Final

2010 City of Snohomish General Sewer Plan and Wastewater Facilities Plan Update

Prepared for

City of Snohomish

February 2011

Prepared by

CH2MHILL

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Slough Road and Highway 9
Snohomish, WA 98290

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This report has been prepared under the direction of a registered professional engineer.

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NOTE: The following tables in the 2005 Plan have been revised and replaced by the following tables in the 2010 Plan Update:

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Acronyms and Abbreviations

µg/l	micrograms per liter
ADWF	average dry weather flow
BOD_5	biochemical oxygen demand
$CBOD_5$	carbonaceous biochemical oxygen demand
CCT	chlorine contact tank
cfu	colony forming units
CS/CM	construction services/construction management
CSO	combined sewer overflow
DO	dissolved oxygen
DOH	Washington State Department of Health
DPMC	dual-power multi-cell
Ecology	Washington State Department of Ecology
ERU	equivalent residential units
EXP	Expansion
FTE	full-time equivalents
gpad	gallons per acre per day
gpcd	gallons per capita per day
HDPE	high-density polyethylene
I/I	infiltration and inflow
IBC	International Building Codes
lb	pound
MBR	membrane bioreactor
MG	million gallons
mg/L	milligrams per liter
mgd	million gallons per day
MLSS	mixed liquor suspended solids
MMF	maximum month flow

NGVD	National Geodetic Vertical Datum
NPDES	National Pollutant Discharge Elimination System
NTU	nephelometric turbidity unit
O&M	operations and maintenance
PDF	peak day flow
PHDF	peak hour dry weather flow
PHF	peak hour flow
ppcd	pounds per capita per day
ppd	pounds per day
SAS	selector activated sludge
SBR	sequencing batch reactor
SCADA	supervisory control and data acquisition
SEPA	State Environmental Policy Act
SERP	State Environmental Review Process
SRT	solids retention time
TDH	total dynamic head
TF/SC	trickling filter/solids contact
TKN	total Kjeldahl nitrogen
TMDL	total maximum daily load
TSS	total suspended solids
UGA	urban growth area
UGA-EXP	urban growth area expansion
UV	ultraviolet
WAS	waste activated sludge
WPCF	water pollution control facility
WWTP	wastewater treatment plant

Executive Summary

<Remove and replace the existing Executive Summary with the following updated Executive Summary.>

This *General Sewer Plan and Wastewater Facilities Plan Update* (2010 Plan Update) for the City of Snohomish updates the *City of Snohomish General Sewer Plan and Wastewater Facilities Plan* (May 2005), which was adopted by the City and approved by Ecology in 2006 (2005 Plan). The updates in this document address the City's sewer system and treatment plant needs through the design year 2024. The recommended alternative is also expected to provide the City's wastewater treatment system through the design life of the proposed facility, which is estimated to be 50 years.

The City's current Wastewater Treatment Plant (WWTP) is not consistently meeting water quality standards for its discharge and has limited capacity for additional flows from long-term growth. Under its existing permit and consent decree, the City is required to make improvements to its wastewater treatment system. In addition, this 2010 Plan Update implements compliance schedules for wastewater treatment system improvements expected to be required by two agreed orders between Ecology and the City (when they are completed, these orders will be included as appendices to this 2010 Plan Update).

This 2010 Plan Update incorporates the following:

- Improvements to the existing WWTP expected to be approved by Ecology in the fall of 2010 under Alternative 5 of the 2005 Plan ("Near-Term WWTP Improvements"), which the City expects will bring the WWTP into compliance with its existing permit, consent decree, and upcoming permit renewal; and
- A regional treatment alternative, which will make improvements to the wastewater treatment system and WWTP that will remove the City's existing discharge to the Snohomish River and transfer the City's flows to the City of Everett WWTP for treatment and discharge ("Everett Conveyance Project") to meet future water quality and growth requirements.

This 2010 Plan Update reflects a decision on which wastewater system alternative to implement: the existing 2005 Plan alternative of a comprehensive upgrade to the Snohomish WWTP, or the Everett conveyance alternative of sending the City's wastewater to the City of Everett Water Pollution Control Facility (WPCF) for treatment or discharge. Both of these system alternatives and the facilities needed to implement them are discussed below. After plan adoption, the City will prepare project-level design documents, obtain necessary permits and rights-of-way, and construct the facilities.

The Washington State Growth Management Act (GMA) requires the City to provide sanitary services for the population growth that will occur over the next several decades. This planning effort is in response to existing population needs and the population increase forecast by the City of Snohomish (see Chapter 3). The City of Snohomish has had a stable population of approximately 9,000 people. Nearly all of the wastewater flow comes from residential use, and there is currently little industrial use in the City. This Plan Update projects a high-end population projection of approximately 17,554 compared with 14,133 assumed in the 2005 Plan and 14,180 in the earlier Comprehensive Plan (Table HO-4), however growth might take longer due to the economic recession. The current WWTP is sized to accommodate projected wastewater flows for this period. Based on the foregoing, it is reasonable to plan and implement improvements based on 50-year projections that are consistent with Countywide and City of Snohomish GMA policies and the useful life of the recommended facilities.

STUDY AREA

Sewer system planning relies on land use plans and population forecasts that conform with GMA, Snohomish County, and City of Snohomish requirements. Forecasts were developed based on three subareas of the City's sewer service area:

1. Snohomish's incorporated Urban Growth Area
2. Snohomish's unincorporated Urban Growth Area
3. Snohomish's UGA Potential Expansion Area (to be determined by County after 2015)

A number of areas have been considered as potential expansions of the UGA. Affected agencies have varied opinions about these expansions; Snohomish County has decided to not consider these potential expansion areas until at least 2015. Therefore, because this plan has a 20-year horizon (2024) and because many of the facilities discussed in this plan will serve at least 50 years into the future (2070), this plan assumes long-term growth of the service area but does not assume a specific location for that growth or any particular UGA expansion**.**

An updated description of the study area includes a corridor along the Snohomish River in which a conveyance pipeline to Everett would be located (Chapters 2 and 10).Collection System Description

Principal improvements to the collection system identified in the 2005 Plan and now implemented include the following:

- Pump rebuilds and a third pump installed at the Rainier Pump Station.
- Pump Station No. 13 (Eden Farms) decommissioned and new Pump Station No. 13 (Clarks Pond) constructed.
- On-site backup emergency generators installed at Pump Stations No. 6, No. 7, and No. 8 meeting consent decree requirements.
- Phases 1 and 4 of the Cemetery Creek trunk sewer constructed to serve the UGA west of SR 9.
- CSO Lift Station No. 1 currently under construction to replace the Ironworks Pump Station.
- New generators at Pump Station No. 4 (Commercial) and Pump Station No. 3 (Lincoln) currently being implemented.

TREATMENT PLANT DISCHARGE REGULATIONS

The WWTP discharges effluent to the Snohomish River under the terms of a National Pollution Discharge Elimination System (NPDES) permit issued by the Washington State Department of Ecology (Ecology). The permit identifies final limits that took effect at the beginning of the current permit cycle on July 1, 2004. Limits are more stringent from July through October, when the river flow is low, than during the rest of the year. Table ES-1 (revised 2010) summarizes the permit's final limits.

TABLE ES-1 (REVISED 2010)
Current NPDES Permit Effluent Limits

Parameter	July through October	November through June
$CBOD_5$		
Monthly average	25 mg/L (minimum 85-percent removal), 58 ppd	25 mg/L (minimum 85-percent removal), 584 ppd
Weekly average	40 mg/L	40 mg/L, 934 ppd
Daily maximum	93 ppd	
TSS		
Monthly average	37 mg/L, 355 ppd	30 mg/L, 701 ppd
Weekly average	56 mg/L, 537 ppd	45 mg/L, 1,051 ppd
Total ammonia (as N)		
Monthly average	29 ppd	N/A
Daily maximum	99 ppd	N/A
Fecal coliform bacteria		
Monthly average	200 cfu per 100 ml	200 cfu per 100 ml
Weekly average	400 cfu per 100 ml	400 cfu per 100 ml
pH		
Daily maximum	6.0	6.0
Daily maximum	9.0	9.0
Total residual chlorine		
Monthly average	83 μg/l (30 μg/l before diffuser)	83 μg/l (30 μg/l before diffuser)
Daily maximum	209 μg/l (76 μg/l before diffuser)	209 μg/l (76 μg/l before diffuser)

TREATMENT PLANT FLOWS AND LOADS

Projections of future flows for the design year (2024) were developed by projecting base flow and infiltration and inflow (I/I) separately. These two components were then summed to determine total flow. Table ES-2 (revised 2010) shows the projected 2024 treatment plant influent flows based on these assumptions.

TABLE ES-2 (REVISED 2010)
Projected Treatment Plant Influent Flows for Design Year 2024

	UGA Only	UGA and Potential UGA-EXP
Average annual flow (mgd)	1.78	1.98
Maximum month flow (mgd)	2.98	3.21
Peak-day flow (mgd)	8.52	8.83
Peak-hour flow (mgd)	22.83	23.51
Average dry weather flow (mgd)	1.29	1.39
Maximum month dry weather flow (mgd)	1.41	1.52
Peak-day dry weather flow (mgd)	2.81	3.03
Peak-hour dry weather flow (mgd)	4.51	4.85

Load Projections

Projected future loads for the design year were estimated using historical per capita loading rates and a projected design year population of 17,554 for the UGA and Potential UGA Expansion (UGA-EXP). Table ES-3 (revised 2010) summarizes the treatment plant load projections for 5-day biochemical oxygen demand (BOD_5), total suspended solids (TSS), and total Kjeldahl nitrogen (TKN).

TABLE ES-3 (REVISED 2010)
Treatment Plant Pollutant Load Projections for 2024

	UGA Only	UGA and Potential UGA-EXP
Average annual BOD_5 load (ppd)	3,359	3,862
Maximum month BOD_5 load (ppd)	3,997	4,596
Peak-day BOD_5 load (ppd)	7,759	8,921

EVALUATION OF REGIONAL TREATMENT

In accordance with state requirements for general sewer plans, the City assessed the feasibility of developing regional wastewater facilities with neighboring communities and industries within 20 miles rather than providing its own treatment facilities.

Under a regional alternative, the City would no longer treat its wastewater for discharge through its existing outfall to the Snohomish River but would convey its wastewater in a small pipe (approximately 20 inches in diameter) to a treatment plant operated by another municipality for treatment and discharge.

The two closest wastewater treatment facilities that could accept the quantity of flow produced by the City of Snohomish are the Brightwater WWTP in Woodinville and the City of Everett WPCF. Conveyance to nearly all the other facilities in the region would be substantially more difficult and costly due to distance from the City of Snohomish. Many of the other facilities discharge into the Snohomish River or associated water bodies and would not provide the water quality, habitat, and environmental benefits of a deep water outfall. Only the Everett and Brightwater facilities could be feasible due to capacity, cost, and other relevant factors.

Conveyance to the Brightwater WWTP is not a cost-effective or feasible alternative. It would be approximately twice as long as the conveyance to the Everett, with greater construction and environmental impacts (such as higher energy use for pumping) and capital and long-term O&M costs. The Brightwater WWTP is currently near completion, and it is unlikely the time and costs associated with plant redesign to accommodate the City flows and negotiation with King County on a connection would allow the City to meet its compliance schedule, which is an essential compliance consideration for the City's plan decision. The estimated total capital and capitalized cost of conveyance to the Brightwater WWTP is likely to exceed $90 million, including approximately $39 million in capital costs, approximately $1.2 million in O&M costs during the current planning period, and an assumed $66.3 million in connection and capacity charges. The net present value of this alternative through the planning period (Year 2024) is estimated to be approximately $82 million, compared with approximately $36 million for the Everett alternative and $47 million for the Snohomish WWTP upgrade alternative.

The flow transfer alternative to Everett involves conveying wastewater from the existing Snohomish WWTP site to Everett for treatment at the Everett WPCF. This alternative would eliminate the Snohomish WWTP discharge to the Snohomish River. Evaluating this alternative includes considering new facilities that would be required at the Snohomish WWTP and Everett WPCF, in addition to the impact of adding Snohomish wastewater flow to the Everett collection system. The City of Everett commissioned an engineering report that evaluated the impact of receiving City of Snohomish wastewater (Carollo, 2009). The report concluded that the Everett WPCF could accept the flow and loads by adjusting the timing of currently scheduled improvements and the addition of a future project.

Several routes for the necessary conveyance pipeline to Everett were evaluated. Alignment 1 (Lowell-Snohomish Road alignment) would be the alignment with the fewest environmental impacts, lowest cost, and most likely to be constructed within the compliance schedule. If the initial river crossing were not constructed on Alignment 1, then Alignment 2 (Riverview Road alignment) would provide a reasonable contingency alignment to accomplish the conveyance. Alignments 3 and 4 (Riverview Road/Fobes Hill or Swans Trail Road/Lowell-Snohomish Road) would not be feasible, reasonable, or practicable alternatives for the conveyance to Everett because they have substantial operational complexity, greater energy use and associated carbon footprint, complicated right-of-way, an impact on residential communities, and would likely take longer to implement than the other alignment alternatives. Alignment 1 is the selected alignment and Alignment 2 would be the alternate route is included in the event that the selected route's river crossing proves unfeasible. Two routes in proximity to these alignments associated with the planned river crossing locations will be further analyzed at the project level: on a portion of the Puget Sound Energy right-of-way and on or near a former rail right-of-way north of Riverview Road. These could be used if they prove feasible, environmentally acceptable, and preferable in terms of operation, cost, and schedule. Facility design along these alignments will be evaluated further in the project-level Engineering Report/Facility Plan and environmental review.

Changes at the existing Snohomish treatment plant would be required as a part of the regional alternative. These include conversion of the existing lagoon to an equalization basin and the addition of a pump station to convey the flows to Everett. The converted lagoon would provide some pretreatment of the wastewater. The pretreatment feature of this alternative would reduce the potential service charge levied by the City of Everett and would also reduce the impact of sedimentation in the force main.

Implementing the Everett Conveyance Project would result in an annual estimated reduction of 65,700 pounds of $CBOD_5$ and 84,300 pounds of TSS going into the Snohomish River at the Snohomish WWTP in 2024 (based on the average annual flow projection in Chapter 8 and the existing WWTP average effluent concentrations). This improves habitat quality and conditions for fish in this reach of the Snohomish River.

By eliminating the Snohomish WWTP discharge to the Snohomish River, the City would meet the requirements of future NPDES permits, total maximum daily load (TMDL) waste load objectives, and growth in the long term including future TMDL requirements or stricter permit limits. The Everett WPCF will also be able to meet its treatment objectives with the additional pollutant loads from Snohomish. Additional environmental, risk analysis, and cost comparisons demonstrated that the regional treatment alternative is cost-effective and financially feasible subject to successful negotiation of interagency cost-sharing agreements.

EVALUATION OF WWTP IMPROVEMENTS

For the overall wastewater system alternative, the 2005 Plan adopted a comprehensive WWTP upgrade to meet current and future water quality and growth requirements, which was approved by Ecology. A Final Draft WWTP Facility Plan Amendment prepared in 2009 (Kennedy/Jenks, 2009) provided preliminary engineering for this WWTP upgrade. The upgrades include major process improvements for secondary treatment, tertiary filtration, and disinfection.

Based on the Final Draft WWTP Facility Plan Amendment (Kennedy/Jenks, 2009), cloth disk filters, selector activated sludge (SAS), and ultraviolet (UV) disinfection are the recommended process alternatives. Cloth disk filters for tertiary filtration would provide a high degree of operational simplicity and have lower construction and life-cycle costs, and a smaller footprint than the other alternatives considered. SAS was selected for secondary treatment because it offers a high degree of flexibility for compliance with future treatment requirements at a relatively modest cost. It would achieve complete nitrification and removal of all soluble carbonaceous biochemical oxygen demand (CBOD) by providing sufficient aeration and solids retention time (SRT), partial denitrification and alkalinity recovery through use of anoxic zones, and removal of TSS to less than 20 milligrams per liter (mg/L) through the use of secondary clarifiers. UV disinfection was selected based on its operational simplicity, improved operational and environmental safety, lower life-cycle costs, greater flexibility for compliance with future treatment requirements, and ability to fit within a smaller footprint. Other WWTP improvements were identified from a condition assessment and the 2005 Plan recommendations.

Regardless of the decision to select the Everett conveyance alternative or continue with the 2005 Plan's WWTP upgrade alternative, a Near-Term WWTP Improvements Project is being implemented to bring the WWTP into compliance with its existing permit, consent decree, and upcoming permit renewal. The project consists of installing a submerged filter media system in the WWTP lagoons, automated dosing of supplemental alkalinity, dissolved oxygen monitoring, improvements for algae control, filtration system improvements, and automated chlorination and dechlorination. This project would implement an alternative considered, but not previously selected in the 2005 Plan. The City determined that further development in this technology makes this an appropriate improvement to implement now.

WASTEWATER SYSTEM ALTERNATIVES COMPARISON

The Everett conveyance alternative appears to be environmentally-preferable because it would remove the discharge to the Snohomish River from the City of Snohomish WWTP. The Snohomish River is currently designated both as an impaired waterbody and critical endangered species habitat. Removal of the City's discharge to the Snohomish River would protect the river and its fisheries and natural resources over the long term while also addressing future planned growth. Before the conveyance line is installed, near-term improvements to the WWTP would enable the City to meet the current NPDES permit requirements.

The WWTP upgrade alternative has fewer risks in terms of management control, permitting, and the absence of a river crossing. However, the WWTP alternative poses higher risks associated with future water quality compliance, operational responsibility, the ability to meet future growth, and cost. Overall, the Everett conveyance alternative poses fewer risks that would result in substantial future costs. Both of the alternatives should be able to meet water quality standards and permit limitations in 2024. Both of the alternatives would result in hardship rates. Because of project design, permitting, and cost, it is unlikely either alternative could be in operation before 2016. Both of the alternatives could be permitted and constructed before the expiration of the City's 2016 permit renewal.

The capital cost to construct the Everett conveyance is estimated to be approximately $22 million compared with approximately $49 million for the WWTP alternative, not including near-term WWTP improvements. The Everett conveyance alternative would require the City of Snohomish to purchase capacity and help pay for an expansion in the Everett WPCF to accommodate Snohomish flows. The net present value in 2024 for the Everett Conveyance alternative is estimated to be approximately $36 million compared to approximately $47 million for the WWTP alternative.

The Everett conveyance would require annual charges to the City of Everett that would not occur with the WWTP alternative. However, the Everett conveyance alternative would have a projected useful service life of approximately 50 years, with some maintenance and replacement costs for the pump station in approximately 20 years. In contrast, the WWTP alternative would require substantial replacement or upgrade to the treatment plant in approximately 20 years. The net present value of the Everett conveyance alternative through the project life is estimated at approximately $59 million compared with $70 million for the WWTP alternative.

The Everett conveyance is therefore the cost-effective alternative. In summary, the Everett conveyance appears to be the cost-effective, environmentally-preferred alternative. Therefore, transfer of flow to the Everett WPCF is considered the preferred wastewater treatment alternative to meet water quality compliance for the long term, combined with implementation of a near-term WWTP improvement project.

SUMMARY OF RECOMMENDATIONS

This section summarizes recommended upgrade projects and associated costs for the City of Snohomish wastewater collection system and treatment plant. Also included is a discussion of implementation schedule.

Collection System Improvements

Recommendations for reducing CSOs in the combined-sewer service area are presented in Volume II of these *Wastewater System Plans* (*Combined-Sewer Overflow Reduction Plan Update*). The improvements consist of the following key elements:

- **Conveyance system upgrades**. These upgrades include rechanneling manholes, adding emergency generators at Pump Station No. 1 (Rainier) and Pump Station No. 14 (Casino), and telemetry upgrades.
- **Continued CSO monitoring**. Continued monitoring is necessary in order to expand upon the limited overflow data available as of the end of 2003.
- **Long-Term system separation.** Separation of the combined sewers will eventually eliminate CSOs. Without replacement, as the existing sewers continue to age I/I would increase, which could result in the recurrence of CSO events. The recommended plan has sewer separation projects starting in 2014 and being completed in 2042.

Wastewater Treatment Plant Improvements

The recommended Near-Term WWTP Improvements Project consists of installing a submerged fixed-film media system in the WWTP lagoons, automated dosing of supplemental alkalinity, dissolved oxygen monitoring, improvements for algae control, filtration system improvements, and automated chlorination and dechlorination. Table ES-4 summarizes capital costs for the recommended improvements.

TABLE ES-4 (REVISED 2010)
Capital Cost Summary for Near-Term Wastewater Treatment Plant Improvements

Improvement	Budgetary Capital Cost/Allowance
Near-Term Improvements	
SFF Media System Equipment	$1,500,000
SFF Media System Installation	$400,000
Automated Dosing of Supplemental Alkalinity	$75,000
Dissolved Oxygen Monitoring	$25,000
Improvements for Algae Control	$20,000
Filtration System Improvements	$50,000
Automated Chlorination/Dechlorination	$60,000

TABLE ES-4 (REVISED 2010)
Capital Cost Summary for Near-Term Wastewater Treatment Plant Improvements

Improvement	Budgetary Capital Cost/Allowance
Subtotal	**$2,130,000**
Taxes	$183,000
Subtotal	**$2,313,000**
Contractor OH, Profit, Mob, Bonds & Insurance	$463,000
Contingency	$578,000
Subtotal	**$3,354,000**
Engineering	$335,000
Construction Management	$335,000
Total	**$4,024,000**

Everett Conveyance Project

The Everett Conveyance Project is expected to consist of a pump station, approximately five miles of force main, at least one crossing of the Snohomish River or tributary, and a connection to Everett's South End Interceptor. Flow equalizing storage is to be provided at the existing City of Snohomish WWTP. Other WWTP modifications include improvements to the headworks, and lagoon modifications including likely decommissioning of Lagoons 2, 3, and 4. The City of Everett has been providing studies of its system hydraulics and costs, as well as including the City of Snohomish flows in Everett's recently completed City of Everett Engineering Report regarding the future improvements Everett will need for its treatment plant. The cities are working toward reaching a final agreement in the fall of 2010. Table ES-5 summarizes capital costs for the Everett Conveyance Project.

TABLE ES-5 (REVISED 2010)
Cost Summary of Recommended Everett Conveyance Project

Description	Estimated Capital Cost
Force main and river crossing (rounded)	$10,842,000
Pump station and WWTP modifications (rounded)	$7,131,000
Estimated Construction Cost	**$17,973,000**
Administration, legal, and permitting (5%)	$899,000
Engineering services (10%)	$1,797,000
Construction services and management (10%)	$1,797,000
Property Acquisition	$100,000
Project Cost not including Everett charge	**$22,566,000**
Estimated Everett connection charge (initial)	$20,000,000
Estimated Project Cost including Everett charge	**$42,566,000**

Implementation Schedule

Table ES-6 shows an overall schedule for activities that must be accomplished to implement the Everett Conveyance Project.

TABLE ES-6 (REVISED 2010)
Implementation Schedule for the Everett Conveyance Project

Item	Estimated Completion Date
Adopt the coordinated Comprehensive Plan amendments and General Sewer Plan & Wastewater Facilities Plan Update	December 2010
Negotiate and approve interlocal agreements	December 2010
Complete Project-Level Engineering Report and Facility Plan and Related Project-Level SEPA Review; prepare permit applications	December 2011
Complete permitting (City of Snohomish, City of Everett, Snohomish County, JARPA)	May 2013
Complete facility design • Submit final plans and specifications - July 2013 • Submit critical milestone report - July 2013 • Decision on final construction schedule – Summer 2013[2] • Submit bid-ready plans and specifications – December 2013[2] • Bid construction – December 2013[2] • Award construction – July 2014[2]	Prior to expiration of 2016 NPDES Permit renewal
Project complete and operational substantial completion by December 2016 subject to 2013 final construction schedule decision[2]	Prior to expiration of 2016 NPDES Permit renewal

NOTES:
[1] JARPA:Joint Aquatic Resource Permit Application (includes U.S. Army Corps of Engineers and related federal reviews, Washington Departments of Ecology, of Fish and Wildlife, and Natural Resources)

[2] Agreed Order 7974, dated Sept. 10, 2010, provides for the City to submit a critical milestone report to Ecology. The City may propose in the report to adjust the final schedule based on readiness to proceed, as described in the order, and will consider the effectiveness of the near term improvements and status of compliance with treatment plant design capacity limitations.

CHAPTER 1

Introduction

<Remove and replace the existing chapter with the following updated chapter.>

PURPOSE

This *General Sewer Plan and Wastewater Facilities Plan Update* (2010 Plan Update) for the City of Snohomish updates the *City of Snohomish General Sewer Plan and Wastewater Facilities Plan* (May 2005), which was adopted by the City and approved by Ecology in 2006 (2005 Plan). The updates in this document address the City's sewer system and treatment plant needs through the design year 2024. The recommended alternative is also expected to provide the City's wastewater treatment system through the design life of the proposed facility, which is estimated to be 50 years.

The City's current WWTP is not consistently meeting water quality standards for its discharge and has limited capacity for additional flows due to long-term growth. Under its existing permit and consent decree, the City is required to make improvements to its wastewater treatment system. In addition, this 2010 Plan Update implements compliance schedules for wastewater treatment system improvements expected to be required by two agreed orders between Ecology and the City.

This 2010 Plan Update incorporates the following:

- Improvements to the existing WWTP expected to be approved by Ecology in the fall of 2010 under Alternative 5 of the 2005 Plan ("Near-Term WWTP Improvements"), which the City expects will bring the WWTP into compliance with its existing permit, consent decree, and upcoming permit renewal; and
- A regional treatment alternative, which will make improvements to the wastewater treatment system and WWTP that will remove the City's existing discharge to the Snohomish River and transfer the City's flows to the City of Everett WWTP for treatment and discharge ("Everett Conveyance Project") to meet future water quality and growth requirements.

This 2010 Plan Update reflects a decision on which wastewater system alternative to implement: the existing 2005 Plan alternative of a comprehensive upgrade to the Snohomish WWTP, or the Everett conveyance alternative of sending the City's wastewater to the City of Everett WPCF for treatment or discharge. Both of these system alternatives and the facilities needed to implement them are discussed below. After plan adoption, the City will prepare project-level design documents, obtain necessary permits and rights-of-way, and construct the facilities.

The Washington State GMA requires the City to provide sanitary services for the population growth that will occur over the next several decades. This planning effort is in response to existing population needs and the population increase forecasted by the City of Snohomish (see Chapter 3). The City of Snohomish has had a stable population of approximately

9,000 people. Nearly all of the wastewater flow comes from residential use, and there is currently little industrial use in the City. This Plan Update projects a high-end population projection of approximately 17,554 compared with 14,133 in the 2005 Plan and 14,180 in Comprehensive Plan (Table HO-4), however, growth might take longer due to the economic recession. The current WWTP is sized to accommodate projected wastewater flows for this period. Based on the foregoing, it is reasonable to plan and implement improvements based on 50-year projections that are consistent with Countywide and City of Snohomish GMA policies and the useful life of the recommended facilities.

AUTHORIZATION AND SCOPE

In order to meet its current Permit compliance schedule, the City retained a consulting engineering firm to prepare an Engineering Report and Facility Plan and related plans and specifications for a comprehensive upgrade of the WWTP in accordance with the preferred alternative in the existing 2005 Plan approved by Ecology. The 2009 Final Draft WWTP Facility Plan Amendment (Kennedy/Jenks, 2009) determined that the cost of the improvements would be approximately $50 million, compared to the approximately $10 million estimated in the 2005 Plan.

Based on this information, the City retained a consulting engineering firm to prepare an Engineering Report and Facility Plan for an apparently environmentally-preferable alternative to convey the City's wastewater to the City of Everett's wastewater treatment plant. The conveyance alternative appears to be environmentally-preferable because it would remove the City of Snohomish's wastewater discharge to the Snohomish River, which is currently both designated as an impaired waterbody and as critical endangered species habitat. Removal of the City's discharge to the Snohomish River would protect the river and its fisheries and natural resources over the long term while also addressing future planned growth. This alternative was considered but not selected for the 2005 Plan for various reasons including its then disproportionately-higher cost estimate.

Based on a preliminary Draft Facility Plan Amendment received by the City in September 2009, the City determined that a conveyance line to Everett would be feasible, assuming an acceptable interlocal agreement could be reached with the City of Everett, that Ecology would support and assist in funding this alternative, and that the compliance schedule could be modified to take into account the public and environmental review, permitting and financial plan required to enable the City's effluent to be removed from the Snohomish River under this alternative.

As described later in Chapter 10, the conveyance to Everett includes a pump station, approximately five miles of force main, at least one crossing of the Snohomish River or tributary, and a connection to Everett's South End Interceptor. Flow equalizing storage is to be provided at the existing City of Snohomish WWTP to limit peak flows to 4,500 gpm. The City of Everett has been providing studies of its system hydraulics and costs, as well as including the City of Snohomish flows in Everett's recently completed Water Pollution Control Facility Engineering Report regarding the future improvements Everett will need for its treatment plant. The cities are working toward reaching a final agreement in the fall of 2010.

Because of the requirements under the Clean Water Act and GMA to amend the City's 2005 Plan and prepare project-level Engineering Report and Facility Plan, to conduct related environmental review under the State Environmental Policy Act (SEPA), and to obtain numerous federal, state and local permits, rights-of-way, and grants, implementation of a conveyance to Everett will likely take approximately six years on an aggressive schedule. The City has determined that compliance with effluent discharge limitations under the NPDES permit and upcoming renewal can likely be met by a Near-Term WWTP Improvements Project that can be constructed by 2012. The Near-Term WWTP Improvements Project would consist of installing a submerged filter media system in the WWTP lagoons and related improvements. The Near-Term WWTP Improvements Project is described in Chapter 11.

Much of the 2005 Plan remains current and does not need to be updated. The scope of work involved in developing this report included the following:

- Updating the regional alternative and WWTP alternatives chapters to incorporate the information summarized above.
- Replacing chapters describing the recommended plan and its financing in order to implement the two improvements noted above.
- Replacing the chapter on land use and population to use current information.
- Adding inserts or replacement sections to other chapters as needed to update information in the plan.

The City has a separate CSO Reduction Plan Update (2005) that addresses CSO Control improvements in detail.

WASTEWATER SYSTEM OWNERSHIP AND OPERATION

The City of Snohomish owns, operates, and maintains the collection system within the City limits, including pump stations. The City currently owns, operates, and maintains the WWTP site and facilities. The City will continue to own, operate, and maintain certain facilities at the current WWTP site under this plan. The City of Everett will own, operate, and maintain the WWTP and facilities that will be used to treat the City of Snohomish wastewater flows when the Everett Conveyance Project is operational under this plan (see the City of Everett's *General Sewer Plan and Wastewater Facility Plan* for City contact information). Below is the contact information for the City of Snohomish's wastewater system:

Timothy C. Heydon, P.E., Public Works Director
City of Snohomish
116 Union Avenue
Snohomish, WA 98290
360.568.3115
heydon@ci.snohomish.wa.us

RELATED STUDIES AND REFERENCES

Following are the following principal studies and planning documents referenced in preparing this report. Other City of Snohomish, City of Everett, and Snohomish County plans and regulations; other federal, state, and local laws and regulations; and Ecology guidance on sewer planning and design, are not listed, as they are widely available on the web and public domain.

- Carollo. 2009. City of Everett Engineering Report, September 2009.
- CH2M HILL, Brown and Caldwell. 2007. Amendment No. 1. Facilities Plan. Brightwater Regional Wastewater Treatment System. May 2007.
- CH2M HILL. 2004. Effluent Mixing Study. Outfall 100. Kimberly-Clark Everett Mill.
- City of Everett. 2005. Port Gardner Outfall Program Fact Sheet.
- City of Snohomish. 2004 and 2005. SEPA Determination of Non-Significance and Notice of Adoption for the 2005 Plan.
- City of Snohomish. 2009. City of Snohomish Comprehensive Plan.
- City of Snohomish. 2010. SEPA Addendum. General Sewer Plan Update and Associated Comprehensive Plan Amendments and Implementing Actions.
- Federal Emergency Management Administration (FEMA). 2005. Flood Insurance Study. Snohomish County, Washington and Incorporated Areas. FEMA
- Kennedy/Jenks Consultants. 2009. Final Draft Wastewater Treatment Plant (WWTP) Facility Plan Amendment.
- Kennedy/Jenks Consultants. 2010. Draft Technical Memorandum City of Snohomish Updated Wastewater Flow and Load Projections.
- Kennedy/Jenks Consultants. 2010. Technical Memorandum. Summary of WWTP Compliance Improvement Considerations.
- Tetra Tech/KCM. 2005. City of Snohomish General Sewer Plan and Wastewater Facilities Plan. May 2005.

CHAPTER 2

Background

<Add the following to the end of the "STUDY AREA" section.>

STUDY AREA

Evaluating the regional alternative for discharge to the City of Everett would increase the study area to include a corridor along the Snohomish River in which a conveyance pipeline would be located; this additional study area is shown in Figure 2-1A (New 2010).

<Add the following to the end of the "Floodplains" section.>

Floodplains

Since the 2005 Plan, the floodplains have been finalized and are described in FEMA's 2005 *Flood Rate Insurance Study and Flood Insurance Rate Maps* (FIRMs). The conveyance line to Everett described in Chapter 10 would be co-located with dike roads in public right-of-way located in or adjacent to floodplains in the additional study area noted above (see Chapter 10).

<Replace the first paragraph of "WATER SUPPLY" with the following.>

WATER SUPPLY

The City water system consists of a source, a treatment plant, storage, and a distribution system. The distribution system consists of metal and plastic pipes, varying in size; 6 million gallons of reservoir storage; and a 2.7 million gallon storage tank. The water source facilities include a diversion dam located 14 miles northeast on the Pilchuck River and four connections to the City of Everett transmission line.

<Replace the last paragraph of "OTHER WASTEWATER FACILITIES" with the following.>

OTHER WASTEWATER FACILITIES

As the City proceeded with developing a WWTP capital improvement plan, the estimated cost of the recommended treatment plant upgrades far exceeded original estimates and the funding the City expected to secure (see Chapters 1 and 11). For this reason, the City reconsidered regional treatment. Only the Everett and Brightwater facilities have the potential to be feasible due to capacity, cost, and other relevant factors. The Brightwater facility is near completion and is not feasible, as explained in Chapter 10. Treatment of City of Snohomish wastewater flows at the Everett WPCF (described in Chapter 10) is the recommended plan described in Chapters 12 and 13.

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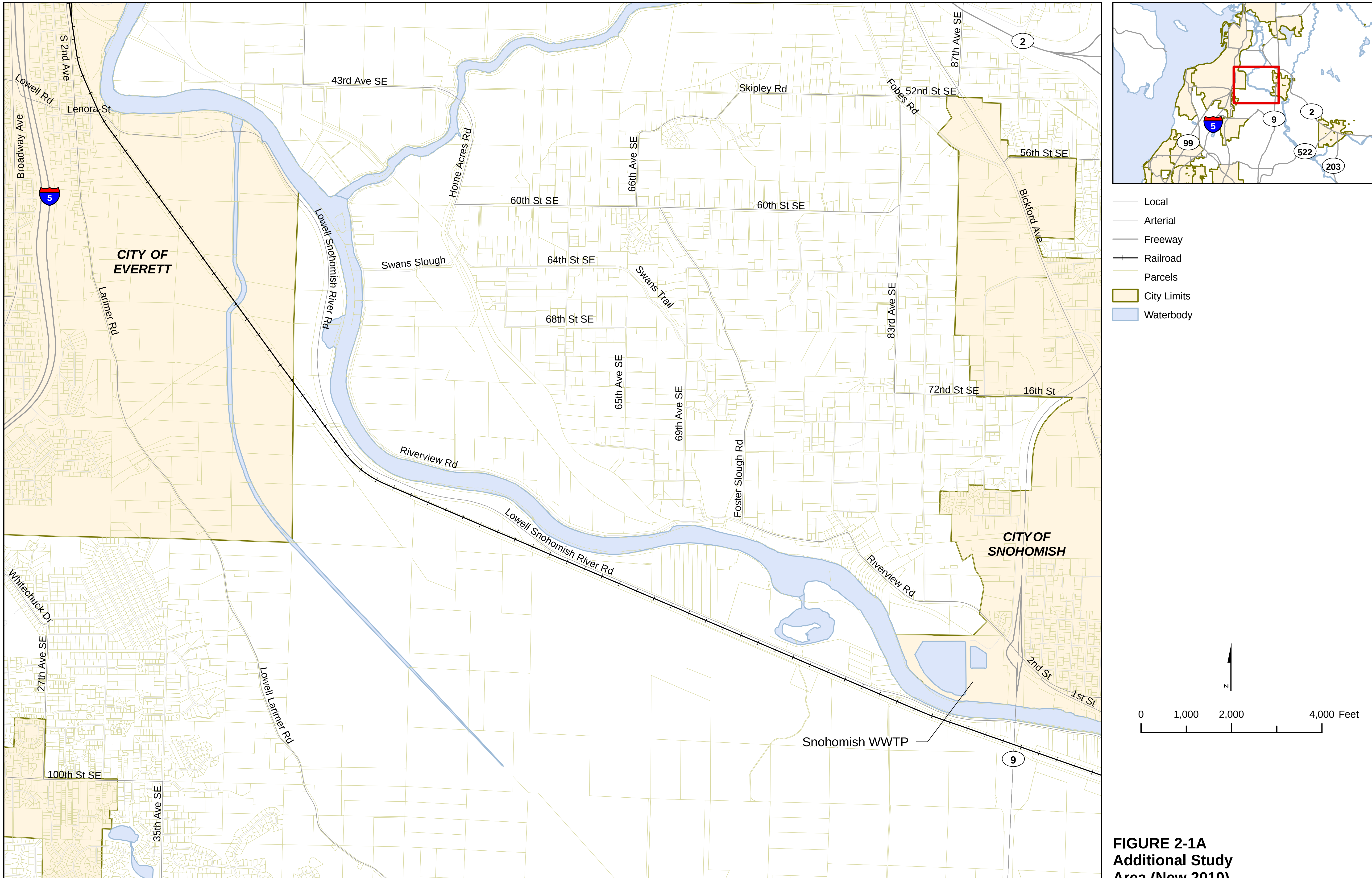


FIGURE 2-1A
Additional Study Area (New 2010)

CHAPTER 3

Land Use and Population

<Remove and replace the chapter with the following updated chapter.>

LAND USE

Current (June 2010) adopted planned land use for the City is shown on Figure 3-1 (New 2010) for the UGA. The land use designations shown in this figure were provided by the City of Snohomish Planning and Development Service Department.

PLANNING AREAS

Sewer system planning relies on land use plans and population forecasts that conform with GMA, Snohomish County, and City of Snohomish requirements. Forecasts were developed based on three subareas of the City's sewer service area:

1. Snohomish's incorporated Urban Growth Area
2. Snohomish's unincorporated Urban Growth Area
3. Snohomish's UGA Potential Expansion Area (to be determined by County after 2015)

The planning areas are shown in Figure 3-2 (Revised 2010) and the forecasts are shown in Figure 3-3 (New 2010). The size of each planning area is listed in Table 3-1 (Revised 2010). Forecast population for the Sewer Planning Area is about 17,500 by the Year 2024.

FIGURE 3-3 (NEW 2010)
Forecast Population for Sewer Study Area

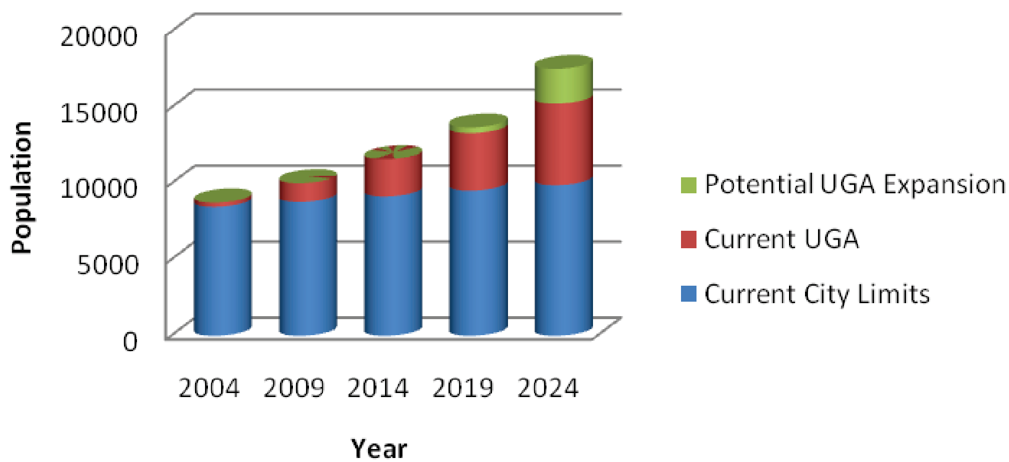


TABLE 3-1 (REVISED 2010)
Planning Area Acreage

Planning Area	Existing City	UGA	Outside UGA	Total
Combined Sewer System	325	0	0	325
Separated Sewer System	1,175	0	0	1,175
Cemetery Creek	350	870	0	1,220
South UGA	0	280	0	280
Potential UGA Expansion	0	0	220	220
Total	1,850	1,150	220	3,800

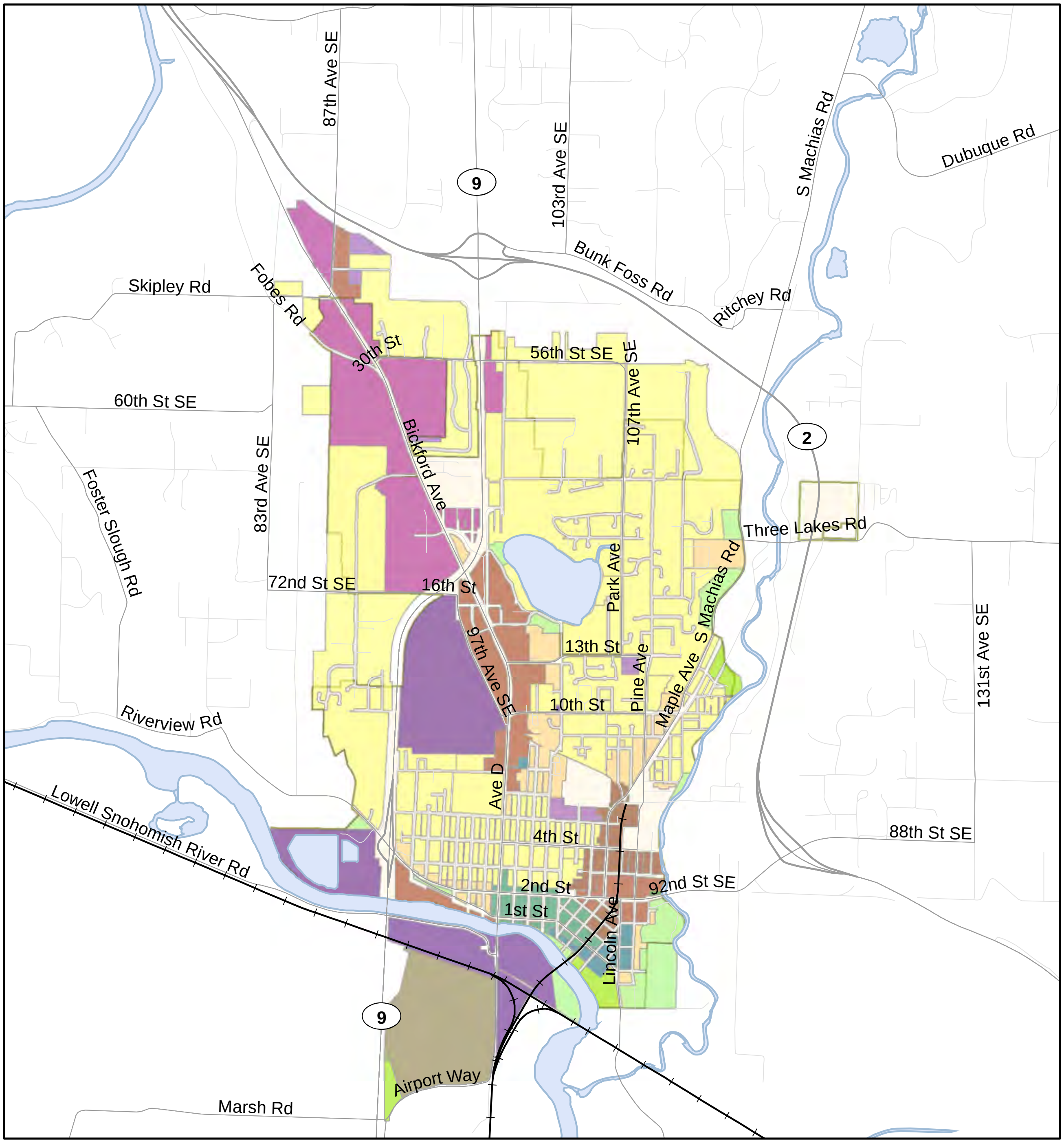
POPULATION

Sewered population projections were updated to reflect the most recent planning conditions and are documented in the *Draft Technical Memorandum City of Snohomish Updated Wastewater Flow and Load Projections* (Kennedy/Jenks, 2010). The 2024 sewered population is expected to be in the range of 9,905 to 17,554. The 2005 Plan assumed a population of 14,133 and the City's earlier Comprehensive Plan (Table HO-4) was based on a population of 14,180. However, these figures were for the UGA area, did not include projections for potential UGA expansion, and indicated a subsequent update would provide an estimate. This 2010 Plan Update provides the updated projection as of 2010.

A number of areas have been considered as potential expansions of the UGA. Affected agencies have varied opinions about these expansions; Snohomish County has decided to not consider these potential expansion areas until at least 2015. Therefore, because this plan has a 20-year horizon and because many of the facilities discussed in this plan will serve at least 50 years into the future, this plan assumes long-term growth of the service area but does not assume a specific location for that growth or any particular UGA expansion**.** The updated population projects are shown in Table 3-3 (revised 2010).

TABLE 3-3 (REVISED 2010)
City of Snohomish Population Forecasts

Sewered Population	2004	2009	2014	2019	2024
City	8,480	8,813	9,168	9,531	9,905
Unincorporated Area	280	1,240	2,434	3,795	5,363
Potential UGA Expansion Area	0	0	0	381	2,286
Total	8,760	10,053	11,602	13,707	17,554



Landuse

- Airport Industry
- Commercial
- Industry
- Business Park
- Mixed Use
- Historic Business
- Low Density Residential
- Medium Density Residential
- High Density Residential
- Single Family Residential
- Open Space
- Park
- Urban Horticulture
- Railroad
- Local
- Freeway
- Arterial
- Waterbody
- City Limits

N

0 0.5 1
Miles

VICINITY MAP

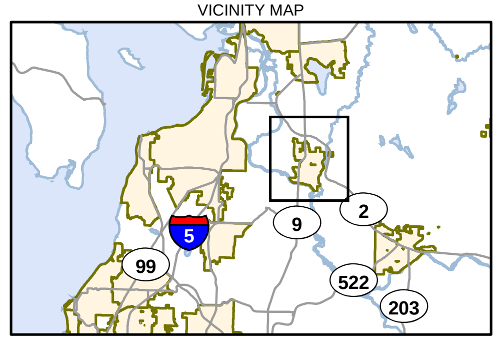


FIGURE 3-1
Current Planned Land Use (Revised 2010)
Facility Plan Amendment

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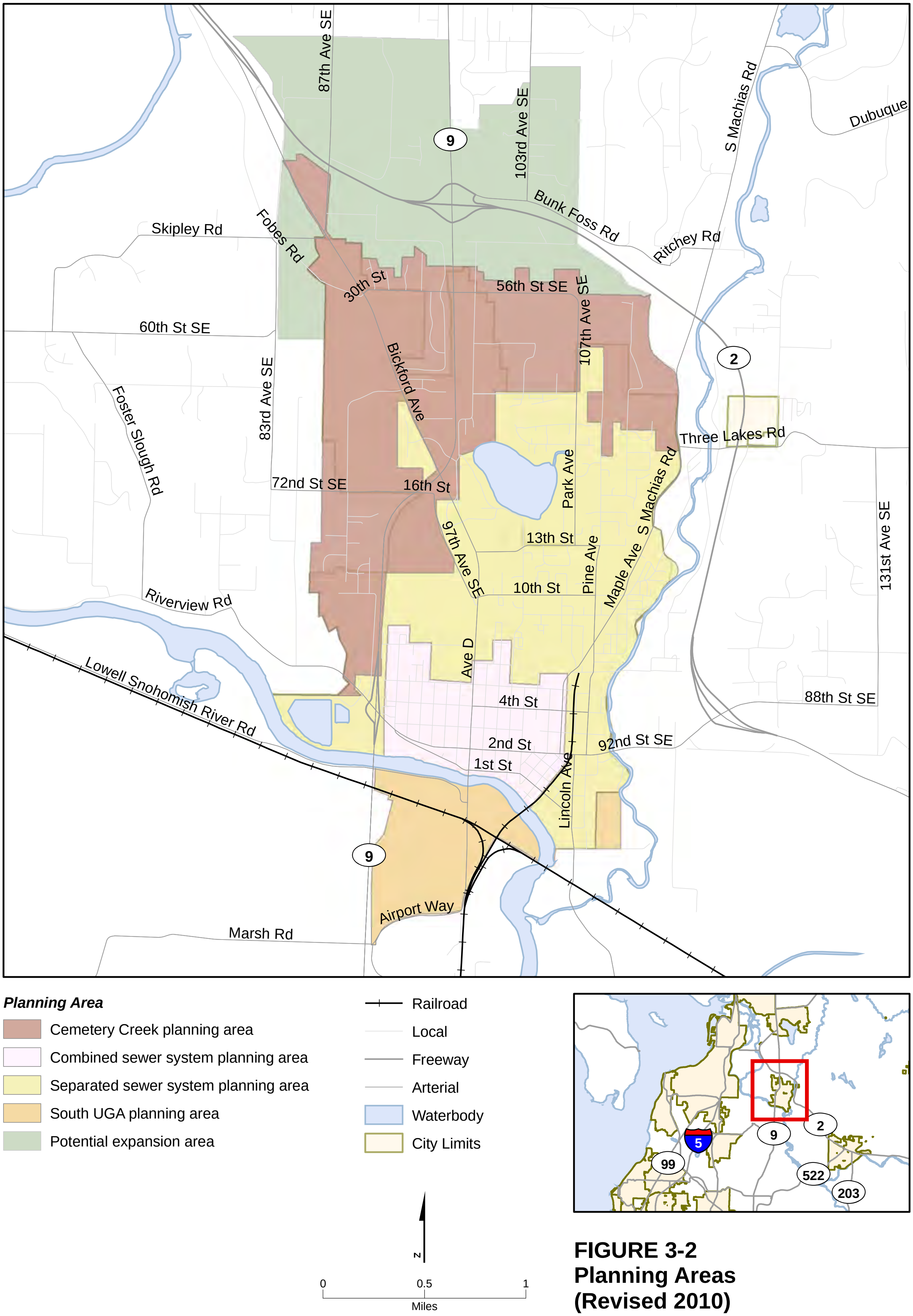

FIGURE 3-2
Planning Areas
(Revised 2010)

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CHAPTER 4

Permits, Requirements, and Regulations

FEDERAL REGULATIONS

<Replace the NEPA section" with the following.>

National Environmental Policy Act

The National Environmental Policy Act (NEPA) requires environmental review of proposed federal actions that could significantly affect the quality of the human environment. This environmental review takes the form of an environmental impact statement if the proposal would have significant impacts, or an environmental assessment, if it would not. Federal actions that typically could not, individually or cumulatively, have a significant environmental impact might be categorically excluded from environmental review under an agency's NEPA implementing procedures. Generally, EPA is the NEPA lead agency for proposals for federal funding of local wastewater treatment facilities. Ecology, EPA, and other agencies try to coordinate early environmental impact review in conjunction with review under the SEPA to facilitate timely funding decisions.

<Replace the "Floodplains/Wetlands section" with the following.>

Floodplains, Wetlands, and Flood Insurance

Various federal laws and requirements, including the Clean Water Act and Executive Orders 11988 and 11990 on floodplains and wetlands, limit federal agency approval of development of wetlands and floodplains. Under the GMA, cities and counties in Washington State are required to limit development in "critical areas," which include wetlands and floodplains. These local critical area regulations implement federal, state, and local protections for wetlands and floodplains.

<Add the following to the end of the "Coastal Zone Management" section.>

Coastal Zone Management

For Snohomish County and the cities of Snohomish and Everett, the local Shoreline Master Programs (SMPs) are the applicable Coastal Zone Management programs and contain the applicable development standards.

<Add the following to the end of the "Endangered Species Act" section.>

Endangered Species Act

- Steelhead trout – federally threatened and federal candidate species

<Add the following to the end of the "Public Participation" section.>

Public Participation

The City of Snohomish has implemented a proactive and extensive public outreach and participation program as part of the development and approval of this General Sewer Plan and companion amendments to the City's Comprehensive Plan.

Public and agency comment and input were solicited initially prior to the development of the Draft GSP with a Request for Consultation and Comment on Scope of SEPA Addendum and the plan updates. The City is preparing a SEPA Addendum on the plan update to supplement the existing environmental review that was performed on the 2005 Plan. The public notice was initially mailed and published on June 11, 2010. The public written comment period for this scoping notice extended until June 29, 2010. The City followed up with interagency and tribal consultations and outreach to environmental groups.

Subsequent to the June Scoping Notice, the SEPA Addendum was circulated with the proposed draft 2010 Plan Update and draft Comprehensive Plan amendments on August 13, 2010 for a 30-day public and agency comment period. Following public hearings and additional opportunities to comment before the Snohomish Planning Commission and City Council, the City Council is to make its decision on adoption of the plan before the end of 2010.

STATE POLICIES AND REGULATIONS

<Add the following to the end of the "NPDES Wastewater Permit" section.>

NPDES Wastewater Permit

The current NPDES permit effluent limits are summarized in Table 4-4 (revised 2010). The NPDES permit allows a maximum monthly average influent flow of up to 2.80 mgd and influent waste loads of 3,960 ppd of $CBOD_5$ and 4,400 ppd of TSS. In addition to effluent limits for $CBOD_5$ and TSS, the permit also specifies effluent limits for ammonia, fecal coliform bacteria, pH, and total residual chorine. Permit limits for total residual chlorine are based on higher limits allowed after the recent completion of outfall diffuser improvements. More stringent limits for $CBOD_5$, TSS, and ammonia during July through October (low river flow period) are the result of an ongoing cleanup plan for the Snohomish Estuary.

TABLE 4-4 (REVISED 2010)
Current NPDES Permit Effluent Limits

Parameter	July through October	November through June
$CBOD_5$		
Monthly average	25 mg/L (minimum 85-percent removal), 58 ppd	25 mg/L (minimum 85-percent removal), 584 ppd
Weekly average	40 mg/L	40 mg/L, 934 ppd
Daily maximum	93 ppd	
TSS		
Monthly average	37 mg/L, 355 ppd	30 mg/L, 701 ppd
Weekly average	56 mg/L, 537 ppd	45 mg/L, 1,051 ppd
Total ammonia (as N)		
Monthly average	29 ppd	N/A
Daily maximum	99 ppd	N/A

TABLE 4-4 (REVISED 2010)
Current NPDES Permit Effluent Limits

Parameter	July through October	November through June
Fecal coliform bacteria		
Monthly average	200 cfu/100 ml	200 cfu/100 ml
Weekly average	400 cfu/100 ml	400 cfu/100 ml
pH		
Daily maximum	6.0	6.0
Daily maximum	9.0	9.0
Total residual chlorine		
Monthly average	83 μg/l (30 μg/l before diffuser)	83 μg/l (30 μg/l before diffuser)
Daily maximum	209 μg/l (76 μg/l before diffuser)	209 μg/l (76 μg/l before diffuser)

<Add the following to the end of the "Total Maximum Daily Load Limits" section.>

Total Maximum Daily Load Limits

TMDLs for $CBOD_5$ and ammonia were approved by Ecology in 2000 to address water quality issues pertaining to dissolved oxygen (DO) in the Snohomish River estuary.

<Add the following to the end of the "Washington Department of Ecology Criteria for Sewage Works Design" section.>

Washington Department of Ecology Criteria for Sewage Works Design

The wastewater facilities proposed in this plan update will comply with the guidelines in the most recent Orange Book, published in August 2008.

<Replace the text in this section with the following:>

State Environmental Policy Act

The SEPA is Washington State's parallel statute to NEPA. Similar to the federal law and White House Council on Environmental Quality NEPA Rules, Ecology issues statewide rules for SEPA compliance, and each agency of the state, including municipalities such as cities and counties, has a set of implementing procedures and carries out SEPA for its own proposed actions. Ecology's process for coordinating environmental review for grant funding is discussed below. The local SEPA process is discussed in the Local Policies section of this chapter.

LOCAL POLICIES

<Replace the last two sentences of the "Consent Decree" section with the following.>

Consent Decree

The 2005 Plan met these requirements. The consent decree was modified in June 2007 to allow the City time to implement required improvements. A copy of the consent decree is included in Appendix D.

<Replace the section "Uniform Fire Code" section with the following.>

Fire Code

County fire officials have authority to enforce the 2006 edition of the International Fire Code adopted by the State of Washington under RCW 19.27.

<Replace the text in the "SEPA Review" section with the following:>

SEPA Review

The City issued a Notice of Adoption and Determination of Non-Significance on the 2005 Plan on March 4, 2005, which was publicly noticed, as well as circulated to agencies with jurisdiction. SEPA directs agencies to use existing environmental information and provides for a SEPA Addendum to be used as the environmental impact report to augment an existing environmental review if there are no new significant adverse impacts. The City is, therefore, preparing a SEPA Addendum on the proposed 2010 Plan Update and companion Comprehensive Plan amendments. The SEPA process is part of a phased review process (called "tiering" under NEPA). The SEPA Addendum on the plan updates will be followed by project-level SEPA review of the facilities that would be constructed to implement the adopted plan.

A plan-level draft SEPA Addendum on the proposed draft 2010 Plan Update and draft Comprehensive Plan amendments was issued for a 30-day public comment period on August 13, 2010. The addendum evaluates the alternatives and their impacts at a plan-level of detail, as provided by SEPA and the GMA. A final SEPA Addendum will be issued prior to final action by the City and Ecology on the plan update.

<Replace the last paragraph of the "Shoreline Management Program" section with the following:>

Shoreline Management Program

Like the City of Snohomish, Snohomish County and City of Everett have also adopted Shoreline Master Programs, whose requirements will apply to any facilities in this plan that would be constructed within the shoreline districts of those neighboring jurisdictions.

CHAPTER 5

Collection System Design Criteria and Flows

<There are no updates for this Chapter.>

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CHAPTER 6

Collection System Description

Improvements to the collection system identified in the 2005 plan that have occurred to the City's collection system since the 2005 Plan include the following:

- Pump rebuilds and a third pump installed at the Rainier Pump Station.
- Pump Station No. 13 (Eden Farms) decommissioned and new Pump Station No. 13 (Clarks Pond) constructed.
- 3 manholes channeled.
- On-site backup emergency generators installed at Pump Stations No. 6, No. 7, and No. 8 meeting consent decree requirements.
- Phases 1 and 4 of the Cemetery Creek trunk sewer constructed to serve the UGA west of SR 9.
- Phases 2 and 3 of the Cemetery Creek trunk sewer partially completed and will serve areas north of Blackman's Lake and east of SR 9 once economic conditions become more favorable.
- CSO Lift Station No. 1 currently under construction to replace the Ironworks Pump Station.
- New generators at Pump Station No. 4 (Commercial) and Pump Station No. 3 (Lincoln) currently being implemented.
- Beacons and horns installed at lift stations where missing to provide visual and audible alarm notification.
- New Pump Station No. 13 (Clarks Pond) constructed to serve plats of Clark's Pond and Rose Lane.

Telemetry upgrades at all stations will be completed pending 2011 funding approval. In addition, the previously recommended purchase of a third trailer-mounted emergency generator is no longer needed.

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CHAPTER 7

Collection System Analysis

NORTH ADDITION PLANNING AREA

<Remove and replace the following of the "Existing Conditions" section.>

Existing Conditions

The North Addition Planning Area is located in the northwestern corner of the 2002 UGA and is approximately 220 acres in size. The estimated area of the North Addition is approximately 80 acres smaller than stated in the 2005 Plan because more recent UGA maps do not include annexation of the area east of State Route 9. UGA additions will not be addressed by the County until after 2015 (see Chapter 3).

<Remove and replace the following in the first sentence of the "Future Conditions" section.>

Future Conditions

This area was recently annexed into the City. Phases 1 and 4 of the Cemetery Creek Trunk provide sewer service for the UGA west of SR 9. Phases 2 and 3 are partially complete and will serve the areas north of Blackmans Lake and east of SR 9 once economic conditions become more favorable.

SUMMARY

<Remove and replace the Table 7-10 with the following Table 7-10 (Revised 2010.>

TABLE 7-10 (REVISED 2010)
Summary of Recommended Collection System Improvements

Project No.	Location	Description	Planning Level Cost
Pump Station No. 2 (Rainier) Interim Improvements			
a.		Install a flow meter to verify pump station capacity.	$23,800
Telemetry Upgrades			
a	Pump Stations	Install fire and intrusion alarms, telemetry data logging and retrieval upgrades, and two pump-running alarms. Provide level sensors with volume calculations at Lincoln, Rainier, Champagne, and Hill Park.	$84,800
Miscellaneous			
a.	Separated Sewer System	Complete channeling of unchanneled manhole.	$16,000
b.	Pump Station No. 3 (Lincoln)	Install a drain in the valve box.	$5,300
c.	Pump Station No. 7 (Champagne)	Replace existing force main and reroute to the gravity sewer at Park and 17th Place.	$175,000

TABLE 7-10 (REVISED 2010)
Summary of Recommended Collection System Improvements

Project No.	Location	Description	Planning Level Cost
d.	Combined Sewer Area	Complete channeling of unchanneled manholes.	$16,000
Kla-Ha-Ya Upgrades			
a.	Kla-Ha-Ya	Eliminate the pump station by requiring installation of private gravity side sewers to the City's gravity sewer on First Avenue.	$0
Rainier Pump Station Replacement			
a.	Rainier Pump Station	Budget amount to complete replace the pump station in the future.	$2,490,000

<Add the following to the end of Chapter 7:>

Improvement alternatives that have been implemented are listed in Chapter 6 of this 2010 Update.

CHAPTER 8

Treatment Plant Flow and Load Evaluation

SEWERED POPULATION

Sewered population projections were updated to reflect the most recent planning conditions and are documented in the *Draft Technical Memorandum City of Snohomish Updated Wastewater Flow and Load Projections* (Kennedy/Jenks, 2010) provided in Appendix N. Projected sewer population is shown in Chapter 3.

HISTORICAL WASTEWATER FLOWS AND LOADS

<Add the following to the end of the "Data Sources" section.>

Data Sources

Data from plant discharge monitoring reports (DMRs) from January 2004 through June 2009 were reviewed for this update. Table 8-7 (revised 2010) summarizes the influent data from this period.

PROJECTED WASTEWATER FLOWS AND LOADS

<Add the following to the end of the "Projected Wastewater Flows and Loads" section.>

Kennedy/Jenks Consultants updated the wastewater flow and load projections in the *Draft Technical Memorandum City of Snohomish Updated Wastewater Flow and Load Projections* (Kennedy/Jenks, 2010) to reflect changes in population projections and the most recent planning conditions. This memo is provided in Appendix N.

TABLE 8-7 (REVISED 2010)
Summary of Plant Influent Data

	Flow (mgd)	7-Day Flow Average (mgd)	30-Day Flow Average (mgd)	BOD 5-Day (mg/L)	BOD 5-Day (lbs/d)	7-Day BOD 5-Day (lbs/d)	30-Day BOD 5-Day (lbs/d)	CBOD 5-Day (mg/L)	CBOD 5-Day (lbs/d)	7-Day CBOD 5-Day (lbs/d)	30-Day CBOD 5-Day (lbs/d)	TSS (mg/L)	TSS (lbs/d)	Weekly TSS (lbs/d)	Monthly TSS (lbs/d)
Overall															
Average	1.18	1.18	1.18	203	1,723	1,725	1,714	179	1,508	1,520	1,514	161	1,389	1,394	1,388
Minimum	0.48	0.62	0.64	52	540	540	1,035	44	200	667	1,054	34	0	715	889
Maximum	7.86	3.74	2.69	461	6,330	6,330	3,430	416	4,268	2,947	2,066	602	7,379	4,604	3,123
November through June (High)															
Average	1.36	1.37	1.38	176	1,756	1,760	1,757	156	1,533	1,546	1,542	146	1,464	1,469	1,474
Maximum	7.86	3.74	2.69	410	6,330	6,330	3,430	340	4,268	2,947	2,066	602	7,379	4,604	3,123
July through October (Low)															
Average	0.77	0.77	0.76	266	1,643	1,662	1,670	234	1,447	1,475	1,460	196	1,216	1,233	1,229
Maximum	2.46	1.24	1.04	461	2,730	2,730	2,252	416	3,086	2,182	1,792	384	3,747	2,621	1,717

NOTES:
BOD biochemical oxygen demand
CBOD carbonaceous biochemical oxygen demand
lbs/d pounds per day
mgd million gallons per day
mg/L milligrams per liter
TSS total suspended solids

DESIGN CRITERIA

<Remove and replace with the following "Design Criteria" section.>

Table 8-13 (revised 2010) shows the revised influent flow, BOD, TSS, and TKN projections for the 2024 planning scenario, which represent the treatment facility design criteria.

TABLE 8-13 (REVISED 2010)
Revised Projections for 2024 Planning Scenarios

	UGA Only	UGA and Potential UGA-EXP
Planning scenario number	**No. 1**	**No. 2**
2024 service area population	15,268	17,554
Average annual flow (mgd)	1.78	1.98
Maximum month flow (mgd)	2.98	3.21
Peak-day flow (mgd)	**8.52**	**8.83**
Peak-hour flow (mgd)	22.83	23.51
Average dry weather flow (mgd)	1.29	1.39
Maximum month dry weather flow (mgd)	1.41	1.52
Peak-day dry weather flow (mgd)	2.81	3.03
Peak-hour dry weather flow (mgd)	4.51	**4.85**
Average annual BOD_5 load (ppd)	3,359	3,862
Maximum month BOD_5 load (ppd)	3,997	4,596
Peak-day BOD_5 load (ppd)	7,759	8,921

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CHAPTER 9

Existing Wastewater Treatment Facility

TREATMENT PLANT PERMIT COMPLIANCE

<Add the following to the end of the "Treatment Plant Permit Compliance" section.>

Data from plant DMRs from January 2004 through June 2009 were reviewed for this update. Table 9-A (New 2010) summarizes the effluent data from this period. Figures 9-A (New 2010) and 9-B (New 2010) compare the treatment plant effluent with the NPDES permit limits for both the low and high river seasons.

Since 2003, the City has had 115 NPDES permit compliance violations, as shown in Table 9-B (New 2010).

TABLE 9-B (NEW 2010)
Summary of NPDES Permit Violations (January 2004 through December 2009)

Year	No. of Violations (total ammonia)	CBOD	Fecal Coliform	Chlorine Residual	Total
2004	4				4
2005	2	2			4
2006	31	32	1	1	65
2007		21	4		25
2008	2	7	2		11
2009	3			3	6
Total	**42**	**62**	**7**	**4**	**115**

TABLE 9-A (NEW 2010)
Summary of Plant Effluent Data (January 2004 through June 2009)

	Flow (mgd)	CBOD 5-Day (mg/L)	CBOD 5-Day (lbs/d)	Weekly CBOD 5-Day (lbs/d)	Monthly CBOD 5-Day (lbs/d)	CBOD 5-Day (percent removal)	TSS (mg/L)	TSS (lbs/d)	Weekly TSS (lbs/d)	Monthly TSS (lbs/d)	Ammonia (mg/L)	Ammonia (lbs/d)	Monthly Ammonia (lbs/d)	Fecal Coliform (#/100 ml)
Overall														
Average	1.13	11	95	102	101	93	14	112	121	119	15	136	135	38
Minimum	0.00	3	5	12	14	5	2	0	3	6	0	0	1	0
Maximum	8.42	62	1,103	898	367	99	49	774	532	343	39	910	406	1,333
November through June (High)														
Average	1.33	10	106	115	115	92	11	116	126	123	16	182	179	42
Maximum	8.42	60	1,103	898	367	99	40	774	532	343	39	910	406	1,333
July through October (Low)														
Average	0.69	13	69	75	75	94	19	101	109	107	12	54	52	30
Maximum	2.86	62	295	248	159	99	49	465	442	249	34	278	175	1,160

FIGURE 9-A (NEW 2010)
WWTP Performance, Low River Season, January 2004 through June 2009

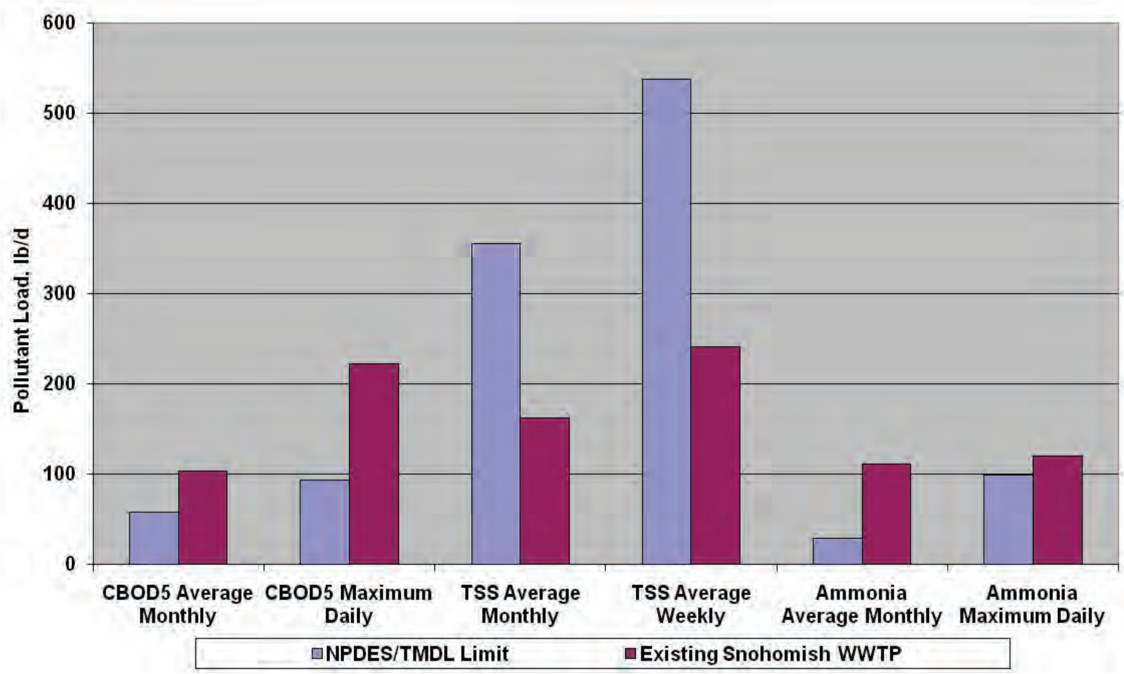
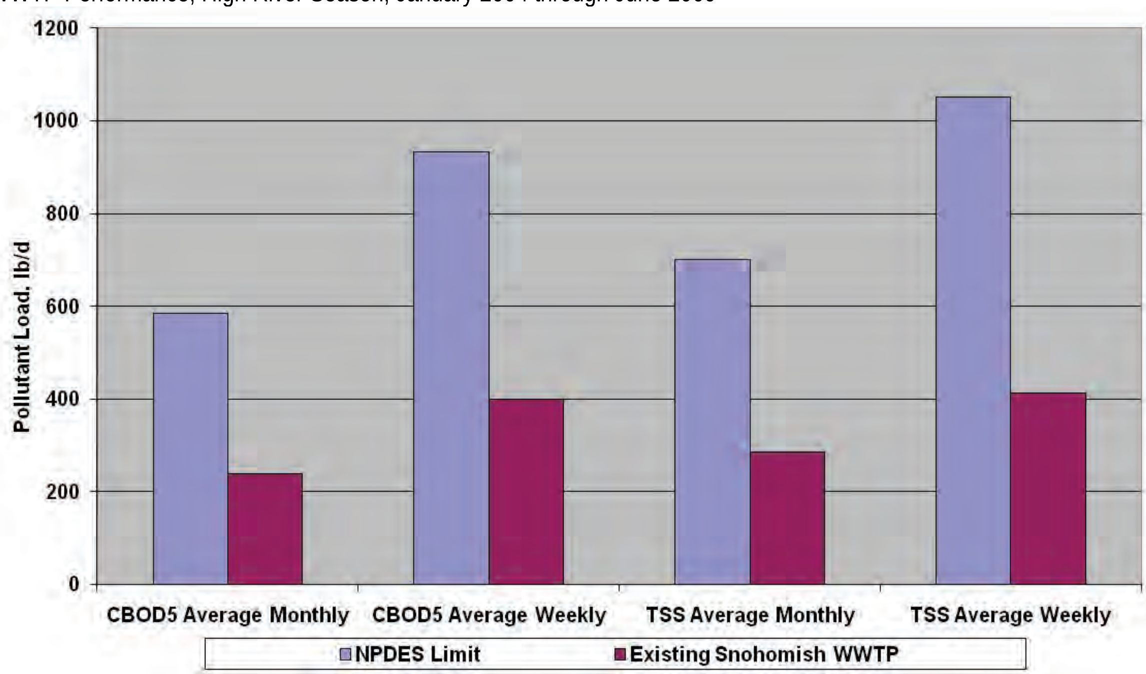


FIGURE 9-B (NEW 2010)
WWTP Performance, High River Season, January 2004 through June 2009



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CHAPTER 10

Regional Wastewater Treatment Alternatives

<Replace this entire chapter with the following.>

Under the requirements of WAC 173-240-050 for General Sewer Plans, the City of Snohomish must assess the feasibility of developing regional wastewater facilities with neighboring communities and industries within 20 miles rather than providing its own treatment facilities. Under a regional alternative, the City would no longer treat its wastewater for discharge through its existing outfall to the Snohomish River but would convey its wastewater in a small pipe (approximately 20 inches in diameter) to a treatment plant operated by another municipality for treatment and discharge.

This chapter evaluates regional wastewater treatment alternatives for the City of Snohomish and neighboring municipalities. The following municipalities and utility districts are within 20 miles of the City of Snohomish:

- City of Marysville
- City of Everett
- Lake Stevens Sewer District
- Olympus Terrace Sewer District (Mukilteo)
- City of Edmonds
- Alderwood Water and Sewer District
- Granite Falls
- Sultan
- Monroe
- King County's Brightwater Treatment Facility

To be feasible, the wastewater treatment facilities, including their outfalls, need to have adequate capacity and meet applicable water quality standards now and in the long-term planning horizon described in this plan. The facilities also need to be available in the timeframe of the City's compliance schedule (for example, any expansion would need to be able to be designed, constructed, and financed in time to be used) and be cost-effective alternatives (for example, facilities need to be close enough that the conveyance facilities costs are not substantially higher than other alternatives).

The two closest wastewater treatment facilities that could accept the quantity of flow produced by the City of Snohomish are the Brightwater WWTP in Woodinville and the City of Everett WPCF. Conveyance to nearly all of the other facilities would be substantially more difficult and costly due to distance from the City of Snohomish. Many of the other facilities discharge into the Snohomish River or associated water bodies and would not provide the water quality, habitat, and environmental benefits of a deep water outfall. Only the Everett and Brightwater facilities could be feasible due to capacity, cost, and other relevant factors.

Consequently, alternatives were developed for consideration to convey wastewater from the existing Snohomish WWTP to Brightwater and the City of Everett. These alternatives, their costs, and other key considerations are analyzed in this chapter. Because this analysis concludes that conveyance to Everett is a feasible and reasonable wastewater system alternative, and because the City is under a tight compliance schedule to make necessary improvements to meet future water quality and growth requirements, alternative routes (alignments) were developed for consideration to implement a conveyance to Everett.

To meet the compliance schedule, it is necessary for the Everett conveyance alignment to be selected as part of the 2010 Plan Update and companion amendments to the Capital Facilities Plan and Utilities elements in the City's Comprehensive Plan. This is also consistent with the GMA provisions for a city's capital facilities plan element to specify the proposed locations and capacities of expanded or new capital facilities and a financing plan for these facilities (RCW 36.70A.070(3)) and for these fundamental land use planning choices to serve as the foundation for project review (RCW 36.70B.030).

A conclusion and recommendation is presented at the end of this chapter regarding the feasibility of the City using a regional facility and the alignment for a conveyance to Everett.

BRIGHTWATER ALTERNATIVE

The Brightwater alternative would involve conveying wastewater from the existing City of Snohomish wastewater lagoons to the Brightwater WWTP in Woodinville.

Plant Capacity and Expansion

The Brightwater WWTP is currently nearing completion. It has a current design capacity of 40.9 mgd. King County's Amendment No. 1 to the Facilities Plan for the Brightwater Regional Wastewater Treatment System assumes that this capacity will be needed by the County to serve its projected growth through 2016. The Brightwater WWTP is designed to allow future expansions, however, the current design would not accommodate current and projected flows from the City of Snohomish. The Brightwater WWTP would need to be expanded for this alternative to be implemented, which would involve additional design, permitting, and construction activities and their associated costs.

Conveyance

Wastewater would still be conveyed through the City's collection system to the existing City WWTP site. The treatment lagoons would be used as equalization basins to allow flow to be pumped to the Brightwater WWTP at a set rate of 5 mgd.

The conveyance system to the Brightwater WWTP would include eight pump stations, a 20-inch-diameter force main, and a 24-inch-diameter gravity sewer pipe. The first pump station would be at the existing City WWTP. The conveyance route would be approximately 55,700 feet long (10.5 miles). This would include approximately 45,000 feet of force main and approximately 10,700 feet of gravity sewer.

Figure 10-1 shows a possible conveyance route to the Brightwater WWTP. The force main would leave the City's WWTP site and would be horizontal directionally drilled beneath the Snohomish River before heading south along SR 9 to Rees Corner and the intersection of SR 9 and Broadway. The route would turn east at this intersection and continue east and south along Broadway until it turned west where Broadway becomes Maltby Road. The route would continue along Maltby Road to the intersection of Maltby Road and State Route 9 at Turner Corner. The route would then turn south along SR 9 and continue to the proposed Brightwater WWTP. Facilities would need to be constructed at the Brightwater WWTP to make the connection to the conveyance line and regulate the incoming flows.

Pump stations would be required to overcome elevation increases over the 10.5-mile route. The system would transition from a 20-inch diameter force main to a 24-inch diameter gravity sewer at the high point at elevation 481 feet. This is along Maltby Road approximately 5,500 feet east of the intersection of State Route 9 and Maltby Road.

The Snohomish River and two streams are crossed along this conveyance route. As noted previously, the pipe would be HDD under the Snohomish River and would likely be attached to the bridges crossing the streams.

Hydraulic Analysis

Total system head was calculated along the conveyance route considering the proposed flow rate, the ground profile, and pipe diameter. System head calculations were developed for several pipe diameters; these resulted in different total system head values, which affected the required number of pump stations. One pump station was included for every 100 feet of total system head. It was determined that the optimal configuration is a 20-inch diameter force main and eight pump stations, which resulted in lower overall pipeline and pump station costs.

Planning-Level Capital Cost Estimate

A planning-level capital cost estimate was developed for this alternative as part of the 2005 Plan and escalated to 2009 dollars using the Seattle Engineering News Record Construction Cost Index (ENR CCI). Unit costs were taken from *RSMeans* cost-estimating data and other local resources. Pump station costs were estimated from pump station cost curves (flow vs. total capital cost) developed from cost data for local pump station projects. The planning-level estimated capital cost for the HDD, pump stations, force main, and gravity sewer from the existing City of Snohomish wastewater treatment plant to the proposed Brightwater WWTP site in Woodinville is $38.6 million; Appendix H presents the itemized cost estimate for the force main, pump stations, and gravity sewer.

This cost does not include land acquisition, easement costs for pump stations and piping, or costs due to delays associated with permit acquisition. At this planning level, the analysis assume the construction and environmental impacts would be similar to the conveyance to Everett, except that the energy impacts and carbon footprint would be greater since pumping would be needed along a route that is twice as long as the Everett conveyance.

FIGURE 10-1
Snohomish to Brightwater Conveyance Map

Other Considerations

The capital cost estimate presented for this alternative does not include connection fees to the Brightwater WWTP facility. The connection fee per residential household to a King County facility could be approximately $9,081 based on the current adopted 2011 King County capacity charge on new connections to the sewer system. For the estimated 7,022 equivalent residential units in the existing City of Snohomish service area in 2024, this would amount to an additional cost of $63.8 million.

Other costs to be considered for this alternative are the operation and maintenance costs associated with the eight pump stations and wastewater treatment and disposal charges from the Brightwater WWTP. These are likely to be higher than conveyance to Everett, because the conveyance line is twice as long as the conveyance to Everett (approximately 10 miles vs. 5 miles). The first year of operations and maintenance (O&M) costs are estimated at approximately $1.2 million. In addition, it is assumed the annual service charge levied by King County would be equal to King County's adopted 2012 monthly sewer rate of $36.10 per ERU. This results in a charge of approximately $2.5 million for the first year of force main operation.

The City has performed preliminary engineering on a conveyance to Everett and has discussed with the City of Everett a potential conveyance during the development of both the 2005 Plan and the 2010 Plan Update. These cities are close to developing an agreement to implement a conveyance to Everett if this alternative is selected. Because of the factors discussed above, detailed discussions with King County about using the Brightwater WWTP would commence for the first time in 2010 and likely take more than one year. A potential conveyance to the Brightwater WWTP would therefore require all milestones in the compliance schedule to be extended by at least one year.

Summary

Conveyance to the Brightwater WWTP would be approximately twice as long as the conveyance to the Everett, with greater construction and environmental impacts (such as higher energy use for pumping) and capital and long-term O&M costs. The Brightwater WWTP is currently near completion, and it is unlikely the time and costs associated with plant redesign to accommodate the City flows and negotiation with King County on a connection would allow the City to meet its compliance schedule, an essential compliance consideration for the City's plan decision.

The total capital and capitalized cost of conveyance to the Brightwater WWTP is likely to exceed $90 million, including approximately $39 million in capital costs, approximately $1.2 million in O&M costs during the current planning period, and an assumed $66.3 million in connection and capacity charges. The net present value of this alternative through the planning period (Year 2024) is approximately $82 million. For these reasons, this alternative is unfeasible and was not considered further in this update.

EVERETT ALTERNATIVE

This flow transfer alternative involves conveying wastewater from the existing Snohomish WWTP site to Everett for treatment at the Everett WPCF. This alternative would eliminate the Snohomish WWTP discharge to the Snohomish River. Evaluating this alternative includes considering new facilities that would be required at the Snohomish WWTP and

Everett WPCF, in addition to the impact of adding Snohomish wastewater flow to the Everett collection system.

Conveyance

Conveyance to the Everett WPCF would include a new pump station located at the Snohomish WWTP because gravity flow from Snohomish to the Everett sewer system is not possible. Locating the pump station at the Snohomish WWTP avoids having to modify the existing Snohomish collection system and also allows CSO reduction projects to proceed as planned.

The Everett WPCF is located on Smith Island on the east side of Interstate 5, adjacent to the Snohomish River and Union Slough, and about 10 miles from the Snohomish WWTP. The closest reasonable tie-in location to the Everett sewer system is the South End Interceptor at Lenora Street, which is approximately 5 miles from the Snohomish WWTP. The tie-in to the Everett sewer system would be a "hot tap," occurring while the South End Interceptor is in service during the dry weather season when there are lower flows. While the Snohomish force main would not cross the Burlington Northern Santa Fe (BNSF) railroad, it would tie in to the South End Interceptor on railroad property.

Four force main alignments were developed and considered for conveying City flows to the Everett South End Interceptor: one south of the Snohomish River and three north of the Snohomish River. Figure 10-2 (Revised 2010) shows each alignment option. These alignments are described and evaluated below.

Alignment 1: Lowell-Snohomish Road

Alignment 1 follows existing public right-of-way along the south side of the Snohomish River and includes two water body crossings. The force main would exit the WWTP to the west and follow the access road to the plant's former 30-acre lagoon where it would follow the lagoon's northern boundary. At the northwestern corner of the lagoon, the force main would angle southwest and cross the Snohomish River near river mile 12.

The approximate 20-inch-diameter pipe would be bored underneath the river using horizontal directional drilling (HDD). The river crossing would be approximately 1,000 feet long. Crossing the river using the SR 9 bridge for support was also considered; however, substandard clearance would prevent the pipe from going underneath the bridge. In addition, the Washington State Department of Transportation (WSDOT) reports that the bridge is classified at a structural deficiency level that would not allow additional loading and might not be able to hold the pipe. The bridge is also slated for replacement, although this project is not currently funded, so that an alignment on a new bridge would not be available within the current timeframe of the compliance schedule.

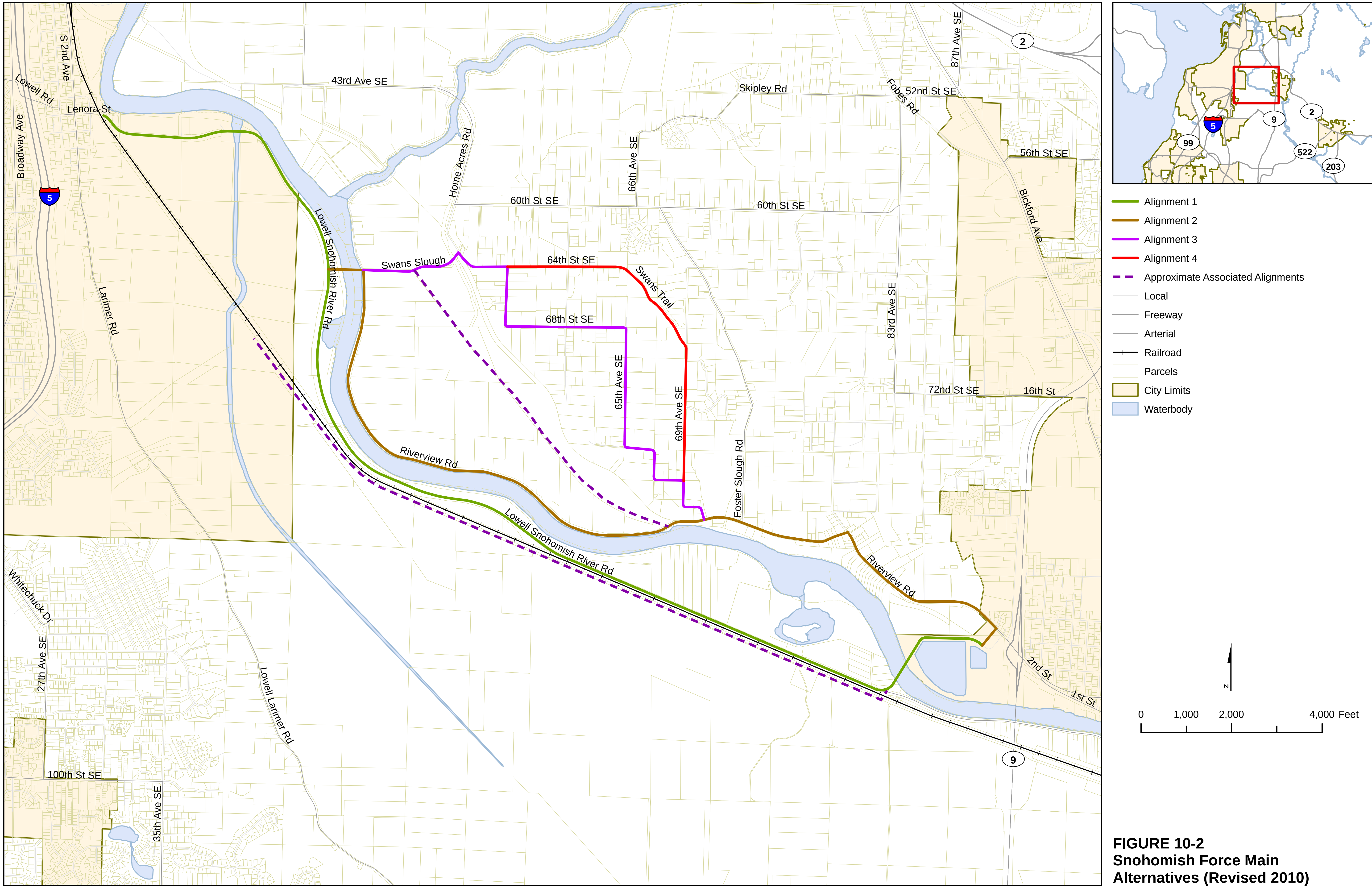

FIGURE 10-2
Snohomish Force Main Alternatives (Revised 2010)

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After crossing the river, the pipe would follow Lowell-Snohomish River Road west for several miles to the City of Everett. Approximately one-half mile before reaching the tie-in location at Lenora Street, the force main would cross Deadwater Slough south of a flow control structure and pump station, which is operated by the Marshland Flood Control District. This would be a shallow HDD crossing approximately 700 feet long. The pipe would then continue along Lowell-Snohomish River Road and tie in to the City of Everett's South End Interceptor, east of where the BNSF railroad crosses the Lowell-Snohomish River Road as it transitions to Lenora Street.

The Lowell-Snohomish Road is a public right-of-way that is part of the dike system along the Snohomish River. The City of Everett's adopted shoreline program restoration element contemplates a future breach of the dike for a Marshlands restoration project. A bridge or similar structural support for the road would need to be constructed to enable the dike breach to occur to provide tidal flow to the Marshlands site. The City shoreline program provides for the restoration project to be coordinated among interested agencies and members of the public, including the City of Everett, Snohomish County, Marshland Flood Control District, the Natural Resource Conservation Service (NRCS), and the Tulalip Tribes. If the restoration project occurs after the conveyance has been constructed in the right-of-way, the approximate 20-inch pipe would be bored under the area breached or included in the overhead structure design. These design options will be addressed during project design and permitting for the conveyance and restoration projects. The pipe will be designed and located in consultation with NRCS and the Marshland Flood Control District to avoid erosion impacts.

This alternative would be 27,000 feet in total length, with approximately 5,000 feet in the City of Everett and 2,000 feet within the City of Snohomish. The remainder of the force main would be within the Lowell-Snohomish River Road right-of-way belonging to Snohomish County and on top of the Marshland Flood Control District dike. This stretch of Lowell-Snohomish River Road is a rural arterial with adjacent properties mainly used for agricultural purposes. Ground elevations along the proposed alignment range from -32 feet at the Snohomish River crossing to 22 feet at the connection with the Everett sewer system. Changes in road elevation are gradual (less than 15 feet total elevation difference) along most of the route. The maximum anticipated hydraulic pressure would be approximately 270 feet (117 pounds per square inch [psi]).

Alignment 2: Riverview Road

This force main route would follow the Snohomish River primarily on the north side of the river and include two water body crossings. The pipe would exit the WWTP to the northeast, follow Riverview Road to the northwest, and go along Riverview Road, following the north bank of the Snohomish River. Riverview Road is a lesser arterial flanked by mostly agricultural land use. At Swans Slough Road, the force main would turn west and cross beneath the Snohomish River near river mile 8.3.

Based on available geotechnical data, more favorable tunnel-crossing conditions would be between river miles 8 and 9.5. Historically, the Snohomish River was used to store and transport logs from Snohomish to Everett. For this reason, logs remain in and below the river bottom. There is also a dense layer of cobbles and gravel below a top layer of silt and sand. The contact between these two layers drops in elevation between Snohomish and

Everett, so this tunneling location is preferred over the upstream river crossing closer to the plant. There would be also a lower risk of stream bank erosion at the downstream river-crossing location. From here the alignment would follow the same path as Alignment 1 along the Lowell-Snohomish River Road to the tie-in with Everett's South End Interceptor. This alignment would also involve crossing the Deadwater Slough flood control structure. The pipe will be designed and located in consultation with Snohomish County to avoid erosion impacts.

Alignment 2 would be approximately 28,000 feet long, with approximately 5,000 feet of the alignment within the City of Everett, 1,000 feet in the City of Snohomish, and the remainder located in Snohomish County road rights-of-way. Ground elevations for this alternative range from -32 feet at the Snohomish River crossing to 81 feet along Riverview Road about 1 mile from the plant. The maximum anticipated line pressure would be approximately 300 feet (130 psi).

Alignment 3: Riverview Road/Fobes Hill/Lowell-Snohomish Road

This alignment would be located on the north side of the Snohomish River and run from the plant to Riverview Road, similar to Alignment 2. The pipe would follow Riverview Road up the hill and continue west along Riverview Road to its intersection with 68th Avenue SE. The force main would then follow this arterial as it zigzags through the primarily residential area southwest of Fobes Hill. From 68th Avenue SE, the alignment would turn west onto 78th Street SE. The pipe would continue to follow the main arterial, going north on 67th Avenue SE, and west on 76th Street SE. The route would again turn north at 65th Avenue SE and follow this road for approximately one-half mile before heading west again on 68th Street SE. The force main would stay on the main road to go north on 57th Avenue SE and west on 64th Street SE, before turning on to Swans Slough Road to cross under the river. After the river crossing, the alignment would follow Lowell-Snohomish River Road to the South End Interceptor tie-in in Everett. This portion of the alignment would also include the flood-control structure crossing at Deadwater Slough in addition to several smaller stream crossings.

The alignment would be about 29,000 feet in length, and like Alignment 2, approximately 5,000 feet would be in the City of Everett, 1,000 feet in the City of Snohomish, and the rest in Snohomish County road rights-of-way. Most of the alignment would be situated in residential areas, with many changes in road elevation because of several peaks and valleys, particularly between Riverview Road and Swans Slough Road. Each peak would require an air release valve and odor control. Ground elevations range from -32 feet to 134 feet. The approximate ground elevation at the South End Interceptor is 31 feet. The maximum anticipated pressure would be 280 feet (121 psi).

Alignment 4: Riverview Road/Swans Trail Road/Lowell-Snohomish Road

Alignment 4 is a variation of Alignment 3. Like Alignment 3, Alignment 4 would follow Riverview Road to 69th Avenue SE. However, instead of turning west on 78th Street SE, the alignment would continue north along 69th Avenue SE and Swans Trail Road. Then, the force main would follow the road west as it turns into 64th Street SE and then intersect with Swans Slough Road at Home Acres Road. From here, the alignment is the same as Alignment 3.

Alignment 4 would be 29,500 feet long, most of which in unincorporated Snohomish County. Like Alignments 2 and 3, about 5,000 feet would be located in Everett and 1,000 feet in Snohomish. Alignment 4 would have significant elevation changes, ranging from a peak of 191 feet at 15,000 feet from the plant, to the low of -32 feet at the river crossing; there are other additional local peaks and valleys along the route as well. This alignment would require many air release valves and odor control. The maximum anticipated pressure would be 280 feet. Most of the alignment would run through residential areas.

Associated Alternatives

Other potential rights-of-way and variations on the above alternatives were also examined, in part because of concerns about dike integrity and impacts. The only alternatives that would be potentially feasible due to river crossing locations and the other factors discussed above, including length, topography, and operational factors, available right-of-way, schedule, cost and environmental impact, including avoidance of neighborhood impacts, are two routes in proximity to the alignments discussed above: on a portion of the Puget Sound Energy right-of-way and on or near a former rail right-of-way north of Riverview Road. Specifically, these routes, which will be studied in project level design and may be used for the final pipeline route, are: (a) generally along or adjacent to the PSE right-of-way on the south side of the river; (b) along the historical rail line to the north of the river at the toe of Fobes Hill; and (c) within any readily available and cost-effective nearby rights of way between or to supplement these two alternatives as necessary. These are also shown on Figure 10-2 and noted on Figure 10-6.

Alignments Summary Comparison

Several factors differ for each alignment, including operational complexity and energy requirements, Snohomish River crossing risk, erosion risk, traffic impact, environmental permits, residential property impact, and the need for odor control.

Alignment 1 would have the lowest operational complexity, while Alignments 3 and 4 would have numerous local high and low spots throughout the route and a relatively wide range in ground elevation that makes pipeline construction and operation substantially more challenging and increases energy use and associated carbon footprint. The topography for Alignment 2 is not as gradual as Alignment 1, nor as problematic as Alignments 3 and 4.

All alignments would cross the Snohomish River and a Marshland Flood Control District structure, although Alignments 2, 3, and 4 would be located at a potentially more favorable tunnel-crossing location. These alignments, however, would have additional smaller stream crossings. The crossing risk for Alignment 1 could be mitigated with subsurface exploration and a test HDD bore. These activities would provide additional geotechnical information at the proposed crossing location that could be incorporated in to design.

Erosion risk would be slightly higher for Alignment 1 at the river-crossing location. Alignment 1 would experience higher traffic volumes than the other alignments, but most work would occur in the shoulder, avoiding the need to block the entire road. Alignments 2, 3, and 4 would impact traffic in residential areas. Accordingly, the impact on residential property would be low for Alignment 1, and high for the other options.

Right-of-way acquisition would be simplest for Alignment 1, somewhat more complex for Alignment 2, and potentially complicated for Alignments 3 and 4 due to their proximity to residences; environmental permitting would similar for all alignments. All alignments would require shoreline permits from the City of Snohomish, City of Everett, and Snohomish County. Alignments 1 and 2 involve more natural area considerations, such as floodplains and coordination with shoreline and restoration projects, while Alignments 3 and 4 involve more urban land use considerations, such as residential neighborhood considerations. Additionally, based on the need for air release valves at local high points, odor control would likely be minimal for Alignment 1 compared with the other alignments.

Based on this analysis, Alignment 1 would be the alignment with the fewest environmental impacts, lowest cost, and most likely to be constructed within the compliance schedule. If the initial river crossing were not constructed on Alignment 1, then Alignment 2 could provide a reasonable contingency alignment to accomplish the conveyance. Alignments 3 and 4 would not be feasible, reasonable, or practicable alternatives for the conveyance to Everett because they have substantial operational complexity, greater energy use and associated carbon footprint, complicated right-of-way, an impact on residential communities, and would like take longer to implement than the other alignment alternatives. Two routes in proximity to these alignments associated with the planned river crossing locations will be further analyzed for feasibility at the project level: a portion of the Puget Sound Energy right-of-way and a former rail right-of-way north of Riverview Road. These could be used if they prove feasible, environmentally acceptable, and preferable in terms of operation, cost, and schedule.

Everett WPCF

Projected influent flow and loading information was provided to the City of Everett to determine if the Everett WPCF has the capacity to treat wastewater from Snohomish. Based on the evaluation documented in the City of Everett Engineering Report (Carollo, 2009), the Everett WPCF has initial capacity to treat raw Snohomish flows and wasteloads, assuming Snohomish begins transferring flow to Everett not sooner than 2014. Current population estimates assume the Everett WPCF would need to be expanded twice between now and approximately 2024 to meet Everett and Snohomish requirements, as described below. This evaluation also did not consider treating Snohomish wastewater before entering the Everett WPCF.

Future upgrades necessary to accommodate projected growth within the existing Everett WPCF service area and flows from Snohomish include expanding the WPCF trickling filter/solids contact (TF/SC) process. An initial planning schedule for coordinating the timing and capacity of future Everett WPCF upgrades is shown on Figures 10-3 and 10-4. If Snohomish did not transfer flows to Everett, then these upgrades would otherwise have to be constructed by 2015, and a second TF/SC expansion would be needed by 2027, to meet City of Everett needs. If the Everett WPCF treats flows from Snohomish, then these second-phase improvements would likely be required in the vicinity of 2024 depending on growth.

FIGURE 10-3 (REVISED 2010)
Everett WPCF Plant Capacity with Proposed Improvements for Maximum Month Dry Weather BOD

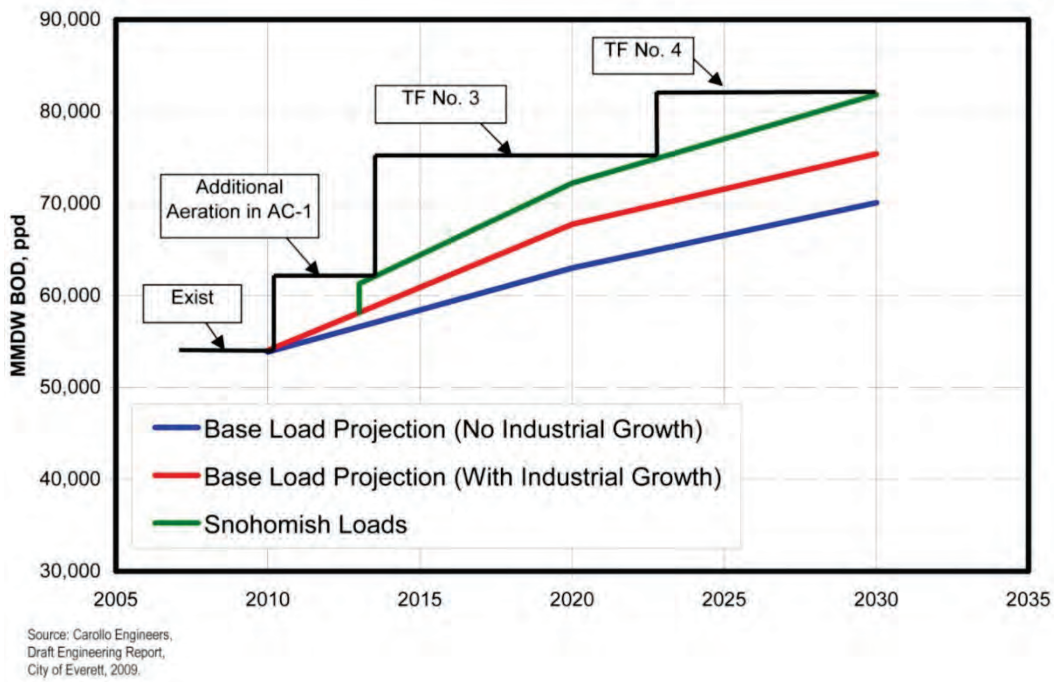
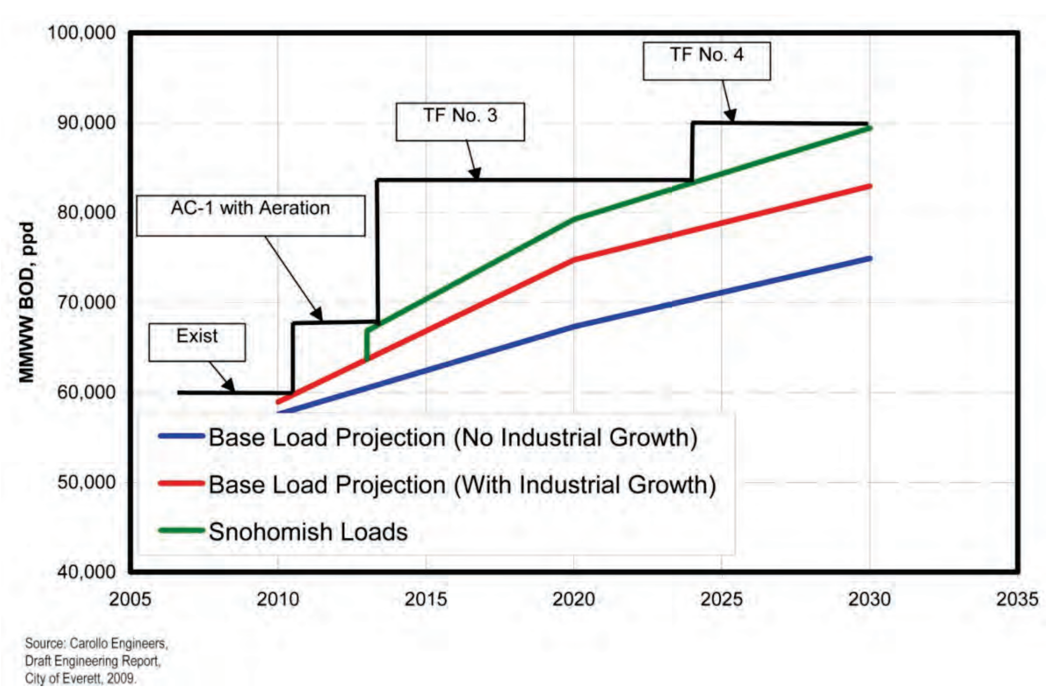


FIGURE 10-4 (REVISED 2010)
Everett WPCF Plant Capacity with Proposed Improvements for Maximum Month Wet Weather BOD
Pump Station



As mentioned previously, a new pump station located at the Snohomish WWTP will be needed to transfer flows to Everett. The following is a conceptual design at the plan level subject to refinement at the project design level. The pump station would be a dry pit facility composed of two main chambers: a dry well and a wet well. Wastewater would enter the wet well, whereas the pumps and motors would be located in the dry well chamber. Chemical addition at the pump station might be necessary to reduce odors generated by the wastewater in the lengthy force main.

Two duty sets of two pumps in series would be used, and another set of pumps would be used for standby, for a total of six pumps. The pumps would be nonclog centrifugal pumps, which are well-suited to handle raw sewage and high flows and heads. Based on available and projected plant flow data, the pumps would need to handle a wide range of flow and pressure. The Everett South End Interceptor has a peak capacity of 4500 gallons per minute (gpm) for Snohomish flows under ultimate conditions in 2050. Everett anticipates the maximum head at the tie-in location is 85 psi, or about 200 feet. Expected total dynamic head (TDH) is expected to range from 30 to 350 feet. The pumps would be sized to handle flows from 500 gpm to 4,500 gpm, the maximum flow accepted by the City of Everett. The pump station would have a footprint of approximately 3,000 square feet and would be located west of the existing WWTP facilities, in the old lagoon. This location would take advantage of gravity flow from the headworks and Lagoon 1 to the pump station wet well. Some filling of the old lagoon would be needed to support the pump station. In addition, the station would be supported by auger driven piles to stabilize against settling and hydraulic uplift.

Force Main

In terms of conceptual design at the plan level, the force main is expected to be designed so the maximum velocity would be approximately 5 feet per second (fps) at 4,500 gpm. This ensures that friction losses in the pipe will not be excessive. The force main would be an approximate 20-inch-diameter, high-density polyethylene (HDPE) pipe. The preliminary design concept for the Snohomish River crossing consists of a 16-inch HDPE pipe in a 24-inch steel casing. This might be revised during project-level design in the required Engineering Report and in the final plans and specifications and bid process.

Treatment Plant Infrastructure

Separate from an Everett conveyance (as explained in Chapters 1, 11, and 12 and Appendix O), the City is implementing a Near-Term WWTP Improvements Project to bring the current WWTP into compliance. The discussion below identifies the improvements needed to the Everett WPCF and Snohomish WWTP to accommodate this flow transfer to Everett under the regional alternative.

Everett WPCF

Based on the City of Everett Engineering Report (Carollo, 2009), the Everett WPCF could handle initial Snohomish flows and wasteloads but would require three major capacity expansions by 2030. The first two Everett WPCF expansions are needed regardless of whether Snohomish sends its wastewater to Everett or not. The first expansion is additional aeration capacity in Aeration Cell 1 (AC-1). The second expansion would be accelerated 1 year with Snohomish flows and loads and would include a third trickling filter and solids contact basin, additional secondary clarifier, gravity belt thickener, and digesters. The third

Everett WPCF expansion would involve adding a fourth trickling filter and solids contact basin. The timing and capacity of these expansions is based on the City of Everett's projected base and industrial growth and projected Snohomish flows and raw wasteloads.

Snohomish WWTP

The principal change to the WWTP at the conceptual plan level involves modification of Lagoon 1 for flow equalization and the likely decommissioning of Lagoons 2, 3, and 4. The improvements will also provide a level of pretreatment to Snohomish flows before they are conveyed to the Everett WPCF.

Historically, the WWTP occasionally receives peak flows greater than the 4,500 gpm conveyance limit set by the City of Everett. With the ongoing CSO reduction project, even higher peak flows could possibly enter the plant and storage would be required. The existing lagoons could provide storage volume; however, due to the direct connection between the river level and the groundwater elevation at the WWTP site, there is a significant risk of lagoon liner uplift if the river level is more than 2 feet higher than the lagoon water surface elevation. Therefore, the lagoons must maintain a minimum water surface elevation close to the river elevation to prevent liner uplift. This is especially significant during the winter when river levels are higher; thus, lagoon levels must be higher. Also, storm events increase the frequency and duration of peak flows that require storage. Facility design will take into account the potential impact of climate change on storm events and flows.

Limited data are available to determine the maximum storage volume needed during the high river season. Data from one extreme storm event in January 2009 provide some information on the amount of storage that would be needed during an extreme wet weather event. During this event, the Snohomish River crested at the third-highest level recorded; plant staff report the lagoons were close to overtopping. The river stage was slightly less than 24 feet (National Geodetic Vertical Datum [NGVD]), which is the 10-year flood elevation determined by FEMA (FEMA, 2005). Based on the available records, this river level has not been exceeded in the last 50 years. Using available river stage, WWTP influent flow, and CSO monitoring data, approximately 3.1 million gallons (MG) of storage would have been required during the January 2009 event to meet Everett's peak conveyance limit and maintain sufficient hydraulic head in the lagoons to prevent liner uplift. This volume assumes the current CSO reduction project was in place and additional flow was being sent to the plant. Setting the minimum lagoon elevation at 23 feet, 1 foot less than the 10-year flood elevation, sufficient storage is provided in Lagoon 1. Since additional wet weather data are not available to assess the storage needs during a range of storm events, as contingency additional storage volume would be provided in Lagoon 1 by raising the embankments. This would be accomplished using vertical vinyl sheet piling to raise the embankment height by 4 feet. Lagoons 2, 3, and 4 would not be needed and would be drained and cleaned. The liners would be breached to avoid damage from hydraulic uplift. Decommissioning Lagoons 2, 3, and 4 in this manner is cost-effective and allows flexibility for future use, should they be required.

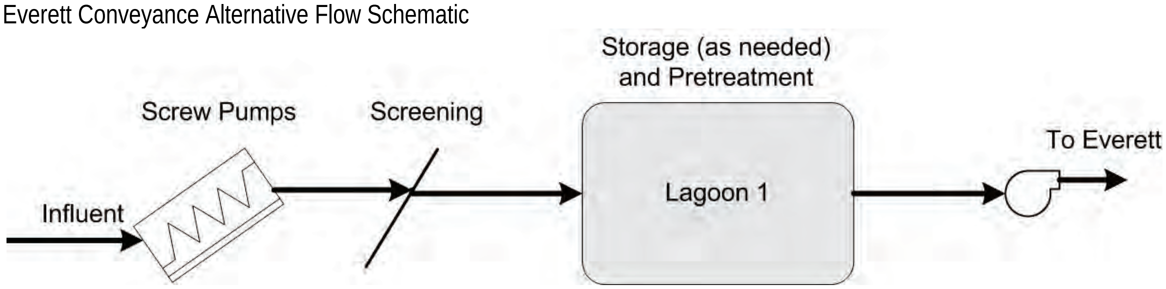
By utilizing Lagoon 1 for peak flow storage, Snohomish could also provide pretreatment in the form of TSS and BOD reductions before transferring flows to Everett. Since Everett has indicated they will charge Snohomish on the basis of flow and BOD, this would decrease the

BOD service charge and could also impact the timing of Everett WPCF improvements. Pretreatment would take place in Lagoon 1, which would provide a minimum of 20 percent BOD removal and 30 percent TSS removal during the high river season, and 40 percent removal of BOD and 50 percent TSS removal during the low river season. These estimates are based on a minimum water surface elevation of 23 feet (NGVD) and continued use of the existing aerators. If Snohomish were to pretreat the wastewater, then the second and third Everett WPCF expansions could be delayed an additional year.

In addition to TSS removal in Lagoon 1, the existing Snohomish WWTP headworks would minimize TSS in the force main and prevent debris and grit from entering the line. Maintaining the headworks would also allow the CSO reduction improvements to proceed as planned since the additional flow will enter the headworks downstream of the screw pumps. The existing screw pumps and influent screens would be retained. As proposed as part of the WWTP alternative, a second mechanical screen in the south channel parallel to the existing mechanical screen is recommended to reduce the amount of floatables and debris entering the pump station. The improvements to the influent screw pumps highlighted in the WWTP alternative would also be needed as part of the Everett conveyance alternative to maintain the pumps' operational reliability. A new grit removal system would not be necessary since Lagoon 1 would still be in operation and currently removes grit sufficiently from the treatment process.

Table 10-1 (Revised 2010) summarizes the effluent that would be sent to Everett for the Everett conveyance alternative with pretreatment, Figure 10-5 (Revised 2010) shows a schematic flow diagram of the Everett conveyance alternative.

FIGURE 10-5 (REVISED 2010)
Everett Conveyance Alternative Flow Schematic



Description of Everett Conveyance Project

In summary, based on the foregoing analysis, the regional alternative will take the form of the Everett Conveyance Project, which consists of the following principal components:

- A force main (pipeline and related facilities) that is approximately 20 inches in diameter and approximately 5 miles long from the Snohomish WWTP to Everett's South End Interceptor. The force main would generally be located in the Lowell-Snohomish River Road (Alignment 1), with a contingency to use Riverview Road (Alignment 2) if the primary river crossing cannot be achieved or in the associated alignments in the PSE or on or near former railroad right-of-way discussed above.

- A pump station at the WWTP site to pump the flows through the force main, sized to handle the maximum flows accepted by the City of Everett.
- Storage capacity and related facilities at the WWTP site.

Figure 10-6 shows the main components of the Everett conveyance alternative, and Figure 10-7 (Revised 2010) shows the WWTP site layout.

If the regional alternative is selected as the adopted plan, these components will be analyzed at the design level in a project-level Engineering Report/Facility Plan and accompanying environmental review by agencies and the public (see Chapter 12). In addition, Everett will design its future WPCF expansions to accommodate City of Snohomish flows. The Cities of Everett and Snohomish would enter into an interlocal agreement to implement the project.

TABLE 10-1 (NEW 2010)
Snohomish Flows and Loads to Everett with Pretreatment at Snohomish WWTP

Year	**2007**		**2010**		**2020**		**2030**	
Service Area	**UGA**	**UGA+ Potential EXP**	**UGA**	**UGA+ Potential EXP**	**UGA**	**UGA+ Potential EXP**	**UGA**	**UGA+ Potential EXP**
Population	9,475	9,475	10,350	10,350	13,696	14,458	17,285	21,857
Maximum monthly flow (mgd)								
July through October	1.30	1.30	1.36	1.36	1.58	1.75	1.80	2.04
November through January	2.31	2.31	2.41	2.41	2.80	3.10	3.22	3.65
Maximum daily flow to Everett (mgd)								
July through October	2.50	2.50	2.60	2.60	3.02	3.35	3.48	3.94
November through January	6.45	6.45	6.45	6.45	6.45	6.45	6.45	6.45
Maximum monthly BOD (ppd)								
July through October	1,488	1,488	1,626	1,626	2,152	2,692	2,715	3,433
November through January	1,984	1,984	2,168	2,168	2,869	3,590	3,620	4,578
Maximum Month TSS (ppd)								
July through October	1,324	1,324	1,446	1,446	1,914	2,394	2,415	3,053
November through January	1,853	1,853	2,024	2,024	2,679	3,352	3,381	4,275
Maximum Month TKN (ppd)								
July through October	361	361	394	394	522	654	659	833
November through January	397	397	434	434	575	719	725	916

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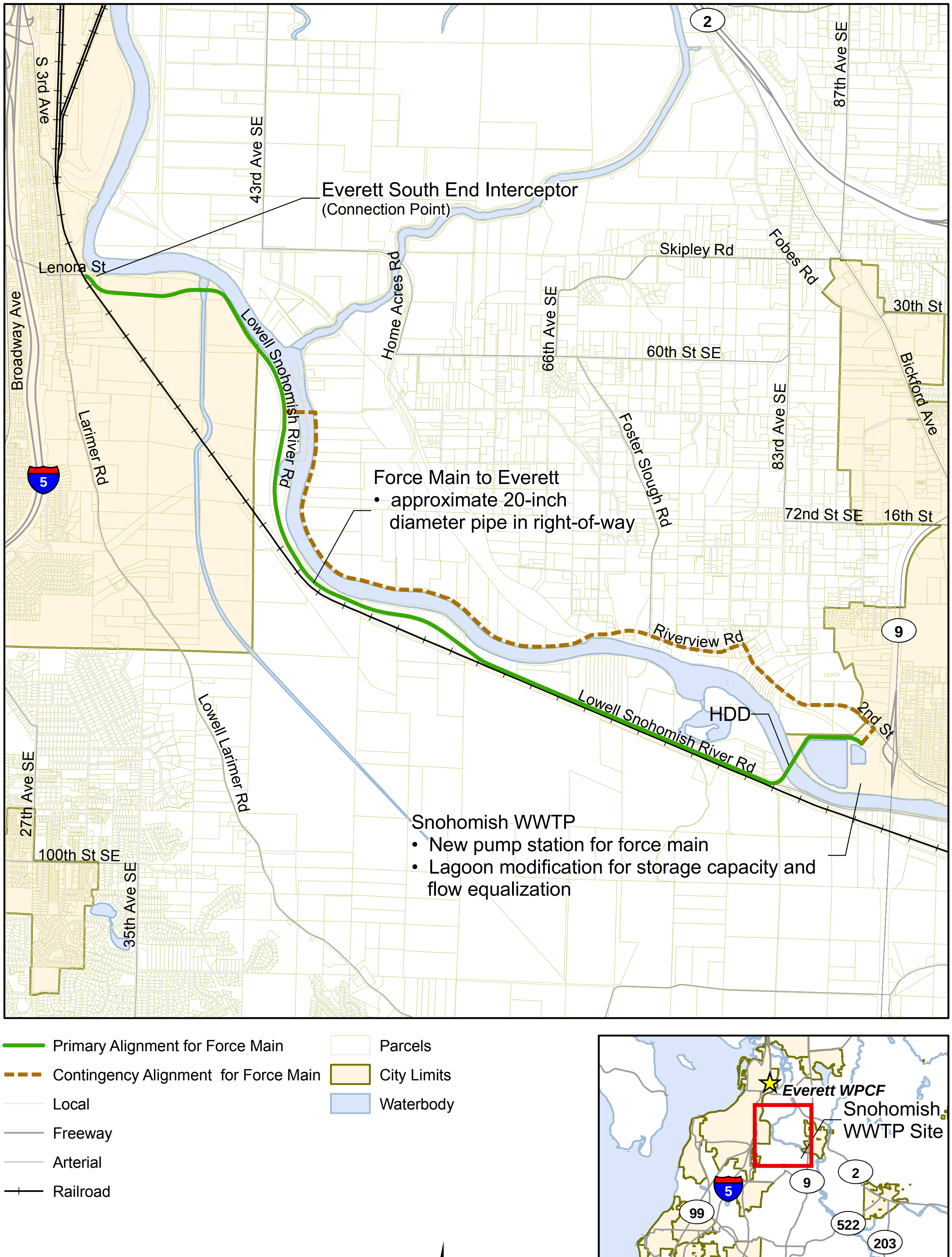

Notes: Project design and construction in and near dikes to be coordinated with County, cities, districts, and NRCS. Routes in proximity to these alignments with the planned river crossing may be used.

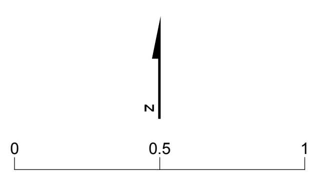

FIGURE 10-6
Everett Conveyance Project (Revised 2010)

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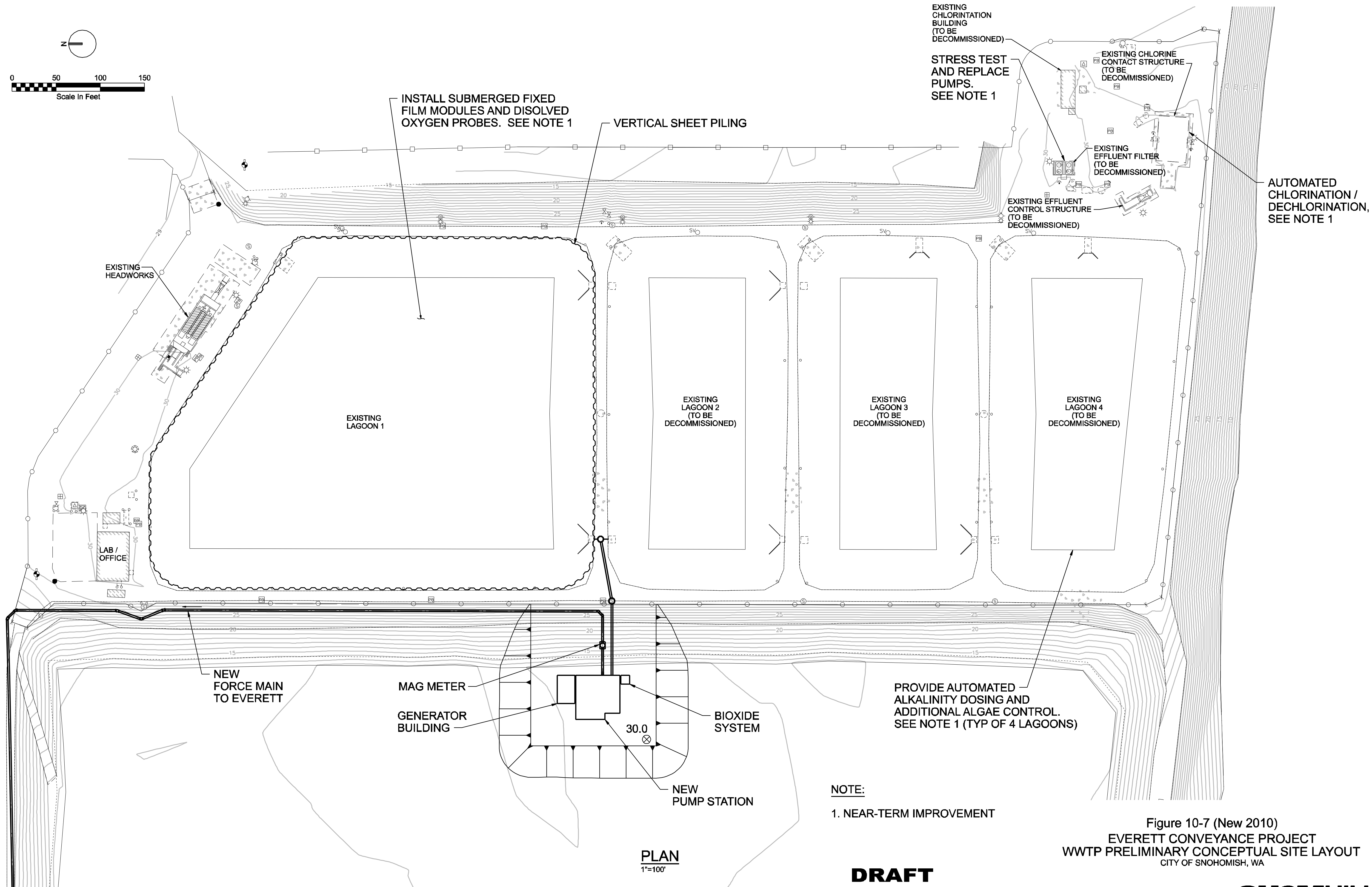

Figure 10-7 (New 2010)
EVERETT CONVEYANCE PROJECT
WWTP PRELIMINARY CONCEPTUAL SITE LAYOUT
CITY OF SNOHOMISH, WA

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Water Quality Impacts of Regional Alternative

By eliminating the Snohomish WWTP discharge to the Snohomish River, the City will be able to meet the requirements of future NPDES permit, TMDL waste load objectives, and growth in the long term, including future TMDL requirements or stricter permit limits. The Everett WPCF would also be able to meet its treatment objectives with the additional pollutant loads from Snohomish.

The City of Everett Engineering Report (Carollo, 2009) describes future plant capacity and operation at the time Snohomish flows would be treated at the Everett WPCF. The Engineering Report recommended Everett WPCF improvements that provide future flow and load capacity for both Low River Flow and High River Flow permit conditions, assuming the North Plant would treat 3 mgd during the Low River season, and up to 15 mgd during the High River Flow season on a maximum monthly basis (Carollo, 2009). The Phase 2 improvements described in the report would be in place when Snohomish begins to send flow to the Everett WPCF.

Based on the proposed Everett WPCF improvements and operations, Table 10-2 (Revised 2010) summarizes the effluent discharge at the two main WPCF outfalls: Port Gardner Bay and the Snohomish River at Everett. These values are compared to the Everett WPCF NPDES permit limits. Values shown are based on the average WPCF effluent concentration from July 2004 through February 2009 and projected 2030 flows (Carollo, 2009). Figures 11-5 through 11-7 also illustrate these loadings.

There will be substantial benefits to water quality in the Snohomish River compared with loading from the existing WWTP or upgraded WWTP, as shown in Tables 10-3 and 10-4. Implementing the Everett Conveyance Project would result in an annual estimated reduction of 65,700 pounds of $CBOD_5$ and 84,300 pounds of TSS going into the Snohomish River in 2024 (based on the average annual flow projections in Chapter 8 and the existing WWTP average effluent concentration).

It is not possible at this time to calculate the cumulative reduction of loading to the river, however, the useful life of the project is approximately 50 years, which would be approximately 2070. In terms of water quality and environmental impact, this reduction results in better habitat quality and conditions to support fish at, and downstream of the current outfall.

TABLE 10-2 (NEW 2010)
Everett Conveyance Alternative Treatment Requirement Comparison

Year-Round	$CBOD_5$ Average Monthly	$CBOD_5$ Average Weekly	$CBOD_5$ Maximum Daily	TSS Average Monthly	TSS Average Weekly
Port Gardner Bay discharge					
Everett WPCF NPDES limit, ppd	4,380	7,010	N/A	5,250	7,880
Everett WPCF without Snohomish, ppd	3,105	5,190		3,327	5,478
Everett WPCF with Snohomish, ppd	3,386	5,660		3,628	5,974

TABLE 10-2 (NEW 2010)
Everett Conveyance Alternative Treatment Requirement Comparison

Year-Round	$CBOD_5$ Average Monthly	$CBOD_5$ Average Weekly	$CBOD_5$ Maximum Daily	TSS Average Monthly	TSS Average Weekly
Snohomish River discharge at Everett WPCF					
Low river season (July through October)					
Everett WPCF NPDES limit, ppd	3,043	5,104	5,402	7,660	11,480
Everett WPCF without Snohomish, ppd	396	667	1,455	1,073	1,819
Everett WPCF with Snohomish, ppd	425	716	1,561	1,151	1,952
High river season (November through June)					
Everett WPCF NPDES limit, ppd	3,190	5,100	N/A	7,660	11,480
Everett WPCF without Snohomish, ppd	2,180	3,430		4,015	6,562
Everett WPCF with Snohomish, ppd	2,377	3,740		4,379	7,156

Everett Conveyance Estimated Costs

Costs for the force main, pump station, and Snohomish WWTP modifications were estimated based on available design criteria and information. This cost is a Class 4 estimate with an expected accuracy of +50 percent/-30 percent and is in 2009 dollars. The estimate is based on a quantity takeoff developed for all elements shown in sufficient detail to quantify. For items known to exist but not defined in project drawings, an allowance was applied based on estimator and project engineer experience.

The final costs of the project will depend on actual labor and material costs at the time of bid, actual site conditions, productivity, competitive market conditions, final project scope, final schedule, and other variable factors. As a result, the final project costs will vary from those presented below. Because of these factors, funding needs must be carefully reviewed prior to making specific financial decisions or establishing final budgets. Construction costs include the following markups:

- Contractor overhead and profit: 16 percent
- Mobilization, bond, and insurance: 10 percent
- Construction cost estimate contingency: 30 percent
- Market conditions: 0 percent
- Sales tax: 8.6 percent

Typically, the cost estimate will include a market conditions factor adjustment. Currently however, the bidding market for this type of project is fairly competitive, so no factor was included for market conditions. This should be reexamined closer to the actual bid date.

Table 10-3 (New 2010) shows the estimated capital cost of the Everett conveyance alternative. Staff from the Cities of Snohomish and Everett are currently discussing the connection and service charges for treating Snohomish wastewater at the Everett WPCF. For the purposes of this update, it is assumed the initial Everett connection charge (capitalized cost) will be approximately $20 million in addition to annual service charges of approximately $1 million. The first year of operations and maintenance (O&M) costs are estimated at approximately $412,000. The net present value of this alternative through the planning period (Year 2024) is approximately $36 million.

TABLE 10-3 (NEW 2010)
Estimated Everett Conveyance Alternative Cost

Description	Cost
Force main and river crossing (rounded)	$10,842,000
Pump station and WWTP modifications (rounded)	$7,131,000
Estimated Construction Cost	**$17,973,000**
Administration, legal, and permitting (5%)	$899,000
Engineering services (10%)	$1,797,000
Construction services and management (10%)	$1,797,000
Property Acquisition	$100,000
Total Capital Cost not including Everett capacity charge	**$22,566,000**
Estimated Everett capital capacity charge[1]	$20,000,000
Estimated Capital Cost including Everett capacity charge	**$42,566,000**[2]

NOTES:
[1] Subject to negotiation.
[2] Does not include the capital cost of near-term WWTP improvements ($4,024,000).

Environmental Impacts

This section summarizes the environmental impacts of the Everett conveyance alternative based on the description of the Everett Conveyance Project and a SEPA plan-level analysis of the alternative presented in the SEPA Addendum on the Proposed 2010 Plan Updates. As described earlier in this chapter, the Everett Conveyance Project would be located in part within the boundaries of the City of Snohomish, the City of Everett, and unincorporated Snohomish County (see Figure 10-2).

Natural Environment

Water Quality

City of Snohomish treatment plant effluent would no longer be discharged to the Snohomish River from the existing WWTP. This would result in substantial environmental benefit to the Snohomish River and watershed, as presented in the preceding section. This would also result in benefit to Puget Sound water quality because of the improved water treatment and outfall at the Everett WPCF and because the Snohomish River watershed is the second largest source of freshwater to Puget Sound.

The Everett Conveyance Project would not move the problem from the Snohomish River to Puget Sound for several reasons. First, City wastewater would receive higher level and more consistent treatment in compliance with water quality standards than provided by the Snohomish WWTP. The improved treatment will provide greater source control and pollution prevention. In addition, the Port Gardner Bay outfall, Outfall 100, the principal discharge for the Everett WPCF, is located in the deep waters of Port Gardner Bay. This outfall is Everett's principal outfall and has been estimated to remove 96 billion pounds of BOD from the river over the expected life of the outfall (City of Everett, 2005). Outfall 100 is a recently constructed state-of-the-art outfall that has been documented to be one of the highest-performing outfalls in Puget Sound, providing greater mixing, circulation, and dispersion of the effluent than the WWTP outfall (CH2M HILL, 2004). Consequently, relocating pollutant net loadings from the City's existing outfall to the City of Everett's discharge locations predominantly at Port Gardner Bay would be superior to the Snohomish WWTP Snohomish River discharge location due to improved treatment and discharge location.

In terms of potential construction impact, waterbody crossings would be bored and no construction activities would occur within any surface waters. All construction would adhere to the applicable federal, state and local regulations, including stormwater management permits and requirements.

Water Resources, Habitat, and Critical Areas

Floodplains

The force main alignment with the conveyance alternative is located in Zone X (0.2 percent annual chance of flood) as designated by FEMA (FEMA, 2005). As analyzed in the alternatives alignment section above, there is no practicable alternative to locating the force main in this area. Because the force main will be buried under existing roadway and right-of-way, it would not increase the potential for flooding or result in any substantial impacts on floodplains. The force main will be designed to meet applicable floodplain standards in the critical area codes of the cities of Snohomish and Everett and Snohomish County, which have been approved by Ecology and FEMA to implement federal and state floodplain management requirements. As noted previously, it will also be designed to consider climate change, designed in consultation with agencies with responsibility for dike maintenance, and designed to coordinate with the contemplated Marshlands restoration project.

Wetlands and Farmlands

There are wetlands within the existing WWTP site and near the Lowell-Snohomish River Road. The proposed pump station and WWTP modifications would not impact wetlands at the existing WWTP site. The force main alignment would occur primarily within existing roadways and previously disturbed areas associated with agricultural activities. If draft project design indicates that construction within a wetland or wetland buffer might be contemplated, alternatives to avoid or otherwise mitigate wetland impacts will be implemented, as required by federal, state, and local regulations, including local critical area regulations. Figure 10-8 (Revised 2010) shows the location of wetlands per the United States Fish and Wildlife Service and prime farmlands as defined by the United States Department of Agriculture Natural Resources Conservation Service (USDA NRCS) and referred to in the SEPA process. Snohomish County has also designated "Agricultural Resources Lands" as part of a GMA requirement to identify critical areas. The County has designated the land adjacent to Lowell-Snohomish River Road in the Study Area as Riverway Commercial Farmland. If the project were to convert any such farmland to nonfarm uses (which is not anticipated), the County will review the proposal for consistency with the Snohomish County Agricultural Advisory Board's "Board Recommended Evaluation of Proposals to

Convert Designated Farmland to Nonfarm Purposes." Everett has not designated any land within the urban growth area as prime agricultural land of long-term commercial significance. RCW 36.70A.060(4) and WAC 365-190-050 require that counties and cities have a program for the transfer or purchase of development rights prior to designating agricultural resource lands of long-term commercial significance in urban growth areas; Everett does not currently have such a program.

Water Resources, Plants, and Animals

The existing WWTP outfall is located in Water Resource Inventory Area (WRIA) 7. By improving water quality (described above) and removing pollutant loading from this reach of the Snohomish River, the regional alternative will improve habitat for fish and wildlife, including endangered salmon runs for Chinook and coho salmon and steelhead. The project will be designed to be consistent and coordinated with the Marshlands restoration project as described previously in this chapter. The overall environmental impact would be to help to implement waterbody recovery and restoration plans for the Snohomish River watershed.

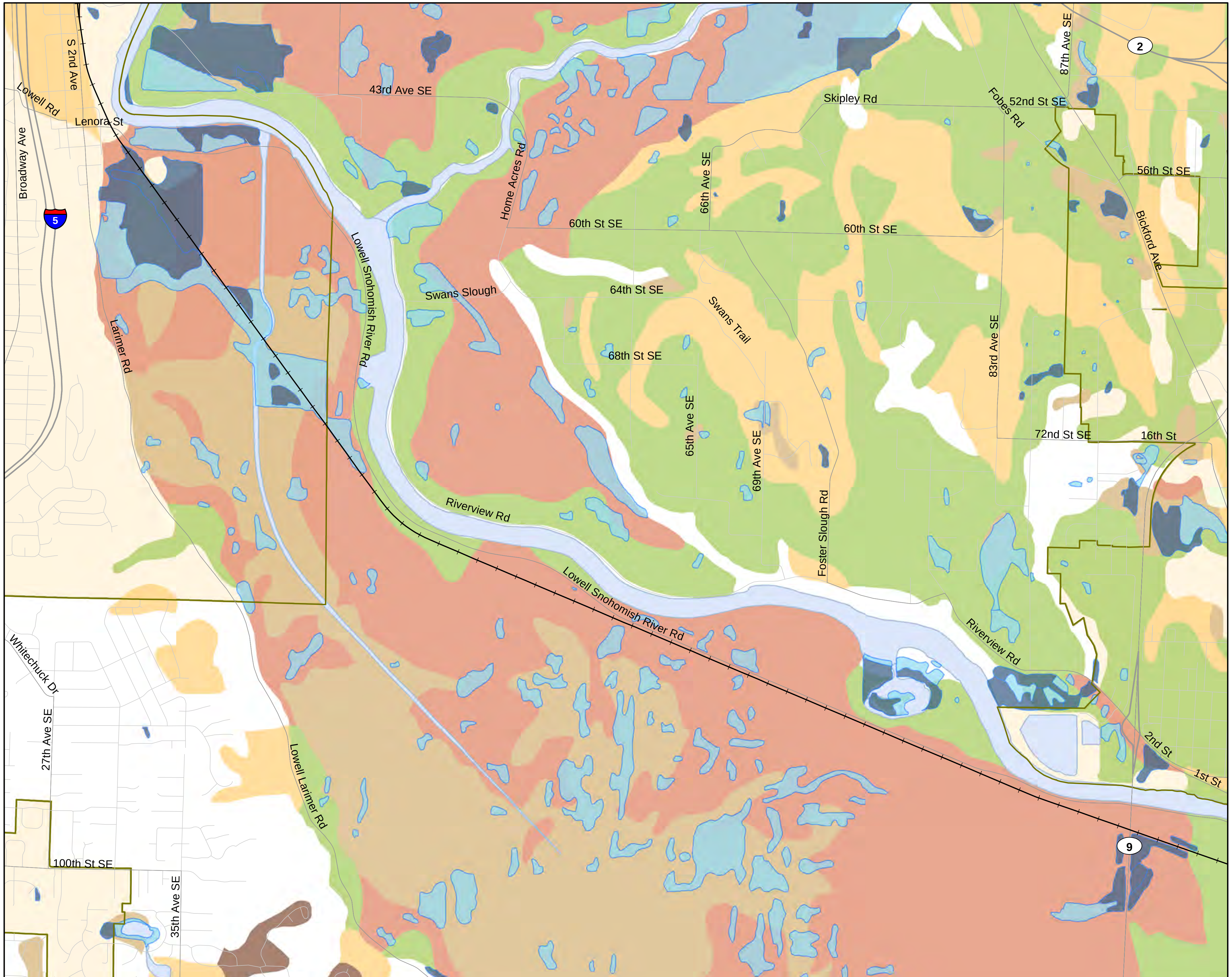
The 7-day average low river flow with a recurrence interval of 20 years (7Q20) is 1,051 cfs at the Ecology-maintained monitoring station in the Snohomish River located at the Avenue D bridge in Snohomish. The removal of approximately 2.0 mgd of effluent from the Snohomish River in 2024 (the equivalent of 3.1 cfs) would be approximately 0.3 percent of the existing flow and will therefore not substantially impact in-stream flows. Separately from the wastewater improvements, the City is working with the Tulalip Tribes and other agencies to improve in-stream flows by improvements in the City water system.

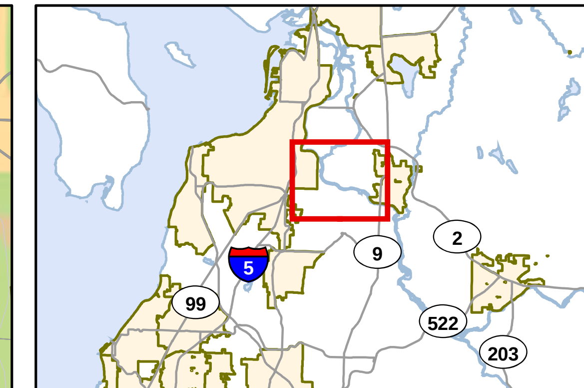
No in-water construction of new facilities is anticipated. There would be temporary construction impacts on the uplands adjacent to the Snohomish River to construct the force main. The alignment would cross two water bodies that provide habitat for fish and wildlife, including the above-listed endangered salmon runs. The project-level Engineering Report/Facility Plan and environmental assessment will include the required federal and local biological assessments and evaluations and local fish and wildlife critical area management plans to assure that conservation measures avoid or otherwise mitigate potential impacts to species and their habitat, as required by the Endangered Species Act and by local critical area codes and shoreline master programs. No substantial adverse impacts on threatened and endangered species or fisheries or aquatic resources are expected from the proposed project.

Because the force main alignment would occur primarily within existing roadways and previously disturbed areas, implementing the Everett conveyance alternative would not require removing substantial amounts of vegetation.

Earth

Because the waterbody crossings will be bored and the force main alignment does not contain steep slopes, no substantial impacts to geologically hazardous areas are anticipated. If any geologically hazardous areas are identified in project design, any required reports and mitigation measures under local critical area ordinance will be undertaken. The pipeline route is in an area identified as subject to liquefaction on Everett and County critical area maps and will follow the critical area requirements at the project review stage. The project will be designed to avoid erosion impacts on current dikes and roadways, including planned use of HDPE material (which is more flexible pipe), maintenance agreements, and contingency measures in the event of pipeline rupture due to flooding or earthquakes. A Channel Migration Study will be conducted at the project level review which will address the risk of failure of the levee supporting the Lowell-Snohomish River Road (which is a concern expressed by Snohomish County). Two additional alternatives suggested by the County will be evaluated further during project level review: on a portion of the Puget Sound Energy right-of-way and on or near a former rail right-of-way north of Riverview Road. The conveyance line will also meet applicable engineering standards and building code requirements for local soil conditions. As noted above in the water quality discussion, erosion controls for construction activities that are required by stormwater management permits and local codes will be implemented.





USDA Natural Resources Conservation Service (NRCS)

- Prime farmland
- Farmland of statewide importance
- Prime farmland if drained
- Prime farmland if drained and flood protected
- Prime farmland if irrigated
- Local
- Arterial
- Freeway
- Railroad
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- City Limits
- Waterbody

Note: City of Everett has not designated any land within the Urban Growth Area as prime agricultural land of long term commercial significance.

N

0 1,000 2,000 4,000 Feet

FIGURE 10-8
Wetlands and Prime Farmlands (Revised 2010)

Air, Energy, and Natural Resources, including Climate Change

The conveyance alternative would not result in any negative air quality impacts. Construction equipment and activities would generate some short-term exhaust and particulate emissions, but measures would be implemented to minimize the impact.

There is some potential for minor and infrequent odor emissions from force main air release valves located at high points in the conveyance line. Odors would be mitigated with standard odor control technology such as carbon canisters. In addition, these valves would be located in low-use areas and will not be located near sensitive receptors.

Project design will address any flood concerns, as noted above. The annual energy requirements of the Everett Conveyance Project would be approximately 1.8 million kilowatt-hours (kWh) compared to an estimated 2.5 million kWh for operation of an essentially rebuilt WWTP (the plan alternative described in Chapter 11). The City is expected to convey maximum month flows of approximately 3.94 mgd and 6.95 mgd during the low river and high river periods, respectively to the Everett WPCF in 2030, compared with projected influent Everett WPCF maximum month flows (independent of Snohomish) of 27.7 mgd and 40 mgd during the dry weather and wet weather periods, respectively (Carollo, 2009). Consequently, although the Everett WPCF expansion to accommodate City flows would involve some increased energy usage, this would be a small incremental increase to that facility compared with the City of Snohomish operating its own WWTP. The Everett Conveyance Project would therefore have the smallest carbon footprint among the alternatives and the lowest impact on greenhouse gas emissions from energy sources needed to power the wastewater system.

Built/Human Environment

Environmental Health

Noise

Construction activities would occur on the WWTP site and an area south of the Snohomish River related to the placement of the conveyance system under the Snohomish River. Activities would also occur primarily within the shoulder of the roadways along the force main alignment related to the placement of the conveyance system.

Construction equipment and activities would generate construction noise and short-term exhaust and particulate emissions. Construction activities would follow the applicable city and county requirements to minimize disturbance.

Land and Shoreline Use

Land Use

The Everett Conveyance Project would be consistent with and implement the goals and policies of the City Comprehensive Plan, including its Shoreline Management Program, by improving Snohomish River water quality and habitat (as discussed previously), meeting applicable water quality standards, and providing essential wastewater utility services to City residents that meet projected growth in the City's land use plan. As with previous General Sewer and Wastewater Facility Plans, the adopted 2010 Plan Update will be incorporated into the City's Comprehensive Plan.

The Everett conveyance alternative is not expected to require any property acquisition except for the HDD retrieval site on private property. Land use is agricultural and based on the USDA NCRS designation, Lowell-Snohomish River Road passes through areas of Prime farmland and Prime farmland if drained and flood protected. Snohomish County classifies the land adjacent to Lowell-Snohomish River Road as Riverway Commercial Farmland. Construction would take place in previously disturbed areas, such as the road shoulder or the WWTP site, and would not impact agricultural activities.

Coastal Resources and Shoreline Use

The SMPs of Snohomish County and the cities of Snohomish and Everett under Washington's Shoreline Management Act (SMA) provide the applicable Coastal Zone Management Program (CZMP) requirements. These SMPs are incorporated into the Comprehensive Plans and development regulations of these three jurisdictions.

None of the facilities would be located on marine waters; they would be located under and adjacent to the Snohomish River. The Snohomish River is a shoreline of statewide significance under the SMA and the SMPs noted above. The conveyance alternative would be consistent with and further these coastal zone management plans by improving water quality and habitat, as explained above. The Everett Conveyance Project will need shoreline substantial development permits from the three jurisdictions, which will make project-level consistency determinations.

Recreation

The Everett Conveyance Project would not be located within any designated recreation areas. A designated bicycle pathway in most locations of the Lowell-Snohomish River Road shoulder would need to be temporarily closed due to construction of the force main in the shoulder. Temporary construction impacts could occur that may include short-term traffic management actions (such as detour or access restrictions) at Rotary and Lowell Riverfront Parks to protect public safety. These will be planned and implemented in coordination with the City of Everett. The pump station and WWTP modifications are located within the existing WWTP site and would not affect any recreational activities.

Historic and Cultural Preservation

Force main construction activities would primarily occur within the road shoulder in areas previously disturbed, thereby, minimizing effects on any cultural resources. If potentially significant archaeological sites are discovered during construction activities, then work would be halted and the applicable state, Tribal, city or county authorities would be contacted.

Transportation

The majority of the construction activities would occur along existing roads and at the WWTP site. Temporary lane closures would be needed to allow for construction activities along the road. Business and residential access issues are not anticipated because only a few businesses and residences are located in close proximity to the construction activities associated with the Everett conveyance alternative.

Public Services, Utilities, and Costs (Economics)

The Everett Conveyance Project meets an identified utility need and would have a beneficial impact on providing essential public services and utilities that comply with the Clean Water Act. The capital cost of the Everett Conveyance Project would likely be funded by a combination of grants, low-interest loans, and revenues. Revenues would likely come from a combination of rates, connection fees, and/or assessments to finance the operating and capital costs, as described in the financing plan in Chapter 13.

Current Snohomish sewer rates are among the highest in Washington. Because of limited grant funds and the cost of the improvements under any alternative, sewer rates would need to be increased to the hardship level. There will be an adverse economic impact on ratepayers under all alternatives potentially available for the City to comply with Clean Water Act requirements. In addition to implementing the project on a schedule that increases the potential for grant funding, it may be possible to mitigate these impacts by timing the required completion of the improvements to provide rate relief (i.e., less severe hardship rates over a longer period of time and rate relief for low income residents similar to current City rate programs) while meeting water quality and growth needs.

Environmental Justice and Social Environment

As noted, the proposed facilities are located within existing wastewater treatment plant facilities and along existing, generally rural arterials. Construction of the proposed facilities would therefore not adversely impact low income or similar communities. Rate hardships will affect all residents of a small rural city, but there may be ways to mitigate these impacts, as discussed above. Removing the City's discharge from its current location in the Snohomish River and consequent improvement in water quality and habitat will benefit salmon runs and the restoration of natural resources in the Snohomish River watershed used by Tribal communities.

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CHAPTER 11

Wastewater Treatment Facility Improvement Alternatives

<Add the following to the end of the chapter.>

2010 UPDATE OVERVIEW

This 2010 Plan Update chapter has three components:

1. **Incorporation of a minor update to the 2005 Plan for the Near-Term WWTP Improvements Project.**

   Alternative 5 in the 2005 Plan, which considered a treatment improvement in the lagoons, was not adopted as part of the recommended plan in 2005. As a result of new filter media technologies, the City and Ecology have agreed that a Near-Term WWTP Improvements Project should be implemented. Although this is being approved by a separate process, it is also included below as part of this 2010 Plan Update to provide a complete plan update document.

2. **An update to the 2005 Plan description of the on-site WWTP upgrade.**

   In the course of preliminary engineering for the 2005 adopted alternative of upgrading the WWTP, substantial changes in the design and cost increases were identified (as explained in Chapter 1). The first portion of the update to this chapter describes these changes from the 2005 Plan recommended alternative described in the preceding sections of this chapter.

3. **An updated comparative evaluation and recommendation for the wastewater system alternatives.**

   Based on the new information available on the regional treatment alternatives (Chapter 10) and the on-site WWTP Improvements (described below in this chapter), the updated on-site WWTP alternative and the Everett Conveyance Project regional alternative are evaluated. The chapter concludes with the recommended alternative for the 2010 Plan Update, whose implementation is described in the Chapter 12 update and financing plan in the Chapter 13 update.

NEAR-TERM WWTP IMPROVEMENTS PROJECT

The Near-Term WWTP Improvements Project is being implemented to bring the WWTP into compliance with its existing permit, consent decree, and upcoming permit renewal. The project consists of installing a submerged fixed-film media system in the WWTP lagoons, automated dosing of supplemental alkalinity, dissolved oxygen monitoring, improvements for algae control, filtration system improvements, and automated chlorination and dechlorination. These improvements are further described in *Technical Memorandum,* *Summary of WWTP Compliance Improvement Considerations* (Kennedy/Jenks, 2010). Table 11-1 (Revised 2010) shows the estimated cost of the near-term improvements.

TABLE 11-1 (NEW 2010)
Capital Cost Summary for Near-Term Wastewater Treatment Plant Improvements

Improvement	Budgetary Capital Cost/Allowance
Near-Term Improvements	
SFF Media System Equipment	$1,500,000
SFF Media System Installation	$400,000
Automated Dosing of Supplemental Alkalinity	$75,000
Dissolved Oxygen Monitoring	$25,000
Improvements for Algae Control	$20,000
Filtration System Improvements	$50,000
Automated Chlorination/Dechlorination	$60,000
Subtotal	**$2,130,000**
Taxes	$183,000
Subtotal	**$2,313,000**
Contractor OH, Profit, Mob, Bonds & Insurance	$463,000
Contingency	$578,000
Subtotal	**$3,354,000**
Engineering	$335,000
Construction Management	$335,000
Total	**$4,024,000**

ON-SITE WASTEWATER TREATMENT FACILITY IMPROVEMENTS (2010 UPDATE)

In order to meet the Permit compliance schedule, the City retained a consulting engineering firm to prepare an Engineering Report and Facility Plan and related plans and specifications for a comprehensive upgrade of the WWTP in accordance with the preferred alternative in the 2005 Plan approved by Ecology. This updated WWTP alternative involves WWTP upgrades to meet the NPDES permit requirements and address other facility needs. The upgrades include major process improvements to secondary treatment, tertiary filtration, and disinfection. This section provides a summary of the recommended WWTP improvement plan as prepared by Kennedy/Jenks. Detailed evaluation of this alternative is provided in the Final Draft WWTP Facility Plan Amendment (Kennedy/Jenks, 2009). The technical evaluations, recommendations, and costs for the WWTP alternative presented herein are without modification to the work prepared by Kennedy/Jenks.

Ecology publishes a manual titled *Criteria for Sewage Works Design,* often referred to as the "Orange Book" (Ecology, 2008). The Orange Book is a design guide and establishes minimum requirements for the design of sewage treatment systems and serves as a basis for Ecology's review of engineering plans and specifications. All of the Snohomish WWTP improvements follow Orange Book guidelines.

The treatment plant upgrades are based on providing treatment for both the current UGA and the potential UGA expansion. Construction cost estimates were prepared to include markups for site work, mechanical, yard piping, electrical, instrumentation and control, mobilization, contractor overhead and profit, design contingency, and sales taxes. Additional construction cost estimate details are provided in the Final Draft WWTP Facility Plan Amendment (Kennedy/Jenks, 2009).

Major Process Improvements

Based on the Final Draft WWTP Facility Plan Amendment (Kennedy/Jenks, 2009), cloth disk filters, selector activated sludge, and UV disinfection are the recommended process alternatives. Cloth disk filters for tertiary filtration will provide a high degree of operational simplicity and have lower construction and life-cycle costs, and a smaller footprint than the other alternatives considered. SAS was selected for secondary treatment because it offers a high degree of flexibility for compliance with future treatment requirements at a relatively modest cost. It will achieve complete nitrification and removal of all soluble CBOD by providing sufficient aeration and SRT, partial denitrification and alkalinity recovery through use of anoxic zones, and removal of TSS to less than 20 mg/L through the use of secondary clarifiers. UV disinfection was selected based on its operational simplicity, improved operational and environmental safety, lower life-cycle costs, greater flexibility for compliance with future treatment requirements, and ability to fit within a smaller footprint.

Other WWTP Improvements Identified from Condition Assessment and Facility Plan Recommendations

The following section summarizes improvements to other unit processes and facilities at the WWTP that are proposed in the 2005 Plan and additional recommendations stemming from a WWTP condition assessment. City staff identified a number of deficiencies at the existing WWTP that should be addressed to the maximum extent possible. These deficiencies are discussed in greater detail in Section 5 and Section 7 of the Final Draft WWTP Facility Plan Amendment (Kennedy/Jenks, 2009).

Headworks

The 2005 Plan recommends upgrading the existing headworks by installing a screenings washer and compactor, providing a new grit removal and dewatering system, and installing a new headworks flow control structure. These upgrades and additional deficiencies and needs at the headworks have been summarized into the following items:

- Headworks Structure Improvements: Fill corners and install isolation gate downstream of manual bar screen to reduce grit deposits. Provide walkway skid resistance.
- Vactor Truck Decant Improvements: Increase outlet pipe size to improve drainage and reduce plugging.

- Influent Flow Monitoring: The 2005 Plan recommends installation of a new Parshall flume as part of the influent flow control structure to measure equalized flow. In addition, the existing nested 12-inch Parshall flume could be removed to expose the installed 18-inch Parshall flume, which should have a capacity of up to 15.9 mgd.
- Influent Pumping: An overflow control structure adjacent to the headworks or overflow control device within the headworks will be provided to divert excess flow to flow equalization and avoid potential flooding of the headworks in case influent flow exceeds the capacity of the influent screw pumps. Additional improvements include steps to improve pump operation and maintenance, such as recoating the screws for corrosion protection.
- Screening: The 2005 Plan recommends adding a screenings washer and compactor. Also, consideration should be given to installing a second manual bar screen in the existing channel south of the mechanical bar screen, which appears to be an overflow channel. Further, the overflow channel along the south side of the headworks structure could potentially be widened and deepened to fit a second mechanical screen without much difficulty. This would improve solids capture and reduce rag accumulation on the lagoon aerators, which is a deficiency noted by WWTP staff.
- Influent Flow Control Structure and Grit Removal: The 2005 Plan proposes a new flow control structure downstream of the headworks to divert peak flows to flow equalization. The 2005 Plan also includes a new vortex grit removal system and a Parshall flume to measure flow to the secondary treatment process. WWTP staff indicated that grit accumulation is a problem upstream of the influent screw pumps. Adding grit removal to the new flow control structure would not remedy that problem, but it would minimize grit deposition in processes downstream of the headworks. The vortex grit removal system could be installed upstream of the influent screw pumps. However, it is currently unclear if this is possible hydraulically, and whether or not the headworks structure could be modified to add this process at the upstream end. This would require a much larger grit removal system than originally proposed in the 2005 Plan, because the 2005 Plan assumed the grit removal system would be sized to treat the equalized flow.

Equalization and Sludge Storage Lagoons

The 2005 Plan proposes the City maintain its existing solids handling, treatment, and disposal strategy, which consists of storing and stabilizing waste sludge in partially mixed lagoons. The 2005 Plan also recommends the accumulated sludge be removed and a contract set up with a company to regularly remove, dewater, and dispose of the sludge. The existing lagoons could also serve as wastewater storage for flow equalization and storage volume for sludge supernatant, though the supernatant is susceptible to algae growth during the warmer dry weather months.

Identified improvements and needs with respect to converting the existing lagoons to sludge storage or equalization lagoons have been condensed into the items listed below:

- New lagoon liner system to meet Ecology requirements.

- Lagoon inlet/outlet and piping improvements to allow for decanting supernatant from the lagoons and delivering sludge to the lagoons.
- Reconstruct access ramps so they are not as steep.
- Rehabilitate/relocate surface aerators.
- Supplemental alkalinity system to buffer pH and avoid nitrification inhibition from low pH.
- Convert one of the existing lagoons for flow equalization and use the remaining lagoons for sludge storage.
- Re-Evaluation of solids storage in lagoons to determine long-term biosolids management at the WWTP.

Effluent Pumping

The 2005 Plan proposed constructing a new effluent pump station in the southern end of the existing CCT. This is required to ensure effluent can be conveyed to the Snohomish River when the river approaches flood elevation and the WWTP is experiencing peak flows. This pump station would have a firm capacity of about 7 mgd, however, the projected equalized PDF projected in this update is 9.32 mgd. Therefore, larger effluent pumps will be required.

Electrical and Instrumentation

- New Electrical Service: The 2005 Plan proposes a new 600-kilowatt standby power generator. It is likely that a larger generator will be required for the selected alternative.
- Fiber Optic and SCADA System Communications: The 2005 Plan proposed the development of a SCADA system for the WWTP, which would be integrated with the collection system. This system should allow for installation of fiber optic cables between the WWTP and City Hall for remote monitoring.

Disinfection

If the existing chlorination building will be reused, it must be modified to correct the leaking walls. If it will not be reused, the building should be demolished.

Site Security and Yard Access

The following are identified deficiencies and needs with respect to site security and access:

- Site lighting improvements to increase illumination and visibility.
- Surveillance equipment as a deterrent against unauthorized entry, theft, and vandalism.
- Relocate the entrance closer to Riverview Road.
- Paving and widening of access roads to accommodate boom and vactor trucks.

Laboratory and Office Building

Identified deficiencies and needs with respect to the Laboratory/Office Building include:

- Building expansion to provide more space for additional personnel, equipment, and maintenance activities.
- Laboratory improvements including a de-ionizing system and additional sink.

Plant Water System

Identified deficiencies and needs with respect to the plant water system are as follows:

- New plant water system and air gap to meet the new air gap separation requirements of the Washington State Department of Health (DOH).
- Potable water piping loop to eliminate the existing dead end and improve WWTP water quality.

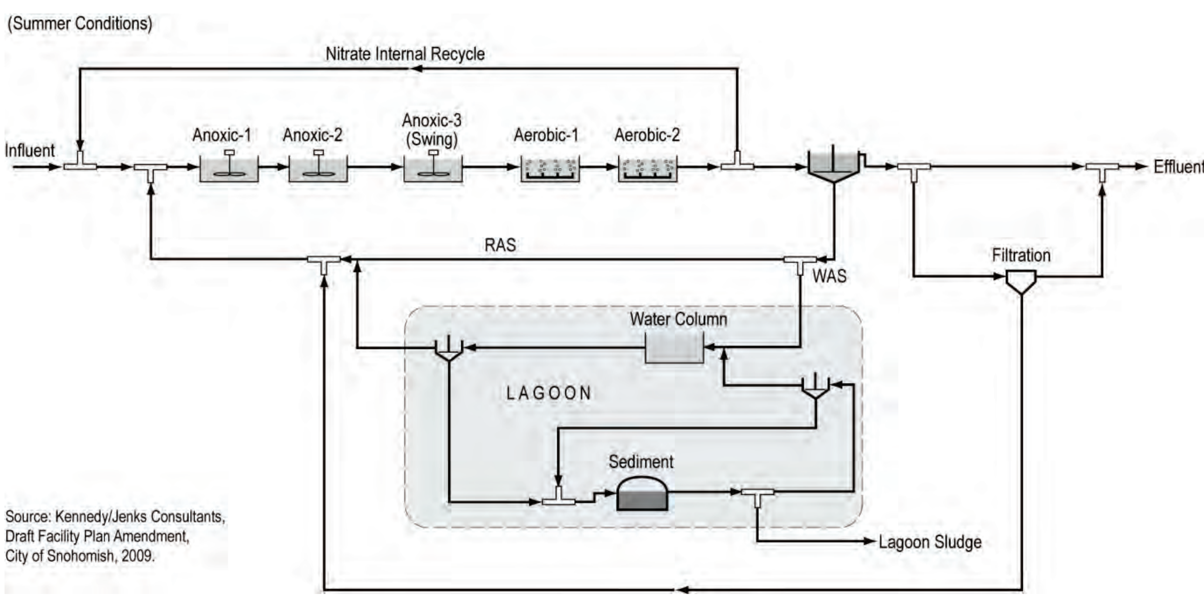
Miscellaneous Site Improvements

Miscellaneous site improvements are also recommended. These improvements are assumed to be included in the contingency of the cost estimates that have already been defined and are documented here to indicate their inclusion in the overall improvement plan. These improvements include the following:

- Landscaping and irrigation.
- Drainage Pump Station for site stormwater and process tank drainage.

Figure 11-1 shows the process layout for this alternative.

FIGURE 11-1 (REVISED 2010)
WWTP Upgrade Modeled Process Layout



Treatment Requirements

Based on the Final Draft WWTP Facility Plan Amendment (Kennedy/Jenks, 2009), the proposed WWTP alternative will meet current NPDES permit limits on a monthly basis. Effluent TSS, $CBOD_5$, and ammonia are predicted to be below the permit concentration and load limits. Table 11-2 summarizes the estimated WWTP performance in 2028 compared to the NPDES permit limits and existing Snohomish WWTP performance. Monthly values for the WWTP alternative are from the process modeling results in the Final Draft WWTP Facility Plan Amendment (Kennedy/Jenks, 2009).

Based on information provided in the Final Draft WWTP Facility Plan amendment (Kennedy/Jenks, 2009) CH2M HILL estimated weekly and daily values for 2028 based on expected performance for this type of plant using information from Wastewater Treatment Engineering (Metcalf and Eddy, 1991) and the WEF Manual of Practice No. 8 (WEF and ASCE, 1998). Existing Snohomish WWTP values are the average maximum value from January 2004 through June 2009. Values are shown for both the low and high river seasons.

TABLE 11-2 (REVISED 2010)
TWTP Upgrade Loads (2028)

	$CBOD_5$ Average Monthly	$CBOD_5$ Average Weekly	$CBOD_5$ Maximum Daily	TSS Average Monthly	TSS Average Weekly	Ammonia Average Monthly	Ammonia Maximum Daily
Low River Season (July through October)							
NPDES/TMDL limit, ppd	58		93	355	537	29	99
Existing Snohomish WWTP performance, ppd	103	161	221	162	241	111	120
WWTP alternative, ppd	21	65	91	19	52	5	24
High River Season (November through June)							
NPDES limit, ppd	584	934	N/A	701	1051	N/A	N/A
Existing Snohomish WWTP performance, ppd	238	400		287	412		
WWTP alternative, ppd	144	379		542	647		

WWTP Conceptual Layout

The recommended 2009 Final Draft WWTP Facility Plan Amendment (Kennedy/Jenks, 2009) conceptual layout of the improved WWTP is shown in Figure 11-2. Most new structures and unit processes are located west of the existing facilities. Based on discussions with the City, installation of the proposed improvements in parallel with the existing treatment plant is the preferred method of expansion. This will minimize disturbances to the existing WWTP during construction by simplifying construction coordination and reducing the potential for interruption of ongoing plant operations. Additionally, this should allow for more equalization and sludge storage volume. Construction of the improvements in the locations shown will require filling in a portion of the large abandoned lagoon to create room for the new structures.

WWTP Improvements Schedule

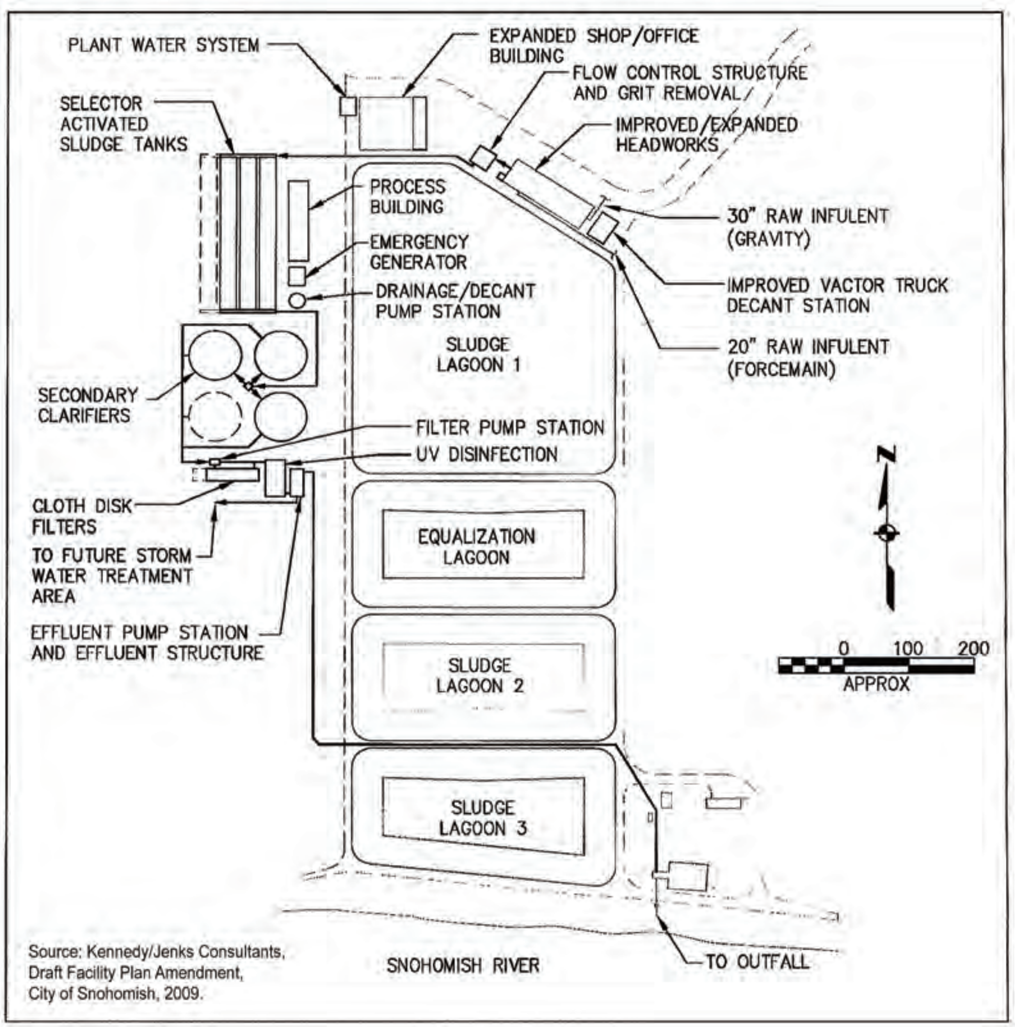
It is anticipated the selected WWTP alternative and improvements would take at least four years for implementation assuming funding is available.

Estimated Capital Costs for Facility Upgrades

This section provides cost estimates as prepared by Kennedy/Jenks of the process upgrades and other WWTP recommendations as part of a comprehensive improvement plan. Table 11-3 summarizes all significant elements of the WWTP improvement plan and associated cost in 2009 dollars. Additional information regarding these cost estimates is provided in the Final Draft WWTP Facility Plan Amendment (Kennedy/Jenks, 2009).

The estimate of probable cost for all proposed improvements is summarized in Table 11-4. Engineering fees and CS/CM fees are also included to provide a total project cost estimate. Because this planning-level estimate was developed conceptually (without the benefit of detailed engineering information, plans or specifications), a number of uncertainties and risks cannot be quantified at this point. Typical cost estimating guides suggest that, for this level of estimate, an additional 30 percent of the project cost should be allocated as a contingency (City Contingency). This is in addition to the design contingency, which accounts for known items that cannot be quantified, that is already included in the estimate subtotals. The City Contingency is a risk-management measure to reduce the chance of the project cost exceeding the project budget. While the City is not obligated to set aside any money as contingency, it is recommended that a 30-percent contingency be allocated to absorb project overruns that may result from unforeseeable issues. The City may elect to modify this contingency during final design.

FIGURE 11-2 (REVISED 2010)
WWTP Upgrade Conceptual Layout



Source: Kennedy/Jenks Consultants, Draft Facility Plan Amendment, City of Snohomish, 2009.

TABLE 11-3 (REVISED 2010)
Snohomish WWTP Upgrade Plan Summary

Unit Process	Summary of Improvement	Estimated Capital Cost (2009 dollars)
Headworks, Influent Pumping and Screening	Improve the headworks structure.	$61,000
	Improve influent screw pumps.	$105,000
	Improve vactor truck decant structure.	$5,000
	Upgrade/expand mechanical screens.	$265,000
	Remove nested Parshall flume for greater influent flow measurement capacity.	$10,000
	Install screenings washer/compactor.	$264,000
Flow Control Structure	Divert flows exceeding peak day to flow equalization. Install flume to measure equalized flow.	$239,000
Grit Removal	Provide grit removal for equalized flow.	$714,000
Secondary Treatment	Replace lagoons with SAS process to provide year-round nitrification. Install secondary clarifiers to settle activated sludge.	$14,430,000
Tertiary Filtration	Replace the existing Dynasand filter with higher-capacity cloth disk filtration units. Install a new higher-capacity filter feed pump station.	$3,400,000
Disinfection	Replace the existing chlorine disinfection system with a UV system. The UV system will be installed in new concrete channels.	$2,900,000
	Repair or demo chlorine building.	$20,000
Effluent Pump Station	Install an effluent pump station and effluent structure to accommodate high river levels and peak flows.	$1,231,000
Solids Handling and Flow Equalization Lagoons	Convert existing lagoons to sludge storage and flow equalization. Provide a new lining system that meets Ecology requirements.	$1,325,000
	Supplemental alkalinity system.	$75,000
	Rehabilitate/relocate surface aerators.	$120,000
	Improve inlet/outlet piping.	$60,000
	Reconstruct access ramps.	$30,000
	Remove sludge from lagoons.	$883,000
Site Security and Yard Access	Provide additional lighting around the fence line.	$20,000
	Relocate entrance closer to road and provide an automated access gate.	$42,000
	Widen access roads and pave in high traffic areas.	$113,000
	Provide surveillance equipment for buildings.	$20,000

TABLE 11-3 (REVISED 2010)
Snohomish WWTP Upgrade Plan Summary

Unit Process	Summary of Improvement	Estimated Capital Cost (2009 dollars)
Electrical and Instrumentation	Replace SCADA system and allow for connection of fiber optic cable in future.	$150,000
	Provide a larger electrical service to accommodate new facilities.	$100,000
	Install a larger standby generator.	$727,000
Laboratory/Office Building	Expand the office building to provide more office space and add a shop/tool room.	$200,000
	Add another sink in the laboratory and provide a water deionizing system.	$25,000
Water System	Install a new non-potable water pumping system with an air gap.	$108,000
	Loop the water pipeline supplying water to improve water quality to WWTP.	$25,000
Miscellaneous Improvements	Provide landscaping and irrigation at entrance and along river trail.	Included in other costs
	Install a plant drain pump station to convey site stormwater and plant drainage back into the WWTP.	Included in other costs

TABLE 11-4 (REVISED 2010)
Estimated WWTP Upgrade Cost

Description	Capital Cost
Subtotal of Re-Evaluated Improvements	$20,750,000
Subtotal of Other Improvements from Facility Plan	$4,060,000
Subtotal of Other Improvements from WWTP Condition Assessment	$2,880,000
Estimated Construction Cost	**$27,690,000**
Mobilization/Demobilization (10% of Construction Cost)	$2,769,000
Bonds/Insurance (5% of Construction Cost)	$1,384,500
Subtotal	**$31,843,500**
Administrative/Legal (5% of Construction Cost)	$1,592,175
Engineering Fees (10% of Construction Cost)	$3,184,350
Construction Services and Management (10% of Construction Cost)	$3,184,350
City Contingency (30 percent of Construction Cost)	$9,553,050
Estimated Capital Cost (Rounded)	**$49,357,000**

Environmental Impacts

This section summarizes and updates the environmental impacts of the WWTP improvements from the 2005 Plan, with minor updates.

Natural Environment

Water Quality

The WWTP upgrade would improve the quality of treatment plan effluent discharged to the Snohomish River. It would meet the stated treatment objectives, but may need to be upgraded again to meet future, potentially stricter NPDES or TMDL limits. No construction activities are proposed within surface waters and all new construction will adhere to the Snohomish Municipal Code and stormwater management provisions.

Water Resources, Habitat, and Critical Areas

Floodplains

The WWTP site is located in Zone X (0.2 percent annual chance of flood) of the floodplain due to the levee/dike surrounding the site. Based on the 2005 Plan, no substantial impact on floodplains would occur from the project and no pristine areas will be disturbed. Project-level design will take climate change into account.

Wetlands and Farmlands

Wetlands are regulated under Chapter 14.51 of the City of Snohomish's Municipal Code. There are wetlands within the existing wastewater treatment facility site. However, none of these will be impacted by the proposed WWTP facility upgrades. Improvements will take place within existing dikes and fence lines. If construction in a wetland or wetland buffer is required, appropriate mitigation as required by the City of Snohomish will be implemented.

There are no important farmlands or formally classified lands in the project area.

Water Resources, Plants, and Animals

Threatened and endangered species and fish and wildlife in the project area are listed in the 2005 Plan. Since that time, steelhead have also been listed in the action area. The WWTP upgrades will occur within the plant's existing fence line. Implementing the upgrades will not require removing substantial amounts of vegetation or critical habitat. The project's potential to impact threatened or endangered plant and animal species would be minimal. No substantial impacts on fisheries or aquatic resources are expected from the proposed WWTP facilities. All construction would meet City of Snohomish requirements regarding stormwater management.

Earth

The WWTP site topography is generally flat with the area around the lagoons classified as Pilchuck loamy sand and Puyallup sandy loam. No substantial impacts to geologically hazardous areas are anticipated. The project will be designed to avoid erosion impacts and erosion controls for construction activities that are required by stormwater management permits and local codes will be implemented.

Air, Energy, and Natural Resources, including Climate Change

As noted in the 2005 Plan, odors occasionally emanate from the lagoons and headworks. The proposed improvements, including screenings washers, would reduce the potential for odors. Some short-term exhaust and particulate emissions would be generated by construction equipment and activities. Vehicles entering and leaving construction sites would also generate dust.

Built/Human Environment

Environmental Health

Noise

Vehicular traffic on SR 9 contributes to ambient noise levels at the WWTP site. The WWTP is located 0.75 miles from the downtown shopping area and 0.6 miles from the high school. Construction activities would be limited to the WWTP site. While there would be a temporary increase in noise levels from construction activities, no substantial noise impacts would result from the WWTP upgrade. Noise levels during construction would be controlled by soundproofing noisy equipment to acceptable noise levels and adhering to City of Snohomish construction noise requirements.

Land and Shoreline Use

Land Use

Though the WWTP is located in a designated critical area, the proposed WWTP facilities are permitted uses within the zoning classification.

Coastal Resources and Shoreline Use

No impacts to coastal resources are expected from the WWTP upgrade, which is located in an urban environment designation under the City of Snohomish Shoreline Management Program. This SMP is the basis for consistency with coastal zone management requirements as explained in Chapter 4.

Recreation

As noted previously, the WWTP upgrades would take place within the existing WWTP fence line, and would not affect the use or accessibility of recreational areas during construction or after project completion.

Historic and Cultural Preservation

No direct impacts on archaeological or historic resources are expected to result from implementation of the WWTP upgrades because the WWTP site has previously been excavated and developed for the existing WWTP facilities. If potentially significant archaeological sites are discovered during excavation, construction will be halted, the City of Snohomish will be notified, and a qualified archaeologist will be retained to determine an appropriate course of action.

Transportation

The WWTP is accessed from 2nd Street, just west of SR 9. Construction traffic would increase in this area and temporary traffic disruption could occur. Business and residential access would not be substantially impacted as the WWTP is not located in a residential or commercial area.

Public Services, Utilities, and Costs (Economics)

Like the Everett Conveyance Project, the WWTP upgrade alternative meets an identified utility need and would have a beneficial impact on providing essential public services and utilities that comply with the Clean Water Act. Based on a survey of treatment plants with similar design flows, the estimated peak day water cost for the proposed WWTP is within the upper range of peak day water costs for similar treatment facilities. The capital cost of the WWTP upgrade would likely be funded by a combination of grants, low-interest loans, and revenues. Revenues would likely come from a combination of rates, connection fees and/or assessments to finance the operating and capital costs.

Current Snohomish sewer rates are among the highest in Washington. Because of limited grant funds and the cost of the improvements under any alternative, sewer rates would need to be increased to the hardship level. There will be an adverse economic impact on ratepayers under all alternatives potentially available for the City to comply with Clean Water Act requirements. In addition to implementing the project on a schedule that increases the potential for grant funding, it may be possible to mitigate these impacts by timing the required completion of the improvements to provide rate relief (i.e., less severe hardship rates over a longer period of time and rate relief for low income residents similar to current City rate programs) while meeting water quality and growth needs.

Environmental Justice and Social Environment

Construction of the proposed facilities would be within the existing WWTP site and would not adversely impact low income or similar communities. Similar to the Everett conveyance alternative, rate hardships will affect all residents of a small rural city, but there may be ways to mitigate these impacts, as discussed previously. Fisheries and habitat in the river would benefit from improved water quality from the City's WWTP discharge.

WASTEWATER SYSTEM ALTERNATIVES COMPARISON

This section compares the regional transfer alternative described and analyzed in Chapter 10 with the 2010 updated information on the City-owned WWTP alternative described above, based on economic and noneconomic factors.

Evaluation Criteria

The alternatives were evaluated based on environmental, regulatory and legal, and water quality impacts, in addition to risks and present worth cost. Impacts considered for each alternative include the following factors:

- Water Quality
- Water Resources, Plants & Animals, Habitat and Critical Areas, including impact on wetlands, floodplains, endangered species and their habitat
- Air , Energy, Natural Resources, and Climate Change
- Environmental Health and Noise
- Land and Shoreline Use, including Coastal Resources
- Recreation
- Cultural Resources, including Historic and Cultural Preservation
- Transportation

- Public Services and Utilities
- Environmental Justice and Social Environment

Water quality impacts considered include the amount of pollutants and flow added to the Snohomish River with the existing Snohomish WWTP, the WWTP alternative, and Everett conveyance alternative. The risk assessment evaluation considers both qualitative and schedule risk for both alternatives. The present worth analysis considers the following criteria:

- Capital costs
- Repair and replacement costs throughout the service life
- Annual O&M costs
- Asset value at the end of the planning period (salvage value)
- Table 11-8 (Revised 2010) summarizes the economic basis of evaluation for the present worth analysis.

Water Quality and Environmental Impact Evaluation

Water quality for the two alternatives is compared and discussed in this section using the values presented in Table 10-2(Revised 2010) and Figures 11-3 through 11-7 (Revised 2010). These compare the Snohomish WWTP's NPDES limits to the effluent from the existing WWTP, WWTP alternative, and Everett conveyance alternative, at the Snohomish WWTP outfall. Since the Everett conveyance alternative would eliminate the WWTP discharge, there would be no pollutant load to the Snohomish River at the WWTP for this alternative. In addition to loading from the wastewater flow, there could be up to one permitted CSO discharge from the existing outfall under either alternative. Both alternatives would comply with applicable TMDL limits for the Snohomish River and Snohomish Estuary.

Figure 11-5 (Revised 2010) shows the anticipated pollutant load to Puget Sound at Port Gardner Bay due to Snohomish with the Everett conveyance alternative. The figure also compares the pollutant load at the Everett WPCF discharge to NPDES permit limits. Figures 11-6 and 11-7 (Revised 2010) compare the additional pollutant load due to Snohomish at the Everett WPCF discharge to the Snohomish River with the values presented in Table 11-2 (Revised 2010).

As these figures show, the Everett conveyance alternative would have the least water quality impact relative to the existing Snohomish WWTP and the WWTP alternative. Although additional flow and load would enter Port Gardner Bay and the Snohomish River at Everett under this alternative, more consistent treatment by the Everett WPCF and the superior discharge location and performance of Outfall 100, would make the Everett conveyance alternative the best alternative to improve water quality in the Snohomish River estuary.

FIGURE 11-3 (NEW 2010)
Alternative Effluent Load Comparison, Low River Season, Snohomish River at Snohomish WWTP Discharge

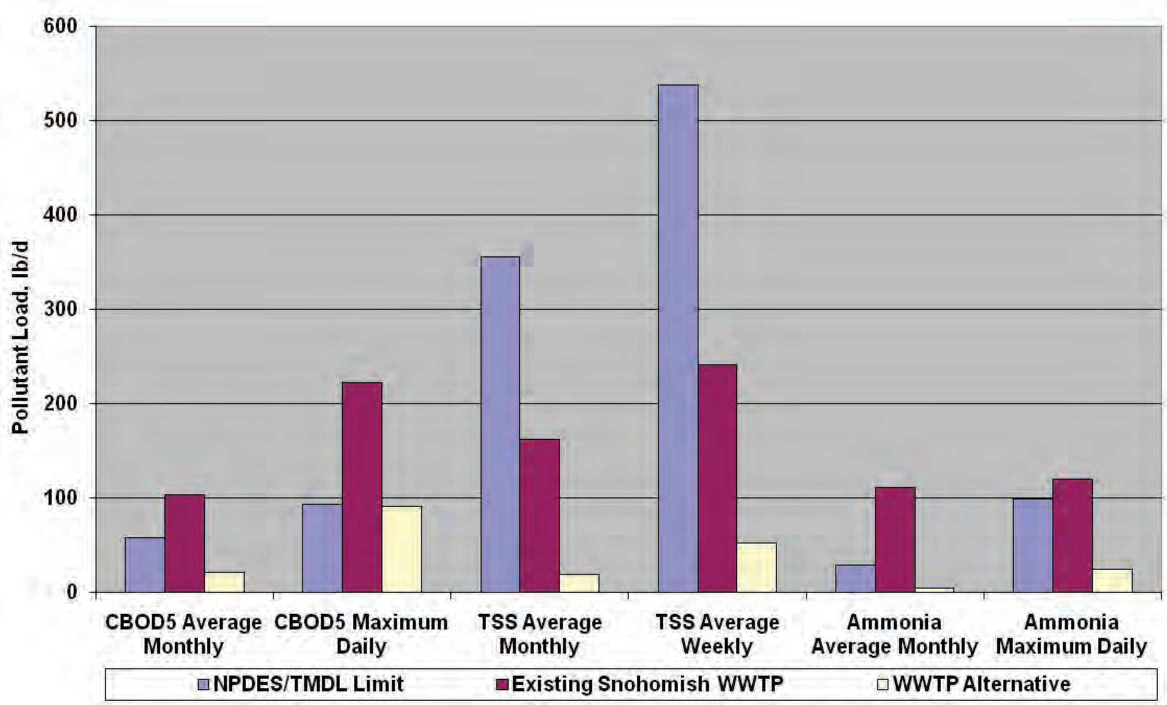


FIGURE 11-4 (NEW 2010)
Alternative Effluent Load Comparison, High River Season, Snohomish River at Snohomish WWTP Discharge

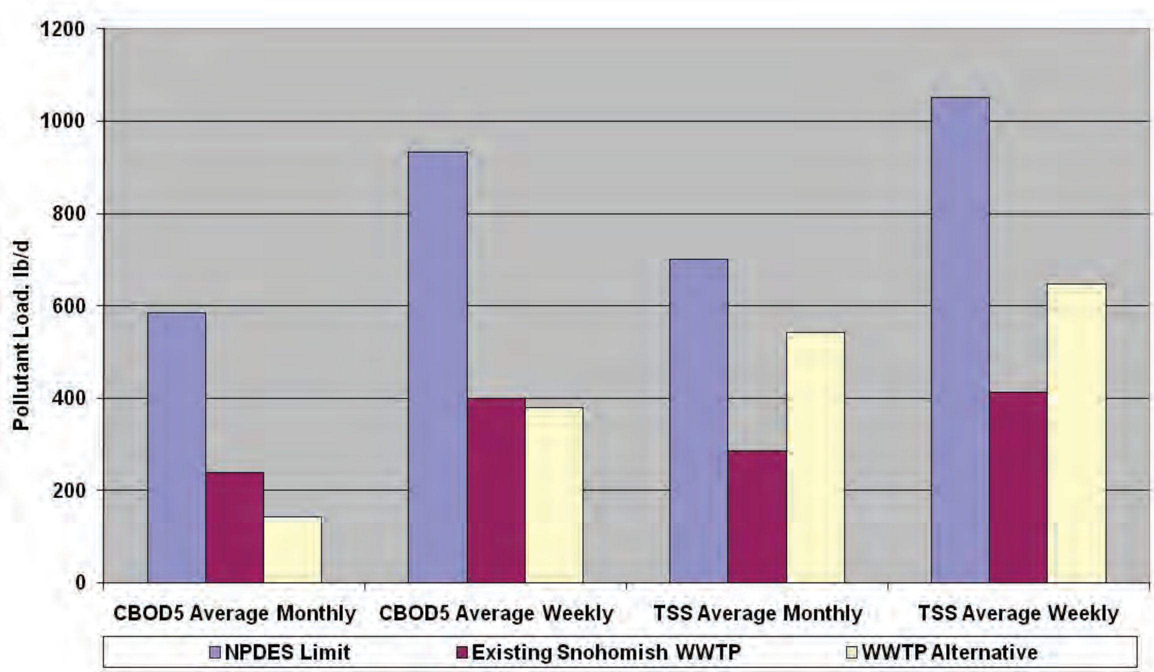


FIGURE 11-5 (NEW 2010)
Alternative Effluent Load Comparison, Year-Round, Port Gardner Bay at Everett WPCF Discharge

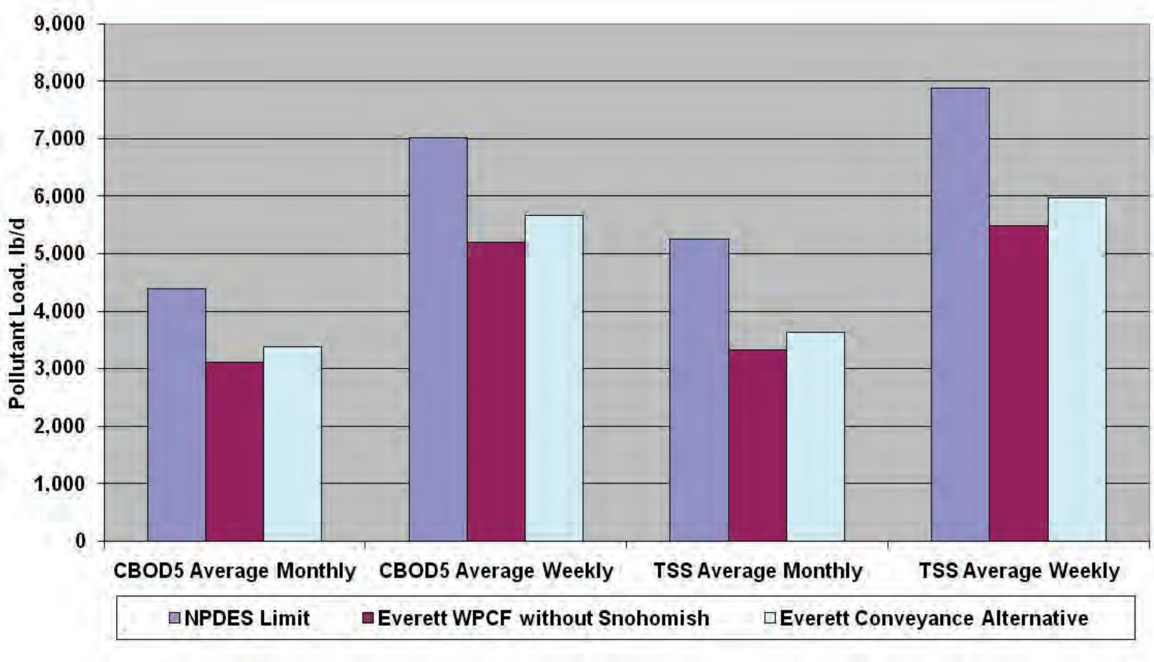


FIGURE 11-6 (NEW 2010)
Alternative Effluent Load Comparison, Low River Season, Snohomish River at Everett WPCF Discharge

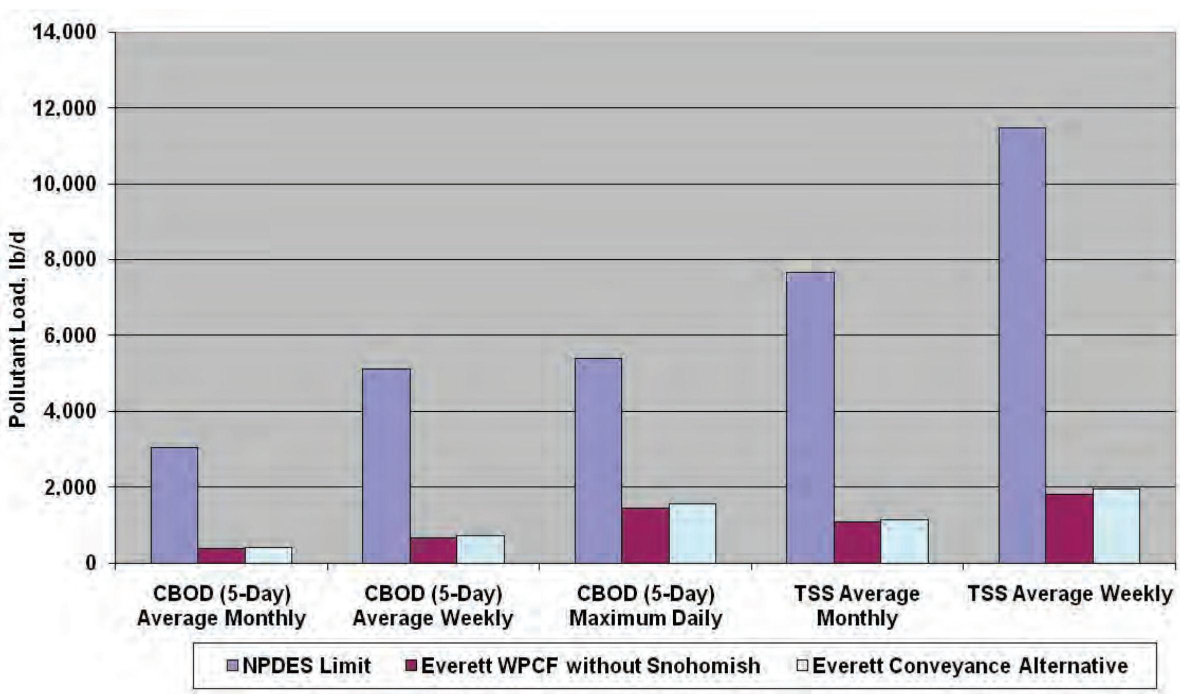


FIGURE 11-7 (NEW 2010)
Alternative Effluent Load Comparison, High River Season, Snohomish River at Everett WPCF Discharge

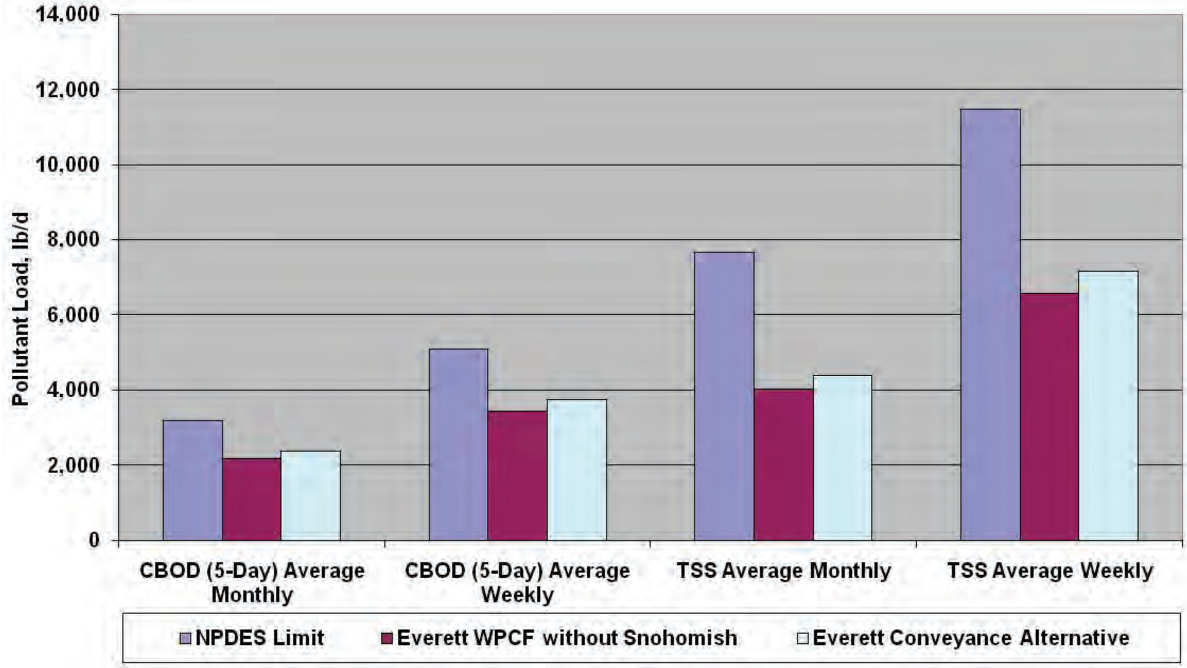


Table 11-5 (Revised 2010) ranks the adverse environmental and water quality impacts for construction and operation of the WWTP and Everett conveyance alternatives based on the information presented in this plan update and the accompanying SEPA Addendum. Adverse impacts were comparatively ranked as high, medium, or low for both the short term during construction, and long term, during operation. Additional water quality and environment benefits for several factors are discussed in this plan update and SEPA Addendum, but are not shown in this table.

TABLE 11-5 (NEW 2010)
Environmental Impact Evaluation

Environmental Factor	WWTP Alternative (construction/operation)	Everett Conveyance Alternative (construction/operation)
Water quality	medium/medium	medium/low
Air, energy, natural resources and climate change	medium/medium	low/low
Environmental health/noise	low/low	low/low
Land use	low/low	low/low
Shoreline/Coastal resources	low/medium	medium/low
Cultural resources	low/low	low/low
Recreation	low/low	low/low
Transportation	medium/low	medium/low
Public services and utilities (including economics)	medium/medium	medium/medium

Risk Evaluation

Key risks were identified and are water quality compliance, management control, operational responsibility, growth, cost, and schedule. Each alternative was then evaluated based on these risks. These risks were assessed using a risk assessment framework where the likelihood and consequence of each risk was assessed. A rating of high indicates a high probability of the risk occurring, while a rating of low indicates a minor chance of that risk occurring. The results of the risk assessment are shown in Table 11-6 (Revised 2010).Schedule risks were evaluated in further detail and are described later.

As shown in the table, there is a high risk for the WWTP alternative and low risk for the Everett conveyance alternative for water quality compliance and associated costs to ratepayers should the Snohomish WWTP NPDES permit limits become more restrictive or additional Snohomish River TMDLs go into effect. As previously noted, the Snohomish River is an "impaired" waterbody under Section 303(d) of the Clean Water Act, which requires allocating pollutant loading among sources that discharge to the river and other actions to help recover water quality. The Snohomish River also contains critical habitat for endangered salmon and other species, and national, regional and local recovery plans are in process. To date, water quality and species recovery have not been achieved. Climate change, growth, and other factors may exacerbate conditions in the future. Consequently, stricter water quality limits and increased protections for the recovery of endangered salmon in the Snohomish River are likely in coming decades.

Under the WWTP alternative, operations and/or facilities at the WWTP would have to be modified and additional treatment employed to meet more strict discharge requirements. The Everett conveyance alternative would eliminate the Snohomish WWTP discharge. Although the Everett WPCF would be subject to more stringent requirements and treatment, Everett has a better discharge location with a new outfall and the Snohomish flow would be a small, incremental portion of the Everett flow (and proportionate treatment upgrade costs).

The alternatives differ in terms of who has management control and operational responsibility for wastewater treatment. Under the WWTP alternative, the City of Snohomish has management control over the entire treatment system and does not have the risk associated with negotiating terms of treatment. The Everett conveyance alternative would have risk associated with the City of Everett having greater control over the design and cost of its treatment system, which would affect the City of Snohomish. In addition, there is some risk the City of Snohomish and City of Everett cannot agree on a future terms of wastewater services contract (the terms of a current agreement will be approved in conjunction with this 2010 plan update). However, federal and state law and Ecology permitting and oversight require the wastewater to be treated, so the risk is relatively low that potential differences could not be resolved in a timely manner. Conversely, under the WWTP alternative, the City would need to permanently staff the treatment plant and would be responsible for its performance, including the risks of noncompliance, which would be Everett's responsibility under the conveyance alternative.

TABLE 11-6 (NEW 2010)
Risk Assessment

Risk	WWTP Alternative	Everett conveyance
Water Quality Compliance: NPDES discharge permit requirements become more restrictive in the future resulting in major capital improvements.	High	Low
Operational responsibility: The City of Snohomish is responsible for staffing the WWTP and for any enforcement actions associated with noncompliance from the treatment system (which can range from penalties to capital improvements to sewer moratoria).	Medium	Low
Management Control: Lack of effective control over management of wastewater treatment and associated costs (for the Everett conveyance alternative, this would mean the City of Everett and City of Snohomish cannot agree to future wastewater service contract terms or dispute resolution regarding treatment and discharge of City of Snohomish flows).	Low	Medium
Growth: City of Snohomish is unable to treat increased flows and loads due to growth to the required water quality regulations.	Medium	Low
Cost: Future major capital improvements may be required.	High	Low

The WWTP alternative would have risk associated with future growth and being unable to treat increased wastewater flows and loads to the water quality standards required without major capital improvements. With the Everett conveyance alternative, the City would participate proportionally with all the users at the Everett WPCF to provide wastewater treatment for future growth, as compared to the WWTP alternative where improvements would be at its sole expense.

There is a higher risk associated with the WWTP alternative for increased future costs and required infrastructure.

Schedule Risks

Schedule risks for both alternatives are shown in Table 11-7 (Revised 2010).

TABLE 11-7 (NEW 2010)
Schedule Risk Assessment

Schedule Risk Assessment	WWTP Alternative	Everett Conveyance
Ecology approvals cannot be obtained or will be lengthy	Medium	Low
Regulatory agencies will not issue permits promptly or may be appealed	Low	Medium
Right-of-ways and/or easements for construction and easement areas cannot obtained	Low	Low
Construction delay due to single (WWTP) vs phased or multiple (Everett Conveyance Project) construction contracts	Medium	Low
Construction delay due to site conditions (WWTP site vs river crossing and force main alignment)	Low	Medium

Table 11-7 (Revised 2010) shows that there is low risk that Ecology would not approve the plan update and subsequent project design for either alternative, although Ecology review and approval of plans and specifications for the WWTP alternative will likely be more detailed and longer than for a pump station, lagoon modification and force main. Both alternatives will meet water quality requirements. There would be more risk associated with permitting for the Everett conveyance alternative because it involves more jurisdictions than the WWTP alternative and two water body crossings. The WWTP alternative is located on City of Snohomish property within the existing WWTP site but given its size could require construction staging area. The Everett conveyance alternative would require easements and working within rights-of-way belonging to the City of Everett, Snohomish County, and one or two private property owners.

It could be more difficult to construct the WWTP alternative on a compressed schedule than the Everett conveyance alternative since the WWTP alternative would likely be completed by one contractor versus multiple contracts for Everett conveyance. Since the Everett conveyance alternative comprises several components located in different areas, portions of the alternative could be constructed at the same time, such as the force main and the pump station. This would provide more flexibility in construction schedule than the WWTP alternative.

The Everett conveyance alternative would require boring a small pipe under two waterbodies. This involves more complex construction than the WWTP alternative, which is on a developed upland site with additional land available.

Economic Evaluation

A net present value (NPV) evaluation was performed comparing the capital and capitalized costs, annual O&M costs, repair and replacement costs, and salvage value of each alternative, using the basis of evaluation summarized in Table 11-8 (Revised 2010) (all costs are in 2009 dollars). The NPV evaluation assumed all mechanical equipment in both alternatives must be replaced every 20 years. As noted earlier, Kennedy/Jenks prepared the WWTP alternative costs as part of the *Final Draft WWTP Facility Plan Amendment* (Kennedy/Jenks, 2009). CH2M HILL prepared the Everett conveyance alternative costs. The percentages for legal/administration, engineering, construction management, mobilization/demobilization, and insurance/bonding applied to the WWTP alternative capital costs were revised to be consistent with the approach CH2M HILL used to prepare the Everett conveyance alternative cost. Table 11-9 (Revised 2010) summarizes the WWTP and Everett conveyance alternatives costs; Figures 11-8 through 11-10 (Revised 2010) graphically show the costs of both alternatives.

TABLE 11-8 (REVISED 2010)
Present Worth Evaluation Economic Basis of Evaluation

Economic Factor	Basis of Evaluation
Present value discount rate for capital, operations and maintenance, and salvage value[1]	4.375 percent
Evaluation period[2]	2009 through 2070
Cost basis	2009 dollars
Sales tax	8.6 percent

TABLE 11-8 (REVISED 2010)
Present Worth Evaluation Economic Basis of Evaluation

Economic Factor	Basis of Evaluation
Salvage value and service life	
River crossing	100 years
Force main	50 years
Pump station	
Structures	50 years
Equipment	20 years
Treatment plant	
Structures	50 years
Equipment	20 years

NOTES:

1. Federal discount rate for water projects
2. 50-year project life with project implemented by 2020

TABLE 11-9 (REVISED 2010)
Economic Evaluation (2009 dollars)

Description	WWTP Alternative	Everett Conveyance Alternative
Total capital cost[1]	$53,060,000	$26,590,000
Initial Everett capital capacity charge[2]	$0	$20,000,000
Total capital cost including Everett capacity charge	$53,060,000	$46,590,000
Year 2020 Snohomish O&M operations and maintenance[3]	$1,302,000	$412,000
Everett annual service charge[2]	$0	$1,000,000
Net present value through 2024 (planning period)[4]	$46,506,000	$36,021,000
Net present value through 2070 (project life)[4,5]	$70,350,000	$59,658,000

NOTES:

1. Construction cost only including Near-Term WWTP Improvements. Near-Term WWTP Improvements are estimated at $4,024,000 with portion included in 2005 WWTP upgrade deducted from WWTP alternative costs.
2. Estimated approximate charge subject to negotiation. Capacity charge is assumed to be paid in equal installments over a 30-year payback period, with the exception of Phase A expansion costs which would be paid from 2010-2015. Phase B costs assumed to occur in 2020.
3. WWTP alternative O&M estimated equal to existing plant O&M budget plus estimated O&M costs of upgrades per the *Final Draft WWTP Facility Plan Amendment* (Kennedy/Jenks, 2009) and 5 FTEs.
4. Includes replacement of equipment every 20 years.
5. The City of Snohomish's share of future Everett WPCF expansions beyond the 2024 planning period was assumed to be $3.25 M every 8 years starting in 2028, based on linear extrapolations of growth (including Everett industry).

FIGURE 11-8 (NEW 2010)
Alternative Capital Cost Comparison (2009 dollars)
**subject to negotiation*

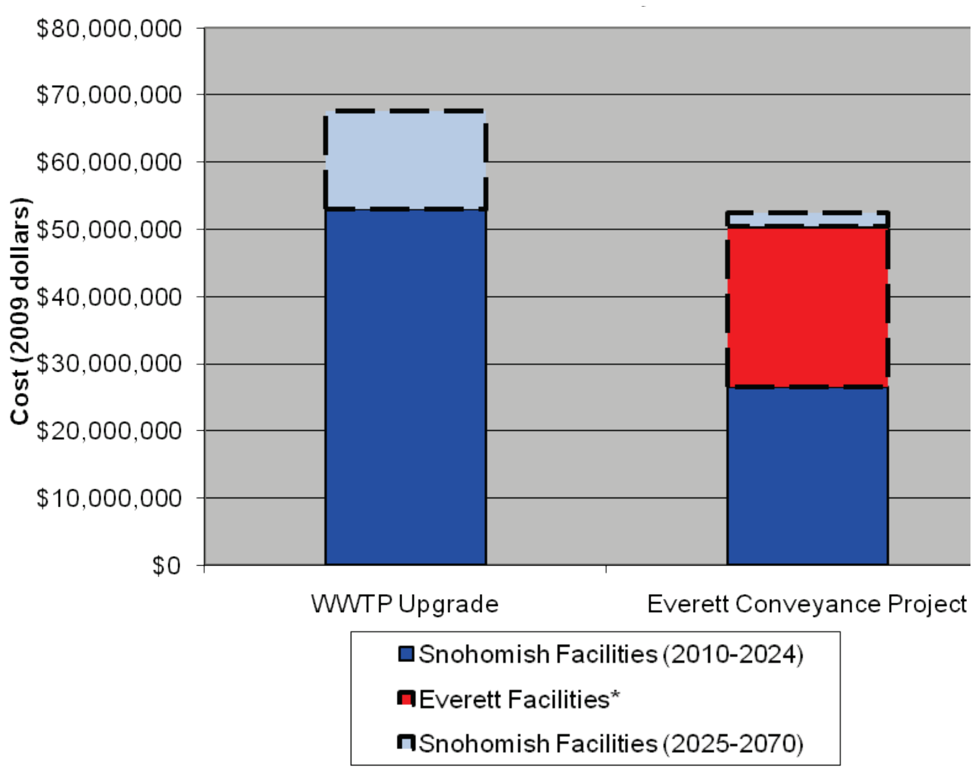


FIGURE 11-9 (NEW 2010)
Alternative Operations and Maintenance Cost Comparison, Year 2020 (First Year of Operation)
**subject to negotiation*

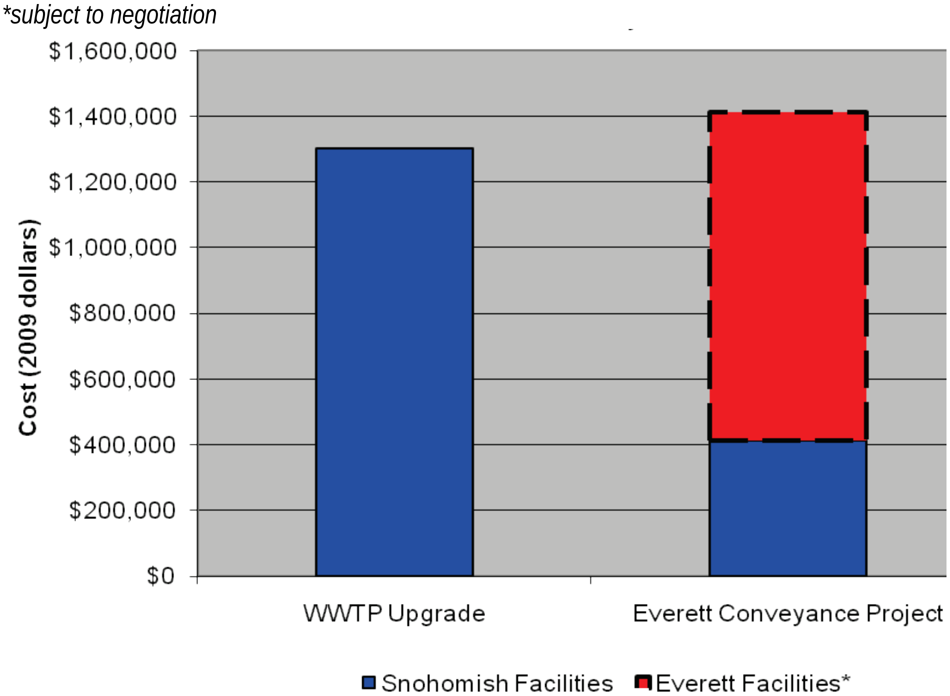
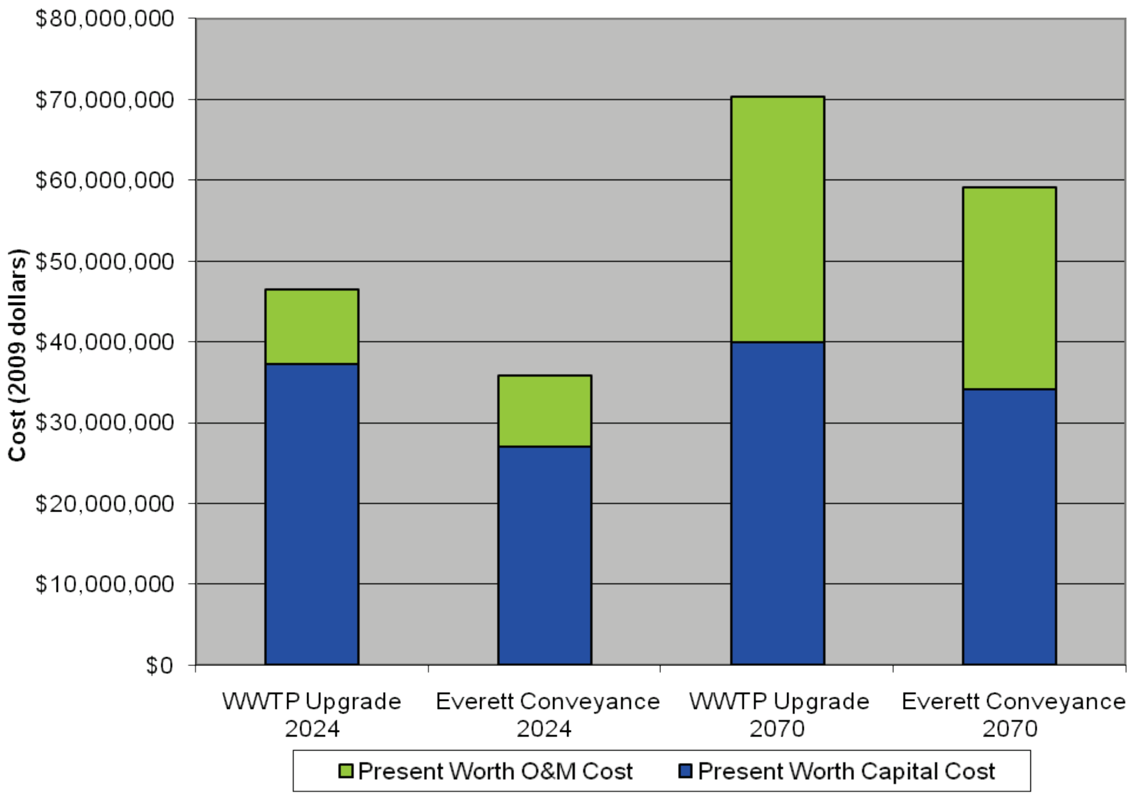


FIGURE 11-10 (NEW 2010)
Alternative Present Worth Cost Comparison



Note: Capital includes major expansion and salvage costs, and operations and maintenance includes repair and equipment replacements costs.

CONCLUSIONS AND RECOMMENDATIONS

The Everett conveyance alternative appears to be environmentally-preferable because it would remove the discharge to the Snohomish River from the City of Snohomish WWTP. The Snohomish River is currently designated both as an impaired waterbody and as critical endangered species habitat. Removal of the City's discharge to the Snohomish River would protect the river and its fisheries and natural resources over the long term while also addressing future planned growth. Before the conveyance line is installed, near-term improvements to the WWTP would enable the City to meet the current NPDES permit requirements.

The WWTP alternative poses higher risks associated with future water quality compliance, operational responsibility, the ability to meet future growth, and cost. The WWTP upgrade alternative has fewer risks in terms of management control, permitting, and the absence of a river crossing. Overall, the Everett conveyance alternative poses fewer risks that could result in substantial future costs. Both of the alternatives should be able to meet water quality standards and permit limitations in 2024. Both of the alternatives are costly – more than $40 million in capital-related costs to construct -- and would result in hardship rates. Because of project design, permitting and cost, it is unlikely either alternative could be in operation before 2016. Both of the alternatives could be permitted and constructed before the expiration of the City's 2016 permit renewal.

The capital cost to construct the Everett conveyance alternative is estimated to be approximately $22 million compared with approximately $49 million for the WWTP alternative, not including near-term WWTP improvements. The Everett conveyance alternative would require the City of Snohomish to purchase capacity and help pay for an expansion in the Everett WPCF to accommodate Snohomish flows. This capitalized cost would be phased and could be in the range of $15 to $20 million as noted. The net present value in 2024 for the Everett conveyance alternative is estimated to be approximately $36 million compared to approximately $47 million for the WWTP alternative.

The Everett conveyance would require annual charges to the City of Everett that would not occur with the WWTP alternative. However, the Everett conveyance alternative would have a projected useful service life of approximately 50 years, with some maintenance and replacement costs for the pump station in approximately 20 years. In contrast, the WWTP alternative would require substantial replacement or upgrade to the treatment plant in approximately 20 years.

The net present value of the Everett conveyance alternative through the project life is estimated at approximately $59 million compared with $70 million for the WWTP alternative. The Everett conveyance is therefore the cost-effective alternative.

In summary, the Everett Conveyance Project appears to be the cost-effective, environmentally-preferred alternative. Transfer of flow to the Everett WPCF along the identified alignment is considered the preferred wastewater treatment alternative to meet water quality compliance for the long term, combined with implementation of a near-term WWTP improvement project.

CHAPTER 12

Recommended Improvements

<Replace entire chapter with the following.>

This chapter summarizes recommended upgrade projects and associated costs for the City of Snohomish wastewater collection system and treatment plant. Cost estimates assume 30 percent contingency, 8.5 percent sales tax, 15 percent engineering (when required by the project), and 10 percent project administration. Estimated costs from the 2005 Plan are updated to 2009 dollars using the Seattle ENR CCI for May 2009. This chapter also discusses an implementation schedule.

COLLECTION SYSTEM IMPROVEMENTS

Improvements to Reduce Combined Sewer Overflows

Recommendations for reducing CSOs in the combined-sewer service area are presented in Volume II of the *Wastewater System Plans* (*Combined-Sewer Overflow Reduction Plan Update*). The improvements consist of the following key elements:

- **Conveyance system upgrades.** These upgrades include replacing Pump Station No. 1 with a higher-capacity combined pump station, installing a new force main routed from the new pump station directly to the treatment plant headworks, and improving the 2^{nd} Street Trunk. The proposed pump station will pump combined sewage at first, providing separate pumping for wastewater and stormwater after separation projects begin. The recommended conveyance system improvements will reduce the occurrence of CSOs to one per year or fewer, as required by regulations.
- **Continued CSO monitoring.** Continued monitoring is necessary in order to expand upon the limited overflow data available as of the end of 2003. This will help to validate the pump and pipe sizes recommended in the conveyance system upgrades.
- **Long-term system separation.** Separation of the combined sewers will eventually eliminate CSOs. The existing combined-sewer system is quite old and will continue to fall into disrepair over the next several decades. Without replacement, the sewers continue to age and infiltration and inflow (I/I) will increase, which could result in the recurrence of CSO events. The recommended plan has sewer separation projects starting in 2014 and being completed in 2042.

Figure 5-1 in the CSO Reduction Plan shows the recommended conveyance improvements, and Figure 4-9 in the same plan shows the sewer separation projects. Table 12-1 (Revised 2010) summarizes the capital costs associated with the recommended CSO reduction improvements.

TABLE 12-1 (REVISED 2010)
Cost Summary for Recommended CSO Reduction Projects

Item	Estimated Cost[1]
Sanitary Sewer Improvements[2]	$4,797,000
Stormwater Projects	$2,860,000
Sewer Separation Projects[3]	$28,339,000
Total CSO Reduction/Elimination Costs	$35,996,000

NOTES:
[1]Estimated costs have not been adjusted for scheduling considerations.
[2]Project is currently under construction.
[3]12-in-diameter storm line completed in 2008.

Additional Collection System Improvements

Collection system improvements other than those to reduce CSOs are discussed in detail in Chapter 7 of this report. The recommended improvements include monitoring flow in the trunk sewers, channeling manholes, replacing damaged and/or under-capacity pipes and force mains, installing telemetry improvements, upgrading deficient pump stations, and providing standby power at the pump stations. Table 12-2 (revised 2010) summarizes the proposed improvements developed in this report and provides planning level cost estimates.

Staffing

Additional staff time will be required for the recommended collection system flow monitoring during rain events. To estimate the staffing cost for City staff conducting this monitoring, it was assumed that there will be about six significant rain events per year that are worth monitoring flows in the trunk sewers. For the first rain event, it is recommended that City staff monitor the entire length of the trunk and identify one or two manholes where surcharging is the highest. For all subsequent monitored rain events, City staff would monitor flows only at these key manholes.

For staffing purposes, assume one full day for two crew members to monitor for the first rain event, and one-half day for two crew members for five subsequent rain events. In addition, it is recommended to allow one-half day for each event for one of the crew members to prepare a memorandum and/or meet with supervisors. This totals approximately two weeks' time for City staff (three days for one person for memoranda and meetings and three and a half days for two people for field work, totaling ten days).

WASTEWATER TREATMENT SYSTEM IMPROVEMENTS

The recommended treatment plant improvements consist of the near-term improvements needed to comply with the WWTP's NPDES Permit. This includes installing a submerged fixed-film media system in the WWTP lagoons, automated dosing of supplemental alkalinity, dissolved oxygen monitoring, improvements for algae control, filtration system improvements, and automated chlorination and dechlorination. Treatment plant improvement recommendations are presented in more detail in Chapter 11.

TABLE 12-2 (REVISED 2010)
Summary of Recommended Collection System Improvements

Project No.	Location	Description	Planning Level Cost
Pump Station No. 2 (Rainier) Interim Improvements			
a.		Install a flow meter to verify pump station capacity.	$23,800
Telemetry Upgrades			
a	Pump Stations	Install fire and intrusion alarms, telemetry data logging and retrieval upgrades, and two pump-running alarms. Provide level sensors with volume calculations at Lincoln, Rainier, Champagne, and Hill Park.	$84,800
Miscellaneous			
a.	Separated Sewer System	Complete channeling of unchanneled manhole.	$16,000
b.	Pump Station No. 3 (Lincoln)	Install a drain in the valve box.	$5,300
c.	Pump Station No. 7 (Champagne)	Replace existing force main and reroute to the gravity sewer at Park and 17th Place.	$175,000
d.	Combined Sewer Area	Complete channeling of unchanneled manholes.	$16,000
Kla-Ha-Ya Upgrades			
a.	Kla-Ha-Ya	Eliminate the pump station by requiring installation of private gravity side sewers to the City's gravity sewer on First Avenue.	$0
Rainier Pump Station Replacement			
a.	Rainier Pump Station	Budget amount to complete replace the pump station in the future.	$2,490,000

TABLE 12-3 (REVISED 2010)
Capital Cost Summary for Near-Term Wastewater Treatment Plant Improvements

Improvement	Budgetary Capital Cost/Allowance
Near-Term Improvements	
SFF Media System Equipment	$1,500,000
SFF Media System Installation	$400,000
Automated Dosing of Supplemental Alkalinity	$75,000
Dissolved Oxygen Monitoring	$25,000
Improvements for Algae Control	$20,000
Filtration System Improvements	$50,000
Automated Chlorination/Dechlorination	$60,000
Subtotal	**$2,130,000**

TABLE 12-3 (REVISED 2010)
Capital Cost Summary for Near-Term Wastewater Treatment Plant Improvements

Improvement	Budgetary Capital Cost/Allowance
Taxes	$183,000
Subtotal	**$2,313,000**
Contractor OH, Profit, Mob, Bonds & Insurance	$463,000
Contingency	$578,000
Subtotal	**$3,354,000**
Engineering	$335,000
Construction Management	$335,000
Total	**$4,024,000**

Figure 10-7 shows the WWTP site plan. Table 12-3 (revised 2010) summarizes capital costs for the recommended improvements.

Staffing

Near-term upgrades to the treatment plant will require three full-time equivalents (FTEs) which is the same as the existing staffing requirements. Once the long-term Everett conveyance infrastructure is in place, this would be reduced to 0.4 FTEs.

EVERETT CONVEYANCE PROJECT

The Everett Conveyance Project is expected to consist of a pump station, approximately five miles of force main, at least one crossing of the Snohomish River or tributary, and a connection to Everett’s south interceptor. Flow equalizing storage is to be provided at the existing City of Snohomish WWTP. Other WWTP modifications include improvements to the headworks, and modification of the existing lagoons likely decommissioning Lagoons 2, 3, and 4 as described in Chapter 10. The City of Everett has been providing studies of its system hydraulics and costs, as well as including the City of Snohomish flows in Everett’s recently completed City of Everett Engineering Report (Carollo, 2009) regarding the future improvements Everett will need for its treatment plant. The cities are working toward reaching a final agreement in the fall of 2010. Table 12-4 summarizes capital costs for the Everett Conveyance Project.

Staffing

It is estimated that 0.5 FTEs will be needed to operate and maintain the force main to Everett and an additional 0.4 FTE would be needed at the WWTP site.

IMPLEMENTATION SCHEDULE

Table 12-5 (Revised 2010) shows an overall implementation schedule for the recommended alternative and shows activities that must be accomplished before construction can begin on the proposed improvements. This schedule is subject to change and may be revised over the course of the project. Tables 12-6 through 12-8 (Revised 2010) present proposed phasing for the collections system improvements not for CSO reduction, treatment facility improvements, and CSO reduction improvements, respectively.

TABLE 12-4 (REVISED 2010)
Cost Summary of Recommended Everett Conveyance Project

Description	Estimated Capital Cost
Force main and river crossing (rounded)	$10,842,000
Pump station and WWTP modifications (rounded)	$7,131,000
Estimated Construction Cost	**$17,973,000**
Administration, legal, and permitting (5%)	$899,000
Engineering services (10%)	$1,797,000
Construction services and management (10%)	$1,797,000
Property Acquisition	$100,000
Total Capital Cost not including Everett capacity charge	**$22,566,000**
Estimated Everett capital capacity charge[1]	$20,000,000
Estimated Capital Cost including Everett capacity charge	**$42,566,000**[2]

NOTES:
[1] Subject to negotiation.
[2] Does not include the capital cost of near-term WWTP improvements ($4,024,000).

TABLE 12-5 (REVISED 2010)
Implementation Schedule for the Everett Conveyance Project

Item	Estimated Completion Date
Adopt the coordinated Comprehensive Plan amendments and General Sewer Plan & Wastewater Facilities Plan Update	December 2010
Negotiate and approve interlocal agreements	December 2010
Complete Project-Level Engineering Report and Facility Plan and Related Project-Level SEPA Review; prepare permit applications	December 2011
Complete permitting (City of Snohomish, City of Everett, Snohomish County, JARPA)	May 2013
Complete facility design • Submit final plans and specifications - July 2013 • Submit critical milestone report - July 2013 • Decision on final construction schedule – Summer 2013[2] • Submit bid-ready plans and specifications – December 2013[2] • Bid construction – December 2013[2] • Award construction – July 2014[2]	Prior to expiration of 2016 NPDES Permit renewal
Project complete and operational substantial completion by December 2016 subject to 2013 final construction schedule decision[2]	Prior to expiration of 2016 NPDES Permit renewal

NOTES:
[1] JARPA: Joint Aquatic Resource Permit Application (includes U.S. Army Corps of Engineers and related federal reviews, Washington Departments of Ecology, of Fish and Wildlife, and Natural Resources)
[2] Agreed Order 7974, dated Sept. 10, 2010, provides for the City to submit a critical milestone report to Ecology. The City may propose in the report to adjust the final schedule based on readiness to proceed, as described in the order, and will consider the effectiveness of the near term improvements and status of compliance with treatment plant design capacity limitations.

TABLE 12-6 (REVISED 2010)
Proposed Phasing for Collection System Improvements

Sequence	Description	Completion Date	Estimated Capital Cost
1	Telemetry upgrades	Originally 2005	$85,000
2	Miscellaneous repairs	Originally 2006	$244,000
3	Kla-Ha-Ya upgrades	Originally 2006	$0
4	Rainier Pump Station replacement	2015	$2,490,000

TABLE 12-7 (REVISED 2010)
Proposed Phasing for Treatment Facility Improvements

Sequence	Description	Completion Date	Estimated Capital Cost
1	Near-term improvements (WWTP Improvement Project)	2012	$3,350,000

TABLE 12-8 (REVISED 2010)
Proposed Phasing for Collection System CSO Reduction Improvements

Sequence	Description	Completion Date	Estimated Capital Cost
Phase I: CSO Reduction			
1	Construct wastewater and stormwater pump station. Install wastewater pumps and controls only. Install wastewater force main to treatment plant. Upgrade sanitary sewer along 2nd Street between treatment plant influent pipe and 2nd and H overflow.	Under construction	$4,797,000
Phase II: Stormwater Trunk System			
1	Stormwater treatment pond improvements (allowance)	2012	$742,000
2	Stormwater pump station and force main, 2nd Street stormwater trunk, Stormwater lagoon improvements	2013	$2,119,000
Phase III: Sewer Separation			
1	Sewer Separation Project 1	2014	$3,264,000
2	Sewer Separation Project 2	2015	$3,020,000
3	Sewer Separation Project 3	2018	$1,765,000
4	Sewer Separation Project 4	2021	$2,255,000
5	Sewer Separation Project 5	2024	$1,882,000
6	Sewer Separation Project 6	2026	$2,368,000
7	Sewer Separation Project 7	2029	$3,182,000

TABLE 12-8 (REVISED 2010)
Proposed Phasing for Collection System CSO Reduction Improvements

Sequence	Description	Completion Date	Estimated Capital Cost
8	Sewer Separation Project 8	2032	$2,857,000
9	Sewer Separation Project 9	2036	$2,685,000
10	Sewer Separation Project 10	2039	$2,675,000
11	Sewer Separation Project 11	2042	$2,387,000

WATER QUALITY PLAN COMPLIANCE

The recommended improvements in this 2010 Plan Update would continue to comply with applicable provisions of the Snohomish River Estuary Total Maximum Daily Load (TMDL) adopted under Section 303(d) of the Clean Water Act. Specifically, the removal of the discharge into the Snohomish River from the Snohomish WWTP will comply by eliminating loading and the need for TMDL limits. As documented in this 2010 Plan Update and shown in Figures 11-3 through 11-7, the addition of the flows to the Everett will not affect the ability of the Everett WPCF to continue to meet applicable TMDL limits for the Snohomish estuary.

The recommended improvements are also consistent with and further the goals of the Puget Sound Action Agenda, specifically Section C.3 on municipal wastewater treatment (http://www.psp.wa.gov/downloads/AA2009/Action_Agenda_FINAL_063009.pdf) approved by EPA on July 15, 2009 under Section 320 of the federal Clean Water Act. The recommended improvements are also consistent with and further the goals of the 2005 Snohomish River Basin Salmon Conservation Plan, specifically Element 10.3 Regulatory and Programmatic actions on water quality (http://www.co.snohomish.wa.us/documents/Departments/Public_Works/surfacewater management/snohomishsalmonplanfinal/Final_Compiled_Plan.pdf).

SEPA AND NEPA COMPLIANCE

SEPA compliance on this 2010 Plan Update has been fulfilled by a SEPA Addendum on the Proposed General Sewer Plan and Associated Proposed Comprehensive Plan Amendments and Implementing Actions (City of Snohomish, 2010).

NEPA compliance is required for federal actions, not for the City of Snohomish or Ecology approval of this 2010 Plan Update. NEPA encourages early review where non-Federal entities may be making application to federal agencies, such as for federal funding. NEPA also allows federal agencies to adopt state environmental reviews, such as SEPA documents. Part 1506 of the NEPA Rules (40 CFR 1506). The SEPA Addendum evaluates the same programmatic environmental impact review of alternatives as would be required under NEPA to facilitate future NEPA compliance for potential funding. As explained in Chapter 4, Ecology uses a State Environmental Review Process (SERP) to provide project-level federal review of potential federal funding of wastewater system improvements to meet early NEPA review. That process will occur as part of the implementation of the plan.

COMMUNITY RELATIONS

As described in Chapter 4, agencies and the public were invited to comment on scoping and on the draft 2010 Plan Update and SEPA Addendum documents (30-day public comment period), as well as City outreach to other jurisdictions and groups known to be interested in the plan update. The Snohomish City Planning Commission and Council public hearings will be conducted as part of the comment process and prior to recommendations and decisions on plan adoption.

CONCLUSIONS

This City of Snohomish *General Sewer Plan and Wastewater Treatment Plant Facilities Plan* has met the project goals by developing and evaluating alternatives for wastewater collection, treatment, storage, and disposal facilities to provide adequate hydraulic and treatment capacity for the planning period. Planning-level cost estimates were prepared to compare the alternatives, and a recommended alternative was selected; rate impacts and phased implementation strategies were also evaluated. The estimated capital costs for designing and constructing the recommended projects, including construction costs, contingency, engineering, construction administration, and sales tax are as follows:

- CSO conveyance improvements: approximately $7.2 million
- Sewer separation system projects: approximately $26.7 million
- Collection system improvements not for CSO reduction: approximately $2.6 million
- Near-term WWTP improvements: approximately $4.0 million
- Conveyance to Everett: approximately $22.5 million

Following are the recommended next steps:

- Prepare a Facility Plan or Engineering Report for the Near Term Wastewater Treatment Plant Improvements.
- Prepare a Facility Plan or Engineering Report for the Everett Conveyance Project.
- Implement the Financial Plan (Chapter 13), making rate adjustments as necessary based on other sources of revenue to assure continued funding of the improvements described in this plan update.

CHAPTER 13

Financing Plan

As a part of the GSP and comprehensive plan update process, this chapter provides a financial analysis and financing plan to implement the 2010 Update, including providing for funding for the Everett Conveyance Project.

The plan includes a series of assumptions regarding project timing, bond financing, loan terms, grant availability, and anticipated interagency agreements between the City of Snohomish and the City of Everett and presents a cash flow picture and approximate rate impact. Several tables illustrate key components of the financing plan. The dollars in these tables are 2010 estimates and will change over time based on actual revenues received, actual costs of the improvements, and financial factors described in the plan. This plan will be incorporated into the City of Snohomish's Capital Facilities Plan to document compliance with RCW 36.70A and RCW 36.70B.030(2)(c).

The intent is to demonstrate the levels of rates and charges that will be necessary to support and implement the proposed plan. The average rates shown in this section reflect an equivalent residential unit and do not reflect the current rate structure. As part of implementing this financing plan, the City will conduct rate studies that will detail the cost of service for the various types of customers. In its annual budget reviews, the City will adjust the rates to meet the funding needs not met by other sources of revenue.

The plan identifies sources of public money to fund the facilities. If probable funding falls short of meeting needs, the contingency plan is for rates to make up the difference. By far the most costly capital improvement in the plan is the Everett Conveyance Project. Because the Everett Conveyance Project has a useful life of approximately 50 years, the project will meet the needs of the land use element of the Comprehensive Plan for many decades.

EXISTING RATE STRUCTURE AND CHARGES

Overview

Basic Service Charges and Customer Base

The current bimonthly base rate for a standard residential unit (5/8 inch meter) is $105. The City bases its rates on meter size and a standard allowance of consumption. An overview of all the current charges is shown in Table 13-1 below.

The base rate covers a standard allowance of consumption of 400 cubic feet or 4 units.

New-Customer Connection Fees and Charges

The City of Snohomish has enacted ordinances establishing three separate new customer connection fees. These are a utility connection fee, a capital facility fee, and a system development charge. The utility connection fee is intended to fund major system replacements of the utility. The capital facility fee is used to fund increases in service capacity beyond those borne by development when such increases are in the best interests of the utility based on planned future growth. The system development fee is used to fund major infrastructure improvements in special benefit areas and apply only to those connections within the special benefit area.

TABLE 13-1 (NEW 2010)
2010 Wastewater Rates (Bimonthly)

Service Meter Size	Included Units	2009 Rate	Included Units	2010 Rate
5/8-inch	4	$105.00	4	$105.00
5/8-inch low-income, senior	8	$26.26	8	$26.26
1-inch	10	$268.82	10	$268.82
1½-inch	23	$604.74	23	$604.74
2-inch	41	$1,075.26	41	$1,075.26
3-inch	92	$2,419.22	92	$2,419.22
4-inch	164	$4,300.78	164	$4,300.78
Nonmetered		$233.96		$233.96
Consumption over the included units “overage”		$3.91		$3.91

NOTE:
Service rate outside city limits at 150 percent.

Currently, the connection fee for a 5/8-inch meter is $2,942 and is higher for larger meter sizes. The capital facility charge is $1,962 and is higher for larger meter sizes. The only current system development fee is for the Cemetery Creek Special Project area and is $8,288 for a 5/8-inch meter.

CASH FLOW REQUIREMENTS 2010–2024

A cash flow analysis has been prepared to suggest a feasible revenue-generation level necessary to support the wastewater utility and the proposed improvements. The cash flow analysis includes a number of types of expenditures:

- Operation and Maintenance: Costs that the City incurs directly for system functions, broken down into the three categories used by the City; Wastewater Administration, Collection, and Treatment.
- Everett User Charges: Funds to be paid to the City of Everett on an annual basis to support Everett’s conveyance and treatment operation and maintenance efforts associated with receiving City of Snohomish wastewater.
- Debt Service: Monies used to retire existing and future bonds and loans used to implement the wastewater conveyance and treatment programs and projects.
- Transfers to the wastewater capital projects fund outside wastewater operations fund.

Existing debt service is from a table provided by the City that reflects a number of different financing instruments. The existing debt service payments on an annual basis are listed in Table 13-2.

TABLE 13-2 (REVISED 2010)
Existing Debt Service Payments

Year	Debt Service
2010	$907,598
2011	$999,725
2012	$1,001,821
2013	$729,084
2014	$728,534
2015	$727,984
2016	$451,461
2017	$174,938
2018	$174,938
2019	$174,388
2020	$173,839
2021	$173,289
2022	$172,739
2023	$172,189
2024	$171,640

In addition, the City has provided information related to transfers to other the wastewater capital projects fund outside of the wastewater operations fund that are reflected in the analysis.

In developing the financial analysis for 2010 through 2024, three different scenarios were evaluated:

- Scenario 1 – CCWF grant funding of $4 million and the remaining funding through revenue bonds
- Scenario 2 – Low interest funding through State loans
- Scenario 3 – No State grants or loans and all funding through revenue bonds

For the financial analysis, a number of assumptions were made. These assumptions are as follows:

All Scenarios

- Inflation: 2.5 percent
- Everett User Charges: Because negotiations between the City and the City of Everett are ongoing and specific details have not been finalized, an assumed annual user charge of $1 million (2010 dollars) has been assumed and inflated to the point at which the Everett Conveyance Alternative is placed in service.
- Annual increase in Everett user charges: 5 percent

- Wastewater treatment O&M will increase at the rate of inflation over time and will drop to 25 percent of its then current rate when the Everett Conveyance Alternative is placed in service.
- As the number of ERU's increase over time, additional revenue can be generated in the form of a New Development fee to support the new facilities. This has been accounted for by totaling the annual debt service payments and prorating the cost between new and existing connections and reducing the rate impact by the annual new development payments
- The City of Everett has proposed a payment schedule for buy-in as shown in Table 13-3.
- The analysis assumes that payment will be made for the existing capacity and collection system capacity at the time the Everett Conveyance Alternative is placed in service. Payment for the first expansion of the Everett plant will be made in 2014, so that Everett has the funds in advance of the required construction.

TABLE 13-3 (NEW 2010)
Proposed Payment Schedule

	Phase A (2014)	Phase B (2022)
Existing Plant	$9.77 million	$1.70 million
Expansion	$5.85 million	$1.55 million
Collection	$1.16 million	$0
	$16.78 million	$3.25 million

Scenario 1 – CCWF grant funding of $4 million and the remaining funding through revenue bonds

- Bond rate: 5.0 percent, with 30 year bond duration. Debt coverage requirements are assumed to be 150 percent of the bonded amounts.
- For planning purposes, one State grant of $4 million ($2 million in 2014 and $2 million in 2015) has been incorporated into the analysis. As noted in this plan, other sources of funding including rate increases will fill the gap if these grants are not made, however, this is likely to cause even greater rate hardship and the need for mitigating measures discussed in earlier chapters.
- The analysis assumes that there will be three bond issues (Scenario 1) used to finance the alternative, each separated by 4 years. Bonds will be issued or loans acquired at the time the costs are incurred. The bond issues will be for $$28.4 million, $10.9 million, and $3.3 million, respectively.
- The City's sewer utility is concurrently supporting a series of collection system and CSO reduction improvements out of its revenue stream. The current projected cost of these facilities is approximately $38 million to be spent over the next 20-40 years. The debt coverage requirement (50 percent excess) will generate about $35 million over the 30-year life of the bonds. For the purposes of this analysis, the debt coverage revenue is

assumed to offset the potential rate impacts of the anticipated collection system and CSO costs.

Scenario 2 – Low interest funding through State loans

- Low interest State loan rate: Loan rates for short-term (1 to 5 year) loans are set at 30 percent of the average market loan rate (30 percent of 5 percent is 1.5 percent) and for long-term (up to 20 years) loans are set at 60 percent of average market loan rate (60 percent of 5 percent is 3 percent). Loan duration is 20 years.
- The analysis assumes that there will be three low-interest loans received. Loans will be acquired at the time the costs are incurred. The loans will be for $32.4 million, $10.9 million, and $3.3 million, respectively.

  The City's sewer utility is concurrently supporting a series of collection system and CSO reduction improvements out of its revenue stream. The current projected cost of these facilities is approximately $38 million to be spent over the next 20-40 years. For the purposes of this analysis under the low-interest loan scenario, the funding of the collection system and CSO reduction improvements is not included. A separate collection system and CSO reduction improvements analysis of fund sources and rate impacts for collection system and CSO reduction improvements will need to be performed to determine future funding for these improvements.

Scenario 3 – No State grants or loans and all funding through revenue bonds

- No State grants or loans will be available,
- Bond rate: 5.0 percent with 30 year bond durations
- Debt coverage requirements are assumed to be 150 percent of the bonded amounts.
- The analysis assumes that there will be three bond issues used to finance the alternative, each separated by 4 years. Bonds will be issued or loans acquired at the time the costs are incurred. The bond issues will be for $32.4 million, $10.9 million, and $3.3 million, respectively.
- The City's sewer utility is concurrently supporting a series of collection system and CSO reduction improvements out of its revenue stream. The current projected cost of these facilities is approximately $38 million to be spent over the next 20 to 40 years. The debt coverage requirement (50 percent excess) will generate about $35 million over the 30-year life of the bonds. For the purposes of this analysis, the debt coverage revenue is assumed to offset the potential rate impacts of the anticipated collection system and CSO costs.

Table 13-4 shows the cash flow for the City's wastewater utility funding of the Everett Conveyance Project based on the assumptions described above for Scenario 1 (CCWF Grant and bond financing). Table 13-5 shows the cash flow for the City's wastewater utility funding of the Everett Conveyance Project based on the assumptions described above for Scenario 2 (low-interest loan financing). Table 13-6 shows the cash flow for the City's wastewater utility funding of the Everett Conveyance Project based on the assumptions described above for Scenario 3 (No State grants or loans and bond financing).

The following conclusions can be drawn concerning the projected cash flow analysis:

- The financing plans presented are adequate to fund the improvements described in the 2010 Plan Update, including the Everett Conveyance Project.
- Under all three scenarios, the projected sewer rates will need to increase in two phases. The first rate increase will occur in 2012 at the start of design and construction for the Everett Conveyance Project.
- A second rate increase will be required at the time the Everett Conveyance Project is placed into service, the annual user charge begins, and payment for the existing Everett capacity becomes due in approximately 2016.

TABLE 13-4 (REVISED 2010)

Cash Flow for Funding of the Everett Conveyance Project, CCWF Grant and Bond Financing

YEAR	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Wastewater Administration	$72,398	$74,208	$76,063	$77,965	$79,914	$81,912	$83,959	$86,058	$88,210	$90,415	$92,676	$94,992	$97,367	$99,801	$102,296
Wastewater Collection	$806,288	$826,445	$847,106	$868,284	$889,991	$912,241	$935,047	$958,423	$982,384	$1,006,943	$1,032,117	$1,057,920	$1,084,368	$1,111,477	$1,139,264
Wastewater Treatment	$556,919	$570,842	$585,113	$599,741	$614,734	$630,103	$157,526	$161,464	$165,500	$169,638	$173,879	$178,226	$182,681	$187,249	$191,930
Everett User Charges							$1,340,096	$1,407,100	$1,477,455	$1,551,328	$1,628,895	$1,710,339	$1,795,856	$1,885,649	$1,979,932
Debt Service															
Existing	$907,598	$999,725	$1,001,821	$729,084	$728,534	$727,984	$451,461	$174,938	$174,938	$174,388	$173,839	$173,289	$172,739	$172,189	$171,640
Bond Issue 1															
Everett Initial Plant Expansion			$380,551	$380,551	$380,551	$380,551	$380,551	$380,551	$380,551	$380,551	$380,551	$380,551	$380,551	$380,551	$380,551
Near-term Improvements			$261,767	$261,767	$261,767	$261,767	$261,767	$261,767	$261,767	$261,767	$261,767	$261,767	$261,767	$261,767	$261,767
Everett Conveyance Alternative			$1,207,745	$1,207,745	$1,207,745	$1,207,745	$1,207,745	$1,207,745	$1,207,745	$1,207,745	$1,207,745	$1,207,745	$1,207,745	$1,207,745	$1,207,745
Debt Coverage			$925,031	$1,393,395	$1,393,395	$1,393,395	$1,393,395	$1,393,395	$1,393,395	$1,393,395	$1,393,395	$1,393,395	$1,393,395	$1,393,395	$1,393,395
Bond Issue 2															
Everett Existing Capacity							$635,553	$635,553	$635,553	$635,553	$635,553	$635,553	$635,553	$635,553	$635,553
Everett Collection System							$75,460	$75,460	$75,460	$75,460	$75,460	$75,460	$75,460	$75,460	$75,460
Debt Coverage							$355,506	$355,506	$355,506	$355,506	$355,506	$355,506	$355,506	$355,506	$355,506
Bond Issue 3															
Phase B Capacity											$211,417	$211,417	$211,417	$211,417	$211,417
Debt Coverage											$105,709	$105,709	$105,709	$105,709	$105,709
Interfund Transfers	$311,350	$319,134	$327,112	$335,290	$343,672	$352,264	$361,071	$370,097	$379,350	$388,833	$398,554	$408,518	$418,731	$429,199	$439,929
To Project Funding	$920,000	$200,000	$205,000	$210,125	$215,378	$220,763	$226,282	$231,939	$237,737	$243,681	$249,773	$256,017	$262,417	$268,978	$275,702
Total Expenditures	$3,574,553	$2,990,354	$5,817,310	$6,063,946	$6,115,682	$6,168,724	$7,865,417	$7,699,996	$7,815,551	$7,935,203	$8,376,833	$8,506,403	$8,641,262	$8,781,645	$8,927,795
ERU (1)	4,140	4,261	4,385	4,512	4,641	4,773	4,908	5,045	5,186	5,483	5,783	6,087	6,395	6,706	7,022
New Development		$8,262	$30,459	$31,280	$30,791	$30,087	$35,270	$32,737	$31,808	$15,099	$16,003	$15,791	$15,584	$15,432	$15,186
Calculated Revenue Requirement	$144	$117	$220	$223	$219	$214	$266	$253	$250	$241	$241	$232	$225	$218	$212

NOTES:

(1) ERU number based on population projections from Draft Technical Memorandum City of Snohomish Updated Wastewater Flow and Load Projections (Kennedy/Jenks Consultants, 2010)

(2) Note that 2009 Office of Financial Management population is 9,145 (approximately 3,500 ERUs). The actual equivalent ERUs for the City in 2010 is approximately 3,500.

(3) Assumes design and construction of the Everett Conveyance Project in the 2012-2016 timeframe. Per Agreed Order No. 7974, Milestone #5 – City will prepare a critical milestone report and may propose an adjustment to the final schedule subject to Ecology approval.

TABLE 13-5 (REVISED 2010)
Cash Flow for Funding of the Everett Conveyance Project, Low-interest Loan Financing

YEAR	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Wastewater Administration	$72,398	$74,208	$76,063	$77,965	$79,914	$81,912	$83,959	$86,058	$88,210	$90,415	$92,676	$94,992	$97,367	$99,801	$102,296
Wastewater Collection	$806,288	$826,445	$847,106	$868,284	$889,991	$912,241	$935,047	$958,423	$982,384	$1,006,943	$1,032,117	$1,057,920	$1,084,368	$1,111,477	$1,139,264
Wastewater Treatment	$556,919	$570,842	$585,113	$599,741	$614,734	$630,103	$157,526	$161,464	$165,500	$169,638	$173,879	$178,226	$182,681	$187,249	$191,930
Everett User Charges							$1,340,096	$1,407,100	$1,477,455	$1,551,328	$1,628,895	$1,710,339	$1,795,856	$1,885,649	$1,979,932
Debt Service															
Existing	$907,598	$999,725	$1,001,821	$729,084	$728,534	$727,984	$451,461	$174,938	$174,938	$174,388	$173,839	$173,289	$172,739	$172,189	$171,640
Loan 1															
Everett Initial Plant Expansion			$393,212	$393,212	$393,212	$393,212	$393,212	$393,212	$393,212	$393,212	$393,212	$393,212	$393,212	$393,212	$393,212
Near-term Improvements			$270,476	$270,476	$270,476	$270,476	$270,476	$270,476	$270,476	$270,476	$270,476	$270,476	$270,476	$270,476	$270,476
Everett Conveyance Alternative			$1,516,790	$1,516,790	$1,516,790	$1,516,790	$1,516,790	$1,516,790	$1,516,790	$1,516,790	$1,516,790	$1,516,790	$1,516,790	$1,516,790	$1,516,790
Loan 2															
Everett Existing Capacity							$656,697	$656,697	$656,697	$656,697	$656,697	$656,697	$656,697	$656,697	$656,697
Everett Collection System							$77,970	$77,970	$77,970	$77,970	$77,970	$77,970	$77,970	$77,970	$77,970
Loan 3															
Phase B Capacity											$218,451	$218,451	$218,451	$218,451	$218,451
Interfund Transfers	$311,350	$319,134	$327,112	$335,290	$343,672	$352,264	$361,071	$370,097	$379,350	$388,833	$398,554	$408,518	$418,731	$429,199	$439,929
To Project Funding	$920,000	$200,000	$205,000	$210,125	$215,378	$220,763	$226,282	$231,939	$237,737	$243,681	$249,773	$256,017	$262,417	$268,978	$275,702
Total Expenditures	$3,574,553	$2,990,354	$5,222,693	$5,000,966	$5,052,701	$5,105,744	$6,470,586	$6,305,165	$6,420,720	$6,540,372	$6,883,328	$7,012,898	$7,147,756	$7,288,139	$7,434,289
ERU (1)	4,140	4,261	4,385	4,512	4,641	4,773	4,908	5,045	5,186	5,483	5,783	6,087	6,395	6,706	7,022
New Development		$8,262	$25,664	$22,910	$22,550	$22,034	$24,938	$22,555	$21,915	$10,402	$11,025	$10,878	$10,735	$10,630	$10,460
Calculated Revenue Requirement	$144	$117	$198	$184	$181	$178	$219	$208	$206	$198	$198	$192	$186	$181	$176

NOTES:
(1) ERU number based on population projections from Draft Technical Memorandum City of Snohomish Updated Wastewater Flow and Load Projections (Kennedy/Jenks Consultants, 2010)

(2) Note that 2009 Office of Financial Management population is 9,145 (approximately 3,500 ERUs). The actual equivalent ERUs for the City in 2010 is approximately 3,500.

(3) Assumes design and construction of the Everett Conveyance Project in the 2012-2016 timeframe. Per Agreed Order No. 7974, Milestone #5 – City will prepare a critical milestone report and may propose an adjustment to the final schedule subject to Ecology approval.

TABLE 13-6 (REVISED 2010)
Cash Flow for Funding of the Everett Conveyance Project, No State grants or loans – bond financing only

YEAR	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Wastewater Administration	$72,398	$74,208	$76,063	$77,965	$79,914	$81,912	$83,959	$86,058	$88,210	$90,415	$92,676	$94,992	$97,367	$99,801	$102,296
Wastewater Collection	$806,288	$826,445	$847,106	$868,284	$889,991	$912,241	$935,047	$958,423	$982,384	$1,006,943	$1,032,117	$1,057,920	$1,084,368	$1,111,477	$1,139,264
Wastewater Treatment	$556,919	$570,842	$585,113	$599,741	$614,734	$630,103	$157,526	$161,464	$165,500	$169,638	$173,879	$178,226	$182,681	$187,249	$191,930
Everett User Charges							$1,340,096	$1,407,100	$1,477,455	$1,551,328	$1,628,895	$1,710,339	$1,795,856	$1,885,649	$1,979,932
Debt Service															
Existing	$907,598	$999,725	$1,001,821	$729,084	$728,534	$727,984	$451,461	$174,938	$174,938	$174,388	$173,839	$173,289	$172,739	$172,189	$171,640
Bond Issue 1															
Everett Initial Plant Expansion			$380,551	$380,551	$380,551	$380,551	$380,551	$380,551	$380,551	$380,551	$380,551	$380,551	$380,551	$380,551	$380,551
Near-term Improvements			$261,767	$261,767	$261,767	$261,767	$261,767	$261,767	$261,767	$261,767	$261,767	$261,767	$261,767	$261,767	$261,767
Everett Conveyance Alternative			$1,467,951	$1,467,951	$1,467,951	$1,467,951	$1,467,951	$1,467,951	$1,467,951	$1,467,951	$1,467,951	$1,467,951	$1,467,951	$1,467,951	$1,467,951
Debt Coverage			$1,055,134	$1,393,395	$1,393,395	$1,393,395	$1,393,395	$1,393,395	$1,393,395	$1,393,395	$1,393,395	$1,393,395	$1,393,395	$1,393,395	$1,393,395
Bond Issue 2															
Everett Existing Capacity							$635,553	$635,553	$635,553	$635,553	$635,553	$635,553	$635,553	$635,553	$635,553
Everett Collection System							$75,460	$75,460	$75,460	$75,460	$75,460	$75,460	$75,460	$75,460	$75,460
Debt Coverage							$355,506	$355,506	$355,506	$355,506	$355,506	$355,506	$355,506	$355,506	$355,506
Bond Issue 3															
Phase B Capacity											$211,417	$211,417	$211,417	$211,417	$211,417
Debt Coverage											$105,709	$105,709	$105,709	$105,709	$105,709
Interfund Transfers	$311,350	$319,134	$327,112	$335,290	$343,672	$352,264	$361,071	$370,097	$379,350	$388,833	$398,554	$408,518	$418,731	$429,199	$439,929
To Project Funding	$920,000	$200,000	$205,000	$210,125	$215,378	$220,763	$226,282	$231,939	$237,737	$243,681	$249,773	$256,017	$262,417	$268,978	$275,702
Total Expenditures	$3,574,553	$2,990,354	$6,207,619	$6,324,152	$6,375,888	$6,428,930	$8,125,623	$7,960,202	$8,075,756	$8,195,409	$8,637,039	$8,766,609	$8,901,468	$9,041,850	$9,188,001
ERU (1)	4,140	4,261	4,385	4,512	4,641	4,773	4,908	5,045	5,186	5,483	5,783	6,087	6,395	6,706	7,022
New Development		$8,262	$33,607	$33,329	$32,808	$32,058	$37,197	$34,636	$33,653	$15,975	$16,870	$16,647	$16,429	$16,268	$16,009
Calculated Revenue Requirement	$144	$117	$235	$232	$228	$223	$275	$262	$258	$249	$248	$240	$232	$224	$218

NOTES:
(1) ERU number based on population projections from Draft Technical Memorandum City of Snohomish Updated Wastewater Flow and Load Projections (Kennedy/Jenks Consultants, 2010)
(2) Note that 2009 Office of Financial Management population is 9,145 (approximately 3,500 ERUs). The actual equivalent ERUs for the City in 2010 is approximately 3,500.
(3) Assumes design and construction of the Everett Conveyance Project in the 2012-2016 timeframe. Per Agreed Order No. 7974, Milestone #5 – City will prepare a critical milestone report and may propose an adjustment to the final schedule subject to Ecology approval.

FUNDING SOURCES

A variety of funding sources are available to the City in addition to revenue from user charges; following is a review of some potential sources.

Public Works Trust Fund

The Washington State Department of Commerce manages the Public Works Trust Fund (PWTF), which provides low-interest revolving loans to help local governments finance public works needs. Eligible projects include repairing, replacing, and improving bridges, roads, domestic water systems, sanitary sewers, and storm sewers; the PTWF cannot be used to finance improvements for growth. Loans may also be used for emergency planning and capital improvement planning.

To qualify for loans, the City must meet two criteria. First, it must have a recently approved (less than five years old) comprehensive plan with a capital facilities plan that identified the improvement project(s) to be paid for by the PWTF loan. Second, the City already must levy a ¼-percent real estate excise tax.

The PWTF loans several million dollars annually to qualified communities. Loans for construction projects require a local match that must come from local revenues or state shared entitlements. A 5-percent match is required for a 2-percent loan, and matches of 10 percent and 15 percent are required for loans of 1 percent and 0.5 percent, respectively.

Community Development Block Grant

Community Development Block Grants (CDBGs) are federal funds administered by the Washington State Department of Commerce that can be used for a variety of urban infrastructure improvements, including sewer system improvements, streets, and sidewalks. Approximately $7 million is available each year, and the maximum grant is $750,000. Eligible projects must principally benefit low- and moderate-income households.

USDA Rural Development

Grant assistance from U.S. Department of Agriculture (USDA) Rural Development (formerly the Farmers Home Administration) can be applied to water and waste disposal facilities in towns with populations up to 10,000 and median income below specified level. The grants may be used to construct, repair, improve, expand, or modify waste collection and treatment facilities. Grants can also be used for legal and engineering costs connected to facility development.

Grants from USDA Rural Development can pay for up to 75 percent of project costs. This source has approximately $500 million in grants annually available, and special preference is given to small towns that are experiencing identified sanitary problems. Preliminary analysis indicates the City's median income is likely above the level for grant eligibility. Several hundred million dollars are also available in loans with interest rates varying based on the particular agency.

State Revolving Fund

Ecology manages the State Revolving Fund (SRF), which can be used to pay for water pollution control projects, such as sanitary sewer and surface water management projects. Eligible projects include secondary sewer treatment facilities, stormwater management projects, and other water pollution control projects. Ecology expects to have about $75 million of available funding for low-interest loans.

To qualify for the SRF for construction financing, the City must have approval of the following: General Sewer Plan, Facility Plan with appropriate Environmental Review Documents (i.e. SEPA and SERP, or NEPA, if required), and Project Plans and Specifications. The City must also demonstrate that it will repay the loan through a dedicated source of funding.

Interest rates for the SRF loan vary with the market rate. The interest rate for short-term (1 to 5 year) loans is 30 percent of the average market rate and the rates for long-term (up to 20 year) loans are 60 percent of the market interest rate, respectively. There are no matching fund requirements. Also, qualified communities may receive additional interest rate reductions based on hardship.

Centennial Clean Water Fund

Ecology's Centennial Clean Water Fund (CCWF) provides grants and loans for planning, design construction, or implementation of water pollution control facilities and other activities to meet state or federal requirements and protect water quality. Ecology distributes approximately $17 million annually for this purpose, and a maximum of $5 million is available per project per funding cycle. Ecology traditionally reserves use of CCWF funds for providing grants to communities that qualify for hardship due to limited availability of funds. Hardship grants are further limited to funding the cost to provide service for the existing residential need, plus additional 10 percent for growth, and the portion of a project eligible for a grant is limited based on hardship severity.

To be eligible for a CCWF, capital improvement projects must be identified in the City's comprehensive plan. An approved engineering report must be completed before applying for design funding, and an approved engineering report with specifications must be completed before applying for construction funding.

CCWF loans rates are the same as the loan rates as the State Revolving Funds Loans program.

Utility Local Improvement Districts

Projects benefiting adjacent properties can be funded through local improvement districts (LIDs). After forming the LID, project costs can be assessed against the benefited properties in proportion to their share of the total benefits. The assessment amount cannot exceed the increase in the value of the property resulting from the project.

The City may also form Utility Local Improvement Districts (ULIDs), which combine property assessments and revenue funding from sewer rate charges; the additional security of the bonds tends to bring lower interest rates. There is also added flexibility and equity as the City can ameliorate the costs of special construction problems or of increasing the capacity of system components.

Developer Extensions

Under a developer extension, the development owner requests sewer service. Filing fees usually cover administration costs only, and the developer pays all extension costs and turns the development over to the City for operation and maintenance.

Legislative Appropriations

In recent years, substantial wastewater system improvements in other small cities, such as Duvall, have been assisted by federal or state legislative appropriations from current or new sources of funding. In recent years, various stimulus programs have also provided funding for important infrastructure improvements. Federal or state appropriations can be an important source of money to fill critical funding needs, and the City will pursue these funds if available.

CONCLUSIONS

The financing plan presented is adequate to fund the improvements described in the 2010 Plan Update, including the Everett Conveyance Project.

For financial analysis purposes, scenarios have been developed that demonstrate a financing plan is in place to fund the Everett Conveyance Project. These scenarios demonstrate the levels of rates and charges that will be necessary to support and implement the Everett Conveyance Project.

This financing plan provides for the City to review the rates each year beginning in 2010 to implement this plan. Because of the high cost of the improvements, the City will pursue additional grant funding opportunities if they become available and will seek to develop rate-relief measures over the period of years needed for project implementation.

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APPENDIX N

Draft Technical Memorandum, City of Snohomish Updated Wastewater Flow and Load Projections (Kennedy/Jenks Consultants, 2010)

DRAFT Technical Memorandum

City of Snohomish
Updated Wastewater Flow and Load Projections

Prepared by:	Tom Giese, P.E.	**Date:**	7 June 2010
Reviewed by:	David Seymour, P.E.	**K/J Project No:**	0797020*01

Introduction

Population growth projections and plans for expanding the current service area have changed significantly since completion of the 2005 General Sewer Plan and Wastewater Facilities Plan (Plan). Consequently, population projections and the associated wastewater flow and load projections must be updated to reflect the most recent planning conditions. Appendix A provides detailed analyses of population, flow, and load projections.

Service Population

Sewered Population Growth within the Urban Growth Area (UGA)

Sewered population growth was estimated using information from the Snohomish County Comprehensive Plan (Comprehensive Plan) 2025 Urban Population Targets and Capacities (UPT&C) Table. Use of this data for projecting sewered population growth was confirmed with the City of Snohomish (City) Planning and Development Department. Although the UPT&C Table was amended in December 2006, it is based on 2002 UGA maps and includes neither the North Addition Planning Area that was added to the City's UGA in 2006 nor the currently proposed UGA expansion north of Highway 2. The projections include the North Addition Planning Area as a part of the unincorporated UGA. The proposed UGA expansion north of Highway 2 is referred to as the "UGA Expansion."

The Comprehensive Plan projects a 2025 population of 9,981 within the 2002 City limits and 4,554 within the unincorporated areas of the City's 2002 UGA. Unincorporated areas in the UPT&C projection include the Cemetery Creek Planning Area and the South UGA Planning Area. Additional population growth is also anticipated in the recently annexed North Addition Planning Area. The City does not anticipate residential growth in the South UGA and does not plan to extend sewer service to that area. With the exception of the South UGA, all new and existing population within the UGA is assumed to receive sewer service. It is assumed that the existing unincorporated population currently served by private septic systems will be converted to sewer service at a rate proportional to population growth within the unincorporated area, such that all unincorporated population will have sewer service by 2025.

The North Addition Planning Area is located at the northwestern corner of the 2002 UGA and is approximately 220 acres in size. The estimated area of the North Addition is approximately 80 acres smaller than stated in the Plan, because more recent UGA maps do not include annexation of the area east of State Route 9, as previously anticipated. For population growth projections, it is assumed that the North Addition sewered population will grow at a rate proportional to the sewered population growth rate in the other unincorporated areas. This applies to both new growth, all of which will receive sewer service and growth from septic-to-sewer conversions.

Based on Comprehensive Plan projections, average yearly population growth rates are 0.64 percent within the City limits and 4.4 percent within the unincorporated areas. However, the sewered population growth rates for the unincorporated areas are higher than 4.4 percent because of the septic-to-sewer conversions for current residents. Growth rates, based on the 2025 City and unincorporated population targets, were applied to updated population growth projections through the 2024 planning horizon used in the Plan.

Sewered Population Growth within the UGA Expansion

In addition to growth inside the UGA, the City is pursuing further expansion of the UGA to include areas north of Highway 2 that are also anticipated to experience population growth within the planning horizon. Although the timing of this UGA expansion is not yet defined, it is assumed to occur within the planning horizon, with development beginning prior to 2024.

The approximately 635-acre UGA Expansion area is estimated to contain 508 acres of developable land. The density of development within the UGA Expansion area is estimated to be six equivalent residential units (ERUs) per acre, which would yield a total of 3,048 ERUs. This is greater than the average density within the current service area of about 2.8 ERUs per acre. Based on the City's historical average population of 2.5 people per ERU, the UGA Expansion area is estimated to represent a population equivalent of about 7,620. This estimate is based on the best available information and may be subject to future revision.

It is assumed that population growth in this area would begin in 2019 and progress linearly, ultimately reaching a population of 7,620 in 2039. At this time, the eventual annexation and timing for development of this expanded UGA is not a certainty.

Wastewater Flows

The Plan estimated wastewater flows by projecting sewage flow from the service population (i.e., base flow) and infiltration and inflow (I/I) separately. These two components, base flow and I/I, were then summed to project the total flow. Considering that I/I can be a major component of the total wastewater flow, this appears to be a reasonable approach for projecting wastewater flows from the sewer service areas.

Base Flow Projections

Per capita wastewater flow rates from the Plan are applied to the revised population projections to estimate future base flow. The Plan assumed a base flow of 74 gallons per capita per day (gpcd) for the maximum month flow (MMF) and peak day flow (PDF). A base flow of 222 gpcd was assumed for the peak hour flow (PHF), which is based on a 3:1 peaking factor for MMF to

PHF. These same base flow values were applied to the projections in this document. As stated previously, it is assumed that sewer service will be extended to the unincorporated and UGA Expansion areas during the planning horizon (with the exception of the South UGA), that all new growth in those areas will receive sewer service, and all existing septic systems will be converted to sewer service by 2025. Base flow projections in millions of gallons per day (MGD) are summarized in Table 1.

Table 1: Base Flow Projections[a]

	2004	2009	2014	2019	2024
City Population Base Flow					
Sewered Population	8,480	8,813	9,168	9,531	9,905
Maximum Month (MGD)	0.63	0.65	0.68	0.71	0.73
Peak Day (MGD)	0.63	0.65	0.68	0.71	0.73
Peak Hour (MGD)	1.88	1.96	2.04	2.12	2.20
Unincorporated Area Base Flow					
Sewered Population	280	1,240	2,434	3,795	5,363
Maximum Month (MGD)	0.02	0.09	0.18	0.28	0.40
Peak Day (MGD)	0.02	0.09	0.18	0.28	0.40
Peak Hour (MGD)	0.06	0.28	0.54	0.84	1.19
UGA Expansion Area Base Flow					
Sewered Population	0	0	0	381	2,286
Maximum Month (MGD)	0.00	0.00	0.00	0.03	0.17
Peak Day (MGD)	0.00	0.00	0.00	0.03	0.17
Peak Hour (MGD)	0.00	0.00	0.00	0.08	0.51

Notes:
(a) See Appendix A for detailed analyses.

I/I Projections

The Plan classified projections for I/I into the following three types of areas:

1. Areas with existing combined sewers: Existing service areas that collect both sewage and stormwater in the same pipelines.

2. Areas with existing separated sewers: Existing service areas that have separate pipelines for collecting sewage and storm water.

3. Areas that will be provided with new separated sewers: Newly constructed service areas to accommodate growth that have separate pipelines for collecting sewage and stormwater.

Each area is assigned a different unit factor for I/I, based on gallons per acre per day (gpad), taken directly from the Plan. These unit factors, the estimated acreage for each sewer type, and the estimated I/I by area type are summarized in Table 2.

Table 2: I/I Estimates for Current Service Area[a]

	I/I (gpad)	2003 Area[b] (acres)	2003 I/I[b] (MGD)
Combined Sewers			
Maximum Month	2,400	325	0.78
Peak Day	17,000	325	5.53
Peak Hour	53,700[c]	325	17.45
Existing Separated Sewers[d]			
Maximum Month	850	915	0.78
Peak Day	2,000	915	1.83
Peak Hour	4,000	915	3.66
New Separated Sewers[e]			
Maximum Month	400	0	0
Peak Day	900	0	0
Peak Hour	1,100	0	0

Notes:
(a) Unit flow factors for I/I by sewer type and acreage for each sewer type were taken directly from Appendix G of the Plan.
(b) Based on values for 2003 reported in the Plan.
(c) The unit flow factor for peak hour I/I was adjusted from the 76,000 gpad presented in the Plan based on information provided by BHC Consultants for the recommended improvements to CSO #1 and CSO #2. Refer to the detailed analysis in Appendix A for more information.
(d) Existing separated sewers are defined as sewers constructed in 2005 or before.
(e) New separated sewers are defined as sewers constructed after 2005.

Flow projections in the Plan assumed that 50 percent of the existing combined sewers would be separated during the planning horizon, which was consistent with the City of Snohomish CSO Reduction Plan prepared by Tetra Tech/KCM. However, the City has more recently expressed uncertainty that more than 20 percent separation of combined sewers will occur during the planning horizon.

For conservative planning purposes, Kennedy/Jenks Consultants assumed that the 2003 area of combined sewers will be reduced by 20 percent by 2028. This means that the storm and sanitary sewers likely will not be separated to the extent previously anticipated for the planning period. The 20 percent combined sewer separation is projected through 2028 at a linear reduction beginning in 2003.

Sewers constructed in 2005 or before are defined as existing separated sewers. This evaluation does not consider any replacement of existing separated sewers during the planning period.

Kennedy/Jenks Consultants assumed that all new growth and new development after 2005 would be classified as new separated sewers. The acreage of new separated sewers is calculated by applying the calculated average 2003 sewer service area population density (6.9 persons per acre) within the existing UGA to the population projection. As noted previously, the population density for the UGA Expansion area is anticipated to be greater. The projection for acreage of new separated sewers includes not only growth but also conversions of septic systems to sewers and separation of combined sewers. By definition, the acreage of existing separated sewers does not change and the acreage of combined sewers declines throughout the planning horizon because of combined sewer separation.

I/I from the UGA Expansion area is calculated separately, because it is estimated to have a higher population density equivalent. As mentioned previously, the UGA Expansion area is about 635 acres in total, but only about 508 acres are developable. For the sewered acreage projections, it is assumed that development within the UGA Expansion area will begin in 2019 and that all 508 acres will be fully developed by 2039. Development of the UGA Expansion area is projected to occur at a linear rate.

Projected I/I by sewer type is summarized in Table 3 below. The increase in area of new separated sewers reflects the projected growth in service population and combined sewer conversions as described previously.

Table 3: I/I Projections for Current and Expanded Service Area[(a)]

	2004	2009	2014	2019	2024
Combined Sewer I/I (City and Unincorporated)					
Existing Combined Sewers (acres)	322	309	296	283	270
Max Month (MGD)	0.77	0.74	0.71	0.68	0.65
Peak Day (MGD)	5.48	5.26	5.04	4.82	4.60
Peak Hour (MGD)	17.31	16.61	15.92	15.22	14.52
Existing Separated Sewer I/I (City and Unincorporated)					
Existing Separated Sewers (acres)	940	965	965	965	965
Max Month (MGD)	0.80	0.82	0.82	0.82	0.82
Peak Day (MGD)	1.88	1.93	1.93	1.93	1.93
Peak Hour (MGD)	3.76	3.86	3.86	3.86	3.86
New Separated Sewer I/I (City and Unincorporated)					
New SS Area (acres)	0	174	410	672	964
Max Month (MGD)	0.00	0.07	0.16	0.27	0.39
Peak Day (MGD)	0.00	0.16	0.37	0.60	0.87
Peak Hour (MGD)	0.00	0.19	0.45	0.74	1.06
New Separated Sewer I/I (UGA Expansion)					
New SS Area (acres)	0	0	0	25	152
Max Month (MGD)	0.00	0.00	0.00	0.01	0.06
Peak Day (MGD)	0.00	0.00	0.00	0.02	0.14
Peak Hour (MGD)	0.00	0.00	0.00	0.03	0.17

Notes:
(a) See Appendix A for detailed analyses.

Dry Weather Flow Projections

Dry weather flows are projected to examine capacities of treatment processes during the critical months of July through October when more stringent mass-based effluent limits are in effect.

Dry weather flows are projected through the planning period by relating historical dry weather flows to the maximum month flow each year. Four years of influent data, from January 2004 to December 2007, were used to calculate the maximum month to dry weather flow ratios. These dry weather flow ratios are summarized in Table 4 below.

Table 4: Dry Weather Flow Ratios

Dry Weather Flow Ratios	Value
ADWF/Maximum Month Flow[a]	0.43
Maximum Month Dry Weather Flow/Maximum Month Flow	0.47
Peak Day Dry Weather Flow/Maximum Month Flow	0.94
PHDF/ADWF[a,b]	3.5

Notes:
(a) PHDF = peak hour dry weather flow; ADWF = average dry weather flow.
(b) Assumed peaking factor based on Figure 3-13 from Wastewater Engineering: Treatment and Reuse 4th Edition, Metcalf and Eddy.

Average Annual Flow Projections

Flow projections in the Plan did not include average annual flow (AAF), and there were no flow factors in the Plan for annual average base flow or I/I. For this reason, a different method is used to calculate AAF.

Historical data for 2001 through 2008 was used to estimate a mean total average annual per capita flow (base flow and I/I) of 130 gpcd. This average annual per capita flow was applied to the projected population for 2008. For all growth beyond 2008, the base flow factor of 74 gpcd from the Plan was used in conjunction with an average annual I/I flow factor of 200 gpad for new development to estimate the total AAF for growth. The value of 200 gpad is comparable to average annual I/I flow factors for other communities in the Puget Sound region. In addition, the total AAF accounted for the drop in I/I due to a reduction in the area of combined sewers, using the lower average annual I/I flow factor of 200 gpad for the area with newly separated storm and sanitary sewers.

Wastewater Loading

Waste load projections are based on population projections. Although I/I represents significant hydraulic loading at the wastewater treatment plant (WWTP), it is assumed to have negligible waste load. Waste load factors [in terms of pounds per capita per day (ppcd)] from the Plan were applied to the updated population projections to develop waste load projections for 5-day biochemical oxygen demand (BOD_5), 5-day carbonaceous biochemical oxygen demand ($CBOD_5$), total suspended solids (TSS), and total Kjeldahl nitrogen (TKN) in terms of pounds per day (ppd). Waste load factors from the Plan are summarized in Table 5.

Table 5: Waste Load Factors and Ratios

Waste Load Factor/Ratio	Value
Average BOD_5 Load (ppcd)	0.22
Average TSS Load (ppcd)	0.22
Maximum Month BOD_5 Peaking Factor	1.19
Maximum Month TSS Peaking Factor	1.27
Peak Day BOD_5 Peaking Factor	2.31
Peak Day TSS Peaking Factor	2.57
BOD_5:$CBOD_5$ Ratio	1.31
TKN:BOD_5 Ratio	0.182

As indicated in Table 5, the Plan used a typical factor of 0.22 ppcd to estimate average BOD_5 and TSS loads. Peaking factors were used to project maximum month and peak day BOD_5 and TSS loads based on the projected average loads. Calculated ratios of BOD_5 to $CBOD_5$ and BOD_5 to TKN were used to project average, maximum month, and peak day loads for $CBOD_5$ and TKN. The waste load projections are summarized in Table 6.

Table 6: Waste Load Projections

	2004	2009	2014	2019	2024
UGA - City and Unincorporated					
Average Annual Load					
Sewered Population	8,760	10,053	11,602	13,327	15,268
BOD_5 (ppd)	1,927	2,212	2,552	2,932	3,359
$CBOD_5$ (ppd)	1,471	1,688	1,948	2,238	2,564
TSS (ppd)	1,927	2,212	2,552	2,932	3,359
TKN (ppd)	351	403	465	534	611
Max Month Load					
BOD_5 (ppd)	2,293	2,632	3,037	3,489	3,997
$CBOD_5$ (ppd)	1,751	2,009	2,319	2,663	3,051
TSS (ppd)	2,448	2,809	3,242	3,724	4,266
TKN (ppd)	417	479	553	635	727
Peak Day Load					
BOD_5 (ppd)	4,452	5,109	5,896	6,773	7,759
$CBOD_5$ (ppd)	3,398	3,900	4,501	5,170	5,923
TSS (ppd)	4,953	5,684	6,560	7,535	8,633
TKN (ppd)	810	930	1,073	1,233	1,412
UGA Expansion Area					
Average Annual Load					
Population	0	0	0	381	2,286
BOD_5 (ppd)	0	0	0	84	503
$CBOD_5$ (ppd)	0	0	0	64	384
TSS (ppd)	0	0	0	84	503
TKN (ppd)	0	0	0	15	92
Max Month Load					
BOD_5 (ppd)	0	0	0	100	599

	2004	2009	2014	2019	2024
$CBOD_5$ (ppd)	0	0	0	76	457
TSS (ppd)	0	0	0	106	639
TKN (ppd)	0	0	0	18	109
Peak Day Load					
BOD_5 (ppd)	0	0	0	193	1,162
$CBOD_5$ (ppd)	0	0	0	148	887
TSS (ppd)	0	0	0	215	1,292
TKN (ppd)	0	0	0	35	212

Summary of Wastewater Flow and Load Projections

Based on conversations with the City, the following two planning scenarios were developed from the updated population, flow, and waste load projections:

1. Expansion of service for population growth within the existing UGA, conversion of all septic systems to sewered connections in the unincorporated areas by 2025, and a 20 percent reduction in area of combined sewers by 2028.

2. Expansion of service for population growth within the existing UGA and UGA Expansion area, conversion of all septic systems to sewered connections in the unincorporated areas by 2025, and a 20 percent reduction in area of combined sewers by 2028.

These separate planning scenarios were developed because annexation and development of the UGA Expansion area are still uncertain at this time. Revised population, flow, and load projections for these two planning scenarios at the end of the planning horizon (2024) are summarized in Table 7 below.

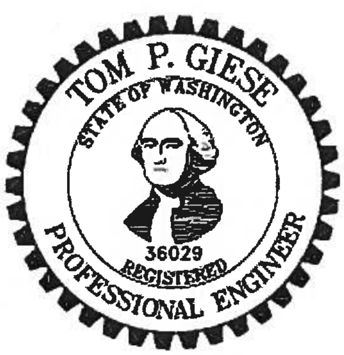
Table 7: Revised Projections for Planning Scenarios

	UGA Only	UGA and UGA Expansion Area
Planning Scenario Number	**#1**	**#2**
2024 Service Area Population	15,268	17,554
Average Annual Flow (MGD)	1.78	1.98
Maximum Month Flow (MGD)	2.98	3.21
PDF (MGD)	8.52	8.83
Peak Hour Flow (MGD)	22.83	23.51
ADWF (MGD)	1.29	1.39
Maximum Month Dry Weather Flow (MGD)	1.41	1.52
Peak Day Dry Weather Flow (MGD)	2.81	3.03
PHDF (MGD)	4.51	4.85
Average Annual BOD_5 Load (ppd)	3,359	3,862
Maximum Month BOD_5 Load (ppd)	3,997	4,596
Peak Day BOD_5 Load (ppd)	7,759	8,921

	UGA Only	UGA and UGA Expansion Area
Average Annual $CBOD_5$ Load (ppd)	2,564	2,948
Maximum Month $CBOD_5$ Load (ppd)	3,051	3,508
Peak Day $CBOD_5$ Load (ppd)	5,923	6,810
Average Annual TSS Load (ppd)	3,359	3,862
Maximum Month TSS Load (ppd)	4,266	4,905
Peak Day TSS Load (ppd)	8,633	9,925
Average Annual TKN Load (ppd)	611	703
Maximum Month TKN Load (ppd)	727	836
Peak Day TKN Load (ppd)	1,412	1,624

Appendices

Appendix A: Analyses of Population, Flow, and Load Projections



Appendix A

Sewered Population, Base Flow, Waste Loading, and Infiltration and Inflow Projection Summary

APPENDIX A: City of Snohomish - Population Projections

Preface:

City of Snohomish Planning and Development Department said to use the population projections from applicable sections of the Snohomish County Comprehensive Plan (CCP), rather than the City Comprehensive Plan. Therefore, the 2025 Urban Population Targets and Capacities Table (Table) from the CCP was used to develop these population projections. It should be noted that, although the Table was ammended in December 2006, the Table is based on 2002 UGA maps and does not include additional residential population from UGA expansions that are currently planned or that have ocurred since. Specifically, the Table population projections do not include residential population projections from the expansion of the UGA to include the North Addition Planning Area or the proposed expanion to include areas north of Highway 2. For this evaluation, population projections for these two areas are added to the population projections in the Table as indicated below.

Population Projections from the Table:

The County Population projections for the City of Snohomish, based on information presented in the Table, are as follows:

	2001	2025	Growth	Growth %/Year
Snohomish City Limits	8,565	9,981	1,416	0.64%
Unincorporated Area	1,613	4,554	2,941	4.42%
Snohomish UGA	10,178	14,535		

Revised Population Projections:

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
"2002 UGA" City Pop.	8,565	8,620	8,675	8,730	8,786	8,842	8,899	8,956	9,013	9,071	9,129	9,187
"2002 UGA" City Septic Pop.	250	250	250	250	250	238	225	213	200	188	175	163
City Pop.	8,315	8,370	8,425	8,480	8,536	8,605	8,674	8,743	8,813	8,883	8,954	9,025
"2002 UGA" Uninc. Pop.	1,613	1,684	1,759	1,836	1,918	2,002	2,091	2,183	2,280	2,381	2,486	2,596
"2002 UGA" Uninc. Pop. Growth	0	71	146	223	305	389	478	570	667	768	873	983
"2002 UGA" Uninc. Sewer Conversion	0	0	0	0	0	81	161	242	323	403	484	565
North UGA Addition Sewer Pop.	0	18	37	57	77	119	162	205	250	296	343	391
Uninc. Sewer Pop.	0	89	183	280	382	589	801	1,018	1,240	1,467	1,700	1,938
North Hwy. 2 Sewer Pop.	0	0	0	0	0	0	0	0	0	0	0	0
UGA Expansion Pop. Equivalents	0	0	0	0	0	0	0	0	0	0	0	0
Total Sewered Pop.	**8,315**	**8,459**	**8,607**	**8,760**	**8,918**	**9,194**	**9,475**	**9,761**	**10,053**	**10,350**	**10,653**	**10,963**
Total Sewered Pop. less UGA Expansion	**8,315**	**8,459**	**8,607**	**8,760**	**8,918**	**9,194**	**9,475**	**9,761**	**10,053**	**10,350**	**10,653**	**10,963**

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
"2002 UGA" City Pop.	9,246	9,305	9,365	9,424	9,485	9,545	9,606	9,668	9,730	9,792	9,855	9,918
"2002 UGA" City Septic Pop.	150	138	125	113	100	88	75	63	50	38	25	13
City Pop.	9,096	9,168	9,240	9,312	9,385	9,458	9,531	9,605	9,680	9,754	9,830	9,905
"2002 UGA" Uninc. Pop.	2,710	2,830	2,955	3,086	3,222	3,365	3,513	3,668	3,831	4,000	4,177	4,361
"2002 UGA" Uninc. Pop. Growth	1,097	1,217	1,342	1,473	1,609	1,752	1,900	2,055	2,218	2,387	2,564	2,748
"2002 UGA" Uninc. Sewer Conversion	645	726	807	887	968	1,048	1,129	1,210	1,290	1,371	1,452	1,532
North UGA Addition Sewer Pop.	441	491	543	597	652	708	766	826	887	950	1,015	1,082
Uninc. Sewer Pop.	2,183	2,434	2,692	2,957	3,229	3,508	3,795	4,091	4,395	4,708	5,031	5,363
North Hwy. 2 Sewer Pop.	0	0	0	0	0	0	381	762	1,143	1,524	1,905	2,286
UGA Expansion Pop. Equivalents	0	0	0	0	0	0	381	762	1,143	1,524	1,905	2,286
Total Sewered Pop.	**11,279**	**11,602**	**11,932**	**12,269**	**12,613**	**12,966**	**13,708**	**14,458**	**15,218**	**15,987**	**16,765**	**17,554**
Total Sewered Pop. less UGA Expansion	**11,279**	**11,602**	**11,932**	**12,269**	**12,613**	**12,966**	**13,327**	**13,696**	**14,075**	**14,463**	**14,860**	**15,268**

Notes:

-Growth rates from 2001 through 2025 for the City Population and Unincorporated Population are calculated based on information presented in the Table, at rates of 0.64% and 4.42% per year respectively.
-Per the Plan, there are currently about 100 residences in the City limits that are on septic (population of 250 people based on 2.5 people per ERU). It is assumed these residences are all converted to sewer service by 2025.
-Although expansion into the UGA expansion areas may not occur in the near future, they will be considered in the flow and load projections.
-It is assumed that all residents will be sewered by 2025, and that all population growth after 2001 is sewered.
-It is assumed that 2001 City and Unincorporated residents served by septic will be converted to a City sewer system at a fixed rate (~13 residents/year City, ~81 residents/year Unincorporated) beginning in 2005 and ending in 2025.
-Projections for the North UGA Addition (recently added post-2001) assumes growth in new population and conversion of existing population to City sewer will be the same as the other unincorporated areas on a per acre basis. The area of the North UGA Addition is approximately 220 acres, compared to approximately 870 acres for the other unincorporated areas (excluding South UGA, which is 280 acres).
-The potential UGA expanion north of Highway 2 is added to the sewer service population projections assuming a buildout of 3,048 ERUs with 2.5 people per ERU. It is assumed that development for the North Highway 2 Area will start in 2019 and progress linearly to buildout by 2039.

APPENDIX A: City of Snohomish - Base Wastewater Flow Projections

Preface:

The existing Plan differentiates I/I from the wastewater flow in the projections of City poulation, due to the high volume of I/I received at the WWTP from the combined sewers
The Plan calculates a base flow for the wastewater generated by the population, and then adds I/I to the base flow.
The base flow used to calculate the maximum month and peak day flows in the Plan is equivalent to 74 gpcd.
The base flow used to calculate the peak hour flow is 222 gpcd, which assumes a 3:1 diurnal peak.
The same base flow numbers were applied to the unincorporated areas and UGA expansion area.

Max Month Base Flow =	74	gpcd
Peak Day Base Flow =	74	gpcd
Peak Hour Base Flow =	222	gpcd

City Population Base Flow Projections (does not include I/I)

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
City Sewer Pop.	8,315	8,370	8,425	8,480	8,536	8,605	8,674	8,743	8,813	8,883	8,954	9,025	9,096	9,168	9,240	9,312	9,385	9,458	9,531	9,605	9,680	9,754	9,830	9,905
Max Month, MGD	0.62	0.62	0.62	0.63	0.63	0.64	0.64	0.65	0.65	0.66	0.66	0.67	0.67	0.68	0.68	0.69	0.69	0.70	0.71	0.71	0.72	0.72	0.73	0.73
Peak Day, MGD	0.62	0.62	0.62	0.63	0.63	0.64	0.64	0.65	0.65	0.66	0.66	0.67	0.67	0.68	0.68	0.69	0.69	0.70	0.71	0.71	0.72	0.72	0.73	0.73
Peak Hour, MGD	1.85	1.86	1.87	1.88	1.90	1.91	1.93	1.94	1.96	1.97	1.99	2.00	2.02	2.04	2.05	2.07	2.08	2.10	2.12	2.13	2.15	2.17	2.18	2.20

Unincorporated Area Base Flow Projections (does not include I/I)

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Uninc. Sewer Pop.	0	89	183	280	382	589	801	1,018	1,240	1,467	1,700	1,938	2,183	2,434	2,692	2,957	3,229	3,508	3,795	4,091	4,395	4,708	5,031	5,363
Max Month, MGD	0.00	0.01	0.01	0.02	0.03	0.04	0.06	0.08	0.09	0.11	0.13	0.14	0.16	0.18	0.20	0.22	0.24	0.26	0.28	0.30	0.33	0.35	0.37	0.40
Peak Day, MGD	0.00	0.01	0.01	0.02	0.03	0.04	0.06	0.08	0.09	0.11	0.13	0.14	0.16	0.18	0.20	0.22	0.24	0.26	0.28	0.30	0.33	0.35	0.37	0.40
Peak Hour, MGD	0.00	0.02	0.04	0.06	0.08	0.13	0.18	0.23	0.28	0.33	0.38	0.43	0.48	0.54	0.60	0.66	0.72	0.78	0.84	0.91	0.98	1.05	1.12	1.19

UGA Expansion Area Base Flow Projections (does not include I/I)

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
UGA Expan. Sewer Pop.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	381	762	1,143	1,524	1,905	2,286
Max Month, MGD	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	0.03	0.06	0.08	0.11	0.14	0.17
Peak Day, MGD	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	0.03	0.06	0.08	0.11	0.14	0.17
Peak Hour, MGD	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	0.08	0.17	0.25	0.34	0.42	0.51

Total Base Flow Projections (not including I/I)

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Max Month, MGD	0.62	0.63	0.64	0.65	0.66	0.68	0.70	0.72	0.74	0.77	0.79	0.81	0.83	0.86	0.88	0.91	0.93	0.96	1.01	1.07	1.13	1.18	1.24	1.30
Peak Day, MGD	0.62	0.63	0.64	0.65	0.66	0.68	0.70	0.72	0.74	0.77	0.79	0.81	0.83	0.86	0.88	0.91	0.93	0.96	1.01	1.07	1.13	1.18	1.24	1.30
Peak Hour, MGD	1.85	1.88	1.91	1.94	1.98	2.04	2.10	2.17	2.23	2.30	2.37	2.43	2.50	2.58	2.65	2.72	2.80	2.88	3.04	3.21	3.38	3.55	3.72	3.90

Total Base Flow Projections less UGA expansion (not including I/I)

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Max Month, MGD	0.62	0.63	0.64	0.65	0.66	0.68	0.70	0.72	0.74	0.77	0.79	0.81	0.83	0.86	0.88	0.91	0.93	0.96	0.99	1.01	1.04	1.07	1.10	1.13
Peak Day, MGD	0.62	0.63	0.64	0.65	0.66	0.68	0.70	0.72	0.74	0.77	0.79	0.81	0.83	0.86	0.88	0.91	0.93	0.96	0.99	1.01	1.04	1.07	1.10	1.13
Peak Hour, MGD	1.85	1.88	1.91	1.94	1.98	2.04	2.10	2.17	2.23	2.30	2.37	2.43	2.50	2.58	2.65	2.72	2.80	2.88	2.96	3.04	3.12	3.21	3.30	3.39

APPENDIX A: City of Snohomish - Infiltration and Inflow Projections

Preface:
Infiltration and inflow (I/I) is added to the base flow projections to calculate the total flow to the Snohomish WWTP. The Plan calculates I/I based on area and type of sewer system, and identified three types of sewers for the City's collection system - combined sewers, separated sewers, and new separated sewers. This ammendment applies a similar methodology and calculates I/I by multiplying a unit I/I flow factor for each sewer type by the estimated acreage of that sewer type. With the exception of the unit flow factor for Peak Hour I/I in Combined Sewers, this evaluation uses the same unit factors developed in the Plan. The Peak Hour I/I flow factor for Combined Sewers was recalculated based on new information provided by BHC Consultants, which indicated that the peak 1-year design CSO flows conveyed to the plant are less than previously anticipated in the Plan. Revisions to the flow factor calculation are described in greater detail below.

CSO #1 Improvements
Based on correspondence with BHC Consultants, the estimated peak flow for a design storm of 1.01 year recurrence frequency at CSO #1 with a 99% level of confidence is about 4,900 gpm above the current capacity of the collection system. According to the Plan, CSO #1 currently limits the treatment plant flows to between 7.5 MGD (Plan, pg. 8-2) and 8.0 MGD (Plan, Appendix E, 2003 Peak Hour Flows - Node 13-2-002). To promote compliance with WAC 173-245, capacity improvements to the collection system downstream of CSO #1 are proposed in order to reduce CSO frequency. For the purposes of this evaluation, these improvements are assumed to increase treatment plant peak hour flows delivered through this section of sewer by 7.1 MGD (~4900 gpm).

CSO #2 Improvements
Based on correspondence with BHC Consultants, the corresponding peak hour flow for a design storm of 1.01 year recurrence frequency at CSO #2 is about 5,500 gpm above the current capacity of Pump Station #1. To promote compliance with WAC 173-245, capacity improvements to the pump station downstream of CSO #2 are proposed in order to reduce CSO frequency. The new pump station will pump flow through a separate forcemain to the WWTP headworks. For the purposes of this evaluation, this improvement is assumed to increase treatment plant peak hour flows delivered from Pump Station #1 by 7.9 MGD (~5500 gpm).

Calculation of Peak Hour Unit I/I
If these collection system capacity improvements were implemented, the treatment plant flows from the 2003 sewered service area could be:

Current System Capacity	8	MGD
Additional Capacity from CSO #1 Improvements	7.1	MGD
Additional Capacity from CSO #2 Improvements	7.9	MGD
2003 Collection System Improved Capacity	23	MGD

To calculate the maximum Peak Hour I/I flow from Combined Sewers after these improvements are implemented, the Peak Hour Base flow and the Peak Hour Separated Sewer Flow are subtracted:

2003 Collection System Improved Capacity	23	MGD	
2003 Peak Hour Base Flow	1.91	MGD	
2003 Peak Hour Separated Sewer I/I Flow	3.66	MGD	(based on Unit I/I of 4,000 gpad for this sewer type)
2003 Peak Hour Combined Sewer I/I Flow	17.43	MGD	

Combined Sewer Peak Hour I/I Flow	17.43	MGD
Combined Sewer Acres	325	acres
Peak Hour I/I unit flow factor for Combined	**53,700**	**gpad**

Combined Sewers		2003 acres	Total I/I gpd	**Unit I/I gpd/acre**	
Maximum Month		325	780,000	**2,400**	
Peak Day		325	5,525,000	**17,000**	
Peak Hour		325	17,452,500	**53,700**	**REVISED FROM 76,000 GPAD

Separated Sewers (constructed 2005 and before)				
Maximum Month		915	777,750	**850**
Peak Day		915	1,830,000	**2,000**
Peak Hour		915	3,660,000	**4,000**

New Separated Sewers (constructed post 2005)				
Maximum Month		0	0	**400**
Peak Day		0	0	**900**
Peak Hour		0	0	**1,100**

IMPORTANT NOTES:
The flows indicated by BHC Consultants represent only additional flow that needs to be delivered to the plant beyond capacity of the existing system. Since the required infrastructure has not yet been built, the functional delivery capacity of the future facilities is not yet known. Assumptions on capacity improvements are based on the best information available from BHC Consultants at the time these projections were prepared. If future improvements expand the capacity of the existing collection system beyond what is assumed in this evaluation, the unit I/I flow factors will need to be re-evaluated to estimate the impact on treatment plant flows.

Sewered Acreage Calculations:
For consistency with the Plan, sewered acreage in 2024 is calculated by applying the 2003 residential sewered population density per acre to the 2024 population projections for the City sewered population, Unincorporated sewered population, and North UGA Addition sewered population. The North Highway 2 UGA expansion is calculated separately, because it is estimated to have a much higher average population density per acre. The North Highway 2 UGA expansion area is about 635 acres in total, but onlyabout 508 acres (80%) are developable. It is assumed that it will take 20 years to develop the North Highway 2 UGA expansion area starting in 2019. It is also assumed that 20% of the combined sewers, as of 2003, will be converted to separated sewers by 2028.

APPENDIX A: City of Snohomish - Infiltration and Inflow Projections

	2003
City Sewered Population	8,425 persons
Unincorporated Sewered Population	183 persons
Sewered Population (not including North Highway 2)	8607 persons
Combined Sewer Acreage	325 acres
Separated Sewer Acreage	915 acres
New Separated Sewer Acreage (Post 2003)	0 acres
Total Sewered Acreage	1240 acres
2003 Sewered Population Density	6.9 persons/acre

	2024
City Sewered Population	9,905 persons
Unincorporated Sewered Population	5,363 persons
Sewered Population (not including North Highway 2 UGA Expansion)	15,268 persons
2028 Sewered Population Density	6.9 persons/acre
Estimated 2024 Sewered Acreage (not including North Highway 2 UGA Expansion)	2200 acres
Acreage of Pre-2003 Separated Sewers	915 acres
Remaining Acreage of Combined Sewers (Assumes 20% Separation by 2028)	270 acres
Acreage of New Seperated Sewers (Including Separated Combined Sewers)	1014 acres
Additional Acreage of New Seperated Sewers (North Highway 2 UGA Expansion)	152 acres
Total Sewered Acreage	2352 acres

I/I Calculations:

Combined Sewer I/I

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
CS Area	325	322	320	317	315	312	309	307	304	302	299	296	294	291	289	286	283	281	278	276	273	270
Max Month, MGD	0.78	0.77	0.77	0.76	0.76	0.75	0.74	0.74	0.73	0.72	0.72	0.71	0.71	0.70	0.69	0.69	0.68	0.67	0.67	0.66	0.66	0.65
Peak Day, MGD	5.53	5.48	5.44	5.39	5.35	5.30	5.26	5.22	5.17	5.13	5.08	5.04	4.99	4.95	4.91	4.86	4.82	4.77	4.73	4.69	4.64	4.60
Peak Hour, MGD	17.45	17.31	17.17	17.03	16.89	16.75	16.61	16.48	16.34	16.20	16.06	15.92	15.78	15.64	15.50	15.36	15.22	15.08	14.94	14.80	14.66	14.52

Separated Sewer (2005 and before) I/I

	Separated Sewer																					
Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
SS Area (2003 and before)	915	940	965	965	965	965	965	965	965	965	965	965	965	965	965	965	965	965	965	965	965	965
Max Month, MGD	0.78	0.80	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Peak Day, MGD	1.83	1.88	1.93	1.93	1.93	1.93	1.93	1.93	1.93	1.93	1.93	1.93	1.93	1.93	1.93	1.93	1.93	1.93	1.93	1.93	1.93	1.93
Peak Hour, MGD	3.66	3.76	3.86	3.86	3.86	3.86	3.86	3.86	3.86	3.86	3.86	3.86	3.86	3.86	3.86	3.86	3.86	3.86	3.86	3.86	3.86	3.86

New Separated Sewer (post 2005) I/I

												New Separated Sewer										
Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
SS Area (post 2003, not incl. North Highway 2)	0	0	0	42	85	129	174	219	266	313	361	410	460	511	564	617	672	727	785	843	903	964
Max Month, MGD	0.00	0.00	0.00	0.02	0.03	0.05	0.07	0.09	0.11	0.13	0.14	0.16	0.18	0.20	0.23	0.25	0.27	0.29	0.31	0.34	0.36	0.39
Peak Day, MGD	0.00	0.00	0.00	0.04	0.08	0.12	0.16	0.20	0.24	0.28	0.32	0.37	0.41	0.46	0.51	0.56	0.60	0.65	0.71	0.76	0.81	0.87
Peak Hour, MGD	0.00	0.00	0.00	0.05	0.09	0.14	0.19	0.24	0.29	0.34	0.40	0.45	0.51	0.56	0.62	0.68	0.74	0.80	0.86	0.93	0.99	1.06

New Separated Sewer (UGA Expansion area) I/I

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
SS Area (post 2003, North Highway 2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	51	76	102	127	152
Max Month, MGD	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	0.01	0.02	0.03	0.04	0.05	0.06
Peak Day, MGD	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	0.02	0.05	0.07	0.09	0.11	0.14
Peak Hour, MGD	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	0.03	0.06	0.08	0.11	0.14	0.17

Total I/I

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Max Month, MGD	1.56	1.57	1.59	1.60	1.61	1.62	1.63	1.64	1.66	1.67	1.68	1.70	1.71	1.72	1.74	1.75	1.78	1.81	1.83	1.86	1.89	1.92
Peak Day, MGD	7.36	7.36	7.37	7.36	7.35	7.35	7.35	7.34	7.34	7.34	7.34	7.34	7.34	7.34	7.34	7.35	7.37	7.40	7.43	7.47	7.50	7.53
Peak Hour, MGD	21.11	21.07	21.03	20.94	20.85	20.76	20.67	20.58	20.49	20.40	20.31	20.23	20.14	20.06	19.98	19.90	19.84	19.79	19.75	19.70	19.65	19.61

Total I/I (less UGA Expansion area)

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Max Month, MGD	1.56	1.57	1.59	1.60	1.61	1.62	1.63	1.64	1.66	1.67	1.68	1.70	1.71	1.72	1.74	1.75	1.77	1.79	1.80	1.82	1.84	1.85
Peak Day, MGD	7.36	7.36	7.37	7.36	7.35	7.35	7.35	7.34	7.34	7.34	7.34	7.34	7.34	7.34	7.34	7.35	7.35	7.36	7.37	7.37	7.38	7.39
Peak Hour, MGD	21.11	21.07	21.03	20.94	20.85	20.76	20.67	20.58	20.49	20.40	20.31	20.23	20.14	20.06	19.98	19.90	19.82	19.74	19.66	19.59	19.51	19.44

APPENDIX A: City of Snohomish - Dry Weather Flow Projections

Preface:

Dry weather flows are projected to examine capacities of treatment processes during the critical dry weather period (July to October), when more stringent effluent limits are in effect. Dry weather flows are projected through the planning period by determining a historical Maximum Month to Peak Day Dry Weather flow ratio, using influent flow data from 2004 to 2007.

2007 Flow, MGD			2006 Flow, MGD			2005 Flow, MGD			2004 Flow, MGD		
Month	Avg	Peak	Month	Avg	Peak	Month	Avg	Peak	Month	Avg	Peak
Jan	1.66	3.88	Jan	2.50	5.22	Jan	1.20	2.67	Jan	1.93	5.33
Feb	1.19	1.88	Feb	1.60	2.89	Feb	1.10	2.27	Feb	1.42	2.10
Mar	1.74	2.94	Mar	1.20	2.37	Mar	1.00	2.48	Mar	1.28	2.53
Apl	1.07	2.11	Apl	1.06	1.55	Apl	1.58	2.86	Apl	0.81	1.07
May	0.84	1.60	May	0.96	2.74	May	1.01	1.56	May	1.01	3.41
June	0.83	1.44	June	0.87	1.35	June	0.98	1.70	June	0.80	1.16
July	0.74	1.66	July	0.70	1.02	July	0.72	0.89	July	0.70	1.10
Aug	0.76	1.49	Aug	0.66		Aug	0.70	0.88	Aug	0.77	1.39
Sept	0.79	1.83	Sept	0.78		Sept	0.70	1.48	Sept	0.80	1.42
Oct	0.98	1.88	Oct	0.81		Oct	0.80	1.60	Oct	0.91	1.51
Nov	1.15		Nov	2.32		Nov	1.30	2.91	Nov	1.30	2.76
Dec	2.35		Dec	2.11		Dec	1.70	3.91	Dec	1.70	5.29

	2007	2006	2005	2004
Maximum Month Flow, MGD	2.35	2.50	1.70	1.93
Average Dry Weather Flow, MGD	0.82	0.74	0.73	0.80
Maximum Month Dry Weather Flow, MGD	0.98	0.81	0.80	0.91
Peak Day Dry Weather Flow, MGD	1.88	1.02	1.60	1.51
Average Dry Weather Flow Peaking Factor	0.35	0.30	0.43	0.41
Maximum Month Flow Dry Weather Peaking Factor	0.42	0.32	0.47	0.47
Peak Day DWF Peaking Factor	0.80	0.41	0.94	0.78

Notes:

-Peak Day is based flows from July - October.

-2006 has incomplete data and is not used in peaking factor

Highest ADWF Peaking Factor **0.43**

Highest Maximum Month DWF Peaking Factor **0.47**

Highest Peak Day DWF Peaking Factor **0.94**

Assumed Peak Hour DWF Peaking Factor **3.50** based on M&E 4th Edition, Residential Population 20,000 people

City, Unincorporated, and UGA Expansion Areas

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Maximum Month Flow, MGD	2.22	2.25	2.28	2.31	2.34	2.38	2.41	2.44	2.48	2.52	2.55	2.59	2.63	2.67	2.71	2.79	2.88	2.96	3.04	3.13	3.21
Average Dry Weather Flow, MGD	0.95	0.97	0.98	0.99	1.01	1.02	1.03	1.05	1.07	1.08	1.10	1.11	1.13	1.15	1.16	1.20	1.23	1.27	1.31	1.34	1.38
Maximum Month Dry Weather Flow, MGD	1.05	1.06	1.07	1.09	1.10	1.12	1.14	1.15	1.17	1.19	1.20	1.22	1.24	1.26	1.28	1.32	1.36	1.39	1.43	1.47	1.52
Peak Day Dry Weather Flow, MGD	2.09	2.12	2.14	2.17	2.21	2.24	2.27	2.30	2.33	2.37	2.40	2.44	2.48	2.51	2.55	2.63	2.71	2.78	2.86	2.94	3.03
Peak Hour Dry Weather Flow, MGD	3.34	3.38	3.42	3.47	3.52	3.57	3.62	3.67	3.73	3.78	3.84	3.90	3.95	4.02	4.08	4.20	4.32	4.45	4.57	4.70	4.83

City and Unincorporated Areas Only

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Maximum Month Flow, MGD	2.22	2.25	2.28	2.31	2.34	2.38	2.41	2.44	2.48	2.52	2.55	2.59	2.63	2.67	2.71	2.76	2.80	2.84	2.89	2.94	2.98
Average Dry Weather Flow, MGD	0.95	0.97	0.98	0.99	1.01	1.02	1.03	1.05	1.07	1.08	1.10	1.11	1.13	1.15	1.16	1.18	1.20	1.22	1.24	1.26	1.28
Maximum Month Dry Weather Flow, MGD	1.05	1.06	1.07	1.09	1.10	1.12	1.14	1.15	1.17	1.19	1.20	1.22	1.24	1.26	1.28	1.30	1.32	1.34	1.36	1.38	1.41
Peak Day Dry Weather Flow, MGD	2.09	2.12	2.14	2.17	2.21	2.24	2.27	2.30	2.33	2.37	2.40	2.44	2.48	2.51	2.55	2.59	2.63	2.68	2.72	2.76	2.81
Peak Hour Dry Weather Flow, MGD	3.34	3.38	3.42	3.47	3.52	3.57	3.62	3.67	3.73	3.78	3.84	3.90	3.95	4.02	4.08	4.14	4.21	4.27	4.34	4.41	4.49

APPENDIX A: City of Snohomish - Average Annual Flow Projections

Historical Data

Year	2001	2002	2003	2004	2005	2006	2007	2008		
AAF	1,280,000	1,100,000	1,060,000	1,119,167	1,065,833	1,297,500	1,175,000	1,210,667		
Population	8,315	8,459	8,607	8,760	8,918	9,194	9,475	9,761		
Per Capita Flow with I/I (gpcd) =	153.9	130.0	123.1	127.8	119.5	141.1	124.0	124.0	Average =	130 gpcd
I/I (gpad) =	536	376	329	356	297	439	327	328	Average =	373 gpad

For flow from population growth beyond 2008, use baseline (average) I/I of 200 gpad, which is comparable to baseline I/I for other Puget Sound communities.

AAF Projections (City & Uninc. Areas Only)

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Population	10,053	10,350	10,653	10,963	11,279	11,602	11,932	12,269	12,613	12,966	13,327	13,696	14,075	14,463	14,860	15,268
AAF from 2008 Population (Base + I/I) (MGD)	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27
Population Beyond 2008	292	589	892	1,202	1,518	1,841	2,171	2,508	2,852	3,205	3,566	3,935	4,314	4,702	5,099	5,507
Base Flow from Population Beyond 2008 (MGD)	0.02	0.04	0.07	0.09	0.11	0.14	0.16	0.19	0.21	0.24	0.26	0.29	0.32	0.35	0.38	0.41
Added Acreage Beyond 2008 (acres)	42	85	129	173	219	265	313	361	411	462	514	567	621	677	735	793
AAF from I/I for New Development Beyond 2008 (gpad)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
AAF from I/I for New Development Beyond 2008 (MGD)	0.01	0.02	0.03	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.14	0.15	0.16
Total AAF (Base + I/I) for New Development Beyond 2008 (MGD)	0.03	0.06	0.09	0.12	0.16	0.19	0.22	0.26	0.29	0.33	0.37	0.40	0.44	0.48	0.52	0.57
Reduction in I/I from 2008 Pop. Due to Sewer Separation (MGD)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01
Total AAF (Base + I/I) (gpd)	**1.30**	**1.33**	**1.36**	**1.40**	**1.43**	**1.46**	**1.49**	**1.53**	**1.56**	**1.60**	**1.63**	**1.67**	**1.71**	**1.75**	**1.79**	**1.83**

AAF Projections (City, Uninc. Areas, & UGA Exp.)

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Population	10,053	10,350	10,653	10,963	11,279	11,602	11,932	12,269	12,613	12,966	13,708	14,458	15,218	15,987	16,765	17,554
AAF from pre-2008 Population (Base + I/I) (MGD)	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27
Population Beyond 2008	292	589	892	1,202	1,518	1,841	2,171	2,508	2,852	3,205	3,947	4,697	5,457	6,226	7,004	7,793
Base Flow from Population Beyond 2008 (MGD)	0.02	0.04	0.07	0.09	0.11	0.14	0.16	0.19	0.21	0.24	0.29	0.35	0.40	0.46	0.52	0.58
Added Acreage Beyond 2008 (acres)	42	85	129	173	219	265	313	361	411	462	539	618	698	779	862	946
AAF from I/I for New Development Beyond 2008 (gpad)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
AAF from I/I for New Development Beyond 2008 (MGD)	0.01	0.02	0.03	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.11	0.12	0.14	0.16	0.17	0.19
Total AAF (Base + I/I) for New Development Beyond 2008 (MGD)	0.03	0.06	0.09	0.12	0.16	0.19	0.22	0.26	0.29	0.33	0.40	0.47	0.54	0.62	0.69	0.77
Reduction in I/I from 2008 Pop. Due to Sewer Separation (MGD)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01
Total AAF (Base + I/I) (gpd)	**1.30**	**1.33**	**1.36**	**1.40**	**1.43**	**1.46**	**1.49**	**1.53**	**1.56**	**1.60**	**1.67**	**1.74**	**1.81**	**1.88**	**1.96**	**2.03**

APPENDIX A: City of Snohomish - Wastewater Loading Projections

Preface:

The following loading factors from the Plan were used to calculate the waste load based on population projections for each area:

Average BOD5 load per capita =	0.22 ppcd
Max Month BOD5 Peaking Factor =	1.19
Peak Day BOD5 Peaking Factor =	2.31
BOD5:CBOD5 Ratio =	1.31
BOD5:TKN Ratio =	0.182
Average TSS load per capita =	0.22
Max Month TSS Peaking Factor =	1.27
Peak Day TSS Peaking Factor =	2.57

City Average Annual Load Projections

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
City Pop.	8,315	8,370	8,425	8,480	8,536	8,605	8,674	8,743	8,813	8,883	8,954	9,025	9,096	9,168	9,240	9,312	9,385	9,458	9,531	9,605	9,680	9,754	9,830	9,905
BOD5, ppd	1,829	1,841	1,853	1,866	1,878	1,893	1,908	1,924	1,939	1,954	1,970	1,985	2,001	2,017	2,033	2,049	2,065	2,081	2,097	2,113	2,130	2,146	2,163	2,179
CBOD5, ppd	1,396	1,406	1,415	1,424	1,434	1,445	1,457	1,468	1,480	1,492	1,504	1,516	1,528	1,540	1,552	1,564	1,576	1,588	1,601	1,613	1,626	1,638	1,651	1,663
TSS, ppd	1,829	1,841	1,853	1,866	1,878	1,893	1,908	1,924	1,939	1,954	1,970	1,985	2,001	2,017	2,033	2,049	2,065	2,081	2,097	2,113	2,130	2,146	2,163	2,179
TKN, ppd	333	335	337	340	342	345	347	350	353	356	359	361	364	367	370	373	376	379	382	385	388	391	394	397

City Max Month Load Projections

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
BOD5, ppd	2,177	2,191	2,206	2,220	2,235	2,253	2,271	2,289	2,307	2,326	2,344	2,363	2,381	2,400	2,419	2,438	2,457	2,476	2,495	2,515	2,534	2,554	2,573	2,593
CBOD5, ppd	1,662	1,673	1,684	1,695	1,706	1,720	1,733	1,747	1,761	1,775	1,789	1,804	1,818	1,832	1,847	1,861	1,876	1,890	1,905	1,920	1,934	1,949	1,964	1,980
TSS, ppd	2,323	2,339	2,354	2,369	2,385	2,404	2,424	2,443	2,462	2,482	2,502	2,521	2,541	2,561	2,582	2,602	2,622	2,643	2,663	2,684	2,705	2,725	2,746	2,767
TKN, ppd	396	399	401	404	407	410	413	417	420	423	427	430	433	437	440	444	447	451	454	458	461	465	468	472

City Peak Day Load Projections

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
BOD5, ppd	4,226	4,254	4,282	4,310	4,338	4,373	4,408	4,443	4,479	4,514	4,550	4,586	4,623	4,659	4,696	4,732	4,769	4,807	4,844	4,881	4,919	4,957	4,995	5,034
CBOD5, ppd	3,226	3,247	3,268	3,290	3,312	3,338	3,365	3,392	3,419	3,446	3,474	3,501	3,529	3,556	3,584	3,612	3,641	3,669	3,698	3,726	3,755	3,784	3,813	3,843
TSS, ppd	4,701	4,732	4,763	4,795	4,826	4,865	4,904	4,943	4,983	5,023	5,062	5,103	5,143	5,183	5,224	5,265	5,306	5,347	5,389	5,431	5,473	5,515	5,558	5,600
TKN, ppd	769	774	779	784	790	796	802	809	815	822	828	835	841	848	855	861	868	875	882	888	895	902	909	916

Uninc. Average Annual Load Projections

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Uninc. Sewer Pop.	0	89	183	280	382	589	801	1,018	1,240	1,467	1,700	1,938	2,183	2,434	2,692	2,957	3,229	3,508	3,795	4,091	4,395	4,708	5,031	5,363
BOD5, ppd	0	20	40	62	84	130	176	224	273	323	374	426	480	536	592	650	710	772	835	900	967	1,036	1,107	1,180
CBOD5, ppd	0	15	31	47	64	99	134	171	208	246	285	326	367	409	452	497	542	589	637	687	738	791	845	901
TSS, ppd	0	20	40	62	84	130	176	224	273	323	374	426	480	536	592	650	710	772	835	900	967	1,036	1,107	1,180
TKN, ppd	0	4	7	11	15	24	32	41	50	59	68	78	87	97	108	118	129	140	152	164	176	189	201	215

Uninc. Max Month Load Projections

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
BOD5, ppd	0	23	48	73	100	154	210	266	325	384	445	507	572	637	705	774	845	918	994	1,071	1,151	1,233	1,317	1,404
CBOD5, ppd	0	18	36	56	76	118	160	203	248	293	340	387	436	486	538	591	645	701	758	818	878	941	1,005	1,072
TSS, ppd	0	25	51	78	107	165	224	284	346	410	475	542	610	680	752	826	902	980	1,060	1,143	1,228	1,315	1,406	1,498
TKN, ppd	0	4	9	13	18	28	38	48	59	70	81	92	104	116	128	141	154	167	181	195	209	224	240	256

Uninc. Peak Day Load Projections

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
BOD5, ppd	0	45	93	142	194	299	407	517	630	745	864	985	1,109	1,237	1,368	1,503	1,641	1,783	1,929	2,079	2,234	2,393	2,557	2,726
CBOD5, ppd	0	35	71	109	148	228	311	395	481	569	659	752	847	944	1,044	1,147	1,252	1,361	1,472	1,587	1,705	1,827	1,952	2,081
TSS, ppd	0	50	103	158	216	333	453	575	701	829	961	1,096	1,234	1,376	1,522	1,672	1,825	1,983	2,146	2,313	2,485	2,662	2,844	3,032
TKN, ppd	0	8	17	26	35	54	74	94	115	136	157	179	202	225	249	273	299	324	351	378	407	435	465	496

UGA Expansion Average Annual Load Projections

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
UGA Expan. Sewer Pop.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	381	762	1,143	1,524	1,905	2,286
BOD5, ppd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	84	168	251	335	419	503
CBOD5, ppd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	64	128	192	256	320	384
TSS, ppd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	84	168	251	335	419	503
TKN, ppd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	31	46	61	76	92

APPENDIX A: City of Snohomish - Wastewater Loading Projections

UGA Expansion Max Month Load Projections

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
BOD5, ppd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	199	299	399	499	598
CBOD5, ppd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	76	152	228	305	381	457
TSS, ppd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	106	213	319	426	532	639
TKN, ppd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	36	54	73	91	109

UGA Expansion Peak Day Load Projections

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
BOD5, ppd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	194	387	581	774	968	1,162
CBOD5, ppd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	148	296	443	591	739	887
TSS, ppd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	215	431	646	862	1,077	1,293
TKN, ppd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	70	106	141	176	211

Total Average Annual Load Projections: City, Unincorporated and UGA Expansion

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
BOD5, ppd	1,829	1,861	1,894	1,927	1,962	2,023	2,084	2,147	2,212	2,277	2,344	2,412	2,481	2,552	2,625	2,699	2,775	2,852	3,016	3,181	3,348	3,517	3,688	3,862
CBOD5, ppd	1,396	1,421	1,446	1,471	1,498	1,544	1,591	1,639	1,688	1,738	1,789	1,841	1,894	1,948	2,004	2,060	2,118	2,177	2,302	2,428	2,556	2,685	2,816	2,948
TSS, ppd	1,829	1,861	1,894	1,927	1,962	2,023	2,084	2,147	2,212	2,277	2,344	2,412	2,481	2,552	2,625	2,699	2,775	2,852	3,016	3,181	3,348	3,517	3,688	3,862
TKN, ppd	333	339	345	351	357	368	379	391	403	414	427	439	452	465	478	491	505	519	549	579	609	640	671	703

Total Max Month Load Projections

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
BOD5, ppd	2,177	2,215	2,253	2,293	2,335	2,407	2,480	2,555	2,632	2,710	2,789	2,870	2,953	3,037	3,124	3,212	3,302	3,394	3,589	3,785	3,984	4,185	4,389	4,596
CBOD5, ppd	1,662	1,691	1,720	1,751	1,782	1,837	1,894	1,951	2,009	2,068	2,129	2,191	2,254	2,319	2,384	2,452	2,521	2,591	2,739	2,889	3,041	3,195	3,350	3,508
TSS, ppd	2,323	2,363	2,405	2,448	2,492	2,569	2,647	2,727	2,809	2,892	2,977	3,063	3,151	3,242	3,334	3,428	3,524	3,623	3,830	4,040	4,252	4,467	4,684	4,905
TKN, ppd	396	403	410	417	425	438	451	465	479	493	508	522	537	553	569	585	601	618	653	689	725	762	799	836

Total Peak Day Load Projections

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
BOD5, ppd	4,226	4,299	4,374	4,452	4,532	4,672	4,815	4,961	5,109	5,260	5,414	5,571	5,732	5,896	6,064	6,235	6,410	6,589	6,966	7,348	7,734	8,124	8,520	8,921
CBOD5, ppd	3,226	3,282	3,339	3,398	3,460	3,567	3,676	3,787	3,900	4,015	4,133	4,253	4,376	4,501	4,629	4,759	4,893	5,030	5,318	5,609	5,904	6,202	6,504	6,810
TSS, ppd	4,701	4,783	4,867	4,953	5,042	5,198	5,357	5,519	5,684	5,852	6,023	6,198	6,377	6,560	6,746	6,937	7,132	7,331	7,750	8,175	8,604	9,039	9,479	9,925
TKN, ppd	769	782	796	810	825	850	876	903	930	957	985	1,014	1,043	1,073	1,104	1,135	1,167	1,199	1,268	1,337	1,408	1,479	1,551	1,624

Total Average Annual Load Projections: City and Unincorporated (less UGA Expansion)

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
BOD5, ppd	1,829	1,861	1,894	1,927	1,962	2,023	2,084	2,147	2,212	2,277	2,344	2,412	2,481	2,552	2,625	2,699	2,775	2,852	2,932	3,013	3,096	3,182	3,269	3,359
CBOD5, ppd	1,396	1,421	1,446	1,471	1,498	1,544	1,591	1,639	1,688	1,738	1,789	1,841	1,894	1,948	2,004	2,060	2,118	2,177	2,238	2,300	2,364	2,429	2,496	2,564
TSS, ppd	1,829	1,861	1,894	1,927	1,962	2,023	2,084	2,147	2,212	2,277	2,344	2,412	2,481	2,552	2,625	2,699	2,775	2,852	2,932	3,013	3,096	3,182	3,269	3,359
TKN, ppd	333	339	345	351	357	368	379	391	403	414	427	439	452	465	478	491	505	519	534	548	564	579	595	611

Total Max Month Load Projections (less UGA Expansion)

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
BOD5, ppd	2,177	2,215	2,253	2,293	2,335	2,407	2,480	2,555	2,632	2,710	2,789	2,870	2,953	3,037	3,124	3,212	3,302	3,394	3,489	3,586	3,685	3,786	3,890	3,997
CBOD5, ppd	1,662	1,691	1,720	1,751	1,782	1,837	1,894	1,951	2,009	2,068	2,129	2,191	2,254	2,319	2,384	2,452	2,521	2,591	2,663	2,737	2,813	2,890	2,970	3,051
TSS, ppd	2,323	2,363	2,405	2,448	2,492	2,569	2,647	2,727	2,809	2,892	2,977	3,063	3,151	3,242	3,334	3,428	3,524	3,623	3,724	3,827	3,932	4,041	4,152	4,266
TKN, ppd	396	403	410	417	425	438	451	465	479	493	508	522	537	553	569	585	601	618	635	653	671	689	708	727

Total Peak Day Load Projections (less UGA Expansion)

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
BOD5, ppd	4,226	4,299	4,374	4,452	4,532	4,672	4,815	4,961	5,109	5,260	5,414	5,571	5,732	5,896	6,064	6,235	6,410	6,589	6,773	6,960	7,153	7,350	7,552	7,759
CBOD5, ppd	3,226	3,282	3,339	3,398	3,460	3,567	3,676	3,787	3,900	4,015	4,133	4,253	4,376	4,501	4,629	4,759	4,893	5,030	5,170	5,313	5,460	5,611	5,765	5,923
TSS, ppd	4,701	4,783	4,867	4,953	5,042	5,198	5,357	5,519	5,684	5,852	6,023	6,198	6,377	6,560	6,746	6,937	7,132	7,331	7,535	7,744	7,958	8,177	8,402	8,633
TKN, ppd	769	782	796	810	825	850	876	903	930	957	985	1,014	1,043	1,073	1,104	1,135	1,167	1,199	1,233	1,267	1,302	1,338	1,374	1,412

APPENDIX A: City of Snohomish - Sewered Population, Base Flow, Waste Loading, and Infiltration and Inflow (I/I) Projection Summary

City, Unincorporated, and UGA Expansion Areas

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Sewered Pop.	8,607	8,760	8,918	9,194	9,475	9,761	10,053	10,350	10,653	10,963	11,279	11,602	11,932	12,269	12,613	12,966	13,708	14,458	15,218	15,987	16,765	17,554
Max Month Base Flow, MGD	0.64	0.65	0.66	0.68	0.70	0.72	0.74	0.77	0.79	0.81	0.83	0.86	0.88	0.91	0.93	0.96	1.01	1.07	1.13	1.18	1.24	1.30
Max Month I/I, MGD	1.56	1.57	1.59	1.60	1.61	1.62	1.63	1.64	1.66	1.67	1.68	1.70	1.71	1.72	1.74	1.75	1.78	1.81	1.83	1.86	1.89	1.92
Max Month Total, MGD	**2.19**	**2.22**	**2.25**	**2.28**	**2.31**	**2.34**	**2.38**	**2.41**	**2.44**	**2.48**	**2.52**	**2.55**	**2.59**	**2.63**	**2.67**	**2.71**	**2.79**	**2.88**	**2.96**	**3.04**	**3.13**	**3.21**
Average Annual Total, MGD	**1.06**	**1.12**	**1.07**	**1.30**	**1.18**	**1.21**	**1.30**	**1.33**	**1.36**	**1.40**	**1.43**	**1.46**	**1.49**	**1.53**	**1.56**	**1.60**	**1.67**	**1.74**	**1.81**	**1.88**	**1.96**	**2.03**
Average Dry Weather Flow, MGD	0.95	0.95	0.97	0.98	0.99	1.01	1.02	1.03	1.05	1.07	1.08	1.10	1.11	1.13	1.15	1.16	1.20	1.23	1.27	1.31	1.34	1.38
Maximum Month Dry Weather, MGD	1.03	1.05	1.06	1.07	1.09	1.10	1.12	1.14	1.15	1.17	1.19	1.20	1.22	1.24	1.26	1.28	1.32	1.36	1.39	1.43	1.47	1.52
Peak Day Dry Weather, MGD	2.07	2.09	2.12	2.14	2.17	2.21	2.24	2.27	2.30	2.33	2.37	2.40	2.44	2.48	2.51	2.55	2.63	2.71	2.78	2.86	2.94	3.03
Peak Hour Dry Weather, MGD	3.34	3.34	3.38	3.42	3.47	3.52	3.57	3.62	3.67	3.73	3.78	3.84	3.90	3.95	4.02	4.08	4.20	4.32	4.45	4.57	4.70	4.83
Peak Day Base Flow, MGD	0.64	0.65	0.66	0.68	0.70	0.72	0.74	0.77	0.79	0.81	0.83	0.86	0.88	0.91	0.93	0.96	1.01	1.07	1.13	1.18	1.24	1.30
Peak Day I/I, MGD	7.36	7.36	7.37	7.36	7.35	7.35	7.35	7.34	7.34	7.34	7.34	7.34	7.34	7.34	7.34	7.35	7.37	7.40	7.43	7.47	7.50	7.53
Peak Day Total, MGD	**7.99**	**8.01**	**8.03**	**8.04**	**8.06**	**8.07**	**8.09**	**8.11**	**8.13**	**8.15**	**8.17**	**8.20**	**8.22**	**8.25**	**8.28**	**8.31**	**8.39**	**8.47**	**8.56**	**8.65**	**8.74**	**8.83**
Peak Hour Base Flow, MGD	1.91	1.94	1.98	2.04	2.10	2.17	2.23	2.30	2.37	2.43	2.50	2.58	2.65	2.72	2.80	2.88	3.04	3.21	3.38	3.55	3.72	3.90
Peak Hour I/I, MGD	21.11	21.07	21.03	20.94	20.85	20.76	20.67	20.58	20.49	20.40	20.31	20.23	20.14	20.06	19.98	19.90	19.84	19.79	19.75	19.70	19.65	19.61
Peak Hour Total, MGD	**23.02**	**23.02**	**23.01**	**22.98**	**22.95**	**22.92**	**22.90**	**22.87**	**22.85**	**22.83**	**22.82**	**22.80**	**22.79**	**22.78**	**22.78**	**22.77**	**22.89**	**23.00**	**23.12**	**23.25**	**23.37**	**23.51**
BOD5 Average Annual (ppd)	1,894	1,927	1,962	2,023	2,084	2,147	2,212	2,277	2,344	2,412	2,481	2,552	2,625	2,699	2,775	2,852	3,016	3,181	3,348	3,517	3,688	3,862
BOD5 Maximum-Month Average (ppd)	2,253	2,293	2,335	2,407	2,480	2,555	2,632	2,710	2,789	2,870	2,953	3,037	3,124	3,212	3,302	3,394	3,589	3,785	3,984	4,185	4,389	4,596
BOD5 Peak Day (ppd)	4,374	4,452	4,532	4,672	4,815	4,961	5,109	5,260	5,414	5,571	5,732	5,896	6,064	6,235	6,410	6,589	6,966	7,348	7,734	8,124	8,520	8,921
CBOD5 Average Annual (ppd)	1,446	1,471	1,498	1,544	1,591	1,639	1,688	1,738	1,789	1,841	1,894	1,948	2,004	2,060	2,118	2,177	2,302	2,428	2,556	2,685	2,816	2,948
CBOD5 Maximum-Month Average (ppd)	1,720	1,751	1,782	1,837	1,894	1,951	2,009	2,068	2,129	2,191	2,254	2,319	2,384	2,452	2,521	2,591	2,739	2,889	3,041	3,195	3,350	3,508
CBOD5 Peak Day (ppd)	3,339	3,398	3,460	3,567	3,676	3,787	3,900	4,015	4,133	4,253	4,376	4,501	4,629	4,759	4,893	5,030	5,318	5,609	5,904	6,202	6,504	6,810
TSS Average Annual (ppd)	1,894	1,927	1,962	2,023	2,084	2,147	2,212	2,277	2,344	2,412	2,481	2,552	2,625	2,699	2,775	2,852	3,016	3,181	3,348	3,517	3,688	3,862
TSS Maximum-Month Average (ppd)	2,405	2,448	2,492	2,569	2,647	2,727	2,809	2,892	2,977	3,063	3,151	3,242	3,334	3,428	3,524	3,623	3,830	4,040	4,252	4,467	4,684	4,905
TSS Peak Day (ppd)	4,867	4,953	5,042	5,198	5,357	5,519	5,684	5,852	6,023	6,198	6,377	6,560	6,746	6,937	7,132	7,331	7,750	8,175	8,604	9,039	9,479	9,925
TKN Average Annual (ppd)	345	351	357	368	379	391	403	414	427	439	452	465	478	491	505	519	549	579	609	640	671	703
TKN Maximum-Month Average (ppd)	410	417	425	438	451	465	479	493	508	522	537	553	569	585	601	618	653	689	725	762	799	836
TKN Peak Day (ppd)	796	810	825	850	876	903	930	957	985	1,014	1,043	1,073	1,104	1,135	1,167	1,199	1,268	1,337	1,408	1,479	1,551	1,624

City and Unincorporated Areas Only

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Sewered Pop.	8,607	8,760	8,918	9,194	9,475	9,761	10,053	10,350	10,653	10,963	11,279	11,602	11,932	12,269	12,613	12,966	13,327	13,696	14,075	14,463	14,860	15,268
Max Month Base Flow, MGD	0.64	0.65	0.66	0.68	0.70	0.72	0.74	0.77	0.79	0.81	0.83	0.86	0.88	0.91	0.93	0.96	0.99	1.01	1.04	1.07	1.10	1.13
Max Month I/I, MGD	1.56	1.57	1.59	1.60	1.61	1.62	1.63	1.64	1.66	1.67	1.68	1.70	1.71	1.72	1.74	1.75	1.77	1.79	1.80	1.82	1.84	1.85
Max Month Total, MGD	**2.19**	**2.22**	**2.25**	**2.28**	**2.31**	**2.34**	**2.38**	**2.41**	**2.44**	**2.48**	**2.52**	**2.55**	**2.59**	**2.63**	**2.67**	**2.71**	**2.76**	**2.80**	**2.84**	**2.89**	**2.94**	**2.98**
Average Annual Total, MGD	**1.06**	**1.12**	**1.07**	**1.30**	**1.18**	**1.21**	**1.30**	**1.33**	**1.36**	**1.40**	**1.43**	**1.46**	**1.49**	**1.53**	**1.56**	**1.60**	**1.63**	**1.67**	**1.71**	**1.75**	**1.79**	**1.83**
Average Dry Weather Flow, MGD	1.05	0.95	0.97	0.98	0.99	1.01	1.02	1.03	1.05	1.07	1.08	1.10	1.11	1.13	1.15	1.16	1.18	1.20	1.22	1.24	1.26	1.28
Maximum Month Dry Weather, MGD	1.03	1.05	1.06	1.07	1.09	1.10	1.12	1.14	1.15	1.17	1.19	1.20	1.22	1.24	1.26	1.28	1.30	1.32	1.34	1.36	1.38	1.41
Peak Day Dry Weather, MGD	2.07	2.09	2.12	2.14	2.17	2.21	2.24	2.27	2.30	2.33	2.37	2.40	2.44	2.48	2.51	2.55	2.59	2.63	2.68	2.72	2.76	2.81
Peak Hour Dry Weather, MGD	3.69	3.34	3.38	3.42	3.47	3.52	3.57	3.62	3.67	3.73	3.78	3.84	3.90	3.95	4.02	4.08	4.14	4.21	4.27	4.34	4.41	4.49
Peak Day Base Flow, MGD	0.64	0.65	0.66	0.68	0.70	0.72	0.74	0.77	0.79	0.81	0.83	0.86	0.88	0.91	0.93	0.96	0.99	1.01	1.04	1.07	1.10	1.13
Peak Day I/I, MGD	7.36	7.36	7.37	7.36	7.35	7.35	7.35	7.34	7.34	7.34	7.34	7.34	7.34	7.34	7.34	7.35	7.35	7.36	7.37	7.37	7.38	7.39
Peak Day Total, MGD	**7.99**	**8.01**	**8.03**	**8.04**	**8.06**	**8.07**	**8.09**	**8.11**	**8.13**	**8.15**	**8.17**	**8.20**	**8.22**	**8.25**	**8.28**	**8.31**	**8.34**	**8.37**	**8.41**	**8.44**	**8.48**	**8.52**
Peak Hour Base Flow, MGD	1.91	1.94	1.98	2.04	2.10	2.17	2.23	2.30	2.37	2.43	2.50	2.58	2.65	2.72	2.80	2.88	2.96	3.04	3.12	3.21	3.30	3.39
Peak Hour I/I, MGD	21.11	21.07	21.03	20.94	20.85	20.76	20.67	20.58	20.49	20.40	20.31	20.23	20.14	20.06	19.98	19.90	19.82	19.74	19.66	19.59	19.51	19.44
Peak Hour Total, MGD	**23.02**	**23.02**	**23.01**	**22.98**	**22.95**	**22.92**	**22.90**	**22.87**	**22.85**	**22.83**	**22.82**	**22.80**	**22.79**	**22.78**	**22.78**	**22.77**	**22.78**	**22.78**	**22.79**	**22.80**	**22.81**	**22.83**
BOD5 Average Annual (ppd)	1,894	1,927	1,962	2,023	2,084	2,147	2,212	2,277	2,344	2,412	2,481	2,552	2,625	2,699	2,775	2,852	2,932	3,013	3,096	3,182	3,269	3,359
BOD5 Maximum-Month Average (ppd)	2,253	2,293	2,335	2,407	2,480	2,555	2,632	2,710	2,789	2,870	2,953	3,037	3,124	3,212	3,302	3,394	3,489	3,586	3,685	3,786	3,890	3,997
BOD5 Peak Day (ppd)	4,374	4,452	4,532	4,672	4,815	4,961	5,109	5,260	5,414	5,571	5,732	5,896	6,064	6,235	6,410	6,589	6,773	6,960	7,153	7,350	7,552	7,759
CBOD5 Average Annual (ppd)	1,446	1,471	1,498	1,544	1,591	1,639	1,688	1,738	1,789	1,841	1,894	1,948	2,004	2,060	2,118	2,177	2,238	2,300	2,364	2,429	2,496	2,564
CBOD5 Maximum-Month Average (ppd)	1,720	1,751	1,782	1,837	1,894	1,951	2,009	2,068	2,129	2,191	2,254	2,319	2,384	2,452	2,521	2,591	2,663	2,737	2,813	2,890	2,970	3,051
CBOD5 Peak Day (ppd)	3,339	3,398	3,460	3,567	3,676	3,787	3,900	4,015	4,133	4,253	4,376	4,501	4,629	4,759	4,893	5,030	5,170	5,313	5,460	5,611	5,765	5,923
TSS Average Annual (ppd)	1,894	1,927	1,962	2,023	2,084	2,147	2,212	2,277	2,344	2,412	2,481	2,552	2,625	2,699	2,775	2,852	2,932	3,013	3,096	3,182	3,269	3,359
TSS Maximum-Month Average (ppd)	2,405	2,448	2,492	2,569	2,647	2,727	2,809	2,892	2,977	3,063	3,151	3,242	3,334	3,428	3,524	3,623	3,724	3,827	3,932	4,041	4,152	4,266
TSS Peak Day (ppd)	4,867	4,953	5,042	5,198	5,357	5,519	5,684	5,852	6,023	6,198	6,377	6,560	6,746	6,937	7,132	7,331	7,535	7,744	7,958	8,177	8,402	8,633
TKN Average Annual (ppd)	345	351	357	368	379	391	403	414	427	439	452	465	478	491	505	519	534	548	564	579	595	611
TKN Maximum-Month Average (ppd)	410	417	425	438	451	465	479	493	508	522	537	553	569	585	601	618	635	653	671	689	708	727
TKN Peak Day (ppd)	796	810	825	850	876	903	930	957	985	1,014	1,043	1,073	1,104	1,135	1,167	1,199	1,233	1,267	1,302	1,338	1,374	1,412

APPENDIX O

Technical Memorandum, Summary of WWTP Compliance Improvement Considerations (Kennedy/Jenks Consultants, 2010)

Kennedy/Jenks Consultants

Technical Memorandum

City of Snohomish
Summary of WWTP Compliance Improvement Considerations

Prepared by:	Tom Giese, P.E.	**Date:**	24 March 2010
Reviewed by:	John Malady, P.E.	**K/J Project No:**	0797020*01

Introduction

The purpose of this Technical Memorandum is to summarize, for review by the Washington State Department of Ecology (Ecology), specific improvements to the City of Snohomish (City) Wastewater Treatment Plant (WWTP) identified as potentially appropriate to support compliance with current National Pollutant Discharge Elimination System (NPDES) permit effluent limits. The information presented herein is meant to describe how the proposed improvements are expected to provide the necessary process enhancements to resolve ongoing issues that have resulted in a history of permit violations.

This Technical Memorandum focuses primarily on improvements to address violations of effluent ammonia, which are reported to account for almost half of the violations over the past 6 years. Additionally, this Technical Memorandum includes descriptions of other process improvements that are proposed to address other recurring permit compliance issues.

Nature of Exceedances

The current NPDES permit effluent limits are summarized in Table 1 below.

Table 1: Current NPDES Permit Effluent Limits

Parameter	July - October	November - June
$CBOD_5$		
Monthly Average	25 mg/l (min. 85% removal), 58 ppd	25 mg/l (min. 85% removal), 584 ppd
Weekly Average	40 mg/l	40 mg/l, 934 ppd
Maximum Daily	93 ppd	
TSS		
Monthly Average	37 mg/l, 355 ppd	30 mg/l, 701 ppd
Weekly Average	56 mg/l, 537 ppd	45 mg/l, 1,051 ppd
Ammonia-N		
Monthly Average	29 ppd	N/A
Daily Maximum	99 ppd	N/A
Fecal Coliform Bacteria		
Monthly Average	200 cfu/100 ml	200 cfu/100 ml
Weekly Average	400 cfu/100 ml	400 cfu/100 ml
pH		
Daily Minimum	6.0	6.0
Daily Maximum	9.0	9.0

Parameter	July - October	November - June
Total Residual Chlorine		
Monthly Average	83 µg/l (30 µg/l before new diffuser)	83 µg/l (30 µg/l before new diffuser)
Daily Maximum	209 µg/l (76 µg/l before new diffuser)	209 µg/l (76 µg/l before new diffuser)

Notes:

$CBOD_5$ = 5-day carbonaceous biochemical oxygen demand
TSS = total suspended solids
ammonia-N = total ammonia (as nitrogen)
mg/l = milligrams per liter
ppd = pounds per day
cfu/100 ml = colony forming units per 100 milliliters
µg/l = micrograms per liter

The four aerated lagoons at the WWTP are part of a hybrid secondary treatment process, combining some aspects of suspended growth and facultative treatment. The first lagoon is a form of low-rate, suspended-growth treatment, with a normal volume of approximately 10 million gallons. The first lagoon was designed to be completely mixed using eighteen 15-horsepower (HP) floating surface aerators. Biological solids are not recycled, so the concentration of suspended microorganisms in this first lagoon is relatively low. Three partially mixed facultative lagoons in series follow the first lagoon, providing a normal volume of approximately 3.5 million gallons each. These three facultative lagoons provide additional biological treatment, as well as settling, storage, and digestion of solids. Each facultative lagoon is only partially mixed and aerated using three 7.5-HP floating surface aerators to allow for settling of solids.

A summary of NPDES permit violations since 2004 are provided in Table 2 below, based on our review of information provided by the City. All of the ammonia-N and all but two of the $CBOD_5$ violations have occurred during the months of July through October and are due to exceeding the effluent mass loading limits.

Table 2: Summary of NPDES Permit Violations 2004 - 2009

Effluent Parameter	# Violations	% of All Violations
Ammonia-N	42	37%
$CBOD_5$	62	54%
TSS	0	0
Fecal Coliform	7	6%
pH	0	0
Chlorine Residual	4	3%
TOTAL	**115**	**100%**

Ammonia-N

At the current average dry weather flow of about 0.8 million gallons per day (MGD) during July through October, NPDES permit limits for ammonia-N mass load require an average effluent ammonia concentration of around 4 milligrams per liter (mg/l) or less. This level of ammonia removal essentially requires complete nitrification (i.e., oxidation of ammonia to nitrate) of the wastewater. The current lagoon system is not capable of consistently achieving complete nitrification without employing additional measures.

In particular, it does not appear that the existing lagoons are capable of providing sufficient solids retention time (SRT) to reliably support complete nitrification for removal of ammonia. SRT is an indication of the average period of time that biological solids remain in the process, whether suspended or fixed to media. Complete nitrification typically requires a much longer SRT than just oxidation of $CBOD_5$ due to the slower growth rate of nitrifying microorganisms.

Nitrification also requires approximately four times the amount of oxygen on a mass basis compared to oxidation of $CBOD_5$. However, it appears that the existing surface aerators should be capable of providing sufficient aeration and mixing energy to support both nitrification and oxidation of $CBOD_5$.

Nitrifying microorganisms are more sensitive to pH compared to typical heterotrophic bacteria used for oxidation of $CBOD_5$. Consumption of alkalinity that occurs during nitrification can cause the pH to drop if there is insufficient alkalinity for buffering, which will then inhibit nitrification. Nitrifying bacteria achieve optimal performance at a pH between 7.5 and 8, but may function adequately at a pH as low as 6.5. Nitrification is normally completely inhibited at a pH below 6.

Normally, about 7.2 mg/l of alkalinity as calcium carbonate ($CaCO_3$) is required per mg/l of ammonia-N, but this is typically in highly aerated and mixed activated sludge tanks that strip CO_2 after it is released from the biological activity. Where CO_2 is not stripped in significant quantities, the alkalinity demand for nitrification can be as high as 10 mg/l as $CaCO_3$ per mg/l of ammonia-N, because CO_2 lowers the pH, thus favoring the formation of bicarbonate (HCO_3^-) and carbonic acid (H_2CO_3) over carbonate (CO_3^{-2}). Because three of the four lagoons are only partially mixed and receive limited aeration, it is expected that nitrification at the WWTP may consume as much as 10 mg/l of alkalinity ($CaCO_3$) per mg/l of ammonia-N.

The May 2005 General Sewer Plan & Wastewater Facilities Plan by Tetra Tech (Plan) indicates that influent alkalinity in the summer ranges from 150 to 200 mg/l as $CaCO_3$. According to the Plan, the projected average influent ammonia-N concentration is around 27 mg/l. Assuming the amount of organic nitrogen that hydrolyzes to ammonia-N approximately equals the amount of ammonia-N assimilated by the biomass, and 10 mg/l of alkalinity is consumed per mg/l of ammonia-N, up to 270 mg/l of alkalinity could be consumed for complete nitrification. In other words, the alkalinity required for complete nitrification is anticipated to normally exceed influent alkalinity concentrations under these assumptions. Furthermore, an effluent alkalinity concentration of 80 mg/l or higher should be maintained to avoid limiting the growth of nitrifying bacteria by providing buffering capacity to maintain a neutral pH. Therefore, influent alkalinity may need to be as high as 350 mg/l to support complete nitrification. At the current average dry weather flow of about 0.8 MGD, it is estimated that approximately 1,000 pounds per day of alkalinity would need to be added to increase the alkalinity to that level.

$CBOD_5$

At the current average dry weather flow of about 0.8 MGD during July through October, the average effluent $CBOD_5$ concentration must be around 8 mg/l or less in order to meet the current NPDES permit limits for $CBOD_5$ mass loading. This level of effluent $CBOD_5$ requires high removal of both soluble and particulate $CBOD_5$, which is challenging for the current lagoon system. Additional measures are required to routinely provide this quality of effluent, particularly with regards to removal of particulates. The existing lagoon system can also generate significant amounts of algae, which can lead to higher effluent $CBOD_5$ if not controlled or removed.

During the wet weather months, infiltration and inflow can dilute the concentration of the influent wastewater and reduce the hydraulic retention time in the lagoons, causing insufficient removal of $CBOD_5$. This problem is expected to be further exacerbated by the diversion of combined sewer overflows (CSOs) with the construction of the new CSO pump station. Additional measures appear to be required to provide sufficient treatment capacity at high flows.

Fecal Coliform and Chlorine Residual

The existing disinfection process has a number of issues that have made operations difficult and less predictable. Addressing these issues should allow the process to perform much more consistently and further reduce fecal coliform and chlorine residual in the effluent.

Performance of the disinfection process is also linked to nitrification. Nitrification occurs as a two-step process. The first step is the conversion of ammonia to nitrite, which typically involves the bacterial species *Nitrosomonas.* The second step is the conversion of nitrite to nitrate, which typically involves the bacterial species *Nitrobacter.* As summer approaches and wastewater temperatures increase, the WWTP has in the past experienced problems with “nitrite lock,” or the accumulation of nitrite in the effluent. Because *Nitrobacter* bacteria typically grow more slowly than *Nitrosomonas* at temperatures up to 14^{o}C, nitrite begins to accumulate more rapidly as wastewater temperatures warm up from the point that nitrification is completely inhibited (typically around 5 ^{o}C), until temperatures exceed 14 ^{o}C. Normally, nitrite accumulation is simply part of a seasonal transition, and the population of *Nitrobacter* organisms catches up as the temperature increases further. However, nitrite accumulation has at times appeared to persist throughout the summer, rather than just in the spring. The occurrence of nitrite accumulation is likely due to nitrification inhibition resulting from low pH cause by insufficient alkalinity and/or an insufficient population of *Nitrobacter* bacteria. The accumulation of nitrite greatly increases the chlorine demand for disinfection, because each milligram of nitrite reacts with 5 milligrams of chlorine to complete the oxidation to nitrate. This can lead to occurrences of under- or over-dosing chlorine, which could then result in higher fecal coliform or chlorine residual in the effluent.

Improvements for Ammonia Removal

Existing Operations

Currently, the WWTP staff reports that they seed the lagoons with bacteria for removal of ammonia and control of algae starting in May and continuing through October. Seeding is started with heavier dosing in May to get the process acclimated, followed by routine daily maintenance doses of bacteria. The City estimates an annual cost of close to $50,000 to purchase the bacteria. This cost does not account for time associated with maintaining the process. Without routine dosing, the bacteria would wash out of the lagoons and the process would lose its effectiveness for supporting nitrification and controlling algae. Since the City has undertaken this approach of dosing bacteria, there have been significantly fewer violations; however, some violations of $CBOD_5$ and ammonia-N mass limits have still occurred. It is possible that increasing the dose of bacteria could further reduce the number of violations, but it may not be practical or cost-effective to eliminate the violations altogether using this technique. It is likely that the violations, particularly with regards to ammonia, occurred due to spikes in loading. Because the occurrence of these spikes are unpredictable, it would be difficult and very expensive to continuously seed the process with bacteria in quantities capable of handling the largest spikes. Therefore, another means of maintaining a sufficient population of microorganisms and increasing the SRT in the lagoons should be considered.

With regards to alkalinity addition for control of pH and to prevent inhibition of nitrification, the WWTP staff currently adds supplemental alkalinity to the wastewater by introducing calcium oxide (lime) directly into the lagoons. The WWTP staff reported that with the alkalinity addition, the pH has remained near neutral based on their periodic measurements. However, with the current procedure of manual dosing and measurement, it is difficult to maintain a consistent pH and avoid under- or over-dosing as influent wastewater characteristics fluctuate.

Integrated Media

Because nitrifying bacteria are not free-swimming microorganisms (as is the case with heterotrophic microorganisms), they must attach to media in order to grow. Unlike a conventional activated sludge facility, lagoons do not contain a large mass of solids to which the nitrifying bacteria can attach. Integrating inert media into the existing lagoon process will provide additional surfaces for nitrifying bacteria and heterotrophic bacteria to attach and form a biofilm. Organic material, ammonia, and nutrients are removed as wastewater flows past the biofilm and microorganisms use these substances for growth. By attaching to the media, a relatively high inventory of microorganisms can be maintained within the process, rather than having most of the microorganisms wash out with the effluent or settle in the lagoons. As a result, this not only increases the concentration of microorganisms providing biological treatment, but also increases the SRT allowing proliferation of nitrifying bacteria. The higher concentration of biomass not only benefits nitrification, but also increases biological treatment capacity to provide improved $CBOD_5$ removal, particularly during CSO events when the hydraulic retention time in the lagoons is reduced significantly. Excess biological solids that accumulate on the media are automatically sloughed and pass to the downstream lagoons where they can be settled out of the liquid stream.

There are two identified methods with which inert media can be integrated into the existing process. The first method utilizes fixed media that is submerged into the lagoon [i.e., submerged fixed film (SFF)]. The second method utilizes moving media that would be contained in a reactor tank [i.e., moving bed bioreactor (MBBR)]. A description of both methods and a discussion of the advantages/disadvantages and relative costs of these two methods are discussed below.

Submerged Fixed Film (SFF)

The primary advantages of SFF are its low comparative cost, modularity, and relatively simple installation. For this application, SFF is less expensive compared with an MBBR because it would not require a separate tank and associated appurtenances to contain the moving media. The SFF modules are literally dropped right into the lagoon and held in place with guy wires. This makes installation relatively quick and straight-forward. It is also relatively simple to add modules as needed to expand the treatment capacity. The SFF modules themselves require essentially no maintenance, as there are no moving parts, growth on the media is self-regulating, and the materials are designed to have a long service life. The primary disadvantage of SFF is that the design of these systems is more empirical. As a result, the required surface area of media cannot be precisely calculated and must be estimated more conservatively using a higher factor of safety.

Two examples of SFF modules are the Entex Webitat™ system and the EDI BioReef™ system. A budgetary proposal was obtained for the Entex Webitat™ system. Based on preliminary considerations, it appears that the Entex Webitat™ system would fit with the existing surface aerators, whereas the EDI BioReef™ system may not. SFF modules for the Entex Webitat™ system consist of knitted polyester BioWeb™ media attached to a stainless steel frame, a shroud surrounding the module, integral air diffusers, and a flat plate on the bottom of the module. Filaments used to create the knitted media form loops that stand out from the fabric, providing numerous growth sites for attached biomass. The material, geometry, and design are arranged to increase substrate distribution and oxygen diffusion. The shroud around the module contains the air from the diffusers to provide high shear of the attached biomass, which is intended to keep the biofilm thin and aerobic for healthy nitrifier growth and control growth of predatory redworms. The integral diffusers are coarse bubble to reduce the potential for fouling. The bottom plate provides stability for the module and has upturned edges to avoid damage to the lagoon floor. The Entex Webitat™ modules arrive fully assembled. Per the manufacturer, the modules need only have an air-line connected, be lifted by crane into the lagoon, and be secured with guy wires that are attached to anchor posts around the perimeter of the lagoon.

A blower is required to supply air to the SFF modules. Additionally, some valves and instrumentation are required to control the supply of air to the modules. Two blowers would be provided (one duty and one standby) for redundancy. The budgetary cost for the SFF modules, blowers, valves, and instrumentation/controls is $1,500,000, as quoted by Entex (see Appendix A). An allowance of $400,000 is added for installation, electrical work, interconnecting piping, and a small metal building for the blowers.

MBBR

The primary advantage of an MBBR system for this application would be that this process allows for a more precise design, which would reduce the surface area of media required by using a less conservative safety factor. However, this process cannot be retrofitted directly into the lagoon and requires the addition of a reactor tank, which makes this process significantly more expensive.

An MBBR typically is a better fit with a conventional activated sludge process where the moving media can be installed in an existing tank and the tank retrofitted accommodate addition of the media. In this type of installation, the media and attached biomass are retained using a sieve, allowing effluent and suspended biomass to pass into the secondary clarifiers. The moving media continually circulates through the aeration basin in a random motion to facilitate adequate oxygen and substrate transfer to the attached biomass. Aeration in the tanks provides the mixing energy to circulate the moving media.

It is not practical to install moving media directly into a lagoon. Lagoons are generally too large to keep the media properly distributed (i.e., avoid media collecting in one area) and mixing energy is generally not distributed evenly enough to keep the media in suspension throughout the lagoon. Additionally, the moving media could cause problems with the existing surface aerators in the lagoons. Therefore, an MBBR for this application would likely most appropriately be installed as a polishing reactor consisting of a prefabricated steel tank containing the moving media, media retention sieves, diffusers, blowers, interconnecting piping, valves, and instrumentation/controls. A prefabricated steel tank would be recommended for this technology to minimize capital cost. As a polishing reactor, effluent from the first lagoon would be pumped into the MBBR before flowing into the downstream partial mixed lagoons. Pumping into the MBBR and aeration to keep the moving media suspended within the MBBR will require significantly more energy compared to the scour air requirements with the SFF media.

Well known manufacturers of MBBRs include Kruger/AnoxKaldness, Siemens/AGAR, Entex, and Brentwood Technologies. The budgetary cost for the moving media, prefabricated steel tank, media retention sieves, diffusers, blowers, and instrumentation/controls is $3,000,000, as quoted by Entex. An allowance of $500,000 is added for installation, electrical work, interconnecting piping and valves, pumping from the first lagoon, and a small metal building for the blowers.

Recommendation

It is expected that either process could perform adequately. Therefore, it is recommended that SFF modules be installed in the first lagoon, because it is anticipated to be significantly more cost-effective, be easier to expand if needed, have a lower carbon footprint, and be less susceptible to mechanical failure compared to installation of an MBBR.

Installations and Experience with Integrated Media

The only known installation using integrated media in the State of Washington is a large scale demonstration facility at the Inland Empire Paper Company facility in Spokane, Washington. In

2006, Inland Empire Paper Company completed pilot-scale testing of an MBBR in an effort to improve performance of its wastewater treatment system. To further substantiate the performance of the MBBR technology, Inland Empire Paper Company began conducting a larger scale trial in spring 2007. This larger scale trial is intended to provide Inland Empire Paper Company with the performance data necessary to evaluate this technology for potential future full-scale implementation.

Throughout the United States, there are at least a couple of dozen applications of integrated media that are in operation, or in the design or construction phase. The first installations in North America utilizing moving media are located in Broomfield, Colorado and Moorhead, Minnesota. Both were commissioned in 2003. The Moorhead, Minnesota facility uses the moving media in a very similar configuration as that described above, in which the moving media is placed within an MBBR polishing reactor. The Moorhead, Minnesota facility has a capacity of 6 MGD. The MBBR polishing reactor was designed for nitrification to replace the function of existing polishing lagoons that followed the existing secondary treatment process. The facility has reportedly been meeting the seasonal compliance standards of less than 4 mg/L ammonia-N for effluent discharge to the Red River over the past 7 years.

The first installation of SFF media was as far back as 1992 at the 10 MGD WWTP in Annapolis, Maryland. SFF media has been used in lagoons as early as the 1994. The first known installation of SFF media in a lagoon is the use of the Ringlace™ product by the Grand County Water and Sanitation District in Winter Park, Colorado. The Ringlace™ product improved nitrification in the lagoon; though, because of the extreme cold weather in this location, did not provide complete nitrification year-round. The Ringlace™ product also demonstrated reduced effluent TSS and algae growth during the summer.

Since this early introduction of SFF media, the media has evolved. The BioWeb™ media manufactured by Entex is a second generation of the Ringlace™ product, originally developed in Japan. The Webitat™ modules are the third generation development, which adds features, such as the shroud, to improve the effectiveness of the BioWeb™ media. A list of municipal facilities using the SFF BioWeb™ media and Webitat™ modules are summarized in Table 3 below. The Kenosha, WI and Port Austin, MI installations are lagoon facilities. The remaining installations are conventional activated sludge facilities. Additional details on these installations are included in Appendix B.

Table 3: SFF Media Installations

Location	Year Commissioned	Facility Capacity
Tallman Island, NY	1996	10 MGD
Greensboro, NC	1997	16 MGD
Windsor Locks, CT	2001	1.4 MGD
Green Cove Springs, FL	2002	0.75 MGD
Port Austin, MI	2003	Unknown
Colony, TX	2005	4.5 MGD
Kenosha, WI	2007	0.075 MGD
Newark, NY	2008	3.3 MGD
Coeur D' Alene	2008	6 MGD

Location	Year Commissioned	Facility Capacity
Johnstown, PA	2008	12 MGD
Mt. Wolf, PA	In Construction	TBD
Stafford, CT	In Construction	TBD

In the past, concerns have been raised about the applicability of knitted media (e.g., Ringlace™ and BioWeb™) for processes using integrated media. The concerns center on the control of biofilm quality and thickness, raising questions about whether biofilms growing on knitted media can contain nitrifying bacteria. Another concern is the occurrence of redworms on knitted media, which are predatory organisms of nitrifying bacteria. As described above, the design of the Webitat™ modules is intended to keep the biofilm thin and aerobic to promote healthy nitrifier growth and to control growth of predatory redworms.

Supplemental Alkalinity

As discussed above, the WWTP staff currently adds supplemental alkalinity to the lagoon process manually. To maintain the appropriate pH for nitrification and reduce the potential for under- or over-dosing, which can adversely affect the process, an automated dosing system is recommended. The automated dosing system would provide a steady dose that is paced with influent flow measurement and could utilize feedback from a pH monitor to confirm the correct dose is being made. This will help make sure that there is sufficient alkalinity to buffer the pH for nitrification and reduce the potential for nitrite lock and/or high effluent ammonia concentrations due to low pH inhibiting nitrification.

Dissolved Oxygen Monitoring

Although the existing surface aerators appear to be capable of providing sufficient oxygen for both nitrification of ammonia-N and oxidation of $CBOD_5$, it would be useful to have some means of tracking dissolved oxygen in the first lagoon at a few locations. A few dissolved oxygen probes and transmitters could be installed to track dissolved oxygen. This would provide the WWTP staff with better information to make appropriate adjustments to operation of the surface aerators to increase the efficiency of the treatment process and reduce energy consumption.

Other Process Improvements

The previous paragraphs focused on improvements for removal of ammonia-N. The paragraphs below discuss other process improvement considerations to address enhanced removal of $CBOD_5$ and reduce fecal coliform and chlorine residual in the effluent.

$CBOD_5$ Removal

As described previously, the existing lagoon process promotes algae growth during the warmer summer months. Some of this algae is discharged, which leads to increased $CBOD_5$ in the effluent. Additionally, the existing lagoon process does not appear to have sufficient capacity for $CBOD_5$ removal at very high influent flows, due to limited hydraulic retention time in the lagoons.

Algae Control

The WWTP staff report that they currently control algae by dosing algae eating bacteria into the process daily. This has helped to reduce the presence of algae in the effluent, but has not entirely eliminated the problem. As stated above, the installation of SFF media has shown to reduce formation of algae in other installations. Additionally, other cost-effective forms of algae control should be investigated including: use of ultrasonic transducers (such as offered by Sonic Solutions) that generate a precise frequency of ultrasonic waves to destroy the algae's cellular functioning and structure; and possible use of solar circulators (such as offered by SolarBee) that improve circulation of nutrients in the secondary lagoon cells so that their uptake is increased and fewer nutrients pass into the final lagoon to support growth of algae. Although these methods of control can substantially reduce the presence of algae in the effluent, they may not completely eliminate the presence of algae. Therefore, it is important to not only control the algae, but to also have the ability to remove algae from the effluent stream in order to meet the discharge limits.

Algae Removal

The WWTP has an existing tertiary filtration system that consists of a continuous backwash, upflow, deep bed sand filter, and a filter feed pump station containing two pumps, one duty and one standby. The purpose of this filtration system is to make sure that effluent $CBOD_5$ and TSS does not exceed the NPDES permit limits. The filter was designed for a maximum hydraulic loading of 2.8 gallons per minute per square foot (gpm/sf) of filter surface area, which yields a design capacity of 0.8 MGD. The filtration system has not been fully operational since its initial installation due to electrical issues. Harmonic distortion from existing adjustable frequency drives associated with the filtration system reportedly caused the chlorinator and sulfonator used for the disinfection process to overheat and shutdown. Electrical improvements are required to correct this problem so that the filters can be utilized without compromising the disinfection process.

The Plan recommended rehabilitating the existing filtration system and improving the capacity of the filter pumps to increase the hydraulic loading to 5 gpm/sf, which would increase the overall capacity of the system to 1.4 MGD. The Plan makes this recommendation based upon the capacity stated in literature provided by the filtration system vendor. We recommend that this capacity be verified through stress testing before undertaking improvements to increase capacity of the existing filtration system. If indeed the filters can perform adequately at this higher loading rate, it appears that replacing the filter feed pumps with higher capacity pumps could take advantage of the full available capacity. However, as mentioned in the Plan, it would need to be verified that the chemical feed system had sufficient capacity, the existing hydraulic infrastructure could handle the higher flows, and the filter reject system could handle the higher loading rate. These elements should be investigated further to evaluate the cost-effectiveness of increasing the capacity of the existing filters, since the current average dry weather flow is already equivalent to the current capacity of the filters.

Increased $CBOD_5$ Treatment Capacity

As described previously, the addition of SFF media to the first lagoon should not only substantially increase the mass of nitrifying bacteria, but also the mass of heterotrophic bacteria responsible for $CBOD_5$ removal. Therefore, installation of SFF media would also significantly increase the capacity of the lagoon process to remove $CBOD_5$. Because the bacteria would be attached to the media, the biomass should not wash out of the lagoons. This means that even during high flow events, the wastewater should still come into contact with a large quantity of biomass, whereas with the current system the biomass has limited contact with the wastewater at high flows.

Reduction of Fecal Coliform and Chlorine Residual

The existing disinfection system uses chlorine to destroy microorganisms in the effluent and maintain compliance with NPDES permit effluent limits for fecal coliform. Chlorine gas is fed from 150-pound gas cylinders to a chlorinator used to blend the chlorine gas with carrier water to make a chlorine solution. Although an oxidation-reduction potential (ORP) sensor has been installed for automated dosing, dosing of chlorine is currently controlled manually. It is reported that the ORP control loop was never properly tuned, such that it does not function properly. Additionally, the ORP sensors are now old enough that they likely require replacement. Chlorine solution is conveyed to a diffuser located in the chlorine mixing manhole, where it is mixed with the effluent prior to entering the chlorine contact tank (CCT). The existing 178,570-gallon CCT is divided into two chambers. Each chamber contains baffling to reduce short circuiting and provide the contact time needed for adequate disinfection. Normally, flow is divided equally among the chambers before recombining prior to discharge.

Disinfected effluent is dechlorinated with sulfur dioxide solution prior to discharge meet NPDES permit effluent limits for chlorine residual. The sulfur dioxide solution is prepared by feeding sulfur dioxide gas from 150-pound cylinders to a sulfonator that blends the gas with carrier water. The sulfur dioxide solution is conveyed to a diffuser located just upstream of the point of discharge into the outfall. As with the chlorine solution feed, the sulfur dioxide feed was designed to be controlled automatically using an ORP sensor, but it is currently controlled manually. As with the chlorine dosing system, this ORP control loop was reportedly never properly tuned and the ORP sensor likely requires replacement.

When the plant has experienced problems with nitrite lock in the past, the lack of automated control has meant that chlorine was more easily over- or under-dosed, due to the high chlorine demand of nitrite. Under-dosing can lead to high fecal coliform concentrations in the effluent. Over-dosing can lead to significantly higher chlorine residuals, which in turn makes it difficult to maintain a very low chlorine residual via manual dosing of sulfur dioxide. So, in addition to enabling automated control of chlorination and dechlorination, prevention of nitrite lock is also important to maintaining compliance with NPDES permit limits for fecal coliform and chlorine residual.

Automation of Chlorination and Dechlorination

As described above, the existing ORP sensors likely need to be replaced and the control loops tuned to initiate automated control of chlorination and dechlorination. ORP is measured in millivolts. A negative reading means that more reducers (e.g., sulfur dioxide) than oxidizers (e.g., chlorine) are present, and a positive reading means that more oxidizers are present. The measured value cannot be related directly to the concentration of any one oxidizing or reducing compound. Rather, the continuous measurement of ORP values by the online ORP sensor provides a trend that can then be related to the concentration of a single oxidizer or reducer. The benefit of using ORP for control is that it is an instantaneous measurement. In comparison, measuring chlorine or sulfite residual directly typically takes a few minutes because it requires a chemical reaction. As a result, it can be more challenging to adjust the dose accurately. Additionally, ORP can detect variations in the oxidant profile and provide information on the relative effectiveness of the disinfectant. This may be beneficial when effluent contains significant amounts of ammonia, organic nitrogen, nitrite, or other organic compounds that can react with chlorine and reduce its disinfecting power.

Prevention of Nitrite Lock

Installation of SFF media is expected to maintain a sufficient population of nitrifying bacteria, such that nitrification should not be inhibited due to an insufficient population of those bacteria. Additionally, automated dosing of supplemental alkalinity, as discussed above, should provide sufficient buffering capacity to maintain an adequate pH, so as not to inhibit nitrification. With these two improvements in place and functioning properly, nitrite lock is not expected to be an issue.

Other Related Improvements

There are a number of other maintenance actions for the disinfection process or other equipment at the WWTP that could enhance the improvements described in this technical memorandum. These are expected to be implemented as part of the normal operation and maintenance of the facility. Timing will depend on the annual budgetary review of capital priorities, available funding, and meeting the NPDES permit requirements to maintain the facility in good working condition.

Summary of Costs

Table 4 below provides a budgetary construction cost for the improvements discussed herein. This cost is based on the budgetary equipment quote from Entex and budgetary allowances for the installation of the SFF media system and all other improvements. Budgetary allowances are being provided for the other improvements, because the scope of these improvements has yet to be sufficiently defined to develop preliminary costs.

Table 4: Budgetary Construction Cost

Improvement	Budgetary Cost/Allowance
SFF Media System Equipment	$1,500,000
SFF Media System Installation	$400,000
Automated Dosing of Supplemental Alkalinity	$75,000
Dissolved Oxygen Monitoring	$25,000
Improvements for Algae Control	$20,000
Filtration System Improvements	$50,000
Automated Chlorination/Dechlorination	$60,000
Subtotal	**$2,130,000**
Taxes (8.6%)	$183,000
Contractor Overhead, Profit, Mobilization, Bonds & Insurance (20%)	$463,000
Contingency (25%)	$578,000
TOTAL	**$3,350,000**

Note that a 25 percent contingency is included in the budgetary construction cost to cover the potential inclusion of additional improvements and the potential for improvements identified herein to exceed the allowances already included. These estimates should be considered as "order of magnitude" costs as defined by the Association for the Advancement of Cost Engineering, which characterizes the expected accuracy.

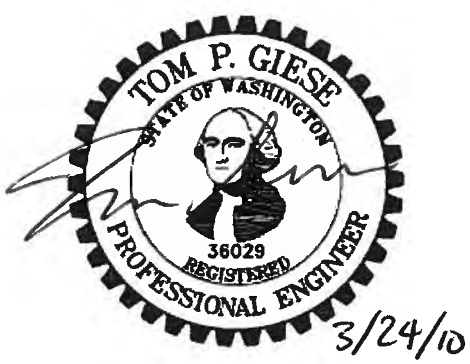
Next Steps

Following review and acceptance of this Technical Memorandum by Ecology, the City plans to proceed with preparation of an official Engineering Report, which will expand on and refine the information presented herein. After review and acceptance of the Engineering Report, the City intends to continue on with design and construction of the proposed WWTP improvements. Absent unforeseen circumstances beyond the control of the City, it is anticipated that the improvements would be operational in early 2012.

Appendices

Appendix A: Submerged Fixed Film System Budgetary Quote by Entex

Appendix B: Submerged Fixed Film Installations by Entex



Appendix A

Submerged Fixed Film System Budgetary Quote by Entex

Engineering a Clean Water Environment

March 16, 2009

Tom Giese
Kennedy/Jenks Consultants
32001 32nd Ave. South
Suite 100
Federal Way, WA 98001

Re: Shohomish, WA WWTP
Webitat™ lagoon upgrade

Dear Tom:

Thanks for the opportunity to present this proposal for a system utilizing Entex's Webitat system for lagoons incorporating our BioWeb™ fixed media to upgrade the Snohomish, WA WWTP for seasonal nitrification.

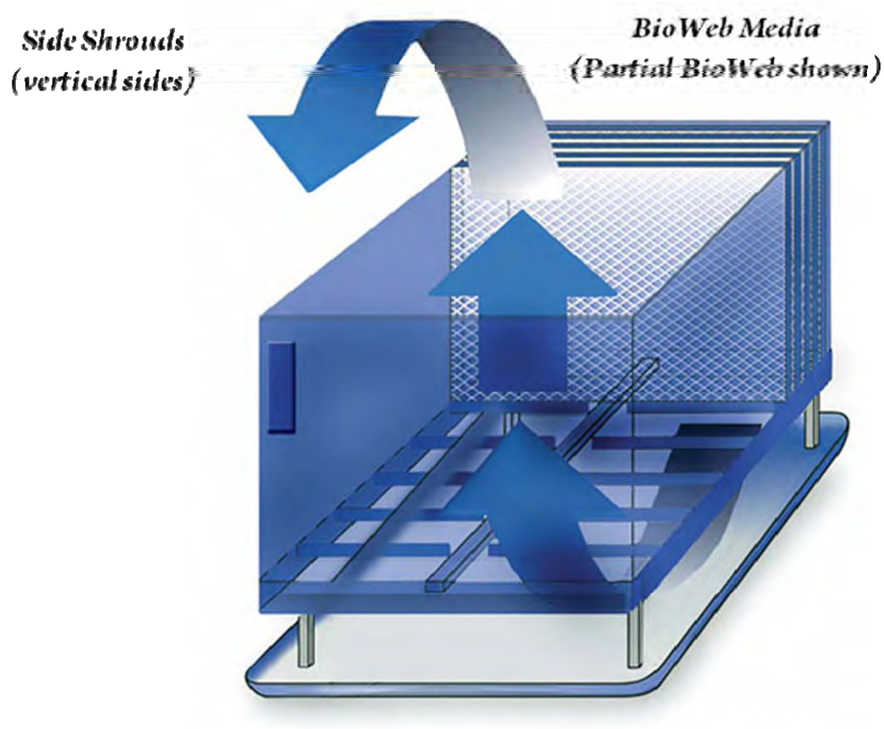
1) Basis of Design

The base design parameters modeled are:

		Influent		Effluent
Flow		1.2 MGD		--
BOD		196 mg/l		< 58 mg/l
TSS		209 mg/l		N/A
NH_3-N		23 mg/l		< 5 mg/l
Total N		N/A		N/A
Total P		6		N/A
Temp		7 degrees min. (C)		--
pH		6.5 – 8.5 max		--
Alkalinity	225 mg/l min (as $CaCO_3$)			

2) Description of system

Entex proposes the use of 42 Webitat modules, incorporating the fixed BioWeb attached growth media. The Webitat system uses air scour through an enclosed module. This arrangement ensures a high shear of the attached growth biomass, increasing kinetic performance. Additionally, this arrangement helps control redworm growth.



Controlled airlift mixing from under Webitat module vertically through module then out of the top

For the Snohomish lagoons, we have designed with an assumed lagoon depth of 12 feet. The Webitat units arrive fully assembled and ready for connection of the air line. The assembled modules have an integral aeration system and a flat plate on the bottom for module stability with upturned edges to prevent perforation or damage to the lagoon floor. The modules then only need to have an air line connected, and be lifted by crane into the lagoon.

Close up of BioWeb fixed media

Installation of Webitat modules at lagoon at Kenosha Beef, Wisconsin

3) Proposed system layout

Entex recommends distributing the Webitat modules evenly spaced in Lagoon #1.

4) Summary of proposed scope of supply

Items included are:

- Equipment as follows:

Entex Webitat system incorporating BioWeb fixed media	42 Webitat modules with over 171,518 ft^2 of BioWeb media. Modules are stainless steel frames, each 6.5 ft l x 6.5 ft w x 9 ft h (BioWeb media height) with 2 ft. legs, and 1 ft freeboard below the water line. Each module has an integral aeration system. Modules have lifting/positioning posts (4) that protrude above water level.
Blower	2 Associated high efficiency turbo blowers to provide up to 70 scfm per Webitat module (Normal operation is 40 scfm per module). Total available air flow is 3,000 scfm. Total power is 50 hp at 1,500 scfm each. The unit comes with a variable speed drive to allow turndown.
Controls, valves and instrumentation	Control Panel for integrated control, motorized valves to balance and control air flow, interconnected with the Control Panel.

- Process Engineering for all equipment, including sizing and selection.
- Review and approval of P&I Diagram for the lagoons.
- Preliminary General Arrangement Drawings and review and approval of final General Arrangement Drawings for the Entex supplied equipment.
- Review of Webitat lagoon drawings with respect to placement, excluding structural design.
- Manufacturers’ service for installation inspection & start up training.

Items not included are:

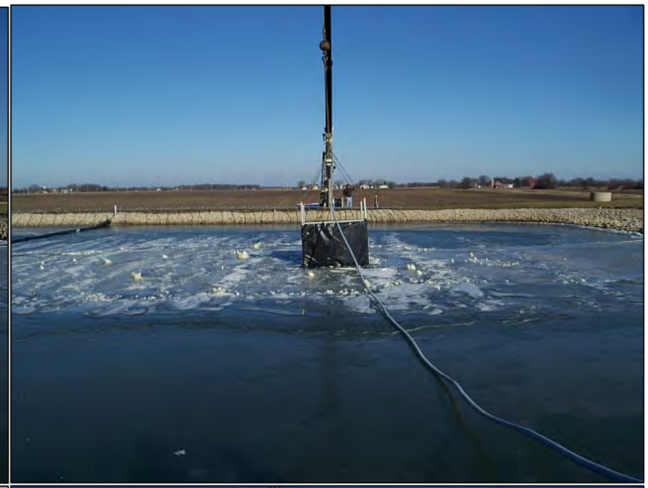
- Unloading and/or installation of modules, blower, instrumentation and control panel
- Interconnecting piping
- Electrical interconnections
- Start-up and operation

5) Summary of installation requirements

No new civil construction is anticipated, unless there is insufficient room in existing buildings for the new blower, necessitating a pad and shelter. No demolition of the existing system is required, except for air piping interconnections.

The Webitat modules will arrive on site fully assembled with BioWeb and the integral aeration system pre-installed. The modules will need to be lifted off the truck with either a fork lift or a crane. Each module will require a single air line connection (flexible hose is acceptable). This may be done prior to lifting into the lagoon, or the connection may be made after placing in the lagoon. Typically a crew of 4-6 can place 6 to 8 modules in a day. Once the modules are in place, they should be secured with guy wires from the lifting posts (which will extend above water level) to either a) a secure post on the surface, or b) to another Webitat module. A minimum of two or a maximum of four lines per module will be sufficient.

The blower will need to be placed on a concrete surface, and appropriate air line interconnections. The control panel will need to be placed on a vertical surface, and appropriate electrical interconnections.



6) Summary of operating costs

In general, the Webitat units require no maintenance. The frames, polyester BioWeb, and the Webitat shroud material are all designed for 20 year life. Similarly, the integral Webitat diffusers are coarse bubble, non-fouling.

The air line to the Webitat may be subject to UV degradation if the air lines are floated on the surface rather than submerged. If exposed to air, the air lines may require periodic replacement after 6-8 years of operation.

The Webitat units may be operated in an air flow regime between a low flow of 25 scfm per module (400 scfm total) and a high flow of 70 scfm per module (1,040 scfm). Normal operation is at 40 scfm per module.

The valves and instrumentation will require periodic maintenance and replacement after extended service. The control panel should provide 20 years of service.

The Turbo blowers will require minimal maintenance, principally changing the air filter periodically. The Turbo blower will draw 50 hp at the maximum air flow of 1,500 scfm. The blower will be equipped with a variable speed drive, and the power draw is roughly proportional to the air flow.

7) Pricing

An estimate for the enclosed scope of work is $1,475,000.

We look forward to working with you on this project. Please call me at 919-933-1380 or E-mail me at Wayne.Flournoy@EntexInc.com if you have any additional questions or concerns.

Sincerely,

Wayne Flournoy, President

Appendix B

Submerged Fixed Film Installations by Entex

ENTEX Technologies
Engineering a Clean Water Environment

Tallman Island, NYC:

This 10 MGD (million gallons per day) flow train of the 80 MGD plant was retrofitted with BioWeb in 1996 to enhance nitrification in short retention time basins. While operation using IFAS showed improved nitrification, especially significant is the documented improved settling characteristics and reduced sludge production. Modules were removed in 2005 due to concerns relative to the integrity of the aluminum frames constructed by the contractor. This allowed for strength testing on media in service for 9 years. The hexagonal matrix provides for exceptional strength still in excess on 750 pounds per ft^2.

Design Engineer:
Luis Carrio, P.E., Chief Process Development Section, NYC Dept. of Environmental Protection, Bureau of Clean Water

Results:
Significantly lower Sludge Volume Index (SVIs), 12-20% reduced sludge yield.

Media Installed:
92 modules with 3,750 ft^2 of BioWeb fixed media, totaling 345,000 ft^2.

Greensboro, NC:

Greensboro's 16 MGD North Buffalo Plant added BioWeb in 1997 to achieve winter nitrification. The additional BioWeb brought the plant into winter ammonia limit compliance. No maintenance has been required since installation.

Operational Contact:
Barbara Hicks, Water Reclamation Mgr.
Department of Water Resources
City of Greensboro, NC

Results:

Stayed well below permit:	NH3-N	CBOD
Summer: Apr 1 - Oct 31	4 mg/l	8 mg/l
Winter: Nov 1 – Mar 31	8 mg/l	16 mg/l

Media Installed:
9 modules each with 6,600 ft^2 of BioWeb fixed media for a total of 59,400 ft^2.

400 Silver Cedar Court, Suite 260, Chapel Hill, NC 27514
919.933.2770 phone 919.287.2258 fax www.entexinc.com

Windsor Locks, CT:

This 1.43 MGD treatment plant was upgraded to denitrify using the MLE process in August 2001. BioWeb was added to increase biomass for nitrification/denitrification. A performance test was conducted during the coldest months of January and February by measuring effluent ammonia in two parallel trains, one with BioWeb and one without. After testing was complete, additional BioWeb modules were installed at the plant. BioWeb removed approximately 100 lbs more ammonia per day than the plant could without BioWeb.

Operational Contact:
Gary Kuczarski, Superintendent
Town of Windsor Locks WPCA
Windsor Locks, CT

Results:
Full nitrification and denitrification, SVIs below 100.

Media Installed:
8 BioWeb modules, 4 in each of two parallel trains, 37,440 ft2.

Green Cove Springs, FL:

In November of 2002 BioWeb was installed in the Harbor Road WWTP at Green Cove Springs, FL as part of a plant upgrade to .75 MGD average flow. The plant was previously not able to nitrify and was facing a new ammonia permit. After installation of the BioWeb media the plant achieved complete nitrification and denitrification to below 10 mg/l Total Nitrogen. Additionally the sludge yield for the plant was reduced by 50% and the plant was able to achieve SVI's below 100 even at extremely high MLSS concentrations.

Operational Contact:
Mike Williams,
City of Green Cove Springs
Green Cove Springs, FL

Media Installed:
4 modules with a total of
60,275 ft^2 of BioWeb fixed media

400 Silver Cedar Court, Suite 260, Chapel Hill, NC 27514
919.933.2770 phone 919.287.2258 fax www.entexinc.com

Port Austin, MI:

In September 2003 BioWeb was installed in the Port Austin WWTP to achieve better nitrification in their lagoon system. The plant was previously not able to maintain the necessary nitrification in the fall and spring to meet their permitted ammonia levels. Media was suspended from floating cables and weighted at the bottom to form long sheets crossing the width of the lagoon multiple times.

Design Engineer:
Mert Alexander P.E.
Wade-Trim, Inc.

Operational Contact:
Don Pascarella
Port Austin Area Sewer and Water Authority

The Colony, TX:

In 2005, The Colony installed BioWeb in their 2 train, concentric ring plant. They needed to expand capacity by 33% from 3.4 million gallons per day (mgd) to 4.5 mgd. Additionally, they needed to nitrify year round to below 3 mg/l. The first train of 12 modules was installed and began service within 24 hours of initial draining. In 2006, the BioWeb modules were converted to run in the Webitat mode.

Operational Contact:
Jason Fulco, WWTP Superintendent

Results:
BOD and TSS well below 10 mg/l, ammonia typically near non-detect levels. Successfully meeting permit.

Media Installed:
24 Webitat modules with 12,500 ft^2 of BioWeb fixed media, totaling 300,000 ft^2.

400 Silver Cedar Court, Suite 260, Chapel Hill, NC 27514
919.933.2770 phone 919.287.2258 fax www.entexinc.com

Kenosha Beef International, Kenosha, WI

In 2007, Kenosha Beef International, Ltd installed two Webitat modules in their existing lagoon. They needed to achieve cold weather nitrification to below 1 mg/l before discharge in the winter when the temperature is as low as 33° F. The flow rate is about 75,000 GPD and is the main flow in the nearby stream in the winter; flow then continues to the Des Plaines River.

The Webitat modules were placed near the influent to the basin, and provide much needed aeration and mixing, as well as adding substantial biomass to the lagoons. The Webitat modules were installed with an integral aeration system. The Webitat integral aeration combines with the Webitat baffle to set up an air lift mixing pattern, enhancing mixing in the lagoon.

Design Engineer:
Richard J. Fulk, P.E.
River's Bend Engineering, Inc

Media Installed:
2 Webitat Modules each with
4, 056 ft^2 of BioWeb, totaling 8,112 ft^2

400 Silver Cedar Court, Suite 260, Chapel Hill, NC 27514
919.933.2770 phone 919.287.2258 fax www.entexinc.com

Newark, NY:

In February 2008 the village of Newark, NY installed three Webitat modules in both of their two trains at their existing wastewater treatment facility in upstate New York. Each of the six Webitat modules are 6-½ ft by 6-½ ft by 11 ft tall. The final installed modules included the standard Webitat integral aeration system and side baffling.

The original 3.3 MGD design experienced significant problems with hydraulic washout and needed to fix a portion of the biomass in the basins to ensure continuous treatment, which was corrected by the addition of the Webitat system. The low temperatures (9°–10° C) experienced routinely during the winters posed an additional challenge in this upstate New York facility.

Operational Contact:
Doug Alaimo
Village of Newark
Newark, NY

Media Installed:
6 Webitat modules each with 4,680 ft^2 of BioWeb, for a total of 28,080 ft^2

400 Silver Cedar Court, Suite 260, Chapel Hill, NC 27514
919.933.2770 phone 919.287.2258 fax www.entexinc.com

Coeur D'Alene, ID

In the spring of 2008, the city of Coeur D'Alene, ID elected to improve nitrification by removing an additional 133 lbs per day of NH_3-N from their existing 6 MGD activated sludge system. In March of 2008, 5 Webitat modules with BioWeb fixed media arrived on site for installation. This installation worked so well, the city purchased another 5 Webitat modules in the early 2009.

The challenge of nitrification at this mountain resort town was increased by the extreme cold temperatures routinely experienced.

Design Contact:
Mario Benisch
HDR Engineers
Portland, OR

Media Installed:
10 Webitat modules with over
60,000 ft^2 of BioWeb media

Johnstown, PA

In the fall of 2008, Johnstown, PA installed 32 BioWeb modules in their existing 12 MGD pure oxygen wastewater treatment plant. The plant needed to reduce the clarifier's solids loading to bring the plant into compliance with their solids effluent limit. The BioWeb system provides additional fixed biomass, allowing the suspended biomass in the system to be reduced, improving the system stability and performance by reducing the clarifier solids loading.

Mr. Frank D'Ettorre of the Johnstown Redevelopment Authority said "Our original estimate for accomplishing our goals was over two and a half million dollars. With Entex's cost-effective technology, we were able to save our ratepayers almost half the original estimate. And, with Entex's system, the construction costs and implementation time was dramatically reduced."

Operational Contact:
Jeff Mulligan
WWTP Superintendant

Media Installed:
32 Webitat modules with over
198,432 ft^2 of BioWeb media

400 Silver Cedar Court, Suite 260, Chapel Hill, NC 27514
919.933.2770 phone 919.287.2258 fax www.entexinc.com

Mt. Wolf, PA

AeroMod's SEQUOX BNR process was selected as the supplier for upgrading the Mt. Wolf, PA wastewater treatment. AeroMod asked Entex to participate with them on this project by providing eight Webitat modules to be installed near the end of their system to provide enhanced nitrification.

Construction of the system began in the fall of 2009.

Operational Contact:
Todd Steinbach
Project Manager, AeroMod

Media Installed:
8 Webitat modules with over
71,887 ft^2 of BioWeb media

Stafford, CT

Facing a new effluent total nitrogen discharge limit, the town of Stafford Springs, Connecticut chose to upgrade their Water Pollution Control Facility using a fixed media Integrated Fixed-Film/Activated Sludge (IFAS) system. The IFAS media would allow a retrofit of the existing aeration basins for biological nutrient removal without having to add basin volume.

The raw influent wastewater was a mixture of municipal and industrial wastes that included a high concentration of fibrous suspended solids from a local textile manufacturer. Because of the unusual nature of the wastewater, a pilot study was commissioned to confirm the design basis for the IFAS system. Piloting of the BioWeb system achieved steady state effluent ammonia concentrations of 1.1 mg/l, well below the target effluent ammonia of 2 mg/l. Construction of the full scale system began in the fall of 2009.

Operational Contact:
Brian Tautic
WWTP Superintendant

Media Installed:
20 Webitat modules with over
122,408 ft^2 of BioWeb media

400 Silver Cedar Court, Suite 260, Chapel Hill, NC 27514
919.933.2770 phone 919.287.2258 fax www.entexinc.com

APPENDIX P

Washington State Department of Ecology Agreed Orders #7973 and #7974

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
Northwest Regional Office • 3190 160th Avenue SE • Bellevue, Washington 98008-5452 • (425) 649-7000

September 10, 2010

CERTIFIED MAIL
7009 2820 0001 7154 4327

Larry Bauman, City Manager
City of Snohomish
116 Union Ave
Snohomish, WA 98290

Dear Mr. Bauman:

Enclosed are copies of the signed and effective Agreed Orders No. 7973 and 7974. The enclosed Orders may not be appealed. The Order ~~Amendment~~ is effective as of September 10, 2010.

If you have any questions concerning the content of the document, please contact Amy Jankowiak at (425) 649-7195 or write, Department of Ecology Northwest Regional Office, 3190 - 160th Avenue SE, Bellevue, Washington 98008-5452 .

Sincerely,

Kevin C. Fitzpatrick
Water Quality Section Manager

KCF:AJ:bl
Enclosure
cc: Karen Guzak, Mayor, City of Snohomish
Steve Schuller, P.E., City Engineer, Snohomish
Kenneth S. Weiner, K&L Gates
Larry Altose, Ecology PIO
Karen Burgess, Municipal Unit Supervisor, Ecology
Amy Jankowiak, Municipal Compliance Specialist, Ecology
Shawn McKone, Facility Manager, Ecology
Jeannie Summerhays, Northwest Regional Director, Ecology
Ron Lavigne, Attorney General's Office for Ecology
Central Files: City of Snohomish WWTP; WA-002954-8; WQ 6.4

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

IN THE MATTER OF AN ADMINISTRATIVE ORDER AGAINST: City of Snohomish	))))	AGREED ORDER No. 7973

To: The Honorable Karen Guzak
Mayor, City of Snohomish
116 Union Avenue
Snohomish, WA 98290

For the site located at:

City of Snohomish Wastewater Treatment Plant at 2115 Second Street, Snohomish, WA 98203

I. INTRODUCTION

This is an Agreed Order between the Department of Ecology (Ecology) and the City of Snohomish (City) to achieve compliance with the City's NPDES Permit No. WA-002954-8 (Permit), Chapter 90.48 Revised Code of Washington (RCW), and Chapters 173-221 and 173-220 Washington Administrative Code (WAC) by taking certain actions which are described below for an upgrade to the City's Wastewater Treatment Plant (WWTP).

II. RECOGNITION OF ECOLOGY'S JURISDICTION

RCW 90.48.030 provides that Ecology shall have the jurisdiction to control and prevent the pollution of streams, lakes, rivers, ponds, inland waters, salt waters, water courses, other surface and underground waters of the state of Washington.

RCW 90.48.120(2) authorizes Ecology to issue Administrative Orders requiring compliance whenever it determines that a person has violated or created a substantial potential to violate any provision of Chapter 90.48 RCW or fails to control the polluting content of waste to be discharged to waters of the state.

The City agrees to undertake all actions required of it by the terms and conditions of this Agreed Order and not to appeal this Agreed Order.

Nothing in this Agreed Order shall in any way relieve the City of its obligations to comply with the requirements of its Permit. Nor shall anything in this Agreed Order limit Ecology's authority to enforce the provisions of the aforementioned Permit.

III. FINDINGS OF FACT

Ecology's determination that a violation has occurred or that there is a substantial potential for a violation is based on the following facts.

1. The WWTP has had a number of effluent violations. Attachment A includes Table 1 and lists violations of Permit effluent limits for the period of October 2004 through September 2009. The list shows 115 effluent violations principally of ammonia and Carbonaceous Biochemical Oxygen Demand (CBOD) discharge limitations in summer months during this period. The ammonia and CBOD limits are in place to correct existing impairments of the Snohomish River Estuary and are consistent with Waste Load Allocations established for the City's WWTP in the 1999 "Snohomish River Estuary Total Maximum Daily Load: Submittal Report." The list in Table 1 does not include design capacity violations, effluent violations prior to October 2004, or other Permit condition violations.

2. During the same period, the WWTP also had several disinfection system failures. A Notice of Violation was issued in March of 2006 (NOV No. 3208) for previous disinfection system violations that occurred in December of 2005. As a follow-up to the NOV, the City received an Order in June of 2006 requiring the evaluation of staffing levels and implementation of staffing recommendations. In September of 2007, staffing levels were increased. The City has received warning letters for the effluent violations. The City has also received one fine and one Order with stipulated penalties (which were assessed and paid) for violations of the treatment plant's General Biosolids Permit and non-compliance with submittals and deadlines (partially due to the discovery of unexpected petroleum contamination which was not part of the original cleanup proposal).

3. The City has frequently been late in meeting certain deadlines detailed in its Permit and related Orders and requests from Ecology.

4. Ecology has met with City staff on numerous occasions, as well as phone conference calls, to discuss the status of progress for improvements to the WWTP. The City has taken action on other compliance schedule milestones required by the current NPDES Permit. The City has completed the Outfall Diffuser improvements in accordance with NPDES Permit compliance schedule Section S9.A, and has designed, permitted, and awarded the construction of the Combined Sewer Overflow (CSO) Reduction project. The plans and specifications for the CSO project were approved by Ecology in December 2009.

5 The City finds it necessary to implement a "Near-Term WWTP Improvement Project" to comply with effluent discharge limitations in the Permit. The Near-Term WWTP Improvement Project, which can be in start-up by the end of 2012, would consist of installing a submerged fixed-film media system in the WWTP lagoons. The City's staff and engineering consultant will also consider other opportunistic treatment improvements as part of this project.

Violation of Discharge Limitations and Compliance Schedule:

WAC 173-220-150 requires that all discharges authorized by a National Pollutant Discharge Elimination System (NPDES) Permit shall be consistent with the terms and requirements of that Permit.

NPDES Waste Discharge Permit No. WA-002954-8 Special Condition No. S1 states that "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..."

Special Condition No. S1.A and B states that, "...the permittee is authorized to discharge municipal wastewater at the permitted location subject to complying with the following limitations..." The limitations for the violated parameters are listed in Table 1. The parameters in Table 1 demonstrate that the City exceeded effluent limits listed in Special Condition S1 of the NPDES Permit.

Special Condition S9 of the NPDES Permit requires the submittal of approvable plans and specifications for both the CSO Reduction and the Wastewater Facilities Plan by July 1, 2008. To date, the plans and specifications for improvements to the City's wastewater facilities have not been submitted.

IV. COMPLIANCE SCHEDULE AND ACTIONS REQUIRED

In accordance with RCW 90.48.120(2) IT IS AGREED, that the City must take the following actions by the dates (milestones) set forth below. These actions are necessary to satisfy the requirements of Chapters 173-220 WAC, 173-221 WAC, and 173-240 WAC. The City has participated in defining these actions and the milestones by which they shall be completed. The City must also submit permit applications and documents needing approvals from the various government agencies in a timely fashion in order to meet the milestone dates for the various tasks.

Near-Term WWTP Improvement Project:

- This Agreed Order contains a compliance schedule for the purpose of achieving compliance in the shortest possible time with the Permit.
- The actions required by this Agreed Order are to be performed in parallel with the actions required under Order No. 7974 for the Long-Term Wastewater Treatment System Improvement Project, which will provide effluent assurance and maintain compliance for the future in light of evolving water quality standards and growth. A delay in this Order shall not be cause for a delay in Order No. 7974.

Schedule:

1. Submit a draft Facility Plan or Engineering Report for Near-Term Wastewater Treatment Plant Improvements to Ecology by September 30, 2010.
2. **Submit a final Facility Plan or Engineering Report for Ecology's approval by November 30, 2010.**
3. Submit preliminary draft Plans and Specifications by June 30, 2011.
4. **Submit final "bid-ready" Plans and Specifications and Construction Quality Assurance Plan by September 30, 2011.**

5. Advertise Bid for Construction of Near-Term Wastewater Treatment Plant Improvements by October 30, 2011.

6. Award Construction Contract by January 30, 2012.

7. **Initiate Start-up of New Treatment Components by September 30, 2012.**

8. **Achieve Substantial Completion of all Near-Term Improvements by November 30, 2012.**

9. Initiate performance data collection for 1-year Process Demonstration Period on July 1, 2013. Demonstration period will end on July 1, 2014.

10. Submit 1-year Process Assessment Report for data collected under milestone #9 by November 30, 2014.

Schedule dates are based on the following agreed assumptions:

- The City and Ecology will conduct concurrent reviews of draft engineering documents submitted under milestone #1. Both entities will complete initial respective reviews within 2 weeks of receipt and provide coordinated comments to consulting engineer within 5 weeks of receipt.

- Milestone #3 assumes that design is not using pre-selection of a preferred vendor for fixed-film media system.

- Ecology acknowledges that milestone #5 requires either approval of final plans and specification or recommendation of addenda to the bid package within 2 weeks of receipt of documents submitted under milestone #4.

Attachment B includes definitions of terms used in this schedule.

Managing Plant Capacity:

The Near-Term WWTP Improvement Project is for the purpose of improving plant effluent quality necessary to achieve compliance in the shortest possible time with Permit limitations in the existing Permit. The City and Ecology agree that the intent of the Near-Term WWTP Improvement Project is not to increase the approved capacity of the treatment plant as measured by influent flow or influent loading of Total Suspended Solids or Biochemical Oxygen Demand.

If the City exceeds the design capacity listed in Section S4.A of the Permit for two months in a row for any of the design parameters listed below, the City will communicate to Ecology steps it will take to address additional flow or waste loading to the plant. Within 90 days of exceeding the design capacity for two months in a row, the City shall impose a City-initiated moratorium on additional hook-ups to the system. The City shall not amend or repeal the moratorium without Ecology's written approval. The City may request a waiver of City-initiated moratorium if flow capacity exceedance is related to wet weather operation during extreme storm events. Request for waiver must demonstrate the following:

- Flow exceedances occurred during November through June Wet Weather Season.

- Excess flow to treatment plant can be attributed to combined sewer flows resulting from a single storm event that exceeds a 1-in-20-year return interval or multiple storm events exceeding a 1-in-10-year return interval with less than 24 hours between storms.
- City must demonstrate full compliance with controls numbers 1 (Proper System O&M), 2 (Maximizing Collection System Storage), and 4 (Maximizing Treatable Flow to POTW) of the Nine Minimum Controls for CSOs listed in Condition S.13.D of the Permit.
- City must demonstrate that treatment plant flow capacity exceedance coincided with a reduction in untreated combined sewer overflow volumes based on historic analysis of similar storm events.

Design parameters: BOD_5 for the maximum month, measured in pounds per day.
TSS for the maximum month, measured in pounds per day.
Average flow for the maximum month.

V. PROGRESS REPORTING

The City of Snohomish and Ecology shall each designate a coordinator to be a point of contact for the implementation of this Agreed Order. The City coordinator shall provide progress reports to Ecology on a monthly basis identifying the status for each of the items listed in the Compliance Schedule of the Agreed Order. Progress Reports shall include the date by which the actions required in the Compliance Schedule were completed. The first compliance report must be submitted by October 15, 2010, and monthly thereafter.

The City must notify Ecology of any occurrence which may result in non-compliance with the requirements of this Agreed Order as soon as it is reasonably aware of the delay. Such notification must state the nature of the potential non-compliance, the reason(s) therefore, and the actions taken by the City to address the potential non-compliance and must be included in the monthly progress report.

VI. STIPULATED PENALTIES

If the City of Snohomish fails to meet milestone #2, 4, or 7, as set forth in the Compliance Schedule in Section IV of this Agreed Order, the City agrees to pay Ecology a stipulated penalty in the amount of $10,000 for each week that the date is missed. Ecology may waive this penalty if the City has demonstrated a good faith effort to meet the deadline AND Ecology concurs that the delay is attributable to delays in acquiring permits/approvals from government agencies, or other unforeseeable causes that are outside of the City's control. If the City believes delays during bidding for construction or construction may impact the ability to achieve milestone #7 and such delay is necessary and customary based on standard bidding and construction practices, such delay must be documented through a bid addendum or construction Change Order and submitted to Ecology for approval in order for Ecology to waive stipulated penalties for that milestone.

If the City fails to submit monthly progress reports by the 15th of each month, the City agrees to pay Ecology a stipulated penalty in the amount of $500 for each late or missing monthly report. Ecology may waive this penalty if the City has demonstrated a good faith effort to meet the deadline AND Ecology concurs that the delay was outside of the City's control.

If stipulated penalties are imposed, Ecology shall notify the City in writing through a notice of Stipulated Penalty. Stipulated Penalties are due within 30 days of receipt of Ecology's notification or, in the event of a dispute, within 30 days of the completion of dispute resolution process under Section X of this Agreed Order for such amount as may be determined to be due, and are not otherwise appealable.

VII. FORCE MAJEURE

If a milestone set forth in the Compliance Schedule is not met or is likely not to be met, the City shall submit to Ecology, in writing, any reasons for failing to meet the specific milestone as soon as they are reasonably aware of the delay. The City shall not be held responsible for a delay if the City has demonstrated a good faith effort to meet the deadline and the delay is attributable to delays outside of the City's control ("force majeure"). For purposes of this Agreed Order, force majeure shall mean only those occurrences or events beyond the control of the City, including acts of God, natural disasters, or action or lack of action by government agencies or third parties on permit, right-of-way, or other requests for required authorizations timely submitted by the City.

VIII. EFFECTIVE DATE

This Order is effective on the date the agreement has been signed by both parties.

IX. TERMINATION OF THE AGREED ORDER

Upon completion by the City of the actions identified in the Compliance Schedule under Section IV of this Agreed Order and issuance of a Notice of Compliance by Ecology, the requirements of this Agreed Order shall be deemed to be fulfilled, and shall have no further effect on the City.

X. DISPUTE RESOLUTION

If a dispute arises between the parties regarding any noncompliance with this Agreed Order, the parties shall attempt to resolve the dispute by informal resolution. A dispute shall be considered to have arisen when one party notifies another, in writing, that there is a dispute. The parties shall seek to resolve the dispute informally, including escalation to senior officials in their respective agencies. If the parties cannot resolve the dispute informally within 30 days, the City shall serve on Ecology a written Statement of Position. Within 30 days after receipt of the City's Statement of Position, Ecology shall provide the City with a final administrative decision. The position advanced by Ecology shall be considered binding unless the City elects to pursue arbitration of the dispute. In order to pursue arbitration, the City shall propose an arbitrator within 10 days of receiving Ecology's administrative decision. The parties will seek to accomplish approval of the arbitrator by Ecology and retention of the arbiter by the City within 30 days of receiving Ecology's administrative decision. The arbitrator shall determine whether Ecology's administrative decision is consistent with this Agreed Order. In making this determination, the arbitrator shall review this Agreed Order, the City's Statement of Position, Ecology's final administrative decision, and evidence from the City and Ecology. The arbitrator will uphold Ecology's administrative decision unless the City demonstrates that Ecology's administrative decision is inconsistent with this Agreed Order. The decision of the arbitrator shall be binding on both parties.

XI. NOTICE

Any deliverables and written notices specifically required to be provided by this Agreed Order shall be transmitted to the coordinators designated under Section V of this Agreed Order unless the parties agree otherwise in writing. Written notices shall be provided by any of the following means: certified mail or courier, facsimile, or email with confirmation of receipt. Nothing in this section otherwise specifies methods of communication among the parties during implementation of this Agreed Order.

XII. THIRD PARTY RIGHT TO APPEAL

By signing this Agreed Order, the City may not appeal this Agreed Order, however, a third party may.

A party other than the City has a right to appeal this Order to the Pollution Control Hearing Board (PCHB) within 30 days of the date of receipt of this Order. The appeal process is governed by Chapter 43.21B RCW and Chapter 371-08 WAC. "Date of receipt" is defined in RCW 43.21B.001(2).

To appeal you must do the following within 30 days of the date of receipt of this Order:

- File your appeal and a copy of this Order with the PCHB (see addresses below). Filing means actual receipt by the PCHB during regular business hours.
- Serve a copy of your appeal and this Order on Ecology in paper form - by mail or in person (see addresses below). E-mail is not accepted.

You must also comply with other applicable requirements in Chapter 43.21B RCW and Chapter 371-08 WAC.

Your appeal alone will not stay the effectiveness of this Order. Stay requests must be submitted in accordance with RCW 43.21B.320.

ADDRESS AND LOCATION INFORMATION

Street Addresses:	Mailing Addresses:
Department of Ecology Attn: Appeals Processing Desk 300 Desmond Drive SE Lacey WA 98503	**Department of Ecology** Attn: Appeals Processing Desk PO Box 47608 Olympia WA 98504-7608
Pollution Control Hearings Board 4224 – 6th Avenue SE Rowe Six, Building 2 Lacey WA 98503	**Pollution Control Hearings Board** PO Box 40903 Olympia WA 98504-0903

CONTACT INFORMATION

Please direct all questions about this Order to:

Department of Ecology
Northwest Regional Office
3190 160th Avenue
Bellevue, WA 98008-5452

Amy Jankowiak
425-649-7195
ajan461@ecy.wa.gov

MORE INFORMATION

Pollution Control Hearings Board Website
www.eho.wa.gov/Boards_PCHB.aspx

Chapter 43.21B RCW - Environmental Hearings Office – Pollution Control Hearings Board
http://apps.leg.wa.gov/RCW/default.aspx?cite=43.21B

Chapter 371-08 WAC – Practice And Procedure
http://apps.leg.wa.gov/WAC/default.aspx?cite=371-08

Chapter 34.05 RCW – Administrative Procedure Act
http://apps.leg.wa.gov/RCW/default.aspx?cite=34.05

Laws: www.ecy.wa.gov/laws-rules/ecyrcw.html

Rules: www.ecy.wa.gov/laws-rules/ecywac.html

SIGNATURES

Sept 7, 2010
Date

Karen Guzak, Mayor
City of Snohomish

September 10, 2010
Date

Kevin C. Fitzpatrick
Water Quality Section Manager
Northwest Regional Office
Department of Ecology

Attachment A: Table 1

Table 1: Violations of the effluent limits set forth in Special Condition S1 of the NPDES Permit No. WA-002954-8 for the period of October 2004 through September 2009:

YEAR	PARAMETER	TYPE	UNIT	NUMBER OF VIOLATIONS
2004	Total Ammonia	Monthly Average	LBS/DAY	1
2004	Total Ammonia	Daily Max	LBS/DAY	3
2005	Carbonaceous BOD	Daily Max	LBS/DAY	2
2005	Total Ammonia	Monthly Average	LBS/DAY	2
2006	Carbonaceous BOD	Monthly Average	LBS/DAY	4
2006	Carbonaceous BOD	Daily Max	LBS/DAY	27
2006	Carbonaceous BOD % Removal	Monthly Average	PERCENT	1
2006	Fecal Coliform	Highest Weekly Geometric Mean Average	#/100ML	1
2006	Total Residual Chlorine	Daily Max	UG/L	1
2006	Total Ammonia	Monthly Average	LBS/DAY	4
2006	Total Ammonia	Daily Max	LBS/DAY	27
2007	Carbonaceous BOD	Monthly Average	LBS/DAY	4
2007	Carbonaceous BOD	Daily Max	LBS/DAY	16
2007	Carbonaceous BOD % Removal	Monthly Average	PERCENT	1
2007	Fecal Coliform	Monthly Geometric Mean	#/100ML	1
2007	Fecal Coliform	Highest Weekly Geometric Mean Average	#/100ML	3
2008	Carbonaceous BOD	Monthly Average	LBS/DAY	2
2008	Carbonaceous BOD	Daily Max	LBS/DAY	
2008	Fecal Coliform	Highest Weekly Geometric Mean Average	#/100ML	2
2008	Total Ammonia	Monthly Average	LBS/DAY	2
2009	Total Residual Chlorine	Daily Max	UG/L	3
2009	Total Ammonia	Monthly Average	LBS/DAY	3
TOTAL VIOLATIONS (past five years)				**115**

Attachment B: Definitions of Terms in Schedule

"Bid-ready" refers to plans and specifications that are sufficiently complete to allow for publishing of an advertisement for bidders. These plans and specifications shall be submitted to Ecology for approval before bid award.

"Construction Quality Assurance Plan" is the document required by WAC 173-240-075 that describes the functional construction project management organization and quality control procedures that will be specifically used for the project.

"Facility Plan or Engineering Report" refers to a single preliminary engineering document developed for the City that thoroughly examines the technical and administrative aspects of the project. Both documents must meet the minimum requirements of WAC 173-240-060. A Facility Plan must also include supplemental information and documents necessary to demonstrate compliance with the facility planning process described in WAC 173-98 (Uses and Limitations of the Water Pollution Control Revolving Fund). This process is required only if the City anticipates applying for Centennial or State Revolving Fund (SRF) loans administered by Ecology.

For the purposes of the Agreed Order, "Final Plans and Specifications" refers to plans and specifications that contain select technical and contractual details of the proposed project. Documents may include placeholders of tentative information on time-sensitive details, such as prevailing wage rates. Documents must be sufficiently complete such that there would only be minor changes between the "final" and "bid ready" documents.

"Plans and Specifications" refers to detailed design drawings and technical specifications for the project, as described by WAC 173-240-070. If the City anticipates use of SRF or Centennial Loan funds for the project, the plans and specifications must also include additional federally-required inserts and contract language. Ecology will provide these inserts to the City.

"Start-up" refers to placing newly constructed components into active service for wastewater treatment. The "start-up period" may include the initial testing and adjustment period, as defined in the construction contract, prior to the City accepting ownership of the improvements.

"Substantial Completion" refers to the date that the City formally notifies their construction contractor that all requirements of the construction contract are satisfied with exception to minor deficiencies.

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

IN THE MATTER OF AN ADMINISTRATIVE ORDER AGAINST: City of Snohomish	))))	AGREED ORDER No. 7974

To: The Honorable Karen Guzak
Mayor, City of Snohomish
116 Union Avenue
Snohomish, WA 98290

For the site located at:

City of Snohomish Wastewater Treatment Plant at 2115 Second Street, Snohomish, WA 98203

I. INTRODUCTION

This is an Agreed Order between the Department of Ecology (Ecology) and the City of Snohomish (City) to achieve and maintain long-term compliance with the City's NPDES Permit No. WA-002954-8 (Permit), Chapter 90.48 Revised Code of Washington (RCW) and Chapters 173-221 and 173-220 Washington Administrative Code (WAC) by taking certain actions which are described below for a Long-Term Wastewater System Improvement project.

II. RECOGNITION OF ECOLOGY'S JURISDICTION

RCW 90.48.030 provides that Ecology shall have the jurisdiction to control and prevent the pollution of streams, lakes, rivers, ponds, inland waters, salt waters, water courses, other surface and underground waters of the state of Washington.

RCW 90.48.120(2) authorizes Ecology to issue Administrative Orders requiring compliance whenever it determines that a person has violated or created a substantial potential to violate any provision of Chapter 90.48 RCW or fails to control the polluting content of waste to be discharged to waters of the state.

The City agrees to undertake all actions required of it by the terms and conditions of this Agreed Order and not to contest Ecology's jurisdiction and authority to administer this Agreed Order.

Nothing in this Agreed Order shall in any way relieve the City of its obligations to comply with the requirements of its Permit. Nor shall anything in this Agreed Order limit Ecology's authority to enforce the provisions of the aforementioned Permit.

III. FINDINGS OF FACT

Ecology's determination that a violation has occurred or that there is a substantial potential for a violation is based on the following facts.

1. The City's Wastewater Treatment Plant (WWTP) has had a number of effluent violations. Attachment A includes Table 1 and lists violations of Permit effluent limits for the period of October 2004 through September 2009. The list shows 115 effluent violations principally of ammonia and Carbonaceous Biochemical Oxygen Demand (CBOD) discharge limitations in summer months during this period. The ammonia and CBOD limits are in place to correct existing impairments of the Snohomish River Estuary and are consistent with Waste Load Allocations established for the City's WWTP in the 1999 "Snohomish River Estuary Total Maximum Daily Load: Submittal Report." The list does not include design capacity violations, effluent violations prior to October 2004, or other permit condition violations.

   A Near-Term WWTP Improvement Project is being done parallel under Order No. 7973. The purpose of that project is to improve plant effluent quality necessary to achieve compliance in the shortest possible time. The intent of that project is not to increase the approved capacity of the treatment plant as measured by influent flow or influent loading of total suspended solids or biochemical oxygen demand. Long-term planning is needed to provide for ongoing compliance with permit limits and water quality standards. The City must plan for adequate treatment for future flows, accounting for:

   - Increases in WWTP capacity as measured by influent flow, influent loading of total suspended solids, and influent biochemical oxygen demand, that is needed to serve future community needs in the City's adopted comprehensive plan.

   - Increased flows to the plant due to an increase of combined sewer system flows diverted to the WWTP by the CSO reduction project.

   - Current and potential waste load allocations established for the Snohomish River Estuary and evolving water quality standards.

2. The WWTP also had several disinfection system failures. A Notice of Violation was issued in March of 2006 (NOV No. 3208) for previous disinfection system violations that occurred in December of 2005. As a follow-up to the NOV, the City received an Order in June of 2006 requiring the evaluation of staffing levels and implementation of staffing recommendations. In September of 2007, staffing levels were increased. The City has received warning letters for the effluent violations. The City has also received one fine and one Order with stipulated penalties (which were assessed and paid) for violations of the treatment plant's General Biosolids Permits and non-compliance with submittals and deadlines (partially due to the discovery of unexpected petroleum contamination which was not part of the original cleanup proposal).

3. The City has frequently been late in meeting certain deadlines detailed in its Permit and related Orders and requests from Ecology.

4. Ecology has met with City staff on numerous occasions, as well as phone conference calls, to discuss the status of progress for improvements to the WWTP. Ecology approved the City's "General Sewer Plan and Wastewater Facilities Plan" document in 2005, which outlined the City's preferred options for long-term wastewater treatment needs. In 2008 the City hired a consultant to revise the 2005 plan. At that time, the City found that the project cost of the upgrade had substantially increased and that a previously-considered environmentally-preferred regional alternative should be re-examined (Attachment B). Attachment B includes a synopsis of the WWTP planning as provided by the City. The City has taken action on other compliance schedule milestones required by the current NPDES Permit. The City has completed the Outfall Diffuser improvements in accordance with NPDES Permit Compliance Schedule Section S9.A, and has designed, permitted, and awarded the construction of the Combined Sewer Overflow (CSO) Reduction project. The plans and specifications for the CSO project were approved by Ecology in December 2009.

5. Treatment technology at the existing WWTP cannot reliably meet stringent water quality standards necessary to protect the Snohomish Estuary. Furthermore, technology to be installed under companion Order #7973 as a "Near-Term Improvement" is considered "New and developmental technology" that does not have a demonstrated track record within the state of Washington of meeting stringent effluent limits necessary for water quality protection.

6. The City and Ecology have determined that additional planning, project development, and project implementation is necessary to ensure long-term, ongoing compliance with the City's current and future permit requirements. This is necessary not only to ensure capacity for future growth, but also as a contingency option in the event the "Near-Term Improvement Project" does not perform as expected.

Violation of Discharge Limitations and Compliance Schedule:

WAC 173-220-150 requires that all discharges authorized by a National Pollutant Discharge Elimination System (NPDES) Permit shall be consistent with the terms and requirements of that permit.

NPDES Waste Discharge Permit No. WA-002954-8 Special Condition No. S1 states that "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...."

Special Condition No. S1.A and B states that, "...the permittee is authorized to discharge municipal wastewater at the permitted location subject to complying with the following limitations..." The limitations for the violated parameters are listed in Table 1. The parameters in Table 1 demonstrate that the City exceeded effluent limits listed in Special Condition S1 of the NPDES Permit.

Special Condition S9 of the NPDES Permit requires the submittal of approvable plans and specifications for both the CSO Reduction and the Wastewater Facilities Plan by July 1, 2008. To date, the plans and specifications for improvements to the City's wastewater facilities have not been submitted.

IV. COMPLIANCE SCHEDULE AND ACTIONS REQUIRED

In accordance with RCW 90.48.120(2) IT IS AGREED, that the City must take the following actions by the dates (milestones) set forth below. These actions are necessary to satisfy the requirements of Chapters 173-220 WAC, 173-221 WAC, and 173-240 WAC. The City has participated in defining these actions and the milestones by which they shall be completed. The City must also submit permit applications and documents needing approvals from the various government agencies in a timely fashion in order to meet the milestone dates for the various tasks.

Long-Term Wastewater System Improvement Project:

- This Agreed Order contains a Compliance Schedule for completing a Long-Term Wastewater System Improvement Project in order to provide for ongoing compliance with the City's current and future Permit requirements in light of evolving water quality standards and growth.

- The actions required by this Agreed Order are to be performed in parallel with the actions required under Order No. 7973 for the Near-Term WWTP Improvement Project. However, a delay in compliance with Order No. 7973 for the Near-Term WWTP Improvement Project shall not be cause for a delay in compliance with this Agreed Order.

Schedule:

1. Submit a draft Facility Plan or Engineering Report to Ecology by June 30, 2011.

2. Submit preliminary Project Plans and Specifications by June 30, 2011.

3. **Submit the final Facility Plan or Engineering Report for Ecology's approval by September 30, 2011.**

4. **Submit Final Plans and Specifications for Ecology approval by July 31, 2013.**

5. Submit a Critical Path Milestone Report for Ecology's approval by July 31, 2013.

6. Submit "bid ready" Plans and Specifications and draft Construction Quality Assurance Plan by December 23, 2013.

7. Bid construction by December 31, 2013.

8. Award construction by July 31, 2014.

9. **Substantial Completion of Construction by November 30, 2016.**

Attachment C includes definitions of terms used in this schedule.

Schedule dates are based on the following agreed assumption:

- The City will submit a critical path milestone report to Ecology as stipulated in milestone #5. The report will review the status of governmental approvals, necessary easements for the project, and overall readiness to proceed. The City may propose in the report to adjust the final schedule based on readiness to proceed. Any schedule adjustment must consider the following:
    - Effectiveness of the "Near-Term Improvements" to meet permit limits.
    - Status of compliance with treatment plant design capacity limitations.
    - And must propose a completion date within the 2016 permit cycle (2016-2020).
- Milestone #4 assumes that required federal permits have been issued.

Acceptance of any proposed schedule adjustments for milestones 6-9 will be at Ecology's discretion; the City shall bear the burden of proof in any dispute on whether Ecology's exercise of discretion is consistent with this Agreed Order.

V. PROGRESS REPORTING

The City and Ecology shall each designate a coordinator to be a point of contact for the implementation of this Agreed Order. The City coordinator shall provide progress reports to Ecology on a monthly basis identifying the status for each of the items listed in the Compliance Schedule of the Agreed Order. Progress reports shall include the date by which the actions required in the Compliance Schedule were completed. The first compliance report must be submitted by October 15, 2010, and monthly thereafter.

The City must notify Ecology of any occurrence which may result in non-compliance with the requirements of this Agreed Order as soon as it is reasonably aware of the delay. Such notification must state the nature of the potential non-compliance, the reason(s) therefore, and the actions taken by the City to address the potential non-compliance and must be included in the monthly progress report.

VI. STIPULATED PENALTIES

If the City of Snohomish fails to meet milestone #3, 4, or 9, as set forth in the Compliance Schedule in Section IV of this Agreed Order, the City agrees to pay Ecology a stipulated penalty in the amount of $10,000 for each week that the date is missed. Ecology may waive this penalty if the City has demonstrated a good faith effort to meet the deadline AND Ecology concurs that the delay is attributable to delays in acquiring permits/approvals from government agencies, or other unforeseeable causes that are outside of the City's control. If the City believes delays during construction may impact the ability to achieve milestone #9 and such delay is necessary and customary based on standard construction practices, such delay must be documented through a Change Order and submitted to Ecology for approval in order for Ecology to waive stipulated penalties for that milestone.

If the City fails to submit monthly progress reports by the 15th of each month, the City agrees to pay Ecology a stipulated penalty in the amount of $500 for each late or missing monthly report. Ecology may waive this penalty if the City has demonstrated a good faith effort to meet the deadline AND Ecology concurs that the delay was outside of the City's control.

If stipulated penalties are imposed, Ecology shall notify the City in writing through a notice of Stipulated Penalty. Stipulated Penalties are due within 30 days of receipt of Ecology's notification or, in the event of a dispute, within 30 days of the completion of dispute resolution process under Section X of this Agreed Order for such amount as may be determined to be due, and are not otherwise appealable.

VII. FORCE MAJEURE

If a milestone set forth in the Compliance Schedule is not met or is likely not to be met, the City shall submit to Ecology, in writing, any reasons for failing to meet the specific milestone as soon as they are reasonably aware of the delay. The City shall not be held responsible for a delay if the City has demonstrated a good faith effort to meet the deadline and the delay is attributable to delays outside of the City's control ("force majeure"). For purposes of this Agreed Order, force majeure shall mean only those occurrences or events beyond the control of the City, including acts of God, natural disasters, or action or lack of action by government agencies or third parties on permit, right-of-way, or other requests for required authorizations timely submitted by the City.

VIII. EFFECTIVE DATE

This Order is effective on the date the agreement has been signed by both parties.

IX. TERMINATION OF THE AGREED ORDER

Upon completion by the City of the actions identified in Section IV of this Agreed Order and issuance of a Notice of Compliance by Ecology, the requirements of this Agreed Order shall be deemed to be fulfilled and shall have no further effect on the City.

X. DISPUTE RESOLUTION

If a dispute arises between the parties regarding any noncompliance with this Agreed Order, the parties shall attempt to resolve the dispute by informal resolution. A dispute shall be considered to have arisen when one party notifies another, in writing, that there is a dispute. The parties shall seek to resolve the dispute informally, including escalation to senior officials in their respective agencies. If the parties cannot resolve the dispute informally within 30 days, the City shall serve on Ecology a written Statement of Position. Within 30 days after receipt of the City's Statement of Position, Ecology shall provide the City with a final administrative decision. The position advanced by Ecology shall be considered binding unless the City elects to pursue arbitration of the dispute. In order to pursue arbitration, the City shall propose an arbitrator within 10 days of receiving Ecology's administrative decision. The parties will seek to accomplish approval of the arbitrator by Ecology and retention of the arbiter by the City within 30 days of receiving Ecology's administrative decision. The arbitrator shall determine whether Ecology's administrative decision is consistent with this Agreed Order. In making this determination, the arbitrator shall review this Agreed Order, the City's Statement of Position, Ecology's final administrative decision, and evidence from the City and Ecology. The arbitrator will uphold Ecology's administrative decision unless the City demonstrates that Ecology's administrative decision is inconsistent with this Agreed Order. The decision of the arbitrator shall be binding on both parties.

XI. NOTICE

Any deliverables and written notices specifically required to be provided by this Agreed Order shall be transmitted to the coordinators designated under Section V of this Agreed Order unless the parties agree otherwise in writing. Written notices shall be provided by any of the following means: certified mail or courier, facsimile, or email with confirmation of receipt. Nothing in this section otherwise specifies methods of communication among the parties during implementation of this Agreed Order.

XI. THIRD PARTY RIGHT TO APPEAL

By signing this Agreed Order, the City may not appeal this Agreed Order, however, a third party may.

A party other than the City has a right to appeal this Order to the Pollution Control Hearing Board (PCHB) within 30 days of the date of receipt of this Order. The appeal process is governed by Chapter 43.21B RCW and Chapter 371-08 WAC. "Date of receipt" is defined in RCW 43.21B.001(2).

To appeal you must do the following within 30 days of the date of receipt of this Order:

- File your appeal and a copy of this Order with the PCHB (see addresses below). Filing means actual receipt by the PCHB during regular business hours.

- Serve a copy of your appeal and this Order on Ecology in paper form - by mail or in person (see addresses below). E-mail is not accepted.

You must also comply with other applicable requirements in Chapter 43.21B RCW and Chapter 371-08 WAC.

Your appeal alone will not stay the effectiveness of this Order. Stay requests must be submitted in accordance with RCW 43.21B.320.

ADDRESS AND LOCATION INFORMATION

Street Addresses:	Mailing Addresses:
Department of Ecology Attn: Appeals Processing Desk 300 Desmond Drive SE Lacey WA 98503 **Pollution Control Hearings Board** 4224 – 6th Avenue SE Rowe Six, Building 2 Lacey WA 98503	**Department of Ecology** Attn: Appeals Processing Desk PO Box 47608 Olympia WA 98504-7608 **Pollution Control Hearings Board** PO Box 40903 Olympia WA 98504-0903

CONTACT INFORMATION

Please direct all questions about this Order to:

Department of Ecology
Northwest Regional Office
3190 160th Avenue
Bellevue, WA 98008-5452

Amy Jankowiak
425-649-7195
ajan461@ecy.wa.gov

MORE INFORMATION

Pollution Control Hearings Board Website
www.eho.wa.gov/Boards_PCHB.aspx

Chapter 43.21B RCW - Environmental Hearings Office – Pollution Control Hearings Board
http://apps.leg.wa.gov/RCW/default.aspx?cite=43.21B

Chapter 371-08 WAC – Practice And Procedure
http://apps.leg.wa.gov/WAC/default.aspx?cite=371-08

Chapter 34.05 RCW – Administrative Procedure Act
http://apps.leg.wa.gov/RCW/default.aspx?cite=34.05

Laws: www.ecy.wa.gov/laws-rules/ecyrcw.html

Rules: www.ecy.wa.gov/laws-rules/ecywac.html

SIGNATURES

[signature] Sept 7. 2010
Karen Guzak, Mayor — Date
City of Snohomish

[signature] September 10, 2010
Kevin C. Fitzpatrick — Date
Water Quality Section Manager
Northwest Regional Office
Department of Ecology

Attachment A: Table 1

Table 1: Violations of the effluent limits set forth in Special Condition S1 of the NPDES Permit No. WA-002954-8 for the period of October 2004 through September 2009:

YEAR	PARAMETER	TYPE	UNIT	NUMBER OF VIOLATIONS
2004	Total Ammonia	Monthly Average	LBS/DAY	1
2004	Total Ammonia	Daily Max	LBS/DAY	3
2005	Carbonaceous BOD	Daily Max	LBS/DAY	2
2005	Total Ammonia	Monthly Average	LBS/DAY	2
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2006	Carbonaceous BOD	Daily Max	LBS/DAY	27
2006	Carbonaceous BOD % Removal	Monthly Average	PERCENT	1
2006	Fecal Coliform	Highest Weekly Geometric Mean Average	#/100ML	1
2006	Total Residual Chlorine	Daily Max	UG/L	1
2006	Total Ammonia	Monthly Average	LBS/DAY	4
2006	Total Ammonia	Daily Max	LBS/DAY	27
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2007	Carbonaceous BOD	Daily Max	LBS/DAY	16
2007	Carbonaceous BOD % Removal	Monthly Average	PERCENT	1
2007	Fecal Coliform	Monthly Geometric Mean	#/100ML	1
2007	Fecal Coliform	Highest Weekly Geometric Mean Average	#/100ML	3
2008	Carbonaceous BOD	Monthly Average	LBS/DAY	2
2008	Carbonaceous BOD	Daily Max	LBS/DAY	5
2008	Fecal Coliform	Highest Weekly Geometric Mean Average	#/100ML	2
2008	Total Ammonia	Monthly Average	LBS/DAY	2
2009	Total Residual Chlorine	Daily Max	UG/L	3
2009	Total Ammonia	Monthly Average	LBS/DAY	3
TOTAL VIOLATIONS (past five years)				**115**

Attachment B: Synopsis of the WWTP planning as provided by the City of Snohomish

1. The City of Snohomish has had a stable population of approximately 9,000 people. Nearly all of the wastewater flow comes from residential use, and there is currently little industrial use in the City. The General Sewer Plan and Comprehensive Plan under the Growth Management Act (GMA) currently indicate a high end population projection of approximately 14,000 in 2024, and growth may take longer due to the economic recession. The current WWTP is sized to accommodate projected wastewater flows for the foreseeable future. Based on the foregoing, it is reasonable to plan and implement improvements based on 50-year projections that are consistent with County-wide and City of Snohomish GMA policies.

2. In order to meet the Permit Compliance Schedule, the City retained a consulting engineering firm to prepare an Engineering Report and Facility Plan and related plans and specifications for a comprehensive upgrade of the WWTP in accordance with the preferred alternative in the existing 2005 General Sewer Plan and Wastewater Facilities Plan ("Existing Plan") approved by Ecology. A preliminary draft Facility Plan determined that the cost of the improvements was more than $30 million compared to the approximately $10 million estimated in the Existing Plan.

3. Based on this information, the City retained a consulting engineering firm to prepare an Engineering Report and Facility Plan for an apparently environmentally-preferable alternative to convey the City's wastewater to the City of Everett's WWTP. The conveyance line alternative appears to be environmentally-preferable because it would remove the City of Snohomish's wastewater from discharging to the Snohomish River, which is currently both designated as an impaired waterbody and as critical endangered species habitat. Removal of the City's discharge to the Snohomish River would protect the river and its fisheries and natural resources over the long term while also addressing future planned growth. This alternative was considered but not selected for the Existing Plan for various reasons, including its then-disproportionately-higher cost estimate.

4. Based on a preliminary draft Facility Plan received by the City in September 2009, the City determined that a conveyance line to Everett would be feasible, assuming an acceptable interlocal agreement could be reached with the City of Everett, that Ecology would support and assist in funding this alternative, and that the Compliance Schedule could be modified to take into account the public and environmental review, permitting, and financial plan required to enable the City's effluent to be removed from the Snohomish River under this alternative. By removing the City's discharge from the Snohomish River, this action will eliminate future non-compliance with discharge limitations described in this Agreed Order.

5. The conveyance to Everett is expected to consist of a pump station, approximately five miles of force main, at least one crossing of the Snohomish River or tributary, and a connection to Everett's south interceptor. Flow equalizing storage is to be provided at the existing City of Snohomish WWTP. The City of Everett has been providing studies of its system hydraulics and costs, as well as including the City of Snohomish flows in Everett's recently completed Water Pollution Control Facility Engineering Report regarding the future improvements Everett will need for its treatment plant. The cities are working toward reaching a final agreement in the fall of 2010.

6. Because of the requirements under the Clean Water Act and GMA to amend the City's Existing Plan and prepare project-level Engineering Report and Facility Plan, to conduct related environmental review under the State Environmental Policy Act (SEPA), and to obtain numerous federal, state and

local permits, rights-of-way, and grants, implementation of a conveyance to Everett will likely take approximately six years on an aggressive schedule. The City has determined that compliance with effluent discharge limitations under the Permit and upcoming renewal can likely be met by a WWTP Improvement Project that can be completed in 2012. The WWTP Improvement Project would consist of installing a submerged filter-media system in the WWTP lagoons and related improvements.

7. The milestones in the Compliance Schedule in this Agreed Order are designed to allow the City to complete reports, plans and specifications, and to raise rates up to the hardship level (i.e., two percent of median household income), sufficient to enable the City to submit timely applications to Ecology to receive grant funding necessary to support the improvements required by this Agreed Order.

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