0.39% | 0.43% | 0.36% | **0.39%** | 0.41% | 0.43% | 0.41% | 0.43% | 0.42% | 0.35% | 0.30% | 0.25% | 0.19% | 0.04% | 0.01% |
| **6.00** | **0.04%** | **0.10%** | **0.11%** | **0.22%** | **0.30%** | **0.41%** | **0.45%** | **0.38%** | **0.41%** | **0.43%** | **0.46%** | **0.44%** | **0.45%** | **0.45%** | **0.37%** | **0.32%** | **0.26%** | **0.20%** | **0.05%** | **0.01%** |
| **5.33** | 0.05% | 0.10% | 0.12% | 0.23% | 0.31% | 0.42% | 0.46% | 0.39% | **0.42%** | 0.44% | 0.47% | 0.45% | 0.47% | 0.46% | 0.38% | 0.32% | 0.27% | 0.21% | 0.05% | 0.01% |
| **4.67** | 0.05% | 0.10% | 0.12% | 0.23% | 0.31% | 0.42% | 0.46% | 0.39% | **0.42%** | 0.44% | 0.47% | 0.45% | 0.46% | 0.46% | 0.38% | 0.32% | 0.27% | 0.20% | 0.05% | 0.01% |
| **4.00** | 0.04% | 0.10% | 0.11% | 0.22% | 0.30% | 0.40% | 0.45% | 0.37% | **0.41%** | 0.42% | 0.45% | 0.43% | 0.45% | 0.44% | 0.37% | 0.31% | 0.26% | 0.20% | 0.05% | 0.01% |
| **3.33** | 0.04% | 0.09% | 0.10% | 0.20% | 0.27% | 0.36% | 0.40% | 0.34% | **0.37%** | 0.38% | 0.40% | 0.39% | 0.40% | 0.40% | 0.33% | 0.28% | 0.23% | 0.18% | 0.04% | 0.01% |
| **2.67** | 0.05% | 0.11% | 0.12% | 0.25% | 0.33% | 0.45% | 0.50% | 0.42% | **0.45%** | 0.47% | 0.50% | 0.48% | 0.50% | 0.49% | 0.41% | 0.35% | 0.29% | 0.22% | 0.05% | 0.02% |
| **2.00** | 0.05% | 0.12% | 0.13% | 0.27% | 0.36% | 0.49% | 0.54% | 0.45% | **0.49%** | 0.51% | 0.54% | 0.52% | 0.54% | 0.53% | 0.44% | 0.37% | 0.31% | 0.24% | 0.06% | 0.02% |
| **1.33** | 0.05% | 0.11% | 0.13% | 0.25% | 0.34% | 0.46% | 0.51% | 0.43% | **0.46%** | 0.48% | 0.51% | 0.49% | 0.51% | 0.50% | 0.42% | 0.35% | 0.29% | 0.22% | 0.05% | 0.02% |
| **0.67** | 0.05% | 0.11% | 0.12% | 0.23% | 0.32% | 0.43% | 0.47% | 0.40% | **0.43%** | 0.45% | 0.48% | 0.46% | 0.47% | 0.47% | 0.39% | 0.33% | 0.27% | 0.21% | 0.05% | 0.01% |

**95% CONCENTRATION=0.48% (DILUTION=210)**
**FLUX-AVG CONCENTRATION=0.23% (DILUTION=430)**

**Notes:**

1. **Printed numbers are effluent concentration for each cell (5.5'W x 0.67'H).**

FILE: G&O016/REPORTS/DYE TRACER & MIXING ZONE STUDY/FIG 2-3-4-5-6-7-15.PPT

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**Figure II-15: EFFLUENT PLUME SECTION AT CHRONIC MIXING ZONE BOUNDARY 6:45-8:25 – October 4, 2005**

## MODEL CALIBRATION

### Summary of Dye Study No. 1

Data from the first dye study were used in a comparison of CORMIX2, UM3, and DKHW. CORMIX2 and DKHW overestimated dilution at the mixing zone boundary. The UM3 model with default calibration parameters significantly underestimated both flux-average and centerline dilution factors compared to observed data. The principal calibration parameter used in UM3 to adjust model predictions to observed data is the Aspiration Entrainment Coefficient (AEC). Additional UM3 model runs were made, adjusting the AEC from 0.1 to 2.0. The resulting dilution prediction at an AEC of 1.3 approached the observed dilution values, suggesting that UM3 may be suitable for this project if properly calibrated.

### Results of Dye Study No. 2 – Low Current Speed

The UM3 model was run at AEC values ranging from 0.2 to 1.0 to best fit the observed concentration data illustrated in Figure II-15. The results are presented in Table II-4. The AEC of 0.6 to 0.8 matched the observed flux-averaged concentration data. None of the predicted centerline dilutions approached the observed peak dilution factor, suggesting that the peak-to-mean algorithm used in UM3 is too conservative (i.e., high). Model output is provided in Attachment II-3.

**Table II-4 Summary of UM3 Dilution Model Calibration**

| Aspiration Entrainment Coefficient | Flux-average Dilution | Centerline Dilution |
|---|---|---|
| 0.2 | 344 | 146 |
| 0.4 | 388 | 166 |
| 0.6 | 420 | 180 |
| 0.8 | 437 | 188 |
| 1.0 | 445 | 193 |

### Results of Dye Study No. 2 – Peak Current Speed

The sampler was positioned near the plume centerline (Station 12+00) at a depth of 4 feet above the bottom between 10:00 and 11:00 a.m. during the second dye study (Figure II-14). As shown in Figure II-3, this was a period of relatively stable peak current speed after the tidal influence had waned. The purpose of this sampling location was to measure the centerline plume concentration.

Figure II-14 clearly shows high frequency temporal variations ranging from 0.3 to 0.7 percent effluent. The one-hour average of the data in Figure II-14 is 0.38 percent effluent (dilution=260). The sampler was clearly at the plume centerline in a plan view, but was held 4 feet above the bottom, thus not at the vertical centerline. The sampler would have needed to be at above 2 feet above bottom to be at the true plume centerline.

If a Gaussian profile is fitted to the vertical profile data, centered at 2 feet above bottom, the ratio of concentration at 4 feet to concentration at 2 feet would be about 80 to 90 percent. As shown in the data in Figure II-14, the ratio near Station 12+00 between 2 feet and 4 feet above bottom is about 5/6. Thus, we can confidently say that for the time-averaged dilution of 260 at 4 feet above the bottom, the dilution factor 2 feet off the bottom was about 210. THIS IS THE TIME-AVERAGED CENTERLINE DILUTION for a one-hour period of relatively steady ambient conditions between 10:00 and 11:00 a.m.

These conditions were modeled using the calibrated UM3 (Attachment II-2). The results show flux-average dilution of 403 and centerline dilution of 114 at the chronic boundary. Since the observed centerline dilution is estimated at 210, this suggests that the peak-to-mean algorithm in UM3 is too high. The peak-to-mean ratio to fit observed centerline dilution to the model flux-average dilution should be on the order of 2 (210/114).

## CONCLUSIONS AND RECOMMENDATIONS

The October dye study successfully captured critical low-flow ambient current conditions, which are a combination of tidal influence and Bonneville Dam release rates. Comprehensive current speed profiles and water surface elevation data were provided by an ADCP mooring deployed for two days.

Extensive tracer concentration data were obtained throughout the plume at the downstream mixing zone boundary, particularly during the critical low current speed period from 6:45 through 8:25 a.m. The observed critical dilution factors were approximately 430:1 for flux-average, and 210:1 for centerline. The UM3 model was run over a range of aspiration entrainment coefficients (AEC). Best fit to the observed data for flux-average dilution was an AEC of 0.6 to 0.8.

# ATTACHMENT II-1:
# TABULAR PLUME DATA FOR DYE STUDY NO. 2

**Profile #1**

| Entry # | Date | Time | Fluor | Height | Station | Conc Eff ppb | Conc BG ppb | Effluent Fraction | Dilution |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2005:10:04 | 6:44:10 | 5.904 | 2 | 1200 | 1156 | 2.2 | 0.32% | 312.0662 |
| 2 | 2005:10:04 | 6:44:20 | 6.302 | 2.5625 | 1200 | 1156 | 2.2 | 0.35% | 281.7877 |
| 3 | 2005:10:04 | 6:44:30 | 6.538 | 3.125 | 1200 | 1156 | 2.2 | 0.38% | 266.4576 |
| 4 | 2005:10:04 | 6:44:40 | 6.285 | 3.6875 | 1200 | 1156 | 2.2 | 0.35% | 282.9604 |
| 5 | 2005:10:04 | 6:44:50 | 6.372 | 4.25 | 1200 | 1156 | 2.2 | 0.36% | 277.0597 |
| 6 | 2005:10:04 | 6:45:00 | 6.252 | 4.8125 | 1200 | 1156 | 2.2 | 0.35% | 285.2648 |
| 7 | 2005:10:04 | 6:45:10 | 6.099 | 5.375 | 1200 | 1156 | 2.2 | 0.34% | 296.4589 |
| 8 | 2005:10:04 | 6:45:20 | 6.139 | 5.9375 | 1200 | 1156 | 2.2 | 0.34% | 293.4484 |
| 9 | 2005:10:04 | 6:45:30 | 6.381 | 6.5 | 1200 | 1156 | 2.2 | 0.36% | 276.4633 |
| 10 | 2005:10:04 | 6:45:40 | 6.112 | 7.0625 | 1200 | 1156 | 2.2 | 0.34% | 295.4737 |
| 11 | 2005:10:04 | 6:45:50 | 6.34 | 7.625 | 1200 | 1156 | 2.2 | 0.36% | 279.2012 |
| 12 | 2005:10:04 | 6:46:00 | 6.61 | 8.1875 | 1200 | 1156 | 2.2 | 0.38% | 262.1073 |
| 13 | 2005:10:04 | 6:46:10 | 6.234 | 8.75 | 1200 | 1156 | 2.2 | 0.35% | 286.5377 |
| 14 | 2005:10:04 | 6:46:20 | 6.046 | 9.3125 | 1200 | 1156 | 2.2 | 0.33% | 300.5442 |
| 15 | 2005:10:04 | 6:46:30 | 5.618 | 9.875 | 1200 | 1156 | 2.2 | 0.30% | 338.1782 |
| 16 | 2005:10:04 | 6:46:40 | 5.84 | 10.4375 | 1200 | 1156 | 2.2 | 0.31% | 317.553 |
| 17 | 2005:10:04 | 6:46:50 | 5.325 | 11 | 1200 | 1156 | 2.2 | 0.27% | 369.8858 |
| 18 | 2005:10:04 | 6:47:00 | 5.007 | 11.5625 | 1200 | 1156 | 2.2 | 0.24% | 411.7895 |
| 19 | 2005:10:04 | 6:47:10 | 4.767 | 12.125 | 1200 | 1156 | 2.2 | 0.22% | 450.2895 |
| 20 | 2005:10:04 | 6:47:20 | 4.313 | 12.6875 | 1200 | 1156 | 2.2 | 0.18% | 547.0388 |
| 21 | 2005:10:04 | 6:47:30 | 3.656 | 13.25 | 1200 | 1156 | 2.2 | 0.13% | 793.8826 |
| 22 | 2005:10:04 | 6:47:40 | 3.81 | 13.8125 | 1200 | 1156 | 2.2 | 0.14% | 717.946 |
| 23 | 2005:10:04 | 6:47:50 | 3.653 | 14.375 | 1200 | 1156 | 2.2 | 0.13% | 795.5217 |
| 24 | 2005:10:04 | 6:48:00 | 3.657 | 14.9375 | 1200 | 1156 | 2.2 | 0.13% | 793.3377 |
| 25 | 2005:10:04 | 6:48:10 | 3.3 | 15.5 | 1200 | 1156 | 2.2 | 0.10% | 1050.812 |
| 26 | 2005:10:04 | 6:48:20 | 2.908 | 16.0625 | 1200 | 1156 | 2.2 | 0.06% | 1632.617 |
| 27 | 2005:10:04 | 6:48:30 | 2.856 | 16.625 | 1200 | 1156 | 2.2 | 0.06% | 1762.032 |
| 28 | 2005:10:04 | 6:48:40 | 2.728 | 17.1875 | 1200 | 1156 | 2.2 | 0.05% | 2189.191 |
| 29 | 2005:10:04 | 6:48:50 | 2.59 | 17.75 | 1200 | 1156 | 2.2 | 0.03% | 2963.828 |
| 30 | 2005:10:04 | 6:49:00 | 2.298 | 18.3125 | 1200 | 1156 | 2.2 | 0.01% | |
| 31 | 2005:10:04 | 6:49:10 | 2.263 | 18.875 | 1200 | 1156 | 2.2 | 0.01% | |
| 32 | 2005:10:04 | 6:49:20 | 2.263 | 19.4375 | 1200 | 1156 | 2.2 | 0.01% | |
| 33 | 2005:10:04 | 6:49:30 | 2.205 | 20 | 1200 | 1156 | 2.2 | 0.00% | |

**Transect #1**

| Entry # | Date | Time | Fluor | Height | Station | Conc Eff ppb | Conc BG ppb | Effluent Fraction | Dilution |
|---|---|---|---|---|---|---|---|---|---|
| 34 | 2005:10:04 | 6:51:40 | 2.208 | 6 | 1142 | 1103 | 2.2 | 0.00% | |
| 35 | 2005:10:04 | 6:51:50 | 2.19 | 6 | 1144.727 | 1103 | 2.2 | 0.00% | |
| 36 | 2005:10:04 | 6:52:00 | 2.212 | 6 | 1147.455 | 1103 | 2.2 | 0.00% | |
| 37 | 2005:10:04 | 6:52:10 | 2.615 | 6 | 1150.182 | 1103 | 2.2 | 0.04% | 2658.681 |
| 38 | 2005:10:04 | 6:52:20 | 2.725 | 6 | 1152.909 | 1103 | 2.2 | 0.05% | 2101.624 |
| 39 | 2005:10:04 | 6:52:30 | 2.961 | 6 | 1155.636 | 1103 | 2.2 | 0.07% | 1449.872 |
| 40 | 2005:10:04 | 6:52:40 | 3.367 | 6 | 1158.364 | 1103 | 2.2 | 0.11% | 945.4606 |
| 41 | 2005:10:04 | 6:52:50 | 3.679 | 6 | 1161.091 | 1103 | 2.2 | 0.13% | 746.0125 |
| 42 | 2005:10:04 | 6:53:00 | 3.347 | 6 | 1163.818 | 1103 | 2.2 | 0.10% | 961.9464 |
| 43 | 2005:10:04 | 6:53:10 | 3.752 | 6 | 1166.545 | 1103 | 2.2 | 0.14% | 710.923 |
| 44 | 2005:10:04 | 6:53:20 | 4.2 | 6 | 1169.273 | 1103 | 2.2 | 0.18% | 551.6762 |
| 45 | 2005:10:04 | 6:53:30 | 4.372 | 6 | 1172 | 1103 | 2.2 | 0.20% | 507.9892 |
| 46 | 2005:10:04 | 6:53:40 | 5.277 | 6 | 1174.727 | 1103 | 2.2 | 0.28% | 358.5806 |
| 47 | 2005:10:04 | 6:53:50 | 5.404 | 6 | 1177.455 | 1103 | 2.2 | 0.29% | 344.3672 |
| 48 | 2005:10:04 | 6:54:00 | 5.802 | 6 | 1180.182 | 1103 | 2.2 | 0.33% | 306.3166 |
| 49 | 2005:10:04 | 6:54:10 | 5.937 | 6 | 1182.909 | 1103 | 2.2 | 0.34% | 295.2509 |
| 50 | 2005:10:04 | 6:54:20 | 6.408 | 6 | 1185.636 | 1103 | 2.2 | 0.38% | 262.2035 |
| 51 | 2005:10:04 | 6:54:30 | 6.988 | 6 | 1188.364 | 1103 | 2.2 | 0.43% | 230.4412 |
| 52 | 2005:10:04 | 6:54:40 | 6.12 | 6 | 1191.091 | 1103 | 2.2 | 0.36% | 281.4675 |
| 53 | 2005:10:04 | 6:54:50 | 6.755 | 6 | 1193.818 | 1103 | 2.2 | 0.41% | 242.2289 |
| 54 | 2005:10:04 | 6:55:00 | 6.628 | 6 | 1196.545 | 1103 | 2.2 | 0.40% | 249.1763 |
| 55 | 2005:10:04 | 6:55:10 | 6.255 | 6 | 1199.273 | 1103 | 2.2 | 0.37% | 272.0968 |
| 56 | 2005:10:04 | 6:55:20 | 6.413 | 6 | 1202 | 1103 | 2.2 | 0.38% | 261.8924 |
| 57 | 2005:10:04 | 6:55:30 | 6.684 | 6 | 1204.727 | 1103 | 2.2 | 0.41% | 246.0643 |
| 58 | 2005:10:04 | 6:55:40 | 6.954 | 6 | 1207.455 | 1103 | 2.2 | 0.43% | 232.0893 |
| 59 | 2005:10:04 | 6:55:50 | 6.73 | 6 | 1210.182 | 1103 | 2.2 | 0.41% | 243.5657 |
| 60 | 2005:10:04 | 6:56:00 | 5.999 | 6 | 1212.909 | 1103 | 2.2 | 0.34% | 290.4323 |
| 61 | 2005:10:04 | 6:56:10 | 6.821 | 6 | 1215.636 | 1103 | 2.2 | 0.42% | 238.7692 |
| 62 | 2005:10:04 | 6:56:20 | 6.87 | 6 | 1218.364 | 1103 | 2.2 | 0.42% | 236.2639 |
| 63 | 2005:10:04 | 6:56:30 | 6.21 | 6 | 1221.091 | 1103 | 2.2 | 0.36% | 275.1502 |
| 64 | 2005:10:04 | 6:56:40 | 5.812 | 6 | 1223.818 | 1103 | 2.2 | 0.33% | 305.4686 |
| 65 | 2005:10:04 | 6:56:50 | 5.813 | 6 | 1226.545 | 1103 | 2.2 | 0.33% | 305.384 |
| 66 | 2005:10:04 | 6:57:00 | 5.502 | 6 | 1229.273 | 1103 | 2.2 | 0.30% | 334.1467 |
| 67 | 2005:10:04 | 6:57:10 | 5.658 | 6 | 1232 | 1103 | 2.2 | 0.31% | 319.0724 |
| 68 | 2005:10:04 | 6:57:20 | 5.338 | 6 | 1234.727 | 1103 | 2.2 | 0.28% | 351.6101 |
| 69 | 2005:10:04 | 6:57:30 | 4.929 | 6 | 1237.455 | 1103 | 2.2 | 0.25% | 404.3065 |
| 70 | 2005:10:04 | 6:57:40 | 4.488 | 6 | 1240.182 | 1103 | 2.2 | 0.21% | 482.2345 |
| 71 | 2005:10:04 | 6:57:50 | 4.392 | 6 | 1242.909 | 1103 | 2.2 | 0.20% | 503.3542 |
| 72 | 2005:10:04 | 6:58:00 | 3.857 | 6 | 1245.636 | 1103 | 2.2 | 0.15% | 665.8736 |
| 73 | 2005:10:04 | 6:58:10 | 3.77 | 6 | 1248.364 | 1103 | 2.2 | 0.14% | 702.7723 |
| 74 | 2005:10:04 | 6:58:20 | 2.563 | 6 | 1251.091 | 1103 | 2.2 | 0.03% | 3039.539 |
| 75 | 2005:10:04 | 6:58:30 | 2.214 | 6 | 1253.818 | 1103 | 2.2 | 0.00% | |
| 76 | 2005:10:04 | 6:58:40 | 2.221 | 6 | 1256.545 | 1103 | 2.2 | 0.00% | |
| 77 | 2005:10:04 | 6:58:50 | 2.261 | 6 | 1259.273 | 1103 | 2.2 | 0.01% | |

**Time Series #1**

| Entry # | Date | Time | Fluor | Height | Station | Conc Eff ppb | Conc BG ppb | Effluent Fraction | Dilution |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2005:10:04 | 7:18:01 | 6.86 | 6 | 1200 | 1055 | 2.2 | 0.44% | 226.4765 |
| 2 | 2005:10:04 | 7:18:11 | 6.99 | 6 | 1200 | 1055 | 2.2 | 0.45% | 220.33 |
| 3 | 2005:10:04 | 7:18:21 | 6.003 | 6 | 1200 | 1055 | 2.2 | 0.36% | 277.5127 |
| 4 | 2005:10:04 | 7:18:31 | 6.251 | 6 | 1200 | 1055 | 2.2 | 0.38% | 260.5235 |
| 5 | 2005:10:04 | 7:18:41 | 6.67 | 6 | 1200 | 1055 | 2.2 | 0.42% | 236.1031 |
| 6 | 2005:10:04 | 7:18:51 | 7.307 | 6 | 1200 | 1055 | 2.2 | 0.48% | 206.6537 |
| 7 | 2005:10:04 | 7:19:01 | 6.704 | 6 | 1200 | 1055 | 2.2 | 0.43% | 234.3207 |
| 8 | 2005:10:04 | 7:19:11 | 7.038 | 6 | 1200 | 1055 | 2.2 | 0.46% | 218.144 |
| 9 | 2005:10:04 | 7:19:21 | 6.486 | 6 | 1200 | 1055 | 2.2 | 0.41% | 246.2391 |
| 10 | 2005:10:04 | 7:19:31 | 6.224 | 6 | 1200 | 1055 | 2.2 | 0.38% | 262.2715 |
| 11 | 2005:10:04 | 7:19:41 | 6.668 | 6 | 1200 | 1055 | 2.2 | 0.42% | 236.2087 |
| 12 | 2005:10:04 | 7:19:51 | 6.852 | 6 | 1200 | 1055 | 2.2 | 0.44% | 226.866 |
| 13 | 2005:10:04 | 7:20:01 | 7.118 | 6 | 1200 | 1055 | 2.2 | 0.47% | 214.5955 |
| 14 | 2005:10:04 | 7:20:11 | 6.298 | 6 | 1200 | 1055 | 2.2 | 0.39% | 257.5355 |
| 15 | 2005:10:04 | 7:20:21 | 6.267 | 6 | 1200 | 1055 | 2.2 | 0.39% | 259.4986 |
| 16 | 2005:10:04 | 7:20:31 | 6.118 | 6 | 1200 | 1055 | 2.2 | 0.37% | 269.3672 |
| 17 | 2005:10:04 | 7:20:41 | 5.832 | 6 | 1200 | 1055 | 2.2 | 0.34% | 290.5784 |
| 18 | 2005:10:04 | 7:20:51 | 5.792 | 6 | 1200 | 1055 | 2.2 | 0.34% | 293.8142 |
| 19 | 2005:10:04 | 7:21:01 | 5.918 | 6 | 1200 | 1055 | 2.2 | 0.35% | 283.8571 |
| 20 | 2005:10:04 | 7:21:11 | 6.397 | 6 | 1200 | 1055 | 2.2 | 0.40% | 251.4607 |
| 21 | 2005:10:04 | 7:21:21 | 6.843 | 6 | 1200 | 1055 | 2.2 | 0.44% | 227.3058 |
| 22 | 2005:10:04 | 7:21:31 | 6.825 | 6 | 1200 | 1055 | 2.2 | 0.44% | 228.1904 |
| 23 | 2005:10:04 | 7:21:41 | 7.053 | 6 | 1200 | 1055 | 2.2 | 0.46% | 217.4697 |
| 24 | 2005:10:04 | 7:21:51 | 6.617 | 6 | 1200 | 1055 | 2.2 | 0.42% | 238.9361 |
| 25 | 2005:10:04 | 7:22:01 | 6.542 | 6 | 1200 | 1055 | 2.2 | 0.41% | 243.0633 |
| 26 | 2005:10:04 | 7:22:11 | 6.641 | 6 | 1200 | 1055 | 2.2 | 0.42% | 237.6448 |
| 27 | 2005:10:04 | 7:22:21 | 6.007 | 6 | 1200 | 1055 | 2.2 | 0.36% | 277.2211 |
| 28 | 2005:10:04 | 7:22:31 | 5.928 | 6 | 1200 | 1055 | 2.2 | 0.35% | 283.0957 |
| 29 | 2005:10:04 | 7:22:41 | 5.853 | 6 | 1200 | 1055 | 2.2 | 0.35% | 288.9079 |
| 30 | 2005:10:04 | 7:22:51 | 6.336 | 6 | 1200 | 1055 | 2.2 | 0.39% | 255.1694 |
| 31 | 2005:10:04 | 7:23:01 | 6.778 | 6 | 1200 | 1055 | 2.2 | 0.43% | 230.5331 |
| 32 | 2005:10:04 | 7:23:11 | 6.867 | 6 | 1200 | 1055 | 2.2 | 0.44% | 226.1368 |
| 33 | 2005:10:04 | 7:23:21 | 7.058 | 6 | 1200 | 1055 | 2.2 | 0.46% | 217.2459 |
| 34 | 2005:10:04 | 7:23:31 | 6.994 | 6 | 1200 | 1055 | 2.2 | 0.45% | 220.1462 |
| 35 | 2005:10:04 | 7:23:41 | 6.523 | 6 | 1200 | 1055 | 2.2 | 0.41% | 244.1315 |
| 36 | 2005:10:04 | 7:23:51 | 6.506 | 6 | 1200 | 1055 | 2.2 | 0.41% | 245.0954 |
| 37 | 2005:10:04 | 7:24:01 | 7.005 | 6 | 1200 | 1055 | 2.2 | 0.46% | 219.6422 |
| 38 | 2005:10:04 | 7:24:11 | 6.835 | 6 | 1200 | 1055 | 2.2 | 0.44% | 227.6981 |
| 39 | 2005:10:04 | 7:24:21 | 6.522 | 6 | 1200 | 1055 | 2.2 | 0.41% | 244.188 |
| 40 | 2005:10:04 | 7:24:31 | 6.255 | 6 | 1200 | 1055 | 2.2 | 0.38% | 260.2665 |
| 41 | 2005:10:04 | 7:24:41 | 6.18 | 6 | 1200 | 1055 | 2.2 | 0.38% | 265.171 |
| 42 | 2005:10:04 | 7:24:51 | 6.016 | 6 | 1200 | 1055 | 2.2 | 0.36% | 276.5673 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 43 | 2005:10:04 | 7:25:01 | 5.789 | 6 | 1200 | 1055 | 2.2 | 0.34% | 294.0598 |
| 44 | 2005:10:04 | 7:25:11 | 5.814 | 6 | 1200 | 1055 | 2.2 | 0.34% | 292.0256 |
| 45 | 2005:10:04 | 7:25:21 | 6.17 | 6 | 1200 | 1055 | 2.2 | 0.38% | 265.839 |
| 46 | 2005:10:04 | 7:25:31 | 6.686 | 6 | 1200 | 1055 | 2.2 | 0.43% | 235.261 |
| 47 | 2005:10:04 | 7:25:41 | 6.483 | 6 | 1200 | 1055 | 2.2 | 0.41% | 246.4115 |
| 48 | 2005:10:04 | 7:25:51 | 6.716 | 6 | 1200 | 1055 | 2.2 | 0.43% | 233.6981 |
| 49 | 2005:10:04 | 7:26:01 | 6.638 | 6 | 1200 | 1055 | 2.2 | 0.42% | 237.8055 |
| 50 | 2005:10:04 | 7:26:11 | 6.655 | 6 | 1200 | 1055 | 2.2 | 0.42% | 236.898 |
| 51 | 2005:10:04 | 7:26:21 | 6.7 | 6 | 1200 | 1055 | 2.2 | 0.43% | 234.529 |
| 52 | 2005:10:04 | 7:26:31 | 6.623 | 6 | 1200 | 1055 | 2.2 | 0.42% | 238.6119 |
| 53 | 2005:10:04 | 7:26:41 | 6.519 | 6 | 1200 | 1055 | 2.2 | 0.41% | 244.3576 |
| 54 | 2005:10:04 | 7:26:51 | 6.61 | 6 | 1200 | 1055 | 2.2 | 0.42% | 239.3153 |
| 55 | 2005:10:04 | 7:27:01 | 6.341 | 6 | 1200 | 1055 | 2.2 | 0.39% | 254.8613 |
| 56 | 2005:10:04 | 7:27:11 | 6.115 | 6 | 1200 | 1055 | 2.2 | 0.37% | 269.5736 |
| 57 | 2005:10:04 | 7:27:21 | 6.231 | 6 | 1200 | 1055 | 2.2 | 0.38% | 261.8161 |
| 58 | 2005:10:04 | 7:27:31 | 6.41 | 6 | 1200 | 1055 | 2.2 | 0.40% | 250.6842 |
| 59 | 2005:10:04 | 7:27:41 | 6.595 | 6 | 1200 | 1055 | 2.2 | 0.42% | 240.1321 |
| 60 | 2005:10:04 | 7:27:51 | 6.671 | 6 | 1200 | 1055 | 2.2 | 0.42% | 236.0502 |
| 61 | 2005:10:04 | 7:28:01 | 6.75 | 6 | 1200 | 1055 | 2.2 | 0.43% | 231.9518 |
| 62 | 2005:10:04 | 7:28:11 | 6.816 | 6 | 1200 | 1055 | 2.2 | 0.44% | 228.6353 |
| 63 | 2005:10:04 | 7:28:21 | 6.968 | 6 | 1200 | 1055 | 2.2 | 0.45% | 221.3466 |
| 64 | 2005:10:04 | 7:28:31 | 6.793 | 6 | 1200 | 1055 | 2.2 | 0.44% | 229.7802 |
| 65 | 2005:10:04 | 7:28:41 | 6.821 | 6 | 1200 | 1055 | 2.2 | 0.44% | 228.3879 |
| 66 | 2005:10:04 | 7:28:51 | 6.861 | 6 | 1200 | 1055 | 2.2 | 0.44% | 226.4279 |
| | | | | | | | **avg** | **0.41%** | **243.9315** |

**Transect #2**

| Entry # | Date | Time | Fluor | Height | Station | Conc Eff ppb | Conc BG ppb | Effluent Fraction | Dilution |
|---|---|---|---|---|---|---|---|---|---|
| 67 | 2005:10:04 | 8:00:10 | 2.248 | 5 | 1142 | 971 | 2.2 | 0.00% | |
| 68 | 2005:10:04 | 8:00:21 | 2.254 | 5 | 1144.727 | 968 | 2.2 | 0.01% | |
| 69 | 2005:10:04 | 8:00:31 | 2.212 | 5 | 1147.455 | 964 | 2.2 | 0.00% | |
| 70 | 2005:10:04 | 8:00:41 | 2.113 | 5 | 1150.182 | 961 | 2.2 | -0.01% | |
| 71 | 2005:10:04 | 8:00:51 | 2.606 | 5 | 1152.909 | 958 | 2.2 | 0.04% | 2359.149 |
| 72 | 2005:10:04 | 8:01:01 | 2.89 | 5 | 1155.636 | 955 | 2.2 | 0.07% | 1383.458 |
| 73 | 2005:10:04 | 8:01:11 | 3.108 | 5 | 1158.364 | 951 | 2.2 | 0.10% | 1047.774 |
| 74 | 2005:10:04 | 8:01:21 | 3.181 | 5 | 1161.091 | 948 | 2.2 | 0.10% | 966.5582 |
| 75 | 2005:10:04 | 8:01:31 | 3.355 | 5 | 1163.818 | 945 | 2.2 | 0.12% | 818.2073 |
| 76 | 2005:10:04 | 8:01:41 | 3.489 | 5 | 1166.545 | 942 | 2.2 | 0.14% | 730.7108 |
| 77 | 2005:10:04 | 8:01:51 | 4.709 | 5 | 1169.273 | 939 | 2.2 | 0.27% | 374.1586 |
| 78 | 2005:10:04 | 8:02:01 | 4.378 | 5 | 1172 | 936 | 2.2 | 0.23% | 429.597 |
| 79 | 2005:10:04 | 8:02:11 | 5.27 | 5 | 1174.727 | 933 | 2.2 | 0.33% | 303.7724 |
| 80 | 2005:10:04 | 8:02:21 | 6.103 | 5 | 1177.455 | 930 | 2.2 | 0.42% | 238.1553 |
| 81 | 2005:10:04 | 8:02:31 | 6.802 | 5 | 1180.182 | 926 | 2.2 | 0.50% | 201.321 |
| 82 | 2005:10:04 | 8:02:41 | 6.493 | 5 | 1182.909 | 923 | 2.2 | 0.46% | 215.1079 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 83 | 2005:10:04 | 8:02:51 | 7.032 | 5 | 1185.636 | 920 | 2.2 | 0.52% | 190.4918 |
| 84 | 2005:10:04 | 8:03:01 | 7.051 | 5 | 1188.364 | 917 | 2.2 | 0.53% | 189.131 |
| 85 | 2005:10:04 | 8:03:11 | 5.921 | 5 | 1191.091 | 915 | 2.2 | 0.41% | 245.7704 |
| 86 | 2005:10:04 | 8:03:21 | 6.255 | 5 | 1193.818 | 912 | 2.2 | 0.44% | 224.801 |
| 87 | 2005:10:04 | 8:03:31 | 6.081 | 5 | 1196.545 | 909 | 2.2 | 0.43% | 234.1261 |
| 88 | 2005:10:04 | 8:03:41 | 6.288 | 5 | 1199.273 | 906 | 2.2 | 0.45% | 221.56 |
| 89 | 2005:10:04 | 8:03:51 | 6.556 | 5 | 1202 | 903 | 2.2 | 0.48% | 207.2657 |
| 90 | 2005:10:04 | 8:04:01 | 6.739 | 5 | 1204.727 | 900 | 2.2 | 0.50% | 198.2772 |
| 91 | 2005:10:04 | 8:04:11 | 6.538 | 5 | 1207.455 | 897 | 2.2 | 0.48% | 206.8071 |
| 92 | 2005:10:04 | 8:04:21 | 6.605 | 5 | 1210.182 | 894 | 2.2 | 0.49% | 203.0184 |
| 93 | 2005:10:04 | 8:04:31 | 6.958 | 5 | 1212.909 | 891 | 2.2 | 0.53% | 187.3647 |
| 94 | 2005:10:04 | 8:04:41 | 6.021 | 5 | 1215.636 | 889 | 2.2 | 0.43% | 232.5788 |
| 95 | 2005:10:04 | 8:04:51 | 6.492 | 5 | 1218.364 | 886 | 2.2 | 0.48% | 206.4081 |
| 96 | 2005:10:04 | 8:05:01 | 7.032 | 5 | 1221.091 | 883 | 2.2 | 0.55% | 182.7692 |
| 97 | 2005:10:04 | 8:05:11 | 7.218 | 5 | 1223.818 | 880 | 2.2 | 0.57% | 175.4474 |
| 98 | 2005:10:04 | 8:05:21 | 6.931 | 5 | 1226.545 | 878 | 2.2 | 0.54% | 185.514 |
| 99 | 2005:10:04 | 8:05:31 | 6.113 | 5 | 1229.273 | 875 | 2.2 | 0.45% | 223.6021 |
| 100 | 2005:10:04 | 8:05:41 | 5.965 | 5 | 1232 | 872 | 2.2 | 0.43% | 231.676 |
| 101 | 2005:10:04 | 8:05:51 | 5.208 | 5 | 1234.727 | 870 | 2.2 | 0.35% | 289.0897 |
| 102 | 2005:10:04 | 8:06:01 | 4.729 | 5 | 1237.455 | 867 | 2.2 | 0.29% | 342.7915 |
| 103 | 2005:10:04 | 8:06:11 | 4.921 | 5 | 1240.182 | 864 | 2.2 | 0.31% | 317.631 |
| 104 | 2005:10:04 | 8:06:21 | 4.892 | 5 | 1242.909 | 862 | 2.2 | 0.31% | 320.0759 |
| 105 | 2005:10:04 | 8:06:31 | 4.358 | 5 | 1245.636 | 859 | 2.2 | 0.25% | 398.068 |
| 106 | 2005:10:04 | 8:06:41 | 3.797 | 5 | 1248.364 | 856 | 2.2 | 0.19% | 536.2761 |
| 107 | 2005:10:04 | 8:06:51 | 2.733 | 5 | 1251.091 | 854 | 2.2 | 0.06% | 1601.971 |
| 108 | 2005:10:04 | 8:07:01 | 2.814 | 5 | 1253.818 | 851 | 2.2 | 0.07% | 1386.456 |
| 109 | 2005:10:04 | 8:07:11 | 2.421 | 5 | 1256.545 | 849 | 2.2 | 0.03% | 3840.419 |
| 110 | 2005:10:04 | 8:07:21 | 2.261 | 5 | 1259.273 | 846 | 2.2 | 0.01% | |

**Profile #2**

| Entry # | Date | Time | Fluor | Height | Station | Conc Eff ppb | Conc BG ppb | Effluent Fraction | Dilution |
|---|---|---|---|---|---|---|---|---|---|
| 111 | 2005:10:04 | 8:24:20 | 5.677 | 2 | 1200 | 639 | 2.2 | 0.54% | 183.7167 |
| 112 | 2005:10:04 | 8:24:31 | 5.836 | 2.633333 | 1200 | 639 | 2.2 | 0.57% | 175.6829 |
| 113 | 2005:10:04 | 8:24:41 | 6.09 | 3.266667 | 1200 | 639 | 2.2 | 0.61% | 164.2116 |
| 114 | 2005:10:04 | 8:24:51 | 5.752 | 3.9 | 1200 | 639 | 2.2 | 0.56% | 179.8376 |
| 115 | 2005:10:04 | 8:25:01 | 4.566 | 4.533333 | 1200 | 639 | 2.2 | 0.37% | 269.9844 |
| 116 | 2005:10:04 | 8:25:11 | 5.158 | 5.166667 | 1200 | 639 | 2.2 | 0.46% | 215.951 |
| 117 | 2005:10:04 | 8:25:21 | 5.439 | 5.8 | 1200 | 639 | 2.2 | 0.51% | 197.2161 |
| 118 | 2005:10:04 | 8:25:31 | 5.445 | 6.433333 | 1200 | 639 | 2.2 | 0.51% | 196.8515 |
| 119 | 2005:10:04 | 8:25:41 | 5.16 | 7.066667 | 1200 | 639 | 2.2 | 0.46% | 215.8051 |
| 120 | 2005:10:04 | 8:25:51 | 5.018 | 7.7 | 1200 | 639 | 2.2 | 0.44% | 226.6796 |
| 121 | 2005:10:04 | 8:26:01 | 4.969 | 8.333333 | 1200 | 639 | 2.2 | 0.43% | 230.6909 |
| 122 | 2005:10:04 | 8:26:11 | 4.939 | 8.966667 | 1200 | 639 | 2.2 | 0.43% | 233.2176 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 123 | 2005:10:04 | 8:26:21 | 4.249 | 9.6 | 1200 | 639 | 2.2 | 0.32% | 311.7535 |
| 124 | 2005:10:04 | 8:26:31 | 3.711 | 10.23333 | 1200 | 639 | 2.2 | 0.24% | 422.7551 |
| 125 | 2005:10:04 | 8:26:41 | 3.349 | 10.86667 | 1200 | 639 | 2.2 | 0.18% | 555.9469 |
| 126 | 2005:10:04 | 8:26:51 | 3.229 | 11.5 | 1200 | 639 | 2.2 | 0.16% | 620.7804 |
| 127 | 2005:10:04 | 8:27:01 | 2.976 | 12.13333 | 1200 | 639 | 2.2 | 0.12% | 823.174 |
| 128 | 2005:10:04 | 8:27:11 | 2.847 | 12.76667 | 1200 | 639 | 2.2 | 0.10% | 987.2999 |
| 129 | 2005:10:04 | 8:27:21 | 2.655 | 13.4 | 1200 | 639 | 2.2 | 0.07% | 1403.919 |
| 130 | 2005:10:04 | 8:27:31 | 2.656 | 14.03333 | 1200 | 639 | 2.2 | 0.07% | 1400.84 |
| 131 | 2005:10:04 | 8:27:41 | 2.8 | 14.66667 | 1200 | 639 | 2.2 | 0.09% | 1064.638 |
| 132 | 2005:10:04 | 8:27:51 | 2.635 | 15.3 | 1200 | 639 | 2.2 | 0.07% | 1468.467 |
| 133 | 2005:10:04 | 8:28:01 | 2.657 | 15.93333 | 1200 | 639 | 2.2 | 0.07% | 1397.775 |
| 134 | 2005:10:04 | 8:28:11 | 2.592 | 16.56667 | 1200 | 639 | 2.2 | 0.06% | 1629.549 |
| 135 | 2005:10:04 | 8:28:21 | 2.408 | 17.2 | 1200 | 639 | 2.2 | 0.03% | 3071.072 |
| 136 | 2005:10:04 | 8:28:31 | 2.361 | 17.83333 | 1200 | 639 | 2.2 | 0.03% | 3967.596 |
| 137 | 2005:10:04 | 8:28:41 | 2.207 | 18.46667 | 1200 | 639 | 2.2 | 0.00% | 91254.72 |
| 138 | 2005:10:04 | 8:28:51 | 2.594 | 19.1 | 1200 | 639 | 2.2 | 0.06% | 1621.277 |
| 139 | 2005:10:04 | 8:29:01 | 2.389 | 19.73333 | 1200 | 639 | 2.2 | 0.03% | 3379.804 |
| 140 | 2005:10:04 | 8:29:11 | 2.365 | 20.36667 | 1200 | 639 | 2.2 | 0.03% | 3871.412 |

**General Time Series near Plume Centerline**

| Entry # | Date | Time | Fluor | Height | Station | Conc Eff ppb | Conc BG ppb | Effluent Fraction | Dilution |
|---|---|---|---|---|---|---|---|---|---|
| 141 | 2005:10:04 | 8:34:00 | 6.715 | 3 | 1200 | 656 | 2.2 | 0.69% | 145.304 |
| 142 | 2005:10:04 | 8:34:11 | 7.264 | 3 | 1200 | 656 | 2.2 | 0.77% | 129.5512 |
| 143 | 2005:10:04 | 8:34:21 | 7.315 | 3 | 1200 | 656 | 2.2 | 0.78% | 128.2595 |
| 144 | 2005:10:04 | 8:34:31 | 6.697 | 3 | 1200 | 656 | 2.2 | 0.69% | 145.8856 |
| 145 | 2005:10:04 | 8:34:41 | 7.461 | 3 | 1200 | 656 | 2.2 | 0.80% | 124.7001 |
| 146 | 2005:10:04 | 8:34:51 | 7.507 | 3 | 1200 | 656 | 2.2 | 0.81% | 123.6193 |
| 147 | 2005:10:04 | 8:35:01 | 7.681 | 3 | 1200 | 656 | 2.2 | 0.84% | 119.6948 |
| 148 | 2005:10:04 | 8:35:11 | 7.355 | 3 | 1200 | 656 | 2.2 | 0.79% | 127.2643 |
| 149 | 2005:10:04 | 8:35:21 | 7.631 | 3 | 1200 | 656 | 2.2 | 0.83% | 120.7968 |
| 150 | 2005:10:04 | 8:35:31 | 7.679 | 3 | 1200 | 656 | 2.2 | 0.84% | 119.7385 |
| 151 | 2005:10:04 | 8:35:41 | 7.498 | 3 | 1200 | 656 | 2.2 | 0.81% | 123.8293 |
| 152 | 2005:10:04 | 8:35:51 | 7.662 | 3 | 1200 | 656 | 2.2 | 0.83% | 120.1112 |
| 153 | 2005:10:04 | 8:36:01 | 7.552 | 3 | 1200 | 656 | 2.2 | 0.82% | 122.5799 |
| 154 | 2005:10:04 | 8:36:11 | 7.49 | 3 | 1200 | 656 | 2.2 | 0.81% | 124.0165 |
| 155 | 2005:10:04 | 8:36:21 | 6.798 | 3 | 1200 | 656 | 2.2 | 0.70% | 142.681 |
| 156 | 2005:10:04 | 8:36:31 | 6.172 | 3 | 1200 | 656 | 2.2 | 0.61% | 165.168 |
| 157 | 2005:10:04 | 8:36:41 | 5.159 | 3 | 1200 | 656 | 2.2 | 0.45% | 221.7125 |
| 158 | 2005:10:04 | 8:36:51 | 6.461 | 3 | 1200 | 656 | 2.2 | 0.65% | 153.9656 |
| 159 | 2005:10:04 | 8:37:01 | 5.755 | 3 | 1200 | 656 | 2.2 | 0.54% | 184.5422 |
| 160 | 2005:10:04 | 8:37:11 | 4.511 | 3 | 1200 | 656 | 2.2 | 0.35% | 283.8803 |
| 161 | 2005:10:04 | 8:37:21 | 4.624 | 3 | 1200 | 656 | 2.2 | 0.37% | 270.6466 |
| 162 | 2005:10:04 | 8:37:31 | 4.797 | 3 | 1200 | 656 | 2.2 | 0.40% | 252.6174 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 163 | 2005:10:04 | 8:37:41 | 5.386 | 3 | 1200 | 656 | 2.2 | 0.49% | 205.9157 |
| 164 | 2005:10:04 | 8:37:51 | 5.298 | 3 | 1200 | 656 | 2.2 | 0.47% | 211.7648 |
| 165 | 2005:10:04 | 8:38:01 | 5.344 | 3 | 1200 | 656 | 2.2 | 0.48% | 208.6665 |
| 166 | 2005:10:04 | 8:38:11 | 6.027 | 3 | 1200 | 656 | 2.2 | 0.58% | 171.426 |
| 167 | 2005:10:04 | 8:38:21 | 6.266 | 3 | 1200 | 656 | 2.2 | 0.62% | 161.3496 |
| 168 | 2005:10:04 | 8:38:31 | 5.33 | 3 | 1200 | 656 | 2.2 | 0.48% | 209.5998 |
| 169 | 2005:10:04 | 8:38:41 | 5.854 | 3 | 1200 | 656 | 2.2 | 0.56% | 179.5423 |
| 170 | 2005:10:04 | 8:38:51 | 6.021 | 3 | 1200 | 656 | 2.2 | 0.58% | 171.6952 |
| 171 | 2005:10:04 | 8:39:01 | 6.407 | 3 | 1200 | 656 | 2.2 | 0.64% | 155.9419 |
| 172 | 2005:10:04 | 8:39:11 | 5.887 | 3 | 1200 | 656 | 2.2 | 0.56% | 177.9353 |
| 173 | 2005:10:04 | 8:39:21 | 5.791 | 3 | 1200 | 656 | 2.2 | 0.55% | 182.6921 |
| 174 | 2005:10:04 | 8:39:31 | 5.659 | 3 | 1200 | 656 | 2.2 | 0.53% | 189.6639 |
| 175 | 2005:10:04 | 8:39:41 | 5.855 | 3 | 1200 | 656 | 2.2 | 0.56% | 179.4931 |
| 176 | 2005:10:04 | 8:39:51 | 5.664 | 3 | 1200 | 656 | 2.2 | 0.53% | 189.3901 |
| 177 | 2005:10:04 | 8:40:01 | 5.959 | 3 | 1200 | 656 | 2.2 | 0.57% | 174.5271 |
| 178 | 2005:10:04 | 8:40:11 | 5.292 | 3 | 1200 | 656 | 2.2 | 0.47% | 212.1758 |
| 179 | 2005:10:04 | 8:40:21 | 5.182 | 3 | 1200 | 656 | 2.2 | 0.45% | 220.0025 |
| 180 | 2005:10:04 | 8:40:31 | 5.326 | 3 | 1200 | 656 | 2.2 | 0.48% | 209.868 |
| 181 | 2005:10:04 | 8:40:41 | 5.162 | 3 | 1200 | 656 | 2.2 | 0.45% | 221.488 |
| 182 | 2005:10:04 | 8:40:51 | 5.09 | 3 | 1200 | 656 | 2.2 | 0.44% | 227.006 |
| 183 | 2005:10:04 | 8:41:01 | 5.248 | 3 | 1200 | 656 | 2.2 | 0.46% | 215.2387 |
| 184 | 2005:10:04 | 8:41:11 | 5.218 | 3 | 1200 | 656 | 2.2 | 0.46% | 217.3782 |
| 185 | 2005:10:04 | 8:41:21 | 5.015 | 3 | 1200 | 656 | 2.2 | 0.43% | 233.0541 |
| 186 | 2005:10:04 | 8:42:50 | 5.27 | 3 | 1200 | 656 | 2.2 | 0.47% | 213.6962 |
| 187 | 2005:10:04 | 8:43:01 | 7.068 | 3 | 1200 | 656 | 2.2 | 0.74% | 134.7673 |
| 188 | 2005:10:04 | 8:43:11 | 7.131 | 3 | 1200 | 656 | 2.2 | 0.75% | 133.0455 |
| 189 | 2005:10:04 | 8:43:21 | 6.072 | 3 | 1200 | 656 | 2.2 | 0.59% | 169.4337 |
| 190 | 2005:10:04 | 8:43:31 | 6.307 | 3 | 1200 | 656 | 2.2 | 0.63% | 159.7388 |
| 191 | 2005:10:04 | 8:43:41 | 6.609 | 3 | 1200 | 656 | 2.2 | 0.67% | 148.7973 |
| 192 | 2005:10:04 | 8:43:51 | 5.072 | 3 | 1200 | 656 | 2.2 | 0.44% | 228.4288 |
| 193 | 2005:10:04 | 8:44:01 | 5.354 | 3 | 1200 | 656 | 2.2 | 0.48% | 208.0049 |
| 194 | 2005:10:04 | 8:44:11 | 5.155 | 3 | 1200 | 656 | 2.2 | 0.45% | 222.0127 |
| 195 | 2005:10:04 | 8:44:21 | 7.072 | 3 | 1200 | 656 | 2.2 | 0.74% | 134.6567 |
| 196 | 2005:10:04 | 8:44:31 | 6.416 | 3 | 1200 | 656 | 2.2 | 0.64% | 155.609 |
| 197 | 2005:10:04 | 8:44:41 | 5.787 | 3 | 1200 | 656 | 2.2 | 0.55% | 182.8959 |
| 198 | 2005:10:04 | 8:44:51 | 6.963 | 3 | 1200 | 656 | 2.2 | 0.73% | 137.7383 |
| 199 | 2005:10:04 | 8:45:01 | 7.163 | 3 | 1200 | 656 | 2.2 | 0.76% | 132.1877 |
| 200 | 2005:10:04 | 8:45:11 | 7.221 | 3 | 1200 | 656 | 2.2 | 0.77% | 130.6607 |
| 201 | 2005:10:04 | 8:45:21 | 6.828 | 3 | 1200 | 656 | 2.2 | 0.71% | 141.7561 |
| 202 | 2005:10:04 | 8:45:31 | 6.427 | 3 | 1200 | 656 | 2.2 | 0.64% | 155.204 |
| 203 | 2005:10:04 | 8:45:41 | 5.74 | 3 | 1200 | 656 | 2.2 | 0.54% | 185.3241 |
| 204 | 2005:10:04 | 8:45:51 | 4.895 | 3 | 1200 | 656 | 2.2 | 0.41% | 243.4313 |
| 205 | 2005:10:04 | 8:46:01 | 4.674 | 3 | 1200 | 656 | 2.2 | 0.38% | 265.1768 |
| 206 | 2005:10:04 | 8:46:11 | 5.497 | 3 | 1200 | 656 | 2.2 | 0.50% | 198.9831 |
| 207 | 2005:10:04 | 8:46:21 | 5.087 | 3 | 1200 | 656 | 2.2 | 0.44% | 227.2419 |

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|---|---|---|---|---|---|---|---|---|---|
| 208 | 2005:10:04 | 8:46:31 | 4.705 | 3 | 1200 | 656 | 2.2 | 0.38% | 261.8952 |
| 209 | 2005:10:04 | 8:46:41 | 3.899 | 3 | 1200 | 656 | 2.2 | 0.26% | 386.1374 |
| 210 | 2005:10:04 | 8:46:51 | 3.699 | 3 | 1200 | 656 | 2.2 | 0.23% | 437.6567 |
| 211 | 2005:10:04 | 8:47:01 | 3.469 | 3 | 1200 | 656 | 2.2 | 0.19% | 516.9798 |
| 212 | 2005:10:04 | 8:47:11 | 2.88 | 3 | 1200 | 656 | 2.2 | 0.10% | 964.7756 |
| 213 | 2005:10:04 | 8:47:21 | 3.079 | 3 | 1200 | 656 | 2.2 | 0.13% | 746.3566 |
| 214 | 2005:10:04 | 8:47:31 | 3.157 | 3 | 1200 | 656 | 2.2 | 0.15% | 685.525 |
| 215 | 2005:10:04 | 8:47:41 | 2.971 | 3 | 1200 | 656 | 2.2 | 0.12% | 850.9046 |
| 216 | 2005:10:04 | 8:47:51 | 4.03 | 3 | 1200 | 656 | 2.2 | 0.28% | 358.4959 |
| 217 | 2005:10:04 | 8:48:01 | 3.459 | 3 | 1200 | 656 | 2.2 | 0.19% | 521.0861 |
| 218 | 2005:10:04 | 8:48:11 | 3.271 | 3 | 1200 | 656 | 2.2 | 0.16% | 612.556 |
| 219 | 2005:10:04 | 8:48:21 | 3.606 | 3 | 1200 | 656 | 2.2 | 0.21% | 466.6056 |
| 220 | 2005:10:04 | 8:48:31 | 4.033 | 3 | 1200 | 656 | 2.2 | 0.28% | 357.9091 |
| 221 | 2005:10:04 | 8:49:50 | 3.309 | 3 | 1200 | 674 | 2.2 | 0.16% | 607.9991 |
| 222 | 2005:10:04 | 8:50:01 | 3.157 | 3 | 1200 | 674 | 2.2 | 0.14% | 704.5674 |
| 223 | 2005:10:04 | 8:50:11 | 3.213 | 3 | 1200 | 674 | 2.2 | 0.15% | 665.6179 |
| 224 | 2005:10:04 | 8:50:21 | 3.299 | 3 | 1200 | 674 | 2.2 | 0.16% | 613.5314 |
| 225 | 2005:10:04 | 8:50:31 | 3.463 | 3 | 1200 | 674 | 2.2 | 0.19% | 533.8646 |
| 226 | 2005:10:04 | 8:50:41 | 3.504 | 3 | 1200 | 674 | 2.2 | 0.19% | 517.079 |
| 227 | 2005:10:04 | 8:50:51 | 3.707 | 3 | 1200 | 674 | 2.2 | 0.22% | 447.426 |
| 228 | 2005:10:04 | 8:51:01 | 3.621 | 3 | 1200 | 674 | 2.2 | 0.21% | 474.5046 |
| 229 | 2005:10:04 | 8:51:11 | 3.475 | 3 | 1200 | 674 | 2.2 | 0.19% | 528.84 |
| 230 | 2005:10:04 | 8:51:21 | 3.851 | 3 | 1200 | 674 | 2.2 | 0.24% | 408.4016 |
| 231 | 2005:10:04 | 8:51:31 | 3.511 | 3 | 1200 | 674 | 2.2 | 0.19% | 514.3181 |
| 232 | 2005:10:04 | 8:51:41 | 3.691 | 3 | 1200 | 674 | 2.2 | 0.22% | 452.2273 |
| 233 | 2005:10:04 | 8:51:51 | 3.758 | 3 | 1200 | 674 | 2.2 | 0.23% | 432.7798 |
| 234 | 2005:10:04 | 8:52:01 | 3.895 | 3 | 1200 | 674 | 2.2 | 0.25% | 397.8 |
| 235 | 2005:10:04 | 8:52:11 | 3.679 | 3 | 1200 | 674 | 2.2 | 0.22% | 455.8965 |
| 236 | 2005:10:04 | 8:52:21 | 3.752 | 3 | 1200 | 674 | 2.2 | 0.23% | 434.4529 |
| 237 | 2005:10:04 | 8:52:31 | 3.639 | 3 | 1200 | 674 | 2.2 | 0.21% | 468.5691 |
| 238 | 2005:10:04 | 8:52:41 | 3.356 | 3 | 1200 | 674 | 2.2 | 0.17% | 583.2794 |
| 239 | 2005:10:04 | 8:52:51 | 3.561 | 3 | 1200 | 674 | 2.2 | 0.20% | 495.4232 |
| 240 | 2005:10:04 | 8:53:01 | 3.691 | 3 | 1200 | 674 | 2.2 | 0.22% | 452.2273 |
| 241 | 2005:10:04 | 8:53:11 | 3.762 | 3 | 1200 | 674 | 2.2 | 0.23% | 431.6716 |
| 242 | 2005:10:04 | 8:53:21 | 3.854 | 3 | 1200 | 674 | 2.2 | 0.25% | 407.6608 |
| 243 | 2005:10:04 | 8:53:31 | 4.032 | 3 | 1200 | 674 | 2.2 | 0.27% | 368.0518 |
| 244 | 2005:10:04 | 8:53:41 | 4.071 | 3 | 1200 | 674 | 2.2 | 0.28% | 360.38 |
| 245 | 2005:10:04 | 8:53:51 | 4.373 | 3 | 1200 | 674 | 2.2 | 0.32% | 310.295 |
| 246 | 2005:10:04 | 8:54:01 | 4.72 | 3 | 1200 | 674 | 2.2 | 0.37% | 267.5678 |
| 247 | 2005:10:04 | 8:54:11 | 4.775 | 3 | 1200 | 674 | 2.2 | 0.38% | 261.8528 |
| 248 | 2005:10:04 | 8:54:21 | 3.887 | 3 | 1200 | 674 | 2.2 | 0.25% | 399.6864 |
| 249 | 2005:10:04 | 8:54:31 | 3.811 | 3 | 1200 | 674 | 2.2 | 0.24% | 418.5419 |
| 250 | 2005:10:04 | 8:54:41 | 4.316 | 3 | 1200 | 674 | 2.2 | 0.31% | 318.6536 |
| 251 | 2005:10:04 | 8:54:51 | 4.539 | 3 | 1200 | 674 | 2.2 | 0.35% | 288.2732 |
| 252 | 2005:10:04 | 8:55:01 | 4.669 | 3 | 1200 | 674 | 2.2 | 0.37% | 273.0948 |

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|---|---|---|---|---|---|---|---|---|---|
| 253 | 2005:10:04 | 8:55:11 | 4.425 | 3 | 1200 | 674 | 2.2 | 0.33% | 303.0431 |
| 254 | 2005:10:04 | 8:55:21 | 3.888 | 3 | 1200 | 674 | 2.2 | 0.25% | 399.4496 |
| 255 | 2005:10:04 | 8:55:31 | 4.216 | 3 | 1200 | 674 | 2.2 | 0.30% | 334.4598 |
| 256 | 2005:10:04 | 8:55:41 | 4.354 | 3 | 1200 | 674 | 2.2 | 0.32% | 313.032 |
| 257 | 2005:10:04 | 8:55:51 | 4.537 | 3 | 1200 | 674 | 2.2 | 0.35% | 288.5199 |
| 258 | 2005:10:04 | 8:56:01 | 4.73 | 3 | 1200 | 674 | 2.2 | 0.38% | 266.5103 |
| 259 | 2005:10:04 | 8:56:11 | 4.438 | 3 | 1200 | 674 | 2.2 | 0.33% | 301.2828 |
| 260 | 2005:10:04 | 8:56:21 | 4.214 | 3 | 1200 | 674 | 2.2 | 0.30% | 334.7919 |
| 261 | 2005:10:04 | 8:56:31 | 4.16 | 3 | 1200 | 674 | 2.2 | 0.29% | 344.0158 |
| 262 | 2005:10:04 | 8:56:41 | 4.117 | 3 | 1200 | 674 | 2.2 | 0.28% | 351.7324 |
| 263 | 2005:10:04 | 8:56:51 | 4.13 | 3 | 1200 | 674 | 2.2 | 0.29% | 349.3632 |
| 264 | 2005:10:04 | 8:57:01 | 3.419 | 3 | 1200 | 674 | 2.2 | 0.18% | 553.1345 |
| 265 | 2005:10:04 | 8:57:11 | 3.365 | 3 | 1200 | 674 | 2.2 | 0.17% | 578.7734 |
| 266 | 2005:10:04 | 8:57:21 | 2.917 | 3 | 1200 | 674 | 2.2 | 0.11% | 940.4058 |
| 267 | 2005:10:04 | 8:57:31 | 2.903 | 3 | 1200 | 674 | 2.2 | 0.10% | 959.1337 |
| 268 | 2005:10:04 | 8:57:41 | 2.559 | 3 | 1200 | 674 | 2.2 | 0.05% | 1878.192 |
| 269 | 2005:10:04 | 8:57:51 | 2.742 | 3 | 1200 | 674 | 2.2 | 0.08% | 1244.042 |
| 270 | 2005:10:04 | 8:58:01 | 2.557 | 3 | 1200 | 674 | 2.2 | 0.05% | 1888.714 |

**Transect 206 ft downstream**

| Entry # | Date | Time | Fluor | Height | Station | Conc Eff ppb | Conc BG ppb | Effluent Fraction | Dilution |
|---|---|---|---|---|---|---|---|---|---|
| 271 | 2005:10:04 | 9:17:20 | 5.365 | 6 | 1200 | 736 | 2.2 | 0.43% | 232.4071 |
| 272 | 2005:10:04 | 9:17:31 | 5.55 | 6 | 1200 | 736 | 2.2 | 0.46% | 219.5726 |
| 273 | 2005:10:04 | 9:17:41 | 5.482 | 6 | 1200 | 736 | 2.2 | 0.45% | 224.122 |
| 274 | 2005:10:04 | 9:17:51 | 5.245 | 6 | 1200 | 736 | 2.2 | 0.41% | 241.566 |
| 275 | 2005:10:04 | 9:18:01 | 5.509 | 6 | 1200 | 736 | 2.2 | 0.45% | 222.2932 |
| 276 | 2005:10:04 | 9:18:11 | 5.418 | 6 | 1200 | 736 | 2.2 | 0.44% | 228.5793 |
| 277 | 2005:10:04 | 9:18:21 | 5.195 | 6 | 1200 | 736 | 2.2 | 0.41% | 245.5988 |
| 278 | 2005:10:04 | 9:18:31 | 5.175 | 6 | 1200 | 736 | 2.2 | 0.40% | 247.2499 |
| 279 | 2005:10:04 | 9:18:41 | 5.165 | 6 | 1200 | 736 | 2.2 | 0.40% | 248.0838 |
| 280 | 2005:10:04 | 9:18:51 | 5.004 | 6 | 1200 | 736 | 2.2 | 0.38% | 262.3282 |
| 281 | 2005:10:04 | 9:19:01 | 5.566 | 6 | 1200 | 736 | 2.2 | 0.46% | 218.5289 |
| 282 | 2005:10:04 | 9:19:11 | 8.494 | 6 | 1200 | 736 | 2.2 | 0.86% | 116.8682 |
| 283 | 2005:10:04 | 9:19:21 | 7.983 | 6 | 1200 | 736 | 2.2 | 0.79% | 127.1949 |
| 284 | 2005:10:04 | 9:19:31 | 6.258 | 6 | 1200 | 736 | 2.2 | 0.55% | 181.2638 |
| 285 | 2005:10:04 | 9:19:41 | 5.857 | 6 | 1200 | 736 | 2.2 | 0.50% | 201.1398 |
| 286 | 2005:10:04 | 9:19:51 | 5.509 | 6 | 1200 | 736 | 2.2 | 0.45% | 222.2932 |
| 287 | 2005:10:04 | 9:20:01 | 6.024 | 6 | 1200 | 736 | 2.2 | 0.52% | 192.3557 |
| 288 | 2005:10:04 | 9:20:11 | 5.339 | 6 | 1200 | 736 | 2.2 | 0.43% | 234.3321 |
| 289 | 2005:10:04 | 9:20:21 | 6.222 | 6 | 1200 | 736 | 2.2 | 0.55% | 182.8862 |
| 290 | 2005:10:04 | 9:20:31 | 6.131 | 6 | 1200 | 736 | 2.2 | 0.53% | 187.1199 |
| 291 | 2005:10:04 | 9:20:41 | 5.189 | 6 | 1200 | 736 | 2.2 | 0.41% | 246.0918 |
| 292 | 2005:10:04 | 9:20:51 | 5.129 | 6 | 1200 | 736 | 2.2 | 0.40% | 251.1329 |

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|---|---|---|---|---|---|---|---|---|---|
| 293 | 2005:10:04 | 9:21:01 | 4.98 | 6 | 1200 | 736 | 2.2 | 0.38% | 264.5929 |
| 294 | 2005:10:04 | 9:21:11 | 5.096 | 6 | 1200 | 736 | 2.2 | 0.39% | 253.9946 |
| 295 | 2005:10:04 | 9:21:21 | 5.141 | 6 | 1200 | 736 | 2.2 | 0.40% | 250.1082 |
| 296 | 2005:10:04 | 9:21:31 | 5.086 | 6 | 1200 | 736 | 2.2 | 0.39% | 254.8747 |
| 297 | 2005:10:04 | 9:21:41 | 4.996 | 6 | 1200 | 736 | 2.2 | 0.38% | 263.0788 |
| 298 | 2005:10:04 | 9:21:51 | 4.784 | 6 | 1200 | 736 | 2.2 | 0.35% | 284.6627 |
| 299 | 2005:10:04 | 9:22:01 | 4.848 | 6 | 1200 | 736 | 2.2 | 0.36% | 277.7826 |
| 300 | 2005:10:04 | 9:22:11 | 4.898 | 6 | 1200 | 736 | 2.2 | 0.37% | 272.6347 |
| 301 | 2005:10:04 | 9:22:21 | 4.754 | 6 | 1200 | 736 | 2.2 | 0.35% | 288.0064 |
| 302 | 2005:10:04 | 9:22:31 | 5.482 | 6 | 1200 | 736 | 2.2 | 0.45% | 224.122 |
| 303 | 2005:10:04 | 9:22:41 | 5.663 | 6 | 1200 | 736 | 2.2 | 0.47% | 212.4078 |
| 304 | 2005:10:04 | 9:22:51 | 5.098 | 6 | 1200 | 736 | 2.2 | 0.39% | 253.8193 |
| 305 | 2005:10:04 | 9:23:01 | 4.993 | 6 | 1200 | 736 | 2.2 | 0.38% | 263.3614 |
| 306 | 2005:10:04 | 9:23:11 | 4.899 | 6 | 1200 | 736 | 2.2 | 0.37% | 272.5337 |
| 307 | 2005:10:04 | 9:23:21 | 6.406 | 6 | 1200 | 736 | 2.2 | 0.57% | 174.8855 |
| 308 | 2005:10:04 | 9:23:31 | 5.196 | 6 | 1200 | 736 | 2.2 | 0.41% | 245.5168 |
| 309 | 2005:10:04 | 9:23:41 | 4.795 | 6 | 1200 | 736 | 2.2 | 0.35% | 283.456 |
| 310 | 2005:10:04 | 9:23:51 | 4.84 | 6 | 1200 | 736 | 2.2 | 0.36% | 278.6244 |
| 311 | 2005:10:04 | 9:24:01 | 5.274 | 6 | 1200 | 736 | 2.2 | 0.42% | 239.287 |
| 312 | 2005:10:04 | 9:24:11 | 4.895 | 6 | 1200 | 736 | 2.2 | 0.37% | 272.9382 |

**General Transects**

| Entry # | Date | Time | Fluor | Height | Station | Conc Eff ppb | Conc BG ppb | Effluent Fraction | Dilution |
|---|---|---|---|---|---|---|---|---|---|
| 313 | 2005:10:04 | 9:32:50 | 4.733 | 4 | 1200 | 759 | 2.2 | 0.33% | 299.4689 |
| 314 | 2005:10:04 | 9:33:01 | 4.835 | 4 | 1200 | 759 | 2.2 | 0.35% | 287.8766 |
| 315 | 2005:10:04 | 9:33:11 | 4.826 | 4 | 1200 | 759 | 2.2 | 0.35% | 288.8632 |
| 316 | 2005:10:04 | 9:33:21 | 4.976 | 4 | 1200 | 759 | 2.2 | 0.37% | 273.2546 |
| 317 | 2005:10:04 | 9:33:31 | 4.778 | 4 | 1200 | 759 | 2.2 | 0.34% | 294.2416 |
| 318 | 2005:10:04 | 9:33:41 | 4.752 | 4 | 1200 | 759 | 2.2 | 0.34% | 297.2394 |
| 319 | 2005:10:04 | 9:33:51 | 4.739 | 4 | 1200 | 759 | 2.2 | 0.33% | 298.7613 |
| 320 | 2005:10:04 | 9:34:01 | 4.837 | 4 | 1200 | 759 | 2.2 | 0.35% | 287.6583 |
| 321 | 2005:10:04 | 9:34:11 | 4.674 | 4 | 1200 | 759 | 2.2 | 0.33% | 306.6107 |
| 322 | 2005:10:04 | 9:34:21 | 4.664 | 4 | 1200 | 759 | 2.2 | 0.32% | 307.855 |
| 323 | 2005:10:04 | 9:34:31 | 4.664 | 4 | 1200 | 759 | 2.2 | 0.32% | 307.855 |
| 324 | 2005:10:04 | 9:34:41 | 4.7 | 4 | 1200 | 759 | 2.2 | 0.33% | 303.4219 |
| 325 | 2005:10:04 | 9:34:51 | 4.651 | 4 | 1200 | 759 | 2.2 | 0.32% | 309.4879 |
| 326 | 2005:10:04 | 9:35:01 | 4.708 | 5 | 1225 | 759 | 2.2 | 0.33% | 302.4541 |
| 327 | 2005:10:04 | 9:35:11 | 4.826 | 5 | 1225 | 759 | 2.2 | 0.35% | 288.8632 |
| 328 | 2005:10:04 | 9:35:21 | 4.677 | 5 | 1225 | 759 | 2.2 | 0.33% | 306.2393 |
| 329 | 2005:10:04 | 9:35:31 | 4.752 | 5 | 1225 | 759 | 2.2 | 0.34% | 297.2394 |
| 330 | 2005:10:04 | 9:37:20 | 5.024 | 5 | 1225 | 759 | 2.2 | 0.37% | 268.6101 |
| 331 | 2005:10:04 | 9:37:31 | 5.075 | 5 | 1225 | 759 | 2.2 | 0.38% | 263.8452 |
| 332 | 2005:10:04 | 9:37:41 | 4.984 | 5 | 1225 | 759 | 2.2 | 0.37% | 272.4694 |

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|---|---|---|---|---|---|---|---|---|---|
| 333 | 2005:10:04 | 9:37:51 | 4.851 | 5 | 1225 | 759 | 2.2 | 0.35% | 286.1391 |
| 334 | 2005:10:04 | 9:38:01 | 4.739 | 5 | 1225 | 759 | 2.2 | 0.33% | 298.7613 |
| 335 | 2005:10:04 | 9:38:11 | 4.799 | 5 | 1225 | 759 | 2.2 | 0.34% | 291.8641 |
| 336 | 2005:10:04 | 9:38:21 | 5.194 | 5 | 1225 | 759 | 2.2 | 0.39% | 253.3583 |
| 337 | 2005:10:04 | 9:38:31 | 4.999 | 5 | 1225 | 759 | 2.2 | 0.37% | 271.0092 |
| 338 | 2005:10:04 | 9:38:41 | 4.559 | 5 | 1225 | 759 | 2.2 | 0.31% | 321.5578 |
| 339 | 2005:10:04 | 9:38:51 | 4.645 | 5 | 1225 | 759 | 2.2 | 0.32% | 310.2474 |
| 340 | 2005:10:04 | 9:39:01 | 4.665 | 5 | 1225 | 759 | 2.2 | 0.32% | 307.7302 |
| 341 | 2005:10:04 | 9:39:11 | 4.684 | 5 | 1225 | 759 | 2.2 | 0.33% | 305.3763 |
| 342 | 2005:10:04 | 9:39:21 | 4.48 | 5 | 1225 | 759 | 2.2 | 0.30% | 332.6995 |
| 343 | 2005:10:04 | 9:39:31 | 4.622 | 5 | 1225 | 759 | 2.2 | 0.32% | 313.1936 |
| 344 | 2005:10:04 | 9:39:41 | 4.82 | 5 | 1225 | 759 | 2.2 | 0.35% | 289.5247 |
| 345 | 2005:10:04 | 9:39:51 | 4.961 | 5 | 1225 | 759 | 2.2 | 0.36% | 274.7392 |
| 346 | 2005:10:04 | 9:40:01 | 5.138 | 5 | 1225 | 759 | 2.2 | 0.39% | 258.1875 |
| 347 | 2005:10:04 | 9:40:11 | 5.078 | 5 | 1225 | 759 | 2.2 | 0.38% | 263.5701 |
| 348 | 2005:10:04 | 9:40:21 | 4.622 | 5 | 1225 | 759 | 2.2 | 0.32% | 313.1936 |
| 349 | 2005:10:04 | 9:40:31 | 4.482 | 5 | 1225 | 759 | 2.2 | 0.30% | 332.4079 |
| 350 | 2005:10:04 | 9:40:41 | 4.484 | 5 | 1225 | 759 | 2.2 | 0.30% | 332.1168 |
| 351 | 2005:10:04 | 9:40:51 | 4.416 | 5 | 1225 | 759 | 2.2 | 0.29% | 342.3081 |
| 352 | 2005:10:04 | 9:41:01 | 4.627 | 5 | 1225 | 759 | 2.2 | 0.32% | 312.5483 |
| 353 | 2005:10:04 | 9:41:11 | 4.552 | 5 | 1225 | 759 | 2.2 | 0.31% | 322.5148 |
| 354 | 2005:10:04 | 9:41:21 | 5.376 | 5 | 1225 | 759 | 2.2 | 0.42% | 238.8397 |
| 355 | 2005:10:04 | 9:41:31 | 5.478 | 5 | 1225 | 759 | 2.2 | 0.43% | 231.4078 |
| 356 | 2005:10:04 | 9:41:41 | 5.516 | 5 | 1225 | 759 | 2.2 | 0.44% | 228.756 |
| 357 | 2005:10:04 | 9:41:51 | 5.371 | 5 | 1225 | 759 | 2.2 | 0.42% | 239.2163 |
| 358 | 2005:10:04 | 9:42:01 | 5.16 | 5 | 1225 | 759 | 2.2 | 0.39% | 256.2685 |
| 359 | 2005:10:04 | 9:42:11 | 5.181 | 5 | 1225 | 759 | 2.2 | 0.39% | 254.4632 |
| 360 | 2005:10:04 | 9:42:21 | 5.33 | 5 | 1225 | 759 | 2.2 | 0.41% | 242.3498 |
| 361 | 2005:10:04 | 9:42:31 | 4.911 | 5 | 1225 | 759 | 2.2 | 0.36% | 279.8063 |
| 362 | 2005:10:04 | 9:42:41 | 5.07 | 5 | 1225 | 759 | 2.2 | 0.38% | 264.3048 |
| 363 | 2005:10:04 | 9:42:51 | 4.905 | 5 | 1225 | 759 | 2.2 | 0.36% | 280.4269 |
| 364 | 2005:10:04 | 9:43:01 | 4.987 | 5 | 1225 | 759 | 2.2 | 0.37% | 272.1761 |
| 365 | 2005:10:04 | 9:43:11 | 5.01 | 5 | 1225 | 759 | 2.2 | 0.37% | 269.9483 |
| 366 | 2005:10:04 | 9:43:21 | 5.087 | 5 | 1225 | 759 | 2.2 | 0.38% | 262.7485 |
| 367 | 2005:10:04 | 9:43:31 | 5.167 | 5 | 1225 | 759 | 2.2 | 0.39% | 255.6639 |
| 368 | 2005:10:04 | 9:43:41 | 5.039 | 5 | 1225 | 759 | 2.2 | 0.37% | 267.1909 |
| 369 | 2005:10:04 | 9:43:51 | 5.336 | 5 | 1225 | 759 | 2.2 | 0.41% | 241.8861 |
| 370 | 2005:10:04 | 9:44:01 | 5.095 | 5 | 1225 | 759 | 2.2 | 0.38% | 262.0224 |
| 371 | 2005:10:04 | 9:44:11 | 4.901 | 5 | 1225 | 759 | 2.2 | 0.36% | 280.8422 |
| 372 | 2005:10:04 | 9:44:21 | 4.724 | 5 | 1225 | 759 | 2.2 | 0.33% | 300.5368 |
| 373 | 2005:10:04 | 9:44:31 | 4.44 | 5 | 1225 | 759 | 2.2 | 0.30% | 338.6406 |
| 374 | 2005:10:04 | 9:44:41 | 4.568 | 5 | 1225 | 759 | 2.2 | 0.31% | 320.3357 |
| 375 | 2005:10:04 | 9:44:51 | 4.59 | 5 | 1225 | 759 | 2.2 | 0.32% | 317.387 |
| 376 | 2005:10:04 | 9:45:01 | 4.613 | 5 | 1225 | 759 | 2.2 | 0.32% | 314.3617 |
| 377 | 2005:10:04 | 9:45:11 | 4.734 | 5 | 1225 | 759 | 2.2 | 0.33% | 299.3508 |

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|---|---|---|---|---|---|---|---|---|---|
| 378 | 2005:10:04 | 9:45:21 | 4.659 | 4 | 1200 | 759 | 2.2 | 0.32% | 308.481 |
| 379 | 2005:10:04 | 9:45:31 | 4.63 | 4 | 1200 | 759 | 2.2 | 0.32% | 312.1625 |
| 380 | 2005:10:04 | 9:45:41 | 4.66 | 4 | 1200 | 759 | 2.2 | 0.32% | 308.3556 |
| 381 | 2005:10:04 | 9:45:51 | 4.494 | 4 | 1200 | 759 | 2.2 | 0.30% | 330.6691 |
| 382 | 2005:10:04 | 9:46:01 | 4.18 | 4 | 1200 | 759 | 2.2 | 0.26% | 383.1085 |
| 383 | 2005:10:04 | 9:46:11 | 4.233 | 4 | 1200 | 759 | 2.2 | 0.27% | 373.1209 |
| 384 | 2005:10:04 | 9:46:21 | 4.677 | 4 | 1200 | 759 | 2.2 | 0.33% | 306.2393 |
| 385 | 2005:10:04 | 9:46:31 | 4.261 | 4 | 1200 | 759 | 2.2 | 0.27% | 368.0518 |
| 386 | 2005:10:04 | 9:46:41 | 4.338 | 4 | 1200 | 759 | 2.2 | 0.28% | 354.7965 |
| 387 | 2005:10:04 | 9:46:51 | 4.344 | 4 | 1200 | 759 | 2.2 | 0.28% | 353.8036 |
| 388 | 2005:10:04 | 9:47:01 | 4.294 | 4 | 1200 | 759 | 2.2 | 0.28% | 362.2516 |
| 389 | 2005:10:04 | 9:47:11 | 4.338 | 4 | 1200 | 759 | 2.2 | 0.28% | 354.7965 |
| 390 | 2005:10:04 | 9:47:21 | 4.294 | 4 | 1200 | 759 | 2.2 | 0.28% | 362.2516 |
| 391 | 2005:10:04 | 9:47:31 | 4.347 | 4 | 1200 | 759 | 2.2 | 0.28% | 353.3092 |
| 392 | 2005:10:04 | 9:47:41 | 4.208 | 4 | 1200 | 759 | 2.2 | 0.26% | 377.7664 |
| 393 | 2005:10:04 | 9:47:51 | 4.122 | 4 | 1200 | 759 | 2.2 | 0.25% | 394.6695 |
| 394 | 2005:10:04 | 9:48:01 | 4.308 | 4 | 1200 | 759 | 2.2 | 0.28% | 359.8457 |
| 395 | 2005:10:04 | 9:48:11 | 4.506 | 4 | 1200 | 759 | 2.2 | 0.30% | 328.9483 |
| 396 | 2005:10:04 | 9:48:21 | 4.449 | 4 | 1200 | 759 | 2.2 | 0.30% | 337.2854 |
| 397 | 2005:10:04 | 9:48:31 | 4.48 | 4 | 1200 | 759 | 2.2 | 0.30% | 332.6995 |
| 398 | 2005:10:04 | 9:48:41 | 4.3 | 4 | 1200 | 759 | 2.2 | 0.28% | 361.2166 |
| 399 | 2005:10:04 | 9:48:51 | 4.223 | 4 | 1200 | 759 | 2.2 | 0.27% | 374.9653 |
| 400 | 2005:10:04 | 9:49:01 | 4.229 | 4 | 1200 | 759 | 2.2 | 0.27% | 373.8565 |
| 401 | 2005:10:04 | 9:49:11 | 4.229 | 4 | 1200 | 759 | 2.2 | 0.27% | 373.8565 |
| 402 | 2005:10:04 | 9:49:21 | 4.217 | 4 | 1200 | 759 | 2.2 | 0.27% | 376.0807 |
| 403 | 2005:10:04 | 9:49:31 | 4.252 | 4 | 1200 | 759 | 2.2 | 0.27% | 369.6661 |
| 404 | 2005:10:04 | 9:49:41 | 4.217 | 4 | 1200 | 759 | 2.2 | 0.27% | 376.0807 |
| 405 | 2005:10:04 | 9:49:51 | 4.427 | 4 | 1200 | 759 | 2.2 | 0.29% | 340.6174 |
| 406 | 2005:10:04 | 9:50:01 | 4.538 | 4 | 1200 | 759 | 2.2 | 0.31% | 324.446 |
| 407 | 2005:10:04 | 9:50:11 | 4.557 | 4 | 1200 | 759 | 2.2 | 0.31% | 321.8306 |
| 408 | 2005:10:04 | 9:50:21 | 4.4 | 4 | 1200 | 759 | 2.2 | 0.29% | 344.7977 |
| 409 | 2005:10:04 | 9:50:31 | 4.524 | 4 | 1200 | 759 | 2.2 | 0.31% | 326.4005 |
| 410 | 2005:10:04 | 9:50:41 | 4.276 | 4 | 1200 | 759 | 2.2 | 0.27% | 365.3925 |
| 411 | 2005:10:04 | 9:50:51 | 4.217 | 4 | 1200 | 759 | 2.2 | 0.27% | 376.0807 |
| 412 | 2005:10:04 | 9:51:01 | 4.155 | 4 | 1200 | 759 | 2.2 | 0.26% | 388.0076 |
| 413 | 2005:10:04 | 9:51:11 | 4.234 | 4 | 1200 | 759 | 2.2 | 0.27% | 372.9375 |
| 414 | 2005:10:04 | 9:51:21 | 4.557 | 4 | 1200 | 759 | 2.2 | 0.31% | 321.8306 |
| 415 | 2005:10:04 | 9:51:31 | 4.34 | 4 | 1200 | 759 | 2.2 | 0.28% | 354.4649 |
| 416 | 2005:10:04 | 9:51:41 | 4.061 | 4 | 1200 | 759 | 2.2 | 0.25% | 407.606 |
| 417 | 2005:10:04 | 9:51:51 | 4.071 | 4 | 1200 | 759 | 2.2 | 0.25% | 405.4275 |
| 418 | 2005:10:04 | 9:52:01 | 4.174 | 4 | 1200 | 759 | 2.2 | 0.26% | 384.273 |
| 419 | 2005:10:04 | 9:52:11 | 4.222 | 4 | 1200 | 759 | 2.2 | 0.27% | 375.1508 |
| 420 | 2005:10:04 | 9:52:21 | 4.084 | 4 | 1200 | 759 | 2.2 | 0.25% | 402.63 |
| 421 | 2005:10:04 | 9:52:31 | 4.1 | 4 | 1200 | 759 | 2.2 | 0.25% | 399.2394 |
| 422 | 2005:10:04 | 9:52:41 | 4.507 | 4 | 1200 | 759 | 2.2 | 0.30% | 328.8057 |

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|---|---|---|---|---|---|---|---|---|---|
| 423 | 2005:10:04 | 9:52:51 | 4.566 | 4 | 1200 | 759 | 2.2 | 0.31% | 320.6064 |
| 424 | 2005:10:04 | 9:53:01 | 4.38 | 4 | 1200 | 759 | 2.2 | 0.29% | 347.9609 |
| 425 | 2005:10:04 | 9:53:11 | 4.501 | 4 | 1200 | 759 | 2.2 | 0.30% | 329.6631 |
| 426 | 2005:10:04 | 9:53:21 | 4.336 | 4 | 1200 | 759 | 2.2 | 0.28% | 355.1287 |
| 427 | 2005:10:04 | 9:53:31 | 4.417 | 4 | 1200 | 759 | 2.2 | 0.29% | 342.1537 |
| 428 | 2005:10:04 | 9:53:41 | 4.301 | 4 | 1200 | 759 | 2.2 | 0.28% | 361.0447 |
| 429 | 2005:10:04 | 9:53:51 | 4.448 | 4 | 1200 | 759 | 2.2 | 0.30% | 337.4354 |
| 430 | 2005:10:04 | 9:54:01 | 4.3 | 4 | 1200 | 759 | 2.2 | 0.28% | 361.2166 |
| 431 | 2005:10:04 | 9:54:11 | 4.418 | 4 | 1200 | 759 | 2.2 | 0.29% | 341.9995 |

**Stationary Time Series #2**

| Entry # | Date | Time | Fluor | Height | Station | Conc Eff ppb | Conc BG ppb | Effluent Fraction | Dilution |
|---|---|---|---|---|---|---|---|---|---|
| 432 | 2005:10:04 | 10:01:00 | 4.83 | 4 | 1200 | 783 | 2.2 | 0.34% | 297.7279 |
| 433 | 2005:10:04 | 10:01:11 | 4.985 | 4 | 1200 | 783 | 2.2 | 0.36% | 281.1578 |
| 434 | 2005:10:04 | 10:01:21 | 5.047 | 4 | 1200 | 783 | 2.2 | 0.36% | 275.0349 |
| 435 | 2005:10:04 | 10:01:31 | 5.233 | 4 | 1200 | 783 | 2.2 | 0.39% | 258.1683 |
| 436 | 2005:10:04 | 10:01:41 | 5.017 | 4 | 1200 | 783 | 2.2 | 0.36% | 277.9639 |
| 437 | 2005:10:04 | 10:01:51 | 5.014 | 4 | 1200 | 783 | 2.2 | 0.36% | 278.2603 |
| 438 | 2005:10:04 | 10:02:01 | 5.048 | 4 | 1200 | 783 | 2.2 | 0.36% | 274.9383 |
| 439 | 2005:10:04 | 10:02:11 | 5.022 | 4 | 1200 | 783 | 2.2 | 0.36% | 277.4714 |
| 440 | 2005:10:04 | 10:02:21 | 5.142 | 4 | 1200 | 783 | 2.2 | 0.38% | 266.1538 |
| 441 | 2005:10:04 | 10:02:31 | 5.108 | 4 | 1200 | 783 | 2.2 | 0.37% | 269.2656 |
| 442 | 2005:10:04 | 10:02:41 | 5.685 | 4 | 1200 | 783 | 2.2 | 0.45% | 224.6842 |
| 443 | 2005:10:04 | 10:02:51 | 5.433 | 4 | 1200 | 783 | 2.2 | 0.41% | 242.1974 |
| 444 | 2005:10:04 | 10:03:01 | 5.275 | 4 | 1200 | 783 | 2.2 | 0.39% | 254.6421 |
| 445 | 2005:10:04 | 10:03:11 | 5.335 | 4 | 1200 | 783 | 2.2 | 0.40% | 249.7685 |
| 446 | 2005:10:04 | 10:03:21 | 5.178 | 4 | 1200 | 783 | 2.2 | 0.38% | 262.9363 |
| 447 | 2005:10:04 | 10:03:31 | 5.241 | 4 | 1200 | 783 | 2.2 | 0.39% | 257.4891 |
| 448 | 2005:10:04 | 10:03:41 | 5.378 | 4 | 1200 | 783 | 2.2 | 0.41% | 246.389 |
| 449 | 2005:10:04 | 10:03:51 | 5.201 | 4 | 1200 | 783 | 2.2 | 0.38% | 260.9211 |
| 450 | 2005:10:04 | 10:04:01 | 5.479 | 4 | 1200 | 783 | 2.2 | 0.42% | 238.7997 |
| 451 | 2005:10:04 | 10:04:11 | 5.309 | 4 | 1200 | 783 | 2.2 | 0.40% | 251.8573 |
| 452 | 2005:10:04 | 10:04:21 | 5.173 | 4 | 1200 | 783 | 2.2 | 0.38% | 263.3785 |
| 453 | 2005:10:04 | 10:04:31 | 5.481 | 4 | 1200 | 783 | 2.2 | 0.42% | 238.6542 |
| 454 | 2005:10:04 | 10:04:41 | 5.767 | 4 | 1200 | 783 | 2.2 | 0.46% | 219.519 |
| 455 | 2005:10:04 | 10:04:51 | 6.371 | 4 | 1200 | 783 | 2.2 | 0.53% | 187.7306 |
| 456 | 2005:10:04 | 10:05:01 | 6.061 | 4 | 1200 | 783 | 2.2 | 0.49% | 202.8035 |
| 457 | 2005:10:04 | 10:05:11 | 6.312 | 4 | 1200 | 783 | 2.2 | 0.53% | 190.4242 |
| 458 | 2005:10:04 | 10:05:21 | 6.587 | 4 | 1200 | 783 | 2.2 | 0.56% | 178.4874 |
| 459 | 2005:10:04 | 10:05:31 | 6.388 | 4 | 1200 | 783 | 2.2 | 0.53% | 186.9686 |
| 460 | 2005:10:04 | 10:05:41 | 5.222 | 4 | 1200 | 783 | 2.2 | 0.39% | 259.108 |
| 461 | 2005:10:04 | 10:05:51 | 5.701 | 4 | 1200 | 783 | 2.2 | 0.45% | 223.6573 |
| 462 | 2005:10:04 | 10:06:01 | 5.848 | 4 | 1200 | 783 | 2.2 | 0.47% | 214.6448 |

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|---|---|---|---|---|---|---|---|---|---|
| 463 | 2005:10:04 | 10:06:11 | 5.93 | 4 | 1200 | 783 | 2.2 | 0.48% | 209.9261 |
| 464 | 2005:10:04 | 10:06:21 | 5.381 | 4 | 1200 | 783 | 2.2 | 0.41% | 246.1567 |
| 465 | 2005:10:04 | 10:06:31 | 4.89 | 4 | 1200 | 783 | 2.2 | 0.34% | 291.0871 |
| 466 | 2005:10:04 | 10:06:41 | 4.735 | 4 | 1200 | 783 | 2.2 | 0.32% | 308.8853 |
| 467 | 2005:10:04 | 10:06:51 | 5.303 | 4 | 1200 | 783 | 2.2 | 0.40% | 252.3443 |
| 468 | 2005:10:04 | 10:07:01 | 4.405 | 4 | 1200 | 783 | 2.2 | 0.28% | 355.1131 |
| 469 | 2005:10:04 | 10:07:11 | 4.835 | 4 | 1200 | 783 | 2.2 | 0.34% | 297.1629 |
| 470 | 2005:10:04 | 10:07:21 | 5.552 | 4 | 1200 | 783 | 2.2 | 0.43% | 233.5991 |
| 471 | 2005:10:04 | 10:07:31 | 5.807 | 4 | 1200 | 783 | 2.2 | 0.46% | 217.0847 |
| 472 | 2005:10:04 | 10:07:41 | 5.654 | 4 | 1200 | 783 | 2.2 | 0.44% | 226.7007 |
| 473 | 2005:10:04 | 10:07:51 | 5.882 | 4 | 1200 | 783 | 2.2 | 0.47% | 212.6628 |
| 474 | 2005:10:04 | 10:08:01 | 5.894 | 4 | 1200 | 783 | 2.2 | 0.47% | 211.9719 |
| 475 | 2005:10:04 | 10:08:11 | 5.898 | 4 | 1200 | 783 | 2.2 | 0.47% | 211.7427 |
| 476 | 2005:10:04 | 10:08:21 | 5.433 | 4 | 1200 | 783 | 2.2 | 0.41% | 242.1974 |
| 477 | 2005:10:04 | 10:08:31 | 5.539 | 4 | 1200 | 783 | 2.2 | 0.43% | 234.5086 |
| 478 | 2005:10:04 | 10:08:41 | 5.665 | 4 | 1200 | 783 | 2.2 | 0.44% | 225.9811 |
| 479 | 2005:10:04 | 10:08:51 | 5.926 | 4 | 1200 | 783 | 2.2 | 0.48% | 210.1515 |
| 480 | 2005:10:04 | 10:09:01 | 5.672 | 4 | 1200 | 783 | 2.2 | 0.44% | 225.5254 |
| 481 | 2005:10:04 | 10:09:11 | 5.419 | 4 | 1200 | 783 | 2.2 | 0.41% | 243.2508 |
| 482 | 2005:10:04 | 10:09:21 | 6.032 | 4 | 1200 | 783 | 2.2 | 0.49% | 204.3383 |
| 483 | 2005:10:04 | 10:09:31 | 6.932 | 4 | 1200 | 783 | 2.2 | 0.60% | 165.4743 |
| 484 | 2005:10:04 | 10:09:41 | 6.202 | 4 | 1200 | 783 | 2.2 | 0.51% | 195.6583 |
| 485 | 2005:10:04 | 10:09:51 | 6.381 | 4 | 1200 | 783 | 2.2 | 0.53% | 187.2816 |
| 486 | 2005:10:04 | 10:10:01 | 6.211 | 4 | 1200 | 783 | 2.2 | 0.51% | 195.2192 |
| 487 | 2005:10:04 | 10:10:11 | 6.555 | 4 | 1200 | 783 | 2.2 | 0.56% | 179.7989 |
| 488 | 2005:10:04 | 10:10:21 | 6.268 | 4 | 1200 | 783 | 2.2 | 0.52% | 192.4839 |
| 489 | 2005:10:04 | 10:10:31 | 5.447 | 4 | 1200 | 783 | 2.2 | 0.41% | 241.1532 |
| 490 | 2005:10:04 | 10:10:41 | 7.477 | 4 | 1200 | 783 | 2.2 | 0.67% | 148.3844 |
| 491 | 2005:10:04 | 10:10:51 | 6.998 | 4 | 1200 | 783 | 2.2 | 0.61% | 163.1981 |
| 492 | 2005:10:04 | 10:11:01 | 7.127 | 4 | 1200 | 783 | 2.2 | 0.63% | 158.9252 |
| 493 | 2005:10:04 | 10:11:11 | 5.149 | 4 | 1200 | 783 | 2.2 | 0.38% | 265.522 |
| 494 | 2005:10:04 | 10:11:21 | 5.549 | 4 | 1200 | 783 | 2.2 | 0.43% | 233.8084 |
| 495 | 2005:10:04 | 10:11:31 | 5.818 | 4 | 1200 | 783 | 2.2 | 0.46% | 216.4246 |
| 496 | 2005:10:04 | 10:11:41 | 5.872 | 4 | 1200 | 783 | 2.2 | 0.47% | 213.2419 |
| 497 | 2005:10:04 | 10:11:51 | 4.492 | 4 | 1200 | 783 | 2.2 | 0.29% | 341.6337 |
| 498 | 2005:10:04 | 10:12:01 | 5.132 | 4 | 1200 | 783 | 2.2 | 0.37% | 267.0615 |
| 499 | 2005:10:04 | 10:12:11 | 4.828 | 4 | 1200 | 783 | 2.2 | 0.34% | 297.9545 |
| 500 | 2005:10:04 | 10:12:21 | 5.249 | 4 | 1200 | 783 | 2.2 | 0.39% | 256.8135 |
| 501 | 2005:10:04 | 10:12:31 | 5.556 | 4 | 1200 | 783 | 2.2 | 0.43% | 233.3207 |
| 502 | 2005:10:04 | 10:12:41 | 5.625 | 4 | 1200 | 783 | 2.2 | 0.44% | 228.6202 |
| 503 | 2005:10:04 | 10:12:51 | 4.772 | 4 | 1200 | 783 | 2.2 | 0.33% | 304.4418 |
| 504 | 2005:10:04 | 10:13:01 | 4.563 | 4 | 1200 | 783 | 2.2 | 0.30% | 331.3687 |
| 505 | 2005:10:04 | 10:13:11 | 4.28 | 4 | 1200 | 783 | 2.2 | 0.27% | 376.454 |
| 506 | 2005:10:04 | 10:13:21 | 4.478 | 4 | 1200 | 783 | 2.2 | 0.29% | 343.7333 |
| 507 | 2005:10:04 | 10:13:31 | 4.716 | 4 | 1200 | 783 | 2.2 | 0.32% | 311.2179 |

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|---|---|---|---|---|---|---|---|---|---|
| 508 | 2005:10:04 | 10:13:41 | 4.842 | 4 | 1200 | 783 | 2.2 | 0.34% | 296.3756 |
| 509 | 2005:10:04 | 10:13:51 | 4.882 | 4 | 1200 | 783 | 2.2 | 0.34% | 291.9554 |
| 510 | 2005:10:04 | 10:14:01 | 4.814 | 4 | 1200 | 783 | 2.2 | 0.33% | 299.5502 |
| 511 | 2005:10:04 | 10:14:11 | 4.746 | 4 | 1200 | 783 | 2.2 | 0.33% | 307.5508 |
| 512 | 2005:10:04 | 10:14:21 | 4.65 | 4 | 1200 | 783 | 2.2 | 0.31% | 319.6018 |
| 513 | 2005:10:04 | 10:14:31 | 5.07 | 4 | 1200 | 783 | 2.2 | 0.37% | 272.8308 |
| 514 | 2005:10:04 | 10:14:41 | 5.188 | 4 | 1200 | 783 | 2.2 | 0.38% | 262.0563 |
| 515 | 2005:10:04 | 10:14:51 | 5.172 | 4 | 1200 | 783 | 2.2 | 0.38% | 263.4671 |
| 516 | 2005:10:04 | 10:15:01 | 5.345 | 4 | 1200 | 783 | 2.2 | 0.40% | 248.9744 |
| 517 | 2005:10:04 | 10:15:11 | 5.368 | 4 | 1200 | 783 | 2.2 | 0.40% | 247.1668 |
| 518 | 2005:10:04 | 10:15:21 | 5.587 | 4 | 1200 | 783 | 2.2 | 0.43% | 231.1852 |
| 519 | 2005:10:04 | 10:15:31 | 5.608 | 4 | 1200 | 783 | 2.2 | 0.44% | 229.7607 |
| 520 | 2005:10:04 | 10:15:41 | 5.641 | 4 | 1200 | 783 | 2.2 | 0.44% | 227.5572 |
| 521 | 2005:10:04 | 10:15:51 | 5.647 | 4 | 1200 | 783 | 2.2 | 0.44% | 227.1611 |
| 522 | 2005:10:04 | 10:16:01 | 5.275 | 4 | 1200 | 783 | 2.2 | 0.39% | 254.6421 |
| 523 | 2005:10:04 | 10:16:11 | 5.425 | 4 | 1200 | 783 | 2.2 | 0.41% | 242.7982 |
| 524 | 2005:10:04 | 10:16:21 | 4.994 | 4 | 1200 | 783 | 2.2 | 0.36% | 280.2521 |
| 525 | 2005:10:04 | 10:16:31 | 4.872 | 4 | 1200 | 783 | 2.2 | 0.34% | 293.048 |
| 526 | 2005:10:04 | 10:16:41 | 4.43 | 4 | 1200 | 783 | 2.2 | 0.28% | 351.132 |
| 527 | 2005:10:04 | 10:16:51 | 5.171 | 4 | 1200 | 783 | 2.2 | 0.38% | 263.5558 |
| 528 | 2005:10:04 | 10:17:01 | 5.092 | 4 | 1200 | 783 | 2.2 | 0.37% | 270.7553 |
| 529 | 2005:10:04 | 10:17:11 | 5.09 | 4 | 1200 | 783 | 2.2 | 0.37% | 270.9427 |
| 530 | 2005:10:04 | 10:17:21 | 4.978 | 4 | 1200 | 783 | 2.2 | 0.35% | 281.8662 |
| 531 | 2005:10:04 | 10:17:31 | 5.001 | 4 | 1200 | 783 | 2.2 | 0.36% | 279.5517 |
| 532 | 2005:10:04 | 10:17:41 | 5.665 | 4 | 1200 | 783 | 2.2 | 0.44% | 225.9811 |
| 533 | 2005:10:04 | 10:17:51 | 5.842 | 4 | 1200 | 783 | 2.2 | 0.47% | 214.9984 |
| 534 | 2005:10:04 | 10:18:01 | 5.142 | 4 | 1200 | 783 | 2.2 | 0.38% | 266.1538 |
| 535 | 2005:10:04 | 10:18:11 | 5.155 | 4 | 1200 | 783 | 2.2 | 0.38% | 264.9829 |
| 536 | 2005:10:04 | 10:18:21 | 5.227 | 4 | 1200 | 783 | 2.2 | 0.39% | 258.68 |
| 537 | 2005:10:04 | 10:18:31 | 4.436 | 4 | 1200 | 783 | 2.2 | 0.29% | 350.1898 |
| 538 | 2005:10:04 | 10:18:41 | 4.495 | 4 | 1200 | 783 | 2.2 | 0.29% | 341.1871 |
| 539 | 2005:10:04 | 10:18:51 | 4.955 | 4 | 1200 | 783 | 2.2 | 0.35% | 284.2194 |
| 540 | 2005:10:04 | 10:19:01 | 5.071 | 4 | 1200 | 783 | 2.2 | 0.37% | 272.7358 |
| 541 | 2005:10:04 | 10:19:11 | 5.531 | 4 | 1200 | 783 | 2.2 | 0.43% | 235.0719 |
| 542 | 2005:10:04 | 10:19:21 | 5.024 | 4 | 1200 | 783 | 2.2 | 0.36% | 277.2749 |
| 543 | 2005:10:04 | 10:19:31 | 4.862 | 4 | 1200 | 783 | 2.2 | 0.34% | 294.1489 |
| 544 | 2005:10:04 | 10:19:41 | 5.307 | 4 | 1200 | 783 | 2.2 | 0.40% | 252.0194 |
| 545 | 2005:10:04 | 10:19:51 | 5.632 | 4 | 1200 | 783 | 2.2 | 0.44% | 228.1539 |
| 546 | 2005:10:04 | 10:20:01 | 5.67 | 4 | 1200 | 783 | 2.2 | 0.44% | 225.6554 |
| 547 | 2005:10:04 | 10:20:11 | 5.508 | 4 | 1200 | 783 | 2.2 | 0.42% | 236.7063 |
| 548 | 2005:10:04 | 10:20:21 | 5.903 | 4 | 1200 | 783 | 2.2 | 0.47% | 211.4568 |
| 549 | 2005:10:04 | 10:20:31 | 6.348 | 4 | 1200 | 783 | 2.2 | 0.53% | 188.7715 |
| 550 | 2005:10:04 | 10:20:41 | 6.958 | 4 | 1200 | 783 | 2.2 | 0.61% | 164.5701 |
| 551 | 2005:10:04 | 10:20:51 | 7.253 | 4 | 1200 | 783 | 2.2 | 0.65% | 154.9623 |
| 552 | 2005:10:04 | 10:21:01 | 7.092 | 4 | 1200 | 783 | 2.2 | 0.62% | 160.0622 |

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|---|---|---|---|---|---|---|---|---|---|
| 553 | 2005:10:04 | 10:21:11 | 7.508 | 4 | 1200 | 783 | 2.2 | 0.68% | 147.5178 |
| 554 | 2005:10:04 | 10:21:21 | 6.851 | 4 | 1200 | 783 | 2.2 | 0.59% | 168.3561 |
| 555 | 2005:10:04 | 10:21:31 | 4.99 | 4 | 1200 | 783 | 2.2 | 0.36% | 280.6539 |
| 556 | 2005:10:04 | 10:21:41 | 5.188 | 4 | 1200 | 783 | 2.2 | 0.38% | 262.0563 |
| 557 | 2005:10:04 | 10:21:51 | 6.198 | 4 | 1200 | 783 | 2.2 | 0.51% | 195.854 |
| 558 | 2005:10:04 | 10:22:01 | 5.802 | 4 | 1200 | 783 | 2.2 | 0.46% | 217.386 |
| 559 | 2005:10:04 | 10:22:11 | 5.511 | 4 | 1200 | 783 | 2.2 | 0.42% | 236.4918 |
| 560 | 2005:10:04 | 10:22:21 | 6.223 | 4 | 1200 | 783 | 2.2 | 0.51% | 194.6369 |
| 561 | 2005:10:04 | 10:22:31 | 5.656 | 4 | 1200 | 783 | 2.2 | 0.44% | 226.5695 |
| 562 | 2005:10:04 | 10:22:41 | 5.432 | 4 | 1200 | 783 | 2.2 | 0.41% | 242.2724 |
| 563 | 2005:10:04 | 10:22:51 | 5.422 | 4 | 1200 | 783 | 2.2 | 0.41% | 243.0243 |
| 564 | 2005:10:04 | 10:23:01 | 5.221 | 4 | 1200 | 783 | 2.2 | 0.39% | 259.1938 |
| 565 | 2005:10:04 | 10:23:11 | 5.278 | 4 | 1200 | 783 | 2.2 | 0.39% | 254.3939 |
| 566 | 2005:10:04 | 10:23:21 | 5.245 | 4 | 1200 | 783 | 2.2 | 0.39% | 257.1509 |
| 567 | 2005:10:04 | 10:23:31 | 5.759 | 4 | 1200 | 783 | 2.2 | 0.45% | 220.0125 |
| 568 | 2005:10:04 | 10:23:41 | 5.463 | 4 | 1200 | 783 | 2.2 | 0.42% | 239.9707 |
| 569 | 2005:10:04 | 10:23:51 | 5.578 | 4 | 1200 | 783 | 2.2 | 0.43% | 231.8012 |
| 570 | 2005:10:04 | 10:24:01 | 5.58 | 4 | 1200 | 783 | 2.2 | 0.43% | 231.664 |
| 571 | 2005:10:04 | 10:24:11 | 6.174 | 4 | 1200 | 783 | 2.2 | 0.51% | 197.0368 |
| 572 | 2005:10:04 | 10:24:21 | 5.801 | 4 | 1200 | 783 | 2.2 | 0.46% | 217.4464 |
| 573 | 2005:10:04 | 10:24:31 | 7.372 | 4 | 1200 | 783 | 2.2 | 0.66% | 151.3968 |
| 574 | 2005:10:04 | 10:24:41 | 6.758 | 4 | 1200 | 783 | 2.2 | 0.58% | 171.7912 |
| 575 | 2005:10:04 | 10:24:51 | 7.023 | 4 | 1200 | 783 | 2.2 | 0.62% | 162.3521 |
| 576 | 2005:10:04 | 10:25:01 | 7.238 | 4 | 1200 | 783 | 2.2 | 0.64% | 155.4237 |
| 577 | 2005:10:04 | 10:25:11 | 7.308 | 4 | 1200 | 783 | 2.2 | 0.65% | 153.2937 |
| 578 | 2005:10:04 | 10:25:21 | 7.145 | 4 | 1200 | 783 | 2.2 | 0.63% | 158.3467 |
| 579 | 2005:10:04 | 10:25:31 | 6.593 | 4 | 1200 | 783 | 2.2 | 0.56% | 178.2436 |
| 580 | 2005:10:04 | 10:25:41 | 6.483 | 4 | 1200 | 783 | 2.2 | 0.55% | 182.8215 |
| 581 | 2005:10:04 | 10:25:51 | 6.673 | 4 | 1200 | 783 | 2.2 | 0.57% | 175.0557 |
| 582 | 2005:10:04 | 10:26:01 | 6.422 | 4 | 1200 | 783 | 2.2 | 0.54% | 185.4629 |
| 583 | 2005:10:04 | 10:26:11 | 6.422 | 4 | 1200 | 783 | 2.2 | 0.54% | 185.4629 |
| 584 | 2005:10:04 | 10:26:21 | 5.449 | 4 | 1200 | 783 | 2.2 | 0.41% | 241.0047 |
| 585 | 2005:10:04 | 10:26:31 | 5.866 | 4 | 1200 | 783 | 2.2 | 0.47% | 213.5909 |
| 586 | 2005:10:04 | 10:26:41 | 5.135 | 4 | 1200 | 783 | 2.2 | 0.37% | 266.7885 |
| 587 | 2005:10:04 | 10:26:51 | 5.08 | 4 | 1200 | 783 | 2.2 | 0.37% | 271.8835 |
| 588 | 2005:10:04 | 10:27:01 | 4.693 | 4 | 1200 | 783 | 2.2 | 0.32% | 314.0892 |
| 589 | 2005:10:04 | 10:27:11 | 5.107 | 4 | 1200 | 783 | 2.2 | 0.37% | 269.3582 |
| 590 | 2005:10:04 | 10:27:21 | 4.979 | 4 | 1200 | 783 | 2.2 | 0.35% | 281.7648 |
| 591 | 2005:10:04 | 10:27:31 | 5.207 | 4 | 1200 | 783 | 2.2 | 0.38% | 260.4005 |
| 592 | 2005:10:04 | 10:27:41 | 4.697 | 4 | 1200 | 783 | 2.2 | 0.32% | 313.586 |
| 593 | 2005:10:04 | 10:27:51 | 5.31 | 4 | 1200 | 783 | 2.2 | 0.40% | 251.7763 |
| 594 | 2005:10:04 | 10:28:01 | 4.98 | 4 | 1200 | 783 | 2.2 | 0.36% | 281.6634 |
| 595 | 2005:10:04 | 10:28:11 | 5.307 | 4 | 1200 | 783 | 2.2 | 0.40% | 252.0194 |
| 596 | 2005:10:04 | 10:28:21 | 5.944 | 4 | 1200 | 783 | 2.2 | 0.48% | 209.1411 |
| 597 | 2005:10:04 | 10:28:31 | 5.354 | 4 | 1200 | 783 | 2.2 | 0.40% | 248.2639 |

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|---|---|---|---|---|---|---|---|---|---|
| 598 | 2005:10:04 | 10:28:41 | 5.618 | 4 | 1200 | 783 | 2.2 | 0.44% | 229.0885 |
| 599 | 2005:10:04 | 10:28:51 | 5.519 | 4 | 1200 | 783 | 2.2 | 0.42% | 235.9218 |
| 600 | 2005:10:04 | 10:29:01 | 5.983 | 4 | 1200 | 783 | 2.2 | 0.48% | 206.985 |
| 601 | 2005:10:04 | 10:29:11 | 5.893 | 4 | 1200 | 783 | 2.2 | 0.47% | 212.0293 |
| 602 | 2005:10:04 | 10:29:21 | 5.59 | 4 | 1200 | 783 | 2.2 | 0.43% | 230.9806 |
| 603 | 2005:10:04 | 10:29:31 | 5.199 | 4 | 1200 | 783 | 2.2 | 0.38% | 261.0951 |
| 604 | 2005:10:04 | 10:29:41 | 5.863 | 4 | 1200 | 783 | 2.2 | 0.47% | 213.7659 |
| 605 | 2005:10:04 | 10:29:51 | 5.753 | 4 | 1200 | 783 | 2.2 | 0.45% | 220.384 |
| 606 | 2005:10:04 | 10:30:01 | 5.535 | 4 | 1200 | 809 | 2.2 | 0.41% | 242.6162 |
| 607 | 2005:10:04 | 10:30:11 | 4.813 | 4 | 1200 | 809 | 2.2 | 0.32% | 309.6537 |
| 608 | 2005:10:04 | 10:30:21 | 5.273 | 4 | 1200 | 809 | 2.2 | 0.38% | 263.3014 |
| 609 | 2005:10:04 | 10:30:31 | 4.826 | 4 | 1200 | 809 | 2.2 | 0.32% | 308.1208 |
| 610 | 2005:10:04 | 10:30:41 | 4.972 | 4 | 1200 | 809 | 2.2 | 0.34% | 291.8922 |
| 611 | 2005:10:04 | 10:30:51 | 5.043 | 4 | 1200 | 809 | 2.2 | 0.35% | 284.6026 |
| 612 | 2005:10:04 | 10:31:01 | 5.3 | 4 | 1200 | 809 | 2.2 | 0.38% | 261.0081 |
| 613 | 2005:10:04 | 10:31:11 | 4.965 | 4 | 1200 | 809 | 2.2 | 0.34% | 292.6312 |
| 614 | 2005:10:04 | 10:31:21 | 5.182 | 4 | 1200 | 809 | 2.2 | 0.37% | 271.3364 |
| 615 | 2005:10:04 | 10:31:31 | 5.155 | 4 | 1200 | 809 | 2.2 | 0.37% | 273.8156 |
| 616 | 2005:10:04 | 10:31:41 | 5.475 | 4 | 1200 | 809 | 2.2 | 0.40% | 247.0611 |
| 617 | 2005:10:04 | 10:31:51 | 5.723 | 4 | 1200 | 809 | 2.2 | 0.44% | 229.6694 |
| 618 | 2005:10:04 | 10:32:01 | 5.127 | 4 | 1200 | 809 | 2.2 | 0.36% | 276.435 |
| 619 | 2005:10:04 | 10:32:11 | 4.707 | 4 | 1200 | 809 | 2.2 | 0.31% | 322.7464 |
| 620 | 2005:10:04 | 10:32:21 | 4.542 | 4 | 1200 | 809 | 2.2 | 0.29% | 345.4847 |
| 621 | 2005:10:04 | 10:32:31 | 4.307 | 4 | 1200 | 809 | 2.2 | 0.26% | 384.0176 |
| 622 | 2005:10:04 | 10:32:41 | 4.591 | 4 | 1200 | 809 | 2.2 | 0.30% | 338.4045 |
| 623 | 2005:10:04 | 10:32:51 | 4.909 | 4 | 1200 | 809 | 2.2 | 0.33% | 298.6804 |
| 624 | 2005:10:04 | 10:33:01 | 4.863 | 4 | 1200 | 809 | 2.2 | 0.33% | 303.8397 |
| 625 | 2005:10:04 | 10:33:11 | 4.246 | 4 | 1200 | 809 | 2.2 | 0.25% | 395.4668 |
| 626 | 2005:10:04 | 10:33:21 | 4.75 | 4 | 1200 | 809 | 2.2 | 0.32% | 317.304 |
| 627 | 2005:10:04 | 10:33:31 | 5.205 | 4 | 1200 | 809 | 2.2 | 0.37% | 269.2596 |
| 628 | 2005:10:04 | 10:33:41 | 5.565 | 4 | 1200 | 809 | 2.2 | 0.42% | 240.4532 |
| 629 | 2005:10:04 | 10:33:51 | 6.139 | 4 | 1200 | 809 | 2.2 | 0.49% | 205.4139 |
| 630 | 2005:10:04 | 10:34:01 | 6.353 | 4 | 1200 | 809 | 2.2 | 0.51% | 194.8291 |
| 631 | 2005:10:04 | 10:34:11 | 6.498 | 4 | 1200 | 809 | 2.2 | 0.53% | 188.2562 |
| 632 | 2005:10:04 | 10:34:21 | 7.121 | 4 | 1200 | 809 | 2.2 | 0.61% | 164.4229 |
| 633 | 2005:10:04 | 10:34:31 | 7.105 | 4 | 1200 | 809 | 2.2 | 0.61% | 164.9593 |
| 634 | 2005:10:04 | 10:34:41 | 6.698 | 4 | 1200 | 809 | 2.2 | 0.56% | 179.8855 |
| 635 | 2005:10:04 | 10:34:51 | 4.61 | 4 | 1200 | 809 | 2.2 | 0.30% | 335.7366 |
| 636 | 2005:10:04 | 10:35:01 | 5.028 | 4 | 1200 | 809 | 2.2 | 0.35% | 286.1122 |
| 637 | 2005:10:04 | 10:35:11 | 5.453 | 4 | 1200 | 809 | 2.2 | 0.40% | 248.732 |
| 638 | 2005:10:04 | 10:35:21 | 5.561 | 4 | 1200 | 809 | 2.2 | 0.42% | 240.7394 |
| 639 | 2005:10:04 | 10:35:31 | 5.275 | 4 | 1200 | 809 | 2.2 | 0.38% | 263.1301 |
| 640 | 2005:10:04 | 10:35:41 | 5.27 | 4 | 1200 | 809 | 2.2 | 0.38% | 263.5587 |
| 641 | 2005:10:04 | 10:35:51 | 5.486 | 4 | 1200 | 809 | 2.2 | 0.41% | 246.2341 |
| 642 | 2005:10:04 | 10:36:01 | 5.223 | 4 | 1200 | 809 | 2.2 | 0.37% | 267.6564 |

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|---|---|---|---|---|---|---|---|---|---|
| 643 | 2005:10:04 | 10:36:11 | 6.149 | 4 | 1200 | 809 | 2.2 | 0.49% | 204.8937 |
| 644 | 2005:10:04 | 10:36:21 | 4.757 | 4 | 1200 | 809 | 2.2 | 0.32% | 316.4353 |
| 645 | 2005:10:04 | 10:36:31 | 4.787 | 4 | 1200 | 809 | 2.2 | 0.32% | 312.7658 |
| 646 | 2005:10:04 | 10:36:41 | 4.671 | 4 | 1200 | 809 | 2.2 | 0.31% | 327.4485 |
| 647 | 2005:10:04 | 10:36:51 | 4.743 | 4 | 1200 | 809 | 2.2 | 0.31% | 318.1774 |
| 648 | 2005:10:04 | 10:37:01 | 5.26 | 4 | 1200 | 809 | 2.2 | 0.38% | 264.42 |
| 649 | 2005:10:04 | 10:37:11 | 4.96 | 4 | 1200 | 809 | 2.2 | 0.34% | 293.1613 |
| 650 | 2005:10:04 | 10:37:21 | 5.411 | 4 | 1200 | 809 | 2.2 | 0.40% | 251.9854 |
| 651 | 2005:10:04 | 10:37:31 | 6.037 | 4 | 1200 | 809 | 2.2 | 0.47% | 210.8744 |
| 652 | 2005:10:04 | 10:37:41 | 6.052 | 4 | 1200 | 809 | 2.2 | 0.48% | 210.0533 |
| 653 | 2005:10:04 | 10:37:51 | 5.676 | 4 | 1200 | 809 | 2.2 | 0.43% | 232.7748 |
| 654 | 2005:10:04 | 10:38:01 | 5.316 | 4 | 1200 | 809 | 2.2 | 0.39% | 259.6679 |
| 655 | 2005:10:04 | 10:38:11 | 5.311 | 4 | 1200 | 809 | 2.2 | 0.38% | 260.0852 |
| 656 | 2005:10:04 | 10:38:21 | 5.308 | 4 | 1200 | 809 | 2.2 | 0.38% | 260.3363 |
| 657 | 2005:10:04 | 10:38:31 | 5.051 | 4 | 1200 | 809 | 2.2 | 0.35% | 283.804 |
| 658 | 2005:10:04 | 10:38:41 | 5.051 | 4 | 1200 | 809 | 2.2 | 0.35% | 283.804 |
| 659 | 2005:10:04 | 10:38:51 | 5.369 | 4 | 1200 | 809 | 2.2 | 0.39% | 255.3251 |
| 660 | 2005:10:04 | 10:39:01 | 5.129 | 4 | 1200 | 809 | 2.2 | 0.36% | 276.2462 |
| 661 | 2005:10:04 | 10:39:11 | 4.897 | 4 | 1200 | 809 | 2.2 | 0.33% | 300.0093 |
| 662 | 2005:10:04 | 10:39:21 | 4.866 | 4 | 1200 | 809 | 2.2 | 0.33% | 303.4978 |
| 663 | 2005:10:04 | 10:39:31 | 4.916 | 4 | 1200 | 809 | 2.2 | 0.34% | 297.9106 |
| 664 | 2005:10:04 | 10:39:41 | 4.49 | 4 | 1200 | 809 | 2.2 | 0.28% | 353.3298 |
| 665 | 2005:10:04 | 10:39:51 | 4.429 | 4 | 1200 | 809 | 2.2 | 0.28% | 362.9992 |
| 666 | 2005:10:04 | 10:40:01 | 4.599 | 4 | 1200 | 809 | 2.2 | 0.30% | 337.276 |
| 667 | 2005:10:04 | 10:40:11 | 4.739 | 4 | 1200 | 809 | 2.2 | 0.31% | 318.6787 |
| 668 | 2005:10:04 | 10:40:21 | 4.564 | 4 | 1200 | 809 | 2.2 | 0.29% | 342.2695 |
| 669 | 2005:10:04 | 10:40:31 | 4.665 | 4 | 1200 | 809 | 2.2 | 0.30% | 328.2455 |
| 670 | 2005:10:04 | 10:40:41 | 4.454 | 4 | 1200 | 809 | 2.2 | 0.28% | 358.973 |
| 671 | 2005:10:04 | 10:40:51 | 4.376 | 4 | 1200 | 809 | 2.2 | 0.27% | 371.8406 |
| 672 | 2005:10:04 | 10:41:01 | 4.478 | 4 | 1200 | 809 | 2.2 | 0.28% | 355.191 |
| 673 | 2005:10:04 | 10:41:11 | 4.274 | 4 | 1200 | 809 | 2.2 | 0.26% | 390.1279 |
| 674 | 2005:10:04 | 10:41:21 | 4.41 | 4 | 1200 | 809 | 2.2 | 0.27% | 366.12 |
| 675 | 2005:10:04 | 10:41:31 | 4.766 | 4 | 1200 | 809 | 2.2 | 0.32% | 315.3255 |
| 676 | 2005:10:04 | 10:41:41 | 4.727 | 4 | 1200 | 809 | 2.2 | 0.31% | 320.192 |
| 677 | 2005:10:04 | 10:41:51 | 4.443 | 4 | 1200 | 809 | 2.2 | 0.28% | 360.7335 |
| 678 | 2005:10:04 | 10:42:01 | 4.299 | 4 | 1200 | 809 | 2.2 | 0.26% | 385.4813 |
| 679 | 2005:10:04 | 10:42:11 | 4.565 | 4 | 1200 | 809 | 2.2 | 0.29% | 342.1248 |
| 680 | 2005:10:04 | 10:42:21 | 4.433 | 4 | 1200 | 809 | 2.2 | 0.28% | 362.3489 |
| 681 | 2005:10:04 | 10:42:31 | 4.489 | 4 | 1200 | 809 | 2.2 | 0.28% | 353.4841 |
| 682 | 2005:10:04 | 10:42:41 | 4.802 | 4 | 1200 | 809 | 2.2 | 0.32% | 310.9628 |
| 683 | 2005:10:04 | 10:42:51 | 4.895 | 4 | 1200 | 809 | 2.2 | 0.33% | 300.232 |
| 684 | 2005:10:04 | 10:43:01 | 4.761 | 4 | 1200 | 809 | 2.2 | 0.32% | 315.9411 |
| 685 | 2005:10:04 | 10:43:11 | 4.956 | 4 | 1200 | 809 | 2.2 | 0.34% | 293.5868 |
| 686 | 2005:10:04 | 10:43:21 | 4.867 | 4 | 1200 | 809 | 2.2 | 0.33% | 303.384 |
| 687 | 2005:10:04 | 10:43:31 | 4.911 | 4 | 1200 | 809 | 2.2 | 0.34% | 298.46 |

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| 688 | 2005:10:04 | 10:43:41 | 4.806 | 4 | 1200 | 809 | 2.2 | 0.32% | 310.4855 |
| 689 | 2005:10:04 | 10:43:51 | 4.623 | 4 | 1200 | 809 | 2.2 | 0.30% | 333.9353 |
| 690 | 2005:10:04 | 10:44:01 | 4.487 | 4 | 1200 | 809 | 2.2 | 0.28% | 353.7932 |
| 691 | 2005:10:04 | 10:44:11 | 4.525 | 4 | 1200 | 809 | 2.2 | 0.29% | 348.0108 |
| 692 | 2005:10:04 | 10:44:21 | 4.428 | 4 | 1200 | 809 | 2.2 | 0.28% | 363.1621 |
| 693 | 2005:10:04 | 10:44:31 | 4.513 | 4 | 1200 | 809 | 2.2 | 0.29% | 349.8163 |
| 694 | 2005:10:04 | 10:44:41 | 5.133 | 4 | 1200 | 809 | 2.2 | 0.36% | 275.8695 |
| 695 | 2005:10:04 | 10:44:51 | 5.346 | 4 | 1200 | 809 | 2.2 | 0.39% | 257.1917 |
| 696 | 2005:10:04 | 10:45:01 | 5.45 | 4 | 1200 | 809 | 2.2 | 0.40% | 248.9616 |
| 697 | 2005:10:04 | 10:45:11 | 5.67 | 4 | 1200 | 809 | 2.2 | 0.43% | 233.1773 |
| 698 | 2005:10:04 | 10:45:21 | 5.793 | 4 | 1200 | 809 | 2.2 | 0.44% | 225.1949 |
| 699 | 2005:10:04 | 10:45:31 | 5.474 | 4 | 1200 | 809 | 2.2 | 0.40% | 247.1366 |
| 700 | 2005:10:04 | 10:45:41 | 4.621 | 4 | 1200 | 809 | 2.2 | 0.30% | 334.2111 |
| 701 | 2005:10:04 | 10:45:51 | 5.065 | 4 | 1200 | 809 | 2.2 | 0.35% | 282.4172 |
| 702 | 2005:10:04 | 10:46:01 | 5.009 | 4 | 1200 | 809 | 2.2 | 0.35% | 288.0474 |
| 703 | 2005:10:04 | 10:46:11 | 5.201 | 4 | 1200 | 809 | 2.2 | 0.37% | 269.6185 |
| 704 | 2005:10:04 | 10:46:21 | 4.571 | 4 | 1200 | 809 | 2.2 | 0.29% | 341.259 |
| 705 | 2005:10:04 | 10:46:31 | 4.789 | 4 | 1200 | 809 | 2.2 | 0.32% | 312.5242 |
| 706 | 2005:10:04 | 10:46:41 | 4.136 | 4 | 1200 | 809 | 2.2 | 0.24% | 417.9366 |
| 707 | 2005:10:04 | 10:46:51 | 4.895 | 4 | 1200 | 809 | 2.2 | 0.33% | 300.232 |
| 708 | 2005:10:04 | 10:47:01 | 4.893 | 4 | 1200 | 809 | 2.2 | 0.33% | 300.4549 |
| 709 | 2005:10:04 | 10:47:11 | 4.879 | 4 | 1200 | 809 | 2.2 | 0.33% | 302.0251 |
| 710 | 2005:10:04 | 10:47:21 | 5.076 | 4 | 1200 | 809 | 2.2 | 0.36% | 281.337 |
| 711 | 2005:10:04 | 10:47:31 | 5.043 | 4 | 1200 | 809 | 2.2 | 0.35% | 284.6026 |
| 712 | 2005:10:04 | 10:47:41 | 4.575 | 4 | 1200 | 809 | 2.2 | 0.29% | 340.6843 |
| 713 | 2005:10:04 | 10:47:51 | 4.816 | 4 | 1200 | 809 | 2.2 | 0.32% | 309.2986 |
| 714 | 2005:10:04 | 10:48:01 | 5.05 | 4 | 1200 | 809 | 2.2 | 0.35% | 283.9036 |
| 715 | 2005:10:04 | 10:48:11 | 4.658 | 4 | 1200 | 809 | 2.2 | 0.30% | 329.1803 |
| 716 | 2005:10:04 | 10:48:21 | 4.597 | 4 | 1200 | 809 | 2.2 | 0.30% | 337.5574 |
| 717 | 2005:10:04 | 10:48:31 | 4.715 | 4 | 1200 | 809 | 2.2 | 0.31% | 321.7197 |
| 718 | 2005:10:04 | 10:48:41 | 4.912 | 4 | 1200 | 809 | 2.2 | 0.34% | 298.35 |
| 719 | 2005:10:04 | 10:48:51 | 4.523 | 4 | 1200 | 809 | 2.2 | 0.29% | 348.3104 |
| 720 | 2005:10:04 | 10:49:01 | 4.818 | 4 | 1200 | 809 | 2.2 | 0.32% | 309.0623 |
| 721 | 2005:10:04 | 10:49:11 | 5.109 | 4 | 1200 | 809 | 2.2 | 0.36% | 278.1455 |
| 722 | 2005:10:04 | 10:49:21 | 5.256 | 4 | 1200 | 809 | 2.2 | 0.38% | 264.7661 |
| 723 | 2005:10:04 | 10:49:31 | 5.319 | 4 | 1200 | 809 | 2.2 | 0.39% | 259.4181 |
| 724 | 2005:10:04 | 10:49:41 | 4.947 | 4 | 1200 | 809 | 2.2 | 0.34% | 294.5487 |
| 725 | 2005:10:04 | 10:49:51 | 4.853 | 4 | 1200 | 809 | 2.2 | 0.33% | 304.985 |
| 726 | 2005:10:04 | 10:50:01 | 4.7 | 4 | 1200 | 809 | 2.2 | 0.31% | 323.6501 |
| 727 | 2005:10:04 | 10:50:11 | 4.894 | 4 | 1200 | 809 | 2.2 | 0.33% | 300.3434 |
| 728 | 2005:10:04 | 10:50:21 | 4.576 | 4 | 1200 | 809 | 2.2 | 0.29% | 340.5409 |
| 729 | 2005:10:04 | 10:50:31 | 4.972 | 4 | 1200 | 809 | 2.2 | 0.34% | 291.8922 |
| 730 | 2005:10:04 | 10:50:41 | 4.949 | 4 | 1200 | 809 | 2.2 | 0.34% | 294.3344 |
| 731 | 2005:10:04 | 10:50:51 | 5.075 | 4 | 1200 | 809 | 2.2 | 0.36% | 281.4348 |
| 732 | 2005:10:04 | 10:51:01 | 5.165 | 4 | 1200 | 809 | 2.2 | 0.37% | 272.8921 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 733 | 2005:10:04 | 10:51:11 | 5.284 | 4 | 1200 | 809 | 2.2 | 0.38% | 262.3622 |
| 734 | 2005:10:04 | 10:51:21 | 5.2 | 4 | 1200 | 809 | 2.2 | 0.37% | 269.7084 |
| 735 | 2005:10:04 | 10:51:31 | 5.315 | 4 | 1200 | 809 | 2.2 | 0.38% | 259.7513 |
| 736 | 2005:10:04 | 10:51:41 | 5.182 | 4 | 1200 | 809 | 2.2 | 0.37% | 271.3364 |
| 737 | 2005:10:04 | 10:51:51 | 5.331 | 4 | 1200 | 809 | 2.2 | 0.39% | 258.4239 |
| 738 | 2005:10:04 | 10:52:01 | 5.626 | 4 | 1200 | 809 | 2.2 | 0.42% | 236.172 |
| 739 | 2005:10:04 | 10:52:11 | 5.37 | 4 | 1200 | 809 | 2.2 | 0.39% | 255.2445 |
| 740 | 2005:10:04 | 10:52:21 | 5.239 | 4 | 1200 | 809 | 2.2 | 0.38% | 266.2472 |
| 741 | 2005:10:04 | 10:52:31 | 5.2 | 4 | 1200 | 809 | 2.2 | 0.37% | 269.7084 |
| 742 | 2005:10:04 | 10:52:41 | 5.336 | 4 | 1200 | 809 | 2.2 | 0.39% | 258.0118 |
| 743 | 2005:10:04 | 10:52:51 | 5.41 | 4 | 1200 | 809 | 2.2 | 0.40% | 252.0639 |
| 744 | 2005:10:04 | 10:53:01 | 5.75 | 4 | 1200 | 809 | 2.2 | 0.44% | 227.9226 |
| 745 | 2005:10:04 | 10:53:11 | 5.083 | 4 | 1200 | 809 | 2.2 | 0.36% | 280.6539 |
| 746 | 2005:10:04 | 10:53:21 | 4.771 | 4 | 1200 | 809 | 2.2 | 0.32% | 314.7122 |
| 747 | 2005:10:04 | 10:53:31 | 4.819 | 4 | 1200 | 809 | 2.2 | 0.32% | 308.9443 |
| 748 | 2005:10:04 | 10:53:41 | 4.934 | 4 | 1200 | 809 | 2.2 | 0.34% | 295.9492 |
| 749 | 2005:10:04 | 10:53:51 | 4.747 | 4 | 1200 | 809 | 2.2 | 0.31% | 317.6777 |
| 750 | 2005:10:04 | 10:54:01 | 4.979 | 4 | 1200 | 809 | 2.2 | 0.34% | 291.1569 |
| 751 | 2005:10:04 | 10:54:11 | 4.232 | 4 | 1200 | 809 | 2.2 | 0.25% | 398.1915 |
| 752 | 2005:10:04 | 10:54:21 | 4.766 | 4 | 1200 | 809 | 2.2 | 0.32% | 315.3255 |
| 753 | 2005:10:04 | 10:54:31 | 4.856 | 4 | 1200 | 809 | 2.2 | 0.33% | 304.6405 |
| 754 | 2005:10:04 | 10:54:41 | 5.196 | 4 | 1200 | 809 | 2.2 | 0.37% | 270.0685 |
| 755 | 2005:10:04 | 10:54:51 | 4.459 | 4 | 1200 | 809 | 2.2 | 0.28% | 358.1785 |
| 756 | 2005:10:04 | 10:55:01 | 4.224 | 4 | 1200 | 809 | 2.2 | 0.25% | 399.7654 |
| 757 | 2005:10:04 | 10:55:11 | 4.234 | 4 | 1200 | 809 | 2.2 | 0.25% | 397.8 |
| 758 | 2005:10:04 | 10:55:21 | 4.324 | 4 | 1200 | 809 | 2.2 | 0.26% | 380.944 |
| 759 | 2005:10:04 | 10:55:31 | 3.964 | 4 | 1200 | 809 | 2.2 | 0.22% | 458.6877 |
| 760 | 2005:10:04 | 10:55:41 | 4.083 | 4 | 1200 | 809 | 2.2 | 0.23% | 429.7 |
| 761 | 2005:10:04 | 10:55:51 | 4.414 | 4 | 1200 | 809 | 2.2 | 0.27% | 365.4585 |
| 762 | 2005:10:04 | 10:56:01 | 4.576 | 4 | 1200 | 809 | 2.2 | 0.29% | 340.5409 |
| 763 | 2005:10:04 | 10:56:11 | 4.612 | 4 | 1200 | 809 | 2.2 | 0.30% | 335.4582 |
| 764 | 2005:10:04 | 10:56:21 | 4.064 | 4 | 1200 | 809 | 2.2 | 0.23% | 434.08 |
| 765 | 2005:10:04 | 10:56:31 | 4.005 | 4 | 1200 | 809 | 2.2 | 0.22% | 448.2688 |
| 766 | 2005:10:04 | 10:56:41 | 3.845 | 4 | 1200 | 809 | 2.2 | 0.20% | 491.8694 |
| 767 | 2005:10:04 | 10:56:51 | 3.768 | 4 | 1200 | 809 | 2.2 | 0.19% | 516.0237 |
| 768 | 2005:10:04 | 10:57:01 | 4.027 | 4 | 1200 | 809 | 2.2 | 0.23% | 442.8709 |
| 769 | 2005:10:04 | 10:57:11 | 3.867 | 4 | 1200 | 809 | 2.2 | 0.21% | 485.378 |
| 770 | 2005:10:04 | 10:57:21 | 4.042 | 4 | 1200 | 809 | 2.2 | 0.23% | 439.2645 |
| 771 | 2005:10:04 | 10:57:31 | 4.289 | 4 | 1200 | 809 | 2.2 | 0.26% | 387.3265 |
| 772 | 2005:10:04 | 10:57:41 | 4.338 | 4 | 1200 | 809 | 2.2 | 0.26% | 378.4496 |
| 773 | 2005:10:04 | 10:57:51 | 4.645 | 4 | 1200 | 809 | 2.2 | 0.30% | 330.9305 |
| 774 | 2005:10:04 | 10:58:01 | 3.841 | 4 | 1200 | 809 | 2.2 | 0.20% | 493.0683 |
| 775 | 2005:10:04 | 10:58:11 | 4.028 | 4 | 1200 | 809 | 2.2 | 0.23% | 442.6286 |
| 776 | 2005:10:04 | 10:58:21 | 3.606 | 4 | 1200 | 809 | 2.2 | 0.17% | 575.4802 |
| 777 | 2005:10:04 | 10:58:31 | 3.686 | 4 | 1200 | 809 | 2.2 | 0.18% | 544.4988 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 778 | 2005:10:04 | 10:58:41 | 3.943 | 4 | 1200 | 809 | 2.2 | 0.22% | 464.2141 |
| 779 | 2005:10:04 | 10:58:51 | 3.798 | 4 | 1200 | 809 | 2.2 | 0.20% | 506.3361 |
| 780 | 2005:10:04 | 10:59:01 | 3.946 | 4 | 1200 | 809 | 2.2 | 0.22% | 463.4165 |
| 781 | 2005:10:04 | 10:59:11 | 3.737 | 4 | 1200 | 809 | 2.2 | 0.19% | 526.4315 |
| 782 | 2005:10:04 | 10:59:21 | 3.742 | 4 | 1200 | 809 | 2.2 | 0.19% | 524.7245 |
| 783 | 2005:10:04 | 10:59:30 | 3.853 | 4 | 1200 | 809 | 2.2 | 0.20% | 489.4889 |
| | | | | | | | **avg** | **0.38%** | **263.0213** |

**Upstream Background Check**

| Entry # | Date | Time | Fluor | Height | Station | Conc Eff ppb | Conc BG ppb | Effluent Fraction | Dilution |
|---|---|---|---|---|---|---|---|---|---|
| 784 | 2005:10:04 | 11:26:37 | 2.249 | | | 837 | 2.2 | 0.01% | 17082.16 |
| 785 | 2005:10:04 | 11:27:30 | 2.224 | | | 837 | 2.2 | 0.00% | 34876.08 |
| 786 | 2005:10:04 | 11:27:41 | 2.189 | | | 837 | 2.2 | 0.00% | -76093.3 |
| 787 | 2005:10:04 | 11:27:51 | 2.207 | | | 837 | 2.2 | 0.00% | 119575.1 |
| 788 | 2005:10:04 | 11:28:01 | 2.258 | | | 837 | 2.2 | 0.01% | 14431.48 |
| 789 | 2005:10:04 | 11:28:11 | 2.229 | | | 837 | 2.2 | 0.00% | 28862.97 |

# ATTACHMENT II-2:
# PEAK-TO-MEAN CALCULATION TABLES

# PEAK-TO-MEAN CALCULATION TABLES

**Table A. Effluent fraction cross section from transects and profiles 6:40 to 7:00 and 8:00 to 8:30**

| | 1152.9 | 1155.6 | 1158.4 | 1161.1 | 1163.8 | 1166.5 | 1169.3 | 1172.0 | 1174.7 | 1177.5 | 1180.2 | 1182.9 | 1185.6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.67 | 0.05% | 0.07% | 0.11% | 0.12% | 0.12% | 0.14% | 0.23% | 0.22% | 0.32% | 0.37% | 0.43% | 0.42% | 0.47% |
| 1.33 | 0.05% | 0.08% | 0.11% | 0.13% | 0.13% | 0.15% | 0.25% | 0.24% | 0.34% | 0.40% | 0.46% | 0.45% | 0.51% |
| 2.00 | 0.05% | 0.08% | 0.12% | 0.14% | 0.13% | 0.16% | 0.27% | 0.26% | 0.36% | 0.42% | 0.49% | 0.48% | 0.54% |
| 2.67 | 0.05% | 0.08% | 0.11% | 0.13% | 0.12% | 0.15% | 0.25% | 0.24% | 0.33% | 0.39% | 0.45% | 0.44% | 0.50% |
| 3.33 | 0.04% | 0.06% | 0.09% | 0.10% | 0.10% | 0.12% | 0.20% | 0.19% | 0.27% | 0.31% | 0.36% | 0.35% | 0.40% |
| 4.00 | 0.04% | 0.07% | 0.10% | 0.12% | 0.11% | 0.14% | 0.22% | 0.21% | 0.30% | 0.35% | 0.40% | 0.39% | 0.45% |
| 4.67 | 0.05% | 0.07% | 0.10% | 0.12% | 0.12% | 0.14% | 0.23% | 0.22% | 0.31% | 0.36% | 0.42% | 0.41% | 0.46% |
| 5.33 | 0.05% | 0.07% | 0.10% | 0.12% | 0.12% | 0.14% | 0.23% | 0.22% | 0.31% | 0.36% | 0.42% | 0.41% | 0.46% |
| 6.00 | 0.04% | 0.07% | 0.10% | 0.12% | 0.11% | 0.14% | 0.22% | 0.21% | 0.30% | 0.36% | 0.41% | 0.40% | 0.45% |
| 6.67 | 0.04% | 0.07% | 0.09% | 0.11% | 0.11% | 0.13% | 0.21% | 0.20% | 0.29% | 0.33% | 0.39% | 0.38% | 0.43% |
| 7.33 | 0.04% | 0.07% | 0.10% | 0.11% | 0.11% | 0.13% | 0.21% | 0.21% | 0.29% | 0.34% | 0.39% | 0.38% | 0.43% |
| 8.00 | 0.04% | 0.07% | 0.10% | 0.12% | 0.11% | 0.14% | 0.22% | 0.21% | 0.30% | 0.35% | 0.40% | 0.39% | 0.44% |
| 8.67 | 0.04% | 0.06% | 0.08% | 0.10% | 0.09% | 0.11% | 0.18% | 0.17% | 0.25% | 0.29% | 0.33% | 0.32% | 0.37% |
| 9.33 | 0.03% | 0.05% | 0.07% | 0.08% | 0.08% | 0.10% | 0.15% | 0.15% | 0.21% | 0.24% | 0.28% | 0.28% | 0.31% |
| 10.00 | 0.03% | 0.04% | 0.06% | 0.07% | 0.06% | 0.08% | 0.13% | 0.12% | 0.17% | 0.20% | 0.24% | 0.23% | 0.26% |
| 10.67 | 0.03% | 0.04% | 0.06% | 0.07% | 0.06% | 0.08% | 0.13% | 0.12% | 0.17% | 0.20% | 0.24% | 0.23% | 0.26% |
| 11.33 | 0.02% | 0.03% | 0.05% | 0.06% | 0.05% | 0.07% | 0.11% | 0.10% | 0.14% | 0.17% | 0.19% | 0.19% | 0.21% |
| 12.00 | 0.02% | 0.03% | 0.04% | 0.05% | 0.05% | 0.06% | 0.09% | 0.09% | 0.13% | 0.15% | 0.17% | 0.17% | 0.19% |
| 12.67 | 0.02% | 0.03% | 0.04% | 0.04% | 0.04% | 0.05% | 0.08% | 0.08% | 0.11% | 0.13% | 0.15% | 0.14% | 0.16% |
| 13.33 | 0.01% | 0.02% | 0.03% | 0.04% | 0.03% | 0.04% | 0.07% | 0.07% | 0.09% | 0.11% | 0.13% | 0.12% | 0.14% |
| 14.00 | 0.01% | 0.02% | 0.03% | 0.03% | 0.03% | 0.04% | 0.06% | 0.06% | 0.08% | 0.09% | 0.11% | 0.11% | 0.12% |
| 14.67 | 0.01% | 0.02% | 0.03% | 0.03% | 0.03% | 0.03% | 0.06% | 0.05% | 0.08% | 0.09% | 0.10% | 0.10% | 0.11% |
| 15.33 | 0.01% | 0.02% | 0.02% | 0.03% | 0.03% | 0.03% | 0.05% | 0.05% | 0.07% | 0.08% | 0.10% | 0.10% | 0.11% |
| 16.00 | 0.01% | 0.02% | 0.02% | 0.03% | 0.03% | 0.03% | 0.05% | 0.05% | 0.07% | 0.08% | 0.09% | 0.09% | 0.10% |
| 16.67 | 0.01% | 0.01% | 0.02% | 0.02% | 0.02% | 0.02% | 0.03% | 0.03% | 0.05% | 0.05% | 0.06% | 0.06% | 0.07% |
| 17.33 | 0.00% | 0.01% | 0.01% | 0.01% | 0.01% | 0.01% | 0.02% | 0.02% | 0.03% | 0.04% | 0.04% | 0.04% | 0.05% |
| 18.00 | 0.00% | 0.00% | 0.01% | 0.01% | 0.01% | 0.01% | 0.02% | 0.02% | 0.02% | 0.02% | 0.03% | 0.03% | 0.03% |
| 18.67 | 0.01% | 0.01% | 0.01% | 0.02% | 0.01% | 0.02% | 0.03% | 0.03% | 0.04% | 0.05% | 0.05% | 0.05% | 0.06% |
| 19.33 | 0.00% | 0.01% | 0.01% | 0.01% | 0.01% | 0.01% | 0.02% | 0.02% | 0.02% | 0.03% | 0.03% | 0.03% | 0.03% |
| 20.00 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.01% | 0.01% | 0.01% | 0.01% | 0.01% | 0.02% | 0.02% | 0.02% |
| 20.67 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| 21.33 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

| | 1188.4 | 1191.1 | 1193.8 | 1196.5 | 1199.3 | 1202.0 | 1204.7 | 1207.5 | 1210.2 | 1212.9 | 1215.6 | 1218.4 | 1221.1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.67 | 0.49% | 0.40% | 0.45% | 0.43% | 0.43% | 0.45% | 0.48% | 0.48% | 0.47% | 0.46% | 0.44% | 0.47% | 0.48% |
| 1.33 | 0.53% | 0.43% | 0.48% | 0.46% | 0.46% | 0.48% | 0.51% | 0.51% | 0.50% | 0.49% | 0.47% | 0.51% | 0.51% |
| 2.00 | 0.56% | 0.45% | 0.51% | 0.49% | 0.49% | 0.51% | 0.54% | 0.54% | 0.54% | 0.52% | 0.50% | 0.54% | 0.54% |
| 2.67 | 0.52% | 0.42% | 0.47% | 0.45% | 0.45% | 0.47% | 0.50% | 0.50% | 0.50% | 0.48% | 0.47% | 0.50% | 0.50% |
| 3.33 | 0.42% | 0.34% | 0.38% | 0.37% | 0.36% | 0.38% | 0.40% | 0.40% | 0.40% | 0.39% | 0.37% | 0.40% | 0.40% |
| 4.00 | 0.46% | 0.37% | 0.42% | 0.41% | 0.40% | 0.42% | 0.45% | 0.45% | 0.44% | 0.43% | 0.42% | 0.45% | 0.45% |
| 4.67 | 0.48% | 0.39% | 0.44% | 0.42% | 0.42% | 0.44% | 0.46% | 0.47% | 0.46% | 0.45% | 0.43% | 0.46% | 0.46% |
| 5.33 | 0.48% | 0.39% | 0.44% | 0.42% | 0.42% | 0.44% | 0.47% | 0.47% | 0.46% | 0.45% | 0.43% | 0.47% | 0.47% |
| 6.00 | 0.47% | 0.38% | 0.43% | 0.41% | 0.41% | 0.43% | 0.46% | 0.46% | 0.45% | 0.44% | 0.42% | 0.45% | 0.46% |
| 6.67 | 0.44% | 0.36% | 0.40% | 0.39% | 0.39% | 0.41% | 0.43% | 0.43% | 0.42% | 0.41% | 0.40% | 0.43% | 0.43% |
| 7.33 | 0.45% | 0.36% | 0.41% | 0.40% | 0.39% | 0.41% | 0.44% | 0.44% | 0.43% | 0.42% | 0.41% | 0.43% | 0.44% |
| 8.00 | 0.46% | 0.37% | 0.42% | 0.41% | 0.40% | 0.42% | 0.45% | 0.45% | 0.44% | 0.43% | 0.42% | 0.44% | 0.45% |
| 8.67 | 0.38% | 0.31% | 0.35% | 0.33% | 0.33% | 0.35% | 0.37% | 0.37% | 0.37% | 0.35% | 0.34% | 0.37% | 0.37% |
| 9.33 | 0.32% | 0.26% | 0.29% | 0.28% | 0.28% | 0.30% | 0.31% | 0.31% | 0.31% | 0.30% | 0.29% | 0.31% | 0.31% |
| 10.00 | 0.27% | 0.22% | 0.25% | 0.24% | 0.24% | 0.25% | 0.26% | 0.26% | 0.26% | 0.25% | 0.24% | 0.26% | 0.26% |
| 10.67 | 0.27% | 0.22% | 0.25% | 0.24% | 0.24% | 0.25% | 0.26% | 0.26% | 0.26% | 0.25% | 0.24% | 0.26% | 0.26% |
| 11.33 | 0.22% | 0.18% | 0.20% | 0.20% | 0.19% | 0.20% | 0.22% | 0.22% | 0.21% | 0.21% | 0.20% | 0.21% | 0.22% |
| 12.00 | 0.20% | 0.16% | 0.18% | 0.17% | 0.17% | 0.18% | 0.19% | 0.19% | 0.19% | 0.18% | 0.18% | 0.19% | 0.19% |
| 12.67 | 0.17% | 0.13% | 0.15% | 0.15% | 0.14% | 0.15% | 0.16% | 0.16% | 0.16% | 0.16% | 0.15% | 0.16% | 0.16% |
| 13.33 | 0.14% | 0.12% | 0.13% | 0.13% | 0.13% | 0.13% | 0.14% | 0.14% | 0.14% | 0.13% | 0.13% | 0.14% | 0.14% |
| 14.00 | 0.13% | 0.10% | 0.11% | 0.11% | 0.11% | 0.11% | 0.12% | 0.12% | 0.12% | 0.12% | 0.11% | 0.12% | 0.12% |
| 14.67 | 0.12% | 0.10% | 0.11% | 0.10% | 0.10% | 0.11% | 0.11% | 0.11% | 0.11% | 0.11% | 0.11% | 0.11% | 0.11% |
| 15.33 | 0.11% | 0.09% | 0.10% | 0.10% | 0.10% | 0.10% | 0.11% | 0.11% | 0.11% | 0.10% | 0.10% | 0.11% | 0.11% |
| 16.00 | 0.11% | 0.09% | 0.10% | 0.09% | 0.09% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% |
| 16.67 | 0.07% | 0.06% | 0.07% | 0.06% | 0.06% | 0.07% | 0.07% | 0.07% | 0.07% | 0.07% | 0.07% | 0.07% | 0.07% |
| 17.33 | 0.05% | 0.04% | 0.04% | 0.04% | 0.04% | 0.05% | 0.05% | 0.05% | 0.05% | 0.05% | 0.04% | 0.05% | 0.05% |
| 18.00 | 0.03% | 0.03% | 0.03% | 0.03% | 0.03% | 0.03% | 0.03% | 0.03% | 0.03% | 0.03% | 0.03% | 0.03% | 0.03% |
| 18.67 | 0.06% | 0.05% | 0.06% | 0.05% | 0.05% | 0.06% | 0.06% | 0.06% | 0.06% | 0.06% | 0.05% | 0.06% | 0.06% |
| 19.33 | 0.04% | 0.03% | 0.03% | 0.03% | 0.03% | 0.03% | 0.03% | 0.03% | 0.03% | 0.03% | 0.03% | 0.03% | 0.03% |
| 20.00 | 0.02% | 0.02% | 0.02% | 0.02% | 0.02% | 0.02% | 0.02% | 0.02% | 0.02% | 0.02% | 0.02% | 0.02% | 0.02% |
| 20.67 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| 21.33 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

| | 1223.8 | 1226.5 | 1229.3 | 1232.0 | 1234.7 | 1237.5 | 1240.2 | 1242.9 | 1245.6 | 1248.4 | 1251.1 | 1253.8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.67 | 0.47% | 0.45% | 0.39% | 0.39% | 0.33% | 0.28% | 0.27% | 0.27% | 0.21% | 0.17% | 0.05% | 0.04% |
| 1.33 | 0.50% | 0.48% | 0.42% | 0.42% | 0.35% | 0.30% | 0.29% | 0.29% | 0.22% | 0.18% | 0.05% | 0.04% |
| 2.00 | 0.53% | 0.51% | 0.44% | 0.44% | 0.37% | 0.32% | 0.31% | 0.30% | 0.24% | 0.20% | 0.06% | 0.04% |
| 2.67 | 0.49% | 0.48% | 0.41% | 0.41% | 0.35% | 0.30% | 0.29% | 0.28% | 0.22% | 0.18% | 0.05% | 0.04% |
| 3.33 | 0.40% | 0.38% | 0.33% | 0.33% | 0.28% | 0.24% | 0.23% | 0.23% | 0.18% | 0.15% | 0.04% | 0.03% |
| 4.00 | 0.44% | 0.43% | 0.37% | 0.37% | 0.31% | 0.26% | 0.26% | 0.25% | 0.20% | 0.16% | 0.05% | 0.04% |
| 4.67 | 0.46% | 0.44% | 0.38% | 0.38% | 0.32% | 0.27% | 0.27% | 0.26% | 0.20% | 0.17% | 0.05% | 0.04% |
| 5.33 | 0.46% | 0.44% | 0.38% | 0.38% | 0.32% | 0.28% | 0.27% | 0.26% | 0.21% | 0.17% | 0.05% | 0.04% |
| 6.00 | 0.45% | 0.43% | 0.37% | 0.37% | 0.32% | 0.27% | 0.26% | 0.26% | 0.20% | 0.16% | 0.05% | 0.04% |
| 6.67 | 0.42% | 0.41% | 0.35% | 0.35% | 0.30% | 0.25% | 0.25% | 0.24% | 0.19% | 0.15% | 0.04% | 0.03% |
| 7.33 | 0.43% | 0.41% | 0.36% | 0.36% | 0.30% | 0.26% | 0.25% | 0.24% | 0.19% | 0.16% | 0.05% | 0.04% |
| 8.00 | 0.44% | 0.42% | 0.37% | 0.36% | 0.31% | 0.26% | 0.26% | 0.25% | 0.20% | 0.16% | 0.05% | 0.04% |
| 8.67 | 0.36% | 0.35% | 0.30% | 0.30% | 0.25% | 0.22% | 0.21% | 0.21% | 0.16% | 0.13% | 0.04% | 0.03% |
| 9.33 | 0.31% | 0.30% | 0.26% | 0.26% | 0.22% | 0.19% | 0.18% | 0.18% | 0.14% | 0.11% | 0.03% | 0.03% |
| 10.00 | 0.26% | 0.25% | 0.21% | 0.21% | 0.18% | 0.15% | 0.15% | 0.15% | 0.12% | 0.09% | 0.03% | 0.02% |
| 10.67 | 0.26% | 0.25% | 0.21% | 0.21% | 0.18% | 0.15% | 0.15% | 0.15% | 0.12% | 0.09% | 0.03% | 0.02% |
| 11.33 | 0.21% | 0.20% | 0.18% | 0.18% | 0.15% | 0.13% | 0.12% | 0.12% | 0.09% | 0.08% | 0.02% | 0.02% |
| 12.00 | 0.19% | 0.18% | 0.16% | 0.15% | 0.13% | 0.11% | 0.11% | 0.11% | 0.08% | 0.07% | 0.02% | 0.02% |
| 12.67 | 0.16% | 0.15% | 0.13% | 0.13% | 0.11% | 0.10% | 0.09% | 0.09% | 0.07% | 0.06% | 0.02% | 0.01% |
| 13.33 | 0.14% | 0.13% | 0.11% | 0.11% | 0.10% | 0.08% | 0.08% | 0.08% | 0.06% | 0.05% | 0.01% | 0.01% |
| 14.00 | 0.12% | 0.11% | 0.10% | 0.10% | 0.08% | 0.07% | 0.07% | 0.07% | 0.05% | 0.04% | 0.01% | 0.01% |
| 14.67 | 0.11% | 0.11% | 0.09% | 0.09% | 0.08% | 0.07% | 0.07% | 0.06% | 0.05% | 0.04% | 0.01% | 0.01% |
| 15.33 | 0.11% | 0.10% | 0.09% | 0.09% | 0.08% | 0.06% | 0.06% | 0.06% | 0.05% | 0.04% | 0.01% | 0.01% |
| 16.00 | 0.10% | 0.10% | 0.08% | 0.08% | 0.07% | 0.06% | 0.06% | 0.06% | 0.05% | 0.04% | 0.01% | 0.01% |
| 16.67 | 0.07% | 0.07% | 0.06% | 0.06% | 0.05% | 0.04% | 0.04% | 0.04% | 0.03% | 0.03% | 0.01% | 0.01% |
| 17.33 | 0.05% | 0.05% | 0.04% | 0.04% | 0.03% | 0.03% | 0.03% | 0.03% | 0.02% | 0.02% | 0.00% | 0.00% |
| 18.00 | 0.03% | 0.03% | 0.03% | 0.03% | 0.02% | 0.02% | 0.02% | 0.02% | 0.01% | 0.01% | 0.00% | 0.00% |
| 18.67 | 0.06% | 0.06% | 0.05% | 0.05% | 0.04% | 0.03% | 0.03% | 0.03% | 0.03% | 0.02% | 0.01% | 0.00% |
| 19.33 | 0.03% | 0.03% | 0.03% | 0.03% | 0.02% | 0.02% | 0.02% | 0.02% | 0.02% | 0.01% | 0.00% | 0.00% |
| 20.00 | 0.02% | 0.02% | 0.02% | 0.02% | 0.01% | 0.01% | 0.01% | 0.01% | 0.01% | 0.01% | 0.00% | 0.00% |
| 20.67 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| 21.33 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

**Table B. Velocity profiles - average of 6:40 to 7:00 and 8:00 to 8:30**

| | 1152.9 | 1155.6 | 1158.4 | 1161.1 | 1163.8 | 1166.5 | 1169.3 | 1172.0 | 1174.7 | 1177.5 | 1180.2 | 1182.9 | 1185.6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.67 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 |
| 1.33 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 |
| 2.00 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 |
| 2.67 | 0.768 | 0.768 | 0.768 | 0.768 | 0.768 | 0.768 | 0.768 | 0.768 | 0.768 | 0.768 | 0.768 | 0.768 | 0.768 |
| 3.33 | 0.802 | 0.802 | 0.802 | 0.802 | 0.802 | 0.802 | 0.802 | 0.802 | 0.802 | 0.802 | 0.802 | 0.802 | 0.802 |
| 4.00 | 0.830 | 0.830 | 0.830 | 0.830 | 0.830 | 0.830 | 0.830 | 0.830 | 0.830 | 0.830 | 0.830 | 0.830 | 0.830 |
| 4.67 | 0.859 | 0.859 | 0.859 | 0.859 | 0.859 | 0.859 | 0.859 | 0.859 | 0.859 | 0.859 | 0.859 | 0.859 | 0.859 |
| 5.33 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 |
| 6.00 | 0.907 | 0.907 | 0.907 | 0.907 | 0.907 | 0.907 | 0.907 | 0.907 | 0.907 | 0.907 | 0.907 | 0.907 | 0.907 |
| 6.67 | 0.923 | 0.923 | 0.923 | 0.923 | 0.923 | 0.923 | 0.923 | 0.923 | 0.923 | 0.923 | 0.923 | 0.923 | 0.923 |
| 7.33 | 0.939 | 0.939 | 0.939 | 0.939 | 0.939 | 0.939 | 0.939 | 0.939 | 0.939 | 0.939 | 0.939 | 0.939 | 0.939 |
| 8.00 | 0.964 | 0.964 | 0.964 | 0.964 | 0.964 | 0.964 | 0.964 | 0.964 | 0.964 | 0.964 | 0.964 | 0.964 | 0.964 |
| 8.67 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 |
| 9.33 | 1.018 | 1.018 | 1.018 | 1.018 | 1.018 | 1.018 | 1.018 | 1.018 | 1.018 | 1.018 | 1.018 | 1.018 | 1.018 |
| 10.00 | 1.046 | 1.046 | 1.046 | 1.046 | 1.046 | 1.046 | 1.046 | 1.046 | 1.046 | 1.046 | 1.046 | 1.046 | 1.046 |
| 10.67 | 1.075 | 1.075 | 1.075 | 1.075 | 1.075 | 1.075 | 1.075 | 1.075 | 1.075 | 1.075 | 1.075 | 1.075 | 1.075 |
| 11.33 | 1.103 | 1.103 | 1.103 | 1.103 | 1.103 | 1.103 | 1.103 | 1.103 | 1.103 | 1.103 | 1.103 | 1.103 | 1.103 |
| 12.00 | 1.109 | 1.109 | 1.109 | 1.109 | 1.109 | 1.109 | 1.109 | 1.109 | 1.109 | 1.109 | 1.109 | 1.109 | 1.109 |
| 12.67 | 1.114 | 1.114 | 1.114 | 1.114 | 1.114 | 1.114 | 1.114 | 1.114 | 1.114 | 1.114 | 1.114 | 1.114 | 1.114 |
| 13.33 | 1.132 | 1.132 | 1.132 | 1.132 | 1.132 | 1.132 | 1.132 | 1.132 | 1.132 | 1.132 | 1.132 | 1.132 | 1.132 |
| 14.00 | 1.150 | 1.150 | 1.150 | 1.150 | 1.150 | 1.150 | 1.150 | 1.150 | 1.150 | 1.150 | 1.150 | 1.150 | 1.150 |
| 14.67 | 1.166 | 1.166 | 1.166 | 1.166 | 1.166 | 1.166 | 1.166 | 1.166 | 1.166 | 1.166 | 1.166 | 1.166 | 1.166 |
| 15.33 | 1.181 | 1.181 | 1.181 | 1.181 | 1.181 | 1.181 | 1.181 | 1.181 | 1.181 | 1.181 | 1.181 | 1.181 | 1.181 |
| 16.00 | 1.187 | 1.187 | 1.187 | 1.187 | 1.187 | 1.187 | 1.187 | 1.187 | 1.187 | 1.187 | 1.187 | 1.187 | 1.187 |
| 16.67 | 1.192 | 1.192 | 1.192 | 1.192 | 1.192 | 1.192 | 1.192 | 1.192 | 1.192 | 1.192 | 1.192 | 1.192 | 1.192 |
| 17.33 | 1.198 | 1.198 | 1.198 | 1.198 | 1.198 | 1.198 | 1.198 | 1.198 | 1.198 | 1.198 | 1.198 | 1.198 | 1.198 |
| 18.00 | 1.203 | 1.203 | 1.203 | 1.203 | 1.203 | 1.203 | 1.203 | 1.203 | 1.203 | 1.203 | 1.203 | 1.203 | 1.203 |
| 18.67 | 1.208 | 1.208 | 1.208 | 1.208 | 1.208 | 1.208 | 1.208 | 1.208 | 1.208 | 1.208 | 1.208 | 1.208 | 1.208 |
| 19.33 | 1.212 | 1.212 | 1.212 | 1.212 | 1.212 | 1.212 | 1.212 | 1.212 | 1.212 | 1.212 | 1.212 | 1.212 | 1.212 |
| 20.00 | 1.200 | 1.200 | 1.200 | 1.200 | 1.200 | 1.200 | 1.200 | 1.200 | 1.200 | 1.200 | 1.200 | 1.200 | 1.200 |
| 20.67 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 |
| 21.33 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 |

| | 1188.4 | 1191.1 | 1193.8 | 1196.5 | 1199.3 | 1202.0 | 1204.7 | 1207.5 | 1210.2 | 1212.9 | 1215.6 | 1218.4 | 1221.1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.67 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 |
| 1.33 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 |
| 2.00 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 |
| 2.67 | 0.768 | 0.768 | 0.768 | 0.768 | 0.768 | 0.768 | 0.768 | 0.768 | 0.768 | 0.768 | 0.768 | 0.768 | 0.768 |
| 3.33 | 0.802 | 0.802 | 0.802 | 0.802 | 0.802 | 0.802 | 0.802 | 0.802 | 0.802 | 0.802 | 0.802 | 0.802 | 0.802 |
| 4.00 | 0.830 | 0.830 | 0.830 | 0.830 | 0.830 | 0.830 | 0.830 | 0.830 | 0.830 | 0.830 | 0.830 | 0.830 | 0.830 |
| 4.67 | 0.859 | 0.859 | 0.859 | 0.859 | 0.859 | 0.859 | 0.859 | 0.859 | 0.859 | 0.859 | 0.859 | 0.859 | 0.859 |
| 5.33 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 |
| 6.00 | 0.907 | 0.907 | 0.907 | 0.907 | 0.907 | 0.907 | 0.907 | 0.907 | 0.907 | 0.907 | 0.907 | 0.907 | 0.907 |
| 6.67 | 0.923 | 0.923 | 0.923 | 0.923 | 0.923 | 0.923 | 0.923 | 0.923 | 0.923 | 0.923 | 0.923 | 0.923 | 0.923 |
| 7.33 | 0.939 | 0.939 | 0.939 | 0.939 | 0.939 | 0.939 | 0.939 | 0.939 | 0.939 | 0.939 | 0.939 | 0.939 | 0.939 |
| 8.00 | 0.964 | 0.964 | 0.964 | 0.964 | 0.964 | 0.964 | 0.964 | 0.964 | 0.964 | 0.964 | 0.964 | 0.964 | 0.964 |
| 8.67 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 |
| 9.33 | 1.018 | 1.018 | 1.018 | 1.018 | 1.018 | 1.018 | 1.018 | 1.018 | 1.018 | 1.018 | 1.018 | 1.018 | 1.018 |
| 10.00 | 1.046 | 1.046 | 1.046 | 1.046 | 1.046 | 1.046 | 1.046 | 1.046 | 1.046 | 1.046 | 1.046 | 1.046 | 1.046 |
| 10.67 | 1.075 | 1.075 | 1.075 | 1.075 | 1.075 | 1.075 | 1.075 | 1.075 | 1.075 | 1.075 | 1.075 | 1.075 | 1.075 |
| 11.33 | 1.103 | 1.103 | 1.103 | 1.103 | 1.103 | 1.103 | 1.103 | 1.103 | 1.103 | 1.103 | 1.103 | 1.103 | 1.103 |
| 12.00 | 1.109 | 1.109 | 1.109 | 1.109 | 1.109 | 1.109 | 1.109 | 1.109 | 1.109 | 1.109 | 1.109 | 1.109 | 1.109 |
| 12.67 | 1.114 | 1.114 | 1.114 | 1.114 | 1.114 | 1.114 | 1.114 | 1.114 | 1.114 | 1.114 | 1.114 | 1.114 | 1.114 |
| 13.33 | 1.132 | 1.132 | 1.132 | 1.132 | 1.132 | 1.132 | 1.132 | 1.132 | 1.132 | 1.132 | 1.132 | 1.132 | 1.132 |
| 14.00 | 1.150 | 1.150 | 1.150 | 1.150 | 1.150 | 1.150 | 1.150 | 1.150 | 1.150 | 1.150 | 1.150 | 1.150 | 1.150 |
| 14.67 | 1.166 | 1.166 | 1.166 | 1.166 | 1.166 | 1.166 | 1.166 | 1.166 | 1.166 | 1.166 | 1.166 | 1.166 | 1.166 |
| 15.33 | 1.181 | 1.181 | 1.181 | 1.181 | 1.181 | 1.181 | 1.181 | 1.181 | 1.181 | 1.181 | 1.181 | 1.181 | 1.181 |
| 16.00 | 1.187 | 1.187 | 1.187 | 1.187 | 1.187 | 1.187 | 1.187 | 1.187 | 1.187 | 1.187 | 1.187 | 1.187 | 1.187 |
| 16.67 | 1.192 | 1.192 | 1.192 | 1.192 | 1.192 | 1.192 | 1.192 | 1.192 | 1.192 | 1.192 | 1.192 | 1.192 | 1.192 |
| 17.33 | 1.198 | 1.198 | 1.198 | 1.198 | 1.198 | 1.198 | 1.198 | 1.198 | 1.198 | 1.198 | 1.198 | 1.198 | 1.198 |
| 18.00 | 1.203 | 1.203 | 1.203 | 1.203 | 1.203 | 1.203 | 1.203 | 1.203 | 1.203 | 1.203 | 1.203 | 1.203 | 1.203 |
| 18.67 | 1.208 | 1.208 | 1.208 | 1.208 | 1.208 | 1.208 | 1.208 | 1.208 | 1.208 | 1.208 | 1.208 | 1.208 | 1.208 |
| 19.33 | 1.212 | 1.212 | 1.212 | 1.212 | 1.212 | 1.212 | 1.212 | 1.212 | 1.212 | 1.212 | 1.212 | 1.212 | 1.212 |
| 20.00 | 1.200 | 1.200 | 1.200 | 1.200 | 1.200 | 1.200 | 1.200 | 1.200 | 1.200 | 1.200 | 1.200 | 1.200 | 1.200 |
| 20.67 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 |
| 21.33 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 |

| | 1223.8 | 1226.5 | 1229.3 | 1232.0 | 1234.7 | 1237.5 | 1240.2 | 1242.9 | 1245.6 | 1248.4 | 1251.1 | 1253.8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.67 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 |
| 1.33 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 |
| 2.00 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 | 0.735 |
| 2.67 | 0.768 | 0.768 | 0.768 | 0.768 | 0.768 | 0.768 | 0.768 | 0.768 | 0.768 | 0.768 | 0.768 | 0.768 |
| 3.33 | 0.802 | 0.802 | 0.802 | 0.802 | 0.802 | 0.802 | 0.802 | 0.802 | 0.802 | 0.802 | 0.802 | 0.802 |
| 4.00 | 0.830 | 0.830 | 0.830 | 0.830 | 0.830 | 0.830 | 0.830 | 0.830 | 0.830 | 0.830 | 0.830 | 0.830 |
| 4.67 | 0.859 | 0.859 | 0.859 | 0.859 | 0.859 | 0.859 | 0.859 | 0.859 | 0.859 | 0.859 | 0.859 | 0.859 |
| 5.33 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 |
| 6.00 | 0.907 | 0.907 | 0.907 | 0.907 | 0.907 | 0.907 | 0.907 | 0.907 | 0.907 | 0.907 | 0.907 | 0.907 |
| 6.67 | 0.923 | 0.923 | 0.923 | 0.923 | 0.923 | 0.923 | 0.923 | 0.923 | 0.923 | 0.923 | 0.923 | 0.923 |
| 7.33 | 0.939 | 0.939 | 0.939 | 0.939 | 0.939 | 0.939 | 0.939 | 0.939 | 0.939 | 0.939 | 0.939 | 0.939 |
| 8.00 | 0.964 | 0.964 | 0.964 | 0.964 | 0.964 | 0.964 | 0.964 | 0.964 | 0.964 | 0.964 | 0.964 | 0.964 |
| 8.67 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 |
| 9.33 | 1.018 | 1.018 | 1.018 | 1.018 | 1.018 | 1.018 | 1.018 | 1.018 | 1.018 | 1.018 | 1.018 | 1.018 |
| 10.00 | 1.046 | 1.046 | 1.046 | 1.046 | 1.046 | 1.046 | 1.046 | 1.046 | 1.046 | 1.046 | 1.046 | 1.046 |
| 10.67 | 1.075 | 1.075 | 1.075 | 1.075 | 1.075 | 1.075 | 1.075 | 1.075 | 1.075 | 1.075 | 1.075 | 1.075 |
| 11.33 | 1.103 | 1.103 | 1.103 | 1.103 | 1.103 | 1.103 | 1.103 | 1.103 | 1.103 | 1.103 | 1.103 | 1.103 |
| 12.00 | 1.109 | 1.109 | 1.109 | 1.109 | 1.109 | 1.109 | 1.109 | 1.109 | 1.109 | 1.109 | 1.109 | 1.109 |
| 12.67 | 1.114 | 1.114 | 1.114 | 1.114 | 1.114 | 1.114 | 1.114 | 1.114 | 1.114 | 1.114 | 1.114 | 1.114 |
| 13.33 | 1.132 | 1.132 | 1.132 | 1.132 | 1.132 | 1.132 | 1.132 | 1.132 | 1.132 | 1.132 | 1.132 | 1.132 |
| 14.00 | 1.150 | 1.150 | 1.150 | 1.150 | 1.150 | 1.150 | 1.150 | 1.150 | 1.150 | 1.150 | 1.150 | 1.150 |
| 14.67 | 1.166 | 1.166 | 1.166 | 1.166 | 1.166 | 1.166 | 1.166 | 1.166 | 1.166 | 1.166 | 1.166 | 1.166 |
| 15.33 | 1.181 | 1.181 | 1.181 | 1.181 | 1.181 | 1.181 | 1.181 | 1.181 | 1.181 | 1.181 | 1.181 | 1.181 |
| 16.00 | 1.187 | 1.187 | 1.187 | 1.187 | 1.187 | 1.187 | 1.187 | 1.187 | 1.187 | 1.187 | 1.187 | 1.187 |
| 16.67 | 1.192 | 1.192 | 1.192 | 1.192 | 1.192 | 1.192 | 1.192 | 1.192 | 1.192 | 1.192 | 1.192 | 1.192 |
| 17.33 | 1.198 | 1.198 | 1.198 | 1.198 | 1.198 | 1.198 | 1.198 | 1.198 | 1.198 | 1.198 | 1.198 | 1.198 |
| 18.00 | 1.203 | 1.203 | 1.203 | 1.203 | 1.203 | 1.203 | 1.203 | 1.203 | 1.203 | 1.203 | 1.203 | 1.203 |
| 18.67 | 1.208 | 1.208 | 1.208 | 1.208 | 1.208 | 1.208 | 1.208 | 1.208 | 1.208 | 1.208 | 1.208 | 1.208 |
| 19.33 | 1.212 | 1.212 | 1.212 | 1.212 | 1.212 | 1.212 | 1.212 | 1.212 | 1.212 | 1.212 | 1.212 | 1.212 |
| 20.00 | 1.200 | 1.200 | 1.200 | 1.200 | 1.200 | 1.200 | 1.200 | 1.200 | 1.200 | 1.200 | 1.200 | 1.200 |
| 20.67 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 |
| 21.33 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 | 1.188 |

**Cell Area** **1.827273 sf**

# PEAK-TO-MEAN CALCULATION TABLES

**Table C. vdA - River flow through each cell (cfs)** **(Tbl B * Cell Area)**

| | 1152.9 | 1155.6 | 1158.4 | 1161.1 | 1163.8 | 1166.5 | 1169.3 | 1172.0 | 1174.7 | 1177.5 | 1180.2 | 1182.9 | 1185.6 | 1188.4 | 1191.1 | 1193.8 | 1196.5 | 1199.3 | 1202.0 | 1204.7 | 1207.5 | 1210.2 | 1212.9 | 1215.6 | 1218.4 | 1221.1 | 1223.8 | 1226.5 | 1229.3 | 1232.0 | 1234.7 | 1237.5 | 1240.2 | 1242.9 | 1245.6 | 1248.4 | 1251.1 | 1253.8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0.67** | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 |
| **1.33** | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 |
| **2.00** | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 |
| **2.67** | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 |
| **3.33** | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 |
| **4.00** | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 |
| **4.67** | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 |
| **5.33** | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 |
| **6.00** | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 |
| **6.67** | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 |
| **7.33** | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 |
| **8.00** | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 |
| **8.67** | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 |
| **9.33** | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 |
| **10.00** | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 |
| **10.67** | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 |
| **11.33** | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 |
| **12.00** | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 |
| **12.67** | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 |
| **13.33** | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 |
| **14.00** | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 |
| **14.67** | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 |
| **15.33** | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 |
| **16.00** | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 |
| **16.67** | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 |
| **17.33** | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 | 2.1885 |
| **18.00** | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 | 2.1987 |
| **18.67** | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 | 2.2069 |
| **19.33** | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 | 2.2150 |
| **20.00** | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 | 2.1931 |
| **20.67** | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 |
| **21.33** | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 | 2.1711 |

**Cell Area** **1.827273 sf**

**Table D. CvdA - Effluent flow through each cell (cfs)** **(Tbl A * Tbl B * Cell Area)**

| | 1152.9 | 1155.6 | 1158.4 | 1161.1 | 1163.8 | 1166.5 | 1169.3 | 1172.0 | 1174.7 | 1177.5 | 1180.2 | 1182.9 | 1185.6 | 1188.4 | 1191.1 | 1193.8 | 1196.5 | 1199.3 | 1202.0 | 1204.7 | 1207.5 | 1210.2 | 1212.9 | 1215.6 | 1218.4 | 1221.1 | 1223.8 | 1226.5 | 1229.3 | 1232.0 | 1234.7 | 1237.5 | 1240.2 | 1242.9 | 1245.6 | 1248.4 | 1251.1 | 1253.8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0.67** | 0.0006 | 0.0010 | 0.0014 | 0.0017 | 0.0016 | 0.0019 | 0.0031 | 0.0030 | 0.0043 | 0.0050 | 0.0058 | 0.0056 | 0.0064 | 0.0066 | 0.0053 | 0.0060 | 0.0058 | 0.0057 | 0.0061 | 0.0064 | 0.0064 | 0.0063 | 0.0062 | 0.0060 | 0.0064 | 0.0064 | 0.0063 | 0.0061 | 0.0052 | 0.0052 | 0.0044 | 0.0038 | 0.0037 | 0.0036 | 0.0028 | 0.0023 | 0.0007 | 0.0005 |
| **1.33** | 0.0007 | 0.0011 | 0.0015 | 0.0018 | 0.0017 | 0.0021 | 0.0034 | 0.0032 | 0.0046 | 0.0053 | 0.0062 | 0.0060 | 0.0068 | 0.0071 | 0.0057 | 0.0064 | 0.0062 | 0.0061 | 0.0065 | 0.0068 | 0.0069 | 0.0068 | 0.0066 | 0.0064 | 0.0068 | 0.0068 | 0.0067 | 0.0065 | 0.0056 | 0.0056 | 0.0047 | 0.0040 | 0.0039 | 0.0038 | 0.0030 | 0.0025 | 0.0007 | 0.0005 |
| **2.00** | 0.0007 | 0.0011 | 0.0016 | 0.0019 | 0.0018 | 0.0022 | 0.0036 | 0.0034 | 0.0049 | 0.0057 | 0.0066 | 0.0064 | 0.0072 | 0.0075 | 0.0061 | 0.0068 | 0.0066 | 0.0065 | 0.0069 | 0.0073 | 0.0073 | 0.0072 | 0.0070 | 0.0068 | 0.0072 | 0.0073 | 0.0072 | 0.0069 | 0.0060 | 0.0059 | 0.0050 | 0.0043 | 0.0042 | 0.0041 | 0.0032 | 0.0026 | 0.0008 | 0.0006 |
| **2.67** | 0.0007 | 0.0011 | 0.0016 | 0.0018 | 0.0017 | 0.0021 | 0.0035 | 0.0033 | 0.0047 | 0.0055 | 0.0063 | 0.0062 | 0.0070 | 0.0073 | 0.0059 | 0.0066 | 0.0064 | 0.0063 | 0.0067 | 0.0070 | 0.0070 | 0.0070 | 0.0068 | 0.0065 | 0.0070 | 0.0070 | 0.0069 | 0.0067 | 0.0058 | 0.0057 | 0.0049 | 0.0042 | 0.0040 | 0.0039 | 0.0031 | 0.0025 | 0.0007 | 0.0006 |
| **3.33** | 0.0006 | 0.0009 | 0.0013 | 0.0015 | 0.0015 | 0.0018 | 0.0029 | 0.0028 | 0.0039 | 0.0046 | 0.0053 | 0.0052 | 0.0059 | 0.0061 | 0.0049 | 0.0055 | 0.0054 | 0.0053 | 0.0056 | 0.0059 | 0.0059 | 0.0058 | 0.0057 | 0.0055 | 0.0059 | 0.0059 | 0.0058 | 0.0056 | 0.0048 | 0.0048 | 0.0041 | 0.0035 | 0.0034 | 0.0033 | 0.0026 | 0.0021 | 0.0006 | 0.0005 |
| **4.00** | 0.0007 | 0.0011 | 0.0015 | 0.0018 | 0.0017 | 0.0021 | 0.0033 | 0.0032 | 0.0045 | 0.0053 | 0.0061 | 0.0060 | 0.0068 | 0.0070 | 0.0057 | 0.0064 | 0.0062 | 0.0061 | 0.0064 | 0.0068 | 0.0068 | 0.0067 | 0.0065 | 0.0063 | 0.0068 | 0.0068 | 0.0067 | 0.0065 | 0.0056 | 0.0056 | 0.0047 | 0.0040 | 0.0039 | 0.0038 | 0.0030 | 0.0024 | 0.0007 | 0.0005 |
| **4.67** | 0.0007 | 0.0011 | 0.0016 | 0.0019 | 0.0018 | 0.0022 | 0.0036 | 0.0034 | 0.0049 | 0.0057 | 0.0066 | 0.0064 | 0.0072 | 0.0075 | 0.0061 | 0.0069 | 0.0066 | 0.0065 | 0.0069 | 0.0073 | 0.0073 | 0.0072 | 0.0070 | 0.0068 | 0.0073 | 0.0073 | 0.0072 | 0.0069 | 0.0060 | 0.0060 | 0.0050 | 0.0043 | 0.0042 | 0.0041 | 0.0032 | 0.0026 | 0.0008 | 0.0006 |
| **5.33** | 0.0007 | 0.0012 | 0.0017 | 0.0020 | 0.0019 | 0.0023 | 0.0037 | 0.0036 | 0.0050 | 0.0059 | 0.0068 | 0.0066 | 0.0075 | 0.0078 | 0.0063 | 0.0071 | 0.0068 | 0.0068 | 0.0071 | 0.0075 | 0.0076 | 0.0075 | 0.0073 | 0.0070 | 0.0075 | 0.0075 | 0.0074 | 0.0072 | 0.0062 | 0.0062 | 0.0052 | 0.0045 | 0.0043 | 0.0042 | 0.0033 | 0.0027 | 0.0008 | 0.0006 |
| **6.00** | 0.0007 | 0.0012 | 0.0017 | 0.0020 | 0.0019 | 0.0023 | 0.0037 | 0.0036 | 0.0050 | 0.0059 | 0.0068 | 0.0067 | 0.0075 | 0.0078 | 0.0063 | 0.0071 | 0.0069 | 0.0068 | 0.0072 | 0.0075 | 0.0076 | 0.0075 | 0.0073 | 0.0070 | 0.0075 | 0.0075 | 0.0074 | 0.0072 | 0.0062 | 0.0062 | 0.0052 | 0.0045 | 0.0043 | 0.0042 | 0.0033 | 0.0027 | 0.0008 | 0.0006 |
| **6.67** | 0.0007 | 0.0011 | 0.0016 | 0.0019 | 0.0018 | 0.0022 | 0.0036 | 0.0034 | 0.0048 | 0.0056 | 0.0065 | 0.0064 | 0.0072 | 0.0075 | 0.0060 | 0.0068 | 0.0066 | 0.0065 | 0.0069 | 0.0072 | 0.0073 | 0.0072 | 0.0070 | 0.0067 | 0.0072 | 0.0072 | 0.0071 | 0.0069 | 0.0059 | 0.0059 | 0.0050 | 0.0043 | 0.0041 | 0.0041 | 0.0032 | 0.0026 | 0.0008 | 0.0006 |
| **7.33** | 0.0007 | 0.0012 | 0.0016 | 0.0019 | 0.0019 | 0.0023 | 0.0037 | 0.0035 | 0.0050 | 0.0058 | 0.0067 | 0.0066 | 0.0074 | 0.0077 | 0.0062 | 0.0070 | 0.0068 | 0.0067 | 0.0071 | 0.0075 | 0.0075 | 0.0074 | 0.0072 | 0.0070 | 0.0074 | 0.0075 | 0.0074 | 0.0071 | 0.0061 | 0.0061 | 0.0052 | 0.0044 | 0.0043 | 0.0042 | 0.0033 | 0.0027 | 0.0008 | 0.0006 |
| **8.00** | 0.0008 | 0.0012 | 0.0017 | 0.0020 | 0.0019 | 0.0024 | 0.0039 | 0.0037 | 0.0052 | 0.0061 | 0.0071 | 0.0069 | 0.0078 | 0.0081 | 0.0066 | 0.0074 | 0.0071 | 0.0071 | 0.0074 | 0.0078 | 0.0079 | 0.0078 | 0.0076 | 0.0073 | 0.0078 | 0.0078 | 0.0077 | 0.0075 | 0.0064 | 0.0064 | 0.0054 | 0.0046 | 0.0045 | 0.0044 | 0.0035 | 0.0028 | 0.0008 | 0.0006 |
| **8.67** | 0.0007 | 0.0010 | 0.0015 | 0.0017 | 0.0017 | 0.0020 | 0.0033 | 0.0031 | 0.0044 | 0.0052 | 0.0060 | 0.0059 | 0.0066 | 0.0069 | 0.0056 | 0.0063 | 0.0061 | 0.0060 | 0.0063 | 0.0067 | 0.0067 | 0.0066 | 0.0064 | 0.0062 | 0.0066 | 0.0067 | 0.0066 | 0.0063 | 0.0055 | 0.0054 | 0.0046 | 0.0039 | 0.0038 | 0.0037 | 0.0029 | 0.0024 | 0.0007 | 0.0005 |
| **9.33** | 0.0006 | 0.0009 | 0.0013 | 0.0015 | 0.0014 | 0.0018 | 0.0029 | 0.0027 | 0.0039 | 0.0045 | 0.0053 | 0.0051 | 0.0058 | 0.0060 | 0.0049 | 0.0055 | 0.0053 | 0.0052 | 0.0055 | 0.0058 | 0.0058 | 0.0058 | 0.0056 | 0.0054 | 0.0058 | 0.0058 | 0.0057 | 0.0055 | 0.0048 | 0.0048 | 0.0040 | 0.0034 | 0.0033 | 0.0033 | 0.0026 | 0.0021 | 0.0006 | 0.0005 |
| **10.00** | 0.0005 | 0.0008 | 0.0011 | 0.0013 | 0.0012 | 0.0015 | 0.0025 | 0.0024 | 0.0033 | 0.0039 | 0.0045 | 0.0044 | 0.0050 | 0.0052 | 0.0042 | 0.0047 | 0.0045 | 0.0045 | 0.0047 | 0.0050 | 0.0050 | 0.0050 | 0.0048 | 0.0047 | 0.0050 | 0.0050 | 0.0049 | 0.0048 | 0.0041 | 0.0041 | 0.0035 | 0.0030 | 0.0029 | 0.0028 | 0.0022 | 0.0018 | 0.0005 | 0.0004 |
| **10.67** | 0.0005 | 0.0008 | 0.0011 | 0.0013 | 0.0013 | 0.0016 | 0.0025 | 0.0024 | 0.0034 | 0.0040 | 0.0046 | 0.0045 | 0.0051 | 0.0053 | 0.0043 | 0.0048 | 0.0047 | 0.0046 | 0.0049 | 0.0051 | 0.0052 | 0.0051 | 0.0050 | 0.0048 | 0.0051 | 0.0051 | 0.0051 | 0.0049 | 0.0042 | 0.0042 | 0.0036 | 0.0030 | 0.0029 | 0.0029 | 0.0023 | 0.0019 | 0.0005 | 0.0004 |
| **11.33** | 0.0004 | 0.0007 | 0.0010 | 0.0011 | 0.0011 | 0.0013 | 0.0021 | 0.0020 | 0.0029 | 0.0034 | 0.0039 | 0.0038 | 0.0043 | 0.0045 | 0.0036 | 0.0041 | 0.0039 | 0.0039 | 0.0041 | 0.0043 | 0.0044 | 0.0043 | 0.0042 | 0.0040 | 0.0043 | 0.0043 | 0.0043 | 0.0041 | 0.0036 | 0.0036 | 0.0030 | 0.0026 | 0.0025 | 0.0024 | 0.0019 | 0.0016 | 0.0005 | 0.0003 |
| **12.00** | 0.0004 | 0.0006 | 0.0008 | 0.0010 | 0.0010 | 0.0012 | 0.0019 | 0.0018 | 0.0026 | 0.0030 | 0.0035 | 0.0034 | 0.0038 | 0.0040 | 0.0032 | 0.0036 | 0.0035 | 0.0034 | 0.0036 | 0.0038 | 0.0038 | 0.0038 | 0.0037 | 0.0036 | 0.0038 | 0.0038 | 0.0038 | 0.0036 | 0.0031 | 0.0031 | 0.0027 | 0.0023 | 0.0022 | 0.0022 | 0.0017 | 0.0014 | 0.0004 | 0.0003 |
| **12.67** | 0.0003 | 0.0005 | 0.0007 | 0.0009 | 0.0008 | 0.0010 | 0.0016 | 0.0015 | 0.0022 | 0.0026 | 0.0030 | 0.0029 | 0.0033 | 0.0034 | 0.0027 | 0.0031 | 0.0030 | 0.0030 | 0.0031 | 0.0033 | 0.0033 | 0.0033 | 0.0032 | 0.0031 | 0.0033 | 0.0033 | 0.0032 | 0.0031 | 0.0027 | 0.0027 | 0.0023 | 0.0019 | 0.0019 | 0.0018 | 0.0014 | 0.0012 | 0.0003 | 0.0003 |
| **13.33** | 0.0003 | 0.0004 | 0.0006 | 0.0008 | 0.0007 | 0.0009 | 0.0014 | 0.0014 | 0.0019 | 0.0023 | 0.0026 | 0.0026 | 0.0029 | 0.0030 | 0.0024 | 0.0027 | 0.0026 | 0.0026 | 0.0027 | 0.0029 | 0.0029 | 0.0029 | 0.0028 | 0.0027 | 0.0029 | 0.0029 | 0.0028 | 0.0027 | 0.0024 | 0.0024 | 0.0020 | 0.0017 | 0.0017 | 0.0016 | 0.0013 | 0.0010 | 0.0003 | 0.0002 |
| **14.00** | 0.0003 | 0.0004 | 0.0006 | 0.0007 | 0.0006 | 0.0008 | 0.0013 | 0.0012 | 0.0017 | 0.0020 | 0.0023 | 0.0022 | 0.0025 | 0.0026 | 0.0021 | 0.0024 | 0.0023 | 0.0023 | 0.0024 | 0.0025 | 0.0025 | 0.0025 | 0.0024 | 0.0024 | 0.0025 | 0.0025 | 0.0025 | 0.0024 | 0.0021 | 0.0021 | 0.0018 | 0.0015 | 0.0015 | 0.0014 | 0.0011 | 0.0009 | 0.0003 | 0.0002 |
| **14.67** | 0.0002 | 0.0004 | 0.0005 | 0.0006 | 0.0006 | 0.0007 | 0.0012 | 0.0011 | 0.0016 | 0.0019 | 0.0022 | 0.0021 | 0.0024 | 0.0025 | 0.0020 | 0.0023 | 0.0022 | 0.0022 | 0.0023 | 0.0024 | 0.0024 | 0.0024 | 0.0023 | 0.0023 | 0.0024 | 0.0024 | 0.0024 | 0.0023 | 0.0020 | 0.0020 | 0.0017 | 0.0014 | 0.0014 | 0.0014 | 0.0011 | 0.0009 | 0.0003 | 0.0002 |
| **15.33** | 0.0002 | 0.0004 | 0.0005 | 0.0006 | 0.0006 | 0.0007 | 0.0012 | 0.0011 | 0.0016 | 0.0018 | 0.0021 | 0.0021 | 0.0023 | 0.0024 | 0.0020 | 0.0022 | 0.0021 | 0.0021 | 0.0022 | 0.0023 | 0.0023 | 0.0023 | 0.0023 | 0.0022 | 0.0023 | 0.0023 | 0.0023 | 0.0022 | 0.0019 | 0.0019 | 0.0016 | 0.0014 | 0.0013 | 0.0013 | 0.0010 | 0.0008 | 0.0002 | 0.0002 |
| **16.00** | 0.0002 | 0.0003 | 0.0005 | 0.0006 | 0.0006 | 0.0007 | 0.0011 | 0.0011 | 0.0015 | 0.0017 | 0.0020 | 0.0020 | 0.0022 | 0.0023 | 0.0019 | 0.0021 | 0.0020 | 0.0020 | 0.0021 | 0.0022 | 0.0022 | 0.0022 | 0.0022 | 0.0021 | 0.0022 | 0.0022 | 0.0022 | 0.0021 | 0.0018 | 0.0018 | 0.0015 | 0.0013 | 0.0013 | 0.0013 | 0.0010 | 0.0008 | 0.0002 | 0.0002 |
| **16.67** | 0.0002 | 0.0002 | 0.0003 | 0.0004 | 0.0004 | 0.0005 | 0.0008 | 0.0007 | 0.0010 | 0.0012 | 0.0014 | 0.0013 | 0.0015 | 0.0016 | 0.0013 | 0.0014 | 0.0014 | 0.0014 | 0.0015 | 0.0015 | 0.0015 | 0.0015 | 0.0015 | 0.0014 | 0.0015 | 0.0015 | 0.0015 | 0.0015 | 0.0013 | 0.0013 | 0.0011 | 0.0009 | 0.0009 | 0.0009 | 0.0007 | 0.0006 | 0.0002 | 0.0001 |
| **17.33** | 0.0001 | 0.0002 | 0.0002 | 0.0003 | 0.0003 | 0.0003 | 0.0005 | 0.0005 | 0.0007 | 0.0008 | 0.0009 | 0.0009 | 0.0010 | 0.0011 | 0.0009 | 0.0010 | 0.0009 | 0.0009 | 0.0010 | 0.0010 | 0.0010 | 0.0010 | 0.0010 | 0.0010 | 0.0010 | 0.0010 | 0.0010 | 0.0010 | 0.0009 | 0.0009 | 0.0007 | 0.0006 | 0.0006 | 0.0006 | 0.0005 | 0.0004 | 0.0001 | 0.0001 |
| **18.00** | 0.0001 | 0.0001 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0003 | 0.0003 | 0.0005 | 0.0005 | 0.0006 | 0.0006 | 0.0007 | 0.0007 | 0.0006 | 0.0007 | 0.0006 | 0.0006 | 0.0007 | 0.0007 | 0.0007 | 0.0007 | 0.0007 | 0.0007 | 0.0007 | 0.0007 | 0.0007 | 0.0007 | 0.0006 | 0.0006 | 0.0005 | 0.0004 | 0.0004 | 0.0004 | 0.0003 | 0.0003 | 0.0001 | 0.0001 |
| **18.67** | 0.0001 | 0.0002 | 0.0003 | 0.0003 | 0.0003 | 0.0004 | 0.0006 | 0.0006 | 0.0009 | 0.0010 | 0.0012 | 0.0011 | 0.0013 | 0.0013 | 0.0011 | 0.0012 | 0.0012 | 0.0012 | 0.0012 | 0.0013 | 0.0013 | 0.0013 | 0.0013 | 0.0012 | 0.0013 | 0.0013 | 0.0013 | 0.0012 | 0.0011 | 0.0011 | 0.0009 | 0.0008 | 0.0007 | 0.0007 | 0.0006 | 0.0005 | 0.0001 | 0.0001 |
| **19.33** | 0.0001 | 0.0001 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0004 | 0.0004 | 0.0005 | 0.0006 | 0.0007 | 0.0007 | 0.0008 | 0.0008 | 0.0006 | 0.0007 | 0.0007 | 0.0007 | 0.0007 | 0.0008 | 0.0008 | 0.0008 | 0.0007 | 0.0007 | 0.0008 | 0.0008 | 0.0008 | 0.0007 | 0.0006 | 0.0006 | 0.0005 | 0.0005 | 0.0004 | 0.0004 | 0.0003 | 0.0003 | 0.0001 | 0.0001 |
| **20.00** | 0.0000 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0002 | 0.0002 | 0.0003 | 0.0003 | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.0003 | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.0003 | 0.0003 | 0.0003 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0001 | 0.0000 | 0.0000 |
| **20.67** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **21.33** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

**Total effluent flow** **3.5674 cfs**
**=** **2.316482 mgd**

# PEAK-TO-MEAN CALCULATION TABLES

**Table E. CvdA for values greater than 0.0010 cfs**

| | 1152.9 | 1155.6 | 1158.4 | 1161.1 | 1163.8 | 1166.5 | 1169.3 | 1172.0 | 1174.7 | 1177.5 | 1180.2 | 1182.9 | 1185.6 | 1188.4 | 1191.1 | 1193.8 | 1196.5 | 1199.3 | 1202.0 | 1204.7 | 1207.5 | 1210.2 | 1212.9 | 1215.6 | 1218.4 | 1221.1 | 1223.8 | 1226.5 | 1229.3 | 1232.0 | 1234.7 | 1237.5 | 1240.2 | 1242.9 | 1245.6 | 1248.4 | 1251.1 | 1253.8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0.67** | | 0.0010 | 0.0014 | 0.0017 | 0.0016 | 0.0019 | 0.0031 | 0.0030 | 0.0043 | 0.0050 | 0.0058 | 0.0056 | 0.0064 | 0.0066 | 0.0053 | 0.0060 | 0.0058 | 0.0057 | 0.0061 | 0.0064 | 0.0064 | 0.0063 | 0.0062 | 0.0060 | 0.0064 | 0.0064 | 0.0063 | 0.0061 | 0.0052 | 0.0052 | 0.0044 | 0.0038 | 0.0037 | 0.0036 | 0.0028 | 0.0023 | | |
| **1.33** | | 0.0011 | 0.0015 | 0.0018 | 0.0017 | 0.0021 | 0.0034 | 0.0032 | 0.0046 | 0.0053 | 0.0062 | 0.0060 | 0.0068 | 0.0071 | 0.0057 | 0.0064 | 0.0062 | 0.0061 | 0.0065 | 0.0068 | 0.0069 | 0.0068 | 0.0066 | 0.0064 | 0.0068 | 0.0068 | 0.0067 | 0.0065 | 0.0056 | 0.0056 | 0.0047 | 0.0040 | 0.0039 | 0.0038 | 0.0030 | 0.0025 | | |
| **2.00** | | 0.0011 | 0.0016 | 0.0019 | 0.0018 | 0.0022 | 0.0036 | 0.0034 | 0.0049 | 0.0057 | 0.0066 | 0.0064 | 0.0072 | 0.0075 | 0.0061 | 0.0068 | 0.0066 | 0.0065 | 0.0069 | 0.0073 | 0.0073 | 0.0072 | 0.0070 | 0.0068 | 0.0072 | 0.0073 | 0.0072 | 0.0069 | 0.0060 | 0.0059 | 0.0050 | 0.0043 | 0.0042 | 0.0041 | 0.0032 | 0.0026 | | |
| **2.67** | | 0.0011 | 0.0016 | 0.0018 | 0.0017 | 0.0021 | 0.0035 | 0.0033 | 0.0047 | 0.0055 | 0.0063 | 0.0062 | 0.0070 | 0.0073 | 0.0059 | 0.0066 | 0.0064 | 0.0063 | 0.0067 | 0.0070 | 0.0070 | 0.0070 | 0.0068 | 0.0065 | 0.0070 | 0.0070 | 0.0069 | 0.0067 | 0.0058 | 0.0057 | 0.0049 | 0.0042 | 0.0040 | 0.0039 | 0.0031 | 0.0025 | | |
| **3.33** | | 0.0009 | 0.0013 | 0.0015 | 0.0015 | 0.0018 | 0.0029 | 0.0028 | 0.0039 | 0.0046 | 0.0053 | 0.0052 | 0.0059 | 0.0061 | 0.0049 | 0.0055 | 0.0054 | 0.0053 | 0.0056 | 0.0059 | 0.0059 | 0.0058 | 0.0057 | 0.0055 | 0.0059 | 0.0059 | 0.0058 | 0.0056 | 0.0048 | 0.0048 | 0.0041 | 0.0035 | 0.0034 | 0.0033 | 0.0026 | 0.0021 | | |
| **4.00** | | 0.0011 | 0.0015 | 0.0018 | 0.0017 | 0.0021 | 0.0033 | 0.0032 | 0.0045 | 0.0053 | 0.0061 | 0.0060 | 0.0068 | 0.0070 | 0.0057 | 0.0064 | 0.0062 | 0.0061 | 0.0064 | 0.0068 | 0.0068 | 0.0067 | 0.0065 | 0.0063 | 0.0068 | 0.0068 | 0.0067 | 0.0065 | 0.0056 | 0.0056 | 0.0047 | 0.0040 | 0.0039 | 0.0038 | 0.0030 | 0.0024 | | |
| **4.67** | | 0.0011 | 0.0016 | 0.0019 | 0.0018 | 0.0022 | 0.0036 | 0.0034 | 0.0049 | 0.0057 | 0.0066 | 0.0064 | 0.0072 | 0.0075 | 0.0061 | 0.0069 | 0.0066 | 0.0065 | 0.0069 | 0.0073 | 0.0073 | 0.0072 | 0.0070 | 0.0068 | 0.0073 | 0.0073 | 0.0072 | 0.0069 | 0.0060 | 0.0060 | 0.0050 | 0.0043 | 0.0042 | 0.0041 | 0.0032 | 0.0026 | | |
| **5.33** | | 0.0012 | 0.0017 | 0.0020 | 0.0019 | 0.0023 | 0.0037 | 0.0036 | 0.0050 | 0.0059 | 0.0068 | 0.0066 | 0.0075 | 0.0078 | 0.0063 | 0.0071 | 0.0068 | 0.0068 | 0.0071 | 0.0075 | 0.0076 | 0.0075 | 0.0073 | 0.0070 | 0.0075 | 0.0075 | 0.0074 | 0.0072 | 0.0062 | 0.0062 | 0.0052 | 0.0045 | 0.0043 | 0.0042 | 0.0033 | 0.0027 | | |
| **6.00** | | 0.0012 | 0.0017 | 0.0020 | 0.0019 | 0.0023 | 0.0037 | 0.0036 | 0.0050 | 0.0059 | 0.0068 | 0.0067 | 0.0075 | 0.0078 | 0.0063 | 0.0071 | 0.0069 | 0.0068 | 0.0072 | 0.0075 | 0.0076 | 0.0075 | 0.0073 | 0.0070 | 0.0075 | 0.0075 | 0.0074 | 0.0072 | 0.0062 | 0.0062 | 0.0052 | 0.0045 | 0.0043 | 0.0042 | 0.0033 | 0.0027 | | |
| **6.67** | | 0.0011 | 0.0016 | 0.0019 | 0.0018 | 0.0022 | 0.0036 | 0.0034 | 0.0048 | 0.0056 | 0.0065 | 0.0064 | 0.0072 | 0.0075 | 0.0060 | 0.0068 | 0.0066 | 0.0065 | 0.0069 | 0.0072 | 0.0073 | 0.0072 | 0.0070 | 0.0067 | 0.0072 | 0.0072 | 0.0071 | 0.0069 | 0.0059 | 0.0059 | 0.0050 | 0.0043 | 0.0041 | 0.0041 | 0.0032 | 0.0026 | | |
| **7.33** | | 0.0012 | 0.0016 | 0.0019 | 0.0019 | 0.0023 | 0.0037 | 0.0035 | 0.0050 | 0.0058 | 0.0067 | 0.0066 | 0.0074 | 0.0077 | 0.0062 | 0.0070 | 0.0068 | 0.0067 | 0.0071 | 0.0075 | 0.0075 | 0.0074 | 0.0072 | 0.0070 | 0.0074 | 0.0075 | 0.0074 | 0.0071 | 0.0061 | 0.0061 | 0.0052 | 0.0044 | 0.0043 | 0.0042 | 0.0033 | 0.0027 | | |
| **8.00** | | 0.0012 | 0.0017 | 0.0020 | 0.0019 | 0.0024 | 0.0039 | 0.0037 | 0.0052 | 0.0061 | 0.0071 | 0.0069 | 0.0078 | 0.0081 | 0.0066 | 0.0074 | 0.0071 | 0.0071 | 0.0074 | 0.0078 | 0.0079 | 0.0078 | 0.0076 | 0.0073 | 0.0078 | 0.0078 | 0.0077 | 0.0075 | 0.0064 | 0.0064 | 0.0054 | 0.0046 | 0.0045 | 0.0044 | 0.0035 | 0.0028 | | |
| **8.67** | | 0.0010 | 0.0015 | 0.0017 | 0.0017 | 0.0020 | 0.0033 | 0.0031 | 0.0044 | 0.0052 | 0.0060 | 0.0059 | 0.0066 | 0.0069 | 0.0056 | 0.0063 | 0.0061 | 0.0060 | 0.0063 | 0.0067 | 0.0067 | 0.0066 | 0.0064 | 0.0062 | 0.0066 | 0.0067 | 0.0066 | 0.0063 | 0.0055 | 0.0054 | 0.0046 | 0.0039 | 0.0038 | 0.0037 | 0.0029 | 0.0024 | | |
| **9.33** | | | 0.0013 | 0.0015 | 0.0014 | 0.0018 | 0.0029 | 0.0027 | 0.0039 | 0.0045 | 0.0053 | 0.0051 | 0.0058 | 0.0060 | 0.0049 | 0.0055 | 0.0053 | 0.0052 | 0.0055 | 0.0058 | 0.0058 | 0.0058 | 0.0056 | 0.0054 | 0.0058 | 0.0058 | 0.0057 | 0.0055 | 0.0048 | 0.0048 | 0.0040 | 0.0034 | 0.0033 | 0.0033 | 0.0026 | 0.0021 | | |
| **10.00** | | | 0.0011 | 0.0013 | 0.0012 | 0.0015 | 0.0025 | 0.0024 | 0.0033 | 0.0039 | 0.0045 | 0.0044 | 0.0050 | 0.0052 | 0.0042 | 0.0047 | 0.0045 | 0.0045 | 0.0047 | 0.0050 | 0.0050 | 0.0050 | 0.0048 | 0.0047 | 0.0050 | 0.0050 | 0.0049 | 0.0048 | 0.0041 | 0.0041 | 0.0035 | 0.0030 | 0.0029 | 0.0028 | 0.0022 | 0.0018 | | |
| **10.67** | | | 0.0011 | 0.0013 | 0.0013 | 0.0016 | 0.0025 | 0.0024 | 0.0034 | 0.0040 | 0.0046 | 0.0045 | 0.0051 | 0.0053 | 0.0043 | 0.0048 | 0.0047 | 0.0046 | 0.0049 | 0.0051 | 0.0052 | 0.0051 | 0.0050 | 0.0048 | 0.0051 | 0.0051 | 0.0051 | 0.0049 | 0.0042 | 0.0042 | 0.0036 | 0.0030 | 0.0029 | 0.0029 | 0.0023 | 0.0019 | | |
| **11.33** | | | 0.0010 | 0.0011 | 0.0011 | 0.0013 | 0.0021 | 0.0020 | 0.0029 | 0.0034 | 0.0039 | 0.0038 | 0.0043 | 0.0045 | 0.0036 | 0.0041 | 0.0039 | 0.0039 | 0.0041 | 0.0043 | 0.0044 | 0.0043 | 0.0042 | 0.0040 | 0.0043 | 0.0043 | 0.0043 | 0.0041 | 0.0036 | 0.0036 | 0.0030 | 0.0026 | 0.0025 | 0.0024 | 0.0019 | 0.0016 | | |
| **12.00** | | | | 0.0010 | 0.0010 | 0.0012 | 0.0019 | 0.0018 | 0.0026 | 0.0030 | 0.0035 | 0.0034 | 0.0038 | 0.0040 | 0.0032 | 0.0036 | 0.0035 | 0.0034 | 0.0036 | 0.0038 | 0.0038 | 0.0038 | 0.0037 | 0.0036 | 0.0038 | 0.0038 | 0.0038 | 0.0036 | 0.0031 | 0.0031 | 0.0027 | 0.0023 | 0.0022 | 0.0022 | 0.0017 | 0.0014 | | |
| **12.67** | | | | | | 0.0010 | 0.0016 | 0.0015 | 0.0022 | 0.0026 | 0.0030 | 0.0029 | 0.0033 | 0.0034 | 0.0027 | 0.0031 | 0.0030 | 0.0030 | 0.0031 | 0.0033 | 0.0033 | 0.0033 | 0.0032 | 0.0031 | 0.0033 | 0.0033 | 0.0032 | 0.0031 | 0.0027 | 0.0027 | 0.0023 | 0.0019 | 0.0019 | 0.0018 | 0.0014 | 0.0012 | |
| **13.33** | | | | | | | 0.0014 | 0.0014 | 0.0019 | 0.0023 | 0.0026 | 0.0026 | 0.0029 | 0.0030 | 0.0024 | 0.0027 | 0.0026 | 0.0026 | 0.0027 | 0.0029 | 0.0029 | 0.0029 | 0.0028 | 0.0027 | 0.0029 | 0.0029 | 0.0028 | 0.0027 | 0.0024 | 0.0024 | 0.0020 | 0.0017 | 0.0017 | 0.0016 | 0.0013 | 0.0010 | |
| **14.00** | | | | | | | 0.0013 | 0.0012 | 0.0017 | 0.0020 | 0.0023 | 0.0022 | 0.0025 | 0.0026 | 0.0021 | 0.0024 | 0.0023 | 0.0023 | 0.0024 | 0.0025 | 0.0025 | 0.0025 | 0.0024 | 0.0024 | 0.0025 | 0.0025 | 0.0025 | 0.0024 | 0.0021 | 0.0021 | 0.0018 | 0.0015 | 0.0015 | 0.0014 | 0.0011 | | |
| **14.67** | | | | | | | 0.0012 | 0.0011 | 0.0016 | 0.0019 | 0.0022 | 0.0021 | 0.0024 | 0.0025 | 0.0020 | 0.0023 | 0.0022 | 0.0022 | 0.0023 | 0.0024 | 0.0024 | 0.0024 | 0.0023 | 0.0023 | 0.0024 | 0.0024 | 0.0024 | 0.0023 | 0.0020 | 0.0020 | 0.0017 | 0.0014 | 0.0014 | 0.0014 | 0.0011 | | |
| **15.33** | | | | | | | 0.0012 | 0.0011 | 0.0016 | 0.0018 | 0.0021 | 0.0021 | 0.0023 | 0.0024 | 0.0020 | 0.0022 | 0.0021 | 0.0021 | 0.0022 | 0.0023 | 0.0023 | 0.0023 | 0.0023 | 0.0022 | 0.0023 | 0.0023 | 0.0023 | 0.0022 | 0.0019 | 0.0019 | 0.0016 | 0.0014 | 0.0013 | 0.0013 | 0.0010 | | |
| **16.00** | | | | | | | 0.0011 | 0.0011 | 0.0015 | 0.0017 | 0.0020 | 0.0020 | 0.0022 | 0.0023 | 0.0019 | 0.0021 | 0.0020 | 0.0020 | 0.0021 | 0.0022 | 0.0022 | 0.0022 | 0.0022 | 0.0021 | 0.0022 | 0.0022 | 0.0022 | 0.0021 | 0.0018 | 0.0018 | 0.0015 | 0.0013 | 0.0013 | 0.0013 | 0.0010 | | |
| **16.67** | | | | | | | | | 0.0010 | 0.0012 | 0.0014 | 0.0013 | 0.0015 | 0.0016 | 0.0013 | 0.0014 | 0.0014 | 0.0014 | 0.0015 | 0.0015 | 0.0015 | 0.0015 | 0.0015 | 0.0014 | 0.0015 | 0.0015 | 0.0015 | 0.0015 | 0.0013 | 0.0013 | 0.0011 | | | | | | |
| **17.33** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| | | |
|---|---|---|
| **Number cells** | **824** | |
| **Total effluent flow** | **3.3795 cfs** | **Mass Recovery** |
| **=** | **2.194512 mgd** | **94.73%** |

**Table F. vdA for values greater than 0.0010 cfs**

| | 1152.9 | 1155.6 | 1158.4 | 1161.1 | 1163.8 | 1166.5 | 1169.3 | 1172.0 | 1174.7 | 1177.5 | 1180.2 | 1182.9 | 1185.6 | 1188.4 | 1191.1 | 1193.8 | 1196.5 | 1199.3 | 1202.0 | 1204.7 | 1207.5 | 1210.2 | 1212.9 | 1215.6 | 1218.4 | 1221.1 | 1223.8 | 1226.5 | 1229.3 | 1232.0 | 1234.7 | 1237.5 | 1240.2 | 1242.9 | 1245.6 | 1248.4 | 1251.1 | 1253.8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0.67** | | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | | |
| **1.33** | | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | | |
| **2.00** | | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | 1.3434 | | |
| **2.67** | | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | 1.4042 | | |
| **3.33** | | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | 1.4650 | | |
| **4.00** | | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | 1.5172 | | |
| **4.67** | | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | 1.5694 | | |
| **5.33** | | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | 1.6135 | | |
| **6.00** | | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | 1.6576 | | |
| **6.67** | | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | 1.6867 | | |
| **7.33** | | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | 1.7158 | | |
| **8.00** | | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | 1.7621 | | |
| **8.67** | | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | 1.8083 | | |
| **9.33** | | | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | 1.8601 | | |
| **10.00** | | | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | 1.9119 | | |
| **10.67** | | | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | 1.9637 | | |
| **11.33** | | | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | 2.0155 | | |
| **12.00** | | | | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | 2.0258 | |
| **12.67** | | | | | | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | 2.0361 | |
| **13.33** | | | | | | | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | 2.0686 | |
| **14.00** | | | | | | | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | 2.1011 | | |
| **14.67** | | | | | | | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | 2.1298 | | |
| **15.33** | | | | | | | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | 2.1585 | | |
| **16.00** | | | | | | | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | 2.1683 | | |
| **16.67** | | | | | | | | | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | 2.1782 | | | | | | |
| **17.33** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| | |
|---|---|
| **Number cells** | **824** |
| **Total flow** | **1462 cfs** |
| **=** | **949 mgd** |

| | |
|---|---|
| **Flux Average Conc** | **0.23%** |
| **Flux Average Dilution** | **433** |

# PEAK-TO-MEAN CALCULATION TABLES

**Table G. Effluent fraction for 95% Mass Recovery**

| | 1152.9 | 1155.6 | 1158.4 | 1161.1 | 1163.8 | 1166.5 | 1169.3 | 1172.0 | 1174.7 | 1177.5 | 1180.2 | 1182.9 | 1185.6 | 1188.4 | 1191.1 | 1193.8 | 1196.5 | 1199.3 | 1202.0 | 1204.7 | 1207.5 | 1210.2 | 1212.9 | 1215.6 | 1218.4 | 1221.1 | 1223.8 | 1226.5 | 1229.3 | 1232.0 | 1234.7 | 1237.5 | 1240.2 | 1242.9 | 1245.6 | 1248.4 | 1251.1 | 1253.8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0.67** | | 0.07% | 0.11% | 0.12% | 0.12% | 0.14% | 0.23% | 0.22% | 0.32% | 0.37% | 0.43% | 0.42% | 0.47% | 0.49% | 0.40% | 0.45% | **0.43%** | 0.43% | 0.45% | 0.48% | 0.48% | 0.47% | 0.46% | 0.44% | 0.47% | 0.48% | 0.47% | 0.45% | 0.39% | 0.39% | 0.33% | 0.28% | 0.27% | 0.27% | 0.21% | 0.17% | | |
| **1.33** | | 0.08% | 0.11% | 0.13% | 0.13% | 0.15% | 0.25% | 0.24% | 0.34% | 0.40% | 0.46% | 0.45% | 0.51% | 0.53% | 0.43% | 0.48% | **0.46%** | 0.46% | 0.48% | 0.51% | 0.51% | 0.50% | 0.49% | 0.47% | 0.51% | 0.51% | 0.50% | 0.48% | 0.42% | 0.42% | 0.35% | 0.30% | 0.29% | 0.29% | 0.22% | 0.18% | | |
| **2.00** | | 0.08% | 0.12% | 0.14% | 0.13% | 0.16% | 0.27% | 0.26% | 0.36% | 0.42% | 0.49% | 0.48% | 0.54% | 0.56% | 0.45% | 0.51% | **0.49%** | 0.49% | 0.51% | 0.54% | 0.54% | 0.54% | 0.52% | 0.50% | 0.54% | 0.54% | 0.53% | 0.51% | 0.44% | 0.44% | 0.37% | 0.32% | 0.31% | 0.30% | 0.24% | 0.20% | | |
| **2.67** | | 0.08% | 0.11% | 0.13% | 0.12% | 0.15% | 0.25% | 0.24% | 0.33% | 0.39% | 0.45% | 0.44% | 0.50% | 0.52% | 0.42% | 0.47% | **0.45%** | 0.45% | 0.47% | 0.50% | 0.50% | 0.50% | 0.48% | 0.47% | 0.50% | 0.50% | 0.49% | 0.48% | 0.41% | 0.41% | 0.35% | 0.30% | 0.29% | 0.28% | 0.22% | 0.18% | | |
| **3.33** | | 0.06% | 0.09% | 0.10% | 0.10% | 0.12% | 0.20% | 0.19% | 0.27% | 0.31% | 0.36% | 0.35% | 0.40% | 0.42% | 0.34% | 0.38% | **0.37%** | 0.36% | 0.38% | 0.40% | 0.40% | 0.40% | 0.39% | 0.37% | 0.40% | 0.40% | 0.40% | 0.38% | 0.33% | 0.33% | 0.28% | 0.24% | 0.23% | 0.23% | 0.18% | 0.15% | | |
| **4.00** | | 0.07% | 0.10% | 0.12% | 0.11% | 0.14% | 0.22% | 0.21% | 0.30% | 0.35% | 0.40% | 0.39% | 0.45% | 0.46% | 0.37% | 0.42% | **0.41%** | 0.40% | 0.42% | 0.45% | 0.45% | 0.44% | 0.43% | 0.42% | 0.45% | 0.45% | 0.44% | 0.43% | 0.37% | 0.37% | 0.31% | 0.26% | 0.26% | 0.25% | 0.20% | 0.16% | | |
| **4.67** | | 0.07% | 0.10% | 0.12% | 0.12% | 0.14% | 0.23% | 0.22% | 0.31% | 0.36% | 0.42% | 0.41% | 0.46% | 0.48% | 0.39% | 0.44% | **0.42%** | 0.42% | 0.44% | 0.46% | 0.47% | 0.46% | 0.45% | 0.43% | 0.46% | 0.46% | 0.46% | 0.44% | 0.38% | 0.38% | 0.32% | 0.27% | 0.27% | 0.26% | 0.20% | 0.17% | | |
| **5.33** | | 0.07% | 0.10% | 0.12% | 0.12% | 0.14% | 0.23% | 0.22% | 0.31% | 0.36% | 0.42% | 0.41% | 0.46% | 0.48% | 0.39% | 0.44% | **0.42%** | 0.42% | 0.44% | 0.47% | 0.47% | 0.46% | 0.45% | 0.43% | 0.47% | 0.47% | 0.46% | 0.44% | 0.38% | 0.38% | 0.32% | 0.28% | 0.27% | 0.26% | 0.21% | 0.17% | | |
| **6.00** | | **0.07%** | **0.10%** | **0.12%** | **0.11%** | **0.14%** | **0.22%** | **0.21%** | **0.30%** | **0.36%** | **0.41%** | **0.40%** | **0.45%** | **0.47%** | **0.38%** | **0.43%** | 0.41% | **0.41%** | **0.43%** | **0.46%** | **0.46%** | **0.45%** | **0.44%** | **0.42%** | **0.45%** | **0.46%** | **0.45%** | **0.43%** | **0.37%** | **0.37%** | **0.32%** | **0.27%** | **0.26%** | **0.26%** | **0.20%** | **0.16%** | | |
| **6.67** | | 0.07% | 0.09% | 0.11% | 0.11% | 0.13% | 0.21% | 0.20% | 0.29% | 0.33% | 0.39% | 0.38% | 0.43% | 0.44% | 0.36% | 0.40% | **0.39%** | 0.39% | 0.41% | 0.43% | 0.43% | 0.42% | 0.41% | 0.40% | 0.43% | 0.43% | 0.42% | 0.41% | 0.35% | 0.35% | 0.30% | 0.25% | 0.25% | 0.24% | 0.19% | 0.15% | | |
| **7.33** | | 0.07% | 0.10% | 0.11% | 0.11% | 0.13% | 0.21% | 0.21% | 0.29% | 0.34% | 0.39% | 0.38% | 0.43% | 0.45% | 0.36% | 0.41% | **0.40%** | 0.39% | 0.41% | 0.44% | 0.44% | 0.43% | 0.42% | 0.41% | 0.43% | 0.44% | 0.43% | 0.41% | 0.36% | 0.36% | 0.30% | 0.26% | 0.25% | 0.24% | 0.19% | 0.16% | | |
| **8.00** | | 0.07% | 0.10% | 0.12% | 0.11% | 0.14% | 0.22% | 0.21% | 0.30% | 0.35% | 0.40% | 0.39% | 0.44% | 0.46% | 0.37% | 0.42% | **0.41%** | 0.40% | 0.42% | 0.45% | 0.45% | 0.44% | 0.43% | 0.42% | 0.44% | 0.45% | 0.44% | 0.42% | 0.37% | 0.36% | 0.31% | 0.26% | 0.26% | 0.25% | 0.20% | 0.16% | | |
| **8.67** | | 0.06% | 0.08% | 0.10% | 0.09% | 0.11% | 0.18% | 0.17% | 0.25% | 0.29% | 0.33% | 0.32% | 0.37% | 0.38% | 0.31% | 0.35% | **0.33%** | 0.33% | 0.35% | 0.37% | 0.37% | 0.37% | 0.35% | 0.34% | 0.37% | 0.37% | 0.36% | 0.35% | 0.30% | 0.30% | 0.25% | 0.22% | 0.21% | 0.21% | 0.16% | 0.13% | | |
| **9.33** | | | 0.07% | 0.08% | 0.08% | 0.10% | 0.15% | 0.15% | 0.21% | 0.24% | 0.28% | 0.28% | 0.31% | 0.32% | 0.26% | 0.29% | **0.28%** | 0.28% | 0.30% | 0.31% | 0.31% | 0.31% | 0.30% | 0.29% | 0.31% | 0.31% | 0.31% | 0.30% | 0.26% | 0.26% | 0.22% | 0.19% | 0.18% | 0.18% | 0.14% | 0.11% | | |
| **10.00** | | | 0.06% | 0.07% | 0.06% | 0.08% | 0.13% | 0.12% | 0.17% | 0.20% | 0.24% | 0.23% | 0.26% | 0.27% | 0.22% | 0.25% | **0.24%** | 0.24% | 0.25% | 0.26% | 0.26% | 0.26% | 0.25% | 0.24% | 0.26% | 0.26% | 0.26% | 0.25% | 0.21% | 0.21% | 0.18% | 0.15% | 0.15% | 0.15% | 0.12% | 0.09% | | |
| **10.67** | | | 0.06% | 0.07% | 0.06% | 0.08% | 0.13% | 0.12% | 0.17% | 0.20% | 0.24% | 0.23% | 0.26% | 0.27% | 0.22% | 0.25% | **0.24%** | 0.24% | 0.25% | 0.26% | 0.26% | 0.26% | 0.25% | 0.24% | 0.26% | 0.26% | 0.26% | 0.25% | 0.21% | 0.21% | 0.18% | 0.15% | 0.15% | 0.15% | 0.12% | 0.09% | | |
| **11.33** | | | 0.05% | 0.06% | 0.05% | 0.07% | 0.11% | 0.10% | 0.14% | 0.17% | 0.19% | 0.19% | 0.21% | 0.22% | 0.18% | 0.20% | **0.20%** | 0.19% | 0.20% | 0.22% | 0.22% | 0.21% | 0.21% | 0.20% | 0.21% | 0.22% | 0.21% | 0.20% | 0.18% | 0.18% | 0.15% | 0.13% | 0.12% | 0.12% | 0.09% | 0.08% | | |
| **12.00** | | | | 0.05% | 0.05% | 0.06% | 0.09% | 0.09% | 0.13% | 0.15% | 0.17% | 0.17% | 0.19% | 0.20% | 0.16% | 0.18% | **0.17%** | 0.17% | 0.18% | 0.19% | 0.19% | 0.19% | 0.18% | 0.18% | 0.19% | 0.19% | 0.19% | 0.18% | 0.16% | 0.15% | 0.13% | 0.11% | 0.11% | 0.11% | 0.08% | 0.07% | | |
| **12.67** | | | | | | 0.05% | 0.08% | 0.08% | 0.11% | 0.13% | 0.15% | 0.14% | 0.16% | 0.17% | 0.13% | 0.15% | **0.15%** | 0.14% | 0.15% | 0.16% | 0.16% | 0.16% | 0.16% | 0.15% | 0.16% | 0.16% | 0.16% | 0.15% | 0.13% | 0.13% | 0.11% | 0.10% | 0.09% | 0.09% | 0.07% | 0.06% | | |
| **13.33** | | | | | | | 0.07% | 0.07% | 0.09% | 0.11% | 0.13% | 0.12% | 0.14% | 0.14% | 0.12% | 0.13% | **0.13%** | 0.13% | 0.13% | 0.14% | 0.14% | 0.14% | 0.13% | 0.13% | 0.14% | 0.14% | 0.14% | 0.13% | 0.11% | 0.11% | 0.10% | 0.08% | 0.08% | 0.08% | 0.06% | 0.05% | | |
| **14.00** | | | | | | | 0.06% | 0.06% | 0.08% | 0.09% | 0.11% | 0.11% | 0.12% | 0.13% | 0.10% | 0.11% | **0.11%** | 0.11% | 0.11% | 0.12% | 0.12% | 0.12% | 0.12% | 0.11% | 0.12% | 0.12% | 0.12% | 0.11% | 0.10% | 0.10% | 0.08% | 0.07% | 0.07% | 0.07% | 0.05% | | | |
| **14.67** | | | | | | | 0.06% | 0.05% | 0.08% | 0.09% | 0.10% | 0.10% | 0.11% | 0.12% | 0.10% | 0.11% | **0.10%** | 0.10% | 0.11% | 0.11% | 0.11% | 0.11% | 0.11% | 0.11% | 0.11% | 0.11% | 0.11% | 0.11% | 0.09% | 0.09% | 0.08% | 0.07% | 0.07% | 0.06% | 0.05% | | | |
| **15.33** | | | | | | | 0.05% | 0.05% | 0.07% | 0.08% | 0.10% | 0.10% | 0.11% | 0.11% | 0.09% | 0.10% | **0.10%** | 0.10% | 0.10% | 0.11% | 0.11% | 0.11% | 0.10% | 0.10% | 0.11% | 0.11% | 0.11% | 0.10% | 0.09% | 0.09% | 0.08% | 0.06% | 0.06% | 0.06% | 0.05% | | | |
| **16.00** | | | | | | | 0.05% | 0.05% | 0.07% | 0.08% | 0.09% | 0.09% | 0.10% | 0.11% | 0.09% | 0.10% | **0.09%** | 0.09% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.10% | 0.08% | 0.08% | 0.07% | 0.06% | 0.06% | 0.06% | 0.05% | | | |
| **16.67** | | | | | | | | | 0.05% | 0.05% | 0.06% | 0.06% | 0.07% | 0.07% | 0.06% | 0.07% | **0.06%** | 0.06% | 0.07% | 0.07% | 0.07% | 0.07% | 0.07% | 0.07% | 0.07% | 0.07% | 0.07% | 0.07% | 0.06% | 0.06% | 0.05% | | | | | | | |
| **17.33** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

**Number cells** **824**

**95 Percentile Conc** **0.48%**
**5 Percentile Dilution** **210**

# ATTACHMENT II-3:
# UM3 MODEL CALIBRATION PRINTOUTS

**OCT 4 7:30 AM - LOW CURRENT MODEL CALIBRATION (AEC = 0.2)**

```
Case 1; ambient file C:\Plumes\Camas2.002.001.db; Diffuser table record 1: ----------------------------------
      Depth    Amb-cur    Amb-dir    Amb-sal    Amb-tem    Amb-pol      Decay    Far-spd    Far-dir    Disprsn
          m        m/s        deg        psu          C      kg/kg        s-1        m/s        deg   m0.67/s2
        0.0      0.264      180.0      0.071      17.08        0.0        0.0      0.264      180.0      0.001
        1.0      0.264      180.0     0.0725      17.08        0.0        0.0      0.264      180.0      0.001
        2.0      0.256      180.0      0.074      17.08        0.0        0.0      0.256      180.0      0.001
        3.0      0.247      180.0     0.0755      17.08        0.0        0.0      0.247      180.0      0.001
        4.0      0.228      180.0      0.077      17.08        0.0        0.0      0.228      180.0      0.001
        5.0       0.21      180.0      0.077      17.08        0.0        0.0       0.21      180.0      0.001
        6.0      0.187      180.0      0.077      17.08        0.0        0.0      0.187      180.0      0.001
        7.0      0.163      180.0      0.077      17.08        0.0        0.0      0.163      180.0      0.001
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
    (in)    (ft)   (deg)   (deg)      ()    (ft)    (ft)    (ft)    (ft)   (MGD)   (psu)     (C) (kg/kg)
     6.0     1.0     0.0   180.0     8.0    10.0    32.0   322.0    21.0    2.53     0.0    20.0     1.0
Froude number:      28.52
        Depth  Amb-cur    P-dia  Polutnt   Dilutn  CL-diln   x-posn   y-posn
Step     (ft)    (m/s)     (in)  (kg/kg)       ()       ()     (ft)     (ft)
   0      21.0    0.177    5.692      1.0      1.0      1.0      0.0      0.0;
  25      21.0    0.177    8.706     0.61     1.64      1.0   -0.386      0.0;
  50      21.0    0.177    13.08    0.372    2.691    1.103   -0.999      0.0;
  75     20.99    0.177    19.09    0.226    4.414    1.667   -2.003      0.0;
  93     20.99    0.177    24.59    0.159    6.304    2.238   -3.139      0.0; bottom hit,
 100     20.98    0.177    27.03    0.138    7.241     2.51   -3.721      0.0;
 125     20.94    0.177    37.22   0.0841    11.88      3.8   -6.819      0.0;
 150     20.84    0.178     50.1   0.0513    19.49     5.82   -12.75      0.0;
 175     20.53     0.18    66.22   0.0313    31.97    9.011   -24.86      0.0;
 185     20.28    0.182    73.72   0.0256    38.97    10.75   -32.51      0.0; acute zone,
 200     19.74    0.186    86.22   0.0191    52.45     14.0   -47.52      0.0;
 225     18.27    0.196    110.7   0.0116    86.05    21.67   -83.08      0.0;
 234     17.71      0.2    120.7  0.00972    102.8    25.54   -96.51      0.0; merging,
 250     16.57    0.208    146.5  0.00708    141.2    37.76   -124.9      0.0;
 275     14.35    0.221    213.2  0.00431    231.6    83.77   -186.5      0.0;
 295     12.07    0.234    296.0   0.0029    344.2    145.7   -258.4      0.0; surface,
Const Eddy Diffusivity.  Farfield dispersion based on wastefield width of      28.85 m
    conc  dilutn   width distnce    time
 (kg/kg)             (m)     (m)    (hrs) (kg/kg)   (s-1)   (m/s)(m0.67/s2)
 2.90E-3   344.8   32.94   98.15   0.033     0.0     0.0   0.163   0.001
```

**OCT 4 7:30 AM - LOW CURRENT MODEL CALIBRATION (AEC = 0.4)**

Case 2; ambient file C:\Plumes\Camas2.002.001.db; Diffuser table record 1: ----------

| Depth | Amb-cur | Amb-dir | Amb-sal | Amb-tem | Amb-pol | Decay | Far-spd | Far-dir | Disprsn |
|---|---|---|---|---|---|---|---|---|---|
| m | m/s | deg | psu | C | kg/kg | s-1 | m/s | deg | m0.67/s2 |
| 0.0 | 0.264 | 180.0 | 0.071 | 17.08 | 0.0 | 0.0 | 0.264 | 180.0 | 0.001 |
| 1.0 | 0.264 | 180.0 | 0.0725 | 17.08 | 0.0 | 0.0 | 0.264 | 180.0 | 0.001 |
| 2.0 | 0.256 | 180.0 | 0.074 | 17.08 | 0.0 | 0.0 | 0.256 | 180.0 | 0.001 |
| 3.0 | 0.247 | 180.0 | 0.0755 | 17.08 | 0.0 | 0.0 | 0.247 | 180.0 | 0.001 |
| 4.0 | 0.228 | 180.0 | 0.077 | 17.08 | 0.0 | 0.0 | 0.228 | 180.0 | 0.001 |
| 5.0 | 0.21 | 180.0 | 0.077 | 17.08 | 0.0 | 0.0 | 0.21 | 180.0 | 0.001 |
| 6.0 | 0.187 | 180.0 | 0.077 | 17.08 | 0.0 | 0.0 | 0.187 | 180.0 | 0.001 |
| 7.0 | 0.163 | 180.0 | 0.077 | 17.08 | 0.0 | 0.0 | 0.163 | 180.0 | 0.001 |

| P-dia | P-elev | V-angle | H-angle | Ports | Spacing | AcuteMZ | ChrncMZ | P-depth | Ttl-flo | Eff-sal | Temp | Polutnt |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (in) | (ft) | (deg) | (deg) | () | (ft) | (ft) | (ft) | (ft) | (MGD) | (psu) | (C) | (kg/kg) |
| 6.0 | 1.0 | 0.0 | 180.0 | 8.0 | 10.0 | 32.0 | 322.0 | 21.0 | 2.53 | 0.0 | 20.0 | 1.0 |

Froude number: 28.52

| Step | Depth (ft) | Amb-cur (m/s) | P-dia (in) | Polutnt (kg/kg) | Dilutn () | CL-diln () | x-posn (ft) | y-posn (ft) | |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 21.0 | 0.177 | 5.692 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0; | |
| 25 | 21.0 | 0.177 | 8.706 | 0.61 | 1.64 | 1.0 | -0.193 | 0.0; | |
| 50 | 21.0 | 0.177 | 13.08 | 0.372 | 2.691 | 1.103 | -0.499 | 0.0; | |
| 75 | 21.0 | 0.177 | 19.09 | 0.226 | 4.414 | 1.667 | -1.002 | 0.0; | |
| 92 | 21.0 | 0.177 | 24.26 | 0.162 | 6.18 | 2.202 | -1.531 | 0.0; | bottom hit, |
| 100 | 21.0 | 0.177 | 27.03 | 0.138 | 7.241 | 2.511 | -1.86 | 0.0; | |
| 125 | 20.99 | 0.177 | 37.23 | 0.0841 | 11.88 | 3.803 | -3.407 | 0.0; | |
| 150 | 20.96 | 0.177 | 50.13 | 0.0513 | 19.49 | 5.834 | -6.35 | 0.0; | |
| 175 | 20.88 | 0.178 | 66.35 | 0.0313 | 31.97 | 9.081 | -12.22 | 0.0; | |
| 200 | 20.66 | 0.179 | 86.71 | 0.0191 | 52.45 | 14.3 | -24.72 | 0.0; | |
| 209 | 20.49 | 0.181 | 95.24 | 0.0159 | 62.69 | 16.84 | -32.68 | 0.0; | acute zone, |
| 225 | 19.87 | 0.185 | 112.1 | 0.0116 | 86.05 | 22.42 | -55.48 | 0.0; | |
| 232 | 19.4 | 0.188 | 120.2 | 0.0101 | 98.85 | 25.31 | -70.43 | 0.0; | merging, |
| 250 | 18.1 | 0.197 | 150.6 | 0.00708 | 141.2 | 39.04 | -107.0 | 0.0; | |
| 275 | 16.33 | 0.21 | 221.5 | 0.00431 | 231.6 | 88.54 | -159.5 | 0.0; | |
| 300 | 14.29 | 0.221 | 337.5 | 0.00263 | 380.0 | 162.3 | -230.8 | 0.0; | |
| 301 | 14.2 | 0.222 | 343.3 | 0.00258 | 387.6 | 165.5 | -234.2 | 0.0; | surface, |

Const Eddy Diffusivity. Farfield dispersion based on wastefield width of 30.06 m

| conc (kg/kg) | dilutn | width (m) | distnce (m) | time (hrs) | (kg/kg) | (s-1) | (m/s) | (m0.67/s2) |
|---|---|---|---|---|---|---|---|---|
| 2.56E-3 | 390.2 | 35.66 | 98.15 | 0.0456 | 0.0 | 0.0 | 0.163 | 0.001 |

**OCT 4 7:30 AM - LOW CURRENT MODEL CALIBRATION (AEC = 0.6)**

```
Case 3; ambient file C:\Plumes\Camas2.002.001.db; Diffuser table record 1: ----------------------------------
      Depth    Amb-cur    Amb-dir    Amb-sal    Amb-tem    Amb-pol      Decay    Far-spd    Far-dir    Disprsn
          m        m/s        deg        psu          C      kg/kg        s-1        m/s        deg   m0.67/s2
        0.0      0.264      180.0      0.071      17.08        0.0        0.0      0.264      180.0      0.001
        1.0      0.264      180.0     0.0725      17.08        0.0        0.0      0.264      180.0      0.001
        2.0      0.256      180.0      0.074      17.08        0.0        0.0      0.256      180.0      0.001
        3.0      0.247      180.0     0.0755      17.08        0.0        0.0      0.247      180.0      0.001
        4.0      0.228      180.0      0.077      17.08        0.0        0.0      0.228      180.0      0.001
        5.0       0.21      180.0      0.077      17.08        0.0        0.0       0.21      180.0      0.001
        6.0      0.187      180.0      0.077      17.08        0.0        0.0      0.187      180.0      0.001
        7.0      0.163      180.0      0.077      17.08        0.0        0.0      0.163      180.0      0.001
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
    (in)    (ft)   (deg)   (deg)      ()    (ft)    (ft)    (ft)    (ft)   (MGD)   (psu)     (C) (kg/kg)
     6.0     1.0     0.0   180.0     8.0    10.0    32.0   322.0    21.0    2.53     0.0    20.0     1.0
Froude number:      28.52
        Depth  Amb-cur    P-dia  Polutnt   Dilutn  CL-diln   x-posn   y-posn
Step     (ft)    (m/s)     (in)  (kg/kg)       ()       ()     (ft)     (ft)
   0      21.0    0.177    5.692      1.0      1.0      1.0      0.0      0.0;
  25      21.0    0.177    8.706     0.61     1.64      1.0   -0.129      0.0;
  50      21.0    0.177    13.08    0.372    2.691    1.103   -0.333      0.0;
  75      21.0    0.177    19.09    0.226    4.414    1.667   -0.668      0.0;
  92      21.0    0.177    24.26    0.162     6.18    2.202   -1.021      0.0; bottom hit,
 100      21.0    0.177    27.03    0.138    7.241    2.511    -1.24      0.0;
 125     20.99    0.177    37.23   0.0841    11.88    3.803   -2.271      0.0;
 150     20.98    0.177    50.14   0.0513    19.49    5.836    -4.23      0.0;
 175     20.95    0.177    66.37   0.0313    31.97    9.094   -8.116      0.0;
 200     20.86    0.178     86.8   0.0191    52.45    14.36   -16.16      0.0;
 223     20.59     0.18    110.2   0.0121    82.71    21.99   -32.46      0.0; acute zone,
 225     20.55     0.18    112.5   0.0116    86.05    22.82   -34.74      0.0;
 232     20.34    0.182    120.8   0.0101    98.85     26.0   -44.88      0.0; merging,
 250      19.0    0.191    152.7  0.00708    141.2    39.97   -92.78      0.0;
 275     17.43    0.202    226.4  0.00431    231.6     92.1   -143.0      0.0;
 300     15.88    0.213    347.2  0.00263    380.0    163.4   -201.3      0.0;
 305     15.54    0.214    379.0  0.00238    419.6    180.3   -215.7      0.0; surface,
Const Eddy Diffusivity.  Farfield dispersion based on wastefield width of      30.96 m
    conc  dilutn   width distnce    time
 (kg/kg)             (m)     (m)    (hrs) (kg/kg)   (s-1)   (m/s)(m0.67/s2)
 2.35E-3   425.0   37.71   98.15  0.0552     0.0     0.0   0.163   0.001
```

**OCT 4 7:30 AM - LOW CURRENT MODEL CALIBRATION (AEC = 0.8)**

```
Case 4; ambient file C:\Plumes\Camas2.002.001.db; Diffuser table record 1: ----------------------------------
      Depth    Amb-cur    Amb-dir    Amb-sal    Amb-tem    Amb-pol      Decay    Far-spd    Far-dir    Disprsn
          m        m/s        deg        psu          C      kg/kg        s-1        m/s        deg   m0.67/s2
        0.0      0.264      180.0      0.071      17.08        0.0        0.0      0.264      180.0      0.001
        1.0      0.264      180.0     0.0725      17.08        0.0        0.0      0.264      180.0      0.001
        2.0      0.256      180.0      0.074      17.08        0.0        0.0      0.256      180.0      0.001
        3.0      0.247      180.0     0.0755      17.08        0.0        0.0      0.247      180.0      0.001
        4.0      0.228      180.0      0.077      17.08        0.0        0.0      0.228      180.0      0.001
        5.0       0.21      180.0      0.077      17.08        0.0        0.0       0.21      180.0      0.001
        6.0      0.187      180.0      0.077      17.08        0.0        0.0      0.187      180.0      0.001
        7.0      0.163      180.0      0.077      17.08        0.0        0.0      0.163      180.0      0.001
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
    (in)    (ft)   (deg)   (deg)      ()    (ft)    (ft)    (ft)    (ft)   (MGD)   (psu)     (C) (kg/kg)
     6.0     1.0     0.0   180.0     8.0    10.0    32.0   322.0    21.0    2.53     0.0    20.0     1.0
Froude number:      28.52
        Depth  Amb-cur    P-dia  Polutnt   Dilutn  CL-diln   x-posn   y-posn
Step     (ft)    (m/s)     (in)  (kg/kg)       ()       ()     (ft)     (ft)
   0      21.0    0.177    5.692      1.0      1.0      1.0      0.0      0.0;
  25      21.0    0.177    8.706     0.61     1.64      1.0  -0.0965      0.0;
  50      21.0    0.177    13.08    0.372    2.691    1.103    -0.25      0.0;
  75      21.0    0.177    19.09    0.226    4.414    1.667   -0.501      0.0;
  92      21.0    0.177    24.26    0.162     6.18    2.202   -0.766      0.0; bottom hit,
 100      21.0    0.177    27.03    0.138    7.241    2.511    -0.93      0.0;
 125      21.0    0.177    37.23   0.0841    11.88    3.803   -1.703      0.0;
 150     20.99    0.177    50.14   0.0513    19.49    5.837   -3.172      0.0;
 175     20.97    0.177    66.38   0.0313    31.97    9.098   -6.079      0.0;
 200     20.92    0.178    86.84   0.0191    52.45    14.38   -12.04      0.0;
 225     20.76    0.179    112.6   0.0116    86.05    22.94   -25.05      0.0;
 232     20.67    0.179    121.0   0.0101    98.85    26.24   -31.39      0.0; merging,
 233     20.65    0.179    122.3  0.00991    100.8    26.86   -32.55      0.0; acute zone,
 250     19.67    0.186    153.7  0.00708    141.2    40.81    -77.7      0.0;
 275     18.12    0.197    229.4  0.00431    231.6    94.42   -131.3      0.0;
 300     16.79    0.207    353.8  0.00263    380.0    164.2   -184.1      0.0;
 307      16.4     0.21    400.5  0.00229    436.5    188.2   -201.8      0.0; surface,
Const Eddy Diffusivity.  Farfield dispersion based on wastefield width of      31.51 m
    conc  dilutn   width distnce    time
 (kg/kg)             (m)     (m)    (hrs) (kg/kg)   (s-1)   (m/s)(m0.67/s2)
 2.25E-3   444.8   39.11   98.15  0.0624     0.0     0.0   0.163   0.001
```

**OCT 4 7:30 AM - LOW CURRENT MODEL CALIBRATION (AEC = 1.0)**

```
Case 5; ambient file C:\Plumes\Camas2.002.001.db; Diffuser table record 1: ----------------------------------
      Depth    Amb-cur    Amb-dir    Amb-sal    Amb-tem    Amb-pol      Decay    Far-spd    Far-dir    Disprsn
          m        m/s        deg        psu          C      kg/kg        s-1        m/s        deg   m0.67/s2
        0.0      0.264      180.0      0.071      17.08        0.0        0.0      0.264      180.0      0.001
        1.0      0.264      180.0     0.0725      17.08        0.0        0.0      0.264      180.0      0.001
        2.0      0.256      180.0      0.074      17.08        0.0        0.0      0.256      180.0      0.001
        3.0      0.247      180.0     0.0755      17.08        0.0        0.0      0.247      180.0      0.001
        4.0      0.228      180.0      0.077      17.08        0.0        0.0      0.228      180.0      0.001
        5.0       0.21      180.0      0.077      17.08        0.0        0.0       0.21      180.0      0.001
        6.0      0.187      180.0      0.077      17.08        0.0        0.0      0.187      180.0      0.001
        7.0      0.163      180.0      0.077      17.08        0.0        0.0      0.163      180.0      0.001
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
    (in)    (ft)   (deg)   (deg)      ()    (ft)    (ft)    (ft)    (ft)   (MGD)   (psu)     (C) (kg/kg)
     6.0     1.0     0.0   180.0     8.0    10.0    32.0   322.0    21.0    2.53     0.0    20.0     1.0
Froude number:      28.52
        Depth  Amb-cur    P-dia  Polutnt   Dilutn  CL-diln   x-posn   y-posn
Step     (ft)    (m/s)     (in)  (kg/kg)       ()       ()     (ft)     (ft)
   0      21.0    0.177    5.692      1.0      1.0      1.0      0.0      0.0;
  25      21.0    0.177    8.706     0.61     1.64      1.0  -0.0772      0.0;
  50      21.0    0.177    13.08    0.372    2.691    1.103     -0.2      0.0;
  75      21.0    0.177    19.09    0.226    4.414    1.667   -0.401      0.0;
  92      21.0    0.177    24.26    0.162     6.18    2.202   -0.613      0.0; bottom hit,
 100      21.0    0.177    27.03    0.138    7.241    2.511   -0.744      0.0;
 125      21.0    0.177    37.23   0.0841    11.88    3.804   -1.363      0.0;
 150     20.99    0.177    50.14   0.0513    19.49    5.837   -2.537      0.0;
 175     20.98    0.177    66.38   0.0313    31.97      9.1   -4.861      0.0;
 200     20.95    0.177    86.85   0.0191    52.45    14.39   -9.605      0.0;
 225     20.85    0.178    112.7   0.0116    86.05    22.99   -19.73      0.0;
 232      20.8    0.178    121.1   0.0101    98.85    26.34   -24.44      0.0; merging,
 239      20.7    0.179    131.7   0.0088    113.5    31.21   -32.05      0.0; acute zone,
 250     20.28    0.182    154.1  0.00708    141.2    41.59    -56.8      0.0;
 275     18.58    0.194    231.3  0.00431    231.6    96.03   -122.6      0.0;
 300      17.4    0.202    358.3  0.00263    380.0    165.0   -172.0      0.0;
 308     17.01    0.205    413.4  0.00224    445.2    192.9   -190.8      0.0; surface,
Const Eddy Diffusivity.  Farfield dispersion based on wastefield width of      31.84 m
    conc  dilutn   width distnce    time
 (kg/kg)             (m)     (m)    (hrs) (kg/kg)   (s-1)   (m/s)(m0.67/s2)
 2.19E-3   456.1    40.1   98.15  0.0682     0.0     0.0   0.163   0.001
```

**OCT 4 11:00 AM - HIGH CURRENT SPEED MODEL CALIBRATION (AEC = 0.4)**

Case 7; ambient file C:\Plumes\Camas2.002.003.db; Diffuser table record 3: ----------

| Depth | Amb-cur | Amb-dir | Amb-sal | Amb-tem | Amb-pol | Decay | Far-spd | Far-dir | Disprsn |
|---|---|---|---|---|---|---|---|---|---|
| m | m/s | deg | psu | C | kg/kg | s-1 | m/s | deg | m0.67/s2 |
| 0.0 | 0.887 | 180.0 | 0.071 | 17.12 | 0.0 | 0.0 | 0.887 | 180.0 | 0.001 |
| 1.0 | 0.887 | 180.0 | 0.0712 | 17.12 | 0.0 | 0.0 | 0.887 | 180.0 | 0.001 |
| 2.0 | 0.841 | 180.0 | 0.0715 | 17.12 | 0.0 | 0.0 | 0.841 | 180.0 | 0.001 |
| 3.0 | 0.794 | 180.0 | 0.0717 | 17.12 | 0.0 | 0.0 | 0.794 | 180.0 | 0.001 |
| 4.0 | 0.728 | 180.0 | 0.072 | 17.12 | 0.0 | 0.0 | 0.728 | 180.0 | 0.001 |
| 5.0 | 0.661 | 180.0 | 0.072 | 17.12 | 0.0 | 0.0 | 0.661 | 180.0 | 0.001 |
| 6.0 | 0.582 | 180.0 | 0.072 | 17.12 | 0.0 | 0.0 | 0.582 | 180.0 | 0.001 |
| 7.0 | 0.503 | 180.0 | 0.072 | 17.12 | 0.0 | 0.0 | 0.503 | 180.0 | 0.001 |

| P-dia | P-elev | V-angle | H-angle | Ports | Spacing | AcuteMZ | ChrncMZ | P-depth | Ttl-flo | Eff-sal | Temp | Polutnt |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (in) | (ft) | (deg) | (deg) | () | (ft) | (ft) | (ft) | (ft) | (MGD) | (psu) | (C) | (kg/kg) |
| 6.0 | 1.0 | 0.0 | 180.0 | 8.0 | 10.0 | 32.0 | 322.0 | 21.0 | 2.8 | 0.0 | 20.2 | 1.0 |

Froude number: 27.01

| Step | Depth (ft) | Amb-cur (m/s) | P-dia (in) | Polutnt (kg/kg) | Dilutn () | CL-diln () | x-posn (ft) | y-posn (ft) | |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 21.0 | 0.55 | 6.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0; | |
| 25 | 21.0 | 0.55 | 8.241 | 0.61 | 1.64 | 1.0 | -0.283 | 0.0; | |
| 50 | 21.0 | 0.55 | 11.1 | 0.372 | 2.69 | 1.0 | -0.797 | 0.0; | |
| 75 | 21.0 | 0.55 | 14.71 | 0.226 | 4.414 | 1.258 | -1.812 | 0.0; | |
| 100 | 20.99 | 0.55 | 19.25 | 0.138 | 7.241 | 1.99 | -3.87 | 0.0; | |
| 123 | 20.98 | 0.551 | 24.48 | 0.0875 | 11.42 | 3.066 | -7.661 | 0.0; | bottom hit, |
| 125 | 20.98 | 0.551 | 25.0 | 0.0841 | 11.88 | 3.185 | -8.129 | 0.0; | |
| 150 | 20.94 | 0.552 | 32.28 | 0.0513 | 19.49 | 5.137 | -17.2 | 0.0; | |
| 170 | 20.85 | 0.554 | 39.5 | 0.0345 | 28.96 | 7.55 | -32.65 | 0.0; | acute zone, |
| 175 | 20.81 | 0.555 | 41.54 | 0.0313 | 31.97 | 8.312 | -39.08 | 0.0; | |
| 200 | 20.3 | 0.567 | 53.22 | 0.0191 | 52.45 | 13.33 | -95.93 | 0.0; | |
| 225 | 19.92 | 0.576 | 67.91 | 0.0116 | 86.05 | 21.69 | -134.7 | 0.0; | |
| 250 | 19.62 | 0.583 | 86.54 | 0.00708 | 141.2 | 35.5 | -173.3 | 0.0; | |
| 275 | 19.35 | 0.59 | 110.2 | 0.00431 | 231.6 | 58.21 | -219.6 | 0.0; | |
| 284 | 19.26 | 0.592 | 120.3 | 0.00361 | 276.8 | 69.64 | -239.1 | 0.0; | merging, |
| 300 | 19.04 | 0.597 | 146.5 | 0.00263 | 380.0 | 105.5 | -289.7 | 0.0; | |
| 308 | 18.91 | 0.6 | 164.9 | 0.00224 | 445.2 | 133.3 | -322.4 | 0.0; | chronic zone, |
| 325 | 18.6 | 0.608 | 217.6 | 0.0016 | 623.4 | 241.2 | -407.7 | 0.0; | |
| 350 | 18.07 | 0.62 | 339.3 | 0.000977 | 1022.8 | 451.5 | -577.3 | 0.0; | |
| 363 | 17.76 | 0.628 | 431.1 | 0.000755 | 1323.1 | 583.0 | -691.1 | 0.0; | surface, |

Outside chronic zone

Visual Plumes, Ver. 1.0; U.S. Environmental Protection Agency, ERD, ORD, 20 July 2001

File Edit Models Stop Run Help

Diffuser: Camas2.002.vpp.db | Ambient: C:\Plumes\Camas2.002.003.db | Special Settings | Text Output | Graphical Output

Clear text display | Clear + | Output options | Numerical only

```
Case 9; ambient file C:\Plumes\Camas2.002.003.db; Diffuser table record 3: ----------------------------------
      Depth     Amb-cur     Amb-dir     Amb-sal     Amb-tem     Amb-pol       Decay     Far-spd     Far-dir     Disprsn
          m         m/s         deg         psu           C       kg/kg         s-1         m/s         deg    m0.67/s2
        0.0       0.887       180.0       0.071       17.12         0.0         0.0       0.887       180.0       0.001
        1.0       0.887       180.0      0.0712       17.12         0.0         0.0       0.887       180.0       0.001
        2.0       0.841       180.0      0.0715       17.12         0.0         0.0       0.841       180.0       0.001
        3.0       0.794       180.0      0.0717       17.12         0.0         0.0       0.794       180.0       0.001
        4.0       0.728       180.0       0.072       17.12         0.0         0.0       0.728       180.0       0.001
        5.0       0.661       180.0       0.072       17.12         0.0         0.0       0.661       180.0       0.001
        6.0       0.582       180.0       0.072       17.12         0.0         0.0       0.582       180.0       0.001
        7.0       0.503       180.0       0.072       17.12         0.0         0.0       0.503       180.0       0.001
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
    (in)    (ft)   (deg)   (deg)      ()    (ft)    (ft)    (ft)    (ft)   (MGD)   (psu)     (C) (kg/kg)
     6.0     1.0     0.0   180.0     8.0    10.0    32.0   322.0    21.0     2.8     0.0    20.2     1.0
Froude number:       30.81
        Depth  Amb-cur    P-dia  Polutnt   Dilutn  CL-diln   x-posn   y-posn
Step     (ft)    (m/s)     (in)  (kg/kg)       ()       ()     (ft)     (ft)
   0     21.0     0.55    5.692      1.0      1.0      1.0      0.0      0.0;
  25     21.0     0.55    7.932     0.61     1.64      1.0   -0.289      0.0;
  50     21.0     0.55    10.82    0.372     2.69      1.0   -0.801      0.0;
  75     21.0     0.55    14.46    0.226    4.414    1.293   -1.791      0.0;
 100    20.99     0.55    19.04    0.138    7.241    2.028   -3.773      0.0;
 124    20.98    0.551    24.56   0.0858    11.65    3.165   -7.607      0.0; bottom hit,
 125    20.98    0.551    24.82   0.0841    11.88    3.225   -7.833      0.0;
 150    20.95    0.552    32.14   0.0513    19.49     5.18   -16.37      0.0;
 172    20.86    0.553     40.2   0.0332    30.13    7.895   -32.37      0.0; acute zone,
 175    20.84    0.554    41.43   0.0313    31.97    8.363   -35.77      0.0;
 200    20.37    0.565    53.18   0.0191    52.45     13.4   -93.04      0.0;
 225    19.88    0.577    67.88   0.0116    86.05    21.67   -142.6      0.0;
 250    19.52    0.586    86.46  0.00708    141.2     35.4   -186.8      0.0;
 275    19.19    0.594    110.1  0.00431    231.6    58.02   -237.7      0.0;
 284    19.08    0.596    120.1  0.00361    276.8    69.35   -259.0      0.0; merging,
 300    18.83    0.602    146.0  0.00263    380.0    104.9   -313.3      0.0;
 303    18.77    0.603    152.4  0.00248    403.2    114.2   -326.0      0.0; chronic zone,
 325    18.32    0.614    216.3   0.0016    623.4    238.8   -440.4      0.0;
 350    17.71    0.629    336.5 0.000977   1022.8    450.3   -623.3      0.0;
 362    17.38    0.637    419.1  0.00077   1297.1    570.0   -736.0      0.0; surface,
Outside chronic zone
 ;
3:41:55 PM. amb fills: 4
```

start | 2 Micros... | Plumes | Camas | 8-30-06 K... | Camas2.xls | Microsoft ... | 4:17 PM

# PART III:
# DILUTION MODELING AND WATER QUALITY COMPLIANCE FOR FACILITY PLANNING

# PART III:
# DILUTION MODELING AND WATER QUALITY COMPLIANCE FOR FACILITY PLANNING

The purpose of this section of the Mixing Zone Study is to establish outfall modifications and mixing zone dilution factors for projected future Camas WWTP flow rates and diffuser options. The mixing zone modeling will be based on the UM3 model calibrated as described in the previous sections of this report. This section will also evaluate reasonable potential to exceed water quality standards, and establish projected effluent limitations for future planning alternatives.

## EFFLUENT FLOW RATES

Gray & Osborne provided the effluent flow design criteria for facility planning presented in Table III-1.

**Table III-1 Effluent Flow Design Criteria for Facility Planning**

| | Winter Flow Criteria | | Summer Flow Criteria | |
|---|---|---|---|---|
| | Max. Month (mgd) | Max. Day (mgd) | Max. Month (mgd) | Max. Day (mgd) |
| 2007 | 3.09 | 7.03 | 2.07 | 3.34 |
| 2025 | 6.10 | 10.04 | 5.09 | 6.36 |

## RECOMMENDED DIFFUSER MODIFICATION

The existing outfall includes a diffuser consisting of eight 6-inch diameter ports discharging horizontally in the same direction as ambient currents. This co-flowing configuration reduces the hydrodynamic mixing potential. Dilution factors would be improved by reorienting the diffuser outlets to a vertical discharge configuration. It is our strong recommendation to proceed with this minor modification to the existing diffuser, and we understand that Gray & Osborne has already proceeded with the permit applications to complete this work.

The new diffuser will consist of eight ports oriented to discharge vertically. Each port will be fitted with a 6-inch Tideflex elastomeric check valve. In addition to aiding in prevention of debris accumulation, the valves will enhance diffuser velocities over the range of operating flow rates. A copy of the performance data for the selected valves is provided in Figure III-1.

# TIDEFLEX DIFFUSER (TFD) SYSTEM DATA ANALYSIS

| | | | |
|---|---|---|---|
| **MEDIA:** | | Effluent | |
| | Density or Spec. Gravity | | lb/ft^3 |
| | | 1 | |

**FLOW RANGE:**

| | | | | |
|---|---|---|---|---|
| 1.3 | MGD | = | 903 | gpm |
| 5.6 | MGD | = | 3889 | gpm |
| 7.2 | MGD | = | 5000 | gpm |

| | | | |
|---|---|---|---|
| **AVAILABLE HEADLOSS@ DIFFUSER:** | Minimum | | feet |
| | Design | | feet |
| | Maximum | | feet |

**MAX. BACKPRESSURE:** _____ feet

| * DIFFUSER SIZE (IN) | CATALOG * NUMBER |
|---|---|
| **6** | **206** |

| | |
|---|---|
| DATE: | 14-Nov-2005 |
| CUSTOMER: | City of Camas, WA |
| CONTACT: | Monte Brachmann |
| ENGINEER: | Gray & Osborne, Inc. |
| CONTACT: | Jay Swift, P.E. |
| PROJECT: | City of Camas, WA - WWTP Outfall |
| REP: | Antec Corporation |
| CONTACT: | Matthew Davidson |

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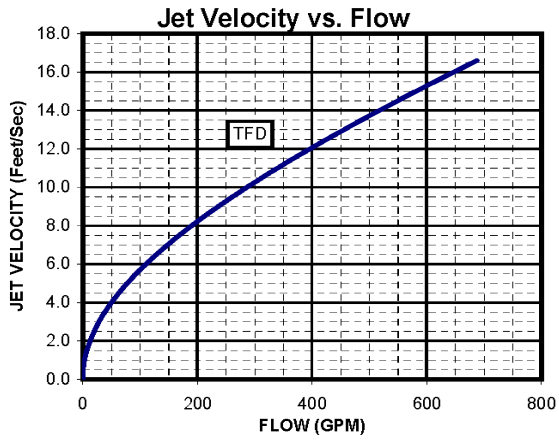
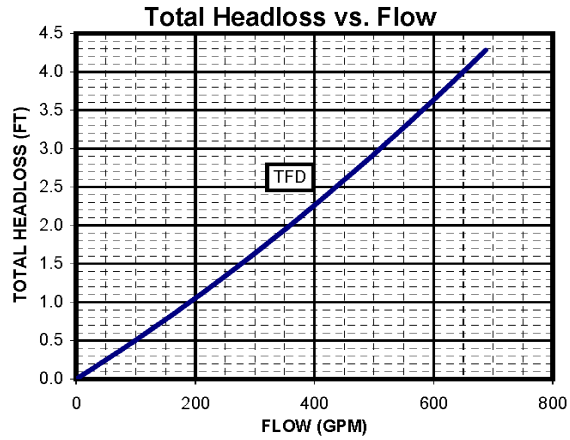
| | | *PER TIDEFLEX DIFFUSER* | | | |
|---|---|---|---|---|---|
| *** TOTAL QUANTITY** | TOTAL FLOW (gpm) | FLOW (gpm) | **JET VELOCITY (fps)** | **TOTAL HEADLOSS @ DIFFUSER (feet)** | EFFECTIVE DIAMETER (in) |
| 8 | 903 | 112.85 | 6.07 | 0.57 | 2.75 |
| | 3889 | 486.11 | 13.50 | 2.83 | 3.83 |
| | 5000 | 625.00 | 15.66 | 3.81 | 4.04 |




TIDEFLEX TECHNOLOGIES, INC. 300 BILMAR DRIVE, PITTSBURGH, PA 15205 (412) 919-0919 phone (412) 919-0918 fax

**Figure III-1. Tideflex Diffuser System Data Analysis**

The port velocities corresponding to a range of operating conditions is presented in Table III-2.

**Table III-2 Diffuser Port Velocities for Tideflex Diffuser Valves**

| Design Year | Season | Max Flow Period | Effluent Flow (mgd) | Flow per Port (gpm) | Discharge Velocity (fps) | Port Area (sq. in.) | Port Dia. (in.) |
|---|---|---|---|---|---|---|---|
| 2007 | Winter | 30-day | 3.09 | 268 | 9.8 | 8.8 | 3.34 |
| 2007 | Winter | 24-hr | 7.03 | 610 | 15.5 | 12.6 | 4.01 |
| 2007 | Summer | 30-day | 2.07 | 180 | 7.8 | 7.4 | 3.07 |
| 2007 | Summer | 24-hr | 3.34 | 290 | 10.1 | 9.2 | 3.42 |
| 2025 | Winter | 30-day | 6.1 | 529 | 14.1 | 12.0 | 3.92 |
| 2025 | Winter | 24-hr | 10.04 | 871 | 19.5 | 14.3 | 4.27 |
| 2025 | Summer | 30-day | 5.09 | 442 | 12.7 | 11.2 | 3.77 |
| 2025 | Summer | 24-hr | 6.36 | 552 | 14.7 | 12.0 | 3.92 |

## DILUTION MODELING

### UM3 Model Calibration Parameter

The UM3 model was calibrated to a range of aspiration entrainment coefficients (AEC). The default AEC of 0.1 is rejected because it fits none of the observed data. Best fit to the October tracer study data was an AEC of 0.6 to 0.8. The February dye study found that even higher values for the AEC above 1.0 matched that data. However, the October current data and plume coverage were better than in February, and the observed AEC is more protective. To be protective, a very conservative AEC = 0.4 will be used for future modeling.

AEC = 0.4 is valid for any diffuser port orientation. A tracer study was conducted for the City of Washougal WWTP outfall in October 2006, which was very similar to the tracer studies conducted for the City of Camas. The Washougal outfall has six ports oriented at a vertical angle of 45 degrees. The results of that model produced an AEC = 0.45 (Cosmopolitan Engineering, *City of Washougal Outfall Mixing Zone Study*, prepared for the City of Washougal and Wallis Engineering, January 2007). This value is consistent with the Camas results, and confirms the selection of AEC = 0.4 as a conservative selection for this project.

### Peak-to-Mean Ratio

The ratio of flux-average to centerline concentration (also known as peak-to-mean ratio) has been a topic of debated amongst researchers recently. The UM3 model calculates the flux-averaged dilution based on ambient conditions and empirical plume and jet equations.

Centerline dilution is then calculated using algorithms embedded in UM3 that have been demonstrated to be inaccurate.

The acute dilution factor in the current NPDES permit (Run NC24) is based on a peak-to-mean ratio of 3.6. However, the field data from the Camas dye studies and data from other researchers indicates the peak-to-mean ratio should be on the order of 2.0 to 2.3. Several supporting papers provided by Walter Frick of EPA, developer of the UM3 model, are provided in Attachment III-1. The Washougal study revealed a peak-to-mean ratio of 2.37. A peak-to-mean ratio of 2.3 will be used for all future UM3 model runs for the Camas outfall.

**Model Results**

A series of UM3 model runs from the Visual Plumes interface, with the Brooks farfield algorithm, are provided in Attachment III-2. The basis of the model runs and the results are described below:

2007 Effluent Flows

| | |
|---|---|
| E-1 | This chronic model run is for near-flood ambient conditions modeled by Ecology in the NPDES permit, the 90$^{th}$ percentile river discharge of 522 kcfs. This run is equivalent to Ecology run NC22B except for the maximum month effluent flow rate for 2007. |
| E-2 | This acute model run is for the same near-flood ambient conditions modeled by Ecology, equivalent to Ecology run NC24 except the maximum day effluent flow rate for 2007. |
| E-3 | This chronic model run corresponds to 2007 winter maximum month flow rate and winter effluent temperature. Ambient current speed is tidally-averaged current profile during the low river flow condition. |
| E-4 | This acute model run corresponds to 2007 maximum day winter flow rate and winter effluent temperature. Ambient current speed is the one-hour minimum velocity profile from the current meter deployment, which is caused by the tidal influence that occurs during low to normal Columbia River flows. |
| E-5 | This chronic model run corresponds to 2007 summer maximum month flow rate and summer effluent temperature. Ambient current speed is tidally-averaged current profile during the low river flow condition (same as E-3). |
| E-6 | This acute model run corresponds to 2007 maximum day summer flow rate and summer effluent temperature. Ambient current speed is the one-hour minimum velocity profile from the current meter deployment (same as E-4). |

2025 Effluent Flows

Model Runs F-1 through F-6 are the same as E-1 through E-6, except using 2025 effluent flow rates rather than 2007.

The results of the modeling are presented in Table III-3 for 2007 effluent flows, and Table III-4 for 2025 flows. The results demonstrate that critical conditions occur during winter flows at the WWTP. The critical condition for acute dilution occurs during the brief tidally-influenced slowdowns that occur near high tide during low river flow conditions.

## REASONABLE POTENTIAL ASSESSMENT

EPA and Ecology use a statistical test to determine a discharge's "reasonable potential" to exceed water quality standards, which is based on effluent and ambient data and acute and chronic dilution factors. If a discharge exhibits a reasonable potential to exceed water quality standards for any parameter, Ecology issues an effluent limitation for that parameter in the NPDES permit. If a parameter does not exhibit a reasonable potential to exceed water quality standards, no NPDES permit limit is required.

## EFFLUENT DATA

Water quality-based effluent limits will be assessed for ammonia and selected metals (cadmium, copper, lead, nickel, silver, zinc and mercury). The critical effluent concentrations used in determination of reasonable potential are based on eight effluent metals scans in 2005 and 2006, and over 400 effluent ammonia samples in 2005 and 2006.

The metals data are provided in Table III-5. The values in red are detected concentrations, and the values in black are the detection levels for non-detected results. High concentrations of cadmium and nickel were measured on June 2, 2006. These values may be anomalous, or if realistic should be evaluated in future sampling efforts.

## Table III-3 Dilution Model Results for 2007 Effluent Flows

| Model Run # | Ambient Condition | Discharge Depth (ft) | Avg Current Speed (m/sec) | Ambient Temp (°C) | Effluent Flow (mgd) | Effluent Temp (°C) | Acute Dilution | Chronic Dilution |
|---|---|---|---|---|---|---|---|---|
| E-1 | (1)Winter High Flow | 26.6 | 1.0 | 12.6 | 3.09 | 16.0 | | 206 |
| E-2 | (1)Winter High Flow | 26.6 | 1.0 | 12.6 | 7.03 | 16.0 | 40 | |
| E-3 | (2)Winter Average | 21.0 | 0.7 | 12.6 | 3.09 | 16.0 | | 257 |
| E-4 | (3)Winter 10% | 21.0 | 0.25 | 12.6 | 7.03 | 16.0 | 35 | |
| E-5 | (2)Summer Average | 21.0 | 0.7 | 21.5 | 2.07 | 22.0 | | 271 |
| E-6 | (3)Summer 10% | 21.0 | 0.25 | 21.5 | 3.34 | 22.0 | 61 | |

(1) Ambient conditions for 522 kcfs river flow (90th percentile) per Ecology NPDES permit (runs NC22 and NC24)
(2) Ambient condition for non-flood river flow based on tidally-averaged current profile from October 2004 current meter deployment.
(3) Ambient condition for acute model runs based on lowest tidally-influenced current profile (duration = 1 hr±) from October 2004 current meter deployment.

## Table III-4 Dilution Model Results for 2025 Effluent Flows

| Model Run # | Ambient Condition | Discharge Depth (ft) | Avg Current Speed (m/sec) | Ambient Temp (°C) | Effluent Flow (mgd) | Effluent Temp (°C) | Acute Dilution | Chronic Dilution |
|---|---|---|---|---|---|---|---|---|
| F-1 | (1)Winter High Flow | 26.6 | 1.0 | 12.6 | 6.10 | 16.0 | | 182 |
| F-2 | (1)Winter High Flow | 26.6 | 1.0 | 12.6 | 10.04 | 16.0 | 41 | |
| F-3 | (2)Winter Average | 21.0 | 0.7 | 12.6 | 6.10 | 16.0 | | 140 |
| F-4 | (3)Winter 10% | 21.0 | 0.25 | 12.6 | 10.04 | 16.0 | 24 | |
| F-5 | (2)Summer Average | 21.0 | 0.7 | 21.5 | 5.09 | 22.0 | | 172 |
| F-6 | (3)Summer 10% | 21.0 | 0.25 | 21.5 | 6.36 | 22.0 | 48 | |

(1) Ambient conditions for 522 kcfs river flow (90th percentile) per Ecology NPDES permit (runs NC22 and NC24)
(2) Ambient condition for non-flood river flow based on tidally-averaged current profile from October 2004 current meter deployment.
(3) Ambient condition for acute model runs based on lowest tidally-influenced current profile (duration = 1 hr±) from October 2004 current meter deployment.

**Table III-5 Camas Effluent Metals Data (µg/L)**

| Date | Cd | Cu | Pb | Ni | Ag | An | Hg |
|---|---|---|---|---|---|---|---|
| 5/13/2005 | 3 | 8 | 5 | 20 | 10 | 18 | 0.056 |
| 7/21/2005 | 10 | 31 | 5 | 20 | 10 | 19 | 0.050 |
| 9/30/2005 | 3 | 5 | 5 | 20 | 10 | 16 | 0.056 |
| 12/7/2005 | 3 | 5 | 5 | 20 | 10 | 15 | 0.050 |
| 3/31/2006 | 3 | 5 | 5 | 20 | 10 | 25 | 0.070 |
| 6/2/2006 | 87 | 12 | 5 | 373 | 70 | 20 | 0.050 |
| 9/12/2006 | 3 | 7 | 5 | 20 | 10 | 31 | |
| 12/18/2006 | 3 | 5 | 5 | 29 | 10 | 30 | 0.050 |
| Count | 8 | 8 | 8 | 8 | 8 | 8 | 7 |
| # Detects | 2 | 4 | 0 | 2 | 0 | 8 | 2 |

Detected Values in Red Detection Limit in Black

## AMBIENT DATA AND WATER QUALITY STANDARDS

No ambient sampling has been conducted in this mixing zone study for ammonia or metals or the parameters that affect their water quality standards (pH, temperature, and hardness). The criteria for ambient concentrations, and ambient-depended water quality criteria, are the same as Ecology cited in Appendix C of the NPDES permit.

## REASONABLE POTENTIAL RESULTS

The reasonable potential to exceed water quality standards for ammonia and metals is presented in Table III-6 for the recommended diffuser modifications. Ammonia only is considered seasonally due to its dependence on ambient pH and temperature. Only cadmium has a reasonable potential to exceed water quality standards, winter and summer. This result suggests that additional effluent monitoring for cadmium should be conducted, as well as potential source control investigations. However, this finding is based on only two detected values, and thus should be sampled more frequently in the future to determine if the reasonable potential is realistic. The ambient concentration used in the analysis is also relatively high, and may need to be assessed in a sampling program.

If the diffuser is modified to a vertical port orientation using Tideflex valves, there is no reasonable potential to exceed ammonia water quality standards in summer or winter, both in 2007 or 2025. Therefore, water quality-based ammonia limits should be deleted from current and future NPDES permits.

## Table III-6 Reasonable Potential Calculation Table

| | | | | State Water Quality Standard | | Max concentration at edge of... | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Parameter | Metal Criteria Translator as decimal Acute | Metal Criteria Translator as decimal Chronic | Ambient Concentration (metals as dissolved) ug/L | Acute ug/L | Chronic ug/L | Acute Mixing Zone ug/L | Chronic Mixing Zone ug/L | LIMIT REQ'D? | Max effluent conc. measured (metals as total recoverable) ug/L | # of samples n | Multiplier | Acute Dil'n Factor | Chronic Dil'n Factor |
| **MODIFIED DIFFUSER (VERTICAL DISCHARGE)** | | | | | | | | | | | | | |
| **2007** | | | | | | | | | | | | | |
| Ammonia-N (summer) | 1.00 | 1.00 | 27 | 5100 | 830 | 431 | 118 | NO | 35200 | 268 | 0.70 | 61 | 271 |
| Ammonia-N (winter) | 1.00 | 1.00 | 19 | 2100 | 470 | 723 | 139 | NO | 35200 | 268 | 0.70 | 35 | 206 |
| Cadmium | 0.940 | 0.940 | 0.53 | 1.70 | 0.61 | 4.95 | 1.28 | YES | 87.00 | 8 | 1.90 | 35 | 206 |
| Copper | 1.000 | 1.000 | 0.86 | 8.65 | 6.14 | 2.52 | 1.14 | NO | 31.00 | 8 | 1.90 | 35 | 206 |
| Lead | 0.470 | 0.470 | 0.06 | 29.3 | 1.14 | 0.19 | 0.08 | NO | 5.0 | 8 | 1.90 | 35 | 206 |
| Nickel | 1.000 | 1.000 | 0.56 | 770.7 | 85.60 | 20.77 | 3.99 | NO | 373.00 | 8 | 1.90 | 35 | 206 |
| Silver | 0.850 | 0.850 | 0.10 | 1.00 | 100.00 | 0.56 | 0.18 | NO | 10.00 | 8 | 1.90 | 35 | 206 |
| Zinc | 1.000 | 1.000 | 2.00 | 62.3 | 56.9 | 3.62 | 2.28 | NO | 31.000 | 8 | 1.90 | 35 | 206 |
| Mercury | 1.000 | 1.000 | | 2.1 | 0.012 | 0.004 | 0.001 | NO | 0.070 | 8 | 1.90 | 35 | 206 |
| **2025** | | | | | | | | | | | | | |
| Ammonia-N (summer) | 1.00 | 1.00 | 27 | 5100 | 830 | 540 | 170 | NO | 35200 | 268 | 0.70 | 48 | 172 |
| Ammonia-N (winter) | 1.00 | 1.00 | 19 | 2100 | 470 | 1046 | 195 | NO | 35200 | 268 | 0.70 | 24 | 140 |
| Cadmium | 0.940 | 0.940 | 0.53 | 1.70 | 0.61 | 6.98 | 1.64 | YES | 87.00 | 8 | 1.90 | 24 | 140 |
| Copper | 1.000 | 1.000 | 0.86 | 8.65 | 6.14 | 3.28 | 1.27 | NO | 31.00 | 8 | 1.90 | 24 | 140 |
| Lead | 0.470 | 0.470 | 0.06 | 29.3 | 1.14 | 0.24 | 0.09 | NO | 5.0 | 8 | 1.90 | 24 | 140 |
| Nickel | 1.000 | 1.000 | 0.56 | 770.7 | 85.60 | 30.04 | 5.61 | NO | 373.00 | 8 | 1.90 | 24 | 140 |
| Silver | 0.850 | 0.850 | 0.10 | 1.00 | 100.00 | 0.77 | 0.21 | NO | 10.00 | 8 | 1.90 | 24 | 140 |
| Zinc | 1.000 | 1.000 | 2.00 | 62.3 | 56.9 | 4.37 | 2.41 | NO | 31.000 | 8 | 1.90 | 24 | 140 |
| Mercury | 1.000 | 1.000 | | 2.1 | 0.012 | 0.006 | 0.001 | NO | 0.070 | 8 | 1.90 | 24 | 140 |

# ATTACHMENT III-1:
# EPA PAPERS REGARDING PEAK-TO-MEAN RATIO

**Peak-to-mean relationships for round and line plumes assuming a Gaussian Profile**

D R A F T

15 November 2001

Walter E. Frick, Don J. Baumgartner, ....

## Introduction

Plume models, such as those used in Visual Plumes (Frick et al., 2001), variously predict average and centerline dilutions and concentrations. Also, environmental concerns and user sophistication lead to increased need to define the spatial properties of plumes. Finally, investigations, such as those conducted by Roberts and Tian (2001), cast doubt on the veracity of the three-halves power profile (Kannberg and Davis, 1976) used in UM3 and other models. In particular, the high peak-to-mean concentrations ratios (up to 3.89) in some ambient and plume regimes are in apparent disagreement with laser-induced fluorescence and other experiments. This work revisits the Gaussian profile and develops its peak-to-mean relationships for round and line plumes.

Mathematica software is used to derive peak-to-mean relationships for round and line plumes. The assumptions used are given in Exhibit 1, as well as notes on other issues impinging on the problem.

It is recommended that the peak-to-mean relationships developed herein be used in lieu of the built-in routines used in Visual Plumes to establish centerline properties based on average properties predicted by UM3. As soon as feasible Visual Plumes will be modified to output centerline values based on an assumed Gaussian profile. At this point the recommendations do not extend to UDKHW and NRFIELD as these models are based on independent theory not affected by these considerations.

This modification is considered to be an interim measure. In the long term, it is recommended that further experimental work be conducted to better establish peak-to-mean relationships. The rapid improvement of modern technology, for example, exploiting LIF visualization and processing technology promises to better define these relationships for the main theoretical approaches, such as the Lagrangian and integral flux modeling approaches.

```
(* Round and line plumes
  Definitions:
   sig is the dimensionless radius (or width)
    chi is the concentration at sig (divided by the
       centerline concentration, i.e., =1 at sig=0
      v is the plume velocity at
          sig (similarly =1 at the centerline)
      ca is the ambient concentration (in the plots
            ranging from 0.001 to 2 times centerline
      va is the ambient velocity (in the plots
            ranging from 0.001 to 1 times centerline
      E is the Napierien base value
      Erf is the error function
      p2m is an abbreviation for peak-to-mean ratio
  Notes:
   Definition of radius and
            width consistent with Fan (1976),
     plume radius = √2
     In principle, va can also be greater than
      internal plume velocities (use formulas)
     UM3 should not be fluxed averaged,
     use solutions for avgchi and lineavg
     The UM3 interpretation
      is probably compatible with LIF results
      (unless the latter are mathematically
        manipulated to correspond to flux averages)
     For fully merged line plumes, the same phi
      is assumed (should be investigated further)
     Formulas do not account
      for vertical variations in ambient values
     Other similar limitations apply
      (for example,the effect of angular difference
        ambient and plume velocities is not conside
*)
```

Exhibit 1. Notes from Mathematica file Gaussian.nb. Assumptions used in deriving the subsequent relationships.

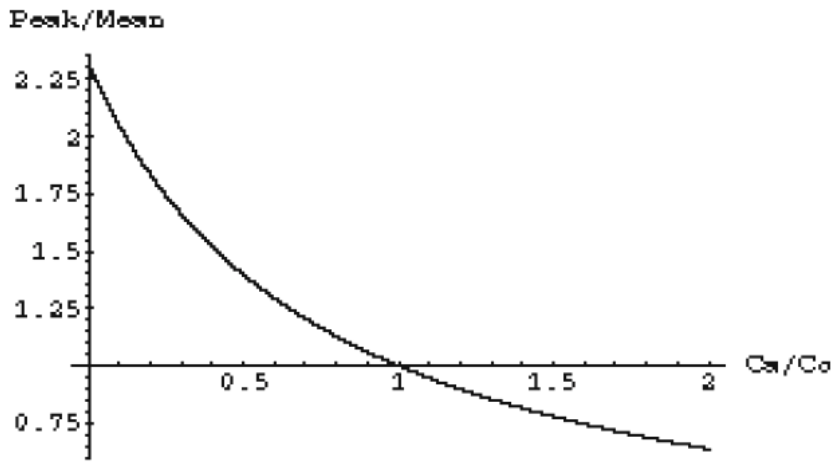



Figure 1. Round plume peak-to-mean ratio as a function of the ratio of the local ambient to centerline plume concentrations. (Inverse of Eqn. 4.)

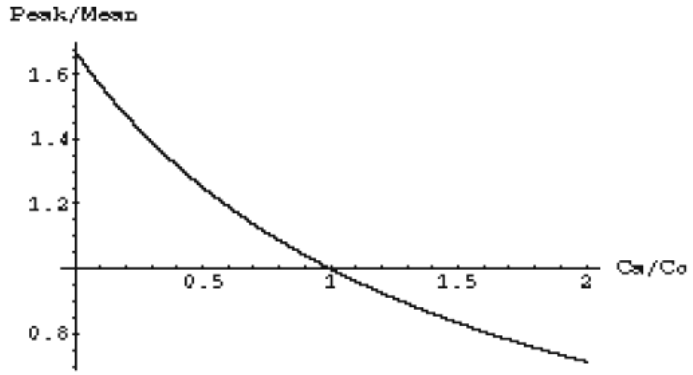



Figure 2. Line plume peak-to-mean ratio as a function of the ratio of the local ambient to

centerline plume concentrations. (Inverse of Eqn. 9.)

**Equations**

$$\Phi = \exp\left(-\sigma^2\right) \tag{1}$$

$$\chi = \left(1 - C_a\right)\Phi + C_a \tag{2}$$

Round-plume average concentration

$$\overline{\chi} = \frac{\int_0^{\sqrt{2}} \chi 2\pi\sigma d\sigma}{\int_0^{\sqrt{2}} 2\pi\sigma d\sigma} \tag{3}$$

$$\overline{\chi} = \frac{1 + C_a}{2} + \frac{C_a - 1}{2e^2} \tag{4}$$

For the corresponding flux average

$$v = \left(1 - v_a\right)\Phi + v_a \tag{5}$$

$$\overline{\chi}_{flux} = \frac{\int_0^{\sqrt{2}} v\chi 2\pi\sigma d\sigma}{\int_0^{\sqrt{2}} v 2\pi\sigma d\sigma} \tag{6}$$

$$\overline{\chi}_{flux} = \frac{-\frac{\left(-1 + C_a\right)\pi\left(-1 + v_a\right)}{2e^4} + 2C_a\pi v_a + \frac{\pi\left(-v_a + C_a\left(-1 + 2v_a\right)\right)}{e^2} - \frac{\pi}{2}\left(-1 - v_a + C_a\left(-1 + 3v_a\right)\right)}{-\pi\left(-1 + v_a\right) + \frac{\pi\left(-1 + v_a\right)}{e^2} + 2\pi v_a} \tag{7}$$

For line plumes the corresponding equations are

$$\overline{\chi}_{line} = \frac{\int_0^{\sqrt{2}} \chi d\sigma}{\int_0^{\sqrt{2}} d\sigma} \tag{8}$$

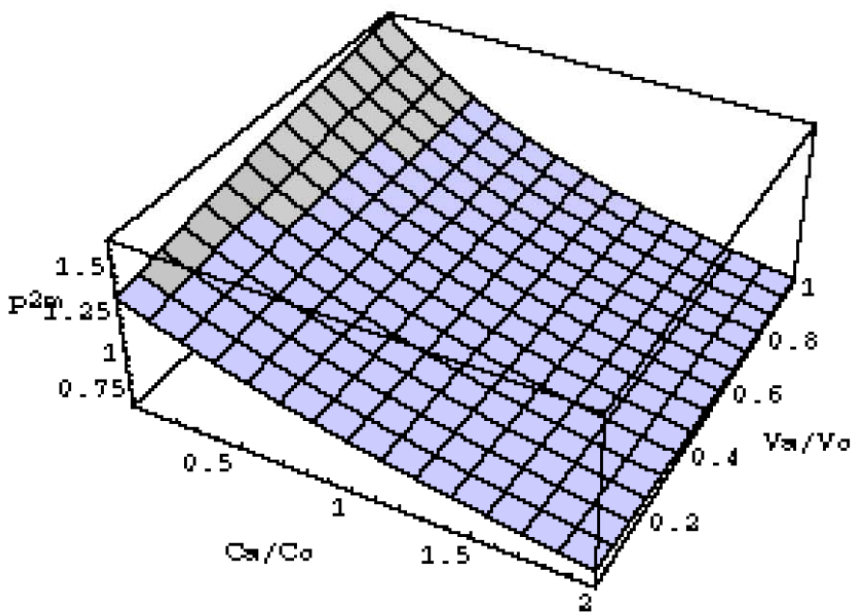
$$\overline{\chi}_{line} = \frac{\sqrt{2}C_a - \frac{\sqrt{\pi}}{2}(C_a - 1)erf\sqrt{2}}{\sqrt{2}} \tag{9}$$

The value of the error function of the square root of two is 0.9545.

$$\overline{\chi}_{line(flux)} = \frac{4\sqrt{2}C_a v_a + (C_a - 1)\sqrt{2\pi}(v_a - 1)erf(2) - 2\sqrt{\pi}\left(-v_a + C_a(2v_a - 1)\right)erf\sqrt{2}}{4\left(\sqrt{2}v_a - \frac{\sqrt{\pi}}{2}(v_a - 1)erf\sqrt{2}\right)} \tag{10}$$

Corresponding plots of the peak-to-mean flux values are given in Figures 3 and 4.

Figure 3. Round plume flux averaged peak-to-mean ratio as functions of the ratio of the local ambient to centerline plume concentrations and the ratio of the local ambient to centerline velocities. (Inverse of Eqn. 7.)



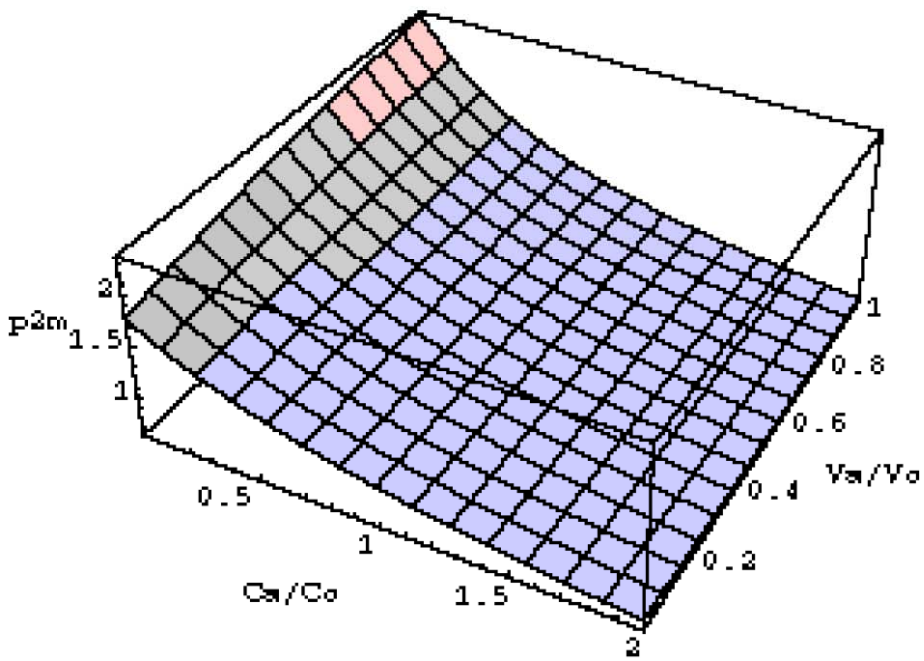



Figure 4. Line plume flux averaged peak-to-mean ratio as functions of the ratio of the local ambient to centerline plume concentrations and the ratio of the local ambient to centerline velocities. (Inverse of Eqn. 10.)

**References**

Fan, L.N., 1967. Turbulent buoyant jets into stratified or flowing ambient fluids. Report No. KH-R-15, W.M. Keck Lab. of Hydraulics and Water Resources, Cal Tech, Pasadena, CA

Frick, W.E., P.J.W. Roberts, L.R. Davis, J. Keyes, D.J. Baumgartner, and K.P. George, 2001. Dilution models for effluent discharges, 4th Edition (Visual Plumes). USEPA, Athens, Georgia (draft). (Visual Plumes model software. U.S. EPA, ORD, CEAM web page release 13 Sep 2001)

Kannberg, L.D. and L.R. Davis, 1976. An experimental/analytical investigation of deep submerged multiple buoyant jets. ERL, Corvallis, OR. EPA-600/3-76-101, Sep. 1976

Roberts, P.J.W. and X. Tian, 2001. New experimental techniques for validation of marine discharge models. Proceedings of the Fifth International Marine Environmental Modelling Seminar. IMEMS-2001, Sintef Applied Chemistry. New Orleans, LA, USA, 9-11 October 2001

## The 3/2 power profile

Users of plume models are frequently interested in estimates of concentrations at the center of or along the centerline plumes. If the model predicts average properties, as the Visual Plumes UM3 model does, profiles, such as the Gaussian distribution, are used to estimate the relationship between these properties. The ratio of the centerline and average plume element concentrations is sometimes called the peak-to-mean ratio.

The three-half power profile found in Kannberg and Davis (19??) can be expressed in terms of the relative radius, $f$,

$$f = r / b \tag{1}$$

where $b$ is the radius of the plume. The three-half power profile is

$$g(f) = \left(1 - f^{3/2}\right)^2 \tag{2}$$

and approximates the Gaussian distribution. The simple mean of this distribution given a circular cross-section is 0.257 of centerline value, thus, the peak-to-mean ratio, $k$, is 3.89.

## Water carrier mass dilution

If ambient water can serve as a marker then the three-half power profile implies a corresponding distribution of dilution across the plume cross-section. The definition of average dilution of the plume element, $S_{avg}$, may be expressed in terms of the mass of ambient water, $M$, mixed with the mass of the material plume element, $m$,

$$S_{avg} = \frac{M + m}{m} \tag{3}$$

This relationship may be generalized to represent the point-wise dilution, $S(f)$. Allowing $dM$ and $dm$ to represent their respective along $f$, and, letting $C_a$ and $C_e$ represent the local ambient and effluent concentrations of a tracer

$$C(dM + dm) = dMC_a + dmC_e$$

$$C = \frac{dMC_a}{dM + dm} + \frac{dmC_e}{dM + dm} = \frac{dM}{dm}\frac{C_a}{S} + \frac{C_e}{S} = \frac{dM}{dm}\frac{C_a}{S} + \frac{dm}{dm}\frac{C_a}{S} - \frac{dm}{dm}\frac{C_a}{S} + \frac{C_e}{S} \tag{4}$$

$$C = C_a - \frac{C_a}{S} + \frac{C_e}{S}$$

But

$$S = \frac{S_{avg}}{kg(f)} \tag{5}$$

Finally,

$$C = C_a - \frac{C_a kg(f)}{S_{avg}} + \frac{C_e kg(f)}{S_{avg}} \tag{6}$$

Although $C_a$ is assumed to be uniformly constant, in fact it will in general vary with depth,

making the plume distribution approximate.

**Flux-averaged concentrations**

Measurements of plumes leading to the distribution given by Eqn. 2 generally appear to represent flux measurements. Given that the longitudinal velocity distribution in the plume shares the same profile, the material element the appropriate distribution of properties may be better given by

$$g(f) = 1 - f^{3/2} \tag{7}$$

The corresponding $k$ for this distribution is only 2.33.

Still simpler and giving $k$ values similar to reported values is the distribution

$$g(f) = 1 - f^{2} \tag{8}$$

where $k = 2.0$. For a line source $k = 1.5$.

**Significance of distributions on models such as the Visual Plumes UM3 model**

The primary predictions of the Visual Plume UM3 model are not affected by the adopted profile. This is due to the fact that UM3, as pointed out above, predicts average dilutions. Centerline dilutions are estimated by superimposing a profile of properties. The results obtained using the 3/2 power profile have been consistently criticized to result in centerline concentrations that are too conservative. This observation agrees with the finding that the zone of established flow is associated with an average dilution of approximately 2:1, more consistent with the distribution given by Eqns. 7 and 8 than by Eqn. 2. In this work Visual Plumes UM3 is modified for the distribution given by Eqn. 8. Thus, earlier versions are considerably more conservative with respect to the prediction of the centerline concentration.

Using Eqns. 6 and 8 and solving for $f$ yields

$$f = \sqrt{1 - \frac{S_{avg}(C - C_a)}{k(C_e - C_a)}} \tag{9}$$

**Effective dilution**

The average mass dilution described by Eqn. 3 only describes the concentration of a pollutant in a plume when the ambient pollutant concentration is zero. At other times it gives a non-conservative estimate of concentrations. Similar statements are true for the centerline and points throughout the plume. A good estimate of actual dilution of pollutants is given by the effective dilution, defined as the ratio of effluent concentration to subsequent plume concentration at any point. The effective dilution, *Seff*, is

$$S_{eff} = \frac{C_e}{C} \tag{10}$$

Visual Plumes allows both $S$ and *Seff* to be reported. The former is most useful for understanding

plume dynamics and whenever the ambient concentration is zero. The latter is recommended whenever the the primary concern is pollutant concentration and the ambient concentration is not zero.

**The Implications of Concentration Profiles**

From Kannberg and Davis (1976) the three-halves power profile may be expressed

$$\Phi = \left(1 - \left(\frac{r}{b}\right)^{\frac{3}{2}}\right)^2 \tag{1}$$

where $r$ is the distance from the centerline of the plume and $b$ is the radius of the plume, assumed for the moment to be round.

Similarly, the Gaussian profile may be expressed

$$\Phi_{Gaussian} = \exp\left(-\left(\frac{r}{b_1}\right)^2\right) \tag{2}$$

where

$$b = 1.888 b_1 \tag{3}$$

Thus, assuming momentarily a Gaussian profile, the ratio of the concentration at $b$ to the centerline concentration is

$$\Phi_{Gaussian} = \exp\left(-(1.888)^2\right) = 0.02831 = 2.831\% \tag{4}$$

The relationship between the two profiles is shown in Figure 1.

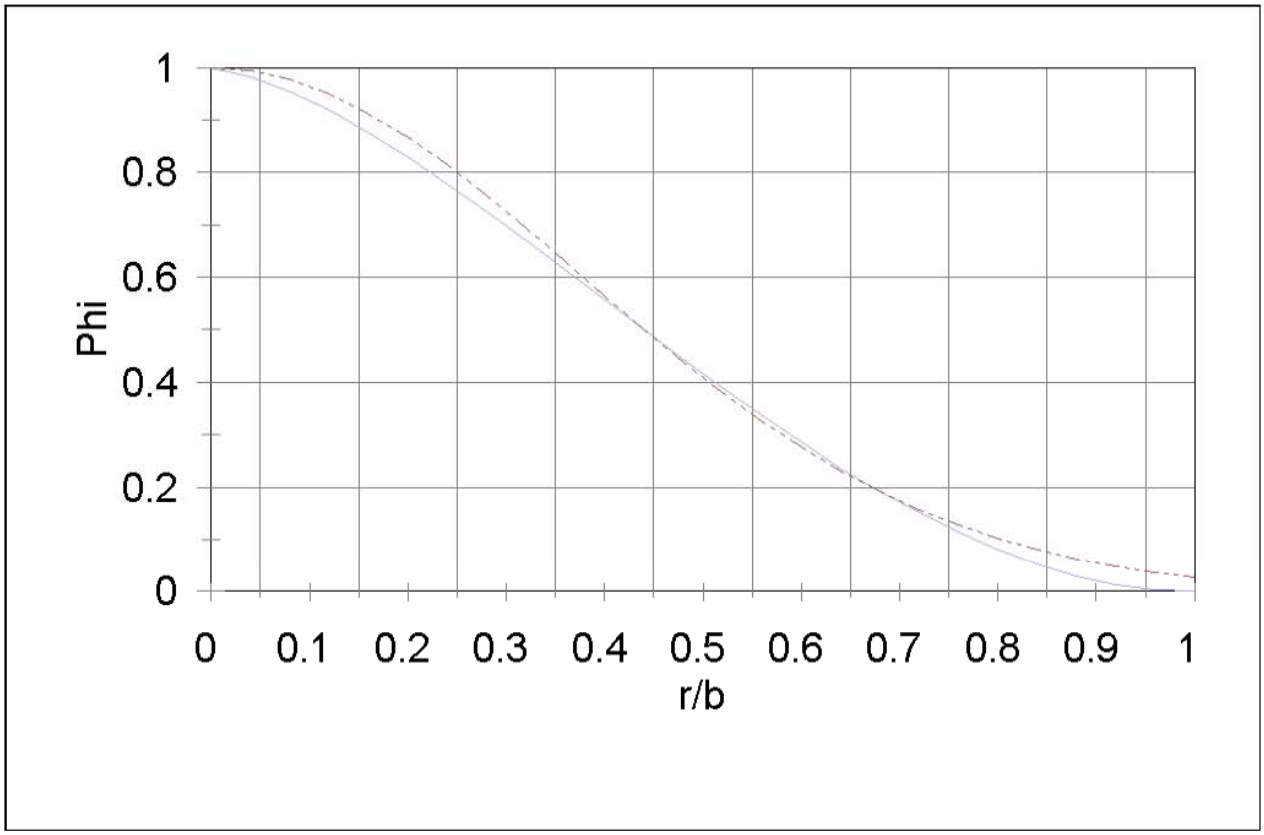



**Figure 1** Comparison of Gaussian (broken) and 3/2 power profiles (solid).

Flux averaging ignored, the peak-to-mean ratios of these profiles is 3.67 and 3.89 for the Gaussian and three-halves power profiles respectively (corresponding to averages of 0.273 and 0.257).

**Flux Averages**

There are at least two common plume model types, Eulerian integral flux and Lagrangian models. While mathematically totally different, the dynamical equivalence of the two approaches has been demonstrated (e.g., Frick, Baumgartner, and Fox, 1994). It is fair to ask whether this equivalence extends to concentration profiles.

Flux averaging considers the fact that more material fluxes through the central portions of the plume cross-section than through comparable areas near the edges of the plume. The flux-averaged concentration may be defined

$$c_{avg} = \frac{\iint cv\,dx\,dy}{\iint v\,dx\,dy} \tag{5}$$

where $c_{avg}$ and $c$ are the average and point concentrations respectively, $v$ is the velocity at any

point in the cross-section, and $dx$ and $dy$ are the cross-sectional differentials whose product defines the differential area.

# ATTACHMENT III-2:
# UM3 MODEL RUNS FOR 2007 AND 2025 DESIGN FLOWS

E-1

/ Windows UM3. 6/21/2007 6:02:01 PM
Case 1; ambient file C:\Plumes\Camascritical.001.db; Diffuser table record 1: ----------

| Depth m | Amb-cur m/s | Amb-dir deg | Amb-sal psu | Amb-tem C | Amb-pol kg/kg | Decay s-1 | Far-spd m/s | Far-dir deg | Disprsn m0.67/s2 |
|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 1.03 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.03 | 180.0 | 0.0003 |
| 1.0 | 1.09 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.09 | 180.0 | 0.0003 |
| 2.0 | 1.09 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.09 | 180.0 | 0.0003 |
| 3.0 | 1.07 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.07 | 180.0 | 0.0003 |
| 4.0 | 1.06 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.06 | 180.0 | 0.0003 |
| 5.0 | 1.03 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.03 | 180.0 | 0.0003 |
| 6.0 | 1.0 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.0 | 180.0 | 0.0003 |
| 7.0 | 0.98 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.98 | 180.0 | 0.0003 |
| 8.0 | 0.95 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.95 | 180.0 | 0.0003 |
| 9.0 | 0.92 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.92 | 180.0 | 0.0003 |
| 10.0 | 0.91 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.91 | 180.0 | 0.0003 |
| 11.0 | 0.89 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.89 | 180.0 | 0.0003 |
| 12.0 | 0.85 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.85 | 180.0 | 0.0003 |

| P-dia (in) | P-elev (ft) | V-angle (deg) | H-angle (deg) | Ports () | Spacing (ft) | AcuteMZ (ft) | ChrncMZ (ft) | P-depth (ft) | Ttl-flo (MGD) | Eff-sal (psu) | Temp (C) | Polutnt (kg/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.34 | 1.0 | 90.0 | 180.0 | 8.0 | 10.0 | 32.0 | 321.0 | 26.6 | 3.09 | 0.0 | 16.0 | 100.0 |

Froude number: 149.0

| Step | Depth (ft) | Amb-cur (m/s) | P-dia (in) | Polutnt (kg/kg) | P-speed (m/s) | Dilutn () | x-posn (ft) | y-posn (ft) | |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 26.6 | 0.947 | 3.34 | 100.0 | 2.994 | 1.0 | 0.0 | 0.0; | |
| 65 | 26.05 | 0.952 | 9.518 | 31.77 | 1.151 | 3.146 | -0.152 | 0.0; | begin overlap, |
| 95 | 25.86 | 0.954 | 12.96 | 20.37 | 0.972 | 4.908 | -0.338 | 0.0; | end overlap, |
| 100 | 25.82 | 0.954 | 13.62 | 18.78 | 0.956 | 5.322 | -0.385 | 0.0; | |
| 200 | 24.45 | 0.966 | 36.56 | 2.664 | 0.938 | 37.51 | -8.323 | 0.0; | |
| 245 | 23.24 | 0.977 | 56.5 | 1.093 | 0.957 | 91.45 | -32.08 | 0.0; | acute zone, |
| 300 | 20.98 | 0.992 | 96.46 | 0.368 | 0.976 | 271.8 | -154.6 | 0.0; | |
| 323 | 19.73 | 0.999 | 120.7 | 0.233 | 0.983 | 428.6 | -284.9 | 0.0; | merging, |
| 328 | 19.41 | 1.002 | 127.5 | 0.211 | 0.985 | 473.2 | -327.4 | 0.0; | chronic zone, |
| 385 | 14.36 | 1.048 | 318.1 | 0.0683 | 1.013 | 1462.9 | -1457.7 | 0.0; | bottom hit, |
| 389 | 13.93 | 1.052 | 342.2 | 0.0631 | 1.016 | 1583.5 | -1593.2 | 0.0; | surface, |

Outside chronic zone
;
6:02:02 PM. amb fills: 2

$$\frac{473}{2.3} = \underline{\underline{206}}$$

E-2

/ Windows UM3. 6/21/2007 6:03:02 PM
Case 1; ambient file C:\Plumes\Camascritical.001.db; Diffuser table record 1: ----------

| Depth m | Amb-cur m/s | Amb-dir deg | Amb-sal psu | Amb-tem C | Amb-pol kg/kg | Decay s-1 | Far-spd m/s | Far-dir deg | Disprsn m0.67/s2 |
|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 1.03 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.03 | 180.0 | 0.0003 |
| 1.0 | 1.09 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.09 | 180.0 | 0.0003 |
| 2.0 | 1.09 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.09 | 180.0 | 0.0003 |
| 3.0 | 1.07 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.07 | 180.0 | 0.0003 |
| 4.0 | 1.06 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.06 | 180.0 | 0.0003 |
| 5.0 | 1.03 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.03 | 180.0 | 0.0003 |
| 6.0 | 1.0 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.0 | 180.0 | 0.0003 |
| 7.0 | 0.98 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.98 | 180.0 | 0.0003 |
| 8.0 | 0.95 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.95 | 180.0 | 0.0003 |
| 9.0 | 0.92 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.92 | 180.0 | 0.0003 |
| 10.0 | 0.91 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.91 | 180.0 | 0.0003 |
| 11.0 | 0.89 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.89 | 180.0 | 0.0003 |
| 12.0 | 0.85 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.85 | 180.0 | 0.0003 |

| P-dia (in) | P-elev (ft) | V-angle (deg) | H-angle (deg) | Ports () | Spacing (ft) | AcuteMZ (ft) | ChrncMZ (ft) | P-depth (ft) | Ttl-flo (MGD) | Eff-sal (psu) | Temp (C) | Polutnt (kg/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4.01 | 1.0 | 90.0 | 180.0 | 8.0 | 10.0 | 32.0 | 321.0 | 26.6 | 7.03 | 0.0 | 16.0 | 100.0 |

Froude number: 214.7

| Step | Depth (ft) | Amb-cur (m/s) | P-dia (in) | Polutnt (kg/kg) | P-speed (m/s) | Dilutn () | x-posn (ft) | y-posn (ft) | |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 26.6 | 0.947 | 4.01 | 100.0 | 4.725 | 1.0 | 0.0 | 0.0; | |
| 100 | 25.05 | 0.961 | 20.86 | 15.81 | 1.098 | 6.323 | -0.605 | 0.0; | |
| 200 | 22.77 | 0.981 | 58.99 | 2.287 | 0.955 | 43.7 | -10.44 | 0.0; | |
| 238 | 21.16 | 0.991 | 85.27 | 1.078 | 0.97 | 92.74 | -32.35 | 0.0; | acute zone, |
| 274 | 19.04 | 1.005 | 120.9 | 0.528 | 0.984 | 189.2 | -92.2 | 0.0; | merging, |
| 300 | 16.75 | 1.026 | 171.5 | 0.316 | 0.996 | 316.6 | -209.4 | 0.0; | |
| 314 | 15.12 | 1.041 | 215.5 | 0.239 | 1.005 | 417.7 | -328.7 | 0.0; | chronic zone, |
| 333 | 12.45 | 1.062 | 300.2 | 0.164 | 1.02 | 608.6 | -591.2 | 0.0; | surface, |

Outside chronic zone
;
6:03:03 PM. amb fills: 2

$$\frac{93}{2.3} = \underline{\underline{40}}$$

E-3

/ Windows UM3. 6/21/2007 6:08:08 PM
Case 1; ambient file C:\Plumes\Camascritical.002.db; Diffuser table record 1: ----------

| Depth m | Amb-cur m/s | Amb-dir deg | Amb-sal psu | Amb-tem C | Amb-pol kg/kg | Decay s-1 | Far-spd m/s | Far-dir deg | Disprsn m0.67/s2 |
|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 0.79 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.79 | 180.0 | 0.0003 |
| 1.0 | 0.77 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.77 | 180.0 | 0.0003 |
| 2.0 | 0.74 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.74 | 180.0 | 0.0003 |
| 3.0 | 0.7 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.7 | 180.0 | 0.0003 |
| 4.0 | 0.65 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.65 | 180.0 | 0.0003 |
| 5.0 | 0.61 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.61 | 180.0 | 0.0003 |
| 6.0 | 0.54 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.54 | 180.0 | 0.0003 |
| 7.0 | 0.46 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 8.0 | 0.46 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 9.0 | 0.46 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 10.0 | 0.46 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 11.0 | 0.46 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 12.0 | 0.46 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |

| P-dia (in) | P-elev (ft) | V-angle (deg) | H-angle (deg) | Ports () | Spacing (ft) | AcuteMZ (ft) | ChrncMZ (ft) | P-depth (ft) | Ttl-flo (MGD) | Eff-sal (psu) | Temp (C) | Polutnt (kg/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.34 | 1.0 | 90.0 | 180.0 | 8.0 | 10.0 | 32.0 | 321.0 | 21.0 | 3.09 | 0.0 | 16.0 | 100.0 |

Froude number: 149.0

| Step | Depth (ft) | Amb-cur (m/s) | P-dia (in) | Polutnt (kg/kg) | P-speed (m/s) | Dilutn () | x-posn (ft) | y-posn (ft) | |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 21.0 | 0.508 | 3.34 | 100.0 | 2.994 | 1.0 | 0.0 | 0.0; | |
| 100 | 19.52 | 0.543 | 18.34 | 15.35 | 0.643 | 6.513 | -0.52 | 0.0; | |
| 200 | 17.55 | 0.585 | 51.64 | 2.26 | 0.554 | 44.22 | -8.208 | 0.0; | |
| 248 | 15.85 | 0.616 | 80.97 | 0.874 | 0.583 | 114.4 | -32.61 | 0.0; | acute zone, |
| 290 | 13.85 | 0.641 | 120.1 | 0.38 | 0.609 | 262.8 | -102.6 | 0.0; | merging, |
| 300 | 13.24 | 0.648 | 134.3 | 0.312 | 0.615 | 320.4 | -136.2 | 0.0; | |
| 331 | 10.88 | 0.683 | 212.0 | 0.169 | 0.638 | 591.9 | -329.4 | 0.0; | chronic zone, |
| 340 | 10.1 | 0.695 | 246.0 | 0.141 | 0.646 | 707.4 | -417.3 | 0.0; | surface, |

Outside chronic zone
;
6:08:09 PM. amb fills: 2

$$\frac{592}{2.3} = 257$$

E-4

/ Windows UM3. 6/21/2007 6:09:17 PM
Case 1; ambient file C:\Plumes\Camascritical.003.db; Diffuser table record 1: ----------

| Depth m | Amb-cur m/s | Amb-dir deg | Amb-sal psu | Amb-tem C | Amb-pol kg/kg | Decay s-1 | Far-spd m/s | Far-dir deg | Disprsn m0.67/s2 |
|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 0.264 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.264 | 180.0 | 0.0003 |
| 1.0 | 0.264 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.264 | 180.0 | 0.0003 |
| 2.0 | 0.256 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.256 | 180.0 | 0.0003 |
| 3.0 | 0.247 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.247 | 180.0 | 0.0003 |
| 4.0 | 0.228 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.228 | 180.0 | 0.0003 |
| 5.0 | 0.21 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.21 | 180.0 | 0.0003 |
| 6.0 | 0.187 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.187 | 180.0 | 0.0003 |
| 7.0 | 0.163 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.163 | 180.0 | 0.0003 |
| 8.0 | 0.163 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.163 | 180.0 | 0.0003 |
| 9.0 | 0.163 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.163 | 180.0 | 0.0003 |
| 10.0 | 0.163 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.163 | 180.0 | 0.0003 |
| 11.0 | 0.163 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.163 | 180.0 | 0.0003 |
| 12.0 | 0.163 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.163 | 180.0 | 0.0003 |

| P-dia (in) | P-elev (ft) | V-angle (deg) | H-angle (deg) | Ports () | Spacing (ft) | AcuteMZ (ft) | ChrncMZ (ft) | P-depth (ft) | Ttl-flo (MGD) | Eff-sal (psu) | Temp (C) | Polutnt (kg/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4.01 | 1.0 | 90.0 | 180.0 | 8.0 | 10.0 | 32.0 | 321.0 | 21.0 | 7.03 | 0.0 | 16.0 | 100.0 |

Froude number: 214.7

| Step | Depth (ft) | Amb-cur (m/s) | P-dia (in) | Polutnt (kg/kg) | P-speed (m/s) | Dilutn () | x-posn (ft) | y-posn (ft) | |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 21.0 | 0.177 | 4.01 | 100.0 | 4.725 | 1.0 | 0.0 | 0.0; | |
| 100 | 16.56 | 0.208 | 28.31 | 13.8 | 0.674 | 7.242 | -0.512 | 0.0; | |
| 199 | 9.766 | 0.247 | 121.1 | 2.11 | 0.245 | 47.38 | -6.763 | 0.0; | merging, |
| 200 | 9.688 | 0.247 | 122.5 | 2.068 | 0.245 | 48.33 | -6.941 | 0.0; | |
| 226 | 7.031 | 0.254 | 178.6 | 1.236 | 0.242 | 80.87 | -15.26 | 0.0; | surface, |

Const Eddy Diffusivity. Farfield dispersion based on wastefield width of 25.87 m

| conc (kg/kg) | dilutn | width (m) | distnce (m) | time (hrs) | (kg/kg) | (s-1) | (m/s) | (m0.67/s2) |
|---|---|---|---|---|---|---|---|---|
| 1.22153 | 81.83 | 31.38 | 97.84 | 0.159 | 0.0 | 0.0 | 0.163 | 3.00E-4 |

count: 1
;
6:09:18 PM. amb fills: 2

$$\frac{81}{2.3} = \underline{\underline{35}}$$

E-5

/ Windows UM3. 6/21/2007 6:10:25 PM
Case 1; ambient file C:\Plumes\Camascritical.002.db; Diffuser table record 1: ----------

| Depth m | Amb-cur m/s | Amb-dir deg | Amb-sal psu | Amb-tem C | Amb-pol kg/kg | Decay s-1 | Far-spd m/s | Far-dir deg | Disprsn m0.67/s2 |
|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 0.79 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.79 | 180.0 | 0.0003 |
| 1.0 | 0.77 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.77 | 180.0 | 0.0003 |
| 2.0 | 0.74 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.74 | 180.0 | 0.0003 |
| 3.0 | 0.7 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.7 | 180.0 | 0.0003 |
| 4.0 | 0.65 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.65 | 180.0 | 0.0003 |
| 5.0 | 0.61 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.61 | 180.0 | 0.0003 |
| 6.0 | 0.54 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.54 | 180.0 | 0.0003 |
| 7.0 | 0.46 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 8.0 | 0.46 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 9.0 | 0.46 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 10.0 | 0.46 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 11.0 | 0.46 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 12.0 | 0.46 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |

| P-dia (in) | P-elev (ft) | V-angle (deg) | H-angle (deg) | Ports () | Spacing (ft) | AcuteMZ (ft) | ChrncMZ (ft) | P-depth (ft) | Ttl-flo (MGD) | Eff-sal (psu) | Temp (C) | Polutnt (kg/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.07 | 1.0 | 90.0 | 180.0 | 8.0 | 10.0 | 32.0 | 321.0 | 21.0 | 2.07 | 0.0 | 22.0 | 100.0 |

Froude number: 255.9

| Step | Depth (ft) | Amb-cur (m/s) | P-dia (in) | Polutnt (kg/kg) | P-speed (m/s) | Dilutn () | x-posn (ft) | y-posn (ft) | |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 21.0 | 0.508 | 3.07 | 100.0 | 2.374 | 1.0 | 0.0 | 0.0; | |
| 100 | 19.92 | 0.534 | 15.24 | 16.36 | 0.586 | 6.114 | -0.434 | 0.0; | |
| 200 | 18.34 | 0.568 | 41.82 | 2.37 | 0.54 | 42.19 | -7.721 | 0.0; | |
| 250 | 16.91 | 0.599 | 66.95 | 0.88 | 0.567 | 113.6 | -32.79 | 0.0; | acute zone, |
| 300 | 15.02 | 0.626 | 107.0 | 0.327 | 0.598 | 305.7 | -123.9 | 0.0; | |
| 313 | 14.47 | 0.633 | 121.0 | 0.253 | 0.605 | 395.4 | -171.1 | 0.0; | merging, |
| 336 | 13.24 | 0.648 | 162.6 | 0.16 | 0.618 | 623.5 | -324.4 | 0.0; | chronic zone, |
| 363 | 11.57 | 0.673 | 251.6 | 0.0939 | 0.636 | 1064.3 | -653.0 | 0.0; | bottom hit, |
| 368 | 11.27 | 0.677 | 274.2 | 0.0851 | 0.639 | 1175.0 | -732.9 | 0.0; | surface, |

Outside chronic zone
;
6:10:26 PM. amb fills: 2

$$\frac{623}{2.3} = \underline{\underline{271}}$$

E-6

/ Windows UM3. 6/21/2007 6:11:13 PM
Case 1; ambient file C:\Plumes\Camascritical.003.db; Diffuser table record 1: ----------

| Depth | Amb-cur | Amb-dir | Amb-sal | Amb-tem | Amb-pol | Decay | Far-spd | Far-dir | Disprsn |
|---|---|---|---|---|---|---|---|---|---|
| m | m/s | deg | psu | C | kg/kg | s-1 | m/s | deg | m0.67/s2 |
| 0.0 | 0.264 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.264 | 180.0 | 0.0003 |
| 1.0 | 0.264 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.264 | 180.0 | 0.0003 |
| 2.0 | 0.256 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.256 | 180.0 | 0.0003 |
| 3.0 | 0.247 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.247 | 180.0 | 0.0003 |
| 4.0 | 0.228 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.228 | 180.0 | 0.0003 |
| 5.0 | 0.21 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.21 | 180.0 | 0.0003 |
| 6.0 | 0.187 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.187 | 180.0 | 0.0003 |
| 7.0 | 0.163 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.163 | 180.0 | 0.0003 |
| 8.0 | 0.163 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.163 | 180.0 | 0.0003 |
| 9.0 | 0.163 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.163 | 180.0 | 0.0003 |
| 10.0 | 0.163 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.163 | 180.0 | 0.0003 |
| 11.0 | 0.163 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.163 | 180.0 | 0.0003 |
| 12.0 | 0.163 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.163 | 180.0 | 0.0003 |

| P-dia | P-elev | V-angle | H-angle | Ports | Spacing | AcuteMZ | ChrncMZ | P-depth | Ttl-flo | Eff-sal | Temp | Polutnt |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (in) | (ft) | (deg) | (deg) | () | (ft) | (ft) | (ft) | (ft) | (MGD) | (psu) | (C) | (kg/kg) |
| 3.42 | 1.0 | 90.0 | 180.0 | 8.0 | 10.0 | 32.0 | 321.0 | 21.0 | 3.34 | 0.0 | 22.0 | 100.0 |

Froude number: 315.2

| Step | Depth (ft) | Amb-cur (m/s) | P-dia (in) | Polutnt (kg/kg) | P-speed (m/s) | Dilutn () | x-posn (ft) | y-posn (ft) | |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 21.0 | 0.177 | 3.42 | 100.0 | 3.086 | 1.0 | 0.0 | 0.0; | |
| 100 | 17.75 | 0.2 | 23.73 | 13.8 | 0.457 | 7.244 | -0.531 | 0.0; | |
| 200 | 13.5 | 0.226 | 89.28 | 2.07 | 0.219 | 48.29 | -6.572 | 0.0; | |
| 231 | 11.6 | 0.236 | 120.5 | 1.121 | 0.222 | 89.23 | -15.54 | 0.0; | merging, |
| 254 | 9.609 | 0.247 | 160.7 | 0.711 | 0.229 | 140.7 | -32.06 | 0.0; | acute zone, |
| 267 | 8.107 | 0.251 | 195.4 | 0.549 | 0.233 | 182.0 | -49.96 | 0.0; | surface, |

Const Eddy Diffusivity. Farfield dispersion based on wastefield width of 26.30 m

| conc (kg/kg) | dilutn | width (m) | distnce (m) | time (hrs) | (kg/kg) | (s-1) | (m/s) | (m0.67/s2) |
|---|---|---|---|---|---|---|---|---|
| 0.54544 | 183.3 | 31.26 | 97.84 | 0.141 | 0.0 | 0.0 | 0.163 | 3.00E-4 |

count: 1
;
6:11:14 PM. amb fills: 2

$$\frac{141}{2.3} = \underline{\underline{61}}$$

F-1

/ Windows UM3. 6/21/2007 6:15:56 PM
Case 1; ambient file C:\Plumes\Camascritical.001.db; Diffuser table record 1: ----------

| Depth m | Amb-cur m/s | Amb-dir deg | Amb-sal psu | Amb-tem C | Amb-pol kg/kg | Decay s-1 | Far-spd m/s | Far-dir deg | Disprsn m0.67/s2 |
|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 1.03 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.03 | 180.0 | 0.0003 |
| 1.0 | 1.09 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.09 | 180.0 | 0.0003 |
| 2.0 | 1.09 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.09 | 180.0 | 0.0003 |
| 3.0 | 1.07 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.07 | 180.0 | 0.0003 |
| 4.0 | 1.06 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.06 | 180.0 | 0.0003 |
| 5.0 | 1.03 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.03 | 180.0 | 0.0003 |
| 6.0 | 1.0 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.0 | 180.0 | 0.0003 |
| 7.0 | 0.98 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.98 | 180.0 | 0.0003 |
| 8.0 | 0.95 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.95 | 180.0 | 0.0003 |
| 9.0 | 0.92 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.92 | 180.0 | 0.0003 |
| 10.0 | 0.91 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.91 | 180.0 | 0.0003 |
| 11.0 | 0.89 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.89 | 180.0 | 0.0003 |
| 12.0 | 0.85 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.85 | 180.0 | 0.0003 |

| P-dia (in) | P-elev (ft) | V-angle (deg) | H-angle (deg) | Ports () | Spacing (ft) | AcuteMZ (ft) | ChrncMZ (ft) | P-depth (ft) | Ttl-flo (MGD) | Eff-sal (psu) | Temp (C) | Polutnt (kg/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.92 | 1.0 | 90.0 | 180.0 | 8.0 | 10.0 | 32.0 | 321.0 | 21.0 | 6.1 | 0.0 | 16.0 | 100.0 |

Froude number: 197.2

| Step | Depth (ft) | Amb-cur (m/s) | P-dia (in) | Polutnt (kg/kg) | P-speed (m/s) | Dilutn () | x-posn (ft) | y-posn (ft) | |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 21.0 | 0.992 | 3.92 | 100.0 | 4.291 | 1.0 | 0.0 | 0.0; | |
| 100 | 19.69 | 1.0 | 19.05 | 16.52 | 1.093 | 6.05 | -0.551 | 0.0; | |
| 200 | 17.66 | 1.018 | 53.0 | 2.37 | 0.99 | 42.17 | -10.25 | 0.0; | |
| 239 | 16.18 | 1.032 | 77.3 | 1.095 | 1.008 | 91.28 | -32.72 | 0.0; | acute zone, |
| 285 | 13.69 | 1.054 | 120.6 | 0.44 | 1.029 | 227.0 | -122.1 | 0.0; | merging, |
| 300 | 12.55 | 1.061 | 145.0 | 0.327 | 1.037 | 305.5 | -192.8 | 0.0; | |
| 316 | 10.94 | 1.066 | 185.1 | 0.238 | 1.044 | 419.3 | -325.7 | 0.0; | chronic zone, |
| 328 | 9.399 | 1.072 | 226.6 | 0.188 | 1.049 | 531.8 | -487.6 | 0.0; | surface, |

Outside chronic zone
;
6:15:57 PM. amb fills: 2

$$\frac{419}{2.3} = \underline{\underline{182}}$$

F-2

/ Windows UM3. 6/21/2007 6:15:36 PM
Case 1; ambient file C:\Plumes\Camascritical.001.db; Diffuser table record 1: ----------

| Depth m | Amb-cur m/s | Amb-dir deg | Amb-sal psu | Amb-tem C | Amb-pol kg/kg | Decay s-1 | Far-spd m/s | Far-dir deg | Disprsn m0.67/s2 |
|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 1.03 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.03 | 180.0 | 0.0003 |
| 1.0 | 1.09 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.09 | 180.0 | 0.0003 |
| 2.0 | 1.09 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.09 | 180.0 | 0.0003 |
| 3.0 | 1.07 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.07 | 180.0 | 0.0003 |
| 4.0 | 1.06 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.06 | 180.0 | 0.0003 |
| 5.0 | 1.03 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.03 | 180.0 | 0.0003 |
| 6.0 | 1.0 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.0 | 180.0 | 0.0003 |
| 7.0 | 0.98 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.98 | 180.0 | 0.0003 |
| 8.0 | 0.95 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.95 | 180.0 | 0.0003 |
| 9.0 | 0.92 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.92 | 180.0 | 0.0003 |
| 10.0 | 0.91 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.91 | 180.0 | 0.0003 |
| 11.0 | 0.89 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.89 | 180.0 | 0.0003 |
| 12.0 | 0.85 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.85 | 180.0 | 0.0003 |

| P-dia (in) | P-elev (ft) | V-angle (deg) | H-angle (deg) | Ports () | Spacing (ft) | AcuteMZ (ft) | ChrncMZ (ft) | P-depth (ft) | Ttl-flo (MGD) | Eff-sal (psu) | Temp (C) | Polutnt (kg/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4.27 | 1.0 | 90.0 | 180.0 | 8.0 | 10.0 | 32.0 | 321.0 | 21.0 | 10.04 | 0.0 | 16.0 | 100.0 |

Froude number: 262.0

| Step | Depth (ft) | Amb-cur (m/s) | P-dia (in) | Polutnt (kg/kg) | P-speed (m/s) | Dilutn () | x-posn (ft) | y-posn (ft) | |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 21.0 | 0.992 | 4.27 | 100.0 | 5.952 | 1.0 | 0.0 | 0.0; | |
| 100 | 19.0 | 1.006 | 24.1 | 15.02 | 1.234 | 6.654 | -0.698 | 0.0; | |
| 200 | 16.27 | 1.031 | 70.13 | 2.197 | 1.004 | 45.49 | -10.94 | 0.0; | |
| 237 | 14.41 | 1.048 | 100.4 | 1.056 | 1.02 | 94.65 | -32.6 | 0.0; | acute zone, |
| 256 | 13.2 | 1.059 | 120.5 | 0.725 | 1.03 | 137.9 | -56.62 | 0.0; | merging, |
| 297 | 8.807 | 1.075 | 218.6 | 0.322 | 1.05 | 310.6 | -225.5 | 0.0; | surface, |

Const Eddy Diffusivity. Farfield dispersion based on wastefield width of 26.89 m

| conc (kg/kg) | dilutn | width (m) | distnce (m) | time (hrs) | (kg/kg) | (s-1) | (m/s) | (m0.67/s2) |
|---|---|---|---|---|---|---|---|---|
| 0.3211 | 311.3 | 27.25 | 97.84 | 0.00951 | 0.0 | 0.0 | 0.85 | 3.00E-4 |

count: 1
;
6:15:37 PM. amb fills: 2

$$\frac{95}{2.3} = \underline{\underline{41}}$$

F-3

/ Windows UM3. 6/21/2007 6:15:05 PM
Case 1; ambient file C:\Plumes\Camascritical.002.db; Diffuser table record 1: ----------

| Depth m | Amb-cur m/s | Amb-dir deg | Amb-sal psu | Amb-tem C | Amb-pol kg/kg | Decay s-1 | Far-spd m/s | Far-dir deg | Disprsn m0.67/s2 |
|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 0.79 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.79 | 180.0 | 0.0003 |
| 1.0 | 0.77 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.77 | 180.0 | 0.0003 |
| 2.0 | 0.74 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.74 | 180.0 | 0.0003 |
| 3.0 | 0.7 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.7 | 180.0 | 0.0003 |
| 4.0 | 0.65 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.65 | 180.0 | 0.0003 |
| 5.0 | 0.61 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.61 | 180.0 | 0.0003 |
| 6.0 | 0.54 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.54 | 180.0 | 0.0003 |
| 7.0 | 0.46 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 8.0 | 0.46 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 9.0 | 0.46 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 10.0 | 0.46 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 11.0 | 0.46 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 12.0 | 0.46 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |

| P-dia (in) | P-elev (ft) | V-angle (deg) | H-angle (deg) | Ports () | Spacing (ft) | AcuteMZ (ft) | ChrncMZ (ft) | P-depth (ft) | Ttl-flo (MGD) | Eff-sal (psu) | Temp (C) | Polutnt (kg/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.92 | 1.0 | 90.0 | 180.0 | 8.0 | 10.0 | 32.0 | 321.0 | 21.0 | 6.1 | 0.0 | 16.0 | 100.0 |

Froude number: 197.2

| Step | Depth (ft) | Amb-cur (m/s) | P-dia (in) | Polutnt (kg/kg) | P-speed (m/s) | Dilutn () | x-posn (ft) | y-posn (ft) | |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 21.0 | 0.508 | 3.92 | 100.0 | 4.291 | 1.0 | 0.0 | 0.0; | |
| 100 | 18.63 | 0.562 | 24.34 | 14.3 | 0.77 | 6.988 | -0.668 | 0.0; | |
| 200 | 15.8 | 0.617 | 72.21 | 2.165 | 0.584 | 46.16 | -8.979 | 0.0; | |
| 244 | 13.59 | 0.644 | 109.3 | 0.906 | 0.61 | 110.3 | -32.18 | 0.0; | acute zone, |
| 254 | 12.98 | 0.651 | 120.0 | 0.743 | 0.616 | 134.5 | -42.77 | 0.0; | merging, |
| 298 | 8.986 | 0.709 | 220.8 | 0.311 | 0.654 | 321.5 | -170.2 | 0.0; | surface, |

Const Eddy Diffusivity. Farfield dispersion based on wastefield width of 26.94 m

| conc (kg/kg) | dilutn | width (m) | distnce (m) | time (hrs) | (kg/kg) | (s-1) | (m/s) | (m0.67/s2) |
|---|---|---|---|---|---|---|---|---|
| 0.31058 | 321.8 | 28.0 | 97.84 | 0.0278 | 0.0 | 0.0 | 0.46 | 3.00E-4 |

count: 1
;
6:15:06 PM. amb fills: 2

$$\frac{322}{2.3} = 140$$

F-4

/ Windows UM3. 6/21/2007 6:14:36 PM
Case 1; ambient file C:\Plumes\Camascritical.003.db; Diffuser table record 1: ----------

| Depth m | Amb-cur m/s | Amb-dir deg | Amb-sal psu | Amb-tem C | Amb-pol kg/kg | Decay s-1 | Far-spd m/s | Far-dir deg | Disprsn m0.67/s2 |
|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 0.264 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.264 | 180.0 | 0.0003 |
| 1.0 | 0.264 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.264 | 180.0 | 0.0003 |
| 2.0 | 0.256 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.256 | 180.0 | 0.0003 |
| 3.0 | 0.247 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.247 | 180.0 | 0.0003 |
| 4.0 | 0.228 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.228 | 180.0 | 0.0003 |
| 5.0 | 0.21 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.21 | 180.0 | 0.0003 |
| 6.0 | 0.187 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.187 | 180.0 | 0.0003 |
| 7.0 | 0.163 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.163 | 180.0 | 0.0003 |
| 8.0 | 0.163 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.163 | 180.0 | 0.0003 |
| 9.0 | 0.163 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.163 | 180.0 | 0.0003 |
| 10.0 | 0.163 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.163 | 180.0 | 0.0003 |
| 11.0 | 0.163 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.163 | 180.0 | 0.0003 |
| 12.0 | 0.163 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.163 | 180.0 | 0.0003 |

| P-dia (in) | P-elev (ft) | V-angle (deg) | H-angle (deg) | Ports () | Spacing (ft) | AcuteMZ (ft) | ChrncMZ (ft) | P-depth (ft) | Ttl-flo (MGD) | Eff-sal (psu) | Temp (C) | Polutnt (kg/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4.27 | 1.0 | 90.0 | 180.0 | 8.0 | 10.0 | 32.0 | 321.0 | 21.0 | 10.04 | 0.0 | 16.0 | 100.0 |

Froude number: 262.0

| Step | Depth (ft) | Amb-cur (m/s) | P-dia (in) | Polutnt (kg/kg) | P-speed (m/s) | Dilutn () | x-posn (ft) | y-posn (ft) | |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 21.0 | 0.177 | 4.27 | 100.0 | 5.952 | 1.0 | 0.0 | 0.0; | |
| 100 | 15.99 | 0.212 | 30.31 | 13.8 | 0.839 | 7.242 | -0.476 | 0.0; | |
| 187 | 8.361 | 0.251 | 120.9 | 2.674 | 0.276 | 37.38 | -5.236 | 0.0; | merging, |
| 200 | 7.106 | 0.254 | 146.6 | 2.083 | 0.263 | 47.99 | -7.297 | 0.0; | |
| 208 | 6.171 | 0.257 | 168.2 | 1.778 | 0.258 | 56.23 | -9.21 | 0.0; | surface, |

Const Eddy Diffusivity. Farfield dispersion based on wastefield width of 25.61 m

| conc (kg/kg) | dilutn | width (m) | distnce (m) | time (hrs) | (kg/kg) | (s-1) | (m/s) | (m0.67/s2) |
|---|---|---|---|---|---|---|---|---|
| 1.75478 | 56.96 | 31.19 | 97.84 | 0.162 | 0.0 | 0.0 | 0.163 | 3.00E-4 |

count: 1
;
6:14:38 PM. amb fills: 2

$$\frac{56}{2.3} = \underline{\underline{24}}$$

F-5

/ Windows UM3. 6/21/2007 6:13:37 PM
Case 1; ambient file C:\Plumes\Camascritical.002.db; Diffuser table record 1: ----------

| Depth m | Amb-cur m/s | Amb-dir deg | Amb-sal psu | Amb-tem C | Amb-pol kg/kg | Decay s-1 | Far-spd m/s | Far-dir deg | Disprsn m0.67/s2 |
|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 0.79 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.79 | 180.0 | 0.0003 |
| 1.0 | 0.77 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.77 | 180.0 | 0.0003 |
| 2.0 | 0.74 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.74 | 180.0 | 0.0003 |
| 3.0 | 0.7 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.7 | 180.0 | 0.0003 |
| 4.0 | 0.65 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.65 | 180.0 | 0.0003 |
| 5.0 | 0.61 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.61 | 180.0 | 0.0003 |
| 6.0 | 0.54 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.54 | 180.0 | 0.0003 |
| 7.0 | 0.46 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 8.0 | 0.46 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 9.0 | 0.46 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 10.0 | 0.46 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 11.0 | 0.46 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 12.0 | 0.46 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |

| P-dia (in) | P-elev (ft) | V-angle (deg) | H-angle (deg) | Ports () | Spacing (ft) | AcuteMZ (ft) | ChrncMZ (ft) | P-depth (ft) | Ttl-flo (MGD) | Eff-sal (psu) | Temp (C) | Polutnt (kg/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.77 | 1.0 | 90.0 | 180.0 | 8.0 | 10.0 | 32.0 | 321.0 | 21.0 | 5.09 | 0.0 | 22.0 | 100.0 |

Froude number: 376.5

| Step | Depth (ft) | Amb-cur (m/s) | P-dia (in) | Polutnt (kg/kg) | P-speed (m/s) | Dilutn () | x-posn (ft) | y-posn (ft) | |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 21.0 | 0.508 | 3.77 | 100.0 | 3.871 | 1.0 | 0.0 | 0.0; | |
| 100 | 18.9 | 0.556 | 22.7 | 14.55 | 0.727 | 6.872 | -0.631 | 0.0; | |
| 200 | 16.34 | 0.61 | 66.16 | 2.187 | 0.575 | 45.72 | -8.838 | 0.0; | |
| 245 | 14.28 | 0.635 | 101.0 | 0.897 | 0.602 | 111.5 | -32.73 | 0.0; | acute zone, |
| 264 | 13.19 | 0.648 | 120.7 | 0.616 | 0.614 | 162.4 | -56.16 | 0.0; | merging, |
| 300 | 10.23 | 0.693 | 196.3 | 0.302 | 0.643 | 331.3 | -172.5 | 0.0; | |
| 309 | 9.308 | 0.705 | 226.9 | 0.253 | 0.652 | 395.9 | -227.6 | 0.0; | surface, |

Const Eddy Diffusivity. Farfield dispersion based on wastefield width of 27.10 m

| conc (kg/kg) | dilutn | width (m) | distnce (m) | time (hrs) | (kg/kg) | (s-1) | (m/s) | (m0.67/s2) |
|---|---|---|---|---|---|---|---|---|
| 0.25217 | 396.5 | 27.76 | 97.84 | 0.0172 | 0.0 | 0.0 | 0.46 | 3.00E-4 |

count: 1
;
6:13:38 PM. amb fills: 2

$$\frac{396}{2.3} = \underline{\underline{172}}$$

F-6

/ Windows UM3. 6/21/2007 6:12:34 PM
Case 1; ambient file C:\Plumes\Camascritical.002.db; Diffuser table record 1: ----------

| Depth m | Amb-cur m/s | Amb-dir deg | Amb-sal psu | Amb-tem C | Amb-pol kg/kg | Decay s-1 | Far-spd m/s | Far-dir deg | Disprsn m0.67/s2 |
|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 0.79 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.79 | 180.0 | 0.0003 |
| 1.0 | 0.77 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.77 | 180.0 | 0.0003 |
| 2.0 | 0.74 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.74 | 180.0 | 0.0003 |
| 3.0 | 0.7 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.7 | 180.0 | 0.0003 |
| 4.0 | 0.65 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.65 | 180.0 | 0.0003 |
| 5.0 | 0.61 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.61 | 180.0 | 0.0003 |
| 6.0 | 0.54 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.54 | 180.0 | 0.0003 |
| 7.0 | 0.46 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 8.0 | 0.46 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 9.0 | 0.46 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 10.0 | 0.46 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 11.0 | 0.46 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 12.0 | 0.46 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |

| P-dia (in) | P-elev (ft) | V-angle (deg) | H-angle (deg) | Ports () | Spacing (ft) | AcuteMZ (ft) | ChrncMZ (ft) | P-depth (ft) | Ttl-flo (MGD) | Eff-sal (psu) | Temp (C) | Polutnt (kg/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.92 | 1.0 | 90.0 | 180.0 | 8.0 | 10.0 | 32.0 | 321.0 | 21.0 | 6.36 | 0.0 | 22.0 | 100.0 |

Froude number: 426.7

| Step | Depth (ft) | Amb-cur (m/s) | P-dia (in) | Polutnt (kg/kg) | P-speed (m/s) | Dilutn () | x-posn (ft) | y-posn (ft) | |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 21.0 | 0.508 | 3.92 | 100.0 | 4.473 | 1.0 | 0.0 | 0.0; | |
| 100 | 18.55 | 0.564 | 24.64 | 14.22 | 0.788 | 7.033 | -0.672 | 0.0; | |
| 200 | 15.65 | 0.619 | 73.7 | 2.158 | 0.587 | 46.33 | -8.91 | 0.0; | |
| 244 | 13.39 | 0.646 | 111.6 | 0.903 | 0.612 | 110.7 | -32.01 | 0.0; | acute zone, |
| 252 | 12.89 | 0.653 | 120.3 | 0.771 | 0.617 | 129.7 | -40.25 | 0.0; | merging, |
| 295 | 8.976 | 0.709 | 218.0 | 0.329 | 0.654 | 304.0 | -158.6 | 0.0; | surface, |

Const Eddy Diffusivity. Farfield dispersion based on wastefield width of 26.87 m

| conc (kg/kg) | dilutn | width (m) | distnce (m) | time (hrs) | (kg/kg) | (s-1) | (m/s) | (m0.67/s2) |
|---|---|---|---|---|---|---|---|---|
| 0.32855 | 304.3 | 28.01 | 97.84 | 0.0299 | 0.0 | 0.0 | 0.46 | 3.00E-4 |

count: 1
;
6:12:35 PM. amb fills: 2

$$\frac{111}{2.3} = \underline{\underline{48}}$$

Gray & Osborne, Inc.
CONSULTING ENGINEERS

March 2, 2009

Mr. David Knight, P.E.
Washington State Department of Ecology
Southwest Regional Office
Water Quality Program
P.O. Box 47775
Olympia, Washington 98504-7775

SUBJECT: SUPPLEMENTAL OUTFALL MIXING ZONE MODELING,
WASTEWATER TREATMENT FACILITY
CITY OF CAMAS, CLARK COUNTY, WASHINGTON
G&O #06518.00

Dear Mr. Knight:

Per our recent discussions regarding effluent dilution modeling and effluent ammonia limitations for the City of Camas Wastewater Treatment Facility, we have asked Cosmopolitan Engineering to model the Camas diffuser using the UM3 model with default parameters and future flows. Attached are two technical memoranda presenting the results of this modeling.

We would appreciate your review and approval of this modeling effort for the determination of dilution values for the Camas diffuser.

Please contact me or John Wilson, P.E., if you need additional information on this supplemental modeling.

Very truly yours,

GRAY & OSBORNE, INC.

Jay L. Swift, P.E.

JLS/hhj
Encl.

cc: Mr. Monte Brachmann, Public Works Director, City of Camas, w/encl.
Mr. Jim Dickinson, Chief Wastewater Treatment Operator, City of Camas, w/encl.
Mr. Eric Levison, Operations Manager, City of Camas, w/encl.
Mr. Greg Zentner, P.E., Washington State Department of Ecology, w/encl.
Mr. Anise Ahmed, P.E., Washington State Department of Ecology, w/encl.
Mr. Bill Fox, P.E., Cosmopolitan Engineering Group

701 Dexter Avenue N., Suite 200 Seattle, Washington 98109 (206) 284-0860 Fax (206) 283-3206

Printed on recycled paper

# Technical Memorandum

PO Box 1678 • Tacoma, WA 98401-1678
711 Pacific Avenue • Tacoma, WA 98402
Phone (253) 272-7220 • Fax (253) 272-7250
BFox@cosmopolitaneng.com

**TM TITLE:** **City of Camas Mixing Zone Study**

**DATE:** January 20, 2009

**TO:** Jay Swift, Gray & Osborne

**PREPARED BY:** Nick Whitaker, Cosmopolitan Engineering Group

**REVIEWED BY:** Bill Fox, PE, Cosmopolitan Engineering Group

**PROJECT #:** G/O016

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## INTRODUCTION

The purpose of this Technical Memorandum (TM) is to update the mixing zone dilution factors and the reasonable potential analysis in *Part III The City of Camas Dye Tracer and Mixing Zone Study* (CEG, June 2007). The mixing zone modeling is based on an updated UM3 model using default values for all calibration parameters. This TM will also evaluate if there is a reasonable potential to exceed water quality standards for the recommended outfall improvements.

## EFFLUENT FLOW RATES

Gray & Osborne provided the effluent flow design criteria for facility planning presented in Table 1.

**Table 1 Effluent Flow Design Criteria for Facility Planning**

| Planning Year | Winter Flow Criteria | | Summer Flow Criteria | |
|---|---|---|---|---|
| | Max. Month (mgd) | Max. Day (mgd) | Max. Month (mgd) | Max. Day (mgd) |
| 2025 | 6.10 | 10.04 | 5.09 | 6.36 |

## RECOMMENDED DIFFUSER MODIFICATION

The existing outfall includes a diffuser consisting of eight, 6-inch-diameter ports discharging horizontally in the same direction as ambient currents. This co-flowing configuration reduces the hydrodynamic mixing potential. Dilution factors would be improved by reorienting the diffuser outlets to a vertical discharge configuration. It is our strong recommendation to proceed with this minor modification to the existing diffuser.

The new diffuser will consist of eight ports oriented to discharge vertically. Each port will be fitted with a 6-inch Tideflex elastomeric check valve. In addition to aiding in the prevention of debris accumulation, the valves will enhance diffuser velocities over the range of operating flow rates. A copy of the performance data for the selected valves is provided in Figure 1.

# TIDEFLEX DIFFUSER (TFD) SYSTEM DATA ANALYSIS

**MEDIA:** Effluent

Density or Spec. Gravity: 1 lb/ft^3

**FLOW RANGE:**

| | | | | |
|---|---|---|---|---|
| 1.3 | MGD | = | 903 | gpm |
| 5.6 | MGD | = | 3889 | gpm |
| 7.2 | MGD | = | 5000 | gpm |

**AVAILABLE HEADLOSS@ DIFFUSER:** Minimum ____ feet; Design ____ feet; Maximum ____ feet

**MAX. BACKPRESSURE:** ____ feet

| * DIFFUSER SIZE (IN) | CATALOG * NUMBER |
|---|---|
| 6 | 206 |

DATE: 14-Nov-2005

CUSTOMER: City of Camas, WA
CONTACT: Monte Brachmann

ENGINEER: Gray & Osborne, Inc.
CONTACT: Jay Swift, P.E.

PROJECT: City of Camas, WA - WWTP Outfall

REP: Antec Corporation
CONTACT: Matthew Davidson

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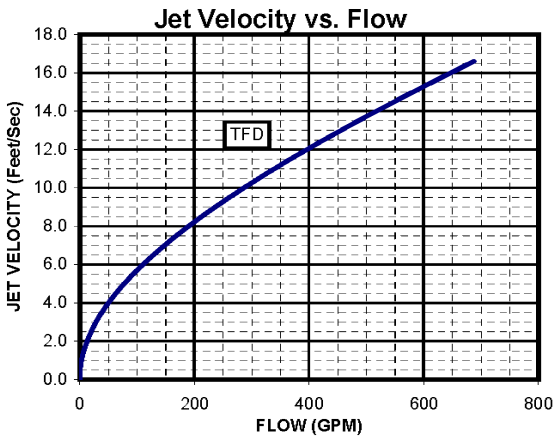
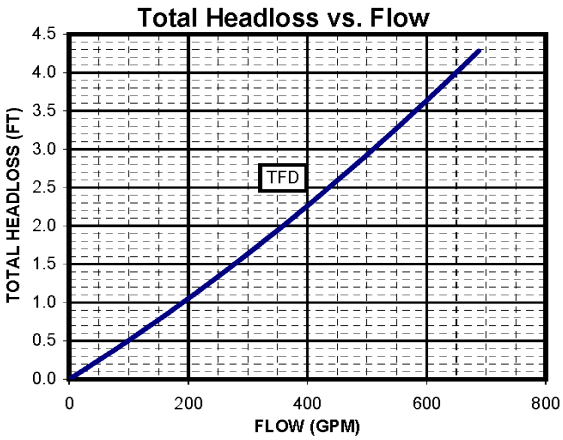
| | | *PER TIDEFLEX DIFFUSER* | | | |
|---|---|---|---|---|---|
| *** TOTAL QUANTITY** | TOTAL FLOW (gpm) | FLOW (gpm) | **JET VELOCITY (fps)** | **TOTAL HEADLOSS @ DIFFUSER (feet)** | EFFECTIVE DIAMETER (in) |
| 8 | 903 | 112.85 | 6.07 | 0.57 | 2.75 |
| | 3889 | 486.11 | 13.50 | 2.83 | 3.83 |
| | 5000 | 625.00 | 15.66 | 3.81 | 4.04 |




TIDEFLEX TECHNOLOGIES, INC. 300 BILMAR DRIVE, PITTSBURGH, PA 15205 (412) 919-0919 phone (412) 919-0918 fax

**Figure 1 Tideflex Diffuser System Data Analysis**

The port velocities corresponding to a range of operating conditions are presented in Table 2.

**Table 2 Diffuser Port Velocities for Tideflex Diffuser Valves**

| Design Year | Season | Max Flow Period | Effluent Flow (mgd) | Flow per Port (gpm) | Discharge Velocity (fps) | Port Area (sq. in.) | Port Dia. (in.) |
|---|---|---|---|---|---|---|---|
| 2025 | Winter | 30-day | 6.1 | 529 | 14.1 | 12.0 | 3.92 |
| 2025 | Winter | 24-hr | 10.04 | 871 | 19.5 | 14.3 | 4.27 |
| 2025 | Summer | 30-day | 5.09 | 442 | 12.7 | 11.2 | 3.77 |
| 2025 | Summer | 24-hr | 6.36 | 552 | 14.7 | 12.0 | 3.92 |

## DILUTION MODELING

### UM3 MODEL

The UM3 models runs were carried out through the Visual Plumes interface. A default aspiration entrainment coefficient (AEC) of 0.1 was used in all the model runs. Additional default values included the diffuser port contraction coefficient of 1. The model configuration applied the Brooks far-field solution with the default dispersion coefficients. There centerline dilutions were used in the reasonable potential analysis.

The centerline dilution concentration in previous studies (CEG, 2007) was determined by dividing the calculated dilution factor by a peak-to-mean ratio of 2.3. This evaluation used a more conservative centerline dilution factor, which is calculated using the algorithms embedded in UM3.

### MODEL RESULTS

A series of UM3 model runs from the Visual Plumes interface, with the Brooks farfield algorithm, are provided in Attachment 1. All model runs are based on the vertical port orientation with Tideflex valves. The basis of the model runs and the results are described below:

| | |
|---|---|
| F-1 | This chronic model run is for near-flood ambient conditions modeled by Ecology in the NPDES permit, the 90$^{th}$ percentile river discharge of 522 kcfs. This run is equivalent to Ecology run NC22B except for the maximum month effluent flow rate for 2025. |
| F-2 | This acute model run is for the same near-flood ambient conditions modeled by Ecology, equivalent to Ecology run NC24 except the maximum day effluent flow rate for 2025. |
| F-3 | This chronic model run corresponds to the 2025 winter maximum month flow rate and winter effluent temperature. Ambient current speed is tidally-averaged current profile during the low river flow condition. |

| | |
|---|---|
| F-4 | This acute model run corresponds to 2025 maximum day winter flow rate and winter effluent temperature. Ambient current speed is the one-hour minimum velocity profile from the current meter deployment, which is caused by the tidal influence that occurs during low to normal Columbia River flows. |
| F-5 | This chronic model run corresponds to 2025 summer maximum month flow rate and summer effluent temperature. Ambient current speed is tidally-averaged current profile during the low river flow condition (same as F-3). |
| F-6 | This acute model run corresponds to 2025 maximum day summer flow rate and summer effluent temperature. Ambient current speed is the one-hour minimum velocity profile from the current meter deployment (same as F-4). |

The results of the modeling are presented in Table 3. The results demonstrate that critical conditions occur during winter flows at the WWTP. The critical condition for acute dilution occurs during the brief tidally-influenced slowdowns that occur near high tide during low river flow conditions.

**Table 3 Dilution Model Results for 2025 Effluent Flows**

| Model Run # | Ambient Condition | Discharge Depth (ft) | Avg Current Speed (m/sec) | Ambient Temp (°C) | Effluent Flow (mgd) | Effluent Temp (°C) | Acute Dilution | Chronic Dilution |
|---|---|---|---|---|---|---|---|---|
| F-1 | (1)Winter High Flow | 26.6 | 1.0 | 12.6 | 6.10 | 16.0 | | 138 |
| F-2 | (1)Winter High Flow | 26.6 | 1.0 | 12.6 | 10.04 | 16.0 | 24 | |
| F-3 | (2)Winter Average | 21.0 | 0.7 | 12.6 | 6.10 | 16.0 | | 122 |
| F-4 | (3)Winter 10% | 21.0 | 0.25 | 12.6 | 10.04 | 16.0 | 19 | |
| F-5 | (2)Summer Average | 21.0 | 0.7 | 21.5 | 5.09 | 22.0 | | 156 |
| F-6 | (3)Summer 10% | 21.0 | 0.25 | 21.5 | 6.36 | 22.0 | 27 | |

(1) Ambient conditions for 522 kcfs river flow (90th percentile) per Ecology NPDES permit (runs NC22 and NC24)
(2) Ambient condition for non-flood river flow based on tidally-averaged current profile from October 2004 current meter deployment.
(3) Ambient condition for acute model runs based on lowest tidally-influenced current profile (duration = 1 hr±) from October 2004 current meter deployment.

## REASONABLE POTENTIAL ASSESSMENT

EPA and Ecology use a statistical test to determine a discharge's "reasonable potential" to exceed water quality standards, which is based on effluent and ambient data and acute and chronic dilution factors. If a discharge exhibits a reasonable potential to exceed water quality standards for any parameter, Ecology issues an effluent limitation for that parameter in the NPDES permit. If a parameter does not exhibit a reasonable potential to exceed water quality standards, no NPDES permit limit is required.

## EFFLUENT DATA

Water quality-based effluent limits are assessed for ammonia and selected metals (cadmium, copper, lead, nickel, silver, zinc, and mercury). The critical effluent concentrations used in determination of reasonable potential are based on eight effluent metals scans in 2005 and 2006, and over 400 effluent ammonia samples in 2005 and 2006.

The metals data are provided in Table 4. The values in red are detected concentrations, and the values in black are the detection levels for non-detected results. High concentrations of cadmium and nickel were measured on June 2, 2006. These values may be anomalous, or if realistic should be evaluated in future sampling efforts.

**Table 4 Camas Effluent Metals Data (µg/L)**

| Date | Cd | Cu | Pb | Ni | Ag | An | Hg |
|---|---|---|---|---|---|---|---|
| 5/13/2005 | 3 | 8 | 5 | 20 | 10 | 18 | 0.056 |
| 7/21/2005 | 10 | 31 | 5 | 20 | 10 | 19 | 0.050 |
| 9/30/2005 | 3 | 5 | 5 | 20 | 10 | 16 | 0.056 |
| 12/7/2005 | 3 | 5 | 5 | 20 | 10 | 15 | 0.050 |
| 3/31/2006 | 3 | 5 | 5 | 20 | 10 | 25 | 0.070 |
| 6/2/2006 | 87 | 12 | 5 | 373 | 70 | 20 | 0.050 |
| 9/12/2006 | 3 | 7 | 5 | 20 | 10 | 31 | |
| 12/18/2006 | 3 | 5 | 5 | 29 | 10 | 30 | 0.050 |
| Count | 8 | 8 | 8 | 8 | 8 | 8 | 7 |
| # Detects | 2 | 4 | 0 | 2 | 0 | 8 | 2 |

Detected Values in Red Detection Limit in Black

## AMBIENT DATA AND WATER QUALITY STANDARDS

No ambient sampling has been conducted in this mixing zone study for ammonia or metals or the parameters that affect their water quality standards (pH, temperature, and hardness). The criteria for ambient concentrations, and ambient-depended water quality criteria, are the same as Ecology cited in Appendix C of the NPDES permit.

## REASONABLE POTENTIAL RESULTS

The reasonable potential to exceed water quality standards for ammonia and metals is presented in Table 5 for the recommended diffuser modifications. Ammonia is the only analyte considered seasonally due to its dependence on ambient pH and temperature. Cadmium was the only analyte with a reasonable potential to exceed water quality standards, both in winter and summer. This result suggests that additional effluent monitoring for cadmium should be conducted, as well as a potential source control investigation. However, this finding is based on only two detected values, and thus should be sampled more frequently in the future to determine if the reasonable potential is realistic. The ambient concentration used in the analysis is also relatively high, and may need to be assessed in a sampling program.

If the diffuser is modified to a vertical port orientation using Tideflex valves, there is no reasonable potential to exceed ammonia water quality standards in summer or winter. The critical condition for ammonia is winter. Comparing the maximum concentration expected at the chronic mixing zone (221 µg/L) to the chronic water quality standard (470 µg/L) reveals a factor of safety greater than two. Therefore, water quality-based ammonia limits should be deleted from current and future NPDES permits.

## Table 5 Reasonable Potential Calculation Table

| | | | | State Water Quality Standard | | Max concentration at edge of... | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Metal Criteria Translator as decimal | Metal Criteria Translator as decimal | Ambient Concentration (metals as dissolved) | Acute | Chronic | Acute Mixing Zone | Chronic Mixing Zone | LIMIT REQ'D? | Max effluent conc. measured (metals as total recoverable) | Coeff Variation | | # of samples | Multiplier | Acute Dil'n Factor | Chronic Dil'n Factor |
| Parameter | Acute | Chronic | ug/L | ug/L | ug/L | ug/L | ug/L | | ug/L | CV | s | n | | | |
| **Modified Diffuser (Vertical Discharge)** | | | | | | | | | | | | | | | |
| **2025** | | | | | | | | | | | | | | | |
| Ammonia-N (summer) | 1.00 | 1.00 | 27.00 | 5100.00 | 830.000 | 939.52 | 184.94 | NO | 35200 | 0.60 | 0.55 | 268 | 0.70 | 27.0 | 156.0 |
| Ammonia-N (winter) | 1.00 | 1.00 | 19.00 | 2100.00 | 470.000 | 1316.16 | 221.02 | NO | 35200 | 0.60 | 0.55 | 268 | 0.70 | 19.0 | 122.0 |
| Cadmium | 0.940 | 0.940 | 0.53 | 1.70 | 0.61 | 8.67 | 1.80 | YES | 87.00 | 0.60 | 0.55 | 8 | 1.90 | 19.0 | 122.0 |
| Copper | 1.000 | 1.000 | 0.86 | 8.65 | 6.14 | 3.91 | 1.34 | NO | 31.00 | 0.60 | 0.55 | 8 | 1.90 | 19.0 | 122.0 |
| Lead | 0.470 | 0.470 | 0.06 | 29.3 | 1.14 | 0.29 | 0.10 | NO | 5.0 | 0.60 | 0.55 | 8 | 1.90 | 19.0 | 122.0 |
| Nickel | 1.000 | 1.000 | 0.56 | 770.7 | 85.60 | 37.79 | 6.36 | NO | 373.00 | 0.60 | 0.55 | 8 | 1.90 | 19.0 | 122.0 |
| Silver | 0.850 | 0.850 | 0.10 | 1.00 | 100.00 | 0.94 | 0.23 | NO | 10.00 | 0.60 | 0.55 | 8 | 1.90 | 19.0 | 122.0 |
| Zinc | 1.000 | 1.000 | 2.00 | 62.3 | 56.9 | 4.99 | 2.47 | NO | 31.000 | 0.60 | 0.55 | 8 | 1.90 | 19.0 | 122.0 |
| Mercury | 1.000 | 1.000 | | 2.1 | 0.012 | 0.01 | 0.001 | NO | 0.070 | 0.60 | 0.55 | 8 | 1.90 | 19.0 | 122.0 |

# Attachment 1

UM3 Model Runs

**F-1**

/ Windows UM3. 1/19/2009 10:19:30 AM

Case 1; ambient file U:\Nick\Camas\VP plumeF1.002.db; Diffuser table record 1: ----------

| Depth | Amb-cur | Amb-dir | Amb-sal | Amb-tem | Amb-pol | Decay | Far-spd | Far-dir | Disprsn |
|---|---|---|---|---|---|---|---|---|---|
| m | m/s | deg | psu | C | kg/kg | s-1 | m/s | deg | m0.67/s2 |
| 0.0 | 1.03 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.03 | 180.0 | 0.0003 |
| 1.0 | 1.09 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.09 | 180.0 | 0.0003 |
| 2.0 | 1.09 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.09 | 180.0 | 0.0003 |
| 3.0 | 1.07 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.07 | 180.0 | 0.0003 |
| 4.0 | 1.06 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.06 | 180.0 | 0.0003 |
| 5.0 | 1.03 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.03 | 180.0 | 0.0003 |
| 6.0 | 1.0 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.0 | 180.0 | 0.0003 |
| 7.0 | 0.98 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.98 | 180.0 | 0.0003 |
| 8.0 | 0.95 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.95 | 180.0 | 0.0003 |
| 9.0 | 0.92 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.92 | 180.0 | 0.0003 |
| 10.0 | 0.91 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.91 | 180.0 | 0.0003 |
| 11.0 | 0.89 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.89 | 180.0 | 0.0003 |
| 12.0 | 0.85 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.85 | 180.0 | 0.0003 |

| P-dia | P-elev | V-angle | H-angle | Ports | Spacing | AcuteMZ | ChrncMZ | P-depth | Ttl-flo | Eff-sal | Temp | Polutnt |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (in) | (ft) | (deg) | (deg) | () | (ft) | (ft) | (ft) | (ft) | (MGD) | (psu) | (C) | (kg/kg) |
| 3.92 | 1.0 | 90.0 | 180.0 | 8.0 | 10.0 | 32.0 | 321.0 | 21.0 | 6.1 | 0.0 | 16.0 | 100.0 |

Froude number: 197.2

| Step | Depth (ft) | Amb-cur (m/s) | P-dia (in) | Polutnt (kg/kg) | Dilutn () | CL-diln () | x-posn (ft) | y-posn (ft) | |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 21.0 | 0.992 | 3.92 | 100.0 | 1.0 | 1.0 | 0.0 | 0.0; | |
| 100 | 19.69 | 1.0 | 19.05 | 16.52 | 6.05 | 2.038 | -0.551 | 0.0; | |
| 200 | 17.66 | 1.018 | 53.0 | 2.37 | 42.17 | 10.59 | -10.25 | 0.0; | |
| 239 | 16.18 | 1.032 | 77.3 | 1.095 | 91.28 | 22.93 | -32.72 | 0.0; | acute zone, |
| 285 | 13.69 | 1.054 | 120.6 | 0.44 | 227.0 | 57.04 | -122.1 | 0.0; | merging, |
| 300 | 12.55 | 1.061 | 145.0 | 0.327 | 305.5 | 84.27 | -192.8 | 0.0; | |
| 316 | 10.94 | 1.066 | 185.1 | 0.238 | 419.3 | 138.0 | -325.7 | 0.0; | chronic zone, |
| 328 | 9.399 | 1.072 | 226.6 | 0.188 | 531.8 | 217.7 | -487.6 | 0.0; | surface, |

Outside chronic zone

;

10:19:33 AM. amb fills: 2

**F-2**

/ Windows UM3. 1/19/2009 12:14:44 PM

Case 1; ambient file U:\Nick\Camas\VP plumeF2.003.db; Diffuser table record 1: ----------

| Depth | Amb-cur | Amb-dir | Amb-sal | Amb-tem | Amb-pol | Decay | Far-spd | Far-dir | Disprsn |
|---|---|---|---|---|---|---|---|---|---|
| m | m/s | deg | psu | C | kg/kg | s-1 | m/s | deg | m0.67/s2 |
| 0.0 | 1.03 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.03 | 180.0 | 0.0003 |
| 1.0 | 1.09 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.09 | 180.0 | 0.0003 |
| 2.0 | 1.09 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.09 | 180.0 | 0.0003 |
| 3.0 | 1.07 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.07 | 180.0 | 0.0003 |
| 4.0 | 1.06 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.06 | 180.0 | 0.0003 |
| 5.0 | 1.03 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.03 | 180.0 | 0.0003 |
| 6.0 | 1.0 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 1.0 | 180.0 | 0.0003 |
| 7.0 | 0.98 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.98 | 180.0 | 0.0003 |
| 8.0 | 0.95 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.95 | 180.0 | 0.0003 |
| 9.0 | 0.92 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.92 | 180.0 | 0.0003 |
| 10.0 | 0.91 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.91 | 180.0 | 0.0003 |
| 11.0 | 0.89 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.89 | 180.0 | 0.0003 |
| 12.0 | 0.85 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.85 | 180.0 | 0.0003 |

| P-dia | P-elev | V-angle | H-angle | Ports | Spacing | AcuteMZ | ChrncMZ | P-depth | Ttl-flo | Eff-sal | Temp | Polutnt |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (in) | (ft) | (deg) | (deg) | () | (ft) | (ft) | (ft) | (ft) | (MGD) | (psu) | (C) | (kg/kg) |
| 4.27 | 1.0 | 90.0 | 180.0 | 8.0 | 10.0 | 32.0 | 321.0 | 21.0 | 10.04 | 0.0 | 16.0 | 100.0 |

Froude number: 262.0

| Step | Depth (ft) | Amb-cur (m/s) | P-dia (in) | Polutnt (kg/kg) | Dilutn () | CL-diln () | x-posn (ft) | y-posn (ft) | |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 21.0 | 0.992 | 4.27 | 100.0 | 1.0 | 1.0 | 0.0 | 0.0; | |
| 100 | 19.0 | 1.006 | 24.1 | 15.02 | 6.654 | 2.475 | -0.698 | 0.0; | |
| 200 | 16.27 | 1.031 | 70.13 | 2.197 | 45.49 | 11.48 | -10.94 | 0.0; | |
| 237 | 14.41 | 1.048 | 100.4 | 1.056 | 94.65 | 23.72 | -32.6 | 0.0; | acute zone, |
| 256 | 13.2 | 1.059 | 120.5 | 0.725 | 137.9 | 34.56 | -56.62 | 0.0; | merging, |
| 297 | 8.807 | 1.075 | 218.6 | 0.322 | 310.6 | 121.2 | -225.5 | 0.0; | surface, |

Const Eddy Diffusivity. Farfield dispersion based on wastefield width of 26.89 m

| conc (kg/kg) | dilutn | width (m) | distnce (m) | time (hrs) | (kg/kg) | (s-1) | (m/s) | (m0.67/s2) |
|---|---|---|---|---|---|---|---|---|
| 0.3211 | 311.3 | 27 | | | | | | |

**F-3**

/ Windows UM3. 1/19/2009 11:58:20 AM

Case 1; ambient file U:\Nick\Camas\VP plumeF3.004.db; Diffuser table record 1: ----------

| Depth | Amb-cur | Amb-dir | Amb-sal | Amb-tem | Amb-pol | Decay | Far-spd | Far-dir | Disprsn |
|---|---|---|---|---|---|---|---|---|---|
| m | m/s | deg | psu | C | kg/kg | s-1 | m/s | deg | m0.67/s2 |
| 0.0 | 0.79 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.79 | 180.0 | 0.0003 |
| 1.0 | 0.77 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.77 | 180.0 | 0.0003 |
| 2.0 | 0.74 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.74 | 180.0 | 0.0003 |
| 3.0 | 0.7 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.7 | 180.0 | 0.0003 |
| 4.0 | 0.65 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.65 | 180.0 | 0.0003 |
| 5.0 | 0.61 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.61 | 180.0 | 0.0003 |
| 6.0 | 0.54 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.54 | 180.0 | 0.0003 |
| 7.0 | 0.46 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 8.0 | 0.46 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 9.0 | 0.46 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 10.0 | 0.46 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 11.0 | 0.46 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 12.0 | 0.46 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |

| P-dia | P-elev | V-angle | H-angle | Ports | Spacing | AcuteMZ | ChrncMZ | P-depth | Ttl-flo | Eff-sal | Temp | Polutnt |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (in) | (ft) | (deg) | (deg) | () | (ft) | (ft) | (ft) | (ft) | (MGD) | (psu) | (C) | (kg/kg) |
| 3.92 | 1.0 | 90.0 | 180.0 | 8.0 | 10.0 | 32.0 | 321.0 | 21.0 | 6.1 | 0.0 | 16.0 | 100.0 |

Froude number: 197.2

| Step | Depth (ft) | Amb-cur (m/s) | P-dia (in) | Polutnt (kg/kg) | Dilutn () | CL-diln () | x-posn (ft) | y-posn (ft) | |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 21.0 | 0.508 | 3.92 | 100.0 | 1.0 | 1.0 | 0.0 | 0.0; | |
| 100 | 18.63 | 0.562 | 24.34 | 14.3 | 6.988 | 2.822 | -0.668 | 0.0; | |
| 200 | 15.8 | 0.617 | 72.21 | 2.165 | 46.16 | 11.36 | -8.979 | 0.0; | |
| 244 | 13.59 | 0.644 | 109.3 | 0.906 | 110.3 | 26.82 | -32.18 | 0.0; | acute zone, |
| 254 | 12.98 | 0.651 | 120.0 | 0.743 | 134.5 | 32.63 | -42.77 | 0.0; | merging, |
| 298 | 8.986 | 0.709 | 220.8 | 0.311 | 321.5 | 121.8 | -170.2 | 0.0; | surface, |

Const Eddy Diffusivity. Farfield dispersion based on wastefield width of 26.94 m

| conc (kg/kg) | dilutn | width (m) | distnce (m) | time (hrs) | (kg/kg) | (s-1) | (m/s) | (m0.67/s2) |
|---|---|---|---|---|---|---|---|---|
| 0.31058 | 321.8 | 28.0 | 97.84 | 0.0278 | 0.0 | 0.0 | 0.46 | 3.00E-4 |

count: 1

;

11:58:22 AM. amb fills: 2

**F-4**

/ Windows UM3. 1/19/2009 12:39:30 PM

Case 1; ambient file U:\Nick\Camas\VP plumeF4.005.db; Diffuser table record 1: ----------

| Depth | Amb-cur | Amb-dir | Amb-sal | Amb-tem | Amb-pol | Decay | Far-spd | Far-dir | Disprsn |
|---|---|---|---|---|---|---|---|---|---|
| m | m/s | deg | psu | C | kg/kg | s-1 | m/s | deg | m0.67/s2 |
| 0.0 | 0.264 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.264 | 180.0 | 0.0003 |
| 1.0 | 0.264 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.264 | 180.0 | 0.0003 |
| 2.0 | 0.256 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.256 | 180.0 | 0.0003 |
| 3.0 | 0.247 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.247 | 180.0 | 0.0003 |
| 4.0 | 0.228 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.228 | 180.0 | 0.0003 |
| 5.0 | 0.21 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.21 | 180.0 | 0.0003 |
| 6.0 | 0.187 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.187 | 180.0 | 0.0003 |
| 7.0 | 0.163 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.163 | 180.0 | 0.0003 |
| 8.0 | 0.163 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.163 | 180.0 | 0.0003 |
| 9.0 | 0.163 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.163 | 180.0 | 0.0003 |
| 10.0 | 0.163 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.163 | 180.0 | 0.0003 |
| 11.0 | 0.163 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.163 | 180.0 | 0.0003 |
| 12.0 | 0.163 | 180.0 | 0.0 | 12.6 | 0.0 | 0.0 | 0.163 | 180.0 | 0.0003 |

| P-dia | P-elev | V-angle | H-angle | Ports | Spacing | AcuteMZ | ChrncMZ | P-depth | Ttl-flo | Eff-sal | Temp | Polutnt |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (in) | (ft) | (deg) | (deg) | () | (ft) | (ft) | (ft) | (ft) | (MGD) | (psu) | (C) | (kg/kg) |
| 4.27 | 1.0 | 90.0 | 180.0 | 8.0 | 10.0 | 32.0 | 321.0 | 21.0 | 10.04 | 0.0 | 16.0 | 100.0 |

Froude number: 262.0

| Step | Depth (ft) | Amb-cur (m/s) | P-dia (in) | Polutnt (kg/kg) | Dilutn () | CL-diln () | x-posn (ft) | y-posn (ft) | |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 21.0 | 0.177 | 4.27 | 100.0 | 1.0 | 1.0 | 0.0 | 0.0; | |
| 100 | 15.99 | 0.212 | 30.31 | 13.8 | 7.242 | 3.664 | -0.476 | 0.0; | |
| 187 | 8.361 | 0.251 | 120.9 | 2.674 | 37.38 | 12.19 | -5.236 | 0.0; | merging, |
| 200 | 7.106 | 0.254 | 146.6 | 2.083 | 47.99 | 15.56 | -7.297 | 0.0; | |
| 208 | 6.171 | 0.257 | 168.2 | 1.778 | 56.23 | 18.92 | -9.21 | 0.0; | surface, |

Const Eddy Diffusivity. Farfield dispersion based on wastefield width of 25.61 m

| conc (kg/kg) | dilutn | width (m) | distnce (m) | time (hrs) | (kg/kg) | (s-1) | (m/s) | (m0.67/s2) |
|---|---|---|---|---|---|---|---|---|
| 1.75478 | 56.96 | 31.19 | 97.84 | 0.162 | 0.0 | 0.0 | 0.163 | 3.00E-4 |

count: 1

;

12:39:32 PM. amb fills: 2

**F-5**

/ Windows UM3. 1/19/2009 12:57:27 PM

Case 1; ambient file U:\Nick\Camas\VP plumeF5.006.db; Diffuser table record 1: ----------

| Depth | Amb-cur | Amb-dir | Amb-sal | Amb-tem | Amb-pol | Decay | Far-spd | Far-dir | Disprsn |
|---|---|---|---|---|---|---|---|---|---|
| m | m/s | deg | psu | C | kg/kg | s-1 | m/s | deg | m0.67/s2 |
| 0.0 | 0.79 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.79 | 180.0 | 0.0003 |
| 1.0 | 0.77 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.77 | 180.0 | 0.0003 |
| 2.0 | 0.74 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.74 | 180.0 | 0.0003 |
| 3.0 | 0.7 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.7 | 180.0 | 0.0003 |
| 4.0 | 0.65 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.65 | 180.0 | 0.0003 |
| 5.0 | 0.61 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.61 | 180.0 | 0.0003 |
| 6.0 | 0.54 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.54 | 180.0 | 0.0003 |
| 7.0 | 0.46 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 8.0 | 0.46 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 9.0 | 0.46 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 10.0 | 0.46 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 11.0 | 0.46 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 12.0 | 0.46 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |

| P-dia | P-elev | V-angle | H-angle | Ports | Spacing | AcuteMZ | ChrncMZ | P-depth | Ttl-flo | Eff-sal | Temp | Polutnt |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (in) | (ft) | (deg) | (deg) | () | (ft) | (ft) | (ft) | (ft) | (MGD) | (psu) | (C) | (kg/kg) |
| 3.77 | 1.0 | 90.0 | 180.0 | 8.0 | 10.0 | 32.0 | 321.0 | 21.0 | 5.09 | 0.0 | 22.0 | 100.0 |

Froude number: 376.5

| Step | Depth (ft) | Amb-cur (m/s) | P-dia (in) | Polutnt (kg/kg) | Dilutn () | CL-diln () | x-posn (ft) | y-posn (ft) | |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 21.0 | 0.508 | 3.77 | 100.0 | 1.0 | 1.0 | 0.0 | 0.0; | |
| 100 | 18.9 | 0.556 | 22.7 | 14.55 | 6.872 | 2.697 | -0.631 | 0.0; | |
| 200 | 16.34 | 0.61 | 66.16 | 2.187 | 45.72 | 11.17 | -8.838 | 0.0; | |
| 245 | 14.28 | 0.635 | 101.0 | 0.897 | 111.5 | 27.11 | -32.73 | 0.0; | acute zone, |
| 264 | 13.19 | 0.648 | 120.7 | 0.616 | 162.4 | 39.52 | -56.16 | 0.0; | merging, |
| 300 | 10.23 | 0.693 | 196.3 | 0.302 | 331.3 | 110.0 | -172.5 | 0.0; | |
| 309 | 9.308 | 0.705 | 226.9 | 0.253 | 395.9 | 156.0 | -227.6 | 0.0; | surface, |

Const Eddy Diffusivity. Farfield dispersion based on wastefield width of 27.10 m

| conc (kg/kg) | dilutn | width (m) | distnce (m) | time (hrs) | (kg/kg) | (s-1) | (m/s) | (m0.67/s2) |
|---|---|---|---|---|---|---|---|---|
| 0.25217 | 396.5 | 27.76 | 97.84 | 0.0172 | 0.0 | 0.0 | 0.46 | 3.00 |

**F-6**

/ Windows UM3. 1/19/2009 1:42:05 PM

Case 1; ambient file U:\Nick\Camas\VP plumeF6.007.db; Diffuser table record 1: ----------

| Depth | Amb-cur | Amb-dir | Amb-sal | Amb-tem | Amb-pol | Decay | Far-spd | Far-dir | Disprsn |
|---|---|---|---|---|---|---|---|---|---|
| m | m/s | deg | psu | C | kg/kg | s-1 | m/s | deg | m0.67/s2 |
| 0.0 | 0.79 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.79 | 180.0 | 0.0003 |
| 1.0 | 0.77 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.77 | 180.0 | 0.0003 |
| 2.0 | 0.74 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.74 | 180.0 | 0.0003 |
| 3.0 | 0.7 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.7 | 180.0 | 0.0003 |
| 4.0 | 0.65 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.65 | 180.0 | 0.0003 |
| 5.0 | 0.61 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.61 | 180.0 | 0.0003 |
| 6.0 | 0.54 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.54 | 180.0 | 0.0003 |
| 7.0 | 0.46 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 8.0 | 0.46 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 9.0 | 0.46 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 10.0 | 0.46 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 11.0 | 0.46 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |
| 12.0 | 0.46 | 180.0 | 0.0 | 21.5 | 0.0 | 0.0 | 0.46 | 180.0 | 0.0003 |

| P-dia | P-elev | V-angle | H-angle | Ports | Spacing | AcuteMZ | ChrncMZ | P-depth | Ttl-flo | Eff-sal | Temp | Polutnt |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (in) | (ft) | (deg) | (deg) | () | (ft) | (ft) | (ft) | (ft) | (MGD) | (psu) | (C) | (kg/kg) |
| 3.92 | 1.0 | 90.0 | 180.0 | 8.0 | 10.0 | 32.0 | 321.0 | 21.0 | 6.36 | 0.0 | 22.0 | 100.0 |

Froude number: 426.7

| Step | Depth (ft) | Amb-cur (m/s) | P-dia (in) | Polutnt (kg/kg) | Dilutn () | CL-diln () | x-posn (ft) | y-posn (ft) | |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 21.0 | 0.508 | 3.92 | 100.0 | 1.0 | 1.0 | 0.0 | 0.0; | |
| 100 | 18.55 | 0.564 | 24.64 | 14.22 | 7.033 | 2.873 | -0.672 | 0.0; | |
| 200 | 15.65 | 0.619 | 73.7 | 2.158 | 46.33 | 11.43 | -8.91 | 0.0; | |
| 244 | 13.39 | 0.646 | 111.6 | 0.903 | 110.7 | 26.92 | -32.01 | 0.0; | acute zone, |
| 252 | 12.89 | 0.653 | 120.3 | 0.771 | 129.7 | 31.49 | -40.25 | 0.0; | merging, |
| 295 | 8.976 | 0.709 | 218.0 | 0.329 | 304.0 | 113.3 | -158.6 | 0.0; | surface, |

Const Eddy Diffusivity. Farfield dispersion based on wastefield width of 26.87 m

| conc (kg/kg) | dilutn | width (m) | distnce (m) | time (hrs) | (kg/kg) | (s-1) | (m/s) | (m0.67/s2) |
|---|---|---|---|---|---|---|---|---|
| 0.32855 | 304.3 | 28. | | | | | | |

# Technical Memorandum

PO Box 1678 • Tacoma, WA 98401-1678
711 Pacific Avenue • Tacoma, WA 98402
Phone (253) 272-7220 • Fax (253) 272-7250
BFox@cosmopolitaneng.com

**TM TITLE:** **City of Camas Mixing Zone Study – 16-Port Diffuser**

**DATE:** February 19, 2009

**TO:** Jay Swift, PE, Gray & Osborne

**PREPARED BY:** Nick Whitaker, Cosmopolitan Engineering Group

**REVIEWED BY:** Bill Fox, PE, Cosmopolitan Engineering Group

**PROJECT #:** G&O016

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## LIST OF ATTACHMENTS

Attachment 1: UM3 Model Runs

## INTRODUCTION

Cosmopolitan Engineering Group completed an update to the *Mixing Zone Analysis* for the City of Camas in a Technical Memorandum (TM) dated January 20, 2009. That TM evaluated mixing for a proposed eight-port diffuser modification in which the discharge ports were oriented vertically with the addition of Tideflex elastomeric check valves. The City of Camas is now considering opening up more ports for their existing diffuser. This TM evaluates the dilution and Reasonable Potential Analysis (RPA) for the proposed extended 16-port diffuser with vertical ports and elastomeric check valves.

## EFFLUENT FLOW RATES

The effluent flow design criteria is the same as the January 20th TM, presented in Table 1.

**Table 1 Effluent Flow Design Criteria for Facility Planning**

| Planning Year | Winter Flow Criteria | | Summer Flow Criteria | |
|---|---|---|---|---|
| | Max. Month (mgd) | Max. Day (mgd) | Max. Month (mgd) | Max. Day (mgd) |
| 2025 | 6.10 | 10.04 | 5.09 | 6.36 |

## POTENTIAL DIFFUSER MODIFICATION

The potential diffuser extension would consist of 16 ports oriented to discharge vertically. Each port would be fitted with a 6-inch Tideflex elastomeric check valve. Port spacing would remain at 10 feet, effectively doubling the diffuser length. Revised performance data for the 16-port arrangement are provided in Table 2.

**Table 2 Diffuser Port Velocities for Tideflex Diffuser Valves**

| Design Year | Season | Max Flow Period | Effluent Flow (mgd) | Flow per Port (gpm) | Discharge Velocity (fps) | Effective Area (sq. in.) | Effective Diameter (in.) |
|---|---|---|---|---|---|---|---|
| 2025 | Winter | 30-day | 6.1 | 265 | 9.6 | 8.89 | 3.36 |
| 2025 | Winter | 24-hr | 10.04 | 436 | 12.6 | 11.05 | 3.75 |
| 2025 | Summer | 30-day | 5.09 | 221 | 8.7 | 8.18 | 3.23 |
| 2025 | Summer | 24-hr | 6.36 | 276 | 9.8 | 9.05 | 3.40 |

## DILUTION MODELING

### UM3 MODEL

The UM3 models runs were carried out through the Visual Plumes interface. A default aspiration entrainment coefficient (AEC) of 0.1 was used in all the model runs. Additional default values included the diffuser port contraction coefficient of 1. The model configuration also applied the Brooks farfield solution with the default dispersion coefficients.

The centerline dilution concentration in previous studies (CEG, 2007) was determined by dividing the calculated dilution factor by a peak-to-mean ratio of 2.3. This evaluation used a more conservative centerline dilution factor, which is calculated using the algorithms embedded in UM3.

## MODEL RESULTS

A series of UM3 model runs from the Visual Plumes interface, with the Brooks farfield algorithm, are provided in Attachment 1. All model runs are based on the vertical port orientation with Tideflex valves. The basis of the model runs and the results are described below:

| | |
|---|---|
| G-1 | This chronic model run is for near-flood ambient conditions modeled by Ecology in the NPDES permit, the 90$^{th}$ percentile river discharge of 522 kcfs. This run is equivalent to Ecology run NC22B except for the maximum month effluent flow rate for 2025. |
| G-2 | This acute model run is for the same near-flood ambient conditions modeled by Ecology, equivalent to Ecology run NC24 except the maximum day effluent flow rate for 2025. |
| G-3 | This chronic model run corresponds to the 2025 winter maximum month flow rate and winter effluent temperature. Ambient current speed is tidally-averaged current profile during the low river flow condition. |
| G-4 | This acute model run corresponds to 2025 maximum day winter flow rate and winter effluent temperature. Ambient current speed is the one-hour minimum velocity profile from the current meter deployment, which is caused by the tidal influence that occurs during low to normal Columbia River flows. |
| G-5 | This chronic model run corresponds to 2025 summer maximum month flow rate and summer effluent temperature. Ambient current speed is tidally-averaged current profile during the low river flow condition (same as G-3). |
| G-6 | This acute model run corresponds to 2025 maximum day summer flow rate and summer effluent temperature. Ambient current speed is the one-hour minimum velocity profile from the current meter deployment (same as G-4). |

The results of the modeling are presented in Table 3. The results demonstrate that critical conditions occur during the 90$^{th}$ percentile high river discharge conditions (Runs G-1 and G-2).

**Table 3 Dilution Model Results for 2025 Effluent Flows**

| Model Run # | Ambient Condition | Discharge Depth (ft) | Avg Current Speed (m/sec) | Ambient Temp (°C) | Effluent Flow (mgd) | Effluent Temp (°C) | Acute Dilution | Chronic Dilution |
|---|---|---|---|---|---|---|---|---|
| G-1 | (1)Winter High Flow | 26.6 | 1.0 | 12.6 | 6.10 | 16.0 | | 121 |
| G-2 | (1)Winter High Flow | 26.6 | 1.0 | 12.6 | 10.04 | 16.0 | 23 | |
| G-3 | (2)Winter Average | 21.0 | 0.7 | 12.6 | 6.10 | 16.0 | | 211 |
| G-4 | (3)Winter 10% | 21.0 | 0.25 | 12.6 | 10.04 | 16.0 | 37 | |
| G-5 | (2)Summer Average | 21.0 | 0.7 | 21.5 | 5.09 | 22.0 | | 185 |
| G-6 | (3)Summer 10% | 21.0 | 0.25 | 21.5 | 6.36 | 22.0 | 27 | |

(1) Ambient conditions for 522 kcfs river flow (90th percentile) per Ecology NPDES permit (runs NC22 and NC24)

(2) Ambient condition for non-flood river flow based on tidally-averaged current profile from October 2004 current meter deployment.

(3) Ambient condition for acute model runs based on lowest tidally-influenced current profile (duration = 1 hr±) from October 2004 current meter deployment.

## REASONABLE POTENTIAL ASSESSMENT

EPA and Ecology use a statistical test to determine a discharge's "reasonable potential" to exceed water quality standards, which is based on effluent and ambient data and acute and chronic dilution factors. If a discharge exhibits a reasonable potential to exceed water quality standards for any parameter, Ecology issues an effluent limitation for that parameter in the NPDES permit. If a parameter does not exhibit a reasonable potential to exceed water quality standards, no NPDES permit limit is required.

### EFFLUENT DATA

Water quality-based effluent limits are assessed for ammonia and selected metals (cadmium, copper, lead, nickel, silver, zinc, and mercury). The critical effluent concentrations used in determination of reasonable potential are based on 12 effluent metals scans in 2005, 2006, and 2008, and over 400 effluent ammonia samples in 2005 and 2006.

The metals data are provided in Table 4. The values in red are detected concentrations, and the values in black are the detection levels for non-detected results. High concentrations of cadmium and nickel were measured on June 2, 2006. These values may be anomalous, or if realistic should be evaluated in future sampling efforts. The 95th percentile values were used in the RPA.

**Table 4 Camas Effluent Metals Data (µg/L)**

| Date | Cd | Cu | Pb | Ni | Ag | An | Hg |
|---|---|---|---|---|---|---|---|
| 5/13/2005 | 3 | 8 | 5 | 20 | 10 | 18 | 0.056 |
| 7/21/2005 | 10 | 31 | 5 | 20 | 10 | 19 | 0.05 |
| 9/30/2005 | 3 | 5 | 5 | 20 | 10 | 16 | 0.056 |
| 12/7/2005 | 3 | 5 | 5 | 20 | 10 | 15 | 0.05 |
| 3/31/2006 | 3 | 5 | 5 | 20 | 10 | 25 | 0.07 |
| 6/2/2006 | 87 | 12 | 5 | 373 | 70 | 20 | 0.05 |
| 9/12/2006 | 3 | 7 | 5 | 20 | 10 | 31 | |
| 12/18/2006 | 3 | 5 | 5 | 29 | 10 | 30 | 0.05 |
| 3/14/2008 | 5 | 20 | 10 | 50 | 10 | 50 | |
| 7/2/2008 | 5 | 20 | 5 | 20 | 10 | 50 | 0.04 |
| 9/22/2008 | 5 | 20 | 5 | 20 | 10 | 50 | 0.16 |
| 11/25/2008 | 5 | 20 | 10 | 20 | 10 | 50 | 0.2 |
| | | | | | | | |
| Count | 12 | 12 | 12 | 12 | 12 | 12 | 10 |
| # Detects | 2 | 4 | 0 | 2 | 0 | 8 | 3 |
| 95th percentile | 44.65 | 24.95 | 10 | 195.35 | 10 | 50 | 0.182 |

Detected Values in Red Detection Limit in Black

## AMBIENT DATA AND WATER QUALITY STANDARDS

No ambient sampling has been conducted in this mixing zone study for ammonia or metals or the parameters that affect their water quality standards (pH, temperature, and hardness). The criteria for ambient concentrations, and ambient-depended water quality criteria, are the same as Ecology cited in Appendix C of the NPDES permit.

## REASONABLE POTENTIAL RESULTS

The reasonable potential to exceed water quality standards for ammonia and metals is presented in Table 5 for the recommended diffuser modifications. Ammonia is the only analyte considered seasonally due to its dependence on ambient pH and temperature. Cadmium was the only analyte with a reasonable potential to exceed water quality standards.

A comparison of the 8-port and 16-port diffusers RPA results in Table 5 shows a decrease in the maximum concentration at the edge of the acute mixing zone boundaries (except for mercury and lead) and nearly identical values for the chronic mixing zone boundary. Based on the Visual Plumes modeling, the outfall extension would decrease the concentrations of Cadmium at the acute mixing zone boundaries, but will not lower concentrations enough to meet the State Water Quality Standards. However, this finding is based on only one high detected value, and thus should be sampled more frequently in the future to determine if the reasonable potential is realistic.

## Table 5 Reasonable Potential Calculation Table

### 8-PORT DIFFUSER

| | | | | State Water Quality Standard | | Max concentration at edge of... | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Metal Criteria Translator as decimal | Metal Criteria Translator as decimal | Ambient Concentration (metals as dissolved) | Acute | Chronic | Acute Mixing Zone | Chronic Mixing Zone | LIMIT REQ'D? | Max effluent conc. measured (metals as total recoverable) | Coeff Variation | | # of samples | Multiplier | Acute Dil'n Factor | Chronic Dil'n Factor |
| Parameter | Acute | Chronic | ug/L | ug/L | ug/L | ug/L | ug/L | | ug/L | CV | s | n | | | |
| **Modified Diffuser (Vertical Discharge)** | | | | | | | | | | | | | | | |
| **2025** | | | | | | | | | | | | | | | |
| Ammonia-N (summer) | 1.00 | 1.00 | 27.00 | 5100.00 | 830.000 | 939.52 | 184.94 | NO | 35200 | 0.60 | 0.55 | 268 | 0.70 | 27.0 | 156.0 |
| Ammonia-N (winter) | 1.00 | 1.00 | 19.00 | 2100.00 | 470.000 | 1316.16 | 221.02 | NO | 35200 | 0.60 | 0.55 | 268 | 0.70 | 19.0 | 122.0 |
| Cadmium | 0.940 | 0.940 | 0.53 | 1.70 | 0.61 | 4.12 | 1.09 | YES | 45.00 | 0.60 | 0.55 | 12 | 1.63 | 19.0 | 122.0 |
| Copper | 1.000 | 1.000 | 0.86 | 8.65 | 6.14 | 2.95 | 1.19 | NO | 25.00 | 0.60 | 0.55 | 12 | 1.63 | 19.0 | 122.0 |
| Lead | 0.470 | 0.470 | 0.06 | 29.3 | 1.14 | 0.46 | 0.12 | NO | 10.0 | 0.60 | 0.55 | 12 | 1.63 | 19.0 | 122.0 |
| Nickel | 1.000 | 1.000 | 0.56 | 770.7 | 85.60 | 17.21 | 3.15 | NO | 195.00 | 0.60 | 0.55 | 12 | 1.63 | 19.0 | 122.0 |
| Silver | 0.850 | 0.850 | 0.10 | 1.00 | 100.00 | 0.82 | 0.21 | NO | 10.00 | 0.60 | 0.55 | 12 | 1.63 | 19.0 | 122.0 |
| Zinc | 1.000 | 1.000 | 2.00 | 62.3 | 56.9 | 4.55 | 2.40 | NO | 31.000 | 0.60 | 0.55 | 12 | 1.63 | 19.0 | 122.0 |
| Mercury | 1.000 | 1.000 | | 2.1 | 0.012 | 0.02 | 0.003 | NO | 0.182 | 0.60 | 0.55 | 10 | 1.74 | 19.0 | 122.0 |

### 16-PORT DIFFUSER

| | | | | State Water Quality Standard | | Max concentration at edge of... | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Metal Criteria Translator as decimal | Metal Criteria Translator as decimal | Ambient Concentration (metals as dissolved) | Acute | Chronic | Acute Mixing Zone | Chronic Mixing Zone | LIMIT REQ'D? | Max effluent conc. measured (metals as total recoverable) | Coeff Variation | | # of samples | Multiplier | Acute Dil'n Factor | Chronic Dil'n Factor |
| Parameter | Acute | Chronic | ug/L | ug/L | ug/L | ug/L | ug/L | | ug/L | CV | s | n | | | |
| **Modified Diffuser (Vertical Discharge)** | | | | | | | | | | | | | | | |
| **2025** | | | | | | | | | | | | | | | |
| Ammonia-N (summer) | 1.00 | 1.00 | 27.00 | 5100.00 | 830.000 | 939.52 | 160.18 | NO | 35200 | 0.60 | 0.55 | 268 | 0.70 | 27.0 | 185.0 |
| Ammonia-N (winter) | 1.00 | 1.00 | 19.00 | 2100.00 | 470.000 | 1090.57 | 222.69 | NO | 35200 | 0.60 | 0.55 | 268 | 0.70 | 23.0 | 121.0 |
| Cadmium | 0.940 | 0.940 | 0.53 | 1.70 | 0.61 | 3.50 | 1.09 | YES | 45.00 | 0.60 | 0.55 | 12 | 1.63 | 23.0 | 121.0 |
| Copper | 1.000 | 1.000 | 0.86 | 8.65 | 6.14 | 2.59 | 1.19 | NO | 25.00 | 0.60 | 0.55 | 12 | 1.63 | 23.0 | 121.0 |
| Lead | 0.470 | 0.470 | 0.06 | 29.3 | 1.14 | 0.39 | 0.12 | NO | 10.0 | 0.60 | 0.55 | 12 | 1.63 | 23.0 | 121.0 |
| Nickel | 1.000 | 1.000 | 0.56 | 770.7 | 85.60 | 14.32 | 3.17 | NO | 195.00 | 0.60 | 0.55 | 12 | 1.63 | 23.0 | 121.0 |
| Silver | 0.850 | 0.850 | 0.10 | 1.00 | 100.00 | 0.70 | 0.21 | NO | 10.00 | 0.60 | 0.55 | 12 | 1.63 | 23.0 | 121.0 |
| Zinc | 1.000 | 1.000 | 2.00 | 62.3 | 56.9 | 4.10 | 2.40 | NO | 31.000 | 0.60 | 0.55 | 12 | 1.63 | 23.0 | 121.0 |
| Mercury | 1.000 | 1.000 | | 2.1 | 0.012 | 0.01 | 0.003 | NO | 0.182 | 0.60 | 0.55 | 10 | 1.74 | 23.0 | 121.0 |

# Attachment 1

UM3 Model Runs

# G-1

```
/ Windows UM3. 2/12/2009 11:20:51 AM
Case 1; ambient file U:\Nick\Camas\VP plumeF1.002.db; Diffuser table record 1: ----------------------------------
      Depth    Amb-cur    Amb-dir    Amb-sal    Amb-tem    Amb-pol      Decay    Far-spd    Far-dir    Disprsn
          m        m/s        deg        psu          C      kg/kg        s-1        m/s        deg   m0.67/s2
        0.0       1.03      180.0        0.0       12.6        0.0        0.0       1.03      180.0     0.0003
        1.0       1.09      180.0        0.0       12.6        0.0        0.0       1.09      180.0     0.0003
        2.0       1.09      180.0        0.0       12.6        0.0        0.0       1.09      180.0     0.0003
        3.0       1.07      180.0        0.0       12.6        0.0        0.0       1.07      180.0     0.0003
        4.0       1.06      180.0        0.0       12.6        0.0        0.0       1.06      180.0     0.0003
        5.0       1.03      180.0        0.0       12.6        0.0        0.0       1.03      180.0     0.0003
        6.0        1.0      180.0        0.0       12.6        0.0        0.0        1.0      180.0     0.0003
        7.0       0.98      180.0        0.0       12.6        0.0        0.0       0.98      180.0     0.0003
        8.0       0.95      180.0        0.0       12.6        0.0        0.0       0.95      180.0     0.0003
        9.0       0.92      180.0        0.0       12.6        0.0        0.0       0.92      180.0     0.0003
       10.0       0.91      180.0        0.0       12.6        0.0        0.0       0.91      180.0     0.0003
       11.0       0.89      180.0        0.0       12.6        0.0        0.0       0.89      180.0     0.0003
       12.0       0.85      180.0        0.0       12.6        0.0        0.0       0.85      180.0     0.0003
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
    (in)    (ft)   (deg)   (deg)      ()    (ft)    (ft)    (ft)    (ft)   (MGD)   (psu)     (C) (kg/kg)
    3.36     1.0    90.0   180.0    16.0    10.0    32.0   321.0    26.6     6.1     0.0    16.0   100.0
Froude number:      144.9
        Depth  Amb-cur    P-dia  Polutnt   Dilutn  CL-diln   x-posn   y-posn
Step     (ft)    (m/s)     (in)  (kg/kg)       ()       ()     (ft)     (ft)
   0      26.6    0.947     3.36    100.0      1.0      1.0      0.0      0.0;
  62     26.08    0.951    9.154     33.5    2.984    1.203   -0.137      0.0; begin overlap,
  95     25.87    0.953    12.84    20.61     4.85    1.537   -0.335      0.0; end overlap,
 100     25.84    0.954    13.49    19.01    5.258    1.607   -0.381      0.0;
 200     24.48    0.966    36.13    2.695    37.09    9.272   -8.312      0.0;
 245      23.3    0.977    55.83    1.106    90.41    22.76   -32.06      0.0; acute zone,
 300     21.06    0.991    95.31    0.372    268.7    67.94   -154.4      0.0;
 324     19.77    0.999    120.4    0.231    432.1    109.4   -291.8      0.0; merging,
 328     19.52    1.001    125.7    0.214    467.8    120.7   -325.7      0.0; chronic zone,
 386     14.45    1.047    316.8   0.0678   1475.1    651.3  -1478.4      0.0; bottom hit,
 390     14.03    1.051    340.8   0.0626   1596.7    704.6  -1614.9      0.0; surface,
Outside chronic zone
 ;
11:2
```

# G-2

```
/ Windows UM3. 2/12/2009 11:25:38 AM
Case 1; ambient file U:\Nick\Camas\VP plumeF2.003.db; Diffuser table record 1: ----------------------------------
      Depth    Amb-cur    Amb-dir    Amb-sal    Amb-tem    Amb-pol      Decay    Far-spd    Far-dir    Disprsn
          m        m/s        deg        psu          C      kg/kg        s-1        m/s        deg   m0.67/s2
        0.0       1.03      180.0        0.0       12.6        0.0        0.0       1.03      180.0     0.0003
        1.0       1.09      180.0        0.0       12.6        0.0        0.0       1.09      180.0     0.0003
        2.0       1.09      180.0        0.0       12.6        0.0        0.0       1.09      180.0     0.0003
        3.0       1.07      180.0        0.0       12.6        0.0        0.0       1.07      180.0     0.0003
        4.0       1.06      180.0        0.0       12.6        0.0        0.0       1.06      180.0     0.0003
        5.0       1.03      180.0        0.0       12.6        0.0        0.0       1.03      180.0     0.0003
        6.0        1.0      180.0        0.0       12.6        0.0        0.0        1.0      180.0     0.0003
        7.0       0.98      180.0        0.0       12.6        0.0        0.0       0.98      180.0     0.0003
        8.0       0.95      180.0        0.0       12.6        0.0        0.0       0.95      180.0     0.0003
        9.0       0.92      180.0        0.0       12.6        0.0        0.0       0.92      180.0     0.0003
       10.0       0.91      180.0        0.0       12.6        0.0        0.0       0.91      180.0     0.0003
       11.0       0.89      180.0        0.0       12.6        0.0        0.0       0.89      180.0     0.0003
       12.0       0.85      180.0        0.0       12.6        0.0        0.0       0.85      180.0     0.0003
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
    (in)    (ft)   (deg)   (deg)      ()    (ft)    (ft)    (ft)    (ft)   (MGD)   (psu)     (C) (kg/kg)
    3.75     1.0    90.0   180.0    16.0    10.0    32.0   321.0    26.6   10.04     0.0    16.0   100.0
Froude number:      181.3
        Depth  Amb-cur    P-dia  Polutnt   Dilutn  CL-diln   x-posn   y-posn
Step     (ft)    (m/s)     (in)  (kg/kg)       ()       ()     (ft)     (ft)
   0      26.6    0.947     3.75    100.0      1.0      1.0      0.0      0.0;
 100     25.43    0.957    17.64     16.9    5.915    1.955   -0.507      0.0;
 200     23.57    0.974    48.68    2.419    41.32    10.37    -9.75      0.0;
 240     22.18    0.985    71.68    1.096    91.24    22.97   -32.17      0.0; acute zone,
 294     19.32    1.003    121.1    0.376    265.8    67.26   -152.1      0.0; merging,
 300     18.89    1.007    129.6    0.334    299.3    78.04   -181.8      0.0;
 319     17.26    1.021    169.4    0.229    436.1    132.9   -324.5      0.0; chronic zone,
 356     12.95     1.06    318.8     0.11    907.4    399.1   -942.5      0.0; surface,
Outside chronic zone
 ;
11:25:40 AM. amb fills: 2
```

# G-3

```
/ Windows UM3. 2/2/2009 9:24:59 AM
Case 1; ambient file U:\Nick\Camas\VP plumeF3.004.db; Diffuser table record 1: ----------------------------------
      Depth    Amb-cur    Amb-dir    Amb-sal    Amb-tem    Amb-pol      Decay    Far-spd    Far-dir    Disprsn
          m        m/s        deg        psu          C      kg/kg        s-1        m/s        deg   m0.67/s2
        0.0       0.79      180.0        0.0       12.6        0.0        0.0       0.79      180.0     0.0003
        1.0       0.77      180.0        0.0       12.6        0.0        0.0       0.77      180.0     0.0003
        2.0       0.74      180.0        0.0       12.6        0.0        0.0       0.74      180.0     0.0003
        3.0        0.7      180.0        0.0       12.6        0.0        0.0        0.7      180.0     0.0003
        4.0       0.65      180.0        0.0       12.6        0.0        0.0       0.65      180.0     0.0003
        5.0       0.61      180.0        0.0       12.6        0.0        0.0       0.61      180.0     0.0003
        6.0       0.54      180.0        0.0       12.6        0.0        0.0       0.54      180.0     0.0003
        7.0       0.46      180.0        0.0       12.6        0.0        0.0       0.46      180.0     0.0003
        8.0       0.46      180.0        0.0       12.6        0.0        0.0       0.46      180.0     0.0003
        9.0       0.46      180.0        0.0       12.6        0.0        0.0       0.46      180.0     0.0003
       10.0       0.46      180.0        0.0       12.6        0.0        0.0       0.46      180.0     0.0003
       11.0       0.46      180.0        0.0       12.6        0.0        0.0       0.46      180.0     0.0003
       12.0       0.46      180.0        0.0       12.6        0.0        0.0       0.46      180.0     0.0003
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
    (in)    (ft)   (deg)   (deg)      ()    (ft)    (ft)    (ft)    (ft)   (MGD)   (psu)     (C) (kg/kg)
    3.36     1.0    90.0   180.0    16.0    10.0    32.0   321.0    21.0     6.1     0.0    16.0   100.0
Froude number:      144.9
        Depth  Amb-cur    P-dia  Polutnt   Dilutn  CL-diln   x-posn   y-posn
Step     (ft)    (m/s)     (in)  (kg/kg)       ()       ()     (ft)     (ft)
   0      21.0    0.508     3.36    100.0      1.0      1.0      0.0      0.0;
 100     19.55    0.543    18.25    15.45    6.472     2.34   -0.518      0.0;
 200      17.6    0.584    51.23    2.271    44.02    10.77   -8.279      0.0;
 248     15.92    0.615    80.32    0.878    113.9    27.63   -32.88      0.0; acute zone,
 291     13.88     0.64    120.3    0.375    266.8     65.1   -105.9      0.0; merging,
 300     13.35    0.647    132.9    0.313    318.9    81.51   -136.5      0.0;
 331     11.02    0.681    209.2     0.17    589.1    211.0   -329.5      0.0; chronic zone,
 341     10.16
```

# G-4

```
/ Windows UM3. 2/2/2009 9:27:04 AM
Case 1; ambient file U:\Nick\Camas\VP plumeF4.005.db; Diffuser table record 1: ----------------------------------
      Depth    Amb-cur    Amb-dir    Amb-sal    Amb-tem    Amb-pol      Decay    Far-spd    Far-dir    Disprsn
          m        m/s        deg        psu          C      kg/kg        s-1        m/s        deg   m0.67/s2
        0.0      0.264      180.0        0.0       12.6        0.0        0.0      0.264      180.0     0.0003
        1.0      0.264      180.0        0.0       12.6        0.0        0.0      0.264      180.0     0.0003
        2.0      0.256      180.0        0.0       12.6        0.0        0.0      0.256      180.0     0.0003
        3.0      0.247      180.0        0.0       12.6        0.0        0.0      0.247      180.0     0.0003
        4.0      0.228      180.0        0.0       12.6        0.0        0.0      0.228      180.0     0.0003
        5.0       0.21      180.0        0.0       12.6        0.0        0.0       0.21      180.0     0.0003
        6.0      0.187      180.0        0.0       12.6        0.0        0.0      0.187      180.0     0.0003
        7.0      0.163      180.0        0.0       12.6        0.0        0.0      0.163      180.0     0.0003
        8.0      0.163      180.0        0.0       12.6        0.0        0.0      0.163      180.0     0.0003
        9.0      0.163      180.0        0.0       12.6        0.0        0.0      0.163      180.0     0.0003
       10.0      0.163      180.0        0.0       12.6        0.0        0.0      0.163      180.0     0.0003
       11.0      0.163      180.0        0.0       12.6        0.0        0.0      0.163      180.0     0.0003
       12.0      0.163      180.0        0.0       12.6        0.0        0.0      0.163      180.0     0.0003
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
    (in)    (ft)   (deg)   (deg)      ()    (ft)    (ft)    (ft)    (ft)   (MGD)   (psu)     (C) (kg/kg)
    3.75     1.0    90.0   180.0    16.0    10.0    32.0   321.0    21.0   10.04     0.0    16.0   100.0
Froude number:      181.3
        Depth  Amb-cur    P-dia  Polutnt   Dilutn  CL-diln   x-posn   y-posn
Step     (ft)    (m/s)     (in)  (kg/kg)       ()       ()     (ft)     (ft)
   0      21.0    0.177     3.75    100.0      1.0      1.0      0.0      0.0;
 100     17.11    0.205    26.29     13.8    7.242    3.554   -0.531      0.0;
 200     11.59    0.236    106.7    2.061    48.49    12.98   -6.815      0.0;
 212     10.77    0.241    120.4    1.625    61.49    15.72   -9.361      0.0; merging,
 244     7.602    0.253    186.0    0.862    115.9    37.09    -25.7      0.0; surface,
Const Eddy Diffusivity.  Farfield dispersion based on wastefield width of      50.44 m
    conc  dilutn   width distnce    time
 (kg/kg)             (m)     (m)    (hrs) (kg/kg)   (s-1)   (m/s)(m0.67/s2)
 0.86125   116.1   57.32   97.84   0.153     0.0     0.0   0.163 3.00E-4
count: 1
 ;
9:27:07 AM. amb fills: 2
```

# G-5

```
/ Windows UM3. 1/30/2009 4:39:10 PM
Case 1; ambient file U:\Nick\Camas\VP plumeF5.006.db; Diffuser table record 1: ----------------------------------
      Depth    Amb-cur    Amb-dir    Amb-sal    Amb-tem    Amb-pol      Decay    Far-spd    Far-dir    Disprsn
          m        m/s        deg        psu          C      kg/kg        s-1        m/s        deg   m0.67/s2
        0.0       0.79      180.0        0.0       21.5        0.0        0.0       0.79      180.0     0.0003
        1.0       0.77                                                           0.77
        2.0       0.74                                                           0.74
        3.0        0.7                                                            0.7
        4.0       0.65                                                           0.65
        5.0       0.61                                                           0.61
        6.0       0.54                                                           0.54
        7.0       0.46                                                           0.46
        8.0       0.46                                                           0.46
        9.0       0.46                                                           0.46
       10.0       0.46                                                           0.46
       11.0       0.46                                                           0.46
       12.0       0.46                                                           0.46
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
    (in)    (ft)   (deg)   (deg)      ()    (ft)    (ft)    (ft)    (ft)   (MGD)   (psu)     (C) (kg/kg)
    3.23     1.0    90.0   180.0    16.0    10.0    32.0   321.0    21.0    5.09     0.0    22.0   100.0
Froude number:      277.0
        Depth  Amb-cur    P-dia  Polutnt   Dilutn  CL-diln   x-posn   y-posn
Step     (ft)    (m/s)     (in)  (kg/kg)       ()       ()     (ft)     (ft)
   0      21.0    0.508     3.23    100.0      1.0      1.0      0.0      0.0;
 100     19.73    0.539    16.81    15.87    6.302    2.211   -0.478      0.0;
 200     17.97    0.576    46.62    2.316    43.17    10.57   -8.063      0.0;
 248     16.45    0.608    73.16    0.895    111.7    27.03   -32.24      0.0; acute zone,
 300     14.23    0.636    119.2     0.32    312.7     76.4   -131.2      0.0;
 301     14.18    0.637    120.3    0.313    319.0    78.02   -134.6      0.0; merging,
 332     12.28    0.662    181.8     0.17    589.4    185.0   -326.4      0.0; chronic zone,
 354     10.74
```

# G-6

```
/ Windows UM3. 1/30/2009 4:40:27 PM
Case 1; ambient file U:\Nick\Camas\VP plumeF6.007.db; Diffuser table record 1: ----------------------------------
      Depth    Amb-cur    Amb-dir    Amb-sal    Amb-tem    Amb-pol      Decay    Far-spd    Far-dir    Disprsn
          m        m/s        deg        psu          C      kg/kg        s-1        m/s        deg   m0.67/s2
        0.0       0.79      180.0        0.0       21.5        0.0        0.0       0.79      180.0     0.0003
        1.0       0.77                                                           0.77
        2.0       0.74                                                           0.74
        3.0        0.7                                                            0.7
        4.0       0.65                                                           0.65
        5.0       0.61                                                           0.61
        6.0       0.54                                                           0.54
        7.0       0.46                                                           0.46
        8.0       0.46                                                           0.46
        9.0       0.46                                                           0.46
       10.0       0.46                                                           0.46
       11.0       0.46                                                           0.46
       12.0       0.46                                                           0.46
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
    (in)    (ft)   (deg)   (deg)      ()    (ft)    (ft)    (ft)    (ft)   (MGD)   (psu)     (C) (kg/kg)
     3.4     1.0    90.0   180.0    16.0    10.0    32.0   321.0    21.0    6.36     0.0    22.0   100.0
Froude number:      304.5
        Depth  Amb-cur    P-dia  Polutnt   Dilutn  CL-diln   x-posn   y-posn
Step     (ft)    (m/s)     (in)  (kg/kg)       ()       ()     (ft)     (ft)
   0      21.0    0.508      3.4    100.0      1.0      1.0      0.0      0.0;
 100      19.5    0.544    18.61    15.38      6.5    2.363   -0.527      0.0;
 200     17.52    0.586    52.32    2.265    44.14    10.79   -8.368      0.0;
 247     15.84    0.616    81.25    0.893    111.9    27.17    -32.5      0.0; acute zone,
 289     13.84    0.641    120.5    0.389    257.2    62.79   -103.6      0.0; merging,
 300     13.17    0.649    136.6    0.313    319.8     82.9   -142.8      0.0;
 328     11.11    0.679    206.6     0.18    556.7    196.8   -324.6      0.0; chronic zone,
 339     10.22    0.693    247.7    0.144    692.2    298.9   -437.4      0.0; surface,
Outside chronic zone
 ;
4:40:29 PM. amb fills: 2
```

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
*PO Box 47775 • Olympia, Washington 98504-7775 • (360) 407-6300*

October 21, 2009

Mr. Monte Brachmann
Public Works Director
City of Camas
PO Box 1055
Camas, WA 98607

Re: Mixing Zone Analysis APPROVAL

Dear Monte,

On March 2, 2009, the City of Camas through Gray & Osborne, Inc. provided the Department of Ecology (Ecology) a report titled "Supplemental Outfall Mixing Zone Modeling, Wastewater Treatment Facility City of Camas, Clark County, WA G&O #06518.00" The report recommends the City improve mixing by installation of an 8-port "tideflex" diffuser (page 3 of the study). It estimates the mixing zone ratios for flows up to 6.1 MGD (maximum month) and 10.04 MGD (max day) in winter and 5.09 MGD (max summer month) and 6.36 (max summer day). The report terms these "2025 flows".

Ecology has confirmed the mixing zone ratios represent a defensible estimation of the mixing at the edge of appropriately sized mixing zones. Ecology accepts the estimates of mixing at the acute and chronic boundaries at critical conditions from this study as being:

| **Condition** | **Acute mixing zone ratio:** | **Chronic mixing zone ratio:** |
|---|---|---|
| **Winter:** | **19:1** | **122:1** |
| **Summer:** | **27:1** | **156:1** |

Accordingly, if construction of the 8-port diffuser described and recommended is included as part of the next facility upgrade, planning documents (General Sewer Plan, Facility Plans, and Plans and Specifications) may use the above ratios for estimation of the reasonable potential for limits for toxic pollutants not already subject to permit limits (e.g. metals).

For pollutants presently subject to limits in the City's NPDES permit, anti-backsliding provisions of the Clean Water Act and state regulations suggest that the Department must continue these limits at current levels. However, it is within Ecology's discretion to conclude that monthly ammonia limits are appropriately protective since daily limits are based on the effluent's variability and these monthly limits. Accordingly, Ecology will have the basis to remove the

daily maximum limits for ammonia from the permit with the completion of this outfall upgrade, and it is our intention is to do so. Monthly average limits for ammonia will continue to be applicable to the discharges – either the limits presently in the permit, or limits similar to those, with some adjustment for seasonality.

Ecology appreciates the City's initiative to provide this study, and patience and help during our review. We worked through some difficult technical issues in modeling this complex and dynamic outfall and receiving environment. We hope that this decision on mixing ratios provides the clarity the City needs to proceed with several projects now in design. We know these projects involve important improvements to the efficiency and reliability of both liquid and residual solids treatment systems. We share your excitement in planning and executing these next phases in the evolution of the city's wastewater treatment plant.

If you have any questions about this approval, please contact me at 360-407-6277.

Sincerely,

David J. Knight P.E.
Environmental Engineer
Southwest Regional Office
Water Quality Program

cc: Mr. Jim Dickinson, Camas WWTP
Mr. Eric Levison, City of Camas
Mr. Jay Swift, Gray & Osborne
Mr. Bill Fox, Cosmopolitan Engineering Group
Mr. Jacek Anuszewski, Ecology
Ms. Pat Bailey, Ecology

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
*PO Box 47775 • Olympia, Washington 98504-7775 • (360) 407-6300*

November 25, 2009

Mr. Monte Brachmann
Public Works Director
City of Camas
PO Box 1055
Camas, WA 98607

Re: Mixing Zone Analysis Approval Follow-up

Dear Mr. Brachmann:

On November 17, 2009, I talked with your consultant, Gray & Osborne about plans we received on November 6, 2009 for "Phase 2 Improvements" at the City's Wastewater Treatment Plant. They made it clear to me that the hydraulics of effluent discharge made it more advantageous to construct the 16-port diffuser outfall than the 8-port diffuser. That was why these new "Plans and Specifications" show the 16-port diffuser.

The 8-port diffuser was previously described as the recommended alternative on page 3 of the report "Supplemental Outfall Mixing Zone Modeling, Wastewater Treatment Facility City of Camas, Clark County, WA G&O #06518.00" Accordingly, I previously sent you a letter approving installation of the 8-port diffuser.

Please now accept this letter as approving the installation of the 16-port diffuser based on the City's Engineering Consultants request. The above modeling report also had an analysis of the 16-port diffuser at "critical conditions" and estimated year 2025 flows. We concur that mixing zone ratios for the 16-port diffuser (when built) will be:

| **Condition** | **Acute mixing zone ratio:** | **Chronic mixing zone ratio:** |
|---|---|---|
| **Winter:** | **23:1** | **121:1** |
| **Summer:** | **27:1** | **185:1** |

Construction of the 16-port diffuser is part of the next "Phase 2" improvements. Therefore, planning documents (General Sewer Plan, Facility Plans, and Plans and Specifications) can use these ratios to evaluate the need for limits for toxic pollutants. Irrespective of new limits for toxic pollutants, we expect to retain the monthly average limit for ammonia, as we have discussed previously.

We understand that this mixing zone approval will allow the City to finish a revised General Sewer Plan / Facility Plan (GSP/FP). We received the last draft GSP/FP in 2007 but it's taken until now to agree on mixing ratios. Plans for the "Phase 2 Improvements" stem from the draft GSP/FP and describe key liquid and residual solids treatment systems. The drawings anticipate increased flow, TSS, and ammonia capacities on sheet G-5.

We can approve project "Plans and Specifications" that increase the capacity of a POTW after we approve a Facility Plan that describes the engineering basis for that new capacity. We hope to receive your combined GSP/FP and documentation of the environmental review process soon enough to approve it and the "Phase 2" plans before the end of this month.

We share your excitement in planning and executing these next phases in the evolution of the city's wastewater treatment plant. If you have any questions about this outfall approval or the understandings described here, please contact me at 360-407-6277.

Sincerely,

David J. Knight P.E.
Environmental Engineer
Southwest Regional Office
Water Quality Program

cc Mr. Jim Dickinson, Operator in Charge
Mr. Eric Levison; Operations Manager
Mr. Jay Swift, Gray & Osborne
Mr. Bill Fox, Cosmopolitan Engineering Group
Mr. Jacek Anuszewski, Ecology
Ms. Pat Bailey, Ecology

# APPENDIX O

# WWTF MODELING REPORT

## Activated Sludge Modeling

An activated sludge computer modeling program was used to model and evaluate the capacity of the Camas WWTF. The model was created using Hydromantis, Inc. General Purpose Simulator (GPS-X Version 5.0) software and physical design data for the treatment facility. GPS-X uses a series of mathematical algorithms to simulate the activated sludge and secondary clarification processes. By using the computer model it is possible to test the ability of the facility to meet its effluent limits at different influent loadings and conditions. Although a well-developed model can be a powerful tool, the results should be viewed with a certain amount of caution. Mathematical models are by nature only approximations of actual conditions and can provide erroneous output as a result of inaccurate input parameters.

The results of this evaluation indicate that the existing three aeration basin treatment trains and three secondary clarifiers have sufficient capacity to achieve nitrification and to achieve an effluent ammonia concentration of less than 1 mg/L at the maximum month design flow and loads. Additional calculations were performed to confirm the results of the activated sludge model. The results of the additional calculations are provided.

The model was calibrated using actual facility performance data recorded in DMRs from the month of November 2006. November 2006 performance was chosen for the calibration since temperatures were quite low; the growth rate of the microorganisms responsible for treatment is the slowest during the winter when the temperature is lower. The existing conditions of the facility were entered into the model and the effluent quality was evaluated. Primary treatment was not modeled using GPS-X; the wastewater characteristic model inputs assume 50 percent TSS removal and 30 percent $BOD_5$ removal during primary treatment. The default values for the aeration basin kinetics were adjusted within the suggested range of textbook values (Metcalf and Eddy, 2003). The values were adjusted so that the performance of the model reasonably matched the performance of the facility as reported in the DMRs. The model performance and results from the calibration are included in Tables 1 and 2.

The activated sludge model was then used to evaluate the performance for the 2025 design conditions established in Table 3. The performance of the facility operating with three aeration basins and three secondary clarifiers online was evaluated. Table 3 provides the model inputs and results for the evaluation conditions.

## TABLE 1

## Model Calibration Inputs
## Based on Actual Plant Operating Conditions and Performance for November 2006

| Inputs | Units | Nov 2006 Calibration |
|---|---|---|
| Primary Effluent TKN | mg/L | 46 |
| Primary Effluent Alkalinity | mg/L | 196 |
| Primary Effluent $CBOD_5$ | mg/L | 55[1] |
| Primary Effluent $BOD_5$ | mg/L | 55 |
| Primary Effluent TSS | mg/L | 61 |
| Primary Effluent nbsCOD | mg/L | 30[2] |
| Primary Effluent Flow | MGD | 3.44 |
| RAS Flow Rate | NA | 50%[3] |
| Aeration Basin Temperature | $^oC$ | 18 |
| Aerated Volume | Mgal | 0.880 |
| Number of Aeration Basins | NA | 2 |
| $2^o$ Clarifier Area | sf | 8836[4] |
| Settling Behavior (0-1; 1 is good) | NA | 0.50 [5] |

1. $CBOD_5$ equals $BOD_5$ to provide a conservative estimate.
2. Influent soluble inert organic material estimated based on experience.
3. Assumption based on design conditions.
4. Two secondary clarifiers in service.
5. Calibrated value.
6. NA: Not applicable.
7. Primary effluent concentrations assume 30% removal and 50% TSS removal.

## TABLE 2

## Model Calibration Results
## Based on Actual Plant Operating Conditions and Performance for November 2006

| Results | Units | Actual Performance | Model Performance |
|---|---|---|---|
| MLSS Concentration | mg/L | 1,995 | 1,966 |
| SRT | d | 9.32[1] | 11.9 |
| SVI | ML/g | 303 | 180 |
| WAS Flow Rate | GPD | 0.01884 | 0.02500 |
| Effluent $BOD_5$ | mg/L | 6.3 | 4.0 |
| Effluent Ammonia-N | mg/L | 0.45 | 0.63 |
| Effluent TSS | mg/L | 5.5 | 8.6 |

1. Calculated based on the average WAS flow rate and an estimated WAS concentration of 10,000 mg/L.

**TABLE 3**

**Activated Sludge Model Results for New Projected Loading Rates**

| **Inputs** | **Units** | **Projected Winter Performance at Design Conditions** |
|---|---|---|
| Aeration Basin Temperature | $^{o}C$ | 12 |
| Influent TKN | mg/L | 51 |
| Primary Effluent Alkalinity | mg/L | 350 |
| Primary Effluent $CBOD_5$ | mg/L | 77 |
| Primary Effluent $BOD_5$ | mg/L | 77 |
| Primary Effluent TSS | mg/L | 79 |
| Primary Effluent nbsCOD | mg/L | 30 |
| Influent Flow | MGD | 6.10 |
| RAS Rate | NA | 50% |
| Aeration Basin Temperature | $^{o}C$ | 12 |
| Aerated Volume | Mgal | 1.32 |
| Number of Aeration Basins | Trains | 3 |
| $2^{o}$ Clarifier Area | sf | 13,254 |
| Settling Behavior (0-1; 1 is good) | NA | 0.50 |
| SVI | NA | 200 |
| **Results** | **Units** | **Value** |
| WAS Flow Rate | MGD | 0.047 |
| MLSS Concentration | mg/L | 2,488 |
| SRT | days | 9.5 |
| Effluent $BOD_5$ | mg/L | 6.4 |
| Effluent Ammonia-N | mg/L | 0.56 |
| Effluent TSS | mg/L | 11.4 |
| WAS Suspended Solids Concentration | mg TSS/L | 7,328 |
| Yield | lb TSS/lb $BOD_{removed}$ | 0.80 |

NA: Not applicable

**Wastewater Influent**

| **bodbased** | **Influent** | |
|---|---|---|
| ***Influent Composition*** | | |
| **Influent Composition** | | |
| total carbonaceous BOD5 | 55 | [mgO2/L] |
| total suspended solids | 61 | [mg/L] |
| total TKN | 46 | [mgN/L] |
| **Organic Variables** | | |
| soluble inert organic material | 30 | [mgCOD/L] |
| active heterotrophic biomass | 0 | [mgCOD/L] |
| active autotrophic biomass | 0 | [mgCOD/L] |
| unbiodegradable particulates from cell decay | 0 | [mgCOD/L] |
| internal cell storage product | 0 | [mgCOD/L] |
| **Dissolved Oxygen** | | |
| dissolved oxygen | 0 | [mgO2/L] |
| **Nitrogen Compounds** | | |
| nitrate and nitrite | 0 | [mgN/L] |
| dinitrogen | 0 | [mgN/L] |
| **Alkalinity** | | |
| alkalinity | 196 | [mgCaCO3/L] |
| ***Influent Stoichiometry*** | | |
| **Local Model Selection** | | |
| base composite variables on ... | Mantis | |
| **Influent Fractions** | | |
| XCOD/VSS ratio | 1.42 | [mgCOD/mgVSS] |
| BOD5/BODultimate ratio | 0.66 | [-] |
| **Mantis Nutrient Fractions** | | |
| N content of active biomass | 0.068 | [mgN/mgCOD] |
| N content of endogenous/inert mass | 0.068 | [mgN/mgCOD] |
| **BODbased Model Coefficients** | | |
| soluble substrate/BODultimate | 0.3 | [-] |
| ammonium/TKN ratio | 0.67 | [-] |
| part. org. N/total org. N ratio | 0.9 | [-] |
| VSS/TSS ratio | 0.85 | [mgVSS/mgTSS] |
| ***Load Type Options*** | | |
| **Load Type** | | |
| loadtype | 3.44 | mgd |

**Plug-Flow Tank**

| **mantis** | | **Aeration Basin** | |
|---|---|---|---|
| ***Physical*** | | | |
| **Dimensions** | | | |
| number of reactors | | 8 | |
| volume setup method | | Individual Volumes | |
| **Individual Volumes** | | | |
| individual volumes | | 2940 | [ft3] |
| | | 2940 | |
| | | 5880 | |
| | | 36100 | |
| | | 36100 | |
| | | 39200 | |
| | | 39200 | |
| | | 39200 | |
| ***Operational*** | | | |
| **Aeration Control** | | | |
| DO setpoint | | 0 | |
| | | 0 | |
| | | 0 | |
| | | 0 | |
| | | 0 | |
| | | 2 | |
| | | 2 | |
| | | 2 | |
| **Internal Flow Distribution** | | | |
| internal recycle | 8,1 | 5.08 | [Mgal/d(US)] |
| | 8,3 | 10.2 | |
| ***Composite Variable Stoichiometry*** | | | |
| **Organic Fractions** | | | |
| XCOD/VSS | | 1.42 | [mgCOD/mgVSS] |
| BOD5/BODultimate ratio | | 0.66 | [-] |
| **Nutrient Fractions** | | | |
| N content of active biomass | | 0.068 | [mgN/mgCOD] |
| N content of endogenous/inert mass | | 0.068 | [mgN/mgCOD] |
| P content of active biomass | | 0.021 | [mgP/mgCOD] |
| P content of endogenous/inert mass | | 0.021 | [mgP/mgCOD] |
| ***Model Stoichiometry*** | | | |
| **Active Heterotrophic Biomass** | | | |
| heterotrophic yield | | 0.666 | [mgCOD/mgCOD] |
| heterotrophic endogenous fraction | | 0.15 | [mgCOD/mgCOD] |
| **Active Autotrophic Biomass** | | | |
| autotrophic yield | | 0.15 | [gCOD/gN] |
| autotrophic endogenous fraction | | 0.08 | [mgCOD/mgCOD] |
| ***Kinetic*** | | | |
| **Active Heterotrophic Biomass** | | | |
| heterotrophic maximum specific growth rate | | 6 | [1/d] |
| readily biodegradable substrate half saturation coefficient | | 10 | [mgCOD/L] |
| aerobic oxygen half saturation coefficient | | 0.2 | [mgO2/L] |
| anoxic oxygen half saturation coefficient | | 0.2 | [mgO2/L] |
| anoxic growth factor | | 0.8 | [-] |

| | | |
|---|---|---|
| nitrate half saturation coefficient | 0.5 | [mgN/L] |
| ammonia (as nutrient) half saturation coefficient | 0.05 | [mgN/L] |
| heterotrophic decay rate | 0.12 | [1/d] |
| **Active Autotrophic Biomass** | | |
| autotrophic maximum specific growth rate | 0.8 | [1/d] |
| ammonia (as substrate) half saturation coefficient | 0.74 | [mgN/L] |
| oxygen half saturation coefficient | 0.5 | [mgO2/L] |
| autotrophic decay rate | 0.1 | [1/d] |
| **Hydrolysis** | | |
| maximum specific hydrolysis rate | 2.81 | [1/d] |
| slowly biodegradable substrate half saturation coefficient | 0.15 | [mgCOD/mgCOD] |
| anoxic hydrolysis factor | 0.6 | [-] |
| **Ammonification** | | |
| ammonification rate | 0.016 | [L/(mgCOD·d)] |
| **Temperature** | | |
| Temperature coefficient for muh | 1.07 | [-] |
| Temperature coefficient for bh | 1.04 | [-] |
| Temperature coefficient for mua | 1.07 | [-] |
| Temperature coefficient for ba | 1.04 | [-] |
| Temperature coefficient for kh | 1.07 | [-] |
| Temperature coefficient for ka | 1.03 | [-] |

**Circular Secondary Clarifier**

| | | |
|---|---|---|
| **simple1d** | **Secondary Clarifier** | |
| ***Physical*** | | |
| **Clarifier Type** | | |
| clarifier type | Sloping Bottom | |
| number of layers | 10 | |
| **Input Required for All Types of Clarifiers** | | |
| feed point from bottom | 3.28 | [ft] |
| **Sloping Bottom Clarifier Input** | | |
| surface | 8840 | [ft2] |
| water depth at sidewall | 13 | [ft] |
| water depth at center | 15 | [ft] |
| ***Operational*** | | |
| **Underflow** | | |
| proportional recycle | On | |
| stream label to which recycle is proportional | 1 | |
| recycle fraction | 0.5 | [-] |
| **Pumped Flow** | | |
| pumped flow | .025 | [MGD(US)] |
| ***Settling*** | | |
| **Double Exponential Parameters** | | |
| use SVI to estimate settling parameters | On | |
| sludge volume index | 200 | [mL/g] |
| clarification (0 - bad, 1 - good) | 0.5 | [-] |
| maximum settling velocity | 6720 | [gal(US)/(ft2·d)] |
| maximum Vesilind settling velocity | 10100 | [gal(US)/(ft2·d)] |
| hindered zone settling parameter | 0.0004 | [L/mgTSS] |
| flocculant zone settling parameter | 0.0025 | [L/mgTSS] |
| non-settleable fraction | 0.001 | [-] |
| maximum non-settleable solids | 20 | [mgTSS/L] |
| **Flow Distribution** | | |
| quiescent zone maximum upflow velocity | 2450 | [gal(US)/(ft2·d)] |
| complete mix maximum upflow velocity | 7360 | [gal(US)/(ft2·d)] |

| Plug-Flow Tank | mantis | Aeration Basin | |
|---|---|---|---|
| **Dimensions** | | | |
| number of reactors | | 8 | |
| volume setup method | | Individual Volumes | |
| **Individual Volumes** | | | |
| individual volumes | | 4410 | [ft3] |
| | | 4410 | |
| | | 8820 | |
| | | 54200 | |
| | | 54200 | |
| | | 58800 | |
| | | 58800 | |
| | | 58800 | |
| **Aeration Control** | | | |
| DO setpoint | | 0 | |
| | | 0 | |
| | | 0 | |
| | | 0 | |
| | | 0 | |
| | | 2 | |
| | | 2 | |
| | | 2 | |
| **Internal Flow Distribution** | | | |
| internal recycle | 8,1 | 5.08 | [Mgal/d(US)] |
| | 8,3 | 10.2 | |
| ***Stoichiometry*** | | | |
| **Organic Fractions** | | | |
| XCOD/VSS | | 1.42 | [mgCOD/mgVSS] |
| BOD5/BODultimate ratio | | 0.66 | [-] |
| **Nutrient Fractions** | | | |
| N content of active biomass | | 0.068 | [mgN/mgCOD] |
| N content of endogenous/inert mass | | 0.068 | [mgN/mgCOD] |
| P content of active biomass | | 0.021 | [mgP/mgCOD] |
| P content of endogenous/inert mass | | 0.021 | [mgP/mgCOD] |
| **Active Heterotrophic Biomass** | | | |
| heterotrophic yield | | 0.666 | [mgCOD/mgCOD] |
| heterotrophic endogenous fraction | | 0.15 | [mgCOD/mgCOD] |
| **Active Autotrophic Biomass** | | | |
| autotrophic yield | | 0.15 | [gCOD/gN] |
| autotrophic endogenous fraction | | 0.08 | [mgCOD/mgCOD] |
| ***Kinetic*** | | | |
| **Active Heterotrophic Biomass** | | | |
| heterotrophic maximum specific growth rate | | 6 | [1/d] |
| readily biodegradable substrate half saturation coefficient | | 10 | [mgCOD/L] |
| aerobic oxygen half saturation coefficient | | 0.2 | [mgO2/L] |
| anoxic oxygen half saturation coefficient | | 0.2 | [mgO2/L] |
| anoxic growth factor | | 0.8 | [-] |
| nitrate half saturation coefficient | | 0.5 | [mgN/L] |
| ammonia (as nutrient) half saturation coefficient | | 0.05 | [mgN/L] |
| heterotrophic decay rate | | 0.12 | [1/d] |
| **Active Autotrophic Biomass** | | | |
| autotrophic maximum specific growth rate | | 0.8 | [1/d] |
| ammonia (as substrate) half saturation coefficient | | 0.74 | [mgN/L] |
| oxygen half saturation coefficient | | 0.5 | [mgO2/L] |
| autotrophic decay rate | | 0.10 | [1/d] |
| **Hydrolysis** | | | |

| | | |
|---|---|---|
| maximum specific hydrolysis rate | 2.81 | [1/d] |
| slowly biodegradable substrate half saturation coefficient | 0.15 | [mgCOD/mgCOD] |
| anoxic hydrolysis factor | 0.6 | [-] |
| **Ammonification** | | |
| ammonification rate | 0.016 | [L/(mgCOD·d)] |
| **Temperature** | | |
| Temperature coefficient for muh | 1.07 | [-] |
| Temperature coefficient for bh | 1.04 | [-] |
| Temperature coefficient for mua | 1.07 | [-] |
| Temperature coefficient for ba | 1.04 | [-] |
| Temperature coefficient for kh | 1.07 | [-] |
| Temperature coefficient for ka | 1.03 | [-] |

**Circular Secondary Clarifier**

| **simple1d** | **Secondary Clarifier** | |
|---|---|---|
| ***Physical*** | | |
| **Clarifier Type** | | |
| clarifier type | Sloping Bottom | |
| number of layers | 10 | |
| **Input Required for All Types of Clarifiers** | | |
| feed point from bottom | 3.28 | [ft] |
| **Sloping Bottom Clarifier Input** | | |
| surface | 13300 | [ft2] |
| water depth at sidewall | 13 | [ft] |
| water depth at center | 15 | [ft] |
| ***Operational*** | | |
| **Underflow** | | |
| proportional recycle | On | |
| stream label to which recycle is proportional | 1 | |
| recycle fraction | 0.5 | [-] |
| **Pumped Flow** | | |
| pumped flow | .047 | [MGD(US)] |
| ***Settling*** | | |
| **Double Exponential Parameters** | | |
| use SVI to estimate settling parameters | On | |
| sludge volume index | 200 | [mL/g] |
| clarification (0 - bad, 1 - good) | 0.5 | [-] |
| maximum settling velocity | 6720 | [gal(US)/(ft2·d)] |
| maximum Vesilind settling velocity | 10100 | [gal(US)/(ft2·d)] |
| hindered zone settling parameter | 0.0004 | [L/mgTSS] |
| flocculant zone settling parameter | 0.0025 | [L/mgTSS] |
| non-settleable fraction | 0.001 | [-] |
| maximum non-settleable solids | 20 | [mgTSS/L] |
| **Flow Distribution** | | |
| quiescent zone maximum upflow velocity | 2450 | [gal(US)/(ft2·d)] |
| complete mix maximum upflow velocity | 7360 | [gal(US)/(ft2·d)] |

**Camas WWTF**

| **Design Year** | **2015** | **2025** |
|---|---|---|
| **Influent Flows** | | |
| Annual Average Flow (MGD) | 4.04 | 5.3 |
| Maximum Month Flow (MGD) | 4.84 | 6.1 |
| Peak Day Flow (MGD) | 8.78 | 10.04 |
| Peak Hour Flow (MGD) | 11.47 | 13.44 |
| **Influent Loading** | | |
| AA BOD (lb/d) | 3,437 | 4,099 |
| AA BOD (mg/L) | 102 | 93 |
| MM BOD (lb/d) | 4,708 | 5,616 |
| MM BOD (mg/L) | 117 | 110 |
| AA TSS (lb/d) | 4,937 | 5,883 |
| AA TSS (mg/L) | 147 | 133 |
| MM TSS (lb/d) | 6,715 | 8,001 |
| MM TSS (mg/L) | 166 | 157 |
| AA NH4-N (lb/d) | 1,149 | 1,389 |
| AA NH4-N (mg/L) | 34 | 31 |
| MM NH4-N (lb/d) | 1,618 | 1,956 |
| MM NH4-N (mg/L) | 40 | 38 |
| AA TKN (lb/d) | 1,588 | 1,917 |
| AA TKN (mg/L) | 47 | 43 |
| MM TKN (lb/d) | 2,130 | 2,573 |
| MM TKN (mg/L) | 53 | 51 |

| **Additional Parameters** | | | | | |
|---|---|---|---|---|---|
| COD | 10,861 | 12,943 | Assumes COD/$BOD_5$ Ratio = | 2.2 | |
| bCOD (biodegradeable COD) | 8,097 | 9,648 | Assumes bCOD/$BOD_5$ Ratio = | 1.64 | where bCOD/BOD5 = |
| nbCOD (non-biodegradeable COD) | 2,765 | 3,294 | | | (ultimate BOD/$BOD_5$)/(1-1.42($f_d$)($Y_H$)) |
| $sBOD_5$ (soluble $BOD_5$) | 1,234 | 1,471 | Assumes $sBOD_5$/$BOD_5$ Ratio = | 0.25 | |
| rbCOD (readily biodegradeable COD) | 1,234 | 1,471 | Assumes rbCOD = $sBOD_5$ | | |
| sCOD (soluble COD) | 2,715 | 3,236 | Assumes sCOD/COD ratio = | 0.25 | |
| $sCOD_e$ (effluent soluble COD) | 741 | 882 | sCOD - (1.6*$sBOD_5$) | | |
| VSS | 1,350 | 1,629 | Assumes VSS/TSS Ratio = | 0.85 | |
| nbVSS (non-biodegradeable VSS) | 344 | 415 | | | |
| *i*TSS (inert TSS) | 238 | 288 | | | |
| TKN | 53 | 51 | | | |
| nbTKN (non-biodegradeable TKN) | 3 | 3 | Assumes nbTKN/TKN Ratio = | 0.05 | |
| bTKN (biodegradeable TKN) | 50 | 48 | | | |

| **Assumptions: (M&E, Fourth Edition p. 704-705)** | | | |
|---|---|---|---|
| $Y_H$ (heterotrophic yield) | 0.4 | lb/lb | lb/lb |
| $Y_n$ (heterotrophic yield) | 0.12 | lb/lb | lb/lb |
| $f_d$ (fraction of cell mass remaining as cell debris) | 0.15 | lb/lb | lb/lb |
| $k_{d,20}$ (endogenous heterotrophic decay coefficient) | 0.12 | $d^{-1}$ | $d^{-1}$ |
| $k_{dn,20}$ (endogenous nitrogenous decay coefficient) | 0.08 | $d^{-1}$ | $d^{-1}$ |
| $\mu_{m,\,max,\,20}$ (heterotrophic growth rate) | 6.0 | g/g*d | g/g*d |
| $\mu_{n,\,max,\,20}$ (autotrophic growth rate) | 0.8 | d-1 | d-1 |
| $K_s$ (substrate half-saturation coefficient) | 20 | $g/m^3$ | $g/m^3$ |
| $K_{n,20}$ (ammonia half-saturation coefficient) | 0.74 | $g/m^3$ | $g/m^3$ |
| $K_o$ (oxygen half-saturation coefficient) | 0.5 | $g/m^3$ | $g/m^3$ |

**Kinetic and Stoichiometric Constants**

| | | | | |
|---|---|---|---|---|
| Design Temperature | 12 | °C | °C | |
| $\mu_{m,max,t}$ (heterotrophic growth rate) | 3.49 | g/g*d | g/g*d | |
| $k_{d,t}$ (endogenous heterotrophic decay coefficient) | 0.088 | $d^{-1}$ | $d^{-1}$ | |
| $\mu_{n,max,t}$ (autotrophic growth rate) | 0.466 | g/g*d | g/g*d | |
| $k_{dn,t}$ (endogenous nitrogenous decay coefficient) | 0.0585 | $d^{-1}$ | $d^{-1}$ | |
| $K_{n,t}$ (ammonia half-saturation coefficient) | 0.490 | $g/m^3$ | $g/m^3$ | |

**SRT Required**

| | | | | |
|---|---|---|---|---|
| N | 12 | | | Effluent Ammonia Nitrogen Concentration (mg/L) |
| DO | 2 | | | Reactor DO Conc. (mg/L) |
| $m_n$ | 0.299 | | | $m_n=m_{n,max}*(N/K_N+N)*(DO/K_o+DO)$ |
| SF | 2 | | | Peaking and Safety Factor |
| $SRT_{ox,reqd}$ | 6.7 | 3.3 | 1.7 | Aerobic SRT = $SF/m_n$ (d) |
| SRT Selected | 9.3 | | | |

**Aeration Basin Sizing (per M&E 2003)**

| | | | | |
|---|---|---|---|---|
| Aerobic Zone: | | | | |
| VSS/TSS fraction of biomass produced | 0.85 | | | |
| Assumed fraction of TKN consumed | 0.7 | | | |
| $No_x$ | 35 | 34 | | lb/d, Conc of $NH_4$-N in influent that is nitrified |
| S (effluent bCOD) | 1.18 | 1.18 | | $g/m^3$ |
| S (effluent bCOD) | 48 | 60 | | lb/d |
| $P_{x,bio}$ (biomass production) | 1,993 | 2,374 | | lb/d |
| $P_{x,VSS}$ (VSS production) | 2,337 | 2,788 | | lb/d $P_{xbio}$ + nbVss |
| $P_{x,TSS}$ (TSS production) | 2,927 | 3,495 | | lb/d $P_{xbio}$/0.85 + nbVss + iTSS |
| RAS ratio | 0.5 | 0.5 | | |
| WAS: | | | | |
| assumed bTKN/$P_{x,bio}$ ratio | 0.12 | | | |
| TSS | 2,927 | 3,495 | | lb/d |
| VSS | 2,337 | 2,788 | | lb/d |
| nbVSS | 344 | 415 | | lb/d |
| *i*TSS | 590 | 706 | | lb/d |
| bTKN | 239 | 285 | | lb/d |
| MLSS | 3000 | 3500 | | mg/L |
| $V_{ox}$ | 1.088 | 1.113 | | MG $P_{x,TSS}$ * SRT / (MLSS * 8.34) |
| Anoxic Zone: | | | | |
| $V_{an}$ initial approximation | 0.22 | 0.22 | | $V_{an}=0.2*V_{AB}$ (use 20% for alkalinity recovery) |
| $HRT_{an}$ | 1.1 | 0.9 | | Anoxic Zone HRT (hrs)=$V_{an}*24/Q_{mm}$ |
| $V_{AB}$ | 1.305 | 1.336 | | MG |
| AB SWD | 21 | 21 | | |
| Existing AB Vol | 0.350 | 0.350 | | MG |
| Existing Anoxic Vol | 0.048 | 0.048 | | MG |
| Addn AB Ox Vol Reqd | 0.738 | 0.763 | | MG |
| Assumed AB SWD | 21.0 | 21.0 | | ft |
| Addn AB Ox SF Reqd | 4697 | 4860 | | SF |

Need to Update

| | | | |
|---|---|---|---|
| Addn Anoxic Vol Reqd | 0.170 | 0.175 | MG |
| Assumed Anoxic SWD | 21.0 | 21.0 | ft |
| Addn Anoxic SF Reqd | 1079 | 1112 | SF |
| Total Addn AB SF Reqd | 5776 | 5972 | SF |

**Selector Sizing**

| | | | |
|---|---|---|---|
| Selector No.1: | | | |
| F/M | 8 | 8 | |
| X | 3000 | 3500 | Reactor MLSS (mg/L) |
| F | 4708 | 5616 | Influent BOD (lb/d) |
| M | 589 | 702 | M= Sel Vol (gal)/10^6*(MLSS*8.34) |
| $V_{sx-1}$ | 23521 | 24049 | (gallons) V=M*1E6/MLSS/8.34 |
| Assumed SWD | 21 | 21 | ft |
| $S_{x-1}$ SF | 150 | 153 | SF |
| | | | |
| Selector No.2: | | | |
| F/M | 4 | 4 | |
| X | 3000 | 3500 | Reactor MLSS (mg/L) |
| F | 4708 | 5616 | Influent BOD (lb/d) |
| M | 113 | 131 | M= Sel Vol (gal)/10^6*(MLSS*8.34) |
| $V_{sx-2}$ | 4500 | 4500 | |
| Assumed SWD | 21 | 21 | ft |
| $S_{x-2}$ SF | 29 | 29 | SF |
| | | | |
| Selector No.3: | | | |
| F/M | 2 | 2 | |
| X | 3000 | 3500 | Reactor MLSS (mg/L) |
| F | 4708 | 5616 | Influent BOD (lb/d) |
| M | 113 | 131 | |
| VSX-3 | 4500 | 4500 | Sel Vol (gal) = M*10^6/(MLSS*8.34) |
| Mixing Rate | 0.02 | 0.02 | scfm/ft$^3$ |
| Air Required | 12 | 12 | scfm |
| Assumed SWD | 21 | 21 | ft |
| $S_{x-2}$ SF | 29 | 29 | SF |

**Nitrogen Balance**

| | | | |
|---|---|---|---|
| $TKN_{in}$ | 2130 | 2573 | lb/d |
| $TKN_{ef}$ Conc | 1 | | mg/L |
| $TKN_{eff}$ | 40 | 51 | lb/d |
| WAS Org-N | 239 | 285 | lb/d |
| TKNox | 1850 | 2237 | lb/d |
| NO-$N_{eff}$ Conc | 6 | 6 | mg/L |
| NO-$N_{eff}$ | 242 | 305 | lb/d |
| $NO_3$-N Denitrified | 1608 | 1932 | lb/d |
| Alk Consumed | 13212 | 15974 | lb/d |
| Alk Produced | 5742 | 6897 | lb/d |
| Residual Alk Reqd to Manintain nuetral pH | 80 | | mg/l |
| Residual Alk Reqd to Manintain nuetral pH | 3229 | 4070 | lb/d |
| Reqd Influent Alk | 265 | 258 | mg/l |
| Actual Influent Alk | | | |
| Reqd Alk Addition | | | |

M&E pg 712

User must enter/verify

M&E ref page

| | | |
|---|---|---|
| b | 0.95 | |
| $C_{s,T,H}$ | 11.53 | mg/L |

**Anoxic Volume pg 762 M&E Fourth Ed.**

| | | | |
|---|---|---|---|
| Xb | 1733 | 2019 | mg/L |
| IR | -1.4 | -1.4 | |
| Flowrate to Anoxic Tank | -4.1 | -5.4 | MGD |
| Nox feed | -207 | -272 | lb/d |
| Detention Time | 2.5 | 2.5 | h (Adjust this cell) |
| Vanox | 0.50 | 0.64 | MGD Compare with Line 98 |
| F/M | 0.6 | 0.5 | |
| SDNR at 20°C pg 755 lb NO3-N/lb biomass-d | 0.225 | 0.230 | |
| influent rbCOD/influent bCOD | 0.15 | 0.15 | |
| SDNR at 10°C lb NO3-N/lb biomass-d | 0.18 | 0.19 | |
| Check NOr lb/d | 1640 | 2461 | Should be greater than Nox feed (Line 168) |

| | | | |
|---|---|---|---|
| $C_{s,20}$ | 9.1 | mg/L | |
| $C_{s,13}$ | 10.53 | mg/L | 1745 |
| a | 0.50 | | |
| F (fouling f | 0.90 | | |
| elevation c | 35.00 | ft | |
| relative pre | 0.9987 | | |
| $g_r$ | 9.8004 | | 1742 |
| $P_{atm}$ | 101.325 | kN/m² | |
| percent ox | 19 | % | |
| $P_{atm,H}$ | 10.33 | m | |
| $C_{s\_,T,H}$ | 14.47 | mg/L | |
| height of a | 0.1524 | m | |
| $r_{T,P}$ | | | |

**AB Aeration**

| | | | |
|---|---|---|---|
| Carbonaceous $O_2$ Demand | 5267 | 6278 | lb/d |
| Nitrogenous $O_2$ Demand | 3413 | 4162 | lb/d |
| Total $O_2$ Demand | 8679 | 10440 | lb/d |
| Diurnal PF | 1.3 | 1.3 | |
| Design $O_2$ Demand | 11283 | 13571 | lb/d |
| SOR | 23435 | 28188 | lb/d |
| Diffuser Efficiency | 2.25 | 2.25 | %/ft |
| Total Efficiency | 0.47 | 0.47 | |
| Air Flow | 1991 | 2395 | scfm |
| Total Air Flow Required | 2003 | 2407 | scfm |

**Secondary Clarifiers**

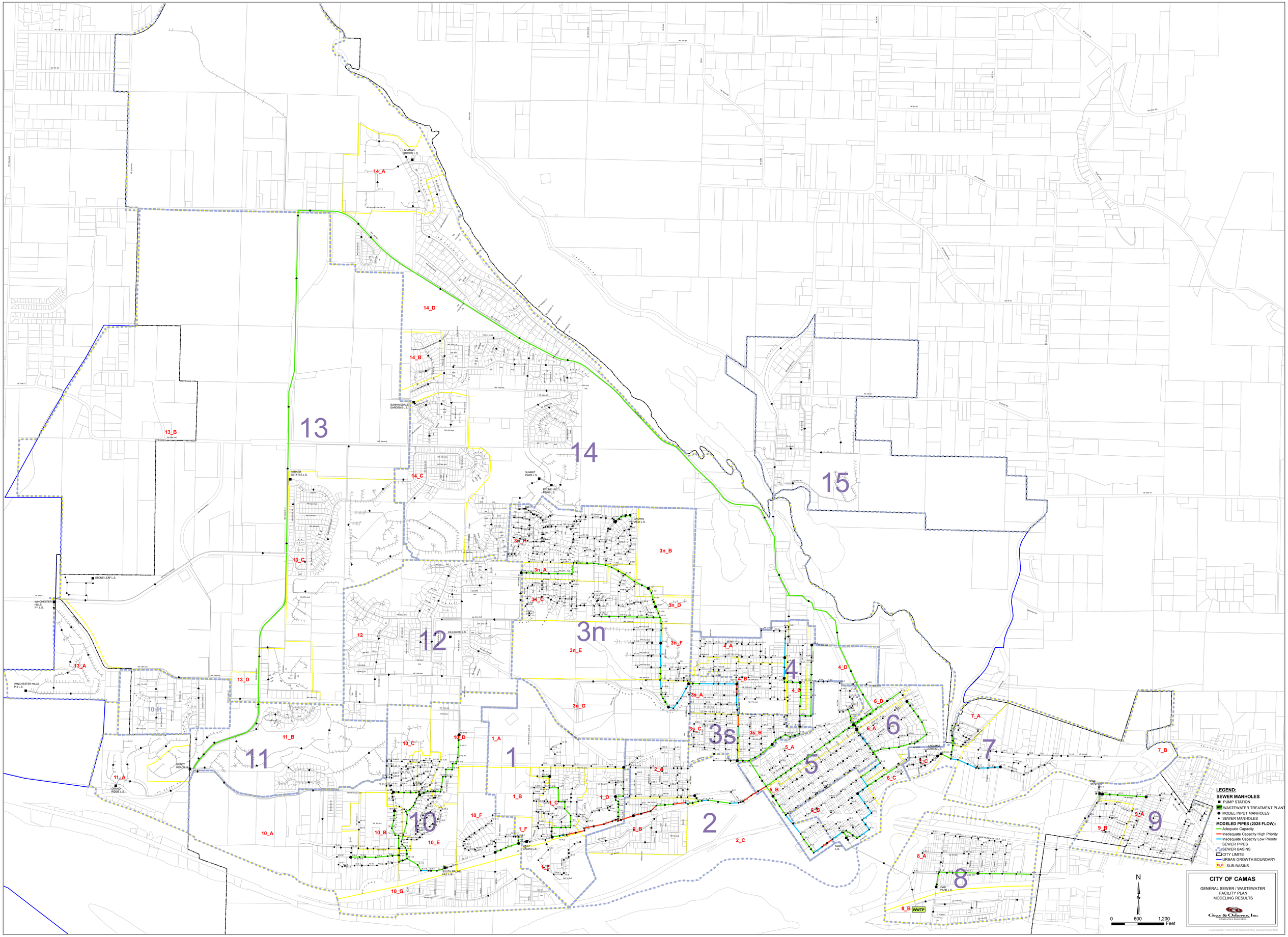
| | | | |
|---|---|---|---|
| QPH | 11.47 | 13.44 | |
| SF Reqd per DOE | 9558 | 11200 | for OFR<1200 gpd/SF |
| SF Reqd per WEF 8 | 7169 | 8400 | for OFR < 1600 gpd/SF |
| Existing 2 x 75 dia SF | 8836 | 8836 | |
| Addn SF Reqd per DOE | 722 | 2364 | |
| Addn SF Reqd per WEF 8 | -1667 | -436 | |

**Digester**

| | | | |
|---|---|---|---|
| nbVSS (non-biodegradeable VSS) | 344 | 415 | |
| *i*TSS (inert TSS) | 238 | 288 | |
| $P_{x,bio}$ (biomass production) | 1993 | 2374 | Biodegradable VSS production, lb/d |
| $P_{x,TSS}$ (TSS production) | 2927 | 3495 | Mass of waste activated sludge per day, lb/d |
| WAS Conc mg/L | 10000 | 10000 | |
| WAS flowrate gpm | 24.4 | 29.1 | |
| WAS flowrate gpd | 35091 | 41903 | |
| D%, Percent VSS destruction | 40 | 40 | |
| $M_w$, Mass of solids Wasted | 1778 | 2126 | $X_{VSS}$*D%+$X_{iVSS}$+$X_{iTSS}$ |
| Xdig | 30000 | 30000 | Digester MLSS, mg/L |
| SRTdig | 60 | 60 | d |
| Vdig | 0.426 | 0.510 | Dig Vol (MG) = SRTdig*Mw/(Xdig*8.34) |

# APPENDIX P

# SEWER SYSTEM BASE MAP


LEGEND:
SEWER MANHOLES
PUMP STATION
WASTEWATER TREATMENT PLANT
MODEL INPUT MANHOLES
SEWER MANHOLES
MODELED PIPES (2025 FLOW):
Adequate Capacity
Inadequate Capacity High Priority
Inadequate Capacity Low Priority
SEWER PIPES
SEWER BASINS
CITY LIMITS
URBAN GROWTH BOUNDARY
13_C SUB-BASINS
CITY OF CAMAS
GENERAL SEWER / WASTEWATER
FACILITY PLAN
MODELING RESULTS
Gray & Osborne, Inc.
CONSULTING ENGINEERS
N
0 600 1,200
Feet
13
14
15
12
3n
11
1
10
2
3s
4
5
6
7
8
9
WWTP
LACAMAS SHORES L.S.
SUNNINGDALE GARDENS L.S.
PARKER ESTATES L.S.
SUMMIT OAKS L.S.
PRUNE HILL PARK L.S.
CROWN VIEW L.S.
STONE LEAF L.S.
WINCHESTER HILLS P-1 L.S.
WINCHESTER HILLS P-2 L.S.
HILLSHIRE L.S.
BRADY ROAD L.S.
GRAND RIDGE L.S.
SOUTH PRUNE HILL L.S.
MEADOWS L.S.
LACAMAS LAKES L.S.
MAIN L.S.
OAK PARK L.S.

# APPENDIX Q

# DESIGN CRITERIA FOR DEVELOPMENTS IN THE CAMAS SEWER SERVICE AREA

**DESIGN CRITERIA FOR COLLECTION SYSTEM COMPONENTS SERVING DEVELOPMENTS WITHIN THE CAMAS SEWER SERVICE AREA**

Required Peak Hour Design Flow for Sizing Collection System Components (Pipes and Pump Stations, etc.) for Residential Flows

**EQUATION 1:**

**Total Design Flow (Peak Hour) = (# of ERUs x *Daily Flow / ERU* x *Orange Book Peaking Factor* x *Camas Site-Specific Adjustment Factor*) + (Acreage x *Areal I/I Rate*)**

Where

- Daily Flow / ERU = 149 gpd / ERU
- *Orange Book Peaking Factor* $= \left(18 + \sqrt{Population/1000}\right) / \left(4 + \sqrt{Population/1000}\right)$
- *Camas Site-Specific Adjustment Factor* = 0.691 (= Ratio of Actual PHF/AAF Peaking Factor Observed within Camas to Theoretical PHF/AAF Peaking Factor, based on Ecology's Orange Book). (PHF = Peak Hour Flow, AAF = Annual Average Flow)
- *Areal I/I Rate* =
  - 500 gpd / developed acre for **new developments** (500 gpd / developed acre is equal to the ~90$^{th}$ percentile I/I per developed acre observed in recently sewered areas within Camas), **or**
  - The Basin-Specific Areal I/I Rates in Table 1, for sizing collection system components for **existing sewered areas**

Substituting these values into Equation 1 yields:

**EQUATION 2:**

**Total Design Flow (Peak Hour) = (# of ERUs x 149 gpd / ERU x *Orange Book Peaking Factor* x 0.691) + (Acreage x *Areal I/I Rate* )**

**TABLE 1**
**BASIN-SPECIFIC AREAL I/I RATES**

| BASIN | BASIN-SPECIFIC AREAL I/I RATES<br><br>(gal./ dev. acre – day)<br>Peak Hour |
|---|---|
| 1 | 14,953 |
| 2 | 10,024 |
| 3 South | 4,461 |
| 3 North | 6,320 |
| 4 | 10,701 |
| 5 | 1,508 |
| 6 | 2,677 |
| 7 | 2,346 |
| 8 | 500 |
| 9 | 500 |
| 10 | 3,157 |
| 11 | 500 |
| 12 | 500 |
| 13 | 500 |
| 14 | 500 |
| 15 | 519 |

# APPENDIX R

# NEPA/SERP/ENVIRONMENTAL REPORT

# State Environmental Review Process (SERP)
# ENVIRONMENTAL REPORT
# 2007 Wastewater Treatment Facility and Main Sewage Pump Station Improvements (Phase II)

**City of Camas**

**May 25, 2007**

**Updated**

**November 2009**

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# CHAPTER 1

# PURPOSE AND NEED

# 1.0 PURPOSE AND NEED

## 1.1 Project Description (Proposed Action or Proposed Project)

**Main Sewage Pump Station:**
The City of Camas proposes to construct a series of major improvements increase reliability and reduce maintenance requirements at its main sewage pump station that pumps nearly all of the City's sewage under the Washougal River to the WWTF. The existing wet well will be enlarged and a grinder facility will be installed to grind debris to prevent clogging of the pumps.

**Wastewater Treatment Facility:**
Camas will construct a $15-20 million upgrade to the existing Wastewater Treatment Plant to increase capacity and provide redundancy that will ultimately ensure public health and safety and enhance the environmental value of the region's natural resources. The design will include a new primary anaerobic digester, new secondary anaerobic digester, new sludge dryer, new secondary clarifier, additional aeration blower, additional bank of ultraviolet disinfection lamps, aeration basin modifications, enlarged odor control biofilter, new septage storage tank, and operational control systems that will integrate the new systems with the existing plant systems.

## 1.2 Purpose and Need for the Project

The Department of Ecology issued a Notice of Violation (number 2981) to the City of Camas on January 9, 2006; the WWTF exceeded its ammonia limits December 2004, February 2005, March 2005, April 2005, May 2005, June 2005, September 2005, October 2005, and November 2005. The proposed Wastewater Treatment Facility Improvement Project will address ammonia removal issues and allow the Camas Wastewater Facilities to meet the requirements of the NPDES Permit through the planning period (2025).

Modeling performed on the City of Camas Wastewater Collection System indicates that the Main Pump Station is over capacity at current maximum flows due to Infiltration and Inflow during storm events and the Station will be over capacity due to projected future loadings associated with growth in the City. Increasing the size of the wet well and installing grinder pumps will improve the reliability of this critical pump station. Further, the pumps motors and emergency generator and the electrical and control systems must be upgraded. All proposed work will occur within the fenced boundaries of the existing WWTF and most new infrastructure will be installed over 200 feet from the Columbia River. A Shoreline Substantial Development Permit will be obtained from the City of Camas for this project.

# CHAPTER 2

# ALTERNATIVES TO THE PROPOSED ACTION

## 2.0 ALTERNATIVES TO THE PROJECT ACTION

The source of the information for this chapter is the *Draft General Sewer/Wastewater Facility Plan for the City of Camas* prepared by Gray & Osborne, Inc. in November 2006. This report discusses treatment alternatives available to meet the needs of the City for the next 20 years.

**Alternative 1: No Action** Taking No Action to upgrade the existing Camas WWTF and Main Pump Station would leave the City with a system unable to meet the plant's ammonia limits and other NPDES Permit requirements.

**Alternative 2: Satellite Water Reuse Facility:** Construction of a 2.1 MGD Membrane BioReactor Water Reuse Facility at the north end of Lacamas Lake near Camp Currie to provide Class A Reuse Water to local clients. This new facility would be a "scalping plant" treating only the liquid portion of the waste stream from Basins 11, 12 and 13 and 2/3 of the flow from Basin 1. Solids would be pumped through City sewers and treated at the existing Wastewater Treatment Facility. Implementation of this alternative would require minor modifications to the STEP line to accommodate the conveyance of solids. The existing WWTF would continue to discharge via the existing outfall, which would also provide a back-up disposal option for the satellite MBR facility as needed.

### 2.1 Screening Evaluation

#### Alternative 1: No Action

Taking no action would leave the City of Camas with a wastewater treatment facility unable to meet the requirements of its NPDES Permit. Water quality in the Columbia River could be jeopardized, especially during high flow events. This could lead to violations of the National Pollutant Discharge Elimination System (NPDES) permit for the facility, resulting in fines, compliance orders and hook-up restrictions from the Department of Ecology.

#### Alternative 2: Satellite Water Reuse Facility:

Advantages of this alternative:

- Construction of a satellite MBR WWTF would reduce the range and scope of improvements required at the existing WWTF to provide service to the growing population of Camas through the planning period.
- The MBR WWTF would provide high quality effluent consistent with Class A Reuse Criteria for potential clients nearby.
- The MBR WWTF would have a small footprint and could easily be upgraded as the population in its service area grows.
- The existing WWTF Outfall could serve the satellite plant during emergencies.

Disadvantages of this alternative include:

- Requires construction of effluent pump station and pipelines.
- Would require an additional WWTF Operator.
- Would require modifications to the STEP line to convey solids to the existing WWTF.
- High cost, compared with the low cost of reclaimed water.
- Would require permitting of a new facility, likely involving work in sensitive areas that would need both federal and local sensitive areas review and concurrence.

**Screening evaluation summary:**

- **Taking No Action** would leave the City of Camas with a WWTF that is unable to consistently meet the requirements of its NPDES Permit in the next few years, especially considering the growing population and tightened permitting requirements.

- **Alternative 2: Satellite Water Reuse Facility:** Construction of a new Water Reuse Facility would be more expensive that upgrading the existing WWTF, and depending upon the location would likely require significantly more permitting and maintenance. It would also require construction of a new effluent pump station and pipeline. The City would be required to hire additional operations and maintenance staff for the new facilities.

- **Alternative 3: Upgrading the existing WWTF and Main Pump Station:** Implementation of this alternative would provide adequate wastewater treatment and conveyance for the City of Camas through the planning period using current growth projections with minimal permitting requirements.

**Findings**

Implementation of either of the proposed system upgrade options would provide adequate wastewater treatment for the City of Camas through the 20-year planning period. Upgrading the existing WWTF and Main Pump Station would provide adequate wastewater treatment and conveyance to meet the requirements of the NPDES Permit through the planning period. Time required for funding, permitting, design and construction of the proposed WWTF Upgrade and Main Pump Station Improvements would be significantly less than the time required to permit construction and operation of a new Satellite MBR WWTF near Lacamas Lake.

# CHAPTER 3
# AFFECTED ENVIRONMENT/ ENVIRONMENTAL CONSEQUENCES

## 3.0 Affected Environment/Environmental Consequences

### 3.1 Land Use/Important Farmland/Formally Classified Lands

#### 3.1.1 Affected Environment

**City of Camas**
The City of Camas is located in southeastern Clark County, approximately 12 miles east of Vancouver at the confluence of the Columbia and Washougal Rivers. The City is bordered by the Columbia River on the south, the City of Washougal and Woodburn Hill on the east, the City of Vancouver and Grass Valley to the west, and Lacamas Lake and Lacamas Park to the north. The City includes approximately 7,400 acres and includes 15,400 residents. A number of light industrial and technical businesses provide much of the employment in the City.

**Camas WWTF and Main Pump Station**
The City of Camas Wastewater Treatment Facility lies at approximately river mile (RM) 120.8 of the Columbia River, just south of the City. The Main Pump Station is located at the corner of Dallas and Third on the west side of the Washougal River across SR 14 from the WWTF. The outfall extends offshore from the WWTF approximately 850 feet where it discharges in 35 feet of water. The 36-inch corrugated steel metal structure lies under quarry spalls on the bottom of the River.

Wastewater Treatment Facility
The City of Camas WWTF is located near the bank of the Columbia River between the SR 14 ROW and a shoreline access roadway for a barge company. The fence surrounding the Camas WWTF is approximately 100 feet from the bank of the Columbia River, and most of the WWTF infrastructure (with the exception of the Equipment Building nearest the outfall at the east end of the site) appears to be set back from the river, just over 200 feet. The site is located in **Section 12 of Township 1 North, Range 3 East** of Clark County and covers about nine acres. The WWTF site has not been used for agriculture or silviculture in recent years, and there are no formally designated prime farmlands in the project area. Vegetation surrounding the site consists primarily of cottonwoods, maples and alders with a few Douglas fir and spruce trees in the area. Vegetation on the WWTF site is limited to domestic grasses and understory adjacent to the WWTF consists of bushes and forbs characteristic of the Columbia River lowlands.

Main Pump Station
The City of Camas Main Pump Station is located approximately one-half mile northwest of the WWTF on the north side of the Washougal River at the corner of Dallas and Third Avenue SE. A shallow driveway extends approximately 25 feet south from Third Avenue SE to the Lift Station. Vegetation surrounding the Lift Station includes cottonwood, maple and alder trees with a few Oregon ash. Blackberries and nettles dominate the understory. Grasses have been planted in the area across Third Avenue SE from the Pump Station, with some ivy growing, just to the west of the auxiliary generator. A large trucking operation (possibly solid waste disposal) is located west of the Main Pump

Station and large trucks pass the station every few minutes during the afternoon. The area to the north and east of the pump station is largely residential.

### 3.1.2. Environmental Consequences

**Alternative 1: No Action**

Taking No Action to improve wastewater treatment facilities in Camas would have no direct impact on existing land use, farmlands or other formally classified lands. The WWTF Site would remain in its present state and facility would eventually become unable to meet the requirements of its National Pollutant Discharge Elimination Permit consistently. This would lead to the imposition of a moratorium on sewer hookups in Camas, which would significantly limit land use options throughout the City/WWTF service area.

**Alternative 2: Satellite Water Reuse Facility:**

- Construction of a new Satellite Water Reuse Facility on recreational/open space land at the north end of Lacamas Lake near Camp Currie would require conversion of several acres of land to Municipal Zoning. The City of Camas would negotiate with Clark County regarding purchase of a site for the new Satellite WRF and would be required to comply with Clark County permitting requirements associated with critical areas, zoning and construction if the new WRF is located in Camp Curry. If the new facility will be constructed within 200 feet of Lacamas Lake a Shoreline Substantial Development Permit would be required from either the City of Camas or Clark County, depending upon the final location. If the new WRF were located within the City of Camas the following permits would be required.

    - City of Camas Building Permit
    - City of Camas Clearing and Grading Permit
    - City of Camas Land Use Conditional Use Permit
    - City of Camas Shoreline Conditional Use Permit

**Alternative 3: Upgrading the existing WWTF and Main Pump Station:**

Implementation of this alternative would maintain the existing land uses in the vicinity of the WWTF and at the Main Pump Station. There would be no modification of land use at the north end of Lacamas Lake. Shoreline Substantial Development/Conditional Use Permits would likely be required for improvements at both the WWTF Site and the Main Pump Station Site.

### 3.1.3 Mitigation

Compliance with the conditions of the Shoreline and/or Land Use Conditional Use Permits, Building Permit and Clearing and Grading Permits would provide adequate mitigation for potential modifications to existing land uses associated with both action alternatives. Implementation of either action alternative would mitigate adverse land use consequences associated with development restrictions that would eventually result from non-compliance with the NPDES permit for the WWTF (No Action Alternative).

The trucking operation west of the Main Pump Station should be contacted regarding potential impacts to traffic associated with construction of the new, larger wet well that would extend northeast into the existing cul-de-sac south of Third Avenue SE.

## 3.2 Floodplain

### 3.2.1 Affected Environment

According to the Flood Insurance Rate Map for the City of Camas (FIRM Panel #530026 0002B), most of the WWTF lies within the 100-year flood plain of the Columbia River and the Main Pump Station is located on fill at the edge of the 100-year floodplain of the Washougal River, which lies approximately 600 feet southeast. The fence around the perimeter of the WWTF lies approximately 100 feet from the shoreline of the Columbia River and most of the WWTF components are located approximately 100 feet north of the fence, *with the exception of the Equipment Building and Manhole adjacent to the effluent pipeline to the outfall. The new Anaerobic Digesters and Digester Building the new Sludge Holding Tank may be located within 200 feet of the Columbia River.*

### 3.2.2 Environmental Consequences

**Alternative 1: No Action**

Taking no action at the Camas WWTF site would have no impact on the floodplain of the Columbia River. It would, however, eventually leave the City of Camas without an adequate wastewater treatment facility.

**Alternative 2: Satellite Water Reuse Facility**

Depending upon the final location of the Water Reuse Facility at the north end of Lacamas Lake, mitigation of floodplain impacts may be required. Because the WRF would pump effluent to potential industrial users in the vicinity, a shoreline/floodplain location is not critical for this facility. Construction of the facility outside of the 100-year floodplain of Lacamas Lake would alleviate any floodplain issues associated with this facility.

Any improvements to the existing WWTF associated with this project would occur within the 100-year floodplain of the Columbia River. Any new critical infrastructure would require a Flood Hazard analysis and any new structures in the floodplain should be flood-proofed (elevated) above the 100-year floodplain.

**Alternative 3: Upgrading the existing WWTF and Main Pump Station:**

Improvements to the existing WWTF will be protected/elevated to at least the 100-year flood elevation plus one foot (two feet, if possible). It appears that the critical infrastructure at the existing pump station is elevated above the 100-year flood elevation. Installation of a new wet well in the cul-de-sac above the Main Pump Station would not adversely impact the 100-year floodplain, as long as construction materials are not placed downhill of the Pump Station.

### 3.2.3 Mitigation

Construction of proposed improvements to the Camas WWTF within the 100-year floodplain of the Columbia River will not displace enough flood flow to result in an increase in the 100-year flood elevation of more than one foot. The new anaerobic digester and top of the sludge holding tank will be elevated above the 100-year flood elevation. A Flood Hazard Analysis will be required for this project by the City of Camas.

In the event that a new WRF is constructed near the north end of Lacamas Lake, the facility should be sited outside of the 100-year floodplain.

## 3.3 Wetlands

### 3.3.1 Affected Environment

**Existing WWTF & Main Pump Station**

There are no formally classified wetlands within the grounds of the Camas WWTF or on the site of the proposed improvements to the Main Pump Station, which is a paved cul-de-sac. Wetlands may be present around the north end of Lacamas Lake. Soils in the vicinity of the WWTF are Hillsborough Silt Loam, which has very slow surface runoff with no erosion hazard. Soils at the Main Pump Station are Sauvie Association, which are deep, moderately well drained and somewhat poorly drained, nearly level to gently sloping soils on bottomlands along the Columbia River. Soils at the northern end of Lacamas Lake are Lauren and Cove Associations. Lauren series soils consist of deep, somewhat excessively drained, gently sloping soils on terraces above the Columbia River consisting of gravel and volcanic ash. Cove soils consist of deep, very poorly drained with clay sub-soils.

### 3.3.2 Environmental Consequences

**Alternative 1: No Action**

Taking no action at either the existing WWTF Site, or the Main Pump Station Site will have no impact on wetlands. Taking no action would eventually leave the City of Camas without an adequate wastewater treatment facility capable of meeting the requirements of its NPDES Permit.

**Alternative 2: Satellite Water Reuse Facility**

Depending upon the site chosen for construction of a Satellite Water Reuse Facility near the north end of Lacamas Lake, the potential to disturb wetlands exists. Siting the facility outside of wetlands would reduce the amount of critical areas permitting required for a Water Reuse Facility.

**Alternative 3: Upgrading the existing WWTF and Main Pump Station**

No wetlands would be disturbed associated with construction of proposed improvements to the Camas WWTF or the City of Camas Main Pump Station.

### 3.3.3 Mitigation

**Alternative 1: No Action**

No wetland impacts to mitigate.

**Alternative 2: Satellite Water Reuse Facility**

Siting the WRF and associated pipelines outside of areas known to have wetland soils would minimize potential for impacts to wetlands. No wetlands in the vicinity of the existing WWTF and Main Pump Station would be impacted under this alternative. In the event that significant infrastructure is sited within wetland areas, Clean Water Act, Section 404 permitting and local critical areas review would be required if more than 0.1 acre of wetlands are impacted. Conditions of the 404 Permit would be implemented during construction and wetlands disturbed during trenching for sewer mains and other underground infrastructure. Wetland mitigation could occur on-site (preferred), or be conducted off-site in accordance with the Department of Ecology's latest wetland mitigation ratios.

**Alternative 3: Upgrading the existing WWTF and Main Pump Station**

No wetlands would be impacted under this alternative, so no wetland mitigation would be required.

## 3.4 Cultural Resources

### 3.4.1 Affected Environment

Robert Whitlam of the Washington State Office of Archaeological and Historic Preservation has been contacted (see correspondence in Appendix) regarding the potential for archaeological, historical and culturally significant resources in the project area. Discussions with Dr. Whitlam determined that the area has a high potential for artifacts of archaeological, historic or cultural significance. Dr. Whitlam recommended that a pedestrian survey of the WWTF and Main Pump Station sites be conducted by professional archaeologists prior to soil disturbing activities.

The City of Camas contracted with Archaeological Investigations Northwest to survey the Camas WWTF Site and the Main Pump Station. This survey was conducted in April of 2007 and the *Archaeological Survey for the City of Camas's Pump Station and Wastewater Facility Improvement, Design Phase 2 Project* (May 1, 2007) determined that "no resources were identified within the proposed project areas," Northwest Archaeological Investigations Northwest recommended a finding of "No Historic Properties Affected." Copies of this report were forwarded to the Department of Archaeology & Historic Preservation, and the Cultural Resources Departments of the Yakama Nation and Cowlitz Tribe; there have been no responses to date (May 24, 2007).

### 3.4.2 Environmental Consequences

**Alternative 1: No Action**

Taking no action would have no impact on historic, archaeological, or cultural resources in the vicinity of the Camas WWTF, Main Pump Station or near the north end of Lacamas Lake.

**Alternative 2: Satellite Water Reuse Facility**

Construction of a new Satellite Water Reuse Facility near the north end of Lacamas Lake has the potential to disturb/discover materials of cultural, historic or archaeological significance. In the event that this alternative is implemented, a professional archaeologist should survey the sites chosen for the new WWTF and any associated infrastructure prior to ground disturbing activities.

**Alternative 3: Upgrading the existing WWTF and Main Pump Station:**

The survey prepared by Archaeological Investigations Northwest indicated that construction of the proposed improvements to the Camas WWTF and the Main Pump Station would have minimal potential for disturbance or discovery of objects of historic, cultural or archaeological significance. However, in the event that significant materials are discovered during construction, mitigation measures outlined below would be conducted to minimize potential for adverse impacts to these resources.

### 3.4.3 Mitigation

During construction, any excavation by the Contractor that uncovers an archaeological, historical, or culturally significant artifact shall be immediately reported to the Project Engineer, a representative of the Public Works Board, the Department of Archaeology & Historic Preservation and the affected Native American Tribes. Construction shall be temporarily halted pending the notification process and further directions issued by the State Historic Preservation Officer (SHPO) and the Tribal Officials.

## 3.5 Biological Resources

### 3.5.1 A. Threatened & Endangered Species Affected Environment

The Camas WWTF is located within 100 feet of the Columbia River and the Main Pump Station is located approximately 600 feet from the Washougal River. The following species/Evolutionarily Significant Units/Distinct Population Segments of salmonids migrate up and down the Columbia River past Camas and are protected under the authority of the Endangered Species Act of 1973:

| Species/ESU | Status | Date | FR Notice |
|---|---|---|---|
| Salmonids Under NMFS Jurisdiction: | | | |
| Lower Columbia Chinook | **Threatened**<br>**Critical habitat** | **6-28-05**<br>**9-2-05** | |
| Lower Columbia steelhead | **Threatened**<br>**Critical habitat** | **3-19-98**<br>**9-2-05** | **63 FR 13347**<br>**65 FR 7764** |
| Columbia River chum | **Threatened**<br>**Critical habitat** | **6-28-05**<br>**9-2-05** | |
| SW Washington & Lower Columbia coho | **Threatened** | **6-28-05** | |
| Upper Columbia spring chinook | **Endangered**<br>**Critical habitat** | **3-24-99**<br>**9-2-05** | **64 FR 14308** |
| Snake River sockeye | **Endangered**<br>**Critical habitat** | **11-20-91**<br>**12-28-93** | **56 FR 58619**<br>**58 FR 53635** |
| Upper Columbia steelhead | **Endangered**<br>**Critical habitat** | **8-18-97**<br>**2-16-00** | **62 FR 43937**<br>**65 FR 7764** |
| Snake River fall chinook | **Threatened**<br>**Critical habitat** | **4-22-92**<br>**12-28-93** | **57 FR 14653**<br>**58 FR 68543** |
| Snake River spring/summer chinook | **Threatened**<br>**Critical habitat** | **4-22-92**<br>**12-28-93** | **57 FR 14653**<br>**58 FR 68543** |
| Mid Columbia steelhead | **Threatened**<br>**Critical habitat** | **3-25-99**<br>**2-16-00** | **64 FR 14517**<br>**65 FR 7764** |
| Snake River steelhead | **Threatened**<br>**Critical habitat** | **8-18-97**<br>**2-16-00** | **62 FR 43937**<br>**65 FR 7764** |
| Upper Willamette steelhead | **Threatened**<br>**Critical habitat** | **3-25-99**<br>**2-16-00** | |
| **USFWS Listed Species** | | | |
| Columbia River bull trout | **Threatened**<br>**Critical habitat** | | |

**LISTED EVOLUTIONARILY SIGNIFICANT UNITS (ESUs) OF CHINOOK SALMON:**

**Lower Columbia chinook salmon, *Oncorhynchus tshawytscha:*** Both spring and fall chinook populations on the lower Columbia River were listed as threatened on March 28, 1998. Critical habitat was updated for this ESU on September 2, 2005.

***Spring chinook*** are present in the Cowlitz, Kalama and Lewis rivers. Spring chinook populations from these rivers are of mixed hatchery and wild origin. Return migration for these stocks occurs from late January to May. Tributary migration occurs from March through July, while spawning extends from late August through early October.

**Lower Columbia *fall chinook*** consists of 14 stocks. These stocks can be further divided into two general groups; the Tule early spawning stocks with strong hatchery influence of mixed origin, and a Lewis River wild stock that spawns later with little hatchery influence. Return migration through the lower Columbia extends from August through November. Spawning is generally October for early stocks and November for late stocks.

**Upper Columbia spring chinook**
Upper Columbia spring chinook salmon were listed as endangered on March 24, 1999. Critical habitat was adopted for this ESU on February 15, 2000 and updated on September 2, 2005. Spring chinook destined for areas upstream of Bonneville Dam usually reach peak abundance at the dam between April 20 and April 28 but can be earlier during low flow years or later during high run-off periods. Tributary entry is May-June with spawning in late August to late September.

**Snake River fall chinook**
Snake River fall chinook salmon were listed as threatened on April 22, 1992, and critical habitat for this ESU was adopted on February 28, 1993.

**Snake River spring/summer chinook**
Snake River spring/summer chinook were listed as threatened on April 22, 1992 and critical habitat was finalized on December 28, 1993.

**COLUMBIA RIVER CHUM SALMON, LISTED THREATENED:**

**Columbia chum salmon, *O. keta*:**

Columbia River chum salmon were once widespread in the lower Columbia River. They were listed as threatened on March 25, 1999, and critical habitat for this ESU was finalized on February 16, 2000 and updated on September 2, 2005. Today chum salmon produced in the lower Columbia are concentrated in the Grays River system near the mouth of the Columbia and near Bonneville Dam in Hardy and Hamilton creeks. A few chum salmon cross Bonneville Dam during some years. These stocks of chum salmon are native. Some non-native chum introductions have been attempted, with no apparent success. Chum enter the Columbia in October and November, and spawn in November and December. The present run size is estimated to range between 3,000 and 10,000 fish annually. According to Joe Hymer of the Washington Department of Fish & Wildlife, hatchery releases of the “threatened” stock of Columbia River chum at the mouth of Grays River occur during June. Juveniles from this release pass through the project area shortly thereafter.

## LISTED ESUs OF COLUMBIA RIVER BASIN STEELHEAD:

**Lower Columbia steelhead, *O. mykiss***
Lower Columbia River steelhead were listed as threatened on March 19, 1999. Critical habitat for this ESU was adopted on February 16, 2000 and updated on September 2, 2005. According to the Columbia River SASSI Appendix, the Lower Columbia River supports five summer steelhead stocks and eighteen winter steelhead stocks. Run timing of the summer steelhead extends from May through October, and run timing of winter steelhead stocks extends from December through April in the Lower Columbia River.

***Mid Columbia steelhead***

Mid Columbia River steelhead were listed as threatened on March 25, 1999. Critical habitat for this species was adopted on February 2, 2000 and updated on September 2, 2005.

***Upper Columbia steelhead***

Upper Columbia River steelhead were listed as endangered on August 18, 1997 and critical habitat for this ESU was adopted on February 16, 2000 and updated on September 2, 2005.

***Snake River steelhead***

Snake River steelhead were listed as threatened on August 18, 1997 and critical habitat for this ESU was adopted on February 16, 2000 and updated on September 2, 2005.

**Upper Willamette River steelhead**
The Upper Willamette River steelhead were listed as threatened on March 25, 1999 and critical habitat was finalized for this ESU on February 16, 2000 and updated on September 2, 2005.

## SNAKE RIVER SOCKEYE, LISTED AS ENDANGERED

**Snake River sockeye salmon, *O. nerka***
Snake River sockeye salmon were listed as endangered on November 20, 1991 and critical habitat for this ESU was adopted on December 28, 1993.

## LOWER COLUMBIA RIVER COHO, LISTED AS THREATENED:

**Lower Columbia River coho, *O. kisutch***, was listed as threatened by the National Marine Fisheries Service on June 28, 2005. Critical Habitat has not yet been proposed.

## COLUMBIA RIVER BULL TROUT, LISTED AS THREATENED:

The US Fish & Wildlife Service listed the **Columbia River bull trout, *Salvelinus confluentus,*** as threatened on June 10, 1998. Critical habitat and ESA Section 4 (d) rules were not adopted at this time. According to Jeff Chan of the Olympia Office of the USFWS, critical habitat for Columbia River bull trout in was adopted on September 26, 2005 and is generally limited to spawning and rearing areas in upper portions of watersheds.

**Bald eagle, *Haliaeetus leucocephalus*:**
According to Priority Species and Habitat Map prepared for this project by the Washington Department of Fish and Wildlife on January 7, 2005, there are no bald eagles known to nest within approximately two miles of the project site. Wintering bald eagles prey on salmon migrating into and out of the Columbia River and may forage offshore in the vicinity of the project area between November 1 and March 31. The bald eagle was removed from the list of species protected under the authority of the Endangered Species Act in 2007.

Species identified as present in Clark County that are not likely to be present in the project area:

**Northern spotted owl, *Strix occidentalis*, Listed Threatened*:***
Northern spotted owls occur in Clark County throughout the year. According to the Priority Habitats & Species Map prepared for the area surrounding Section 12, Township 1 North, Range 3 East on April 23, 2007, there are no northern spotted owl nests or management circles within two miles of the project area.

**Gray wolf, *Canis lupus*, Listed Endangered:**
Gray wolves have not been sighted in Clark County in many years. Further, the gray wolf population in Washington State is thought to be concentrated in the northeastern corner of the state, and any wolves occurring in the SW corner of the state are likely to be hybrids, which are not eligible for protection under the Endangered Species Act. All work on the proposed Camas WWTF and Main Pump Station Improvement Project will occur on the fenced, developed WWTF site and at the Main Pump Station, which is located adjacent to heavy truck traffic on Third Avenue SE, so it is unlikely that gray wolves would be impacted.

***Listed plant species:***

- Golden paintbrush, *Castilleja levisecta*, Listed as Threatened in 1990: Historically occurred in the Mill Plain area of Clark County Washington. Typically found in wet prairie areas.

- Water howellia, *Howellia aquatilis*, Listed as Threatened in 1994, occurs in two small populations in the floodplain of the Columbia River in Clark County on the Ridgefield Wildlife Refuge across Lake River from the City of Ridgefield.

- Bradshaw's lomatium, *Lomatium bradshawii*, was listed as Endangered on September 30, 1988. It is thought to be endemic to the area around (within ten miles of) Salem, Oregon. According to Ron Klump of the US Army Corps of Engineers, it was recently discovered along Lacamas Creek near a golf course in Camas, Washington.

### 3.5.1 B. Fish & Wildlife

**Fish**
In addition to the populations of listed fishes presented in Section 3.5.1 A., fish species in the Columbia River near the Camas WWTF may include the following: shad, bass, perch, sturgeon (both white and green) and Pacific lamprey. The

Priority Habitats & Species Map provided by WDFW on April 23, 2007 indicated that reticulated sculpins were present in the Columbia River near Camas.

**Wildlife**

Large game animals present in the vicinity of Camas are likely to include Roosevelt elk, black-tailed deer and black bear. Smaller common mammals include beaver, coyote, raccoons, mountain beaver, snowshoe hare, brush rabbit, purple marten striped skunk, opossum, river otter, mink, weasels and red squirrels. Less common mammals include cougar, bobcat, muskrat, flying squirrel and porcupine. Various species of shrews, rodents and bats are also common.

Waterfowl in the vicinity of the WWTF includes mallards, wood ducks, common merganser, great blue heron, green heron, belted kingfisher and the American dipper. Many species of migrating ducks, geese and swans also migrate past Camas. Birds of prey include the goshawk, Cooper's hawk, sharp shinned hawk, osprey red-tailed hawk, kestrel and northern harrier. Owls that may be present in the vicinity include the great horned owl, western screech owl, northern sawhet and northern pygmy owl. The Camas WWTF lies within the range of the northern spotted owl, but no "northern spotted owl centers" were indicated on the Habitats and Species Map prepared for the vicinity of Township 1 North, Range 3 East, Section 12 (WDFW April 23, 2007).

A wide variety of upland birds may be present in the vicinity of Camas. Species of concern to the US Fish & Wildlife Service include Peregrine falcon *(Falco peregrinus)* and the olive-sided flycatcher *(Contopus cooperi)*. Other common birds present may include Steller's jay, American crows and a variety of woodpeckers, swallows, nuthatches, wrens, sparrows, vireos and finches. The Priority Habitats & Species Maps provided by WDFW on April 23, 2007 indicated that purple martins nest in Washougal and at the Port of Camas/Washougal.

The only snake species common to the project area is the northwestern garter snake. It is unlikely that turtles would be found in the vicinity of the Camas WWTF in the Columbia River or at the Main Pump Station Site above the Washougal River. The lizard most likely to be present is the American alligator lizard. Species of Concern to the USFWS include the long-eared myotis *(Myotis evotis)*, long-legged myotis *(Myotis volans)*, western toad *(Bufo boreas)* (Mathews 1999).

### 3.5.1 C. Vegetation

The Camas area was originally forested with tidal wetlands along the Columbia River. Most of the hillsides in the Camas area have been logged at least once. Common species in order of prominence include: Douglas-fir *(Pseudotsuga menziesii)*, red alder *(Alnus rubra)*, big-leaf maple *Acer macrophyllum)*, and black cottonwood *(Populus trichocarpa)*. Other species found in the area include Grand

fir *(Abies grandis)*, Western red cedar *(Thuja plicata)* and Oregon ash *(Fraxinus latifiola).* Various species of undergrowth include salal, several varieties of berries, innumerable species of brush, sword ferns, honeysuckle, vine maple and others. Grasses consist of bentgrass, brome, cheat and other local grasses. Blue camas may be found growing in open fields.

### 3.5.2 A. Threatened & Endangered Species Environmental Consequences

**Alternative 1: No Action**

Taking no action to upgrade the Camas wastewater collection and treatment facilities would have no construction impacts on bald eagles, or the 14 species of salmonids protected or under consideration for listing for protection under the authority of the Endangered Species Act of 1973. If no action is taken to improve the capacity and efficiency of the Camas wastewater collection and treatment system, it will eventually be unable to consistently treat the volume of wastewater generated by growth, or meet the requirements of its NPDES permit. This would result in increased biological oxygen demand (BOD) and bacterial and nutrient contamination in the Columbia River near the outfall, which could adversely affect listed salmonids migrating through the area.

**Alternative 2: Satellite Water Reuse Facility**

Construction of a new Satellite Water Reuse Facility near the north end of Lacamas Lake would likely require clearing of a forested area. As the WRF would not require an outfall it could be located more than 200 feet from the lake or its significant tributaries. Pipes, pump stations and other infrastructure required to convey treated WRF effluent to client industries to the west may require work in shoreline areas. The Priority Habitats & Species Map prepared for the area surrounding the existing WWTF indicates that there are no known bald eagle nests in this area. Further, the PHS Map indicates that anadromous fish cannot access Lacamas Lake, so direct impacts to listed salmonids are unlikely. Any site proposed for the WRF and associated infrastructure should be surveyed for the potential presence of Bradshaw's lomatium, which was recently discovered in the vicinity of Lacamas Lake (Ron Klump personal communication 2006). This work would have **no effect** on bald eagles nesting approximately five miles to the southwest at the existing WWTF and would not be likely to disturb eagles foraging along Lacamas Lake and the Columbia River during the winter months.

Implementation of this alternative would allow the Camas WWTF to meet the requirements of its NPDES permit over the planning period and would help to maintain water quality in the Columbia River. Implementation of this alternative would not adversely affect the 14 species of salmonids listed or under consideration for protection under the authority of the Endangered Species Act of 1973.

**Alternative 3: Upgrading the existing WWTF and Main Pump Station:**

Upgrading the Camas WWTF and Main Pump Station on their existing sites would have little, if any, potential to adversely impact listed species of fish and wildlife present in the vicinity. Operation of the upgraded WWTF and Main Pump Station would improve wastewater treatment and conveyance capacity and help to improve and maintain water quality and fisheries habitat in the Columbia and Washougal rivers.

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### 3.5.2 B. Fish & Wildlife Environmental Consequences

**Alternative 1: No Action**

Taking no action to upgrade the Camas WWTF will have no direct, or immediate, impact on fish or wildlife populations in the area. However, not upgrading the plant would lead to more frequent discharges of wastewater not meeting NPDES permit requirements and subsequent contamination of the Columbia River in the future, with potential to impact to fish and wildlife present in the vicinity of the outfall.

**Alternative 2: Satellite Water Reuse Facility**

Construction of a new WRF and associated pipelines and pump station near the north end of Lacamas Lake would have minimal potential for disturbance of listed wildlife species, provided the new facility is located outside of stream and lake buffers and other critical habitat. Operation of the new WRF with conveyance of high quality effluent to industrial clients located to the west would eliminate discharge of wastewater effluent into the environment for the portion of the City of Camas WRF service area. It would also reduce the amount of water withdrawn from streams and groundwater by these industries, which would improve in-stream flows and water quality in the area.

**Alternative 3: Upgrading the existing WWTF and Main Pump Station:**

Upgrading the Camas WWTF and the Main Pump Station on their respective sites has very limited potential to adversely impact water quality and fisheries habitat in the Columbia River. Construction BMPs for control of sedimentation and erosion will be implemented to minimize potential for adverse impact to adjacent streams and wildlife habitat. Construction noise would not be significantly louder than the existing noise levels associated with operation of the existing aeration basins and blowers. Operational noise generated by the upgraded WWTF and Main Pump Station would not be significantly louder than the current noise levels on these sites. Wastewater treatment and conveyance capacity will be improved initially and maintained through the planning period (2025), which will improve and maintain water quality and fisheries habitat near the existing outfall approximately 1,000 feet south of the WWTF in the Columbia River. It should be noted that minor modifications to the risers on the existing outfall have been made to improve dilution of effluent. Potential impacts to listed species associated with work on the outfall were addressed and reviewed under US Army Corps of Engineers Reference Number 20040120 completed in August 2006.

### 3.5.2 C. Vegetation Environmental Consequences

**Alternative 1: No Action**

Taking no action at the Camas WWTF would result in no impacts to vegetation on the site or near the north end of Lacamas Lake. Nutrient levels in the Columbia River near the outfall would increase, which would increase algal productivity and eventually cause low dissolved oxygen levels once the algae start to decompose.

**Alternative 2: Satellite Water Reuse Facility**
Construction of a new Water Reuse Facility near the north end of Lacamas Lake would require clearing existing vegetation from the site and related mitigation as determined by local Sensitive Areas Regulations and permit conditions from the Clean Water Act, Section 404 Permit and/or Hydraulic Project Approval (if necessary). Reuse of effluent from the WRF by local client industries would reduce the amount of effluent discharged to the Columbia River, which would reduce the amount of aquatic plant life in the vicinity of the outfall slightly. This would reduce the potential for low dissolved oxygen levels near the outfall due to decomposition of excess aquatic plant life, which would improve habitat for listed salmonids and other aquatic life.

Implementation of this alternative would reduce the extent of improvements at the existing WWTF Site required to meet the requirements of the NPDES Permit for the Camas WWTF. This would reduce the potential for disturbance of noise sensitive wildlife during construction in the area.

**Alternative 3: Upgrading the existing WWTF and Main Pump Station:**
Upgrading the existing WWTF and Main Pump Station will have no effect on vegetation outside of these sites. A small amount of grass will be removed from within the grounds of the WWTF to allow construction of the new Aerobic Digester Building and Sludge Holding Tank. The proposed enlargement of the wet well and installation of the grinder facility will occur in the cul-de-sac south of Third Avenue, which is currently paved. Operation of the upgraded WWTF and Main Pump Station will not change these facilities' impacts to adjacent upland vegetation. Improving wastewater treatment and conveyance capacity will allow the WWTF to meet the requirements of its NPDES Permit through the planning period (2025). Thus, algal productivity near the outfall will remain near current conditions.

### 3.5.3 Mitigation

- Construction Best Management Practices for the control of sedimentation and erosion shall be implemented to minimize potential short-term water quality impacts.
- Major ground-disturbing construction activities shall be restricted to the drier summer months to minimize the potential for erosion and sedimentation.
- Limiting noise-generating construction activities to the summer months will reduce the potential for noise-related disturbance to foraging bald eagles during the winter.
- Disturbed areas not covered by new structures will be landscaped with grass or native vegetation to minimize the potential for erosion and sedimentation.

## 3.6 Water Quality

### 3.6.1 Affected Environment

**Surface Water**
The Washougal and Columbia Rivers are classified as a Class A freshwater water according to the Washington Administrative Code (WAC) 173-201A-130. The outfall for the Camas WWTF is located approximately 800 feet offshore in the

Columbia River. The Camas WWTF discharged a Maximum Month Flow of 3.09 MGD and a Peak Day Flow of 7.03 MGD in 2005. The Columbia River flows west approximately 100 feet south of the WWTF fence. The Main Pump Station lies approximately 600 feet north of the Washougal River, which flows south to its confluence with the Columbia within a mile downstream. The Pump Station pumps most of the wastewater flow from the City of Camas under the Washougal River to the WWTF.

**Surface Water Quality**
Portions of the Columbia River upstream of Camas are on the 2004 CWA Section 303 (d) List for temperature. Lacamas Lake is on the 303(d) List for Total PCBs and Total Phosphorus. A portion of the City of Camas receives domestic and industrial water from surface water impoundments on Jones and Boulder creeks, tributaries to the Little Washougal River.

**Groundwater:**
The City of Camas has a number of wells at sites along the Washougal River and is investing in improvements to existing wells and drilling a number of new wells to replace capacity of failing systems. The City is in the process of transferring existing water rights from Georgia Pacific to the City to meet future water demands. The City does not have a need to develop additional water rights at this time, however, if current water rights transfer efforts are unsuccessful, water reclamation may become a viable option in the future as industrial and residential water demands increase.

### 3.6.2 Environmental Consequences

**Alternative 1: No Action**
**Surface Water**
There would be no construction impacts associated with taking no action to improve the Camas Wastewater Treatment System. If the WWTF were not upgraded, the number of days when the system is unable to meet the requirements of its National Pollutant Discharge Elimination System (NPDES) Permit would increase. BOD coliform and nutrient loading to the Columbia River would increase. This could lead to enforcement actions by the Departments of Health and Ecology and may lead to moratoria on future hookups to the wastewater conveyance and treatment system in Camas. Implementation of this alternative would be likely to preclude expansion of the service area in the future.

**Groundwater**
Taking no action to improve wastewater treatment and conveyance in Camas would not directly impact groundwater quality or quantity in the area.

**Alternative 2: Satellite Water Reuse Facility**

**Surface Water**
Construction of a Water Reuse Facility near the north end of Lacamas Lake to convert a portion of the Camas wastewater flows to Class A Water Reuse Standards would have minimal potential for adverse impacts to surface water, due to the limited size of the facility and the fact that the plant would only use the surface water discharge to the Columbia River under emergency conditions. Construction BMPs for control of sedimentation and erosion would be implemented to minimize release of turbid water into adjacent water bodies and wetlands.

**Groundwater**
Providing a source of water treated to Class A Water Reuse Standards to industrial clients to the east of Lacamas Lake would reduce industrial demand for process water in Camas. Implementation of this alternative would preserve groundwater quantity and quality in the area for future use.

**Alternative 3: Upgrading the existing WWTF and Main Pump Station:**

**Surface Water**
Construction of proposed improvements to the Camas WWTF and the Main Pump Station would have minimal potential for adverse impact to water quality in the Columbia and Washougal Rivers. Ground disturbance associated with WWTF improvements would be limited to the summer construction season, largely within previously disturbed areas more than 200 feet from the Columbia River. Construction BMPs for control of sedimentation and erosion will be implemented to minimize turbid runoff, and disturbed areas not covered with new structures will be reseeded with grass to stabilize soils. Improvements to the Main Pump Station will occur within the existing footprint, or in the paved cul-de-sac immediately north of the building, which lies more than 600 feet from the Washougal River. Construction BMPs similar to those employed for the WWTF improvements will be implemented.

Operation of the improved WWTF and Main Pump Station will provide adequate wastewater treatment and conveyance for the City of Camas through the planning period. The improved facilities should meet the requirements of the NPDES Permit through 2025 under most conditions. BOD, bacterial and nutrient loadings near the outfall should not be significant problems under normal operating conditions.

**Groundwater**
Construction of proposed improvements to the Camas WWTF and the Main Pump Station have limited potential for adverse impacts to groundwater due to the

limited scope and depth of excavation of the proposed improvements. No construction runoff will be routed to groundwater.

Operation of the upgraded WWTF would not directly impact groundwater, as effluent will be treated to secondary standards and discharged to the Columbia River via the existing outfall. Upgrading the existing WWTF to produce water suitable for groundwater recharge is neither feasible, nor required at this time.

### 3.6.3 Mitigation

Construction shall take place during the dry season and construction best management practices shall be implemented to minimize the potential for generation of sediment-laden runoff from the construction sites for the new wastewater treatment plant, pump stations and any associated force mains or gravity mains.

Construction BMPs for control of sedimentation and erosion will be implemented during construction to minimize creation and discharge of turbid runoff from constructions sites.

Most construction activities will be limited to the footprint of the existing WWTF and Main Pump Station. The wet well at the pump station will be expanded to the north in a paved cul-de-sac south of Third Avenue SE.

## 3.7 Coastal Lands

### 3.7.1 Affected Environment

The proposed project area in Camas is located approximately 120 river miles inland from the Pacific Ocean in Clark County and is not subject to the requirements of the Coastal Zone Management Act. The City of Camas and its WWTF are located adjacent to the Columbia River and are subject to the Shoreline Management Review Regulations of the State of Washington. A Shoreline Substantial Development Permit is required by the City of Camas for proposed improvements to the WWTF, as it is located within 200 feet of the Columbia River. No Shoreline Permit would be required for the improvements to the Main Pump Station as it is located approximately 600 feet from the Washougal River. Work at both facilities will require Conditional Use Permits.

## 3.8 Socioeconomic/Environmental Justice

### 3.8.1 Affected Environment

**Demographics & Waste Load Projections**

The approximate total population in Cathlamet in 2002 was estimated at 13,540 residents. The number of housing units in Camas was 5,153, which includes a total of 278 housing units including single-family homes and apartment units. There were approximately 2.6 persons per residential unit, which is consistent with OFM estimates for Clark County at 2.65 persons per household for 2005. Population projections through 2025 indicate that the population within the City's current boundaries will expand to approximately 22,360 by the end of the planning period. The 2025 population within the City's Urban Growth Boundary is estimated at 24,700 (General Sewer/Wastewater Facility Plan, G&O 2006).

**Employment**

The economic base in Camas consists of a number of industrial concerns including Georgia Pacific (are they still running the mill?) Bodycote, Columbia Litho, Inc., Brown's Chevrolet, Heraeus Shin-Etsu America, Landa, Linear Technology, Sharp Electronics Corporation, Shell Oil Products and Wafertech. Minor industrial concerns included Fort James Camas, Furuno USA Inc., Lemon Aid Automotive, Post Records and Westlie Motors.

### 3.8.2 Environmental Consequences

The Camas WWTF provides service to the City residents and industrial facilities. Expansion of the capacity of the WWTF and the Main Pump Station will allow expansion of the population and industrial development.

Failure to provide adequate capacity to serve these areas could lead to a situation where the existing WWTF could not meet the requirements of its NPDES Permit,

which would result in a moratorium on new hookups to the system. Placing a moratorium on development could stifle economic activity and future growth in Cathlamet.

### 3.8.3 Mitigation

Implementation of the proposed WWTP upgrades will mitigate potential water quality impacts associated with expansion of the population and industrial development in the service area over the next 20 years. It would allow the WWTP to meet the requirements of its NPDES permit through the planning period.

## 3.9 Miscellaneous Issues

#### 3.9.1.1 Air Quality - Affected Environment

Air Quality in the vicinity of Camas is generally good due to winds in the Columbia Gorge influenced by storms off the Pacific Ocean and the general lack of large industrial developments in the immediate vicinity.

#### 3.9.1.2 Air Quality-Environmental Consequences

Emissions to the air associated with the WWTP upgrade would be temporary. Potential sources of emissions would include fugitive dust and exhaust associated with construction activities. Air pollution abatement equipment (biofilters) will be installed as a portion of the proposed system improvements. Once construction is complete, operation of the improved water system will have no impact on air quality.

#### 3.9.1.3 Air Quality - Mitigation

As a routine matter, building permit conditions include watering as the primary dust control measure during ground disturbing construction activities.

#### 3.9.2.1 Transportation-Affected Environment

The Town of Cathlamet is accessed via State Route 13, which provides access to the City of Vancouver and the I-5 corridor to the west and the Columbia Gorge to the east. Construction of the proposed improvements to the WWTF would increase large vehicle traffic to the site for approximately one year. Work at the Main Pump Station would last for several months. Upgrading the pump station may require planning of detour routes for truck traffic from the transfer station to the west. Once construction is complete and the wastewater treatment improvements are in operation, no increase in traffic over existing conditions is anticipated.

#### 3.9.3.1 Noise

Noise associated with construction vehicles and equipment will be present in the project area for approximately six. Once outdoor construction activities are complete, noise levels will return to near normal through the next 14 months of construction activity. Once construction is complete, noise levels will return to preconstruction levels, as new noise-generating equipment (pumps, blowers etc.) will be housed in soundproof enclosures.

## 4.0 Summary of Mitigation

Mitigation of potential impacts to the human environment as a result of this project will include:

a) Major ground-disturbing construction activities shall take place during the dry season and construction best management practices shall be implemented to minimize the potential for generation of sediment-laden runoff from construction sites associated with wastewater treatment and conveyance system upgrades.

b) Limiting major noise-generating construction activities to the drier summer months reduces the potential for disturbance of bald eagles foraging along the Columbia River.

c) Financial impacts to low income populations shall be mitigated through the acquisition of grants and low-interest loans;

d) Noise impacts shall be addressed by limitation of hours of outdoor construction; and installation of pumps and aerators in soundproof buildings;

e) During construction, any excavation by the contractor that uncovers an historical or archaeological artifact shall be immediately reported to the Project Engineer, a representative of the Public Works Board, and the Cowlitz and Yakama Tribes. Construction shall be temporarily halted pending the notification process and further directions issued by the State Historic Preservation Officer (SHPO) and Tribal Officials.

## 5.0 Correspondence

## 6.0 Exhibits

## REFERENCES


Gray & Osborne, Inc. 2001. *Biological Evaluation for the First Street, Howerton Way and Waterfront Way Improvements*, prepared for the Washington State Department of Transportation, Vancouver, Washington, July 13.

Gray & Osborne, Inc. 2001. *Wastewater Facility Plan Amendment, prepared for the Town of Cathlamet, November.*

Gray & Osborne, Inc. 2005. *Biological Evaluation for the Camas WWTF Outfall Improvements*, associated with the Rivers & Harbors Act, Section 10 Permit issued by the US Army Corps of Engineers, December 6.

Gray & Osborne, Inc. 2006. *General Sewer/Wastewater Facility Plan for the City of Camas, Draft*, Seattle Office, November.

Hart, J.L. 1973. *Pacific Fishes of Canada*, Fisheries Research Board of Canada, Bulletin 180, Ottawa, Canada.

Holman, Eric 2001. Personal communication regarding the presence of listed salmonids in the project area. WDFW Vancouver Office, July 11.

Hymer, Joe 2001. Personal communication regarding the presence of listed salmonids in the project area. WDFW Vancouver Office, July 12.

Mathews, Daniel 1999. *Cascade-Olympic Natural History, A Trailside Reference*, Second Edition, Raven Editions, Portland Oregon.

US Department of Agriculture, Soil Conservation Service 1972. *Soil Survey of Clark County, Washington*, in cooperation with Washington Agricultural Experiment Station, November 1972.

Washington State Department of Ecology 2000, *2000 Washington State Water Quality Assessment, Section 305 (b) Report*, Olympia, Washington, August.

Washington State Department of Fish and Wildlife 1993. *Salmon and Steelhead Stock Inventory*, Appendix 3 Columbia River Stocks, Olympia, Washington, June.

Washington State Department of Fish & Wildlife 2007. Priority Habitats & Species Maps for Section 12, Township 1 North, Range 3 East, April 23.

Washington State Department of Transportation 2001, *Local Agency Environmental Classification Summary for the First Avenue, Howerton Way and Waterfront Way Improvement Project*, prepared for the Town of Ilwaco by Gray & Osborne, July.

# 5. Correspondence

CITY OF CAMAS
616 Northeast Fourth Avenue
P.O. Box 1055
Camas, Washington 98607
PH: 360-834-6864 • F: 360-834-1535
http://www.ci.camas.wa.us

# NOTICE OF FINAL DECISION
# SITE PLAN PERMIT
## File# SPRV 09-09 (Wastewater Treatment Facility)

Issued: November 2, 2009

| | |
|---|---|
| Proposal | The City of Camas proposes to upgrade the main pump station at the Camas Wastewater Treatment Facility to improve sewage conveyance and sludge/biosolids handling. |
| Location | 1129 Polk Street, Camas, WA. Tax Parcel #87360-000 |
| Owner | City of Camas<br>616 NE 4th Avenue<br>Camas, WA 98607 |

## I. BACKGROUND

- The project area is 3.02 acres.
- The application is subject to Site Plan and SEPA permits. The applicant has submitted an application for a consolidated review process.
- There is a portion of the project that lies within the 200-foot shoreline buffer of a water of state-wide significance, the Columbia River.
- The City of Camas, as lead agency for review of this proposal, made a State Environmental Policy Act (SEPA) determination that this proposal does not have a probable significant adverse impact on the environment. A Determination of Non-Significance (DNS) was issued on October 6, 2009, and the comment period ended on October 20, 2009 with no appeals being filed.

## II. DECISION

Site Plan Review (SPRV 09-09) is approved based on the applicant's narrative and drawings contained in the application file dated September 15, 2009. **APPROVAL** OF SPRV 09-09 IS BASED ON THE FOLLOWING FINDINGS OF FACT AND CONCLUSIONS OF LAW:

## III. FINDINGS OF FACT – BASED ON SITE PLAN REVIEW CRITERIA OF APPROVAL – CMC 18.18.060 (A-F)

*A) Compatibility with the City's Comprehensive Plan;*
FINDING: The proposed project is in compliance with the City of Camas Comprehensive Plan, Chapter ten, and page X-2. The benefit of this capitol improvement project is intended to meet the needs of the City until 2025.

*B) Compliance with all applicable design and development regulations;*
FINDING: The applicant has provided a site plan and building elevations that are in compliance with Site Plan (CMC18.18)

*C) Availability and accessibility of adequate public services such as roads, sanitary and storm sewer, and water to serve the site at the time development is to occur, unless otherwise provided for by the applicable regulations;*
FINDING: The project is a renovation of the public sanitary service system and therefore is in compliance with this criterion.

*D) Adequate provisions are made for other public and private services and utilities, parks and trails;*
FINDING: The project is within an existing public facility that has existing public roads and access. No changes to the access is proposed or required.

*E) Adequate provisions are made for maintenance of public services; and*
FINDING: The Public Works Department has procedures in place to maintain the new buildings and landscaping.

F) *All relevant statutory codes, regulations, ordinances and compliance with the same. The review and decision of the city shall be in accordance with the provisions of CMC Chapter 18.55.*
FINDING: As stated in the responses to criteria A-F, this proposal satisfactorily complies with relevant statutes and codes.

## IV. FINDINGS OF FACT –SHORELINE MANAGEMENT(CMC18.88)

*CMC18.88.120 Exceptions, "Whenever an applicant claims that, or it appears that, he is exempt from the necessity of a substantial development permit under RCW 90.58.030, the administrator shall decide whether he is in fact exempt, and may refer the matter to SMRC or the city attorney for assistance in resolving such question.*

FINDING: The application included a letter dated, October 28, 2009, in which it states that the project is exempt given that it meets the criteria for "normal maintenance or repair of existing structures". The work proposed within the shoreline is to replace and repair 16 risers that will improve the dilution of effluent and protect water quality. The described work is not a new use or new development according to the SMP, rather as repair of an existing development.

## V. CONCLUSIONS OF LAW

As conditioned, SPRV 09-09 meets the approval criteria for site plan review contained in Section 18.18.060 CMC.

1. As proposed, SPRV 09-09 is compatible with the City of Camas Comprehensive Plan.
2. As proposed, SPRV 09-09 complies with the applicable design and development standards contained in the Camas Municipal Code and other applicable regulations.
3. The review and decision associated with SPRV 09-09 is in compliance with Chapter 18.55 CMC.

As proposed, SPRV 09-09 meets the exemption criteria for Shoreline Substantial Development permits pursuant to WAC 173-27-040 for "normal repair of existing structures" and pursuant to Camas Shorelines Master Program, Chapter 2-6.

## VI. CONDITIONS OF APPROVAL FOR WASTEWATER TREATMENT FACILITY

The application has been approved as proposed in the drawings received September 15, 2009. The following conditions shall be required in addition to what is included in the application materials:

1. The applicant shall install landscaping as proposed on Sheet G-17 within one-year of the issuance of this decision.
2. The applicant shall obtain building permits for all structures.

**DATED this 2nd Day of November, 2009**

Phil Bourquin,
Community Development Director

APPEALS

This is a Type II Decision and is appealable to the City Council pursuant to CMC18.55.210

# GRAY & OSBORNE, INC.
# TELEPHONE/MEETING CONVERSATION RECORD

| | |
|---|---|
| ☒~~☐~~☒~~☐~~ **Telephone Conversation**<br><br>☐ **Meeting** | **Location of Phone Conversation:**<br>GRAY & OSBORNE INC.<br><br>**Place of Meeting:** |

| | | | | |
|---|---|---|---|---|
| **Date:** | 10-29-2009~~12-3-2008~~~~5/29/08~~~~5/2/06~~ ~~5/4/06~~ | ~~**Time:**~~ | 1030~~11~~ ~~00~~ ~~a.m.~~ | ~~p.m.~~ |
| **Discussion with:** | Danette Guy~~Clint Stanovsky~~ ~~Jim Bay, City of Sequim; Harold Peterson~~ | | | |
| **Firm/City with:** | US Army Corps of Engineers, Vancouver Office~~Town of Skykomish~~ | | | |
| **Phone Number:** | 360 906-7274~~425 649-1649~~ | | | |
| **Gray & Osborne Personnel:** | Jim Dougherty~~Jim Dougherty~~~~Eric Delfel~~ | | | |
| **Project:** | Camas WWTF Phase 2 Upgrades~~Pipeline crossings of Maloney Creek and Old Maloney Creek culvert & backflow prevention on stormwater outfall at west end of Town~~ ~~Solana Reservoir and Booster Station~~ | | | |
| **Subject:** | Rivers & Harbors Act, Section 10 Permit for outfall modifications~~Permitting strategies~~~~Pump Selection, Vent Calculations~~ | | | |
| **G&O Job Number:** | 07511.00~~07479.000~~~~04915~~ | | | |

**REMARKS:**

~~Jim Bay called on 5/2 and forwarded an e-mail to me regarding the pump selection at the Solana Booster Stations. The e-mail indicated that Harold Peterson and his group could not find horizontal split case pumps for the 225 gpm and 25 gpm pumps. I spoke with Tim Wahlquist at Pump Tech, who was able to provide me with a Peerless Model 2TU1062 for the 225 gpm pump, but said that horizontal split case pumps are not a good fit for the 25 gpm pumps.~~

~~I spoke with Harold Peterson and informed him that horizontal split case pumps are preferred for the 1,000 gpm and 225 gpm pumps due to their low NPSH requirements, which allows the reservoir to be drained lower on the suction side of the pumps, and due to the ease with which operators can work on the pumps. However, a centrifugal pump selection is appropriate for the 25 gpm, or jockey pump. I also requested that care be taken with the selection of the jockey pump to ensure that there is sufficient NPSH to allow operation of the pumps even if the reservoir is nearly empty.~~

I spoke with Danette Guy, ACOE Project Manager for the Camas WWTF Phase 2 Improvement Project, this morning regarding the Rivers & Harbors Act, Section 10 Permit for the proposed improvements to the Camas WWTF outfall diffuser. She said that the JARPA and Informal ESA Consultation Document for the project have been sent to the Corps' Seattle District Office for review and approval. She said that there were a number of more difficult projects included in the pile forwarded to Seattle, and that it is unlikely that the Seattle Office will act on the City of Camas application any time soon.

Danette recommended that we leave the current Rivers & Harbors Act, Section 10 Permit approval letter in the Specifications Package for the project, along with the list of conservation measures from the current ESA document. Her main concerns were compliance with the in-water work window and the conditions of the Hydraulic Project Approval issued by WDFW on October 26, 2006.

**14. Conservation measures:**

*Conservation measures are measures that would reduce or eliminate adverse impacts of the proposed activity (examples: work done during the recommended work window [to avoid times when species are most likely to be in the area], silt curtain, erosion control best management practices, percent grating on a pier to reduce shading impacts).*

Mitigation measures designed to minimize potential impacts of the Camas Wastewater Treatment Facility outfall modifications and operation of the facility once the modifications are completed include:

1. Construction equipment and vessels shall be fueled, maintained and stored off-site to minimize the potential for spills of hazardous materials, including fuels, lubricants and coolants.

2. Construction would be limited to the in-water work window established by the Washington Department of Fish & Wildlife, Vancouver Office, which extends from November 1 to February 28 in the Lower Columbia River, or during the summer low flow period between July 15 and September 15 to take advantage of low flows and improved visibility for the proposed under water work.

3. To minimize the potential for accidents resulting in direct effects to listed and candidate fish species, construction vessels and equipment will be fitted with emergency spill kits and construction crews will be trained in their use.

**MEMORANDUM**

| | |
|---|---|
| TO: | Sarah Fox, City of Camas |
| FROM: | Jim Dougherty |
| DATE: | 10-28-2009 |
| SUBJECT: | Justification of Shoreline Exemption for proposed Wastewater Treatment Facility outfall riser repairs/improvements |

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The proposed improvements to the City of Camas Wastewater Treatment Facility outfall riser structures include removing 90-degree bends from a total of 16 risers to improve dilution of effluent and installation of Tideflex Valves to eliminate entrapment or impingement of fish species protected under the authority of the Endangered Species Act. The proposed project will open eight (8) risers, which are currently unused, to improve and preserve dilution of wastewater effluent over the next 20 years. This project qualifies for an exemption to the Shoreline Substantial Development permitting process per WAC 173-27-040 for "normal maintenance or repair of existing structures," because it improves the function of the existing riser structures and puts currently unused risers into service to improve effluent dilution and protect water quality as the City of Camas grows.

Implementation of the proposed outfall riser modifications is consistent with the intent of the Shoreline Management Act for the following reasons:

1. It recognizes and protects both state and local interests (clean water).
2. It does not change the nature of the shoreline (or the nature of the WWTF outfall on the benthic surface of the Columbia River).
3. It provides both short-term and long-term improvements to water quality.
4. It protects the ecology of the Columbia River shoreline by improving dilution of wastewater treatment facility effluent.
5. It does not affect public access to the shoreline.
6. Recreational use of the Columbia River will be made safer by more effective dilution of WWTF effluent.

**MEMORANDUM**

| | |
|---|---|
| TO: | Sarah Fox, Planner, City of Camas |
| FROM: | Jim Dougherty |
| DATE: | September 8, 2009 |
| SUBJECT: | Narrative discussion regarding the Camas WWTF Phase 2 Improvements Project compliance with Camas City Code requirements as discussed at the August 29, 2009 Pre-Application Meeting |

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This memorandum addresses compliance with Camas City Codes for the City's Wastewater Facilities Phase 2 Improvement Project, per the August 29, 2009 Pre-Application Meeting summary, file PA09-16. Site planning issues will be addressed in the order they were presented in the Pre-Application Meeting Summary.

1. Additions and modifications to the WWTP will require a Site Plan Permit, which is considered a Type II permit, requiring the following information:

- Application form (attached);
- Current mailing list of all owners within 300 feet of the parcel (attached)
- Narrative addressing approval criteria (see following responses)
- Necessary drawings (see site plans & maps from Clark County illustrating critical areas in the vicinity of the Camas WWTP, attached);
- Pre-Application notes (attached);
- SEPA Checklist (attached).

2. The application should address the criteria for Site Plan approval pursuant to CMC18.18.040:

A. Written description addressing project scope:

**Main Sewage Pump Station:** The City will construct improvements to increase reliability and reduce maintenance requirements at the main sewage pump station, which pumps nearly all of the City's sewage under the Washougal River to the WWTF site. The existing wet well will be enlarged and a grinder facility will be installed to grind debris to prevent clogging of the pumps. These improvements will mostly occur underground and the area of impervious surfaces adjacent to the Main Pump Station will not change.

**Wastewater Treatment Facility:** Camas will construct an upgrade to the existing Wastewater Treatment Facility to improve sludge/biosolids handling capacity and ensure redundancy that will ensure public health and safety and enhance the environmental value to the region's natural resources. The design will include the following improvements:

- two new primary anaerobic digesters,
- a new sludge storage tank,
- a new digester building and associated sludge handling equipment,
- new sludge dryer,
- additional aeration blower,
- additional bank of UV disinfection lamps,
- aeration basin modifications,
- enlarged odor control biofilter,
- new septage/centrate/WAS storage tank,
- and operational control systems that will integrate the new systems with the existing WWTF systems.
- The existing aerobic digester number 1, a portion of the service roadway and a portion of the aerobic digester number 2 structures will be demolished and removed from the site.

***The project will result an 8,500 square foot reduction of impervious surfaces on the WWTF site.***

B. Vicinity Map: See Sheet G-1 in drawing package previously submitted.

C. Topographic Map with 1-foot contours: See Sheet G-7.

D. Site Plans: See Site Plan and Area Identification Sheet G-11.

E. Circulation Plan: The access points for the site, driveways, streets and roads serving the Camas WWTF will not change significantly as a result of this project. Further, the project will not generate more than 100 average daily trips.

F. Preliminary drainage and stormwater runoff plan: See Sheet G-15 for the Site Grading and Storm Drain Plan. The majority of the existing stormwater system will remain the same.

G. Site Utility Plan: See Sheet G-16 for the Site Utility Piping Plan.

H. Landscaping Plan: See Sheet G-17 for the Landscape and Irrigation Plan. Note that the existing site is shielded from the view from the east of the residential neighborhood and from the view from the north of commuters travelling on SR 14 by rows of large Leyland Cypress trees located on the wastewater treatment facility property. The view from the south of boat traffic on the Columbia river is currently obstructed by trees which line the river on the south side of the facility. The property to the west of the facility is owned by the City and is densely populated with trees which also serve to shield the view of traffic on SR 14. Once construction is complete, disturbed areas will be hydroseeded. Seven Leyland cypresses will be added to existing landscaping to replace the seven that will have to be removed during construction.

I. Building elevations and architectural style: See the following sheets:

- A-1, Digester Building & Dryer Building Details;
- A15-1, Dryer Building Plans & Schedules;
- A15-2 Dryer Building Exterior Elevations & Building Sections
- A18-1 Digester Building Plans & Schedules;
- A18-2 Digester Building Sections & Elevations.

J. See attached Engineer's Estimate.

3. The proposed WWTF Phase 2 Improvements will upgrade the facility's sludge/biosolids treatment and storage and make significant improvements to the Main Pump Station that will improve performance. The existing aerobic digester will be demolished and two new anaerobic digesters will be constructed adjacent to a new Digester Building. A new Digested Sludge Holding Tank will be constructed east of the Digester Building, and a new biofilter will be installed adjacent to (west of) the existing biofilter. Half of the existing Aerobic Digester No. 2 will be demolished, and the other half will be modified to serve as Septage/Centrate/WAS Storage Tanks. The overall area of impervious surfaces on the WWTF site will be reduced by 8,500 square feet. Disturbed areas will be hydroseeded with grass once construction is complete and seven Leyland cypresses will be added to the existing landscaping on the site.

Improvements to the Main Pump Station will include enlargement of the existing wet well and installation of a grinder facility to grind debris to prevent clogging of the pumps. These improvements will mostly occur underground and the area of impervious surfaces adjacent to the Main Pump Station will not change.

4. Additional Issues:

Building:

- The contractor will obtain a building permit
- An Electrical permit will be obtained and electrical work will be inspected per requirements of the Washington State Department of Labor and Industries

Fire:
A Fire Permit will be obtained for the project.

Engineering:

- Construction plans have been prepared by a licensed Washington State Engineer in accordance with the City of Camas Standards.
- Stormwater Management: The proposed project will reduce impervious surfaces on the WWTF site by 8,500 square feet. No modification to the existing stormwater facility is required.
- A traffic study will not be required.
- Utility Plan is presented in Sheets G-8 through G-16 (previously submitted).
- Erosion Control Bond: The proposed improvements to the Camas WWTF and Main Pump Station will disturb significantly less than one acre. Therefore, an Erosion Control Bond will not be required, per Camas Municipal Code Section 17.21.030.
- NPDES Construction Stormwater Permit: No NPDES Construction Stormwater Permit will be required, as the proposed construction project will disturb less than one acre.

**MEMORANDUM**

TO: Jim Hodges, Eric Nutting, Jay Swift
FROM: Jim Dougherty
DATE: 8-20-2009
SUBJECT: Permits required for Camas WWTF Outfall Modification Project

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1. Federal Permits
   - Rivers & Harbors Act, Section 10 Permit from US Army Corps of Engineers, Nationwide Permit 7 for outfall modifications (application to Danette Guy USACOE, July 2009)
   - Endangered Species Act compliance, US Fish & Wildlife Service & NOAA Fisheries (forwarded to Dan Guy @ NMFS and ACOE in July 2009).

2. State Permits
   - Hydraulic Project Approval, Washington Department of Fish & Wildlife, HPA issued October 26, 2006, good through February 28, 2011.
   - Aquatic Lands Use Authorization, Washington Department of Natural Resources, application assembled October 2006, status?

3 City Permits
   - Shoreline Substantial Development? Shoreline Exemption?
   - Critical Areas review
   - SEPA DNS (required for HPA & Shoreline permitting).

Gray & Osborne, Inc.
CONSULTING ENGINEERS
701 DEXTER AVENUE NORTH SUITE 200
SEATTLE, WASHINGTON 98109 • (206) 284-0860

**MEMORANDUM**

| | |
|---|---|
| TO: | Sarah Fox, City of Camas |
| FROM: | Jim Dougherty |
| DATE: | September 3, 2009 |
| SUBJECT: | Responses to Site Plan Approval Requirements for the City Camas WWTF |

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Camas Municipal Code 18.18.040: Submittal and contents of a complete application.
A. The scope of the proposed Camas Wastewater Facilities Upgrade Phase 2 Project includes:

1. Main Sewage Pump Station: Camas will construct a series of major improvements to increase reliability and reduce maintenance requirements at its main pump station, which pumps nearly all of the City's sewage under the Washougal River to the Camas WWTF. The existing wet well will be enlarged and a grinder facility will be installed to grind debris to prevent clogging of the pumps.

2. Wastewater Treatment Facility: Camas will construct a $15-20 million upgrade to the existing Wastewater Treatment Facility to improve sludge/biosolids handling capacity and ensure redundancy that will ultimately ensure public safety and enhance environmental value of the region's natural resources. The design will include to new primary anaerobic digesters, a new sludge storage tank, new sludge dryer, additional aeration blower, enlarged odor control biofilter, new septage centrate/WAS storage centrate/WAS tank, and operational control systems that will integrate the new systems with the existing WWTF systems.

# STATE ENVIRONMENTAL POLICY ACT

# DETERMINATION OF NON-SIGNIFICANCE

Mail Comments to:
City of Camas
Community Development Director
P.O. Box 1055
Camas, WA 98607

| | |
|---|---|
| CASE NO: | SEPA09-20 (Camas Wastewater Treatment Facility Renovation, City file #SPRV09-09) |
| APPLICANT: | City of Camas, Public Works Department |
| REQUEST: | Equipment upgrades to both the main sewage pump station and the wastewater treatment facility. This project will reduce maintenance issues and improve handling capacity of these facilities to serve the City until 2025. |
| LOCATION: | 1129 SE Polk Street, Camas, WA |
| Legal Description: | NW & SW ¼, S13, T1N, R35 and Tax parcel #87360-000 |
| SEPA Determination: | Determination of Non-Significance |
| **Comment Deadline:** | October 20, 2009, at 5:00 p.m. |

As lead agency under the State Environmental Policy Act (SEPA) Rules [Chapter 197-11, Washington Administrative Code (WAC)], the City of Camas must determine if there are possible significant adverse environmental impacts associated with this proposal. The options include the following:

- DS = Determination of Significance (The impacts cannot be mitigated through conditions of approval and, therefore, requiring the preparation of an Environmental Impact Statement (EIS).
- MDNS = Mitigated Determination of Non-Significance (The impacts can be addressed through conditions of approval), or;
- DNS = Determination of Non-Significance (The impacts can be addressed by applying the Camas Municipal Code).

**Determination:**
Determination of Non-Significance (DNS). The City of Camas, as lead agency for review of this proposal, has determined that this proposal does not have a probable significant adverse impact on the environment. An Environmental Impact Statement (EIS) is not required under RCW 43.21C.030(2)(e). This decision was made after review of a completed environmental checklist and other information on file with the City.

Date of Publication & Comment Period:

Publication date of this DNS is **October 6, 2009**, and is issued under WAC 197-11-340. The lead agency will not act on this proposal until the close of the 14-day comment period which ends on **October 20, 2009**.

SEPA Appeal Process:

An appeal of any aspect of this decision, including the SEPA determination and any required mitigation, must be filed with the City Clerk within fourteen (14) calendar days from the date of the decision notice. The letter of appeal should contain the following information:

1. The case number designated by the City of Camas, and the name of the applicant; and
2. The name and signature of each person or group (petitioners), and a statement showing that each petitioner is entitled to file an appeal as described within the Camas Municipal Code. If multiple parties file a single petition for review, then the petition shall designate one party as the contact representative with the Planning Department. All contact with the Planning Department regarding the petition, including notice, shall be with this contact person

The appeal request is to be submitted to the City Clerk between 8:00 a.m. and 5:00 p.m. Monday through Friday, at the address listed below:

Appeal to the City of Camas SEPA Official
Community Development Department
616 NE Fourth Avenue / P.O. Box 1055
Camas, Washington 98607

Staff Contact Person: Sarah Fox, Planner II (360) 817-1562 ext. 4269
Responsible Official: Phil Bourquin (360) 817-1562

**Phil Bourquin, Community Development Director and SEPA Official**

10-01-09
**Date**

STATE OF WASHINGTON

**DEPARTMENT OF ARCHAEOLOGY & HISTORIC PRESERVATION**

*1063 S. Capitol Way, Suite 106 • Olympia, Washington 98501*
*Mailing address: PO Box 48343 • Olympia, Washington 98504-8343*
*(360) 586-3065 • Fax Number (360) 586-3067 • Website: www.dahp.wa.gov*

RECEIVED
MAY 30 2007
PUBLIC WORKS BOARD

May 25, 2007

Ms. Kelly Snyder
Public Works Board
PO Box 48319
Olympia, Washington 98504-8319

Log No.: 052507-18-CTED
Re: City of Camas Main Sewage Pump Station Project
Loan # *N.A.*

Dear Ms. Snyder;

Thank you for contacting our department. We have reviewed the professional archaeological survey report by AINW, Inc for the proposed City of Camas Main Sewage Pump Station and Wastewater Treatment Facility Phase II Improvement Project in Clark County, Washington.

We concur with their professional recommendations and your determination of NO Historic Properties Affected.

These comments are based on the information available at the time of this review and on the behalf of the State Historic Preservation Officer in conformance with Executive Order 05-05 as an agency with technical expertise and permit authority pursuant to RCW 27.44 and RCW 27.53. Should additional information become available, our assessment may be revised.

In the event that archaeological or historic materials are discovered during project activities, work in the immediate vicinity must stop, the area secured, and the tribes' cultural departments and this department notified. Thank you for the opportunity to comment and a copy of these comments should be included in subsequent environmental documents.

Sincerely,

Robert G. Whitlam, Ph.D.
State Archaeologist
(360) 586-3080
email: rob.whitlam@dahp.wa.gov

# GRAY & OSBORNE, INC.
# TELEPHONE/MEETING CONVERSATION RECORD

| | |
|---|---|
| ☒**Telephone Conversation** | **Location of Phone Conversation:**<br>GRAY & OSBORNE INC. |
| ☐**Meeting** | **Place of Meeting:** |

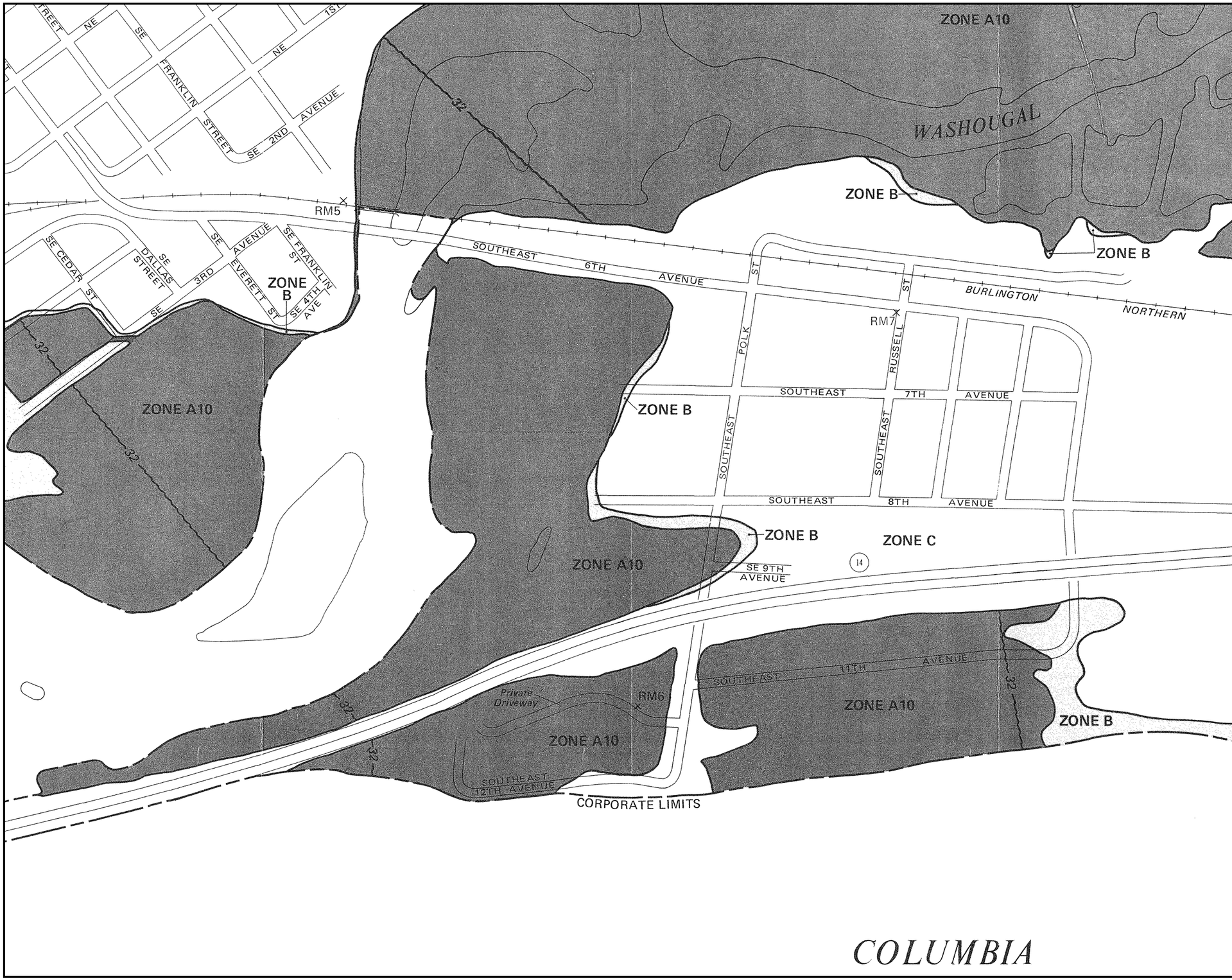
| | | | | |
|---|---|---|---|---|
| **Date:** | 4-13-07 | | | 1315 |
| **Discussion with:** | Jo Reese | | | |
| **Firm/City with:** | Archaeological Associates Northwest in Portland | | | |
| **Phone Number:** | 503 761-6605 | | | |
| **Gray & Osborne Personnel:** | Jim Dougherty | | | |
| **Project:** | Camas WWTF Upgrade | | | |
| **Subject:** | Archaeological Survey/Executive Order 0505 Protocols, Tribal coordination | | | |
| **G&O Job Number:** | 07511 | | | |

**REMARKS:**

Jo Reese called to update her progress on the archaeological work for the Camas WWTF and the Lift Station at Third & Dallas across the Washougal River. She said that she has signed and returned the contract to Gray & Osborne, and that she is planning on having teams in the field with the Geotech on Monday.

She said that she thought she could get the reports out by the end of the month. She said that she would send copies to the Department of Archaeology and Historic Preservation, the Cowlitz Tribe and the Yakama Tribes. Jo said that she would contact the Cowlitz Tribe to make sure that they received the report and that they are aware of the critical timing associated with the Public Works Trust Fund loan application. I told Jo that I would contact Bill White at the Yakamas to let him know that the report is coming and that we will need a letter from the YIN for the loan application. Hopefully, this will speed tribal consultation up a bit.

# 6.0 Exhibits




APPROXIMATE SCALE

400 0 400 FEE

NATIONAL FLOOD INSURANCE PROGRAM

# FIRM
## FLOOD INSURANCE RATE MAP

CITY OF
**CAMAS, WASHINGTON**
CLARK COUNTY

**PANEL 2 OF 2**
(SEE MAP INDEX FOR PANELS NOT PRINTED)

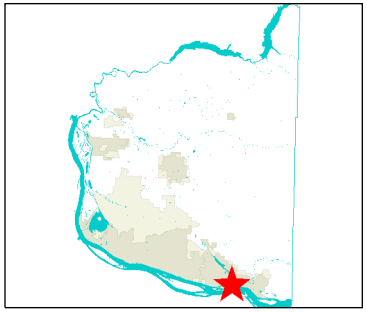
**COMMUNITY-PANEL NUMBER**
**530026 0002 B**

**EFFECTIVE DATE:**
**FEBRUARY 18, 1981**

federal emergency management agency
federal insurance administration

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

# Camas WWTP Aerial



## Legend

- Parcels
- Roads
  - Alley
  - Arterial
  - DNR
  - DNR (Private Land)
  - Driveway
  - Interstate
  - Interstate Ramp
  - Primary Arterial
  - Private Roads
  - Private Roads w/o Names
  - Public Roads
  - SR Ramp
  - State Route
- Aerial Photography
- Waterbodies
- City Boundaries
- Urban Growth Boundaries
- County Boundary
- County Boundary

0 550 1100 1650 ft.

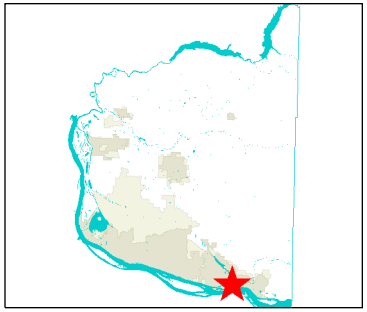
Map center: 45° 34' 47.9" N, 122° 23' 39.7" W

N

Scale: 1:5,868

Information shown on this map was collected from several sources. Neither Clark County, Washington, nor the producer of this document accept responsibility for any inaccuracies that may be present.

# Camas WWTP



## Legend

- Parcels
- Roads
  - Alley
  - Arterial
  - DNR
  - DNR (Private Land)
  - Driveway
  - Interstate
  - Interstate Ramp
  - Primary Arterial
  - Private Roads
  - Private Roads w/o Names
  - Public Roads
  - SR Ramp
  - State Route
- Waterbodies
- City Boundaries
- Urban Growth Boundaries
- County Boundary
- County Boundary

0 900 1800 2700 ft.

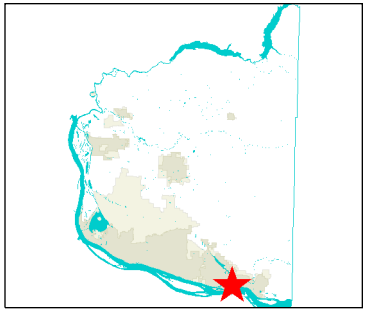
Map center: 45° 34' 49.5" N, 122° 23' 36.8" W

N

Scale: 1:9,413

Information shown on this map was collected from several sources. Neither Clark County, Washington, nor the producer of this document accept responsibility for any inaccuracies that may be present.

# County Wetland Inventory



## Legend

- Parcels
- Roads
- Alley
- Arterial
- DNR
- DNR (Private Land)
- Driveway
- Interstate
- Interstate Ramp
- Primary Arterial
- Private Roads
- Private Roads w/o Names
- Public Roads
- SR Ramp
- State Route
- County Wetland Inventory
- Waterbodies
- City Boundaries
- Urban Growth Boundaries
- County Boundary
- County Boundary

0 900 1800 2700 ft.

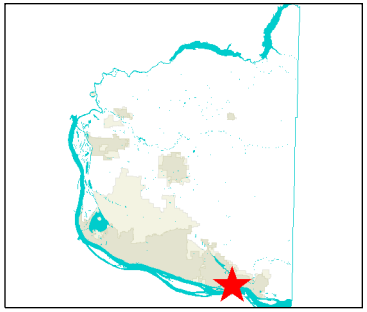
Map center: 45° 34' 45.4" N, 122° 23' 37.3" W

N

Scale: 1:9,413

Information shown on this map was collected from several sources. Neither Clark County, Washington, nor the producer of this document accept responsibility for any inaccuracies that may be present.

# NWI Map



## Legend

- Parcels
- Roads
  - Alley
  - Arterial
  - DNR
  - DNR (Private Land)
  - Driveway
  - Interstate
  - Interstate Ramp
  - Primary Arterial
  - Private Roads
  - Private Roads w/o Names
  - Public Roads
  - SR Ramp
  - State Route
- NWI Mapped Wetland
  - 1
- Waterbodies
- City Boundaries
- Urban Growth Boundaries
- County Boundary
- County Boundary

0 900 1800 2700 ft.

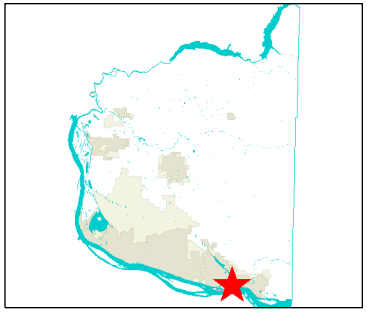
Map center: 45° 34' 45.4" N, 122° 23' 37.3" W

N

Scale: 1:9,413

Information shown on this map was collected from several sources. Neither Clark County, Washington, nor the producer of this document accept responsibility for any inaccuracies that may be present.

# Floodplains & 200 ft Shoreline Buffer



## Legend

- Parcels
- Roads
  - Alley
  - Arterial
  - DNR
  - DNR (Private Land)
  - Driveway
  - Interstate
  - Interstate Ramp
  - Primary Arterial
  - Private Roads
  - Private Roads w/o Names
  - Public Roads
  - SR Ramp
  - State Route
- 200-foot Shoreline Buffer
- Floodplains
  - Floodway Fringe
  - Floodway
- Waterbodies
- City Boundaries
- Urban Growth Boundaries
- County Boundary
- County Boundary

0 900 1800 2700 ft.

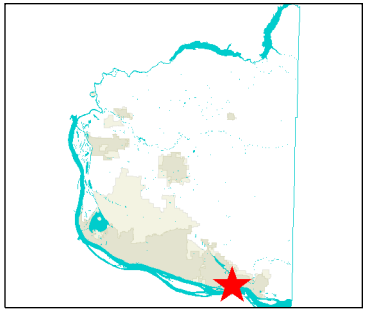
Map center: 45° 34' 45.4" N, 122° 23' 37.3" W

N

Scale: 1:9,413

Information shown on this map was collected from several sources. Neither Clark County, Washington, nor the producer of this document accept responsibility for any inaccuracies that may be present.

# Severe Erosion Hazard Area



## Legend

- Parcels
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  - DNR
  - DNR (Private Land)
  - Driveway
  - Interstate
  - Interstate Ramp
  - Primary Arterial
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  - Private Roads w/o Names
  - Public Roads
  - SR Ramp
  - State Route
- Severe Erosion Hazard Area
  - 1
- Waterbodies
- City Boundaries
- Urban Growth Boundaries
- County Boundary
- County Boundary

0 900 1800 2700 ft.

Map center: 45° 34' 45.4" N, 122° 23' 37.3" W

N

Scale: 1:9,413

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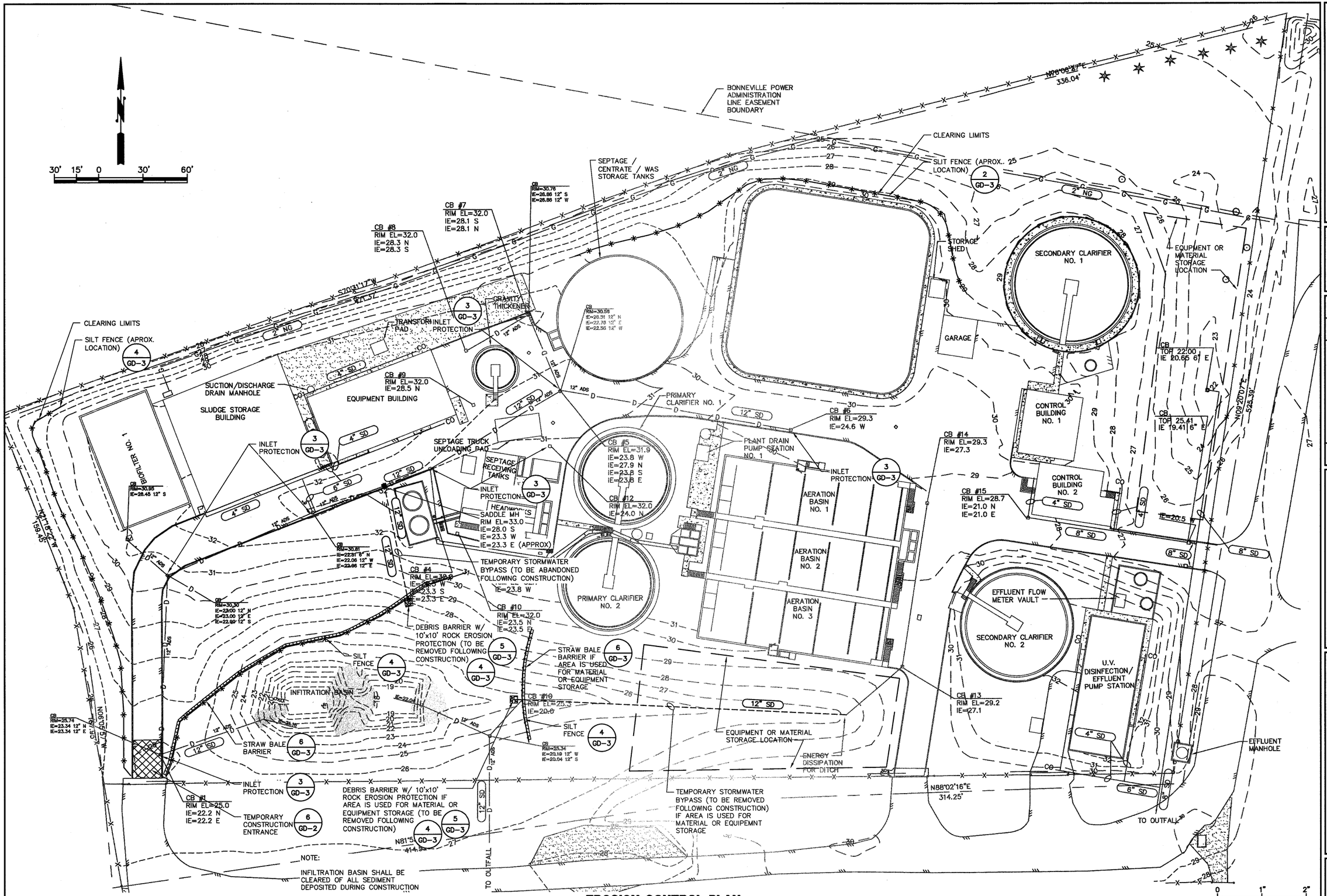



NOTE:
INFILTRATION BASIN SHALL BE CLEARED OF ALL SEDIMENT DEPOSITED DURING CONSTRUCTION

## EROSION CONTROL PLAN

SCALE: 1"=30'


Gray & Osborne, Inc.
CONSULTING ENGINEERS
701 DEXTER AVENUE NORTH SUITE 200
SEATTLE, WASHINGTON 98109 · (206) 284-0860


| | |
|---|---|
| DATE: OCT. 2009 | |
| SCALE: NOTED | |
| DRAWN: M.A.N. | |
| CHECKED: E.F.N. | |
| APPROVED: J.P.W. | |

| No. | REVISION | DATE | APPD |
|---|---|---|---|
| | | | |

CITY OF CAMAS
CLARK COUNTY WASHINGTON
WWTF IMPROVEMENTS - PHASE 2
EROSION CONTROL PLAN

SHEET: G-8
OF: 22

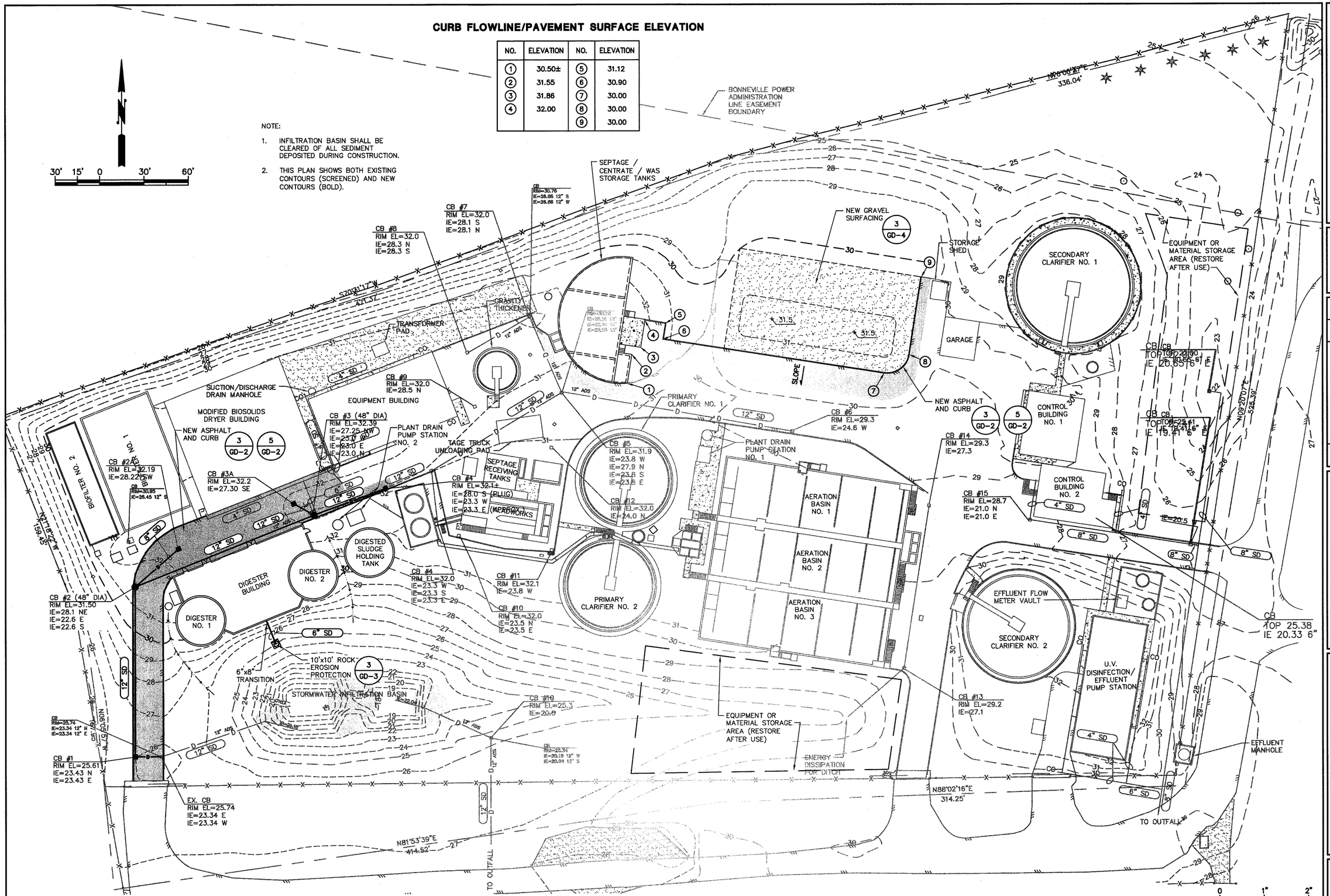
JOB NO.: 07511
DWG: EROSION

## CURB FLOWLINE/PAVEMENT SURFACE ELEVATION

| NO. | ELEVATION | NO. | ELEVATION |
|---|---|---|---|
| 1 | 30.50± | 5 | 31.12 |
| 2 | 31.55 | 6 | 30.90 |
| 3 | 31.86 | 7 | 30.00 |
| 4 | 32.00 | 8 | 30.00 |
| | | 9 | 30.00 |

NOTE:

1. INFILTRATION BASIN SHALL BE CLEARED OF ALL SEDIMENT DEPOSITED DURING CONSTRUCTION.
2. THIS PLAN SHOWS BOTH EXISTING CONTOURS (SCREENED) AND NEW CONTOURS (BOLD).




## SITE GRADING AND STORM DRAIN PLAN

SCALE: 1"=30'


Gray & Osborne, Inc.
CONSULTING ENGINEERS
701 DEXTER AVENUE NORTH, SUITE 200
SEATTLE, WASHINGTON 98109 - (206) 284-0860


| | |
|---|---|
| DATE: OCT. 2009 | |
| SCALE: NOTED | |
| DRAWN: B.W. | |
| CHECKED: E.F.N. | |
| APPROVED: J.P.W. | |

| No. | REVISION | DATE | APPD |
|---|---|---|---|
| | | | |

JOHN P. WILSON, STATE OF WASHINGTON, REGISTERED PROFESSIONAL ENGINEER, 16204

ERIC F. NUTTING, STATE OF WASHINGTON, REGISTERED PROFESSIONAL ENGINEER, 36883

CITY OF CAMAS
CLARK COUNTY WASHINGTON
WWTF IMPROVEMENTS - PHASE 2

SITE GRADING AND STORM DRAIN PLAN

SHEET: G-16
OF: 22

JOB NO.: 07511
DWG: GRADING

**BIOLOGICAL EVALUATION**

**For the**

**Wastewater Treatment Facility**
**and**
**Main Pump Station Improvements**

**City of Camas**

**G & O PROJECT NUMBER 07511**

*Last updated May 30, 2007*

# 1. INTRODUCTION

**1.**

## 1.2 Purpose and Need for the Project

The Department of Ecology issued a Notice of Violation (number 2981) to the City of Camas on January 9, 2006; the WWTF exceeded its ammonia limits December 2004, February 2005, March 2005, April 2005, May 2005, June 2005, September 2005, October 2005, and November 2005. The proposed Wastewater Treatment Facility Improvement Project will address ammonia removal issues and allow the Camas Wastewater Facilities to meet the requirements of the NPDES Permit through the planning period (2025).

Modeling performed on the City of Camas Wastewater Collection System indicates that the Main Pump Station is over capacity at current maximum flows due to Infiltration and Inflow during storm events and the Station will be over capacity due to projected future loadings associated with growth in the City. Increasing the size of the wet well and installing grinder pumps will improve the reliability of this critical pump station. Further, the pumps motors and emergency generator and the electrical and control systems must be upgraded. All proposed work will occur within the fenced boundaries of the existing WWTF and most new infrastructure will be installed over 200 feet from the Columbia River. A Shoreline Substantial Development Permit will be obtained from the City of Camas for this project.

Projects utilizing funding from the Washington State Public Works Board must prepared documentation for ESA consultation with the US Fish & Wildlife Service and the National Marine Fisheries Service (NOAA Fisheries) to determine potential impacts to species listed as “threatened” or “endangered” under the authority of the ESA. Further, the Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996, requires that federally funded or permitted projects that may adversely affect Essential Fish Habitat (EFH) must be reviewed by the

National Marine Fisheries Service. This BE has been prepared to assess the proposed action's likely impact on EFH.

## 2. PROJECT DESCRIPTION

**Overview**
Gray and Osborne, Inc. is providing engineering services to the City of Camas for improvements to the City's WWTF to provide adequate wastewater treatment to comply with the conditions of its National Pollutant Discharge Elimination System Permit through the planning period (2025). The purpose of this Biological Evaluation is to analyze potential impacts to species protected under the authority of the Endangered Species Act associated with proposed improvements to the City of Camas WWTF and Main Pump Station. This project will occur in addition to the modifications to the diffusers on the Camas WWTF Outfall, which were permitted in 2006 (Corps Reference Number 200501420).

### 1 Project Description (Proposed Action or Proposed Project)

**Main Sewage Pump Station:**
The City of Camas proposes to construct a series of major improvements increase reliability and reduce maintenance requirements at its main sewage pump station that pumps nearly all of the City's sewage under the Washougal River to the WWTF. The existing wet well will be enlarged and a grinder facility will be installed to grind debris to prevent clogging of the pumps.

**Wastewater Treatment Facility:**
Camas will construct a $15-20 million upgrade to the existing Wastewater Treatment Plant to increase capacity and provide redundancy that will ultimately ensure public health and safety and enhance the environmental value of the region's natural resources. The design will include a new primary anaerobic digester, new secondary anaerobic digester, new sludge dryer, new secondary clarifier, additional aeration blower, additional bank of ultraviolet disinfection lamps, aeration basin modifications, enlarged odor control biofilter, new septage storage tank, and operational control systems that will integrate the new systems with the existing plant systems.

The Camas WWTF and Main Pump Station are located in **Section 12 of Township 1 North, Range 3 East** in Clark County. Proposed WWTF improvements will occur within the footprint of the existing facility and will involve upgrading existing infrastructure by converting the function of a number of structures and upgrading the function of others. New structures to be built on the site include: a new biofilter and sludge dryer in the NE corner of the facility, new anaerobic digesters and a new digester building, and a new sludge holding tank. Work at the Main Pump Station would include internal improvements (i.e. grinder pumps) and construction of a larger wet well in the cul-de-sac immediately north of the Station, south of SE Third Avenue. Construction activities would typically be limited to the hours of 7:00 a.m. to 5:00 p.m. Monday through Friday.

## 3. DESCRIPTION OF THE PROJECT AREA

The City of Camas Wastewater Treatment Facility lies approximately 100 feet north of the Columbia River at river mile (RM) 120.8, at the corner of SE 12th Avenue and SE Polk Street, across SR 14 from the City. The Main Pump Station is located south of the intersection of SE 3rd Avenue and Dallas Street approximately 600 feet north of the Washougal River.

## 4. DESCRIPTION OF SPECIES AND HABITAT

**Listed Species under the Jurisdiction of the National Marine Fisheries Service,** (from the NMFS Northwest Region Webpage, visited May 21, 2007):

**The following table presents evolutionarily significant units (ESUs) of salmon that pass Camas during rearing and transport portions of their life cycles**

| Species/ESU | Status | Date | FR Notice |
|---|---|---|---|
| **Salmonids Under NMFS Jurisdiction:** | | | |
| **Lower Columbia Chinook** | Threatened<br>Critical habitat | 6-28-05<br>9-2-05 | |
| **Lower Columbia steelhead** | Threatened<br>Critical habitat | 3-19-98<br>9-2-05 | 63 FR 13347<br>65 FR 7764 |
| **Columbia River chum** | Threatened<br>Critical habitat | 6-28-05<br>9-2-05 | |
| **SW Washington & Lower Columbia coho** | Threatened | 6-28-05 | |
| **Upper Columbia spring chinook** | Endangered<br>Critical habitat | 3-24-99<br>9-2-05 | 64 FR 14308 |
| **Lower Columbia River coho** | Threatened | 6-28-05 | |
| **Snake River sockeye** | Endangered<br>Critical habitat | 11-20-91<br>12-28-93 | 56 FR 58619<br>58 FR 53635 |
| **Upper Columbia steelhead** | Endangered<br>Critical habitat | 8-18-97<br>2-16-00 | 62 FR 43937<br>65 FR 7764 |
| **Snake River fall chinook** | Threatened<br>Critical habitat | 4-22-92<br>12-28-93 | 57 FR 14653<br>58 FR 68543 |
| **Snake River spring/summer chinook** | Threatened<br>Critical habitat | 4-22-92<br>12-28-93 | 57 FR 14653<br>58 FR 68543 |
| **Mid Columbia steelhead** | Threatened<br>Critical habitat | 3-25-99<br>2-16-00 | 64 FR 14517<br>65 FR 7764 |
| **Snake River steelhead** | Threatened<br>Critical habitat | 8-18-97<br>2-16-00 | 62 FR 43937<br>65 FR 7764 |
| **Upper Willamette steelhead** | Threatened<br>Critical habitat | 3-25-99<br>2-16-00 | |

| *USFWS Listed Species* | |
|---|---|
| **Columbia River bull trout** | Threatened<br>Critical habitat |

**LISTED EVOLUTIONARILY SIGNIFICANT UNITS (ESUs) OF CHINOOK SALMON:**

**Lower Columbia chinook salmon, *Oncorhynchus tshawytscha:*** Both spring and fall chinook populations on the lower Columbia River were listed as threatened on March 28, 1998. Critical habitat was updated for this ESU on September 2, 2005.

***Spring chinook*** are present in the Cowlitz, Kalama and Lewis rivers. Spring chinook populations from these rivers are of mixed hatchery and wild origin. Return migration for these stocks occurs from late January to May. Tributary migration occurs from March through July, while spawning extends from late August through early October.

**Lower Columbia *fall chinook*** consists of 14 stocks. These stocks can be further divided into two general groups; the Tule early spawning stocks with strong hatchery influence of mixed origin, and a Lewis River wild stock that spawns later with little hatchery influence. Return migration through the lower Columbia extends from August through November. Spawning is generally October for early stocks and November for late stocks.

**Upper Columbia spring chinook**

Upper Columbia spring chinook salmon were listed as endangered on March 24, 1999. Critical habitat was adopted for this ESU on February 15, 2000 and updated on September 2, 2005. Spring chinook destined for areas upstream of Bonneville Dam usually reach peak abundance at the dam between April 20 and April 28 but can be earlier during low flow years or later during high run-off periods. Tributary entry is May-June with spawning in late August to late September.

**Snake River fall chinook**

Snake River fall chinook salmon were listed as threatened on April 22, 1992, and critical habitat for this ESU was adopted on February 28, 1993.

**Snake River spring/summer chinook**

Snake River spring/summer chinook were listed as threatened on April 22, 1992 and critical habitat was finalized on December 28, 1993.

**LOWER COLUMBIA RIVER COHO, LISTED AS THREATENED:**
**Lower Columbia River coho*, O. kisutch,*** was listed as threatened by the National Marine Fisheries Service on June 28, 2005. Critical Habitat has not yet been proposed.

**COLUMBIA RIVER CHUM SALMON, LISTED THREATENED:**
***Columbia chum salmon*, O. keta*:***
Columbia River chum salmon were once widespread in the lower Columbia River. They were listed as threatened on March 25, 1999, and critical habitat for this ESU was finalized on February 16, 2000 and updated on September 2, 2005. Today chum salmon produced in the lower Columbia are concentrated in the Grays River system near the mouth of the Columbia and near Bonneville Dam in Hardy and Hamilton creeks. A few chum salmon cross Bonneville Dam during some years. These stocks of chum salmon are native. Some non-native chum introductions have been attempted, with no apparent success. Chum enter the Columbia in October and November, and spawn in November and December. The present run size is estimated to range between 3,000 and 10,000 fish annually. According to Joe Hymer of the Washington Department of Fish & Wildlife, hatchery releases of the "threatened" stock of Columbia River chum at the mouth of Grays River occur during June. Juveniles from this release pass through the project area shortly thereafter.

**LISTED ESUs OF COLUMBIA RIVER BASIN STEELHEAD:**

**Lower Columbia steelhead, *O. mykiss***
Lower Columbia River steelhead were listed as threatened on March 19, 1999. Critical habitat for this ESU was adopted on February 16, 2000 and updated on September 2, 2005. According to the Columbia River SASSI Appendix, the Lower Columbia River supports five summer steelhead stocks and eighteen winter steelhead stocks. Run timing of the summer steelhead extends from May through October, and run timing of winter steelhead stocks extends from December through April in the Lower Columbia River.
**Mid Columbia steelhead**
Mid Columbia River steelhead were listed as threatened on March 25, 1999. Critical habitat for this species was adopted on February 2, 2000 and updated on September 2, 2005.
**Upper Columbia steelhead**
Upper Columbia River steelhead were listed as endangered on August 18, 1997 and critical habitat for this ESU was adopted on February 16, 2000 and updated on September 2, 2005.
**Snake River steelhead**
Snake River steelhead were listed as threatened on August 18, 1997 and critical habitat for this ESU was adopted on February 16, 2000 and updated on September 2, 2005.

**Upper Willamette River steelhead**
The Upper Willamette River steelhead were listed as threatened on March 25, 1999 and critical habitat was finalized for this ESU on February 16, 2000 and updated on September 2, 2005.

***SNAKE RIVER SOCKEYE, LISTED AS ENDANGERED***
**Snake River sockeye salmon, *O. nerka***
Snake River sockeye salmon were listed as endangered on November 20, 1991 and critical habitat for this ESU was adopted on December 28, 1993.

**COLUMBIA RIVER BULL TROUT, LISTED AS THREATENED:**
The US Fish & Wildlife Service listed the **Columbia River bull trout, *Salvelinus confluentus***, as threatened on June 10, 1998. Critical habitat and ESA Section 4 (d) rules were not adopted at this time. According to Jeff Chan of the Olympia Office of the USFWS, critical habitat for Columbia River bull trout in was adopted on September 26, 2005 and is generally limited to spawning and rearing areas in upper portions of watersheds.

**Lower Columbia chinook salmon, *Oncorhynchus tshawytscha:*** Both spring and fall chinook populations on the lower Columbia River were listed as threatened on March 28, 1998. Critical habitat was designated for this ESU on September 2, 2005.

***Spring chinook*** are present in the Cowlitz, Camas and Lewis rivers. Spring chinook populations from these rivers are of mixed hatchery and wild origin. Return migration for these stocks occurs from late January to May. Tributary migration occurs from March through July, while spawning extends from late August through early October.

**The Lower Columbia *fall chinook*** ESU consists of 14 stocks. These stocks can be further divided into two general groups; the Tule early spawning stocks with strong hatchery influence of mixed origin, and a Lewis River wild stock that spawns later with little hatchery influence. Return migration through the lower Columbia extends from August through November. Spawning is generally October for early stocks and November for late stocks.

**Upper Columbia spring chinook**
Upper Columbia spring chinook were listed as endangered on March 24, 1999. Critical habitat was adopted for this ESU on February 15, 2000. Spring chinook destined for areas upstream of Bonneville Dam usually reach peak abundance at the dam between April 20 and April 28 but can be earlier during low flow years or later during high run-off periods. Tributary entry is May-June with spawning in late August to late September.

**Snake River fall chinook**
Snake River fall chinook were listed as threatened on April 22, 1992, and critical habitat for this ESU was adopted on February 28, 1993.

**Snake River spring/summer chinook**
Snake River spring/summer chinook were listed as threatened on April 22, 1992 and critical habitat was finalized on December 28, 1993.

**COLUMBIA RIVER CHUM SALMON, LISTED THREATENED:**
**Columbia chum salmon, *Oncorhynchus keta:***
Columbia River chum salmon were once widespread in the lower Columbia River. They were listed as threatened on March 25, 1999, and critical habitat for this ESU was designated on September 2, 2005. Today chum salmon produced in the lower Columbia are concentrated in the Grays River system near the mouth of the Columbia and near Bonneville Dam in Hardy and Hamilton creeks. These stocks of chum salmon are native. Some non-native chum introductions have been attempted, with no apparent success. Chum enter the Columbia in October and November, and spawn in November and December. The present run size is estimated to range between 3,000 and 10,000 fish annually.

**LISTED ESUs OF COLUMBIA RIVER BASIN STEELHEAD:**
**Lower Columbia steelhead *Oncorhynchus mykiss***
Lower Columbia River steelhead were listed as threatened on March 19, 1999. Critical habitat for this ESU was designated on September 2, 2005. According to the SASSI Columbia River Appendix, the Lower Columbia River supports five summer steelhead stocks and eighteen winter steelhead stocks. Run timing of the summer steelhead extends from May through October, and run timing of winter steelhead stocks extends from December through April in the Lower Columbia River.

**Mid Columbia steelhead**
Mid Columbia River steelhead were listed as threatened on March 25, 1999. Critical habitat for this species was adopted on September 2, 2005.

**Upper Columbia steelhead**
Upper Columbia River steelhead were listed as endangered on August 18, 1997 and critical habitat for this ESU was adopted on September 2, 2005.

**Snake River steelhead**
Snake River steelhead were listed as threatened on August 18, 1997 and critical habitat for this ESU was adopted on September 2, 2005.

**Upper Willamette River steelhead**
Upper Willamette River steelhead were listed as threatened on March 25, 1999 and critical habitat was finalized for this ESU on September 2, 2005.

**SNAKE RIVER SOCKEYE, LISTED AS ENDANGERED**
**Snake River sockeye salmon, *Oncorhynchus nerka***

Snake River sockeye salmon were listed as endangered on November 20, 1991 and critical habitat for this ESU was adopted on December 28, 1993.

**LOWER COLUMBIA RIVER COHO SALMON, Listed as Threatened:**
**Lower Columbia River coho*, Oncorhynchus kisutch,*** has been a candidate for listing for protection under the authority of the Endangered Species Act since July 25, 1995. The National Marine Fisheries Service proposed this species for listing as "threatened" on June 16, 2005.

**CRITICAL HABITAT FOR LISTED ANADROMOUS FISHES**
The National Marine Fisheries Service designated critical habitat for each of these listed ESUs on September 2, 2005. Critical habitat for these listed salmonids includes all reaches of the Columbia River and its tributary streams below long-standing natural barriers, with the exception of areas covered under Habitat Conservation Plans. The waters of the Columbia River near Camas are considered critical habitat for both out-migrating juveniles and returning adults.

**Use of the Waters Adjacent to the Project Area by Listed Salmonids**
Joe Hymer of the Washington Department of Fish and Wildlife Vancouver Office indicated that juvenile salmonids from any of the listed species use the waters of the Columbia River for transport, feeding and rearing. Juvenile salmonids school in the shallows along the shore as much as possible and may be present along the shoreline near the Camas WWTF. Outmigrating juvenile salmonids of the various listed ESUs may be present in the Lower Columbia River almost continuously throughout the year (personal communication July 12, 2001) with peak concentrations present from April through June. Abundance of juvenile salmonids is lowest during the mid summer months.

Outmigrating juvenile salmonids generally prefer to remain in shallow areas within the range of light penetration near the edge of the river as much as possible. Near Camas, they may school near the shore of the Camas WWTF near the project area while feeding, rearing and migrating toward the Pacific Ocean.

**Factors Affecting Production**

**Habitat**
Habitat degradation for each of these species has occurred due to historical and present-day logging activities and urbanization of the lower drainages.

**Hatchery**
Many of these stocks have been supplemented by hatchery fish over the past 50 to 100 years with mixed results. Introduction of non-Columbia River stocks from hatcheries has modified some of these stocks significantly. In some cases hatchery fish are thought to compete with the wild stocks that are listed as "threatened" or "endangered" under the

authority of the ESA. In other cases, hatchery enhanced stocks are all that remain of some of the Upper Columbia River and Upper Snake River Stocks.

**ESSENTIAL FISHERIES HABITAT**
Commercially important salmonid species present in the Lower Columbia include Columbia River chinook salmon, Columbia River coho and a small population of pink salmon.

**Species under the jurisdiction of USFWS:**

**COLUMBIA RIVER BULL TROUT, LISTED AS THREATENED:**
The US Fish & Wildlife Service listed the **Columbia River bull trout, *Salvelinus confluentus,*** as threatened on June 10, 1998. Critical Habitat for Columbia River bull trout was designated on September 26, 2005. The designated critical habitat nearest the project area occurs in the lower Lewis River. Most bull trout production in the Lewis River occurs above Merwin Dam. Only a few bull trout have been collected below the dam.

**BALD EAGLE**
**Bald Eagle, *Haliaeetus leucocephalus***
According to Priority Species and Habitat Map prepared for this project by the Washington Department of Fish and Wildlife on April 23, 2007, there are no bald eagles known to nest within approximately two miles of the project site. Wintering bald eagles prey on salmon migrating into and out of the Columbia River and may forage offshore in the vicinity of the project area between November 1 and March 31.

**Species identified as present in Clark County that are not likely to be present in the project area:**

**Northern spotted owl, *Strix occidentalis,* Listed Threatened*:***
Northern spotted owls occur in Clark County throughout the year. According to the Priority Habitats & Species Map prepared for the area surrounding Section 12, Township 1 North, Range East on April 23, 2007, there are no northern spotted owl nests or management circles within two miles of the project area.

**Gray wolf, *Canis lupus*, Listed Endangered:**
According to the WDFW Wildlife Biologist for Clark County, gray wolves have not been sighted in Clark County in many years. Further, the gray wolf population in Washington State is concentrated in the northeastern corner of the state, and any wolves occurring in the SW corner of the state are likely to be hybrids, which are not eligible for protection under the Endangered Species Act. All work on the proposed outfall improvement project will occur offshore from a boat in the Columbia River, so it is unlikely that gray wolves would be impacted (discussion with C. Dugger 2005).

**Listed plant species:**

- Golden paintbrush, *Castilleja levisecta,* Listed as Threatened in 1990: Historically occurred in the Mill Plain area of Clark County Washington. Typically found in wet prairie areas.

- Water howellia, *Howellia aquatilis,* Listed as Threatened in 1994, occurs in two small populations in the floodplain of the Columbia River in Clark County on the Ridgefield Wildlife Refuge across Lake River from the City of Ridgefield.

- Bradshaw's lomatium, *Lomatium bradshawii,* was listed as Endangered on September 30, 1988. It is thought to be endemic to the area around (within ten miles of) Salem, Oregon. According to Ron Klump of the US Army Corps of Engineers, it was recently discovered along Lacamas Creek near Camas, Washington.

## 5. Inventories and Surveys:

The Washington State Salmon and Steelhead Stock Inventory, Appendix 3: Columbia River Stocks was reviewed in the preparation of this document. Habitat biologists from Regions 5 of the Washington Department of Fish and Wildlife were interviewed for information regarding migration timing of the various listed salmonid stocks. Engineers and the biologists from the US Army Corps of Engineers Office in Vancouver, Washington were interviewed regarding permitting requirements for the outfall improvement project

## 6. Analysis of Effects:

### Water Quality & Fisheries Habitat

**Construction:**

Upgrading the Camas WWTF and Main Pump Station on their existing sites would have little, if any, potential to adversely impact listed species of fish and wildlife present in the vicinity, because work would be restricted to areas more than 100 feet from the Columbia River and more than 600 feet from the Washougal. Further, construction BMPs for control of sedimentation and erosion will be implemented; i.e. major ground disturbing work will occur during the dry season, silt fences will be installed between work areas and adjacent sensitive habitat areas, and disturbed areas will be replanted with grass and native vegetation to minimize runoff.

**Operation**

Operation of the upgraded WWTF and Main Pump Station would improve wastewater treatment and conveyance capacity and help to improve and maintain water quality and fisheries habitat in the Columbia and Washougal rivers. Implementation of these improvements in conjunction with the outfall modifications permitted in 2006 would

improve WWTF effluent quality and dilution through the planning period (2025). . Improving dilution of effluent from the WWTF may reduce impacts associated with pollutants in the effluent, which would improve water quality near the point of discharge and the dilution zone. Water quality in the Columbia River beyond the dilution zone should not be adversely affected regardless of loading over the planning period. Therefore, improving capacity of the Camas WWTF and Main Pump Station will have **no effect** on listed adult salmonids passing through the project area. Juvenile salmonids would be unaffected, as they generally migrate along the shoreline, well landward of the Camas WWTF Outfall.

## EFFECTS OF THE PROJECT ON PROPOSED CRITICAL HABITAT

### A. DESIGNATED CRITICAL HABITAT FOR CHINOOK SALMON, STEELHEAD AND CHUM SALMON: PRIMARY CONSTITUENT ELEMENTS. (I.e., physical and biological features) essential to the conservation of steelhead and discussion of potential project impacts:

#### 1. Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development*:*

According to the WDFW SASSI for Columbia River steelhead (WDF 1992), Lower Columbia chinook salmon, Lower Columbia steelhead, Lower Columbia coho and Columbia River chum salmon migrate past the City of Camas WWTF outfall. These species utilize the area for rearing, foraging and transportation. Chum salmon spawn in lower reaches of streams in the area, including the Washougal River. Substrate quality in the immediate project area is not conducive to salmonid spawning, as benthos are primarily sand that is unsuitable for spawning and larval development. Implementation of the proposed project would result in improved mixing and dilution of effluent from the Camas WWTF through the planning period (2025). This would improve water quality and rearing and transportation habitat. Construction of the proposed WWTF and Main Pump Station improvements will have no effect on water quantity or substrates supporting spawning, incubation and larval development.

#### 2. Freshwater migration corridors free of obstruction, freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions that support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

Work associated with the proposed WWTF and Main Pump Station Improvements will occur more than 100 feet from the north bank of the Columbia River and more

than 600 feet from the Washougal. Therefore, there will be no adverse impacts to riparian vegetation and substrate. Once construction of the proposed improvements is complete water quality in the vicinity of the WWTF outfall will be improved. This, coupled with the recently permitted modifications to the outfall diffusers, will improve the migration corridors in the Columbia River. The proposed outfall improvements will improve water quality, and will have no effect on water quantity or floodplain connectivity in the Columbia River.

**3. In-water habitat with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival:**

Proposed improvements to the Camas WWTF in conjunction with outfall improvements permitted in 2006 will improve water quality in the Columbia River by improving and preserving effluent quality through the planning period and enhancing mixing of effluent. This project will have no effect on water quantity, natural cover, aquatic vegetation, large rocks or boulders, side channels, undercut banks etc. as all work will occur more than 100 feet from the north shore of the Columbia River.

**4. Estuarine areas free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between freshwater and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation:**

The proposed improvements to the Camas WWTF and Main Pump Station will have no quantifiable effect on the Columbia River estuary approximately 100 miles downstream from Camas.

**5. Nearshore marine areas free of obstruction with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels:**

Proposed improvements to the Camas WWTF and Main Pump Station will improve water in the mixing zone downstream of the facility through the planning period, but it is unlikely that these improvements will be observable or detectable in nearshore marine areas more than 120 miles downstream from Camas.

**6. Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation:**

The proposed project will have no effect on nearshore marine areas, as the Camas WWTF is approximately 120 miles upstream from the mouth of the Columbia River, and the level of effluent treatment and dilution will not change enough to be observable 120 miles downstream.

**B. BULL TROUT PROPOSED CRITICAL HABITAT PRIMARY CONSTITUENT ELEMENTS.** USFWS (2004) identified nine primary constituent elements (PCEs) (i.e., physical and biological features) essential to the conservation of bull trout using the best scientific and commercial data available. These nine PCEs are summarized from the Federal Register below. Most of these elements are focused on freshwater systems and the impacts that may occur there. These PCEs apply to the proposed project, because the Project will take place in the freshwater.

**1. Water temperatures ranging from 36 to 59 ºF (2 to 15 ºC), with adequate thermal refugia available for temperatures at the upper end of this range:**

The water temperature in the Lower Columbia River is likely adequate for subsistence of bull trout during the late fall, winter and early spring. Late spring through early fall, temperatures in the Columbia River downstream of the project area are likely to be too high for bull trout. The nearest known concentration of bull trout for the project area is in the Lewis River, which is approximately 30 miles downstream of Camas.

Proposed modifications to the Camas WWTF and Main Pump Station in addition to the outfall modifications permitted in 2006 will improve mixing of the higher quality effluent with flow in the main channel of the Columbia River, which would potentially lower in-stream temperatures slightly and improve habitat for foraging or migrating bull trout.

**2. Complex stream channels:**

The Camas WWTF discharges into the mainstem of the Columbia River. Improving wastewater treatment through the planning period will improve and preserve water quality in the Columbia, but it will have no effect on complex stream channels in this system.

3. **Substrates of sufficient amount, size, and composition to ensure success of egg and juvenile survival.**

Bull trout do not spawn in the lower reaches of the Columbia River, as water temperature, water quality and benthic composition are inadequate. Temperatures are too high, water quality is compromised and benthic substrate is muddy sand, which is not suitable for bull trout spawning. The proposed project will have no impact on the nearest areas appropriate for bull trout spawning, which are upstream of Merwin Dam on the Lewis River. The proposed WWTF and Main Pump Station Improvements will have no effect on substrates in the Columbia or Washougal rivers.

4. **A natural hydrograph, or if regulated, a hydrograph that demonstrates the ability to support bull trout populations.**

The hydrograph of the Lower Columbia River is tidally influenced and controlled by Bonneville Dam. However, the lower reaches may provide transportation, rearing and foraging habitat for bull trout during the cooler months. Improvements to the Camas WWTF and Main Pump Station will not impact the hydrograph of the Columbia and Washougal rivers near Camas, which do not currently support bull trout populations, due to sub-optimal water quality conditions.

5. **Springs, seeps, groundwater sources and subsurface water:**

The proposed improvements to the Camas WWTF and Main Pump Station will have no effect on springs, seeps, groundwater sources or subsurface waters, because all work would be conducted within the confines of the WWTF and the only area to be disturbed outside of the footprint of the existing Main Pump Station will be in the paved cul-de-sac south of Third Avenue SE more than 600 feet from the Washougal River.

6. **Migratory corridors with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering and foraging habitats, including intermittent or seasonal barriers induced by high water temperatures or low flows:**

Improving and preserving the quality of the effluent from the Camas WWTF will improve water quality and the migratory corridor through the area. Water quality problems associated with the effluent will be mitigated significantly by the proposed treatment and conveyance system improvements to provide adequate migratory corridors in the Columbia River through the planning period.

7. **An abundant food base including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish:**

Implementation of the proposed improvements to the Camas WWTF and Main Pump Station, coupled with the outfall improvements permitted in 2006 will

improve mixing and dilution of effluent, but they will have no effect on the food base for bull trout that may occasionally migrate through the project area offshore of the City of Camas. There will be no trench excavation in the Columbia River associated with the proposed WWTF and Pump Station improvements, so benthic macroinvertebrates will not be adversely impacted. Water quality in the Columbia River downstream of the project area will be improved, so there will be no adverse impact on the food base for bull trout that may occasionally pass through the project area.

**8. Few or no nonnative predatory, interbreeding, or competitive species present:**

Implementation of the proposed WWTF and Pump Station improvements will help to improve and maintain water quality through the planning period (2025). The proposed improvements to the City of Camas WWTF and Main Pump Station will have no effect on non-native predatory**,** interbreeding or competitive species present in the Columbia River.

**9. Permanent water of sufficient quantity and quality such that normal reproduction, growth and survival are not inhibited:**

Implementation of the proposed improvements to the City of Camas WWTF and Main Pump Station will result in improved/ preserved water quality in the Columbia River in the project vicinity and downstream. Bull trout do not reproduce in the Lower Columbia River, however they rear and forage in the main-stem Columbia and up several tributaries in the area. Implementation of the proposed project will preserve water quality in foraging, rearing and migratory habitat for bull trout.

Based on this analysis, the proposed modifications to the Camas WWTF outfall will result **in no destruction or adverse modification** of proposed critical habitat for bull trout.

Based on this analysis, the proposed installation and operation of the proposed modifications to the Camas WWTF outfall will result in **no destruction or adverse modification** of designated critical habitat for the following listed species present in the Lower Columbia River:

- Upper Columbia River spring chinook salmon;
- Upper Columbia River steelhead;
- Mid Columbia River steelhead;
- Snake River steelhead;
- Snake River spring/summer chinook salmon;
- Snake River fall chinook salmon;
- Snake River sockeye salmon;

- Upper Willamette River steelhead;
- Lower Columbia River chinook salmon;
- Lower Columbia River coho salmon
- Lower Columbia River steelhead;
- Columbia River bull trout.

**Potential for Impacts to Bald Eagles**

**Construction:**
Proposed improvements to the City of Camas WWTF will occur within the existing footprint more than 100 feet from the Columbia River. Noise associated with this work is not likely to be louder than the pumps and blowers currently in use on the WWTF site. Modifications to the Main Pump Station will occur in a paved area immediately north of the existing facility. According to the Priority Habitats & Species Maps prepared for the project area on April 23, 2007, these project areas are more than one half mile from the nearest bald eagle nests and out of line-of-sight, so bald eagles will not be impacted by construction activities. Noise generated by construction activities will not be likely to cause wintering bald eagles passing near the WWTF or Pump Station sites to miss feeding opportunities. Therefore, the proposed construction activities will have no effect on bald eagles.

**Operation:**
Operation of the upgraded WWTF and Main Pump Station will preserve the quality of surface waters in the vicinity of the Camas WWTF Outfall through the planning period. Effluent will be discharged via the newly upgraded outfall, which was permitted in 2006. This will aid in dispersion as flows increase over the next 20 years. Operation of the modified outfall will have **no effect** on wintering bald eagles that may forage in the vicinity of the project.

**Indirect Effects**
Improvements to the Camas WWTF and Main Pump Station will provide adequate treatment of wastewater and dilution of effluent over the range of volumes anticipated through 2025. This will provide for growth anticipated in Camas over the next 20 years, but will not cause the growth to occur.

**Population growth**
While the proposed project will help to provide adequate conveyance, treatment and dilution for flows anticipated over the course of the planning period; it will not contribute to population growth or to an increase in tourist activity in the City and Port of Camas-Washougal. It is unlikely that implementation of the proposed WWTF and Pump Station improvements would lead directly to a significant increase in the permanent population of Camas.

**Potential for Impacts to Northern Spotted Owls**

The potential for adverse impacts to Northern spotted owls associated with implementation of the proposed project is low, because there are no active nests or Spotted Owl Management Circles within two miles of the project area (Priority Habitats & Species Map prepared by WDFW on April 23, 2007).

**Potential for Impacts to the Gray Wolf**
The potential for adverse impacts to the gray wolf associated with implementation of the proposed improvements to the Camas WWTF and Main Pump Station is very low. Gray wolves have not been sighted in the Camas area for many years, and the majority of the gray wolf population in Washington occurs in the northwest corner of the state approximately 300 miles from the project area in Camas.

**Potential for Impacts to Listed Plant Species**
Implementation of the proposed improvements to the Camas WWTF outfall will not impact listed plant species occurring in the Camas area, because all work associated with the proposed project will occur either within the existing WWTF and Main Pump Station footprints, or in a paved cul-de-sac immediately north of the pump station. Therefore, the proposed WWTF and Main Pump Station improvements will have **no effect** on golden paintbrush, water howellia or Bradshaw's lomatium.

**Management Actions related to the Species:**

Mitigation measures designed to minimize potential impacts of the Camas Wastewater Treatment Facility outfall modifications and operation of the facility once the modifications are completed include:

1. Construction equipment shall be fueled, maintained and stored off-site to minimize the potential for spills of hazardous materials, including fuels, lubricants and coolants into sensitive areas adjacent to the Camas WWTF (Columbia River) and the Main Pump Station (steep slopes).

2. No in-water work is planned associated with the proposed improvements to the Camas WWTF and Main Pump Station. In the event that in-water work is required, construction would be limited to the in-water work window established by the Washington Department of Fish and Wildlife, Vancouver Office, which extends from November 1 to February 28 in the Lower Columbia River.

3. To minimize the potential for accidents resulting in direct effects to listed and candidate fish species, construction equipment will be fitted with emergency spill kits and construction crews will be trained in their use.

4. Construction BMPs for the control of sedimentation and erosion will be implemented during construction; i.e. major ground disturbing activities will occur during the dry summer months, silt fences will be used, as necessary, between excavation areas and

adjacent sensitive areas, and straw bales will be used to prevent turbid runoff from leaving the worksite.

5. Limiting noise-generating construction activities to the summer months will reduce the potential for noise-related disturbance to foraging bald eagles during the winter.

6. Disturbed areas not covered by new structures will be landscaped with grass or native vegetation to minimize the potential for erosion and sedimentation.

**Conclusions:**

1. Potential impacts to listed salmon associated with the construction and operation of the proposed improvements to the Camas WWTF Outfall and the indirect effects associated with the proposed improvements will be minimal or discountable. They will have **no effect** on the listed anadromous salmonids that occur in the Columbia River near the project area. These species/Evolutionarily Significant Units include:
   - Lower Columbia River chinook salmon
   - Lower Columbia River steelhead
   - Lower Columbia River coho salmon
   - Columbia River chum salmon
   - Upper Columbia River spring chinook salmon
   - Upper Columbia River steelhead
   - Mid Columbia River steelhead
   - Snake River steelhead
   - Snake River spring/summer chinook salmon
   - Snake River fall chinook salmon
   - Snake River sockeye salmon
   - Upper Willamette River steelhead
   - Columbia River bull trout

2. All proposed improvements to the Camas WWTF and Main Pump Station will occur within the existing footprints of these structures, except the installation of a new wet well at the pump station, which will be located in an existing paved cul-de-sac off SW Third Avenue Immediately north of the Station. Both of these sites are located more than 0.5-mile from the nearest bald eagle nest. Therefore, the proposed improvements to the Camas WWTF and Main Pump Station will have **no effect** on nesting bald eagles or wintering bald eagles that may forage in the project area.

3. The gray wolf, listed as Endangered, is not likely to be present in the vicinity of Camas. Any wolves that wandered through the vicinity would be likely to avoid the noise generated by the existing WWTF treatment processes and SR 14. Therefore, implementation of the proposed improvements to the Camas WWTF and Main Pump Station will have **no effect** on any gray wolves that may wander through the area

during construction and operation of the proposed improvements to the Camas WWTF and the Main Pump Station.

4. Similarly, because all work will occur offshore in the Columbia River, the proposed outfall improvements will have **no effect** on golden paintbrush, water howellia and Bradshaw's lomatium.

5. Essential Fisheries Habitat: Potential water quality impacts associated with construction of the proposed improvements to the Camas WWTF and the Main Pump Station will not adversely impact water quality in the Columbia River or the Washougal, as Construction BMPs for the control of sedimentation will be implemented. Further, operation of the Camas WWTF with the improved outfall configuration permitted in 2006 will result in significantly improved effluent mixing and dilution, which will improve EFH for migrating chinook, coho and pink salmon. Therefore, the proposed project will have **no effect** on EFH.

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US Army Corps of Engineers ®
Seattle District

# INFORMAL ESA CONSULTATION
## For Impacts to Aquatic and Terrestrial Listed Species and Designated / Proposed Critical Habitat from Camas WWTP Outfall Modifications

***** This form is for projects that have insignificant or discountable impacts on listed species. It contains all the information required for a biological evaluation, but in abbreviated form and with minimal instructions on how to fill it out. For more detailed instructions, a format for development of a biological assessment or biological evaluation can be found on the Seattle District Corps website (www.nws.usace.army.mil – click on regulatory and then on endangered species, BA Template). You may also contact the Corps at 206-764-3495 for further information.***

1. **Proposed Activity**: Camas WWTP Outfall Modifications: Removal of 90-degree bends on 16 risers along the outer (southern) 150 feet of the 36-inch outfall pipeline discharging to the Columbia River. Tideflex valves will be installed to allow effluent to discharge vertically into the flow of the river.
2. **Drawings -** See attached Drawings.
3. **Date**: June 10. 2009 **Corps Ref No**.: Not yet assigned (UPI **358094-09-01)**
4. **Applicant**: City of Camas Public Works Department: Monte Brachmann

   **Address:** 616 Fourth Avenue

   **City:** Camas **State:** WA **Zip**: 98607

5. **Agent:** Jay Swift PE, Gray & Osborne, Inc.
   **Address**: 701 Dexter Avenue North, Suite 200

   **City:** Seattle **State:** WA Zip: 98109

6. **Project Name**: Camas WWTP Outfall Modifications
7. **Location(s) of Activity**:

   **Section:** 12 **Township:** 1 North **Range:** 3 East

   **Latitude**: 45°34'36" North **Longitude:** 122°23'28" West

   **Waterbody**: Columbia River **County:** Clark

8. **Description of Work:**

*Describe the proposed project.*

Divers will cut the eight six-inch risers currently in use on the existing 36-inch outfall pipeline to remove the 90-degree elbow. The inner eight risers will be similarly modified and opened for use associated with the proposed outfall improvements. Divers will then install the Tideflex "duckbill" valves with hose clamps on the vertical riser sections, allowing effluent to discharge vertically into the flow of the Columbia River. Divers will likely be required to temporarily relocate a small number of quarry spalls to modify the risers and install the "duckbill" valves on the risers. These rocks will be replaced in, or near, their original locations once the risers are modified and the Tideflex valves are installed. The footprint of the outfall will not change.

***<u>This project received a Nationwide Permit under a SLOPES categorical biological evaluation in 2006. The permit has expired and a new JARPA and this Corps of Engineers Informal ESA Consultation Document are being prepared for this re-permitting effort.</u>***

**9. Construction Techniques**:

*Describe methods and timing of construction to be employed in building the project and any associated features. Identify actions that could affect listed / proposed species or designated / proposed critical habitat and describe in sufficient detail to allow an assessment of potential impacts. Consider actions such as vegetation removal, temporary or permanent elevations in noise level, channel modifications, hydrological or hydraulic alterations, access roads, power lines etc. Also discuss construction techniques associated with any interdependent or interrelated projects.*

*Address the following:*

A. Construction sequencing and timing of each stage (duration and dates):
The proposed outfall improvements will be conducted during the in-water work window for the Lower Columbia River, which extends from November 1 through February 28 in accordance with the provisions of the Hydraulic Project Approval from the Washington Department of Fish & Wildlife dated October 26, 2006, or during the summer low flow period extending from July 15 to September 15 to take advantage of low flows and low turbidity levels in the river. The proposed outfall modifications are expected to take a team of divers approximately one week.

B. Site preparation:
Divers may be required to temporarily remove riprap and quarry spalls from around the outfall risers before they can cut the 90-degree bends off and clamp the Tideflex valves in place.

C. Equipment to be used:
Divers will use either surface supplied air or SCUBA to conduct work on the outfall. 90-degree bends will be cut off the risers using either a hacksaw or an underwater cutting torch. Tideflex valves will be installed and held in place by hose clamps.

D. Construction materials to be used:
Tideflex valves, hose clamps, saws or underwater cutting torch

E. Work corridor:
The Camas WWTP Outfall consists of a 36-inch diameter corrugated metal pipe (CMP), which extends from the northern shore of the Columbia River approximately 850 feet south into the Columbia River channel. The diffuser portion of the outfall is located along the outer/southern 150 feet of the pipe at a depth of approximately -35 feet. The existing outfall includes 16 vertical risers, each with a 90-degree bend pointed downstream. The eight diffusers closest to shore are capped off and are not currently in operation. These diffusers will be uncapped, 90-degree bends will be cut off and the risers will be fitted with a Tideflex valve and put into use. The work corridor will extend approximately 20 feet to either side of the diffuser.

F. Staging areas and equipment wash outs:
Staging for the proposed outfall improvement project will likely occur in the parking lot at the boat ramp or marina nearest the outfall.

G. Stockpiling areas:
SCUBA gear, Tideflex valves and hand tools will all be stockpiled on-board the work boat.

H. Running of equipment during construction:
In the event that surface supplied air is used during the proposed outfall modifications, a compressor is likely to be operated on-board the work boat. The workboat may idle on station during construction activities to provide diver support.

I. Soil stabilization needs / techniques:
No soil disturbance is anticipated associated with the proposed outfall modification project. Rocks disturbed during construction will be replaced in or near their original locations. Divers will avoid disturbing benthic sediments as much as possible to minimize turbidity generated and preserve working visibility.

J. Clean-up and re-vegetation:
A small amount of algae growing on the diffuser and adjacent riprap may be disturbed by construction activities. It is anticipated that vegetative cover along the outfall corridor will return to pre-construction conditions within one year.

K. Storm water controls / management:
None required, as all work will be completed under the surface of the Columbia River and no new stormwater will be generated.

L. Source location of any fill used:
Not applicable. No fill material will be installed associated with the proposed project.

M. Location of any spoil disposal:
Not applicable. No dredging or dumping of spoils is anticipated associated with the proposed WWTP outfall improvements.

## 10. Action Area

*Please describe the action area. The action area means all areas to be affected directly (e.g., earth moving, vegetation removal, construction noise, placement of fill, release of environmental contaminants) and indirectly by the proposed action. Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur. (for example: action area for a new pier could be considered at least one mile. This includes the project area, area where construction and the noise of construction will be heard (direct effects), and the area where increased boating activity is expected to occur (an indirect effect).*

The action area for the proposed outfall modification project is limited by the distance that construction activities can be heard underwater in the Lower Columbia River. Noise generated by boat activities and saws and cutting torches may be heard up to a mile in all directions underwater. The project corridor will extend approximately 25 feet on either side of the existing outfall from the point on the pipe 700 feet south of the north bank of the Columbia River to the end of the pipe approximately 850 feet offshore.

**11. Species Information**:

**Listed Species in Clark County under the authority of the US Fish & Wildlife Service** from (www.fws.gov/westwafwo/speciesmap/CLARK.html) include:

- Bull trout, *Salvelinus confluentus*
- Gray wolf, *Canis lupus*
- Northern spotted owl, *Strix occidentalis caurina*
- Golden paintbrush, *Castilleja levisecta*
- Water howellia, *Howellia aquatilis*
- Bradshaw's lomatium, *Lomatium bradshawii*

Bull trout occasionally pass through the project area en route to the Pacific Ocean and on their return upstream. None of the other listed species in Clark County are likely to be present in the middle of the Columbia River.

**Species identified as present in Clark County that are not likely to be present in the project area:**

**Northern spotted owl, *Strix occidentalis,* Listed Threatened*:***
Northern spotted owls occur in Clark County throughout the year. According to the Priority Habitats & Species Map prepared for the area surrounding Section 12, Township 1 North, Range 3 East on January 7, 2005, there are no northern spotted owl nests or management circles within two miles of the project area.

**Gray wolf, *Canis lupus*, Listed Endangered:**
The gray wolf population in Washington State is concentrated in the northeastern corner of the state. Any wolves occurring in the SW corner of the state are likely to be hybrids, which are not eligible for protection under the Endangered Species Act. All work on the proposed outfall improvement project will occur offshore from a boat in the Columbia River, so it is unlikely that gray wolves would be impacted.

**Listed plant species:**

**Golden paintbrush, *Castilleja levisecta,* Listed as Threatened in 1990:** Historically occurred in the Mill Plain area of Clark County Washington. Typically found in wet prairie areas.

**Water howellia, *Howellia aquatilis,* Listed as Threatened in 1994,** occurs in two small populations in the floodplain of the Columbia River in Clark County on the Ridgefield Wildlife Refuge across Lake River from the City of Ridgefield.

**Bradshaw's lomatium, *Lomatium bradshawii,* was listed as Endangered on September 30, 1988.** It is thought to be endemic to the area around (within ten miles of) Salem, Oregon. According to Ron Klump of the US Army Corps of Engineers, it was recently discovered along Lacamas Creek near Camas, Washington.

**Listed Species present in Clark County under the authority of the National Marine Fisheries Service/NOAA Fisheries:**

**Green sturgeon, *Acipenser medirostris,* Threatened**
The green sturgeon was listed as threatened on April 7, 2006. Critical habitat was proposed on September 8, 2008 and included the Columbia River estuary approximately 100 miles downstream of the City of Camas and the project area.

**Eulachon, *Thaleichthys pacificus*, Proposed for listing as Threatened**
Eulachon were proposed for listing as threatened in March 2009: Eulachon are present in the Columbia River at least as far upstream as Bonneville Dam upstream of Camas. Significant reductions in the number of eulachon returning to the Columbia River since the early 1990s have led to the proposal to list the Distinct Population Segment south of the Canadian Border as Threatened.

**Listed Pacific Salmon:**
The following table presents the listed ESUs of Pacific Salmon present in the Columbia River. The ESUs most likely to be present include Lower Columbia River chinook, coho, steelhead and Columbia River chum. The remaining ESUs migrate past the Camas WWTP outfall en route to the Pacific Ocean and on their return spawning runs. Returning salmonids utilize transportation habitat in the middle of the river closer to the point of discharge from the Camas WWTP.

| Species/ESU | Status | Date | FR Notice |
|---|---|---|---|
| ESUs Under NMFS Jurisdiction | | | |
| Lower Columbia chinook | **Threatened** | **3-24-98** | **63 FR14308** |
| | **Critical habitat** | **9-2-05** | **70 FR 52631** |
| Lower Columbia steelhead | **Threatened** | **3-19-98** | **63 FR 13347** |
| | **Critical habitat** | **9-2-05** | **70 FR 52631** |
| Columbia River chum | **Threatened** | **3-25-99** | **63 FR 30455** |
| | **Critical habitat** | **9-2-05** | **70 FR 52631** |
| Lower Columbia coho | **Proposed Threatened** | **6-16-05** | |
| Upper Columbia spring chinook | **Endangered** | **3-24-99** | **64 FR 14308** |
| | **Critical habitat** | **9-2-05** | **70 FR 52631** |
| Snake River sockeye | **Endangered** | **11-20-91** | **56 FR 58619** |
| | **Critical habitat** | **12-28-93** | **58 FR 53635** |
| Upper Columbia steelhead | **Endangered** | **8-18-97** | **62 FR 43937** |
| | **Critical habitat** | **9-2-05** | **70 FR 52631** |
| Snake River fall chinook | **Threatened** | **4-22-92** | **57 FR 14653** |
| | **Critical habitat** | **12-28-93** | **58 FR 68543** |
| Snake River spring/summer chinook | **Threatened** | **4-22-92** | **57 FR 14653** |
| | **Critical habitat** | **12-28-93** | **58 FR 68543** |
| Mid Columbia steelhead | **Threatened** | **3-25-99** | **64 FR 14517** |
| | **Critical habitat** | **9-2-05** | **70 FR 52631** |
| Snake River steelhead | **Threatened** | **8-18-97** | **62 FR 43937** |
| | **Critical habitat** | **9-2-05** | **70 FR 52631** |

| | | | |
|---|---|---|---|
| Upper Willamette steelhead | | **3-25-99**<br>**9-2-05** | |
| Southwest Washington & Lower Columbia River cutthroat trout | **Proposed Removed** | **4-26-99**<br>**7-5-0** | **64 FR 16397** |
| Columbia River bull trout (USFWS) | **Threatened**<br>**Critical habitat** | **6-10-98**<br>**9-25-05** | |

**LISTED EVOLUTIONARILY SIGNIFICANT UNITS (ESUs) OF CHINOOK SALMON:**

**Lower Columbia chinook salmon, *Oncorhynchus tshawytscha:*** Both spring and fall chinook populations on the Lower Columbia River were listed as threatened on March 28, 1998. Critical habitat was designated for this ESU on September 2, 2005.

**Spring chinook** are present in the Cowlitz, Camas and Lewis rivers. Spring chinook populations from these rivers are of mixed hatchery and wild origin. Return migration for these stocks occurs from late January to May. Tributary migration occurs from March through July, while spawning extends from late August through early October.

**Lower Columbia fall chinook** consist of 14 stocks. These stocks can be further divided into two general groups: the Tule early spawning stocks with strong hatchery influence of mixed origin, and a Lewis River wild stock that spawns later with little hatchery influence. Return migration through the lower Columbia extends from August through November. Spawning is generally October for early stocks and November for late stocks.

**Upper Columbia spring chinook**
Upper Columbia spring chinook were listed as endangered on March 24, 1999. Critical habitat was adopted for this ESU on February 15, 2000. Spring chinook destined for areas upstream of Bonneville Dam usually reach peak abundance at the dam between April 20 and April 28 but can be earlier during low flow years or later during high run-off periods. Tributary entry is May-June with spawning in late August to late September.

**Snake River fall chinook**
Snake River fall chinook were listed as threatened on April 22, 1992 and Critical Habitat for this ESU was adopted on February 28, 1993.

**Snake River spring/summer chinook**
Snake River spring/summer chinook were listed as threatened on April 22, 1992 and Critical Habitat was finalized on December 28, 1993.

**COLUMBIA RIVER CHUM SALMON, LISTED THREATENED:**

**Columbia chum salmon, *Oncorhynchus keta:***
Columbia River chum salmon were once widespread in the Lower Columbia River. They were listed as threatened on March 25, 1999, and critical habitat for this ESU was designated on September 2, 2005. Today chum salmon present in the lower Columbia are concentrated in the Grays River system near the

mouth of the Columbia and near Bonneville Dam in Hardy and Hamilton Creeks. These stocks of chum salmon are native. Some non-native chum introductions have been attempted, with no apparent success. Chum enter the Columbia in October and November, and spawn in November and December. The present run size is estimated to range between 3,000 and 10,000 fish annually.

**LISTED ESUs OF COLUMBIA RIVER BASIN STEELHEAD:**

**Lower Columbia steelhead *Oncorhynchus mykiss***
Lower Columbia River steelhead were listed as threatened on March 19, 1999. Critical habitat for this ESU was designated on September 2, 2005. According to the SASSI Columbia River Appendix, the Lower Columbia River supports five summer steelhead stocks and eighteen winter steelhead stocks. Run timing of the summer steelhead extends from May through October, while run timing of winter steelhead stocks extends from December through April in the Lower Columbia River.

**Mid Columbia steelhead**
Mid Columbia River steelhead were listed as threatened on March 25, 1999. Critical habitat for this species was adopted on September 2, 2005.

**Upper Columbia steelhead**
Upper Columbia River steelhead were listed as endangered on August 18, 1997. Critical Habitat for this ESU was adopted on September 2, 2005.

**Snake River steelhead**
Snake River steelhead were listed as threatened on August 18, 1997. Critical Habitat for this ESU was adopted on September 2, 2005.

**Upper Willamette River steelhead**
Upper Willamette River steelhead were listed as threatened on March 25, 1999. Critical Habitat was finalized for this ESU on September 2, 2005.

**SNAKE RIVER SOCKEY, Listed as Endangered**
**Snake River sockeye salmon, *Oncorhynchus nerka***
Snake River sockeye salmon were listed as endangered on November 20, 1991. Critical Habitat for this ESU was adopted on December 28, 1993.

**LOWER COLUMBIA RIVER COHO SALMON, Listed as Threatened**:

**Lower Columbia River coho, *Oncorhynchus kisutch:*** The National Marine Fisheries Service re-defined the Lower Columbia River ESU and listed this species as "Threatened" on June 28, 2005.

**CRITICAL HABITAT FOR LISTED ANADROMOUS FISHES**
The National Marine Fisheries Service designated critical habitat for each of these listed ESUs on September 2, 2005. Critical habitat for these listed salmonids includes all reaches of the Columbia River and its tributary streams below long-standing natural barriers, with the exception of areas covered under Habitat Conservation Plans. The waters of the Columbia River near Camas are considered critical habitat for both out-migrating juveniles and returning adults. Critical Habitat for Lower Columbia River coho is under development.

**Use of the Waters Adjacent to the Project Area by Listed Salmonids**
Joe Hymer of the Washington Department of Fish & Wildlife Vancouver Office indicated that juvenile salmonids from any of the listed species use the waters of the Columbia River for transport, feeding and rearing. Juvenile salmonids school in the shallows along the shore as much as possible and may be present along the shoreline near the Camas WWTP. Out-migrating juvenile salmonids of the various listed ESUs may be present in the Lower Columbia River almost continuously throughout the year (personal communication, July 12, 2001) with peak concentrations present from April through June. Abundance of juvenile salmonids is lowest during the mid summer months.

Out-migrating juvenile salmonids generally prefer to remain in shallow areas within the range of light penetration near the edge of the river as much as possible. Near Camas, they may school near the shore of the Camas WWTP near the project area while feeding, rearing and migrating toward the Pacific Ocean.

**12. Existing Environmental Conditions**:
Provide color photographs of local area, shoreline conditions and proposed project site.
*Describe existing environmental conditions for the following:*

A. Shoreline riparian vegetation and habitat features
Shoreline habitat west of the Camas WWTP outfall consists of a mixture of deciduous trees typical of the Columbia River Gorge including alders, cottonwoods, poplars and Oregon ash. There is a commercial pier that extends into the Columbia River directly offshore of the Camas WWTP. East of the outfall, vegetation along the shoreline is limited to grasses and shrubs associated with residential and commercial developments (see attached aerial photo).

B. Aquatic substrate and vegetation
Benthic substrate upstream and downstream of the Camas WWTP Outfall is most likely muddy sand with some gravel. The diffuser is bedded in riprap and quarry spalls for protection from logs, rocks and other debris migrating downstream on the bottom of the Columbia River.

C. Surrounding land/water uses
Land use on the north side of the Columbia River includes the Camas WWTP, SR 14 and commercial and residential developments to the east. There is a commercial dock immediately south of the Camas WWTP. The Columbia River is a major marine transportation corridor. Recreational fishing and wind surfing activities may occur in the area as well. Land use on the south side of the Columbia River is dominated by Interstate 84 and associated commercial and residential developments.

D. Level of development
The immediate project area in the Columbia River is fully developed as the Camas WWTP Outfall, which includes a 36-inch CMP outfall that extends approximately 850 feet south of the north shore of the Columbia River. A narrow, tree-dominated shoreline area extends from the road along the Camas WWTP fence line west to the SR-14 ROW. The area east of the Camas WWTP contains a mixture of residential and industrial developments (see attached aerial photo).

E. Water quality
Water quality in the vicinity of Camas is generally good; this stretch of the Columbia River is on the 2009 CWA 303(d) list for temperature.

F. Distance to nearest bald eagle nest and wintering features (perch trees; roost trees; and important foraging areas such as waterfowl concentration areas and salmon spawning areas).

According to Priority Species and Habitat Map prepared for this project by the Washington Department of Fish and Wildlife on January 7, 2005, there are no bald eagles known to nest within approximately two miles of the project site. Wintering bald eagles prey on salmon migrating into and out of the Columbia River and may forage offshore in the vicinity of the project area between November 1 and March 31.

G. Distance to nearest marbled murrelet nesting and foraging areas.

The Camas WWTP Outfall is located at approximately RM 120.8. The maximum distance from salt water where marbled murrelets are thought to nest is approximately 60 miles. Therefore, the nearest marbled murrelet nesting area is likely to be in old growth forests at least 60 miles downstream of the project area.

H. Distance to nearest bull trout spawning / foraging / overwintering areas. Is the project in or adjacent to bull trout migratory waters?

Anadromous/amphidromous bull trout migrate past the Camas WWTP Outfall in the Columbia River. The nearest bull trout spawning areas are likely in the upper reaches and tributaries of the Washougal River. Bull trout could forage in any of the larger streams along the Columbia River corridor.

I. Is the project located within designated / proposed bull trout critical habitat? If so, please address the proposed projects' potential direct and indirect effect to primary constituent elements (please see the USFWS proposed rule – Federal Register / Vol. 69, No. 122/ Friday, June 25, 2004; Page 35776).

No.

J. Is the project located within designated / proposed Pacific salmon critical habitat? If so, please address the proposed projects' potential direct and indirect effect to primary constituent elements (please see the NOAA-Fisheries proposed rule – Federal Register / Vol. 69, No. 239/ Tuesday, December 14, 2004; Page 74581).

EFFECTS OF THE PROJECT ON PROPOSED CRITICAL HABITAT

A. DESIGNATED CRITICAL HABITAT FOR CHINOOK SALMON, STEELHEAD AND CHUM SALMON: PRIMARY CONSTITUENT ELEMENTS. (i.e., physical and biological features) essential to the conservation of steelhead and discussion of potential project impacts: Yes.

1. Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development*:*

According to the WDFW SASSI for Columbia River steelhead (WDF 1992), Lower Columbia chinook salmon, Lower Columbia steelhead, Lower Columbia coho and Columbia River chum salmon migrate past the City of Camas WWTP outfall. These species utilize the area for rearing, foraging and transportation. Chum salmon spawn in lower reaches of streams in the area, including the Washougal River. Substrate quality in the immediate project area is not conducive to salmonid spawning, as benthos are primarily sand that is unsuitable for spawning and larval development. Implementation of the proposed project would result in improved mixing and dilution of effluent from the Camas WWTP. This would improve water quality and rearing and

transportation habitat. This work will be completed either during the WDFW In-Water Work Window established for the Lower Columbia River, which extends from November 1 to February 28; or during the summer low flow period to take advantage of the lightest currents and best visibility for underwater work. Construction of the proposed outfall improvements will have no effect on water quantity or substrates supporting spawning, incubation and larval development.

2. Freshwater migration corridors free of obstruction, freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions that support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

Once the outfall modifications are complete, the proposed project will improve migration corridors in the Columbia River. Effluent discharged via the outfall will receive more complete mixing and dilution than under existing conditions. Riparian vegetation will not be impacted by the proposed outfall improvements, which will be installed in situ beneath the surface of the Columbia River 700 to 850 feet offshore of the WWTP. The proposed outfall improvements will improve water quality, and will have no effect on water quantity or floodplain connectivity in the Columbia River.

3. In-water habitat with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival:

Proposed improvements to the Camas WWTP outfall will improve water quality in the Columbia River by enhancing mixing of effluent. This project will have no effect on water quantity, natural cover, aquatic vegetation, large rocks or boulders, side channels, undercut banks etc. as all work will occur on the existing WWTP outfall in the Columbia River channel.

4. Estuarine areas free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between freshwater and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation:

The proposed improvements to the Camas WWTP outfall will have no quantifiable effect on the Columbia River estuary approximately 100 miles downstream from Camas.

5. Nearshore marine areas free of obstruction with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels:

Proposed improvements to the Camas WWTP outfall will improve water in the mixing zone downstream of the facility, but it is unlikely that these improvements will be observable or detectable in nearshore marine areas more than 120 miles downstream from Camas.

6. Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation:

The proposed project will have no effect on nearshore marine areas, as the Camas WWTP is approximately 120 miles upstream from the mouth of the Columbia River and the level of effluent treatment and dilution will not change enough to be observable 120 miles downstream.

K. Presence of forage fish (marine areas only).

Not applicable, as the project area is 120 miles upstream from the Pacific Ocean.

**13. Effects Analysis:**

*Describe the direct and indirect effects of the action on the proposed and listed species as well as designated and proposed critical habitat within the action area. Consider the impact to both individuals and the population. Discuss the short-term, construction-related, impacts as well as the long-term and permanent effects.*

**Water Quality & Fish Habitat**

**Construction:**

Modification of the Camas WWTP outfall to the Columbia River will be accomplished by divers over the course of a few days. It is unlikely that the work will take more than a week to complete. Construction will take place either during the work window established by the Washington Department of Fish and Wildlife, which extends from November 1 to February 28 in the Lower Columbia River, or during low flow summer months, July 15 to September 15, to take advantage of the lowest stream flows and best underwater working visibility. Any salmon, eulachon or green sturgeon present in the vicinity of the outfall during diving operations would be able to avoid noise, turbidity and disturbance generated by divers. Discussion of the proposed project and the limited potential for impacts to listed salmonids, eulachon and green sturgeon with Dan Guy, NMFS Vancouver Office on June 12, 2009, led him to support the idea of conducting the diving operations for the outfall modification during the low flow period on the Columbia between mid July and early September to take advantage of lower current speeds and better visibility for the proposed underwater work.

**Operation**

According to Mr. Bill Fox of Cosmopolitan Engineering (Memo to Jay Swift P.E. of Gray & Osborne, dated May 6, 2005), diffusing the effluent vertically from the outfall into the Columbia River will help to improve water quality in the dilution zone downstream of the outfall. Improving dilution of effluent from the WWTP may reduce impacts associated with pollutants in the effluent, which would improve water quality near the point of discharge and the dilution zone. Water quality in the Columbia River beyond the dilution zone should not be adversely affected regardless of loadings. Therefore, reorientation of the risers on the Camas WWTP outfall, opening the inshore eight outfall ports, and operation of the Camas WWTP with these improvements will improve and preserve water quality and habitat conditions for listed salmonids passing through the project area through the planning period, 2025, and beyond.

**Potential for Impacts to Northern Spotted Owls**
The potential for adverse impacts to Northern spotted owls associated with implementation of the proposed project is low, because there are no active nests or Spotted Owl Management Circles within two miles of the project area (Priority Habitats & Species Map prepared by WDFW on January 7, 2005).

**Potential for Impacts to the Gray Wolf**
The potential for adverse impacts to the gray wolf associated with implementation of the proposed improvements to the Camas WWTP outfall is very low. Gray wolves have not been sighted in the Camas area for many years, and the majority of the gray wolf population in Washington occurs in the northeast corner of the state approximately 300 miles from the project area offshore of Camas.

**Potential for Impacts to Listed Plant Species**
Implementation of the proposed improvements to the Camas WWTP outfall will not impact listed plant species occurring in the Camas area, because all work associated with the proposed project will occur off shore beneath the surface of the Columbia River. Therefore, the proposed WWTP outfall improvement project will have no effect on golden paintbrush, water howellia or Bradshaw's lomatium.

**14. Conservation measures:**

*Conservation measures are measures that would reduce or eliminate adverse impacts of the proposed activity (examples: work done during the recommended work window [to avoid times when species are most likely to be in the area], silt curtain, erosion control best management practices, percent grating on a pier to reduce shading impacts).*

Mitigation measures designed to minimize potential impacts of the Camas Wastewater Treatment Facility outfall modifications and operation of the facility once the modifications are completed include:

1. Construction equipment and vessels shall be fueled, maintained and stored off-site to minimize the potential for spills of hazardous materials, including fuels, lubricants and coolants.

2. Construction would be limited to the in-water work window established by the Washington Department of Fish & Wildlife, Vancouver Office, which extends from November 1 to February 28 in the Lower Columbia River, or during the summer low flow period between July 15 and September 15 to take advantage of low flows and improved visibility for the proposed under water work.

3. To minimize the potential for accidents resulting in direct effects to listed and candidate fish species, construction vessels and equipment will be fitted with emergency spill kits and construction crews will be trained in their use.

**15. Determination of Effect:**

*Provide a summary of impacts concluding with statement(s) of effect, by species. Even projects that are intended to benefit the species might have short-term adverse impacts and those must be addressed. For this template, only the following determinations are valid for listed species or designated critical habitat:*

1. Potential impacts to listed salmon associated with the construction and operation of the proposed improvements to the Camas WWTP Outfall and the indirect effects associated with the proposed improvements will be minimal or discountable and long-term impacts on the listed anadromous salmonids that occur in the Columbia River near the project area are likely to be positive. Therefore, the proposed improvements to the Camas WWTP Outfall **may affect, but are unlikely to adversely affect** the following species/ESUs and their critical habitat:
   - Lower Columbia River chinook salmon
   - Lower Columbia River steelhead
   - Lower Columbia River coho
   - Columbia River chum salmon
   - Upper Columbia River spring chinook salmon
   - Upper Columbia River steelhead
   - Mid Columbia River steelhead
   - Snake River steelhead
   - Snake River spring/summer chinook salmon
   - Snake River fall chinook salmon
   - Snake River sockeye salmon
   - Upper Willamette River steelhead
   - Columbia River bull trout
   - Green sturgeon

2. The gray wolf, listed as Endangered, is not likely to be present in the vicinity of Camas. Any wolves that wandered through the vicinity would likely be unaware of the project activity taking place offshore in the Columbia River. Therefore, implementation of the proposed improvements to the Camas WWTP Outfall, which will occur under water, will have **no effect** on any gray wolves that may wander through the area during construction and operation of the Camas WWTP and its upgraded outfall.

3. Similarly, because all work will occur offshore in the Columbia River, the proposed outfall improvements will have **no effect** on golden paintbrush, water howellia and Bradshaw's lomatium.

4. There are no northern spotted owl nesting areas within two miles of the project area; therefore, the project will have **no effect** on northern spotted owls.

5. Eulachon will be able to avoid any noise or disturbance caused by divers during construction and they would benefit from improved water quality in the vicinity of the Camas WWTP Outfall once construction is completed. Therefore, the proposed project **is not likely to jeopardize the continued existence** of eulachon population present in the Columbia River near the Camas WWTP Outfall. In the event that eulachon are eventually listed as threatened, the proposed project **may affect, but is not likely to adversely affect** this species.

6. The proposed improvements to the Camas WWTP **is not likely to jeopardize** proposed Critical Habitat for green sturgeon present in the Columbia River estuary approximately 100 miles downstream of the project area.

## 16. EFH Analysis

### A. Effects of the Proposed Action

i. Effects on EFH (groundfish, coastal pelagic, and salmon EFH should be discussed separately)

Commercially important salmonid species present in the Lower Columbia include Columbia River chinook salmon, Columbia River coho and a small population of pink salmon**.** Proposed modifications to the Camas WWTP Outfall in the middle of the Columbia River are unlikely to affect out-migrating juveniles as they generally remain close to the shoreline while outfall modification will occur near mid-channel. Returning salmonids are mobile enough to avoid any noise or disturbance associated with divers modifying the risers along the outer portion of the outfall.

ii. Effects on Managed Species (unless effects to an individual species are unique, it is not necessary to discuss adverse effects on a species-by species basis)

Construction of the proposed improvements to the Camas WWTP Outfall will be made by a team of divers using hand tools over the course of a few days. Commercially important chinook, coho and pink salmon populations that may migrate through the project area will be able to avoid any disturbance.

iii. Effects on Associated Species, Including Prey Species

Construction impacts associated with minor improvements to the Camas WWTP Outfall by a team of divers using hand tools over a period of one week or less is unlikely to have any significant impact on fish and invertebrate species that are prey for chinook, coho or pink salmon, due to the limited work area and scope of activities. Any prey fish populations, including eulachon will be able to avoid the minimal amount of noise and disturbance caused by divers working on the outfall.

iv. Cumulative Effects

Modeling conducted by Cosmopolitan Engineers indicated that opening the inner eight risers on the diffuser and reorienting discharge from horizontal to vertical directly into the flow of the Columbia River will improve dilution of effluent discharged by the Camas WWTP. This will minimize adverse impacts to water quality and fisheries habitat in the mixing zone in the middle of the Columbia River as the service area population grows and flows increase.

### B. Proposed Conservation Measures

- Construction equipment and vessels shall be fueled, maintained and stored off-site to minimize the potential for spills of hazardous materials, including fuels, lubricants and coolants.

- Construction would be limited to the in-water work window established by the Washington Department of Fish & Wildlife, Vancouver Office, which extends from November 1 to February 28 in the Lower Columbia River. Alternatively, work may be conducted during the summer low

flow period to facilitate construction activities by allowing divers to work in the least current and lowest turbidity/best visibility.

- To minimize the potential for accidents resulting in direct effects to listed and candidate fish species, construction vessels and equipment will be fitted with emergency spill kits and construction crews will be trained in their use.

**C. Conclusions for EFH** (taking into account proposed conservation measures)

The proposed project will have no effect on EFH for chinook, coho and pink salmon present in the Columbia River near the Camas WWTP Outfall.

**17. References:**


Ellenburg, Martin 2002. Personal communication regarding in-water construction timing in the Lower Columbia River, Washington Department of Fish and Wildlife Vancouver Office, October 3.

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Zahn, Max 2001. Personal communication regarding potential impacts to bald eagles associated with project construction and operation. WDFW Montesano Office, May 14.

**18. Appendices:**

A. Maps & Figures

B. Correspondence & Background Information

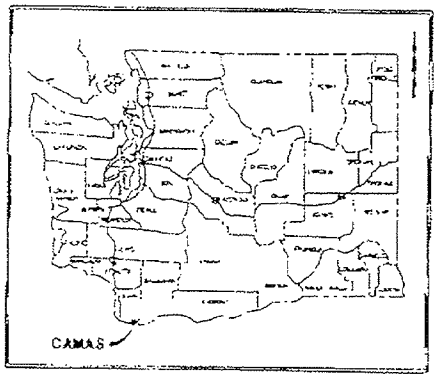
C. Previously Issued Permits

- Rivers & Harbors Act Section 10 Permit
- Hydraulic Project Approval

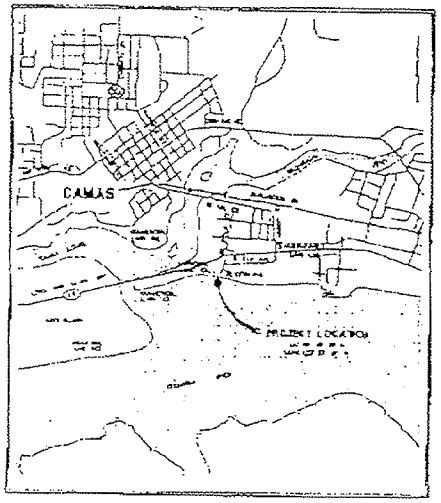
| | |
|---|---|
| Corps Project Manager | Date |
| Corps Environmental Analyst/ESA Coordinator | Date |

# Appendix A

# Maps & Figures




VICINITY MAP




LOCATION MAP

INDEX

GENERAL

| SHEET No | DESCRIPTION |
|---|---|
| | GENERAL |
| G-1 | LOCATION MAP, VICINITY MAP, AND SHEET INDEX |
| G-2 | OUTFALL PLAN AND PROFILE |
| G-3 | OUTFALL DETAILS |

DIRECTIONS TO CITY OF CAMAS WASTEWATER TREATMENT FACILITY:

FROM I-5 HEADING SOUTHBOUND, MERGE ONTO I-205 S toward [illegible]
7 TOTAL: [illegible] I-84/GRESHAM/I-84, GO 10.0 MILES
MERGE ONTO [illegible] E VIA EXIT 27 TOWARD CAMAS, GO 9.0 MILES
TURN RIGHT ONTO SE UNION ST, GO [illegible] MILES
SE UNION ST BECOMES SE 11TH AVENUE, GO [illegible] MILES
SE 11TH AVENUE BECOMES POLK STREET, GO [illegible] MILES
POLK STREET BECOMES SE 13TH AVENUE, GO [illegible] MILES
TURN RIGHT ONTO [illegible] AVE FROM SE 13TH AVENUE

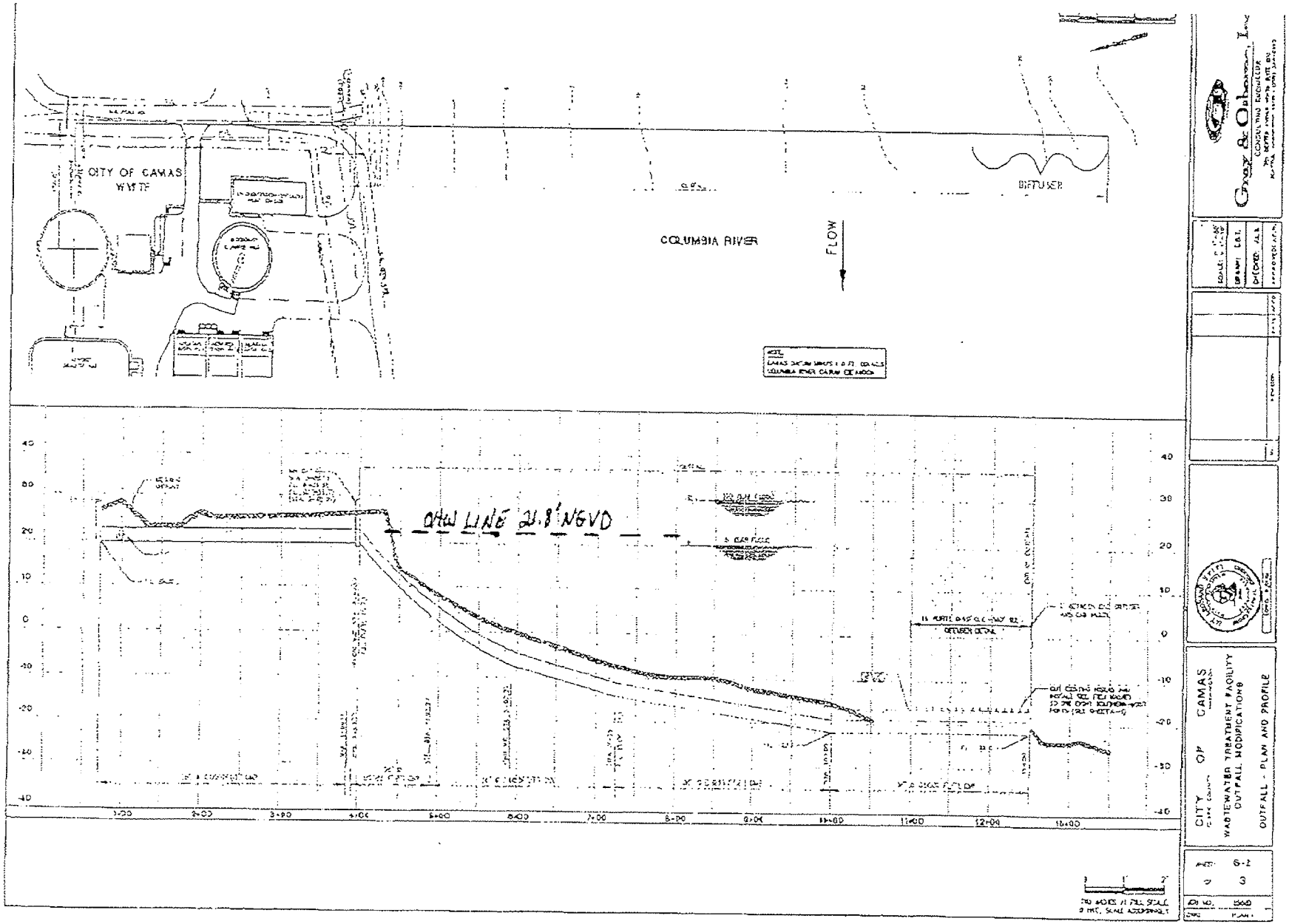
Group Six Consulting Engineers

CITY OF CAMAS
WASTEWATER TREATMENT FACILITY
OUTFALL MODIFICATIONS
LOCATION MAP, VICINITY MAP
AND SHEET INDEX

SHEET 1 OF 3

REF: 200501420
CAMAS PUBLIC WORKS
DATE: APRIL 18, 2006

SHEET 1 OF 3

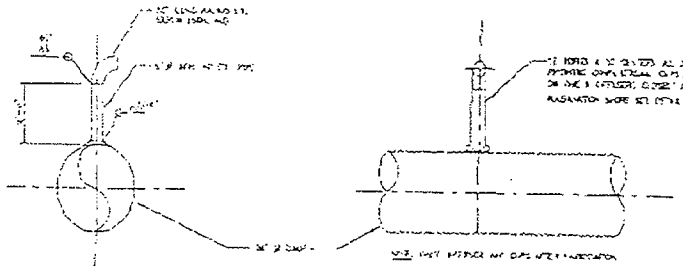



OHW = ORDINARY HIGH WATER

REF: 200501420
CAMAS PUBLIC WORKS

DATE: APRIL 18, 2006

SHEET 2 OF 3



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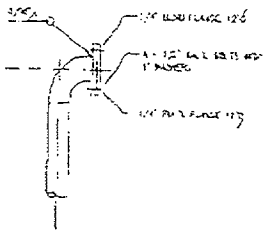

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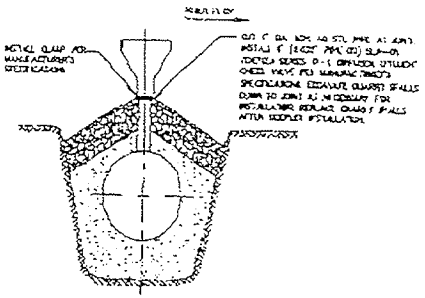

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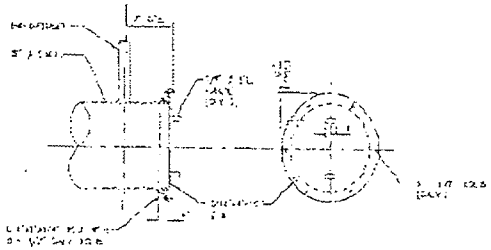

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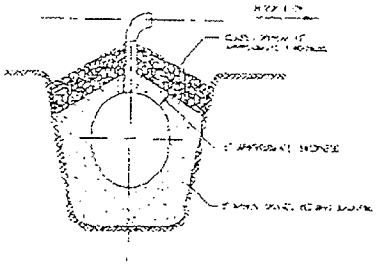

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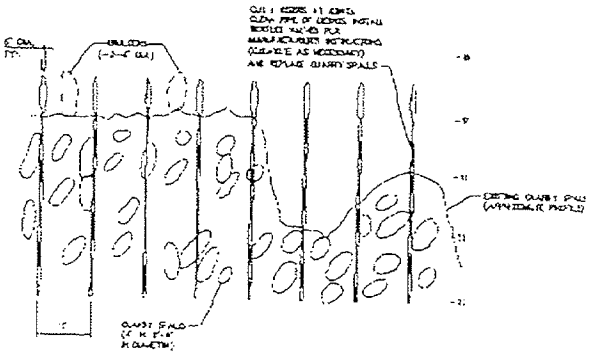


QUARRY SPALLS DETAIL

Gray & Osborne, Inc.
CONSULTING ENGINEERS

CITY OF CAMAS
WASHINGTON

WASTEWATER TREATMENT FACILITY
OUTFALL MODIFICATIONS

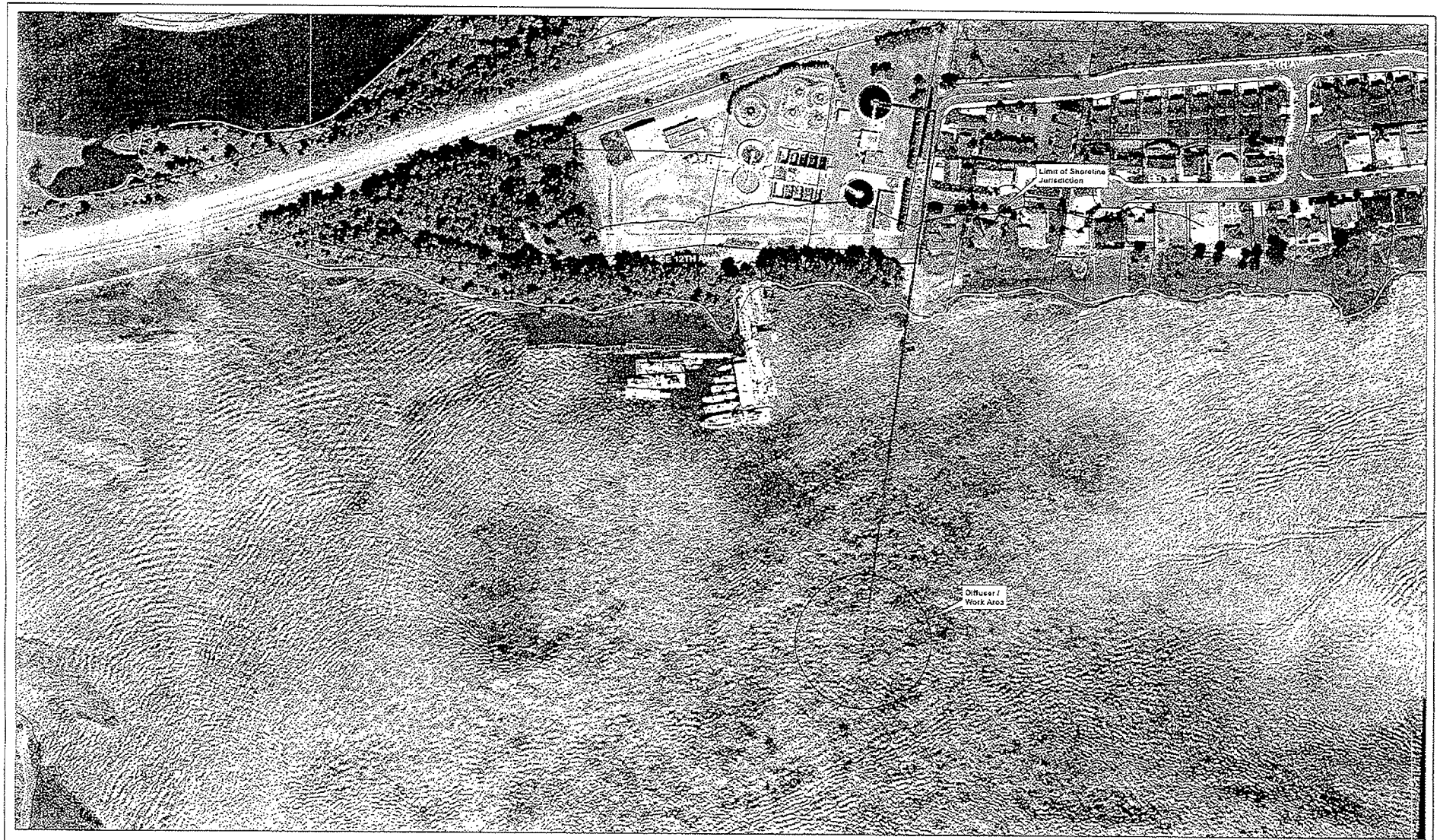
OUTFALL - DETAILS

SHEET G-3
3

REF: 200501420
CAMAS PUBLIC WORKS

DATE: APRIL 18, 2006

SHEET 3 OF 3

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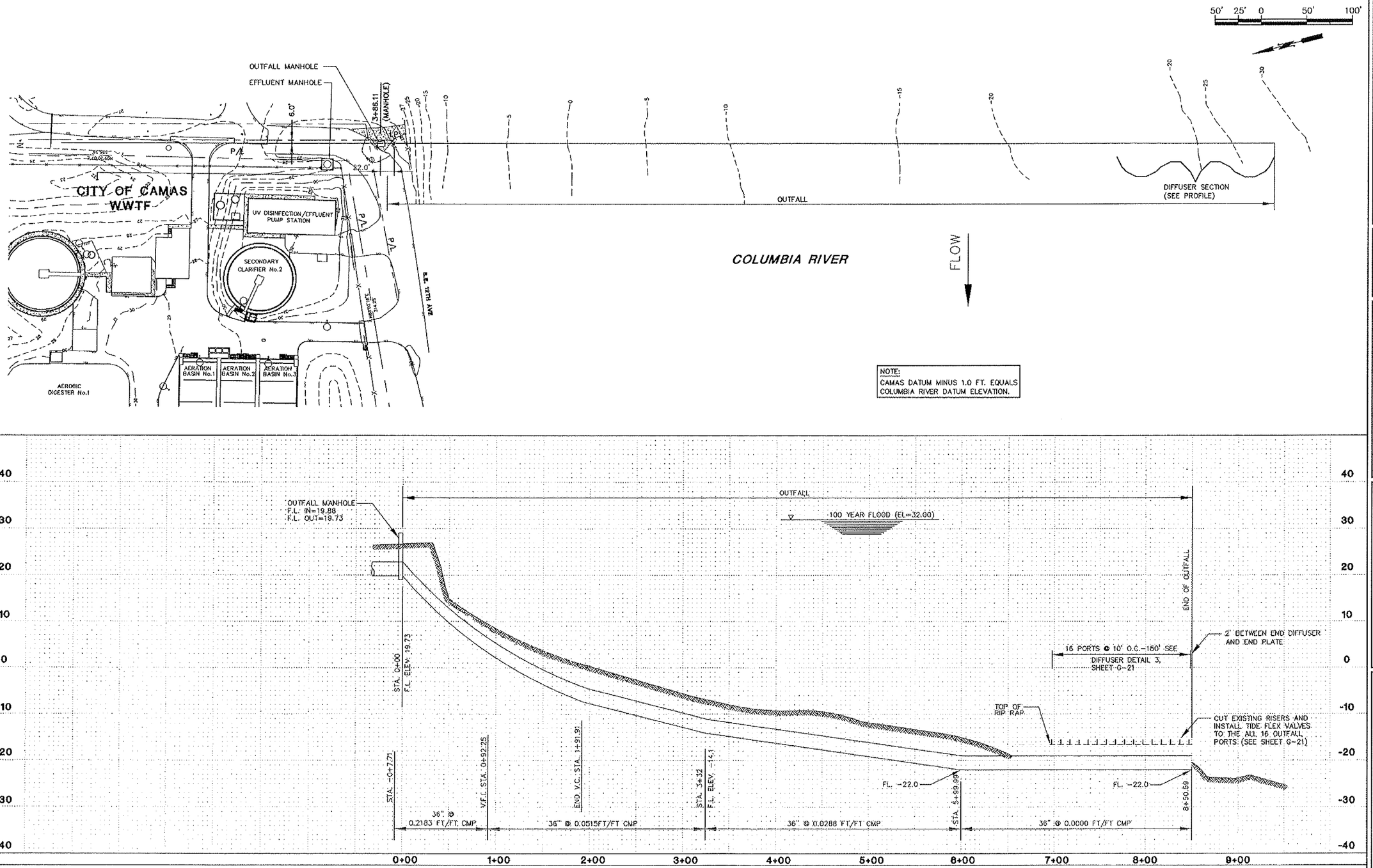
CITY OF CAMAS
WASTEWATER TREATMENT FACILITY
OUTFALL MODIFICATIONS

Ordinary High Water
OUTFALL LINE
DIFFUSER





Gray & Osborne, Inc.
CONSULTING ENGINEERS
701 DEXTER AVENUE NORTH SUITE 200
SEATTLE, WASHINGTON 98109 · (206) 284-0860


DATE: APR. 2009
SCALE: H 1"=50' V 1"=10'
DRAWN: E.S.T.
CHECKED: E.F.N.
APPROVED: J.P.W.

| No. | REVISION | DATE | APPD |
|---|---|---|---|

JOHN P. WILSON STATE OF WASHINGTON 24271 REGISTERED PROFESSIONAL ENGINEER

ERIC F. NUTTING STATE OF WASHINGTON 33900 REGISTERED PROFESSIONAL ENGINEER

CITY OF CAMAS
CLARK COUNTY WASHINGTON
WWTF IMPROVEMENTS - PHASE 2
OUTFALL MODIFICATIONS
PLAN AND PROFILE

SHEET: G-20
OF: 21
JOB NO.: 07511
DWG: OUTFALL

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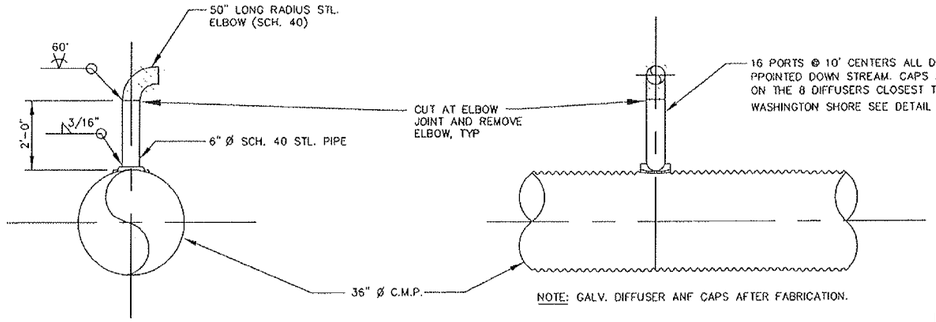


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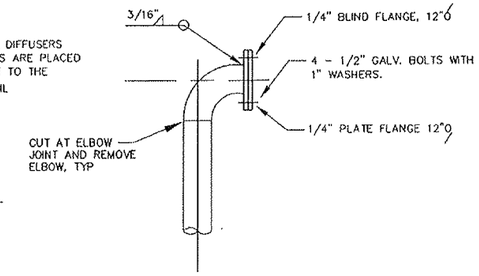


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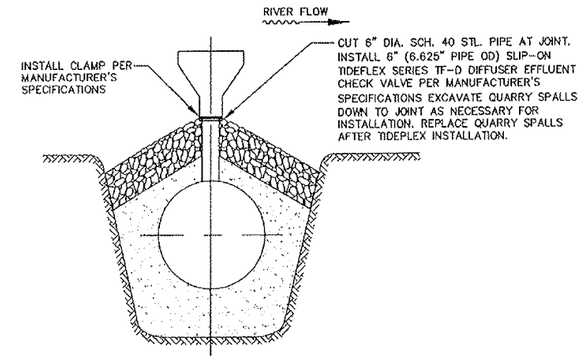


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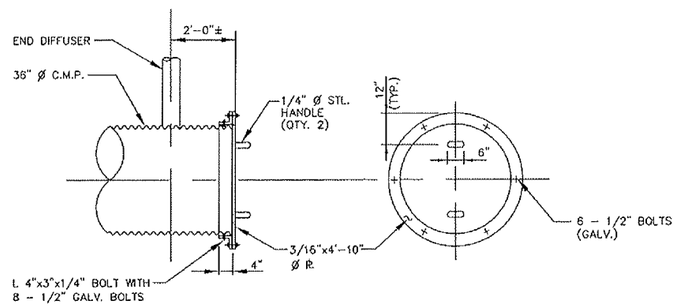


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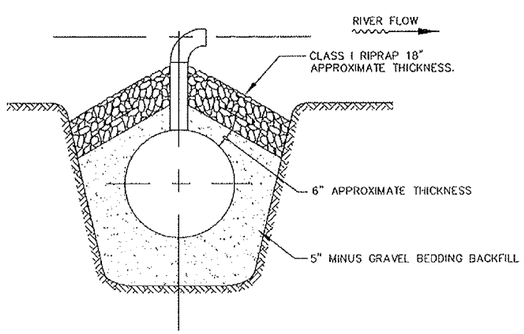


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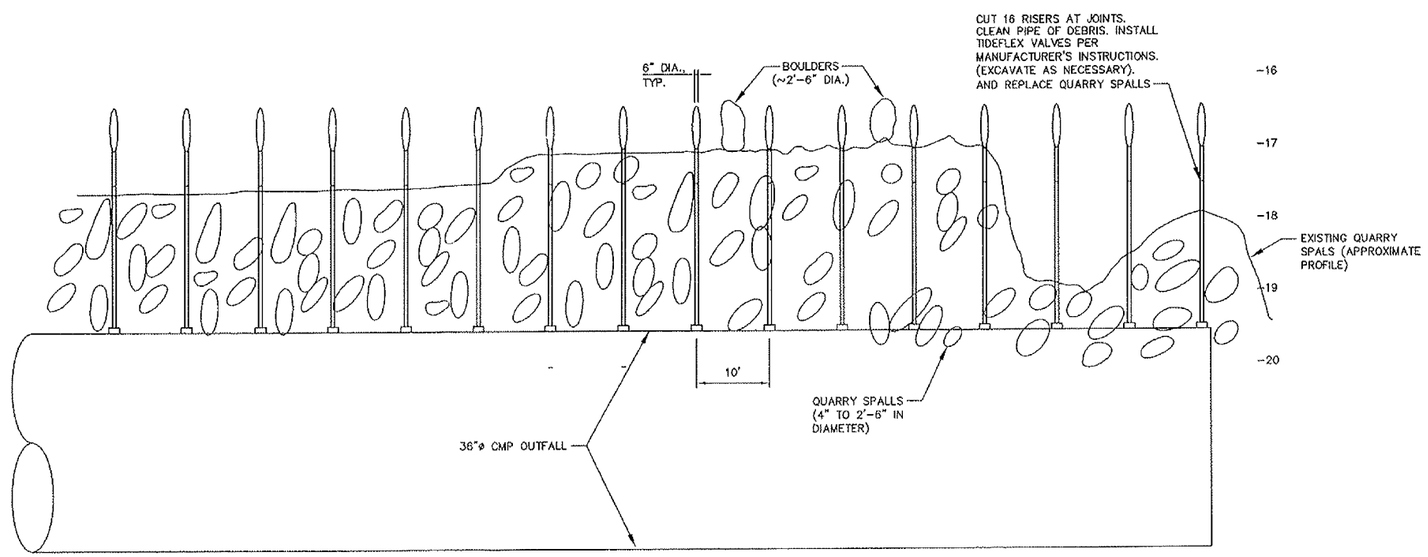


## QUARRY SPALLS DETAIL

SCALE: H 1"=10'
V 1"=1'

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TWO INCHES AT FULL SCALE.
IF NOT, SCALE ACCORDINGLY


Gray & Osborne, Inc.
CONSULTING ENGINEERS
701 DEXTER AVENUE NORTH SUITE 200
SEATTLE, WASHINGTON 98109 - (206) 284-0860


DATE: APR. 2009
SCALE: H 1"=50' V 1"=10'
DRAWN: E.S.T.
CHECKED: E.F.N.
APPROVED: J.P.W.

| No. | REVISION | DATE | APPD |
|---|---|---|---|
| | | | |

JOHN P. WILSON — STATE OF WASHINGTON — 24931 — REGISTERED PROFESSIONAL ENGINEER

ERIC F. NUTTING — STATE OF WASHINGTON — 33990 — REGISTERED PROFESSIONAL ENGINEER

CITY OF CAMAS
CLARK COUNTY WASHINGTON
WWTF IMPROVEMENTS - PHASE 2
OUTFALL MODIFICATIONS - DETAILS

SHEET: G-21
OF: 21
JOB NO.: 07511
DWG: OUTFALL


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# Appendix 2

# Correspondence

# &

# Background Information

# GRAY & OSBORNE, INC.
# TELEPHONE/MEETING CONVERSATION RECORD

| | |
|---|---|
| ☒**Telephone Conversation** | **Location of Phone Conversation:**<br>GRAY & OSBORNE INC. |
| ☐**Meeting** | **Place of Meeting:** |

| | | | | |
|---|---|---|---|---|
| **Date:** | 10-29-2009 | | 1030 | |
| **Discussion with:** | Danette Guy | | | |
| **Firm/City with:** | US Army Corps of Engineers, Vancouver Office | | | |
| **Phone Number:** | 360 906-7274 | | | |
| **Gray & Osborne Personnel:** | Jim Dougherty | | | |
| **Project:** | Camas WWTF Phase 2 Upgrades | | | |
| **Subject:** | Rivers & Harbors Act, Section 10 Permit for outfall modifications | | | |
| **G&O Job Number:** | 07511.00 | | | |

**REMARKS:**

I spoke with Danette Guy, ACOE Project Manager for the Camas WWTF Phase 2 Improvement Project, this morning regarding the Rivers & Harbors Act, Section 10 Permit for the proposed improvements to the Camas WWTF outfall diffuser. She said that the JARPA and Informal ESA Consultation Document for the project have been sent to the Corps' Seattle District Office for review and approval. She said that there were a number of more difficult projects included in the pile forwarded to Seattle, and that it is unlikely that the Seattle Office will act on the City of Camas application any time soon.

Danette recommended that we leave the current Rivers & Harbors Act, Section 10 Permit approval letter in the Specifications Package for the project, along with the list of conservation measures from the current ESA document. Her main concerns were compliance with the in-water work window and the conditions of the Hydraulic Project Approval issued by WDFW on October 26, 2006.

# GRAY & OSBORNE, INC.
# TELEPHONE/MEETING CONVERSATION RECORD

| | |
|---|---|
| ☒**Telephone Conversation** | **Location of Phone Conversation:** GRAY & OSBORNE INC. |
| ☐**Meeting** | **Place of Meeting:** |

| | | | | |
|---|---|---|---|---|
| **Date:** | 6-12-2009 | | | 1200 |
| **Discussion with:** | Dan Guy | | | |
| **Firm/City with:** | NOAA Fisheries Vancouver | | | |
| **Phone Number:** | 360 906-7274 | | | |
| **Gray & Osborne Personnel:** | Jim Dougherty | | | |
| **Project:** | Camas WWTP Outfall Improvements | | | |
| **Subject:** | ESA Consultation | | | |
| **G&O Job Number:** | 07511.00 | | | |

**REMARKS:**

I received a call from Dan Guy, Division Manager for the NMFS Vancouver Office, regarding the Camas Outfall re-permitting effort. He said to send him an advanced copy of the Biological Evaluation and JARPA form along with the concurrence letter or Corps Permit for the project. He said to forward the same information to Danette at ACOE Vancouver. He asked when the City of Camas was proposing to do the work, and I said that it would likely be within this winter's work window, which extends from November through February. He said that he thought NMFS should be able to work with the Corps to meet this schedule. We'll need to send him a copy of the ACOE Informal ESA Consultation Form, JARPA and the Corps Permit and HPA obtained for the project in 2006 as soon as possible. We also need to add green sturgeon and eulachon to the biological evaluation, which will take a couple more hours.

Dan called back with a few more questions. Specifically, he wanted to know how the diffuser/riser system worked and why we were going to cut off the 90 degree bends. I explained that modeling done by Cosmopolitan Engineers determined that direct, vertical discharge into the flow of the Columbia River would result in approximately four times the mixing as the existing configuration. He said that if all we were doing is having divers cutting the ends of the risers, he would recommend doing the work in the summer during low flow for diver safety and ease of operations. I agreed that this is a good idea and will modify the Informal ESA Consultation document accordingly. Dan said to get the updated forms and drawings to him as soon as possible and he would do what he can to expedite the project with WDFW and USFWS in Vancouver. This means the City will need to get the work done fairly soon after the permit is issued.

WASHINGTON STATE DEPARTMENT OF
**Natural Resources**

DOUG SUTHERLAND
*Commissioner of Public Lands*

May 2, 2007

GRAY & OSBORNE, INC.
REC'D - SEATTLE
MAY 07 2007
JOB #_____

Jim Dougherty
Gray & Osborne Inc
701 Dexter Avenue North
Seattle WA 98109

**SUBJECT: City of Camas – Proposed Wastewater Facility and Lift Station Improvements (T01N R03E S11-14)**

**NOTE: The Washington Natural Heritage Program (WNHP) is expanding our Information Request Service to include a new self-service system. Data users now have the choice of accessing limited tabular information for free, via our website, or licensing and using the WNHP GIS data set. The self-service tabular information now available on the WNHP website (http://www.dnr.wa.gov/nhp/contact/selfservicesys.html) consists of a Township, Range, and Section (TRS) list where Natural Heritage features are reported to occur. Attribute data is not included, however, the data user can refer to the list to determine whether it is necessary to contact WNHP for more information. For-profit organizations will be charged a fee for acquiring the GIS data set and for follow-up consultations with WNHP staff.**

We've searched the Natural Heritage Information System for information on rare plants and high quality native wetland and terrestrial ecosystems in the vicinity of your project. A summary of this information is enclosed. In your planning, please consider protection of these significant natural features. Please contact us for consultation on projects that may have an effect on these rare species or high quality ecosystems.

The information provided by the Washington Natural Heritage Program is based solely on existing information in the database. There may be significant natural features in your study area of which we are not aware. These data are being provided to you for informational and planning purposes only - the Natural Heritage Program has no regulatory authority. This information is for your use only for environmental assessment and is not to be redistributed. Others interested in this information should be directed to contact the Natural Heritage Program.

The Washington Natural Heritage Program is responsible for information on the state's rare plants as well as high quality ecosystems. For information on animal species of concern, please contact Priority Habitats and Species, Washington Department of Fish and Wildlife, 600 Capitol Way N, Olympia WA 98501-1091, or by phone (360) 902-2543.

Please visit our internet website at http://www.dnr.wa.gov/nhp for more information. Lists of rare plants and their status, rare plant fact sheets, as well as rare plant survey guidelines are available for download from the site. Please call me at (360) 902-1697 if you have any questions.

Sincerely,

Sandy Swope Moody

Sandy Swope Moody, Environmental Review Coordinator
Washington Natural Heritage Program

Enclosures

Asset Management & Protection Division, PO Box 47014, Olympia WA 98504-7014

WASHINGTON NATURAL HERITAGE INFORMATION SYSTEM
ENDANGERED, THREATENED AND SENSITIVE PLANT SPECIES &
HIGH QUALITY WETLAND ECOSYSTEMS AND HIGH QUALITY TERRESTRIAL ECOSYSTEMS
IN THE VICINITY OF CITY OF CAMAS WWTF & LIFT STATION IMPROVEMENTS
REQUESTED BY GRAY & OSBORNE INC

Data Current as of May 2007


| TOWNSHIP, RANGE AND SECTION | ELEMENT NAME | STATE STATUS | FEDERAL STATUS |
|---|---|---|---|
| T01N R03E S10 E2ofSW | *Cimicifuga elata* var. *elata* (Tall bugbane) | S | SC |
| T01N R03E S02 W2ofW2 | PSEUDOTSUGA MENZIESII / CORYLUS CORNUTA / POLYSTICHUM MUNITUM FOREST (DOUGLAS-FIR / BEAKED HAZEL / SWORDFERN) | | |
| T01N R03E S02 SE<br>S46 NW | QUERCUS GARRYANA / TOXICODENDRON DIVERSILOBUM / ELYMUS GLAUCUS WOODLAND (OREGON WHITE OAK / PACIFIC POISON-OAK / BLUE WILDRYE) | | |
| T01N R03E S02<br>S46 | North Pacific Herbaceous Bald and Bluff | | |
| T01N R03E S02<br>S46 NW | *Perideridia oregana* (Oregon yampah) | R1 | |
| T01N R03E S12 NE<br>S48<br>T01N R04E S07 NW<br>S37 | *Trillium parviflorum* (Small-flowered trillium) | S | |

**WASHINGTON NATURAL HERITAGE INFORMATION SYSTEM**
**Rare Plant Species**

**FEDERAL STATUS DEFINITIONS- (Note: Federally listed plant species are subject to the US Endangered Species Act.)**

**LE = Listed Endangered:** Any taxon that is in danger of extinction throughout all or a significant portion of its range and that has been formally listed as such in the Federal Register under the Federal Endangered Species Act.

**LT = Listed Threatened:** Any taxon that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range and that has been formally listed as such in the Federal Register under the Federal Endangered Species Act.

**PE = Proposed Endangered:** Any taxon that is in danger of extinction throughout all or a significant portion of its range and that has been proposed for listing as such in the Federal Register under the Federal Endangered Species Act.

**PT = Proposed Threatened:** Any taxon that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range and that has been proposed for listing as such in the Federal Register under the Federal Endangered Species Act.

**C = Candidate species:** Taxa for which current information indicates the probable appropriateness of listing as Endangered or Threatened and that has been published in the Federal Register as a candidate for listing under the Federal Endangered Species Act.

**SC = Species of Concern:** Species whose conservation standing is of concern but for which status information is still needed. Species of concern lists are not published in the Federal Register.

**STATE STATUS DEFINITIONS- (Note: The state ESA does not include provisions to list or protect rare plant species – the state rare plant list is advisory only.)**

**E = Endangered:** Any taxon in danger of becoming extinct or extirpated from Washington within the foreseeable future if factors contributing to its decline continue. Populations of these taxa are at critically low levels or their habitats have been degraded or depleted to a significant degree.

**T = Threatened:** Any taxon likely to become Endangered in Washington within the foreseeable future if factors contributing to its population decline or habitat degradation or loss continue.

**S = Sensitive:** Any taxon that is vulnerable or declining and could become Endangered or Threatened in the state without active management or removal of threats.

**X = Possibly Extinct or Extirpated from Washington:** Based on recent field searches, a number of plant taxa are considered to be possibly extinct or extirpated from Washington. Taxa in this group are all high priorities for field investigations. If found, they will be assigned one of the above status categories.

**R = Review:** Taxa of potential concern, but for which no status has yet been assigned.
Group 1 = Taxa in need of additional field work before a status can be assigned.
Group 2 = Taxa with unresolved taxonomic questions.

**W = Watch:** Taxa more abundant and/or less threatened in Washington than previously assumed.

**Non-Vascular Plant:**

**P = Priority:** At this time, there is insufficient information to assign a statewide status to most of the non-vascular taxa. For now, the lichen and macrofungi lists have been divided into two priority groups based on criteria of occurrence pattern, vulnerability, threats, degree of protection, and taxonomy.

# WASHINGTON NATURAL HERITAGE PROGRAM

## CRITERIA FOR HIGH-QUALITY WETLAND ECOSYSTEMS

The WNHP does not maintain a comprehensive inventory of all wetlands in the state. The database includes information only on those areas that have been surveyed by the program scientists and found to be relatively undisturbed high-quality wetlands. For wetlands included in the database, the physical characteristics, biota, ecosystem functions, processes and settings are essentially natural. For example, to be included in the WNHP database, a freshwater wetland site must meet these six criteria:

1. A native wetland ecosystem type (element) considered important for preservation within the state.

2. Little or no human-caused changes to wetland topography or soils.

3. No human caused changes to hydrology of the wetland, or the wetland appears to have recovered from any changes.

4. Few or no exotic plant species.

5. Little human-caused disturbance of native vegetation, or vegetation has recovered from past disturbance.

6. No major water quality problems.

Criteria 2-6 are weighted based on the amount of disturbance present in <u>all</u> known examples of a given wetland type. Thus a disturbed wetland may be included in the WNHP Information System if it has one of the highest quality examples remaining of a particular wetland type. On the other hand, an equally disturbed site may not be included in the WNHP Information System if it contains a wetland type which has many other undisturbed examples. A severe degree of disturbance would exclude a site from being entered into the WNHP Information System, even if no better examples of that wetland type exist.

## CRITERIA FOR HIGH-QUALITY TERRESTRIAL ECOSYSTEMS

Occurrences of terrestrial ecosystem types are determined by the characteristics of each individual ecosystem type. Ecological quality refers to both the ecological condition and the ecological viability of a particular community.

Condition is determined by relative importance of native versus non-native species, extent and nature of human-caused disturbance, and how well the occurrence represents the ecosystem type definition. Viability is determined by size of the area and landscape setting.

Minimum criteria for an occurrence of a terrestrial ecosystem:

1. Native plants dominate the site: tree layers composed of only native species, at least 80 percent of the shrub and herbaceous layers are composed of native plants. Non-native plants are generally insignificant.

2. Little or insignificant disturbance to vegetation by logging, conversion to agriculture, heavy grazing, residential development, or other recent human extractive activities that alter the ecosystem processes.

3. Large enough for minimal viability and ecological function: at least 100 acres for forests in the montane provinces and at least four average tree heights wide at its narrowest width, at least 20 acres for forest in the Puget Lowlands, and at least 10 acres for native grasslands.

The degree to which these criteria are applied to a site depends on characteristics of the particular ecosystem types present. Some ecosystem types are found almost exclusively as small patches, perhaps in areas smaller than in criterion 3. In this case, meeting criteria 1 and 2 would be sufficient. Large but moderately disturbed ecosystems representative of types that have been altered throughout their range because of various land uses may need only meet criteria 1 and 3.

WASHINGTON DEPARTMENT OF FISH AND WILDLIFE - HABITATS AND SPECIES REPORT
IN THE VICINITY OF T01R03E SECTION 11
Report Date: April 23, 2007

## Information About Priority Habitats and Species Polygons

Priority Habitats and Species (PHS) polygons are labeled with a unique number and "+" symbol, roughly in the center of the polygon on the map. This PHS Poly number refers to a list of form numbers and species and habitat codes contained in the PHS Polygon Cross Reference Report (listed below). The form numbers refer to the attached PHS Polygon Report. This report details each species or habitat depicted as a polygon on the map. For a complete description of the codes used in this report please refer to the Fish and Wildlife Map Products document. This document may be viewed on our web site at http://www.wdfw.wa.gov/hab/release.htm.

Priority Habitats and Species Polygon - Summary Habitat and Species List:

This report and the accompanying maps may contain some species or habitats that are not considered priority by the agency. YES under the "PHS" column in the table below indicates that the species is considered a priority and is on the Priority Habitats and Species List and/or the Species of Concern List. NO under the "PHS" column indicates the species/habitat is not considered an agency priority.

| PHS | State Status | PHS Code | Common Name | Species Use | Species Use Description |
|---|---|---|---|---|---|
| YES | | OAK | OAK WOODLAND | | |
| YES | | RIPAR | RIPARIAN ZONES | | |
| YES | | UNOS | URBAN NATURAL OPEN SPACE | | |

Priority Habitats and Species Polygon Cross Reference Report:

Form number 900000 indicates presence of PHS is unknown or the area was not mapped. Form numbers 909998, 909997, or 909996 indicate compilation errors.

| PHS Poly# | Form# | PHS Code*Species Use |
|---|---|---|
| 2 | 900000 | *- |
| 3 | 913312 | UNOS*- |
| 4 | 913312 | UNOS*- |
| 5 | 913312 | UNOS*- |
| 6 | 902114-913312 | RIPAR*-UNOS*- |
| 7 | 912981-913312 | OAK*-UNOS*- |
| 8 | 913312 | UNOS*- |
| 9 | 900000 | *- |
| 10 | 912981 | OAK*- |
| 11 | 912981 | OAK*- |
| 12 | 912993 | OAK*- |
| 13 | 912981 | OAK*- |
| 14 | 912981 | OAK*- |
| 15 | 912993 | OAK*- |
| 16 | 912993 | OAK*- |
| 17 | 912981 | OAK*- |
| 18 | 912981 | OAK*- |
| 19 | 913312 | UNOS*- |
| 20 | 912993-913312 | OAK*-UNOS*- |
| 21 | 913311 | RIPAR*- |
| 22 | 913311 | RIPAR*- |
| 23 | 913311 | RIPAR*- |
| 24 | 913311 | RIPAR*- |
| 25 | 913311 | RIPAR*- |
| 26 | 900000 | *- |

## Information About Wildlife Heritage Point Report

Wildlife Heritage points on the map can be referenced to this report by noting the quadpt number where the point occurs on the map, and then looking up the information listed below. This report is sorted by the quadpt number and provides details on each species depicted on the map. For a complete description of the codes used in this report, please refer to the Fish and Wildlife Map Products document. This document may be viewed on our web site at http://www.wdfw.wa.gov/hab/release.htm.

Wildlife Heritage Point - Summary Species List:

This report and the accompanying maps may contain some species or habitats that are not considered priority by the agency. YES under the "PHS" column in the table below indicates that the species is considered a priority and is on the Priority Habitats and Species List and/or the Species of Concern List. NO under the "PHS" column indicates the species/habitat is not considered an agency priority.

| PHS | State Status | Species Code | Common Name | Species Use | Species Use Description |
|---|---|---|---|---|---|
| YES | ST | HALE | BALD EAGLE | B | BREEDING OCCURRENCE |
| NO | SM | PAHA | OSPREY | B | BREEDING OCCURRENCE |
| YES | SC | PRSU | PURPLE MARTIN | B | BREEDING OCCURRENCE |

Wildlife Heritage Point Report:

Quadpt#: 4512254011 Species Code: PAHA Species Use: B Common Name: OSPREY
Date: 19890628 Class: SA Accuracy: C Scientific Name: PANDION HALIAETUS
State Status: SM Federal Status: Priority: NO WDFW Region: 5 Verified: V

Township - Range - Section: T02N R03E S35 SWOFSW Occurrence#: 94 Sequence#: 2
General Description: LACAMAS LAKE TERR: OSPREY NEST IN BROKEN-TOP SNAG ALONG LACAMAS LAKE. NEST ABOUT 0.5MI SE OF NEST #1 WHICH WAS ABANDONED IN 85.

Quadpt#: 4512254015 Species Code: PRSU Species Use: B Common Name: PURPLE MARTIN
Date: 19910830 Class: SA Accuracy: C Scientific Name: PROGNE SUBIS
State Status: SC Federal Status: Priority: YES WDFW Region: 5 Verified: V
Township - Range - Section: T01N R03E S48 Occurrence#: 62 Sequence#: 1
General Description: PURPLE MARTIN NESTING IN 2 PILINGS ON THE UPSTREAM SIDE OF THE BOAT RAMP, PORT OF CAMAS-WASHOUGAL MARINA.

Quadpt#: 4512254026 Species Code: HALE Species Use: B Common Name: BALD EAGLE
Date: 20040407 Class: SA Accuracy: C Scientific Name: HALIAEETUS LEUCOCEPHALUS
State Status: ST Federal Status: FT Priority: YES WDFW Region: 5 Verified: V
Township - Range - Section: T01N R03E S15 NEOFSW Occurrence#: 1660 Sequence#: 1
General Description: BALD EAGLE NEST. AIR GPS (NAD 27) 544659 E 5046292 N

Quadpt#: 4512254027 Species Code: HALE Species Use: B Common Name: BALD EAGLE
Date: 20050708 Class: SA Accuracy: C Scientific Name: HALIAEETUS LEUCOCEPHALUS
State Status: ST Federal Status: FT Priority: YES WDFW Region: 5 Verified: V
Township - Range - Section: T01N R03E S46 SWOFNE Occurrence#: 1534 Sequence#: 1
General Description: BALD EAGLE NEST IN D. FIR > 35" DBH. TREE TOO TALL AND SITE TOO DENSE TO VIEW JUVENILES FROM GROUND.

## Codes Used In Wildlife Heritage Point Report

Quadpt# : A sequential number for a point based on a US Geological Survey 7.5-minute quadrangle.

Species Code : Alphanumeric code which identifies the species. List of codes are available in the documentation.

Species Use : Criteria that identifies how the area is used by the indicated species. List of codes are available in the documentation.

Common Name : Common name of the species.

Date : Date of the observation by year, month, and day (yyyymmdd).

Class : Code that separates animals into general groups.
AA = Artifical animal (e.g., nest platforms not used yet).
EA = Exotic animal.
GA = Game animal.
NA = No animal found after target specific survey completed.
SA = Special animal (e.g., state listed and monitor species).
ST = Split territory.
ZA = Zapped animal. Site no longer supports original occurrence.

Accuracy : Mapping accuracy of the site as determined by the individual doing the mapping.
C = Accurate to within 1/4 mile radius and confirmed by a reliable source.
G = Location known only to a general locality.
N = Accurate to within one mile radius.
U = Accurate to within 1/4 mile radius and unconfirmed by a reliable source.

Scientific Name : Scientific name of the species.

State Status : State listing status of species.
SE = State endangered. SC = State candidate.
ST = State threatened. SM = State monitor.
SS = State sensitive.

Federal Status : Federal listing status of species.
FE = Federal endangered. FC = Federal candidate.
FT = Federal threatened. FCo = Federal concern.

Priority : Species and habitats that are considered to be priorities for conservation and management by Washington Department of Fish and Wildlife (WDFW). For a copy of the most current Priority Habitats and Species List contact WDFW PHS Section at (360)902-2543, or it is available on our web site at http://www.wdfw.wa.gov/hab/phspage.htm.
YES = Indicates that the species is considered a WDFW priority and is on the Priority Habitat and Species List and/or Species of Concern List.
NO = Indicates that the species is not a WDFW priority.

WDFW Region : This contains the WDFW administrative region number 1 through 6.

Verified : Verification code for an observation.
V = Verified by a reliable source, generally WDFW or other agency biologist.
U = Not verified by a reliable source, or identification of species is uncertain.
1 = Confirmed grizzly bear or wolf observation.
2 = Probable grizzly bear or wolf observation.

Township - Range - Section : The legal description of the species occurrence.

Occurrence# : An ascension catalog number that combined with sequence number identifies a unique record within a species.

Sequence# : Occurrences with multiple locations of a species.

General Description : Description of location of a species.

Form#: 902114 PHS Code: RIPAR Species Use: Common Name: RIPARIAN ZONES
Season: Definition: 5 Accuracy: 1 Scientific Name:
State Status: Federal Status: Priority: YES Site Name: LOWER WASHOUGAL RIVER-LACAMAS CREEK RIPAR
General Description: LOWER WASHOUGAL RIVER-LACAMAS CREEK RIPARIAN CORRIDOR, INCLUDING WETLANDS AND DE CIDUOUS FOREST ALONG WASHOUGAL AND MIXED CONIFEROUS-DECIDUOUS FOREST ALONG LACAM AS CREEK - LOWER AREA USED BY WINTERFOWL AND WADING BIRDS, GREAT HORNED OWLS

Source: DNR ORTHO PHOTO, 1984
Source Date: 84 Source Code: ORTHO
Synopsis:

Source: DUGGER, CARL WDW
Source Date: 032091 Source Code: PROF
Synopsis: OBSERVATIONS DURING PROF DUTIES FORM 1983 TO 1991

Source: ZIMMERMAN, TARA WDW
Source Date: 032191 Source Code: PROF
Synopsis: OBSERVATIONS DURING PROF DUTIES FROM 1983 TO 1991

Form#: 912981 PHS Code: OAK Species Use: Common Name: OAK WOODLAND
Season: Definition: 5 Accuracy: 1 Scientific Name:
State Status: Federal Status: Priority: YES Site Name: CLARK COUNTY OAK WOODLANDS
General Description: OAK WOODLANDS

Source: CHAPPELL, CHRISTOPHER B ET AL WA DEPT OF NATURAL RESOURCES
Source Date: 102999 Source Code: LIT
Synopsis: A GEOGRAPHIC INFORMATION SYSTEM MAP OF EXISTING GRASSLANDS AND OAK WOODLANDS IN THE PUGET LOWLAND AND WILLAMETTE VALLEY ECOREGIONS, WASHINGTON.

Source: MANLOW, STEVE AND ERIC HOLMAN WDFW, DAVE HOWE AND BRENT DAVIS CLARK CO
Source Date: 11 00 Source Code: PROF
Synopsis: OBSERVATIONS OF OAK WOODLANDS DURING FIELD REVIEWS AND SITE INSPECTIONS.

Form#: 912993 PHS Code: OAK Species Use: Common Name: OAK WOODLAND
Season: Definition: 5 Accuracy: 1 Scientific Name:
State Status: Federal Status: Priority: YES Site Name: WASHOUGAL OAKS
General Description: OAK WOODLANDS ADJACENT TO WASHOUGAL RIVER AND SHEPARD HILL.

Source: HOLMAN, ERIC WDFW
Source Date: 11 00 Source Code: PROF
Synopsis: OBSERVATIONS OF OAK WOODLANDS DURING PROJECT REVIEWS AND PHS MAPPING EFFORTS.

Source: MANLOW, STEVE WDFW
Source Date: 11 00 Source Code: PROF
Synopsis: OBSERVATIONS OF OAK WOODLANDS DURING PROJECT REVIEWS AND PHS MAPPING EFFORTS.

Form#: 913311 PHS Code: RIPAR Species Use: Common Name: RIPARIAN ZONES
Season: Definition: 5 Accuracy: 1 Scientific Name:
State Status: Federal Status: Priority: YES Site Name: LADY AND AKERMAN ISLANDS
General Description: RIPARIAN ZONE ON LADY AND ACKERMAN ISLANDS. COLUMBIA RIVER COTTONWOOD HABITAT.

Source: DUGGER, CARL WDFW HABITAT PROGRAM
Source Date: 09 02 Source Code: PROF
Synopsis: SITE VISITED ON A REGULAR BASIS.

Form#: 913312 PHS Code: UNOS Species Use: Common Name: URBAN NATURAL OPEN SPACE
Season: Definition: 5 Accuracy: 1 Scientific Name:
State Status: Federal Status: Priority: YES Site Name: CAMAS UNOS
General Description: URBAN NATURAL OPEN SPACE IN THE VICINITY OF CAMAS AND WASHOUGAL. AREA SUPPORTS MATURE TIMBER. FREQUENT OBSERVATIONS OF VAUX SWIFTS SURROUNDING DEAD LAKE.

Source: DUGGER, CARL AND STEVE MANLOW WDFW HABITAT PROGRAM
Source Date: 10 02 Source Code: PROF
Synopsis: OBSERVATIONS OF URBAN NATURAL OPEN SPACE HABITAT IN THE VICINITY OF CAMAS FROM 1991 TO THE PRESENT.

## Codes Used In Priority Habitat and Species Polygon Report

Form# : Unique number that links the information in the reports to features on the map.

PHS Code : This contains a code that identifies the fish and wildlife species found in the area or the habitat that occurs there. List of codes are available in the documentation.

Species Use : Criteria that identifies how the area is used by the indicated species. List of codes are available in the documentation. This field is not used if a habitat is described.

Common Name : Common name of the species or habitat.

Season : Season of species use. Use is indicated by the presence of a non-blank character in one or more postions or sub-strings of the field position.
Position 1: W = Winter use. Position 2: S = Spring use.
Position 3: U = Summer use. Position 4: F = Fall use.
Position 5: S = Severe winter use.

Definition : Identifies the definitions or criteria used to classify the area as a priority. List of codes are available in the documentation.

Accuracy : Mapping accuracy of the line delineation as determined by the mapper.
1 = Accurate within a 1/4 mile. 3 = Location known to within one mile.
2 = Accurate within a 1/2 mile. 4 = Location known to general locality only.

Scientific Name : Scientific name of the species.

State Status : State listing status of species.
SE = State endangered. SC = State candidate.
ST = State threatened. SM = State monitor.
SS = State sensitive.

Federal Status : Federal listing status of species.
FE = Federal endangered. FC = Federal candidate.
FT = Federal threatened. FCo = Federal concern.

Priority : Species and habitats that are considered to be priorities for conservation and management by Washington Department of Fish and Wildlife (WDFW). For a copy of the most current Priority Habitats and Species List contact WDFW PHS Section at (360)902-2543, or it is available on our web site at http://www.wdfw.wa.gov/hab/phspage.htm.
YES = Indicates that the species is considered a WDFW priority and is on the Priority Habitat and Species List and/or Species of Concern List.
NO = Indicates that the species is not a WDFW priority.

Site Name : Name assigned to the area based generally on a local place name.

General Description : Description about the area, including how it is used and why it is important.

Source : Identifies and describes the source responsible for the information described on the form or drawn on the map. Single or multiple sources may be cited.

Source Date : Date of source of information.

Source Code : Code identifying the source of information.

Synopsis : Brief narrative describing content of source of information.

WASHINGTON DEPARTMENT OF FISH AND WILDLIFE
PRIORITY FISH REPORT FROM THE WASHINGTON LAKES AND RIVERS INFORMATION SYSTEM (WLRIS) DATABASE
FOR TOWNSHIP T01R03E, SECTION 11
Report Date: April 23, 2007

## Information About The Fish Presence Report

The fish information in this report only includes information that Washington Department of Fish and Wildlife (WDFW) maintains in a central computer database. This information only documents the location of important fish resources to the best of our knowledge. It is not a complete inventory of the fish species in the state. Fish are identified as priority by WDFW if they meet one of three criterion as listed in the Priority Habitats and Species List. The list is available by contacting WDFW Priority Habitats and Species section at (360)902-2543, or it is available on our web site at http://www.wdfw.wa.gov/hab/phspage.htm. To insure appropriate use of this information users are encouraged to consult with WDFW biologists.

Streams with presence of priority anadromous and resident fish species from the WLRIS database are highlighted on the accompanying map. Due to the complexity of displaying linear features individual species that utilize each river reach are not distinguishable. If more species specific information is needed, users should request individual species maps, digital data, or contact the WLRIS database manager.

State status information is not available in the WLRIS database for these species. Please see WDFW Species of Concern List for current status. For a copy of this list, contact WDFW Endangered Species Section at (360)902-2515, or it is available on our web site at http://www.wdfw.wa.gov/wlm/diversty/soc/soc.htm.

Priority Anadromous Fish Presence:

| Code | Common Name | Stream Name | Stream LLID | Record Date |
|---|---|---|---|---|
| CHFA | Fall Chinook | Columbia River | 1240483462464 | 05-03-14 |
| CHMF | Fall Chum | Columbia River | 1240483462464 | 05-03-14 |
| CHSP | Spring Chinook | Columbia River | 1240483462464 | 05-03-14 |
| CHSU | Summer Chinook | Columbia River | 1240483462464 | 04-03-26 |
| COHO | Coho Salmon | Columbia River | 1240483462464 | 05-03-14 |
| DBT | Dolly Varden/Bull Trout | Columbia River | 1240483462464 | 05-03-14 |
| PINK | Pink Salmon | Columbia River | 1240483462464 | 05-03-14 |
| SOCK | Sockeye Salmon | Columbia River | 1240483462464 | 05-03-14 |
| STSU | Summer Steelhead | Columbia River | 1240483462464 | 05-03-14 |
| STWI | Winter Steelhead | Columbia River | 1240483462464 | 05-03-14 |
| CHMF | Fall Chum | Lacamas Creek | 1223935455865 | 05-03-14 |
| COHO | Coho Salmon | Lacamas Creek | 1223935455865 | 05-03-14 |
| CHFA | Fall Chinook | Stream name(s) not in database | 1223700455885 | 05-03-14 |
| CHFA | Fall Chinook | Stream name(s) not in database | 1223955455836 | 05-03-14 |
| CHFA | Fall Chinook | Stream name(s) not in database | 1223964455727 | 05-03-14 |
| CHMF | Fall Chum | Stream name(s) not in database | 1223700455885 | 05-03-14 |
| CHMF | Fall Chum | Stream name(s) not in database | 1223955455836 | 05-03-14 |
| CHMF | Fall Chum | Stream name(s) not in database | 1223964455727 | 05-03-14 |
| COHO | Coho Salmon | Stream name(s) not in database | 1223700455885 | 05-03-14 |
| COHO | Coho Salmon | Stream name(s) not in database | 1223955455836 | 05-03-14 |
| COHO | Coho Salmon | Stream name(s) not in database | 1223964455727 | 05-03-14 |
| DBT | Dolly Varden/Bull Trout | Stream name(s) not in database | 1223964455727 | 05-03-14 |
| STSU | Summer Steelhead | Stream name(s) not in database | 1223700455885 | 05-03-14 |
| STSU | Summer Steelhead | Stream name(s) not in database | 1223955455836 | 05-03-14 |
| STSU | Summer Steelhead | Stream name(s) not in database | 1223964455727 | 05-03-14 |
| STWI | Winter Steelhead | Stream name(s) not in database | 1223700455885 | 05-03-14 |
| STWI | Winter Steelhead | Stream name(s) not in database | 1223955455836 | 05-03-14 |
| STWI | Winter Steelhead | Stream name(s) not in database | 1223964455727 | 05-03-14 |
| CHFA | Fall Chinook | Washougal River | 1223962455734 | 05-03-14 |
| CHMF | Fall Chum | Washougal River | 1223962455734 | 05-03-14 |
| COHO | Coho Salmon | Washougal River | 1223962455734 | 05-03-14 |
| STSU | Summer Steelhead | Washougal River | 1223962455734 | 05-03-14 |
| STWI | Winter Steelhead | Washougal River | 1223962455734 | 05-03-14 |

Priority Resident Fish Presence:

| Code | Common Name | Stream Name | Stream LLID | Record Date |
|---|---|---|---|---|
| CCT | Resident Cutthroat | Stream name(s) not in database | 1223700455885 | 05-03-14 |
| CCT | Resident Cutthroat | Stream name(s) not in database | 1223955455836 | 05-03-14 |
| CCT | Resident Cutthroat | Stream name(s) not in database | 1223963455976 | 05-03-14 |
| CCT | Resident Cutthroat | Stream name(s) not in database | 1223964455727 | 05-03-14 |
| CCT | Resident Cutthroat | Columbia River | 1240483462464 | 05-03-14 |
| CCT | Resident Cutthroat | Lacamas Creek | 1223935455865 | 05-03-14 |
| RBT | Rainbow Trout | Lacamas Creek | 1223935455865 | 04-10-19 |
| CCT | Resident Cutthroat | Washougal River | 1223962455734 | 05-03-14 |

## Codes Used In The Fish Presence Report

Code : WDFW alphanumeric code that identifies the fish species.

Common Name : Common name of the fish species.

Stream Name : Stream name based on the US Geological Survey, Geographic Names Information System database.

Stream LLID : Unique stream identifier (ID) generated from the node latitude and longitude located at a stream's mouth. This ID is to be construed only as an ID, and not necessarily as a reference to a stream's location.

Record Date : Date the information was entered into the database.

# Appendix 3

# Previously Issued Permits

JD
TZ
JW
outfall
Camas File 05680

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
*PO Box 47775 • Olympia, Washington 98504-7775 • (360) 407-6300*

GRAY & OSBORNE, INC.
REC'D - SEATTLE
AUG 14 2006
JOB #

August 11, 2006

Monte Brachmann
City of Camas
616 Fourth Avenue
Camas, WA 98607

RE: U.S. Army Corps of Engineers Reference #200501420
Nationwide Permit #3 for Diffuser Cap Maintenance, Columbia River, Clark County, Washington

Dear Mr. Brachmann:

This letter is to confirm that the above-referenced project will not require an individual water quality certification or Coastal Zone Management consistency determination from the Department of Ecology. Your project does not meet our criteria for requiring an individual certification under Nationwide Permit #3.

Please note that this letter does not exempt the applicant from compliance with other requirements of federal, state, and local agencies.

Please contact me if you have any questions regarding this letter at (360) 407-7391 or e-mail rcol461@ecy.wa.gov.

Sincerely,

Dori Ochoa
for

Randi Redick
Federal Permit Manager
Shorelands and Environmental Assistance Program

RR:dn

cc: Ron Klump, U.S. Army Corps of Engineers
Jay Swift, Gray & Osborne, Inc.

Washington Department of FISH and WILDLIFE

# HYDRAULIC PROJECT APPROVAL

RCW 77.55.021 - Appeal pursuant to Chapter 34.05 RCW

Southwest
2108 Grand Boulevard
Vancouver, WA 98661
(360) 696-6211

Issue Date: October 26, 2006
Project Expiration Date: February 28, 2011

Control Number: 105882-1
FPA/Public Notice #: N/A

| PERMITTEE | AUTHORIZED AGENT OR CONTRACTOR |
|---|---|
| City of Camas Public Works | Gray & Osborne, Inc. |
| ATTENTION: Monte Brachmann | ATTENTION: Jay Swift |
| 616 Fourth Avenue | 701 Dexter Avenue North |
| Camas, WA 98607 | Seattle, WA 98109 |
| 360-817-1560 | 206-284-0860 |
| Fax: 360-834-1535 | Fax: 206-283-3206 |

Project Name: WS-635 WWTF Outfall Modifications

Project Description: Re-orient the eight diffuser risers currently in use on the City of Camas outfall, and install Tideflex Valves on the ends of the risers to minimize entrainment of debris in the diffuser pipe.

## PROVISIONS

1. Work below the ordinary high water line shall only occur between November 1 and February 28 in the years 2006, 2007, 2008, 2009, 2010, 2011.

2. NOTIFICATION REQUIREMENT: The Area Habitat Biologist (AHB) listed below shall receive written notification (email, phone, FAX or mail) from the person to whom this Hydraulic Project Approval (HPA) is issued (permittee) or the agent/contractor no less than three working days prior to the start of construction activities. The notification shall include the permittee's name, project location, starting date for work, and the control number for this HPA.

3. Work shall be accomplished per plans and specifications approved by the Washington Department of Fish and Wildlife entitled JARPA and dated 12/14/05, except as modified by this Hydraulic Project Approval. A copy of these plans shall be available on site during construction.

4. The outfall facility shall be maintained by the owner(s) per RCW 77.57.030 to ensure continued, unimpeded fish passage. If the structure becomes a hindrance to fish passage, the owner(s) shall be responsible for obtaining an Hydraulic Project Approval and providing prompt repair. Financial responsibility for maintenance and repairs shall be that of the owner(s).

5. The outfall structure shall be constructed to prevent the entry of fish.

6. The outfall structure shall be constructed and maintained to ensure the unimpeded passage of fish.

7. If at any time, as a result of project activities, fish are observed in distress, a fish kill occurs, or water quality problems develop (including equipment leaks or spills), immediate notification shall be made to the Washington Department of Ecology at 1-800-258-5990, and to the Area Habitat Biologist listed below.

Issue Date: October 26, 2006 | Control Number: 105882-1

Project Expiration Date: February 28, 2011 | FPA/Public Notice #: N/A

## PROJECT LOCATIONS

Location #1

| WORK START: November 01, 2006 | | | | | WORK END: February 28, 2011 | |
|---|---|---|---|---|---|---|
| WRIA: 27.0001 | Waterbody: Columbia River | | | | Tributary to: Pacific Ocean | |
| 1/4 SEC: NW 1/4 | Section: 13 | Township: 01 N | Range: 03 E | Latitude: N 45.5767 | Longitude: W 122.3911 | County: Clark |
| Location #1 Driving Directions | | | | | | |

## NOTES

## APPLY TO ALL HYDRAULIC PROJECT APPROVALS

This Hydraulic Project Approval pertains only to those requirements of the Washington State Hydraulic Code, specifically Chapter 77.55 RCW (formerly RCW 77.20). Additional authorization from other public agencies may be necessary for this project. The person(s) to whom this Hydraulic Project Approval is issued is responsible for applying for and obtaining any additional authorization from other public agencies (local, state and/or federal) that may be necessary for this project.

This Hydraulic Project Approval shall be available on the job site at all times and all its provisions followed by the person(s) to whom this Hydraulic Project Approval is issued and operator(s) performing the work.

This Hydraulic Project Approval does not authorize trespass.

The person(s) to whom this Hydraulic Project Approval is issued and operator(s) performing the work may be held liable for any loss or damage to fish life or fish habitat that results from failure to comply with the provisions of this Hydraulic Project Approval.

Failure to comply with the provisions of this Hydraulic Project Approval could result in a civil penalty of up to one hundred dollars per day and/or a gross misdemeanor charge, possibly punishable by fine and/or imprisonment.

All Hydraulic Project Approvals issued pursuant to RCW 77.55.021 (EXCEPT agricultural irrigation, stock watering or bank stabilization projects) or 77.55.141 are subject to additional restrictions, conditions or revocation if the Department of Fish and Wildlife determines that new biological or physical information indicates the need for such action. The person(s) to whom this Hydraulic Project Approval is issued has the right pursuant to Chapter 34.04 RCW to appeal such decisions. All agricultural irrigation, stock watering or bank stabilization Hydraulic Project Approvals issued pursuant to RCW 77.55.021 may be modified by the Department of Fish and Wildlife due to changed conditions after consultation with the person(s) to whom this Hydraulic Project Approval is issued: PROVIDED HOWEVER, that such modifications shall be subject to appeal to the Hydraulic Appeals Board established in RCW 77.55.301.

## APPEALS INFORMATION

If you wish to appeal the issuance or denial of, or conditions provided in a Hydraulic Project Approval, there are informal and formal appeal processes available.

Issue Date: October 26, 2006 | Control Number: 105882-1

Project Expiration Date: February 28, 2011 | FPA/Public Notice #: N/A

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A. INFORMAL APPEALS (WAC 220-110-340) OF DEPARTMENT ACTIONS TAKEN PURSUANT TO RCW 77.55.021, 77.55.141, 77.55.181, and 77.55.291: A person who is aggrieved or adversely affected by the following Department actions may request an informal review of:

(A) The denial or issuance of a Hydraulic Project Approval, or the conditions or provisions made part of a Hydraulic Project Approval; or

(B) An order imposing civil penalties. A request for an INFORMAL REVIEW shall be in WRITING to the Department of Fish and Wildlife HPA Appeals Coordinator, 600 Capitol Way North, Olympia, Washington 98501-1091 and shall be RECEIVED by the Department within 30 days of the denial or issuance of a Hydraulic Project Approval or receipt of an order imposing civil penalties. If agreed to by the aggrieved party, and the aggrieved party is the Hydraulic Project Approval applicant, resolution of the concerns will be facilitated through discussions with the Area Habitat Biologist and his/her supervisor. If resolution is not reached, or the aggrieved party is not the Hydraulic Project Approval applicant, the Habitat Technical Services Division Manager or his/her designee shall conduct a review and recommend a decision to the Director or his/her designee. If you are not satisfied with the results of this informal appeal, a formal appeal may be filed.

B. FORMAL APPEALS (WAC 220-110-350) OF DEPARTMENT ACTIONS TAKEN PURSUANT TO RCW 77.55.021 (EXCEPT agricultural irrigation, stock watering or bank stabilization projects) or 77.55.291:
A person who is aggrieved or adversely affected by the following Department actions may request a formal review of:

(A) The denial or issuance of a Hydraulic Project Approval, or the conditions or provisions made part of a Hydraulic Project Approval;

(B) An order imposing civil penalties; or

(C) Any other 'agency action' for which an adjudicative proceeding is required under the Administrative Procedure Act, Chapter 34.05 RCW.

A request for a FORMAL APPEAL shall be in WRITING to the Department of Fish and Wildlife HPA Appeals Coordinator, shall be plainly labeled as 'REQUEST FOR FORMAL APPEAL' and shall be RECEIVED DURING OFFICE HOURS by the Department at 600 Capitol Way North, Olympia, Washington 98501-1091, within 30-days of the Department action that is being challenged. The time period for requesting a formal appeal is suspended during consideration of a timely informal appeal. If there has been an informal appeal, the deadline for requesting a formal appeal shall be within 30-days of the date of the Department's written decision in response to the informal appeal.

C. FORMAL APPEALS OF DEPARTMENT ACTIONS TAKEN PURSUANT TO RCW 77.55.021 (agricultural irrigation, stock watering or bank stabilization only), 77.55.141, 77.55.181, or 77.55.241: A person who is aggrieved or adversely affected by the denial or issuance of a Hydraulic Project Approval, or the conditions or provisions made part of a Hydraulic Project Approval may request a formal appeal. The request for FORMAL APPEAL shall be in WRITING to the Hydraulic Appeals Board per WAC 259-04 at Environmental Hearings Office, 4224 Sixth Avenue SE, Building Two - Rowe Six, Lacey, Washington 98504; telephone 360/459-6327.

D. FORMAL APPEALS OF DEPARTMENT ACTIONS TAKEN PURSUANT TO CHAPTER 43.21L RCW: A person who is aggrieved or adversely affected by the denial or issuance of a Hydraulic Project Approval, or the conditions or provisions made part of a Hydraulic Project Approval may request a formal appeal. The FORMAL APPEAL shall be in accordance with the provisions of Chapter 43.21L RCW and Chapter 199-08 WAC. The request for FORMAL APPEAL shall be in WRITING to the Environmental and Land Use Hearings Board at Environmental Hearings Office, Environmental and Land Use Hearings Board, 4224 Sixth Avenue SE, Building Two - Rowe Six, P.O. Box 40903, Lacey, Washington 98504; telephone 360/459-6327.

E. FAILURE TO APPEAL WITHIN THE REQUIRED TIME PERIODS results in forfeiture of all appeal rights. If there is no timely request for an appeal, the department action shall be final and unappealable.

Washington
Department of
FISH and
WILDLIFE

# HYDRAULIC PROJECT APPROVAL

RCW 77.55.021 - Appeal pursuant to Chapter 34.05 RCW

Southwest
2108 Grand Boulevard
Vancouver, WA 98661
(360) 696-6211

Issue Date: October 26, 2006 | Control Number: 105882-1

Project Expiration Date: February 28, 2011 | FPA/Public Notice #: N/A

ENFORCEMENT: Sergeant Webb (38) P3

| | | | |
|---|---|---|---|
| Habitat Biologist<br>Anne Friesz | friesarf@dfw.wa.gov<br>360-906-6764 | | for Director<br>WDFW |

CC: WRIA file, Olympia
Todd Welker, DNR PC Region

# LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES AND CRITICAL HABITAT; CANDIDATE SPECIES; AND SPECIES OF CONCERN IN **CLARK COUNTY** AS PREPARED BY THE U.S. FISH AND WILDLIFE SERVICE WESTERN WASHINGTON FISH AND WILDLIFE OFFICE

**(Revised November 1, 2007)**

## LISTED

Bull trout (*Salvelinus confluentus*)

Gray wolf (*Canis lupus*)

Northern spotted owl (*Strix occidentalis caurina*)

Major concerns that should be addressed in your Biological Assessment of project impacts to listed species include:

1. Level of use of the project area by listed species.
2. Effect of the project on listed species' primary food stocks, prey species, and foraging areas in all areas influenced by the project.
3. Impacts from project activities and implementation (e.g., increased noise levels, increased human activity and/or access, loss or degradation of habitat) that may result in disturbance to listed species and/or their avoidance of the project area.

*Castilleja levisecta* (golden paintbrush) [historic]

*Howellia aquatilis* (water howellia)

*Lomatium bradshawii* (Bradshaw's lomatium)

Major concerns that should be addressed in your Biological Assessment of project impacts to listed plant species include:

1. Distribution of taxon in project vicinity.
2. Disturbance (trampling, uprooting, collecting, etc.) of individual plants and loss of habitat.
3. Changes in hydrology where taxon is found.

## DESIGNATED

Critical habitat for bull trout

**PROPOSED**

None

**CANDIDATE**

(Brush Prairie) Mazama pocket gopher (*Thomomys mazama* ssp. *oregonus*)
Oregon spotted frog (*Rana pretiosa*)

**SPECIES OF CONCERN**

Aleutian Canada goose (*Branta canadensis leucopareia*)
Bald eagle (*Haliaeetus leucocephalus*)
California wolverine (*Gulo gulo luteus*)
Cascades frog (*Rana ascadae*)
Coastal cutthroat trout (*Oncorhynchus clarki clarki*) [southwest Washington DPS]
Larch Mountain salamander (*Plethodon larselli*)
Long-eared myotis (*Myotis evotis*)
Long-legged myotis (*Myotis volans*)
Northern goshawk (*Accipiter gentilis*)
Northwestern pond turtle (*Emys* (= *Clemmys*) *marmorata marmorata*)
Olive-sided flycatcher (*Contopus cooperi*)
Pacific lamprey (*Lampetra tridentata*)
Pacific Townsend=s big-eared bat (Corynorhinus townsendii townsendii)
Peregrine falcon (*Falco peregrinus*)
River lamprey (*Lampetra ayresi*)
Slender-billed white-breasted nuthatch (*Sitta carolinensis aculeata*)
Tailed frog (*Ascaphus truei*)
Van Dyke=s salamander (*Plethodon vandykei*)
Western gray squirrel (*Sciurus griseus griseus*)

Western toad (*Bufo boreas*)
*Cimicifuga elata* (tall bugbane)
*Corydalis aquae-gelidae* (Clackamas corydalis)
*Lathyrus torreyi* (Torrey's peavine) [historic]

**DEPARTMENT OF THE ARMY**
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-3755

REPLY TO
ATTENTION OF

APR 28 2006

Regulatory Branch

Mr. Monte Brachmann
City of Camas Public Works
616 Fourth Avenue
Camas, Washington 98607

Reference: 200501420
Camas Public Works

Dear Mr. Brachmann:

Our regulatory program utilizes a series of nationwide permits (NWPs) to authorize specific categories of work that have minimal impact on the aquatic environment when conducted in accordance with the permit conditions (*Federal Register*, January 15, 2002, Vol. 67, No. 10). Based on the information you provided to us, NWP 3, Maintenance, authorizes your proposal to replace/modify 8 diffuser caps on the waste water line, as depicted on the enclosed drawings dated April 18, 2006. The project would occur in the Columbia River near Camas, Clark County, Washington.

In order for this NWP authorization to be valid, you must ensure that the work is performed in accordance with the enclosed *Nationwide Permit 3, Terms and Conditions* and the following special conditions that we have added to ensure that this project would have no more than a minimal adverse impact on the aquatic environment:

a. If future operations by the United States require the removal, relocation, or other alteration of the work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, you will be required, upon due notice from the U.S. Army Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

b. In order to meet the requirements of the Endangered Species Act (ESA) SLOPES III Programmatic Consultation, you must comply with the enclosed *Terms and Conditions of the SLOPES III Programmatic Consultation for* "Overwater and in-water structures ". If you cannot

comply with the terms and conditions of this programmatic consultation, you must, prior to commencing construction, contact the U.S. Army Corps of Engineers, Seattle District, Regulatory Branch for an individual consultation in accordance with the requirements of the ESA.

We have reviewed your project pursuant to the requirements of the Endangered Species Act (ESA). The U.S. Army Corps of Engineers has consulted on a programmatic basis with the National Marine Fisheries Service and the U.S. Fish and Wildlife Service for certain actions and determined that this project meets the requirements of NWP National General Condition 11 provided you comply with special condition "b" listed above. We have also reviewed your project pursuant to the requirements of the Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act of 1996 in regards to Essential Fish Habitat (EFH). We have determined that the proposed action will not adversely affect EFH for federally managed fisheries in Washington.

Our verification of this NWP is valid for 2 years from the date of this letter unless the NWP is modified, reissued or revoked. All of the existing NWPs are scheduled to be modified, reissued, or revoked prior to March 18, 2007. It is incumbent upon you to remain informed of changes to the NWPs. We will issue a public notice when the NWPs are reissued. Furthermore, if you commence or are under contract to commence this activity before the date that the relevant nationwide permit is modified or revoked, you will have twelve (12) months from the date of the modification or revocation of the NWP to complete the activity under the present terms and conditions of this nationwide permit. This verification includes a preliminary jurisdictional determination that is not appealable.

If this project complies with all terms and conditions of this NWP, you will need no further authorization from us. However, you must still obtain all State and local permits that apply to your project. Also, we remind you that failure to comply with all terms and conditions of this NWP verification invalidates your authorization and could result in a violation of Section 10 of the 1899 Rivers and Harbors Act.

Upon completing the authorized work, please fill out and return the enclosed *Certificate of Compliance with Department of the Army Permit* form to the address indicated on the form. Your signature on this form is our assurance that the completed work and any required mitigation was conducted in accordance with the terms and conditions of this NWP.

Thank you for your cooperation during the permit process. Your efforts help us protect our nation's aquatic resources, including wetlands. We are interested in your thoughts and opinions concerning your experience with our Regulatory Program and encourage you to complete a customer service survey form. This form and information about our program is available on our website at: www.nws.usace.army.mil click on Regulatory – Regulatory/Permits.

A copy of this letter with enclosures will be furnished to Mr. Jay Swift, Gray and Osborne, Inc., 701 Dexter Avenue North, Suite 200, Seattle, Washington 98109. If you have any questions about this letter or our regulatory program, please contact me at (360) 750-9046 or via email at Ron.Klump@usace.army.mil.

Sincerely,

Kristina G. Tong

for Ron Klump, Project Manager
Enforcement Section

Enclosures

US Army Corps
of Engineers ®
Seattle District

# NATIONWIDE PERMIT 3
# Terms and Conditions

Effective Date: March 18, 2002


A. Description of Authorized Activities – page 1

B. Corps Regional Specific Conditions for this NWP – page 2

C. EPA, Puyallup Tribe and Chehalis Tribe WQC Conditions for this NWP – page 3

D. State WQC Conditions for this NWP – page 3

E. State CZM Consistency Determination Conditions for this NWP – page 4

F. Corps National General Conditions for all NWPs – page 4

G. Corps Regional General Conditions for all NWPs – page 11

H. Additional Limitations on the Use of NWPs – page 13

I. Further Information – page 13


**In addition to any special condition that may be required on a case-by-case basis by the District Engineer, the following terms and conditions must be met, as applicable, for a Nationwide Permit 3 authorization to be valid in Washington State.**

## A. DESCRIPTION OF AUTHORIZED ACTIVITIES

**Maintenance.** Activities related to:

(i) The repair, rehabilitation, or replacement of any previously authorized, currently serviceable, structure, or fill, or of any currently serviceable structure or fill authorized by 33 CFR 330.3, provided that the structure or fill is not to be put to uses differing from those uses specified or contemplated for it in the original permit or the most recently authorized modification. Minor deviations in the structure's configuration or filled area including those due to changes in materials, construction techniques, or current construction codes or safety standards which are necessary to make repair, rehabilitation, or replacement, are permitted, provided the adverse environmental effects resulting from such repair, rehabilitation, or replacement are minimal. Currently serviceable means useable as is or with some maintenance, but not so degraded as to essentially require reconstruction. This NWP authorizes the repair, rehabilitation, or replacement of those structures or fills destroyed or damaged by storms, floods, fire, or other discrete events, provided the repair, rehabilitation, or replacement is commenced,

or is under contract to commence, within two years of the date of their destruction or damage. In cases of catastrophic events, such as hurricanes or tornadoes, this two-year limit may be waived by the District Engineer, provided the permittee can demonstrate funding, contract, or other similar delays.

(ii) Discharges of dredged or fill material, including excavation, into all waters of the US to remove accumulated sediments and debris in the vicinity of, and within, existing structures (e.g., bridges, culverted road crossings, water intake structures, etc.) and the placement of new or additional riprap to protect the structure, provided the permittee notifies the District Engineer in accordance with General Condition 13. The removal of sediment is limited to the minimum necessary to restore the waterway in the immediate vicinity of the structure to the approximate dimensions that existed when the structure was built, but cannot extend further than 200 feet in any direction from the structure. The placement of riprap must be the minimum necessary to protect the structure or to ensure the safety of the structure. All excavated materials must be deposited and retained in an upland area unless otherwise specifically approved by the District Engineer under separate authorization. Any bank stabilization measures not directly associated with the structure will require a separate authorization from the District Engineer. (Sections 10 and 404)

(iii) **REVOKED**

This permit does not authorize maintenance dredging for the primary purpose of navigation and beach restoration. This permit does not authorize new stream channelization or stream relocation projects. Any work authorized by this permit must not cause more than minimal degradation of water quality, more than minimal changes to the flow characteristics of the stream, or increase flooding (See General Conditions 9 and 21). (Sections 10 and 404)

**NOTE:** This NWP authorizes the repair, rehabilitation, or replacement of any previously authorized structure or fill that does not qualify for the Section 404(f) exemption for maintenance.

# B. CORPS REGIONAL CONDITIONS FOR THIS NWP

**Regional Condition for NWP 3(i) – Maintenance, Repair**
The repair or replacement of existing permitted bank protection must incorporate the least environmentally damaging practicable methods. These methods include but are not limited to the use of bioengineering, biotechnical design, root wads, large woody debris, native plantings, and fish friendly riprap designs.

**Regional Condition for NWP 3(ii) – Sediment Removal, Riprap Placement**

The permittee must avoid and minimize discharges into waters of the United States at the project site to the maximum extent practicable, and the "Notification" must include a written justification to the District Engineer detailing compliance with this condition. To enable the Corps in making this determination, the notification must include the following assessments:

a. Why the discharge must occur in waters of the United States and why avoidance or additional minimization cannot be achieved.

b. How the proposed project incorporates least environmentally damaging practicable bank protection methods. These methods include but are not limited to the use of bioengineering, biotechnical design, root wads, large woody debris, native plantings, and fish friendly riprap designs.

## C. EPA, Puyallup Tribe and Chehalis Tribe WQC CONDITIONS FOR THIS NWP

EPA, Puyallup Tribe and Chehalis Tribe water quality certification (WQC) has been denied without prejudice. An individual WQC is required for all Section 404 activities.

## D. STATE WQC CONDITIONS FOR THIS NWP

State WQC has been partially denied without prejudice for this permit. An individual 401 Certification is required for projects or activities authorized under this NWP if the project/activity will likely result in any of the following adverse effects:

1. The project or activity will likely cause or contribute to an exceedance of a State water quality standard (WAC 173-201A) or sediment quality standard (WAC 173-204). The requirement to obtain an individual 401 certification shall not apply to projects or activities that are carried out in accordance with the following permits, approvals, or management practices. These projects are presumed to comply with state water quality standards including state sediment management standards:

a. Projects or activities where the discharges authorized under this NWP are explicitly authorized or covered by a National Pollutant Discharge Elimination System permit.

b. Projects, activities or portions of projects or activities designed, constructed and maintained in accordance with the stormwater standards and practices contained in the most current version of Ecology's Stormwater Manual or an Ecology approved equivalent.

c. For WSDOT in-water or over-water construction and maintenance activities, an individual 401 certification is not required for those projects carried out in compliance with 2 through 4 below and the Ecology approved Implementing Agreement regarding compliance with the state of Washington Surface Water Quality Standards.

Compliance with this condition will be determined through receipt of a signed statement by the WSDOT project engineer or maintenance supervisor, guaranteeing that the project will meet the latest Ecology approved Water Quality Implementing Agreement for work In-Water. This statement shall be sent to the Corps of Engineers along with the JARPA application.

2. For projects/activities not designed in accordance with either Ecology's stormwater manual or an Ecology approved equivalent, or for projects where there is credible site specific information which indicates that the permits, approvals, or management practices identified above will not be sufficient to meet state water quality standards, the applicant may provide documentation with the application that the project/activity will otherwise comply with state water quality standards. An individual 401 Certification is required for projects which are unable to provide documentation that the project/activity will otherwise comply with state water quality standards.

3. Projects or activities that cause or contribute to a discharge to a waterbody on the state's list of impaired waterbodies [i.e., the 303(d) list] and the discharge may result in further exceedances of a specific parameter the waterbody is listed for. The current list of 303(d)-listed waterbodies is available on Ecology's web site at http:*//www.ecy.wa.gov/programs/wq/303d/1998/wrias/1998_water_segs.pdf* or by contacting Ecology's Federal Permits staff.

NOTE: An individual 401 Certification will <u>not</u> be required if the applicant provides documentation showing that the project or activity will either <u>not</u> result in a discharge containing the listed parameter or, if present, the parameter will <u>not</u> contribute to an increased impairment of the waterbody.

4. Projects that do not incorporate structures and/or modifications beneficial for fish or wildlife habitat (e.g., soil bioengineering, biotechnical design, rock barbs, etc.).

NOTE: An individual 401 certification will not be required if the project/activity is designed and constructed in accordance to guidelines developed by the Washington State Department of Fish and Wildlife.

## E. STATE CZM CONSISTENCY DETERMINATION CONDITIONS FOR THIS NWP

The Coastal Zone Management (CZM) Consistency Determination has been partially denied without prejudice for this NWP. An individual CZM Consistency Response must be obtained for projects requiring individual 401 Certification and located within counties in the coastal zone.

## F. CORPS NATIONAL GENERAL CONDITIONS FOR ALL NWPs

1. **Navigation**. No activity may cause more than a minimal adverse effect on navigation.

2. **Proper Maintenance**. Any structure or fill authorized shall be properly maintained, including maintenance to ensure public safety.

3. **Soil Erosion and Sediment Controls**. Appropriate soil erosion and sediment controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high tide line, must be permanently stabilized at the earliest practicable date. Permittees are encouraged to perform work within waters of the United States during periods of low-flow or no-flow.

4. **Aquatic Life Movements**. No activity may substantially disrupt the necessary life-cycle movements of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the area, unless the activity's primary purpose is to impound water. Culverts placed in streams must be installed to maintain low flow conditions.

5. **Equipment.** Heavy equipment working in wetlands must be placed on mats, or other measures must be taken to minimize soil disturbance.

6. **Regional and Case-By-Case Conditions**. The activity must comply with any regional conditions that may have been added by the Division Engineer (see 33 CFR 330.4(e)) and with any case specific conditions added by the Corps or by the state or tribe in its Section 401 Water Quality Certification and Coastal Zone Management Act consistency determination.

7. **Wild and Scenic Rivers**. No activity may occur in a component of the National Wild and Scenic River System; or in a river officially designated by Congress as a "study river" for possible inclusion in the system, while the river is in an official study status; unless the appropriate Federal agency, with direct management responsibility for such river, has determined in writing that the proposed activity will not adversely affect the Wild and Scenic River designation, or study status. Information on Wild and Scenic Rivers may be obtained from the appropriate Federal land management agency in the area (e.g., National Park Service, U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service).

8. **Tribal Rights**. No activity or its operation may impair reserved tribal rights, including, but not limited to, reserved water rights and treaty fishing and hunting rights.

9. **Water Quality**.

(a) In certain states and tribal lands an individual 401 Water Quality Certification must be obtained or waived (See 33 CFR 330.4(c)).

(b) For NWPs 12, 14, 17, 18, 32, 39, 40, 42, 43, and 44, where the state or tribal 401 certification (either generically or individually) does not require or approve water quality management measures, the permittee must provide water quality management measures that will ensure that the authorized work does not result in more than

minimal degradation of water quality (or the Corps determines that compliance with state or local standards, where applicable, will ensure no more than minimal adverse effect on water quality). An important component of water quality management includes stormwater management that minimizes degradation of the downstream aquatic system, including water quality (refer to General Condition 21 for stormwater management requirements). Another important component of water quality management is the establishment and maintenance of vegetated buffers next to open waters, including streams (refer to General Condition 19 for vegetated buffer requirements for the NWPs). This condition is only applicable to projects that have the potential to affect water quality. While appropriate measures must be taken, in most cases it is not necessary to conduct detailed studies to identify such measures or to require monitoring.

10. **Coastal Zone Management**. In certain states, an individual state coastal zone management consistency concurrence must be obtained or waived (see 33 CFR 330.4(d)).

11. **Endangered Species**.

(a) No activity is authorized under any NWP which is likely to jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act (ESA), or which will destroy or adversely modify the critical habitat of such species. Non-federal permittees shall notify the District Engineer if any listed species or designated critical habitat might be affected or is in the vicinity of the project, or is located in the designated critical habitat and shall not begin work on the activity until notified by the District Engineer that the requirements of the ESA have been satisfied and that the activity is authorized. For activities that may affect Federally-listed endangered or threatened species or designated critical habitat, the notification must include the name(s) of the endangered or threatened species that may be affected by the proposed work or that utilize the designated critical habitat that may be affected by the proposed work. As a result of formal or informal consultation with the FWS or NMFS the District Engineer may add species-specific regional endangered species conditions to the NWPs.

(b) Authorization of an activity by a NWP does not authorize the "take" of a threatened or endangered species as defined under the ESA. In the absence of separate authorization (e.g., an ESA Section 10 Permit, a Biological Opinion with "incidental take" provisions, etc.) from the USFWS or the NMFS, both lethal and non-lethal "takes" of protected species are in violation of the ESA. Information on the location of threatened and endangered species and their critical habitat can be obtained directly from the offices of the USFWS and NMFS or their world wide web pages at *http://www.fws.gov/r9endspp/endspp.html* and *http://www.nmfs.noaa.gov/prot_res/overview/es.html* respectively.

12. **Historic Properties**. No activity which may affect historic properties listed, or eligible for listing, in the National Register of Historic Places is authorized, until the District Engineer has complied with the provisions of 33 CFR part 325, Appendix C. The prospective permittee must notify the District Engineer if the authorized activity may affect any historic properties listed, determined to be eligible, or which the prospective permittee has reason to believe may be eligible for listing on the National Register of Historic Places, and shall not begin the activity until notified by the District Engineer that the requirements of the National Historic Preservation Act have been satisfied and that the activity is authorized. Information on the location and existence of historic resources can be obtained from the State Historic Preservation Office and the National Register of Historic Places (see 33 CFR 330.4(g)). For activities that may affect historic properties listed in, or eligible for listing in, the National Register of Historic Places, the notification must state which historic property may be affected by the proposed work or include a vicinity map indicating the location of the historic property.

13. **Notification**.

(a) **Timing**: Where required by the terms of the NWP, the prospective permittee must notify the District Engineer with a preconstruction notification (PCN) as early as possible. The District Engineer must determine if the notification is complete within 30 days of the date of receipt and can request additional information necessary to make the PCN complete only once. However, if the prospective permittee does not provide all of the requested information, then the District Engineer will notify the prospective permittee that the notification is still incomplete and the PCN review process will not commence until all of the requested information has been received by the District Engineer. The prospective permittee shall not begin the activity:

(1) Until notified in writing by the District Engineer that the activity may proceed under the NWP with any special conditions imposed by the District or Division Engineer; or

(2) If notified in writing by the District or Division Engineer that an Individual Permit is required; or

(3) Unless 45 days have passed from the District Engineer's receipt of the complete notification and the prospective permittee has not received written notice from the District or Division Engineer. Subsequently, the permittee's right to proceed under the NWP may be modified, suspended, or revoked only in accordance with the procedure set forth in 33 CFR 330.5(d)(2).

(b) **Contents of Notification**: The notification must be in writing and include the following information:

(1) Name, address and telephone numbers of the prospective permittee;

(2) Location of the proposed project;

(3) Brief description of the proposed project; the project's purpose; direct and indirect adverse environmental effects the project would cause; any other NWP(s), Regional General Permit(s), or Individual Permit(s) used or intended to be used to authorize any part of the proposed project or any related activity. Sketches should be provided when necessary to show that the activity complies with the terms of the NWP (Sketches usually clarify the project and when provided result in a quicker decision.);

(4) For NWPs 7, 12, 14, 18, 21, 34, 38, 39, 40, 41, 42, and 43, the PCN must also include a delineation of affected special aquatic sites, including wetlands, vegetated shallows (e.g., submerged aquatic vegetation, seagrass beds), and riffle and pool complexes (see paragraph 13(f));

(5) For NWP 7 (Outfall Structures and Maintenance), the PCN must include information regarding the original design capacities and configurations of those areas of the facility where maintenance dredging or excavation is proposed;

(6) For NWP 14 (Linear Transportation Projects), the PCN must include a compensatory mitigation proposal to offset permanent losses of waters of the US and a statement describing how temporary losses of waters of the US will be minimized to the maximum extent practicable;

(7) For NWP 21 (Surface Coal Mining Activities), the PCN must include an Office of Surface Mining (OSM) or state-approved mitigation plan, if applicable. To be authorized by this NWP, the District Engineer must determine that the activity complies with the terms and conditions of the NWP and that the adverse environmental effects are minimal both individually and cumulatively and must notify the project sponsor of this determination in writing;

(8) For NWP 27 (Stream and Wetland Restoration Activities), the PCN must include documentation of the prior condition of the site that will be reverted by the permittee;

(9) For NWP 29 (Single-Family Housing), the PCN must also include:

(i) Any past use of this NWP by the Individual Permittee and/or the permittee's spouse;

(ii) A statement that the single-family housing activity is for a personal residence of the permittee;

(iii) A description of the entire parcel, including its size, and a delineation of wetlands. For the purpose of this NWP, parcels of land measuring 1/4-acre or less will not require a formal on-site delineation. However, the applicant shall provide an indication of where the wetlands are and the amount of wetlands that exists on the property. For parcels greater than 1/4-acre in size, formal wetland delineation must be prepared in accordance with the current method required by the Corps. (See paragraph 13(f));

(iv) A written description of all land (including, if available, legal descriptions) owned by the prospective permittee and/or the prospective permittee's spouse, within a one mile radius of the parcel, in any form of ownership (including any land owned as a partner, corporation, joint tenant, co-tenant, or as a tenant-by-the-entirety) and any land on which a purchase and sale agreement or other contract for sale or purchase has been executed;

(10) For NWP 31 (Maintenance of Existing Flood Control Facilities), the prospective permittee must either notify the District Engineer with a PCN prior to each maintenance activity or submit a five year (or less) maintenance plan. In addition, the PCN must include all of the following:

(i) Sufficient baseline information identifying the approved channel depths and configurations and existing facilities. Minor deviations are authorized, provided the approved flood control protection or drainage is not increased;

(ii) A delineation of any affected special aquatic sites, including wetlands; and,

(iii) Location of the dredged material disposal site;

(11) For NWP 33 (Temporary Construction, Access, and Dewatering), the PCN must also include a restoration plan of reasonable measures to avoid and minimize adverse effects to aquatic resources;

(12) For NWPs 39, 43 and 44, the PCN must also include a written statement to the District Engineer explaining how avoidance and minimization for losses of waters of the US were achieved on the project site;

(13) For NWP 39 and NWP 42, the PCN must include a compensatory mitigation proposal to offset losses of waters of the US or justification explaining why compensatory mitigation should not be required. For discharges that cause the loss of greater than 300 linear feet of an intermittent stream bed, to be authorized, the District Engineer must determine that the activity complies with the other terms and conditions of the NWP, determine adverse environmental effects are minimal both individually and cumulatively, and waive the limitation on stream impacts in writing before the permittee may proceed;

(14) For NWP 40 (Agricultural Activities), the PCN must include a compensatory mitigation proposal to offset losses of waters of the US. This NWP does not authorize the relocation of greater than 300 linear-feet of existing serviceable drainage ditches constructed in non-tidal streams unless, for drainage ditches constructed in intermittent non-tidal streams, the District Engineer waives this criterion in writing, and the District Engineer has determined that the project complies with all terms and conditions of this NWP, and that any adverse impacts of the project on the aquatic environment are minimal, both individually and cumulatively;

(15) For NWP 43 (Stormwater Management Facilities), the PCN must include, for the construction of new stormwater management facilities, a maintenance plan (in accordance with state and local requirements, if applicable) and a compensatory mitigation proposal to offset losses of waters of the US. For discharges that cause the loss of greater than 300 linear feet of an intermittent stream bed, to be authorized, the District Engineer must determine that the activity complies with the other terms and conditions of the NWP, determine adverse environmental effects are minimal both individually and cumulatively, and waive the limitation on stream impacts in writing before the permittee may proceed;

(16) For NWP 44 (Mining Activities), the PCN must include a description of all waters of the US adversely affected by the project, a description of measures taken to minimize adverse effects to waters of the US, a description of measures taken to comply with the criteria of the NWP, and a reclamation plan (for all aggregate mining activities in isolated waters and non-tidal wetlands adjacent to headwaters and any hard rock/mineral mining activities);

(17) For activities that may adversely affect Federally-listed endangered or threatened species, the PCN must include the name(s) of those endangered or threatened species that may be affected by the proposed work or utilize the designated critical habitat that may be affected by the proposed work; and

(18) For activities that may affect historic properties listed in, or eligible for listing in, the National Register of Historic Places, the PCN must state which historic property may be affected by the proposed work or include a vicinity map indicating the location of the historic property.

(c) **Form of Notification**: The standard Individual Permit application form (Form ENG 4345) may be used as the notification but must clearly indicate that it is a PCN and must include all of the information required in (b) (1)-(18) of General Condition 13. A letter containing the requisite information may also be used.

(d) **District Engineer's Decision**: In reviewing the PCN for the proposed activity, the District Engineer will determine whether the activity authorized by the NWP will result in more than minimal individual or cumulative adverse environmental effects or may be contrary to the public interest. The prospective permittee may submit a proposed mitigation plan with the PCN to expedite the process. The District Engineer will consider any proposed compensatory mitigation the applicant has included in the proposal in determining whether the net adverse environmental effects to the aquatic environment of the proposed work are minimal. If the District Engineer determines that the activity complies with the terms and conditions of the NWP and that the adverse effects on the aquatic environment are minimal, after considering mitigation, the District Engineer will notify the permittee and include any conditions the District Engineer deems necessary. The District Engineer must approve any compensatory mitigation proposal before the permittee commences work. If the prospective permittee is required to submit a compensatory mitigation proposal with the PCN, the proposal may be either conceptual or detailed. If the prospective permittee elects to submit a compensatory mitigation plan with the PCN, the District Engineer will expeditiously review the proposed compensatory mitigation plan. The District Engineer must review the plan within 45 days of receiving a complete PCN and determine whether the conceptual or specific proposed mitigation would ensure no more than minimal adverse effects on the aquatic environment. If the net adverse effects of the project on the aquatic environment (after consideration of the compensatory mitigation proposal) are determined by the District Engineer to be minimal, the District Engineer will provide a timely written response to the applicant. The response will state that the project can proceed under the terms and conditions of the NWP. If the District Engineer determines that the adverse effects of the proposed work are more than minimal, then the District Engineer will notify the applicant either: (1) That the project does not qualify for authorization under the NWP and instruct the applicant on the procedures to seek authorization under an Individual Permit; (2) that the project is authorized under the NWP subject to the applicant's submission of a mitigation proposal that would reduce the adverse effects on the aquatic environment to the minimal level; or (3) that the project is authorized under the NWP with specific modifications or conditions. Where the District Engineer determines that mitigation is required to ensure no more than minimal adverse effects occur to the aquatic environment, the activity will be authorized within the 45-day PCN period. The authorization will include the necessary conceptual or specific mitigation or a requirement that the applicant submit a mitigation proposal that would reduce the adverse effects on the aquatic environment to the minimal level. When conceptual mitigation is included, or a mitigation plan is required under item (2) above, no work in waters of the US will occur until the District Engineer has approved a specific mitigation plan.

(e) **Agency Coordination**: The District Engineer will consider any comments from Federal and state agencies concerning the proposed activity's compliance with the terms and conditions of the NWPs and the need for mitigation to reduce the project's adverse environmental effects to a minimal level. For activities requiring notification to the District Engineer that result in the loss of greater than 1/2-acre of waters of the US, the District Engineer will provide immediately (e.g., via facsimile transmission, overnight mail, or other expeditious manner) a copy to the appropriate Federal or state offices (USFWS, state natural resource or water quality agency, EPA, State Historic Preservation Officer (SHPO), and, if appropriate, the NMFS). With the exception of NWP 37, these agencies will then have 10 calendar days from the date the material is transmitted to telephone or fax the District Engineer notice that they intend to provide substantive, site-specific comments. If so contacted by an agency, the District Engineer will wait an additional 15 calendar days before making a decision on the notification. The District Engineer will fully consider agency comments received within the specified time frame, but will provide no response to the resource agency, except as provided below. The District Engineer will indicate in the administrative record associated with each notification that the resource agencies' concerns were considered. As required by section 305(b)(4)(B) of the Magnuson-Stevens Fishery Conservation and Management Act, the District Engineer will provide a response to NMFS within 30 days of receipt of any Essential Fish Habitat conservation recommendations. Applicants are encouraged to provide the Corps multiple copies of notifications to expedite agency notification.

(f) **Wetland Delineations**: Wetland delineations must be prepared in accordance with the current method required by the Corps (For NWP 29 see paragraph (b)(9)(iii) for parcels less than (1/4-acre in size). The permittee may ask the Corps to delineate the special aquatic site. There may be some delay if the Corps does the delineation. Furthermore, the 45-day period will not start until the wetland delineation has been completed and submitted to the Corps, where appropriate.

14. **Compliance Certification**. Every permittee who has received NWP verification from the Corps will submit a signed certification regarding the completed work and any required mitigation. The certification will be forwarded by the Corps with the authorization letter and will include:

(a) A statement that the authorized work was done in accordance with the Corps authorization, including any general or specific conditions;

(b) A statement that any required mitigation was completed in accordance with the permit conditions; and

(c) The signature of the permittee certifying the completion of the work and mitigation.

15. **Use of Multiple Nationwide Permits**. The use of more than one NWP for a single and complete project is prohibited, except when the acreage loss of waters of the US authorized by the NWPs does not exceed the acreage limit of the NWP with the highest specified acreage limit (e.g. if a road crossing over tidal waters is constructed under NWP 14, with associated bank stabilization authorized by NWP 13, the maximum acreage loss of waters of the US for the total project cannot exceed 1/3-acre).

16. **Water Supply Intakes**. No activity, including structures and work in navigable waters of the US or discharges of dredged or fill material, may occur in the proximity of a public water supply intake except where the activity is for repair of the public water supply intake structures or adjacent bank stabilization.

17. **Shellfish Beds**. No activity, including structures and work in navigable waters of the US or discharges of dredged or fill material, may occur in areas of concentrated shellfish populations, unless the activity is directly related to a shellfish harvesting activity authorized by NWP 4.

18. **Suitable Material.** No activity, including structures and work in navigable waters of the US or discharges of dredged or fill material, may consist of unsuitable material (e.g., trash, debris, car bodies, asphalt, etc.) and material used for construction or discharged must be free from toxic pollutants in toxic amounts (see section 307 of the CWA).

19. **Mitigation**. The District Engineer will consider the factors discussed below when determining the acceptability of appropriate and practicable mitigation necessary to offset adverse effects on the aquatic environment that are more than minimal.

(a) The project must be designed and constructed to avoid and minimize adverse effects to waters of the US to the maximum extent practicable at the project site (i.e., on site).

(b) Mitigation in all its forms (avoiding, minimizing, rectifying, reducing or compensating) will be required to the extent necessary to ensure that the adverse effects to the aquatic environment are minimal.

(c) Compensatory mitigation at a minimum one-for-one ratio will be required for all wetland impacts requiring a PCN, unless the District Engineer determines in writing that some other form of mitigation would be more environmentally appropriate and provides a project-specific waiver of this requirement. Consistent with National policy, the District Engineer will establish a preference for restoration of wetlands as compensatory mitigation, with preservation used only in exceptional circumstances.

(d) Compensatory mitigation (i.e., replacement or substitution of aquatic resources for those impacted) will not be used to increase the acreage losses allowed by the acreage limits of some of the NWPs. For example, 1/4-acre of wetlands cannot be created to change a 3/4-acre loss of wetlands to a 1/2-acre loss associated with NWP 39 verification. However, 1/2-acre of created wetlands can be used to reduce the impacts of a 1/2-acre loss of wetlands to the minimum impact level in order to meet the minimal impact requirement associated with NWPs.

(e) To be practicable, the mitigation must be available and capable of being done considering costs, existing technology, and logistics in light of the overall project purposes. Examples of mitigation that may be appropriate and practicable include, but are not limited to: reducing the size of the project; establishing and maintaining wetland or upland vegetated buffers to protect open waters such as streams; and replacing losses of aquatic resource functions and values by creating, restoring, enhancing, or preserving similar functions and values, preferably in the same watershed.

(f) Compensatory mitigation plans for projects in or near streams or other open waters will normally include a requirement for the establishment, maintenance, and legal protection (e.g., easements, deed restrictions) of vegetated buffers to open waters. In many cases, vegetated buffers will be the only compensatory mitigation required. Vegetated buffers should consist of native species. The width of the vegetated buffers required will address documented water quality or aquatic habitat loss concerns. Normally, the vegetated buffer will be 25 to 50 feet wide on each side of the stream, but the District Engineers may require slightly wider vegetated buffers to address documented water quality or habitat loss concerns. Where both wetlands and open waters exist on the project site, the Corps will determine the appropriate compensatory mitigation (e.g., stream buffers or wetlands compensation) based on what is best for the aquatic environment on a watershed basis. In cases where vegetated buffers are determined to be the most appropriate form of compensatory mitigation, the District Engineer may waive or reduce the requirement to provide wetland compensatory mitigation for wetland impacts.

(g) Compensatory mitigation proposals submitted with the "notification" may be either conceptual or detailed. If conceptual plans are approved under the verification, then the Corps will condition the verification to require detailed plans be submitted and approved by the Corps prior to construction of the authorized activity in waters of the US.

(h) Permittees may propose the use of mitigation banks, in-lieu fee arrangements or separate activity-specific compensatory mitigation. In all cases that require compensatory mitigation, the mitigation provisions will specify the party responsible for accomplishing and/or complying with the mitigation plan.

20. **Spawning Areas**. Activities, including structures and work in navigable waters of the US or discharges of dredged or fill material, in spawning areas during spawning seasons must be avoided to the maximum extent practicable. Activities that result in the physical destruction (e.g., excavate, fill, or smother downstream by substantial turbidity) of an important spawning area are not authorized.

21. **Management of Water Flows**. To the maximum extent practicable, the activity must be designed to maintain preconstruction downstream flow conditions (e.g., location, capacity, and flow rates). Furthermore, the activity must not permanently restrict or impede the passage of normal or expected high flows (unless the primary purpose of the fill is to impound waters) and the structure or discharge of dredged or fill material must withstand expected high flows. The activity must, to the maximum extent practicable, provide for retaining excess flows from the site, provide for maintaining surface flow rates from the site similar to preconstruction conditions, and provide for not increasing water flows from the project site, relocating water, or redirecting water flow beyond preconstruction conditions. Stream channelizing will be reduced to the minimal amount necessary, and the activity must, to the maximum extent practicable, reduce adverse effects such as flooding or erosion downstream and upstream of the project site, unless the activity is part of a larger system designed to manage water flows. In most cases, it will not be a requirement to conduct detailed studies and monitoring of water flow. This condition is only applicable to projects that have the potential to affect waterflows. While appropriate measures must be taken, it is not necessary to conduct detailed studies to identify such measures or require monitoring to ensure their effectiveness. Normally, the Corps will defer to state and local authorities regarding management of water flow.

22. **Adverse Effects From Impoundments**. If the activity creates an impoundment of water, adverse effects to the aquatic system due to the acceleration of the passage of water, and/or the restricting its flow shall be minimized to the maximum extent practicable. This includes structures and work in navigable waters of the US, or discharges of dredged or fill material.

23. **Waterfowl Breeding Areas**. Activities, including structures and work in navigable waters of the US or discharges of dredged or fill material, into breeding areas for migratory waterfowl must be avoided to the maximum extent practicable.

24. **Removal of Temporary Fills**. Any temporary fills must be removed in their entirety and the affected areas returned to their preexisting elevation.

25. **Designated Critical Resource Waters**. Critical resource waters include, NOAA-designated marine sanctuaries, National Estuarine Research Reserves, National Wild and Scenic Rivers, critical habitat for Federally listed threatened and endangered species, coral reefs, state natural heritage sites, and outstanding national resource waters or other waters officially designated by a state as having particular environmental or ecological significance and identified by the District Engineer after notice and opportunity for public comment. The District Engineer may also designate additional critical resource waters after notice and opportunity for comment.

(a) Except as noted below, discharges of dredged or fill material into waters of the US are not authorized by NWPs 7, 12, 14, 16, 17, 21, 29, 31, 35, 39, 40, 42, 43, and 44 for any activity within, or directly affecting, critical resource waters, including wetlands adjacent to such waters. Discharges of dredged or fill materials into waters of the US may be authorized by the above NWPs in National Wild and Scenic Rivers if the activity complies with General Condition 7. Further, such discharges may be authorized in designated critical habitat for Federally listed threatened or endangered species if the activity complies with General Condition 11 and the USFWS or the NMFS has concurred in a determination of compliance with this condition.

(b) For NWPs 3, 8, 10, 13, 15, 18, 19, 22, 23, 25, 27, 28, 30, 33, 34, 36, 37, and 38, notification is required in accordance with General Condition 13, for any activity proposed in the designated critical resource waters including wetlands adjacent to those waters. The District Engineer may authorize activities under these NWPs only after it is determined that the impacts to the critical resource waters will be no more than minimal.

26. **Fills Within 100-Year Floodplains**. For purposes of this General Condition, 100-year floodplains will be identified through the existing Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Maps or FEMA-approved local floodplain maps.

(a) Discharges in Floodplain; Below Headwaters. Discharges of dredged or fill material into waters of the US within the mapped 100-year floodplain, below headwaters (i.e., 5 cfs), resulting in permanent above-grade fills, are not authorized by NWPs 39, 40, 42, 43, and 44.

(b) Discharges in Floodway; Above Headwaters. Discharges of dredged or fill material into waters of the US within the FEMA or locally mapped floodway, resulting in permanent above-grade fills, are not authorized by NWPs 39, 40, 42, and 44.

(c) The permittee must comply with any applicable FEMA-approved state or local floodplain management requirements.

27. **Construction Period**. For activities that have not been verified by the Corps and the project was commenced or under contract to commence by the expiration date of the NWP (or modification or revocation date), the work must be completed within 12-months after such date (including any modification that affects the project). For activities that have been verified and the project was commenced or under contract to commence within the verification period, the work must be completed by the date determined by the Corps. For projects that have been verified by the Corps, an extension of a Corps approved completion date maybe requested. This request must be submitted at least one month before the previously approved completion date.

## G. CORPS REGIONAL GENERAL CONDITIONS FOR ALL NWPs

1. **Mature Forested and Bog and Bog-like Wetlands**. The use of NWPs is specifically prohibited in mature forested wetlands or bog and bog-like wetlands or just these components of a wetland system (as defined in the Definition section of this Public Notice), except for projects provided coverage under the following NWPs:

NWP 3(i,ii) – Maintenance
NWP 20 – Oil Spill Cleanup
NWP 32 – Completed Enforcement Actions
NWP 38 – Cleanup of Hazardous and Toxic Waste
NWP 40(a) – USDA program participant

NOTE: NWP regulations do not allow the regional conditioning of NWP 40(a).

2. **Access**. You must allow representatives from this office to inspect the authorized activity at any time deemed necessary to ensure that it is being, or has been, accomplished in accordance with the terms and conditions of your permit.

3. **Commencement Bay**. An individual permit is required in the Commencement Bay Study Area (CBSA) for activities which would have qualified for the following NWPs:

NWP 12 – Utility Line Activities (substations and access roads)
NWP 13 – Bank Stabilization
NWP 14 – Linear Transportation Crossings
NWP 23 – Approved Categorical Exclusions
NWP 29 – Single-Family Housing
NWP 39 – Residential, Commercial, and Institutional Developments
NWP 40 – Agricultural Activities
NWP 41 – Reshaping Existing Drainage Ditches
NWP 42 – Recreational Facilities
NWP 43 – Stormwater Management Facilities

The CBSA is located near the southern end of Puget Sound's main basin at Tacoma, Pierce County, Washington. The CBSA extends from Brown's Point around the bay to Point Defiance and includes the commercial waterways, wetlands, and any other jurisdictional waters. From Point Defiance, the line runs southeast to State Route 7 (Pacific Avenue), then south to the centerline of I-5; then east (northbound lanes) along I-5 to the Puyallup River. The boundary extends 200 feet on either side of the Puyallup River southeast to the Clark Creek Road (Melroy) Bridge. From the Puyallup River, the boundary extends east along I-5 to 70th Avenue E. The line then returns to Brown's Point to the northwest, following the 100-foot contour elevation above sea level located east of Hylebos Creek and Marine View Drive.

4. **Mill Creek Special Area Management Plan (SAMP)**. Within the boundaries of the (SAMP), the following NWPs can be used only in those areas designated as "Developable Wetlands":

NWP 14 – Linear Transportation Crossings
NWP 23 – Approved Categorical Exclusions
NWP 29 – Single-Family Housing
NWP 33 – Temporary Construction, Access and Dewatering
NWP 39 – Residential, Commercial, and Institutional Developments
NWP 40 – Agricultural Activities
NWP 41 – Reshaping Existing Drainage Ditches
NWP 42 – Recreational Facilities
NWP 43 – Stormwater Management Facilities

Until the SAMP is approved, the users of these NWPs listed above (except NWP 40a.) must notify the District Engineer in accordance with General Condition 13 for any acreage or volume proposed. Once the SAMP is approved, the "Notification" limits will be as specified in the individual NWPs.

Mitigation requirements for these projects must either be onsite or within the areas designated as "Preferred Mitigation Sites". Mitigation plans must comply with the requirements found within the Mill Creek Special Area Management Plan, King County, Washington, dated April 2000.

An individual permit is required for all proposals in "Developable Wetlands" that would have qualified for NWPs other than those listed above.

NWP 27, Stream Restoration and Enhancement Activities, can be used within the SAMP, but, must comply with the requirements found within the Mill Creek Special Area Management Plan, King County, Washington.

The Mill Creek SAMP applies to all areas and tributaries drained by Mill Creek (Auburn), Mullen Slough, Midway Creek, Auburn Creek, and the area bounded by 4th Street Northeast in Auburn on the south, and the Ordinary High Water mark of the Green River on the east and north.

5. **Prohibited Work Times for Bald Eagle Protection**. For compliance with National General Condition 11, the following construction activity prohibitions apply to protect bald eagles, listed as threatened under the Endangered Species Act:

(a) No construction activity authorized under a NWP shall occur within 1/4 mile of an occupied bald eagle nest, nocturnal roost site, or wintering concentration area, within the following seasonal work prohibition times.

(b) No construction activity authorized under a NWP shall occur within 1/2 mile BY LINE OF SIGHT of an occupied bald eagle nest or nocturnal roost site, within the following seasonal work prohibition times:

Work prohibition times:

(1) Nesting between January 1 and August 15 each year.
(2) Wintering areas between November 1 and March 31 each year.

Exceptions to these prohibited work times can be made by request to the Corps and approved by the U.S. Fish and Wildlife Service (USFWS).

Contact the USFWS to determine if a bald eagle nest, nocturnal roost, or wintering concentration occurs near your proposed project:

West of Cascades: Olympia Office – (360) 753-9440
East of Cascades: Ephrata – (509) 754-8580 or Spokane – (509) 893-8002
Mainstem of the Columbia River downstream from McNary Dam: Portland – (503) 231-6179

# H. ADDITIONAL LIMITATIONS ON THE USE OF NWPs

1. District Engineers have authority to determine if an activity complies with the terms and conditions of an NWP.

2. NWPs do not obviate the need to obtain other Federal, state, or local permits, approvals, or authorizations required by law.

3. NWPs do not grant any property rights or exclusive privileges.

4. NWPs do not authorize any injury to the property or rights of others.

5. NWPs do not authorize interference with any existing or proposed Federal project.

6. If future operations by the United States require the removal, relocation, or other alteration of the work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, you will be required, upon due notice from the U. S Army Corps of Engineers, to remove, relocate, or alter the

structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

# I. FURTHER INFORMATION

Further information about the U.S. Army Corps of Engineers regulatory program, including nationwide permits, may also be accessed on our Internet page: ***http://www.nws.usace.army.mil*** (select "Regulatory/Permits").

US Army Corps
of Engineers
Seattle District

# Terms and Conditions of the SLOPES III Programmatic Consultation for "Over-water and In-Water Structures"

Applicability: These conditions are applicable to activities involving over-water and in-water structures that were included in a programmatic consultation between the U.S. Army Corps of Engineers (Corps) and the National Marine Fisheries Service (NMFS) that addressed certain activities in the Lower Columbia River within the State of Washington. For additional information, please refer to "Endangered Species Act – Section 7 Consultation Programmatic Biological Opinion and Conference Opinion & Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation: Revised Standard Local Operating Procedures for Endangered Species (SLOPES III) to Administer Certain Activities Authorized or Carried Out by the Department of the Army in the State of Oregon and on the North Shore of the Columbia River," dated November 30, 2004.

Location: Within Washington State, the Lower Columbia programmatic consultation addressed activities that would occur in the mainstem Columbia River, including certain sloughs and adjacent wetlands, downstream of McNary Dam. Washington State tributaries of the Columbia River, the mainstem Columbia River upstream of Dam, and all other portions of the Seattle District were excluded from the action area of this programmatic consultation.

Description of Activity: Over-water and in-water structures include recreational boating facilities and dock and wharf facilities operated by ports and other commercial entities. Recreational boating requires construction and maintenance of a variety of types and sizes of structures. Some are water dependent, and will be placed in riparian, nearshore, and over-water areas. Others are "related facilities" (e.g., parking lots, picnic areas) that are not water dependent. For purposes of this consultation, actions proposed to support recreational boating facilities are construction of boat ramps; maintenance, repair, and relocation of structures within an existing marina; structures in fleeting and anchorage areas; installation of small temporary floats; and repair of navigational aids. Commercial dock and wharf facilities also entail many different types and sizes of structures, often installed and operated over large areas. For purposes of this consultation, however, the proposed action includes the following work: (1) Replacement of existing pilings, fender piles, group pilings, walers, and fender pads; (2) installation of new mooring dolphins and structural pilings; (3) height extension of existing pilings; and (4) recycling of large wood obstructions that limit the usefulness of dock and wharf facilities.

Terms and Conditions: To comply with the requirements of the Endangered Species Act (ESA) and Magnuson-Stevens Fishery Conservation and Management Act, a Department of the Army permittee for this activity must comply with the applicable terms and conditions listed below. These terms and conditions, specified in the above-referenced programmatic biological opinion, are necessary to implement the reasonable and prudent measures described in the biological opinion. These terms and conditions are non-discretionary, and compliance with these terms and conditions is necessary to exempt the permittee from the prohibitions of Section 9 of the ESA.

## Conditions of Standard Local Operating Procedures for Endangered Species

a. Salvage notice. If a sick, injured, or dead specimen of a threatened or endangered species is found, the finder must notify the Vancouver Field Office of NOAA Fisheries Law Enforcement at (360) 418-4246. The finder must take care in handling of sick or injured specimens to ensure effective treatment, and in handling dead specimens to preserve biological material in the best possible condition for later analysis of cause of death. The finder also has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not disturbed unnecessarily.

b. Project Completion Report or Memo to File. Each permit issued by the Corps under this Opinion must require the applicant to submit a project completion report to the Corps within 60 days of finishing work below

ordinary high water; for each project carried by the Corps, the project supervisor must prepare a project completion memo to file. Each report or memo must contain the following information and be available for inspection on request by NOAA Fisheries.

i. Applicant's name and permit number (if any).

ii. Corps contact person.

iii. Project name.

iv. Type of activity.

v. Project site including any compensatory mitigation site by 5th field HUC.

vi. Start and end dates for work completed.

vii. Photos of habitat conditions at the project site including any compensatory mitigation site, before, during, and after project completion.[1]

viii. Projects with the following work elements must include these data.

(1) Work Cessation—Dates work ceased due to high flows.[2]

(2) Fish Screen—Proof of compliance with NOAA Fisheries fish screen criteria.[3]

(3) Pollution Control—A summary of pollution and erosion control inspections, including any erosion control failure, contaminant release, and correction effort.

(4) Drilling—Describe the drilling method and steps taken to isolate drilling operations, fluids, slurry and spoils from flowing water.

(5) Pilings. The number, type, and diameter of pilings removed, broken during removal, and installed; and any sound attenuation measures used.

(6) Site Preparation—Riparian area cleared within 150 feet of ordinary high water; upland area cleared; new impervious area created.

(7) Streambank Stabilization—Type and amount of materials used; project size (one bank or two, width and linear feet).

(8) Road Construction, Repairs, and Improvements—Rationale for any new permanent road crossing design.

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[1] Relevant habitat conditions may include characteristics of channels, eroding, and stable streambanks in the project area, riparian vegetation, water quality, flows at base, bankfull and over-bankfull stages, and other visually discernable environmental conditions at the project area, and upstream and downstream from the project. Include general views and close-ups of the project and project area, including pre- and post-construction. Label each photo with date, time, project name, photographer's name, and a comment about the subject.

[2] "High flows" means any flow likely to rise above the top of an work isolation area or otherwise inundate a work area that would normally be dry.

[3] National Marine Fisheries Service, Juvenile Fish Screen Criteria (revised February 16, 1995) and Addendum; Juvenile Fish Screen Criteria for Pump Intakes (May 9, 1996) (guidelines and criteria for migrant fish passage facilities, and new pump intakes and existing inadequate pump intake screens) or as amended (http://www.nwr.noaa.gov/1hydrop/hydroweb/ferc.htm).

(9) In-water and Over-water Structures—Area of new in-water or over-water structure.

c. Site Restoration and/or Compensatory Mitigation Report. Each applicant must submit a site restoration and/or compensatory mitigation report by December 31 each year after the project is completed until the Corps approves that the site restoration and/or compensatory mitigation performance standards have been met. This report must describe the date and purpose of each visit to a restoration and/or compensatory mitigation site, site conditions observed during that visit, and any corrective action planned or taken.

**General Conditions for Surveying, Exploration, Construction, Operation, and Maintenance**

a. Exclusions. Any exploration or construction activity, including surface water diversion and release of construction discharge water within 300 feet upstream from any occupied redd until fry emerge or within 300 feet of native submerged aquatic vegetation is not authorized by this Opinion, unless otherwise approved in writing by NOAA Fisheries. Requests for approval should be submitted with the project notification form. Permits for the following types of exploration, construction, and mitigation actions are not authorized by this Opinion.

i. Use of pesticides.

ii. Use of short pieces of plastic ribbon to determine flow patterns.

iii. Temporary roads or drilling pads built on steep slopes where grade, soil types, or other features suggest a likelihood of excessive erosion or failure.

iv. Exploratory drilling in estuaries that cannot be conducted from a work barge or an existing bridge, dock, or wharf.

v. Installation of a fish screen on any permanent water diversion or intake that is not already screened.

vi. Any projects that require in-water installation of hollow steel piling greater than 24-inches in diameter or use of H-pile larger than designation HP24.

vii. Drilling or sampling in an EPA-designated Superfund Site, a state-designated cleanup area, or the likely impact zone of a significant contaminant source, as identified by historical information or the Corps' best professional judgment.

viii. Compensatory mitigation actions that require construction of permanent structures, maintenance beyond the establishment period or after the performance standards have been met, or creation of habitat functions where they did not historically exist, or that simply preserve existing functions.

b. Pollution and Erosion Control Plan. A pollution and erosion control plan must be prepared and carried out to prevent pollution caused by surveying or construction operations. The pollution and erosion control plan must be commensurate with the scale of the project, contain pertinent elements listed below, and meet requirements of all applicable laws and regulations. Submit an electronic copy of this plan with the project notification form.

i. Goal. The goal is to avoid or minimize the adverse effects of pollution and erosion by limiting soil disturbance, scheduling work when the fewest number of fish are likely to be present, managing likely pollutants, and limiting the harm that may be caused by accidental discharges of pollutants and sediment.

ii. Responsible Party. The name, address, and telephone number of the person responsible for accomplishment of the pollution and erosion control plan.

iii. Minimum Area. Practices to confine vegetation removal and soil disturbance to the minimum area necessary to complete the project and otherwise prevent erosion and sedimentation associated with access

roads, stream crossings, drilling sites, construction sites, borrow pit operations, haul roads, equipment and material storage sites, fueling operations, staging areas, and roads being decommissioned.

iv. In-water Work Timing. Develop a schedule to complete all work below ordinary high water, except hydraulic and topographic measurements within the wetted channel,[4] inside the most recent Oregon Department of Fish & Wildlife (ODFW) or the Corps Seattle District preferred in-water work period,[5] as appropriate for the project area unless otherwise approved in writing by NOAA Fisheries. Requests for approval should be submitted with the project notification form.

v. Cease Work During High Flows. Project operations must cease under high flow conditions that may inundate the project area except for efforts to avoid or minimize resource damage.

vi. Concrete, Cement, and Grout. Practices to confine, remove, and dispose of excess concrete, cement, grout, and other mortars or bonding agents, including measures for washout facilities.

vii. Construction Debris. Practices to prevent construction debris from dropping into any stream or waterbody and to remove any material that does drop with a minimum disturbance to the streambed and water quality.

viii. Hazardous Materials. A description of any regulated or hazardous products or materials that will be used for the project including procedures for inventory, storage, handling, and monitoring.

ix. Spill Containment. A spill containment and control plan with notification procedures, specific cleanup and disposal instructions for different products, a description of quick response containment and cleanup supplies that will be available on the site, including a supply of sediment control materials (*e.g.*, a silt fence, straw bales,[6] an oil absorbing, floating boom whenever surface water is present), proposed methods for disposal of spilled materials, and employee training for spill containment.

c. Work Area Isolation Plan. Except for piling installation[7] completed in compliance with all other relevant terms and conditions, a work area isolation plan must be prepared and carried out for any project that requires work below ordinary high water where adult or juvenile fish are reasonably certain to be present or 300 feet or less upstream from spawning habitats, unless otherwise approved in writing by NOAA Fisheries. The work area isolation plan must be commensurate with the scale of the project, contain the pertinent elements listed below, and meet requirements of all applicable laws and regulations. Submit an electronic copy of this plan with the project notification form.

i. Goal. The goal to minimize the adverse effects of erosion and other types of pollution by removing from flowing water and fish from the work area.

ii. Responsible Party. The name and address of the person responsible for meeting each component of the work area isolation plan including a fishery biologist experienced with work area isolation and competent to ensure the safe handling of all ESA-listed fish that will be responsible for the capture and release operation.

iii. Flow Conditions. An estimate of the range of flows likely to occur during isolation.

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[4] Hydraulic and topographic measurements within the wetted channel may be completed anytime except during the spawning period, unless a fisheries biologist verifies that no redds are occupied within 300 feet downstream from the measurement site.

[5] ODFW, Oregon Guidelines for Timing of In-water Work to Protect Fish and Wildlife Resources (June 2000) at http://www.dfw.state.or.us/lands/0600_inwtrguide.pdf and U.S. Army Corps of Engineers, Seattle District Regulatory Branch, Allowable Work Windows at http://www.nws.usace.army.mil/PublicMenu/Menu.cfm?sitename=REG&pagename=work_windows as amended.

[6] When available, certified weed-free straw or hay bales must be used to prevent introduction of noxious weeds.

[7] Pilings may be installed without work isolation provided all other relevant terms and conditions are met.

iv. Plan View. A plan view of all isolation elements and fish release areas.

v. Equipment and Materials List. A list of equipment and materials that are necessary to complete work area isolation including fish screen for any pump used to dewater the isolation area, and that will be available onsite to provide appropriate redundancy of key plan functions (*e.g.*, operational, properly-sized, back-up pumps and generators).

vi. Sequence and Schedule. The sequence and schedule of dewatering and rewatering activities.

d. Capture and Release. Before and intermittently during isolation of an in-water work area, fish trapped in the area must be captured using a trap, seine, electrofishing, or other methods as are prudent to minimize risk of injury, then released at a safe release site.

i. Do not use electrofishing if water temperatures exceed 18°C or are expected to rise above 18°C, unless no other method of capture available.

ii. If electrofishing equipment is used to capture fish, comply with NOAA Fisheries' electrofishing guidelines.[8]

iii. Handle ESA-listed fish with extreme care keeping fish in water to the maximum extent possible during seining and transfer procedures to prevent the added stress of out-of-water handling.

vi. Ensure water quality conditions are adequate in buckets or tanks used to transport fish by providing circulation of clean, cold water using aerators to provide dissolved oxygen and minimizing holding times.

v. Release fish into a safe release site as quickly as possible and as near as possible to capture sites.

vi. Do not transfer the ESA-listed fish to anyone except NOAA Fisheries personnel unless otherwise approved in writing by NOAA Fisheries. Requests for approval should be submitted with the project notification form.

vii. Obtain all other Federal, state, and local permits necessary to conduct the capture and release activity.

viii. Allow NOAA Fisheries or its designated representative to accompany the capture team during the capture and release activity and to inspect the team's capture and release records and facilities.

ix. Submit an electronic copy of the Salvage Report Form (Appendix B) to NOAA Fisheries at slopes.nwr@noaa.gov within 10 calendar days of completion of the salvage operation.

e. Fish Passage. Safe passage around or through the project area must be provided for any adult and juvenile salmon or steelhead species present during construction unless passage did not previously exist or as otherwise approved in writing by NOAA Fisheries. Requests for approval should be submitted with the project notification form.

i. Fish ladders (*e.g.*, pools and weirs, vertical slots, Denil fishways) and fish trapping systems are not authorized by this Opinion.

ii. After project completion, adult and juvenile passage upstream and downstream must not be impaired for the life of the project.

f. Stormwater Management Plan. A stormwater management plan must be prepared and carried out for any project that will produce any new impervious surface or a land cover that will slow the entry of water into the

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[8] National Marine Fisheries Service Guidelines for Electrofishing Waters Containing Salmonids Listed Under the Endangered Species Act (June 2000) (http://www.nwr.noaa.gov/1salmon/salmesa/final4d.htm).

soil. The stormwater management plan must be commensurate with the scale of the projects, contain the pertinent elements listed below, and meet requirements of all applicable laws and regulations. Submit an electronic copy of this plan with the project notification form.

i. Goal. The goal is to minimize adverse effects due to the quantity and quality of stormwater runoff for the life of the project by maintaining or restoring natural runoff conditions.

ii. Responsible Party. The name, address, and telephone number of the person responsible for accomplishment of the stormwater management plan.

iii. Management Practices and Facilities. A system of management practices and if necessary, structural facilities designed to complete the following functions.

(1) Minimize, disperse, and infiltrate stormwater runoff onsite using sheet flow across permeable vegetated areas to the maximum extent possible without causing flooding, erosion impacts, or long-term adverse effects to groundwater.

(2) Pre-treat stormwater from pollution generating surfaces including bridge decks before infiltration or discharge into a freshwater system, as necessary to minimize any nonpoint source pollutant (*e.g.*, debris, sediment, nutrients, petroleum hydrocarbons, metals) likely to be present in the volume of runoff predicted from a six-month, 24-hour storm.[9]

(3) Ensure that the duration of post project discharge matches the predeveloped discharge rates from 50 percent of the two-year peak flow up to the 50-year peak flow.

iv. Continuous Rainfall/Runoff. For projects that require engineered water quality or detention facilities to meet stormwater requirements, use a continuous rainfall/runoff model if available for the project area to calculate stormwater facility water quality and flow control rates.

v. Permeable Pavements. Use permeable pavements for load-bearing surfaces including multiple-use trails to the maximum extent feasible based on soil, slope, and traffic conditions.

vi. Facilities Inside the Riparian Management Area. Install structural facilities outside wetlands or the riparian management area[10] whenever feasible, otherwise provide compensatory mitigation to offset any long-term adverse effects. Identify the location of all stormwater facilities relative to the riparian management area.

vii. Recordkeeping. Document completion of the following activities according to a regular schedule for the operation, inspection, and maintenance of all structural facilities and conveyance systems in a log available for inspection on request by the Corps and NOAA Fisheries.

(1) Inspect and clean each facility as necessary to ensure that the design capacity is not exceeded, heavy sediment discharges are prevented, and whether improvements in operation and maintenance are needed.

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[9] A six-month, 24-hour storm may be assumed to be 72 percent of the two-year, 24-hour amount. See, Washington State Department of Ecology (2001), Appendix I-B-1.

[10] "Riparian management area" means land: (1) within 150 feet of any natural water occupied by listed salmonids during any part of the year or designated as critical habitat; (2) within 100 feet of any natural water within one-fourth mile upstream from areas occupied by listed salmonids or designated as critical habitat and that is physically connected by an above-ground channel system such that water, sediment, or woody material delivered to such waters will eventually be delivered to water occupied by listed salmon or designated as critical habitat; and (3) within 50 feet of any natural water upstream from areas occupied by listed salmonids or designated as critical habitat and that is physically connected by an above-ground channel system such that water, sediment, or woody material delivered to such waters will eventually be delivered to water occupied by listed salmon or designated as critical habitat. "Natural water" means all perennial or seasonal waters except water conveyance systems that are artificially constructed and actively maintained for irrigation.

(2) Promptly repair any deterioration threatening the effectiveness of any facility.

(3) Post and maintain a warning sign on or next to any storm drain inlet as appropriate for the receiving water that says, "Dump No Waste – Drains to Groundwater, Streams, or Lakes."

(4) Only dispose of sediment and liquid from any catch basin in an approved facility.

viii. Runoff/Discharge into a Freshwater System. When stormwater runoff will be discharged directly into surface water or a wetland, or indirectly through a conveyance system, the following requirements apply.

(1) Maintain natural drainage patterns and whenever possible ensure that discharges from the project site occur at the natural location.

(2) Use a conveyance system comprised entirely of manufactured elements (*e.g.*, pipes, ditches, outfall protection) that extends to the ordinary high water line of the receiving water unless existing topography and vegetative site conditions will provide adequate biofiltration to remove likely sediment and other pollutants.

(3) Stabilize any erodible elements of this system as necessary to prevent erosion.

(4) Do not divert surface water from or increase discharge to an existing wetland if that will cause a measurable or detectable adverse effect to wetland hydrology, soils, or vegetation.

(5) The velocity of discharge water released from an outfall or diffuser port may not exceed four feet per second, and the maximum size of any aperture may not exceed one inch.

g. Site Restoration Plan. A site restoration plan must be prepared and carried out to ensure that all streambanks, soils, and vegetation disturbed by the project are cleaned up and restored as follows. The site restoration plan must be commensurate with the scale of the project, contain the pertinent elements listed below, and meet requirements of all applicable laws and regulations. Submit an electronic copy of this plan with the project notification form.

i. Goal. The goal is to reestablish habitat access, water quality, production of habitat elements (*e.g.*, large wood), channel conditions, flows, watershed conditions, and other aquatic habitat forming processes that were harmed during project completion.

ii. Responsible Party. The name, address, and telephone number of the person responsible for accomplishment of the site restoration plan including providing and managing any financial assurances and monitoring necessary to ensure restoration success.

iii. Baseline Information. This information may be obtained from existing sources (*e.g.*, land use plans, watershed analyses, subbasin plans), where available.

(1) A functional assessment of adverse effect, *i.e.*, the location, extent and function of the riparian and aquatic resources that will be adversely affected by construction and operation of the project.

(2) The location and extent of resources surrounding the restoration site including historic and existing conditions.

iv. Objectives. Restoration objectives that describe the extent and methods of site restoration necessary to offset adverse effects of the project by aquatic resource type.

(1) Restore damaged streambanks to a natural slope, pattern, and profile suitable for establishment of permanent wood vegetation unless precluded by pre-project conditions (*e.g.*, a natural rock wall).

(2) Replant each area requiring revegetation before the first April 15 following construction. Use a diverse assemblage of species native to the project area or region including grasses, forbs, shrubs, and trees. Noxious or invasive species may not be used.

(3) Use as much as possible of the large wood, native trees, native vegetation, topsoil, and native channel material that was stockpiled during site preparation.

(4) Do not apply surface fertilizer within 50 feet of any stream channel.

(5) Install fencing as necessary to prevent access to revegetated sites by livestock or unauthorized persons.

v. Performance Standards. Use the following standards to help design the plan and assess whether the restoration goal is met. While no single criterion is sufficient to measure success, the intent is that these features should be present within reasonable limits of natural and management variation.

(1) Human and livestock disturbance if any is confined to small areas necessary for access or other special management situations.

(2) Areas with signs of significant past erosion are completely stabilized and healed; bare soil spaces are small and well dispersed.

(3) Soil movement such as active rills and soil deposition around plants or in small basins is absent or slight and local.

(4) Native woody and herbaceous vegetation, and germination microsites are present and well distributed across the site.

(5) Plants have normal, vigorous growth form and a high probability of remaining vigorous, healthy, and dominant over undesired competing vegetation.

(6) Vegetation structure is resulting in rooting throughout the available soil profile.

(7) Plant litter is well distributed and effective in protecting the soil with little or no litter accumulated against vegetation as a result of active sheet erosion ("litter dams").

(8) A continuous corridor of shrubs and trees appropriate to the site are present to provide shade and other habitat functions for the entire streambank.

(9) Streambanks are stable, well vegetated, and protected at margins by roots that extend below baseflow elevation or by coarse-grained alluvial debris.

vi. Work Plan. Develop a work plan with sufficient detail to include a description of the following elements as applicable:

(1) Water supply source if necessary.

(2) Boundaries for the restoration area.

(3) Restoration methods, timing, and sequence.

(4) Geomorphology and habitat features of stream or other open water.

(5) Site management and maintenance requirements including a plan to control exotic invasive vegetation.

(6) Elevation and slope of the restoration area to ensure they conform to required elevation and hydrologic requirements of target plant species.

(7) Woody native vegetation appropriate to the restoration site.[11] This must be a diverse assemblage of species that are native to the project area or region including grasses, forbs, shrubs, and trees. This may include allowances for natural regeneration from an existing bank or planting.

vii. Five-Year Monitoring and Maintenance Plan. Develop a five-year monitoring and maintenance plan with the following elements as applicable:

(1) A schedule to visit the restoration site annually for five years or longer as necessary to confirm that the performance standards are achieved. Despite the initial five-year planning period, site visits and monitoring must continue from year to year until the Corps certifies that site restoration performance standards have been met.

(2) During each visit, inspect for and correct any factors that may prevent attainment of performance standards (*e.g.*, low plant survival, invasive species, wildlife damage, drought).

(3) Keep a written record to document the date of each visit, site conditions, and any corrective actions taken.

h. Compensatory Mitigation Plan. A compensatory mitigation plan must be prepared and carried as necessary to ensure the project does not cause a long-term loss of riparian or aquatic functions. The compensatory mitigation plan must be commensurate with the scale of the project, contain the pertinent elements listed below, and meet requirements of all applicable laws and regulations. Submit an electronic copy of this plan with the project notification form.

i. Actions of Concern. The following actions require a Compensatory Mitigation Plan to offset long-term adverse effects:

(1) Riparian and aquatic habitats displaced by construction of structural stormwater facilities, a new or enlarged boat ramp, or scour protection.

(2) Riparian and benthic habitat displaced by new or enlarged over-water structures.

(3) Other activities that prevent development of properly functioning riparian and aquatic habitat processes.

ii. Goal. The goal is to ensure that completion of the project does not cause a net loss of riparian and aquatic habitat functions.

iii. Responsible Party. The name, address, and telephone number of the person responsible for accomplishment of the compensatory mitigation plan including providing and managing any financial assurances and monitoring necessary to ensure compensatory mitigation success.

iv. Objectives. Compensatory mitigation objectives related to the extent and type of compensatory mitigation necessary to offset unavoidable losses to riparian and aquatic habitat at the project site.

(1) Elements of a site restoration plan outline above.

(2) Watershed-level considerations related to specific aquatic resource needs of the affected area.

(3) Existing technology and logistical concerns.

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[11] Use reference sites to select vegetation for the mitigation site whenever feasible. Historic reconstruction, vegetation models, or other ecologically-based methods may also be used as appropriate.

iv. Drilling Waste Containment. All drilling equipment, drill recovery, recycling pits, and any waste or spoil produced must be contained as necessary to prevent any drilling fluids or other wastes from entering the stream.

(1) All drilling fluids and waste must be completely recovered then recycled or disposed to prevent entry into flowing water.

(2) Drilling fluids must be recycled using a tank instead of drill recovery/recycling pits whenever feasible.

(3) When drilling is completed, try to remove the remaining drilling fluid from the sleeve (*e.g.,* by pumping) to reduce turbidity when the sleeve is removed.

k. Heavy Equipment. Use of heavy equipment is restricted as follows:

i. Choice of Equipment. When heavy equipment will be used, the equipment selected must have the least adverse effects on the environment (*e.g.*, minimally sized, low ground pressure equipment).

ii. Vehicle and Material Staging. Store construction materials and fuel and operate, maintain, and store vehicles as follows:

(1) To reduce the staging area and likelihood of contamination, ensure that only enough supplies and equipment to complete a specific job will be stored onsite.

(2) Complete vehicle staging, cleaning, maintenance, refueling, and fuel storage in a vehicle staging area placed 150 feet or more from any stream, waterbody, or wetland unless otherwise approved in writing by NOAA Fisheries. Requests for approval should be submitted with the project notification form.

(3) Inspect all vehicles operated within 150 feet of any stream, waterbody, or wetland daily for fluid leaks before leaving the vehicle staging area. Repair any leaks detected in the vehicle staging area before the vehicle resumes operation. Document inspections in a record that is available for review on request by the Corps or NOAA Fisheries.

(4) Before operations begin and as often as necessary during operation, steam clean all equipment that will be used below ordinary high water until all visible external oil, grease, mud, and other visible contaminates are removed. Complete all cleaning in the staging area.

(5) Diaper all stationary power equipment (*e.g.*, generators, cranes, and stationary drilling equipment) operated within 150 feet of any steam, waterbody, or wetland to prevent leaks unless suitable containment is provided to prevent likely spills from entering any stream or waterbody.

l. Pre-construction Activity. The following actions must be completed before significant[12] alteration of the project area.

i. Marking. Flag the boundaries of clearing limits associated with site access and construction to prevent ground disturbance of critical riparian vegetation, wetlands, areas below ordinary high water, and other sensitive sites beyond the flagged boundary.

ii. Temporary Erosion Controls. All temporary erosion controls must be in place and appropriately installed downslope of project activity until site restoration is complete.

m. Site Preparation. Native materials including large wood, native vegetation, weed-free topsoil, and native channel materials (gravel, cobble, and boulders) disturbed during site preparation must be conserved onsite for site restoration.

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[12] "Significant" means an effect can be meaningfully measured, detected, or evaluated.

i. If possible, leave native materials where they are found. In areas to be cleared, clip vegetation at ground level to retain root mass and encourage reestablishment of native vegetation.

ii. If native materials are moved, damaged, or destroyed, replace them with a functional equivalent during site restoration.

iii. Stockpile all large wood[13] taken from below ordinary high water and from within 150 feet of a stream, waterbody, or wetland, native vegetation, weed-free topsoil, and native channel material displaced by construction for use during site restoration.

iv. As part of the site restoration, all large wood taken from the riparian zone or stream during construction must be returned to those areas and placed in a natural configuration that may be expected to function naturally.

n. Temporary Access Roads and Drilling Pads. All temporary access roads and drilling pads must be constructed as follows.

i. Existing Ways. Use existing roadways, travel paths, and drilling pads whenever possible unless construction of a new way or drilling pad would result in less habitat take. When feasible, eliminate the need for an access road by walking a tracked drill or spider hoe to a survey site or lower drilling equipment to a survey site using a crane.

ii. Soil Disturbance and Compaction. Minimize soil disturbance and compaction whenever a new temporary road or drill pad is necessary within wetlands or the riparian management area by clearing vegetation to ground level and placing clean gravel or geotexile fabric unless otherwise approved in writing by NOAA Fisheries. Requests for approval should be submitted with the project notification form.

iii. Temporary Stream Crossings.

(1) Minimize the number of temporary stream crossings.

(2) Design temporary road crossings as follows.

(a) A qualified fish biologist will survey and map spawning habitat, any occupied spawning redds, and native submerged aquatic vegetation within 300 feet upstream downstream and 100 feet upstream from a proposed crossing.

(b) Do not place a stream crossing within 300 feet downstream or 100 feet upstream from any occupied redd until fry emerge or within 300 feet of native submerged aquatic vegetation.

(c) Design the crossing to provide for foreseeable risks (*e.g.*, flooding and associated bedload and debris to prevent the diversion of streamflow out of the channel and down the road if the crossing fails).

(d) Vehicles and machinery must cross riparian areas and stream at right angles to the main channel wherever possible.

iv. Obliteration. When the project is complete, obliterate all temporary access roads that will not be in footprint of a new bridge or other permanent structure, stabilize the soil, and revegetate the site.

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[13] "Large wood" means a tree, log, or redwood big enough to dissipate stream energy associated with high flows, capture bedload, stabilize streambanks, influence channel characteristics, and otherwise support aquatic habitat function, given the slope and bankfull channel width of the stream in which the wood occurs. See Oregon Department of Forestry and ODFW, "A Guide to Placing Large Wood in Streams, May 1995, http://www.nwr.noaa.gov/1salmon/salmesa/4ddocs/lrgwood.pdf

o. Earthwork. Earthwork including drilling, excavation, dredging, filling, and compacting must be completed as quickly as possible.

i. Site Stabilization. Stabilize all disturbed areas including obliteration of temporary roads following any break in work unless construction will resume within four days.

ii. Inspection of Erosion Controls. Monitor instream turbidity and inspect all erosion controls daily during the rainy season, weekly during the dry season, or more often as necessary to ensure the erosion controls are working adequately.[14]

(1) If monitoring or inspection shows that the erosion controls are in effective, immediately mobilize work crews to repair, replace, or reinforce controls as necessary.

(2) Remove sediment from erosion controls before it reaches one-third of the exposed height of the control.

iii. Drilling, Boring, Jacking. If drilling, boring, or jacking is used, the following conditions apply.

(1) Isolate drilling operations in wetted stream channels using a steel pile, sleeve, or other appropriate isolation method to prevent drilling fluids from contacting water.

(2) If it is necessary to drill through a bridge deck, use containment measures to prevent drilling debris from entering the channel.

(3) Sampling and directional drill recovery/recycling pits and any associated waste or spoils must be completely isolated from surface waters, off-channel habitats, and wetlands. All waste or spoils must be covered if precipitation is falling or imminent. All drilling fluids and waste must be recovered and recycled or disposed to prevent entry into flowing water.

(4) If a drill boring conductor breaks and drilling fluid or waste is visible in a water or a wetland, all drilling activity must cease pending written approval from NOAA Fisheries to resume drilling.

p. Treated Wood. Use of lumber, pilings, or other wood products that are treated or preserved with pesticidal compounds (including but not limited to alkaline, copper quaternary, ammoniacal copper arsenate, ammoniacal copper zinc arsenate, copper boron azole, chromated copper arsenate, copper naphthenate, creosote, and pentachlorophenol) may not be used below ordinary high water or as part of an in-water or over-water structure except as described below.

i. Onsite Storage. Treated wood shipped to the project area must be stored out of contact with standing water and wet soil and protected from precipitation.

ii. Visual Inspection. Each load and piece of treated wood must be visually inspected and rejected for use in or above aquatic environments if visible residues, bleeding of preservative, preservative-saturated sawdust, contaminated soil, or other matter is present.

iii. Pilings. Pilings treated with ammoniacal copper zinc arsenate, chromated copper arsenate, or creosote may be installed below ordinary high water according to NOAA Fisheries' guidelines,[15] provided that no more

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[14] "Working adequately" means that upland work is not contributing visible sediment to water, and in-water work does not increase ambient stream turbidity by more than ten percent above background 100 feet below the discharge, when measured relative to a control point immediately upstream from the turbidity causing activity.

[15] Letter from Steve Morris, National Marine Fisheries Service to W.B. Paynter, Portland District, U.S. Army Corps of Engineers (December 9, 1998) (transmitting a document titled "Position Document for the Use of Treated Wood in Areas within Oregon Occupied by Endangered Species Act Proposed and Listed Anadromous Fish Species," National Marine Fisheries Service, December 1998).

than 50 piles are used. Also note that these guidelines do not apply to pilings treated with any other preservative and do not authorize use of treated wood for any other purpose.

iv. Prefabrication and Field Preservative Treatment. Use prefabrication to the extent feasible to ensure that cutting, drilling, and field preservative treatment is minimized. When field fabrication is necessary, all cutting and drilling of treated wood and field preservative treatment of wood exposed by cutting and drilling, will occur above ordinary high water to minimize discharge of sawdust, drill shavings, excess preservative and other debris in riparian, or aquatic habitats. Use tarps, plastic tubs, or similar devices to contain the bulk of any fabrication debris and wipe off any excess field preservative.

v. Abrasion Prevention. All treated wood structures including pilings must have design features to avoid or minimize impacts and abrasion by livestock, pedestrians, vehicles, vessels, floats, *etc.,* to prevent the deposition of treated wood debris and dust in riparian or aquatic habitats.

vi. Waterproof Coating. Treated wood may be used to construct a bridge, over-water structure, or an in-water structure provided that all surfaces exposed to leaching by precipitation, overtopping waves, or submersion are coated with a waterproof seal or barrier that will be maintained for the life of the project. Coatings and any paint-on field treatment must be carefully applied and contained to reduce contamination. Surfaces that are not exposed to precipitation or wave attack, such as parts of a timber bridge completely covered by the roadway wearing surface of the bridge deck are exempt from this requirement.

vii. Debris Removal. Projects that require removal of treated wood must use the following precautions.

(1) Ensure that to the extent feasible, no treated wood debris falls into the water. If treated wood debris does fall into the water, remove it immediately.

(2) After removal, place treated wood debris in an appropriate dry storage site until it can be removed from the project area. Do not leave treated wood construction debris in the water or stacked on the streambank at or below the ordinary high water.

(3) Evaluate treated wood construction debris removed during a project including treated wood pilings to ensure proper disposal of debris.

q. Piling Installation. Hollow steel piling 24 inches in diameter or smaller and H-pile designated as HP24 or smaller may be installed below ordinary high water as follows.

i. Minimize the number and diameter of pilings as feasible.

ii. Repairs, upgrades, and replacement of existing pilings consistent with these terms and conditions are allowed. In addition, up to five single pilings or one dolphin consisting of three to five pilings may be added to an existing facility per in-water construction period.

iii. Whenever feasible, use vibratory hammer for piling installation. Otherwise, use the smallest drop or hydraulic impact hammer necessary to complete the job and set the drop height to the minimum necessary to drive the piling.

iv. When using an impact hammer to drive or proof steel piles, one of the following sound attenuation devices must be used to reduce sound pressure levels by 20 dB.

(1) Place a block of wood or other sound dampening material between the hammer and the piling being drive.

(9) Non-water-related facilities (*e.g.*, parking lots, picnic areas, restrooms) inside the riparian management area.

(10) Any other over-water structure more than six feet wide unless otherwise approved in writing by NOAA Fisheries. Requests for approval should be submitted with the project notification form.

ii. Excluded Locations for New or Expanded Structures.

(1) Estuarine or saltwater.[17]

(2) Insufficient flow to dissipate fuels and other pollutants from vessels.

(3) Within 0.5 miles downstream from the confluence of a spawning tributary.

(4) An area where a floating dock is likely to ground out or where moored boats will prop wash the bottom.

(5) Requires pre-construction excavation, routine maintenance dredging (*e.g.*, alcoves, backwater sloughs, side channels, other shallow-water areas), or construction of a breakwater, jetty, or groin.

b. New Structures, Maintenance, and Replacement Authorized by this Opinion. New structures may be built and existing structures may be repaired or replaced as follows:

i. Applicable Terms and Conditions. Any new over-water or in-water structure, or replacement or upgrade of an existing structure authorized by this Opinion must be consistent with all applicable terms and conditions of this Incidental Take Statement including, but not limited to those that are relevant to monitoring and construction (*e.g.*, project notification, project completion report, minimum area, timing of in-water work, pollution and erosion control, piling installation and removal, treated wood, work area isolation, site restoration, compensatory mitigation).

ii. Educational Signs. Because the best way to minimize adverse effects caused by boating is to educate the public about pollution and its prevention, the following information must be posted and maintained on a permanent sign at all public facilities authorized by this Opinion.

(1) A description of the ESA-listed salmonids, which are or may be present in the project area.

(2) Notice that the adults and juveniles of these species and their habitats are to be protected so that they can successfully migrate, spawn, rear, and complete other behaviors necessary for their recovery.

(3) Lack of necessary habitat conditions may result in a variety of adverse effects including direct mortality, migration delay, reduced spawning, loss of food sources, reduced growth, reduced populations, and decreased productivity.

(4) All users of the facility are required or encouraged to: (1) follow procedures and rules governing use of sewage pump-out facilities; (2) minimize the fuel and oil released into surface waters during fuelings and from bilges and gas tanks; (3) avoid cleaning boat hulls in the water to prevent the release of cleaner, paint, and solvent; (4) practice sound fish cleaning and waste management, including proper disposal of fish waste; and (5) dispose of all solid and liquid waste produced while boating in a proper facility away from surface waters.

iii. Flotation.

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[17] "Estuary or other saltwater area" means an area with maximum intrusion of more than 0.5 ppt measured at depth; in the Columbia River, this includes all areas downstream from Jim Crow Sands (river mile 27).

(1) Permanently encapsulate all synthetic flotation material to prevent breakup into small pieces and dispersal in water.

(2) Install small temporary floats less than seven days before a scheduled event, remove them five days after a scheduled event is concluded, and do not leave them in place longer than 21 days total.

(3) Install mooring buoys and temporary floats (*e.g.*, shellfish traps) more than 300 feet from native submerged aquatic vegetation, more than 50 feet from the shoreline, and in water deeper than 20 feet at all times, or as necessary that gear does not ground out unnecessarily, and boats do not prop wash the bottom.

iv. Access Maintenance. Sediment or other debris including large wood that obstructs or interferes with normal use of an over-water or in-water structure may be removed or excavated as follows provided that the materials are all naturally—occurring; and sediment consists of more than 80 percent sand, gravel, or other naturally—occurring; any sediment consists of more than 80 percent sand, gravel or other naturally—occurring bottom material; and the area to be excavated is not within an EPA-designated Superfund Site, state-designated cleanup area, or the likely impact zone of a significant contaminant source, as identified by historical information on the Corps' best professional judgment.

(1) Only the minimum amount of sediment and debris necessary to restore normal use may be removed or excavated.

(2) All sediment and debris must be side cast or returned to the water downstream from the structure where it will continue to provide aquatic habitat function, unless otherwise approved in writing by NOAA Fisheries. Requests for approval should be submitted with the project notification form.

v. Boat Ramps. Concrete boat ramps must consist of pre-cast concrete slabs below the ordinary high water, and upland portions of the ramp must be completed in the dry so that no wet concrete that has cured less than 24 hours is allowed to contact any wetland or channel below ordinary high water. Rock may be used to construct a footing or other protection necessary to prevent scouring, downcutting, or failure at the boat ramp provided that the rock does not extend further than four feet from the edge of the ramp in any direction.

vi. Covered Moorages and Boathouses. Any replacement roof, wall, or garage door for covered moorages and boathouses must be made of translucent materials. In addition, each side (except the door) of the boathouse must have windows at least four feet wide installed the length of the boathouse subject to breaks only for structural support. Skylights (at least two 4-feet by 4-feet) may be installed in the roof in lieu of translucent panels.

vii. Marinas. An existing marina may be modified within the existing footprint of the moorage or in water more than 50 feet from the shoreline and more than 20 feet deep except that structures may not be placed in areas that support aquatic vegetation or areas where boat operations may damage aquatic vegetation.

viii. Piscivorus Bird Deterrence. Fill all pilings, mooring buoys, and navigational aids (*e.g.*, channel markers) with devices to prevent perching by piscivorus birds.