CITY OF NORTH BEND

KING COUNTY **WASHINGTON**

WASTEWATER SYSTEM FACILITIES PLAN REVISION

PREPARED BY TETRA TECH
DECEMBER 2016

REVISED BY GRAY & OSBORNE, INC.
NOVEMBER 2017
G&O #17456

Gray & Osborne, Inc.
CONSULTING ENGINEERS

CITY OF NORTH BEND

KING COUNTY **WASHINGTON**

NORTH BEND

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WASTEWATER SYSTEM FACILITIES PLAN REVISION

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11/3/2017

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ACRONYMS/ABBREVIATIONS

Acronym or Abbreviation	Definition
3W water	non-potable water
7Q10	low flow over a 7-day period that is statistically likely to occur once every 10 years low flow
BOD	biochemical oxygen demand
$CBOD_5$	five-day carbonaceous biochemical oxygen demand
cfu/100 mL	colony-forming units per 100 milliliters
CIP	capital improvement plan
CLDR	Constrained Low Density Residential
CMOM	Capacity, Management, Operation, and Maintenance
CR	Cottage Residential
DC	Downtown Commercial
DMR	discharge monitoring reports
DO	dissolved oxygen
DTAS	deep-tank activated sludge
EFH	Essential Fish Habitat
EP-1	Employment Park – 1
EP-2	Employment Park – 2
ERU	equivalent residential unit
GFC	General Facility Charge
gpad	gallons per acre per day
gpcd	gallons per capita per day
gpd	gallons per day
gpm	gallons per minute
HDR	High Density Residential
HDR	High Density Residential with Density Restrictions
IC	Interchange Commercial
IMU	Interchange Mixed Use
IPS	influent pump station
LDR	Low Density Residential
MBR	membrane bioreactor
MCC	motor control center
MCP	main control panel
mgd	million gallons per day
MH	manhole
mJ/cm^2	millijoules per square centimeter
MLSS	mixed-liquor suspended solids
MLVSS	mixed-liquor volatile suspended solids
MTU	master telemetry unit
NB	Neighborhood Business
NBOD	nitrogenous biological oxygen demand
NPDES	National Pollutant Discharge Elimination System

Acronym or Abbreviation	Definition
O&M	operation and maintenance
OCU	odor control unit
OFM	Washington Office of Financial Management
PE	population equivalent
PLC	programmable logic controller
POSPF	Park/Open Space/Public Facilities
ppcd	pounds per capita per day
ppd	pounds per day
RAS	return activated sludge
SCADA	supervisory control and data acquisition
SRP	soluble reactive phosphorus
SSO	sanitary sewer overflow
SVI	sludge volume index
SWMM	Storm Water Management Model
TDH	total dynamic head
TKN	total Kjeldahl nitrogen
TMDL	total maximum daily load
TP	total phosphorus
TSS	total suspended solids
UGA	urban growth area
ULID	Utility Local Improvement District
ULID 6	Utility Local Improvement District 6
VSS	volatile suspended solids
WAC	Washington Administrative Code
WAS	waste activated sludge

Text^{R} Indicates that the December 2016 text was modified or new text was added as part of this November 2017 revision of the plan.

EXECUTIVE SUMMARY

The City of North Bend *Wastewater System Facilities Plan* is a comprehensive planning document for all elements of the City of North Bend's wastewater system – collection, treatment, biosolids management and effluent disposal or reuse. It addresses all areas currently served by the City's wastewater system as well as those expected to be served by the system over a 20-year planning period (by 2036). The facilities plan identifies improvements needed to collect and treat wastewater in the City's sewer service area and provides a capital improvement plan (CIP) to implement the improvements over the next 20 years.

WASTEWATER SERVICE AREA DESCRIPTION

The planning area for this facilities plan is defined as North Bend's Urban Growth Area (UGA), which encompasses about 6 square miles (see Figure ES-1). The UGA consists of the area within the North Bend city limits, the unincorporated area between the city limits and Interstate 90 (I-90), and the Riverbend area south of I-90. Many places within the planning area can be classified as critical areas. The combination of rivers and flat valley floors makes the region prone to extreme flooding and results in the presence of many wetland areas. The entire planning area is in the upgradient region of the East King County Ground Water Management Area. This area is classified as a critical aquifer recharge area with a rating for susceptibility to contamination from human activity of moderately high (Category I) to high (Category II).

The U.S. Environmental Protection Agency (EPA) and Federal Emergency Management Agency (FEMA) have procedures for floodplain management and wellhead protection that must be followed when development may impact a flood hazard area or critical aquifer recharge area. The facilities plan addresses these critical areas in its assessment of current system conditions and recommendations for expansions and improvements.

The City's wastewater system collects and treats wastewater from all sewered areas of the City of North Bend. The newest addition to the service area is at the east end of the city, where Utility Local Improvement District 6 (ULID 6) was formed to finance bringing sewer service to recently annexed areas. The ULID 6 project included installation of sewer pipelines, construction of a new pump station and connection to the existing treatment plant. The project was completed in 2011. There are currently 1,266 residential and commercial sewer accounts. These consist primarily of single-family residences (1,018 accounts), commercial customers (153 accounts), and multifamily residential housing (74 accounts serving an estimated 529 residential units). Other accounts include mixed-use and senior customers. There are no known significant industrial users currently connected to the City's wastewater collection system.

Although North Bend has adopted regulations intended to encourage installation of sewers throughout the City to protect the critical aquifer recharge areas and the City's potable water supply, progress has been slow because of the high cost of new sewers.

Large areas of the City still use on-site septic systems. Such systems provide sewage treatment and disposal for a third of the residential development within the city limits and all residential development outside the city but within the UGA. Some commercial development within the UGA also uses on-site septic systems. It is expected that on-site septic systems will continue to provide a major source of wastewater treatment and disposal in the North Bend planning area in the near future.

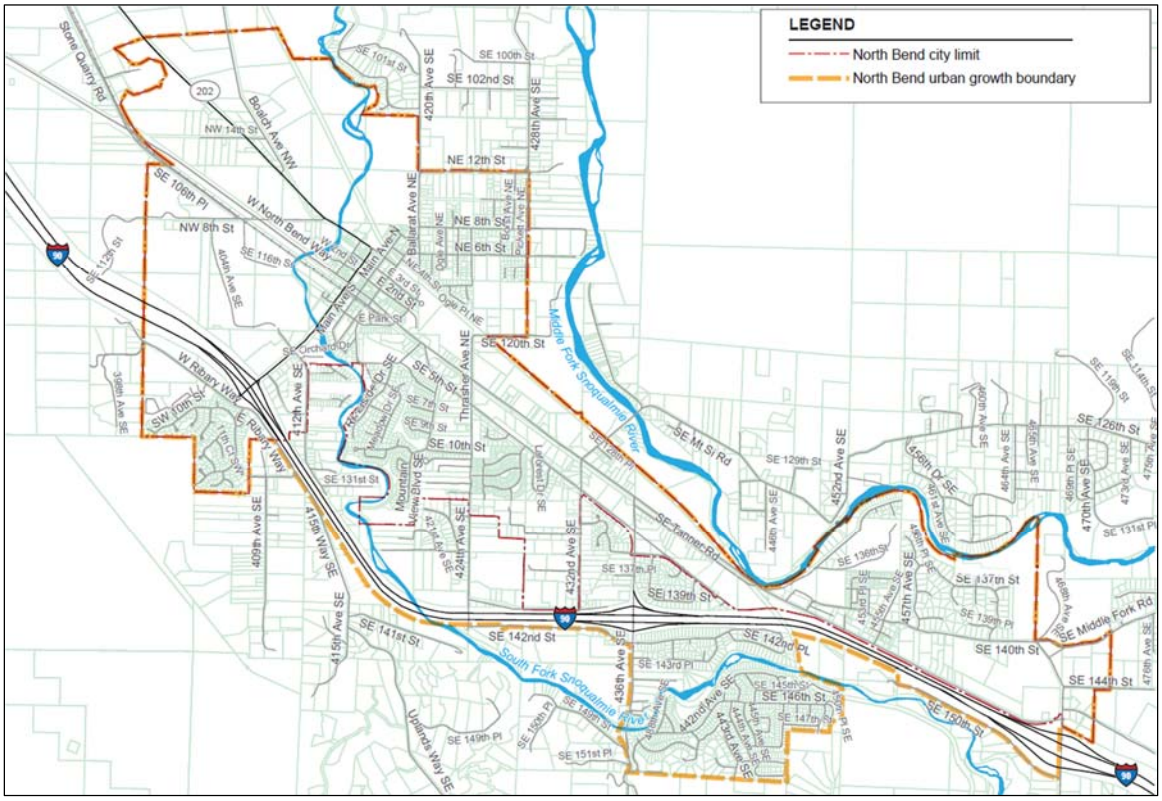


FIGURE ES-1

North Bend Wastewater Facilities Plan Planning Area

The City had an estimated population of 6,296 as 2015. This includes 4,147 residents served by the City wastewater system; the remaining 2,149 residents are served by on-site septic systems with drainfields.

GROWTH PROJECTIONS

Planning for wastewater system future needs requires projections of anticipated growth in the planning area. Such projections determine the expected quantities of wastewater that system facilities need to be able to accommodate over the course of a defined planning period. The following sections describe anticipated changes in land use over the 20-year planning period and the associated growth in population.

LAND USE AND EMPLOYMENT

King County's most recent buildable lands report identifies a housing target of 665 new units for North Bend for 2006 through 2031. Since 2006, the City saw total net new housing of 234 units, so an additional 431 units are needed by 2031 to reach the housing target. As of May 8, 2015, North Bend had approximately 700 single-family, cottage and multifamily units under development review, which means that the City should reach its housing target well ahead of the 2031 projection.

The County's buildable lands report also identifies an employment target of 1,050 new jobs in North Bend for 2006 through 2031. According to the City's 2015 Land Use Element, North Bend has the capacity for 7,092 new jobs. All potential employment zones are within the current city limits.

SEWERED AREA

The following assumptions about sewered area were made for this facilities plan:

- The developed area currently contributing flow to the City sewer system covers 796 acres.
- Sewered area at the end of the planning period is assumed to be 1,255 acres, consisting of the current sewered area plus all 459 acres of available residential area.
- The ultimate future sewered area is assumed to be 2,486 acres, calculated as the entire UGA area minus unzoned areas and areas zoned for parks, open space and public facilities.

POPULATION

The City of North Bend's 2015 population is 6,296 and an additional 2,676 residents live in unincorporated areas of the UGA, for a total planning area population of 8,972. Average population per household is 2.57 residents. City utility records show 1,614 current residential sewer accounts, representing a sewered population of 4,147 – 66 percent of the city population.

Projections of future sewered population in the planning area account for total population associated with overall area growth as well as future connection to the sewer system by existing homes that are now served by on-site septic systems. Table ES-1 and Figure ES-2 show the resulting projections of sewered population. Table ES-1 also shows the projected population at a future time when all residences and businesses in the planning area will be connected to the sewer system.

TABLE ES-1

Population Projections

	2015	2020	2025	2030	2035	2036	Future
Population Within the City Limits							
On Sewer	4,147	5,784	7,454	9,100	10,668	10,968	16,500
On Septic System	2,149	1,740	1,330	921	512	430	0
Total	**6,296**	**7,524**	**8,785**	**10,021**	**11,180**	**11,398**	**16,500**
Population in the Unincorporated UGA							
On Sewer	0	0	138	310	480	514	5,500
On Septic System	2,676	2,813	2,813	2,777	2,742	2,734	0
Total	**2,676**	**2,813**	**2,951**	**3,087**	**3,221**	**3,248**	**5,500**
Total Planning Area (UGA) Population							
On Sewer	4,147	5,784	7,593	9,410	11,148	11,482	22,000
On Septic System	4,825	4,553	4,143	3,698	3,254	3,164	0
Total	**8,972**	**10,337**	**11,735**	**13,108**	**14,401**	**14,646**	**22,000**

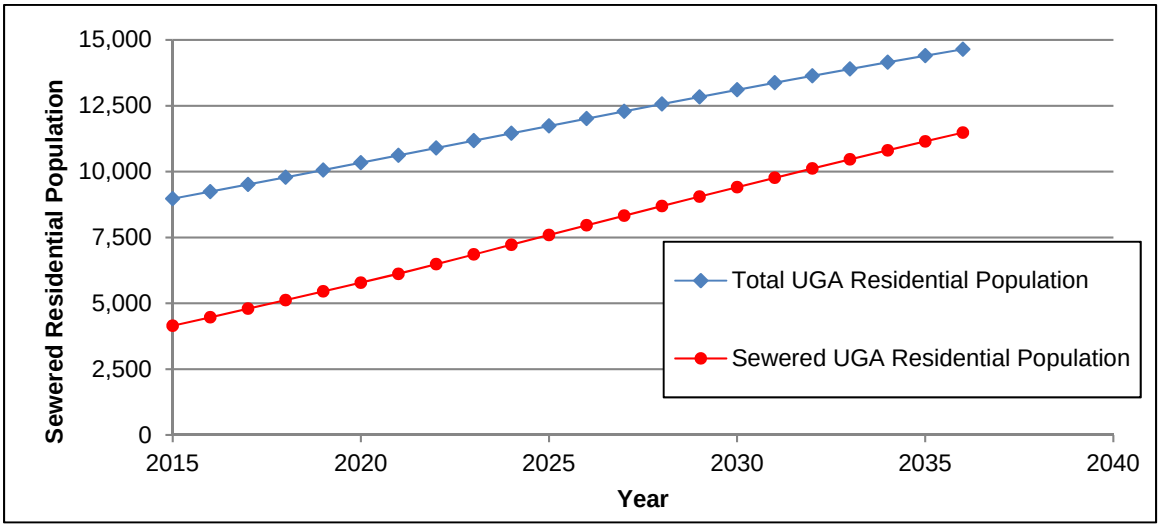


FIGURE ES-2

Projected Annual Population Growth Rate Through 2065

WASTEWATER FLOWS

Wastewater system improvements must be sized to have adequate capacity for the wastewater flows the system is projected to convey and treat over the course of the planning period. System flows consist of base sewage flow from connected customers (residential and commercial) as well as infiltration and inflow into the system from groundwater and stormwater.

EXISTING BASE FLOW

Base wastewater flows includes contributions from residential sources as well as commercial sources. To simplify wastewater planning and ensure consistency, non-residential sources are often estimated as a comparable residential source, using one of the following equivalencies:

- Equivalent residential unit (ERU) – An ERU represents the amount of wastewater contributed by an average residential household in the planning area. A business with wastewater flow equal to twice the wastewater flow from an average residential home would be treated as 2 ERUs.

- Population equivalent (PE) – A PE represents the average amount of wastewater contributed by each resident in the planning area. A business with wastewater flow equal to five times the wastewater flow from an average individual person would be treated as 5 PEs.

Based on City utility account records, North Bend's base wastewater flow is 123 gallons per day per ERU. Sewer flow from non-residential sources is converted to ERUs using this value, and the equivalent sewered population is calculated by dividing the number of ERUs by the average household population of 2.57. The estimated current numbers of ERUs and sewered population are as shown on Table ES-2.

TABLE ES-2

Estimated Current Base Flow in Equivalent Residential Units and Population Equivalents

	Equivalent Residential Units	Sewered Population Equivalents
Residential Subtotal	1,614	4,147
Commercial Subtotal	678	1,743
Total	**2,292**	**5,890**

EXISTING I/I

Infiltration and inflow (I/I) are sources of water other than sanitary sewage entering the sewer system:

- Infiltration is groundwater that enters the system underground, through cracks or joints.

- Inflow is water entering the sewer collection system from street and area drains, catch basins, manhole covers, roof downspouts, and building foundation drains.

I/I is a year-round problem for North Bend. Summer groundwater infiltration is 45 percent of average dry-weather flow to the treatment plant, and winter I/I is 70 percent of maximum-month flow to the plant. North Bend wastewater flows have exceeded EPA standards that define excessive infiltration and excessive inflow.

PROJECTED FUTURE FLOW

Future wastewater flows are estimated using the projections of future population and development in combination with two types of design criteria:

- Unit design criteria define the typical amount of flow from a single "unit" such as a person, household, business, or acre of land.

- Peaking factors define standard ratios between average flows and likely peak values.

The facilities plan establishes unit design criteria and peaking factors based on analysis of historical wastewater flows in North Bend as well as regionally and nationally accepted industry standards for these criteria. Resulting projections of total flow to the treatment plant are presented in Table ES-3. The City must implement a successful I/I control program to achieve these projected future flows. Without a successful I/I program, future flows will be larger and more capacity improvements will be required in the collection system and treatment plant.

TABLE ES-3

Estimated Future Flows to Treatment Plant

Year	Total Sewered Population Equivalent	Dry-Weather Flow (million gallons/day)	Maximum-Month Flow (million gallons/day)	Peak-Day Flow (million gallons/day)	Peak-Hour Flow (million gallons/day)
2015	5,890	0.53	1.19	3.30	4.00
2020	7,792	0.64	1.36	3.64	4.45
2025	9,872	0.76	1.54	4.00	4.94
2030	11,957	0.88	1.73	4.38	5.44
2035	13,945	1.00	1.91	4.74	5.92
2036	14,327	1.02	1.95	4.82	6.02
Future	26,274	1.84	3.15	8.31	10.43

WASTEWATER POLLUTANT LOADS AND WATER QUALITY

Wastewater treatment facilities must have adequate capacity to treat expected pollutant loads to the treatment plant. The North Bend wastewater treatment plant discharges treated effluent to the South Fork Snoqualmie River, and the plant's permit for that discharge (its National Pollutant Discharge Elimination System, or NPDES, permit) establishes limits on the pollutants the plant can put into the river. Understanding the influent wastewater characteristics and pollutant loadings, along with the receiving water quality objectives and effluent limitations, is fundamental for selection of the most appropriate treatment system for the City.

Like wastewater flows, wastewater pollutant loads are projected using projections of future population and development in combination with unit design criteria and peaking factors. The key pollutant loads of interest for planning are biochemical oxygen demand (BOD), total suspended solids (TSS), nutrients (phosphorus and nitrogen), and temperature.

BOD, TSS, NITROGEN AND PHOSPHORUS

Table ES-4 summarizes projected future BOD and TSS loads and concentrations in the treatment plant influent, based on growth projections and selected unit load design criteria. The projections show that growth in the planning area will cause BOD and TSS loads to more than double by the end of the 20-year planning period. The loads of nitrogen and phosphorus will increase in proportion to BOD and TSS loads.

TABLE ES-4

Projected Future Treatment Plant Influent BOD and TSS Loads

Year	Sewered Population Equivalents	Projected BOD and TSS Load (pounds/day) Annual Average	Maximum Month	Peak Day	Projected BOD and TSS Concentration (mg/liter) Dry-Weather Flow	Maximum-Month Flow
2015	5,890	1,178	1,414	1,885	267	119
2020	7,792	1,558	1,870	2,494	291	137
2025	9,872	1,974	2,369	3,159	311	153
2030	11,957	2,391	2,870	3,826	324	166
2035	13,945	2,789	3,347	4,463	334	175
2036	14,327	2,865	3,438	4,585	335	176
Future	26,274	5,255	6,306	8,408	343	200

The NPDES permit sets a maximum limit for the total load of these pollutants allowed into the river, as well as a minimum limit for how much the plant's treatment processes should reduce the influent concentration of these pollutants. At the projected influent concentrations of BOD, TSS and nitrogen, a well-run conventional secondary treatment plant should be able to comply with the existing and future permit requirements. Chemical addition will be required in the near future to remove soluble reactive phosphorus to meet a limit of 2 to 3 pounds per day for the maximum day and 1 to 1.5 pounds per day as a monthly average during from August through October; these limits are in accordance total maximum daily load allocations for the Snoqualmie River established in 1994.

TEMPERATURE

The 2011 *Snoqualmie River Temperature Total Maximum Daily Load* report established effluent temperature load allocations for the North Bend wastewater treatment plant discharge to the South Fork Snoqualmie River. The report concluded that the North Bend treatment plant would not require mitigation until effluent flow approaches 0.81 million gallons per day, provided that the temperature of the effluent remains at 22 degrees C. The report noted that if effluent temperature were to increase to 23 degrees C, then mitigation would be needed when effluent flow during the critical period reaches about 0.70 million gallons per day.

PERMITS, REQUIREMENTS AND REGULATIONS

Federal, state, and local regulations drive much of the decision-making for wastewater facilities planning. The following were key to development of this plan.

Federal Regulations and Guidelines

- National Pollutant Discharge Elimination System (NPDES) permits regulate point discharges into water.
- The Clean Water Act requires publicly owned wastewater treatment facilities to provide at least secondary treatment and sets standards for effluent quality.
- Federal standards apply to sewage sludge from wastewater treatment plants.
- The EPA outlines requirements for wastewater treatment plant equipment reliability.
- The EPA's Capacity, Management, Operation, and Maintenance program outlines recommended guidelines for wastewater system practices to reduce sewage overflows.

State Policies and Regulations

- Washington's Water Quality Standards for Surface Waters define water quality criteria for each segment of the Snoqualmie River.
- Total maximum daily load studies for the Snoqualmie River have established limits on discharges to the river and its forks, based on temperature, ammonia, fecal coliform, biochemical oxygen demand and phosphorus (the phosphorus limits have not yet been established). Specific numerical limits are assigned for discharges by the City of North Bend.
- The Washington Department of Ecology oversees the NPDES permitting of the City of North Bend wastewater treatment plant. The current permit was issued in May 2013 and will be renewed in 2018.
- The state has its own standards for water reclamation, use and disposal of sludge, treatment plant equipment reliability, and septic systems.

Local Policies

- The City of North Bend municipal code requires that sewers be installed for all new or revised development in the city, except in special situations, and that homes with failing septic systems connect to sewers if available within 200 feet. The municipal code also sets regulations relating to critical areas, stormwater management, shoreline protection, and building structural and fire safety that will apply to work proposed in this facilities plan.
- The City's Comprehensive Plan recommends that the City adopt policies preventing land uses that could adversely affect groundwater in any way that would jeopardize the existing and future quality of the drinking water supply.
- North Bend voluntarily participates in FEMA's Community Rating System, a program that provides reduced federal flood insurance premiums in communities that adopt optional floodplain management measures. The City's wastewater treatment plant is located in a mapped floodplain.

This facilities plan determined "excessive thermal load" as the amount of thermal loading, in British thermal units (BTU), that would cause a rise in river temperature of 0.3 degrees C or more (0.3 degrees C is the plant's "thermal load allocation"). The projections indicate that 2019 is the first year that the peak instantaneous thermal load will reach the thermal load allocation at some point during the day. By 2035, the projected thermal load exceeds the thermal load allocation from about 10:00 a.m. until 10:00 p.m. The facilities plan provides estimates of quantities of effluent that can be stored during the hottest part of the day to avoid excessive temperature loading to the river.

WATER QUALITY CRITERIA

Water quality criteria establish maximum concentrations of toxic pollutants that are allowed to be present in a river at the edge of an outfall mixing zone (the region of the river around the outfall where initial dilution of the effluent with river water occurs). Ecology spreadsheets were used to evaluate future North Bend treatment plant effluent dilution in the receiving water, the South Fork Snoqualmie River. The results indicate that there is no reasonable potential for violation of water quality standards for the 2036 effluent flows. Therefore, it is not expected that effluent limits will be established for these toxic constituents.

WASTEWATER COLLECTION SYSTEM

EXISTING FACILITIES

The existing North Bend sanitary sewer collection system has seen progressive expansion since the first sewer facilities were constructed in early 1950s. By 2001, when a previous City sewer plan was prepared, the collection system almost doubled in size. This expansion took place east and south of the city's core area. The most extensive additions were in the commercial area west of the South Fork Snoqualmie River adjacent to the South Fork/I-90 Interchange. These improvements include the South Fork Lift Station and its force main over the Snoqualmie River, also serving the North Bend Premium Outlets mall and the Nintendo distribution center. The City formed ULID 6 in 2007 to expand the collection system in the Tanner and Truck Town areas. As part of the ULID 6 expansion, a new influent pump station was constructed adjacent to the City wastewater treatment plant. Today, the City is served by 27 miles of sewer, 1.1 miles of force mains, and four lift stations (see Figure ES-3):

- **South Fork Lift Station –** The South Fork Lift Station was constructed in 1986 at the southeast corner of the intersection of Bendigo Boulevard South and South Fork Way SW. Its force main follows Bendigo Boulevard, crosses the South Fork of the Snoqualmie River attached to the road bridge, and discharges to a sewer just north of the bridge.

- **Snoqualm Lift Station –** The Snoqualm Lift Station is in the roadway at the intersection of Snoqualm Place and NE 8th Street. It serves 14 houses on Snoqualm Place. It is equipped with two grinder pumps.

- **Nintendo Lift Station –** The Nintendo Lift Station is a private station owned and operated by Nintendo. It was intended to be a temporary lift station that would be abandoned when gravity sewers are installed in the future to serve the Meadowbrook area. This lift station is on the Nintendo distribution center property and provides service to that facility. It pumps flow through a force main discharging to a gravity sewer adjacent to the North Bend Premium Outlets.

- **E.J. Roberts Park Lift Station –** The E.J. Roberts Park Lift Station serves the restroom facilities at the park. The lift station has a single grinder pump. Its force main conveys discharge to a manhole at the intersection of Thrasher Avenue NE and NE 4th Street.

On-site septic systems currently provide sewage treatment and disposal for about a third of the residential development within the city limits and all residential development in the UGA outside the city limits. The City has not inventoried or mapped the location of septic systems in North Bend, but any development with no mapped sewer nearby can be assumed to be serviced by on-site septic systems. The largest developed area in the city that is currently unsewered is the Silver Creek neighborhood. Because of the environmental contamination that can result when septic systems fail, the City of North Bend has adopted measures requiring sewer service for almost all new development and conversion to sewer service for properties where septic systems have failed.

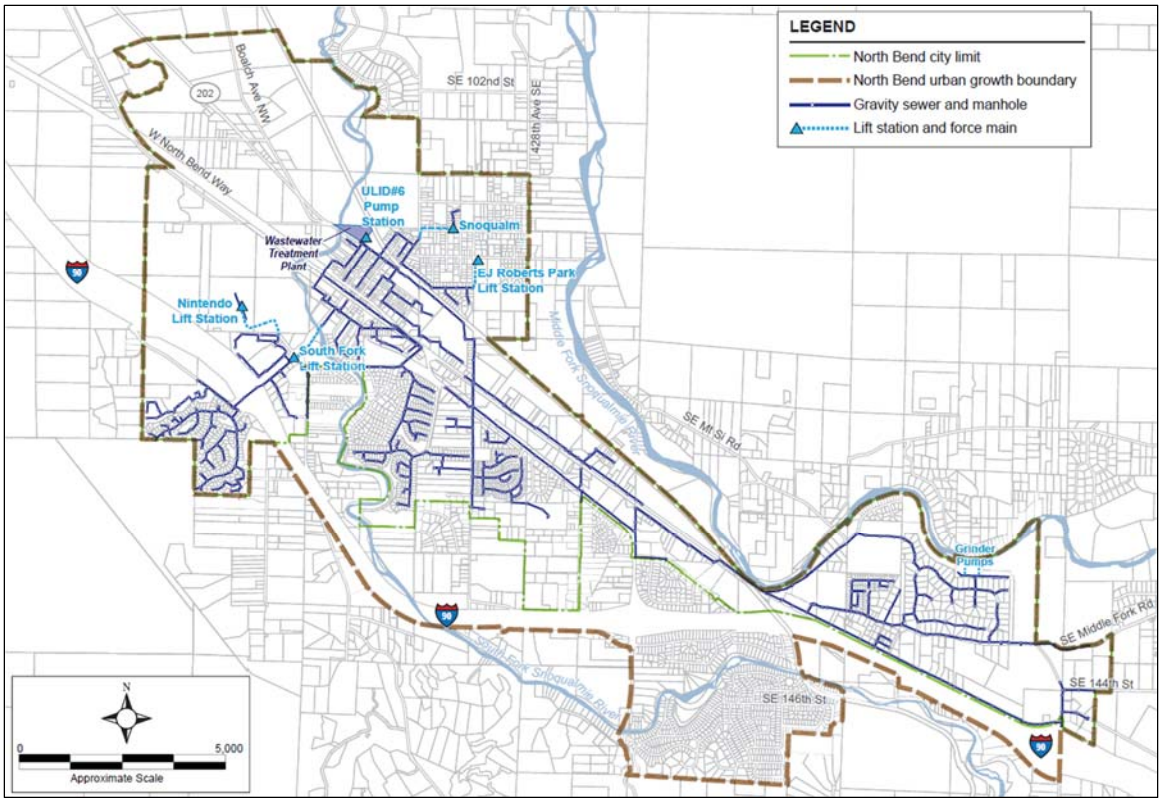


FIGURE ES-3

Existing City Collection System

SYSTEM CONDITION EVALUATION

The following deficiencies have been identified at the wastewater collection system lift stations:

- **South Fork Lift Station –** Testing has indicated that the pumps at this lift station are not providing the full capacity the station was designed for. Access to the station's drywell is via a small-diameter manway with a 20-foot vertical ladder and no landing. This needs to be upgraded with a new concrete stairwell with landings. The wet well and dry well ventilation system is inadequate, and there are strong foul odors at the station. The standby power and pump controls need to be coordinated for reliable operation when power fails. The station needs to be outfitted for bypass pumping. The existing force main is nearly 40 years old and it conveys sewage from the pump station over the South Fork River on an existing bridge to the gravity collection system serving the core area. A condition assessment of the pipeline is recommended prior to upgrading the station.

- **Snoqualm Lift Station –** The Snoqualm Lift Station is in fair condition and generally functions well. It is in a poor location in the roadway intersection. The control panel is in a planter strip below waist level, requiring operators to kneel to access the controls. Improvements are needed to provide status information to the SCADA (supervisory control and data acquisition) system. The station should also be equipped with station bypass piping and fittings.

- **Nintendo Lift Station –** The Nintendo Lift Station is operated and maintained by Nintendo. Any failures or issues at the station are currently handled by Nintendo staff. No deficiencies have been reported for this station by City staff.

- **E.J. Roberts Lift Station –** The E.J. Roberts Lift Station is in fair condition and has generally functioned well since installation. Following a mechanical failure in spring 2016, the grinder pump unit was replaced and the station has continued to function well since then.

No sanitary sewer overflows were reported in the collection system in 2014 or 2015. One overflow, of less than 50 gallons, occurred on January 20, 2016. This event did not occur during a storm and was addressed by local maintenance of the sewer. Areas of the collection system considered most vulnerable to overflow were inspected during and after severe storm and flow events in the winter of 2015 to 2016, and no evidence was found of severe surcharge or overflow.

INFILTRATION AND INFLOW

Treatment plant flow data indicate that significant levels of infiltration and inflow enter the sewer system year-round. I/I is most severe during winter wet weather when rain is falling heavily, groundwater is at or near the ground surface level, and shallow side sewers are submerged in groundwater. Plant flows and I/I reached new highs in November and December 2015. Infiltration is also significant during dry weather, with about half of the average plant flows in the summer attributed to groundwater leaking into deep mainline sewers. The City has not thoroughly studied the sources or conducted flow measurements or spot inspections for I/I since the I/I improvements in 1998 and 2003. In 2015, the City identified areas where stormwater ponded over sanitary sewer manholes. Some of these manholes may represent significant sources of inflow. The South Fork Lift Station basin probably has the highest level of I/I. The core area where original sewers or side sewers have not been rehabilitated probably has the next highest level of I/I.

CAPACITY ANALYSIS

A computer modeling analysis of the wastewater collection system was performed for the facilities plan. For existing-condition peak wet-weather flows, the model found that no City sewers are under capacity as long as there is no backwater condition at the treatment plant's influent pump station (the ULID 6 Pump Station). If water is high in the wet well of the ULID 6 Pump Station, creating a backwater effect, then surcharging may occur in some sewers, though no overflows are predicted by the modeling.

With projected 2036 peak wet-weather flows and full connection of the service area, the existing system has a relatively low risk of experiencing capacity limitations. The magnitude of flow in the collection system is highly dependent on the location and type of future development, so future flows may deviate from the model predictions. It is recommended that periodic review and monitoring of collection system flows be undertaken to confirm that peak flow can be accommodated without risk of overflows.

RECOMMENDED IMPROVEMENTS

Based on the assessment of existing conditions and future requirements for the collection system, improvements were identified to ensure that the collection system meets the City's needs through the end of the 20-year planning period. Four types of improvements were identified:

- **I/I Flow Reduction –** Based on this cost-effectiveness assessment, it is recommended that the City incorporate I/I rehabilitation into its annual operation and maintenance program. The annual program should focus initially on the most promising opportunities for controlling I/I. Later tasks would include flow monitoring to confirm how I/I is spread across the City and assess the effectiveness of I/I reduction measures.

- **Lift Station Upgrades –** At the South Fork Lift Station, pumps should be repaired or replaced, dry well access should be improved, ventilation should be improved, odor control should be provided, the control system should be upgraded, and provisions should be made to allow for bypass pumping. Any pump station capacity upgrade should be coupled with an upgrade of the force main, surge protection, or both. The condition of the existing force main from the South Fork Lift station should be evaluated, particularly the steel pipe section on each side of and on the Bendigo Boulevard bridge. The Snoqualm Lift Station should be improved with radio telemetry, backup power, provisions for bypass pumping, and a relocated control panel.

- **Extensions to Unsewered Areas –** Within the city limits, any existing unsewered development that experiences failures of on-site septic systems will need to transition to sewer service to protect public health and the

environment. In wellhead protection areas, given the particular risks to drinking water supplies, conversion of on-site systems to sewers may be warranted regardless of whether onsite system failures have occurred. The City is currently evaluating the need for special requirements for wellhead protection areas. In unincorporated areas of the UGA, sewer service will be extended as a result of annexation requests to serve development.

- **Improved Operation and Maintenance (O&M) –** The collection system O&M program should be updated to include regular programs of inspections, cleaning, flow monitoring, and the I/I reduction measures described above.

WASTEWATER TREATMENT PLANT EVALUATION

The City of North Bend wastewater treatment plant is located on the bank of the South Fork of the Snoqualmie River by State Route 202 (Bendigo Boulevard North). The plant uses an oxidation ditch for treatment and discharges treated and disinfected effluent to the South Fork of the Snoqualmie River. Figure ES-4 shows the current plant site.

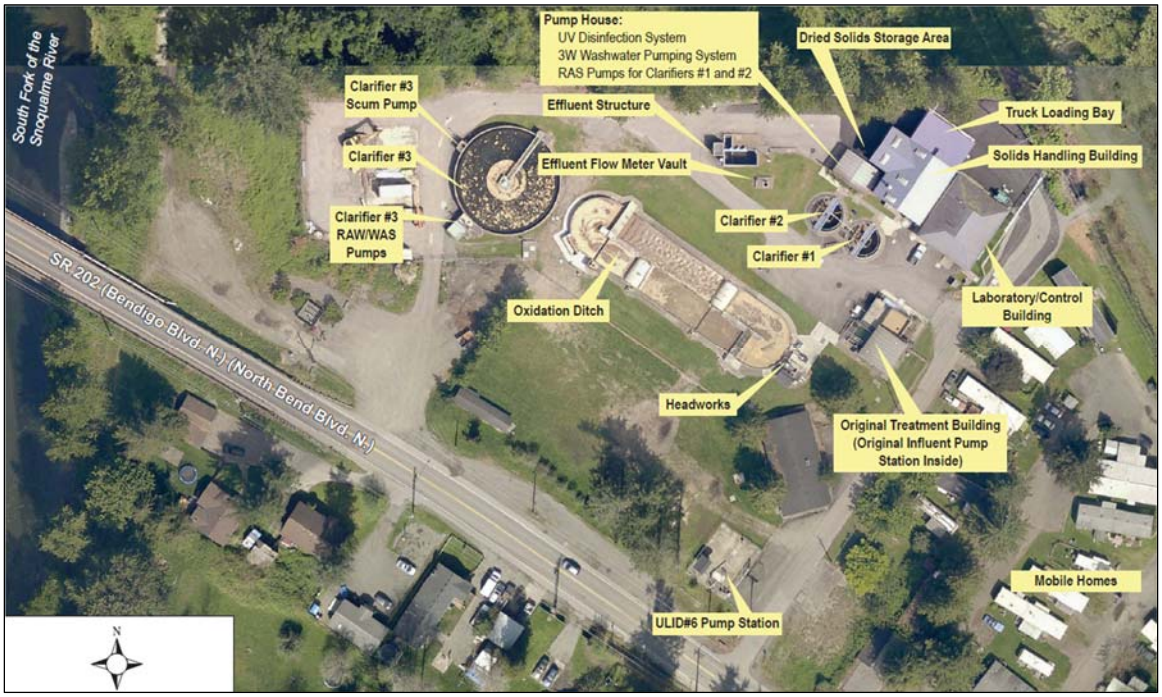


FIGURE ES-4

North Bend Wastewater Treatment Plant Site

Current processes for the liquid stream at the wastewater treatment plant are as follows:

- Wastewater enters the ULID 6 Pump Station, which serves as the plant's current influent pump station, through a pipe from a manhole (MH-A) on Bendigo Boulevard North.

- The plant's original influent pump station (IPS) receives sewage from mobile homes next to the plant, storm drainage from the southeast section of the plant, recycle flow from pumps in the Solids Handling Building, and excess collection system flows that exceed the capacity of the ULID 6 Pump Station.

- The original IPS force main is connected to the ULID 6 Pump Station force main just upstream of the current headworks facility. The combined raw wastewater flows are discharged to the north channel of the headworks, which features a mechanical fine screen to remove screenings entering the plant and a washer/compactor to remove water so that the screenings can be disposed of as solid waste.

- The headworks south channel receives return activated sludge (RAS) from the main secondary clarifier (Clarifier 3). This channel features a manual bar screen for screening of the RAS flows.

- Screened wastewater and RAS continue to the oxidation ditch, which is aerated by four brush rotors.

- Mixed liquor from the oxidation ditch normally is conveyed over two adjustable outlet weirs on the oxidation ditch to the 80-foot-diameter Clarifier 3. During peak flow events or in the event of a failure of Clarifier 3, mixed liquor can also be diverted to two older, smaller clarifiers (Clarifiers 1 and 2).

- Secondary effluent from the clarifiers is combined and conveyed to UV reactors for disinfection.

- Most of the disinfected effluent leaves the plant through a 21-inch reinforced concrete outfall pipe from the effluent structure, except for a small quantity that is recycled as non-potable plant reuse water.

Current processes for the solids stream at the wastewater treatment plant are as follows:

- A pump station next to Clarifier 3 pumps RAS from the clarifier to the headworks influent channel, where a slide gate prevents the RAS from mixing with raw influent. The headworks discharges the screened RAS back to the oxidation ditch.

- A pump station next to Clarifier 3 pumps waste activated sludge (WAS) to an aerated sludge holding tank.

- A centrifuge in the Solids Handling Building dewaters the WAS from the aerated sludge holding tank. The sludge cake produced is conveyed to a disposal container or truck for transport to a disposal site or to an off-site location for further treatment and/or reuse.

- As of this year (2016)^{R}, the City has been conveying dewatered sludge to containers to be transported off site for disposal at a landfill; the City previously heat dried the sludge to produce Class A biosolids, but has discontinued this process because of reliability, odor, safety and operating cost concerns and problems with excess heat in the treatment plant's effluent.

OVERALL TREATMENT PLANT CAPACITY

Table ES-5 compares the hydraulic and treatment process capacities of the plant to current flows and loads. The existing overall treatment plant flows and loads are all well below the plant's design capacity, and flow projections developed for this facilities plan do not show total flows exceeding design capacities for nearly 10 years. However, due to various condition deficiencies, not all processes at the plant are currently achieving their design capacity. These deficiencies and potential solutions are addressed in the individual process evaluations provided in the facilities plan.

TABLE ES-5

Wastewater Treatment Plant Hydraulic and Treatment Process Capacity

Flow	Treatment Plant Capacity	Existing Flow or Load
Dry-Weather Flow (mgd)	1.26	0.53
Annual Average Flow (mgd)	1.67	0.77
Maximum-Month Flow (mgd)	2.58	1.19
Peak-Day Flow (mgd)	4.48	3.11
Peak-Hour Flow (mgd)	5.10	3.8
Maximum Month BOD Load (ppd)	2,805	1,414
Maximum Month TSS Load (ppd)	2,304	1,414

WASTEWATER TREATMENT PLANT PERMIT COMPLIANCE

The NPDES permit specifies limits for treatment plant influent flow, BOD load and TSS load. Based on the projections developed for the facilities plan, the limits are not expected to be exceeded before the following timeframes:

- Maximum-month flow is projected to reach the permit limit after 2036.

- Maximum-month BOD load is projected to reach the permit limit in 2029 or 2030.

- Maximum-month TSS load is projected to reach the current permit limit in 2024 or 2025. However, the 2018 permit renewal is expected to include higher limits, which the plant is projected to reach in 2029 or 2030.

The North Bend wastewater treatment plant's discharge monitoring reports from 2011 through 2015 were reviewed to assess the plant's recent record of compliance with the NPDES permit requirements for effluent:

- **BOD and TSS –** BOD and TSS effluent concentrations and loads were below the limit every month in the period analyzed. The permit's 85 percent monthly BOD and TSS removal requirements were achieved in all but 3 months.

- **Fecal Coliform Bacteria –** The plant has met effluent fecal coliform permit limits consistently since 2011.

- **pH –** There was one instance during the review period in which pH measurement was outside the permits limits.

- **Total Oxygen Demand –** Effluent nitrogenous + carbonaceous biochemical oxygen demand is listed in the NPDES permit as the indication of oxygen demand in the effluent discharge. The plant has met the permit limits consistently since 2011.

- **Phosphorus –** Soluble reactive phosphorus limits have been proposed but not yet established. The phosphorus effluent loads have been well above the proposed limits every month except one in the period analyzed.

INDIVIDUAL TREATMENT PLANT PROCESSES

Based on an assessment of each process at the treatment plant, the following key deficiencies have been identified:

- **ULID 6 Pump Station –** This station's small pump failed shortly after startup in 2009 for unclear reasons, and it failed again almost immediately after being repaired. The electrical control panels, which are installed above ground, are in a location susceptible to flood damage.

- **Headworks –** Headworks performance during high flows has indicated that the mechanical screen does not provide its design capacity. The headworks slide gate interferes with maintenance access to the influent mechanical fine screen.

- **Oxidation Ditch –** New instrumentation and programming is needed for the aeration system. Two rotors are under bridge walkway structures that do not contain splashing from the rotors; they also are old and deteriorating, with peeling paint. Splashing of the uncovered rotors presents a health risk as well as aesthetic issues. Rotors 201 and 202 still have the original baffles, which have a much lower efficiency of oxygen transfer than the new baffles installed in 2006 on Rotors 203 and 204.

- **Clarifier 3 –** The clarifier drive failed in 2015 and emergency repairs were made to keep it in service. Permanent improvement is still needed. Liquid clarifier effluent is not screened, and grease balls and large debris that leave the clarifier are believed to have broken lamps in the UV system. An additional large clarifier is needed to enable the City to take Clarifier 3 out of service for maintenance, to meet Ecology's reliability requirements, and to maintain good clarifier performance during peak flow events.

- **Clarifiers 1 and 2 –** Because they have been used only sporadically as backup units since Clarifier 3 was installed, the clarifiers are in poor condition and need significant maintenance.

- **UV Disinfection –** UV disinfection system has not always performed well, and a third reactor is needed to provide reliable disinfection.

- **Effluent Structure –** The outfall has higher head loss than expected, and effluent pumps are needed now, unless the head loss at the outfall can be reduced. The structure also has experienced overflows during extreme wet-weather events.

- **Outfall –** The outfall pipe in the past has accumulated grease and sediment. The diffusion structure has become partially filled with sediment and debris, and plant effluent has overflowed out the top of the structure.

- **Sludge Holding and Digestion –** The sludge holding tank is old, small and difficult to operate. The tank has overflowed on occasion, because the submerged section of the overflow pipe in the old influent pump station wet well becomes plugged with grease and solids. Attempts to remove the grease from the pipeline have failed, and the control system does not trigger an alarm or shut off the flow of waste sludge into the tank when the

tank is full. The tank can store waste sludge for only a few days, which is too little time for flexibility in scheduling sludge wasting and too little time for sludge digestion.

- **Dewatering –** The centrifuge is too small and requires too much operator attention. It needs to be completely rebuilt or replaced for reliable operation.

- **Dewatered Sludge Loading Station –** Excessive foul odors are released as sludge is dropped into the transfer containers at the sludge loading station.

- **Dryer –** In the spring of 2015, the plant discontinued the use of its thermal sludge dryer due to maintenance and reliability issues and adverse thermal impacts on the treatment plant effluent. The City is not likely to operate the sludge dryer in the future.

- **Buildings –**
  - The Original Treatment Building, which houses the original IPS, is the oldest building on the treatment plant site. It has been modified many times and is at the end of its useful life.
  - The laboratory/control building is sufficient for the current plant and staff, but expanded facilities will be needed if plant capacity and staffing are increased.
  - The Pump House, which houses the UV disinfection system and the RAS/WAS pumps for Clarifiers 1 and 2, has significant structural deficiencies. The concrete south wall is severely cracked and leaning.

- **Flow Measurement and Sampling –** The existing wastewater samplers need modifications to reliably obtain representative samples of treatment plant influent and effluent. The 8-inch effluent flow meter is too small and has excessive head loss for high flows.

- **Original Influent Pump Station –** The original IPS is old and in poor condition. Current pump capacity is less than 50 percent of the rated capacity. Improved ventilation is needed at the wet well and pump room.

- **Recycle Flows –** The Solids Handling Building Pump Station pumps recycle flows (centrifuge centrate and RAS from the small clarifiers) to the original IPS, which in turn pumps the recycle flows to the headworks. These recycle flows contribute to overloading at the headworks. A better approach would be keep these flows out of the original IPS and headworks by routing them directly to the oxidation ditch.

- **Standby Power –** The standby power system is marginal. The existing 250 kW generator was installed in 1979 and is at the end of its expected service life. It should be replaced soon for reliable service. Additional standby power is needed for reliable plant operation.

- **SCADA –** The SCADA system has extensive deficiencies.

TREATMENT PLANT SITE

The treatment plant site has limited buffering from the neighboring community. It is highly visible from adjacent roads and is not aesthetically pleasing. There is little or no landscaping to screen the site from view. Old equipment and utility supplies are stored on the grounds next to several storage sheds. The plant buildings are basic low-cost structures added to the site as needed. An old youth activity center building on the site is vacant and unused since it was damaged during a flood. The plant stormwater system does not meet current standards for stormwater management. The improvement plan includes upgrading the plant stormwater system for the WWTP site to achieve compliance with Ecology's Stormwater Management Manual for Western Washington including the 2014 revisions and the 2016 King County Surface Water Design Manual.[R]

Treatment plant facilities must be built above expected 100-year flood levels. Wastewater treatment plant record drawings indicate that some, but not all, structures at the plant are sufficiently above predicted flood levels.

TREATMENT PLANT IMPROVEMENTS

Based on the assessment of existing conditions and future requirements for the facilities at the wastewater treatment plant, alternatives were identified and evaluated for improving the plant to ensure that it meets the City's needs through the end of the 20-year planning period. Three evaluations were performed:

- An assessment of treatment plant outfall location options to facilitate water quality and permit compliance.

- A review of options for reusing or disposing of biosolids generated at the treatment plant to meet state biosolids management standards and achieve conformance under Washington's general permit for biosolids.

- An evaluation of plant-wide combinations of improvements based on alternative choices of plant location and secondary treatment technology.

OUTFALL RELOCATION

Consideration was given to selecting a new outfall location on the Middle Fork or main stem Snoqualmie River for effluent discharge from the existing treatment plant site. A

new outfall at either of the identified new locations would have the same effluent limits as the existing South Fork outfall, except for temperature and phosphorus. The assessment of these alternative locations found that they would not significantly reduce treatment costs, because the effluent limits would generally be the same as for the existing outfall. Based on this initial screening, no alternative outfall locations are recommended.

BIOSOLIDS PROGRAM OPTIONS

The City needs to upgrade its biosolids program as soon as possible. Ecology approved the City's current program, which disposes of dewatered unstabilized sludge in a landfill, only as an interim measure when the City's sludge dryer failed in 2014. Moreover, the existing biosolids facilities release significant foul odors and cause odor complaints in large areas of the City. Based on a screening of three approaches, the facilities plan recommends that the City implement Class B aerobic digestion and land application of biosolids as the most efficient and economical way to reduce foul odors at the plant site and comply with Ecology requirements.

PLANT-WIDE IMPROVEMENT ALTERNATIVES

Five plant-wide improvement alternatives were developed for evaluation. Each would meet the City's treatment needs through 2036, with flexibility to expand the plant for future needs after 2036. Each alternative is distinguished by the treatment plant location and type of secondary treatment technology.

- Alternative 1 – Expand Oxidation Ditch on Existing Site
- Alternative 2 – New Activated Sludge Plant on Existing Site
- Alternative 3 – New Advanced-Technology Biological Treatment Plant on Existing Site
- Alternative 4 – New Oxidation Ditch Plant at New Site
- Alternative 5 – Regional Plant at Snoqualmie

Each alternative includes phasing, with projects to address existing needs in Phase 1 and projects to meet future demand through the planning period in Phase 2. Planning level capital cost estimates for the treatment plant alternatives are presented in Table ES-6. Alternatives 3, 4 and 5 have significantly higher total capital costs than Alternatives 1 and 2. Alternative 3 is expensive because it uses a more expensive treatment process. Alternatives 4 and 5 are expensive because they have significant conveyance costs to transport North Bend wastewater to a new site.

TABLE ES-6

Planning-Level Capital Cost Estimates for Treatment Plant Alternatives

	Alt. 1 – Oxidation Ditch, Existing Site	Alt. 2 – New Plant, Existing Site	Alt. 3 – Advanced Treatment, Existing Site	Alt. 4 – Oxidation Ditch, New Site	Alt. 5 – Oxidation Ditch, Snoqualmie
Subtotal Treatment Facility Phase 1	$14,154,000	$16,457,000	$84,729,000	$28,794,000	$28,236,000
Subtotal Treatment Facility Phase 2	$5,480,000	$6,450,000	$1,260,000	$950,000	—
Subtotal Conveyance to New Site	—	—	—	$20,600,000	$21,800,000
Total Capital Cost	**$19,634,000**	**$22,907,000**	**$85,989,000**	**$50,344,000**	**$50,036,000**

Alternatives 1 and 2 would have lower implementation costs, because only about 73 percent of the improvements would be implemented in Phase 1, with the remaining 27 percent deferred about 10 years to Phase 2. Alternatives 3, 4 and 5 would require almost 100 percent of the improvements to be constructed immediately in Phase 1. Based on this cost comparison, Alternatives 3, 4 and 5 were dismissed from further consideration and Alternatives 1 and 2 were carried forward for a life cycle cost comparison.

A simplified analysis of O&M costs was developed that compares only the O&M for components that differ between Alternatives 1 and 2, that is for grit, aeration basin and cooling systems. The average annual O&M costs based on this analysis are presented in Table ES-7. These estimates indicate that Alternative 2 would have about 50 percent higher O&M costs for these systems.

TABLE ES-7

Simplified O&M Cost Comparison for Alternatives 1 and 2

	Alt. 1 – Expand Oxidation Ditch, Existing Site	Alt. 2 – New Activated Sludge Plant, Existing Site
Estimated Annual O&M, 2020 to 2028	$46,750	$72,400
Estimated Annual O&M, 2029 to 2036	$93,400	$160,900

The O&M cost estimates indicate that Alternative 2 would average $25,700 per year more than Alternative 1 from 2020 to 2028 and $67,500 per year more from 2029 to 2036. The 2016 present worth of these extra O&M costs is estimated to be $516,000, assuming a 3 percent interest rate. This indicates a total present worth for Alternative 2

that is $3.79 million higher than that of Alternative 1, $3.27 million higher capital cost and $516,000 higher present worth of O&M.

RECOMMENDED PLAN

This recommended plan for upgrading wastewater facilities in the City of North Bend covers collection system and treatment plant improvements in two phases. Phase 1 covers the period from 2016 to 2020, and Phase 2 covers the period from 2020 to 2036. The recommended improvements will provide reliable operation and capacity through the end of the planning period in 2036.

COLLECTION SYSTEM IMPROVEMENTS

The following improvements, to be implemented by 2018, are needed to address deficiencies at the South Fork and Snoqualm Lift Stations:

- **South Fork Lift Station**
  - Control system upgrade, integration with wastewater treatment plant
  - Pump control programming and integration with automated transfer switch
  - Predesign study to verify upgrade requirements
  - Pump upgrade
  - Upgrades to dry well entry, personnel and equipment access
  - Wet well and dry well ventilation system and foul air treatment
  - Provision for bypass pumping

- **Snoqualm Lift Station**
  - Radio telemetry system, integrated with wastewater treatment plant control interface
  - Uninterruptible power supply for instrumentation and radio telemetry system
  - Control panel upgrade to meet code
  - Provision for bypass pumping

The collection system is projected to provide service to 80 percent of all currently unsewered development within the city limits by 2036 and into any areas of the UGA that become annexed to the city. Local improvement districts and developer extensions will likely be the primary methods of extending sewer service to currently unsewered or unconnected development in the city. Financial aid, grants and hardship funding may be available to reduce the cost of installing sewers in some neighborhoods.

There are three existing privately owned, operated, and maintained individual household grinder pump stations in the City service area that discharge to the City's wastewater

collection system. The Washington State Department of Ecology has determined that private ownership, operation, and maintenance of these grinder pump stations is not consistent with WAC 173-240-104. The City, in turn, will modify its municipal code for development so that all individual residence grinder pump stations will be owned, operated, and maintained by the City including any easements required for access for routine maintenance and replacement. In addition, the City will diligently pursue acquiring ownership and assuming responsibility for operation and maintenance for the three existing grinder pump stations before 2020.[R]

In addition, it is recommended that the City incorporate I/I rehabilitation into its annual operation and maintenance program, as the most economical way to address I/I at this time. The annual program should focus initially on the most promising opportunities for controlling I/I. The City will implement appropriate corrective action to address the three known significant defects in the collection system by 2020.[R] Later tasks would include flow monitoring to confirm how I/I is spread across the City. Subsequent work would focus on the most promising I/I control areas. A key goal is to clarify what level of I/I control is cost-effective in North Bend so the City can make informed decisions when future capacity-enhancing upgrades are being considered.

WASTEWATER TREATMENT PLANT IMPROVEMENTS

Alternative 1 is the recommended treatment plant improvement alternative. The Phase 1 improvements will upgrade the plant so it can reliably treat the wastewater flows and loads authorized in the current NPDES permit. The Phase 2 improvements will increase plant capacity for conditions expected in 2036 and beyond. Improvements are summarized in Table ES-8.

TABLE ES-8

Treatment Plant Components of Recommended Plan

Process	Improvement
Phase 1	
ULID 6 Pump Station	Replace the small pump and reprogram the pump station to improve peak-flow capacity. Install a bar screen, flow baffle and isolation gate in the wet well to protect the pumps and improve maintenance access. Raise the electrical and control panel approximately 4 feet.
Headworks	Construct a new headworks with two channels for mechanical screens and one channel for a manually raked bar screen. Install the mechanical screen at the existing headworks in one of the new mechanical screen channels. Provide odor control. The unused former youth activity center building at the site of the new headworks will be demolished.

TABLE ES-8 (continued)

Treatment Plant Components of Recommended Plan

Process	Improvement
New Oxidation Ditch	Construct a new 15-foot-deep oxidation ditch with brush aerators.
New Clarifier	Construct a second 80-foot-diameter clarifier, similar to existing Clarifier 3. Construct a splitter box to route mixed liquor from the new oxidation ditch to the clarifiers.
Existing Clarifier 3	Replace the clarifier drive, regrout the clarifier floor, install a screen to reduce floatables in effluent, and reroute the Clarifier 3 RAS force main to discharge to the new oxidation ditch.
New UV/Effluent Building	Construct a new UV/Effluent Building to replace the structurally deficient existing Pump House. The new UV/Effluent Building will house the UV system, new effluent flow measurement and pumping systems, control valve to divert excess warm effluent to storage, and the relocated 3W water system.
UV Disinfection	Rebuild the existing UV disinfection system and install it in a new UV/Effluent Building. Install a third UV unit for reliability. Incorporate the UV system into the SCADA system.
Effluent Pumping	Install two new effluent pumps in the new UV/Effluent Building to discharge peak flows to the South Fork Snoqualmie River outfall during high-flow conditions.
Effluent Flow Metering	Install a larger effluent flow meter and the existing effluent flow meter in the new UV/Effluent Building, with electric actuator valves.
Outfall Diffuser Manhole	Replace riprap on the bank side of the outfall diffuser manhole with clean riprap. Install a flow-relief system at the top of the diffuser manhole and a second diffuser manhole higher on the river bank for use during high-flow conditions in the river.
Effluent Temperature Control	Convert the existing small clarifiers and effluent structure to store excess warm effluent. Install structures to shade the effluent structure and Clarifiers 1 and 2.
Convert Oxidation Ditch to Aerobic Digester	Modify the existing oxidation ditch for use as an aerobic sludge digester and to serve as a standby oxidation ditch.

TABLE ES-8 (continued)

Treatment Plant Components of Recommended Plan

Process	Improvement
SCADA Improvements	Upgrade the SCADA system to current standards and incorporate plant components currently omitted from the system.
3W Water	Relocate the existing 3W water system to the new UV/Effluent Building. Extend the 3W piping system to new areas of the plant to supply plant water.
Pipe Rerouting	Extend the Solids Handling Building Pump Station force main to discharge to the new oxidation ditch. Reroute the sanitary sewer conveying flow from the treatment plant laboratory and neighboring mobile homes to the ULID 6 Pump Station rather than the original influent pump station
Site Work and Landscaping	Plant a landscaping buffer along Bendigo Boulevard. Provide paving, fencing, flood mitigation, site stormwater management system improvements,[R] and other site improvements as needed.
Phase 2	
Headworks	Install a new mechanical screen in the second mechanical screen channel. Construct a new flow splitter to route flows from the headworks to two oxidation ditches.
New Oxidation Ditch	Construct a second oxidation ditch.
UV Disinfection	Install a fourth UV unit.
Phosphorus Removal	Install phosphorus removal facilities.
Sludge Thickening	Construct a new facility for recuperative thickening of digested waste activated sludge, in order to maintain a sludge concentration of 2 percent in the aerobic digester. The thickening facility will include a rotary drum thickener and polymer feed system in an all-weather enclosure above the 100-year flood. To optimize the use of the polymer, the digested sludge sent to the centrifuge should be no thicker than 1.5 percent; therefore dilution of the digested sludge will be provided using 3W water.
SCADA	Incorporate all new Phase 2 equipment into the treatment plant SCADA system.
Laboratory/Control Building	Flood-proof the existing laboratory/control building by raising it approximately 4 feet. Provide four additional work stations for plant staff.
Solids Handling Building Maintenance Shop	Provide a new maintenance shop in the existing Solids Handling Building after removal of the existing sludge dryer and sludge hopper.

TABLE ES-8 (continued)

Treatment Plant Components of Recommended Plan

Process	Improvement
New Centrifuge	Install a new, larger centrifuge in the Solids Handling Building. Remove and scrap the existing dryer and sludge hopper.
Solids Loading Area Odor Control	Provide an odor control system for the sludge loading area.
Influent and Effluent Sampling System	Upgrade the existing controls to collect flow composite samples at the new headworks and existing effluent sampling systems.
New Electrical Building	Construct a new 50-by-35-foot electrical building.
New Motor Control Centers	Install new motor control centers in the new electrical building for all new equipment and to replace all existing motor control centers.
New Standby Generator and Load Center	Install a new 750-kW generator with an automatic transfer switch in the new Electrical Building.
Original Treatment Building and IPS	Demolish the original treatment building and original IPS.
Pump House	Demolish the above-grade portion of the existing Pump House.
Site Work and Landscaping	Improve main entrance road to the plant, including site security and landscaping.[R]

FIVE-YEAR CAPITAL IMPROVEMENT PLAN

The proposed implementation of the recommended Phase 1 improvements over 5 years is presented in Table ES-9. Capital costs are presented without escalation. For large projects spread over 2 years, it is assumed that design is completed in the first year, at 13 percent of the total project cost. Costs presented in this facilities plan were developed to a level of accuracy suitable for preliminary planning; refined cost estimates will be required prior to use for City budgeting.

ADDITIONAL O&M COST

Table ES-10 summarizes increased annual O&M costs through 2020 associated with the recommended collection system and treatment improvements. Costs presented in this facilities plan were developed to a level of accuracy suitable for preliminary planning; refined cost estimates will be required prior to use for City budgeting. The estimated annual O&M costs include work for reduction of I/I in the City collection system and for maintaining the existing and any future individual residential customer grinder pump stations.[R]

TABLE ES-9

Five-Year Capital Improvement Plan

	2016	2017	2018	2019	2020	Total
Collection System						
Snoqualm Lift Station SCADA System Integration	$55,000					**$55,000**
South Fork Lift Station SCADA & Controls	$56,000					**$56,000**
South Fork Lift Station Pumps, Dry Well, Odor Control, Predesign Study		$152,520	$351,480			**$504,000**
Treatment Plant						
ULID 6 Pump Station Improvements						
Pump Replacement, Bar Screen, Gate, Controls	$24,700	$165,300				**$190,000**
Electrical and Control Panel Floodproofing		$23,400	$156,600			**$180,000**
UV Disinfection System and Effluent Discharge						
New UV/Effluent Building	$81,900	$548,100				**$630,000**
UV Disinfection System	$94,900	$635,100				**$730,000**
Disinfected Effluent Piping	$45,500	$304,500				**$350,000**
New Effluent Pumps	$29,900	$200,100				**$230,000**
Relocate 3W Water	$22,100	$147,900				**$170,000**
Effluent Flow Meter	$24,700	$165,300				**$190,000**
Outfall Diffuser Structure	$39,000	$261,000				**$300,000**
Solids Handling Building Pump Station Force Main to Oxidation Ditch	$14,300	$95,700				**$110,000**
Solids Loading Odor Control		$50,000				**$50,000**
Influent and Effluent Sampling System Improvements		$26,000				**$26,000**
SCADA Upgrade		$330,000				**$330,000**
Effluent Temperature Equalization		$158,000				**$158,000**
New Clarifier		$366,600	$2,453,400			**$2,820,000**
Site Work Fencing, Paving, Flood Mitigation		$36,400	$243,600			**$280,000**
Landscaping		$26,000	$174,000			**$200,000**
Lab and Mobile Home Park Sanitary Sewer to ULID 6 PS			$110,000			**$110,000**
Existing Clarifier Repair			$160,000			**$160,000**
New Centrifuge			$152,100	$1,017,900		**$1,170,000**
Convert Oxidation Ditch to Digester						
Brush Rotor Support Repair	$20,000					**$20,000**
Aeration Controls, Covers, Walkways & Piping			$88,400	$591,600		**$680,000**
Headworks – Screening				$149,500	$1,000,500	**$1,150,000**
New Oxidation Ditch				$247,000	$1,653,000	**$1,900,000**
New Electrical Building and Motor Control Centers				$88,400	$591,600	**$680,000**
New Standby Generator in Building				$174,200	$1,165,800	**$1,340,000**
Total	**$508,000**	**$3,591,920**	**$3,889,580**	**$2,268,600**	**$4,410,900**	**$14,769,000**

TABLE ES-10

Estimated Annual O&M Cost Increases Associated with Recommended Improvements

Description	Incremental Annual O&M Cost				
	2016	**2017**	**2018**	**2019**	**2020**
Increase Without Recommended Improvements	$7,000	$13,000	$20,000	$27,000	$34,000
Collection System Asset Management (includes I/I Reduction Program)	$213,000	$484,000	$319,000	$319,000	$319,000
Delete Sludge Dryer Natural Gas	($24,000)	($26,000)	($27,000)	($29,000)	($30,000)
Power	$2,000	$2,000	$2,000	$3,000	$6,000
Chemical and Material	$4,000	$4,000	$4,000	$4,000	$5,000
Labor	$50,000	$100,000	$200,000	$200,000	$200,000
Lab Testing	$2,000	$2,000	$2,000	$2,000	$2,000
Sludge Hauling	$6,000	$18,000	$32,000	$46,000	$53,000
Equipment Replacement and Structural Maintenance	$20,000	$27,000	$59,000	$79,000	$121,000
Total Annual Incremental Cost	**$280,000**	**$624,000**	**$611,000**	**$651,000**	**$710,000**

FINANCING ANALYSIS

A sewer rate study conducted for this wastewater facilities plan identified rate adjustments required to ensure that adequate funds are available to implement recommended capital improvements and maintain operation of the City's wastewater facilities through 2020.

North Bend's sewer utility is an enterprise fund, meaning that it is self-sufficient, and rates and fees collected for sewer service support the financial obligations of the utility. The primary sources of funding are monthly user charges for service and a developer connection charge called a general facility charge, or GFC. The study found a revenue deficiency at current rate levels. Sewer rates will need to increase to meet the total annual revenue requirement in all years. Rate revenues would need to increase by 12.7 percent in 2016 and 2017, 8.25 percent in 2018 and 2019 and 8.0 percent in 2020.

The rate study identified new sewer rates that achieve three goals established by the City:

- To meet the projected 5-year sewer utility revenue requirements,
- To adjust rates so that the average sewer rate cost per cubic meter of water consumption is the same for residential customers and commercial customers, and
- To set consumption-based rates that encourage water conservation.

Based on the proposed rates, an average residential monthly sewer bill in 2016 will increase from $76.09 under the previous rate structure to $78.13, an increase of

2.7 percent. The average commercial customer's monthly 2016 bill will increase $210.68 to $328.96, a 56.1 percent increase.

The rate study assessed the GFC to determine equitable charges based on the wastewater facilities now in use and to be implemented under the recommended plan. System costs to be recovered by the GFC include two parts: an existing cost portion based on historical investments in existing infrastructure, and a future cost portion that recovers costs related to planned capital projects. The future cost basis includes only the recommended improvements required to accommodate expected growth in the city, not improvements to repair existing facilities. The GFC to cover these costs was calculated to be $10,222 per connection throughout the city except within the ULID 6 area, where the GFC is $7,699.

The City adopted the sewer rate study's recommended adjustments in July 2016.

CHAPTER 1

INTRODUCTION AND BACKGROUND

1.1 ABOUT THIS PLAN

1.1.1 PURPOSE

The City of North Bend needs a comprehensive plan for improving and expanding its wastewater system. The City's most recent wastewater planning document, the July 2001 *City of North Bend Final Comprehensive Sewer Plan* (the 2001 Sewer Plan), is now 14 years old. A variety of developments in the years since that plan was prepared warrant the development a complete wastewater comprehensive plan:

- The City did not experience the rate of growth projected in the 2001 Sewer Plan due to a number of circumstances, including a local building moratorium relating to water rights and economic stagnation. The moratorium was lifted in 2009 when the City received a water right for the Centennial Well.

- For the last 3 years, the City has experienced moderate growth due to development.

- Since 2014, numerous developers have proposed major projects that would accelerate growth in the City and require significant wastewater system capacity. Permitting has begun or been completed for development of more than 900 new residential units as well as additional commercial businesses.

- Subsequent to the adoption of the 2001 Sewer Plan, the City annexed a previously unincorporated portion of its urban growth area (UGA) and extended sewer service to the newly incorporated area.

- Many of the treatment plant improvements recommended in the 2001 Sewer Plan have been completed.

- In 2015, the City constructed three "critical improvements" to the plant that were identified in 2014.

- A series of short-term investigations have identified additional improvements needed for the plant to consistently and reliably meet the discharge requirements set forth in the City's National Pollutant Discharge Elimination System (NPDES) permit.

The City now wants to consider a wide range of wastewater system improvement alternatives to meet the needs of residents and businesses now and over a 20-year planning period.

1.1.2 PROJECT SCOPE

The *City of North Bend Wastewater System Facilities Plan* is a comprehensive planning document for all elements of the City's wastewater system – collection, treatment, biosolids management and effluent disposal or reuse. It addresses all areas currently served by the City's wastewater system as well as those expected to be served by the system within the 20-year planning period. The facilities plan identifies improvements needed to collect and treat wastewater in the City's sewer service area and provides a capital improvement plan (CIP) to implement the improvements over the next 20 years. The City will use the CIP as a basis for updating its monthly wastewater service charge and its wastewater system development fee for new sewer connections.

The facilities plan meets the wastewater facilities engineering report requirements defined in Washington Administrative Code (WAC) 173-240-060 and requirements for a federal wastewater facilities plan as defined in the Code of Federal Regulations under 40 CFR 35.917-1. The plan will be submitted to the Washington Department of Ecology for approval so the City can proceed with the recommended improvements.

Preparation of this facilities plan included the following activities:

- Gathering and reviewing key information from the City necessary for the wastewater facilities plan.
- Coordinating with regulatory authorities and preparing an overview of regulations that apply to City wastewater facilities.
- Defining the basic planning area, including existing and future land use, existing population, and population projections.
- Defining capacity of the existing wastewater collection system and identifying improvements needed to provide reliable sewer service to existing and future development.
- Conducting a preliminary feasibility analysis of regional wastewater facilities to serve the Cities of North Bend and Snoqualmie and the Snoqualmie Tribe.

- Defining the existing wastewater treatment system and identifying improvements needed to provide reliable treatment for existing and future development.

- Evaluating the existing treatment plant effluent outfall and evaluate three alternatives for effluent disposal.

- Assessing the existing North Bend facilities for sewage sludge, scum and screenings, estimating solids quantities for existing and future conditions, and evaluating alternatives to provide cost-effective solids treatment, disposal and reuse for existing and future conditions.

- Performing a rate study and financing analysis.

- Conducting public outreach to inform the community of planning progress and to receive input from residents and businesses.

- Completing all required environmental documentation.

1.2 RELATED STUDIES

The following studies were reviewed in preparation of this updated facilities plan:

- City of North Bend Final Engineering Report/Facility Plan; Wastewater Treatment Plant. Prepared for the City of North Bend by Earth Tech. Bellevue, Washington. December 1996.

- City of North Bend Infiltration & Inflow Study. Prepared for the City of North Bend by Gray & Osborne, Inc. Seattle, Washington. August 1997.

- City of North Bend Final Comprehensive Sewer Plan. Prepared for the City of North Bend by Earth Tech. Bellevue, Washington. July 2001.

- Evaluation of Water Quality-Based NPDES Permit Limitations. Prepared for the City of North Bend by Cosmopolitan Engineering Group. Tacoma, Washington. October 2004.

- City of North Bend Wastewater Treatment Plant Outfall Inspection Report. Prepared for the City of North Bend by Tetra Tech. Seattle, Washington. November 2014.

- Preliminary Design Report, ULID [Utility Local Improvement District] 6; City of North Bend. Prepared for the City of North Bend by Gray & Osborne, Inc. Arlington, Washington. January 2009.

- City of North Bend Improvements to Wastewater Treatment Plant; Predesign Report for Critical Improvements. Prepared for the City of North Bend by Tetra Tech. Seattle, Washington. July 2014.

- City of North Bend Improvements to Wastewater Treatment Plant; Predesign Report for High Priority Improvements. Prepared for the City of North Bend by Tetra Tech. Seattle, Washington. March 2015.

- The City of North Bend Comprehensive Plan. City of North Bend as amended in 2007 and 2013.

1.3 WASTEWATER SERVICE AREA DESCRIPTION

1.3.1 PHYSICAL FEATURES

Geographic Limits

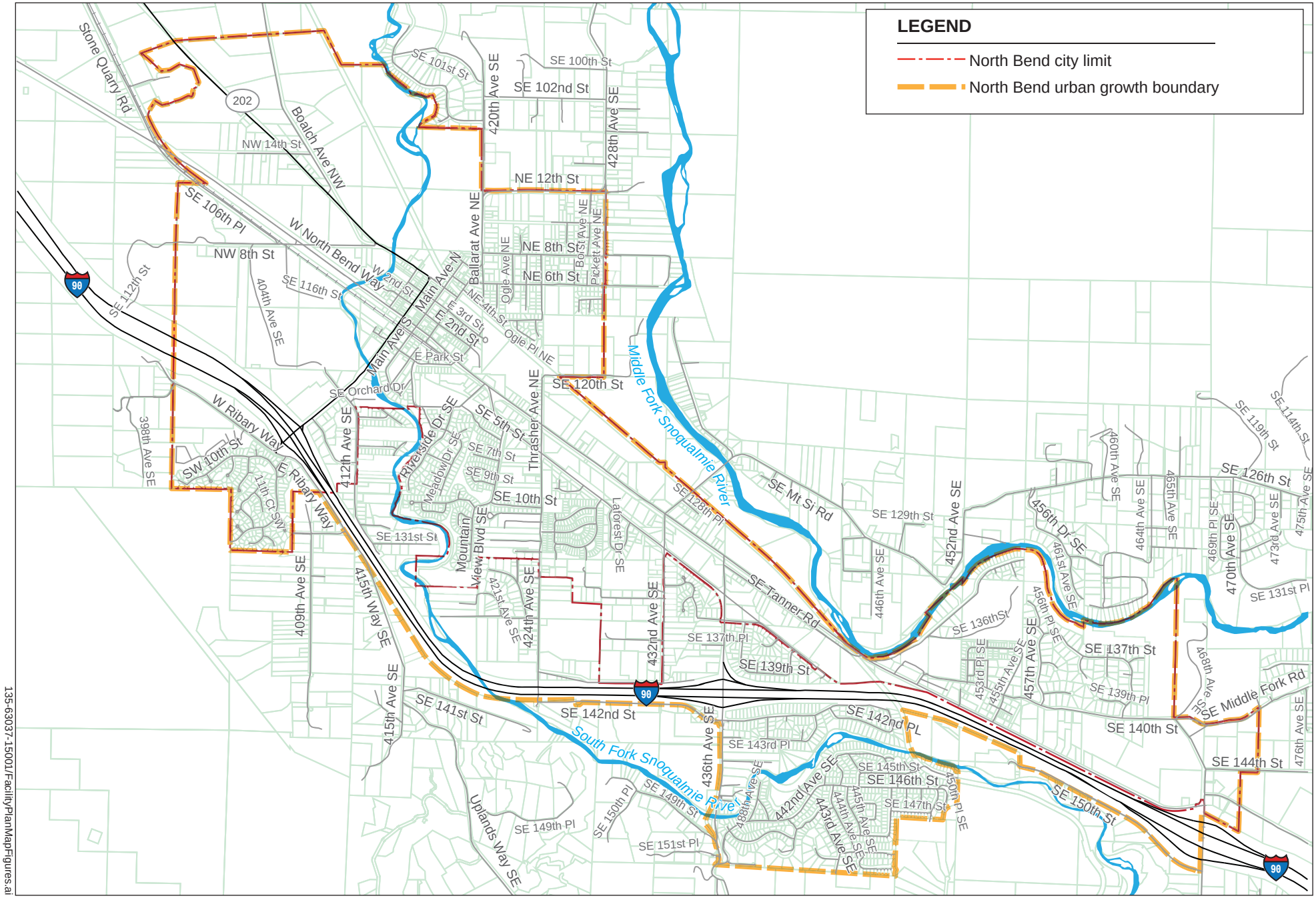
The City of North Bend covers 4.31 square miles near the foothills of the Cascade Mountains, 31 miles east of Seattle in the upper valley of the Snoqualmie River. The City of Snoqualmie borders the City of North Bend on the north; North Bend is otherwise surrounded by unincorporated King County.

The planning area for this facilities plan is defined as North Bend's Urban Growth Area (UGA), as shown on Figure 1-1. It encompasses about 6 square miles. The UGA consists of the area within the North Bend city limits, the unincorporated area between the city limits and Interstate 90 (I-90), and the Riverbend and Forster Woods areas south of I-90.

Topography and Geology

The City of North Bend is located in the Snoqualmie Valley between Mount Si and Rattlesnake Mountain, near the confluence of the North, Middle, and South Forks of the Snoqualmie River. I-90 runs northwest-southeast through the planning area. The region is fairly flat, but southwest of the interstate the terrain rises steeply toward Rattlesnake Ridge. Mount Si rises steeply from the flat land to the northeast of the city, across the Middle Fork of the Snoqualmie River. Local topography is shown on Figure 1-2.

The geology of almost all of the city and its UGA consists of younger alluvium, which is described as moderately sorted deposits of cobble gravel, pebbly sand and sandy silt along major rivers and stream channels. A few small areas of the city and UGA consist of till or recessional outwash deposits (King County, 2004).



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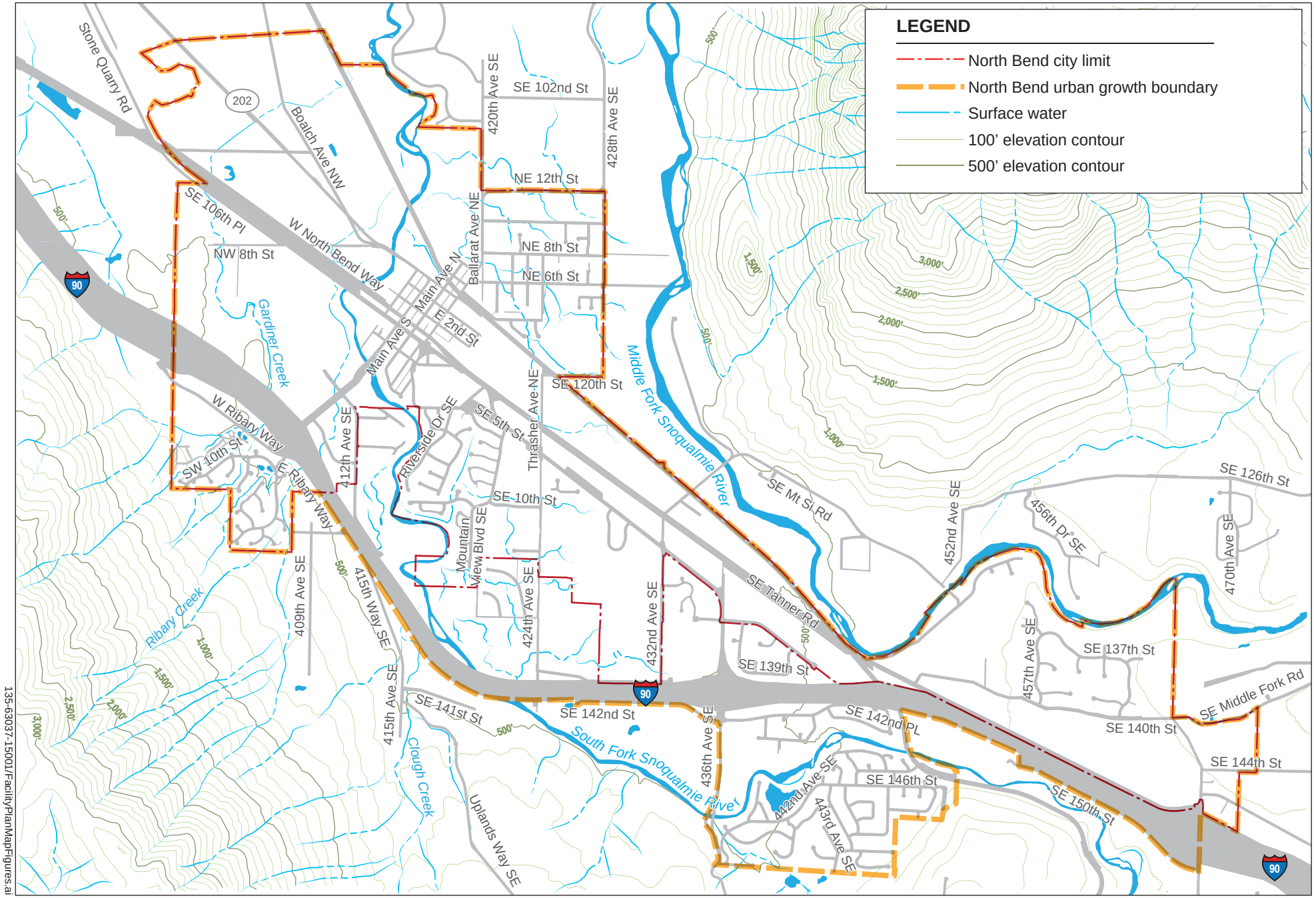
City of North Bend
WASTEWATER SYSTEM FACILITIES PLAN

Figure 1-1.
NORTH BEND CITY LIMITS AND URBAN GROWTH AREA



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City of North Bend
WASTEWATER SYSTEM FACILITIES PLAN

Figure 1-2.
CITY OF NORTH BEND SURFACE WATERS AND TOPOGRAPHY

Climate

The climate in the Upper Snoqualmie River basin varies from moist alpine conditions in the Cascade mountain range headwaters, to moist temperate conditions in the lower valley in and around North Bend. The Cascade mountain range forms a barrier to the movement of moist air from the Pacific Ocean, resulting in significant precipitation during late fall and winter. Winter snowfall and subsequent snowmelt result in elevated spring runoff in the rivers, which can result in flooding. Rainfall dominates the lower elevations of the upper river basin. In the North Bend area, the average annual precipitation is 60 inches per year.

Critical Areas

Many places within the planning area can be classified as critical areas. The combination of rivers and flat valley floors makes the region prone to extreme flooding and results in the presence of many wetland areas. The U.S. Environmental Protection Agency (EPA) and Federal Emergency Management Agency (FEMA) have procedures for floodplain management and wellhead protection that must be followed when development may impact a flood hazard area or critical aquifer recharge area. Key critical areas are summarized below; details are provided in the Critical Areas Element of the North Bend Comprehensive Plan.

Surface Waters, Flood Zones and Wetlands

North Bend is located on the floor of the Upper Snoqualmie Valley, upstream of Snoqualmie Falls and near the confluence of the three forks of the Snoqualmie River (North, Middle and South). Originating from the western slopes of the Cascades, these rivers drain a combined area of approximately 380 square miles. Tributary streams within the North Bend UGA include Gardiner Creek, Ribary Creek and Clough Creek. Major surface water features are shown on Figure 1-2.

High annual precipitation and melting snow in the Upper Snoqualmie Basin contribute to the potential for significant winter flooding from November through February. Rivers that carry runoff out of the upper basin are constricted downstream and collect on the flat valley floor where North Bend is located. Although incorporated North Bend with its developed areas occupies less than 1 percent of the entire river basin, its location makes it vulnerable to major flooding. Flooding of lowland areas by excessive stormwater runoff and snowmelt is one of North Bend's most common and costly natural hazards. Areas most affected by flooding lie to the northwest, north and east. Mapped flood zones in the city are shown on the City's Special Flood Hazard Map, Figure 1-3.

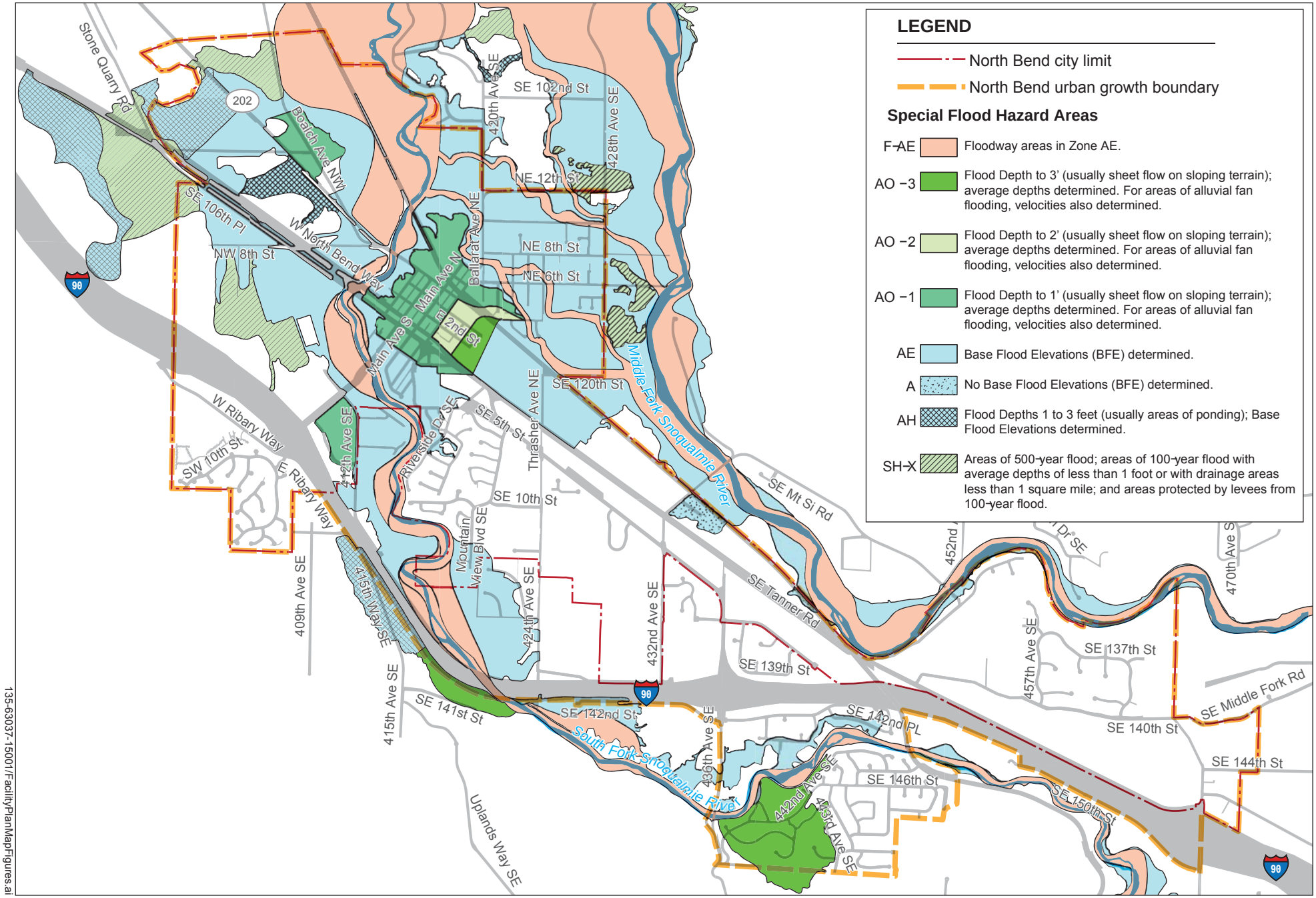
Wetland preservation and protection can significantly reduce public and private costs associated with downstream flooding. North Bend has recognized the value of natural wetlands and has mapped probable wetland areas within the planning area, based on aerial photographs, U.S. Soil Conservation Service Soil Survey maps, National Wetland Inventory maps and the 1981 King County Wetland Inventory.

Groundwater

The sole source of domestic water for the North Bend planning area is groundwater contained in underground aquifers and delivered through springs and wells. Most aquifers are replenished, or recharged, by rainwater. Development can threaten the quantity as well as quality of groundwater by drawdown and contamination. Wastewater system failures, including wastewater collection systems leaks or overflow and failed on-site septic systems, pose particular risks (viral, microbial, and direct chemical) of groundwater contamination. Once groundwater is contaminated, it is difficult, costly, and sometimes impossible to restore. Preventing contamination is necessary to avoid potential risks to public health, significant costs, and hardship. North Bend land use actions must consider potential impacts on aquifers to avoid or mitigate any depletion or degradation of them.

The protection of groundwater requires an understanding of the quantity of water replenishing aquifers, the quantity being withdrawn from them, and the potential for contamination. Washington's Growth Management Act requires cities to classify aquifer recharge areas according to vulnerability. A highly vulnerable recharge area is one where land uses could contribute contamination that might degrade groundwater quality and hydrogeologic conditions facilitate such contamination. Vulnerability is low where land uses do not contribute contaminants that could degrade groundwater and hydrogeologic conditions do not facilitate degradation. Classification, identification and regulation of aquifer recharge areas in the North Bend area are based on technical studies and King County's *East King County Ground Water Management Plan*. Figure 1-4 shows the most current mapping of wellhead protection areas and critical aquifer recharge areas in the North Bend planning area.

Critical aquifer recharge areas are areas that overlie significant groundwater resources and are particularly susceptible to groundwater contamination from pollutants released on or near the surface. Almost all of the North Bend planning area lies within a Category II critical aquifer recharge area (medium susceptibility to groundwater contamination); a few small portions of the planning area, including the northeast quarter of the Silver Creek neighborhood, are in Category I critical aquifer recharge areas (high susceptibility to groundwater contamination). All public water systems that use groundwater for supply of



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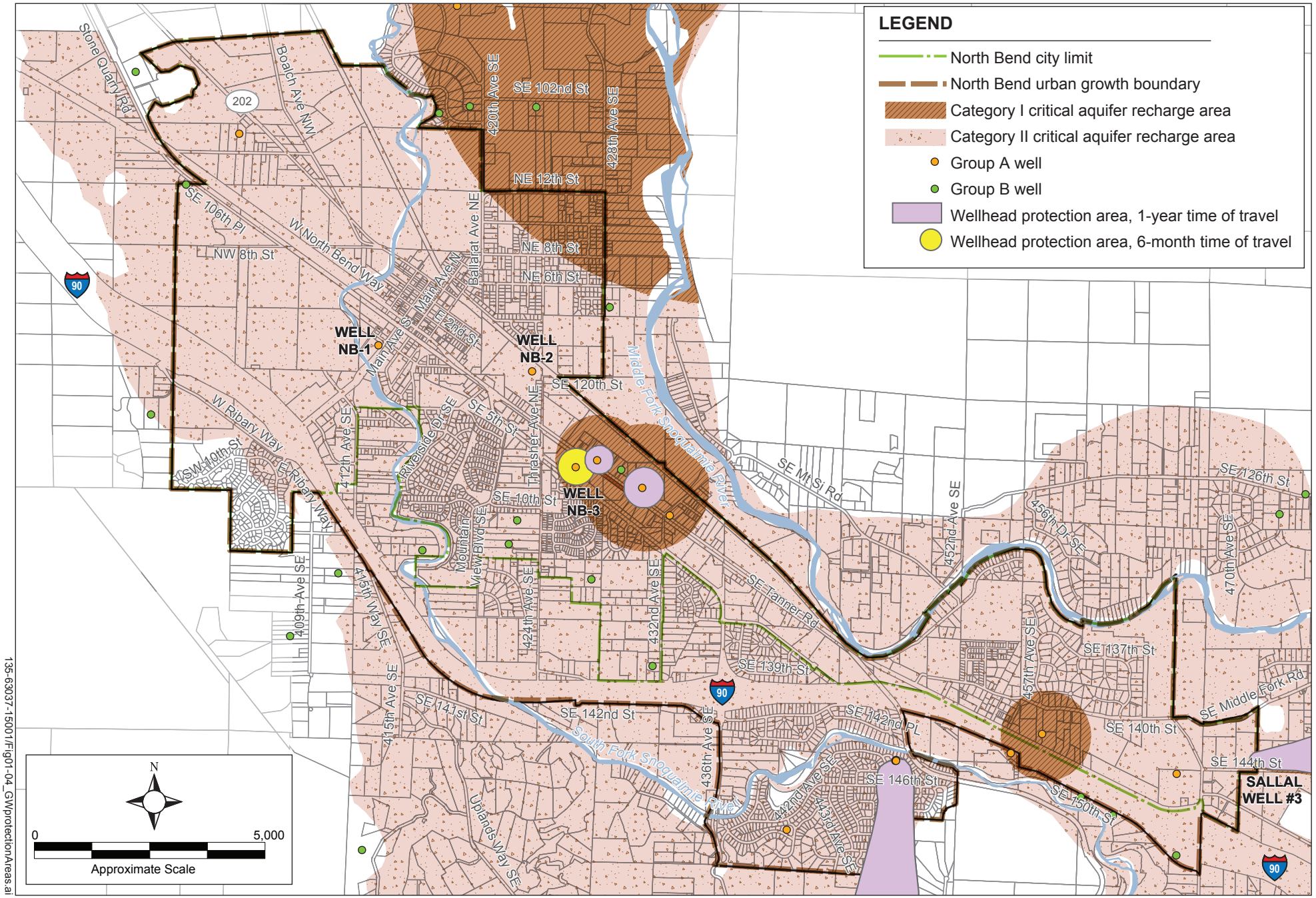
City of North Bend
WASTEWATER SYSTEM FACILITIES PLAN

Figure 1-3.
CITY OF NORTH BEND MAPPED FLOOD ZONES



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City of North Bend
WASTEWATER SYSTEM FACILITIES PLAN

Figure 1-4.
CITY OF NORTH BEND WELLHEAD PROTECTION AREAS AND CRITICAL AQUIFER RECHARGE AREAS

drinking water are required to establish and implement well head protection protect the groundwater from contamination due to land use.

Steep Slopes

Debris flow landslide hazard areas lie principally outside the North Bend city limits, but landslide paths can directly impact the incorporated city. Steep slopes along Rattlesnake Mountain are of concern because they are susceptible to erosion and landslides. Most debris flow landslide hazard areas in the planning area involve a few feet of relatively loose erodible soil on slopes underlain by denser and typically less permeable till or bedrock. Areas with erodible surface soils underlain with relatively impermeable soils on slopes of 15 percent or greater and with drainage from topographically higher areas, and all areas with steep slopes greater than 40 percent have been identified as potential debris flow or landslide hazard areas.

1.3.2 BUILT ENVIRONMENT

Wastewater System Ownership and Operation

The City of North Bend owns, operates, and maintains[R] all portions of its wastewater system. Wastewater Treatment Plant Manager Mark Fogle is the authorized representative; contact information is as follows:

Phone: (425) 888-7672
Email: mfogle@northbendwa.gov
Address: 400 Bendigo Boulevard North, North Bend, Washington 98045

Development Served

The City's wastewater system collects and treats wastewater from all sewered areas of the City of North Bend. The newest addition to the service area is at the east end of the city, where Utility Local Improvement District 6 (ULID 6) was formed to finance bringing sewer service to recently annexed areas. The ULID 6 project included installation of sewer pipelines, construction of a new pump station and connection to the existing treatment plant. The project was completed in 2011.

There are currently 1,266 residential and commercial sewer accounts. These consist primarily of single-family residences (1,018 accounts), commercial customers (153 accounts), and multifamily residential housing (74 accounts serving an estimated 529 residential units). Other accounts include mixed-use and senior customers. There are no known significant industrial users currently connected to the City's wastewater collection system. The City had an estimated population of 6,296 as 2015. This includes 4,147 residents served by the City

wastewater system; the remaining 2,149 residents are served by on-site septic systems with drainfields.

On-Site Septic Systems

Although North Bend has adopted regulations to encourage installation of sewers throughout the City, this has progressed slowly because of the high cost of new sewers. Large areas of the City still use on-site septic systems. Such systems provide sewage treatment and disposal for about a third of the residential development within the city limits and all residential development outside the city but within the UGA. Some commercial development within the UGA also uses on-site septic systems. It is expected that on-site septic systems will continue to provide a major source of wastewater treatment and disposal in the North Bend planning area in the near future.

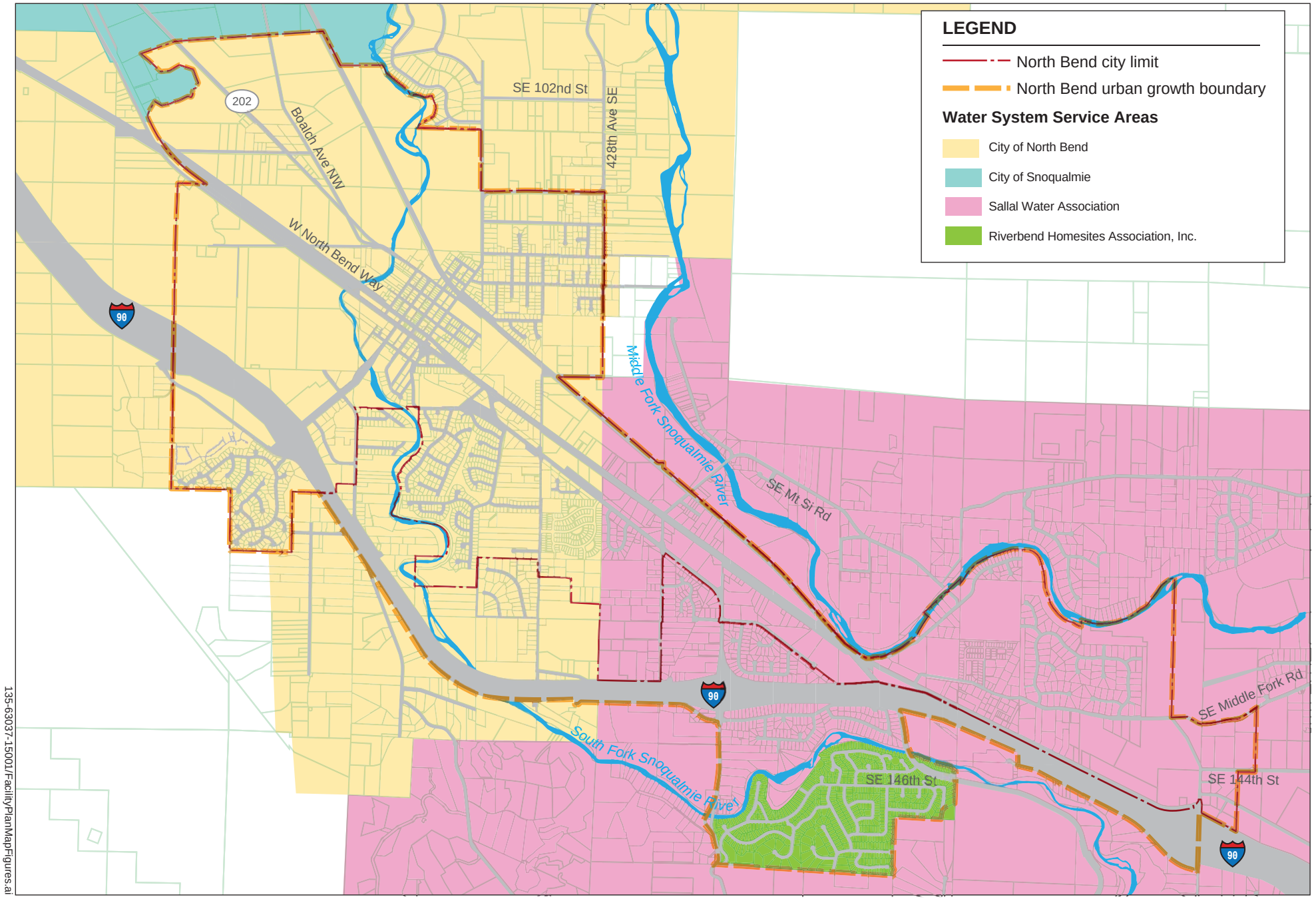
State and county regulations govern the design, installation and maintenance of on-site septic systems, and the King County Health Department issues permits for their installation. However, many homeowners know little about the operation and maintenance of their septic systems, so septic system failures are a problem. Failing septic systems can pose a serious risk to public health and the environment. Many failures involve the surfacing of liquid wastes in backyards and nearby storm drainage systems, allowing direct human contact with untreated wastes. Equally dangerous is the contamination of groundwater by pathogenic organisms. Inadequately treated septic system effluent can be transported within groundwater to a domestic water supply well, resulting in residents unknowingly drinking contaminated water. High levels of nitrate in a groundwater supply have been directly attributable to improperly treated septic tank effluent.

Water Supply

Drinking water in North Bend is supplied from public, private and individual water systems. The City of North Bend and the Sallal Water Association serve most of the community and are classified as Class A water systems. Several smaller private systems also serve the planning area, and an unknown number of individually owned systems serve individual residences or businesses. The City of North Bend water system serves 8.5 square miles, including adjoining areas in unincorporated King County, as shown in Figure 1-5.

The Sallal Water Association is a private cooperative system serving the City east of SE 428th. The City of Snoqualmie water service area borders the City of North Bend on the northwest.

Figure 1-6 shows the water supply facilities owned and operated by the City, including water sources, reservoirs and pump station. North Bend's original water source was the Mount Si Springs, located northeast of the city. These



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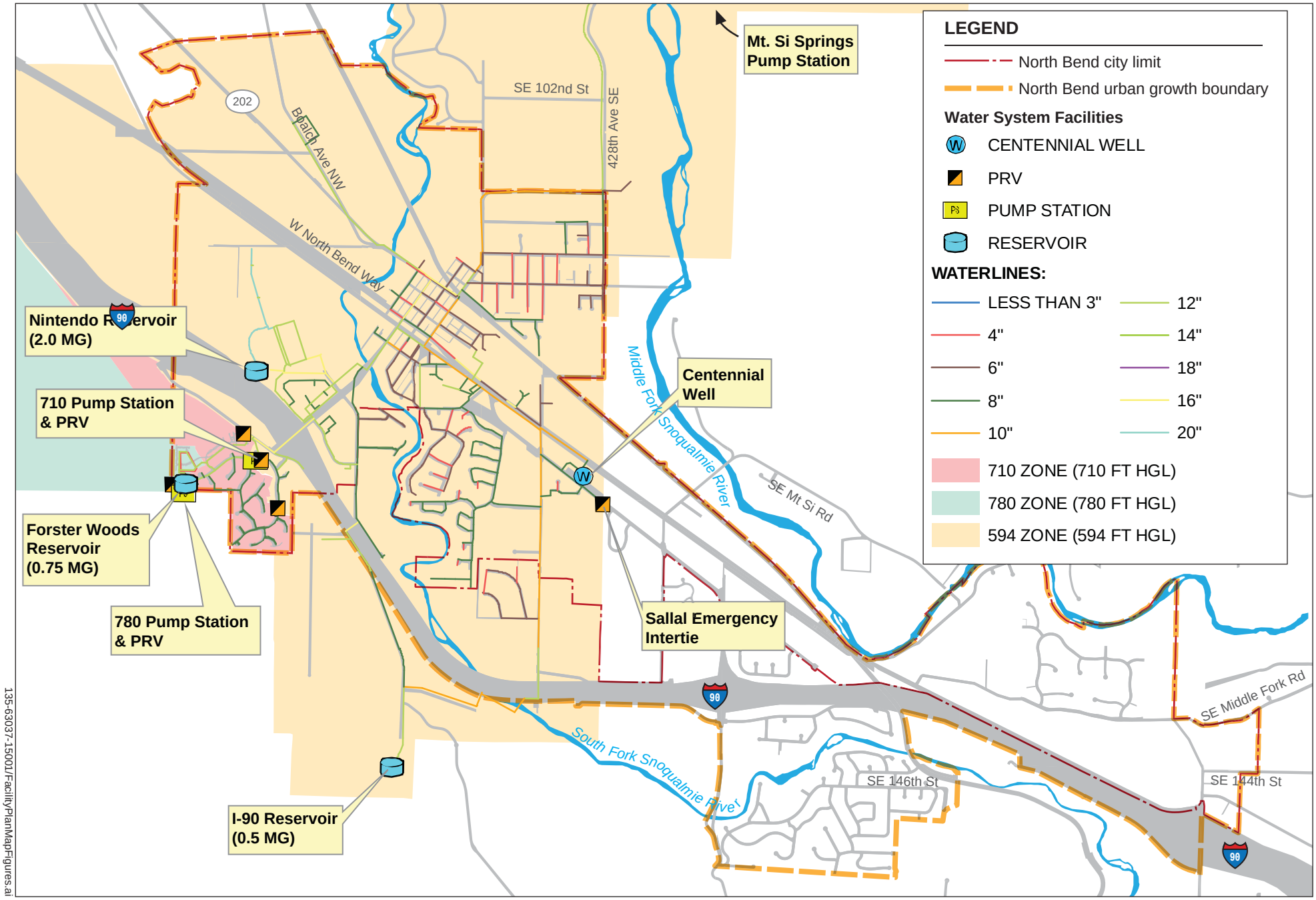
City of North Bend
WASTEWATER SYSTEM FACILITIES PLAN

Figure 1-5.
CITY OF NORTH BEND WATER SYSTEM SERVICE AREAS



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City of North Bend
WASTEWATER SYSTEM FACILITIES PLAN

Figure 1-6.
CITY OF NORTH BEND WATER SYSTEM FACILITIES

springs were put into service in the late 1960s. Water rights to the spring allow the City to withdraw 336 acre-feet per year, with an allowable instantaneous right of 2,244 gallons per minute. The City learned in 1999 that demand for water had exceeded the rights the City had for withdrawal of water at the Mount Si spring. The City went into a development moratorium to curtail additional requests for water other than those approvals vested before the moratorium's effective date. In 2008, the City received a new water right permit for groundwater from a new production well, named the Centennial Well, at the City's Public Works facility. This water right permit requires mitigation of the well's effects on the Snoqualmie River. With the construction of the new well and mitigation facilities, the City allowed its development moratorium to expire in February 2009.

Regional efforts to address water supply issues need to include further analysis of groundwater recharge and groundwater use. Wellhead protection studies provide information about where water purveyors' wells are being recharged and the wells' contamination susceptibility.

Adjacent Wastewater Systems

The wastewater system owned and operated by the City of Snoqualmie is approximately 5 miles west of the North Bend treatment plant. The Snoqualmie wastewater system serves all of the City of Snoqualmie, with an estimated 2015 population of 12,850, as well as the casino property operated by the Snoqualmie Indian Tribe between Snoqualmie and North Bend. Regional treatment with the City of Snoqualmie is evaluated in the alternatives analysis later in this report. Regional treatment with the Snoqualmie Tribe was considered in preliminary planning for this report, because in recent years the Snoqualmie Tribe expressed interest in having wastewater from its casino property treated at a regional plant with North Bend, instead of at the Snoqualmie plant. However, regional treatment with the Snoqualmie Tribe was not carried forward to the alternative analysis due to lack of interest by the Tribe and legal limitations of North Bend to provide sewer service outside its UGA.

The wastewater system owned and operated by the Washington State Patrol Fire Training Academy is approximately 7 miles east of the North Bend treatment plant and 3 miles east of the North Bend City limits and UGA boundary. The Fire Training Academy system provides Class A reclaimed water treatment of domestic wastewater and firefighting water generated at the academy. The reclaimed water is reused for firefighting training exercises. Regional treatment with the Fire Academy is not considered in this report because the Academy just completed construction of its reclaimed water treatment plant in 2009, and because of the long conveyance distance to North Bend.

Historic and Cultural Areas

Preservation of heritage sites helps to maintain the City's aesthetic and cultural diversity and provides continuity with its past. Heritage sites include buildings, properties, natural areas and structures of cultural significance. Identifying heritage resources and determining appropriate measures for their protection, preservation or restoration is an ongoing process involving the King County Landmarks Commission, the City of North Bend and state and federal agencies. Key historic sites in North Bend that deserve public intervention for protection include the historic Tollgate and Meadowbrook Farms, which are now in public ownership, and the historic downtown commercial district, which was formally designated in 2000. New sites may be added to the Historic Sites Survey over time. The Land Use Element of the City's Comprehensive Plan lists sites that have local historic importance.

A Cultural Resource Assessment Report (CRA) was prepared for the recommended alternative as part of this Facilities Plan and is presented in Appendix J. According to the Washington State Department of Archaeology and Historic Preservation (DAHP) Statewide Predictive Model (DAHP 2010), the existing wastewater treatment plant site has a Moderate to High Risk for buried precontact archaeological sites. Based on this information, a field assessment including surface and subsurface survey was accomplished at the property. No precontact or historic archaeological resources or environmental indicators of past cultural activities were observed. The old influent pump station building including the sludge holding tank and the former Snoqualmie Valley Youth Center building were recorded in the Washington State Historic Property Inventory because they are more than 50 years old.[R]

The CRA reports that previous construction of the City's wastewater facility has caused extensive, deep disturbance across the site. Nevertheless, intact archaeological remains (if present) could be encountered in discrete pockets not disturbed by previous construction. The CRA recommends that the City create and implement a Cultural Resources Inadvertent Discovery Plan (IDP) to be used during any further site investigations and construction. The CRA also recommends the City request the DAHP to determine the Youth Center and Old Influent Pump Station and Solids Holding Tank Not Eligible for Register-listing.[R]

1.4 PERMITS, REQUIREMENTS AND REGULATIONS

Wastewater must be collected, treated, and disposed of or reused in a way that protects public health and receiving water quality, generates no objectionable off-site odors or aesthetic nuisances, and complies with all applicable regulations. Wastewater treatment facilities must meet the regulations and requirements of many federal, state, and local regulatory agencies. Appendix A presents rules and

regulations that typically apply to wastewater projects. Key points are summarized in the sections below.

1.4.1 FEDERAL REGULATIONS AND GUIDELINES

Programs and policies to protect water quality were first initiated on a nationwide scale by the federal Water Pollution Control Act of 1948. That act has seen numerous amendments, including the Clean Water Act of 1972, which, among other changes, established National Pollutant Discharge Elimination System (NPDES) permits that regulate point discharges into water. The current Clean Water Act requires publicly owned wastewater treatment facilities to provide a minimum of secondary treatment, with the following standards for effluent quality:

- The monthly average of biochemical oxygen demand (BOD) and total suspended solids (TSS) concentrations shall not exceed 30 milligrams per liter (mg/L).
- The weekly average of BOD and TSS concentrations shall not exceed 45 mg/L.
- The monthly average removal of BOD and TSS shall be at least 85 percent.
- The pH of the effluent shall be between 6.0 and 9.0.

Sewage sludge generated at wastewater treatment plants is subject to standards set under Part 503 of the Code of Federal Regulations (CFR). Sludge management requirements under this regulation apply to pathogen reduction, vector-attraction reduction, metals concentrations, reporting, monitoring and management practices.

An important reference for wastewater treatment plant equipment reliability is the U.S. Environmental Protection Agency's 1974 *Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability* (EPA 1974). This document outlines requirements in three reliability classes, with provisions for each common treatment plant unit process.

Beyond these wastewater-specific federal requirements, any work proposed in this facilities plan will have to comply with federal requirements relating to the environment, agricultural lands, and cultural and historic resources.

In addition to regulatory requirements, the EPA has developed a set of guidelines for wastewater system practices to reduce sewage overflows. The guidelines are recommended but not required. They are presented in the EPA's Capacity,

Management, Operation, and Maintenance (CMOM) program. CMOM programs incorporate many standard operation and maintenance activities, but they also include information management to achieve the following:

- Better manage, operate, and maintain collection systems.
- Investigate capacity-constrained areas of the collection system.
- Proactively prevent sanitary sewer overflows.
- Respond to sanitary sewer overflow events.

1.4.2 STATE POLICIES AND REGULATIONS

Washington State has developed several requirements pertaining to surface water quality that are relevant for wastewater planning in North Bend:

- The state's Water Quality Standards for Surface Waters (WAC 173-201A) define expected uses for various segments of the Snoqualmie River, with water quality criteria that apply to each segment depending on its designated uses.

- Total maximum daily load (TMDL) studies for the Snoqualmie River have established specific limits on discharges to the river and its forks, based on temperature, ammonia, fecal coliform 5-day carbonaceous biochemical oxygen demand ($CBOD_5$) and phosphorus (the phosphorus limits have been proposed but not yet established):

    - The *Snoqualmie River Total Maximum Daily Load Study* (Ecology, 1994) allocates the City of North Bend 175 pounds per day (ppd) of $CBOD_5$ and 58.2 ppd of ammonia during August, September and October.

    - The *Snoqualmie River Temperature Total Maximum Daily Load; Water Quality Improvement Report and Implementation Plan* (Ecology, 2011) limits North Bend treatment plant effluent temperature to an increase of 0.3 degrees C above the temperature criterion of 16 degrees C at the edge of a mixing zone, based on 25 percent of the critical low flow. This allocation applies from June through September.

    - The 1994 TMDL study proposes a limit of 2 to 3 ppd of soluble reactive phosphorus from the North Bend treatment plant during August, September and October. The phosphorus TMDL has not yet been implemented, but Ecology has indicated that it will likely include the phosphorus TMDL in North Bend's next NPDES permit (for 2018 to 2023).

- The Washington Department of Ecology oversees the NPDES permitting of the City of North Bend wastewater treatment plant. The current permit, issued in May 2013, defines the following requirements (the permit is provided in Appendix B):

    - The following limits are established for influent flow to the treatment plant (note that these limits are greater than the plant's actual current capacity):

        - Average treatment plant influent flow for the maximum month not to exceed 2.58 million gallons per day,
        - BOD_5 influent loading for the maximum month not to exceed 2,805 pounds per day (ppd),
        - TSS influent loading for the maximum month not to exceed 2,304 ppd.

    - Effluent limits are established as summarized in Table 1-1.

    - Monitoring requirements are defined, including the monitoring of effluent nutrient and temperature levels.

    - A study is required to assess options for reducing effluent temperatures during the critical period, with implementation of identified low-technology improvements and best management practices by July 2016.

The state also has its own standards for water reclamation, use and disposal of sludge, treatment plant equipment reliability, on-site sewage (septic) systems, and protection of environmental and cultural resources.

TABLE 1-1

NPDES Permit Limits for North Bend Wastewater Treatment Plant Effluent Discharge

Parameter	November to July	August to October
Carbonaceous Biochemical Oxygen Demand (5-day)		
Maximum Average Monthly Concentration	25 mg/L	25 mg/L
Maximum Average Monthly Load	538 ppd	—
Minimum Average Monthly Removal of Influent Load	85%	85%
Maximum Average Weekly Concentration	40 mg/L	40 mg/L
Maximum Average Weekly Load	861 ppd	—
Total Suspended Solids		
Maximum Average Monthly Concentration	30 mg/L	30 mg/L
Maximum Average Monthly Load	646 ppd	350 ppd
Minimum Average Monthly Removal of Influent Load	85%	85%
Maximum Average Weekly Concentration	45 mg/L	45 mg/L
Maximum Average Weekly Load	968 ppd	525 ppd
Fecal Coliform Bacteria		
Monthly Geometric Mean	200/100 mL	200/100 mL
7-Day Geometric Mean	400/100 mL	400/100 mL
Daily pH		
Minimum	6	6
Maximum	9	9
Total Oxygen Demand (NBOD [(1)]+CBOD)		
Maximum Average Monthly Load	—	164 ppd
Maximum Daily Load	—	300 ppd

(1) NBOD = nitrogenous biological oxygen demand.

1.4.3 LOCAL POLICIES

North Bend Municipal Code

City requirements pertaining to sewers are outlined in Title 13 and Title 19 (Chapter 19.02) of the North Bend Municipal Code. The Municipal Code requires that sewers be installed for all new or revised development in the city, except in special situations, and that homes with failing septic systems connect to sewers if available within 200 feet (Chapter 13.06, Water and Sewer Requirements). The code requires that on-site septic systems comply with King County Health Department regulations for design, installation and maintenance (Chapter 13.12, Sewers–Adoption of County Code). The Municipal Code sets

forth extensive standards for the planning, design, and construction of the collection facilities (Chapter 19.02).

The municipal code also sets regulations relating to critical areas, stormwater management, shoreline protection, and building structural and fire safety that will apply to work proposed in this facilities plan. The City is currently developing updates to the municipal code that will better clarify circumstances in which revised development may allow continued use of existing on-site septic systems.

North Bend Comprehensive Plan

The City's Comprehensive Plan recommends (Policy SA-4.2) that the City adopt policies preventing land uses that could adversely affect groundwater in any way that would jeopardize the existing and future quality of the drinking water supply. The Comprehensive Plan specifically recommends the following to help protect aquifer recharge areas (Policy SA-4.3):

- Take corrective action to remove contaminant loading due to failing sewer and septic systems in susceptible aquifer recharge areas.
- Monitor the mandatory septic tank inspection and reporting required by County Health Department rules.
- Evaluate the need for sewer line connection as an aquifer protection technique in the future.

North Bend Participation in Community Rating System

North Bend voluntarily participates in FEMA's Community Rating System, a program that provides reduced federal flood insurance premiums in communities that adopt optional floodplain management measures. The system awards ratings based on the number of such measures in place, and reduces insurance premiums by a percentage based on those ratings. North Bend currently holds a Class 6 rating, which qualifies City floodplain property owners for a 20 percent discount in flood insurance premiums.

Among the floodplain management measures North Bend has implemented (North Bend Municipal Code Chapter 14.12 Floodplain Management) are the following requirements for critical facilities such as structures at the City's wastewater treatment plant:

> Construction of new critical facilities shall only be allowed within the floodplain when no reasonable alternative site is available. Critical facilities constructed within the floodplain shall have the lowest floor elevated to 3 or more feet above the level of the base flood elevation.

> Floodproofing and sealing measures must be taken to ensure toxic or hazardous substances will not be displaced by or released into floodwaters. Access routes elevated to or above the level of the 100-year frequency flood shall be provided to all critical facilities to the extent possible.

The City's wastewater treatment plant is located in a mapped floodplain (see Figure 1-4). The flood zone designations at the plant are as follows:

- The eastern half of the plant site is in an AO-1 zone, which means that the elevation of the water surface during a 100-year flood event could be up to 1 foot above the ground surface. Critical structures in that zone must therefore be 4 feet above the ground to meet the requirement of being 3 feet above the flood level. Most of the structures at the plant are on this portion of the site.

- The western half of the plant site is in an AE zone, for which 100-year flood elevations of the South Fork Snoqualmie River have been calculated; the estimated 100-year flood elevation on this portion of the site is 435 feet.

Puget Sound Clean Air Agency

The Puget Sound Clean Air Agency must provide approval for any project that could lead to the release of contaminants into the atmosphere.

CHAPTER 2

PLANNING INFORMATION

2.1 GROWTH PROJECTIONS

Planning for wastewater system future needs requires projections of anticipated growth in the planning area. Such projections determine the expected quantities of wastewater that system facilities need to be able to accommodate over the course of a defined planning period. The planning period for this facilities plan is 20 years (through 2036). The following sections describe anticipated changes in land use over that period and the associated growth in population.

2.1.1 LAND USE

Existing Land Use

The Land Use Element of the City of North Bend Comprehensive Plan (City of North Bend, 2015) identifies the type, location, and intensity of the following land use types:

- Residential Land Uses – Low- to high-density housing
- Commercial Land Uses – Retail, services and office
- Employment Park Land Uses – Office parks, high-technology business parks, warehouses, heavy industrial, and manufacturing businesses
- Parks, Open Space, and Public Facilities Land Uses – Recreational open space, active and passive parks, and publicly owned facilities
- Mixed Use – Combinations of retail/commercial/office and/or service uses with residential use in the same building or on the same site.

Table 2-1 summarizes the distribution of land use by zoning designation throughout the City of North Bend UGA.

Future Land Use

King County's most recent buildable lands report (King County, 2014a) identifies a housing target of 665 new units for North Bend for 2006 through 2031. Since 2006, the City saw total net new housing of 234 units, so an additional 431 units are needed by 2031 to reach the housing target.

According to the City's 2015 Land Use Element, North Bend has 459 net acres available for new residential development, providing capacity for 2,331 new housing units within the UGA under current zoning. This exceeds the target, with a surplus of 1,666 units. As of May 8, 2015 North Bend had approximately 700 single-family, cottage and multi-family units under development review, which means that the City should reach its housing target well ahead of the 2031 projection.

TABLE 2-1

2015 Land Area by Zoning Designation in the Planning Area

Zoning District	Description	Area (acres)	% of Total
Residential Land Uses			
Low Density Residential (LDR)	Single-family structures at a maximum density of four dwelling units per acre	1,177	30%
Constrained Low Density Residential (CLDR)	A portion of the LDR designation with development constraints (e.g., flood hazard, habitat, geological hazard)	368	10%
Cottage Residential (CR)	Innovative housing types on smaller lot sizes with increased densities	61	2%
High Density Residential (HDR)	Predominantly multifamily structures allowing for a mix of housing types	37	1%
High Density Residential with Density Restrictions (HDR)	A portion of the HDR designation with density restrictions	10	0%
Commercial and Mixed-Use Land Uses			
Downtown Commercial (DC)	Commercial land uses within the historic, or traditional downtown area	67	2%
Interchange Commercial (IC)	Businesses serving the travel and tourist trade while also supplying goods and services in larger-scale commercial development	77	2%
Interchange Mixed Use (IMU)	IC activities modified to protect adjacent residential uses	40	1%
Neighborhood Business (NB)	Small-scale retail centers for shops providing goods to serve the everyday needs of the surrounding population, where mixed-use development can be encouraged	167	4%

TABLE 2-1 (continued)

2015 Land Area by Zoning Designation in the Planning Area

Zoning District	Description	Area (acres)	% of Total
Employment Park Land Uses			
Employment Park-1 (EP-1)	Areas where future employment growth for North Bend will occur, including indoor fabrication, research and development, finance and other service related businesses, and distribution facilities	350	9%
Employment Park-2 (EP-2)		133	3%
Parks, Open Space, and Public Facilities Land Uses			
Park/Open Space/Public Facilities (POSPF)	All public parks, schools and community facilities, as well as developed trails and other public recreational corridors and lands	652	17%
Unzoned			
Unzoned Areas	Rights-of-way and water bodies	728	19%
Total		**3,866**	**100%**

(1) Source: City of North Bend, 2015.

The Land Use Element assumes the following densities for future residential development in the planning area:

- Low-Density Residential – 4 dwelling units per acre
- Cottage Residential – 8 dwelling units per acre
- Constrained Low Density Residential – 2 dwelling units per acre
- High-Density Residential – 12 dwelling units per acre
- Downtown Commercial – 16 dwelling units per acre
- Neighborhood Business – 16 dwelling units per acre

The County's buildable lands report also identifies an employment target of 1,050 net new jobs for North Bend for 2006 through 2031. According to the City's 2015 Land Use Element, North Bend has the capacity for 7,092 new jobs, exceeding the target with a surplus of 6,042 jobs. All potential employment zones are within the current city limits; none remain in the unincorporated UGA. The estimated total available land supply in the city for commercial and industrial development is 251 adjusted net acres (reducing industrial and commercial zoned areas to account for unbuildable critical areas, rights of way, open space and utilities). The Land Use Element assumes the following floor area ratios (the ratio of a building's total floor area to the area of the parcel it is built on) for future commercial and industrial development in the city:

- Downtown Commercial – 1.5
- Employment Park 1 – 0.4
- Employment Park 2 – 0.5
- Interchange Commercial – 0.35
- Interchange Mixed Use – 0.35
- Neighborhood Business – 0.75

Sewered Area

The following assumptions about sewered area were made for this facilities plan:

- The developed area currently contributing flow to the City sewer system covers 796 acres; this is the assumed area for 2015.

- Sewered area in 2035 is assumed to be 1,255 acres, consisting of the current sewered area plus all of the 459 acres of available residential area. All available new commercial/industrial development area is assumed to be already served by sewers, so the sewered area will not increase to serve this development.

- The ultimate future sewered area is assumed to be 2,486 acres, calculated as the entire UGA area (3,866 acres) minus unzoned areas (728 acres) and areas zoned for parks, open space and public facilities (652 acres) (see Table 2-1).

A commonly used growth model was applied to develop a growth projection that achieves the assumed sewered areas for 2015, 2035 and the ultimate future condition.

2.1.2 POPULATION

Historical and Existing

According to the Washington Office of Financial Management (OFM), the City of North Bend's 2015 population is 6,296. Based on estimates from the 2015 Land Use Element update of the *City of North Bend Comprehensive Plan* (City of North Bend, 2015) and OFM's 2015 third-quarter population adjustment (OFM, 2015), the City's 2015 UGA population includes an additional 2,676 residents in unincorporated areas, for a total population of 8,972. Population per household, according to the 2015 Land Use Element, is as follows:

- Owner-occupied housing – 2.8 per household
- Renter-occupied housing – 2.2 per household
- Residential average – 2.57 per household

City utility records show 1,614 current residential sewer accounts. At the average population per household of 2.57, this represents a sewered population of 4,147 – 66 percent of the city population. The remaining 34 percent uses on-site septic systems (see Section 2.2.2 for further explanation of these estimates). Assuming a constant ratio of sewered population to total city population, the recent history of North Bend's total and sewered population growth is as shown in Table 2-2.

TABLE 2-2

Population Estimates for the City of North Bend, 2010 to 2015

	2010	2011	2012	2013	2014	2015
Total City Population (1)	5,731	5,830	5,855	6,020	6,280	6,296
Sewered Population (2)	3,775	3,840	3,856	3,965	4,136	4,147

(1) Estimates from Washington Office of Financial Management.
(2) 2015 estimate calculated as described in Section 2.1.2; earlier estimates calculated assuming constant ratio of sewered to total population.

Future

Projections of future population in the planning area need to account for two trends: increasing total population associated with overall area growth; and future connection to the sewer system by existing homes that are now served by on-site septic systems, as those systems eventually fail over time. Projections for both of these trends are described below.

Total Residential Population

A projection of future population growth was developed to be consistent with expected development in the planning area. The 2015 *North Bend Comprehensive Plan Update* projected a planning area population of 14,401 in 2035 (City of North Bend, 2015). To estimate yearly population through the planning period, it was assumed that growth would be non-linear, with the growth rate higher in the near term (based on current development projects) and decreasing as the planning area develops. An iterative analysis was used to model the growth rate curve between the 2015 population of 8,972 and the projected 2035 population of 14,401. The resulting growth curve is shown in Figure 2-1. The resulting projections for population are shown in Figure 2-2.

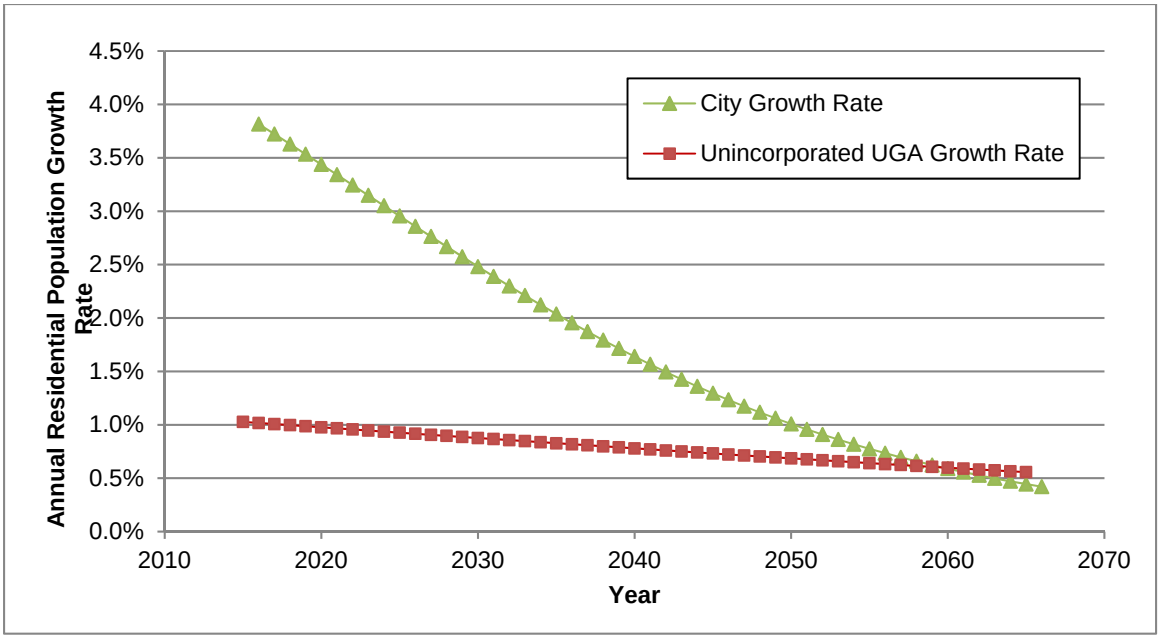


FIGURE 2-1

Projected Annual Population Growth Rate Through 2065

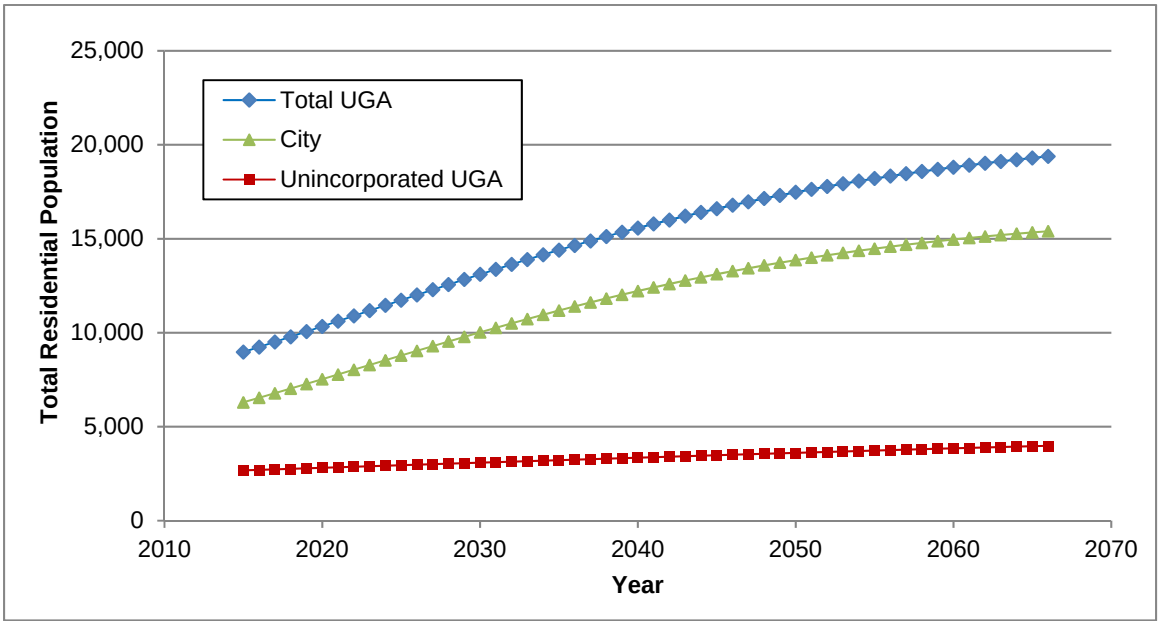


FIGURE 2-2

Projected Residential Population Through 2065

Sewered Population

The following assumptions were used to project future sewered population:

- Eighty percent of homes now using septic systems within the city limits would be sewered by 2036, with an equal number of such homes becoming sewered each year beginning in 2016.

- Population growth in the unincorporated UGA would continue to be served by septic systems until sewers become available to the area in 2022. Starting in that year, an equal number of homes would be sewered each year (all new homes and some existing homes) until 200 homes are sewered by 2036. These connections of septic system to sewers are likely to occur if the new sewers are constructed by the City or developers. They are less likely if they require homeowners to form ULIDs to fund construction.

Table 2-3 and Figure 2-3 show the resulting projections of sewered population. Table 2-3 also shows the projected population at a future time when all residences and businesses in the planning area will be connected to the sewer system.

TABLE 2-3

Population Projections

Year	Residential Population								
	City			Unincorporated UGA			Total UGA		
	On Sewer	On Septic System	Total	On Sewer	On Septic System	Total	On Sewer	On Septic System	Total
2015	4,147	2,149	**6,296**	0	2,676	**2,676**	4,147	4,825	**8,972**
2016	4,469	2,067	**6,536**	0	2,703	**2,703**	4,469	4,770	**9,240**
2017	4,794	1,985	**6,780**	0	2,731	**2,731**	4,794	4,716	**9,511**
2018	5,122	1,903	**7,026**	0	2,758	**2,758**	5,122	4,661	**9,784**
2019	5,452	1,822	**7,274**	0	2,786	**2,786**	5,452	4,608	**10,060**
2020	5,784	1,740	**7,524**	0	2,813	**2,813**	5,784	4,553	**10,337**
2021	6,117	1,658	**7,775**	0	2,841	**2,841**	6,117	4,499	**10,616**
2022	6,451	1,576	**8,027**	35	2,834	**2,868**	6,486	4,410	**10,896**
2023	6,786	1,494	**8,280**	69	2,827	**2,896**	6,855	4,321	**11,176**
2024	7,121	1,412	**8,533**	104	2,820	**2,923**	7,224	4,232	**11,456**
2025	7,454	1,330	**8,785**	138	2,813	**2,951**	7,593	4,143	**11,735**
2026	7,787	1,248	**9,036**	173	2,805	**2,978**	7,960	4,053	**12,014**
2027	8,119	1,167	**9,286**	207	2,798	**3,005**	8,326	3,965	**12,291**
2028	8,449	1,085	**9,533**	241	2,791	**3,032**	8,690	3,876	**12,566**
2029	8,776	1,003	**9,779**	276	2,784	**3,060**	9,051	3,787	**12,838**
2030	9,100	921	**10,021**	310	2,777	**3,087**	9,410	3,698	**13,108**
2031	9,422	839	**10,261**	344	2,770	**3,114**	9,765	3,609	**13,375**
2032	9,739	757	**10,497**	378	2,763	**3,141**	10,117	3,520	**13,637**
2033	10,053	675	**10,729**	412	2,756	**3,168**	10,465	3,431	**13,896**
2034	10,363	594	**10,956**	446	2,749	**3,195**	10,809	3,343	**14,151**
2035	10,668	512	**11,180**	480	2,742	**3,221**	11,148	3,254	**14,401**
2036	10,968	430	**11,398**	514	2,734	**3,248**	11,482	3,164	**14,646**
Future	16,500		**16,500**	5,500		**5,500**	22,000		**22,000**

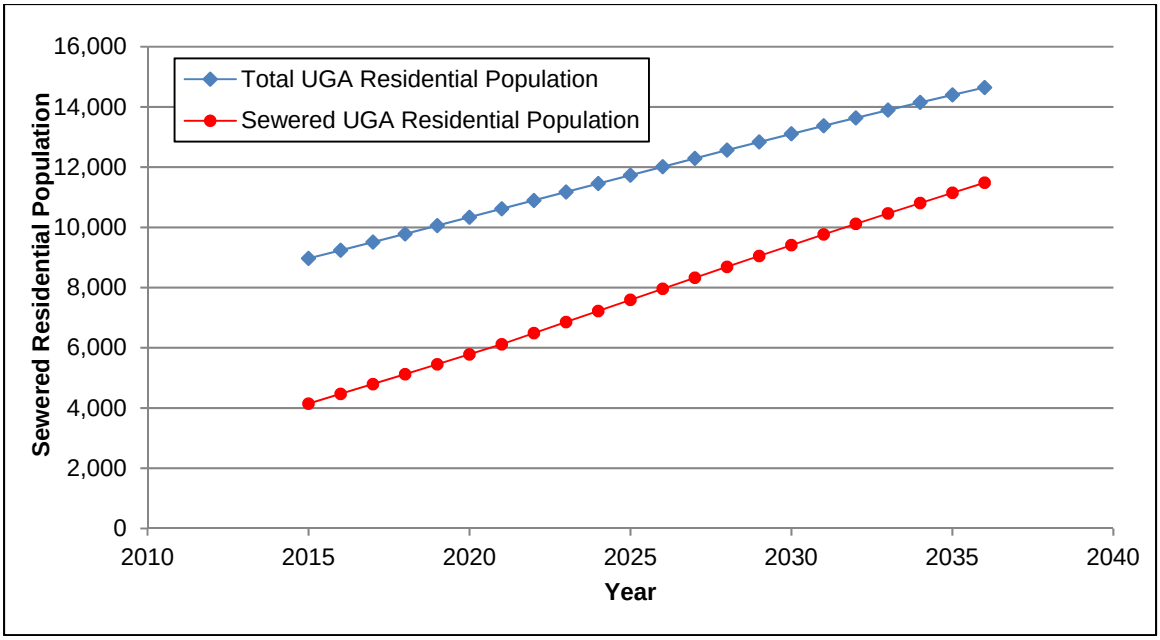


FIGURE 2-3

Projected Sewered Population Through 2036

2.2 WASTEWATER FLOWS

Wastewater system improvements must be sized to have adequate capacity for the wastewater flows the system is projected to convey and treat over the course of the planning period. Future wastewater flows are estimated using the projections of future population and development in combination with two types of design criteria:

- Unit design criteria define the typical amount of flow from a single "unit" such as a person, household, business, or acre of land.
- Peaking factors define standard ratios between average flows and likely peak values.

System flows consist of base sewage flow from connected customers as well as infiltration and inflow (I/I) into the system from groundwater and stormwater. The sections below describe total flows as well as the individual components of flow.

2.2.1 HISTORICAL TOTAL TREATMENT PLANT INFLUENT FLOWS

Total wastewater flows from the City service area are measured with influent and effluent flow meters at the wastewater treatment plant. Accurate influent flow

data have been available since March 2013. Because of the influent meter's location, flow from four neighboring mobile homes and from the treatment plant laboratory/control building are not measured. However, these flows are minor, making up less than 0.3 percent of the total influent flows. Effluent flows have been measured since 2000. Before accurate influent flow meter readings became available in 2013, the effluent flow meter provided the only valid measurement of total treatment plant flows. It provides an accurate indication of daily-average influent flows, but not instantaneous or peak-hour influent flows, because influent flow variations are attenuated through the plant, and extreme effluent flow peaks are greater than the calibrated range of the meter. Table 2-4 summarizes historical sewage flows measured at the treatment plant.

TABLE 2-4

Historical Treatment Plant Flow Data

Year	Dry-Weather Flow (1) (mgd)	Annual Average Flow (1) (mgd)	Maximum-Month Flow (1) (mgd)	Peak-Day Flow (1) (mgd)	Peak-Hour Flow (2) (mgd)
2007		0.48	0.64	1.20	N/A
2008		0.45	0.56	1.16	N/A
2009	0.38	0.47	0.81	1.20	N/A
2010	0.32	0.54	0.76	1.64	N/A
2011	0.46	0.65	0.95	1.39	N/A
2012	0.47	0.69	0.85	1.45	N/A
2013	0.50	0.67	0.89	1.60	N/A
2014	0.53	0.75	1.19	2.08	2.7
2015	0.44	0.77	1.19	3.11	3.8

(1) Measured by the effluent flow meter.
(2) Measured by the influent flow meter.

The following data are of note:

- Dry-weather flow during the extremely dry summer of 2015 was 0.44 million gallons per day (mgd).
- The annual average flow has grown to 0.77 mgd.
- The maximum-month flow was 1.19 mgd in February 2014, November 2015 and December 2015.

- The greatest peak-day flow was 3.11 mgd, on November 17, 2015, following an extremely rainy period.

- The greatest peak-hour flow was 3.8 mgd, on November 17, 2015.

2.2.2 BASE WASTEWATER FLOWS

Estimated Current Base Flow

Base flows are the direct contributions of sewage to a wastewater system from connected residential and commercial users. Estimates of existing base flows were developed for this facilities plan based on records of water use by residential and commercial sewer customers, on the assumption that all water delivered to a home or business is ultimately discharged back to the sewer system. Because this is not the case for water used for outdoor irrigation, the analysis of base flows excluded water records for the dry season, when outdoor watering occurs. The current estimated base flow, assuming it to be equal to winter water consumption, is 281,000 gallons per day (gpd), based on the City's utility billing records for average water use from November 2014 through March 2015. Table 2-5 summarizes the components of this estimate.

TABLE 2-5

Estimated Current Base Flow[R]

Service Type[R]	Average Flow (gpd)
Single-Family Residential	126,335
Multifamily Residential	65,673
Senior Residential	4,200
Residential Mixed Use	1,691
Residential Subtotal	*197,899*
Commercial	81,136
Commercial Mixed Use	2,025
Commercial Subtotal	*83,161*
Total	**281,060 (0.28 mgd)**

(1) Source: City of North Bend Utility Billing Account Data for November 2014 through March 2015.

Equivalent Residential Units and Population Equivalents

Wastewater flows are contributed by residential and commercial sources, and therefore are affected by planning area population as well as planning area commercial development. To simplify wastewater planning and ensure

consistency, non-residential sources are often estimated as a comparable residential source, using one of the following equivalencies:

- **Equivalent Residential Unit (ERU) –** An ERU represents the amount of wastewater contributed by an average residential household in the planning area. A business with wastewater flow equal to twice the wastewater flow from an average residential home would be treated as 2 ERUs.

- **Population equivalent (PE) –** A PE represents the average amount of wastewater contributed by each resident in the planning area. A business with wastewater flow equal to five times the wastewater flow from an average individual person would be treated as 5 PEs.

The wastewater flow per ERU was estimated from City utility account records, which indicate that the 197,899 gpd of residential flow contribution for winter 2014-2015 came from 1,614 residential units. This yields a base wastewater flow of 123 gpd per ERU. When sewer flow from a non-residential sources is converted to ERUs using this value, the equivalent sewered population of that source can be calculated by dividing the number of ERUs by the City's average household population of 2.57.

Using these equivalencies and the flow estimates based on winter water use, the current numbers of ERUs and sewered population by land use are as shown on Table 2-6.

TABLE 2-6

Estimated Current Base Flow, Equivalent Residential Units, and Population Equivalents[R]

	November 2014 to March 2015 Average Flow (gpd)	Equivalent Residential Units (1)	Sewered Population Equivalents (2)
Single-Family Residential	126,335	1,018	
Multifamily Residential	65,673	529	
Senior Residential	4,200	53	
Residential mixed Use	1,691	14	
Residential Subtotal	*197,899*	*1,614*	*4,147*
Commercial	81,136	661	
Commercial Mixed Use	2,025	17	
Commercial Subtotal	*83,161*	*678*	*1,743*
Total	**281,060**	**2,292**	**5,890**

(1) ERU count for single-family, multifamily, senior residential, and residential mixed use accounts taken from City utility records; ERU count for commercial and commercial mixed use accounts calculated as flow divided by 123 gpd per ERU.

(2) Sewered population equivalent calculated as the number of ERUs multiplied by the average household population of 2.57.

Base Wastewater Flow Design Criteria for This Facilities Plan

Residential Base Flow Design Criteria

Based on recorded flows and calculated PE values, 4,147 residents currently discharge sewage to the North Bend sewer system, at an average rate of 48 gallons per capita per day (gpcd). A unit flow of 50 gpcd was chosen as the design criterion for future residential base wastewater flows for this facilities plan, providing a contingency factor for planning. The selected rate is within the range of unit flows reported in *Updated Planning Assumptions for Wastewater Flow Forecasting* (King County, 2014b), which indicates that winter water use averages 46 gpcd in Seattle and 56 gpcd in other areas of King County. This empirically derived unit flow rate for the City of North Bend is significantly lower than the 80 gpcd value used in the 1996 Treatment Plant Engineering Report, 2001 Sewer Plan and ULID 6 pipeline and pump station design.

Commercial Base Flow Design Criteria

The City's utility billing records show that commercial sources contribute a total base flow of 678 ERUs. This equals 1,743 PEs, equivalent to 19.4 percent of the total planning area residential population of 8,972. The largest commercial source is a grocery store that discharges about 3,500 gpd, or 28 ERUs. The

following design criteria were established for estimating commercial base wastewater flows for this facilities plan:

- The commercial base flows are estimated so commercial population equivalents equal 19.4 percent of the total City and UGA residential population.

- The distribution of future commercial flows among sewer system sub-basins and land use zones is estimated assuming a base flow of 20 gpd per employee or 0.1 gpd per square foot of floor area, with floor area ratios based on zoning as described in Section 2.1.

- Flows from individual future commercial projects will be estimated on a case-by-case basis at the time they are developed, using appropriate unit flow criteria, such as unit flows per employee and other unit criteria from the Washington Department of Ecology's *Criteria for Sewage Works Design* (Ecology, 2008), also known as the Orange Book. This includes unit flows such as the following:

    - Hotels (rooms only) – 130 gpd/room
    - Nursing homes – 200 gpd/bed
    - Elementary schools – 10 gpd/person
    - Restaurants – 50 gpd/seat

Industrial Base Flow Design Criteria

Industry is different from commercial development because wastewater can be generated from manufacturing processes. Important factors in estimating industrial wastewater flows are the type and size of industry operations, manufacturing techniques, and whether on-site pretreatment is provided. These factors can combine to produce considerable variation in industrial wastewater discharge rates and quality. North Bend has no industrial users that meet the EPA's definition of a significant industrial user (40 CFR 403): one that discharges 25,000 gpd or more of process wastewater, generates 5 percent or more of the wastewater treatment plant dry-weather flow or load, has the potential to adversely affect the treatment plant's performance, or is subject to EPA pretreatment standards.

If an industry proposes to locate in North Bend in the future, then the City should notify Ecology and require an engineering report to evaluate the industry's impact on the wastewater system, as outlined in WAC 173-240-130 and pretreatment requirements, as outlined in 40 CFR 403. The City is not obligated to accept industrial waste. Ecology has permitting authority for industrial sewer users, not North Bend, and the City should require waste discharging monitoring reports if industrial users are permitted

Peaking Factors

The base residential and commercial unit flows provide estimates for an annual average of base flow. The following peaking factors are applied to the annual average flow to estimate higher flow levels:

- Maximum-month flow peaking factor = 1.2 (based on monthly winter water use records)
- Peak-day flow peaking factor = 1.6 (based on dry-weather records, excluding dry-weather I/I)
- Peak-hour flow peaking factor:
  - In the collection system – 4 (based on peaking factors recommended in Ecology's Orange Book for upstream basins in collection systems).
  - At the treatment plant – 2.5 (based on diurnal flow records at the North Bend treatment plant and the minimum peaking factor recommended in Ecology's Orange Book).

Assumed 2015 Base Flows

Using the design criteria described above the 2015 base flow values used as a starting point for future flow projections are as shown on Table 2-7.

TABLE 2-7

Assumed 2015 Base Flows Used for Flow Projections

	Calculation	Result
Average Base Flow	2015 Population Equivalent (5,890 (1)) * 50 gpcd unit flow criterion	294,500 gpd
Maximum-Month Base Flow	Average Base Flow * Peaking Factor (1.2)	353,400 gpd
Peak-Day Base Flow	Average Base Flow * Peaking Factor (1.6)	471,200 gpd
Peak-Hour Base Flow	Average Base Flow * Peaking Factor (4, for collection system) Average Base Flow * Peaking Factor (2.5, for treatment plant)	1,178,000 gpd (collection system) 736,250 gpd (treatment plant)

(1) From Table 2-6.

2.2.3 INFILTRATION AND INFLOW

Infiltration and inflow (I/I) are sources of water other than sanitary sewage entering the sewer system:

- Infiltration is groundwater that enters the system underground, through cracks or joints. Daily volumes of sewer system infiltration fluctuate with seasonal changes in groundwater depths, ranging from low flows in late summer to very high sustained flows in wet weather. With rising groundwater levels during the wet season, a greater portion of the system becomes submerged. Infiltration from private side sewer laterals is generally acknowledged as one of the most significant contributors to this flow source, particularly in older systems.

- Inflow is water entering the sewer collection system from street and area drains, catch basins, manhole covers, roof downspouts, and building foundation drains.

North Bend's wastewater system must have capacity for both base flow and I/I, which occurs in all sanitary sewer systems in western Washington. The City has taken steps to control I/I for many years. The City conducted I/I studies in 1974, 1986 and 1997, and constructed improvements to reduce I/I from 1998 to the early 2000s to comply with an Ecology consent order.

The City's total wastewater flow rate is significantly affected by I/I. The rainfall and flow graph in Figure 2-4 shows that flow at the treatment plant increases with prolonged rainfall; data in the graph are from the City's treatment plant discharge monitoring reports and Weather Underground's Silver Creek Rain Gage, about eight blocks east of the plant near Ogle Avenue NE and NE 8th Street.

Estimated Current I/I

I/I is commonly evaluated as a unit flow per acre of contributing area. The per-acre unit I/I in gallons per acre per day (gpad) was estimated based on flow data for the past six years for average dry-weather flow, maximum-month flow, peak-day flow, and peak-hour flow. I/I was calculated from the total flow data by subtracting the assumed 2015 base flow (see Table 2-7). The result was then divided by the contributing service area of 796 acres. Results are presented in Table 2-8.

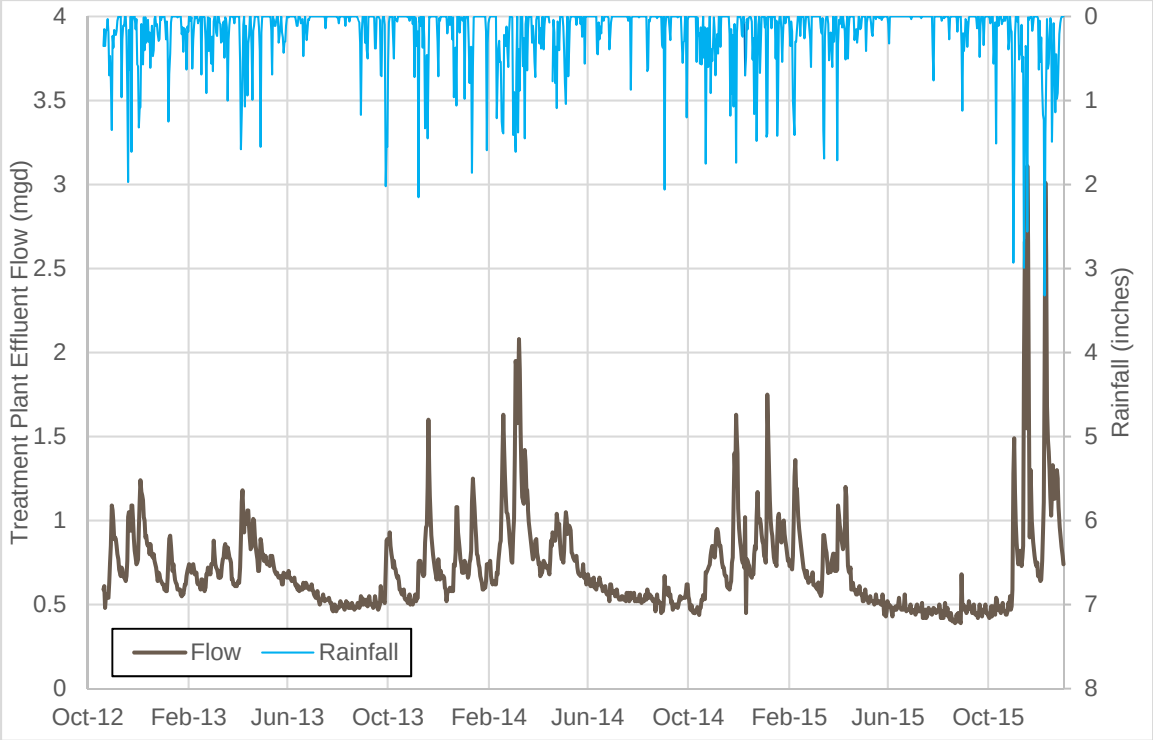


FIGURE 2-4

Historical Daily Flow and Rainfall, 2013 through 2015

TABLE 2-8

Recorded I/I Flows, 2000 through 2015

	Average Dry-Weather Flow	Maximum-Month Flow	Peak-Day Flow	Peak-Hour Flow
Date of Recorded Event	Summer 2014	March 2014, November 2015, December 2015	Nov. 17, 2015	Nov. 17, 2015
Total Recorded Flow	0.53 mgd	1.19 mgd	3.11 mgd	3.8 mgd
Calculated I/I Flow (1)	0.24 mgd	0.84 mgd	2.64 mgd	3.06 mgd
Unit I/I Flow (2)	296 gpad	1,051 gpad	3,315 gpad	3,849 gpad

(1) I/I flow calculated as total recorded flow minus the base flow values listed in Table 2-7.
(2) Unit I/I flow calculated as I/I flow divided by the service area of 796 acres.

Assessment of Current I/I Against Existing Standards

EPA Standards for Excessive Infiltration and Excessive Inflow

The U.S. Environmental Protection Agency sets standards for defining excessive infiltration and excessive inflow. When infiltration or inflow exceeds these standards, federal financing eligibility requires an analysis of ways to manage the high flows. The standards are as follows (EPA, 1985):

- Infiltration is excessive if the average daily flow per capita (excluding industrial and commercial flows from individual sources contributing 50,000 gpd or more) is 120 gpcd or more over a 7- to 14-day dry period during seasonal high groundwater. This amount allows for 70 gpcd of domestic wastewater base flow and 50 gpcd of infiltration (EPA, 1984).

- Inflow is excessive if the total daily flow (excluding industrial and commercial flows from individual sources contributing 50,000 gpd or more) during periods of significant rainfall exceeds 275 gpcd.

The summary of recent seasonal I/I flows presented in Table 2-8 indicates that I/I is a year-round problem for North Bend. Summer I/I from groundwater infiltration is 45 percent of average dry weather flow to the treatment plant, and winter I/I is 70 percent of maximum month flow to the plant. Table 2-9 and Table 2-10 summarize the largest infiltration and inflow events, respectively, in North Bend in the last six years. The data indicate that North Bend wastewater flows exceeded the 120-gpcd infiltration standard by 44 percent in January 2015 and exceeded the 275-gpcd inflow standard by 192 percent in December 2015.

TABLE 2-9

North Bend Peak Infiltration Events and EPA Criteria

	9-Day Dry Period with Seasonal High Groundwater, January 6 to 14, 2015	**11-Day Dry Period with Seasonal High Groundwater, May 1 to 11, 2013**
Prior Rainfall	2.8 inches in 2 days before dry period	2.3 inches in 4 days before dry period
Sewered Population Equivalent	5,890	5,630 (1)
Average Daily Flow	1.02 mgd average over 9 days	0.76 mgd average over 11 days
Unit Flow	173 gpcd	135 gpcd
EPA Infiltration Standard	**120 gpcd**	**120 gpcd**

(1) 2013 sewered population equivalent estimated from 2015 estimate assuming 2013 through 2015 change equivalent to that of total city population, as shown in Table 2-2.

TABLE 2-10

North Bend Peak Inflow Events and EPA Criteria

	Significant Rain, Jan. 5, 2015	Significant Rain, March 9, 2014	Significant Rain, Nov. 17, 2015	Significant Rain, Dec. 9, 2015
Rainfall	2.8 inches rain in 2 days	8.5 inches rain in 9 days	10.4 inches in 12 days	8.1 inches in 7 days
Sewered Population Equivalent	5,890	5,875 (1)	5,890	5,890
Average Daily Flow	1.75 mgd	2.08 mgd	3.11 mgd	3.01 mgd
Unit Flow	297 gpcd	354 gpcd	528 gpcd	511 gpcd
EPA Inflow Standard	**275 gpcd**	**275 gpcd**	**275 gpcd**	**275 gpcd**

(1) 2014 sewered population equivalent estimated from 2015 estimate assuming 2014 through 2015 change equivalent to that of total city population, as shown in Table 2-2.

King County and Previous North Bend I/I Design Criteria

Table 2-11 compares the recent peak-hour I/I unit flow from North Bend flow data to I/I design criteria established by King County and in previous North Bend studies. North Bend's peak-hour I/I rates from 2009 to 2015 are about the same as the gravity sewer design criteria proposed in the 2001 Sewer Plan and higher than all the other design criteria considered. The 1,100-gpad rate used for the 2007 ULID 6 design was used for many years to estimate peak I/I in northwest Washington, until it was superseded by new King County I/I criteria in 2014.

TABLE 2-11

I/I Design Criteria Comparison

	Peak-Hour I/I
2009–2015 City of North Bend I/I Flows	3,849 gpad
2007 ULID 6 Design Criteria for Gravity Sewers	1,100 gpad
2001 Sewer Plan I/I Criteria for Existing Gravity Sewers	3,732 gpad
2001 Sewer Plan I/I Criteria for Future Vacuum Sewers	2,040 gpad
2014 King County Criteria (King County, 2014b)	
New Sewers	2,000 gpad
20-Year-Old Sewers	2,300 gpad
50-Year-Old Sewer	2,600 gpad

I/I Design Criteria for This Facilities Plan

Facility plan design criteria for I/I are summarized in Table 2-12 and were selected as follows:

- I/I in existing sewers is assumed to continue throughout the 20-year planning period at the current levels shown in Table 2-8. This assumes the City will implement an annual I/I maintenance program to prevent existing I/I from increasing, as discussed in Section 5.1.

- I/I for new sewers is assumed to be as follows:

    - A new-sewer peak-hour I/I rate of 2,000 gpad is assumed, based primarily on King County criteria. This represents a realistic level of I/I for new sewers in western Washington. Based on the projected sewered population for 2036 (Table 2-3) and the assumed 2036 service area of 1,255 acres, this value would be equivalent to 175 gpcd, significantly below EPA's 275 gpcd criteria for excessive peak-hour inflow.

    - Dry-weather, maximum-month and peak-day I/I unit flows for new sewers were calculated assuming that the ratio of each of those flows to the peak-hour flow is approximately the same as for existing sewers.

TABLE 2-12

I/I Design Criteria for Facility Plan

	Existing Sewers	New Sewers
Dry-Weather I/I Unit Flow	296 gpad	150 gpad
Maximum-Month I/I Unit Flow	1,051 gpad	520 gpad
Peak-Day I/I Unit Flow	3,315 gpad	1,740 gpad
Peak-Hour I/I Unit Flow	3,849 gpad	2,000 gpad

2.2.4 PROJECTED FUTURE FLOWS

Base Wastewater Flows

Table 2-13 shows projections of base wastewater residential and commercial flows based on the growth projections and the selected design criteria. Residential flows are based on the total sewered population equivalent in the UGA. The commercial base flows are estimated so that commercial population equivalents equal 19.4 percent of the total City and UGA residential population.

TABLE 2-13

Base Flow Projections

Year	Total Sewered Population Equivalent			Base Flow (mgd)		
	Residential	Commercial	Total	Residential	Commercial	Total
2015	4,147	1,743	**5,890**	0.21	0.09	**0.29**
2016	4,469	1,795	**6,264**	0.22	0.09	**0.31**
2017	4,794	1,848	**6,642**	0.24	0.09	**0.33**
2018	5,122	1,901	**7,023**	0.26	0.10	**0.35**
2019	5,452	1,954	**7,407**	0.27	0.10	**0.37**
2020	5,784	2,008	**7,792**	0.29	0.10	**0.39**
2021	6,117	2,062	**8,180**	0.31	0.10	**0.41**
2022	6,486	2,117	**8,603**	0.32	0.11	**0.43**
2023	6,855	2,171	**9,026**	0.34	0.11	**0.45**
2024	7,224	2,226	**9,450**	0.36	0.11	**0.47**
2025	7,593	2,280	**9,872**	0.38	0.11	**0.49**
2026	7,960	2,334	**10,294**	0.40	0.12	**0.51**
2027	8,326	2,388	**10,714**	0.42	0.12	**0.54**
2028	8,690	2,441	**11,131**	0.43	0.12	**0.56**
2029	9,051	2,494	**11,545**	0.45	0.12	**0.58**
2030	9,410	2,547	**11,957**	0.47	0.13	**0.60**
2031	9,765	2,598	**12,364**	0.49	0.13	**0.62**
2032	10,117	2,649	**12,767**	0.51	0.13	**0.64**
2033	10,465	2,700	**13,165**	0.52	0.14	**0.66**
2034	10,809	2,749	**13,558**	0.54	0.14	**0.68**
2035	11,148	2,798	**13,945**	0.56	0.14	**0.70**
2036	11,482	2,845	**14,327**	0.57	0.14	**0.72**
Future	22,000	4,274	**26,274**	1.10	0.21	**1.31**

Total Wastewater Flows

Projections of total flow to the treatment plant, including base flow and I/I, are presented in Table 2-14. Future dry-weather flows are estimated by adding existing dry-weather flow to new flows associated with growth, including base flows at 50 gpcd and I/I at 150 gpad. The maximum-month flow is projected to be reduced to 136 gpcd by the end of the 20-year planning period. This is greater than the EPA excessive infiltration standard of 120 gpcd for a dry period in the middle of the wet season. The peak-day flow is projected to be reduced to 336 gpcd by the end of the 20-year planning period, which exceeds the EPA excessive inflow standard of 275 gpcd for the peak day. These projections assume that the City will implement an annual I/I maintenance program as part of ongoing operation and maintenance activities, to prevent existing I/I from

increasing. Potential methods for addressing these excessive I/I flows are addressed in the collection system and treatment plant improvement discussions in Chapters 5 and 7 of this facilities plan.

2.3 WASTEWATER LOADS

Wastewater treatment facilities must be sized to have adequate capacity to treat expected pollutant loads to the treatment plant through the end of the planning period. Like wastewater flows, wastewater loads are projected using the projections of future population and development in combination with unit design criteria and peaking factors. The key pollutant loads of interest for planning are biochemical oxygen demand (BOD), total suspended solids (TSS), nutrients (nitrogen and phosphorus), and temperature. The sections below describe historical and projected future levels of these loads.

TABLE 2-14

Estimated Future Flows to Treatment Plant

Year	Total Sewered Population Equivalent	Dry-Weather Flow (mgd)	Maximum-Month Flow		Peak-Day Flow		Peak-Hour Flow (mgd)
			(mgd)	(gpcd)	(mgd)	(gpcd)	
2015	5,890	0.53	1.19	202	3.30	560	4.00
2016	6,264	0.55	1.22	195	3.37	537	4.09
2017	6,642	0.57	1.26	189	3.43	517	4.18
2018	7,023	0.60	1.29	184	3.50	499	4.27
2019	7,407	0.62	1.33	179	3.57	482	4.36
2020	7,792	0.64	1.36	175	3.64	467	4.45
2021	8,180	0.66	1.40	171	3.71	454	4.55
2022	8,603	0.69	1.43	166	3.78	440	4.64
2023	9,026	0.71	1.47	163	3.86	427	4.74
2024	9,450	0.74	1.51	159	3.93	416	4.84
2025	9,872	0.76	1.54	156	4.00	406	4.94
2026	10,294	0.79	1.58	154	4.08	396	5.04
2027	10,714	0.81	1.62	151	4.15	388	5.14
2028	11,131	0.84	1.66	149	4.23	380	5.24
2029	11,545	0.86	1.69	147	4.30	373	5.34
2030	11,957	0.88	1.73	145	4.38	366	5.44
2031	12,364	0.91	1.77	143	4.45	360	5.54
2032	12,767	0.93	1.80	141	4.52	354	5.63
2033	13,165	0.96	1.84	140	4.60	349	5.73
2034	13,558	0.98	1.88	138	4.67	344	5.83
2035	13,945	1.00	1.91	137	4.74	340	5.92
2036	14,327	1.02	1.95	136	4.82	336	6.02
Future	26,274	1.84	3.15	120	8.31	316	10.43

2.3.1 INFLUENT BOD LOADS

Historical BOD Load Data Quality Review

Currently, the BOD load in influent wastewater at the plant is measured once a week. Figure 2-5 shows measured BOD loads from 2006 to September 2015. Measured BOD loads increased gradually from 2006 to early 2010, with normal monthly swings, but changed significantly from February 2011 to July 2014. Thereafter BOD loads returned to a pattern similar to the 2006 to 2010 trend line.

A review of the treatment plant's sampling history led to a determination that the BOD data from 2011 through mid-2014 are inaccurate, based on the following:

- **February 2011 to early 2012 –** BOD measurements were low during this period, after the sewage sampler had been moved in 2010 from the old headworks to the new ULID 6 Pump Station wet well.[R] This may have been because samples from the wet well included partially settled sewage with reduced BOD. The sampler was moved to the new headworks channel in early 2012.

- **Early 2012 to October 2013 –** BOD measurements were high after the sampler was moved to the new headworks channel, likely because this channel conveyed return activated sludge from the clarifier as well as raw sewage. This effect was addressed in October 2013 by installing a new headworks gate to route return activated sludge through the standby headworks channel, separate from influent sewage flows.

- **October 2013 to July 2014 –** BOD measurements continued to be high after return activated sludge was excluded from the influent samples. An independent waste characterization study commissioned in March 2013 to check loads at the plant found that City BOD measurements were significantly high. The City identified problems with their instruments and dilution water used for the BOD test.[R] These issues were corrected by July 2014.[R]

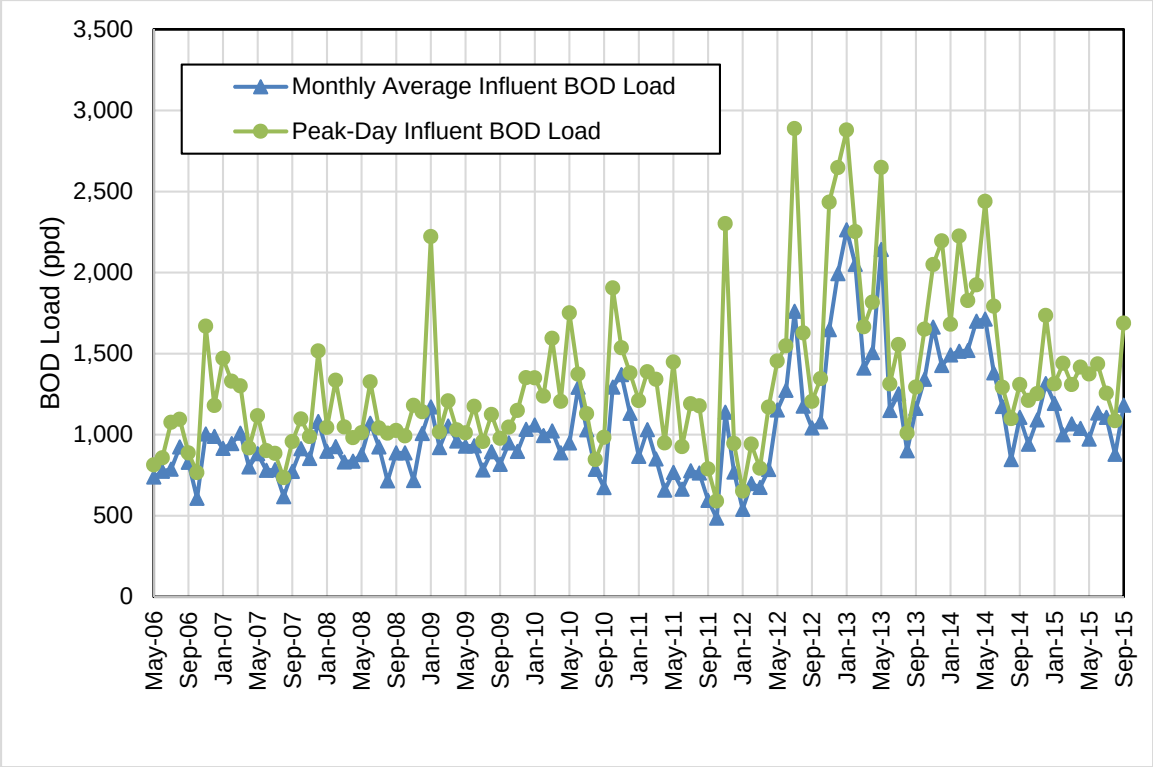


FIGURE 2-5

Historical Treatment Plant Influent BOD Loads

- In August and September 2015, an independent laboratory performed the BOD analyses for the treatment plant's monthly discharge monitoring reports. The results were consistent with plant BOD measurements since July 2014, and the BOD loads since July 2014 are in line with the 2006 to 2010 trend line.

BOD data since July 2014 are considered to provide a reasonable basis for planning. This conclusion is supported by City data on waste sludge production. The current sludge production is consistent with current BOD loads, whereas it was inconsistent with BOD data from 2010 to mid-2014. The historical BOD loads used for this facilities plan are summarized in Table 2-15.

TABLE 2-15

Historical BOD Data

Year	Annual Average BOD Load (ppd)	Maximum-Month BOD Load (ppd)	Maximum-Month BOD Peaking Factor	Peak-Day BOD Load (ppd)	Peak-Day BOD Peaking Factor
2006	831	1,004	1.21	1,669	2.01
2007	863	1,081	1.25	1,516	1.76
2008	881	1,070	1.21	1,325	1.50
2009	944	1,171	1.24	1,351	1.15
2010	1,040	1,370	1.32	1,905	1.83
2011–June 2014	**Bad Data**				
2014 July–December	1,079	1,315	1.22	1,735	1.61
2015	1,063	1,193	1.15	1,688	1.59

BOD Design Criteria for This Facilities Plan

For this facilities plan, future BOD loads to the treatment plant are estimated assuming a unit load of 0.2 pounds per capita per day (ppcd), which is consistent with Ecology Orange Book guidelines and North Bend's 2001 Sewer Plan. This unit loading is conservative because it is slightly higher than North Bend's recent average BOD load of 0.19 ppcd from November 2014 to March 2015 (the time period used to determine population equivalents discharging to the sewer system). The following peaking factors are applied to the annual average BOD load to estimate higher load levels (based on historical treatment plant influent flow data; see Table 2-15):

- Maximum-month peaking factor = 1.2
- Peak-day peaking factor = 1.6.

Future BOD Projections

Table 2-16 summarizes future BOD load projections, based on growth projections and the selected unit load design criteria. The 2015 loads calculated from this approach are slightly higher than the measured values for 2015, but are similar; the higher values provide a conservative measure for planning. The projections show that growth in the planning area will cause BOD loads to more than double by the end of the 20-year planning period.

TABLE 2-16

Projected Future Treatment Plant Influent BOD Loads

Year	Sewered Population Equivalents	Projected BOD Load (ppd)			Year	Sewered Population Equivalents	Projected BOD Load (ppd)		
		Annual Average	Max. Month	Peak Day			Annual Average	Max. Month	Peak Day
2015	5,890	1,178	1,414	1,885	2026	10,294	2,059	2,471	3,294
2016	6,264	1,253	1,503	2,005	2027	10,714	2,143	2,571	3,428
2017	6,642	1,328	1,594	2,125	2028	11,131	2,226	2,671	3,562
2018	7,023	1,405	1,685	2,247	2029	11,545	2,309	2,771	3,695
2019	7,407	1,481	1,778	2,370	2030	11,957	2,391	2,870	3,826
2020	7,792	1,558	1,870	2,494	2031	12,364	2,473	2,967	3,956
2021	8,180	1,636	1,963	2,618	2032	12,767	2,553	3,064	4,085
2022	8,603	1,721	2,065	2,753	2033	13,165	2,633	3,160	4,213
2023	9,026	1,805	2,166	2,888	2034	13,558	2,712	3,254	4,339
2024	9,450	1,890	2,268	3,024	2035	13,945	2,789	3,347	4,463
2025	9,872	1,974	2,369	3,159	2036	14,327	2,865	3,438	4,585
					Future	26,274	5,255	6,306	8,408

Table 2-17 shows projected BOD concentrations, based on projected BOD loads and treatment plant influent flows. Projected concentration will average around 125 mg/L during maximum-month flows early in the planning period, increasing to around 175 mg/L by the end of the planning period. At these concentrations, a well-run conventional secondary treatment plant should be able to comply with a permit requirement to reduce the influent concentration by at least 85 percent.

2.3.2 INFLUENT TSS LOADS

Historical TSS Loads

Influent concentrations of TSS are determined from analyses conducted on the same samples collected for BOD analyses. The historical TSS loads measured at the treatment plant from 2006 to September 2015 are summarized in Table 2-18 and Figure 2-6. TSS loads generally increased from 2006 to the present. This growth is similar to growth in BOD loads during this period, but TSS loads show less variability than BOD loads during the period from 2010 to July 2014 when BOD data appeared to be unreliable. The March 2013 waste characterization study found that City TSS measurements averaged 96 percent of the study's independent measurements; City measurements on individual samples ranged from 50 to 200 percent of the independent measurements.

TABLE 2-17

Projected Future Treatment Plant Influent BOD Concentrations

Year	Projected BOD Concentration (mg/L)		Year	Projected BOD Concentration (mg/L)	
	Dry-Weather Flow	Maximum-Month Flow		Dry-Weather Flow	Maximum-Month Flow
2015	267	119	2026	314	156
2016	272	123	2027	317	159
2017	278	127	2028	319	161
2018	282	130	2029	322	164
2019	287	134	2030	324	166
2020	291	137	2031	326	168
2021	295	141	2032	329	170
2022	300	144	2033	330	172
2023	304	147	2034	332	173
2024	307	150	2035	334	175
2025	311	153	2036	335	176
			Future	343	200

TABLE 2-18

Historical TSS Data

Year	Annual Average TSS Load (ppd)	Maximum-Month TSS		Peak-Day TSS	
		Load (ppd)	Peaking Factor	Load (ppd)	Peaking Factor
2006	514	661	1.29	839	1.63
2007	524	744	1.42	928	1.77
2008	528	627	1.19	801	1.52
2009	529	935	1.77	1,535	2.90
2010	618	823	1.33	1,149	1.86
2011	887	1,205	1.36	2,525	2.84
2012	917	981	1.07	2,080	2.27
2013	820	1001	1.22	2,307	2.81
2014	806	973	1.20	1,576	1.96
2015	923	1,263	1.37	1,876	2.03

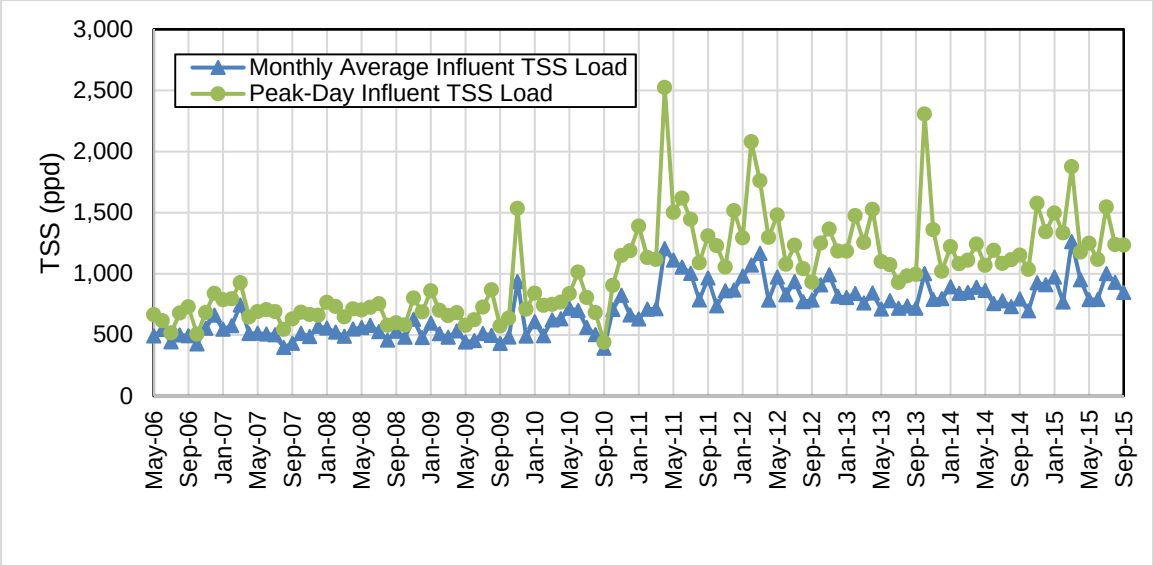


FIGURE 2-6

Historical Treatment Plant Influent TSS Loads

TSS Design Criteria for This Facilities Plan

For this facilities plan, future TSS loads to the treatment plant are estimated assuming a unit load of 0.2 ppcd, which is consistent with Ecology Orange Book guidelines and North Bend's 2001 Sewer Plan. This unit loading is conservative compared to North Bend's recent TSS loads, which averaged 0.16 ppcd from November 2014 to March 2015. The TSS peaking factors are assumed to be the same as those for BOD: 1.2 for maximum-month loads and 1.6 for peak-day loads. These peaking factors are similar to those for historical maximum-month loads and slightly lower than those for historical peak-day loads.

Future TSS Loads

Table 2-19 summarizes future TSS load projections, based on growth projections and the selected unit load design criteria. The 2015 annual average and maximum-month loads calculated from this approach are slightly higher than the measured values for 2015, but are similar; the higher values provide a conservative measure for planning. The projections show that growth in the planning area will cause TSS loads to more than double by the end of the 20-year planning period. Since the TSS estimating criteria are the same those for BOD, the projected future TSS loads and concentrations are the same as the BOD projections.

Table 2-20 shows projected TSS concentrations, based on projected TSS loads and treatment plant influent flows. Projected concentration will average around

125 mg/L during maximum-month flows early in the planning period, increasing to around 175 mg/L by the end of the planning period. At these concentrations, a well-run conventional secondary treatment plant should be able to comply with a permit requirement to reduce the influent concentration by 85 percent.

TABLE 2-19

Projected Future Treatment Plant Influent TSS Loads

Year	Sewered Population Equivalents	Projected TSS Load (ppd)		
		Annual Average	Maximum Month	Peak Day
2015	5,890	1,178	1,414	1,885
2016	6,264	1,253	1,503	2,005
2021	8,180	1,636	1,963	2,618
2026	10,294	2,059	2,471	3,294
2031	12,364	2,473	2,967	3,956
2036	14,327	2,865	3,438	4,585
Future	26,274	5,255	6,306	8,408

TABLE 2-20

Projected Future Treatment Plant Influent TSS Concentrations

Year	Projected TSS Concentration (mg/L)	
	Dry-Weather Flow	Maximum-Month Flow
2015	267	119
2016	272	123
2021	295	141
2026	314	156
2031	326	168
2036	335	176
Future	343	200

2.3.3 INFLUENT NUTRIENT LOADS

Nitrogen and phosphorus are the most common nutrients in municipal wastewater. They are important because they can stimulate algae growth in the receiving water. Non-oxidized forms of these nutrients, such as ammonia, can be toxic and deplete oxygen from the receiving water if dilution in the receiving water is not adequate. Typical parameters used to assess nutrients in wastewater are ammonia, nitrate, nitrite, total Kjeldahl nitrogen (TKN), orthophosphate, and total phosphorus (TP). TKN is a measure of the ammonia concentration plus organic nitrogen concentration. The NPDES permit limits ammonia discharges

from the plant from August through October. There are currently no permit limits on phosphorus discharges, but they likely will be included in the treatment plant's next NPDES permit, to be issued in 2018.

Historical Data

Influent concentrations of nutrients are not routinely measured, since such measurements are not required for process control or the plant's monthly discharge monitoring reports. The limited data set used for this analysis consists of 15 daily 24-hour composite samples taken during the 2013 wastewater characterization study. TKN concentrations ranged from 20 to 45 mg/L, with an average of 28 mg/L resulting in an average TKN loading of 0.044 ppcd. TP concentrations ranged from 1.9 to 3.4 mg/L, with an average of 2.8 mg/L. Average loading of TP was 0.0044 ppcd. These measurements are all within the typical range of domestic wastewater.

Nutrient Design Criteria for This Facilities Plan

Future average total Kjeldahl nitrogen (TKN) and total phosphorus (TP) unit loads are assumed to be 0.05 ppcd and 0.005 ppcd, respectively. These values are slightly higher than measured in the 2013 wastewater characterization study, but they are within standard industry ranges of 0.032 to 0.06 ppcd for TKN and 0.004 to 0.008 ppcd for TP. Design peaking factors for both nutrients are 1.2 for maximum month and 1.6 for peak day.

Future Nutrient Loads

TKN and TP load projections are shown in Table 2-21.

TABLE 2-21

Projected Future Treatment Plant Influent Nutrient Loads

Year	Sewered Population Equivalents	Projected TKN Loads (ppd)			Projected TP Loads (ppd)		
		Annual Average	Maximum Month	Peak Day	Annual Average	Maximum Month	Peak Day
2015	5,890	295	353	471	29	35	47
2016	6,264	313	376	501	31	38	50
2021	8,180	409	491	654	41	49	65
2026	10,294	515	618	824	51	62	82
2031	12,364	618	742	989	62	74	99
2036	14,327	716	860	1,146	72	86	115
Future	26,274	1,314	1,576	2,102	131	158	210

2.3.4 TEMPERATURE LOADS

The *Snoqualmie River Temperature Total Maximum Daily Load (TMDL)* (Washington Department of Ecology, 2011) calculated the allowable temperature of the North Bend wastewater treatment plant effluent discharge for various combinations of river flow and effluent flow, based on the criterion that the plant thermal load to the river may not increase the river water temperature 0.3 degrees C or more. The TMDL set the following effluent temperature load allocations for the North Bend wastewater treatment plant discharge to the river:

- 23.5 degrees C from June through August and 21.8 degrees C in September for a wastewater treatment plant flow of 0.65 mgd (the annual average flow at the time of the study in 2011)

- 18 degrees C from June through August and 17.6 degrees C in September for a future treatment plant flow of 2.4 mgd.

Historical Data

According to the TMDL report, the maximum effluent temperature at the treatment plant during June, July and August historically ranged from 20 degrees C to 21 degrees C, but it increased to 22 degrees C in 2009 and 2010. The TMDL report concluded that the North Bend treatment plant was operating within the allowable temperature allocation limits and would not require mitigation until effluent flow approaches 0.81 mgd, provided that the temperature of the effluent remains at 22 degrees C. The report noted that if effluent temperature were to increase to 23 degrees C, then mitigation would be needed when effluent flow during the critical period reaches about 0.70 mgd.

A recent temperature monitoring study examined water temperatures from June through October of 2014. The study recorded "1-D_{max}" effluent temperatures (daily maximum temperatures) and "7-D_{max}" river temperatures (the average of seven consecutive measures of daily maximum temperatures). The plant effluent temperature peaked between 20 degrees C (68 degrees F) and 21 degrees C (69.8 degrees F). The river water temperatures met the criterion of 16 degrees C (60.8 degrees F) for most of the observed period, although some measurements exceeded the criterion in July and August (Tetra Tech, 2015a). Additional temperature monitoring from June through October 2015 showed that plant effluent temperature peaked between 20 degrees C and 21 degrees C again, despite unusually dry conditions with warmer raw sewage.

Projected Future Treatment Plant Thermal Loading

A study of North Bend treatment plant flow temperatures determined the effluent thermal load on the South Fork of the Snoqualmie River in the summer of 2014

(Tetra Tech, 2015b). Additional study for this facilities plan determined the thermal load in the summer of 2015 and projected future thermal load through 2036, based on the estimated future dry-weather sewage flows to the treatment plant (Table 2-14). "Excessive thermal load" was calculated as the amount of thermal loading, in British thermal units (BTU), that would cause a rise in river temperature of 0.3 degrees C or more (0.3 degrees C is the plant's "thermal load allocation"). Figure 2-7 shows the growth projections for excessive thermal loading over the course of a typical 24-hour period (diurnal curves).

The projections indicate the following:

- In 2014 and 2015, the instantaneous thermal load never exceeded the thermal load allocation over the course of the 24-hour period.
- 2019 is the first year that the peak instantaneous thermal load reaches the thermal load allocation.
- In 2025, the projected thermal load exceeds the thermal load allocation for a few hours in the early afternoon.
- By 2035, the projected thermal load exceeds the thermal load allocation from about 10:00 a.m. until 10:00 p.m.
- At buildout, the projection shows thermal load exceeding the thermal load allocation for all but a few hours in the early morning.

Based on the thermal loading projections and the NPDES limits for thermal loading, projections have been developed of total future effluent flow and the amount of flow in excess of the permit limit. Table 2-22 shows the amount of excess effluent flow (excess thermal load) that would exactly achieve the temperature limit. Actual storage volumes will be larger to provide a 0.1 degrees C buffer and safety factor for meeting the temperature limit.

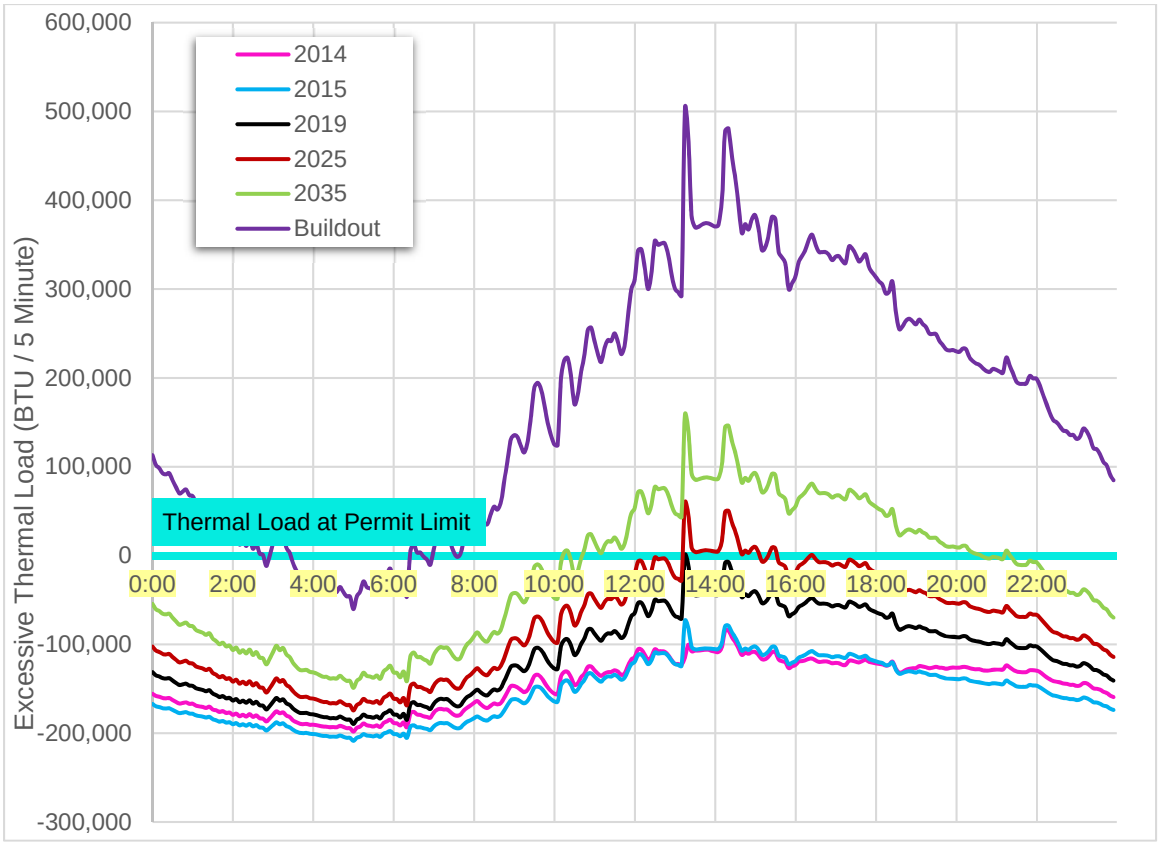


FIGURE 2-7

Projected Diurnal Curve for Excessive Thermal Load, 2015 to Buildout, 3 Percent Growth After 2016

TABLE 2-22

Volume Projections for Effluent Flow and Excess Thermal Load, 3 Percent Growth After 2016

Year	Estimated Average Effluent Flow During Dry Weather (mgd)	Effluent with Excessive Thermal Load (gallons/day)	Year	Estimated Average Effluent Flow During Dry Weather (mgd)	Effluent with Excessive Thermal Load (gallons/day)
2014	0.55	0	2026	0.79	8,316
2015	0.44	0	2027	0.81	13,947
2016	0.55	0	2028	0.84	20,556
2017	0.57	0	2029	0.86	28,119
2018	0.60	0	2030	0.88	36,017
2019	0.62	0	2031	0.91	44,113
2020	0.64	125	2032	0.93	52,977
2021	0.66	539	2033	0.96	62,513
2022	0.69	1,121	2034	0.98	72,922
2023	0.71	1,815	2035	1.00	84,140
2024	0.74	2,697	2036	1.02	96,005
2025	0.76	4,820	Future	1.84	706,935

2.4 FUTURE EFFLUENT LIMITS FOR RIVER DISCHARGE

The North Bend Wastewater Treatment plant discharges treated and disinfected effluent to the South Fork of the Snoqualmie River approximately 2.2 miles upstream of its confluence with the mainstem of the Snoqualmie River. After running several miles to the northwest, the Snoqualmie River merges with the Skykomish River to form the Snohomish River, which discharges to Puget Sound at Port Gardner Bay located between Everett and Marysville. Documented beneficial uses of the waters in the South Fork and the mainstem of the Snoqualmie River downstream of the confluence with the South Fork include: Recreation (i.e., extraordinary primary contact), Municipal and Agricultural Water Supply, and Wildlife Habitat (including fish and non-fish organisms). The Snoqualmie River watershed provides an important spawning and rearing habitat for several salmonid fish species including the threatened fall Chinook, steelhead, and bull trout populations. Chinook are known to spawn heavily in the mainstem downstream of Snoqualmie Falls.[R]

Planning for wastewater treatment plant improvements requires a consideration of what limits may be imposed on future treated effluent from the plant. The wastewater treatment plant's existing NPDES permit requires plant effluent to meet standard secondary treatment requirements for BOD, TSS and fecal

coliform, comply with TMDLs for temperature and dissolved oxygen, and achieve water quality criteria at the edge of the outfall mixing zone. These limits are summarized in Section 1.4.2 and further described in Appendix A. This section evaluates potential future limits for the river discharge options. Considerations related to effluent reuse are presented in the following section.

2.4.1 OXYGEN DEMAND LIMITS

The treatment plant's NPDES permit limits total oxygen demand in the effluent to 164 ppd for average dry-weather conditions (August to October). For this limit, total oxygen demand is measured as NBOD+CBOD. NBOD load can be calculated from ammonia (NH_3) concentration. Assuming 1 mg/L of ammonia in the effluent (a concentration readily achieved by common treatment technology) and using projections for future flows, the allowable future CBOD concentrations were estimated as shown on Table 2-23 for the following conditions:

- The average flow over the 3-month dry-weather period and the average flow during the maximum-flow month of the dry-weather period. Plant records show that the maximum-month dry-weather flow is 1.2 times the average for the 3-month period.

- Projected flows for 2036 and for a future time when all residences and businesses in the planning area will be connected to the sewer system.

TABLE 2-23

Effluent CBOD and NH_3 Required for Oxygen TMDL Compliance

	Average Dry-Weather Flow		Maximum-Month Dry-Weather Flow	
	2036	**Future**	**2036**	**Future**
Plant Influent Flow (mgd)	1.0	1.8	1.2 (2)	2.2 (2)
NH_3 Concentration (mg/L)	1	1	1	1
NH_3 Load (ppd)	8.3	15	10	18
NBOD Load (ppd) (1)	18	32	22	40
NBOD+CBOD Load Permit Limit (ppd)	164	164	164	164
Maximum CBOD Load (ppd)	146	132	142	124
Maximum CBOD Concentration (mg/L)	**17.5**	**8.8**	**14.2**	**6.8**

(1) NBOD load = 2.155 x NH_3 load.
(2) Maximum-month dry-weather flow = 1.2 x average dry-weather flow, based on plant flow records for August to October 2013.

The CBOD concentration that would need to be achieved in 2036 based on these estimates would be achievable with conservatively designed secondary treatment

technology. The lower concentrations required at future development would require supplemental treatment with filtration or chemical addition. The maximum allowable CBOD effluent concentration could be raised if the ammonia concentration is reduced.

2.4.2 PHOSPHORUS LIMITS

Ecology's 1994 TMDL study for the Snoqualmie River indicates that North Bend treatment plant effluent causes excessive levels of phosphorus in the South Fork of the Snoqualmie River and recommends phosphorus limits on the effluent from August through October. Ecology has not yet implemented the phosphorus limits, but has indicated that the plant's next NPDES permit, to be issued in 2018, will include the limits. This would set discharge limits for soluble reactive phosphorus (SRP) at 2 to 3 ppd for the maximum day and 1 to 1.5 ppd for the dry-weather average day. Table 2-24 summarizes the estimated allowable average effluent SRP concentrations for average-day limits (based on the full three-month dry-weather period and on the dry-weather maximum month). Reducing phosphorus to these concentrations would require chemical treatment and filtration. An alternative approach for reducing phosphorus load to the river would be to reuse a portion of the effluent for irrigation through land application from August through October.

TABLE 2-24

Effluent SRP Required for Proposed Phosphorus TMDL Compliance

	Average Dry-Weather Flow		Maximum-Month Dry-Weather Flow	
	2036	**Future**	**2036**	**Future**
Effluent Flow to Outfall (mgd)	1.0	1.8	1.2 (1)	2.2 (1)
SRP Load Permit Limit (ppd)	1	1	1	1
Maximum SRP Concentration (mg/L)	**0.12**	**0.067**	**0.10**	**0.055**

(1) Maximum-month dry-weather flow = 1.2 x average dry-weather flow, based on plant flow records for August to October 2013.

2.4.3 WATER QUALITY CRITERIA

Water quality criteria for outfalls establish maximum concentrations of pollutants that are allowed to be present in the river at the edge of the outfall mixing zone (the region of the river around the outfall where initial dilution of the effluent with river water occurs). An analysis of treatment plant effluent flows and river flows is used to calculate dilution factors. A dilution factor is calculated by dividing the portion of river flow rate allowed for dilution by the treatment plant flow rate. Dilution factors are calculated for dry-weather conditions, when river flows are

lowest so effluent dilution is lowest. Different effluent flows (average or maximum-day) and different portions of river volume are used to calculate the dilution factor for different types of water quality impacts: acute or chronic impacts on aquatic life, and carcinogenic or non-carcinogenic impacts on human health. Once dilution factors are calculated, pollutant concentrations at the edge of the mixing zone can be predicted based on historical effluent water quality data.

Ecology spreadsheets were used to evaluate North Bend treatment plant effluent dilution in the receiving water, the South Fork Snoqualmie River, for 2036 and for future full connection to the sewer system. The analysis used flow data developed for this facilities plan and historical river flow data to estimate dilution factors. Based on the calculated dilution factors, maximum predicted and allowable pollutant concentrations at the edge of the mixing zone were calculated, based on available information on background water quality in the South Fork Snoqualmie River and historical pollutant concentrations in the treatment plant effluent. Treatment plant effluent concentration data were taken from Ecology's fact sheet for the 2013 NPDES permit (see Appendix B), which identifies chemicals of concern and summarizes historical plant data for each. The mixing zone analysis spreadsheets are provided in Appendix C.

The predicted 2036 dry-weather flow of 1.02 mgd (see Table 2-14) corresponds to a dry-weather maximum-month flow of 1.2 mgd. For this flow, the estimated dilution provided by the existing outfall during the three-month dry-weather period, based on the spreadsheet analysis, is as follows:

- Acute Aquatic Life Dilution Factor = 1.8
- Chronic Aquatic Life Dilution Factor = 6.8
- Carcinogenic Human Health Dilution Factor = 6.1
- Non-Carcinogen Human Health Dilution Factor = 8.2

Using these dilution factors, maximum pollutant concentrations were estimated for all pollutants identified as chemicals of concern in Ecology's 2013 NPDES permit fact sheet. Table 2-25 and Table 2-26 summarize the concentrations of pollutants at the edge of the outfall mixing zone, the corresponding water quality criteria, and whether there is a reasonable potential that there will be violations of the water quality criteria.

TABLE 2-25

Aquatic Life Reasonable Potential Analysis for 2036

	Acute Concentration (µg/L)		Chronic Concentration (µg/L)		Reasonable Potential to Cause Violations of Water Quality Standards?
	Water Quality Criterion	Predicted Maximum Concentration at Edge of Outfall Mixing Zone	Water Quality Criterion	Predicted Maximum Concentration at Edge of Outfall Mixing Zone	
Ammonia as Total NH_3	21,945	567	1,605	148	No
Arsenic (dissolved)	360	10.3	190	3.3	No
Chromium (Tri)	276	0.20	56	0.14	No
Copper	7.72	3.76	3.42	1.9	No
Lead	25.6	0.55	0.53	0.14	No
Mercury	2.1	0.008	0.012	0.003	No
Nickel	696	1.66	48	0.67	No
Selenium	20	1.72	5	0.45	No
Silver	0.82	0.11	—	0.03	No
Zinc	56.2	47.1	31.8	19.6	No

TABLE 2-26

Human Health Reasonable Potential Analysis for 2036

	Concentration (µg/L)		Reasonable Potential to Cause Violations of Water Quality Standards?
	Water Quality Criterion	Predicted Maximum Concentration at Edge of Outfall Mixing Zone	
Antimony	14	0.066	No
Mercury	0.14	0.0004	No
Nickel	610	0.29	No
Selenium	170	0.15	No

The results indicate that there is no reasonable potential for violation of water quality standards for the 2036 effluent flows. Therefore, it is not expected that effluent limits will be established for these constituents. A similar analysis for the future condition with full connection to the sewer system, included in Appendix C, found the same result for that future condition.

2.5 EFFLUENT REUSE CONSIDERATIONS

Reclamation and reuse of treated wastewater is becoming increasingly common in Washington. Reclaimed wastewater is used for a variety of end uses, including landscape and golf course irrigation, industrial reuse, stream flow augmentation, and groundwater recharge. Treatment requirements vary widely, depending on the end use as well as local requirements.

2.5.1 RESTRICTIONS RELATED TO WATER QUALITY

The most likely types of reuse for treated effluent from the North Bend treatment plant are subsurface stream flow augmentation, groundwater recharge and irrigation. Applicable effluent limits for these uses would be as follows:

- **Subsurface Stream Flow Augmentation –** The 2015 Temperature Reduction Study considered this type of reuse to discharge excess warm effluent to the ground next to the river and cool it with groundwater as it flows to the river. It is assumed that effluent limits for this reuse would be similar to those for discharge to the existing outfall, with some adjustment because the effluent would be filtered by the soil and cooled and diluted by groundwater before it enters the river.

- **Groundwater Recharge –** Effluent limits for this reuse would be established to protect the high quality potable groundwater in North Bend. This would require treatment to meet Class A reclaimed water standards and treatment to lower total inorganic nitrogen to about 5 mg/L or less, depending on existing background levels of nitrogen. The treatment would be most effective in the dry season, because recharge by surface percolation could be restricted due to high groundwater level in the wet season.

- **Irrigation –**
  - **Irrigation of Public Spaces –** Effluent limits for effluent application to public spaces would require treatment to meet Class A reclaimed water standards and would restrict irrigation to agronomic rates consistent with the rate of water and nutrient uptake by the vegetation.

  - **Irrigation of Fodder or Fiber Crops –** Effluent limits for effluent application to these crops would require secondary treatment and restrict irrigation to agronomic rates. Access to the irrigation areas would be restricted; the site would be off limits to the public.

2.5.2 RESTRICTIONS RELATED TO WATER RIGHTS

In North Bend, disposition of treated wastewater is constrained by water rights restrictions. An estimated 93 percent of the current base sewage flow is derived from the City's Centennial Well and Mount Si Springs water sources; the remaining 7 percent is derived from water sources operated by the Sallal Water Association. Water rights for these sources have the following restrictions:

- **Centennial Well –** Treatment plant effluent derived from Centennial Well water is not available for reuse, because the water right agreement requires that effluent flows to the Snoqualmie River be at least 60 percent of the water volume pumped from the well. The 60-percent criterion is based on historical effluent flows during summer low-flow conditions and recognition that some of the well water is returned to groundwater by septic tank drainfields and some of the treatment plant effluent is derived from infiltration of groundwater into sanitary sewers. The City augments the treatment plant effluent flow to the river by piping purchased water from the Cedar River watershed to the South Fork of the Snoqualmie River. This mitigates for water use when minimum instream flows are not met at the downstream Snoqualmie River gauges. Effluent reuse for irrigation would reduce treatment plant effluent flow, making it more difficult to meet the 60 percent criterion.

- **Mount Si Springs –** All sewage derived from Mount Si Springs water may be available for reclamation and reuse January through June and October through December. Water rights restrictions may prohibit use of this source for water supply in July, August and September.

- **Sallal Water Association –** All sewage derived from Sallal Water Association water is available for reclamation and reuse. This is estimated to be 20,000 gallons per day in 2015. This quantity is not expected to increase significantly, because future growth is expected to be supplied by water from City sources, not from Sallal.

2.5.3 POTENTIAL END USES

Potential end-uses of reclaimed water during the summer low-flow period include the following:

- There is currently some non-consumptive reuse at the treatment plant for hose bibs, spray washing of equipment, and other general non-potable uses. This reuse is non-consumptive, except for incidental evaporation, because the reused water is ultimately discharged as plant effluent to the river.

- Industrial water use in North Bend is minimal, so substantial industrial use of reclaimed water is not possible.

- Stream-flow augmentation is the most promising water reuse option in North Bend, considering the water rights restrictions. It is identified in the City's 2015 Temperature Reduction Study as a promising alternative for meeting the temperature TMDL when dry-weather effluent flows exceed 1.4 mgd.

- Groundwater recharge would be possible to supplement low river flows during the summer. However, this type of reuse would require treatment to meet Class A reclaimed water standards and would be much more expensive than discharge of secondary effluent to the river through an outfall or by subsurface stream flow augmentation.

- Although water rights restrictions appear to preclude irrigation reuse in North Bend, there are opportunities for landscape irrigation if water rights can be modified to allow this. Public parks where irrigation reuse could be feasible include Torguson Park (15 acres) and Tollgate Park (38 acres). At a typical irrigation application rate of 1 inch per week, 20,000 gpd of wastewater can irrigate 5 acres. At this rate, 60,000 gpd would be sufficient for irrigation of Torguson Park and 200,000 gpd would be sufficient for irrigation of Tollgate Park. Irrigation of both parks with a total of 260,000 gpd would use about 50 percent of the current dry-weather wastewater flows and 25 percent of the projected 2036 dry-weather flows.

CHAPTER 3

EXISTING COLLECTION SYSTEM

3.1 HISTORY OF SYSTEM DEVELOPMENT

Figure 3-1 shows the extent of the existing North Bend sanitary sewer collection system. The system has seen progressive expansion since the first sewer facilities were constructed in early 1950s. Initial sewer installation in 1950 and 1951 consisted of approximately 16,000 feet of sewers serving the core downtown area. These sewers were constructed in conjunction with construction of a primary wastewater treatment facility, replacing the previous common use of on-site disposal systems or direct discharge to the South Fork Snoqualmie River. Most of the side sewer connections in the core area were installed over the next two years.

By 2001, when the previous Sewer Plan was prepared, the collection system almost doubled in size. This expansion took place east and south of the core area. The most extensive additions were in the commercial area west of the South Fork Snoqualmie River adjacent to the South Fork/I-90 Interchange. These improvements include the South Fork Lift Station and its force main over the Snoqualmie River, also serving the North Bend Premium Outlets mall and the Nintendo distribution center.

During this period, problems caused by excessive I/I were identified and a number of investigations were made. A 1997 I/I study completed in response to a Department of Ecology consent decree (DE 95WQ-N354) focused on the downtown core area where sewer lines were aging. The original mainline sewers were constructed using corrugated metal pipe (CMP) and concrete pipe with rigid joints. The study recommended removal of excessive I/I by rehabilitation of manholes and replacement of CMP and concrete sewers in two phases:

- Phase I, implemented in 1998, replaced approximately 5,500 feet of mainline sewers and 80 side sewers in the right of way, and 40 side sewers on private property. Ecology agreed to require replacement of only the side sewers with flows greater than 1,400 gallons per day. For an average lot size of 0.2 acres in the downtown core, that equates to 7,000 gallons per acre per day.

- Phase II, completed in 2003, replaced approximately 2,700 feet of mainline sewer and 70 side sewers to the edge of the right of way.

In 1999, the City adopted a policy to provide sewer service in future development areas using vacuum sewers. This policy was based on a study comparing construction and operational costs of vacuum sewers and gravity sewers. The

proposed systems rely on vacuum stations to draw wastewater from parcels and pump it downstream by pressurized force mains. The 2001 Sewer Plan also assumed that vacuum sewer systems would be used for future expansion.

The City formed ULID 6 in 2007 to expand the collection system in the Tanner and Truck Town areas. The ULID 6 area of coverage was expanded in 2008. In keeping with the 2001 Sewer Plan, the expansion was initially planned to use vacuum sewers. However, detailed design development estimated flow rates that would require additional piping and lift stations to accommodate vacuum sewer design criteria. Based on an evaluation of alternatives and a value engineering review, a gravity sewer system was constructed.

As part of the ULID 6 expansion, a new influent pump station was constructed adjacent to the City wastewater treatment plant. This pump station with three pumps, designed to provide a firm capacity of 3,540 gallons per minute (gpm) (5.1 mgd), was configured to allow future elimination of the plant's original influent pump station.

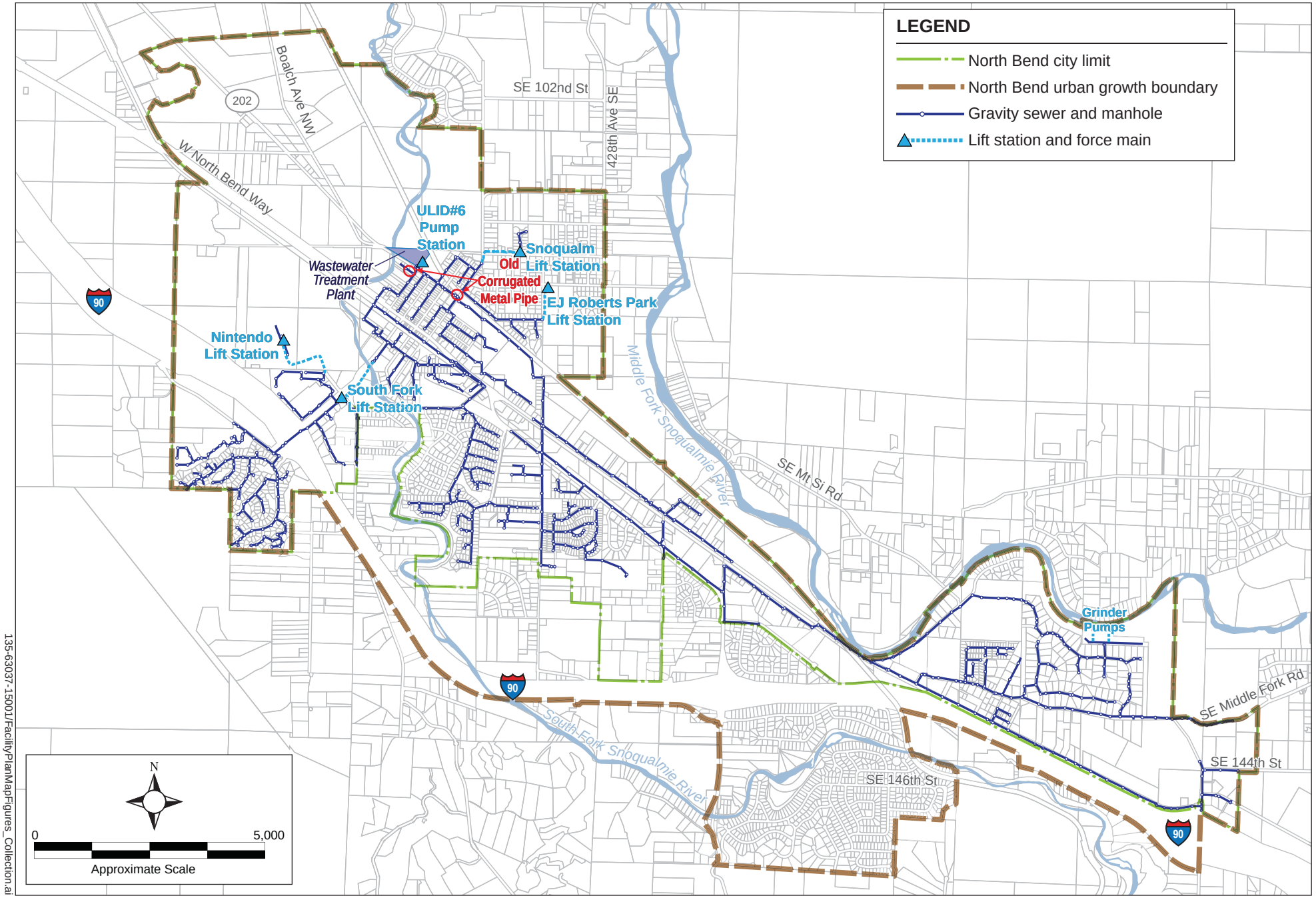
3.2 SERVICE SUB-AREAS

For the collection system analysis, the UGA was divided into seven sub-areas as shown in Figure 3-2:

- **Core Area –** The Core Area includes the downtown area of North Bend and residential areas between Mountain View Boulevard SE and the South Fork of the Snoqualmie River. The wastewater treatment plant is in the Core Area, at the intersection of Sydney Avenue North and Bendigo Boulevard North. Part of the south half of this area, along the South Fork Snoqualmie River, is developed but unsewered.

- **South Fork –** This area between I-90 and the South Fork of the Snoqualmie River includes a major commercial area near Bendigo Boulevard South and some residential development east of 412th Avenue SE. The gravity collection system drains to the South Fork Lift Station at the intersection of Bendigo Boulevard South and South Fork Way SW. From there, flows are conveyed through the force main across the South Fork of the Snoqualmie River to discharge to a manhole in the Core Area. The residential development is largely outside the city limits and is unsewered.

- **Gardiner Creek –** This fully sewered residential area is southwest of I-90, with road access from East and West Ribary Way. The area is served by a gravity sewer that is routed along Bendigo Boulevard South and under the I-90 interchange bridge to the South Fork Lift Station.



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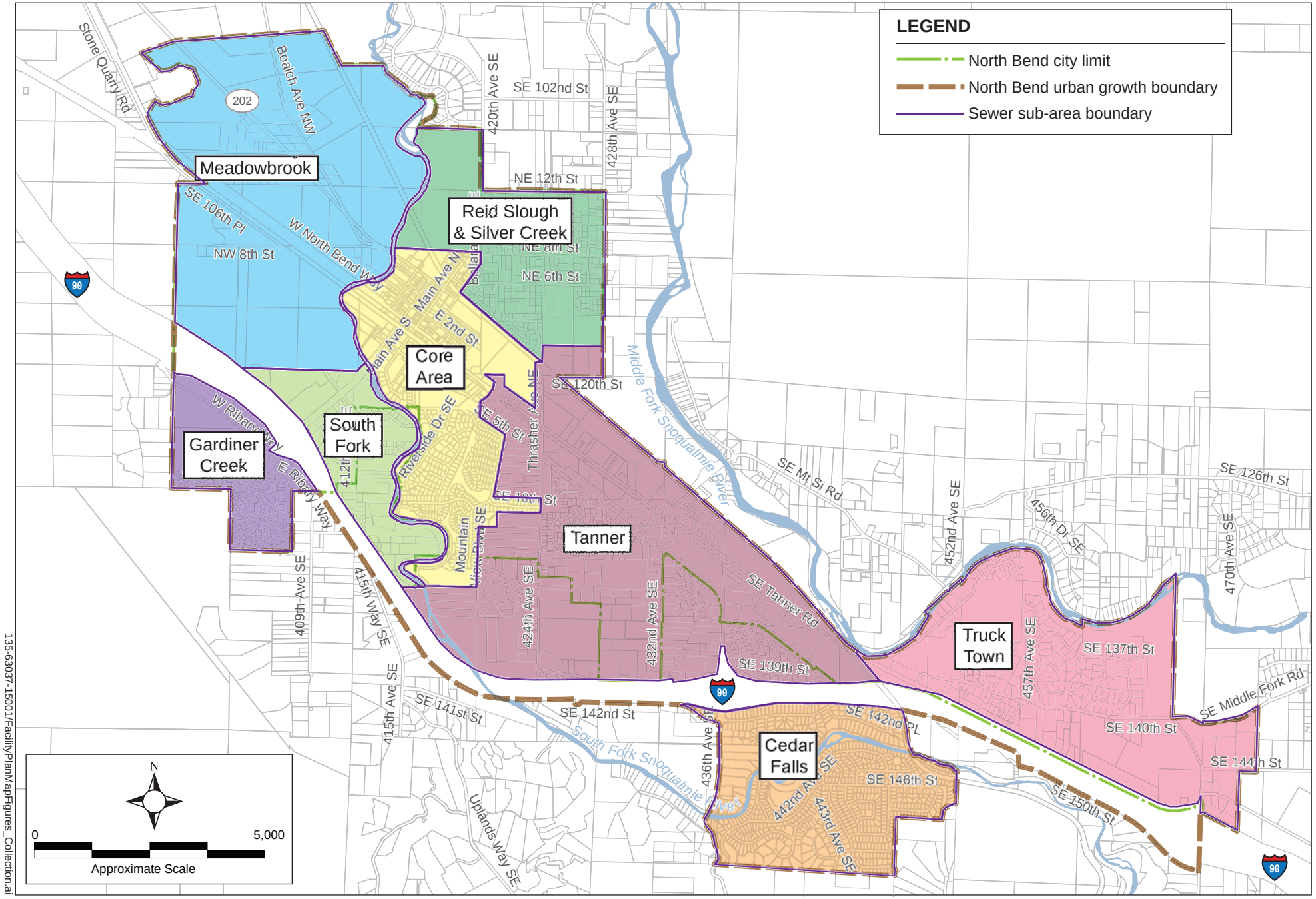
City of North Bend
WASTEWATER SYSTEM FACILITIES PLAN

Figure 3-1.
CITY OF NORTH BEND COLLECTION SYSTEM SEWERS



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WASTEWATER SYSTEM FACILITIES PLAN

Figure 3-2.
CITY OF NORTH BEND SEWER SUB-AREAS

- **Meadowbrook –** This area is north of the South Fork sub-area between I-90 and the South Fork of the Snoqualmie River. It is largely farmland but includes the Nintendo distribution center and some other commercial properties and residential homes. The Nintendo facility is the only property in the sub-area connected to the collection system. Nintendo owns and operates a small private lift station at the edge of its property that pumps Nintendo wastewater to a manhole adjacent to the North Bend Premium Outlets. From there, wastewater flows to the South Fork Lift Station.

- **Reid Slough and Silver Creek Area –** This sub-area north of the Core Area extends to the city limits. It has some residential development, but only one block, along Snoqualm Place, is currently connected to the collection system. That block is served by a small lift station in the right-of-way at the intersection of Snoqualm Place and NE 8th Street. A small lift station is also located in E.J. Roberts Park serving the park restroom facilities.

- **Tanner Area –** This area is between the Core Area and the Truck Town sub-area. It extends from I-90 to the northeastern city limit. The sub-area includes both commercial and residential areas. Some parts are connected to the collection system, but many properties have yet to be developed or are served by septic systems. The Opstad Elementary School in this area was initially connected to the collection system by a lift station and force main but is now connected by gravity sewer. The ULID 6 improvements provided a trunk sewer through this sub-area.

- **Truck Town –** This easternmost sub-area is between I-90 and the Middle Fork of the Snoqualmie River. Sewers serving properties that were part of ULID 6 drain by gravity to the trunk sewer along SE Tanner Road and SE Cedar Falls Way toward the Core Area and the treatment plant.

An eighth sub-area, Cedar Falls, is within the City's urban growth boundary, but it is completely outside the city limits and the existing sewer service area. The area is largely residential, with wastewater treatment provided by on-site septic systems.

3.3 GRAVITY SEWERS

The City's sub-areas are served by 27 miles of sewer and 1.1 miles of force mains, as shown in Figure 3-1, with diameters ranging from 2 to 30 inches, as summarized in Table 3-1. The system includes sewers that are smaller than the desired 8-inch diameter and some with flatter slopes than recommended in City code; however, the City has not received any complaints of sewage backups, nor have any SSOs occurred due to any of these pipes.

TABLE 3-1

Length of Gravity Sewer and Force Mains, by Diameter

Diameter	Gravity Sewer Length (feet)	Force Main Length (feet)
2″	—	1,681
4″	—	1,630
6″	1,570	—
8″	82,678	1,145
10″	9,741	—
12″	15,517	—
15″	12,453	—
16″	799	—
18″	4,755	—
21″	8,610	—
27″	5,257	—
30″	340	—
Total	**141,720**	**4,456**

As shown in Table 3-2, most of the sewers are polyvinyl chloride (PVC) pipe. High-density polyethylene pipe (HDPE) was installed under previous I/I control projects. City GIS records indicate that three segments of CMP were not replaced during the I/I improvement projects. Two of the segments are in an easement extending to the northwest off Sydney Avenue North, behind houses along Bendigo Boulevard, as shown in Figure 3-1. Visual observation indicates these two segments are contributing significant I/I and should be replaced. The third segment of CMP remaining in the system is located on East 4th Street immediately west of Ballarat Avenue North. The condition of this pipe segment should be investigated and it should be replaced or slip-lined with PVC pipe under the City's annual I/I reduction program. Appendix D provides more detail on the existing sewer system, including detailed maps and tables with the size, slope and capacity of the gravity sewers. Side sewers outside the right of way are privately owned and the responsibility of the property owner. Conditions and risk associated with side sewers are discussed in Chapter 4.

TABLE 3-2

Length of Gravity Sewer and Force Mains, by Pipe Material

Material	Gravity Sewer Length (feet)	Force Main Length (feet)
CMP	286	—
CMP Slip-Lined	362	—
Ductile Iron	808	171
Galvanized	—	272
HDPE	2,990	—
PVC	133,902	1,352
Unknown	3,372	2,661
Total	**141,720**	**4,456**

3.4 LIFT STATIONS AND FORCE MAINS

The City currently owns, operates, and maintains three lift stations in the collection system, as summarized in Table 3-3 and described below. There is one privately owned lift station and one grinder pump station that serve the Nintendo facility, a commercial business. Nintendo operates and maintains its sewage lift station and grinder pump station.

There is also an influent pump station at the treatment plant, the ULID 6 Pump Station at the treatment plant, which pumps all the City wastewater flow to the treatment processes, as discussed in Chapter 6.

TABLE 3-3

Lift Station Characteristics

	Nintendo Lift Station [3]	South Fork Lift Station	Snoqualm Lift Station	E.J. Roberts Park Lift Station
Pumps				
Station Type	Wet Well Submersible	Wet Pit/Dry Pit	Wet Well Submersible	Wet Well Submersible
Year Built/ Remodeled	1990	1986/1998	1999	1991
No. of Pumps	2	2	2	1
Firm Capacity	160 gpm	848 gpm [1]	~40 gpm	unknown
Motor Size	5 hp	30 hp	2 hp	2 hp
Monitoring and Alarms				
Telemetry	None	Wet well level & 14 status indicators/alarms	None	None
Local Alarms	None	None	Light and horn	Light and horn
Odor Control				
Station Odor Control	None	None	none	none
Electrical				
Standby Power	None	60 kW generator	5 kW portable generator	none
Force Main				
Diameter	4-inch	8-inch	2-inch	2-inch
Length	1,630	1,145	1,031	650
Material	Unknown	Ductile iron, galvanized & PVC [2]	PVC	PVC

(1) South Fork Lift Station Upgrade Predesign Report, 2013 indicates actual pumping capacity is 848 gpm, not 1,066 gpm as designed.

(2) Ductile iron 171 feet, PVC 702 feet. Bridge crossing galvanized steel 272 feet.

(3) The Nintendo Lift Station is owned, operated, and maintained by Nintendo of America Inc., a commercial distribution center.[R]

3.4.1 SOUTH FORK LIFT STATION

The South Fork Lift Station is at the southeast corner of the intersection of Bendigo Boulevard South and South Fork Way SW. Its 8-inch force main is routed along Bendigo Boulevard, crosses the South Fork of the Snoqualmie River attached to the road bridge, and discharges to a 21-inch sewer just north of the bridge.

The station was constructed in 1986 as a Lakeside package pump station with two 7.5 hp pumps, a prefabricated steel drywell structure with ladder access, and an 8-foot diameter precast concrete wet well. In 1998, two new 1,066 gpm, 30 hp pumps were installed, along with new controls and standby power to increase the firm capacity to 1.5 mgd (firm capacity is the total station capacity with one pump out of service). The actual firm capacity is less than designed, at about 1.2 mgd (848 gpm), as discussed in Chapter 4. The buried sections of the force main are ductile iron and PVC pipe, and the section at the bridge is galvanized steel pipe covered with insulation.

The South Fork Lift Station is outfitted with telemetry that is integrated into the citywide supervisory control and data acquisition (SCADA) system. Information on wet well level and 14 other status indicators or alarms can be relayed to the City's control center at the wastewater treatment plant.

3.4.2 SNOQUALM LIFT STATION

The Snoqualm Lift Station is in the roadway at the intersection of Snoqualm Place and NE 8th Street. It serves 14 houses on Snoqualm Place. It is equipped with two grinder pumps. The lift station controls provide an external alarm light and horn. Its 2-inch force main discharges to a 12-inch sewer at a manhole on Ballarat Avenue North, between NE 6th Street and NE 8th Street. A capped 6-inch vacuum sewer force main is installed parallel to the 2-inch force main, for future use if vacuum sewers are provided in the Silver Creek area.

3.4.3 NINTENDO LIFT STATION

The Nintendo Lift Station is a private station owned, operated, and maintained by Nintendo. The station collects only sanitary wastewater generated by the Nintendo facility only; there is no process water or surface water discharge associated with this station.[R] It was intended to be a temporary lift station that would be abandoned when gravity sewers are installed in the future to serve the Meadowbrook area. This lift station is on the Nintendo distribution center property and provides service to that facility. The lift station is a wet well style station outfitted with two submersible pumps automatically operated in an alternating duty and standby control strategy.[R] It pumps flow through a 4-inch force main discharging to the City's sewage collection system at an 8-inch gravity sewer manhole[R] adjacent to the North Bend Premium Outlets.

Nintendo also owns, operates, and maintains a single grinder pump station to handle the sanitary wastes generated by security personnel at the guard building at the entrance to the Nintendo facility. The grinder pump station is located adjacent to the guard building and the grinder pump station discharges to the City's sewage collection system at the same location as described in the previous paragraph.[R]

3.4.4 E.J. ROBERTS PARK LIFT STATION

The City's E.J. Roberts Park Lift Station serves the restroom facilities at the park. The lift station has a single grinder pump. Controls provide an external alarm light and horn. A 2-inch force main conveys the grinder pump discharge to a manhole at the intersection of Thrasher Avenue NE and NE 4th Street.

3.4.5 INDIVIDUAL RESIDENTIAL PUMPING SYSTEMS

There are three existing privately owned, operated, and maintained individual household grinder pump stations in the City service area that discharge to the City's wastewater collection system. All three of the grinder pumps are located in the Truck Town drainage basin as shown on Map 13 in Appendix D. The Washington State Department of Ecology has determined that private ownership, operation, and maintenance of these grinder pump stations is not consistent with WAC 173-240-104. Based on Ecology's policy regarding private ownership including operation and maintenance of grinder pump stations, the City will modify its municipal code for development so that all (new and existing) individual residence grinder pump stations will be owned, operated, and maintained by the City including any easements required for access for routine maintenance and replacement. The City will diligently pursue acquiring ownership and assuming responsibility for operation and maintenance for the three existing grinder pump stations before 2020.[R]

3.5 OPERATION AND MAINTENANCE

3.5.1 SEWERS

Sewers are currently inspected in response to reports of potential issues from members of the public. For cleaning or video inspection of sewers, the City primarily uses on-call contractors to perform the work under the supervision of Public Works staff members. The City purchased a crawler-cam in 2017 that allows City personnel to conduct timely localized inspection of manholes and sewers.[R]

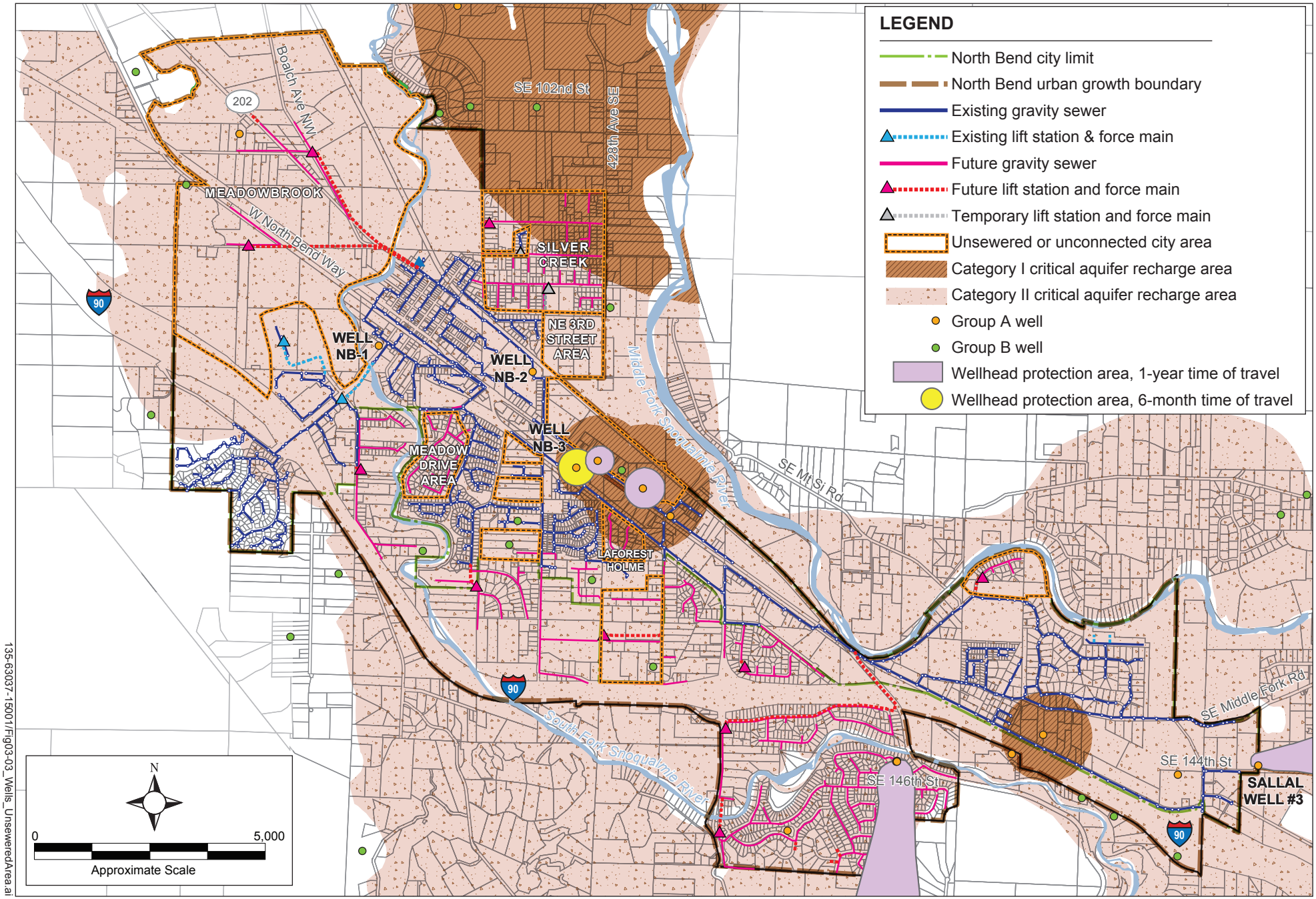
3.5.2 LIFT STATIONS

The City's [R] collection system lift stations are inspected one to two times per month. Station wet wells are cleaned about once every six months. Maintenance of mechanical equipment is performed as outlined in the operation and maintenance manual for each item. This is supplemented by interim maintenance when issues are identified by inspection or by telemetry warning signals.

3.6 AREAS NOT SERVED BY COLLECTION SYSTEM

On-site septic systems currently provide sewage treatment and disposal for about a third of the residential development within the city limits and all residential development in the UGA outside the city limits. The City has not inventoried or mapped the location of septic systems in North Bend, but any development with no mapped sewer nearby can be assumed to be serviced by on-site septic systems. Figure 3-3 shows all such areas within the city limits. It also shows the urban growth area outside the city limits, which is entirely unsewered. The largest developed area in the city that is currently unsewered is the Silver Creek neighborhood.

Because of the environmental contamination that can result when septic systems fail, the City of North Bend has adopted measures requiring sewer service for almost all new development and conversion to sewer service for properties where septic systems have failed (see Section 1.4.3). Many of the on-site systems are compromised by seasonal high groundwater levels. They also are located in critical aquifer recharge areas. The City is currently evaluating whether further protection is needed for critical aquifer recharge areas and for wellhead protection areas, which define groundwater risk areas around wells that supply local drinking water systems. Figure 3-3 shows preliminary mapping of these areas, which is still in development. Several unsewered or unconnected areas lie within or near the preliminary wellhead protection areas; the most fully developed of these is the LaForest Holme development, southeast of the Centennial Well and the Public Works Facility.



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WASTEWATER SYSTEM FACILITIES PLAN

Figure 3-3.
UNSEWERED AREAS, WELLHEAD PROTECTION AREAS, AND CRITICAL AQUIFER RECHARGE AREAS

CHAPTER 4

COLLECTION SYSTEM EVALUATION

4.1 SYSTEM CONDITION

4.1.1 PIPE CONDITION

Closed-circuit television (CCTV) inspection of parts of the City's collection system has been conducted in the past as part of development construction and previous collection system rehabilitation. Ongoing programmatic CCTV inspection of existing sewer mains is not currently included in the collection system asset management program. Recent information on existing pipe conditions is unavailable for much of the system.

4.1.2 LIFT STATIONS

South Fork Lift Station

Figure 4-1 shows the South Fork Lift Station.

FIGURE 4-1

South Fork Lift Station

The following deficiencies have been identified at this lift station:

- **Pump Capacity –** Testing performed in 2013 indicated that the pumping capacities of the station's two pumps are 1,036 gpm (1.49 mgd) and 848 gpm (1.22 mgd). Therefore, the actual firm capacity of the station is only 848 gpm (1.22 mgd), approximately 218 gpm (0.314 mgd) less than the design capacity. Existing peak flows exceed the firm capacity, so the duty and standby pumps run at the same time to pump peak flows. Peak flow was estimated to be 1.7 mgd on November 17, 2015, the day when the highest peak flow occurred at the treatment plant. There is no flow meter at the lift station and the 2013 testing did not assess peak flow, so peak flow was estimated based on recorded changes in wet well level as the lead and lag pumps cycled on and off.

- **Drywell Access –** The drywell access is inadequate. Access is via a small-diameter manway with 20-foot vertical ladder and no landing. A small davit crane is next to the manway to hoist a person out of the drywell in an emergency. This needs to be upgraded with a new concrete stairwell with landings.

- **Ventilation –** The wet well and dry well ventilation system is inadequate.

- **Odor Control –** There are strong foul odors at the station, and odor control is needed.

- **Standby Power Controls –** The standby power and pump controls and programming need to be coordinated for reliable operation when commercial power fails.

- **Station Bypass –** The station needs to be outfitted for bypass pumping.

- **Force Main –** The existing 8-inch force main is marginally large enough for existing flows. The existing peak flow velocity in the force main is 6.6 feet per second at 1.49 mgd pumping capacity. The velocity reached 7.6 feet per second on November 17, 2015 when the estimated peak flow reached 1.7 mgd. The 7.6 foot-per-second velocity is just within the Orange Book guideline of 8 feet per second for peak force main velocity. High velocities result in significant pressure drop in the pipe, which adversely affects pumping capacity. They also may result in pressure surges (water hammer) when the pumps turn off, which could cause leaks or failure at weak spots in the force main. The weakest portion of the force main is likely the nearly 40-year-old galvanized steel pipe on the bridge across the South Fork of the Snoqualmie River. Insulation on the galvanized pipe is in poor condition, and the condition of the pipe under

the insulation is unknown. Additional analysis is needed to determine whether force main improvements are warranted at this time.

Snoqualm Lift Station

The Snoqualm Lift Station is in fair condition and generally functions well. It is in a poor location in the roadway intersection (see Figure 4-2). The control panel is in a planter strip below waist level, requiring operators to kneel to access the controls (see Figure 4-3). The control panel needs to be adjusted so that the bottom of the panel is at least 3 feet above the ground.

Improvements are needed to provide status information to the SCADA system. The current system notifies the operators of high wet well level conditions by a light on the control panel but provides no other status or alarm conditions. The station should also be equipped with station bypass piping and fittings.

FIGURE 4-2

Snoqualm Lift Station in Roadway

FIGURE 4-3

Snoqualm Lift Station Control Panel

Nintendo Lift Station

The Nintendo Lift Station (Figures 4-4 and 4-5) is operated and maintained by Nintendo. Any failures or issues at the station are currently handled by Nintendo staff. Operation and maintenance of the lift station should be by the City, as required by the Department of Ecology. No deficiencies have been reported for this station by City staff. Improvements are needed to provide status information to the SCADA system, and the station should be equipped with bypass piping and fittings. In addition, a flow meter and flow data recorder should be installed.

FIGURE 4-4

Nintendo Lift Station Wall Mounted Control Panel

FIGURE 4-5

Nintendo Lift Station Wet Well

E.J. Roberts Lift Station

The E.J. Roberts Lift Station (Figures 4-6 and 4-7) is in fair condition and has generally functioned well since installation. The station is outfitted with a single grinder pump. Following a mechanical failure in spring 2016, the grinder pump unit was replaced and the station has continued to function well since then.

FIGURE 4-6

E.J. Roberts Lift Station Adjacent to Park Restrooms

FIGURE 4-7

E.J. Roberts Lift Station – Grinder Pump Installation

4.1.3 SANITARY SEWER OVERFLOWS

No sanitary sewer overflows (SSOs) were reported in the collection system in 2014 or 2015. One SSO (estimated to be less than 50 gallons) occurred on January 20, 2016. This event did not occur during a storm and was addressed by local maintenance of the sewer (jetting and root cutting). Areas of the collection system considered most vulnerable to overflow were inspected during and after severe storm and flow events in the winter of 2015 to 2016, and no evidence was found of severe surcharge or overflow.

4.1.4 INFILTRATION AND INFLOW

Treatment plant flow data indicate that significant levels of infiltration and inflow enter the sewer system year-round. I/I is most severe during winter wet weather when rain is falling heavily, groundwater is at or near the ground surface level, and shallow side sewers are submerged in groundwater. Plant flows and I/I reached new highs in November and December 2015. Infiltration is also significant during dry weather, with about half of the average plant flows in the summer attributed to groundwater leaking into deep mainline sewers.

The City has a general awareness of I/I sources, but it has not thoroughly studied the sources or conducted flow measurements or spot inspections for I/I since the I/I improvements in 1998 and 2003. In 2015, the City identified areas where stormwater ponded over sanitary sewer manholes, as shown in Figure 4-8. Some of these manholes may represent significant sources of inflow during ponding due to unplugged manhole cover pick-holes, cracks in the manhole chimney grout or leaks at manhole joints. Other sources of I/I are less apparent and are not uniform across the sewer system.

I/I varies based on pipe age, pipe material, groundwater conditions and other factors. To assess I/I for this facilities plan, the collection system was divided into areas as shown in Figure 4-9, and a range of peak I/I in each area was estimated as shown in Table 4-1. Table 4-2 shows two estimates for how contributions from these areas might have been distributed to achieve the total 3.06-mgd peak-hour I/I observed on November 17, 2015. The following sections describe the individual sewer contributing areas.

TABLE 4-1

Variation in Peak Wet-Weather I/I Rate by Sewer Contributing Area

Area No.	Contributing Area	Likely Range of Peak I/I (gpad)	Sewer Service Area (acres)
1	Sewers Developed Since 2001	1,100–2,300	473
2	Mainline & Side Sewers Rehabilitated to Buildings	1,100–2,300	10
3	Mainline & Side Sewers Rehabilitated to Edge of Right-of-Way	3,000–5,000	42
4	South Fork Lift Station Basin	9,000–13,000	132
5	Core Area Not Rehabilitated	3,000–9,000	139

TABLE 4-2

Potential Contribution of Sewer Contributing Areas to November 17, 2015, Peak Flow

Area No.	Contributing Area	Potential Contribution to Peak I/I, November 17, 2015	
		Estimate 1	Estimate 2
1	Sewers Developed Since 2001	0.95 mgd @ 2,000 gpad	0.52 mgd @ 1,100 gpad
2	Mainline & Side Sewers Rehabilitated to Buildings	0.02 mgd @ 2,000 gpad	0.01 mgd @ 1,100 gpad
3	Mainline & Side Sewers Rehabilitated to Edge of Right-of-Way	0.17 mgd @ 4,000 gpad	0.17 mgd @ 4,000 gpad
4	South Fork Lift Station Basin	1.39 mgd @ 10,000 gpad	1.45 mgd @ 11,000 gpad
5	Core Area Not Rehabilitated	0.53 mgd @ 3,800 gpad	0.91 mgd @ 6,500 gpad
Total		**3.06 mgd @ 3,846 gpad**	**3.06 mgd @ 3,846 gpad**

Sewers Developed Since 2001

For sewers developed since 2001, peak I/I is estimated to range from 1,100 to 2,300 gpad. The low end of this range (1,100 gpad) has been used for decades as a standard estimate of peak I/I in the Puget Sound area. North Bend's ULID 6 sewers were designed with peak I/I capacity of 1,100 gpad, and the actual peak I/I rates in the those sewers and other new mainline sewers in North Bend may meet this criteria. The North Bend Municipal Code (19.02.040.M) requires all new mainline sewers to meet stringent leakage limits before acceptance by the City.

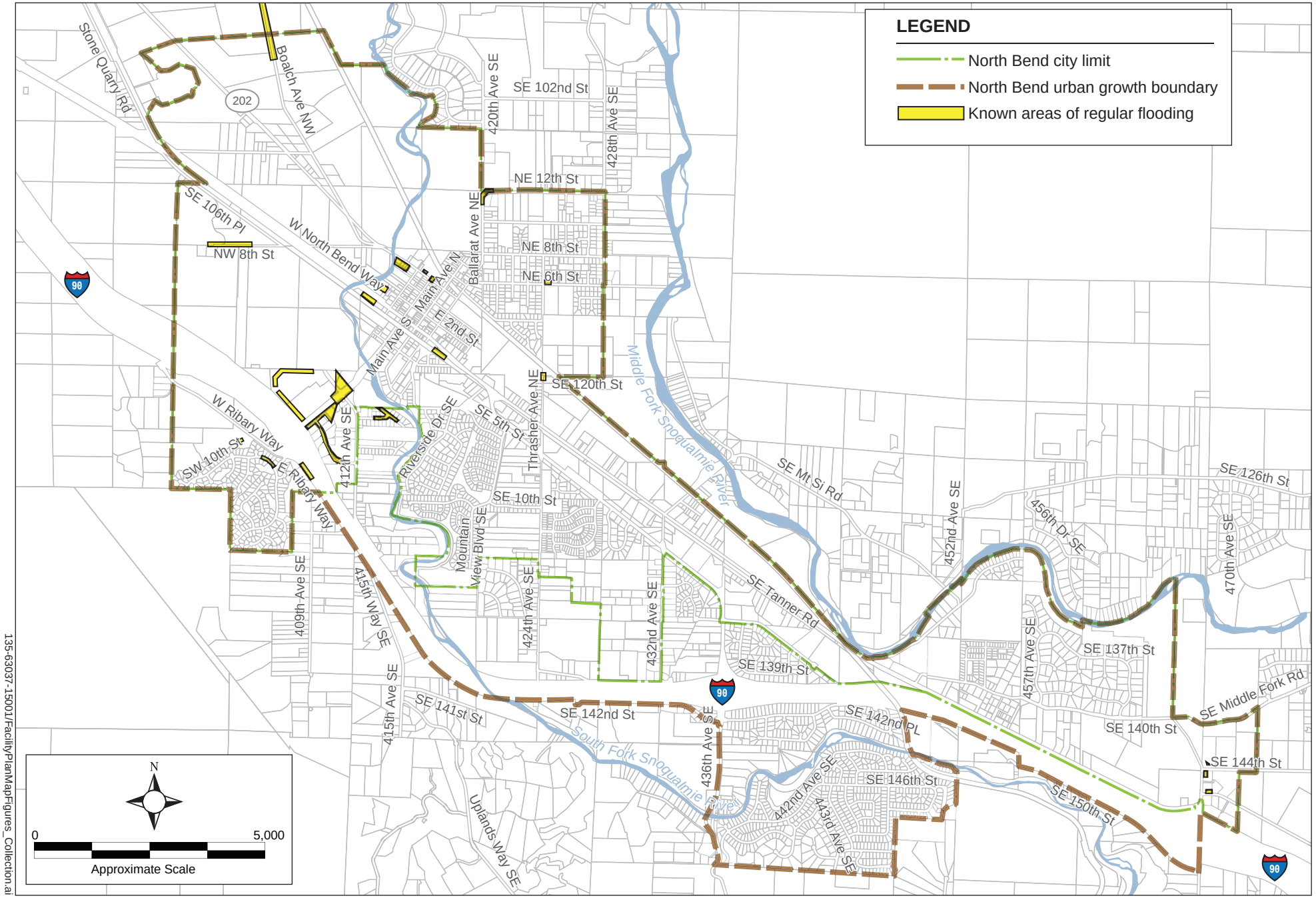

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Figure 4-8.
KNOWN SURFACE PONDING AREAS
WHERE INFLOW MAY OCCUR

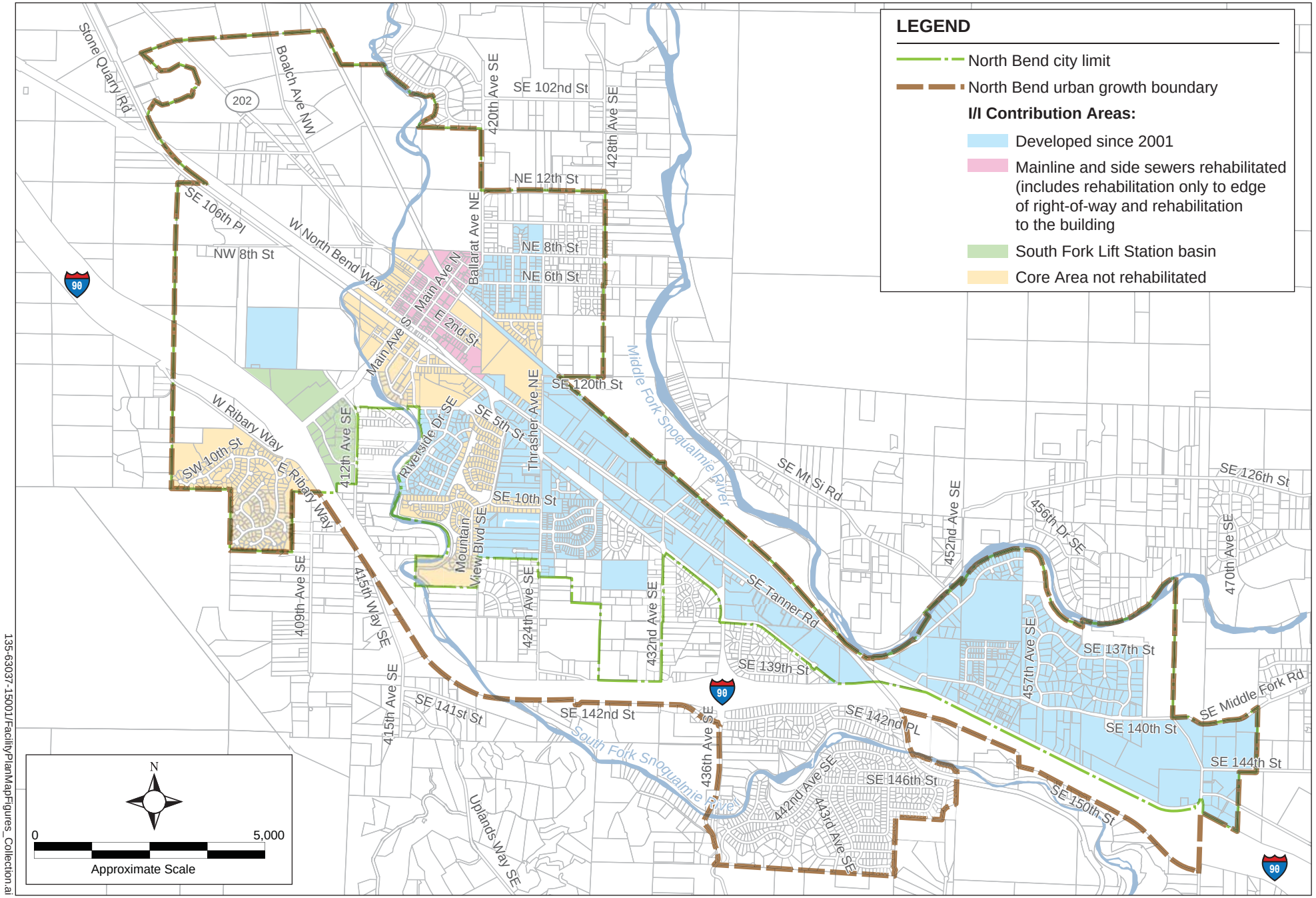

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Figure 4-9.
ASSUMED VARIATION IN COLLECTION SYSTEM AREAS I/I

However, King County recently determined that 1,100 gpad is rarely achieved in new sewer systems after side sewers are installed, despite leakage testing. Some new systems have up to 5,000 gpad peak I/I shortly after construction. As a result, King County suggests that it is more realistic to plan for peak I/I of 2,000 gpad for new sewer systems, 2,300 gpad for 20-year-old sewer systems, and 2,600 gpad for sewer systems 40 or more years old (King County, 2014b).

Mainline and Side Sewers Rehabilitated to Buildings

For older mainline and side sewers that were rehabilitated under the 1998 to 2003 I/I reduction project all the way to the connection to each building, peak I/I is estimated to range from 1,100 to 2,300 gpad – equivalent to new sewers. I/I improvements replaced approximately 50 percent of private side sewers in the Core Area, consisting of those with estimated flow greater than 1,400 gpd (approximately equivalent to 5,000 gpad). Significant side sewer infiltration rates had been reported prior to replacement.

Mainline and Side Sewers Rehabilitated to Edge of Right-of-Way

For older mainline and side sewers that were rehabilitated under the 1998-2003 I/I reduction project only up to the edge of the public right-of-way, peak I/I is estimated to range from 3,000 to 5,000 gpad. The I/I improvements project did not replace private side sewers in the Core Area that were leaking from 350 to 1,400 gpd. The range used for these sewers assumes that the side sewers leak at an average rate of 800 to 900 gpd, and that there are four to five side sewers per acre.

South Fork Lift Station Basin

Peak I/I is estimated to range from 9,000 to 13,000 gpad in the South Fork Lift Station Basin. I/I flow at the lift station is estimated to have reached 1.45 mgd (1,000 gpm) on November 17, 2015, the day when the highest peak flow occurred at the treatment plant. The I/I component was estimated by subtracting the estimated peak base flow of 0.25 mgd from the total flow of 1.7 mgd. The estimate corresponds to 11,000 gpad, but the actual I/I rate could have ranged between 9,000 and 13,000 gpad, given the uncertainty of the flow estimate.

Core Area Not Rehabilitated

Relatively little is known about I/I in the Core Area with original sewers. City GIS records indicate there are three remaining corrugated metal pipe segments, and investigation has found those pipes to be very leaky. The records indicate that the other mainline sewers in this area are constructed with suitable pipe materials, and the side sewers in the City rights of way are likely constructed with similar suitable material; however, there is significant uncertainty about the

condition and materials of construction of side sewers on private property, particularly those that are more than 25 years old. Given these uncertainties, the peak I/I in this area is estimated to range from 3,000 to 9,000 gpad. The low end of this range allows for side sewer I/I similar to what was found in the rehabilitated area of the downtown core; the high end allows for significant mainline sewer I/I. Flow estimates for Contributing Areas 1 and 2 in Table 4-2 assume that I/I in these areas could be relatively high – around 6,500 gpad – if the post-2001 sewers have I/I at 1,100 gpad as intended in North Bend's municipal code. I/I in this area could be around 3800 gpad, at the low end of the range, if the post-2001 sewers have I/I at 2,000 gpad as typically occurs in King County.

Summary

There is significant I/I in the system, but limited current flow data to identify where it is occurring. The evaluation in this plan is based on deductions using data such as pipe material, age, and past projects.

The South Fork Lift Station basin probably has the highest level of I/I. The unrehabilitated Core Area probably has the next highest level of I/I. The rehabilitated Core Area with original side sewers is also a likely source of significant I/I.

Assuming King County's 2,000-gpad criterion for normal peak I/I, 1.59 mgd of the 3.06-mgd peak I/I on November 17, 2015 would be normal I/I, leaving 1.47 mgd of excess I/I. Excess I/I above the "normal" criterion is assumed to be flow that could be removed with cost-effective I/I reduction measures. CCTV inspection and flow monitoring would be needed to accurately quantify where excess I/I occurs across the City and identify where the best opportunities are for future I/I reduction efforts.

4.2 EXISTING CAPACITY ANALYSIS

An analysis of the wastewater collection system was performed using the EPA's Storm Water Management Model (SWMM) software and CHI-Water's PC-SWMM software.

4.2.1 MODEL CONSTRUCTION

Data Sources

Geographic information system (GIS) data from the City was used to model the physical layout of the collection system. This included the location of manholes and details on pipe diameters, manhole rim elevations and invert elevations.

Modeling of Physical System Features

Manholes and Sewers

The base physical layout of the models was constructed by importing data from GIS databases. The model of the collection system was reviewed to determine where GIS data were missing or appeared incorrect (for example, where pipe slopes appeared to be in the wrong direction). Missing or apparently erroneous data were completed or revised based on estimates from the adjacent sewer slopes or invert elevations.

Downstream Boundary Condition

The downstream boundary condition for the model (the discharge to the ULID 6 Pump Station) was modeled as a free discharge outfall for most simulations. However, the effect of an elevated pump station wet well level was also examined by use of a fixed downstream water elevation at the model boundary.

Lift Stations

The largest three collection system lift stations (South Fork, Snoqualm and Nintendo) were incorporated into the model as pump elements. The E.J. Roberts Lift Station was not included as it serves only one structure and its flow loads can be accounted for in the area gravity flows.

For the Snoqualm and Nintendo model pump elements, a fixed discharge rate equal to the firm capacity of the lift station with the largest pump out of service was assigned. For the South Fork Lift Station, a fixed discharge rate was assigned to the model element and the value was adjusted to equate to the peak model flow rate from the upstream collection system. This approach was selected so that the upstream sewer capacity could be assessed without backwater conditions related to station capacity. Comparison of peak flows to the firm capacity at each lift station was assessed separately.

Flow Distribution

Base Flow

Base flow was estimated from City water consumption data and was distributed throughout the collection system by correlating customer addresses with parcel data in GIS. A peaking factor of 4.0 was used for the simulation of peak flow conditions as documented in Section 2.2.2. This was applied to residential and commercial flows.

Inflow and Infiltration

While the treatment plant data allowed calibration of the peak wet-weather flows, limited data was available to calibrate model results across the City; therefore, the model is less accurate for localized areas in the upstream system. No temporary flow monitoring information from mainline sewers was available. However, historical flows at the South Fork Lift Station were estimated for peak wet-weather events based on pump run time data and pump drawdown test results.

For the sewer contributing areas described in Section 4.1.4, the modeling used peak wet-weather I/I values as shown in Table 4-3. To be conservative, levels near the high end of the ranges shown on Table 4-1 were assumed. The resulting peak wet weather model flow at the treatment plant was 3,270 gpm (4.7 mgd) 18 percent greater than the historical peak during the November 17, 2015 storm event. The resulting peak wet-weather model flow at the South Fork Lift Station was 1,330 gpm (1.9 mgd), similar to the flow estimated from recorded data.

TABLE 4-3

Peak Wet-Weather I/I Rates Assumed for Modeling

Area No.	Contributing Area	Peak Wet Weather I/I (gpad)	Basis for Estimate
1	Sewers Developed Since 2001	2,000	King County Estimate of New Development
2	Mainline & Side Sewers Rehabilitated to Buildings	2,000	King County Estimate of New Development
3	Mainline & Side Sewers Rehabilitated to Edge of Right-of-Way	4,000	Greater than Contributing Area 2
4	South Fork Lift Station Basin	11,000	Based on estimated peak wet weather flow at Lift Station
5	Core Area Not Rehabilitated	6,500	Greater than Contributing Area 3

Mini-Basins and Flow Input Model Junctions

The existing collection system service area was subdivided into mini-basins, each with an area of approximately 20 acres, as shown in Figure 4-10. Within each mini-basin, a model junction was selected to represent the point of flow input. The flow input junctions were selected to be close to the middle of the mini-basin, preventing model anomalies associated with the representation of the flow input. Estimated existing base flows and I/I were aggregated for each mini-basin and attributed to the flow input model junction, as presented in Appendix E.

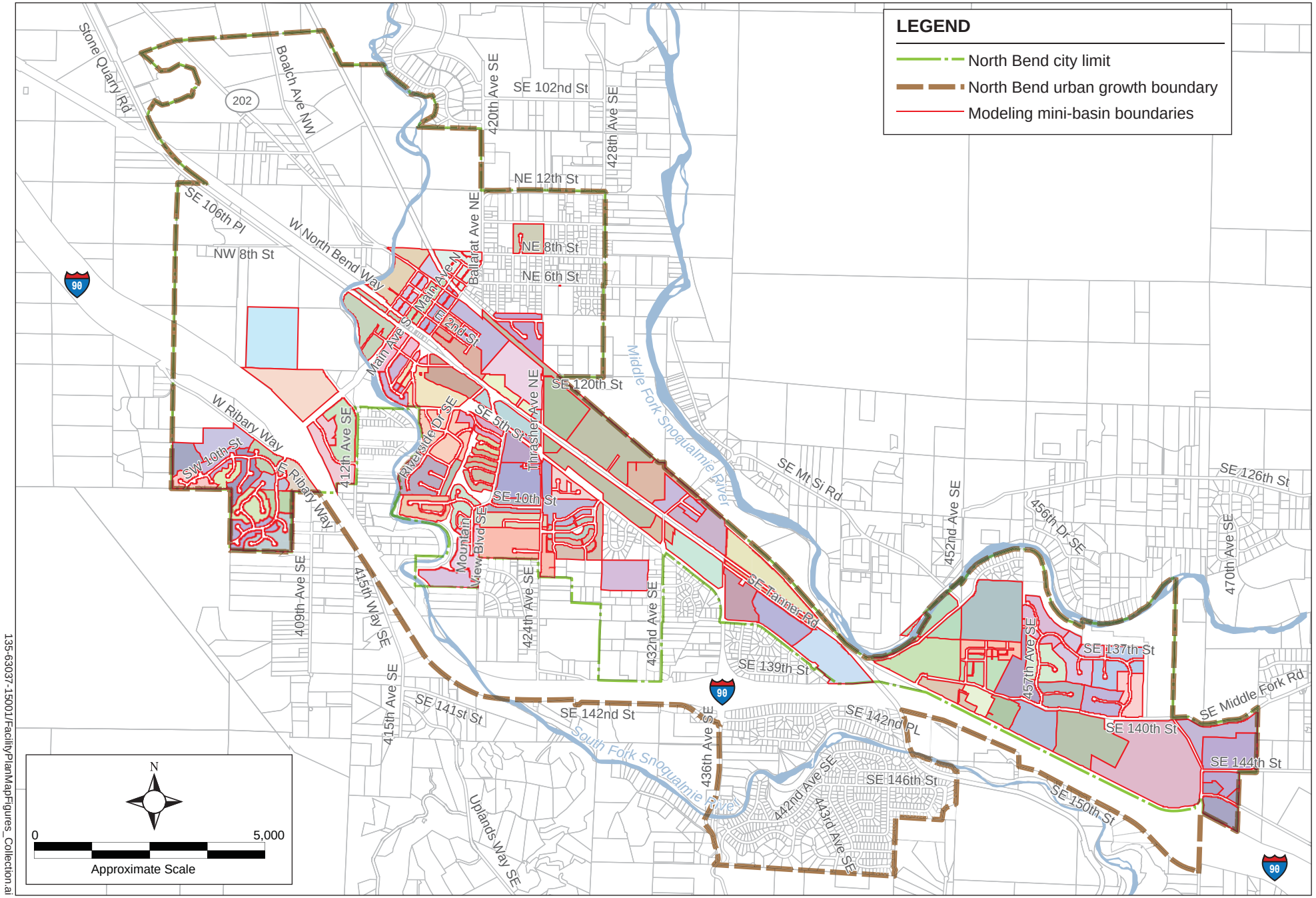

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Figure 4-10.
MINI-BASINS USED FOR MODELING
EXISTING COLLECTION SYSTEM

4.2.2 RESULTS

The peak wet-weather flow simulations for existing conditions indicate that several gravity sewers exceed a North Bend's Public Works standard that limits flow in existing gravity sewers to 75 percent of capacity. Figure 4-11 indicates where existing sewers are estimated to exceed 75 percent or 80 percent of full capacity; the modeling of this condition found no sewers that exceed 100 percent of full capacity. All the estimated exceedances are in the South Fork Lift Station basin, and they result from high I/I in that basin, which was estimated at 11,000 gpad for the model simulations. This is 10 times more I/I than the generally accepted design allowance of 1100 gpad.

The simulations indicate no surcharging in any sewers during existing peak flows, when the water level in the ULID 6 Pump Station wet well is below the sewer inlets to the wet well. However, simulations indicated that surcharging would occur in the downtown core area sewers when peak flows exceed the capacity of the ULID 6 pump station and the wet well level rises above the sewer inlets at the station. When this occurs the water level in the pump station wet well rises and the pumps convey more flow to the treatment plant as the pumping head is reduced. If the water level continues to rise, it overflows to the treatment plant's Original Influent Pump Station, which pumps the excess flows to the plant.

During the extreme peak flow event on November 17, 2015 the ULID 6 Pump Station wet well level reportedly rose up to within 4 feet of the top of the wet well hatch. Modeling indicates this would cause extensive surcharging in the downtown core sewers but that no SSOs would occur. The City checked the sewers and found no indication of SSOs to the ground surface and no indication of any surcharging above the manhole channels.

The results of the modeling simulations are approximate because of the numerous assumptions used to estimate future flows and I/I flows in the sewer system.

Should the City experience SSOs or backups or if inspections indicate surcharging, then additional investigation of the sewer network should be implemented to improve the information about collection system performance.

The estimated peak wet weather flow to the South Fork Lift Station (1,180 gpm, 1.7 mgd) has exceeded the station's firm capacity (848 gpm, 1.22 mgd). The peak model flow was estimated to be 1,300 gpm (1.9 mgd).

4.3 FUTURE CAPACITY ANALYSIS

The collection system model was used to identify parts of the system likely to experience flow capacity limitations in the future when the sewer system is

expanded to currently unsewered areas. The following sections describe model revisions and results for this analysis.

4.3.1 MODEL CONSTRUCTION

Flow Distribution

Base Flow

Base flow for the future condition was modeled as follows:

- **Residential Flow –** The additional sewered population used for the future condition is documented in Section 2.1.2. This includes additional sewered population resulting from future development and from connection of currently unsewered development. The equivalent residential flow load was based on the housing density associated with the zoning, adjusted uniformly so that the total population matched the estimates in Section 2.1.2.

- **Commercial Flow –** The additional commercial flows and equivalent residential units used for the future condition are documented in Section 2.2.4. The equivalent commercial flow was distributed based on commercial zoning, adjusting the area contribution so that the total commercial flow matched the estimates in Section 2.2.4.

- **Peaking Factor –** A peaking factor of 4.0 was used for the simulation of peak flow conditions for the existing collection system capacity analysis, as documented in Section 2.2.2. This was applied to residential and commercial flows.

Inflow and Infiltration

I/I for post-2001 sewers and future development was estimated by assuming 2,300 gpad for the additional development area (459 acres) in the City and UGA identified in the City's Comprehensive Plan. This represents the 2,000 gpad suggested by King County for new development, with a provision for degradation of the collection system over time. King County suggests a 7-percent increase in I/I per decade. I/I from other existing sewered development was assumed to remain at the levels shown in Table 4-3 due to I/I control measures to be implemented over time as part of the City's asset management.

Mini-Basins and Flow Input Model Junctions

The new areas within the City's UGA that would be included in the future collection system service area were divided into mini-basins of about 100 acres

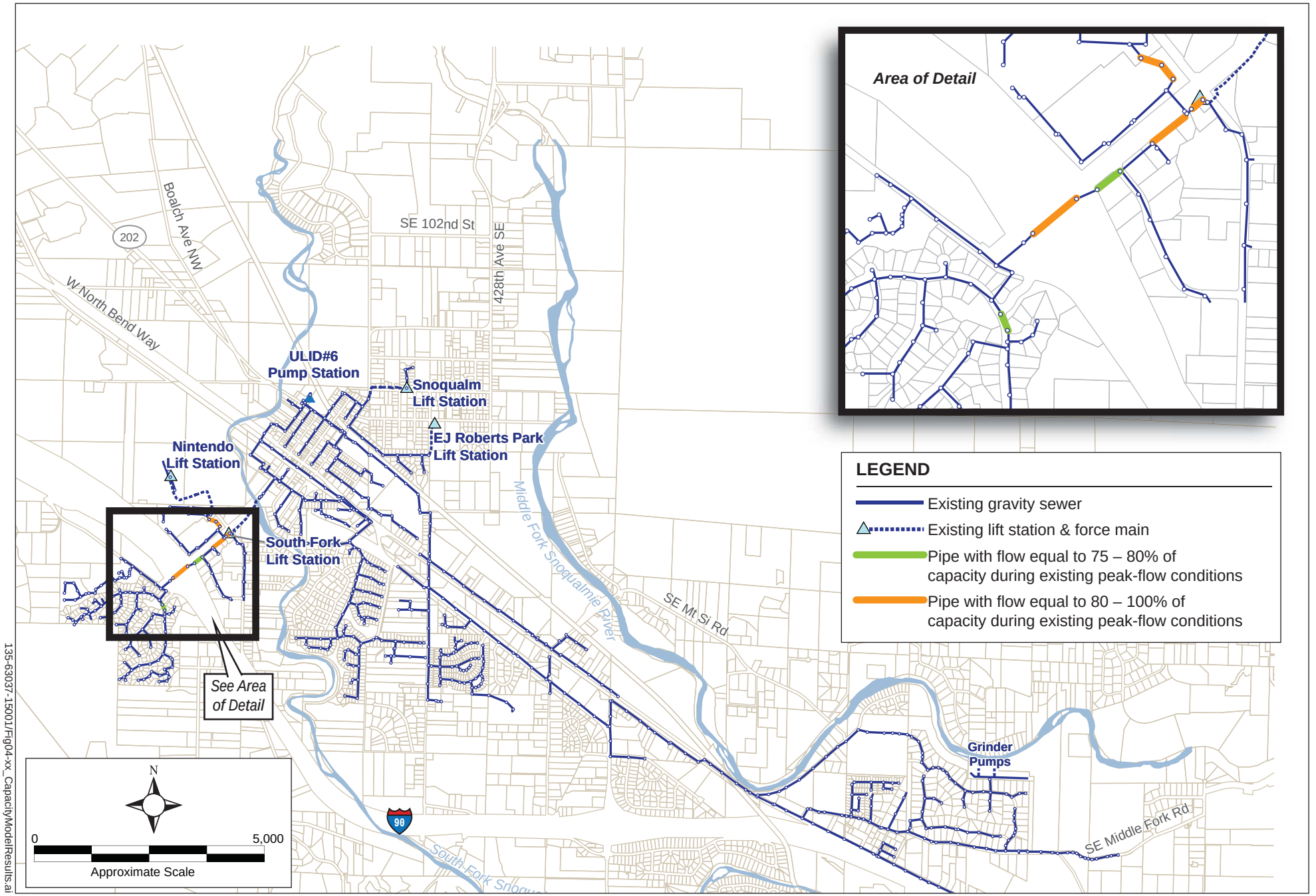

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Figure 4-11.
EXISTING PEAK-FLOW CAPACITY MODELING RESULTS

each, as shown in Figure 4-12. This represents the approximate area of residential development that can be served by an 8-inch gravity sewer at a minimum slope of 0.4 percent.

For each future mini-basin, a model junction within the existing network was selected to represent the point of flow input. The flow input junctions were selected to be close to the middle of the mini-basin, preventing model anomalies associated with the representation of the flow inputs. Estimated future base flows and I/I were aggregated for each mini-basin and attributed to the flow input model as presented in Appendix E.

4.3.2 RESULTS

Table 4-4 shows future lift station flows predicted by the model, along with future force main requirements. The existing Snoqualm and E.J. Roberts Park Lift stations are not shown because they will be eliminated when sewers are constructed in the Silver Creek area; until then they will be unchanged from existing conditions.

TABLE 4-4

Future Lift Station Flows and Force Mains

	Future Peak Flow to Wet Well mgd (gpm)	Future pumping rate (gpm)	Force Main Diameter (inches)	Force Main Velocity (feet/second)	Force Main length (feet)
Existing Lift Stations					
South Fork LS	2.57 (1784)	1784	12	5.1	1,145
Nintendo LS	0.23 (160)	160	4	3,7	1,630
Future Lift Stations					
Meadowbrook LS 1	0.55 (382)	382	6	4.3	3,500
Meadowbrook LS 2	0.51 (354)	354	6	4.0	3,800
SW Mt Si Blvd LS	0.27 (188)	188	4	4.8	200
Silver Creek LS	0.39 (271)	271	6	3.1	1,100
Mountain View Blvd LS	0.41 (285)	285	6	3.2	600
Quadrant LS	0.56 (389)	389	6	4.4	2,900
437 PL SE LS	0.09 (63)	140	4	3.6	200
Cedar Falls LS 1	1.29 (896)	896	10	3.7	5,800
Cedar Falls LS 2	0.88 (611)	611	8	3.6	1,000
Tanner Rd LS	0.08 (52)	140	4	3.6	500

The diameter of the force main at the South Fork lift station will likely need to be increased to 12 inches, because the existing 8-inch pipe is very small for the projected peak flow of 2.57 mgd, The existing force main would have a velocity of 11.5 feet per second, well above the 8 feet per second Orange Book guideline for peak velocity, and surge protection will likely be needed to protect the 8-inch pipe from being damaged by pressure surges (water hammer), which occur when the pumps turn off. The pressure surges could cause leaks or failure at weak spots in the force main. The weakest portion of the force main is likely the 30-year-old galvanized iron pipe hung on the bridge across the South Fork of the Snoqualmie River.

Figure 4-13 shows the results of modeling of future conditions for existing gravity sewers. This shows where flows are predicted to exceed 75 percent, 80 percent or 100 percent of full flow capacity. These predictions are approximate because of the numerous assumptions used to estimate future flows and I/I flows in the sewer system. Key results are as follows:

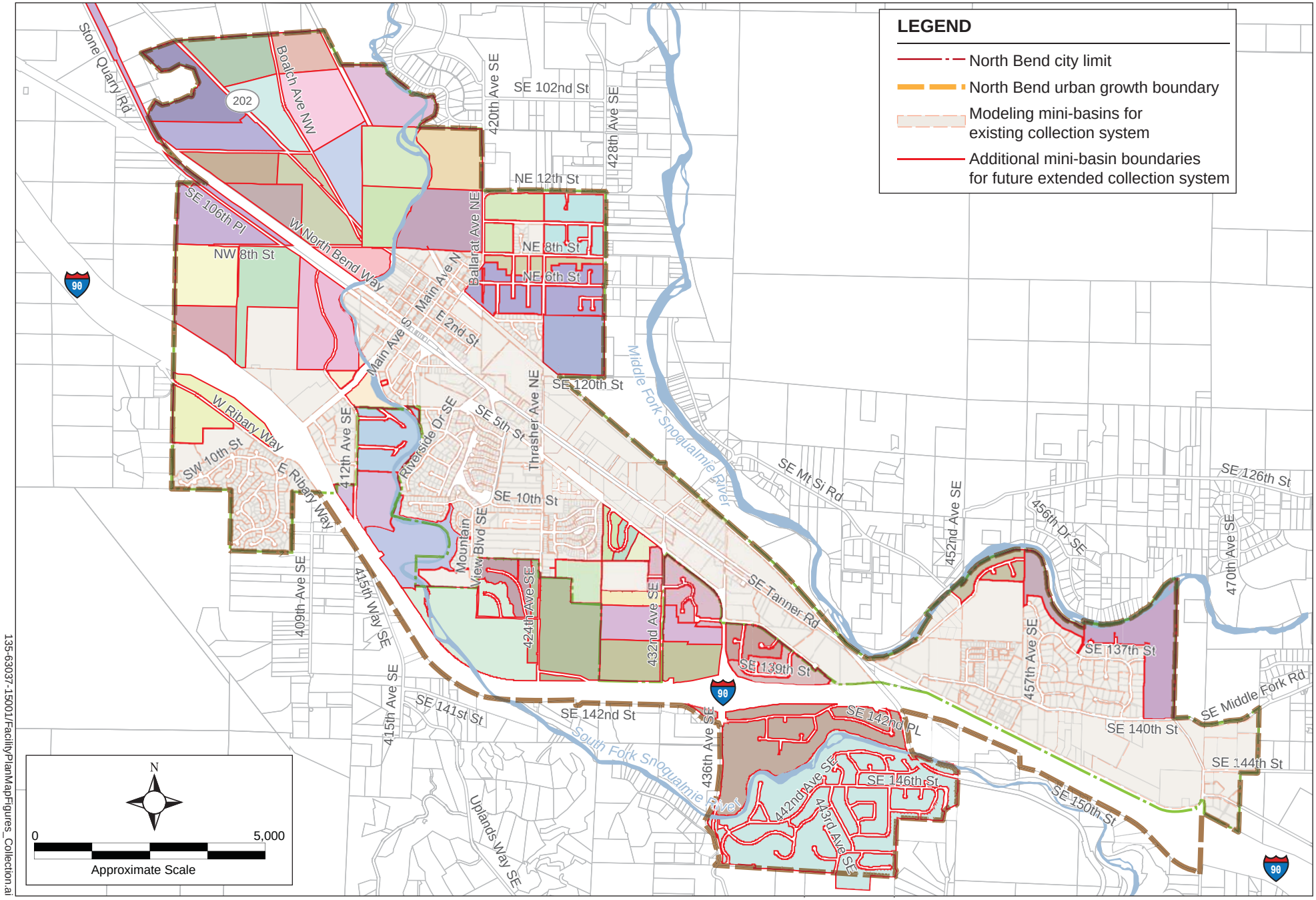

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Figure 4-12.
ADDITIONAL MINI-BASINS FOR FUTURE DEVELOPMENT

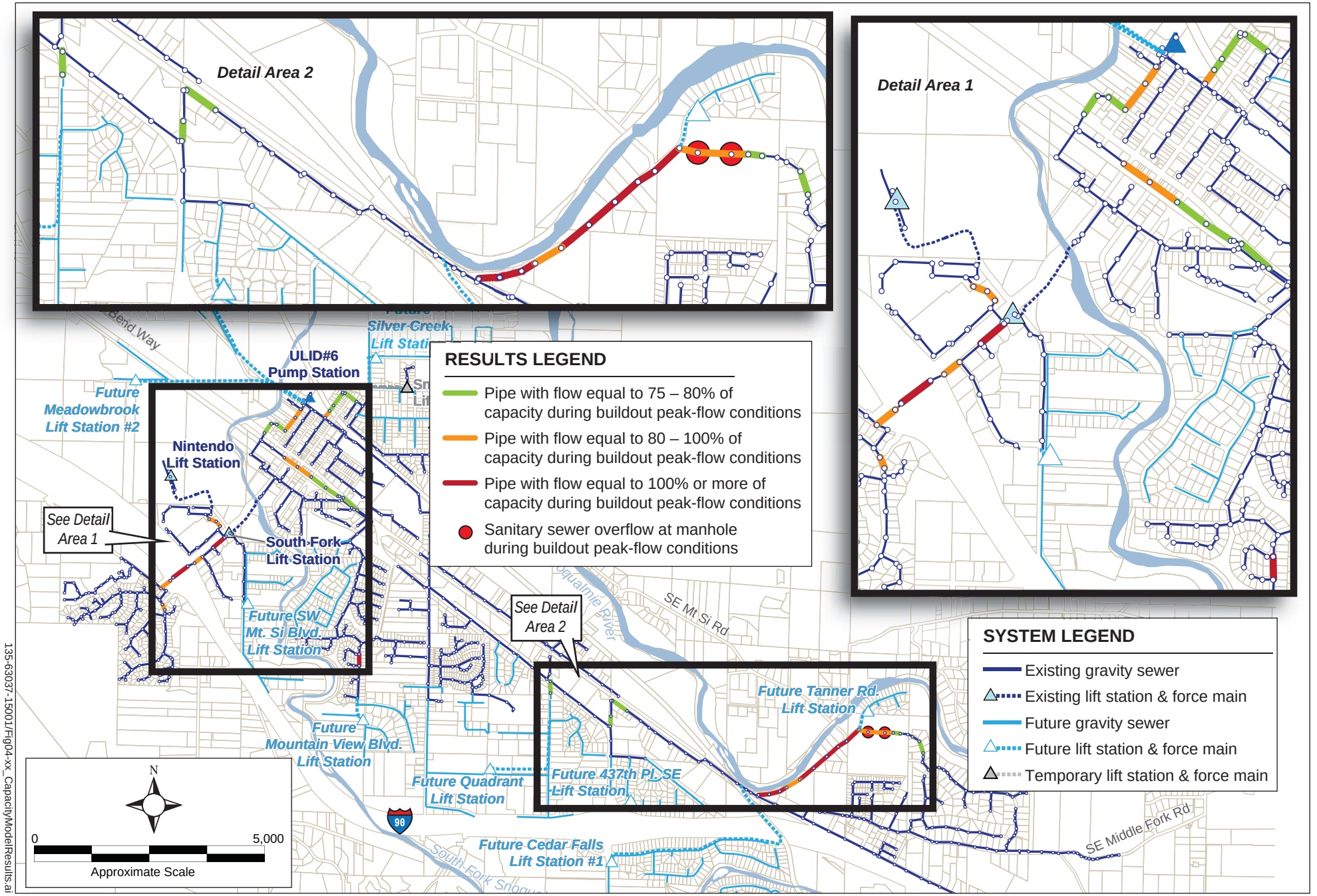

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Figure 4-13.
BUILDOUT PEAK-FLOW CAPACITY MODELING RESULTS

- **South Fork Basin –** Some sewers in this basin are predicted to exceed 80 percent to 100 percent of full flow capacity. The exceedances result primarily from the 11,000 gpad used to model I/I flow in this basin, which is 10 times higher than the typical historical design allowance of 1,100 gpad.

- **Core Area –** Some sewers in this area are predicted to exceed 75 to 80 percent of full flow capacity, but no sewers are predicted to exceed 100 percent of full capacity. The exceedances result from high I/I flows in old sewers in the core area and upstream of the South Fork Lift Station, plus high flows from future commercial areas assumed to reach the maximum development allowed by City zoning.

- **Mountain View Boulevard –** A sewer on Mountain View Boulevard is predicted to exceed 100 percent of full flow capacity. This is caused by flows from new development projected to occur in the UGA south of SE 13th Place.

- **432nd Avenue SE (Stilson Avenue) –** A sewer on 432nd Avenue SE is predicted to exceed 80 percent of full flow capacity. This is caused by flows from new development from SE Cedar Falls Way to I-90, including the new Quadrant Homes development. This exceedance could be corrected by increasing the size of the pipe or by extending the proposed Quadrant Homes Pump Station force main to the 21-inch sewer on SE Cedar Falls Way (Truck Town sewer).

- **436th Avenue SE –** Two sewers near the intersection of 436th Avenue SE and Tanner Road are predicted to exceed 75 and 80 percent of full flow capacity. This exceedance results from an I/I allowance of 2,300 gpad for the model simulation, which is 2.1 times more than the design allowance of 1,100 gpad. It also results from high commercial growth in the Truck Town area, which is assumed to reach the maximum development allowed by City zoning.

- **Tanner Road –** Approximately 3,300 feet of sewer on Tanner Road is predicted to range from 75 percent to over 100 percent more than full capacity. Surcharging is predicted upstream of the overloaded pipes, with flooding at two manholes. This results from an I/I allowance of 2,300 gpad for the model simulation, which is 2.1 times more than the design allowance of 1,100 gpad. Analysis indicates that this pipe segment has sufficient capacity through the end of the 20-year planning period. Flows in this sewer should be regularly monitored to determine when additional capacity is required.

- The modeled future peak flow at the South Fork Lift Station is 1,784 gpm (2.57 mgd). This is significantly greater than the current firm capacity of 838 gpm (1.22 mgd).

A sensitivity analysis examined the effect of increasing capacity in sewers shown on Figure 4-13 to have flows more than 100 percent of full capacity. This would prevent surcharging in upstream sewers and result in the transmission of higher peak flows to downstream sewers. The analysis predicted that no downstream capacity issues would result from such sewer upsizing.

When new development is proposed, the City should verify whether the flows are consistent with the modeling assumptions so that sewer capacity is not exceeded.

CHAPTER 5

COLLECTION SYSTEM IMPROVEMENTS

Based on the assessment of existing conditions and future requirements for the collection system, improvements were identified to ensure that the collection system meets the City's needs through the end of the 20-year planning period. Four types of improvements were identified:

- I/I Flow Reduction
- Lift Station Upgrades
- Extensions to Unsewered Areas
- Improved Operation and Maintenance (O&M).

Based on the capacity analysis of the existing system detailed in Chapter 4, no upsizing of existing gravity sewers has been identified as necessary within the 20-year planning period.

5.1 I/I FLOW REDUCTION

An evaluation found that the City's existing sewer pipes have deficiencies that result in I/I well above normally accepted levels. If cost-effective measures can be taken to reduce I/I in the City's collection system, then the City may be able to forego other improvements in the collection system and treatment plant that would be needed to provide capacity for high flows with I/I. In general, I/I reduction is cost-effective only if the resulting decrease in flow allows the City to avoid capital improvements that would cost more than the I/I reduction measures.

For example, according to the 2001 Sewer Plan, the City's 1998 I/I reduction project cost $1.98 million ($2.7 million in 2015 dollars) and did not reduce peak flows at the treatment plant (though it did reduce average winter flows by 142,000 gpd and average summer flows by 170,000 gpd). Because treatment plant peak flow was not reduced, the same capital cost expenditures for plant expansion were needed after completion of the 1998 I/I improvements that would have been needed without the improvements. Experience in other collection systems has shown that peak flows often are unchanged by I/I reduction projects because of numerous unrepaired leaks in shallow side sewers on private property. This indicates that the City would need to find and correct side sewer leaks to significantly reduce peak flow, which can greatly increase the cost of I/I reduction measures.

For this facilities plan, a preliminary assessment was made of improvements needed to provide adequate system capacity if I/I is not reduced, and the potential cost and effectiveness of measures to reduce I/I. The need for improvements to

address capacity deficiencies at the treatment plant is explained in detail in Chapters 7 and 8.

5.1.1 CAPITAL IMPROVEMENTS REQUIRED IF I/I IS NOT REDUCED

South Fork Lift Station

The estimated peak flow of 1.7 mgd at the South Fork Lift Station on November 17, 2015 exceeded the station's firm capacity (1.2 mgd) by 0.5 mgd. If I/I is not reduced, larger pumps will be needed at the lift station. If the peak I/I to the lift station can be reduced from the estimated November 17, 2015 level of 11,000 gpad to King County's identified normal I/I level of 2,000 gpad, then peak flow at the station would be reduced to 0.6 mgd, about half of the station's existing firm capacity. This would eliminate the need for larger pumps, and it should reduce peak flow at the treatment plant by about 1.1 mgd. Alternately, it may be possible to avoid replacing the pumps through a combination of I/I reduction and a new larger force main, which would increase the output of the existing pumps. A predesign study should be conducted to determine whether I/I reduction and a new force main would be more cost-effective than upgrading the pumps. The study should also evaluate impacts of any lift station upgrade on the downstream gravity sewers.

Headworks Screen

The existing wastewater treatment plant headworks screening capacity is 3.5 mgd, which is 0.3 mgd less than the historical peak treatment plant flow. If I/I is not reduced, a second mechanical screen is needed, with capacity for projected flows through 2029, when a new headworks is planned. The estimated project cost is $290,000. The projected 2029 treatment plant peak flows is 5.3 mgd. I/I reduction would need to reduce the peak flow by 1.8 mgd for the existing screen to have sufficient capacity for the 2029 peak flow. This would require elimination of virtually all the existing excess I/I in the entire City and limiting I/I in future sewers to less than 2,000 gpad.

If peak flow is reduced by 1.1 mgd with I/I control in the South Fork Lift Station as discussed above, then the existing screen would have sufficient capacity through 2020. This would allow the City to defer the new screen for 4 to 5 years and provide more time to determine whether further I/I control would be more cost-effective than installing the new screen at that time.

Other Treatment Plant Improvements

Three other treatment plant capacity-related improvements are likely needed regardless of I/I reductions:

- **New 80-Foot Diameter Clarifier –** The City needs a second 80-foot-diameter clarifier at an estimated cost of $2.52 million. Under Ecology and EPA reliability requirements, the treatment plant must have capacity to treat half the peak flows with its existing 80-foot-diameter clarifier out of service. The existing standby clarifiers do not have this much capacity and they are in poor condition. The new clarifier is needed as soon as possible so the existing 80-foot clarifier can be taken out of service for required repairs. The new clarifier will provide sufficient capacity for the entire 20-year planning period and beyond, regardless of whether I/I is reduced.

- **Third UV Disinfection Unit –** The City needs a third UV disinfection unit (reactor, ballasts and controls) at an estimated cost of $275,000. The unit is needed immediately as a standby UV unit, because the existing UV units have failed repeatedly from lamp breakage during high flows and from electronic failures. Adding the third UV unit will provide sufficient disinfection capacity for the entire 20-year planning period and beyond.

- **Effluent Pumping –** Effluent pumps are needed at an estimated project cost of $390,000. The peak flow capacity of the existing outfall system will be increased by planned improvements, but this capacity increase is not expected to eliminate the need for effluent pumps during high river conditions.

5.1.2 I/I CONTROL ALTERNATIVES

Three I/I control alternative were considered for this facilities plan, as described in the sections below.

Annual O&M Program

This would incorporate I/I rehabilitation into the annual operation and maintenance program to maintain the sewers and prevent I/I from increasing. The cost of this program is estimated to average $330,000 per year for five years, with a long-term present worth of $1.6 million. This program would address the most significant items identified each year by CCTV inspection of the collection system or other known significant defects in the City's collection system, such as replacement or slip-lining of old CMP with new pipe complying with City code. It would prevent I/I from increasing and it might gradually reduce I/I below existing levels. The 5-year program would clarify the feasibility and cost-effectiveness of I//I control in North Bend and inform future decisions about when it would be cost-effective to increase capacity in the collection system or treatment plant.

Pilot I/I Control Program

This would be a pilot project to continue I/I reduction in the core area and gather information on the feasibility of significantly reducing I/I in the South Fork Lift Station basin. The cost of the pilot project is estimated to be $2.5 million. It would include the following improvements:

- Replace 127 leaking side sewers that were left in place in the core area in the 1998 and 2003 I/I rehabilitation projects. This would reduce peak I/I by approximately 0.1 mgd, assuming average side sewer I/I of 800 gpd

- Replace the remaining 286 feet of corrugated pipe in the core area. This would reduce average I/I by 7,500 gpd but result in no measureable reduction in peak I/I, based on results of the 1998 I/I reduction project.

- Perform 24 spot repairs to mainline sewers, or replace up to 1,100 feet of pipe in the Core Area or South Fork Lift Station basin. This would reduce average I/I by 30,000 gpd but result in no measureable reduction in peak I/I, based on results of the 1998 I/I reduction project. It might significantly reduce I/I if major point sources of excess I/I are found in the South Fork Lift Station basin.

- Rehabilitate up to 10 manholes where ponding of surface water occurs (see Figure 4-8). This would reduce peak I/I by 10 gpm per manhole, with a total peak I/I reduction of 100 gpm (0.14 mgd)

- Conduct CCTV inspection of 10,000 feet of sewer.

Based on these rough estimates, the pilot project might reduce average I/I by 40,000 gpd and peak I/I by 0.24 mgd if I/I reductions are comparable to the 1998 I/I improvement projects. This would not be sufficient to avoid the $360,000 for new pumps at the South Fork Lift Station, or the $290,000 headworks at the treatment plant. Some of the pilot improvements may be cost-effective, such as upgrading the manholes in ponded area, but much larger I/I reduction would need to be achieved for the whole pilot project to be cost-effective. The only way to determine the true cost-effectiveness in North Bend would be to implement and monitor the effectiveness of the improvements.

Follow-Up I/I Reduction Program

This project would build on the results of the pilot I/I reduction project, at an estimated cost of $9.2 million. It might include the following improvements (actual improvements would depend on results of the pilot project):

- Replace 70 leaking side sewers that were left in place in the 1998 and 2003 I/I rehabilitation projects. This might result in no measureable reduction in peak I/I, based on the results of the 1998 I/I reduction projects, or it might reduce peak I/I by 0.14 mgd, assuming average side sewer I/I flows of 2,000 gpd.

- Replace 20,000 feet of mainline pipe. This is expected to be less cost-effective than the 1998 and 2003 I/I reduction project, which replaced 8,200 feet of badly leaking corrugated metal and concrete pipe.

- Rehabilitate up to 10 manholes where ponding of surface water occurs (see Figure 4-8). This would reduce peak I/I by 10 gpm per manhole, with a total reduction of peak I/I by 100 gpm (0.14 mgd).

- Conduct CCTV inspection of all sewers in the City.

5.1.3 I/I CONCLUSIONS

Based on this cost-effectiveness assessment, it is recommended that the City incorporate I/I rehabilitation into its annual operation and maintenance program, as the most economical way to address I/I at this time. The annual program should focus initially on the most promising opportunities for controlling I/I. That is, replace any remaining CMP including but not limited to, the two pipe segments northwest of Sydney Avenue North just south of Bendigo Boulevard North, and the single segment on East 4th Street immediately west of the intersection of East 4th Street and Ballarat Avenue North as discussed in Section 3.3, Gravity Sewers, and Section 4.1.4, Infiltration and Inflow–Core Area Not Rehabilitated; rehabilitate and flood-proof manholes in known surface water ponding areas; conduct CCTV, and inspect the South Fork Lift Station collection system and implement the most promising I/I reduction there. These corrective actions are should be completed before the end of 2020.R

After the above corrective action work is complete, additional tasks would include flow monitoring to confirm how I/I is spread across the City.R Subsequent work would focus on the most promising I/I control areas. A key goal is to clarify what level of I/I control is cost-effective in North Bend so the City can make informed decisions when future capacity-enhancing upgrades are being considered.

5.2 LIFT STATION UPGRADES

Several improvements are needed to address known deficiencies at the South Fork and Snoqualm Lift Stations, as listed in Table 5-1. Additional capital cost estimate details are provided in Appendix F. These improvements will provide reliable operation and capacity through the end of the planning period in 2036. The current City goal calls for completion of these projects by 2018.

TABLE 5-1

Recommended Improvements at City Lift Stations

Project Summary Description	Work Items	2016	2017	2018
South Fork Lift Station Upgrade, SCADA & Controls	SCADA and control system upgrade: • PLC upgrade, integration with wastewater treatment plant • Pump control programming and integration with automated transfer switch	$56,000		
Snoqualm Lift Station Improvements	SCADA system integration: • Radio telemetry system, integrated with wastewater treatment plant control interface • Uninterruptible power supply for instrumentation and radio telemetry system • Control panel upgrade to meet code • Provision for bypass pumping	$55,000		
South Fork Lift Station Upgrade, Pumps, Wet Well & Bypass	Pump replacements, odor control upgrade and dry well access: • Predesign study • Pump upgrade • Upgrades to dry well entry, personnel and equipment access • Wet well and dry well ventilation system and foul air treatment • Provision for bypass pumping		$152,000	$352,000
Total		**$111,000**	**$152,000**	**$352,000**

Further investigation is recommended prior to pump upgrade at the South Fork Lift Station to determine the cause of the reduced existing pump capacity. Possible causes include pump ragging, impeller damage or volute damage. A preliminary design study should be performed to determine whether rigorous I/I control in the contributory collection system upstream of the South Fork Lift

Station would be a more cost-effective alternative than upgrading the station with larger capacity pumps, which would trigger a need to construct a larger force main and possibly larger gravity sewers downstream. The study should also evaluate the need for pressure surge control and appropriate control strategies for both the existing and future flows from the pump station.

All lift stations need to be outfitted to allow bypass pumping systems to be installed in cased of extended power outage or failure of the pump or control systems. Needed modifications would include suction connection, appropriate pump selection, and a discharge connection to the force main.

5.3 EXTENSIONS TO UNSEWERED AREAS

It is expected that the collection system eventually will be extended to provide service to all currently unsewered development in the city. The system also will be extended into any areas of the UGA that become annexed to the city in response to requests associated with proposed development. Figure 5-1 shows a planning-level concept for extending the existing system to provide service to all properties in the City and UGA using gravity sewers.

5.3.1 SEWER CONNECTIONS FOR AREAS USING ON-SITE SEPTIC SYSTEMS

Within the city limits, any unsewered development that experiences failures of onsite septic systems will need to transition to sewer service to protect public health and the environment. In wellhead protection areas, given the particular risks to drinking water supplies, conversion of onsite systems to sewers may be warranted regardless of whether onsite system failures have occurred. The City is currently evaluating the need for special requirements for wellhead protection areas.

ULIDs will likely be the primary method of extending sewer service to currently unsewered or unconnected development in the City. Financial aid, grants and hardship funding may be available to reduce the cost of installing sewers in densely developed neighborhoods such as the Silver Creek, SE 12th Street and Tanner Road areas. Additional financial aid may be available if groundwater quality is being adversely affected by existing on-site septic and drainfield systems, and for neighborhoods inside the 6-month travel zone of a wellhead protection area or buffer zone, such as the Riverside and LaForest Holme areas. Table 5-2 provides planning level project costs for extending service to these areas. More detail on the proposed sewer extensions is provided in Appendix D, including larger maps and tables with pipe size, slope and capacity. Additional capital cost estimate details are provided in Appendix F.

TABLE 5-2

Preliminary Cost Estimates for Sewer Conversion Areas

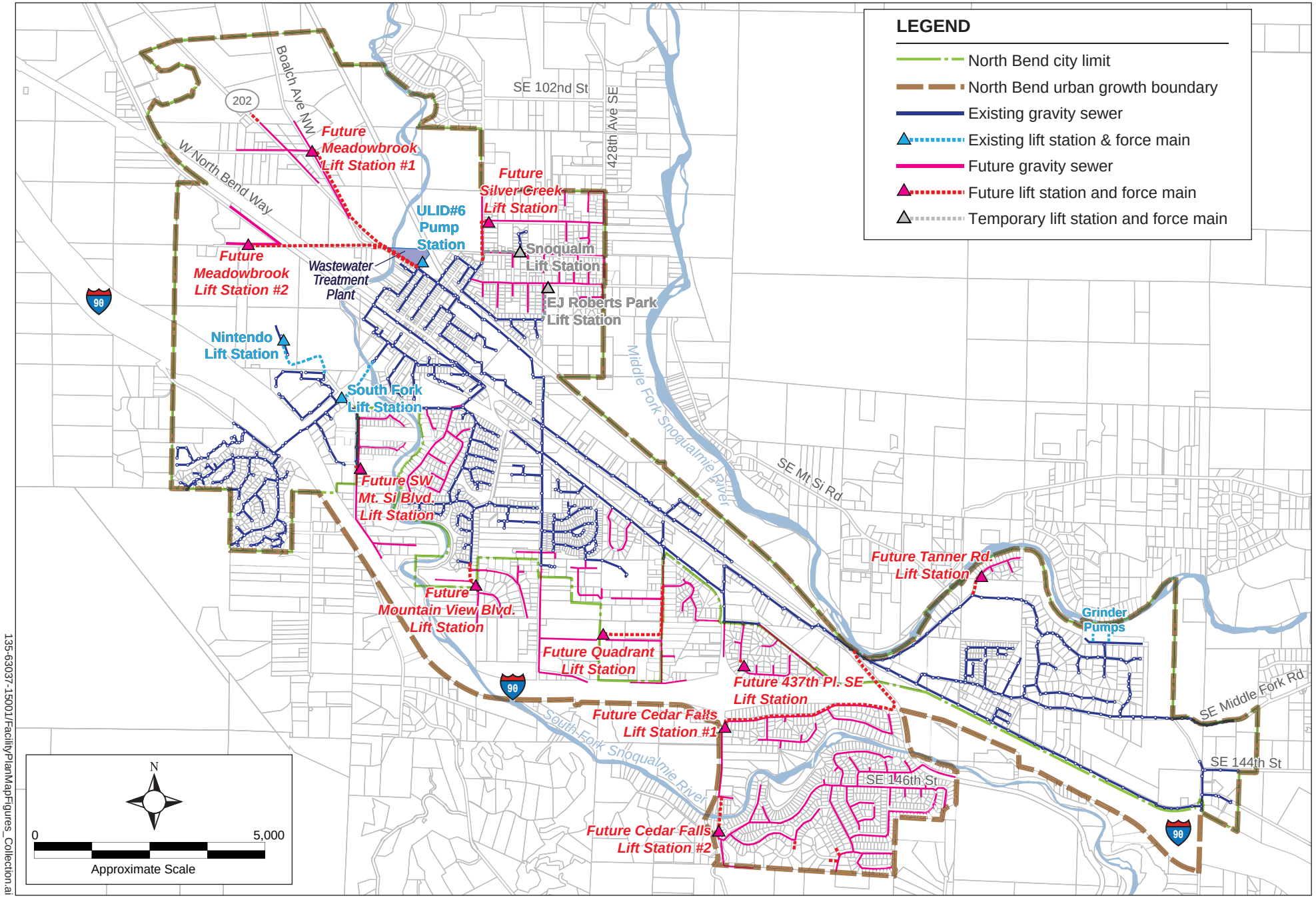
Area Name	Description	Estimated Project Cost to Provide Sewers (1)
Silver Creek	Unsewered development east of Ballarat Avenue NE, from NE 4th Street to NE 12th Street (SE 108th Street)	$16,250,000
Riverside	Unsewered development along Meadow Drive SE and Riverside Drive SE between SE Orchard Drive and SE 10th Street	$2,930,000
SE 12th Street	Unsewered development on SE 12th Street between 423rd Avenue SE and Patkanim Avenue SE	$500,000
LaForest Holme	Unsewered development along LaForest Drive SE, adjacent to SE Cedar Falls Way	$1,280,000
Tanner Road	Unsewered development along SE Tanner Road east of 452nd Avenue SE	$1,780,000

(1) Costs in 2016 dollars.

5.3.2 SEWER CONNECTIONS FOR CURRENTLY UNDEVELOPED AREAS

The timing of new sewer installation to undeveloped areas will be dictated by economic and market forces. The City of North Bend municipal code requires that sewers be installed for all new or revised development in the city, with limited exceptions (Chapter 13.06, Water and Sewer Requirements). In unincorporated areas of the UGA, sewer service will be extended as a result of annexation requests to serve development.

Without City involvement, sewer extensions, if they occur at all, would likely be only big enough for local projects and would include numerous small pump stations, which would have significantly higher City operating costs. The proposed sewer layout shown in Figure 5-1 is configured with gravity trunk sewers and few pump stations to minimize long-term City operation and maintenance costs. City code allows for the Public Works Director to require a developer to upsize sewers to accommodate future development. Implementing this plan will require City participation and latecomer agreements to encourage developers and existing property owners to install longer trunks or larger pump stations than initially needed, with the legal instruments to recover the extra cost in the future when capacity set asides are needed.



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City of North Bend
WASTEWATER SYSTEM FACILITIES PLAN

Figure 5-1.
EXTENSION OF EXISTING WASTEWATER COLLECTION SYSTEM TO FUTURE SERVICE AREAS

5.3.3 TYPE OF SEWER SYSTEM TO BE INSTALLED

The 2001 Sewer Plan recommended a system of vacuum sewers and pump stations, to address high groundwater in the service area. However, subsequent analysis during the planning of ULID 6 determined that gravity sewers are more cost-effective. The City identifies gravity sewer systems as the preferred means for conveying sewage in the City, but recognizes that lift stations will be needed in many instances. Future development should evaluate complete gravity systems or hybrid systems incorporating gravity and local lift stations, including low-pressure sewer systems for small areas isolated areas. The selection of conveyance should consider topography and groundwater and be approved by the City prior to detailed design.

5.4 IMPROVED OPERATION AND MAINTENANCE

5.4.1 SEWERS

Sewer Inspection and Cleaning

It is recommended that all City sewers be systematically inspected by CCTV, with the oldest sewers to be inspected in the first two years and the remaining sewers over 10 years. The inspection should be done to the standards of the Pipeline Assessment Certification Program, with the video and subsequent reports archived. This inspection should identify system defects and help identify sewers and side sewer laterals that need significant maintenance, rehabilitation and replacement. A system of preventive maintenance should be implemented that includes cleaning and removal of tree roots. For sewers of greater significance or with likelihood of recurring issues, a schedule for preventative maintenance should be set.

Force Main Inspection and Condition Assessment

Periodic assessment of force main conditions is recommended. This may include the following:

- Visual inspection of the galvanized steel section of South Fork Lift Station force main attached to the underside of the South Fork River bridge.
- Non-destructive testing of force mains.
- Coupon sampling of force main materials where there is potential for pipeline deterioration.

5.4.2 FLOW MONITORING AND DATA COLLECTION

Collection of flow monitoring data will enable measurement of base flow and I/I in City sewers. It is recommended that the gravity sewer system be visually checked at key locations to estimate dry-weather and wet-weather flows. Figure 5-2 shows a preliminary set of key manhole locations that should be checked. Combining velocity readings from a portable velocity sensor with estimates of water depth would enable estimates of flow at each location.

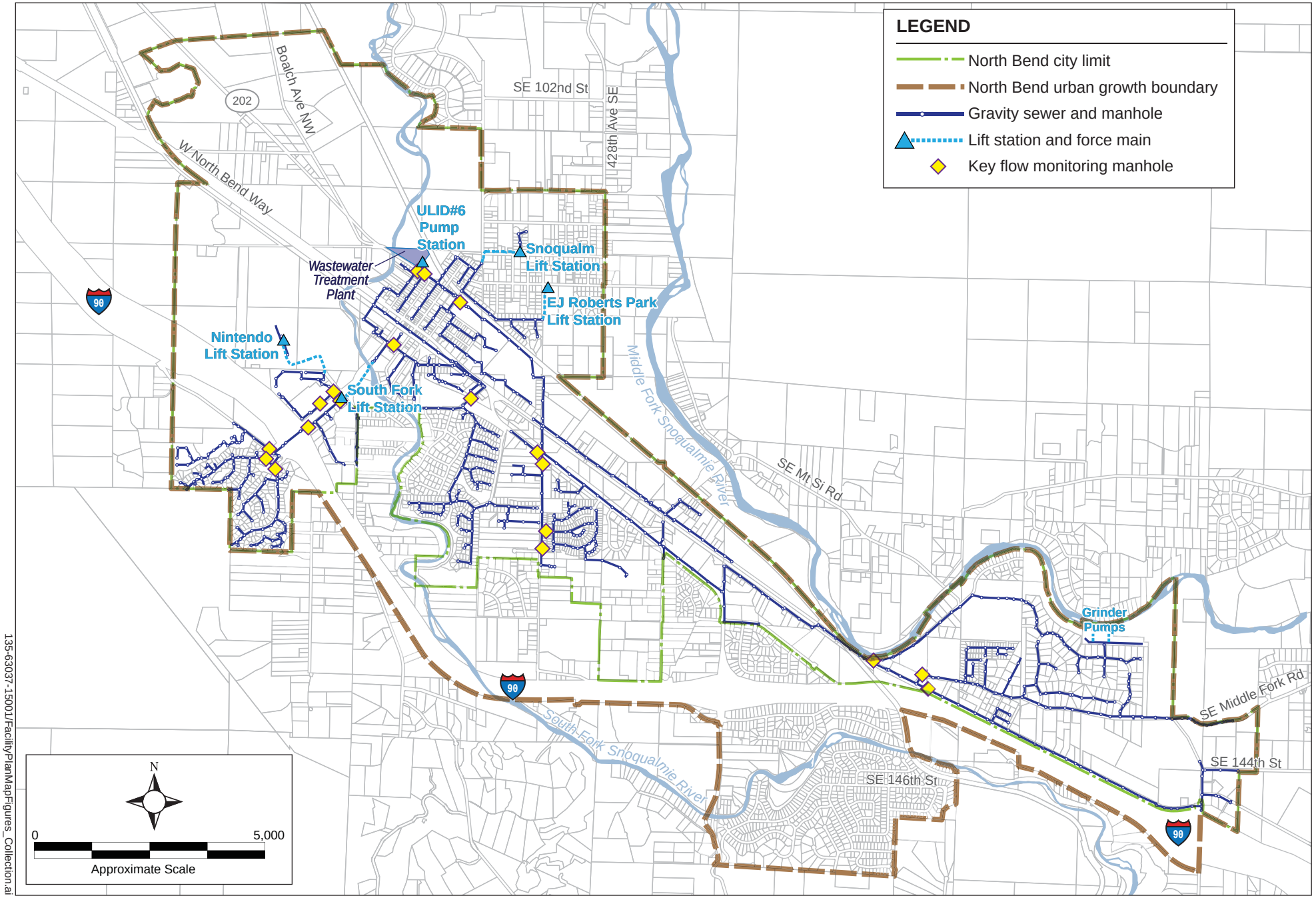
Periodic installation of temporary flow monitors at key locations in the network is also recommended. These flow monitors should record both water depth and water velocity, so that total flow can be derived. Installation of the meters should be at locations that have been screened to ensure that poor site hydraulics do not limit the accuracy of the data collection. A typical flow monitor installation would occur during the wet-weather season between September and April. This period may be extended if specific dry-weather flow information is desired. The first installation should occur in September 2017, with advance planning beginning in June 2017.

Flow monitoring should also incorporate collection of local rainfall data. Due to the City location adjacent to the South Fork and Middle Fork of the Snoqualmie River and their influence on groundwater, data on river stage should also be collected.

5.4.3 CMOM PROGRAM

It is recommended that the City implement a Capacity, Management, Operation, and Maintenance (CMOM) program following EPA guidance. A CMOM program should incorporate the following elements:

- Level of Service
- Performance Measurements
- Information Systems
- Asset Identification and Capitalization
- Failure Impact Evaluation and Risk Management
- Condition Assessment
- Rehabilitation and Replacement Planning
- Capacity Assurance Planning
- Maintenance Analysis and Planning
- Financial Management
- Continuous Improvement



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City of North Bend
WASTEWATER SYSTEM FACILITIES PLAN

Figure 5-2.
KEY MANHOLES FOR FUTURE FLOW MONITORING

CHAPTER 6

EXISTING WASTEWATER TREATMENT PLANT

6.1 WASTEWATER TREATMENT PLANT OVERVIEW

The City of North Bend wastewater treatment plant is on the bank of the South Fork of the Snoqualmie River by State Route 202 (Bendigo Boulevard North). The plant currently uses an oxidation ditch process for treatment, applies ultraviolet light for disinfection of the treated wastewater, and discharges to the South Fork of the Snoqualmie River. The original plant was constructed in 1954 but provided only primary treatment. Numerous upgrades have been constructed:

- 1978 – Plant Upgrade to provide secondary treatment
- 1995 – New Control Building
- 1997 Phase I Improvements – Clarifier 3
- 2000 Phase IIA Improvements – Ultraviolet (UV) disinfection
- 2001 Phase IIB Improvements – 3W water system improvements
- 2004 SCADA System installation
- 2004 Phase IIC Improvements – Two additional brush rotors, sludge dryer, centrifuge, sludge holding facilities and 3W water pump replacement
- 2009 – ULID 6 Pump Station and new headworks with mechanical fine screen
- 2013 Improvements – Foul air collection and treatment system improvements for sludge dryer and slide gate for separating influent flows from return flows in headworks for representative sampling
- 2015 Critical Improvements – New loading station for dewatered sludge, new oxidation ditch outlet weir and level monitoring system, and replacement of the two original brush aerators

Figure 6-1 shows the current plant site. Figure 6-2 shows the overall process diagram of the treatment plant.

6.1.1 LIQUID TREATMENT

Current processes for the liquid stream at the wastewater treatment plant are as follows:

- Wastewater enters the ULID 6 Pump Station, which serves as the plant's current influent pump station, through a 27-inch pipe from a 72-inch-diameter manhole (MH-A) on Bendigo Boulevard North.

- The plant's original influent pump station (IPS) receives sewage from mobile homes next to the plant, storm drainage from the southeast section of the plant, recycle flow from pumps in the Solids Handling Building, and excess collection system flows that exceed the capacity of the ULID 6 Pump Station.

- The original IPS force main is connected to the ULID 6 Pump Station force main just upstream of the current headworks facility. The combined raw wastewater flows are discharged to the north channel of the headworks, which features a mechanical fine screen to remove screenings entering the plant and a washer/compactor to remove water so that the screenings can be disposed of as solid waste.

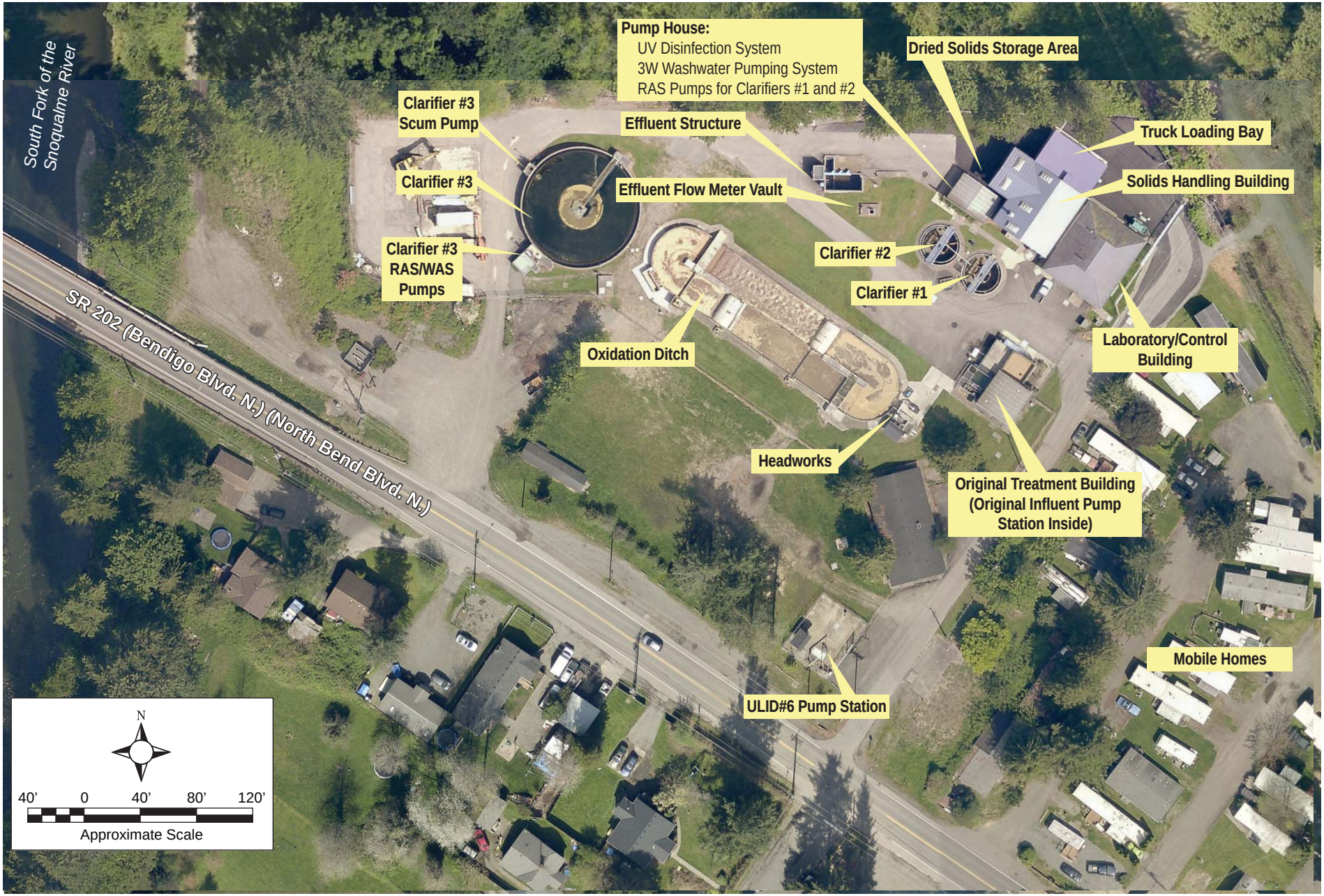
- The headworks south channel receives return activated sludge (RAS) from the main secondary clarifier (Clarifier 3). This channel features a manual bar screen for screening of the RAS flows.

- Screened wastewater and RAS continue to the oxidation ditch, which is aerated by four brush rotors.

- Mixed liquor from the oxidation ditch normally is conveyed over two adjustable outlet weirs on the oxidation ditch to the 80-foot-diameter Clarifier 3. During peak flow events or in the event of a failure of Clarifier 3, mixed liquor can also be diverted to two older, smaller clarifiers (Clarifiers 1 and 2).

- Secondary effluent from the clarifiers is combined and conveyed to UV reactors for disinfection.

- Most of the disinfected effluent leaves the plant through a 21-inch reinforced concrete outfall pipe from the effluent structure, except for a small quantity that is recycled as non-potable plant reuse water.



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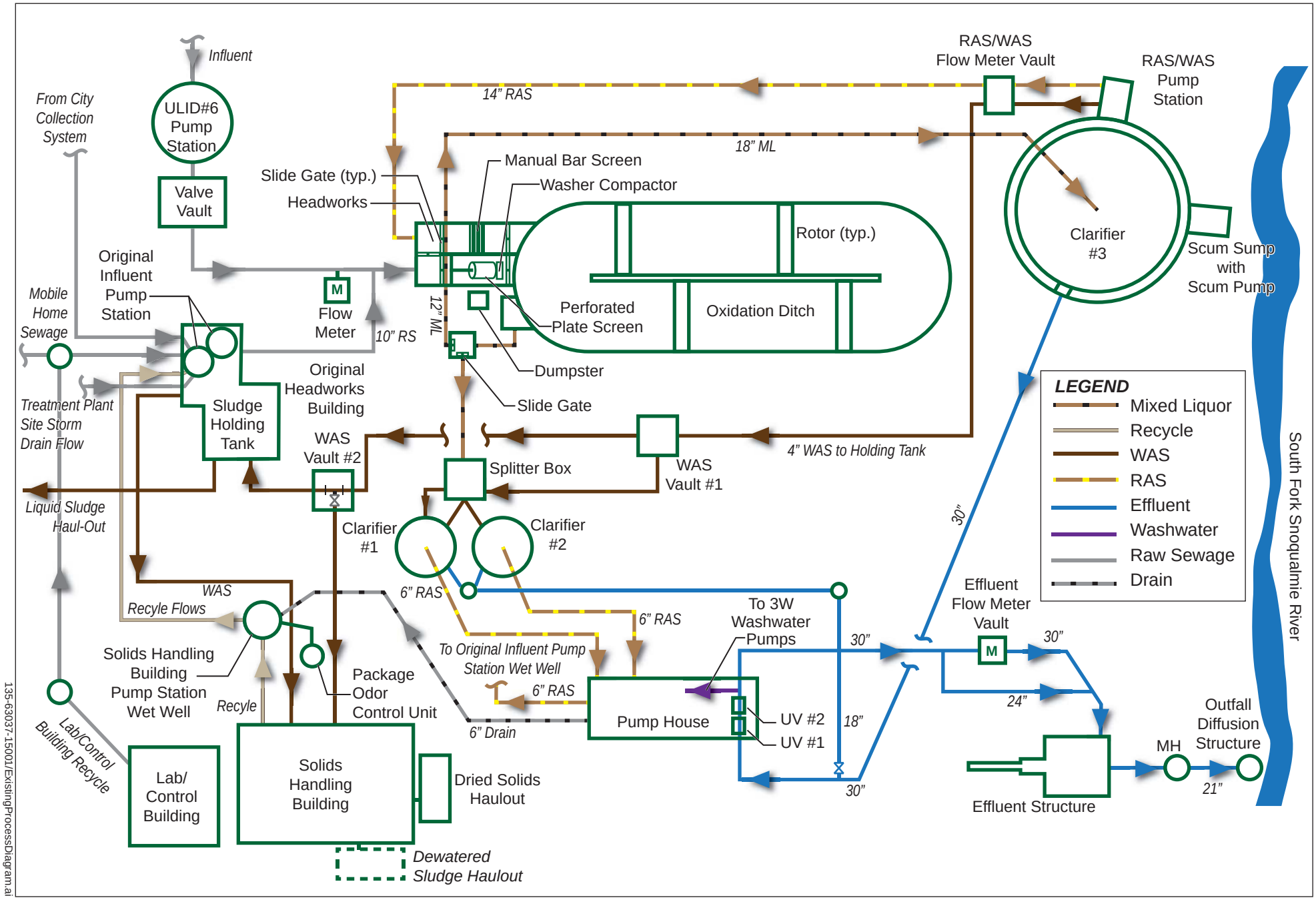
City of North Bend
WASTEWATER SYSTEM FACILITIES PLAN

Figure 6-1.
CITY OF NORTH BEND WASTEWATER TREATMENT PLAN



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City of North Bend
WASTEWATER SYSTEM FACILITIES PLAN

Figure 6-2.
WASTEWATER TREATMENT PLANT PROCESS DIAGRAM

6.1.2 SOLIDS TREATMENT

Current processes for the solids stream at the wastewater treatment plant are as follows:

- A duplex RAS pump station next to Clarifier 3 pumps RAS from the clarifier to the headworks influent channel, where a slide gate prevents the RAS from mixing with raw influent. The headworks discharges the screened RAS back to the oxidation ditch.

- A single-pump waste activated sludge (WAS) pump station next to Clarifier 3 pumps WAS to an aerated sludge holding tank.

- Sludge from the sludge holding tank is dewatered in a centrifuge in the Solids Handling Building then transferred to a sludge hopper.

- As of this year, the City has been conveying dewatered sludge to containers to be transported off-site for disposal at a landfill; the City previously thermally dried the sludge to produce Class A biosolids, but has discontinued this process because of reliability, odor, safety and operating cost concerns and problems with excess heat in the treatment plant's effluent.

6.2 SYSTEM COMPONENTS

6.2.1 INFLUENT PUMP STATION

The ULID 6 Pump Station is adjacent to the treatment plant, at the intersection of Bendigo Boulevard North and Sydney Avenue North. The pump station, constructed in 2009, receives wastewater from the entire sewered area of the City of North Bend through the influent 27-inch sewer from MH-A, except for sewage flows generated by four residences in the mobile home park immediately east of the entrance to the plant. The pump station is rated for a firm capacity of 5.6 mgd. In the event that high flows exceed the pump station's capacity, the excess flow surcharges Manhole MH-A and is diverted to the plant's original IPS through a 15-inch pipe.[R]

The pump station is outfitted with three non-clog submersible pumps installed inside a wet well constructed of 12-foot-diameter precast concrete manhole sections. The wet well has an ultrasonic level sensor, as well as floats, to control the start and stop of the pumps. Currently, plant operators run one large pump under normal operations. The force mains from the three pumps combine into an 18-inch force main that discharges the raw sewage to the plant headworks. An electromagnetic flow meter in a meter vault measures the pumped flow from the 18-inch force main. A schematic of the pump station is provided in Figure 6-3.

6.2.2 HEADWORKS

The treatment plant headworks (see Figure 6-4) is upstream of the oxidation ditch and consists of two channels (north and south), each 2.5 feet wide:

- Raw sewage from the ULID 6 Pump Station force main discharges to the north channel, where it passes through the mechanical fine screen before going to the oxidation ditch. A high-level float switch and an ultrasonic level sensor measure the water level in the channel.

- Return activated sludge discharges to the south channel from a 14-inch pipe from the RAS/WAS pump station. RAS passes through the manual bar screen before going to the oxidation ditch. The south channel is also a bypass channel for influent flows exceeding the capacity of the north channel.

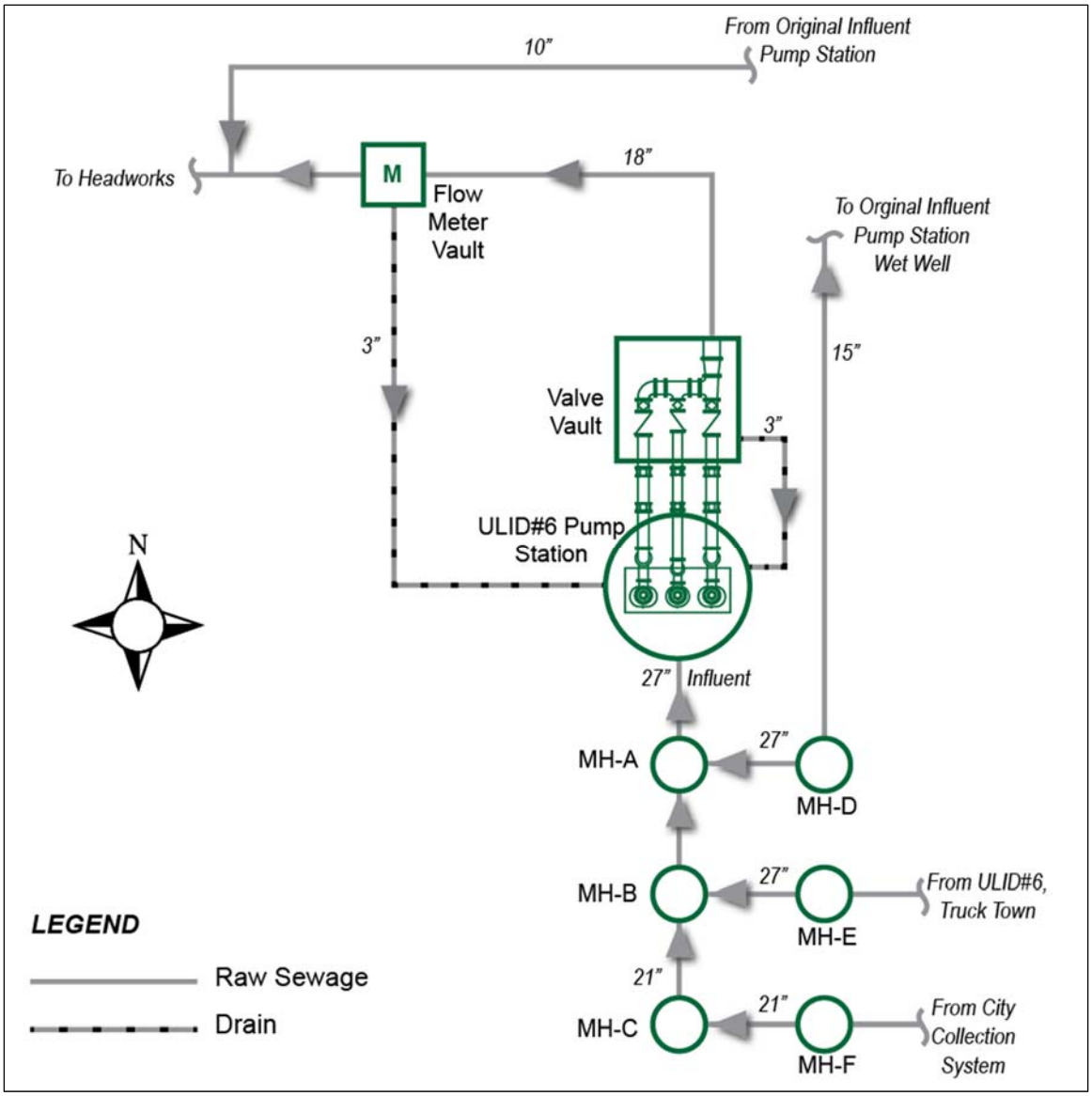


FIGURE 6-3

ULID 6 Pump Station Schematic

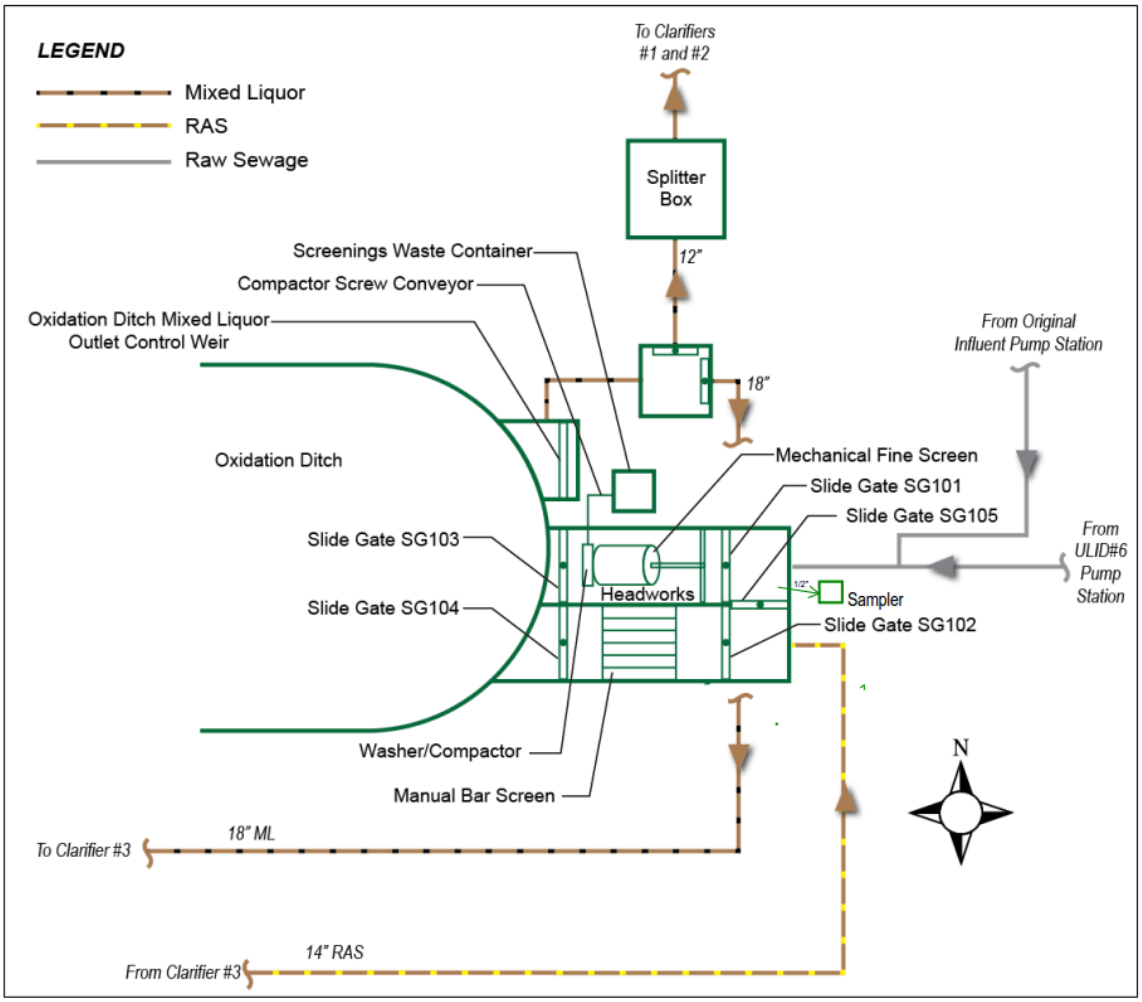


FIGURE 6-4

Wastewater Treatment Plant Headworks[R]

A slide gate isolates the two flow streams so that RAS does not affect influent sampling. The two flows combine in the oxidation ditch. The mechanical fine screen and the washer/compactor are supplied with water from the plant's 3W water system. Screenings (materials removed from the wastewater by the screens) are washed and conveyed through the washer/compactor unit located next to the fine screen. The washer/compactor dewaters the screenings and discharges the dry screenings into a waste container. The wash water is discharged to the oxidation ditch.

6.2.3 OXIDATION DITCH

The oxidation ditch is a 191-foot-long oval structure with a central dividing wall, located next to the headworks (see Figure 6-5). Screened wastewater and RAS from the headworks enter the oxidation ditch from the east side and are mixed with the mixed-liquor suspended solids (MLSS) activated sludge already present in the oxidation ditch. Mixed liquor rotation in the ditch is clockwise.

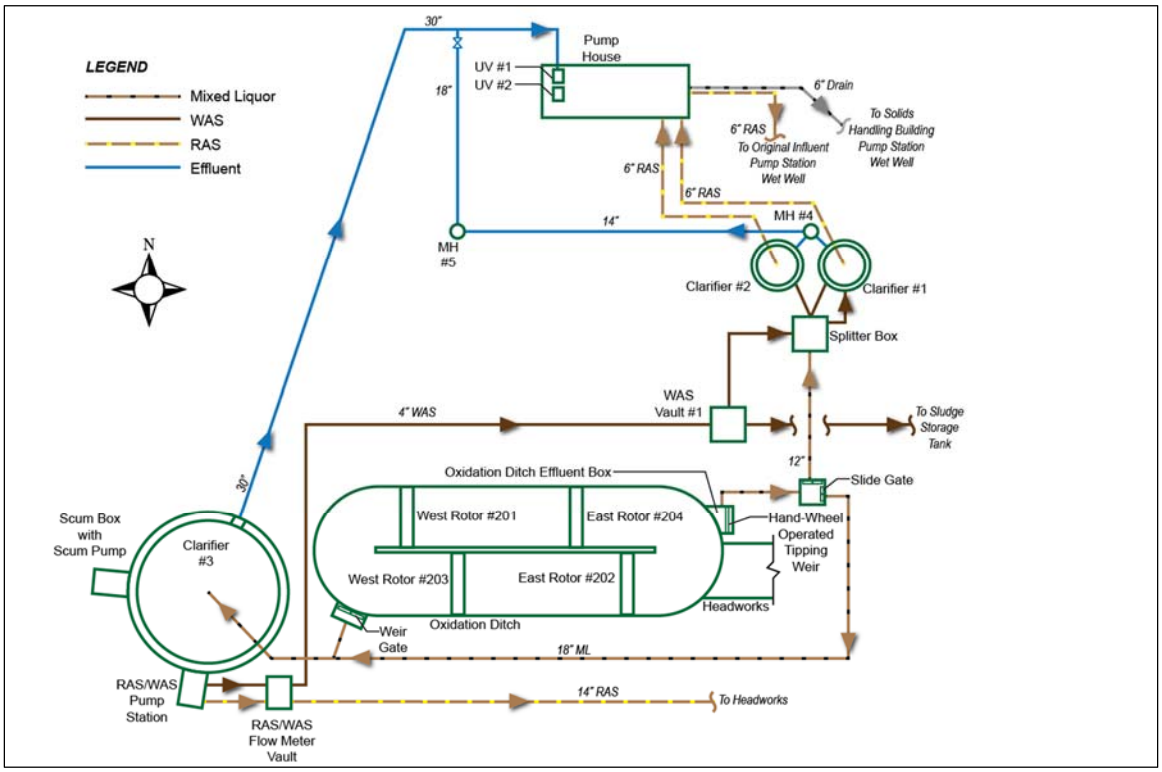


FIGURE 6-5

Wastewater Treatment Activated Sludge Process

Four brush rotors supply oxygen from the air and keep the contents of the oxidation ditch mixed and moving. The original ditch had two brush rotors (Rotor 201 and 202), and two more were added in 2006 to supply additional mixing and aeration capacity (Rotor 203 and 204). The two newer rotors are covered with fiberglass panels and the two older rotors are located under bridge walkway structures.

Mixed liquor flows out of the oxidation ditch via a 13-foot-long weir gate constructed in 2015 or via the original 4-foot-long tipping weir and is routed to the plant's secondary clarifiers via flow splitter boxes, slide gates and buried pipes. The first flow splitter box is next to the oxidation ditch. Mixed liquor

flows into it from the oxidation ditch tipping weir. The splitter box can route mixed liquor to Clarifier 3 or to the second splitter box, which routes flow to either Clarifier 1 or Clarifier 2.

MLSS consists mostly of microorganisms and non-biodegradable suspended matter. When raw sewage with high organic load mixes with MLSS in the presence of oxygen, the organic load is oxidized by the microbes. Dissolved oxygen (DO) concentration in the oxidation ditch is controlled by adjusting the immersion depth of the brush rotors and by cycling the rotors on and off. High DO levels occur immediately downstream of each operating rotor, and DO levels decrease as the mixed liquor flows downstream, yielding low DO or anoxic zones downstream. The next operating rotor creates a high DO zone, and so on, as mixed liquor circulates around the oxidation ditch. These alternating zones promote nitrification, denitrification, alkalinity recovery and energy conservation.

When the rotor immersion depth is increased, more oxygen is transferred to the mixed liquor and the mixed liquor circulates faster around the oxidation ditch. The immersion depth of the rotor can be controlled by varying the water level, which is accomplished by adjusting the outlet weir up or down using a hand wheel. Aeration and mixing performance can also be adjusted by changing the rotor rotation speed with different size sheaves. Lower speeds provide more mixing and less aeration per horsepower; higher speeds do the opposite.

Cyclic operation of the rotors with timer controls also creates alternating high and low DO conditions and provides another opportunity for denitrification. When the rotors are operating, mixed liquor moves through the oxidation ditch at 1 to 2 feet per second. When they cycle off, momentum of the mixed liquor causes it to continue to circulate around the oxidation ditch and keep the MLSS well mixed for 30 minutes or longer before circulation slows to the point that significant settling begins. If the rotors are off too long (about 2 to 3 hours, depending on MLSS concentration and temperature), solids will settle and the oxidation ditch will become anaerobic; this leads to foul odors being released when the rotors are restarted and can cause effluent quality to deteriorate, which can interfere with the UV disinfection process.[R]

6.2.4 SECONDARY CLARIFIERS

The North Bend treatment plant has two small secondary clarifiers (Clarifiers 1 and 2) and one large secondary clarifier (Clarifier 3) (see Figure 6-5). MLSS settles in each clarifier and is transported to the center of the clarifier by rotating rake arms. The concentrated, settled sludge is then withdrawn by pumps and returned to the inlet of the headworks, where it then flows back into the oxidation ditch as return activated sludge (RAS).

Clarifiers 1 and 2 were constructed during the 1978 plant upgrade. Each is 26 feet in diameter with 10-foot side water depth and 1:16 bottom slope. Mixed liquor enters through a 10-inch pipe from the Clarifier 1 and 2 splitter box. Clarified effluent leaves each clarifier via outlet weirs and a 10-inch diameter pipe to Manhole MH-4; from there it flows to the UV disinfection reactors. Settled sludge is removed from the clarifiers through 6-inch sludge lines and is pumped by three sludge pumps in the basement of the Pump House adjacent to the two clarifiers. Scum is removed from at the scum skimmer tipping pipes and routed to a scum box located between the two clarifiers. It is pumped out of the scum box by the sludge pumps.

Clarifier 3 is an 80-foot-diameter clarifier that was constructed in 1997. It has a side water depth of 14 feet and a bottom slope of 1:12. Mixed liquor from the oxidation ditch is conveyed to the clarifier through a 30-inch pipe from the 13-foot outlet weir and an 18-inch pipe from the original 4-foot tipping weir that transitions to 30-inch right before the clarifier. Sludge settles in the bottom of the clarifier, and clarified effluent discharges over a peripheral weir into an effluent launder trough and drop box. Effluent is conveyed from this drop structure to the UV disinfection reactors through a 24-inch pipe. Settled sludge is transported to the center of the clarifier by a spiral scraper mechanism. A sludge collector ring in the center of the clarifier has ports at the inboard end of the scraper blades to allow the RAS pump to withdraw the settled sludge. This clarifier was designed for a maximum-month flow rate of 2.35 mgd and a peak flow rate of 5.0 mgd.

6.2.5 DISINFECTION

The UV disinfection system consists of two UV reactors in parallel, installed at the plant in 2000. These are closed-vessel, in-line, medium-pressure, high-intensity UV reactors. The UV system has a peak capacity of 5.10 mgd, with each unit (reactor, ballasts and controls) capable of treating 2.55 mgd with secondary effluent transmittance of 65 percent or greater at 254 nm. At these flows and transmittance levels, the system is designed to reduce fecal coliform levels to 200 colony-forming units per 100 milliliters (200 cfu/100 mL) (maximum 30-day geometric mean of daily samples) and 400 cfu/100 mL (maximum 7-day geometric mean of daily samples). Each UV reactor has an automatic cleaning mechanism to periodically clean the quartz sleeve and maintain its maximum UV transparency.[R]

Random measurement of UV transmittance at 254 nm during 2015 and 2016 indicate the UV transmittance is consistently greater than 65 percent under normal plant operation. Measured UV transmittance of the secondary effluent range from 67 to 75 percent transmittance at 254 nm.[R]

The UV reactors are located in the Pump House basement and the ballast and controls are on the ground floor. Effluent from the secondary clarifiers is carried

in a 30-inch diameter pipe that is reduced to a 24-inch diameter right before it enters into the Pump House. Secondary effluent goes upward through the UV reactor and then out. The disinfected effluent leaves in a 24-inch diameter pipe parallel to and above the influent pipe. After the effluent pipe leaves the Pump House it is increased to a 30-inch diameter pipe that conveys the effluent to the effluent flow meter and effluent structure. Final effluent is metered and then discharged to the outfall from the effluent structure. An effluent flow schematic is provided in Figure 6-6.

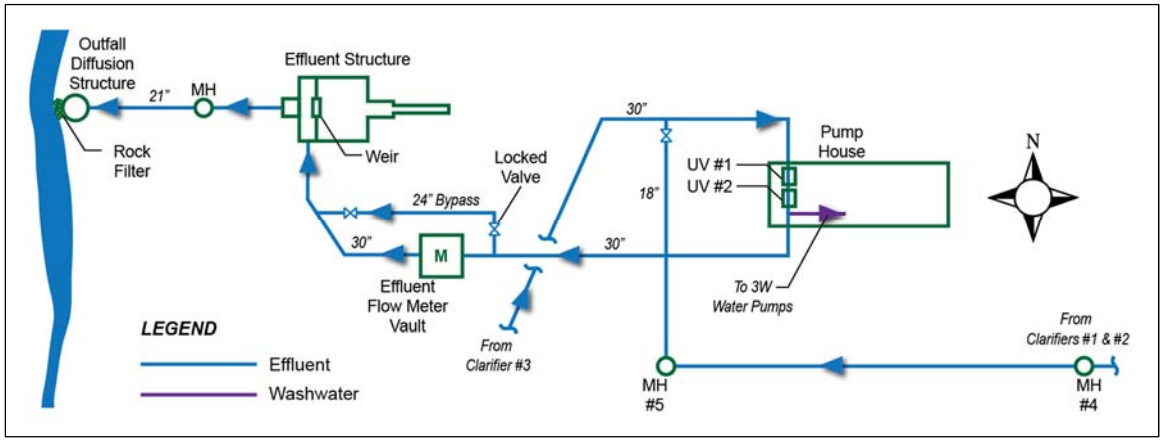


FIGURE 6-6

Effluent Flow Schematic

6.2.6 EFFLUENT STRUCTURE

Disinfected effluent from the UV system is conveyed through a 30-inch-diameter pipe to an effluent flow meter vault. At the vault, the pipe is reduced to an 8-inch diameter pipe for the 8-inch diameter effluent mag-flow meter. After flow measurement, flow is conveyed from the vault through a 30-inch-diameter pipe to an effluent structure (see Figure 6-6).

When the flow meter is not working and needs to be removed for repair or replacement, flow can be bypassed through a 24-inch pipe by opening a normally locked closed valve. Bypassing the effluent flow meter requires that notification be given to the Washington Department of Ecology. In November 2015 and in January 2016, the bypass valve was opened to relieve excessive head loss through the existing 8-inch diameter piping and flow meter that caused overtopping of Clarifier 3 during extremely high flow events associated with unusually intense wet weather.

The effluent structure is the facility that provided chlorine disinfection before the plant's UV disinfection system was installed. Flow from the effluent flow meter

vault enters an effluent basin on the west side of the structure and then passes through a check-valve-controlled orifice to a discharge vault connected to the 21-inch outfall pipe. Flow from the effluent structure discharge vault enters the outfall for discharge to the South Fork Snoqualmie River.

Weir plates separate the effluent basin from the adjacent unused chlorine contact tank. Flows may overtop the weir plates into the contact tank if flow from the treatment plant is high or if the South Fork Snoqualmie River is at a high stage at the outfall discharge location. The contact tank is currently drained by a float-actuated electric sump pump. Pumps will be installed in the future to overcome the backwater from the river during high river flows. The pumps will enable discharge to the river for river stages up to the 100-year river flood elevation.

6.2.7 OUTFALL DIFFUSION STRUCTURE

The wastewater treatment plant discharges treated effluent to the South Fork of the Snoqualmie River through a 450-foot-long, 21-inch-diameter, reinforced concrete pipe and an outfall diffusion structure on the east bank of the river (see Figure 6-6). Effluent flows through the outfall diffusion structure and then a cobblestone filter into the river. The structure consists of a 96-inch diameter manhole with ports constructed from concrete masonry units laid on their side, spanning 106 degrees of the perimeter on the river side of the structure; the discharge ports are buttressed with 6- to 10-inch cobblestone filter to protect the structure and distribute flow into the river. The outfall and diffusion structure were constructed in 1978. The outfall structure and pipeline were cleaned and video-inspected in 2014.

6.2.8 SLUDGE HOLDING AND DIGESTION

WAS from the treatment plant clarifiers enters a 37,900-gallon aerated sludge holding tank through a 4-inch WAS line (see Figure 6-7). The sludge holding tank is aerated with fine-bubble membrane disc diffusers 16 feet below the high water surface. An emergency overflow weir in the tank conveys excess WAS to the original IPS wet well to prevent overtopping of the tank walls. The sludge level in the sludge holding tank is monitored by an ultrasonic transducer.

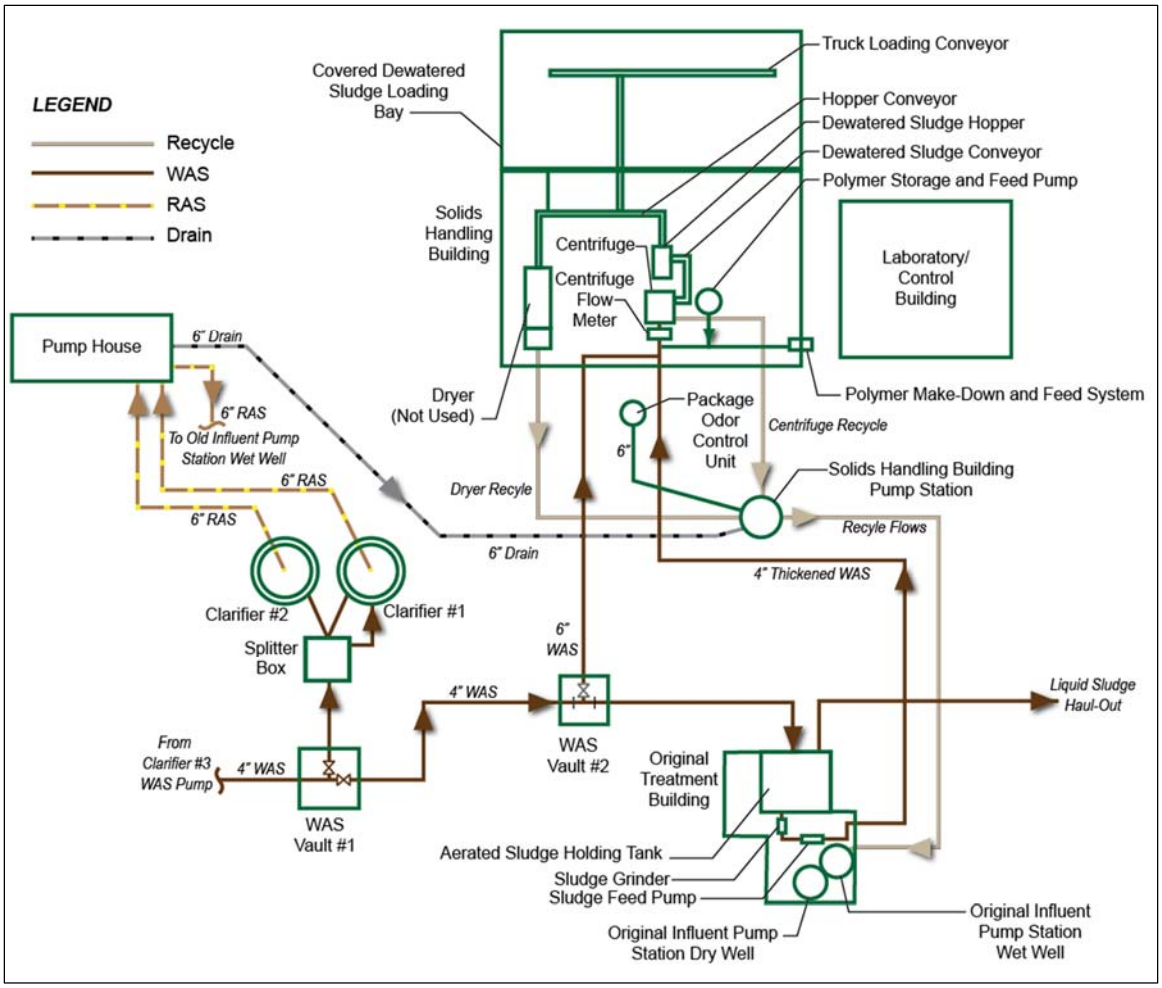


FIGURE 6-7

Sludge Process Flow Schematic

Sludge thickened in the holding tank is drawn through an inline grinder by a centrifugal sludge pump. The grinder reduces oversized solids that could cause damage or interfere with the operation and performance of downstream sludge pumping and dewatering equipment. The sludge grinder is located in the Original Treatment Building. It consists of a rotary cutter to grind oversized solids. The sludge feed pump, also located in the Original Treatment Building, is capable of passing 3/4-inch solids and 3-inch semi-solids without clogging. It also can operate dry. The pump can be operated at speeds from 20 to 200 rpm; the speed is adjusted to achieve a desired sludge flow rate of 15 to 60 gpm. The pump discharges sludge through a 4-inch force main to the Solids Handling Building.

6.2.9 SLUDGE DEWATERING

The Solids Handling Building houses a centrifuge that thickens sludge from about 0.7 percent solids to 16 to 20 percent solids (see Figure 6-7). Thickened solids are then hauled off site. Facilities are provided to allow hauling of liquid sludge from the holding tank when the centrifuge is down for maintenance.

Centrifuge

WAS from the sludge holding tank is pumped to the centrifuge by the sludge feed pump. WAS enters the centrifuge through a central feed pipe, where it is pushed to a rotating bowl through discharge ports. The cylindrical bowl rotates continuously. As it rotates, solids particles adhere to the bowl wall under the effect of centrifugal force. The separated solids are then transported through a conical section by a scroll conveyor that rotates at a different speed than the bowl. Further dewatering occurs as the solids pass through the conical section of the bowl. Recycle from the centrifuge – called "centrate" – is removed through an overflow weir at the end of the bowl. The weir diameter can be adjusted to optimize the performance of the centrifuge by discharging more clear liquid. The centrifuge has a capacity to dewater approximately 180 pounds of dry solids per hour when the centrifuge is fed WAS at approximately 0.7 percent solids. The centrifuge becomes hydraulically limited at a feed sludge rate of approximately 50 gpm.

A feed system adds polymer to the WAS before it enters the centrifuge. The polymer feed system consists of a metering pump, solenoid valve, pressure gauge, pressure switch and thermal flow sensor. Polymer is mixed with potable water for dilution in the polymer blending unit. An electromagnetic flow meter measures the flow to the centrifuge of sludge plus polymer solution.

A screw conveyor collects solids from the centrifuge and discharges to the sludge dryer feed hopper, which has a sidewall height of 8.5 feet. The low end of the conveyor has a 3-inch drain with an electrically actuated control valve. Controls for operating the sludge conveyor are located in the centrifuge control panel and are integrated with the centrifuge PLC.

Dewatered Sludge Loading Station

New facilities installed at the treatment plant in 2015 convey dewatered sludge from the centrifuge to a transfer container for disposal. The dewatered sludge can be temporarily stored in the 28-cubic-yard hopper previously used for the drying system until enough has accumulated for disposal, but experience has demonstrated that loading the sludge directly into the sludge haul vehicle produces less odor than accumulating sludge in the hopper. An inclined conveyor transfers dewatered sludge from the hopper inside the Solids Handling Building to

a covered outdoor loading station. The inclined conveyor drops the sludge onto a distribution conveyor over the transfer container below, through three gates that distribute the load evenly in the transfer container.

Sludge Drying System

The treatment plant has a thermal sludge drying system designed to produce Class A biosolids. In the spring of 2015, the plant discontinued the use of the sludge dryer due to maintenance issues and adverse thermal impacts on the treatment plant effluent. The system remains in place but is inactive. Its major components are as follows:

- A 28-cubic-yard sludge hopper to hold dewatered sludge conveyed from the centrifuge (still operational)
- A dehydration chamber consisting of a double-walled drum; hot oil circulated in the annular space between the inner and outer walls heats the sludge to evaporate water
- A thermal fluid system to heat the oil that heats the sludge dryer
- A multi-chamber condenser/wet scrubber to cool the air and remove moisture and particulates

6.2.10 SUPPORT FACILITIES

Enclosed Structures

Support facilities at the treatment plant are generally located in one of four main buildings at the plant:

- **Original Treatment Building –** This building houses the original IPS, the sludge grinder and sludge feed pump, the aerated sludge holding tank, and a standby generator.
- **Laboratory/Control Building –** This building houses the laboratory and MCC and SCADA control systems. The electrical service switchboard is on the outside of the building, on the east side.
- **Pump House –** This building houses the UV disinfection system, RAS/WAS pumps, the 3W water system, and a small maintenance shop.
- **Solids Handling Building –** This building houses the centrifuge, dryer, polymer storage and feed system, sludge hopper and conveyor, sludge flow meter and odor control, with a covered loading bay for dewatered

sludge in the back. The Solids Handling Building Pump Station and associated odor control system are outside the front of the building.

Flow Measurement

Total Treatment Plant Flow

Total wastewater flows from the City service area are measured with influent and effluent flow meters at the wastewater treatment plant. The influent flow meter does not measure the flows from the laboratory/control building, the four mobile home connections in the adjacent trailer park to the east, or any stormwater collected by the treatment plant collection system (parking lot in front of the laboratory/control building and sludge loading bay).

Raw sewage pumped from the ULID 6 Pump Station to the plant headworks is monitored by a magnetic flow meter installed in a vault on the 18-inch raw sewage force main, about 50 feet from the pump station valve vault. Isolation valves are located on the force main upstream and downstream of the flow meter. Influent flows not measured by the ULID 6 flow meter, including flow from four neighboring mobile homes and from the treatment plant laboratory/control building, are minor, making up less than 0.3 percent of the total influent flows. The flow meter records the flow and sends a signal to the plant PLC. The pumped flows are instantaneously recorded on the plant SCADA computer. This meter was installed in 2009 but provided incorrect data for its first several years of operation, incorrectly indicating flows up to 300 gpm when the pumps were off and there was no flow through the flow meter. This problem was discovered in March 2013 and corrected by reprogramming.

Effluent flows are measured with an 8-inch diameter magnetic flow meter a few feet upstream of the treatment plant effluent structure. Disinfected effluent from the UV system is conveyed toward the meter by gravity through a 30-inch pipe. Isolation valves are provided upstream and downstream of the flow meter. From the time that it was installed in 2000 until the influent flow meter began to work correctly in 2013, the effluent flow meter provided the only valid measurement of total treatment plant flows. It provides an accurate indication of daily-average influent flows, but not instantaneous or peak-hour flows, because influent flow variations are attenuated through the plant upstream of the effluent flow meter.

Internal Treatment Plant Flows

Internal plant flows of liquids and solids are measured as follows:

- **RAS/WAS Flow Meters –** The 12-inch RAS force main and the 4-inch WAS force main are metered downstream of the RAS/WAS pump station in the RAS/WAS meter vault. Two meters are provided:

- **RAS Flow Meter –** The RAS flow meter measures the RAS flow rate from Clarifier 3 to the plant headworks. The RAS flow rate is set by manual adjustment of the variable frequency drives on the RAS pumps.

- **WAS flow meter –** The WAS flow meter measures the WAS flow rate from Clarifier 3 to the sludge holding tank. WAS flow is measured to determine the volume of sludge wasted for control of the activated sludge process.

- **Centrifuge Flow Meter –** An electromagnetic flow meter measures the combined flow of thickened sludge and polymer into the centrifuge. It is located on the centrifuge skid.

- **Old Influent Pump Station –** Flows pumped by the old influent pump station are not measured. The normal quantity of flow from this pump is dominated by the centrate return flow when the centrifuge is operating; this is an internal recycle flow. Wastewater flows from the lab/control building and the four mobile home customers are inconsequential with regard to the total plant flow. The flow of stormwater from the solids loading area is inconsequential because that area is covered by a canopy. The flow of stormwater from the parking area at the lab/control building is also inconsequential due to the small catchment area which is approximately 6,000 square feet.

Internal Pump Systems

RAS/WAS Pumping

Three constant-speed sludge pumps for Clarifiers 1 and 2 are located in the basement of the Pump House. Each has a rated capacity of 375 gallons per minute (gpm). If both Clarifiers 1 and 2 are in service, one pump is set to pump RAS or WAS from Clarifier 1, another is set to pump from Clarifier 2, and the third is a standby pump. For RAS pumping, valves are set to route pump discharge to the Solids Handling Building Pump Station and then to the original IPS, which pumps the RAS to the headworks; from there the RAS returns to the oxidation ditch.

For WAS pumping, the valves are set to route pump discharge to the sludge storage tank for storage and further processing as waste sludge. As a secondary function, the sludge pumps can be set to pump scum from the scum box between Clarifiers 1 and 2 to the sludge storage tank. They can also be set to drain Clarifiers 1 and 2 to the original IPS via the Solids Handling Building Pump Station.

The sludge pumps for Clarifier 3 are located in the 10-foot-square RAS/WAS wet well attached to the side of the clarifier (see Figure 6-5). Sludge from the clarifier enters the wet well through a 12-inch pipe, which can be blocked with a slide gate in the wet well to shut off flow. The wet well houses two submersible pumps for RAS pumping (P301 and P302) and one for WAS pumping (P303). The RAS pumps discharge to the headworks through a common 12-inch force main with a 10-inch-diameter magnetic RAS flow meter. The WAS pump discharges to the sludge storage tank through a 4-inch force main with a 4-inch-diameter WAS flow meter. The RAS pumps have variable frequency drives that are manually adjusted to control the rate of RAS pumping; the minimum turndown that can be sustained without pump capacity attenuation is 350 gpm. The WAS pump is a constant-speed pump. The WAS wasting rate is manually controlled through time of operation or volume discharged as measured by the WAS flow meter and monitoring of the level in the aerated sludge holding tank.

Solids Handling Building Pump Station

The Solids Handling Building Pump Station wet well and valve vault were constructed in 2004. The wet well is a 6-foot-diameter precast manhole approximately 9 feet deep. The following sources discharge to the wet well:

- 6-inch Solids Handling Building drain
- 4-inch biofilter drain
- 4-inch MH-4 drain
- 6-inch drain force main from the Clarifier 1 and sludge pumps
- 2-inch drain from the valve vault

The pump station includes two submersible pumps P617 and P618, with one duty and one standby. Each pump's 4-inch pump discharge line contains a check valve and a plug valve in a vault downstream from the wet well. The two 4 discharge lines combine at a wye section. Recycle from the pump station is returned to the original IPS wet well. Foul air from the wet well is treated with a packaged odor scrubber system.

Original Influent Pump Station

The original IPS is a wet well/dry well station constructed with the original primary treatment plant in 1951. The original IPS wet well and dry well are located in the Original Treatment Building. The mechanical and electrical components were replaced during the 1978 station upgrade. The 1978 pump motors were replaced with similar motors after they were worn out. After construction of the new ULID 6 Pump Station in 2009, this pump station is no longer the main pump station. It now serves the following functions:

- It acts as a supplement station during high flow events.
- It serves as the influent pump station for return of all plant recycle flows except RAS.
- It is the sole means of conveying raw sewage from the plant control building and seven homes in the adjacent mobile home park.

The pump station has three levels: access level, mezzanine level and the lower level. The dry well and wet well are each 20 feet deep and have access by ladder from the finish floor elevation. The normal storage capacity of the wet well is 1,450 gallons. The pump station has two 20-HP variable speed pumps, each with a capacity of 850 gpm. The pumps can be fitted with larger impellers with 40 hp motors, so that each could pump up to 1,665 gpm. The two pumps discharge to a common 8-inch force main header that connects to the 18-inch ULID 6 discharge force main.

Odor Control

Sludge Dryer

The sludge dryer odor control unit (OCU) is an 8-foot diameter, 10-foot high circular HDPE vessel filled with wood chips overlain with a thick layer of activated carbon. The biofilter media is made of a bulking agent (50 to 75 percent) and a compost material (50 to 25 percent). The vessel can be accessed through a 24-inch access on the top. The system has a capacity of 500 cfm. It is currently located along the treatment plant's north fence line near the effluent structure and is unused because the dryer is no longer used. When it was in use, dryer foul air would pass through the mist eliminator and enter the OCU unit through an 8-inch inlet. The air would move upward through the biofilter media in the OCU and be released to the atmosphere through an 8-inch exhaust stack on the top of the vessel. When the media was saturated, new media would be placed through this access door.

Other Solids Handling Building Processes

A separate OCU treats foul air off-gassed from the head space of the Solids Handling Building Pump Station, the head space of the dewatered sludge hopper, and the centrifuge solids discharge chute. This packaged odor scrubber OCU is outside, on the west side of the Solids Handling Building Pump Station. It has a rated capacity of 100 cfm and holds approximately 5 cubic feet of proprietary media.

3W Water System

The 3W water supply system is located in the Pump House basement, along with the UV reactors and the original clarifier sludge pumps. Water supply to the system is through a 4-inch 3W pipe connected to the final disinfected plant effluent 24-inch pipe. The disinfected effluent is withdrawn from a pipe manifold and drawn through two manually cleaned basket strainers in parallel by two in-line centrifugal pumps (P413, P414). Each pump is rated for a minimum flow of 20 gpm at 300 feet of head and a maximum flow of 60 gpm at 200 feet of head. A pressure regulating valve on the discharge side of the booster pumps regulates the pressure leaving the pumps at 130 psi.

The booster pumps are connected to a hydropneumatic tank on one side and to an automatic self-cleaning filter on the other side. The filter is intended to remove solids that would clog the spray nozzles on the sludge dryer flue; it is no longer in use. The hydropneumatic tank stores and supplies pressurized water during periods of low flow or no demand. It has a capacity of 264 gallons and a pressure rating of 150 psi. The automatic self-cleaning filter includes a coarse strainer, fine screen, dirt collector and hydraulic motor enclosed in a single filter housing. A chemical feed system chlorinates the 3W water for use in the plant. The system includes a manually adjustable chemical feed pump to inject hypochlorite from a 55-gallon drum into the 3W piping. The hypochlorite system is not currently in use.

Laboratory

The treatment plant laboratory is located in the Laboratory/Control Building. The laboratory includes a fume hood, BOD incubator, microscope, refrigerator, analytical balance, vacuum pump, deionized water system, dishwasher, emergency eyewash/shower and various cabinets and counter areas.

Plant Electrical Power Supply

Puget Sound Energy (PSE) supplies electric power to a PSE-owned pad-mounted transformer at the south corner of the Laboratory/Control Building. Under normal circumstances, the utility feeds power to all loads. The transformer provides service to the service entrance switchboard on the east side of the Laboratory/Control Building, which feeds the loads as follows:

- MCC Main and MCC Extension via the automatic transfer switch ATS-1, which powers most of the plant.

- Panelboard PNL-SHB, which powers the Solids Handling Building.

- Panelboard A and Panelboard B, via the ATS-2 which provides power to the influent screen and ULID 6 pump station.

Standby Power Generation

The wastewater treatment plant has two standby power sources:

- **Permanently Installed Generator –** The permanently installed standby generator is located on the ground floor of the Original Treatment Building. It is a 250-kW generator designed to supply 480-volt, 3-phase, 4-wire power to all loads on MCC Main, MCC Extension, and Panelboard PNL-SHB. The generator and the utility are both physically connected to an automatic transfer switch (ATS-1), providing two sources of independent power. ATS-1 is electrically and mechanically interlocked to prevent supplying the load from more than one power source at a time.

- **Portable Generator –** A portable generator can be used to provide power to the influent screen and ULID 6 pump station. The portable generator must be connected with a cord and connector to the receptacle on the exterior of the north wall of the Laboratory/Control Building; the generator is normally connected to that receptacle. The portable generator is an 80-kW generator designed to supply 480-volt, 3-phase, 4-wire power to all loads on Panelboard A and Panelboard B. The generator and the utility are both physically connected to an automatic transfer switch (ATS-2), providing two sources of independent power. ATS-2 is electrically and mechanically interlocked to prevent supplying the load from more than one power source at a time.

Motor Control Centers

The motor control centers (MCCs) are free-standing, front-connected, grouped motor control assemblies. Compartments within each MCC house circuit breakers to provide power to electrical equipment that has local starters or no motors.

Control Systems

The main control panel (MCP) is a large panel in the electrical room of the Laboratory/Control Building that contains hand/off/auto switches, control timers, a chart recorder, a local annunciator, control relays, and indicating lights. The MCP was replaced when the plant was improved in 2004. Adjacent and connected to the MCP is the master telemetry unit (MTU) panel, which houses a programmable logic controller (PLC). The MTU communicates to offsite locations by radio, to the supervisory control and data acquisition (SCADA) computer and the ULID 6 Pump Station over Ethernet, and to MCC equipment in

the control room by hard-wiring. Outputs from the MTU drive two automatic alarm dialers, which notify the on-call operator of alarms by telephone. Alarms and other monitored data also are transmitted to the SCADA system by Ethernet connection.

The ULID 6 Control Panel controls the three pumps based on wet well level, as monitored by an ultrasonic level transmitter backed up by floats. Flow at the station is monitored by an electromagnetic flow meter. This is the only local control panel connected to the SCADA system. Wet well level, station flow, motor status and alarms are transmitted to the SCADA system via Ethernet. Level set points may be set from the SCADA interface.

The following additional local control panels throughout the plant have no connection to SCADA or the auto-dialer: sludge dryer, centrifuge, UV equipment, 3W system, headworks, Solids Handling Building Pump Station (controls two pumps in lead, lag operation based on float switches in the wet well).

CHAPTER 7

WASTEWATER TREATMENT PLANT EVALUATION

7.1 PERMIT COMPLIANCE

7.1.1 INFLUENT LIMITS

Maximum-month capacity limits for the wastewater treatment plant influent are specified in the NPDES permit for total flow, BOD load and TSS load. The permit limits are listed in Table 7-1, along with existing flows and loads from treatment plant monitoring records.

TABLE 7-1

Permit Influent Limits and Existing Flows and Loads

Description	Existing	NPDES Permit Limits
Maximum-Month Flow	1.19 mgd (2014 and 2015)	2.58 mgd
Maximum-Month BOD Load	1,771 ppd (2015)	2,805 ppd
Maximum-Month TSS Load	1,263 ppd (2015)	2,304 ppd

The permit states that an engineering report must be prepared and a schedule developed for steps to maintain plant capacity if flows or loads exceed the limits or if they reach 85 percent of the limits for three or more consecutive months. None of the historical maximums at the North Bend plant are approaching the limits or the 85-percent trigger. Based on the flow and load projections presented in Chapter 3, permit limits are not expected to be exceeded before the following timeframes:

- Maximum-month flow is projected to reach the permit limit of 2.58 mgd after 2036.
- Maximum-month BOD load is projected to reach the permit limit of 2,805 ppd in 2029 or 2030.
- Maximum-month TSS load is projected to reach the permit limit of 2,304 ppd in 2024 or 2025.

By the time the plant's next permit is issued in 2018, it is likely that improvements recommended in this facilities plan will have been implemented, increasing the plant's capacity to treat solids. Therefore it is assumed that the 2018 permit upgrade will increase the TSS limit to be equal to the BOD load of

2,805 ppd. Projected influent TSS loads will not reach that revised limit until 2029 or 2030.

7.1.2 EFFLUENT LIMITS

The North Bend wastewater treatment plant's discharge monitoring reports (DMR) provide data on the plant's effluent that can be used to assess compliance with the NPDES permit requirements (see Table 1-1). DMR effluent data from 2011 through 2015 were reviewed to assess the plant's recent record of compliance.

$CBOD_5$ and TSS

Effluent $CBOD_5$ and TSS samples are collected and analyzed twice during weeks when effluent is being discharged. Table 7-2 summarizes the average monthly and average weekly $CBOD_5$ and TSS effluent data. The data are plotted in comparison to permit requirements in Figures 7-1 through 7-6. The $CBOD_5$ and TSS effluent concentrations and loads were below the limit every month in the period analyzed.

TABLE 7-2

Average Monthly and Average Weekly Flow, CBOD and TSS

	Avg. Flow (mgd)	$CBOD_5$					TSS				
		Conc. (mg/L)		Load (ppd)		Removal	Conc. (mg/L)		Load (ppd)		Removal
		Avg. Monthly	Avg. Weekly	Avg. Monthly	Avg. Weekly		Avg. Monthly	Avg. Weekly	Avg. Monthly	Avg. Weekly	
Jan-11	0.95	5	11	52	116	94.4%	5	11	156	395	81.5%(1)
Feb-11	0.65	4	5	22	31	97.0%	4	5	18	26	97.5%
Mar-11	0.72	1	2	8	17	99.1%	1	2	12	14	98.4%
Apr-11	0.82	5	7	30	59	94.9%	5	7	33	47	97.4%
May-11	0.67	1	2	8	14	98.9%	1	2	16	21	98.6%
Jun-11	0.64	2	3	8	16	98.5%	2	3	16	27	98.5%
Jul-11	0.53	2	2	8	10	98.4%	2	2	14	22	98.6%
Aug-11	0.50	2	4	13	26	98.0%	2	4	11	16	98.6%
Sep-11	0.46	1	2	5	11	98.9%	1	2	13	19	98.6%
Oct-11	0.55	7	12	32	59	93.9%	7	12	35	51	95.3%
Nov-11	0.73	3	5	20	35	97.6%	3	5	29	43	96.7%
Dec-11	0.62	3	5	16	27	98.1%	3	5	17	23	98.0%
Jan-12	0.78	5	7	30	46	95.2%	5	7	37	59	96.3%
Feb-12	0.82	6	7	38	52	93.5%	6	7	50	114	96.0%
Mar-12	0.78	8	10	51	67	92.8%	8	10	54	95	95.6%
Apr-12	0.71	4	5	24	34	96.9%	4	5	14	24	98.2%
May-12	0.72	3	5	20	34	98.0%	3	5	8	10	99.1%
Jun-12	0.72	3	3	15	18	98.7%	3	3	11	15	98.6%
Jul-12	0.60	2	3	10	17	99.2%	2	3	9	10	99.1%
Aug-12	0.52	2	3	9	17	99.1%	2	3	11	13	98.6%
Sep-12	0.47	2	3	8	13	99.2%	2	3	11	15	98.6%

TABLE 7-2 (continued)

Average Monthly and Average Weekly Flow, CBOD and TSS

	Avg. Flow (mgd)	$CBOD_5$					TSS				
		Conc. (mg/L)		Load (ppd)			Conc. (mg/L)		Load (ppd)		
		Avg. Monthly	Avg. Weekly	Avg. Monthly	Avg. Weekly	Removal	Avg. Monthly	Avg. Weekly	Avg. Monthly	Avg. Weekly	Removal
Oct-12	0.57	2	3	11	18	99.0%	2	3	19	28	98.0%
Nov-12	0.83	2	3	15	22	98.5%	2	3	34	53	96.6%
Dec-12	0.85	3	4	18	25	98.5%	3	4	22	35	97.4%
Jan-13	0.66	3	4	14	22	98.8%	3	4	26	39	96.9%
Feb-13	0.67	4	4	21	24	98.3%	4	4	31	46	96.3%
Mar-13	0.73	5	9	28	47	97.6%	5	9	57	82	92.7%
Apr-13	0.89	7	10	49	59	95.0%	7	10	49	76	94.1%
May-13	0.72	6	9	39	53	96.7%	6	9	26	37	96.4%
Jun-13	0.62	5	7	27	36	97.0%	5	7	26	33	96.6%
Jul-13	0.52	3	4	11	17	98.9%	3	4	18	25	97.5%
Aug-13	0.50	3	4	12	16	98.7%	2	3	9	12	98.7%
Sep-13	0.54	2	3	8	11	99.1%	2	3	8	10	98.9%
Oct-13	0.64	2	3	11	15	97.7%	2	3	22	37	96.1%
Nov-13	0.80	2	4	18	48	99.0%	4	8	33	95	97.0%
Dec-13	0.71	3	5	5	10	98.5%	7	8	9	13	95.5%
Jan-14	0.77	5	7	31	40	97.6%	11	13	69	114	92.5%
Feb-14	0.90	9	14	64	114	95.2%	11	22	76	126	90.7%
Mar-14	1.21	12	17	144	221	80.3%(1)	12	20	161	289	84.3%(1)
Apr-14	0.81	4	6	25	37	98.1%	4	6	24	40	97.2%
May-14	0.79	3	4	19	20	98.3%	3	7	16	37	97.9%
Jun-14	0.61	4	6	20	31	98.4%	5	11	24	57	96.9%
Jul-14	0.55	3	5	14	23	98.7%	3	5	15	21	98.1%
Aug-14	0.53	3	5	12	22	98.5%	3	4	13	19	98.2%
Sep-14	0.54	2	3	10	12	98.8%	5	6	23	31	97.1%
Oct-14	0.58	3	3	12	17	98.3%	7	12	32	61	95.6%
Nov-14	0.87	3	5	22	49	98.0%	4	6	32	46	96.6%
Dec-14	0.83	8	10	57	75	94.5%	10	14	69	79	92.3%
Jan-15	0.94	6	10	60	114	95.2%	14	30	166	366	88.8%
Feb-15	0.83	3	4	20	24	97.7%	13	38	105	329	89.4%
Mar-15	0.70	4	4	24	28	97.4%	6	8	32	39	97.5%
Apr-15	0.75	3	4	18	22	97.9%	3	4	19	30	98.1%
May-15	0.52	3	3	11	12	98.5%	5	13	21	41	97.3%
Jun-15	0.48	3	4	12	14	98.7%	5	6	18	25	97.7%
Jul-15	0.46	3	4	11	14	98.8%	3	7	11	14	98.9%
Aug-15	0.44	2	3	9	12	98.9%	3	6	10	21	98.9%
Sep-15	0.47	1	2	5	6	99.5%	2	2	6	7	99.3%

(1) Failed to achieve permit requirement.

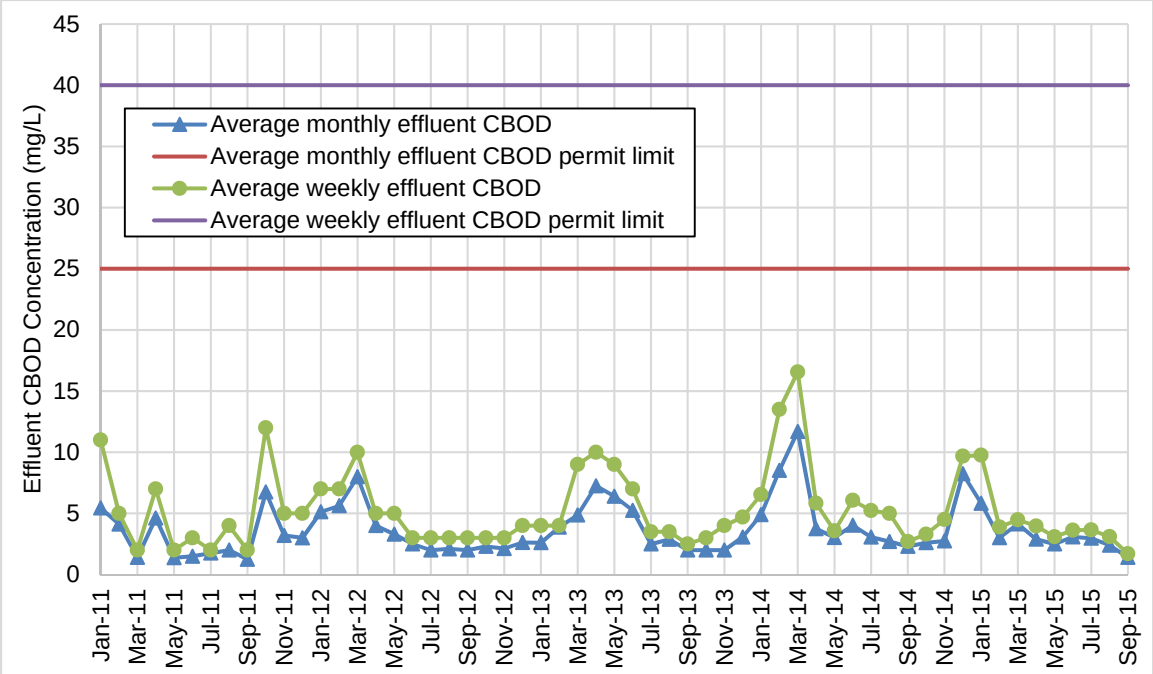


FIGURE 7-1

2011 Through 2015 Effluent $CBOD_5$ Concentration

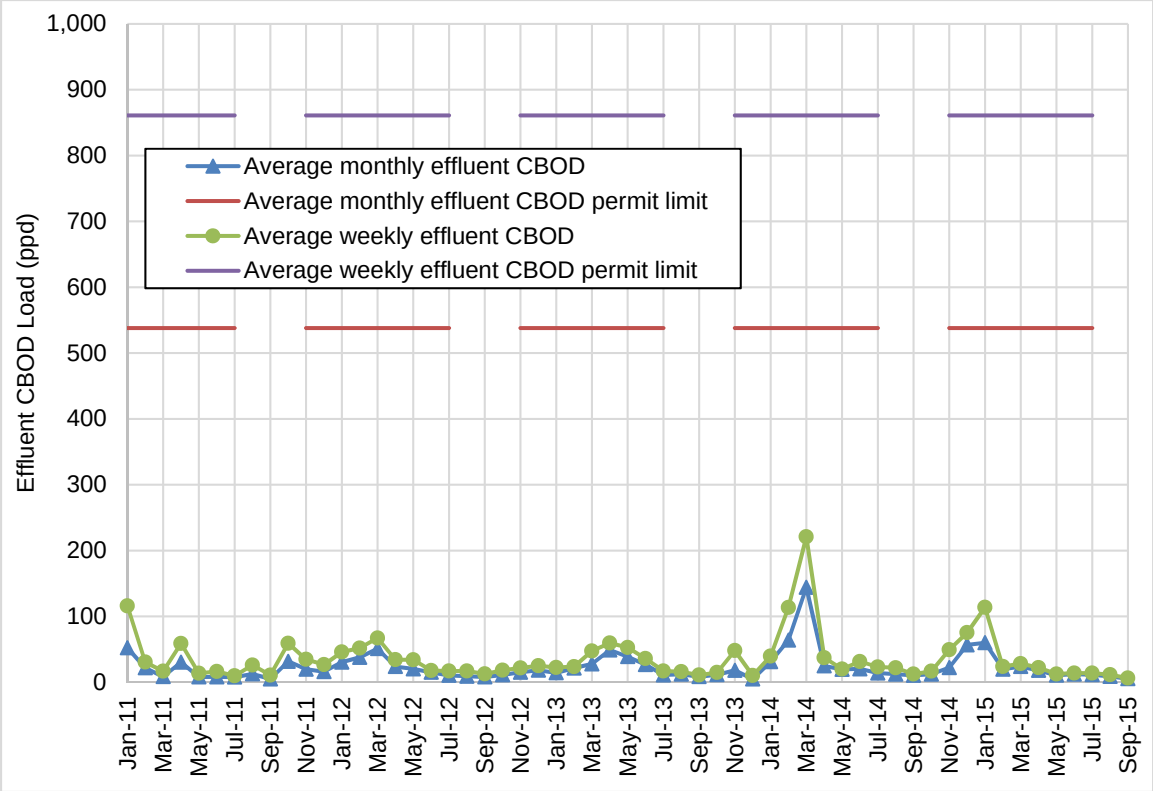


FIGURE 7-2

2011 Through 2015 Effluent $CBOD_5$ Load

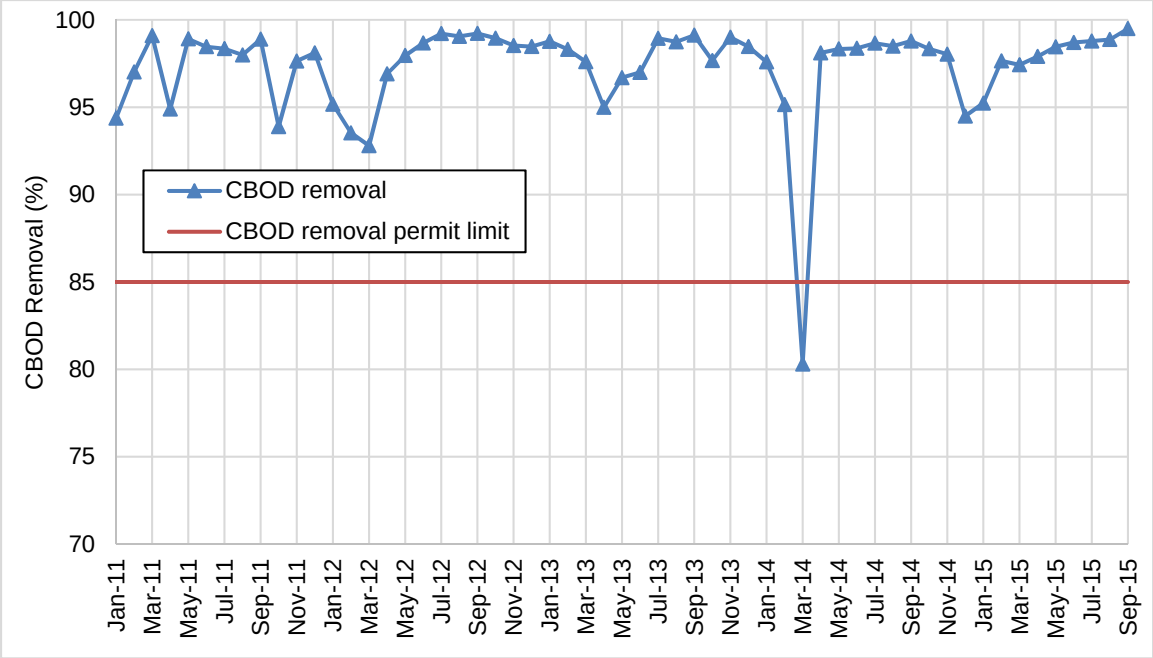


FIGURE 7-3

2011 Through 2015 Monthly Percent Removal $CBOD_5$

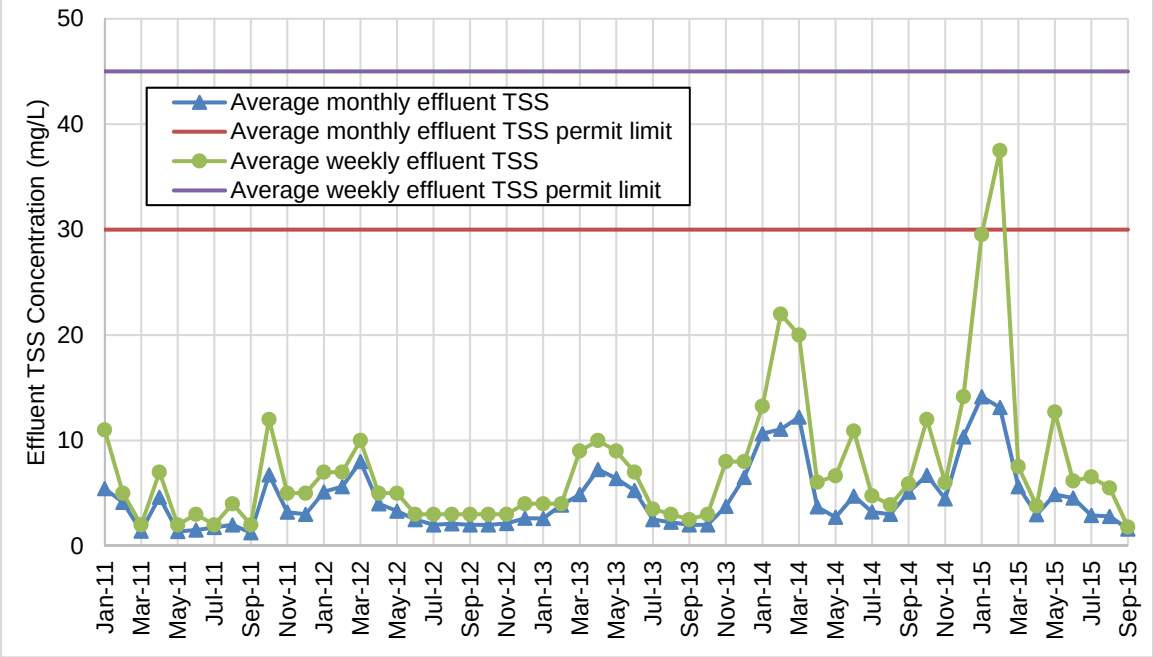


FIGURE 7-4

2011 Through 2015 Effluent TSS Concentration

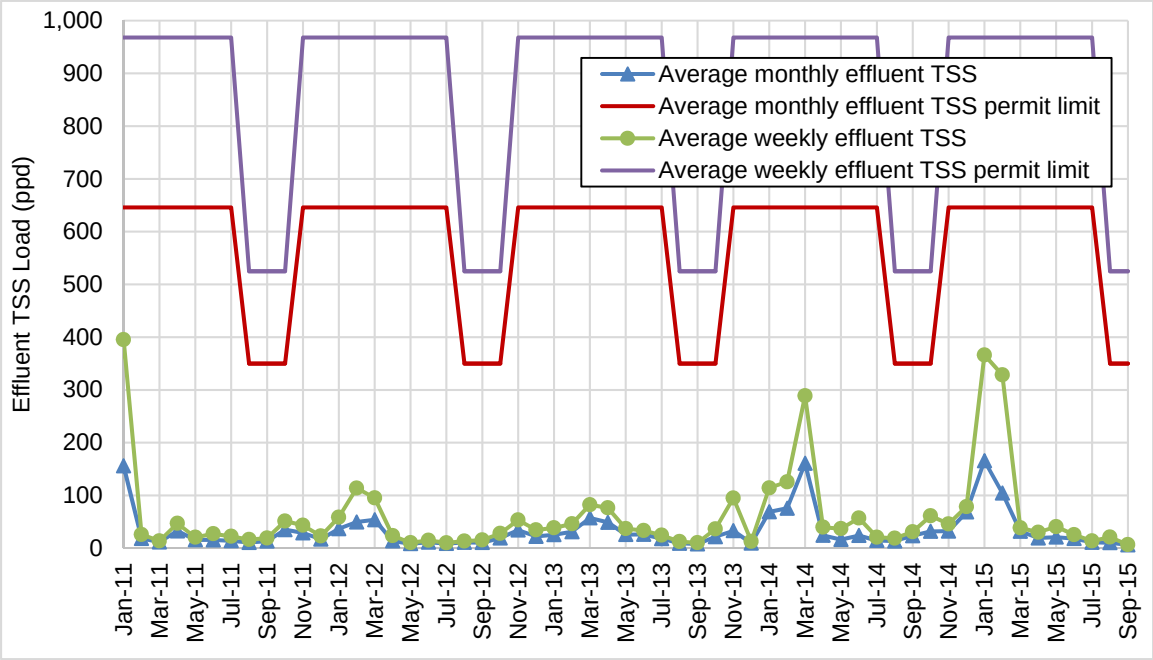


FIGURE 7-5

2011 Through 2015 Effluent TSS Load

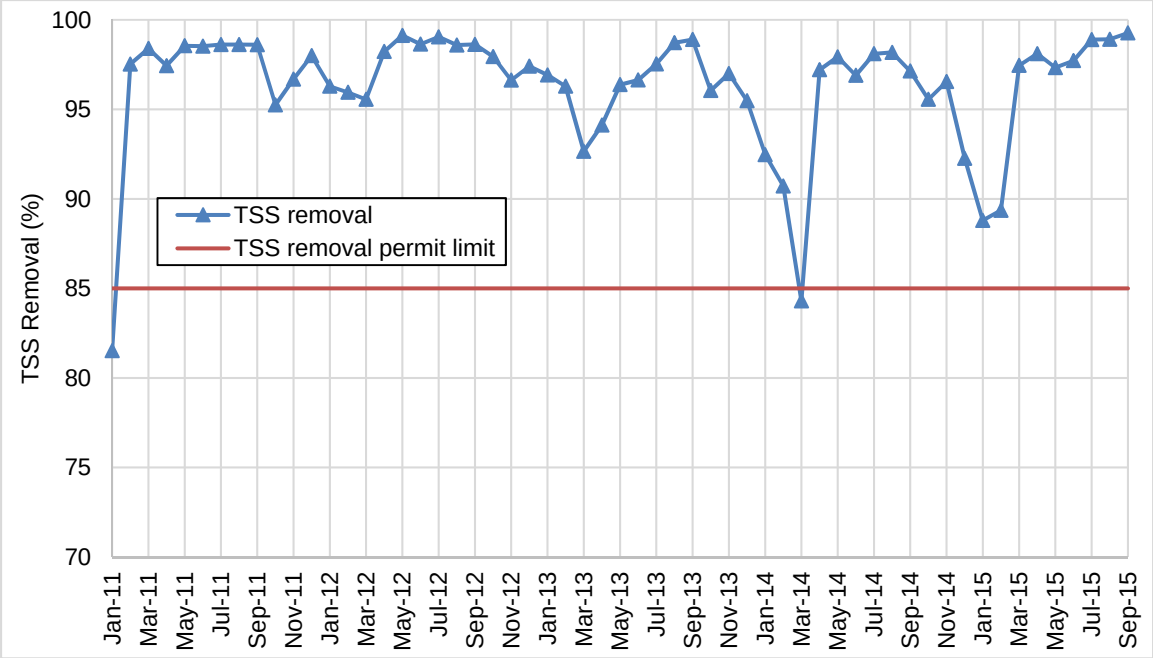


FIGURE 7-6

2011 Through 2015 Monthly Percent Removal TSS

The 85 percent monthly $CBOD_5$ and TSS removal requirements were achieved in all but the following months:

- $CBOD_5$ removal, March 2014
- TSS removal, January 2011 and March 2014

The failure to achieve removal requirements in March 2014 was because the oxidation ditch was unable to handle high flows that month. The liquid level in the oxidation ditch became too high, causing the brush rotors to trip off and upsetting the activated sludge process.

Fecal Coliform Bacteria

Fecal bacteria samples are collected and analyzed two to five times during the weeks when effluent is being discharged. Figure 7-7 shows plant records for effluent fecal coliform compared to the NPDES permit limit. The plant has met the permit limits consistently since 2011.

pH

pH samples are collected and analyzed every day that effluent is discharged. Figure 7-8 shows plant records for effluent pH compared to the NPDES permit

limit. There was one instance during the review period in which pH measurement was outside the permits limits: a pH of 5.4 in January 2011.

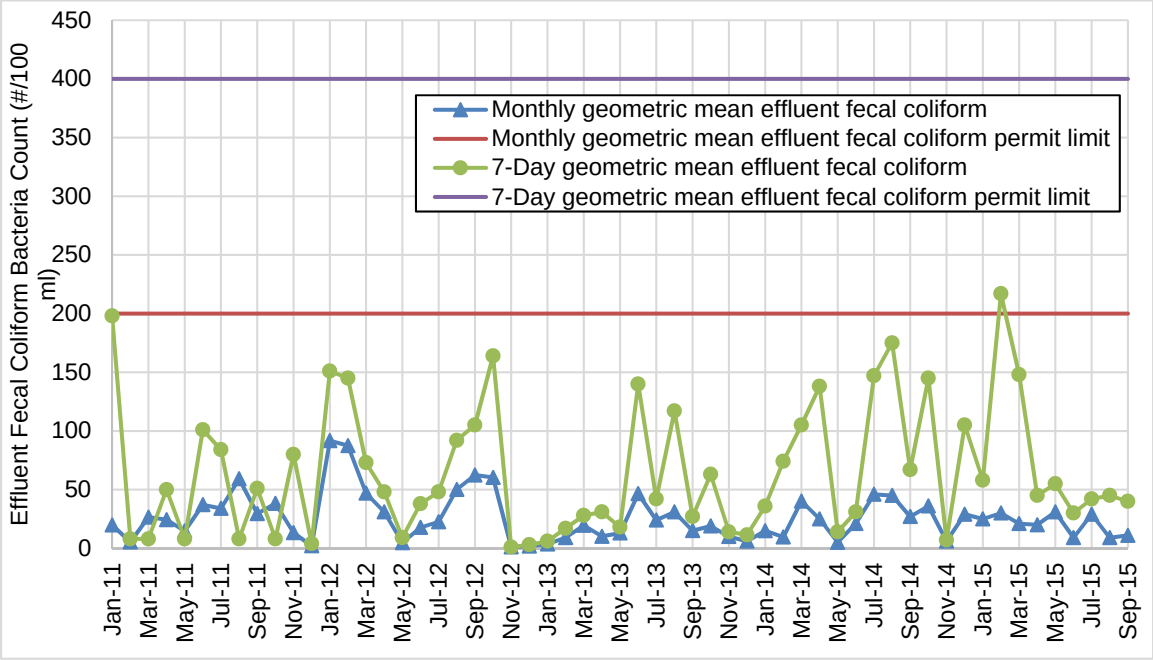


FIGURE 7-7

2011 Through 2015 Effluent Fecal Coliform Bacteria Count

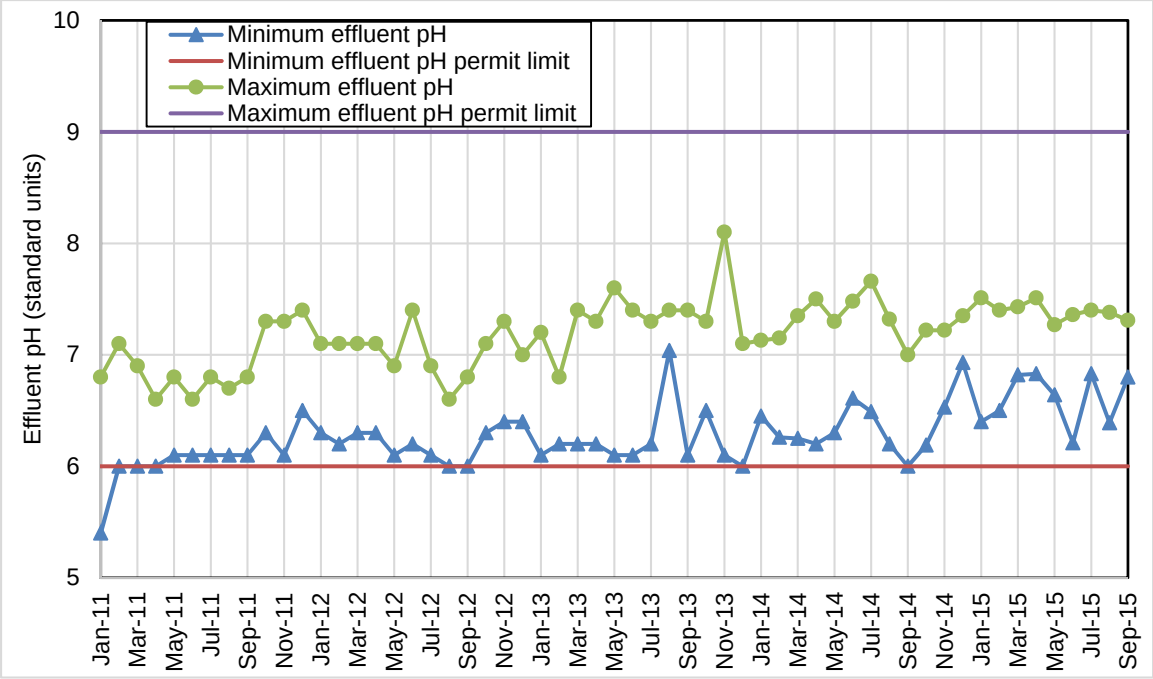


FIGURE 7-8

2011 Through 2015 Effluent pH

Total Oxygen Demand

Effluent nitrogenous + carbonaceous biochemical oxygen demand (NBOD + CBOD) is listed in the NPDES permit as the indication of oxygen demand in the effluent discharge. Effluent NBOD + CBOD samples are collected and analyzed twice during weeks when effluent is being discharged. Figure 7-9 shows plant records for effluent NBOD + CBOD compared to the NPDES permit limit, which applies only from August through October. The plant has met the permit limits consistently since 2011.

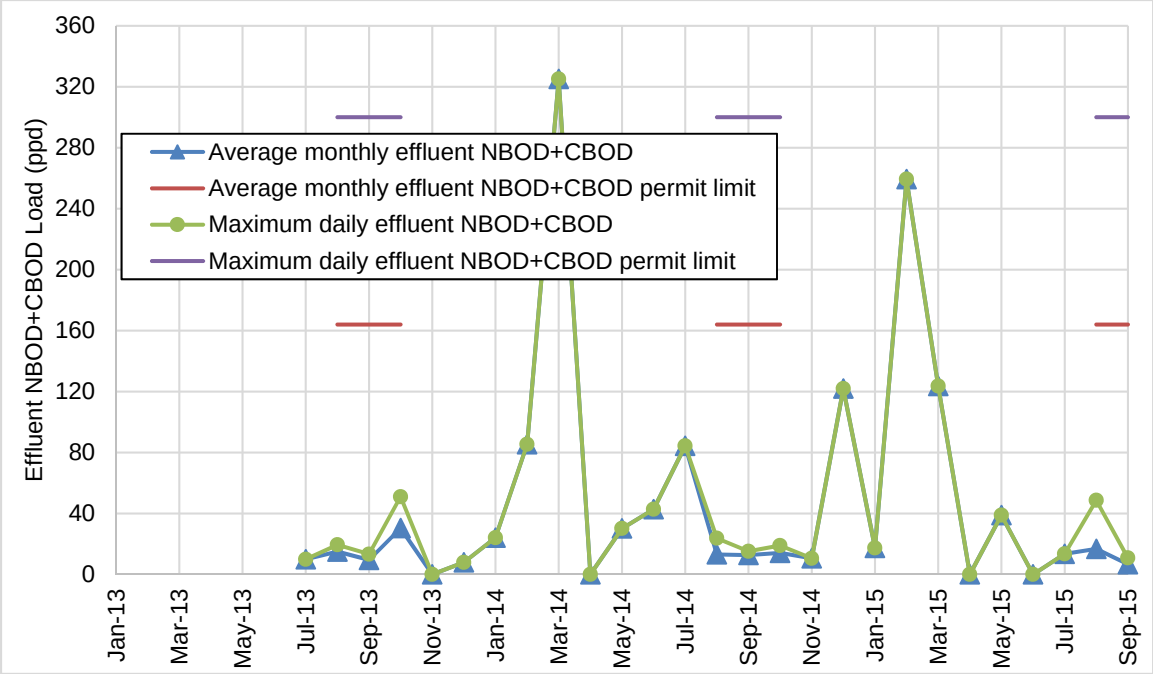


FIGURE 7-9

2011 Through 2015 Effluent Oxygen Demand

Phosphorus

The 2013 NPDES permit requires the City to collect and analyze a composite sample of effluent once a month for total phosphorus and soluble reactive phosphorus (SRP). Table 7-3 summarizes the phosphorus effluent data. The data are plotted in comparison to the proposed TMDL permit requirements in Figure 7-10. The SRP effluent loads were well above the proposed limits every month except one in the period analyzed.

7.2 LIQUID STREAM CAPACITY AND CONDITION EVALUATION

An analysis was performed to evaluate the ability of each unit process to satisfy Ecology design criteria and existing permit limits under existing and design year flows and loads. Reliability issues were also evaluated for some processes, along with the condition of equipment.

TABLE 7-3

Monthly Treatment Plant Effluent Phosphorus Loads

Date	Total Phosphorus (ppd)	SRP (ppd)	Date	Total Phosphorus (ppd)	SRP (ppd)
7/9/2013	1.9	1.3	10/2/14	18.2	15.7
08/09/13	6.5	6.8	11/5/14	32.8	28.4
09/05/13	13.1	13.7	12/3/14	10.5	7.5
10/02/13	6.2	6.1	1/14/15	0.5	0.1
11/14/13	4.9	0.1	2/5/15	31.0	27.5
12/4/13	0.8	0.1	3/4/15	1.7	1.2
1/8/14	2.3	12.2	4/3/15	3.5	0.7
2/5/14	6.8	5.5	5/6/15	2.0	1.6
3/5/14	5.9	2.4	6/4/15	4.8	4.3
4/4/14	0.9	0.1	7/2/15	10.9	9.6
5/6/14	1.3	0.7	8/4/15	10.1	9.2
6/4/14	5.9	3.6	9/1/15	2.2	1.8
7/2/14	4.0	2.6	10/6/15	11.3	11.4
8/7/14	5.2	3.4	11/13/15	4.6	3.6
9/3/14	17.3	15.8	12/1/15	0.7	0.2

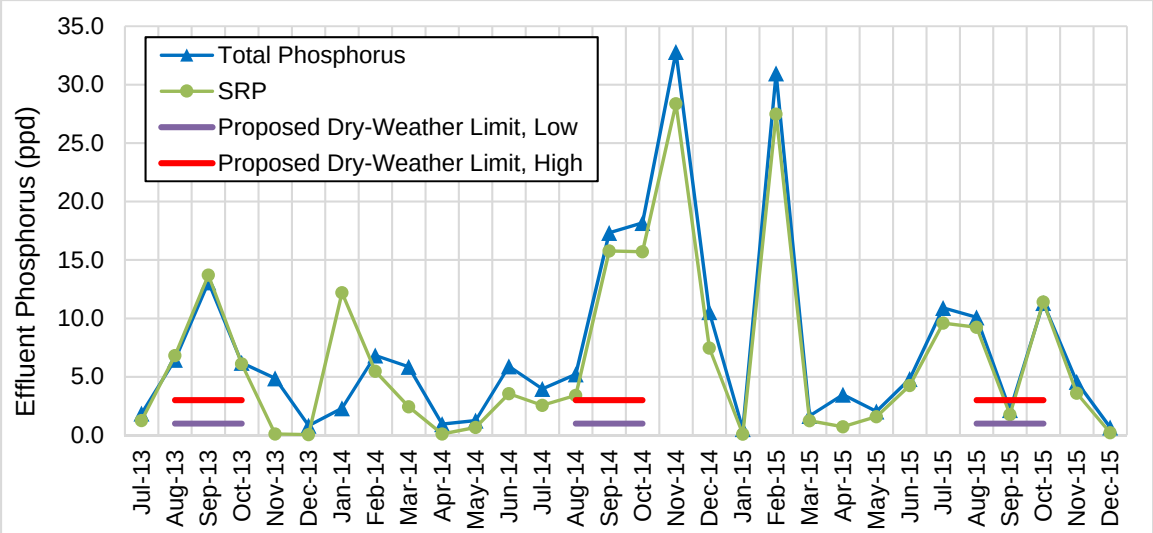


FIGURE 7-10

2013 Through 2015 Effluent Phosphorus Loads

7.2.1 OVERALL PLANT DESIGN CAPACITIES

Hydraulic Capacity

The hydraulic capacity of the treatment plant is identified in the 1996 Treatment Plant Engineering Report, 2001 Sewer Plan, and treatment plant construction documents. Table 7-4 summarizes the hydraulic capacities indicated by these documents for the plant with one oxidation ditch and one 80-foot clarifier, assuming completion of improvements recommended in the 1996 Treatment Plant Engineering Report and 2001 Sewer Plan.

TABLE 7-4

Wastewater Treatment Plant Hydraulic Capacity

Flow	Hydraulic Capacity	Existing Flows (2014-2015) (2)
Dry-Weather Flow	1.26 mgd	0.53 mgd
Annual Average Flow	1.67 mgd	0.77 mgd
Maximum-Month Flow	2.56 mgd, 2.58 mgd (1)	1.19 mgd
Peak-Day Flow	4.48 mgd	3.11 mgd
Peak-Hour Flow	5.10 mgd	3.8 mgd

(1) Maximum-month flow capacity is given as 2.56 mgd in the 1996 Treatment Plant Engineering Report and 2.58 in the 2001 Sewer Plan.
(2) Existing flows from historical treatment plant flow data (see Table 2-4).

The table also shows current flows based on monitoring data. The existing overall treatment plant flows are all well below the plant's design capacity, and flow projections developed for this facilities plan do not show total flows exceeding design capacities for nearly 10 years. However, due to various condition deficiencies, not all processes at the plant are currently achieving their design capacity. These deficiencies and potential solutions are addressed in the individual process evaluations provided in subsequent sections of this chapter.

Figure 7-11 shows the hydraulic profile through the plant at the design peak-hour flow of 5.1 mgd. The hydraulic profile provides little reserve head between each treatment process. This limits the flexibility to expand the plant in the future with parallel treatment units and flow splitter boxes. Any future expansion of the plant would likely require modifications to provide additional head in order to divide flows through parallel treatment trains.

Treatment Process Capacity

The 1996 Treatment Plant Engineering Report and 2001 Sewer Plan also define overall treatment capacity for influent BOD and TSS. Table 7-5 compares these

design capacities to existing treatment plant influent loads. The existing overall treatment plant loads are well below the plant's design capacity.

TABLE 7-5

Wastewater Treatment Plant Treatment Process Capacity

Load	Treatment Process Capacity	Existing (1)
Maximum Month BOD Load (1) (ppd)	2,805 ppd	1,414 ppd
Maximum Month TSS Load (1) (ppd)	2,304 ppd	1,414 ppd

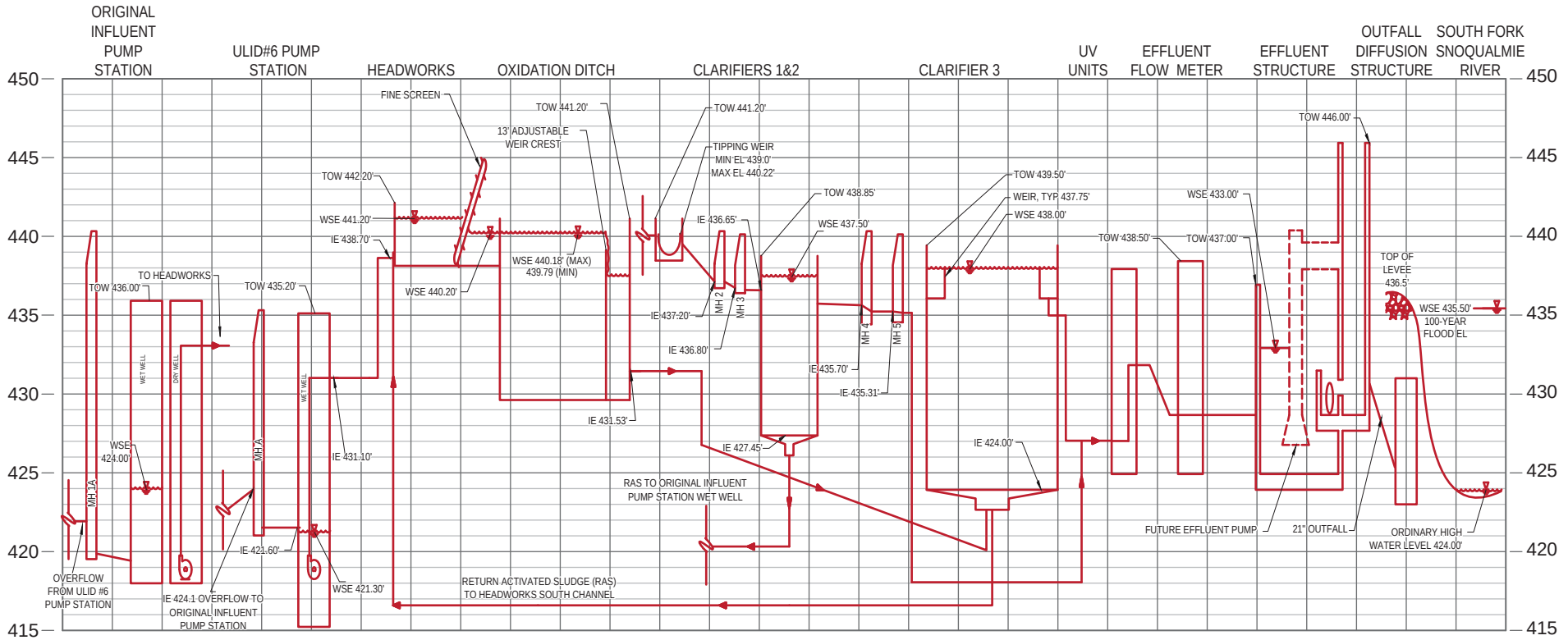
(1) Existing loads are calculated based on 2015 sewered population equivalent, unit loads per capita, and peaking factor (see Table 2-16 and Table 2-19). These values are higher than actual recorded loads, providing a conservative assessment of available capacity.

7.2.2 INFLUENT PUMP STATION

Influent sewage is pumped primarily by the ULID 6 Pump Station, which is designed to pump influent peak flows up to 5.6 mgd with the largest pump out of service, slightly more than the 5.1 mgd treatment plant design peak-hour flow. This station has one 1,300 gpm (1.9 mgd) lead pump to pump low flows and two 2,600 gpm (3.7 mgd) pumps (lag and standby) to pump high flows. The 1,300 gpm pump (P-2) failed shortly after startup in 2009 for unclear reasons, and it failed again almost immediately after being repaired. Problems with the pump station include the pump control strategy for the operation of pump P-2 allows the pump to reduce the rate of flow below its ability to expel grit from the volute due to an oversized vertical riser pump discharge pipe; the wastewater inlet to the pump station wet well causes significant entrainment of air, particularly at low wet well levels; no provisions for isolating the wet well from influent sewage flow to allow for routine inspection and maintenance of the wet well and ancillary system equipment installed in the wet well; and no provision for bypass of the station and use of the City's diesel-driven, trailer-mounted pumping system in case of planned maintenance or emergency repair of the pump station. Upgrades planned to address these deficiencies are presented in Section 9.1.2.[R]

To accommodate increased flows projected for the future, the station capacity could be expanded to approximately 10 mgd, by installing new larger pumps in the wet well and larger piping and electrical gear.[R]

The ULID 6 Pump Station is located in the floodplain, and is required by Ecology Orange Book guidelines to function normally during a 100-year flood, which is at elevation 436.2 feet (1929 National Geodetic Vertical Datum), one foot above existing ground. The pump station wet well and valve vaults are below the flood elevation and have water-tight access hatches that protect them from flooding. However, the electrical control panels, which are installed above ground, are susceptible to flood damage because they are mounted on a concrete slab at elevation 435.2 feet, which is 1.0 foot below the 100-year flood elevation.



135-63037-15001/HydraulicProfile.ai

TETRA TECH

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Seattle, Washington 98101
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City of North Bend
WASTEWATER SYSTEM FACILITIES PLAN

Figure 7-11.
WASTEWATER TREATMENT PLANT HYDRAULIC PROFILE

7.2.3 HEADWORKS

The existing headworks was designed with an intent to handle a 6.1 mgd peak influent flow through the mechanical fine screen in the north channel. There were past issues with hydraulic overloading of the north channel when RAS flow from Clarifier 3 was routed to the north channel in addition to the flow from the ULID 6 Pump Station and the original IPS. This caused influent samples to become non-representative due to the comingling of RAS with the influent sewage. This also resulted in overflows from the north channel when average influent raw sewage flow exceeded 2 mgd and all three flow sources (ULID 6 IPS, old IPS, and RAS) discharged to the headworks simultaneously. This was corrected in 2014 by routing the RAS flow through the manual bar screen in the headworks south channel. However, recent headworks performance during high flows has indicated that the mechanical screen does not provide its rated design capacity; the actual estimated capacity of the screen is 3.5 mgd. Review of the specification for the screen indicate that some, if not all of the hydraulic capacity limitations of the screen, are attributable to specification of a fouling factor for the screen performance to account for the fact that the screen fluid is raw sewage, not clean water.[R]

The hydraulic capacity of the headworks would be difficult to expand because the structure has limited freeboard to carry more flow. It also is attached to the existing oxidation ditch, with no room to add a channel or route flows to a future aeration basin.

The isolation slide gate downstream of the headwork mechanical fine screen interferes with maintenance access to the influent mechanical fine screen. The screen cannot tilted up to allow for maintenance of screen lower bearings and the channel bottom closure brush because it bumps into the upstream gate frame. The gate frame needs to be modified to allow the upper part of the gate frame and slide closure to be removed to allow for proper screen maintenance. If this is not done then screen maintenance will need to be accomplished by lifting the entire screen assembly out of the headwork with an overhead crane and then reinstalling it after the maintenance is completed.[R]

The original treatment plant included grit removal in its headworks, but the current headworks, in operation since 2009, does not provide grit removal. Experience has shown that grit generally does not cause problems in mechanically aerated oxidation ditches such as used at the North Bend plant. Many oxidation ditches have operated successfully with grit accumulating in the ditch for over 20 years. Grit has not caused any operation or maintenance problems at the North Bend treatment plant. Since 2009, all the grit in raw wastewater passes through the headworks and settles in the oxidation ditch. No grit has been found in the clarifier, and there was no indication of grit-induced wear on the centrifuge when

it was inspected in 2016.[R] Grit accumulations in the oxidation ditch are small, even though the ditch has not been emptied and cleaned out since it was built in 1979.

7.2.4 OXIDATION DITCH

The 1996 Treatment Plant Engineering Report and 2001 Sewer Plan recommended improvements to the oxidation ditch to achieve the design hydraulic capacity and treatment process BOD and TSS capacity. Most of the recommended improvements were implemented by 2006, but two key improvements – a longer outlet weir, and an anoxic selector tank – were deferred. A third improvement, the addition of two new brush rotors, was implemented incompletely. The new rotors were installed, but the original rotors were not completely refurbished as planned, leaving one out of service and one operating poorly. These deferrals and partial implementation led to NPDES compliance issues and difficulties with peak flows.

In March 2014, the oxidation ditch was unable to handle peak-day flows of 2 mgd. The liquid level in the oxidation ditch became too high, causing the brush rotors to trip off for an extended period and upsetting the activated sludge process. In 2015, the City added the recommended longer outlet weir and completed refurbishment of the original brush rotors to increase the oxidation ditch's flow and load capacity. The City again deferred the anoxic selector tank until it is needed in the future. All four brush rotors are equipped with flow dispersion baffles to direct the flow from the brushes downward to mix and aerate the full depth of the ditch. Rotors 201 and 202 still have the original baffles, which are much less effective in reducing the standing wave and consequently may have a slightly lower oxygen transfer capacity than the Rotors 203 and 204 with the new baffles installed in 2006 on Rotors 203 and 204.

The 2001 Sewer Plan indicated that the anoxic selector tank is needed for nitrification and pH control during the summer, and to increase the maximum-month BOD capacity to 2,805 ppd. Since this selector tank has not been constructed yet, it is necessary to operate the ditch with an internal anoxic selector zone during the summer, when the plant must meet nitrogen-removal permit limits. The City currently accomplishes this by running only three of the four brush rotors in the ditch, which creates an anoxic zone at the unused rotor. Without the added selector volume, it might be necessary to operate the ditch with an 8-day sludge age when BOD loads reach 2,805 ppd, instead of the 10-day sludge age indicated in the 2001 Sewer Plan. The BOD load on the plant is projected to reach the capacity of 2,805 ppd by 2029. With completion of the 2015 improvements, the oxidation ditch can, when operated as an oxidation ditch with timed cyclic aeration period or with an internal anoxic zone and 8-day sludge age, provide adequate secondary treatment to meet anticipated permit limits at BOD loads up to 2,805 ppd.

Rotors 201 and 202 are located under bridge walkway structures. The walkways do not contain splashing from the rotors; they also are old and deteriorating, with peeling paint. Splashing of the uncovered rotors presents a health risk as well as aesthetic issues. Repainting the walkways would require measures to address lead-based primer paint that was applied to them when constructed in 1979.

7.2.5 SECONDARY CLARIFIERS

Clarifier 3

Clarifier 3 was planned to have hydraulic capacity for peak-hour flows up to 5 mgd when oxidation ditch improvements recommended in the 2001 Sewer Plan are completed. Since the anoxic selector at the oxidation ditch has not been constructed, the clarifier has less effective capacity.

According to Department of Ecology criteria for oxidation ditches, Clarifier 3 should perform acceptably with peak-hour overflow rates up to 700 gpd per square foot, with MLSS up to 3,500 mg/L, and with a sludge volume index (SVI), which is a measure of sludge settleability, up to 150 mL/g. In recent years, the MLSS concentration was often higher than these guidelines, sometimes reaching 4,000 to 6,000 mg/L. These high concentrations, occurring because sludge disposal was limited by the sludge dryer system, resulted in poor sludge settleability (high SVIs) and effluent violations. Table 7-6 compares recent MLSS and SVI to design criteria from the 2001 Sewer Plan and the Ecology Orange Book. Clarifier 3 was able to treat these high MLSS concentrations only because it was generally operated with overflow rates well below its design capacity and the Ecology guidelines, as shown in Table 7-7. The exception is the peak-hour flow, recorded in November 2015, which exceeded the Ecology criterion for oxidation ditches but still was well below the plant's design capacity and the Ecology criterion for activated sludge processes.

TABLE 7-6

Clarifier 3 MLSS Loading and SVI (1)

	2014–2015 Conditions	Design Rating (2)	Department of Ecology Criteria	
			Oxidation Ditch	Activated Sludge
MLSS (mg/L)	3,500–6,000	3,500	2,500–3,500	1,500–3,500
Sludge Volume Index (mL/g)	150–900	—	150	150

(1) Assuming the small clarifiers are out of service.
(2) Design rating designated in 2001 Sewer Plan.[R]

TABLE 7-7

Clarifier 3 Hydraulic Loading Rates [1]

	Influent Flow (mgd)		Overflow Rate (gpd/square foot)			
					Department of Ecology Criteria	
	2014-2015 Conditions	Design Capacity [2]	2014-2015 Conditions	Design Capacity [2]	Oxidation Ditch	Activated Sludge
Dry-Weather Flow	0.53	1.26	88	251		
Maximum-Month Flow	1.19	2.58	237	513		
Peak-Day Flow	3.11	4.48	414	891		
Peak-Hour Flow	3.80	5.1	757	1,014	700	1,200

(1) Assuming the small clarifiers are out of service.
(2) Design capacity designated in 2001 Sewer Plan.

In late summer 2015, the City was able to increase sludge wasting, thereby reducing the MLSS concentration to 3,500 mg/L. The City also operated the brush rotors to create an anoxic zone in the oxidation ditch. These operational changes significantly improved the sludge settleability, denitrification, and effluent quality.

Clarifier 3 is well designed and generally works well, including the RAS, WAS and scum pump systems, except for the following deficiencies:

- **Drive Unit –** The clarifier drive failed during the summer of 2015 and emergency repairs were made to keep it in service. Permanent improvement is still needed.

- **Scum Removal –** Scum collected at the large clarifier is pumped back to the oxidation ditch. This results in significant amounts of scum on the clarifier surface and carryover of scum, grease balls and other floating debris into the clarifier effluent, which degrades effluent quality and adversely impacts the UV disinfection system.

- **Lack of Screening –** Liquid clarifier effluent is not screened, and grease balls and large debris that leave the clarifier are believed agglomerate in the pipeline conveying the clarifier effluent to the UV disinfection system and then become dislodged and mobile during high flow events, which has contributed to broken lamps in the UV reactors on several occasions. This

needs to be prevented to meet NPDES disinfection requirements and to reduce repair costs at the UV system.

- **RAS Pumps –** The RAS pumps for Clarifier 3 have too much capacity and insufficient turn-down ability for efficient and effective operation of the activated sludge process, particularly during dry-weather flows. RAS flows are manually set and are not flow-paced. RAS Pump 1 was replaced approximately six years ago, but with a pump having significantly different characteristics than the original pump. The original pump model was no longer available and the replacement pump provides far too much flow capacity and is not compatible with existing electrical controls. Operation at low speed or with a throttled discharge valve allows the pump to operate for short periods of time, but operation soon becomes impaired due to ragging. Pump 1 needs to be replaced with a properly sized pump for the service. The control system for both pumps needs to be improved to provide pulse sequence pumping during extended periods of low influent flow to the plant.

Clarifiers 1 and 2

Clarifiers 1 and 2 both have a hydraulic capacity of 0.44 mgd. Because they have been used only sporadically as backup units since Clarifier 3 was installed, they are in poor condition and need significant maintenance. Their RAS/WAS and scum pumps also need significant maintenance. RAS pumping requires concurrent operation of the Solids Handling Building Pump Station and the original IPS. Several isolation valves on the clarifier suction piping are inoperable and need to be replaced if the clarifiers are operated for more than a few hours. There is no piping to allow conveyance of WAS from this clarifier system to the existing sludge holding tank. This would not be an issue unless Clarifier 3 was removed from operation for more than a few days.

Total Clarifier Hydraulic Capacity

The 2001 Sewer Plan recommended adding a second large (80-foot-diameter) clarifier when plant flows approach the design flows. However, an additional large clarifier is needed now to enable the City to take Clarifier 3 out of service for maintenance and meet Ecology's reliability requirements. The NPDES permit requires the plant to meet Class 2 reliability requirements, which require that the plant have capacity for half of the flow with the largest clarifier out of service. The small clarifiers met this criteria for flows at the time the large clarifier was constructed in 1998. However, flows have since increased, and the small clarifiers do not have capacity for half of current flows during wet weather. Together they have capacity for only about 0.88 mgd, which corresponds to only 17 percent of the peak-hour design flow of 5.1 mgd. This insufficient reserve

capacity makes it difficult for the City to take the large clarifier out of service for maintenance and repairs.

A second large clarifier is also needed now to maintain good clarifier performance during peak flow events. The existing clarifier performs adequately with peak-day flows up to about 4 mgd. The corresponding overflow rate of 800 gpd per square foot is above Ecology's guideline of 700 gpd per square foot for use with oxidation ditches; it is lower than the 1,000 gpd per square foot design overflow rate indicated in the 2001 Sewer Plan and recommended by Ecology for use with conventional activated sludge treatment.

7.2.6 DISINFECTION

The UV disinfection system has not always performed well, and a third reactor is needed to provide reliable disinfection in case of a reactor failure and during reactor maintenance.[R] Issues with the UV system in recent years include the following:

- The UV control panels overheated during the summer of 2014 due to failed control panel cooling fans. One ballast in the panel burned out and was difficult to replace. The panels overheated again on hot days in the summer of 2015, after the cooling fans were replaced.

- The UV control panels are a safety hazard. On hot days, the panel doors must be left open with supplemental external fan cooling to avoid overheating the ballasts, creating a risk of electrocution by exposed high voltage conductors or severe burn in the event of capacitor failure.

- The UV reactors have occasionally overheated and shut off automatically when there is no flow through the system at night.

- Numerous UV lamps have been broken during high flows, apparently by floatables, including grease balls enmeshed with rags that collect in the UV feed pipelines during low flows and are carried into the UV reactors during high flows.

- Daily fecal coliforms have exceeded 1,000 cfu/100 mL during several high flow events. This is suspected to be due to a combination of degraded UV transmittance associated with lack of aeration and the resulting poor mixed liquor settling characteristics. The monthly and weekly average fecal coliform permit limits (200 cfu/100 mL and 400 cfu/100 mL) have been met in spite of this issue, because the high flows occurred for only short periods.

- The existing disinfection system has the UV reactors arranged in parallel fed from a common undisinfected effluent manifold and discharging to a common disinfected effluent manifold. Manually actuated valves are provided on each side of the UV reactor to allow isolation. In the event that an operating reactor fails, an operator must be present at the site to isolate the failed reactor to prevent the discharge of undisinfected or inadequately disinfected effluent and to open the valves for the other reactor and energize the power system if it is not already in service. In addition, if one of two existing reactors is isolated for maintenance and peak hourly flows exceed 2.5 mgd then the sole functional reactor will become a hydraulic bottleneck that could cause the clarifier overtop and not provide adequate disinfection to ensure compliance with NPDES effluent limits for fecal coliform bacteria.[R]

7.3 EFFLUENT DISPOSAL ANALYSIS

The North Bend treatment plant's outfall facilities include an effluent structure and an outfall pipe with a diffusion structure on the east bank of the South Fork of the Snoqualmie River.

7.3.1 EFFLUENT STRUCTURE

The effluent structure was modified in 2001 so that effluent pumps can be added in the future to pump peak flows to the outfall during flood conditions. Installation of the pumps was deferred because the 1996 Treatment Plant Engineering Report had concluded that the pumps are not needed for current peak flows. However, recent experience has shown that the outfall has higher head loss than expected, and effluent pumps are needed now, unless the head loss at the outfall can be reduced. The structure also has experienced overflows during extreme wet-weather events.

7.3.2 OUTFALL

Outfall Condition

The outfall pipe and diffusion structure were inspected in September 2014. The outfall pipe was found to have significant accumulations of grease and sediment. The diffusion structure was partially filled with sediment and debris that completely blocked the lower three rows of outlet ports in the structure, and plant effluent had recently overflowed out the top of the structure. The outfall pipe and diffusion structure were cleaned and found to be in good condition.

Outfall Capacity

After the cleaning, plant effluent flowed out the diffusion structure wall and through the adjacent cobblestone filter to the river as designed. However, subsequent overflows occurred at the diffusion structure in November and December 2015 when effluent flows reached 3.8 mgd and the river was flowing at high water levels (see Figure 7-12). This indicates a need for improvements, such as the following:

- Further cleaning or replacement of the diffusion structure and cobblestone filter
- Providing effluent pumping and pressurized operation to discharge high flows
- Other improvements to reduce head loss and allow gravity discharge during normal flows

Outfall Mixing Zone

A dye test conducted during the 2014 outfall inspection showed that the outfall plume remains close to the east bank of the river during low flows and is totally laminar, with no significant dispersion until the plume reaches the Snoqualmie Valley Trail Bridge 650 feet downstream. Upon entering the pool immediately downstream of the bridge, the dyed flow appeared to completely mix with the main flow through eddy-induced advection, as shown in Figure 7-13. Outfall dilution modeling of the dry-weather, low-river-flow condition indicates that dilution is sufficient to meet standards for all water quality parameters except temperature (see Section 7.1.2).

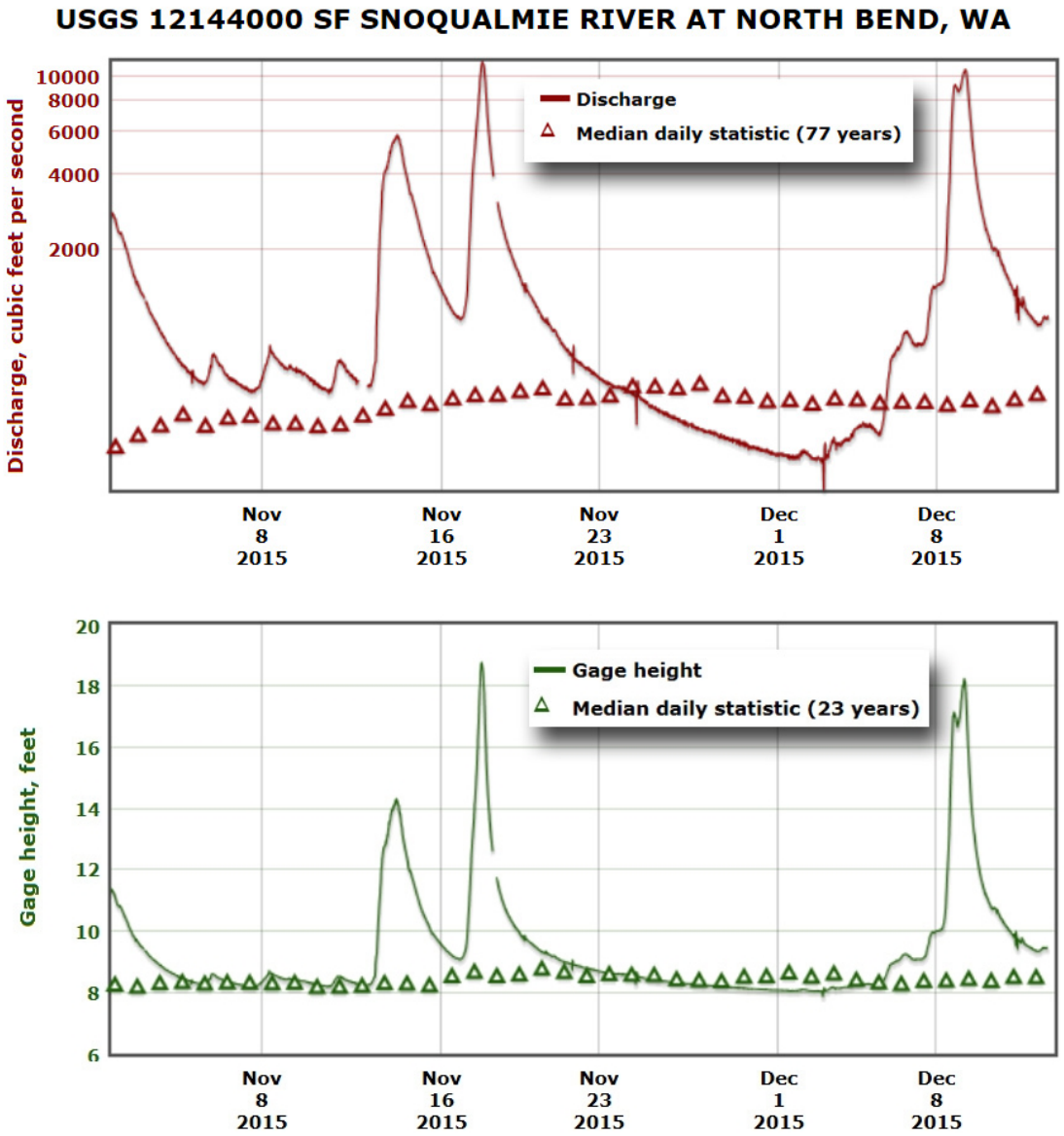
Outfall Temperature Loading

The 2013 NPDES permit required the City to prepare a temperature reduction study by July 2015, implement best temperature management practices and low cost improvements by July 2016, and commit to design and construction of needed long-term improvements. The City prepared the study as required, and it recommends an implementation plan to meet temperature limits by 2018, when Ecology plans to issue the next NPDES permit and require compliance with the temperature TMDL. The plan estimates the following:

- Weekly-average dry-weather effluent flows up to 0.87 mgd (expected in 2025) will comply with temperature requirements with no improvements to the plant or outfall.

- Weekly-average dry-weather flows up to 1.39 mgd (expected shortly after 2036) will comply if the City stores effluent flow containing excessive heat during the day when effluent temperature is high and discharges the stored flow at night when effluent temperature and flow are lower.

- Weekly average dry-weather flows above 1.39 mgd will need to be mechanically cooled at the plant with a heat pump or chiller for discharge to the existing outfall, or they will need to be discharged elsewhere, such as to groundwater via a buried perforated pipe to mix warm effluent with cool groundwater flowing to the river.



Source: USGS, 2016.

FIGURE 7-12

High South Fork Snoqualmie River Flows in November and December 2015

FIGURE 7-13

Dye Test Results – Laminar Flow Upstream of Trail Bridge (top and middle), Dispersed Flow Downstream (bottom)

7.4 BIOSOLIDS FACILITIES ANALYSIS

There have been significant problems with the solids handling facilities at the treatment plant in recent years. Excessive maintenance and emergency repairs have been needed to keep the system functioning. There are still deficiencies, and the facilities are barely able to keep up with sludge wasting needed for good performance of the liquid treatment process.

7.4.1 SLUDGE HOLDING AND DIGESTION

The sludge holding tank is old, small and difficult to operate. The tank has overflowed on occasion, because the submerged section of the overflow pipe in the old influent pump station wet well becomes plugged with grease and solids. Attempts to remove the grease from the pipeline have failed, and the control system does not trigger an alarm or shut off the flow of waste sludge into the tank when the tank is full. The tank can store waste sludge for only one or two days, which is too little time for flexibility in scheduling sludge wasting and too little time for sludge digestion.

7.4.2 DEWATERING

The centrifuge rotating assembly was replaced in 2016, but the centrifuge is too small and requires too much operator attention.

Waste sludge from Clarifier 3 generally contains less than 0.5 percent solids under normal operation. The sludge dewatering centrifuge is hydraulically limited to approximately 60 gpm. At a sludge concentration of 0.5 percent, the solids throughput capacity of the centrifuge is limited to approximately 150 pounds of solids per hour. If not hydraulically limited, the solids handling capacity would be about 600 pounds of solids per hour. Pre-thickening of the waste activated sludge or future aerobically digested sludge would reduce sludge processing time by the existing dewatering system. Any such thickening should provide a solids concentration of no more than 1.5 percent for optimal operation of the centrifuge.

Plant staff need to operate the centrifuge 40 to 60 hours per week to keep up with sludge wasting from the liquid process, and an operator must be on duty whenever it runs because the controls and alarms are not integrated with the plant SCADA system. This requires careful scheduling. The conveying system that transports dewatered sludge from the centrifuge to the sludge hopper is subject to occasional plugging due to a design defect, which results in a broken conveyor auger or spillage of dewatered solids on the floor of the Solids Handling Building. When problems occur, expensive overtime work is needed to implement repairs or catch up with sludge wasting.

7.4.3 DEWATERED SLUDGE LOADING STATION

The dewatered sludge loading facilities work well for transferring sludge directly from the dewatered sludge hopper at the dryer into a sludge transfer container, except that excessive foul odors are released as sludge is dropped into the transfer containers. The foul odors are most severe when sludge accumulates in the 28-cubic-yard dewatered sludge hopper for several days before being loaded into a sludge transfer container, which typically holds 20 to 22 cubic yards. The sludge becomes anaerobic and generates foul odors while stored in the hopper, and the odors are released when the sludge drops from the distribution conveyor into the container. Plant staff have employed the following operational measures to limit foul odors:

- Covering the solids in the transfer container with plastic at the end of each day to minimize odor release.
- Maximizing sludge digestion in the sludge holding tank to improve sludge stability (this is limited by the small size of the tank).
- Loading dewatered sludge into the transfer containers sooner after is deposited in the dewatered sludge hopper, to reduce the time to generate foul odors in the sludge hopper.

These operational improvements are interim measures to reduce odors until the facilities can be improved to reduce, capture and treat foul odors.

7.4.4 DRYER

In the spring of 2015, the plant discontinued the use of its thermal sludge dryer due to maintenance and reliability issues and adverse thermal impacts on the treatment plant effluent. The City is not likely to operate the sludge dryer in the future for the following reasons:

- The manufacturer of the sludge dryer is no longer in business, and spare parts and technical service are not readily available.
- The process is not reliable and is subject to frequent mechanical failure.
- The cost of operation and maintenance is significantly more than hauling and landfilling the dewatered sludge.
- The process generates nuisance odors, and a major odor control upgrade would be needed to significantly reduce or eliminate odor complaints.

- Waste heat from the sludge dryer exacerbates the thermal quality of the plant effluent.

Because the City cannot operate the sludge dryer in a reliable or cost-effective manner, the City requested and was granted a temporary two-year authorization by Ecology and the Kittitas County Health Department to dispose of its sludge by landfilling at the Republic Services, Inc. Roosevelt Landfill in Kittitas County.

7.5 SUPPORT FACILITIES ANALYSIS

7.5.1 ENCLOSED STRUCTURES

The condition of the four main buildings at the plant is as follows:

- The Original Treatment Building (old IPS and sludge holding tank building) is the oldest building on the treatment plant site. It has been modified many times since its original construction. The building is old and at the end of its useful life.

- The laboratory/control building is in good condition and sufficient for the current plant and staff. However, expanded facilities will be needed if plant capacity and staffing are increased. The building is not in compliance with floodplain management standards in the City of North Bend Municipal Code (Chapter 14.12) and would need to be raised to achieve compliance. The laboratory/control building is an essential facility at the treatment plant, since it houses the laboratory and the electrical controls for emergency power switching and power distribution to the process systems.

- The Pump House has significant structural deficiencies. The concrete south wall is severely and profusely cracked around the window and along the base of the wall at the joint with the floor. The wall is not plumb and is leaning south.

- The Solids Handling Building is in good condition and sufficient in space for all its current uses.

7.5.2 FLOW MEASUREMENT AND SAMPLING

The existing wastewater samplers need modifications to reliably obtain representative samples of treatment plant influent and effluent. Both collect time-composite samples rather than flow-proportional samples, and the influent sampler takes samples from the headworks channel whether the influent pumps are running or not. These conditions result in unrepresentative samples. Both samplers are currently on commercial power without standby power in the event

of a power failure. The influent sampler is within the Class 1, Division 2 hazardous (classified) zone, which extends 18 inches above the headworks.

The existing 8-inch effluent flow meter is too small and has excessive head loss for high flows. This resulted in effluent flows overtopping the clarifier on November 17, 2015 when peak influent flows reached approximately 3.8 mgd and the river level was high. This meter needs to be replaced with a larger meter or a parallel meter needs to be installed to provide capacity for high flows.

7.5.3 ORIGINAL INFLUENT PUMP STATION

The original IPS is old and in poor condition. Current pump capacity is less than 50 percent of the rated capacity. Isolation valves between the pumps and the wet well and on the discharge side of the pumps are frozen. Pump maintenance cannot be accomplished without isolation, and therefore has not been done for several years. The pumps likely need to be replaced, along with suction and discharge valves.

Improved ventilation is needed at the wet well and pump room. A flow meter is needed to measure flow from the pump station and should be integrated with the plant SCADA system. The original IPS needs to be programmed so the pumps operate only when there is sufficient capacity at the headworks or the ULID 6 Pump Station is out of service. For reliable operation as a backup when the ULID 6 Pump Station is out of service, the pumps at the original IPS do not have adequate capacity.

7.5.4 SOLIDS HANDLING BUILDING PUMP STATION

The Solids Handling Building Pump Station is in good condition and operates well. However, it causes several problems because it pumps recycle flows to the original IPS, which in turn pumps the recycle flows to the headworks. These recycle flows include centrifuge centrate and RAS from the small clarifiers, which can change pollutant concentrations in raw sewage samples collected at the headworks. The recycle flows contribute to overloading at the headworks and use inefficient double pumping – first at the Solids Handling Building Pump Station and second at the original IPS. A better approach would be keep these flows out of the original IPS and headworks by routing the Solids Handling Building Pump Station flows directly to the oxidation ditch.

7.5.5 ODOR CONTROL

Foul odors have occurred at the plant for many years, and the City has received many complaints. In recent years most of the foul odors were from the sludge dryer, but this has not been an issue since the City stopped using the dryer in the spring of 2015. On several occasions, the oxidation ditch released foul odors

when brush Rotors 201 and 202 were unable to provide sufficient aeration; this has not been an issue since Rotors 203 and 204 were installed in 2015.

Currently, the main source of foul odors is the dewatered sludge loading station when anaerobic sludge is loaded into an open transport container. The City is modifying sludge loading procedures to reduce these odors. Improvements will likely be needed to completely control this source of foul odors. Some foul odors are also released at the headworks and the sludge storage tank at the Original Treatment Building. These odors can be minimized with good operation. Improvements will likely be needed to completely control these foul odors. With good operation, no odor control should be needed for the oxidation ditch, clarifiers or effluent structure.

7.5.6 3W WATER

The 3W water system is in good conditions and works well in general. During some low flow periods, the 3W water pumps lose their prime and stop pumping, and no alarm is activated to alert operators. This typically occurs during dry weather at night, between original IPS pumping cycles and when 3W water is activated for demand such as wash water for the headworks screen, spray water for Clarifier 3 or polymer dilution for the centrifuge. The flow in the 24-inch diameter UV effluent pipe can be so low that there is not enough 3W water for plant operation. To restart the 3W pumps, an operator needs to re-prime the pump by purging air from the supply pipe and pump. A 3W supply reservoir is needed that would always provide enough 3W water. Currently, the 3W pumping system is not monitored by SCADA and therefore 3W water supply has gone undetected, leading poor performance of the influent mechanical fine screen and bypass to the manual bar rack, interruption of operation of the centrifuge, and poor performance of the scum collection system at the secondary clarifier as a result of loss of the surface spray water system.[R]

The 3W water is currently disinfected by the UV disinfection reactors. This eliminates most of the health risk associated with using 3W water at the plant. However, for safety, a sodium hypochlorite dosing system should be provided to further reduce pathogens and prevent regrowth of bacteria and pathogens in the 3W system, especially if a 3W storage reservoir is provided.[R]

7.5.7 STANDBY POWER

The standby power system for the plant is marginal. The existing 200 kW diesel-driven generator was installed in 1979 and is at the end of its expected service life. It should be replaced soon for reliable service. Additional standby power is needed for reliable plant operation during a sustained power outage. The existing standby power system does not provide power to the solids handling

building or to oxidation ditch Rotors 203 and 204. These facilities need power to provide reliable treatment when commercial power fails for more than a week.[R]

A separate 80 kW diesel-driven, trailer-mounted generator was installed in 2009 in conjunction with the construction of the ULID 6 influent pump station for the sole purpose of powering the pump station in case of a power outage.[R]

7.5.8 SCADA

The SCADA system has extensive deficiencies:

- The main control panel was built in 1979 and is obsolete and needs to be replaced.
- Troubleshooting the system is difficult because of poor documentation for the hardware and software.
- A new alarm system is needed with more alarms, better alarm logs, callout features and remote access.
- The PLC needs to be replaced. It was installed in 2009, and few programmers can program it.
- More automation is needed to improve plant performance and reliability.
- New input/output blocks and programming are needed for the following processes:
    - Reprogram ULID 6 for better solids transport, lead/lag and variable speed pumping
    - Coordinate original IPS operation with ULID 6 pump station
    - Flow-proportional control of samplers
    - Oxidation ditch aeration control based on levels of dissolved oxygen and oxygen reduction potential
    - UV reactor flow pacing and on/off valves
    - Flow control for RAS and WAS pumping
    - Integration of existing pump controls
    - Flow meter to measure original IPS flows
    - Larger effluent flow meter
    - Better data management and logging.

7.6 TREATMENT PLANT SITE ANALYSIS

7.6.1 STORMWATER

The existing stormwater system is sufficient to convey stormwater off site. Stormwater treatment is mostly limited to overland flow through gravel and grass areas before entering storm drains, ditches or swales that flow to the river. However, stormwater from the area around the original headworks drains to the original IPS and is pumped to the plant for treatment. Vacuum truck wastes and old mechanical equipment are stored outside in some areas of the site, and there is a risk that oil or leachate from these areas could contaminate stormwater flows. The stormwater system will need to be upgraded to comply with current stormwater treatment standards when the plant is remodeled or expanded.

7.6.2 FLOOD PROTECTION

Treatment plant facilities must be built above expected 100-year flood levels in order to comply with state and federal reliability requirements and with North Bend's code requirement that critical facilities be 3 feet above surrounding 100-year flood elevations. Wastewater treatment plant record drawings indicate that some, but not all, structures at the plant comply with the 3-foot requirement:

- The following plant structures are 3 feet or more above the 100-year flood elevation:
    - Headworks (top of wall)
    - Oxidation ditch (top of wall)
    - Clarifiers (top of wall)
    - Effluent structure (top of wall)
    - Solids handling building (floor)
- The following plant structures are less than 3 feet above the 100-year flood and are not flood-proofed:
    - ULID 6 Pump Station control panels and standby generator
    - Original IPS and standby generator
    - Laboratory/control building (floor) and electrical gear
    - Pump house (floor)

Flood mapping designates the eastern portion of the plant site as being in the AO-1 flood zone, which means water depth up to 1 foot is expected for the 100-year flood. Inundation of the plant access roads – Sydney Avenue North and North Bend Boulevard – would make plant access difficult during a flood. New development on any part of the plant in the AO-1 zone will be required to elevate

functional areas a minimum of 3 feet above the predicted 100-year flood elevation (4 feet above ground).

The western half of the plant site is in an AE flood zone, for which 100-year flood elevations of the South Fork Snoqualmie River have been calculated; the estimated 100-year flood elevation on this portion of the site is 435 feet. New development on any part of the plant in the AE zone will be required to elevate functional areas a minimum of 3 feet above the predicted 100-year flood elevation.

7.6.3 SECURITY

Site security is provided by a chain link fence around the site and a fire alarm system. All access gates remain closed and locked when a qualified operator is not on site. The primary access gate to the plant from Sydney Avenue North is left open when an operator is on site. Other access gates are opened when needed but are closed and locked when access is no longer needed. Treatment plant security has not been an issue.

7.6.4 MITIGATION, BUFFERS AND AESTHETICS

The plant site has limited buffering from the neighboring community as follows:

- On the southwest, the plant borders a major arterial road, Highway 202 (Bendigo Boulevard). A neighborhood of single-family homes is across this road, 200 feet from the oxidation ditch and 100 feet from the ULID 6 pump station.

- On the southeast, the plant borders Sydney Avenue North. A mobile home park is across this road, 50 feet from the ULID 6 pump station, plant headworks and sludge storage tank.

- On the northeast, the plant borders the Snoqualmie Valley Trail, which is 50 feet from the sludge loading area.

- There is good buffering on the north, where the plant borders the Tollgate Farms natural area, which is owned by the City.

- There is good buffering on the northwest, where the plant borders the South Fork of the Snoqualmie River and mostly vacant land across the river.

The plant is highly visible from adjacent roads and is not aesthetically pleasing. There is little or no landscaping to screen the site from view. Old equipment and utility supplies are stored on the grounds next to several storage sheds. The

exteriors of the tanks are weathered and moss-covered. The plant buildings are basic low-cost structures added to the site as needed. An old youth activity center building on the site is vacant and unused since it was damaged during a flood.

CHAPTER 8

TREATMENT FACILITY IMPROVEMENTS

Based on the assessment of existing conditions and future requirements for the facilities at the wastewater treatment plant, alternatives were identified and evaluated for improving the plant to ensure that it meets the City's needs through the end of the 20-year planning period. Three evaluations were performed:

- An assessment of treatment plant outfall location options to facilitate water quality and permit compliance.
- A review of options for reusing or disposing of biosolids generated at the treatment plant to meet state biosolids management standards (WAC 173-308) and achieve conformance under Washington's general permit for biosolids (see Appendix A).
- An evaluation of plant-wide combinations of improvements based on alternative choices of plant location and secondary treatment technology.

8.1 ASSESSMENT OF OUTFALL RELOCATION

Consideration was given to selecting a new outfall location on the Middle Fork or main stem Snoqualmie River for effluent discharge from the existing treatment plant site. Potential locations are shown on Figure 8-1.

8.1.1 PERMIT AND WATER QUALITY CONSIDERATIONS

A new outfall at either of the identified new locations would have the same effluent limits as the existing South Fork outfall (see Section 2.4), except for temperature and phosphorus, as discussed below.

Temperature Limits

A new outfall would be established at a location with river temperatures similar to those at the current location but with greater river flows. New temperature limits would be calculated using Department of Ecology spreadsheets, based on river temperature monitoring data collected at each location. The 7Q10 low flow (the low flow over a seven-day period that is statistically likely to occur once every 10 years) at the current South Fork location is 80 cubic feet per second, and up to 1.4 mgd can be discharged to the South Fork in compliance with temperature limits (Tetra Tech, 2015b). Assuming that the temperature-based outfall discharge limit is proportional to the river flow, the TMDL would allow discharge as follows at alternative outfall locations:

- 2.2 mgd to the Middle Fork, where the 7Q10 low flow is 125 cubic feet per second.

- 6 mgd to the main stem, where the 7Q10 low flow is 340 cubic feet per second.

Phosphorus Limits

A new outfall on the main stem or Middle Fork could have SRP limits when the next NPDES permit is issued in 2018. Under the 1994 phosphorus TMDL, which is based on North Bend's current discharge to the South Fork, North Bend's effluent SRP would be limited to 2 to 3 ppd.

If North Bend constructs a new main stem outfall, then Ecology could consider higher limits:

- The 1994 TMDL allocates 2 ppd of SRP to North Bend for discharge to the South Fork and 14 ppd of SRP to Snoqualmie for discharge to the main stem, which has greater flow.

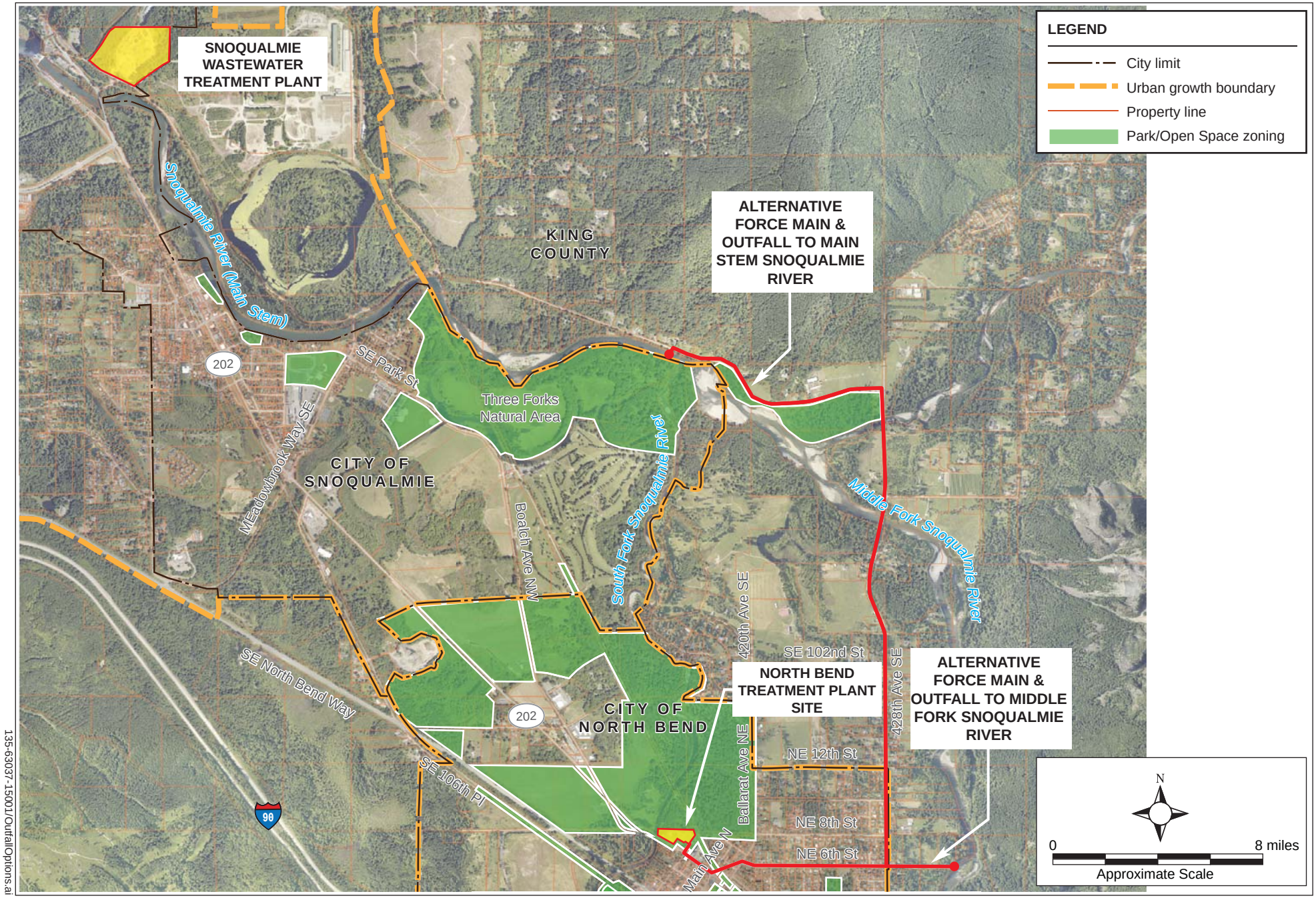
- The total contribution from both cities under the 1994 TMDL is 16 ppd of SRP.

- If North Bend were to discharge to the main stem with its higher flow, essentially equivalent to the Snoqualmie outfall, then it would be appropriate for both cities to have half of the TMDL's proposed total SRP of 16 ppd. This would make North Bend's allowable SRP at the new outfall 8 ppd.

Even if North Bend's SRP allocation were increased from 2 ppd to 8 ppd, the North Bend plant would still need to provide SRP treatment or reuse its effluent through summer land application to meet the higher SRP limits.

8.1.2 EQUIPMENT AND COST

The alternative outfall locations would require a new effluent pump station with high-head pumps, a 20- to 24-inch diameter force main to the river, an effluent diffuser structure in the river bank or the river, and extensive mitigation and permitting. Permitting would be especially difficult for an outfall on the main stem, because the main stem is outside the North Bend city limits. Overall project costs for the alternative outfall facilities are estimated to range from $10 million for the closest location on the Middle Fork to $25 million for the location on the main stem.



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City of North Bend
WASTEWATER SYSTEM FACILITIES PLAN

Figure 8-1.
OUTFALL LOCATION OPTIONS

8.1.3 CONCLUSION

The alternative locations would not significantly reduce treatment costs, because the effluent limits would generally be the same as for the existing outfall. Although compliance with the temperature TMDL and the potential phosphorus TMDL would be somewhat simpler than at the existing South Fork outfall, the associated savings would be small compared to the costs of the new outfall. Based on this initial screening, no alternative outfall locations are recommended.

8.2 BIOSOLIDS PROGRAM OPTIONS

The City needs to upgrade its biosolids program as soon as possible. Ecology approved the City's current program, which disposes of dewatered unstabilized sludge in a landfill, only as an interim measure when the City's Class A sludge dryer failed in 2014. Moreover, the existing biosolids facilities release significant foul odors and cause odor complaints in large areas of the City. Three levels of biosolids management were considered for the treatment plant improvements:

- **Beneficial Reuse, Class B Biosolids –** This would use aerobic digestion of waste activated sludge to meet Class B biosolids requirements for vector attraction, heavy-metal concentration, and concentrations of other toxic contaminants. The digested sludge would be dewatered and trucked to agricultural land application sites. This is the most common, affordable beneficial reuse program used by similar sized municipal treatment plants in western Washington.

- **Beneficial Reuse, Class A Biosolids –** Class A biosolids can be produced with a thermal dryer, composting, auto-thermal aerobic digestion and other processes. All of these are more complex and have more significant odor control issues than producing Class B biosolids with aerobic digestion. This approach was rejected because it would be more expensive than beneficial reuse of Class B biosolids.

- **Non-Beneficial Reuse –** This would continue the City's current biosolids management program of disposing of unstabilized, non-Class B sludge in a landfill. Ecology approved this as an interim measure only. Ecology will not allow the program to continue in the long term unless the City can show that beneficial reuse would cause significant financial hardship on the City. Ecology expects that the City can afford beneficial reuse, because virtually all similar municipal plants in western Washington have affordable beneficial reuse programs and because North Bend previously demonstrated that it could afford a Class A biosolids reuse program. This alternative was rejected.

Based on the screening of these approaches, this report assumes that the City will implement Class B aerobic digestion and land application of biosolids as the most efficient and economical way to reduce foul odors at the plant site and comply with Ecology requirements.

8.3 EVALUATION OF PLANT-WIDE ALTERNATIVES

The following sections describe five alternatives that were developed for evaluation, each of which would meet the City's treatment needs through 2036, with flexibility to expand the plant for future needs after 2036. Each alternative is distinguished by the treatment plant location (the existing site, some other new location in North Bend, or the City of Snoqualmie treatment plant) and type of secondary treatment technology (oxidation ditch, activated sludge, or membrane bioreactor).

Given the location and secondary treatment technology selected for each alternative, necessary improvements for all treatment plant processes were identified. Each alternative includes phasing, with projects to address existing needs in Phase 1 and projects to meet future demand through the planning period in Phase 2.

8.3.1 ALTERNATIVE 1 – EXPAND OXIDATION DITCH ON EXISTING SITE

This alternative would use the oxidation treatment process on the existing site. In Phase 1, between 2016 and 2020, existing deficiencies at the treatment plant would be corrected so the plant can reliably treat the wastewater flows and loads allowed by the existing NPDES permit. This would provide sufficient treatment capacity through 2029. Phase 2 would add phosphorus removal by 2023 and expand the treatment plant hydraulic capacity by 2029 to handle growth expected from 2029 to 2036 and beyond. This would be accomplished by constructing a new headworks and a new oxidation ditch on the existing site by 2020, converting the existing oxidation ditch for use as an aerobic digester by 2020, and constructing a second oxidation ditch by 2029. Improvements for each plant process are described below. No odor scrubbing is proposed for the oxidation ditches, secondary clarifiers, or effluent structure, because these processes typically have little or no offensive odor with normal operation.

Liquid-Stream Treatment Improvements

ULID 6 Pump Station

In Phase 1, the failed small pump at the ULID 6 Pump Station would be replaced and the pumps and variable-frequency drives would be reprogrammed to improve peak-flow capacity. A bar screen, flow baffle and isolation gate would be installed in the wet well to protect the pumps and improve maintenance access.

Facilities would be installed to facilitate rapid deployment and activation of a portable bypass pumping system in case of existing pumping system failure or maintenance requiring isolation and dewatering of the pump station wet well. The electrical and control panel would be raised approximately 4 feet to be 3 feet above the surrounding 100-year flood elevation. After the Phase 1 improvements are completed, no further improvements will be needed at the ULID 6 Pump Station through the 20-year planning period.

Headworks

For Phase 1, a new headworks would be constructed by 2020 for use with a new oxidation ditch. The new headworks would include two channels for mechanical screens and one channel for a manually raked bar screen. The mechanical screen at the existing headworks would be moved to the new headworks and installed in one of the new mechanical screen channels. Odor control would be provided with channel covers and a carbon odor scrubber unit. The unused existing youth center building at the site of the new headworks would be demolished.

For Phase 2, a 6 mgd mechanical screen would be installed in the new headworks in the second mechanical screen channel. A flow splitter would be constructed to route flows from the headworks to two oxidation ditches initially and to three oxidation ditches in the future. The headworks and splitter box would be configured so a grit chamber can be added in the future if needed.

Grit removal is not provided in this alternative because there have been no grit problems at this plant. The oxidation ditch collects the grit and has surface aeration, which is unaffected by grit accumulation. The new oxidation ditch can be drained and grit can be removed from it in 2029 when a second oxidation ditch is built. Thereafter, the oxidation ditches can be drained and grit can be removed every 10 to 20 years as needed.

Secondary Treatment Process with Nitrogen Removal

The following improvements would address identified deficiencies at the oxidation ditch and clarifiers:

- **New Oxidation Ditch –**
  - For Phase 1, the existing 10-foot-deep oxidation ditch would be replaced with a new 15-foot-deep oxidation ditch. The treatment process would be similar to the existing oxidation ditch process except that it would use a deeper tank with smaller footprint. The oxidation ditch would hold 600,000 gallons, and it would be operated with a sludge age of 8 days or more to meet summer nitrogen removal requirements. Portable pumps would be used to drain the new oxidation ditch as needed for maintenance.

- For Phase 2, a second new 15-foot-deep oxidation ditch would be constructed. The splitter box included in the Phase 2 headworks improvements would route flow from the headworks to each ditch.

- **New Clarifier –** In Phase 1, a second 80-foot-diameter clarifier would be constructed, similar to existing Clarifier 3. This Clarifier 4 would be used while the existing Clarifier 3 is taken out of service for several weeks for improvements. Clarifier 4 would satisfy Class 2 reliability requirements, which are currently not being met at the plant. It would also provide additional hydraulic capacity, which will be needed by 2025 when peak flows are projected to reach the design capacity of Clarifier 3. The new clarifier would include a new RAS/WAS pump station, flow meters, scum collection and pumping system, and control system. No additional clarifiers would be needed through the end of the 20-year planning period.

- **Existing Clarifier Improvements –** Phase 1 improvements would include replacement of the clarifier drive and re-grouting the clarifier floor. Screens would be installed to reduce floatables in effluent. The RAS force main from Clarifier 3 would be routed to discharge to the new oxidation ditch.

Phosphorus Removal

This alternative assumes that the next NPDES permit, which is scheduled to be issued in 2018, will require compliance with TMDL phosphorus limits by 2023. Compliance with the TMDL would require chemical treatment with alum or polyaluminum chloride to precipitate soluble reactive phosphorus to achieve the TMDL goals during from August through October. Chemical addition for phosphorus removal would not be required from November through July. This would require providing the following equipment for Phase 2:

- Alum and magnesium hydroxide feed pumps and flocculation mixing equipment at the headworks and upstream of the secondary clarifiers.

- A 5,000-gallon alum tank.

The alum would form a chemical precipitate floc incorporating the SRP, which would settle in the secondary clarifiers and be removed from the process along with waste activated sludge. The magnesium hydroxide would provide alkalinity to offset the effect of the alum dose and enhance the gravity clarification process. Magnesium hydroxide would be purchased as a 50-percent slurry and delivered in 250- to 300-gallon totes.

UV Disinfection

For Phase 1, the existing UV disinfection system would be rebuilt and installed in a new UV/Effluent Building. Various UV components would be upgraded to prevent overheating, breakage and safety hazards, and to increase capacity so that each of the two existing UV reactors could disinfect up to 2.5 mgd at a dose of 30 millijoules per square centimeter (mJ/cm^2). A third 2.5-mgd UV unit would be installed for reliability, and the UV system would be incorporated into the treatment plant SCADA system.

The new UV/Effluent Building would replace the structurally deficient existing Pump House. In addition to the UV system, it would house new effluent flow measurement and pumping systems, a flow control valve to divert excess warm effluent to retention storage as part of the effluent temperature mitigation improvements, and the relocated and upgraded 3W water system (i.e., plant effluent reuse system used for plant wash water.

After Phase 1, a fourth new UV unit would be added by 2026 when peak flows are expected to exceed 5 mgd.

Alternative technologies for disinfection were evaluated in the WWTP Temperature Reduction Study submitted to Ecology in July 2015. Disinfection systems evaluated included enclosed-vessel medium-pressure UV (MP-UV) which is the existing disinfection technology; sodium hypochlorite disinfection with sulfur dioxide dechlorination; open-channel low-pressure high-intensity UV (LPHI-UV), and peracetic acid. The study found enclosed-vessel MP-UV to be the most cost-effective technology considering both monetary and non-monetary criteria. The existing MP-UV disinfection system has generally performed well since it was installed in 2000. The technology has advanced with the use of electronic ballasts, which are more efficient and provide more turndown capability resulting in significant energy savings compared to the old magnetic ballast power systems. The energy requirements currently for MP-UV systems are comparable to LPHI-UV based on empirical disinfection efficacy. The MP-UV disinfection system requires a small footprint as compared to the other alternatives, which is important given the limited space available on the City wastewater treatment plant site. MP-UV systems use less than half the bulbs used by LPHI-UV systems and therefore have reduced risk for release of mercury to the environment through bulb breakage during use or disposal/recycling. Disinfection with sodium hypochlorite with sulfur dioxide for dechlorination or disinfection with peracetic acid both involve risk to plant personnel associated with handling significant quantities of corrosive and hazardous chemicals, and risk of spill or unintentional release that could impact human health and the environment. With regard to peracetic acid, supply is limited and the performance of the process is considered an emerging technology for wastewater disinfection.[R]

Effluent-Related Improvements

River Discharge

The following Phase 1 improvements would address identified deficiencies in the existing effluent discharge to the South Fork of the Snoqualmie River:

- **Effluent Pumping –** Install two new effluent pumps in the new UV/Effluent Building. Each pump would have a variable-frequency drive and a capacity of 3,750 gpm, to discharge peak flows to the South Fork outfall during high-flow conditions.

- **Effluent Flow Metering –** Install a new, larger effluent flow meter and the existing effluent flow meter in the new UV/Effluent Building, with electric actuator valves for accurate flow measurement over a wide range of flows.

- **Outfall Diffuser Manhole –** Reduce the pressure loss through the manhole by replacing the silt clogged riprap rock on the bank side of the manhole with clean riprap. Install a flow-relief system at the top of the diffuser manhole. Install a second diffuser manhole higher on the river bank, near the existing diffusion structure, for use during high-flow conditions in the river.

- **Effluent Temperature Control –** Provide 113,000 gallons storage for excess warm effluent during the daytime to provide temperature control through 2036 as indicated in Table 2-22. This storage includes 33,000 gallons in the effluent structure, 40,000 gallons in each small clarifier, and up to 500,000 gallons in Clarifier 3 or 4, if needed; during the critical period for temperature control, only one of the large clarifiers will be needed for treatment, so the other will be available for temperature-mitigation storage. These improvements will involve the following:

    - Shade the effluent structure and small clarifiers.

    - Install two thermal return-water pumps and a flow meter to return stored warm effluent to the liquid treatment process.

    - Install temperature probes on effluent and return-flow conveyance systems.

Although excess effluent thermal load is expected to be minimal through 2025, temperature control is included in Phase 1 to allow evaluation of the effectiveness

of the control measures and to adjust them as needed. After the Phase 1 improvements are completed, no additional effluent flow metering, pumping or temperature control improvements would be needed, except possibly shading Clarifier 3 late in the 20-year planning period.

Effluent Reuse

Based on the discussion presented in Section 2.5, the only types of water reuse that are practical in North Bend at this time are the current non-consumptive reuses at the treatment plant (for hose bibs, spray washing of equipment, and other general non-potable uses) and stream flow augmentation, as identified in the 2015 Temperature Reduction Study. This alternative would continue non-consumptive reuse at the treatment plant. It would be designed to accommodate stream flow augmentation reuse in the future if this is needed to comply with Snoqualmie River temperature limitations.

In the event that landscape irrigation or other types of Class A reuse become feasible in the future without impairing water rights (see Section 2.5.2) this alternative would be designed to allow for future upgrade to meet Class A reclaimed water standards by reserving space for filtration, disinfection and effluent pumping. An on-site clear well would be required for storage and pumping of filtered effluent, and a conveyance system would be required to transport the reclaimed water to the irrigation sites.

Solids Handling Improvements

For Phase 1, the following improvements would address existing deficiencies in treatment plant solids handling:

- **Convert Existing Oxidation Ditch to Aerobic Digester –** Modify the existing oxidation ditch for use as an aerobic sludge digester to produce Class B biosolids and to serve as a standby oxidation ditch in the event that the new oxidation ditch must be taken out of service for repairs. Solids will be thickened to a concentration of 1.5 percent by decanting supernatant over the existing oxidation ditch outlet weir. Modifications will include a new isolation gate and submersible pump in the outlet weir box to pump decanted supernatant to the liquid treatment process. Modifications would include the following:

    - Repair of the drive-shaft support brackets for Rotor 204.

    - New aeration controls based on new dissolved oxygen and oxidation reduction potential sensors.

- New flow dispersion baffles, covers and access walkways for the two older brush rotors to improve mixing, to reduce transmission of spray and odors and to improve safety for operation.

- Removal of accumulated grit from oxidation ditch.

- Installation of two new submersible chopper sludge feed pumps to convey Class B biosolids from the oxidation ditch to the centrifuge in the Solids Handling Building for dewatering.

- **New Centrifuge –** Install a new, larger capacity centrifuge in the existing solids building for dewatering, with a motor control center, a flow meter, a polymer feed system, and exhaust fan for odor control, and a system for conveying the dewatered sludge directly to the sludge loading area. Remove and scrap the existing dryer and sludge hopper.

- **Sludge Loading Area Odor Control –** Provide an odor containment curtain and blower at the existing sludge loading area to capture foul air and convey it to the existing sludge dryer off gas bioscrubber for treatment.

- **Solids Handling Building Pump Station Force Main Rerouting –** Extend the Solids Handling Building Pump Station force main to discharge to the new oxidation ditch.

For this alternative, the City would contract with a private company or public agency to haul away dewatered biosolids weekly and land-apply them for beneficial use on a permitted site. Companies and agencies that the City may contract with include Cascade Materials or Tenelco in Snohomish County, King County/Boulder Park in Douglas County, and Natural Selection Farms in Sunnyside in Yakima County.

For Phase 2, the original oxidation ditch would continue to be used as an aerobic digester. Its 600,000-gallon capacity would be sufficient for aerobic digestion beyond 2036. Maximum-month sludge production in 2036 would be 0.9 pounds of raw sludge per pound of BOD treated in the Phase 2 oxidation ditches, or 3,438 pounds per day. Aerobic digestion would destroy 38 percent of the waste activated sludge volatile solids and reduce the fecal coliform concentration to less than 2 million fecal coliforms per gram of dry solids. The brush aerators would be retained and used for aeration and mixing until they wear out in 15 to 20 years (2030 to 2035). At that time they could be replaced with diffused aeration and submersible mixers, which are more common for use in aerobic digesters, or a new, deeper digester could be constructed to use less land area on the site.

For Phase 2, a sludge thickener would be provided to increase the digester solids concentration up to 3 percent and the digester solids retention time to 45 days or more. Digested solids would continue to be dewatered with the centrifuge installed in Phase 1 to a solids concentration of 16 percent; this would require the sludge to be diluted to no more than 1.5 percent solids after digestion before entering the centrifuge. The City would continue contracting with a private company or public agency to transport the dewatered sludge at least weekly for beneficial use on a permitted site.

Support Facilities Improvements

For Phase 1, the following improvements would address identified deficiencies in treatment plant support facilities:

- **Influent and Effluent Sampling System Improvements –** Upgrade the existing controls to collect flow composite samples at the new headworks and existing effluent sampling systems.

- **Reroute Lab and Mobile Home Sewer Flow to ULID 6 Pump Station –** Reroute the sanitary sewer conveying flow from the treatment plant lab and neighboring mobile homes to the ULID 6 Pump Station, instead of to the original influent pump station .

- **New Electrical Building –** Construct a new 50-by-35-foot electrical building, with space for new MCCs, SCADA system, standby generator and connection to the power distribution center.

- **New MCCs –** Provide new MCCs in the new electrical building for all new equipment and to replace all existing MCCs in the existing Laboratory/Control Building.

- **New Standby Generator and Load Center –** Provide new 750 kW generator with an automatic transfer switch in the new Electrical Building to replace the existing 250-kW and 80-kW standby generators. The new generator will be sized to provide standby power to all the existing, Phase 1 and Phase 2 facilities, including the ULID 6 pump station. Install a new load center.

- **SCADA System Improvements –** Add equipment to upgrade the SCADA system to current standards and incorporate plant components currently omitted from the SCADA system. Configure the SCADA system so it can be expanded to serve all the existing, Phase 1 and Phase 2 facilities. Add a historian for improved data management. Add a WIN-911 alarm system.

- **3W Water System Improvements –** Relocate the existing 3W water system (pumps, filter and chlorination system) to the new UV/Effluent Building. Extend the 3W piping system to new areas of the plant to supply plant water to a new headworks, clarifier sprays, hose bibs, and landscape irrigation.

- **Treatment Plant Landscaping and Aesthetics Improvements –** Implement various landscaping and aesthetics work items.

For Phase 2, the following support facility improvements would be needed:

- **Laboratory/Control Building –** Flood-proof the existing laboratory/control building by raising it approximately 4 feet (3 feet above the surrounding 100-year flood elevation). Remodel the MCC room to provide four additional work stations for plant staff.

- **Solids Handling Building Maintenance Shop –** Provide a new maintenance shop in the existing Solids Handling Building after removal of the existing sludge dryer and sludge hopper.

- **SCADA –** Integrate all Phase 2 SCADA inputs, outputs, control loops and display screens into the SCADA system installed in Phase 1.

- **Original Treatment Building and Influent Pump Station –** Demolish the original treatment building and original IPS. The building and pump station will not be needed after a new electrical building, aerobic digester, ULID 6 Pump Station upgrades and I/I control are provided in Phase 1.

- **Pump House –** Demolish the above-grade portion of the existing Pump House after the new UV/Effluent Building is completed. Retain the below-grade portion of the Pump House building for potential future use with the existing small clarifiers.

- **Treatment Plant Landscaping and Aesthetics Improvements –** Implement various landscaping and aesthetics work items.

8.3.2 ALTERNATIVE 2 – NEW ACTIVATED SLUDGE PLANT ON EXISTING SITE

This alternative would implement a deep-tank activated sludge (DTAS) process for secondary treatment on the existing site. In Phase 1, between 2016 and 2020, existing deficiencies at the treatment plant would be corrected so the plant can reliably treat the wastewater flows and loads allowed by the existing NPDES permit. This would provide sufficient treatment capacity through 2029. Phase 2 would add phosphorus removal by 2023 and expand the treatment plant capacity

by 2029 to handle growth expected from 2029 to 2036 and beyond. This would be accomplished by constructing a new headworks and DTAS basin on the existing site by 2020 and constructing a second DTAS basin by 2029. The scope of the Phase 1 and Phase 2 improvements would be the same as for Alternative 1 except as follows:

- **Headworks –** In addition to the headworks improvements included in Alternative 1, a vortex-style grit chamber would be installed to reduce grit accumulation in downstream aeration basins.

- **Secondary Treatment Process with Nitrogen Removal –** The secondary process for this alternative would be the same as for Alternative 1, except two new 20-foot-deep DTAS basins would be constructed by 2029 instead of 15-foot-deep oxidation ditches; 20-foot-deep basins would allow for a small footprint on the site and more efficient oxygen transfer. Improvements would feature the following:

    - Each DTAS basin would hold 600,000 gallons – a 450,000-gallon aerobic zone and 150,000-gallon anoxic selector zone.

    - Fine-bubble aeration would be provided in the aerobic zones, with blowers in a new mechanical building.

    - Submersible wall pumps would circulate mixed liquor between the aerobic and selector zones.

    - Submersible mixers would mix the anoxic zones.

- **Effluent Temperature Control –** The warm-water storage system included in Alternative 1 would be combined with mechanical cooling, such as a chiller or heat pump, to further cool the effluent. More cooling would be needed for Alternative 2 than for Alternatives 1 and 4, because DTAS basins are heated by the warm compressed air used for diffused aeration, whereas oxidation ditches are cooled by splashing at the mechanical aerators. If no mechanical cooling were provided, the secondary effluent produced in this alternative would be 2 degrees F to 4 degrees F warmer than effluent from the oxidation ditches in Alternatives 1 and 4.

8.3.3 ALTERNATIVE 3 – NEW ADVANCED-TECHNOLOGY BIOLOGICAL TREATMENT PLANT ON EXISTING SITE

This alternative would replace the existing oxidation ditch plant with a new, high-tech plant on the existing site to provide the highest protection for local water quality and the highest level of aesthetic mitigation for the City. The

high-tech plant would use the membrane bioreactor (MBR) treatment process, like that used at King County's Carnation and Brightwater treatment plants. The new MBR facilities would be constructed in Phase 1, from 2016 to 2020. Critical corrective improvements would be implemented that are needed to allow the existing plant to meet NPDES permit requirements while the new MBR facilities are constructed. Phosphorus removal would be provided in Phase 2, by 2023.

Liquid-Stream Treatment Improvements

ULID 6 Pump Station

Improvements to the ULID 6 Pump Station would be the same as for Alternatives 1 and 2.

Headworks

A new headworks with grit chamber would be constructed for Phase 1 with two 6 mgd mechanical screens with 2 mm openings – one duty and one standby. This would provide fine screening at all times to prevent damage to the treatment membranes. The headworks would be constructed so a third mechanical screen could be added in the future.

Secondary Treatment Process with Nitrogen Removal

Corrective improvements to the existing secondary treatment system would be limited to replacing or repairing the existing drive on Clarifier 3. No improvements would be made to the existing oxidation ditch aerator controls, covers or walkways or to the existing clarifier scum and RAS/WAS systems.

Membrane bioreactor facilities would be constructed by 2020. The MBR process is similar to the selector activated-sludge process, except that it uses membranes instead of clarifiers to separate treated effluent from mixed liquor. It uses smaller aeration tanks, because it operates at much higher mixed-liquor solids concentrations. It also operates at a higher sludge age for good operation of the membranes, and it produces higher quality effluent that meets Class A reclaimed water standards. The process would feature the following:

- The two membrane bioreactor basins would be constructed in Phase 1 by 2020.
- Each membrane bioreactor train would hold 400,000 gallons – a 320,000-gallon aerobic zone and an 80,000-gallon anoxic zone.

- The MBR process would include membrane tanks with a total volume of 130,000 gallons, with 6 mgd peak-flow capacity and 4.8 mgd equalized peak flow capacity.

- MBR tanks would be 18 feet deep and use flat-plate membrane technology.

- Mixed liquor solids concentration would be 10,000 mg/L.

- 15-day sludge age would allow for nitrification and denitrification and good membrane performance.

- Diffused air aeration would be provided by high-efficiency blowers in a building, fine-bubble diffusers on the floor of the aerobic zones, and coarse-bubble diffusers under the membrane units.

- Automatic aeration control would be provided by a PLC and probes that continuously monitor dissolved oxygen in aerobic zones and oxidation reduction potential in anoxic zones.

- Submersible pumps would circulate mixed liquor between the biological reactor aerobic zones, anoxic zones and membrane tanks.

- Submersible mixers would mix the anoxic zones.

- The existing 80-foot clarifier would be converted to a 500,000-gallon influent flow equalization/storage tank to equalize peak flows during wet weather and store excess warm effluent flows during summer.

Phosphorus Removal

Phosphorus removal would be implemented in Phase 2, the same as for Alternatives 1 and 2.

Disinfection

Phase 1 corrective improvements to the existing UV disinfection system (the same as for Alternatives 1 and 2) would give the UV disinfection system sufficient capacity for secondary disinfection through the 20-year planning period. The existing UV units would be used to disinfect the MBR effluent by reinstalling them in the new MBR facility.

The UV system would be designed so it can be upgraded in the future when the existing UV equipment becomes obsolete or wears out, or if Class A disinfection

is needed because irrigation water reuse becomes feasible through changes in water rights restrictions.

Effluent-Related Improvements

Phase 1 corrective improvements to the outfall diffuser manhole would be the same as for Alternatives 1 and 2. Effluent flow measurement and pumping improvements would be provided inside the MBR building, similar to the effluent flow measurement and pumping improvements inside the new UV/Effluent Building included in Alternatives 1 and 2.

Temperature Control

Temperature control improvements would be the same as those for Alternative 2, but larger-capacity mechanical cooling would be provided. The increased cooling capacity would be needed because there would be higher temperatures in the MBRs from diffused aeration and biological reactions in the MBR basins.

Effluent Reuse

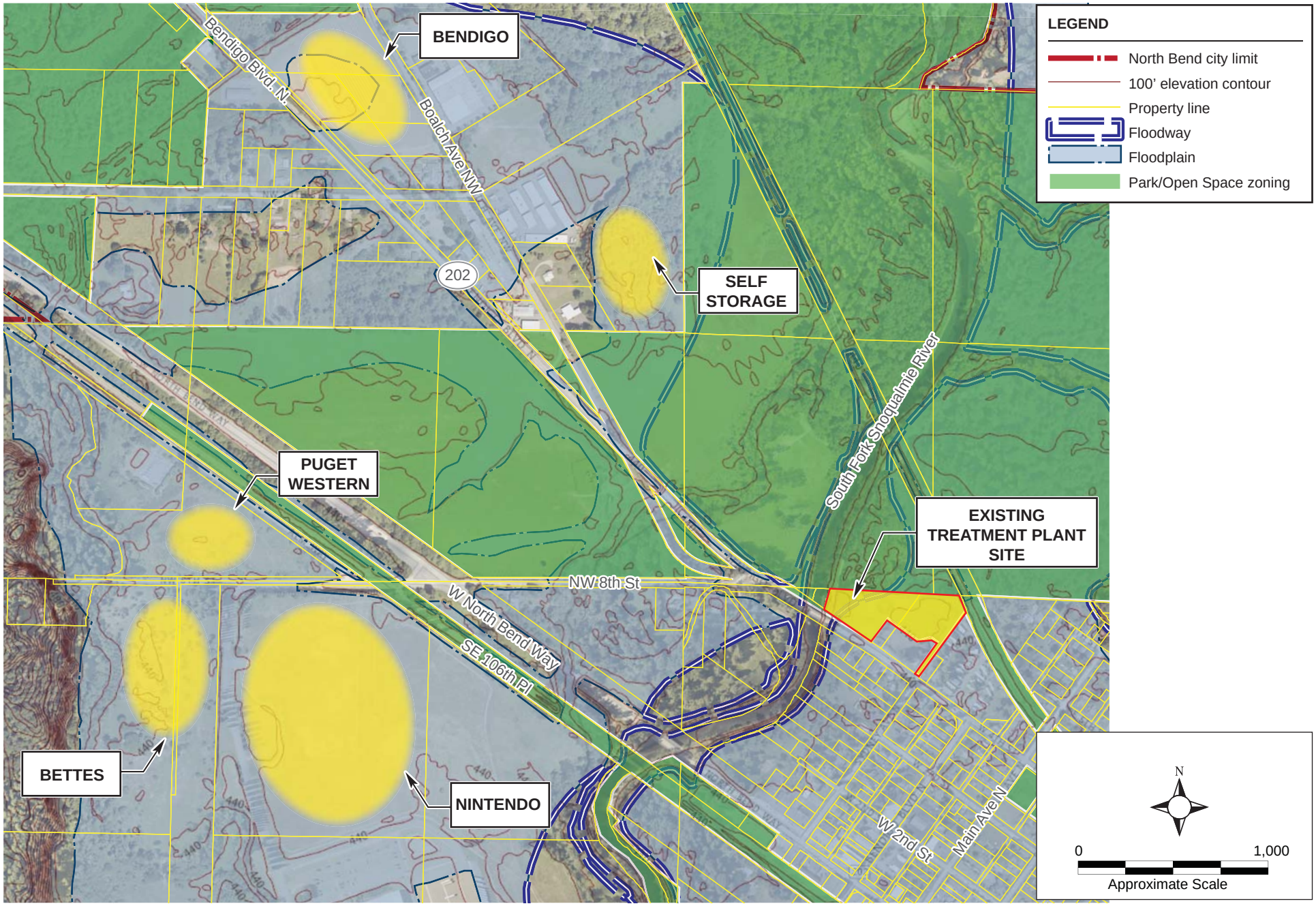
Like Alternatives 1 and 2, this alternative would continue non-consumptive reuse at the plant and would be designed to accommodate stream flow augmentation reuse in the future if it is needed to comply with Snoqualmie River temperature limitations.

In the event that landscape irrigation or other types of Class A reuse become feasible in the future, this alternative would be designed to allow for future upgrade to meet Class A reclaimed water standards. This would require supplemental disinfection, an on-site clear well for storage and pumping of filtered effluent, and a conveyance system to transport the reclaimed water to the irrigation sites.

Solids Handling Improvements

The biosolids facilities for this alternative would need capacity in 2036 for 0.8 pounds of raw sludge per pound of BOD treated in the MBR process. The maximum-month waste sludge production would be 2,407 pounds per day.

After the new MBR facilities are operational in 2020, this alternative would convert the original oxidation ditch for use as an aerobic digester. Its 600,000-gallon capacity would be sufficient for aerobic digestion beyond 2036. Aerobic digestion would destroy 38 percent of waste activated sludge volatile solids. The brush aerators would be retained for aeration and mixing until they wear out in 15 to 20 years (2030 to 2035). At that time they could be replaced



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City of North Bend
WASTEWATER SYSTEM FACILITIES PLAN

Figure 8-2.
SITES FOR CONSIDERATION AS POTENTIAL FUTURE TREATMENT PLANT LOCATIONS

with diffused aeration and submersible mixers, which are more common for use in aerobic digesters.

A new solids handling building would be constructed by 2020 as part of the new MBR plant. It would include a new polymer system, thickener, dewatering centrifuge and sludge truck loading facilities. Sludge would be thickened to 3 to 4 percent, and digested solids would be dewatered with a centrifuge to a solids concentration of about 20 percent.

Support Facilities Improvements

Corrective improvements to existing support facilities would consist of those described for Alternative 1 for the influent and effluent sampling system, the SCADA system and the laboratory and mobile home sanitary sewer. The original IPS would be demolished. A new electrical supply, load center, standby power, MCCs, electrical rooms, 3W water system and landscaping would be provided with the new MBR facilities.

8.3.4 ALTERNATIVE 4 – NEW OXIDATION DITCH PLANT AT NEW SITE

This alternative would construct a new oxidation ditch treatment plant at a new site, away from developed areas of the City and with more area for expansion and site buffers. Critical corrective improvements would be made at the existing plant to allow it to meet NPDES permit requirements while the new plant is constructed. The existing treatment plant would be demolished after the new plant is constructed. Phosphorus removal would be provided in Phase 2, by 2023, if required by the next NPDES permit.

Site Selection

A preliminary review was conducted to identify potential sites for a new treatment plant. Sites were reviewed using King County aerial photos and GIS map information and a brief drive-by survey. No property owners were contacted to confirm availability of the sites, and no inspections were conducted to confirm on-site conditions. More detailed site evaluations would be needed to select a new site if this alternative were chosen as the preferred alternative. The following criteria were used to identify potential sites:

- Inside city limits
- Zoned for industrial or commercial land use
- Away from existing residential development
- Close to the existing treatment plant to minimize conveyance costs
- Larger than the existing treatment plant site
- Flat, with good soil conditions
- Outside of floodway

- Little or no wetland or sensitive areas on site
- Only one or two property owners
- Not zoned for parks and open space (like Tollgate Farms)

Five sites were identified that meet these criteria, all in lightly developed areas on the west end of the City, about a mile from the existing plant site (see Figure 8-2):

- **Site 1, Nintendo –** This is a rectangular parcel owned by Nintendo, north of the existing Nintendo manufacturing facilities and south of NW 8th Street. It is flat and zoned for industrial land use. The only existing improvements are a paved access driveway, a gravel trail and some landscaping. The entire parcel is in the floodplain, so flood mitigation would be needed.

- **Site 2, Victoria Bettes –** This site consists of two parcels owned by Victoria Bettes that are zoned for industrial land use. The parcels include a flat area between the Nintendo property and Gardiner Creek, The only existing improvements are small agricultural buildings, fencing and driveways. The flat area is in the floodplain, so flood mitigation would be needed. Sensitive-area setbacks would be required from Gardiner Creek. The west parcel includes a large forested hillside west of Gardiner Creek that would not be suitable for a treatment plant.

- **Site 3, Puget Western –** This is triangular site owned by Puget Western, a land development company. It is undeveloped flat land zoned for industrial land use, north of the Nintendo and Victoria Bettes properties, north of NW 8th Street and south of the Tanner Electric Cooperative substation. It is all in the floodplain and would require flood mitigation if developed. Setbacks would be required from Gardiner Creek, which runs along the west side of the property.

- **Site 4, Bendigo Properties –** This site includes five contiguous parcels owned by Bendigo Properties. It is a flat area zoned for commercial land use, between State Highway 202 and Boalch Avenue NW, west of Calvary Chapel and the Mt Si Gymnastics Academy. The site is used to grow crops, The only existing improvements are fencing and site access driveways. Some of the property is above the floodplain, but most of it is in the floodplain and would require flood mitigation if developed. Setbacks would be required from Gardiner Creek, which runs through the north parcel. This property is more suitable for commercial development like neighboring properties than for use as a treatment plant site. During the course of developing this Facilities Plan, other development of this site has begun, so it is no longer available for consideration as a new treatment plant site.

- **Site 5, Eastside Self Storage –** This site is the undeveloped east portion the Eastside Self Storage property on the east side of Boalch Avenue NW. It is flat land with commercial zoning, between self-storage buildings and the South Fork Snoqualmie River. The flat area is in the floodplain and would require flood mitigation if developed. The treatment plant would need to be east of the stormwater/flood mitigation ponds that are behind the self-storage buildings. This property is more suitable for commercial development like neighboring properties than for use as treatment plant site.

Treatment plant facilities and site improvements would be similar at all of these sites and would include the elements described in the following sections.

Conveyance to New Site

Force Main

A new 5,000-foot-long, 20-inch-diameter force main would be constructed from the ULID 6 Pump Station to the new plant site. The force main would follow a route along existing road right-of-way to the selected site. A 24-inch-diameter, 300-foot-long microtunnel would be required under the South Fork of the Snoqualmie River at the Highway 202 bridge.

ULID 6 Pump Station

The ULID 6 Pump Station would be improved to pump raw sewage to the new treatment plant site. This would require the improvements needed for Treatment Plant Alternative 1, with the following modifications:

- All three pumps would be replaced with new higher-capacity pumps with larger electric motors to convey peak flows through the 20-inch-diameter force main. The new pumps would include one 50-hp, 1,600-gpm pump (at 80 feet of head), and two 75-hp, 2,600-gpm pumps (at 80 feet of head) – about 2 times more horsepower than the original ULID 6 pumps.

- New variable-frequency drives, controls, electrical gear and standby power for the larger pumps would be provided 3 feet above the 100-year flood elevation.

- New influent flow meter.

- New odor control system would be provided.

Liquid-Stream Treatment Facilities

Headworks

No improvements would be made at the existing headworks. A new headworks at the new site would be the same as for Phase 1 for Alternative 1, except a new 6 mgd mechanical screen would be installed instead of reusing the 3.5 mgd screen from the existing headworks.

Secondary Treatment Process with Nitrogen Removal

The failing drive on Clarifier 3 would be replaced so it can function reliably while the new plant is built. No corrective improvements would be made to the existing oxidation ditch aerator controls, covers or walkways or to the existing clarifier scum and RAS/WAS systems.

The secondary process for this alternative would be the same as for Phase 2 for Alternative 1. Two 600,000-gallon oxidation ditches would be built for secondary treatment, nitrification and denitrification. Two 80-foot clarifiers would be built on the new site, similar to the 80-foot clarifier on the existing site.

Phosphorus Removal

Phosphorus removal at the new plant would be the same as for Alternative 1.

Disinfection

The existing UV disinfection system would be the same as for Phase 1 for Alternatives 1, 2 and 3. The UV equipment would include three UV units, each with capacity to disinfect up to 2.5 mgd flow at a dose of 30 mJ/cm^2. The UV disinfection equipment upgraded in Phase 1 at the existing treatment plant would be relocated to the new plant for use in the disinfection process there. A new building and piping would be constructed at the new plant site for the relocated UV equipment.

Effluent-Related Facilities

Temperature Control

This alternative would divert excess warm effluent from the South Fork outfall, store it in an empty, covered (shaded) 80-foot clarifier during the daytime, and discharge it to the outfall at night when sewage flows and temperatures are lower. This storage may not be needed, because cooling of raw sewage and effluent in the 5,000 feet of pipelines to and from the new site might be sufficient to comply

with river temperature requirements. This storage system is proposed to be conservative, as it can be provided at low cost compared to other alternatives.

Effluent Disposal

A new effluent structure would be constructed at the new plant site, with weirs and gates to route effluent to the plant's outfall and excess warm effluent to storage and cooling. Effluent discharge facilities would require capacity for peak flows of 6.0 mgd in 2036 and 10.4 mgd for future full connection of the UGA to the sewer system. Effluent pumping would convey peak flows up to 6 mgd to the outfall during 100-year flood conditions. Two 75-hp, 4,200-gpm effluent pumps (at 80 feet of head) would be provided. This is 2 times more horsepower than Alternative 1, because there would be 4,700 feet more pipe between the plant and outfall.

This alternative includes a new outfall to the South Fork of the Snoqualmie River. A 4,700-foot, 24-inch outfall pipe would convey effluent from the new plant site to two new diffuser structures on the west bank of the South Fork. The existing effluent diffuser structure on the east bank would be abandoned, because using it with the new plant site would require the outfall pipe to cross the river, which would be more expensive. The new diffuser structures would feature a metal-grate top and debris screen. Like the existing South Fork outfall, they would be on the river bank rather than submerged in the river, to avoid the outfall being covered by sediment, gravel and cobbles as the riverbed changes.

Effluent Reuse

Like the existing-site alternatives, this alternative would provide non-consumptive reuse at the plant and would be designed to accommodate stream flow augmentation reuse in the future if it is needed to comply with Snoqualmie River temperature limitations.

In the event that landscape irrigation or other types of Class A reuse become feasible in the future, this alternative would be designed to allow for future upgrade to meet Class A reclaimed water standards by reserving space for filtration, disinfection and effluent pumping. After treatment in the oxidation ditches, effluent filtration and supplemental disinfection would be required. An on-site clear well would be required for storage and pumping of filtered effluent, along with a conveyance system to transport the reclaimed water to the irrigation sites.

Solids Handling Facilities

Biosolids facilities for this alternative would produce Class B biosolids. This alternative would construct all new biosolids facilities on the new plant site,

including a 400,000-gallon aerobic digester, a solids handling building with blowers, a sludge thickener, a dewatering centrifuge, a polymer system, a fully enclosed drive-through sludge transport vehicle loading garage, and odor control for biosolids capacity through 2036. For future expansion after 2036, the sludge thickener would run more hours per week and an additional 200,000-gallon digester would be added, for a total digester capacity of 600,000 gallons.

Support Facilities

Flow Measurement and Sampling

Flow measurement facilities would be provided to monitor flows of the plant influent, effluent, RAS, WAS and thickened sludge. Sampling facilities would be provided at the headworks and effluent structure to characterize the quality of the raw sewage and treated effluent.

Plant Drain System

A plant drain system and pump station would be provided to pump miscellaneous wastewater from treatment plant sources to the treatment processes. This would include wastewater from the laboratory, restrooms, floor drains, scum system, sludge thickener, centrifuge, sludge truck load areas, tank drains and other process. All plant drain water would be routed to the treatment processes and metered so that it does not distort monitoring of raw sewage flows and loads.

3W Water

A 3W water system would be constructed to supply plant water to the headworks, clarifier sprays, polymer feed system, sludge thickener, centrifuge, hose bibbs, landscape irrigation and possibly a wet scrubber for odor control. The 3W system would include three pumps and a hydropneumatic tank for flexibility to meet varying demand. It would also include a strainer to remove solids and a hypochlorite feed system to further disinfect plant water to protect operators from pathogen exposure and prevent slime growth in the 3W piping distribution system.

SCADA

A SCADA system would be installed for system control and data acquisition at the treatment plant and wastewater collection system. It would include several operator work stations and be integrated with the overall City SCADA system.

Power Supply

A power supply system would be provided, including a new commercial power service entrance, commercial site transformer, standby generator with diesel fuel supply, automatic transfer switch, and motor control centers.

Laboratory/Control Building

A new laboratory/control building would be provided similar in size to the building at the existing plant site. It would include a control room, laboratory with a sample preparation area, offices and work stations for plant staff, meeting room, break room and locker rooms. The building would be designed for future expansion.

Maintenance Shop

A maintenance shop would be provided with a workshop, parts and equipment storage, flammable liquid storage, a welding area and a two-bay repair area/garage. This could be a stand-alone building or it could be combined with the laboratory/control building.

Odor Control

Odor control facilities would be provided to capture and treat foul odors. This would include an odor scrubber to serve the headworks and solids handling facilities. No odor scrubbing would be provided for the activated sludge aeration basins, secondary clarifiers and effluent structure, because these processes typically have little or no odor.

Site Improvements

The site would be cleared and regraded for the treatment plant. Site access roads and parking would be provided. Fencing would be provided for site security. Stormwater runoff would be collected and treated in compliance with state and local regulations. The plant would be fully functional up to a 100-year flood, and floodwater storage would be provided on-site or nearby to compensate for areas of the site raised above the floodplain. Landscaping would provide an aesthetic appearance and screen the plant from public view.

8.3.5 ALTERNATIVE 5 – REGIONAL PLANT AT SNOQUALMIE

This alternative would convey all of North Bend's raw sewage to the City of Snoqualmie for treatment, with discharge of treated effluent to the Snoqualmie River. Critical corrective improvements would be made at the existing North Bend plant to allow it to meet NPDES permit requirements while facilities for the

regional treatment system are constructed. The existing North Bend treatment plant would be demolished after the new regional treatment system is operational. North Bend would remain responsible for operating and maintaining the wastewater collection system within the City.

Conveyance to Snoqualmie

Force Main

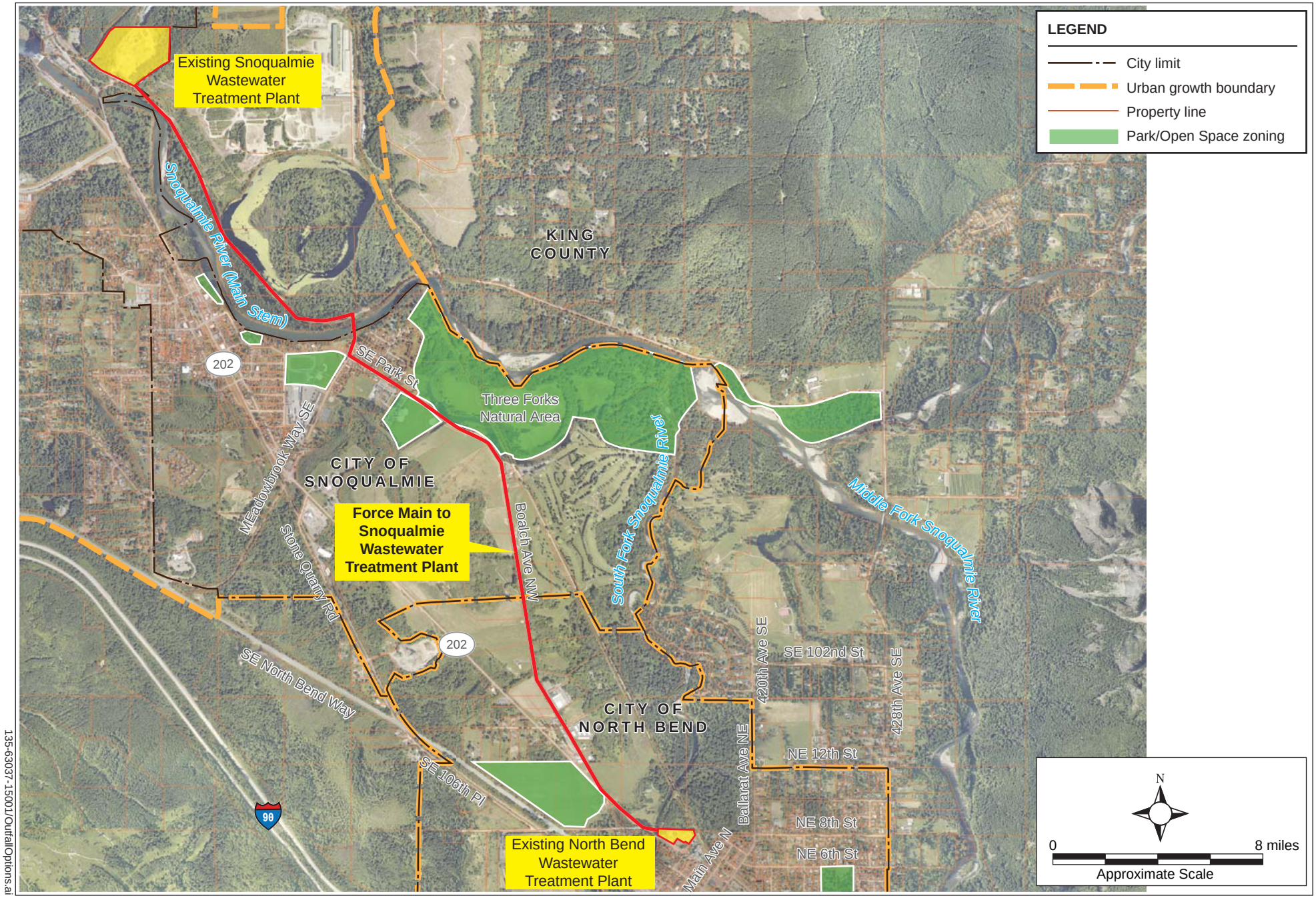
A new 22,000-foot-long, 24-inch-diameter force main would be constructed from the existing North Bend plant to the Snoqualmie plant. The force main would be installed in existing road right-of-way as shown in Figure 8-3. The force main could not be installed in the Snoqualmie Valley Trail because the BNSF Railway owns this right-of-way and prohibits installation of buried utilities there. The force main would require two river crossings: a 24-inch, 300-foot-long microtunnel under the South Fork of the Snoqualmie River at Highway 202; and a 24-inch, 400-foot-long microtunnel under the main stem of the Snoqualmie River at Meadowbrook Way SE.

ULID 6 Pump Station

The ULID 6 Pump Station would be improved to convey raw sewage through the new force main to the Snoqualmie treatment plant. This would require improvements similar to those described for Treatment Plant Alternative 4.

Snoqualmie Wastewater Treatment Plant Improvements

The City of Snoqualmie completed a General Sewer Plan in 2013 that analyzed the capacity of the Snoqualmie wastewater treatment plant for existing and future conditions. Table 8-1 summarizes the capacity analysis and shows that Snoqualmie has insufficient capacity for North Bend's existing and projected future flows. The Snoqualmie plant would need capacity upgrades to treat North Bend's wastewater through 2036.



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City of North Bend
WASTEWATER SYSTEM FACILITIES PLAN

Figure 8-3.
FORCE MAIN TO SNOQUALMIE WASTEWATER TREATMENT PLANT

TABLE 8-1

Snoqualmie Treatment Plant Capacity Deficit for North Bend Wastewater

Year	2012	2016	2018	2032	Future
Maximum-Month Flow (Snoqualmie Design Capacity 2.15 mgd)					
Snoqualmie Estimated Flow (mgd) (2)	1.55	1.74 (1)	1.83	1.95	2.01
Snoqualmie Reserve Capacity (mgd)	0.60	0.41	0.32	0.20	0.14
North Bend Estimated Flow (mgd)		1.22	1.29	1.80	3.15
Capacity Deficit (mgd)		0.81	0.97	1.60	3.01
Peak-Hour Flow (Snoqualmie Design Capacity 7.30 mgd)					
Snoqualmie Estimated Flow (mgd) (2)	5.0	5.47 (1)	5.7	5.89	5.97
Snoqualmie Reserve Capacity (mgd)	2.3	1.83	1.6	1.41	1.33
North Bend Estimated Flow (mgd)		4.09	4.27	5.63	10.4
Capacity Deficit (mgd)		2.26	2.67	4.22	9.07
Maximum-Month BOD Load (Snoqualmie Design Capacity 5,220 ppd)					
Snoqualmie Estimated BOD (ppd) (2)	3,224	3,762 (1)	4,031	4,378	4,530
Snoqualmie Reserve Capacity (ppd)	1,996	1,458	1,189	842	690
North Bend Estimated BOD (ppd)		1,503	1,685	3,064	6,306
Capacity Deficit (ppd)		45	496	2,222	5,616

(1) Interpolated between 2012 and 2018.
(2) From City of Snoqualmie Sewer Plan, 2012.

This alternative assumes that Snoqualmie would charge North Bend the full replacement cost for the treatment capacity needed for North Bend's sewage. The cost for this treatment capacity is estimated for this planning effort through 2036, based on implementing the following improvements:

- **Headworks –** A new headworks would be needed, comparable to the existing Snoqualmie headworks.

- **Odor Control –** Odor control would be required at the headworks because of the long conveyance detention time from North Bend during dry-weather months.

- **Secondary Treatment Process with Biological Phosphorus and Nitrogen Removal –** One additional oxidation ditch with anaerobic and anoxic selector zones would be needed (for a total of three ditches).

- **Clarifiers –** Two additional clarifiers would be needed (for a total of four).

- **Phosphorus Removal –** Phosphorus removal would be accomplished primarily by the biological phosphorus removal process in the oxidation ditches. If needed, additional removal would be by chemical treatment

using the existing alum storage tank, chemical feed pumps and flocculation system.

- **UV Disinfection –** The existing open channel UV system would be upgraded to 16-mgd secondary disinfection capacity, including 10 mgd for Snoqualmie flows and 6 mgd for North Bend by 2036. To meet the design criteria established by the City of Snoqualmie, the system would include redundancy so that 16 mgd could be disinfected with one UV channel out of service. The system would be expandable to 20 mgd for future peak hour flows, including 10 mgd for Snoqualmie and 10 mgd for North Bend. The UV system would be reconfigured to allow separate streams to be disinfected. Non-filtered secondary effluent would be disinfected to meet requirements for discharge to the river, and filtered effluent would be disinfected to meet Class A reclaimed water requirements.

- **Temperature Control –** No temperature control would be required to discharge effluent to the existing outfall to the Snoqualmie River.

- **Effluent Disposal –** The existing outfall has capacity for all of Snoqualmie and North Bend's projected flows through 2036, up to 16 mgd. There is sufficient head to convey the increased flows, because the existing effluent 90-degree weir at the plant can be replaced with a higher 120-degree v-notch weir or Cipoletti weir, and the flood level of the Snoqualmie River has been lowered several feet by river channel modifications completed since the original outfall design.

- **Effluent Reuse –** All of North Bend's treated wastewater would be discharged to the Snoqualmie River to satisfy water rights requirements for North Bend's Centennial Well

- **Solids Handling Facilities –** Snoqualmie's existing solids handling system is inadequate for North Bend's solids and would require a sludge thickener, Class B aerobic digester, sludge pumps, dewatering centrifuge and truck loading facilities.

- **Support Facilities –** Support facilities would require upgrades including expansion of the laboratory/control building, maintenance facilities, commercial power supply, standby power, SCADA control system, stormwater management, access roads, parking and other site improvements.

Actual costs charged by Snoqualmie for treatment capacity would depend on how Snoqualmie assigns the following costs to North Bend:

- $3,956.24 per ERU latecomer fee, owed to Quadrant Homes
- 150-percent non-resident surcharge
- $2,500 per ERU sewer connection fee, per Snoqualmie sewer ordinance
- Capital improvement fee for ongoing improvements to the existing Snoqualmie plant including disinfection, standby power and solids handling system

8.3.6 ESTIMATED COSTS

Capital Costs

Planning level capital cost estimates for the treatment plant alternatives are presented in Table 8-2. A detailed cost estimate by work item is included in Appendix F. Alternatives 3, 4 and 5 have significantly higher total capital costs than Alternatives 1 and 2. Alternative 3 is expensive because it uses the expensive MBR treatment process. Alternatives 4 and 5 are expensive because they have significant conveyance costs to transport North Bend wastewater to a new site.

Alternatives 1 and 2 would have lower implementation costs, because only about 73 percent of the improvements would be implemented in Phase 1, with the remaining 27 percent deferred about 10 years to Phase 2. Alternatives 3, 4 and 5 would require almost 100 percent of the improvements to be constructed immediately in Phase 1. Based on this cost comparison, Alternatives 3, 4 and 5 were dismissed from further consideration and Alternatives 1 and 2 were carried forward for a life cycle cost comparison.

TABLE 8-2

Planning-Level Capital Cost Estimates for Treatment Plant Alternatives

	Alt. 1: Oxidation Ditch, Existing Site	Alt. 2: DTAS, Existing Site	Alt. 3: MBR, Existing Site	Alt. 4: Oxidation Ditch, New Site	Alt. 5: Oxidation Ditch, Snoqualmie
Conveyance to New Treatment Facility Site (Phase 1)					
Conveyance to Snoqualmie	—	—	—	$0	$21,800,000
Conveyance to New North Bend Site	—	—	—	$10,600,000	—
Conveyance to North Bend Outfall	—	—	—	$10,000,000	—
Subtotal Conveyance to New Site (Phase 1)	—	—	—	*$20,600,000*	*$21,800,000*
Treatment Facility Improvements, Phase 1					
ULID 6 Pump Station Improvements	$370,000	$370,000	$370,000	$370,000	$370,000
Headworks – Screening	$1,150,000	$1,150,000	*in MBR cost*	$1,150,000	$1,700,000
Headworks – Grit Removal	—	$600,000	*in MBR cost*	—	$600,000
New Aeration Basins (Oxidation Ditch, DTAS, or MBR)	$1,900,000	$2,490,000	$77,100,000	$3,800,000	$3,500,000
Existing Clarifier Repair	$160,000	$160,000	—	—	—
New Clarifiers (or Membranes for MBR)	$2,820,000	$2,820,000	*in MBR cost*	$5,640,000	$5,700,000
New UV Effluent Building and Piping	$980,000	$980,000	*in MBR cost*	$980,000	—
UV Disinfection System	$730,000	$730,000	*in MBR cost*	$730,000	$2,300,000
New Effluent Pumps	$230,000	$230,000	*in MBR cost*	$230,000	—
Effluent Flow Meter	$190,000	$190,000	*in MBR cost*	$190,000	—
Effluent Temperature Equalization	$158,000	$158,000	*in MBR cost*	$158,000	—
Effluent Cooling	—	$1,113,000	$1,113,000	—	—
Outfall Diffuser Structure	$300,000	$300,000	$300,000	$300,000	—
Convert Oxidation Ditch to Digester	$700,000	$700,000	$700,000	—	—
New Aerobic Digester	—	—	—	$2,400,000	$3,500,000
Solids Handling Building & Loading Facility	—	—	$1,400,000	$1,400,000	$1,400,000
Sludge Thickener	—	—	$390,000	$390,000	—
New Centrifuge	$1,170,000	$1,170,000	$1,170,000	$1,250,000	$1,250,000
Solids Loading Odor Control	$50,000	$50,000	$50,000	$50,000	$50,000
Influent and Effluent Sampling System Improvements	$26,000	$26,000	$26,000	$26,000	$26,000
New Electrical Building and MCCs	$680,000	$680,000	*in MBR cost*	$680,000	—
SCADA Upgrade	$330,000	$330,000	—	—	—
SCADA	—	—	*in MBR cost*	$710,000	$730,000
New Standby Generator in Building	$1,340,000	$1,340,000	*in MBR cost*	$1,340,000	$2,100,000
3W Water	$170,000	$170,000	*in MBR cost*	$800,000	$500,000
Laboratory/Control Building	—	—	*in MBR cost*	$1,600,000	$1,400,000
Laboratory and Mobile Home Park Sewers to ULID 6 PS	$110,000	$110,000	$110,000	$110,000	$110,000
Solids Handling Building PS Force Main to Headworks	$110,000	$110,000	—	—	—
Site Work Fencing, Paving, Flood Mitigation	$280,000	$280,000	*in MBR cost*	$600,000	$600,000
Landscaping	$200,000	$200,000	*in MBR cost*	$400,000	$400,000
Demolish Existing Plant	—	—	$2,000,000	$2,000,000	$2,000,000
Land Acquisition	—	—	$0	$1,500,000	$0
Subtotal Treatment Facility Phase 1	*$14,154,000*	*$16,457,000*	*$84,729,000*	*$28,794,000*	*$28,236,000*

TABLE 8-2 (continued)

Planning-Level Capital Cost Estimates for Treatment Plant Alternatives

	Alt. 1: Oxidation Ditch, Existing Site	Alt. 2: DTAS, Existing Site	Alt. 3: MBR, Existing Site	Alt. 4: Oxidation Ditch, New Site	Alt. 5: Oxidation Ditch, Snoqualmie
Treatment Facility Improvements, Phase 2					
Headworks, Screening and Flow Splitter	$900,000	$900,000	—	—	—
New Aeration Basins (Oxidation Ditch or DTAS)	$1,900,000	$2,490,000	—	—	—
UV Disinfection, Add 4th Reactor	$290,000	$290,000	—	—	—
Phosphorus Removal	$900,000	$1,200,000	$1,200,000	$900,000	—
Sludge Thickening	$390,000	$390,000	—	—	—
SCADA	$120,000	$150,000	—	—	—
Laboratory/Control Building – Floodproofing	$280,000	$280,000	—	—	—
Laboratory/Control Building – Add Office Space	$60,000	$60,000	—	—	—
Solids Handling Building, Add Maintenance Shop	$90,000	$90,000	—	—	—
Demolish Original Treatment Building	$80,000	$80,000	—	—	—
Demolish Pump House Upper Level	$20,000	$20,000			
Site work	$250,000	$300,000	$60,000	$50,000	—
Landscaping	$200,000	$200,000	—	—	—
Subtotal Treatment Facility Phase 2	*$5,480,000*	*$6,450,000*	*$1,260,000*	*$950,000*	—
Total Treatment Facility	*$19,634,000*	*$22,907,000*	*$85,989,000*	*$29,744,000*	*$28,236,000*
Total Capital Cost	**$19,634,000**	**$22,907,000**	**$85,989,000**	**$50,344,000**	**$50,036,000**

Life-Cycle Cost Comparison, Alternatives 1 and 2

Operation and Maintenance Cost

Operation and maintenance (O&M) costs would be the same for Alternatives 1 and 2 except for aeration and mixing in the aeration basins (oxidation ditch or DTAS), grit removal, and temperature control. Digester aeration and mixing O&M costs would be the same for Alternatives 1 and 2 because both would use the existing oxidation ditch for digestion. The new headworks and one oxidation ditch or DTAS basin would begin operation in 2020, and a second oxidation ditch or DTAS basin would begin operation in 2029. Alternative 1 would use oxidation ditches with brush aerators, Alternative 2 would use DTAS basins with fine-bubble aeration, submersible mixers and recirculation pumps, and would include grit removal. Alternative 2 also would have supplemental mechanical cooling for TMDL compliance that would not be needed for Alternative 1; the mechanical cooling would be operated three months each year: August, September and October.

A simplified analysis of O&M costs was developed that compares only the O&M components that differ between Alternatives 1 and 2. The average annual O&M costs based on this analysis are presented in Table 8-3 for 2020 through 2028 and in Table 8-4 for 2029 through 2036. These estimates indicate that Alternative 2 would have about 50 percent higher O&M costs, because of extra costs for the grit and mechanical cooling systems. O&M costs for the DTAS aeration basin mixing, recirculation and annual diffuser maintenance are greater than estimated savings from more efficient diffuse air aeration.

TABLE 8-3

Alternatives 1 and 2 Annual Cost for Aeration, Mixing, Grit Removal, Mechanical Cooling; 2020 to 2028

	Alt. 1: Oxidation Ditch, Existing Site		**Alt. 2: DTAS, Existing Site**	
	Quantity	**Annual Cost**	**Quantity**	**Annual Cost**
Labor ($70/hour)				
Aeration & Mixing O&M	365 hours/year (1 hour/day)	$25,600	365 hours/year (1 hour/day)	$25,600
Aeration Diffuser O&M	N/A	$0	80 hours/year	$5,600
Grit Removal	N/A	$0	96 hours/year (2 hours/week)	$6,700
Power ($0.08 per kW-hour)				
Aeration	Turndown to 25 BHP, 24 hours/day	$13,150	Turndown to 20 BHP, 24 hours/day	$10,500
Mixing at 30 hp/MG	N/A	$0	Mixers 1 at 4.5 BHP & 1 recirculation pumps at 5 BHP, 24 hours/day	$5,000
Grit Removal	N/A	$0	1 BHP 24 hours/day & 10 BHP 2 hours/day	$1,000
Supplies				
	4% of equip. cost	$8,000	4% of equip. cost	$18,000
Total		**$46,750**		**$72,400**

TABLE 8-4

Alternatives 1 and 2 Annual Cost for Aeration, Mixing, Grit Removal, Mechanical Cooling; 2029 to 2036

	Alt. 1: Oxidation Ditch, Existing Site		Alt. 2: DTAS, Existing Site	
	Quantity	**Annual Cost**	**Quantity**	**Annual Cost**
Labor ($70/ hour)				
Aeration & Mixing O&M	730 hours/year (2 hours/day)	$51,100	730 hours/year (2 hours/day)	$51,100
Aeration Diffuser O&M	N/A	$0	160 hours/year	$11,200
Grit Removal	N/A	$0	96 hours/year (2 hours/week)	$6,700
Mechanical Cooling (1)	N/A	$0	96 hours/year (12 weeks @ 8 hours/week)	$6,700
Power ($0.08 per kW-hour)				
Aeration	Turndown to 50 BHP 2 at 25 BHP, 24 hours/day	$26,300	Turndown to 40 BHP, 24 hours/day	$21,000
Mixing at 30 hp/MG	N/A	$0	Mixers 2 at 4.5 BHP & 2 recirculation pumps at 5 BHP, 24 hours/day	$10,000
Grit Removal	N/A	$0	1 BHP 24 hours/day & 10 BHP 2 hours/day	$1,000
Mechanical Cooling	N/A	$0	190,000 kW-hours	$15,200
Supplies				
	4% of equip. cost	$16,000	4% of equip. cost	$38,000
Total		**$93,400**		**$160,900**

(1) North Bend Wastewater Treatment Plant Temperature Reduction Study, July 2015.

Present Worth

The O&M cost estimates indicate that Alternative 2 would average $25,700 per year more than Alternative 1 from 2020 to 2028 and $67,500 per year more from 2029 to 2036. The 2016 present worth of these extra O&M costs is estimated to be $516,000, assuming a 3-percent interest rate. This indicates a total present worth for Alternative 2 that is $3.79 million higher than that of Alternative 1: $3.27 million higher capital cost and $516,000 higher present worth of O&M.

Qualitative Evaluation, Alternatives 1 and 2

Alternatives 1 and 2 are qualitatively similar except as follows:

- Alternative 2 would fit on the site better. Alternative 1 would require slightly more land because it uses 15-foot deep aeration tanks and Alternative 2 uses 20-foot deep aeration tanks. The site area is limited, and it would be beneficial to use 20-foot-deep basins to preserve as much open land area as possible for buried utilities and future expansion. The 20-foot-deep basins would allow up to four aeration tanks on the site in the future between the existing oxidation ditch and Bendigo Boulevard; whereas the 15-foot-deep tanks would allow up to three oxidation ditches between the existing ditch and Bendigo Boulevard. A fourth ditch could be added in the future at the site of the existing oxidation ditch. Alternative 1 could use 20-foot-deep basins if different mechanical aeration equipment and tank configuration were used, although this is not commonly done.

- Alternative 1 would use less energy, because the loop configuration of the oxidation ditch would provide more efficient mixing.

- Alternative 1 would use less energy, because mechanical cooling of effluent would not be needed. This would become a more significant advantage after 2036 as the City approaches full connection to the sewer system and there is more effluent with excess heat.

- Alternative 1 would be simpler to maintain because it would require less equipment and the aeration basins would not need to be drained for annual inspection and maintenance of aeration diffusers, as would be required for Alternative 2.

CHAPTER 9

RECOMMENDED PLAN

This chapter summarizes the recommended plan for upgrading wastewater facilities in the City of North Bend. The recommended plan covers collection system and treatment plant improvements in two phases. Phase 1 covers the period from 2016 through 2020, and Phase 2 covers the period from 2020 through 2036. A discussion on rate impacts and means of financing and implementing the recommended improvements is provided at the end of this chapter.

9.1 RECOMMENDED IMPROVEMENTS

9.1.1 COLLECTION SYSTEM IMPROVEMENTS

Existing System Upgrades

The following improvements are needed to address known deficiencies at the South Fork and Snoqualm Lift Stations:

- **South Fork Lift Station –** SCADA and control system upgrade:
  - PLC upgrade, integration with wastewater treatment plant
  - Pump control programming and integration with automated transfer switch
- **South Fork Lift Station –** Pump replacements, odor control upgrade and dry well access:
  - Complete a predesign study to determine the most cost-effective and reliable means for addressing the capacity needs and risk issues associated with operation of the lift station throughout the planning period with due consideration of existing force main condition, pressure surges, downstream sewer capacity, and cost-effectiveness of significant long-term I/I reduction and control.
  - This facilities plan assumes the need for two new 1,784 gpm pumps to replace the existing pumps. However, one of the two existing pumps has been reported to have significantly less capacity than the other and may need to be replaced for that reason regardless of I/I reduction effectiveness.

- Upgrades to dry well entry, personnel and equipment access.
- Wet well and dry well ventilation system and foul air treatment.
- Provision for bypass pumping/

- **Snoqualm Lift Station –** SCADA system integration:
  - Radio telemetry system, integrated with wastewater treatment plant control interface.
  - Uninterruptible power supply for instrumentation and radio telemetry system.
  - Control panel upgrade to meet code and address security of status controls.
  - Provision for bypass pumping.

The current City goal calls for completion of these projects by 2018. These improvements will provide reliable operation and capacity through the end of the planning period in 2036.

System Expansion

This report assumes that the collection system will be extended to provide service to 80 percent of all currently unsewered development within the city limits by 2036 and into any areas of the UGA that become annexed to the city. ULIDs will likely be the primary method of extending sewer service to currently unsewered or unconnected development in the city. Financial aid, grants and hardship funding may be available to reduce the cost of installing sewers in some neighborhoods. These include densely developed neighborhoods such as the Silver Creek, SE 12th Street and Tanner Road areas, and any neighborhoods in a wellhead protection area or buffer zone, such as the Riverside and LaForest Holme areas.

9.1.2 WASTEWATER TREATMENT PLANT IMPROVEMENTS

Based on comparison of the five treatment plant alternatives in Chapter 8, Alternatives 1 is the recommended alternative. The Phase 1 improvements will upgrade the plant so it can reliably treat the wastewater flows and loads authorized in the current NPDES permit and the state general permit for biosolids management. The Phase 2 improvements will increase plant capacity for conditions expected in 2036 and beyond.

Specific Phase 1 plant improvements, to be implemented from 2016 to 2020, are as follows:

- **ULID 6 Pump Station –** Replace the small pump and reprogram the pump station to improve peak-flow capacity. Install a bar screen, flow baffle and isolation gate in the wet well to protect the pumps and improve maintenance access. Raise the existing electrical and control panels approximately 4 feet (3 feet above the 100-year flood elevation).

- **Headworks –** Construct a new headworks with two channels for mechanical screens and one channel for a manually raked bar screen. Install the mechanical screen at the existing headworks in one of the new mechanical screen channels. Provide odor control with channel covers and a carbon odor scrubber unit. The unused former youth activity center building at the site of the new headworks will be demolished. The need for a grit chamber will be evaluated during design after a quantitative evaluation is completed on grit accumulation in the existing oxidation ditch.

- **New Oxidation Ditch –** Construct a new 15-foot-deep oxidation ditch with brush aerators. This oxidation ditch will be operated with a sludge age of 8 days or more to meet summer nitrogen removal requirements.

- **New Clarifier –** Construct a second 80-foot-diameter clarifier, similar to existing Clarifier 3. The new clarifier will include a new RAS/WAS pump station, flow meters, scum collection and pumping, and a control system. Construct a splitter box to route mixed liquor from the new oxidation ditch to the clarifiers.

- **Existing Clarifier 3 –** Replace the clarifier drive, re-grout the clarifier floor, install a screen to reduce floatables in effluent, and reroute the Clarifier 3 RAS force main to discharge to the new oxidation ditch

- **New UV/Effluent Building –** Construct a new UV/Effluent Building to replace the structurally deficient existing Pump House. The new UV/Effluent Building will house the UV system, new effluent flow measurement and pumping systems, a control valve to divert excess warm effluent to storage, and the relocated 3W water system. Add an automated pulse flush system to minimize accumulation of solids in the pipeline to the UV system during extended low flows (dry-weather period).

- **UV Disinfection –** Rebuild the existing UV disinfection system and install it in a new UV/Effluent Building. Install a third 2.5-mgd UV unit for reliability. Incorporate the UV system into the treatment plant SCADA system.

- **Effluent Pumping –** Install two new effluent pumps in the new UV/Effluent Building to discharge peak flows to the South Fork outfall during high-flow conditions.

- **Effluent Flow Metering –** Install a new, larger effluent flow meter and the existing effluent flow meter in the new UV/Effluent Building, with electric actuator valves for accurate flow measurement over a wide range of flows.

- **Outfall Diffuser Manhole –** Replace riprap on the bank side of the existing outfall diffuser manhole with clean riprap. Install a flow-relief system at the top of the existing diffuser manhole. Construct a second diffuser manhole higher on the river bank, near the existing diffusion structure, for use during high-flow conditions in the river.

- **Effluent Temperature Control –** Convert the existing small clarifiers and effluent structure to store excess warm effluent for night-time discharge from August through October. Install automatically controlled valves, along with thermal return water pumps, and temperature and flow sensors to control flow of excess warm effluent into and out of the small clarifiers and old contact tank. Install structures to shade the effluent structure and Clarifiers 1 and 2.

- **Convert Existing Oxidation Ditch to Aerobic Digester –** Modify the existing oxidation ditch for use as an aerobic sludge digester to produce Class B biosolids and to serve as a standby oxidation ditch. Solids will be thickened to a concentration of 1.5 percent by decanting supernatant over the existing oxidation ditch outlet weir. Modifications will include a new isolation gate and submersible pump in the outlet weir box to pump decanted supernatant to the liquid treatment process; new aeration controls based on new dissolved oxygen and oxidation reduction potential sensors; new flow dispersion baffles, covers and access walkways for the two older brush rotors; repair of the drive-shaft support brackets for Rotor 204; and two new submersible chopper sludge feed pumps to convey biosolids to the centrifuge in the Solids Handling Building for dewatering.

- **New Centrifuge –** Install a new, larger centrifuge in the Solids Handling Building, with a motor control center, a flow meter, a polymer feed system, and exhaust fan for odor control, and a conveying system to the sludge loading area. Remove and scrap the existing dryer and sludge hopper.

- **Solids Loading Area Odor Control –** Provide an odor control system for the sludge loading area, including odor containment curtain, blower and discharge to the existing sludge dryer off-gas bioscrubber for treatment.

- **Influent and Effluent Sampling System Improvements –** Upgrade the existing controls to collect flow composite samples at the new headworks and existing effluent sampling systems.

- **New Electrical Building –** Construct a new 50-by-35-foot electrical building.

- **New MCCs –** Install new MCCs in the new electrical building for all new equipment and to replace all existing MCCs.

- **New Standby Generator and Load Center –** Install a new 750 kW generator with an automatic transfer switch in the new Electrical Building.

- **SCADA Improvements –** Upgrade the SCADA system to current standards and incorporate plant components currently omitted from the SCADA system (headwork, UV disinfection, and solids handling processes)

- **3W Water –** Relocate the existing 3W water system (pumps, filter and chlorination system) to the new UV/Effluent Building. Extend the 3W piping system to new areas of the plant to supply plant water to a new headworks, clarifier sprays, hose bibbs, and landscape irrigation.

- **Pipe Rerouting:**
  - Extend the Solids Handling Building Pump Station force main to discharge to the new oxidation ditch.

  - Reroute the sanitary sewer conveying flow from the treatment plant laboratory and neighboring mobile homes to the ULID 6 Pump Station rather than the original influent pump station

- **Site Work and Landscaping –** Plant a landscaping buffer along Bendigo Boulevard. Provide paving, fencing, flood mitigation, and other site improvements as needed.

Specific Phase 2 plant improvements, to be implemented from 2023 to 2029, are as follows:

- **Headworks –** Install a new 6-mgd mechanical screen in the second mechanical screen channel. Construct a new flow splitter to route flows

from the headworks to two oxidation ditches (and to three oxidation ditches in the future), configured so a grit chamber can be added in the future if needed.

- **New Oxidation Ditch –** Construct a second 15-foot-deep oxidation ditch.

- **UV Disinfection –** Install a fourth UV unit.

- **Phosphorus Removal –** Install phosphorus removal facilities, including alum storage tank, alum and magnesium hydroxide feed pumps and flocculation mixing equipment.

- **Sludge Thickening –** Construct a new mechanical thickening facility to thicken raw waste activated sludge and operate the aerobic digester at up to 3 percent solids concentration. The thickening facility will include a rotary drum thickener and polymer feed system in an all-weather enclosure above the 100-year flood elevation. The thickener will be fed directly by the clarifier WAS pumps. Thickened sludge will be discharged into the digester and filtrate will be routed to the oxidation ditches.

- **SCADA –** Incorporate all new Phase 2 equipment into the treatment plant SCADA system.

- **Laboratory/Control Building –** Flood-proof the existing laboratory/control building by raising it approximately 4 feet (3 feet above the surrounding 100-year flood elevation). Remodel the MCC room to provide four additional work stations for plant staff.

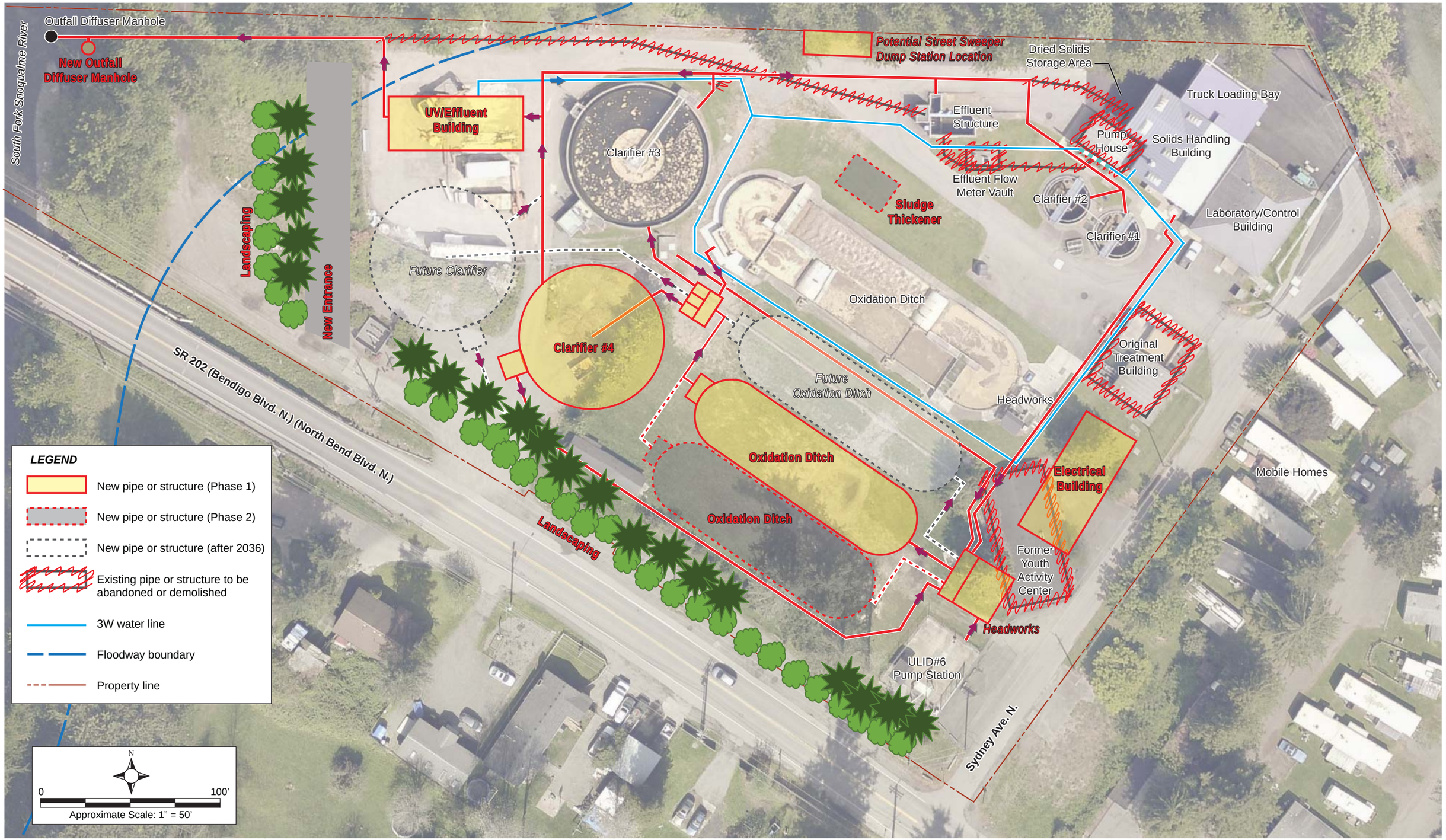
- **Solids Handling Building Maintenance Shop –** Provide a new maintenance shop in the existing Solids Handling Building after removal of the existing sludge dryer, sludge hopper, and Pump House.

- **Original Treatment Building and Pump Station –** Demolish the original treatment building and original IPS. The building and pump station will not be needed after a new electrical building, aerobic digester, ULID 6 Pump Station upgrades and I/I control are provided in Phase 1.

- **Pump House –** Demolish the above-grade portion of the existing Pump House building. Retain the below-grade portion of the building for potential future use with the existing small clarifiers.

- **Site Work and Landscaping**

Figure 9-1 shows the site plan of the recommended improvements. A hydraulic profile is presented in Figure 9-2. Figure 9-3 is a process flow schematic for the



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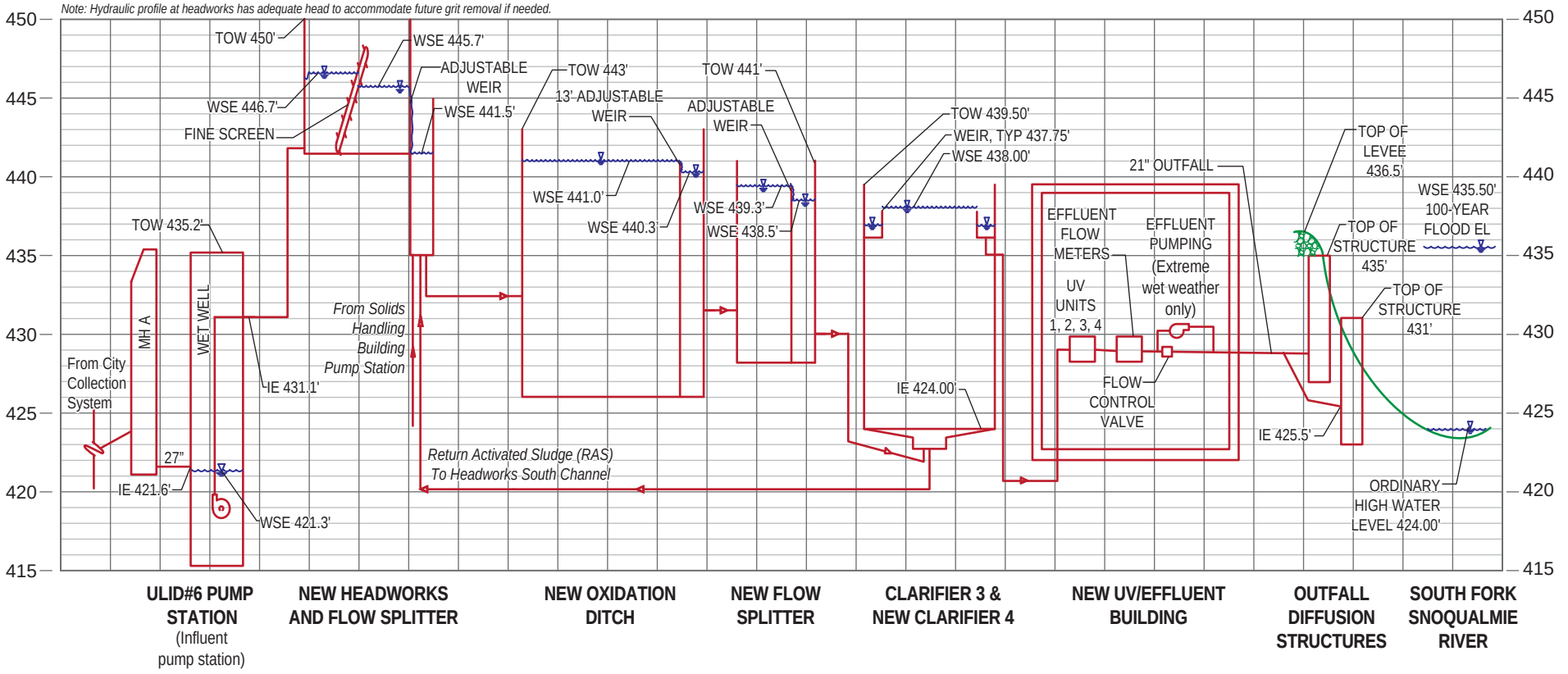
City of North Bend
WASTEWATER SYSTEM FACILITIES PLAN

Figure 9-1.
SITE PLAN FOR RECOMMENDED TREATMENT PLANT IMPROVEMENTS



Elevations in NGVD1929

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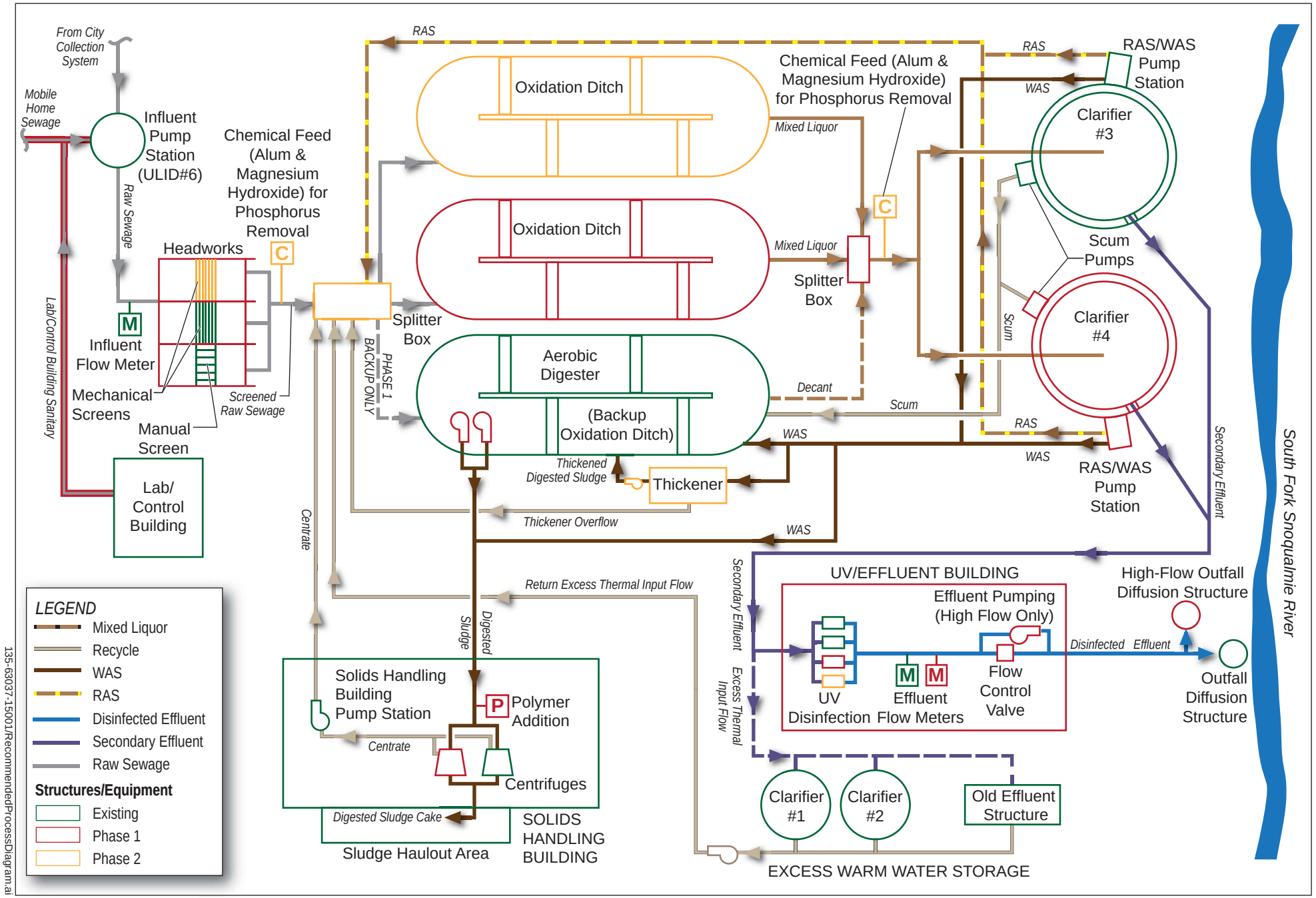
City of North Bend
WASTEWATER SYSTEM FACILITIES PLAN

Figure 9-2.
PROPOSED WASTEWATER TREATMENT PLANT
HYDRAULIC PROFILE



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City of North Bend
WASTEWATER SYSTEM FACILITIES PLAN

Figure 9-3.
RECOMMENDED TREATMENT PLANT PROCESS DIAGRAM

upgraded treatment plant. Design criteria for the recommended upgrades are shown in Table 9-1. Modeling was conducted to validate the performance of the recommended treatment processes, specifically to meet the effluent requirements and biosolids quality. Results are presented in Appendix G.

TABLE 9-1

Design Criteria for Treatment Plant Facilities

Process/Equipment Description	Capacity/Value		
	Existing	**Phase 1 (2020)**	**Phase 2 2028**
Treatment Plant Rated Capacity			
Flow			
Average Annual	1.67 mgd	1.67 mgd	2.34 mgd
Max. Month Wet Weather	2.56 mgd	2.56 mgd	5.1 mgd
Max. Month Dry Weather	1.26 mgd	1.26 mgd	2.5 mgd
Peak Day	4.48 mgd	4.48 mgd	8.48 mgd
Peak Hourly	5.1 mgd	5.1 mgd	10.2 mgd
Pollutant Loadings			
BOD @ Max. Month	2,805 ppd	2,805 ppd	5,600 ppd
TSS @ Max. Month	2,304 ppd	2,805 ppd	5,600 ppd
ULID 6 (Influent) PS			
Firm Capacity	5.6 mgd	5.3 mgd	6.1 mgd
Number of Pumps	3 (2 firm, 1 standby)	3 (2 firm, 1 standby)	3 (2 firm, 1 standby)
Type	Immersible Screw Centrifugal	Immersible Screw Centrifugal	Immersible Screw Centrifugal
Pumps 1 & 3 Rated Capacity (each)	2,600 gpm @ 20′ TDH	2,100 gpm @ 24′ TDH	2,100 gpm @ 24′ TDH
Pumps 2 Rated Capacity	1,300 gpm @ 20′ TDH	1,600 gpm @ 24′ TDH	2,100 gpm @ 24′ TDH
Original Influent Pump Station			
Number of Pumps	2	N/A	N/A
Rated Capacity Each	850 gpm	N/A	N/A
Total Capacity	1,665 gpm	N/A	N/A
Power, each	20 hp	N/A	N/A

TABLE 9-1 (continued)

Design Criteria for Treatment Plant Facilities

Process/Equipment Description	Capacity/Value		
Headworks			
Mechanical Fine Screen			
Number	1	1	2
Type	6 mm Perforated Plate Screen	6 mm Perforated Plate Screen	6 mm Perforated Plate Screen
Peak Flow Capacity Screen 01	5 mgd with 40% fouling & 12″ head loss	5 mgd with 40% fouling & 12″ head loss (relocated)	5 mgd with 40% fouling & 12″ head loss (relocated)
Peak Flow Capacity Screen 02	Not Applicable	Not Applicable	7 mgd with 40% fouling & 12″ head loss (relocated)
Washer Compactor (matched with MFS)			
Number	1	1	2
Capacity	75 ft^3/hr raw wet	75 ft^3/hr raw wet	75 ft^3/hr raw wet
Screenings Volume Reduction	80%	80%	80%
Organic Constituents Removal	95%	95%	95%
Manual Screen			
Type	manual bar screen	manual bar screen	manual bar screen
Bar	0.25 thick bars @ 1.5 in	0.25 thick bars @ 1.5 in	0.25 thick bars @ 1.5 in
Capacity	5.3 mgd with 35% fouling & 12″ head loss	7.3 mgd with 60% fouling & 12″ head loss	7.3 mgd with 35% fouling & 12″ head loss

TABLE 9-1 (continued)

Design Criteria for Treatment Plant Facilities

Process/Equipment Description	Capacity/Value		
Oxidation Ditch			
Number of Ditches	1	1 (w/aerobic digester as standby)	2
Depth	10 feet	15	15 feet
Length	191 feet	191 feet	191 feet
Width	45 feet	45 feet	45 feet
Volume	600,000 gal	600,000 gal	600,000 gal
Detention Time			
@ Design Avg. Annual Flow	8.6 hours	8.6 hours	14.8 hours
@ Design Max. Month Flow	5.6 hours	5.6 hours	14.8 hours
Design Avg. MLSS Conc.	4,200 mg/L	4,000 mg/L	4,000 mg/L
Design Avg. MLVSS Conc.	3,000 mg/L	3,000 mg/L	3,000 mg/L
F/M Ratio			
@ Design Max. Month BOD 2,804 ppd	0.18 lb BOD/lb MLVSS	0.18 lb BOD/lb MLVSS	0.18 lb BOD/lb MLVSS
Solids Retention Time @ Yield 0.9 lb TSS/lb BOD applied			
@ Design Annual Average BOD 2,017 ppd	11.6 days	11.6 days	11.6 days
@ Design Maximum Month BOD Load	8.3 days	8.3 days	8.3 days
Aeration Equipment			
Type of Aeration	Brush Rotors	Brush Rotors	Brush Rotors
Number of Rotors	4 per ditch	4 per ditch	4 per ditch
Oxygen Transfer Capacity @ 13.5 in. max submergence	124 lb O_2 per hour per rotor	124 lb O_2 per hour per rotor	124 lb O_2 per hour per rotor
Total Oxygen Transfer Capacity	496 lb O_2 per hour	496 lb O_2 per hour	992 lb O_2 per hour

TABLE 9-1 (continued)

Design Criteria for Treatment Plant Facilities

Process/Equipment Description	Capacity/Value		
Secondary Effluent Thermal Equalization			
Type	NA	Repurposed original secondary clarifiers and chlorine contact tank	Repurposed original secondary clarifiers and chlorine contact tank
Total Equalization Volume Available	NA	113,000 gallons	113,000 gallons
Clarifier storage volume	NA	2 @ 40,000 gal	2 @ 40,000 gal
Storage volume contact chamber	NA	1 @ 33,000 gal	1 @ 33,000 gal
Thermal Return Water Pumps			
Number of Sludge Pumps	Not applicable	2 (1 duty, 1 standby)	2 (1 duty, 1 standby)
Rated Capacity (each)	Not applicable	50-300 gpm	50-300 gpm
Secondary Clarifiers			
Type	Center feed w/spiral scraper	Center feed w/spiral scraper	Center feed w/spiral scraper
Number	1	2	2
Diameter	80 feet	80 feet	80 feet
Side Water Depth	14 feet	14 feet	14 feet
Volume	526,000 gallons	526,000 gallons	526,000 gallons
Overflow Rate at Maximum Month Flow	421 gpd/sq. ft.	211 gpd/sq. ft.	421 gpd/sq. ft.
Overflow Rate at Peak Hour Flow per clarifier	1,104 gpd/sq. ft.	552 gpd/sq. ft.	1,104 gpd/sq. ft.
Return Activated Sludge Pumps			
No. of RAS Pumps per clarifier	2	2	2
Type	Submersible	Submersible	Submersible
Rated Capacity (each)	1,750 gpm @ 16′ TDH	1,750 gpm @ 16′ TDH	1,750 gpm @ 16′ TDH
Rated Power (each)	14 hp	14 hp	14 hp

TABLE 9-1 (continued)

Design Criteria for Treatment Plant Facilities

Process/Equipment Description	Capacity/Value		
Waste Activated Sludge Pumps			
Number of WAS Pumps	1	1	1
Type	Submersible	Submersible	Submersible
Rated Capacity (each)	180 gpm @ 28′ TDH	180 gpm @ 28′ TDH	180 gpm @ 28′ TDH
Rated Power (each)	3 hp	3 hp	3 hp
Scum Pumps			
Number of Scum Pumps	1	1	1
Type	Submersible	Submersible	Submersible
Rated Capacity	90 gpm @ 24′ TDH	90 gpm @ 24′ TDH	90 gpm @ 24′ TDH
Rated Power	1.9 hp	1.9 hp	1.9 hp
UV Disinfection System			
Peak Flow Capacity	5.10 mgd	5.10 mgd	7.65 mgd
Number of UV Units	2 duty + no standby	2 duty + 1 standby	3 duty + 1 standby
UV Unit Model	Inline Vessel	Inline Vessel	Inline Vessel
Type of lamps	Medium Pressure high intensity arc tubes	Medium Pressure high intensity arc tubes	Medium Pressure high intensity arc tubes
Lamps per vessel	6	6	6
Total No of Lamps	12	12	12
Max Operating Power/Lamp	3.7 kW	3.7 kW	3.7 kW
Minimum UV Dose	25,000 mJ/cm^2	25,000 mJ/cm^2	25,000 mJ/cm^2
Design Transmittance	65% @ 254 nm	65% @ 254 nm	65% @ 254 nm
Fecal Coliform	200/100 mL (30-day geometric mean of daily samples)	200/100 mL (30-day geometric mean of daily samples)	200/100 mL (30-day geometric mean of daily samples)

TABLE 9-1 (continued)

Design Criteria for Treatment Plant Facilities

Process/Equipment Description	Capacity/Value		
Sludge Holding Tank/Aerobic Digester (AD)			
Tank Volume	37,900 gallons	600,000 gallons	600,000 gallons
Type	Membrane Disc Diffusers	Mechanical-brush	Mechanical-brush
Total Air Supply Rate	115 scfm	N/A	N/A
No of Blowers	1	0	0
Number of brush aeration rotors	0	4 total 2 duty 2 standby	4 total 2 duty 2 standby
Oxygen transfer rate per rotor	0	100 lb O_2/hour	100 lb O_2/hour
Mixing System Type	air	Mechanical via brush rotors	Mechanical via brush rotors
Mixing energy available w/ duty aerators		1 hp/1000 cu. ft.	1 hp/1000 cu. ft.
WAS from Secondary Treatment – max. month	2,520 ppd	2,520 ppd	5,040 ppd
Volatile Solids from Secondary Treatment	2,141 ppd	2,141 ppd	4,284 ppd
Recuperative Thickening Process	Not Applicable	Decant (time automated)	Rotary Drum Thickening
Design solids concentration in tank/AD	0.5% to 1%	1.5% max	3% max
Solids Retention Time	0.5 day	45 days	45 days
Quality of Biosolids Produced	Unstabilized sewage sludge	Class B Biosolids	Class B Biosolids
Digested solids production at 38% VSS removal	2520 ppd	1649 ppd	3299 ppd
Centrifuge Sludge/Biosolids Feed System			
Grinding			
Number of Grinders	1		
Rated Capacity Grinder 1	100 gpm		
Rated Horsepower	7.5 hp		
Rated Capacity Grinder 2	NA		
Rated Horsepower	7.5 hp		

TABLE 9-1 (continued)

Design Criteria for Treatment Plant Facilities

Process/Equipment Description	Capacity/Value		
Centrifuge Sludge Feed Pump			
Type of Pump	Positive Displacement	Submersible chopper	Submersible chopper
Number of Pumps	1	2	2
Rated Capacity Pump 1	15-60 gpm	15-60 gpm	30-120 gpm
Rated Horsepower Pump 1	3 hp	3 hp	3 hp
Rated Capacity Pump 2	NA	30-120 gpm	30-120 gpm
Rated Horsepower Pump 2	NA	7.5	7.5
Centrifuge			
Centrifuge 1			
Solids Concentration to Centrifuge,	0.5 to 1%	0.5 to 1.5%	1 - 3%
Sludge Flow Rate	40 - 60 gpm	40 - 60 gpm	40 - 60 gpm
Main Motor	30 hp	30 hp	30 hp
Conveyor/Scroll Hydraulic back drive	7.5 hp	7.5 hp	7.5 hp
Solids Concentration from Centrifuge	16% minimum	16% minimum	16% minimum
Sludge Solids Produced	200 lb/hour @ 0.5% feed	300 lb/hour @ 1% feed	300 lb/hour @ 1% feed
% Solids Capture	95% minimum	95% minimum	95% minimum
Centrifuge 2			
Solids Feed Concentration	NA	0.5 to 1.5%	1 - 3%
Sludge Flow Rate	NA	75-125 gpm max	75-125 gpm max
Main Motor	NA	50 hp	50 hp
Conveyor/Scroll Hydraulic back drive	NA	10 hp	10 hp
Solids Concentration from Centrifuge	NA	16% minimum	16% minimum
Sludge Solids Produced	NA	600 lb/hour @1% feed	600 lb/hour @1% feed
% Solids Capture	NA	95% minimum	95% minimum

TABLE 9-1 (continued)

Design Criteria for Treatment Plant Facilities

Process/Equipment Description	Capacity/Value		
Polymer Feed Systems			
Polymer for Thickening	NA	NA	10-20 lb active polymer per dry ton solids
Polymer for Dewatering	15-40 lb active polymer per dry ton solids	15-40 lb active polymer per dry ton solids	15-40 lb active polymer per dry ton solids
Dewatered Conveyor System			
From Centrifuge 1 to Truck Loading Conveyer	120 cu. ft./hour	120 cu. ft./hour	120 cu. ft./hour
From Centrifuge 2 to Truck Loading Conveyer	120 cu. ft./hour	190 cu. ft./hour	190 cu. ft./hour
Dewatered Cake Truck Loading Conveyor System	190 cu. ft./hour	190 cu. ft./hour	190 cu. ft./hour
Solids Handing Building Pump Station			
Number of Pumps	2 (1 duty and 1 standby)	2 (1 duty and 1 standby)	2 (1 duty and 1 standby)
Rated capacity, each	360 gpm @ 19.5 TDH	360 gpm @ 19.5 TDH	360 gpm @ 19.5 TDH
3W Water System			
Pressurization Pumps			
Number of Pumps	2	2	2
Rated Capacity	60 gpm @ 90 psi	60 gpm @ 90 psi	60 gpm @ 90 psi
Hydropneumatic Tank			
Volume	264 gallons	264 gallons	264 gallons
Chemical Feed for Phosphorus Control			
Poly aluminum chloride @ 8% Aluminum			
Mixed Liquor Splitter Box to clarifiers	NA	70 gpd	140 gpd
Magnesium Hydroxide (@40% $Mg(OH_2)$			
Aerobic reactor	NA	0 to 100 gpd	0 to 200 gpd
Mixed Liquor Splitter Box to clarifiers	NA	0 to 10 gpd	0 to 20 gpd
Aerobic Digester	NA	0 to 20 gpd	0- 40 gpd

TABLE 9-1 (continued)

Design Criteria for Treatment Plant Facilities

Process/Equipment Description	Capacity/Value		
Effluent Pumps			
Number	0	2 (1 duty + 1 standby)	3 (2 duty + 1 standby)
Type		self-priming centrifugal	self-priming centrifugal
Capacity per pump		3,750 gpm	3,750 gpm
Effluent Requirements			
COD, 5-day (year around)	25 mg/L	25 mg/L	25 mg/L
COD, 5-day (year around)	85% removal	85% removal	85% removal
COD, 5-day (November - July)	538 ppd	538 ppd	1076 ppd
NBOD + CBOD, 5-day Dry (August - October)	164 ppd	164 ppd	164 ppd
TSS, 5-day (year around)	30 mg/L	30 mg/L	30 mg/L
TSS (year around)	85% removal	85% removal	85% removal
TSS (November - July)	646 ppd	646 ppd	1292 ppd
COD, 5-day (August - October)	350 ppd	350 ppd	350 ppd
Soluble Reactive Phosphorus (Aug-Oct)	NA	1-1.5 ppd	1-1.5 ppd
Temperature (June-September)	NA	rise of 0.3° C in river	rise of 0.3° C in river

Notes: TDH = total dynamic head; MLVSS = mixed-liquor volatile suspended solids; VSS = volatile suspended solids.

9.2 ESTIMATED CAPITAL COST

Estimated costs for recommended improvements are presented in Table 9-2. Capital costs are in 2015 dollars and include construction cost, contractor overhead and profit (15 percent), a planning-level contingency (20 percent), sales tax (8.9 percent), engineering design (13 percent), and construction administration (10 percent). Detailed capital cost estimates are included in Appendix F. Costs presented in this facilities plan were developed to a level of accuracy suitable for preliminary planning; refined cost estimates will be required prior to use for City budgeting.

TABLE 9-2

Planning-Level Capital Cost Estimates for Recommended Capital Improvements

	Est. Capital Cost
Collection System Improvements, Phase 1	
South Fork Lift Station Upgrade SCADA & Controls	$56,000
South Fork Lift Station Upgrade Pumps, Dry Well & Odor Control	$504,000
Snoqualm Lift Station SCADA System Integration	$55,000
Total Collection System	*$615,000*
Treatment Facility Improvements, Phase 1	
ULID 6 Pump Station Improvements	$370,000
Headworks	$1,150,000
New Oxidation Ditch	$1,900,000
Existing Clarifier Repair	$160,000
New Clarifiers	$2,820,000
New UV Effluent Building and Piping	$980,000
UV Disinfection System	$730,000
New Effluent Pumps	$230,000
Effluent Flow Meter	$190,000
Effluent Temperature Equalization	$158,000
Outfall Diffuser Structure	$300,000
Convert Oxidation Ditch to Digester	$700,000
New Centrifuge	$1,170,000
Solids Loading Area Odor Control	$50,000
Influent and Effluent Sampling System Improvements	$26,000
New Electrical Building and MCCs	$680,000
SCADA Upgrade	$330,000
New Standby Generator	$1,340,000
3W Water	$170,000
Laboratory and Mobile Home Park Sewers to ULID 6 PS	$110,000
Solids Handling Building PS Force Main to Headworks	$110,000
Site Work Fencing, Paving, Flood Mitigation	$280,000
Landscaping	$200,000
Total Treatment Facility Phase 1	***$14,154,000***

TABLE 9-2 (continued)

Planning-Level Capital Cost Estimates for Recommended Capital Improvements

	Est. Capital Cost
Treatment Facility Improvements, Phase 2	
Headworks, Screening and Flow Splitter	$900,000
New Oxidation Ditch	$1,900,000
UV Disinfection, Add 4th Reactor	$290,000
Phosphorus Removal	$900,000
Sludge Thickening	$390,000
SCADA	$120,000
Laboratory/Control Building – Flood-Proofing	$280,000
Laboratory/Control Building – Add Office Space	$60,000
Solids Handling Building, Add Maintenance Shop	$90,000
Demolish Original Treatment Building	$80,000
Demolish Pump House Upper Level	$20,000
Site work	$250,000
Landscaping	$200,000
Total Treatment Facility Phase 2	*$5,480,000*
Total Capital Cost	**$20,249,000**

9.3 OPERATION AND MAINTENANCE REQUIREMENTS

9.3.1 COLLECTION SYSTEM O&M

Inspection, Condition Assessment and Routine Maintenance

It is recommended that all City sewers be systematically inspected by CCTV, with the oldest sewers to be inspected in the first two years and the remaining sewers over 10 years. This inspection should identify system defects and help identify sewers that need significant maintenance, rehabilitation and replacement. Periodic assessment of force main conditions should include the following:

- Visual inspection of the galvanized steel section of South Fork Lift Station force main attached to the underside of the South Fork River bridge.
- Non-destructive testing of force mains.
- Coupon sampling of force main materials where there is potential for pipeline deterioration.

A system of preventive maintenance should be implemented that includes cleaning and removal of tree roots. For sewers of greater significance or with

likelihood of recurring issues, a schedule for preventive maintenance should be set. It is recommended that the City implement a capacity, management, operation, and maintenance (CMOM) program following EPA guidance.

Flow Monitoring

Collection of flow monitoring data will enable measurement of base flow and I/I in City sewers. Combining velocity readings from a portable velocity sensor with estimates of water depth at key locations in the network would enable estimates of flow. Periodic installation of temporary flow monitors at key locations is also recommended. These flow monitors should record both water depth and water velocity, so that total flow can be derived. The first installation should occur in September 2017. Flow monitoring should also incorporate collection of local rainfall data. Data on river stage should also be collected.

I/I Reduction Program

It is recommended that the City incorporate I/I rehabilitation into its annual operation and maintenance. The annual program should initially replace any remaining CMP and rehabilitate manholes in ponding areas by installing watertight covers. Subsequent work would focus on the most promising I/I control areas. The estimated number of projects per year is as follows:

- Side sewer replacement – 15 per year
- Sewer repair and replacement – 700 feet per year
- Manhole rehabilitation – 10 per year.

9.3.2 TREATMENT PLANT O&M

The new headworks and one oxidation ditch will begin operation in 2020, and a second oxidation ditch will begin operation in 2029. The oxidation ditches will use brush aerators, with requirements for labor, power, and supplies. The improvements will require additional staffing and will increase annual costs for power and supplies.

9.3.3 ADDITIONAL O&M COST

Table 9-3 summarizes increased annual O&M costs through 2020 associated with the recommended collection system and treatment improvements. Costs presented in this facilities plan were developed to a level of accuracy suitable for preliminary planning; refined cost estimates will be required prior to use for City budgeting.

Prior to 2012 there were only two certified operators (one Grade 2 and one Grade 1) responsible for operation and maintenance of the collection and

treatment plant. This level of staffing proved to be in adequate and resulted in minimal preventative maintenance. in 2013 a third staff operator (operator in training) was added to improve the plant operations and to address deferred maintenance work. In 2014 a wastewater facilities manager position was created requiring a Grade 3 operator certification; the position was filled in early 2015. An additional staff operator position was authorized in 2015 to improve maintenance of the wastewater collection system. Evaluation staffing level needs for the wastewater collection system and treatment plant evaluation for this wastewater facility plan indicated that the facility is understaffed. The recommended staffing for the plant in 2015 was determined to be a minimum of five with addition of a sixth operator in 2018. The recommended staffing for the plant in 2018 consist of one wastewater facilities plant manager (Grade 3 or higher), two wastewater treatment plant operators (Grade 2 or higher), two wastewater collections operators (Grade 2 or higher) and Collections/Treatment plant operator (Operator in Training or higher). One Grade 2 operator or higher should be present during all regular shifts. This level of staffing should be adequate to properly operate and maintain the collection system and treatment plant including conventional laboratory work needed for process control. One additional plant operator may be justified when the Phase 2 improvements are constructed (i.e., circa 2026), but an evaluation should be accomplished at that time to determine if the position is needed.[R]

TABLE 9-3

Estimated Annual O&M Cost Increases Associated with Recommended Improvements

Description	Incremental Annual O&M Cost				
	2016	**2017**	**2018**	**2019**	**2020**
Utilities Without Process Change for Treatment Plant & Collection System (1)	**$7,000**	**$13,000**	**$20,000**	**$27,000**	**$34,000**
Collection system asset management					
Cleaning and CCTV (all old system in first 2 years, remainder over 10 years)	$57,000	$57,000	$28,000	$28,000	$28,000
Flow monitoring	$20,000	$20,000	$20,000	$20,000	$20,000
Side sewer replacement (15 per year)	$60,000	$180,000	$120,000	$120,000	$120,000
Sewer repair and replacement (700 feet per year)	$71,000	$212,000	$141,000	$141,000	$141,000
Manhole rehabilitation and covers (10 per year)	$5,000	$15,000	$10,000	$10,000	$10,000
Total	***$213,000***	***$484,000***	***$319,000***	***$319,000***	***$319,000***
Delete sludge dryer natural gas	**($24,000)**	**($26,000)**	**($27,000)**	**($29,000)**	**($30,000)**
Power					
Power for sludge truck loading building odor control system & carbon filter	$5,000	$5,000	$5,000	$5,000	$5,000
UV power (includes $ savings for new more efficient UV units)	($3,000)	($3,000)	($3,000)	($2,000)	($2,000)
Generator fuel (for 1/2 year in 2020)					$3,000
Total	***$2,000***	***$2,000***	***$2,000***	***$3,000***	***$6,000***
Chemical and Material					
Polymer – dewatering	$1,000	$1,000	$1,000	$1,000	$2,000
Carbon medium replacement for odor control carbon filter	$2,500	$2,500	$2,500	$2,500	$2,500
Total	***$4,000***	***$4,000***	***$4,000***	***$4,000***	***$5,000***
Labor					
Treatment plant operators			$100,000	$100,000	$100,000
Collection system operator	$50,000	$100,000	$100,000	$100,000	$100,000
Total	***$50,000***	***$100,000***	***$200,000***	***$200,000***	***$200,000***
Lab Testing	**$2,000**	**$2,000**	**$2,000**	**$2,000**	**$2,000**
Sludge Hauling	**$6,000**	**$18,000**	**$32,000**	**$46,000**	**$53,000**
Equipment Replacement and Structural Maintenance	**$20,000**	**$27,000**	**$59,000**	**$79,000**	**$121,000**
Total Annual Incremental Cost	**$280,000**	**$624,000**	**$611,000**	**$651,000**	**$710,000**

(1) From City of North Bend 2015 Sewer Expenditure Report Utilities Budget.

9.4 FIVE-YEAR CAPITAL IMPROVEMENT PLAN

The proposed implementation of the recommended Phase 1 improvements over 5 years is presented in Table 9-4. Capital costs are presented without escalation. For large projects spread over two years, it is assumed that design is completed in the first year, at 13 percent of the total project cost. Costs presented in this facilities plan were developed to a level of accuracy suitable for preliminary planning; refined cost estimates will be required prior to use for City budgeting.

TABLE 9-4

Five-Year Capital Improvement Plan

	2016	2017	2018	2019	2020	Total
Collection System						
Snoqualm Lift Station SCADA System Integration	$55,000					**$55,000**
South Fork Lift Station SCADA & Controls	$56,000					**$56,000**
South Fork Lift Station Force Main Condition Assessment, Pumps, Dry Well & Odor Control, Predesign Study		$152,520	$351,480			**$504,000**
Treatment Plant						
ULID 6 Pump Station Improvements						
Pump replacement, bar screen, gate, controls	$24,700	$165,300				**$190,000**
Electrical and control panel floodproofing		$23,400	$156,600			**$180,000**
UV Disinfection System and Effluent Discharge						
New UV/Effluent Building	$81,900	$548,100				**$630,000**
UV Disinfection System	$94,900	$635,100				**$730,000**
Disinfected Effluent Piping	$45,500	$304,500				**$350,000**
New Effluent Pumps	$29,900	$200,100				**$230,000**
Relocate 3W Water	$22,100	$147,900				**$170,000**
Effluent Flow Meter	$24,700	$165,300				**$190,000**
Outfall Diffuser Structure	$39,000	$261,000				**$300,000**
Solids Handling Building Pump Station Force Main to Oxidation Ditch	$14,300	$95,700				**$110,000**
Solids Loading Odor Control		$50,000				**$50,000**
Influent and Effluent Sampling System Improvements		$26,000				**$26,000**
SCADA Upgrade		$330,000				**$330,000**
Effluent Temperature Equalization		$158,000				**$158,000**
New Clarifier		$366,600	$2,453,400			**$2,820,000**
Site Work Fencing, Paving, Flood Mitigation		$36,400	$243,600			**$280,000**
Landscaping		$26,000	$174,000			**$200,000**
Lab and Mobile Home Park Sanitary Sewer to ULID 6 PS			$110,000			**$110,000**
Existing Clarifier Repair			$160,000			**$160,000**
New Centrifuge			$152,100	$1,017,900		**$1,170,000**
Convert Oxidation Ditch to Digester						
Brush Rotor Support Repair	$20,000					**$20,000**
Aeration Controls, Covers, Walkways & Piping			$88,400	$591,600		**$680,000**
Headworks – Screening				$149,500	$1,000,500	**$1,150,000**
New Oxidation Ditch				$247,000	$1,653,000	**$1,900,000**
New Electrical Building and MCCs				$88,400	$591,600	**$680,000**
New Standby Generator in Building				$174,200	$1,165,800	**$1,340,000**
Total	**$508,000**	**$3,691,920**	**$3,889,580**	**$2,268,600**	**$4,410,900**	**$14,769,000**

9.5 FINANCING ANALYSIS

A sewer rate study conducted for this wastewater facilities plan identified rate adjustments required to ensure that adequate funds are available to implement recommended capital improvements and maintain operation of the City's wastewater facilities through 2020. A rate study forecasts the amount of revenue that needs to be generated to meet each year's expected financial obligations. The objective of the study is to evaluate the sufficiency of the current level of rates charged to sewer users in the City. The study assesses operating revenues, O&M expenses, debt service payments, capital needs, and all other revenues or expenses related to operation of the City's wastewater facilities. Details of the financial analysis are provided in Appendix H.

9.5.1 CURRENT SEWER FUNDING

North Bend's sewer utility is an enterprise fund, meaning that it is self-sufficient and rates and fees collected for sewer service support the financial obligations of the utility. The primary sources of funding are monthly user charges for service and developer connection charges. The City can adjust user rates as needed to meet financial objectives. The most recent adjustment was adopted by the North Bend City Council in July 2016. The council agenda bill, draft ordinance and meeting minutes for the adoption are included in Appendix H.

9.5.2 ASSUMPTIONS

The following is a list of the key revenue and expense factors and assumptions used in the analysis:

- **Revenue –** The City has two general revenue sources: revenue from charges for service (rate revenue) and miscellaneous (non-rate) revenue. In the event of a forecasted annual shortfall, rate revenue can be increased to meet the annual revenue requirement.

- **General Facility Charge (GFC) Revenue –** The GFC is a fee charged to new customers connecting to the system. This revenue source is used to fund the capital improvement program. It is assumed that 100 to 113 new ERUs will connect to the sewer system each year through the study period.

- **Growth –** The annual average growth in rate revenue resulting from population and development growth is assumed to be 4.33 percent beginning in 2017.

- **Expenses –** O&M expense projections are based on the 2016 budget and are forecast to increase with general cost inflation of 2.29 percent, labor

cost inflation of 2.87 percent, and benefit cost inflation of 8.0 percent. Additional O&M expenses are assumed to be incurred as improvements are implemented over the course of the study period.

- **Existing Debt –** The City has five outstanding sewer debt issues, with obligations ranging from $390,000 in 2016 to $324,000 in 2020.

- **Future Debt –** The City will have access to a $3.5 million line of credit to implement Phase 1 recommended improvements through 2019. The funds will be rolled into two 25-year bond issues: the first in 2017 and the second in 2019.

- **Capital Funding Plan –** The rate study assumed a cost of recommended improvements over the study period, inflated to the year of construction, of $15.6 million. The recommended improvements in this facilities plan have been modified since the rate study was performed, but the cost estimate of Phase 1 improvements ($14.7 million without inflation) remains within the level of accuracy of this assumption.

- **Fund Balances –** Operating reserves provide a cushion to ensure that adequate cash is maintained to deal with variations such as seasonal fluctuations in billings and receipts, unanticipated cash expenses, or lower than expected revenue collections. The City's current policy is to maintain a minimum balance in the operating fund equal to 90 days of O&M expenses.

- **Capital Fund –** A capital fund is cash set aside in case of an emergency should a piece of equipment or a portion of the utility's infrastructure fail unexpectedly. It can also be used for unanticipated capital needs such as capital project cost overruns. The minimum capital fund target for the City has been set at 2 percent of sewer utility asset value.

9.5.3 STUDY RESULTS FOR CURRENT REVENUES

Table 9-5 provides a summary of the five-year revenue requirement based on the assumptions described above. The study indicates a deficiency at current rate levels. Sewer rates will need to increase to meet the total annual revenue requirement in all years. Rate revenues would need to increase by 12.7 percent in 2016 and 2017, 8.25 percent in 2018 and 2019 and 8.0 percent in 2020.

TABLE 9-5

Five-Year Revenue Requirement Summary

	2016	2017	2018	2019	2020
Revenues					
Rate Revenues	$1,780,500	$1,857,577	$1,937,991	$2,021,887	$2,109,413
Non-Rate Revenues	$2,000	$3,955	$4,195	$4,205	$4,255
Total	*$1,782,500*	*$1,861,532*	*$1,942,186*	*$2,026,092*	*$2,113,668*
Expenses					
Cash Operating Expenses	$1,468,388	$1,872,891	$1,933,744	$2,040,488	$2,189,293
Existing Debt Service	$390,251	$289,722	$389,638	$326,907	$324,071
Rate-Funded System Reinvestment	$23,764	$89,096	$321,646	$621,925	$851,750
Total	*$1,882,403*	*$2,251,709*	*$2,645,028*	*$2,989,320*	*$3,365,114*
Net Surplus (Deficiency)	**($99,903)**	**($390,177)**	**($702,842)**	**($963,228)**	**($1,251,446)**

9.5.4 RECOMMENDED SEWER RATE UPDATE

The rate study identified new sewer rates that achieve three goals established by the City:

- To meet the projected 5-year sewer utility revenue requirements.
- To adjust rates so that the average sewer rate cost per cubic meter of water consumption is the same for residential customers and commercial customers.
- To set consumption-based rates that encourage water conservation.

The proposed rates to achieve these goals are presented in Table 9-6.

TABLE 9-6

2016 Updated City of North Bend Sewer Rates

	Base [(1)]	2016	2017	2018	2019	2020
Proposed Increase		12.7%	12.7%	8.25%	8.35%	8.0%
Fixed Charge						
Single Family (per account)	$49.20	$55.45	$62.49	$67.65	$73.23	$79.09
Senior/ Disabled (per account)	$22.57	$25.43	$28.66	$31.02	$33.58	$36.27
Multi Family (per unit)	$49.20	$55.45	$62.49	$67.65	$73.23	$79.09
Commercial (per account)	$49.20	$55.45	$62.49	$67.65	$73.23	$79.09
Mixed Use						
Commercial (per account)	$49.20	$55.45	$62.49	$67.65	$73.23	$79.09
Per Residential (per unit)	$49.20	$55.45	$62.49	$67.65	$73.23	$79.09
Outside City	$73.80	$83.17	$93.73	$101.46	$109.83	$118.62
Charge per Cubic Meter Consumed Over 10 Cubic Meters per Month						
Single Family	$4.92	$5.54	$6.24	$6.75	$7.31	$7.89
Senior/ Disabled	n/a	n/a	n/a	n/a	n/a	n/a
Multi Family	$4.92	$5.54	$6.24	$6.75	$7.31	$7.89
Commercial	$4.92	$5.54	$6.24	$6.75	$7.31	$7.89
Mixed Use	$4.92	$5.54	$6.24	$6.75	$7.31	$7.89
Outside City	$7.38	$8.32	$9.38	$10.15	$10.99	$11.87

(1) The base rate is a modification of the previous sewer rate to equalize unit rates for residential and commercial customers. It achieves the same net revenue as the previous sewer rate.

Based on these rates, an average residential monthly sewer bill in 2016 will increase from $76.09 under the previous rate structure to $78.13, an increase of 2.7 percent. The average commercial customer's monthly 2016 bill will increase $210.68 to $328.96, a 56.1-percent increase. As the recommended improvements are implemented, the rates will be reviewed to ensure that the revenue generated is appropriate for actual wastewater system costs. Construction costs and O&M costs developed for this facilities plan and used to determine the rates are planning-level estimates; actual costs may be higher or lower.

9.5.5 RECOMMENDED GENERAL FACILITIES CHARGE UPDATE

The rate study assessed the GFC to determine equitable charges based on the wastewater facilities now in use and to be implemented under the recommended plan. The purpose of the GFC connection fee is two-fold: to provide a source for capital financing; and to equitably recover a proportionate share of utility plant-in-service costs from new customers. The cost of the system to be recovered by the GFC includes two parts: an existing cost portion based on historical investments in existing infrastructure, and a future cost portion that recovers costs related to planned capital projects. The rate study estimated an existing cost basis of $20.1 million and a future cost basis based on proposed

improvements of $10.9 million. The future cost basis includes only the recommended improvements that are required to accommodate expected growth in the city, not improvements to repair existing facilities.

The GFC to cover these costs was calculated as the total existing and future cost basis divided by the projected 2029 sewer service area of 4,492 ERUs (the equivalent population of 11,545, as listed in Table 2-13, divided by the average population of 2.57 per ERU). For households within the ULID 6 service area, the portion of the cost basis related to the collection system was not counted as residents of that area pay for collection system costs through the ULID 6 assessment. The resulting GFC is $10,222 per connection throughout the city except within the ULID 6 area, where the GFC is $7,699. The City's current GFC is $5,852.

It is anticipated that the GFC will be updated automatically each year based on increases in the Seattle construction cost index. The City also should review the GFC as improvements are implemented to ensure that it accounts for actual capital costs.

CHAPTER 10

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APPENDIX A

SUMMARY OF REGULATIONS

APPENDIX A

SUMMARY OF REGULATIONS

Wastewater must be collected, treated, and disposed of or reused in a way that protects public health and receiving water quality, generates no objectionable off-site odors or aesthetic nuisances, and complies with all applicable regulations. Wastewater treatment facilities must meet the regulations and requirements of many federal, state, and local regulatory agencies. This appendix summarizes applicable rules and regulations that typically apply to wastewater projects.

FEDERAL REGULATIONS AND POLICIES

FEDERAL WATER QUALITY LEGISLATION

Programs and policies designed to protect water quality were first initiated on a nationwide scale by the Federal Water Pollution Control Act of 1956. This act was amended by the Water Quality Act of 1965, the Clean Water Restoration Act of 1966, and the Water Quality Improvement Act of 1970. The Federal Water Pollution Act Amendment of 1972 (Public Law 92-500) replaced the previous language of the act entirely. This act requires states to establish water quality standards for all of their water bodies. The standard must consist of two parts: a designation of the use of the water body; and the water quality criteria that water body must maintain to protect the designated uses from pollution. The State of Washington complies with this regulation through WAC 173-201A, which is described later.

The Clean Water Act of 1977, in further amending the act, required any agency conducting an activity that may result in a discharge into navigable waters to obtain certification from a water pollution control agency verifying that the discharge complies with applicable effluent limitations and water quality standards. The 1977 amendments established the National Pollutant Discharge Elimination System (NPDES) permits, which regulate point discharges into water, and required water quality planning by states. Grants for facilities and training were also authorized under these amendments.

With increased environmental awareness of the extent and effects of nonpoint pollution, including stormwater, Congress passed additional amendments to the Clean Water Act as the Water Quality Act of 1987. Section 319 directs states in developing programs to reduce nonpoint source pollution, which had become increasingly evident as point sources of pollution had been abated. The amendments required each state to do the following:

- Submit a report identifying navigable waters that cannot meet water quality standards without action to control pollution.

- Identify the categories of pollution sources.
- Describe processes for identifying best management practices and control strategies.
- Identify state and local programs for controlling pollution from both point and nonpoint sources.

FEDERAL EFFLUENT LIMITATIONS

Section 301 of the Federal Water Pollution Control Act requires all publicly owned wastewater treatment facilities to provide a minimum of secondary treatment unless a special waiver is obtained. This act requires the following:

- The monthly average of biochemical oxygen demand (BOD) and total suspended solids (TSS) concentrations shall not exceed 30 milligrams per liter (mg/L).
- The weekly average of BOD and TSS concentrations shall not exceed 45 mg/L.
- The monthly average removal of BOD and TSS shall be at least 85 percent.
- The pH of the effluent shall be between 6.0 and 9.0.

There can be exceptions to these regulations when treatment plants receive combined sewer flows or certain industrial wastes. However, in general, these are the minimum federal requirements for effluent quality. The Washington State Department of Ecology administers these regulations under the NPDES.

FEDERAL STANDARDS FOR USE OR DISPOSAL OF SLUDGE

Under Code of Federal Regulations Part 503 (40 CFR 503, published in 1993), land-applied sludge must meet requirements for pathogen and vector attraction reduction. Two basic classes for pathogen reduction are established in the regulations. In general, sludge distributed in bagged form must meet Class A requirements. Sludge applied to the land in bulk form must meet Class B requirements. The discussion below focuses on the regulations applicable to bulk land application because that is the only disposal option evaluated in this facilities plan.

Pathogen Reduction

Class A sludge must have levels of fecal coliform organisms below 1,000 per gram of total solids and meet other time and temperature requirements, or the sludge must have

been treated with a "process to further reduce pathogens," as defined by the U.S. Environmental Protection Agency (EPA). These processes include composting, heat drying, heat treatment, thermophilic aerobic digestion, irradiation, and pasteurization.

Class B sludge must have levels of fecal coliform organisms less than 2 million per gram of total solids, or meet other requirements, or the sludge must have been treated with an EPA-defined "process to significantly reduce pathogens." These processes include aerobic digestion for a mean cell residence time greater than 40 days at 20 degrees C or 60 days at 15 degrees C, air drying, anaerobic digestion, composting, or lime stabilization.

Vector Attraction Reduction

The regulations require that land-applied sludge be processed to reduce its "vector attraction." This means that the sludge should be stabilized sufficiently to not be an attraction to rodents or birds that could spread pathogens contained in the sludge and thereby increase the risk of human exposure. The basic measure of the adequacy of sludge stabilization in the regulations is that the volatile solids concentration in the sludge be reduced through processing by at least 38 percent. A series of alternative procedures are provided for reducing vector attraction, including injection below the ground surface.

Metals

Limits are specified for the concentration of various metals in the sludge and for the cumulative loading of these metals on the land used for its application. Table A-1 lists the concentration limits for any sludge that is land applied. Table A-2 lists further guidelines for sludge that is land applied in bulk. Either the monthly average concentration criteria or the cumulative pollutant loading rate criteria must be met.

TABLE A-1

Ceiling Concentrations for Metals in Land-Applied Sludge

Parameter	Ceiling Concentration Limit (mg/kg)	Parameter	Ceiling Concentration Limit (mg/kg)
Arsenic	75	Molybdenum	75
Cadmium	85	Nickel	420
Copper	4,300	Selenium	100
Lead	840	Zinc	7,500
Mercury	57		

TABLE A-2

Metal Concentration Limits for Bulk Sewage Sludge Land Application

Parameter	Monthly Average Concentration Limit (mg/kg)	Cumulative Pollutant Loading Rate (kg/hectare)
Arsenic	41	41
Cadmium	39	39
Copper	1,500	1,500
Lead	300	300
Mercury	17	17
Nickel	420	420
Selenium	100	100
Zinc	2,800	2,800

Other Measures

In addition to regulating biosolids quality, the regulations require management measures, including the following:

- Record-Keeping and Reporting – Records must be kept by the producer describing the quantity and quality of the biosolids that have been applied to specific sites for up to five years. Even if the producer has a contract for biosolids disposal with a private contractor, the producer is ultimately responsible for the record-keeping and reporting.

- Monitoring – The producer is responsible for monitoring the biosolids for metals and specific pathogens on a regular basis.

- Management Practices – Biosolids should not be applied to flooded, frozen, or snow-covered ground, so that biosolids do not enter surface waters.

EPA RELIABILITY CRITERIA

An important reference for wastewater treatment plant reliability is the EPA's *Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability* (EPA 1974). This document outlines flood protection and reliability requirements for treatment facilities. Treatment works are required to be protected from damage during a 100-year flood and to remain fully operational during a 25-year flood. Reliability requirements are outlined for three reliability classes, with specific provisions for each unit process:

- Class I – Works discharging into navigable waters that could be permanently or unacceptably damaged by effluent that was degraded in quality for only a few hours. Examples of Reliability Class I works might

be those discharging near drinking water reservoirs, into shellfish waters, or in proximity to areas used for water contact sports.

- Class II – Works discharging into navigable waters that would not be permanently or unacceptably damaged by short-term effluent quality degradation, but could be damaged by continued (on the order of several days) effluent degradation.

- Class III – Works not otherwise classified as Reliability Class I or II.

Table A-3 summarizes requirements for component reliability based on class.

TABLE A-3

Summary of EPA Design Criteria for System and Component Reliability

Component	Class I	Class II	Class III
Trash removal	Required	Same as Class I	Same as Class I
Grit removal	Required if sludge is handled	Same as Class I	Same as Class I
Clean-out of solids	Provisions for cleaning of solids required for components prior to degritting or sedimentation	Same as Class I	Same as Class I
Controlled diversion	Screened, gravity overflow required with alarm, annunciation, and measurement of flow discharged. Holding basin required	Same as Class I, but no holding basin required	Same, as Class I but no holding basin required
Unit operation bypassing	Required except for unit operations with two or more open basins	Same as Class I	Same as Class I
Mechanically cleaned bar screens	Backup manual screen required	Same as Class I	Same as Class I
Pumps	Capacity to handle peak flow with any one pump out of service must be provided	Same as Class I	Same as Class I
Comminution	Overflow bypass must be provided with manual bar screen	Same as Class I	Same as Class I
Primary sedimentation basins	With largest unit out, remaining units shall have design flow of at least 50 percent of the total design flow to that unit	Same as Class I	At least two basins

TABLE A-3 (continued)

Summary of EPA Design Criteria for System and Component Reliability

Component	Class I	Class II	Class III
Final and chemical sedimentation basins, trickling filters, filters, and activated carbon columns	With largest unit out, remaining units shall have design flow of at least 75 percent of the total design flow to that unit	With largest unit out, remaining units shall have design flow of at least 50 percent of the total design flow to that unit; backup not required for chemical sedimentation basins, filters, and activated carbon columns	At least two basins; backup not required for chemical sedimentation basins, filters, and activated carbon columns
Aeration basin	At least two equal volumes shall be provided	Same as Class I	Single basin permissible
Aeration blowers or brush aerators	Sufficient to provide for peak oxygen demands with the largest capacity unit out of service	Same as Class I	At least two units
Diffusers	Designed so that isolation of the largest section of diffusers does not measurably impair oxygen transfer capability	Same as Class I	Same as Class I
Chemical flash mixer	At least two basins or a backup means of adding chemicals	Backup not required	Backup not required
Flocculation basins	At least two basins	Backup not required	Backup not required
Disinfectant contact basins	With largest unit out, remaining units shall have design flow of at least 50 percent of the total design flow to that unit	Same as Class I	Same as Class I
Sludge handling	Alternate methods of sludge disposal or treatment shall be provided for each sludge treatment unit without installed backup capability. No recycles permitted that will compromise liquid treatment.	Same as Class I	Same as Class I

TABLE A-3 (continued)

Summary of EPA Design Criteria for System and Component Reliability

Component	Class I	Class II	Class III
Sludge holding tanks	May be used to back up downstream tanks	Same as Class I	Same as Class I
Sludge pumps	A backup pump shall be provided for each set of pumps that performs the same function. With any one pump out of service, the remaining pumps shall have capacity to handle the peak flow.	Same as Class I	Same as Class I
Anaerobic sludge digestion	At least two digestion tanks shall be provided. At least two of the tanks shall be designed to permit processing all types of sludge normally digested. Tanks shall have sufficient flexibility or backup equipment to ensure that mixing is not lost when any one piece of equipment is out of service. Uninstalled backup is acceptable for mixing equipment	Same as Class I	Same as Class I
Aerobic sludge digestion	Backup aeration basin not required. At least two blowers shall be provided. Uninstalled backup is permissible. Largest section of diffusers can be isolated.		
Sludge holding tanks	May be used to back up downstream tanks	Same as Class I	Same as Class I
Vacuum filter	There shall be sufficient number of vacuum filters to enable the design flow to be dewatered with largest capacity unit out of service. Two vacuum pumps and two filtrate pumps shall service each vacuum filter. These may be uninstalled.	Same as Class I	Same as Class I

TABLE A-3 (continued)

Summary of EPA Design Criteria for System and Component Reliability

Component	Class I	Class II	Class III
Centrifuges	There shall be sufficient number of units to enable the design flow to be dewatered with largest capacity unit out of service. The backup unit may be uninstalled.	Same as Class I	Same as Class I
Incinerators	A backup incinerator is not required. Auxiliary equipment shall be provided with backup.	Same as Class I	Same as Class I
Electric power source	Two separate and independent sources of electric power shall be provided either from two separate utility substations or from a single substation and a works-based generator. Capacity of backup power shall be sufficient to operate all vital components during peak wastewater flow, together with critical lighting and ventilation.	Same as Class I except vital components to support the secondary processes need not be included as long as treatment equivalent to sedimentation and disinfection is provided.	Sufficient to operate screening or comminution, main wastewater pumps, primary sedimentation basins, and disinfection facility during peak flow, together with critical lighting and ventilation.
Power distribution external to the works	The independent sources of power shall be distributed to the works' transformers in a way to minimize common mode failures from affecting both sources.	Same as Class I	Same as Class I

TABLE A-3 (continued)

Summary of EPA Design Criteria for System and Component Reliability

Component	Class I	Class II	Class III
Instrumentation and control systems	Automatic control systems whose failure could result in a controlled diversion or violation of effluent limits shall be provided with a manual override. Instrumentation whose failure could result in a controlled diversion or violation of effluent limits shall be provided with an installed backup sensor and readout. Alarms shall be provided for equipment whose failure could result in a controlled diversion or violation of effluent limits. Vital instrumentation and control equipment shall be designed to permit alignment and calibration without causing a controlled diversion a violation of effluent limits.	Same as Class I	Same as Class I
Auxiliary systems	If a malfunction of the system can result in controlled diversion or violation of effluent limits and the required function cannot be done by any other means, then the system shall have backup capability.	Same as Class I	Same as Class I

(1) Source: U.S. Environmental Protection Agency. Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability. MCD-05, EPA-430-99-74-001. Office of Water Program Operations. Washington, D.C.

NATIONAL ENVIRONMENTAL POLICY ACT

The National Environmental Policy Act requires environmental documentation for projects that could have a significant adverse impact on the quality of the natural and human environment. The EPA can declare that a proposed action is categorically exempt from these requirements. Otherwise, the proposing agency must prepare an environmental information document, commonly referred to as an environmental assessment or environmental report. An environmental report considers elements of the environment such as soils, water quality and air quality, and addresses how a proposed project complies with federal and state regulations. The EPA uses the environmental

report to determine whether to issue a "finding of no significant impact" or to require an environmental impact statement.

CLEAN AIR ACT

The federal Clean Air Act of 1992 requires that all federally funded projects comply with state and regional air quality plans. The local air-quality authority for King County is the Puget Sound Clean Air Agency; agency requirements are discussed later in this appendix.

HISTORICAL AND ARCHAEOLOGICAL SITES

Cultural resources are addressed in over 100 federal laws, regulations, and guidelines, including the National Environmental Policy Act and the National Historic Preservation Act. Section 106 of the Act requires federally assisted undertakings to take into account their effects on historic properties that are included in or may be eligible to be included in the National Register of Historic Places. Historic properties include prehistoric archaeological sites as well as buildings, structures, and other sites. If a project impacts identified historical or archaeological sites, a more detailed evaluation of the site and potential impact of the project on the site will be required. Three elements are involved in cultural resources studies following Section 106 procedures:

- The identification and evaluation of historic properties.
- Assessment of effects of the proposed undertaking on historic properties.
- Consultation among principal parties to consider ways to avoid, reduce, or mitigate adverse effects.

The first element, identification and evaluation, is of most concern at the beginning stages of projects. Methods for identification of historic properties consist of archival research, field survey, and consultation.

FLOODPLAINS, WETLANDS, AND FLOOD INSURANCE

The EPA restricts treatment projects on environmentally sensitive lands such as floodplains and wetlands.

AGRICULTURAL LANDS

It is EPA policy under the Farmland Protection Policy Act (PL 97-98) to protect agricultural lands from "irreversible loss as an environmental or essential food production resource."

WILD AND SCENIC RIVERS

To comply with the Wild and Scenic Rivers Act, proposed projects should not directly and adversely impact any wild, scenic, or recreational river area. The Middle Fork of the Snoqualmie River is one of six rivers in Washington designated under this act.

FISH AND WILDLIFE PROTECTION

The Fish and Wildlife Coordination Act requires that projects "controlling or modifying any natural streams or other body of water" be done in a way that protects fish and wildlife resources and habitats.

ENDANGERED SPECIES ACT

Projects with a federal "nexus," including federal permits, approvals or funding, must comply with the Endangered Species Act. Listed species include the following:

- Bull trout – federally threatened and a state species of concern
- Chinook salmon – federally threatened and a state species of concern
- Coho salmon – federal candidate species
- Bald eagle – federal and state threatened species.

MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

In 1998, the National Marine Fisheries Service issued interim final regulations to implement the Essential Fish Habitat (EFH) requirements of the 1996 Sustainable Fisheries Act. This act significantly amended the Magnuson-Stevens Fishery Conservation and Management Act of 1976.

The Magnuson-Stevens Act requires the following: for federal actions that may adversely affect EFH, except activities covered by a General Concurrence, federal agencies must provide a written assessment of the effects of the action on EFH. EFH is defined as "waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." EFH must always include the critical habitat of endangered and threatened species.

STATE REGULATIONS AND POLICIES

WATER QUALITY STANDARDS FOR SURFACE WATERS

The federal Clean Water Act allows states to establish more stringent water quality requirements than are required by federal law. Washington's Department of Ecology adopted water quality standards that became effective in 2006 and were most recently

revised in 2012. General conditions listed in the standards are as follows (WAC 173-201A-010):

- All surface waters are protected by qualitative criteria, designated uses, and an anti-degradation policy.
- Based on the use designations, criteria are assigned to a water body to protect the existing and designated uses.
- Where multiple criteria for the same water quality parameter are assigned to a water body to protect different uses, the most stringent criterion for each parameter is to be applied.

Surface waters of the state include lakes, rivers, ponds, streams, inland waters, salt waters, wetlands, and all other surface waters and water courses within the jurisdiction of the state of Washington. Standards for freshwaters are based on a given water body's designated uses for aquatic life, recreation, water supply, and miscellaneous uses (wildlife habitat, harvesting, commerce and navigation, boating and aesthetics). The designated uses for all segments of the Snoqualmie River are listed in Table A-4. Water quality standards that must be met based on these uses are outlined in WAC 173-201A.

SNOQUALMIE RIVER WATER QUALITY LIMITATIONS

The *Snoqualmie River Total Maximum Daily Load (TMDL) Study* (1994) limits ammonia, five-day carbonaceous biochemical oxygen demand ($CBOD_5$), and fecal coliform bacteria discharges to the Snoqualmie River during the critical low flow months of August, September and October. The TMDL study evaluated options that included wastewater discharges at Fall City and Carnation, in addition to the existing plants at North Bend, Snoqualmie, and Duvall (the Carnation plant subsequently began operating in 2008). The TMDL allocates the City of North Bend 175 pounds per day (ppd) of $CBOD_5$ and 58.2 ppd of ammonia during the months of August, September and October. Technology-based standards meet the fecal coliform requirements of the TMDL.

The *Snoqualmie River Basin Temperature TMDL* (2011) includes temperature load allocations for the treatment plants at North Bend, Snoqualmie, Carnation, and Duvall, as well as allocations for stream shading throughout the watershed. The TMDL temperature allocation for the North Bend plant limits effluent temperature to an increase of 0.3 degrees C above the temperature criterion of 16 degrees C at the edge of a mixing zone based on 25 percent of the critical low flow. This allocation applies from June through September. The specific temperature allocation depends on effluent dilution factors and must be calculated each NPDES permit cycle. If critical season flow or effluent temperature increases, future permits may include effluent temperature or flow limits based on the TMDL.

TABLE A-4

Designated Uses for Segments of the Snoqualmie River

	Aquatic Life Uses			Recreation Uses		Water Supply Uses				Misc. Uses				
	Char Spawning /Rearing	Core Summer Habitat	Spawning/Rearing	Extraordinary Primary Contact	Primary Contact	Domestic Water	Industrial Water	Agricultural Water	Stock Water	Wildlife Habitat	Harvesting	Commerce/Navigation	Boating	Aesthetics
Snoqualmie River from mouth to confluence with Harris Creek (latitude 47.7686 longitude -121.9605; Sect. 5 T25N R6E)			✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Snoqualmie River and tributaries from and including Harris Creek (latitude 47.7686 longitude -121.9605; Sect. 5 T25N R6E) to west boundary of Twin Falls State Park on south fork (river mile 9.1).		✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Snoqualmie River, South Fork, from west boundary of Twin Falls State Park (river mile 9.1) to headwaters (including tributaries).		✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
Snoqualmie River, North Fork, from mouth to Sunday Creek.		✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
Snoqualmie River, North Fork, and Sunday Creek: All waters (including tributaries) above the confluence.	✓			✓		✓	✓	✓	✓	✓	✓	✓	✓	✓

TABLE A-4 (continued)

Designated Uses for Segments of the Snoqualmie River

	Aquatic Life Uses			Recreation Uses		Water Supply Uses				Misc. Uses				
	Char Spawning /Rearing	Core Summer Habitat	Spawning/Rearing	Extraordinary Primary Contact	Primary Contact	Domestic Water	Industrial Water	Agricultural Water	Stock Water	Wildlife Habitat	Harvesting	Commerce/Navigation	Boating	Aesthetics
Snoqualmie River, Middle Fork, from mouth to Dingford Creek (Except where designated char).		✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
Snoqualmie River, Middle Fork, and Dingford Creek: All waters (including tributaries) above the confluence.	✓			✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
Snoqualmie River's Middle Fork's unnamed tributaries at latitude 47.5389 longitude -121.5629 (Sect. 29 T24N R10E).	✓			✓		✓	✓	✓	✓	✓	✓	✓	✓	✓

(1) Source: Water Quality Standards for Surface Waters of the State of Washington. Chapter 173-201A WAC, Amended May 9, 2011. Revised January 2012. Washington Department of Ecology Publication 06-10-091.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT

Wastewater Effluent

The State of Washington administers the federal effluent limitations through the NPDES program. All wastewater discharges into the waters of the state, including treated effluent from treatment plants, must be permitted through the Department of Ecology with an NPDES Permit. The City of North Bend's current NPDES permit, issued on May 23, 2013, applies to the City's wastewater treatment plant. A copy of the permit is included in Appendix B.

Influent Limits

The NPDES permit identifies the following rated capacity for influent wastewater flow to the City's treatment plant:

- Average flow for the maximum month = 2.58 million gallons per day (mgd)
- BOD_5 loading for the maximum month = 2,805 pounds per day (ppd)
- TSS loading for the maximum month = 2,304 ppd

Effluent Limits

Effluent limits in an NPDES permit must be either technology-based or water quality-based. Technology-based limits are based on the treatment methods available to treat specific pollutants. They are set by the EPA and published as a regulation, or Ecology develops the limit on a case-by-case basis. Water quality-based limits are calculated so that the effluent will comply with surface water quality standards, groundwater standards, sediment quality standards, or the National Toxics Rule.

Currently, effluent discharge limits for the North Bend treatment plant are established for two periods each year: August through October, when flow is low in the receiving water (the South Fork Snoqualmie River), and November through July. Technology-based limits apply year-round to all parameters except $CBOD_5$. For $CBOD_5$, the limit is water-quality based from August through October, based on the established TMDL for the receiving water. Table A-5 summarizes effluent limits established in the NPDES permit.

Other Special Conditions

To ensure that North Bend is able to comply with the Snoqualmie River Basin Temperature TMDL as flows increase, the NPDES permit includes a requirement for a study of options to reduce effluent temperatures during the critical period. The study was prepared and submitted to Ecology prior to the permit deadline of July 31, 2015. Identified low-technology improvements and best management practices are to be implemented by July 31, 2016.

Stormwater Discharge

Construction projects that disturb more than 5 acres require a construction general permit for stormwater discharge under NPDES requirements; mitigation measures are required, including preparation of a Storm Water Pollution Prevention Plan. During construction, temporary erosion and sediment control measures are required.

STANDARDS FOR WATER RECLAMATION

The Washington State Departments of Health and Ecology jointly released a set of standards for wastewater reclamation projects in September 1997. The *Water Reclamation and Reuse Standards* describe the treatment and quality requirements for a variety of beneficial end uses. Four classes of reuse quality are listed, along with their suitability for various end uses: from Class A (highest quality) to Class D (lowest quality). For uses such as direct injection into a drinking water aquifer, there are more stringent standards than any of these four classes.

TABLE A-5

NPDES Permit Limits for North Bend Wastewater Treatment Plant Effluent Discharge

Parameter	November–July	August–October
Carbonaceous Biochemical Oxygen Demand (5-day)		
Maximum Average Monthly Concentration	25 mg/L	25 mg/L
Maximum Average Monthly Load	538 ppd	—
Minimum Average Monthly Removal of Influent Load	85%	85%
Maximum Average Weekly Concentration	40 mg/L	40 mg/L
Maximum Average Weekly Load	861 ppd	—
Total Suspended Solids		
Maximum Average Monthly Concentration	30 mg/L	30 mg/L
Maximum Average Monthly Load	646 ppd	350 ppd
Minimum Average Monthly Removal of Influent Load	85%	85%
Maximum Average Weekly Concentration	45 mg/L	45 mg/L
Maximum Average Weekly Load	968 ppd	525 ppd
Fecal Coliform Bacteria		
Monthly Geometric Mean	200/100 mL	200/100 mL
7-Day Geometric Mean	400/100 mL	400/100 mL
Daily pH		
Minimum	6	6
Maximum	9	9
Total Oxygen Demand (NBOD [(1)] + CBOD)		
Maximum Average Monthly Load	—	164 ppd
Maximum Daily Load	—	300 ppd

(1) NBOD = nitrogenous biological oxygen demand.

Landscape irrigation requires Class A reclaimed water, which is defined as follows:

> *"Class A Reclaimed Water"* means reclaimed water that, at a minimum, is at all times an oxidized, coagulated, filtered, disinfected wastewater. The wastewater shall be considered adequately disinfected if the median number of total coliform organisms in the wastewater after disinfection does not exceed 2.2 per 100 milliliters, as determined from the bacteriological results of the last 7 days for which analyses have been completed, and the number of total coliform organisms does not exceed 23 per 100 milliliters in any sample.

If surface percolation is used for land application of reclaimed water, a nitrogen reduction step is required in addition to other Class A requirements.

The *Water Reclamation and Reuse Standards* also list requirements for redundancy, including redundant filtration and disinfection equipment. Storage requirements are also listed, including emergency storage and wintertime storage.

STATE WASTE DISCHARGE PERMIT, WASTEWATER EFFLUENT

All wastewater disposed of via land application must be permitted through the Department of Ecology with a State Waste Discharge Permit. Disposal via land application is generally taken to mean that the land application process is relied on to provide further treatment. Effluent to be disposed of via land application is assumed not to meet reclaimed water standards before being land applied (similar to septic tank drainfield systems).

In comparison, "water reclamation" via land application is taken to mean that the effluent is treated to a high degree before being land applied, the land is not needed for further treatment, and the land application is for a beneficial use, such as groundwater recharge. Refer to the "Standards for Water Reclamation" above.

WASHINGTON STATE STANDARDS FOR USE AND DISPOSAL OF SLUDGE

WAC 173-308, *Biosolids Management*, establishes guidelines for treatment and land application of biosolids generated by municipal wastewater treatment facilities. These mirror the federal guidelines in 40 CFR 503. The state Department of Ecology has authority to enforce these rules and may, if it chooses, delegate some of the authority to local health departments.

Biosolids facilities in Washington operate under a statewide General Permit for Biosolids Management issued by the Department of Ecology. Rather than being issued an individual permit, facilities apply for, and gain coverage under the general permit. The general permit covers all permitted facilities in Washington and provides authorization of biosolids management in accordance with WAC 173-308.

WASHINGTON DEPARTMENT OF ECOLOGY CRITERIA FOR SEWAGE WORKS DESIGN

The Ecology-developed *Criteria for Sewage Works Design* (Ecology 2008), also known as the Orange Book, is a guide for design of sewage collection and treatment systems. Any projects initiated under the authority of this facilities plan must conform to the most recent revision of the Orange Book that is available at the time the project is designed. The primary goals of the manual are as follows:

- To ensure that the design of sewage collection and treatment systems is consistent with state public health and water quality objectives.
- To establish a basis for the design and review of plans and specifications for sewage treatment works and sewerage systems.
- To establish the minimum requirements and limiting factors for review of sewage treatment work and sewerage system plans and specifications.
- To assist the owner or the owner's authorized engineer in the preparation of plans, specifications, reports, and other data.
- To guide departments in their determination of whether to issue approvals, permits, or certificates for sewage treatment works or a sewer systems.

Ecology uses the Orange Book design guidelines to review and approve reports, plans, and specifications. Design guidelines presented in this book will be used to evaluate the capacity of the proposed treatment facility and to establish design criteria. The Orange Book also presents guidelines for wastewater treatment flood protection, reliability and, component design, including the number of units required for operation during peak flows. The Orange Book requires that existing plants be protected against 100-year flood damage (the same as the federal criteria) and that new plants remain fully operational during a 100-year flood (more stringent than the federal 25-year flood federal criteria). In general, state reliability requirements follow the federal requirements outlined in Table A-3. The state applies its reliability classifications to public works as follows:

- Class I – Works whose discharge or potential discharge meets either of the following criteria:
    - The discharge is into a public water supply or shellfish or primary contact recreation waters.
    - As a result of its volume or character, the discharge could permanently or unacceptably damage or affect the receiving waters or public health if normal operations were interrupted.

- Class II – Works whose discharge, or potential discharge, as a result of its volume and/or character, would not permanently or unacceptably damage or affect the receiving waters or public health during periods of short-term operations interruptions, but could be damaging if continued interruption of normal operations were to occur (on the order of several days).

- Class III – Works not otherwise classified as Reliability Class I or II.

ON-SITE SEWAGE REQUIREMENTS

On-site septic systems or on-site sewage systems are the most common methods of wastewater treatment for homes, commercial establishments, and other places that are not connected to a public sewer system. An on-site sewage system uses a network of pipes, a septic tank and a drainfield to provide subsurface soil treatment and dispersal of sewage. Properly functioning on-site sewage systems protect public health and the environment by preventing untreated wastewater from coming into contact with people, groundwater or surface water. On-site sewage systems are regulated based on wastewater flows:

- Smaller on-site sewage systems are designed for flows up to 3,500 gallons per day (gpd). The State Board of Health promulgates rules for these systems and local health jurisdictions, such as the King County Health Department, have authority for implementation and approval.

- The Washington Department of Health has jurisdiction over the management of large on-site sewage systems disposing of 3,500 to 100,000 gpd.

- Ecology has regulatory authority for all systems over 100,000 gpd.

On-site septic systems may not be used for treatment and disposal of industrial wastewater or combined sanitary sewer and stormwater systems.

JOINT AQUATIC RESOURCES PERMIT

State agencies other than the Department of Ecology can have involvement in construction and operation of facilities located in critical areas. The Department of Fish and Wildlife has involvement in cases involving fish-bearing streams. The Department of Natural Resources has authority for facilities to be constructed on tidelands or along shorelines. To promote efficiency and reduce overlap, state agencies and the U.S. Army Corps of Engineers developed the Joint Aquatic Resources Permit Application, which can be submitted for the following permits:

- The Department of Fish and Wildlife's Hydraulic Project Approval

- Local agency shoreline management permits

- Department of Ecology Water Quality Certification and Approval for Exceedance of Water Quality Standards
- Corps of Engineers Section 404 and Section 10 Permits
- Marine and aquatic lease

If construction will be performed in any state waterways, a Joint Aquatic Resources Permit Application may need to be prepared.

STATE ENVIRONMENTAL POLICY ACT

A State Environmental Policy Act review is an environmental checklist completed to ensure the state that there are no adverse environmental impacts from proposed projects. The checklist for this facilities plan is provided in Appendix I.

The checklist will evaluate potential impacts of work proposed in this facilities plan. If the responsible official determines there will be no probable significant adverse environmental impacts from the proposed projects or that the impacts would be properly mitigated, the lead agency would prepare and issue a "determination of nonsignificance" or "mitigated determination of nonsignificance". The responsible official would send the determination of nonsignificance and environmental checklist to agencies with jurisdiction, Ecology and affected tribes. These entities may submit comments to the lead agency within 15 days. An agency with jurisdiction may assume lead agency status within the 15-day period if it disagrees with the threshold determination.

A "determination of significance," which acknowledges the potential for significant environmental impacts, would require an environmental impact statement that describes existing conditions, addresses and evaluates alternatives, analyzes potential environmental impacts and addresses mitigation measures. A scoping process would have to be conducted at the beginning of the environmental impact statement, in which the City would inform agencies and the public of the proposed projects and solicit comments that would have to be addressed in the environmental impact statement.

STATE ENVIRONMENTAL REVIEW PROCESS; DEPARTMENT OF ECOLOGY DOCUMENTATION

To be eligible for financial assistance from the State Water Pollution Control Revolving Fund, this plan must comply with the State Environmental Review Process (WAC 173-98-100). The process was established "to help ensure that environmentally sound alternatives are selected and to satisfy the state's responsibility to help ensure that recipients comply with the National Environmental Policy Act and other applicable environmental laws, regulations, and executive orders."

In addition, the Department of Ecology has established requirements for environmental documentation in coordination with the U.S. Department of Agriculture's Rural Development program. Requirements include sending out a project description and summary of the proposed action to applicable regulatory agencies and requesting input and comments regarding the proposed action.

OFFICE OF ARCHAEOLOGY AND HISTORIC PRESERVATION APPROVAL

State laws addressing historic preservation include the Indian Graves and Records Act (RCW 27.44), which prohibits knowingly disturbing a Native American or historic grave, and the Archaeological Sites and Resources Act (RCW 27.53), which requires that anyone proposing to excavate into, disturb, or remove artifacts from an archaeological site on public or private lands obtain a permit from the Office of Archaeology and Historic Preservation.

Archival research, including a check of the Washington state site inventory and records at the Office of Archaeology and Historic Preservation, is conducted prior to any field activity in order to determine if sites are already recorded in the project area or its vicinity. Other information is collected from ethnographic and historic accounts, previous regional cultural resource investigations, maps, photographs, and environmental information. Research to determine the age of landforms involved and the extent of modern disturbance is especially important. Locations of archaeological sites may be identified by this process. The potential for buried and hence undiscovered sites, or uplifted former shorelines favorable for habitation, may also be determined.

Field visits are made after completion of the background research to verify field conditions, discuss construction locations and methods, and identify historic properties. The results of these investigations are presented in a report for submittal to appropriate agencies, including the Office of Archaeology and Historic Preservation. The report includes recommendations for dealing with any sites discovered, additional discovery measures, if necessary, monitoring high-potential locations, and a plan to be enacted in the event archaeological material is encountered during construction.

If during construction, archaeological resources are found, all work will be halted and the concerned tribe and State Office of Archaeology and Historic Preservation will be contacted.

LOCAL REGULATIONS AND POLICIES

CITY SEWER REGULATIONS

City regulations pertaining to sewers are outlined in Title 13 of the North Bend Municipal Code (see box on next page). The following are key requirements:

- Installation of public water and sewer systems is required for any new construction of business, commercial and industrial uses.

- For existing business, commercial and industrial structures, any expansion, alteration, or change in use is permitted to use private water and sewer systems.

- All new residential subdivisions containing five or more lots are required to install public water and sewer prior to final plat approval.

- Installation of public water and sewer prior to certificate of occupancy is required for residential short plats and building permits for new construction in residential zones.

- Installation of public sewer and water is required for short plats and building permits for nonresidential uses permitted in residential zones, such as uses for churches, schools, and similar uses, unless the applicant can demonstrate that water consumption and sewage treatment and disposal needs would be no greater than the construction of four dwelling units.

The municipal code adopts King County code (King County Ordinance 931) for regulation of sewage disposal systems, certificates of competency for sewage disposal system designers and sewage disposal system installers, permits, defining offenses, and the protection of human health and safety.

CITY OF NORTH BEND MUNICIPAL CODE CHAPTER 13.06. WATER AND SEWER REQUIREMENTS

13.06.010 Minimum water and sewer requirements.

The following are established as minimum requirements for providing for public water and sewer, as indicated by type of use:

A. Business, commercial and industrial uses:
   1. Installation of public water and sewer systems is required for any new con-struction of business, commercial and industrial uses.
   2. For existing structures, any expansion, alteration, or changes in use will be permitted to use private water and sewer systems, all remaining subject to any other applicable city regulations.

B. Use for residential subdivisions of five lots or greater:
   1. All new residential subdivisions containing five or more lots shall be required to install public water and sewer prior to final plat approval.

C. Use for residential short plats, and for building permits, for new construction in high density zones:
   1. Installation of public water and sewer prior to certificate of occupancy is required for residential short plats and building permits, for new construction in LDR and HDR zones.

D. Use for residential short plats and building permits for new construction in low density zones:
   1. Installation of public sewer and water is required for short plats and building permits for nonresidential uses permitted in residential zones, such as uses for churches, schools, and similar uses, unless the applicant can demonstrate that the impact of the use in terms of water consumption and sewage treatment and disposal would be no greater than the construction of four dwelling units. (Ord. 1020 (part), 1997; Ord. 581 § 1, 1983).

13.06.020 Satisfying requirements.

The public water and sewer requirements set forth in Section 13.06.010 may be met by:

A. Installation of required public water and sewer; or by

B. Establishing, to the satisfaction of the city council, binding provisions that will insure future installation of water or sewer, or both, in an orderly and timely manner consistent with the generation of water and sewer needs by the particular use. (Ord. 581 § 2, 1983).

13.06.030 Requirements are minimums.

The public water and sewer requirements set forth in Section 13.06.010 are the minimum requirements which must be met. It is recognized that with respect to specific situations, obligations now do and in the future may exist which exceed these requirements, and it is further recognized that other specific provisions of this city code may be supplemental or more stringent, and continue to apply. The requirements of this chapter do not limit the obligations already entered into regarding particular circumstances and uses, nor do they limit the authority of the city to impose more strict requirements should this appear desir-able, such as incident to SEPA review. (Ord. 581 § 3, 1983).

13.06.040 Water flow requirements for new construction.

All new construction within the city shall be served by sufficient water flow in order to meet the fire flow policies set forth in the city 1985 Water System Plan. The construction of any and all public utilities to meet said fire flow requirements shall be deemed a cost to be paid for by the proponent of any new construction project. (Ord. 676 § 1, 1986).

13.06.050 Waiver of immediate connection – Conditions.

Upon application from the interested agency or party, in all nonresidential zones the city council may, in its sole discretion, waive the requirement of the extension of and hook up to the public sanitary sewer system prior to building occupancy, if it finds all of the conditions set forth below are met:

A. The proposed use is an essential public facility providing a public service or the property is owned by and operated by a nonprofit organization intending to conduct a public service use upon the property (nonprofit status to be demonstrated by Internal Revenue Code 501(c)(3) approval);

B. The city's adopted comprehensive sewer plan indicates that sanitary sewer line will be extended to serve the property;

C. An on-site sewage disposal system for the property in question can be designed and implemented so that the public health, safety, and welfare will not be endangered and said system will comply with the city's health standards;

D. The owner of the subject property agrees not to protest the formation of a local improvement district for the extension of said sanitary sewer line if the subject property is included in the district as a benefited property; provided, this shall not be deemed a limitation upon the owner's right to protest the assessment roll. (Ord. 1056 §§ 1, 2, 1998: Ord. 961 § 1, 1995: Ord. 668 § 1, 1985. Formerly 13.36.370).

CRITICAL AREAS REGULATIONS

City regulations pertaining to critical areas are outlined in Title 14 of the North Bend Municipal Code (Chapters 14.05–14.12). The city regulates all uses, activities and development within, adjacent to or likely to affect one or more critical areas. Critical areas regulated include:

- Wetland areas
- Critical aquifer recharge areas
- Rivers and streams
- Fish and wildlife habitat conservation areas
- Geologically hazardous areas
- Frequently flooded areas

The city has prepared the following maps that show approximate boundaries for critical areas in the city:

- Special flood hazard area map
- River channel migration hazard map
- Critical aquifer recharge area map
- Wetland area map
- Erosion/debris flow
- Rivers and streams
- Fish and wildlife habitat areas

Copies of the maps are available for viewing at the North Bend community services department. These maps provide only approximate boundaries of known features and are not adequate substitutes for more detailed maps or studies that could identify alternative locations of known features or additional critical areas not illustrated on the maps. Project applicants must determine on a case-by-case basis whether a critical area exists on or near the subject property.

FLOODPLAIN MANAGEMENT

The design and construction of capital improvements recommended in this sewer plan must comply with the floodplain management regulations outlined in Title 14 of the North Bend Municipal Code (Chapter 14.12). For critical facilities within a mapped floodplain, the following regulations apply (14.12.030(D)):

> Critical facilities include, but are not limited to, schools, hospitals, police, fire and emergency response installations, nursing homes, wastewater treatment plants, potable water and sanitary sewer system components, and hazardous materials production. Construction of new critical facilities shall only be allowed within the floodplain when no reasonable alternative site is available. Critical facilities

constructed within the floodplain shall have the lowest floor elevated to three or more feet above the level of the base flood elevation. Floodproofing and sealing measures must be taken to ensure toxic or hazardous substances will not be displaced by or released into floodwaters. Access routes elevated to or above the level of the 100-year frequency flood shall be provided to all critical facilities to the extent possible.

STORMWATER REGULATIONS

The design and construction of capital improvements recommended in this sewer plan must comply with the stormwater regulations outlined in Title 14 of the North Bend Municipal Code (Chapter 14.16). The City has adopted by reference King County's *Surface Water Design Manual* (North Bend Municipal Code 14.16.060) and the *King County Stormwater Pollution Control Manual* (North Bend Municipal Code 14.16.070). Stormwater and drainage features should incorporate low impact development techniques that mimic predevelopment hydrologic conditions, when technically feasible.

SHORELINE MANAGEMENT

All uses, activities, or development occurring within shoreline jurisdictions of the City of North Bend must conform to the intent and requirements of the City's Shoreline Master Program, as outlined in North Bend Municipal Code Chapter 14.20. The City's shoreline jurisdiction includes the following:

- Shoreline water bodies
- The area from a water body to 200 feet upland of the ordinary high-water mark
- Floodways
- Up to 200 feet of floodplain contiguous with floodways
- Associated wetlands

The city's regulated shorelines include the Middle Fork Snoqualmie River throughout the city limits and the South Fork Snoqualmie River throughout the city limits. The city has predesignated the portion of the South Fork Snoqualmie River in the urban growth area outside the city limits, which will become effective upon annexation.

EAST KING COUNTY GROUNDWATER MANAGEMENT PLAN

In April 1990, the Department of Ecology designated East King County, including the North Bend planning area, as Groundwater Management Area 14, pursuant to RCW 90.44. The designation authorized King County to develop a groundwater management plan for the area. The groundwater management plan process was overseen by an advisory committee with representatives of cities, health agencies, state and federal agencies, and public and special interest groups. The City of North Bend participated on the advisory committee.

The first phase of the groundwater management plan process included technical studies of groundwater resources in the area. A comprehensive inventory of 600 to 800 wells in the area was conducted to identify aquifers and other geologic features. Of those wells, approximately 150 were sampled for water quality data. The *East King County Ground Water Management Plan* was completed in December 1998 and approved by the King County Council and certified by the Department of Ecology in 2000. The King County Council has passed an ordinance establishing a new East King County Ground Water Management Committee to monitor progress made under the plan, chart out subsequent groundwater protection efforts and revise the plan as necessary.

INTERNATIONAL FIRE CODE AND NATIONAL FIRE PROTECTION ASSOCIATION

Local county fire officials have authority to enforce the national International Fire Code, which identifies required measures to prevent, control and mitigate dangers related to the use and storage of hazardous chemicals. Local officials have authority to enforce National Fire Protection Association standards. The associations Standard 820, "Fire Protection in Wastewater Treatment and Collection Facilities," is of particular interest.

INTERNATIONAL BUILDING CODE AND WASHINGTON STATE ENERGY CODE

Local City building officials have authority to enforce the International Building Code as well as the Washington State Energy Code. These codes govern structural, architectural and mechanical design of buildings.

PUGET SOUND CLEAN AIR AGENCY

The Puget Sound Clean Air Agency is a local regulatory agency with jurisdiction over air emissions in the Puget Sound region (King, Kitsap, Pierce and Snohomish Counties). The agency's primary concern with wastewater treatment facilities is odor generation. If odor-producing facilities are designed, the Puget Sound Clean Air Agency should be consulted for input and comments. At least 60 days prior to the construction of such facilities, a notice of construction must be filed with the agency. A permit is required to construct, erect, install, alter, reconstruct, or relocate any stationary or portable device capable of releasing contaminants in the atmosphere.

APPENDIX B

NPDES PERMIT

Issuance Date: May 23, 2013
Effective Date: July 1, 2013
Expiration Date: June 30, 2018

National Pollutant Discharge Elimination System
Waste Discharge Permit No. WA0029351

State of Washington
DEPARTMENT OF ECOLOGY
Northwest Regional Office
3190 160th Avenue SE
Bellevue, WA 98008-5452

In compliance with the provisions of
The State of Washington Water Pollution Control Law
Chapter 90.48 Revised Code of Washington
and
The Federal Water Pollution Control Act
(The Clean Water Act)
Title 33 United States Code, Section 1342 et seq.

CITY OF NORTH BEND
P.O. Box 896
North Bend, WA 98045

is authorized to discharge in accordance with the Special and General Conditions that follow.

Plant Location: 400 Bendigo Blvd. N. North Bend, WA 98045	Receiving Water: Snoqualmie River, South Fork
Treatment Type: Oxidation Ditch	Discharge Location, Outfall 001: Latitude: 47.499589 Longitude: -121.787731

Kevin C. Fitzpatrick
Water Quality Section Manager
Northwest Regional Office
Washington State Department of Ecology

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Summary of Permit Report Submittals

Refer to the Special and General Conditions of this permit for additional submittal requirements.

Permit Section	Submittal	Frequency	First Submittal Date
S3.A	Discharge Monitoring Report	Monthly	August 15, 2013
S3.E	Reporting Permit Violations	As necessary	
S3.F	Other Reporting	As necessary	
S4.B	Plans for Maintaining Adequate Capacity	As necessary	
S4.D	Notification of New or Altered Sources	As necessary	
S5.F	Bypass Notification	As necessary	
S5.G	Operations and Maintenance Manual Update	1/permit cycle	July 31, 2014
S6.E	Industrial User Survey Submittal	1/permit cycle	December 31, 2017
S8	Acute Toxicity Effluent Test Results	2/permit cycle	October 31, 2016 April 30, 2017
S9	Chronic Toxicity Effluent Test Results	2/permit cycle	January 31, 2017 July 31, 2017
S10	Temperature Reduction Study Scope of Work	1/permit cycle	July 31, 2014
S10	Temperature Reduction Study Report	1/permit cycle	July 31, 2015
S10	Temperature Reduction Implementation Letter	1/permit cycle	July 31, 2016
S11	Outfall Evaluation	1/permit cycle	October 31, 2014
S12	Application for Permit Renewal	1/permit cycle	December 31, 2017
G1	Notice of Change in Authorization	As necessary	
G4	Reporting Planned Changes	As necessary	
G5	Engineering Report for Construction or Modification Activities	As necessary	
G7	Notice of Permit Transfer	As necessary	
G10	Duty to Provide Information	As necessary	
G13	Payment of Fees	As assessed	
G20	Compliance Schedules	As necessary	
G21	Contract Submittal	As necessary	

Special Conditions

S1. Discharge limits

All discharges and activities authorized by this permit must comply 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 violates the terms and conditions of this permit.

S1.A. Effluent limits, August through October

Beginning on the effective date of this permit, the Permittee may discharge treated municipal wastewater to the Snoqualmie River during August, September, and October at the permitted location subject to compliance with the following limits:

Effluent Limits: Outfall 001 **Latitude 47.499589 Longitude -121.787731**		
Parameter	**Average Monthly [a]**	**Average Weekly [b]**
Carbonaceous Biochemical Oxygen Demand (5-day) ($CBOD_5$)	25 milligrams/liter (mg/L) 85% removal of influent $CBOD_5$	40 mg/L
Total Suspended Solids (TSS)	30 mg/L 350 lbs/day 85% removal of influent TSS	45 mg/L 525 lbs/day
Parameter	**Daily Minimum**	**Daily Maximum**
pH	6.0 standard units	9.0 standard units
Parameter	**Monthly Geometric Mean**	**7-day Geometric Mean**
Fecal Coliform Bacteria [c]	200/100 milliliter (mL)	400/100 mL
Parameter	**Average Monthly**	**Maximum Daily [d]**
NBOD+CBOD [e]	164 lbs/day	300 lbs/day

[a]	Average monthly effluent limit means the highest allowable average of daily discharges over a calendar month. To calculate the discharge value to compare to the limit, you add the value of each daily discharge measured during a calendar month and divide this sum by the total number of daily discharges measured. See footnote c for fecal coliform calculations.
[b]	Average weekly discharge limit means the highest allowable average of "daily discharges" over a calendar week, calculated as the sum of all "daily discharges" measured during a calendar week divided by the number of "daily discharges" measured during that week. See footnote c for fecal coliform calculations.
[c]	Ecology provides directions to calculate the monthly and the 7-day geometric mean in publication No. 04-10-020, *Information Manual for Treatment Plant Operators* available at: http://www.ecy.wa.gov/pubs/0410020.pdf
[d]	Maximum daily effluent limit is the highest allowable daily discharge. The daily discharge is the average discharge of a pollutant measured during a calendar day. For pollutants with limits expressed in units of mass, calculate the daily discharge as the total mass of the pollutant discharged over the day. This does not apply to pH or temperature.
[e]	NBOD+CBOD means **N**itrogenous + **C**arbonaceous **B**iochemical **O**xygen **D**emand (5-day) NBOD+CBOD is defined by the following equation: **NBOD+CBOD (lbs/day) = (2.155 * ammonia-N (lbs/day)) + $CBOD_5$ (lbs/day)** Where total ammonia (as N) and $CBOD_5$ are measurements from the same daily composite sample.

S1.B. Effluent limits, November through July

Beginning on the effective date of this permit, the Permittee may discharge treated municipal wastewater to the Snoqualmie River during November through July at the permitted location subject to compliance with the following limits:

Effluent Limits: Outfall 001 Latitude 47.499589 Longitude -121.787731		
Parameter	**Average Monthly [a]**	**Average Weekly [b]**
Carbonaceous Biochemical Oxygen Demand (5-day) ($CBOD_5$)	25 milligrams/liter (mg/L) 538 pounds/day (lbs/day) 85% removal of influent $CBOD_5$	40 mg/L 861 lbs/day
Total Suspended Solids (TSS)	30 mg/L 646 lbs/day 85% removal of influent TSS	45 mg/L 968 lbs/day
Parameter	**Daily Minimum**	**Daily Maximum**
pH	6.0 standard units	9.0 standard units
Parameter	**Monthly Geometric Mean**	**7-day Geometric Mean**
Fecal Coliform Bacteria [c]	200/100 milliliter (mL)	400/100 mL

[a]	Average monthly effluent limit means the highest allowable average of daily discharges over a calendar month. To calculate the discharge value to compare to the limit, you add the value of each daily discharge measured during a calendar month and divide this sum by the total number of daily discharges measured. See footnote c for fecal coliform calculations.
[b]	Average weekly discharge limitation means the highest allowable average of "daily discharges" over a calendar week, calculated as the sum of all "daily discharges" measured during a calendar week divided by the number of "daily discharges" measured during that week. See footnote c for fecal coliform calculations.
[c]	Ecology provides directions to calculate the monthly and the 7-day geometric mean in publication No. 04-10-020, Information Manual for Treatment Plant Operators available at: http://www.ecy.wa.gov/pubs/0410020.pdf

S1.C. Mixing zone authorization for Outfall 001

The paragraphs below define the maximum boundaries of the mixing zones.

Chronic mixing zone

The width of the chronic mixing zone is limited to a distance of 17 feet. The length of the chronic mixing zone extends 100 feet upstream and 256 feet downstream of the outfall. The mixing zone extends from the discharge ports to the top of the water surface. The concentration of pollutants at the edge of the chronic zone must meet chronic aquatic life criteria and human health criteria.

Chronic mixing zone – temperature only

The river flow available for chronic dilution in the mixing zone is limited to 25% of the 7Q10 flow.

Acute mixing zone

The river flow available for acute dilution in the mixing zone is limited to 2.5% of the 7Q10 flow. The concentration of pollutants at the edge of the acute zone must meet acute aquatic life criteria.

Available Dilution (dilution factor)	
Acute Aquatic Life Criteria	2.8
Chronic Aquatic Life Criteria	14.8
Temperature	20.9
Human Health Criteria - Carcinogen	60.7
Human Health Criteria - Non-carcinogen	18.4

S2. Monitoring requirements

S2.A. Monitoring schedule

The Permittee must monitor in accordance with the following schedule and the requirements specified in Appendix A.

Parameter	Units & Speciation	Minimum Sampling Frequency	Sample Type
(1) Wastewater Influent			
Wastewater Influent means the raw sewage flow from the collection system into the treatment facility. Sample the wastewater entering the headworks of the treatment plant excluding any side-stream returns from inside the plant.			
Biochemical Oxygen Demand (BOD_5)	mg/L	1/week	24-hour composite [a]
BOD_5	lbs/day	1/week	Calculated [b]
Carbonaceous Biochemical Oxygen Demand ($CBOD_5$)	mg/L	2/week	24-hour composite
Total Suspended Solids (TSS)	mg/L	2/week	24-hour composite
TSS	lbs/day	2/week	Calculated
(2) Final Wastewater Effluent			
Final Wastewater Effluent means wastewater exiting the last treatment process or operation.			
Flow	MGD	Continuous [c]	Metered/recorded
$CBOD_5$	mg/L	2/week	24-hour composite
$CBOD_5$	lbs/day	2/week	Calculated
$CBOD_5$	% removal [d]	1/month	Calculated
TSS	mg/L	2/week	24-hour composite
TSS	lbs/day	2/week	Calculated
TSS	% removal	1/month	Calculated
Fecal Coliform [e]	#Organisms /100 ml	2/week	Grab [f]
pH [g]	Standard Units	1/day	Grab
Temperature [h]	Degrees centigrade (°C)	Continuous	Measurement
7-DAD Max Temperature [i]	°C	1/day	Calculated

Parameter	Units & Speciation	Minimum Sampling Frequency	Sample Type
(3) Final Wastewater Effluent – August, September, & October only			
Total Ammonia	mg/L as N	2/week	24-hour composite
Total Ammonia	lbs/day	2/week	Calculated
NBOD+CBOD [j]	lbs/day	2/week	Calculated
(4) Whole Effluent Toxicity Testing – Final Wastewater Effluent			
Acute Toxicity Testing	See Section S8	2/permit cycle August 2016 February 2017	24-hour composite
Chronic Toxicity Testing	See Section S9	2/permit cycle November 2016 May 2017	24-hour composite
(5) Effluent Characterization – Final Wastewater Effluent			
Total Ammonia	mg/L as N	1/month (November through July only)	24-hour composite
Total Phosphorus	mg/L as P	1/month	24-hour composite
Soluble Reactive Phosphorus (as P)	mg/L as P	1/month	24-hour composite
Nitrate plus Nitrite Nitrogen	mg/L as N	1/month	24-hour composite
Total Kjeldahl Nitrogen (TKN)	mg/L as N	1/month	24-hour composite
(6) Permit Renewal Application Requirements – Final Wastewater Effluent [k]			
The Permittee must record and report the wastewater treatment plant flow discharged on the day it collects the sample for priority pollutant testing with the discharge monitoring report.			
Dissolved Oxygen	mg/L	4/permit cycle July 2016 October 2016 January 2017 April 2017	Grab
Oil and Grease	mg/L	"	Grab
Total Dissolved Solids	mg/L	"	24-hour composite
Total Hardness	mg/L	"	24-hour composite
Cyanide	micrograms/liter (µg/L)	"	Grab
Total Phenolic Compounds	µg/L	"	Grab
Priority Pollutants (PP) – Metals	µg/L; nanograms(ng/L) for mercury	"	24-Hour composite Grab for mercury
PP – Volatile Compounds	µg/L	"	Grab
PP – Acid Compounds	µg/L	"	24-Hour composite
PP – Base/Neutral Compounds	µg/L	"	24-Hour composite

[a]	24-hour composite means a series of individual samples collected over a 24-hour period into a single container, and analyzed as one sample.
[b]	Calculation means figured concurrently with the respective sample, using the following formula: Concentration (in mg/L) X Flow (in MGD) X Conversion Factor (8.34) = lbs/day
[c]	Continuous means uninterrupted except for brief lengths of time for calibration, for power failure, or for unanticipated equipment repair or maintenance.

Parameter	Units & Speciation	Minimum Sampling Frequency	Sample Type
[d]	% removal = (Influent concentration (mg/L) – Effluent concentration (mg/L)) / Influent concentration (mg/L) x 100 Calculate the percent (%) removal of $CBOD_5$ and TSS using the above equation.		
[e]	Report a numerical value for fecal coliforms following the procedures in Ecology's *Information Manual for Wastewater Treatment Plant Operators*, Publication Number 04-10-020 available at: http://www.ecy.wa.gov/programs/wq/permits/guidance.html . Do not report a result as too numerous to count (TNTC).		
[f]	Grab means an individual sample collected over a fifteen (15) minute, or less, period.		
[g]	Report the daily minimum and maximum pH.		
[h]	The Permittee must determine and report a daily maximum from half-hour measurements in a 24-hour period. Continuous monitoring instruments must achieve an accuracy of 0.2 degrees C and the Permittee must verify accuracy annually.		
[i]	Calculate a 7-DAD Max for each day by averaging each day's maximum temperature value with the values from the six (6) preceding days.		
[j]	NBOD+CBOD is defined by the following equation: **NBOD+CBOD (lbs/day) = (2.155 x ammonia-N (lbs/day)) + $CBOD_5$ (lbs/day)** Where total ammonia-N and $CBOD_5$ are measurements from the same daily composite sample.		
[k]	See Appendix A for the required detection (DL) or quantitation (QL) levels. Report single analytical values below detection as "less than (detection level)" where (detection level) is the numeric value specified in attachment A. Report single analytical values between the agency-required detection and quantitation levels with qualifier code of j following the value. To calculate the average value (monthly average): • Use the reported numeric value for all parameters measured between the agency-required detection value and the agency-required quantitation value. • For values reported below detection, use one-half the detection value if the lab detected the parameter in another sample for the reporting period. • For values reported below detection, use zero if the lab did not detect the parameter in another sample for the reporting period. If the Permittee is unable to obtain the required DL and QL in its effluent due to matrix effects, the Permittee must submit a matrix-specific detection limit (MDL) and a quantitation limit (QL) to Ecology with appropriate laboratory documentation.		

S2.B. Sampling and analytical procedures

Samples and measurements taken to meet the requirements of this permit must represent the volume and nature of the monitored parameters. The Permittee must conduct representative sampling of any unusual discharge or discharge condition, including bypasses, upsets, and maintenance-related conditions that may affect effluent quality.

Sampling and analytical methods used to meet the monitoring requirements specified in this permit must conform to the latest revision of the *Guidelines Establishing Test Procedures for the Analysis of Pollutants* contained in 40 CFR Part 136.

S2.C. Flow measurement, field measurement, and continuous monitoring devices

The Permittee must:

1. Select and use appropriate flow measurement, field measurement, and continuous monitoring devices and methods consistent with accepted scientific practices.
2. Install, calibrate, and maintain these devices to ensure the accuracy of the measurements is consistent with the accepted industry standard and the manufacturer's recommendation for that type of device.
3. Calibrate micro-recording temperature devices, known as thermistors, using protocols from Ecology's Quality Assurance Project Plan Development Tool (*Continuous Temperature Sampling Protocols for the Environmental Monitoring and Trends*). This document is available online at: http://www.ecy.wa.gov/programs/eap/qa/docs/QAPPtool/Mod6%20Ecology%20SOPs/Protocols/ContinuousTemperatureSampling.pdf
   Calibration as specified in this document is not required if the Permittee uses recording devices certified by the manufacturer.
4. Use field measurement devices as directed by the manufacturer and do not use reagents beyond their expiration dates.
5. Calibrate these devices at the frequency recommended by the manufacturer.
6. Maintain calibration records for at least three years.

S2.D. Laboratory accreditation

The Permittee must ensure that all monitoring data required by Ecology is prepared by a laboratory registered or accredited under the provisions of chapter 173-50 WAC, Accreditation of Environmental Laboratories. Flow, temperature, pH, and internal process control parameters are exempt from this requirement. The Permittee must obtain accreditation for pH if it must receive accreditation or registration for other parameters.

S2.E. Request for reduction in monitoring

The Permittee may request a reduction of the sampling frequency after twelve (12) months of monitoring. Ecology will review each request and at its discretion grant the request when it reissues the permit or by a permit modification.

The Permittee must:

1. Provide a written request.
2. Clearly state the parameters for which it is requesting reduced monitoring.
3. Clearly state the justification for the reduction.

S3. Reporting and recording requirements

The Permittee must monitor and report in accordance with the following conditions. Falsification of information submitted to Ecology is a violation of the terms and conditions of this permit.

S3.A. Reporting

The first monitoring period begins on the effective date of the permit. The Permittee must:

1. Summarize, report, and submit monitoring data obtained during each monitoring period on the electronic Discharge Monitoring Report (DMR) form provided by Ecology within WQWebDMR. Include data for each of the parameters tabulated in Special Condition S2 and as required by the form. Report a value for each day sampling occurred (unless specifically exempted in the permit) and for the summary values (when applicable) included on the electronic form.

   To find out more information and to sign up for WAWebDMR go to: http://www.ecy.wa.gov/programs/wq/permits/paris/webdmr.html

   If unable to submit electronically (for example, if you do not have an internet connection), the Permittee must contact Ecology to request a waiver and obtain instructions on how to obtain a paper copy DMR.

   The Permittee may submit DMRs on the paper form provided by Ecology until October 1, 2013.

2. Enter the "no discharge" reporting code for an entire DMR, for a specific monitoring point, or for a specific parameter as appropriate, if the Permittee did not discharge wastewater or a specific pollutant during a given monitoring period.

3. Report single analytical values below detection as "less than the detection level (DL)" by entering < followed by the numeric value of the detection level (e.g. < 2.0) on the DMR. If the method used did not meet the minimum DL and quantitation level (QL) identified in the permit, report the actual QL and DL in the comments or in the location provided.

4. Calculate average values (unless otherwise specified in the permit) using:

   a. The reported numeric value for all parameters measured between the agency-required detection value and the agency-required quantitation value.

   b. One-half the detection value (for values reported below detection) if the lab detected the parameter in another sample for the reporting period.

   c. Zero (for values reported below detection) if the lab did not detect the parameter in another sample for the reporting period.

5. Report single-sample grouped parameters (for example priority pollutants, PAHs, pulp and paper chlorophenolics, TTOs) on the WAWebDMR form and include: sample date, concentration detected, detection limit (DL) (as necessary), and laboratory quantitation level (QL) (as necessary). The Permittee must also submit an electronic PDF copy of the laboratory report using WAWebDMR.

If the Permittee has obtained a waiver from electronic reporting or if submitting prior to the compliance date, the Permittee must submit a paper copy of the laboratory report providing the following information: date sampled, sample location, date of analysis, parameter name, CAS number, analytical method/number, detection limit (DL), laboratory quantitation level (QL), reporting units, and concentration detected.

The contract laboratory reports must also include information on the chain of custody, QA/QC results, and documentation of accreditation for the parameter.

6. Ensure that DMRs are electronically submitted no later than the dates specified below, unless otherwise specified in this permit.

   Until the compliance date identified in S3.A.1 or if the Permittee has obtained a waiver, it must ensure that paper forms are postmarked or received by Ecology no later than the dates specified below, unless otherwise specified in this permit.

7. Submit DMRs for parameters with the monitoring frequencies specified in S2. The Permittee must submit monthly DMRs by the 15th day of the following month.

8. Submit reports to Ecology online using Ecology's electronic WQWebDMR submittal forms (electronic DMRs) as required above. Send reports to Ecology at:

   Water Quality Permit Coordinator
   Department of Ecology
   Northwest Regional Office
   3190 160th Avenue SE
   Bellevue, WA 98008-5452

S3.B. Records retention

The Permittee must retain records of all monitoring information for a minimum of three (3) years. Such information must include all calibration and maintenance records and all original recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit. The Permittee must extend this period of retention during the course of any unresolved litigation regarding the discharge of pollutants by the Permittee or when requested by Ecology.

S3.C. Recording of results

For each measurement or sample taken, the Permittee must record the following information:

1. The date, exact place, method, and time of sampling or measurement.
2. The individual who performed the sampling or measurement.
3. The dates the analyses were performed.

4. The individual who performed the analyses.
5. The analytical techniques or methods used.
6. The results of all analyses.

S3.D. Additional monitoring by the Permittee

If the Permittee monitors any pollutant more frequently than required by Condition S2 of this permit, then the Permittee must include the results of such monitoring in the calculation and reporting of the data submitted in the Permittee's DMR.

S3.E. Reporting permit violations

The Permittee must take the following actions when it violates or is unable to comply with any permit condition:

1. Immediately take action to stop, contain, and cleanup unauthorized discharges or otherwise stop the noncompliance and correct the problem.
2. If applicable, immediately repeat sampling and analysis. Submit the results of any repeat sampling to Ecology within thirty (30) days of sampling.

a. Immediate reporting

The Permittee must immediately report to Ecology and the Local Health Jurisdiction (at the numbers listed below), all:

- Failures of the disinfection system.
- Collection system overflows.
- Plant bypasses resulting in a discharge.
- Any other failures of the sewage system (pipe breaks, etc).

Northwest Regional Office	425-649-7000
King County Environmental Health Services	206-205-4394

b. Twenty-four-hour reporting

The Permittee must report the following occurrences of noncompliance by telephone, to Ecology at the telephone numbers listed above, within 24 hours from the time the Permittee becomes aware of any of the following circumstances:

1. Any noncompliance that may endanger health or the environment, unless previously reported under immediate reporting requirements.
2. Any unanticipated bypass that causes an exceedance of an effluent limit in the permit (See Part S5.F, "Bypass Procedures").
3. Any upset that causes an exceedance of an effluent limit in the permit (See G.15, "Upset").

4. Any violation of a maximum daily or instantaneous maximum discharge limit for any of the pollutants in Section S1.A and S1.B of this permit.
5. Any overflow prior to the treatment works, whether or not such overflow endangers health or the environment or exceeds any effluent limit in the permit.

c. Report within five days

The Permittee must also provide a written submission within five days of the time that the Permittee becomes aware of any reportable event under subparts a or b, above. The written submission must contain:

1. A description of the noncompliance and its cause.
2. The period of noncompliance, including exact dates and times.
3. The estimated time the Permittee expects the noncompliance to continue if not yet corrected.
4. Steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance.
5. If the noncompliance involves an overflow prior to the treatment works, an estimate of the quantity (in gallons) of untreated overflow.

d. Waiver of written reports

Ecology may waive the written report required in subpart c, above, on a case-by-case basis upon request if the Permittee has submitted a timely oral report.

e. All other permit violation reporting

The Permittee must report all permit violations, which do not require immediate or within 24 hours reporting, when it submits monitoring reports for S3.A ("Reporting"). The reports must contain the information listed in subpart c, above. Compliance with these requirements does not relieve the Permittee from responsibility to maintain continuous compliance with the terms and conditions of this permit or the resulting liability for failure to comply.

f. Report submittal

The Permittee must submit reports to the address listed in S3.A.

S3.F. Other reporting

The Permittee must report a spill of oil or hazardous materials in accordance with the requirements of RCW 90.56.280 and chapter 173-303-145. You can obtain further instructions at the following website: http://www.ecy.wa.gov/programs/spills/other/reportaspill.htm.

Where the Permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application, or in any report to Ecology, it must submit such facts or information promptly.

S3.G. Maintaining a copy of this permit

The Permittee must keep a copy of this permit at the facility and make it available upon request to Ecology inspectors.

S4. Facility loading

S4.A. Design criteria

The flows or waste loads for the permitted facility must not exceed the following design criteria:

Maximum Month Design Flow (MMDF)	2.58 MGD
BOD_5 Influent Loading for Maximum Month	2,805 lb/day
TSS Influent Loading for Maximum Month	2,304 lb/day

S4.B. Plans for maintaining adequate capacity

a. Conditions triggering plan submittal

The Permittee must submit a plan and a schedule for continuing to maintain capacity to Ecology when:

1. The actual flow or waste load reaches 85 percent of any one of the design criteria in S4.A for three consecutive months; or
2. The projected plant flow or loading would reach design capacity within five years.

b. Plan and schedule content

The plan and schedule must identify the actions necessary to maintain adequate capacity for the expected population growth and to meet the limits and requirements of the permit. The Permittee must consider the following topics and actions in its plan.

1. Analysis of the present design and proposed process modifications
2. Reduction or elimination of excessive infiltration and inflow of uncontaminated ground and surface water into the sewer system
3. Limits on future sewer extensions or connections or additional waste loads
4. Modification or expansion of facilities
5. Reduction of industrial or commercial flows or waste loads

Engineering documents associated with the plan must meet the requirements of WAC 173-240-060, "Engineering Report," and be approved by Ecology prior to any construction.

S4.C. Duty to mitigate

The Permittee must take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this permit that has a reasonable likelihood of adversely affecting human health or the environment.

S4.D. Notification of new or altered sources

1. The Permittee must submit written notice to Ecology whenever any new discharge or a substantial change in volume or character of an existing discharge into the wastewater treatment plant is proposed which:
    a. Would interfere with the operation of, or exceed the design capacity of, any portion of the wastewater treatment plant.
    b. Is not part of an approved general sewer plan or approved plans and specifications.
    c. Is subject to pretreatment standards under 40 CFR Part 403 and Section 307(b) of the Clean Water Act.
2. This notice must include an evaluation of the wastewater treatment plant's ability to adequately transport and treat the added flow and/or waste load, the quality and volume of effluent to be discharged to the treatment plant, and the anticipated impact on the Permittee's effluent [40 CFR 122.42(b)].

S5. Operation and maintenance

The Permittee must at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances), which are installed to achieve compliance with the terms and conditions of this permit. Proper operation and maintenance also includes keeping a daily operation logbook (paper or electronic), adequate laboratory controls, and appropriate quality assurance procedures. This provision of the permit requires the Permittee to operate backup or auxiliary facilities or similar systems only when the operation is necessary to achieve compliance with the conditions of this permit.

S5.A. Certified operator

This permitted facility must be operated by an operator certified by the state of Washington for at least a Class II plant. This operator must be in responsible charge of the day-to-day operation of the wastewater treatment plant. An operator certified for at least a Class I plant must be in charge during all regularly scheduled shifts.

S5.B. Operation and maintenance program

The Permittee must:

1. Institute an adequate operation and maintenance program for the entire sewage system.
2. Keep maintenance records on all major electrical and mechanical components of the treatment plant, as well as the sewage system and pumping stations. Such records must clearly specify the frequency and type of maintenance recommended by the manufacturer and must show the frequency and type of maintenance performed.
3. Make maintenance records available for inspection at all times.

S5.C. Short-term reduction

The Permittee must schedule any facility maintenance, which might require interruption of wastewater treatment and degrade effluent quality, during non-critical water quality periods and carry this maintenance out in a manner approved by Ecology.

If a Permittee contemplates a reduction in the level of treatment that would cause a violation of permit discharge limits on a short-term basis for any reason, and such reduction cannot be avoided, the Permittee must:

1. Give written notification to Ecology, if possible, thirty (30) days prior to such activities.
2. Detail the reasons for, length of time of, and the potential effects of the reduced level of treatment.

This notification does not relieve the Permittee of its obligations under this permit.

S5.D. Electrical power failure

The Permittee must ensure that adequate safeguards prevent the discharge of untreated wastes or wastes not treated in accordance with the requirements of this permit during electrical power failure at the treatment plant and/or sewage lift stations. Adequate safeguards include, but are not limited to, alternate power sources, standby generator(s), or retention of inadequately treated wastes.

The Permittee must maintain Reliability Class II (EPA 430/9-74-001) at the wastewater treatment plant. Reliability Class II requires a backup power source sufficient to operate all vital components and critical lighting and ventilation during peak wastewater flow conditions. Vital components used to support the secondary processes (i.e., mechanical aerators or aeration basin air compressors) need not be operable to full levels of treatment, but must be sufficient to maintain the biota.

S5.E. Prevent connection of inflow

The Permittee must strictly enforce its sewer ordinances and not allow the connection of inflow (roof drains, foundation drains, etc.) to the sanitary sewer system.

S5.F. Bypass procedures

This permit prohibits a bypass, which is the intentional diversion of waste streams from any portion of a treatment facility. Ecology may take enforcement action against a Permittee for a bypass unless one of the following circumstances (1, 2, or 3) applies.

1. Bypass for essential maintenance without the potential to cause violation of permit limits or conditions.

   This permit authorizes a bypass if it allows for essential maintenance and does not have the potential to cause violations of limits or other conditions of this permit, or adversely impact public health as determined by Ecology prior to the bypass. The Permittee must submit prior notice, if possible, at least ten (10) days before the date of the bypass.

2. Bypass which is unavoidable, unanticipated, and results in noncompliance of this permit.

   This permit authorizes such a bypass only if:

   a. Bypass is unavoidable to prevent loss of life, personal injury, or severe property damage. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which would cause them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass.

   b. No feasible alternatives to the bypass exist, such as:

      - The use of auxiliary treatment facilities.
      - Retention of untreated wastes.
      - Maintenance during normal periods of equipment downtime, but not if the Permittee should have installed adequate backup equipment in the exercise of reasonable engineering judgment to prevent a bypass.
      - Transport of untreated wastes to another treatment facility or preventative maintenance), or transport of untreated wastes to another treatment facility.

   c. Ecology is properly notified of the bypass as required in Condition S3.E of this permit.

3. If bypass is anticipated and has the potential to result in noncompliance of this permit.

   a. The Permittee must notify Ecology at least thirty (30) days before the planned date of bypass. The notice must contain:

      - A description of the bypass and its cause.
      - An analysis of all known alternatives which would eliminate, reduce, or mitigate the need for bypassing.
      - A cost-effectiveness analysis of alternatives including comparative resource damage assessment.
      - The minimum and maximum duration of bypass under each alternative.
      - A recommendation as to the preferred alternative for conducting the bypass.
      - The projected date of bypass initiation.
      - A statement of compliance with SEPA.
      - A request for modification of water quality standards as provided for in WAC 173-201A-410, if an exceedance of any water quality standard is anticipated.
      - Details of the steps taken or planned to reduce, eliminate, and prevent reoccurrence of the bypass.

b. For probable construction bypasses, the Permittee must notify Ecology of the need to bypass as early in the planning process as possible. The Permittee must consider the analysis required above during preparation of the engineering report or facilities plan and plans and specifications and must include these to the extent practical. In cases where the Permittee determines the probable need to bypass early, the Permittee must continue to analyze conditions up to and including the construction period in an effort to minimize or eliminate the bypass.

c. Ecology will consider the following prior to issuing an administrative order for this type of bypass:

- If the bypass is necessary to perform construction or maintenance-related activities essential to meet the requirements of this permit.
- If feasible alternatives to bypass exist, such as the use of auxiliary treatment facilities, retention of untreated wastes, stopping production, maintenance during normal periods of equipment down time, or transport of untreated wastes to another treatment facility.
- If the Permittee planned and scheduled the bypass to minimize adverse effects on the public and the environment.

After consideration of the above and the adverse effects of the proposed bypass and any other relevant factors, Ecology will approve or deny the request. Ecology will give the public an opportunity to comment on bypass incidents of significant duration, to the extent feasible. Ecology will approve a request to bypass by issuing an administrative order under RCW 90.48.120.

S5.G. Operations and maintenance (O&M) manual

a. O&M manual requirements

The Permittee must:

1. Update the Operations and Maintenance (O&M) Manual to meet the requirements of 173-240-150 WAC and submit it to Ecology for approval by July 31, 2014. The Permittee must submit a paper copy and an electronic copy (preferably as a PDF).
2. Submit to Ecology for review substantial changes or updates to the O&M Manual whenever it incorporates them into the manual. The Permittee must submit a paper copy and an electronic copy (preferably as a PDF).
3. Keep the approved O&M Manual at the permitted facility.
4. Follow the instructions and procedures of this manual.

b. O&M manual components

In addition to the requirements of WAC 173-240-080 (1) through (5), the O&M Manual must include:

1. Emergency procedures for cleanup in the event of wastewater system upset or failure.
2. A review of system components which if failed could pollute surface water or could impact human health. Provide a procedure for a routine schedule of checking the function of these components.
3. Wastewater system maintenance procedures that contribute to the generation of process wastewater.
4. Reporting protocols for submitting reports to Ecology to comply with the reporting requirements in the discharge permit.
5. Any directions to maintenance staff when cleaning or maintaining other equipment or performing other tasks which are necessary to protect the operation of the wastewater system (for example, defining maximum allowable discharge rate for draining a tank, blocking all floor drains before beginning the overhaul of a stationary engine).
6. The treatment plant process control monitoring schedule.
7. Minimum staffing and certification levels adequate to operate and maintain the treatment processes and carry out compliance monitoring required by the permit.

S6. Pretreatment

S6.A. General requirements

The Permittee must work with Ecology to ensure that all commercial and industrial users of the publicly owned treatment works (POTW) comply with the pretreatment regulations in 40 CFR Part 403 and any additional regulations that the Environmental Protection Agency (U.S. EPA) may promulgate under Section 307(b) (pretreatment) and 308 (reporting) of the Federal Clean Water Act.

S6.B. Duty to enforce discharge prohibitions

1. Under federal regulations (40 CFR 403.5(a) and (b)), the Permittee must not authorize or knowingly allow the discharge of any pollutants into its POTW which may be reasonably expected to cause pass through or interference, or which otherwise violate general or specific discharge prohibitions contained in 40 CFR Part 403.5 or WAC-173-216-060.
2. The Permittee must not authorize or knowingly allow the introduction of any of the following into their treatment works:
    a. Pollutants which create a fire or explosion hazard in the POTW (including, but not limited to waste streams with a closed cup flashpoint of less than 140 degrees Fahrenheit or 60 degrees Centigrade using the test methods specified in 40 CFR 261.21).

b. Pollutants which will cause corrosive structural damage to the POTW, but in no case discharges with pH lower than 5.0, or greater than 11.0 standard units, unless the works are specifically designed to accommodate such discharges.

c. Solid or viscous pollutants in amounts that could cause obstruction to the flow in sewers or otherwise interfere with the operation of the POTW.

d. Any pollutant, including oxygen-demanding pollutants, (BOD_5, etc.) released in a discharge at a flow rate and/or pollutant concentration which will cause interference with the POTW.

e. Petroleum oil, non-biodegradable cutting oil, or products of mineral origin in amounts that will cause interference or pass through.

f. Pollutants which result in the presence of toxic gases, vapors, or fumes within the POTW in a quantity which may cause acute worker health and safety problems.

g. Heat in amounts that will inhibit biological activity in the POTW resulting in interference but in no case heat in such quantities such that the temperature at the POTW headworks exceeds 40 degrees Centigrade (104 degrees Fahrenheit) unless Ecology, upon request of the Permittee, approves, in writing, alternate temperature limits.

h. Any trucked or hauled pollutants, except at discharge points designated by the Permittee.

i. Wastewaters prohibited to be discharged to the POTW by the Dangerous Waste Regulations (chapter 173-303 WAC), unless authorized under the Domestic Sewage Exclusion (WAC 173-303-071).

3. The Permittee must also not allow the following discharges to the POTW unless approved in writing by Ecology:

   a. Noncontact cooling water in significant volumes.

   b. Stormwater and other direct inflow sources.

   c. Wastewaters significantly affecting system hydraulic loading, which do not require treatment, or would not be afforded a significant degree of treatment by the system.

4. The Permittee must notify Ecology if any industrial user violates the prohibitions listed in this section (S6.B), and initiate enforcement action to promptly curtail any such discharge.

S6.C. Wastewater discharge permit required

The Permittee must

1. Establish a process for authorizing non-domestic wastewater discharges that ensures all SIUs in all tributary areas meet the applicable state waste discharge permit (SWDP) requirements in accordance with chapter 90.48 RCW and chapter 173-216 WAC.

2. Immediately notify Ecology of any proposed discharge of wastewater from a source, which may be a significant industrial user (SIU) [see fact sheet definitions or refer to 40 CFR 403.3(t)(i)(ii)].
3. Require all SIUs to obtain a SWDP from Ecology prior to accepting their non-domestic wastewater, or require proof that Ecology has determined they do not require a permit.
4. Require the documentation as described in S6.C.3 at the earliest practicable date as a condition of continuing to accept non-domestic wastewater discharges from a previously undiscovered, currently discharging and unpermitted SIU.
5. Require sources of non-domestic wastewater, which do not qualify as SIUs but merit a degree of oversight, to apply for a SWDP and provide it a copy of the application and any Ecology responses.
6. Keep all records documenting that its users have met the requirements of S6.C.

S6.D. Identification and reporting of existing, new, and proposed industrial users

1. The Permittee must take continuous, routine measures to identify all existing, new, and proposed SIUs and potential significant industrial users (PSIUs) discharging or proposing to discharge to the Permittee's sewer system (see Appendix C of the fact sheet for definitions).
2. Within 30 days of becoming aware of an unpermitted existing, new, or proposed industrial user who may be a significant industrial user (SIU), the Permittee must notify such user by registered mail that, if classified as an SIU, they must apply to Ecology and obtain a State Waste Discharge Permit. The Permittee must send a copy of this notification letter to Ecology within this same 30-day period.
3. The Permittee must also notify all Potential SIUs (PSIUs), as they are identified, that if their classification should change to an SIU, they must apply to Ecology for a State Waste Discharge Permit within 30 days of such change.

S6.E. Industrial user survey

The Permittee must complete an industrial user survey listing all SIUs and potential significant industrial users (PSIUs) discharging to the POTW. The Permittee must submit the survey to Ecology by December 31, 2017. At a minimum, the Permittee must develop the list of SIUs and PSIUs by means of a telephone book search, a water utility billing records search, and a physical reconnaissance of the service area. Information on PSIUs must include, at a minimum, the business name, telephone number, address, description of the industrial process(s), and the known wastewater volumes and characteristics.

S7. Solid wastes

The Permittee must handle and dispose of all solid waste material in such a manner as to prevent its entry into state ground or surface water.

S8. Acute toxicity

S8.A. Testing when there is no permit limit for acute toxicity

The Permittee must:

1. Conduct acute toxicity testing on final effluent during August 2016 and February 2017.
2. Submit the results to Ecology by October 31, 2016 and April 30, 2017.
3. Conduct acute toxicity testing on a series of at least five concentrations of effluent, including 100% effluent and a control.
4. Use each of the following species and protocols for each acute toxicity test:

Acute Toxicity Tests	Species	Method
Fathead minnow 96-hour static-renewal test	*Pimephales promelas*	EPA-821-R-02-012
Daphnid 48-hour static test	*Ceriodaphnia dubia, Daphnia pulex,* or *Daphnia magna*	EPA-821-R-02-012

S8.B. Sampling and reporting requirements

1. The Permittee must submit all reports for toxicity testing in accordance with the most recent version of Ecology Publication No. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*. Reports must contain bench sheets and reference toxicant results for test methods. If the lab provides the toxicity test data in electronic format for entry into Ecology's database, then the Permittee must send the data to Ecology along with the test report, bench sheets, and reference toxicant results.
2. The Permittee must collect 24-hour composite effluent samples for toxicity testing. The Permittee must cool the samples to 0 - 6 degrees Celsius during collection and send them to the lab immediately upon completion. The lab must begin the toxicity testing as soon as possible but no later than 36 hours after sampling was completed.
3. The laboratory must conduct water quality measurements on all samples and test solutions for toxicity testing, as specified in the most recent version of Ecology Publication No. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*.
4. All toxicity tests must meet quality assurance criteria and test conditions specified in the most recent versions of the EPA methods listed in Subsection A and the Ecology Publication No. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*. If Ecology determines any test results to be invalid or anomalous, the Permittee must repeat the testing with freshly collected effluent.
5. The laboratory must use control water and dilution water meeting the requirements of the EPA methods listed in Section A or pristine natural water of sufficient quality for good control performance.

6. The Permittee must conduct whole effluent toxicity tests on an unmodified sample of final effluent.
7. The Permittee may choose to conduct a full dilution series test during compliance testing in order to determine dose response. In this case, the series must have a minimum of five effluent concentrations and a control. The series of concentrations must include the acute critical effluent concentration (ACEC). The ACEC equals 36% effluent.
8. All whole effluent toxicity tests, effluent screening tests, and rapid screening tests that involve hypothesis testing must comply with the acute statistical power standard of 29% as defined in WAC 173-205-020. If the test does not meet the power standard, the Permittee must repeat the test on a fresh sample with an increased number of replicates to increase the power.

S9. Chronic toxicity

S.A. Testing when there is no permit limit for chronic toxicity

The Permittee must:

1. Conduct chronic toxicity testing on final effluent during November 2016 and May 2017.
2. Submit the results to Ecology by January 31, 2017 and July 31, 2017.
3. Conduct chronic toxicity testing on a series of at least five concentrations of effluent and a control. This series of dilutions must include the acute critical effluent concentration (ACEC). The ACEC equals 36% effluent. The series of dilutions should also contain the CCEC of 6.8% effluent.
4. Compare the ACEC to the control using hypothesis testing at the 0.05 level of significance as described in Appendix H, EPA/600/4-89/001.
5. Perform chronic toxicity tests with all of the following species and the most recent version of the following protocols:

Freshwater Chronic Test	Species	Method
Fathead minnow survival and growth	*Pimephales promelas*	EPA-821-R-02-013
Daphnid survival and reproduction	*Ceriodaphnia dubia*	EPA-821-R-02-013

S.B. Sampling and reporting requirements

1. The Permittee must submit all reports for toxicity testing in accordance with the most recent version of Ecology Publication No. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*. Reports must contain bench sheets and reference toxicant results for test methods. If the lab provides the toxicity test data in electronic format for entry into Ecology's database, then the Permittee must send the data to Ecology along with the test report, bench sheets, and reference toxicant results.
2. The Permittee must collect 24-hour composite effluent samples for toxicity testing. The Permittee must cool the samples to 0 - 6 degrees Celsius during

collection and send them to the lab immediately upon completion. The lab must begin the toxicity testing as soon as possible but no later than 36 hours after sampling was completed.

3. The laboratory must conduct water quality measurements on all samples and test solutions for toxicity testing, as specified in the most recent version of Ecology Publication No. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*.
4. All toxicity tests must meet quality assurance criteria and test conditions specified in the most recent versions of the EPA methods listed in Section A. and the Ecology Publication no. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*. If Ecology determines any test results to be invalid or anomalous, the Permittee must repeat the testing with freshly collected effluent.
5. The laboratory must use control water and dilution water meeting the requirements of the EPA methods listed in Subsection A. or pristine natural water of sufficient quality for good control performance.
6. The Permittee must conduct whole effluent toxicity tests on an unmodified sample of final effluent.
7. The Permittee may choose to conduct a full dilution series test during compliance testing in order to determine dose response. In this case, the series must have a minimum of five effluent concentrations and a control. The series of concentrations must include the CCEC and the ACEC. The CCEC and the ACEC may either substitute for the effluent concentrations that are closest to them in the dilution series or be extra effluent concentrations. The CCEC equals 6.8% effluent. The ACEC equals 36% effluent.
8. All whole effluent toxicity tests that involve hypothesis testing must comply with the chronic statistical power standard of 39% as defined in WAC 173-205-020. If the test does not meet the power standard, the Permittee must repeat the test on a fresh sample with an increased number of replicates to increase the power.

S10. Temperature reduction study

The Permittee must prepare a study of potential management methods (Best Management Practices, BMPs) and equipment that may be used to reduce the temperature of the effluent or remove it from the river (outfall relocation, water re-use) during the critical period (June through September). The study must include identification of alternatives and associated costs. The Permittee must:

1. Submit a scope of work for the study to Ecology by July 31, 2014.
2. Submit the completed temperature reduction study to Ecology by July 31, 2015.
3. Implement any best management practices and initiate low-cost technology (such as tree planting or shading) identified by the temperature reduction study by July 31, 2016.

4. Submit a letter to Ecology by July 31, 2016, summarizing the BMPs and/or technologies implemented. This letter must also include a schedule for design and construction of any longer-term projects identified by the temperature reduction study.

S11. Outfall evaluation

The Permittee must inspect the submerged portion of the outfall line and diffuser to document its integrity and continued function. If conditions allow for a photographic verification, the Permittee must include such verification in the report. If damage is found, the report must include a plan for completing repairs. The Permittee must submit the inspection report to Ecology by October 31, 2014.

The inspector must at minimum:

- Assess the physical condition of the outfall pipe, diffuser, and associated couplings.
- Describe the effluent and river flow patterns and gravel bar accumulation in the vicinity of the diffuser.
- Ensure diffuser ports are free of obstructions and are allowing uniform flow.
- Confirm physical location (latitude/longitude) of the diffuser section of the outfall.

S12. Application for permit renewal or modification for facility changes

The Permittee must submit an application for renewal of this permit by December 31, 2017. The Permittee must submit a paper copy and an electronic copy (preferably as a PDF).

The Permittee must also submit a new application or supplement at least one hundred eighty (180) days prior to commencement of discharges, resulting from the activities listed below, which may result in permit violations. These activities include any facility expansions, production increases, or other planned changes, such as process modifications, in the permitted facility.

GENERAL CONDITIONS

G1. Signatory requirements

1. All applications, reports, or information submitted to Ecology must be signed and certified:

   a. In the case of corporations, by a responsible corporate officer. For the purpose of this section, a responsible corporate officer means:

      - A president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision making functions for the corporation, or
      - The manager of one or more manufacturing, production, or operating facilities, provided, the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long-term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

   b. In the case of a partnership, by a general partner.

   c. In the case of sole proprietorship, by the proprietor.

   d. In the case of a municipal, state, or other public facility, by either a principal executive officer or ranking elected official.

   Applications for permits for domestic wastewater facilities that are either owned or operated by, or under contract to, a public entity shall be submitted by the public entity.

2. All reports required by this permit and other information requested by Ecology must be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

   a. The authorization is made in writing by a person described above and submitted to Ecology.

   b. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility, such as the position of plant manager, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.)

3. Changes to authorization. If an authorization under paragraph 2.b, above, is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph 2.b,

above, must be submitted to Ecology prior to or together with any reports, information, or applications to be signed by an authorized representative

4. Certification. Any person signing a document under this section must make the following certification:

   "I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

G2. Right of inspection and entry

The Permittee must allow an authorized representative of Ecology, upon the presentation of credentials and such other documents as may be required by law:

1. To enter upon the premises where a discharge is located or where any records must be kept under the terms and conditions of this permit.
2. To have access to and copy, at reasonable times and at reasonable cost, any records required to be kept under the terms and conditions of this permit.
3. To inspect, at reasonable times, any facilities, equipment (including monitoring and control equipment), practices, methods, or operations regulated or required under this permit.
4. To sample or monitor, at reasonable times, any substances or parameters at any location for purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act.

G3. Permit actions

This permit may be modified, revoked and reissued, or terminated either at the request of any interested person (including the Permittee) or upon Ecology's initiative. However, the permit may only be modified, revoked and reissued, or terminated for the reasons specified in 40 CFR 122.62, 40 CFR 122.64 or WAC 173-220-150 according to the procedures of 40 CFR 124.5.

1. The following are causes for terminating this permit during its term, or for denying a permit renewal application:
   a. Violation of any permit term or condition.
   b. Obtaining a permit by misrepresentation or failure to disclose all relevant facts.
   c. A material change in quantity or type of waste disposal.

d. A determination that the permitted activity endangers human health or the environment, or contributes to water quality standards violations and can only be regulated to acceptable levels by permit modification or termination.

e. A change in any condition that requires either a temporary or permanent reduction, or elimination of any discharge or sludge use or disposal practice controlled by the permit.

f. Nonpayment of fees assessed pursuant to RCW 90.48.465.

g. Failure or refusal of the Permittee to allow entry as required in RCW 90.48.090.

2. The following are causes for modification but not revocation and reissuance except when the Permittee requests or agrees:

a. A material change in the condition of the waters of the state.

b. New information not available at the time of permit issuance that would have justified the application of different permit conditions.

c. Material and substantial alterations or additions to the permitted facility or activities which occurred after this permit issuance.

d. Promulgation of new or amended standards or regulations having a direct bearing upon permit conditions, or requiring permit revision.

e. The Permittee has requested a modification based on other rationale meeting the criteria of 40 CFR Part 122.62.

f. Ecology has determined that good cause exists for modification of a compliance schedule, and the modification will not violate statutory deadlines.

g. Incorporation of an approved local pretreatment program into a municipality's permit.

3. The following are causes for modification or alternatively revocation and reissuance:

a. When cause exists for termination for reasons listed in 1.a through 1.g of this section, and Ecology determines that modification or revocation and reissuance is appropriate.

b. When Ecology has received notification of a proposed transfer of the permit. A permit may also be modified to reflect a transfer after the effective date of an automatic transfer (General Condition G7) but will not be revoked and reissued after the effective date of the transfer except upon the request of the new Permittee.

G4. Reporting planned changes

The Permittee must, as soon as possible, but no later than sixty (60) days prior to the proposed changes, give notice to Ecology of planned physical alterations or additions to the permitted facility, production increases, or process modification which will result in:

1. The permitted facility being determined to be a new source pursuant to 40 CFR 122.29(b)
2. A significant change in the nature or an increase in quantity of pollutants discharged.
3. A significant change in the Permittee's sludge use or disposal practices. Following such notice, and the submittal of a new application or supplement to the existing application, along with required engineering plans and reports, this permit may be modified, or revoked and reissued pursuant to 40 CFR 122.62(a) to specify and limit any pollutants not previously limited. Until such modification is effective, any new or increased discharge in excess of permit limits or not specifically authorized by this permit constitutes a violation.

G5. Plan review required

Prior to constructing or modifying any wastewater control facilities, an engineering report and detailed plans and specifications must be submitted to Ecology for approval in accordance with chapter 173-240 WAC. Engineering reports, plans, and specifications must be submitted at least one hundred eighty (180) days prior to the planned start of construction unless a shorter time is approved by Ecology. Facilities must be constructed and operated in accordance with the approved plans.

G6. Compliance with other laws and statutes

Nothing in this permit excuses the Permittee from compliance with any applicable federal, state, or local statutes, ordinances, or regulations.

G7. Transfer of this permit

In the event of any change in control or ownership of facilities from which the authorized discharge emanate, the Permittee must notify the succeeding owner or controller of the existence of this permit by letter, a copy of which must be forwarded to Ecology.

1. Transfers by Modification

   Except as provided in paragraph (B) below, this permit may be transferred by the Permittee to a new owner or operator only if this permit has been modified or revoked and reissued under 40 CFR 122.62(b)(2), or a minor modification made under 40 CFR 122.63(d), to identify the new Permittee and incorporate such other requirements as may be necessary under the Clean Water Act.

2. Automatic Transfers

   This permit may be automatically transferred to a new Permittee if:

   a. The Permittee notifies Ecology at least thirty (30) days in advance of the proposed transfer date.

   b. The notice includes a written agreement between the existing and new Permittees containing a specific date transfer of permit responsibility, coverage, and liability between them.

c. Ecology does not notify the existing Permittee and the proposed new Permittee of its intent to modify or revoke and reissue this permit. A modification under this subparagraph may also be minor modification under 40 CFR 122.63. If this notice is not received, the transfer is effective on the date specified in the written agreement.

G8. Reduced production for compliance

The Permittee, in order to maintain compliance with its permit, must control production and/or all discharges upon reduction, loss, failure, or bypass of the treatment facility until the facility is restored or an alternative method of treatment is provided. This requirement applies in the situation where, among other things, the primary source of power of the treatment facility is reduced, lost, or fails.

G9. Removed substances

Collected screenings, grit, solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters must not be resuspended or reintroduced to the final effluent stream for discharge to state waters.

G10. Duty to provide information

The Permittee must submit to Ecology, within a reasonable time, all information which Ecology may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The Permittee must also submit to Ecology upon request, copies of records required to be kept by this permit.

G11. Other requirements of 40 CFR

All other requirements of 40 CFR 122.41 and 122.42 are incorporated in this permit by reference.

G12. Additional monitoring

Ecology may establish specific monitoring requirements in addition to those contained in this permit by administrative order or permit modification.

G13. Payment of fees

The Permittee must submit payment of fees associated with this permit as assessed by Ecology.

G14. Penalties for violating permit conditions

Any person who is found guilty of willfully violating the terms and conditions of this permit is deemed guilty of a crime, and upon conviction thereof must be punished by a fine of up to ten thousand dollars ($10,000) and costs of prosecution, or by imprisonment in the discretion of the court. Each day upon which a willful violation occurs may be deemed a separate and additional violation.

Any person who violates the terms and conditions of a waste discharge permit may incur, in addition to any other penalty as provided by law, a civil penalty in the amount of up to ten thousand dollars ($10,000) for every such violation. Each and every such violation is a separate and distinct offense, and in case of a continuing violation, every day's continuance is deemed to be a separate and distinct violation.

G15. Upset

Definition – "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limits because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limits if the requirements of the following paragraph are met.

A Permittee who wishes to establish the affirmative defense of upset must demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

1. An upset occurred and that the Permittee can identify the cause(s) of the upset.
2. The permitted facility was being properly operated at the time of the upset.
3. The Permittee submitted notice of the upset as required in Condition S3.E.
4. The Permittee complied with any remedial measures required under S4.C of this permit.

In any enforcement action the Permittee seeking to establish the occurrence of an upset has the burden of proof.

G16. Property rights

This permit does not convey any property rights of any sort, or any exclusive privilege.

G17. Duty to comply

The Permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application.

G18. Toxic pollutants

The Permittee must comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if this permit has not yet been modified to incorporate the requirement.

G19. Penalties for tampering

The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit must, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than two (2) years per violation, or by both. If a conviction of a person is for a violation committed after a first conviction of such person under this condition, punishment must be a fine of not more than $20,000 per day of violation, or by imprisonment of not more than four (4) years, or by both.

G20. Compliance schedules

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit must be submitted no later than fourteen (14) days following each schedule date.

G21. Contract review

The Permittee must submit to Ecology any proposed contract for the operation of any wastewater treatment facility covered by this permit. The review is to ensure consistency with chapters 90.46 and 90.48 RCW. In the event that Ecology does not comment within a thirty (30)-day period, the Permittee may assume consistency and proceed with the contract.

Appendix A

LIST OF POLLUTANTS WITH ANALYTICAL METHODS, DETECTION LIMITS AND QUANTITATION LEVELS

The Permittee must use the specified analytical methods, detection limits (DLs) and quantitation levels (QLs) in the following table for permit and application required monitoring unless:

- Another permit condition specifies other methods, detection levels, or quantitation levels.
- The method used produces measurable results in the sample and EPA has listed it as an EPA-approved method in 40 CFR Part 136.

If the Permittee uses an alternative method, not specified in the permit and as allowed above, it must report the test method, DL, and QL on the discharge monitoring report or in the required report.

If the Permittee is unable to obtain the required DL and QL in its effluent due to matrix effects, the Permittee must submit a matrix-specific detection limit (MDL) and a quantitation limit (QL) to Ecology with appropriate laboratory documentation.

When the permit requires the Permittee to measure the base neutral compounds in the list of priority pollutants, it must measure all of the base neutral pollutants listed in the table below. The list includes EPA required base neutral priority pollutants and several additional polynuclear aromatic hydrocarbons (PAHs). The Water Quality Program added several PAHs to the list of base neutrals below from Ecology's Persistent Bioaccumulative Toxics (PBT) List. It only added those PBT parameters of interest to Appendix A that did not increase the overall cost of analysis unreasonably.

Ecology added this appendix to the permit in order to reduce the number of analytical "non-detects" in permit-required monitoring and to measure effluent concentrations near or below criteria values where possible at a reasonable cost.

CONVENTIONAL PARAMETERS

Pollutant & CAS No. ***(if available)***	**Recommended Analytical Protocol**	**Detection (DL)[1]** ***µg/L unless specified***	**Quantitation Level (QL)[2]** ***µg/L unless specified***
Biochemical Oxygen Demand	SM5210-B		2 mg/L
Chemical Oxygen Demand	SM5220-D		10 mg/L
Total Organic Carbon	SM5310-B/C/D		1 mg/L
Total Suspended Solids	SM2540-D		5 mg/L
Total Ammonia (as N)	SM4500-NH3-B and C/D/E/G/H		20
Flow	Calibrated device		
Dissolved oxygen	SM4500-OC/OG		0.2 mg/L
Temperature (max. 7-day avg.)	Analog recorder or Use micro-recording devices known as thermistors		0.2º C
pH	SM4500-H^+ B	N/A	N/A

NONCONVENTIONAL PARAMETERS

Pollutant & CAS No. ***(if available)***	**Recommended Analytical Protocol**	**Detection (DL)[1]** ***µg/L unless specified***	**Quantitation Level (QL)[2]** ***µg/L unless specified***
Total Alkalinity	SM2320-B		5 mg/L as CaCO3
Chlorine, Total Residual	SM4500 Cl G		50.0
Color	SM2120 B/C/E		10 color units
Fecal Coliform	SM 9221E,9222	N/A	Specified in method - sample aliquot dependent
Fluoride (16984-48-8)	SM4500-F E	25	100
Nitrate + Nitrite Nitrogen (as N)	SM4500-NO3- E/F/H		100
Nitrogen, Total Kjeldahl (as N)	SM4500-N_{org}B/C and SM4500NH_3-B/C/D/EF/G/H		300
Soluble Reactive Phosphorus (as P)	SM4500- PE/PF	3	10
Phosphorus, Total (as P)	SM 4500 PB followed by SM4500-PE/PF	3	10
Oil and Grease (HEM)	1664 A or B	1,400	5,000
Salinity	SM2520-B		3 practical salinity units or scale (PSU or PSS)
Settleable Solids	SM2540 -F		100
Sulfate (as mg/L SO_4)	SM4110-B		200
Sulfide (as mg/L S)	SM4500-S^2F/D/E/G		200
Sulfite (as mg/L SO_3)	SM4500-SO3B		2000
Total Coliform	SM 9221B, 9222B, 9223B	N/A	Specified in method - sample aliquot dependent
Total dissolved solids	SM2540 C		20 mg/L
Total Hardness	SM2340B		200 as CaCO3
Aluminum, Total (7429-90-5)	200.8	2.0	10
Barium Total (7440-39-3)	200.8	0.5	2.0
BTEX (benzene +toluene + ethylbenzene + m,o,p xylenes)	EPA SW 846 8021/8260	1	2
Boron Total (7440-42-8)	200.8	2.0	10.0
Cobalt, Total (7440-48-4)	200.8	0.05	0.25
Iron, Total (7439-89-6)	200.7	12.5	50
Magnesium, Total (7439-95-4)	200.7	10	50
Molybdenum, Total (7439-98-7)	200.8	0.1	0.5
Manganese, Total (7439-96-5)	200.8	0.1	0.5
NWTPH Dx	Ecology NWTPH Dx	250	250
NWTPH Gx	Ecology NWTPH Gx	250	250
Tin, Total (7440-31-5)	200.8	0.3	1.5
Titanium, Total (7440-32-6)	200.8	0.5	2.5

PRIORITY POLLUTANTS

Pollutant & CAS No. ***(if available)***	**Recommended Analytical Protocol**	**Detection (DL)[1]** ***µg/L unless specified***	**Quantitation Level (QL)[2]** ***µg/L unless specified***
METALS, CYANIDE & TOTAL PHENOLS			
Antimony, Total (7440-36-0)	200.8	0.3	1.0
Arsenic, Total (7440-38-2)	200.8	0.1	0.5
Beryllium, Total (7440-41-7)	200.8	0.1	0.5
Cadmium, Total (7440-43-9)	200.8	0.05	0.25
Chromium (hex) dissolved (18540-29-9)	SM3500-Cr EC	0.3	1.2
Chromium, Total (7440-47-3)	200.8	0.2	1.0
Copper, Total (7440-50-8)	200.8	0.4	2.0
Lead, Total (7439-92-1)	200.8	0.1	0.5
Mercury, Total (7439-97-6)	1631E	0.0002	0.0005
Nickel, Total (7440-02-0)	200.8	0.1	0.5
Selenium, Total (7782-49-2)	200.8	1.0	1.0
Silver, Total (7440-22-4)	200.8	0.04	0.2
Thallium, Total (7440-28-0)	200.8	0.09	0.36
Zinc, Total (7440-66-6)	200.8	0.5	2.5
Cyanide, Total (57-12-5)	335.4	5	10
Cyanide, Weak Acid Dissociable	SM4500-CN I	5	10
Cyanide, Free Amenable to Chlorination (Available Cyanide)	SM4500-CN G	5	10
Phenols, Total	EPA 420.1		50

Pollutant & CAS No. ***(if available)***	**Recommended Analytical Protocol**	**Detection (DL)[1]** ***µg/L unless specified***	**Quantitation Level (QL)[2]** ***µg/L unless specified***
ACID COMPOUNDS			
2-Chlorophenol (95-57-8)	625	1.0	2.0
2,4-Dichlorophenol (120-83-2)	625	0.5	1.0
2,4-Dimethylphenol (105-67-9)	625	0.5	1.0
4,6-dinitro-o-cresol (534-52-1) (2-methyl-4,6,-dinitrophenol)	625/1625B	1.0	2.0
2,4 dinitrophenol (51-28-5)	625	1.0	2.0
2-Nitrophenol (88-75-5)	625	0.5	1.0
4-nitrophenol (100-02-7)	625	0.5	1.0
Parachlorometa cresol (59-50-7) (4-chloro-3-methylphenol)	625	1.0	2.0
Pentachlorophenol (87-86-5)	625	0.5	1.0
Phenol (108-95-2)	625	2.0	4.0
2,4,6-Trichlorophenol (88-06-2)	625	2.0	4.0

PRIORITY POLLUTANTS (continued)

Pollutant & CAS No. *(if available)*	Recommended Analytical Protocol	Detection (DL)[1] *µg/L unless specified*	Quantitation Level (QL)[2] *µg/L unless specified*
VOLATILE COMPOUNDS			
Acrolein (107-02-8)	624	5	10
Acrylonitrile (107-13-1)	624	1.0	2.0
Benzene (71-43-2)	624	1.0	2.0
Bromoform (75-25-2)	624	1.0	2.0
Carbon tetrachloride (56-23-5)	624/601 or SM6230B	1.0	2.0
Chlorobenzene (108-90-7)	624	1.0	2.0
Chloroethane (75-00-3)	624/601	1.0	2.0
2-Chloroethylvinyl Ether (110-75-8)	624	1.0	2.0
Chloroform (67-66-3)	624 or SM6210B	1.0	2.0
Dibromochloromethane (124-48-1)	624	1.0	2.0
1,2-Dichlorobenzene (95-50-1)	624	1.9	7.6
1,3-Dichlorobenzene (541-73-1)	624	1.9	7.6
1,4-Dichlorobenzene (106-46-7)	624	4.4	17.6
Dichlorobromomethane (75-27-4)	624	1.0	2.0
1,1-Dichloroethane (75-34-3)	624	1.0	2.0
1,2-Dichloroethane (107-06-2)	624	1.0	2.0
1,1-Dichloroethylene (75-35-4)	624	1.0	2.0
1,2-Dichloropropane (78-87-5)	624	1.0	2.0
1,3-dichloropropene (mixed isomers) (1,2-dichloropropylene) (542-75-6)[3]	624	1.0	2.0
Ethylbenzene (100-41-4)	624	1.0	2.0
Methyl bromide (74-83-9) (Bromomethane)	624/601	5.0	10.0
Methyl chloride (74-87-3) (Chloromethane)	624	1.0	2.0
Methylene chloride (75-09-2)	624	5.0	10.0
1,1,2,2-Tetrachloroethane (79-34-5)	624	1.9	2.0
Tetrachloroethylene (127-18-4)	624	1.0	2.0
Toluene (108-88-3)	624	1.0	2.0
1,2-Trans-Dichloroethylene (156-60-5) (Ethylene dichloride)	624	1.0	2.0
1,1,1-Trichloroethane (71-55-6)	624	1.0	2.0
1,1,2-Trichloroethane (79-00-5)	624	1.0	2.0
Trichloroethylene (79-01-6)	624	1.0	2.0
Vinyl chloride (75-01-4)	624/SM6200B	1.0	2.0

PRIORITY POLLUTANTS (continued)

Pollutant & CAS No. *(if available)*	Recommended Analytical Protocol	Detection (DL)[1] *µg/L unless specified*	Quantitation Level (QL)[2] *µg/L unless specified*
BASE/NEUTRAL COMPOUNDS (compounds in bold are Ecology PBTs)			
Acenaphthene (83-32-9)	625	0.2	0.4
Acenaphthylene (208-96-8)	625	0.3	0.6
Anthracene (120-12-7)	625	0.3	0.6
Benzidine (92-87-5)	625	12	24
Benzyl butyl phthalate (85-68-7)	625	0.3	0.6
Benzo(*a*)anthracene (56-55-3)	625	0.3	0.6
Benzo(b)fluoranthene (3,4-benzofluoranthene) (205-99-2)[4]	610/625	0.8	1.6
Benzo(j)fluoranthene (205-82-3)[4]	625	0.5	1.0
Benzo(k)fluoranthene (11,12-benzofluoranthene) (207-08-9)[4]	610/625	0.8	1.6
Benzo(r,s,t)pentaphene (189-55-9)	625	0.5	1.0
Benzo(*a*)pyrene (50-32-8)	610/625	0.5	1.0
Benzo(*ghi*)Perylene (191-24-2)	610/625	0.5	1.0
Bis(*2-chloroethoxy)*methane (111-91-1)	625	5.3	21.2
Bis(*2-chloroethyl*)ether (111-44-4)	611/625	0.3	1.0
Bis(*2-chloroisopropyl*)ether (39638-32-9)	625	0.3	0.6
Bis(*2-ethylhexyl*)phthalate (117-81-7)	625	0.1	0.5
4-Bromophenyl phenyl ether (101-55-3)	625	0.2	0.4
2-Chloronaphthalene (91-58-7)	625	0.3	0.6
4-Chlorophenyl phenyl ether (7005-72-3)	625	0.3	0.5
Chrysene (218-01-9)	610/625	0.3	0.6
Dibenzo (a,h)acridine (226-36-8)	610M/625M	2.5	10.0
Dibenzo (a,j)acridine (224-42-0)	610M/625M	2.5	10.0
Dibenzo(a-*h*)anthracene (53-70-3)(1,2,5,6-dibenzanthracene)	625	0.8	1.6
Dibenzo(a,e)pyrene (192-65-4)	610M/625M	2.5	10.0
Dibenzo(a,h)pyrene (189-64-0)	625M	2.5	10.0
3,3-Dichlorobenzidine (91-94-1)	605/625	0.5	1.0
Diethyl phthalate (84-66-2)	625	1.9	7.6
Dimethyl phthalate (131-11-3)	625	1.6	6.4
Di-n-butyl phthalate (84-74-2)	625	0.5	1.0
2,4-dinitrotoluene (121-14-2)	609/625	0.2	0.4
2,6-dinitrotoluene (606-20-2)	609/625	0.2	0.4

PRIORITY POLLUTANTS (continued)

Pollutant & CAS No. *(if available)*	Recommended Analytical Protocol	Detection (DL)[1] *µg/L unless specified*	Quantitation Level (QL)[2] *µg/L unless specified*
BASE/NEUTRAL COMPOUNDS (compounds in bold are Ecology PBTs)			
Di-n-octyl phthalate (117-84-0)	625	0.3	0.6
1,2-Diphenylhydrazine (*as Azobenzene*) (122-66-7)	1625B	5.0	20
Fluoranthene (206-44-0)	625	0.3	0.6
Fluorene (86-73-7)	625	0.3	0.6
Hexachlorobenzene (118-74-1)	612/625	0.3	0.6
Hexachlorobutadiene (87-68-3)	625	0.5	1.0
Hexachlorocyclopentadiene (77-47-4)	1625B/625	0.5	1.0
Hexachloroethane (67-72-1)	625	0.5	1.0
Indeno(*1,2,3-cd*)Pyrene (193-39-5)	610/625	0.5	1.0
Isophorone (78-59-1)	625	0.5	1.0
3-Methyl cholanthrene (56-49-5)	625	2.0	8.0
Naphthalene (91-20-3)	625	0.3	0.6
Nitrobenzene (98-95-3)	625	0.5	1.0
N-Nitrosodimethylamine (62-75-9)	607/625	2.0	4.0
N-Nitrosodi-n-propylamine (621-64-7)	607/625	0.5	1.0
N-Nitrosodiphenylamine (86-30-6)	625	0.5	1.0
Perylene (198-55-0)	625	1.9	7.6
Phenanthrene (85-01-8)	625	0.3	0.6
Pyrene (129-00-0)	625	0.3	0.6
1,2,4-Trichlorobenzene (120-82-1)	625	0.3	0.6

Pollutant & CAS No. *(if available)*	Recommended Analytical Protocol	Detection (DL)[1] *µg/L unless specified*	Quantitation Level (QL)[2] *µg/L unless specified*
DIOXIN			
2,3,7,8-Tetra-Chlorodibenzo-P-Dioxin (176-40-16) (2,3,7,8 TCDD)	1613B	1.3 pg/L	5 pg/L

PRIORITY POLLUTANTS (continued)

Pollutant & CAS No. *(if available)*	Recommended Analytical Protocol	Detection (DL)[1] *µg/L unless specified*	Quantitation Level (QL)[2] *µg/L unless specified*
PESTICIDES/PCBs			
Aldrin (309-00-2)	608	0.025	0.05
alpha-BHC (319-84-6)	608	0.025	0.05
beta-BHC (319-85-7)	608	0.025	0.05
gamma-BHC (58-89-9)	608	0.025	0.05
delta-BHC (319-86-8)	608	0.025	0.05
Chlordane (57-74-9) [5]	608	0.025	0.05
4,4'-DDT (50-29-3)	608	0.025	0.05
4,4'-DDE (72-55-9)	608	0.025	0.05[10]
4,4' DDD (72-54-8)	608	0.025	0.05
Dieldrin (60-57-1)	608	0.025	0.05
alpha-Endosulfan (959-98-8)	608	0.025	0.05
beta-Endosulfan (33213-65-9)	608	0.025	0.05
Endosulfan Sulfate (1031-07-8)	608	0.025	0.05
Endrin (72-20-8)	608	0.025	0.05
Endrin Aldehyde (7421-93-4)	608	0.025	0.05
Heptachlor (76-44-8)	608	0.025	0.05
Heptachlor Epoxide (1024-57-3)	608	0.025	0.05
PCB-1242 (53469-21-9) [6]	608	0.25	0.5
PCB-1254 (11097-69-1)	608	0.25	0.5
PCB-1221 (11104-28-2)	608	0.25	0.5
PCB-1232 (11141-16-5)	608	0.25	0.5
PCB-1248 (12672-29-6)	608	0.25	0.5
PCB-1260 (11096-82-5)	608	0.13	0.5
PCB-1016 (12674-11-2) [6]	608	0.13	0.5
Toxaphene (8001-35-2)	608	0.24	0.5

1. Detection level (DL) or detection limit means the minimum concentration of an analyte (substance) that can be measured and reported with a 99% confidence that the analyte concentration is greater than zero as determined by the procedure given in 40 CFR part 136, Appendix B.

   Quantitation Level (QL) also known as Minimum Level of Quantitation (ML) – The lowest level at which the entire analytical system must give a recognizable signal and acceptable calibration point for the analyte. It is equivalent to the concentration of the lowest calibration standard, assuming that the lab has used all method-specified sample weights, volumes, and cleanup procedures. The QL is calculated by multiplying the MDL by 3.18 and rounding the result to the number nearest to (1, 2, or 5) x 10^n, where n is an integer. (64 FR 30417).
   ALSO GIVEN AS:
   The smallest detectable concentration of analyte greater than the Detection Limit (DL) where the accuracy (precision & bias) achieves the objectives of the intended purpose. (Report of the Federal Advisory Committee on Detection and Quantitation Approaches and Uses in Clean Water Act Programs Submitted to the US Environmental Protection Agency, December 2007).

2. NWTPH Dx - Northwest Total Petroleum Hydrocarbons Diesel Extended Range – see http://www.ecy.wa.gov/biblio/97602.html
3. NWTPH Gx - Northwest Total Petroleum Hydrocarbons Gasoline Extended Range – see http://www.ecy.wa.gov/biblio/97602.html
4. 1, 3-dichloroproylene (mixed isomers) You may report this parameter as two separate parameters: cis-1, 3-dichlorpropropene (10061-01-5) and trans-1, 3-dichloropropene (10061-02-6).
5. Total Benzofluoranthenes - Because Benzo(b)fluoranthene, Benzo(j)fluoranthene and Benzo(k)fluoranthene co-elute you may report these three isomers as total benzofluoranthenes.
6. Chlordane – You may report alpha-chlordane (5103-71-9) and gamma-chlordane (5103-74-2) in place of chlordane (57-74-9). If you report alpha and gamma-chlordane, the DL/PQLs that apply are 0.025/0.050.

   PCB 1016 & PCB 1242 – You may report these two PCB compounds as one parameter called PCB 1016/1242.

Fact Sheet for NPDES Permit WA0029351
City of North Bend WWTP

May 23, 2013

Purpose of this fact sheet

This fact sheet explains and documents the decisions the Department of Ecology (Ecology) made in drafting the proposed National Pollutant Discharge Elimination System (NPDES) permit for the City of North Bend Wastewater Treatment Plant (WWTP).

This fact sheet complies with Section 173-220-060 of the Washington Administrative Code (WAC), which requires Ecology to prepare a draft permit and accompanying fact sheet for public evaluation before issuing an NPDES permit.

Ecology makes the draft permit and fact sheet available for public review and comment at least thirty (30) days before issuing the final permit. Copies of the fact sheet and draft permit for the North Bend WWTP, NPDES permit WA0029351, were available for public review and comment from April 3, 2013, until May 3, 2013. For more details on preparing and filing comments about these documents, please see *Appendix A – Public Involvement Information.*

The City of North Bend reviewed the draft permit and fact sheet for factual accuracy. Ecology corrected any errors or omissions regarding the facility's location, history, wastewater discharges, or receiving water prior to publishing this draft fact sheet for public notice.

After the public comment period closes, Ecology will summarize substantive comments and provide responses to them. Ecology will include the summary and responses to comments in this fact sheet as *Appendix F - Response to Comments,* and publish it when issuing the final NPDES permit. Ecology will not revise the rest of the fact sheet, but the full document will become part of the legal history contained in the facility's permit file.

Summary

The City of North Bend operates an oxidation ditch wastewater treatment plant that discharges to the South Fork of the Snoqualmie River. Ecology issued the previous permit for this facility on April 7, 2006.

The proposed permit contains the same effluent limits for fecal coliform bacteria and pH as the permit issued in 2006. Significant changes from the previous permit include:

- The proposed permit includes revised mass-based limits for total suspended solids (TSS) based on increased hydraulic capacity of the treatment plant.
- The proposed permit includes revised mass-based limits for carbonaceous biochemical oxygen demand ($CBOD_5$) based on increased hydraulic capacity of the treatment plant for the months of November through July.
- During the months of August through October the proposed permit replaces limits for $CBOD_5$ and ammonia with the combined parameter NBOD+CBOD.
- The proposed permit removes the mercury limits from the previous permit; improved test methods have demonstrated the effluent has no reasonable potential to cause violations of the mercury water quality criteria.

- The proposed permit removes the receiving water testing for copper, mercury, silver, and zinc.
- The proposed permit requires the City to conduct monthly baseline effluent nutrient monitoring. Ecology is adding this nutrient monitoring to all NPDES permits for domestic wastewater treatment plants to aid in assessing nutrient impacts to waters of the State.
- The proposed permit adds effluent temperature as a required continuous effluent monitoring parameter.
- To ensure that North Bend is able to comply with the Snoqualmie River Basin Temperature TMDL (2011) as flows increase, the proposed permit includes a requirement for a study of options to reduce effluent temperatures during the critical period.

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I. Introduction

The Federal Clean Water Act (FCWA, 1972, and later amendments in 1977, 1981, and 1987) established water quality goals for the navigable (surface) waters of the United States. One mechanism for achieving the goals of the Clean Water Act is the National Pollutant Discharge Elimination System (NPDES), administered by the federal Environmental Protection Agency (EPA). The EPA authorized the state of Washington to manage the NPDES permit program in our state. Our state legislature accepted the delegation and assigned the power and duty for conducting NPDES permitting and enforcement to Ecology. The Legislature defined Ecology's authority and obligations for the wastewater discharge permit program in 90.48 RCW (Revised Code of Washington).

The following regulations apply to domestic wastewater NPDES permits:

- Procedures Ecology follows for issuing NPDES permits (chapter 173-220 WAC).
- Technical criteria for discharges from municipal wastewater treatment facilities (chapter 173-221 WAC).
- Water quality criteria for surface waters (chapter 173-201A WAC).
- Water quality criteria for ground waters (chapter 173-200 WAC).
- Whole effluent toxicity testing and limits (chapter 173-205 WAC).
- Sediment management standards (chapter 173-204 WAC).
- Submission of plans and reports for construction of wastewater facilities (chapter 173-240 WAC).

These rules require any treatment facility owner/operator to obtain an NPDES permit before discharging wastewater to state waters. They also help define the basis for limits on each discharge and for requirements imposed by the permit.

Under the NPDES permit program and in response to a complete and accepted permit application, Ecology must prepare a draft permit and accompanying fact sheet, and make them available for public review before final issuance. Ecology must also publish an announcement (public notice) telling people where they can read the draft permit, and where to send their comments, during a period of thirty days (WAC 173-220-050). (See *Appendix A – Public Involvement Information* for more detail about the public notice and comment procedures). After the public comment period ends, Ecology may make changes to the draft NPDES permit in response to comment(s). Ecology will summarize the responses to comments and any changes to the permit in Appendix F.

II. Background Information

Table 1. General Facility Information

Facility Information	
Applicant	City of North Bend
Facility Name and Address	North Bend Wastewater Treatment Plant 400 Bendigo Blvd. N. North Bend, WA 98045
Contact at Facility	Frank Page, P.E, Public Works Director 425-888-0486
Responsible Official	Kenneth G. Hearing, Mayor P.O. Box 896 North Bend, WA 98045 425-888-7625
Type of Treatment	Oxidation Ditch
Facility Location (NAD83/WGS84 reference datum)	Latitude: 47.499021 Longitude: -121.78533
Discharge Waterbody Name and Location (NAD83/WGS84 reference datum)	Snoqualmie River, South Fork Latitude: 47.499589 Longitude: -121.787731

Permit Status	
Renewal Date of Previous Permit	April 7, 2006
Application for Permit Renewal Submittal Date	November 19, 2010
Date of Ecology Acceptance of Application	September 6, 2011

Inspection Status	
Date of Last Non-sampling Inspection Date	March 8, 2013

Figure 1. Facility Location Map

A. Facility description

History

The City of North Bend, incorporated in 1909, covers approximately three square miles. The current population of North Bend (2010) is approximately 5,733. Sanitary sewers serve about 75 percent of the city's housing units and most of the commercial areas. Sewer facilities, including a primary treatment plant, were first constructed in 1950 and 1951. North Bend added an oxidation ditch to provide secondary treatment in 1978. Additional treatment plant improvements include a secondary clarifier constructed in 1998, ultraviolet disinfection and effluent pumping (2000), effluent reuse (3W) system (2003), sludge dewatering and drying system and oxidation ditch rotors (2004), and renovation of headworks and influent pump station (2011).

Collection system status

The original collection system was constructed in the 1950s, and grew significantly starting in the 1980s. North Bend's wastewater collection system is located primarily in the downtown, Si View subdivision, the Exit 31 Interchange, and Forester Woods areas. The City of North Bend owns two lift stations; three other lift stations are privately owned and maintained.

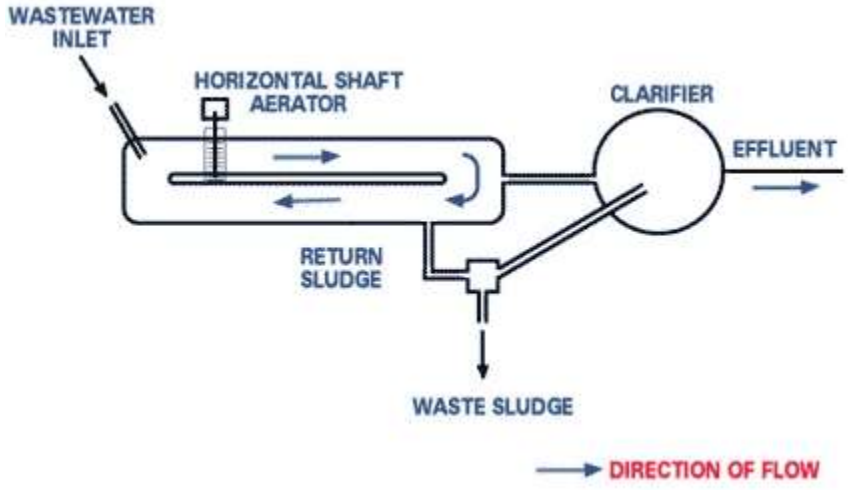
The older part of the collection system underwent extensive repairs to correct excessive inflow and infiltration in a two-phase project constructed in 1998 and 2003. These repairs resulted in a significant decrease in wet weather flows to the treatment plant.

Treatment processes

Sewage influent passes through a mechanically cleaned fine screen and enters the oxidation ditch. The oxidation ditch consists of a long channel of elliptical shape equipped with surface rotor aerators. During extended aeration, microorganisms digest the organic material in the sewage. Solids are then settled out in the secondary clarifier. Some of the settled solids return to the oxidation ditch to maintain the biological process and some are processed for disposal. Ultraviolet (UV) lights disinfect the clarified effluent before it enters the Snoqualmie River.

Figure 2 shows a simplified schematic of oxidation ditch treatment.

Figure 2. Oxidation Ditch Treatment Schematic



Solid wastes

The treatment facilities remove solids during the treatment of the wastewater at the headworks with fine screens, and at the secondary clarifier, in addition to incidental solids (rags, scum, and other debris) removed as part of the routine maintenance of the equipment. Solids removed from the secondary clarifier are dewatered in a centrifuge and dried in a Fenton drier. The North Bend WWTP disposes dried biosolids at Boulder Park Inc. in Douglas County, WA. Screenings are washed and compacted, then disposed of as solid waste along with incidental grit, rags and scum at the Roosevelt Landfill through a contract with Republic Services, Inc.

Discharge outfall

The treated and disinfected effluent flows into the South Fork of the Snoqualmie River. Wastewater effluent leaving the plant enters a 21-inch pipe that extends 445 feet to an 8-foot diameter diffusion manhole located near the east bank of the river. The diffusion manhole is exposed on the river bank, with wastewater effluent flowing down the river bank before it reaches the river.

B. Description of the receiving water

The North Bend WWTP discharges to the South Fork of the Snoqualmie River. Other nearby point source outfalls include the City of Snoqualmie, located downstream on the main stem Snoqualmie River. Significant nearby non-point sources of pollutants include forestry, agricultural activities, and runoff from developed areas and roadways.

The ambient background data used for this permit includes data from Ecology ambient monitoring stations 07M070 (SF Snoqualmie R. at North Bend, 1991) and 07M120 (SF Snoqualmie R. at 468th Ave. SE, 2006). Ambient temperature data is from the Snoqualmie River Basin Temperature TMDL study. The City of North Bend collected copper, mercury, silver, and zinc data for the river upstream of their discharge during the previous permit term.

Table 2. Ambient Background Data

Parameter	Value Used
Temperature (highest annual 7-DADMax)	18.8 °C
pH (Maximum / Minimum)	7.6 / 7.1 standard units
Dissolved Oxygen (Minimum)	10.2 mg/L
Total Ammonia-N	0.012 mg/L
Fecal Coliform (Maximum)	32/100 mL
Turbidity (Maximum)	2.1 NTU
Hardness (Aug-Oct)	21.3 mg/L as CaCO3
Arsenic (90th percentile dissolved)	0.776 µg/L
Lead	not detected
Copper (90th percentile total recoverable)	1.2 µg/L
Mercury (90th percentile total recoverable)	0.000472 µg/L
Nickel (90th percentile dissolved)	0.32 µg/L
Silver	not detected
Zinc (90th percentile total recoverable)	9.9 µg/L

C. Wastewater influent characterization

The City of North Bend reported the treatment plant flows and concentration of influent pollutants in discharge monitoring reports. Table 3 and Figures 3 through 5 describe the characteristics of the influent wastewater:

Table 3. Wastewater Influent Characterization (May 2006 – March 2012)

Parameter	Units	Value	Statistic
BOD_5	lbs/day	869 1,370	Average Highest month
BOD_5	mg/L	224 764	Average Highest month
$CBOD_5$		268	Average Highest month
TSS	lbs/day	617 1,205	Average Highest month
TSS	mg/L	146 243	Average Highest month

Figure 3. Monthly average flow

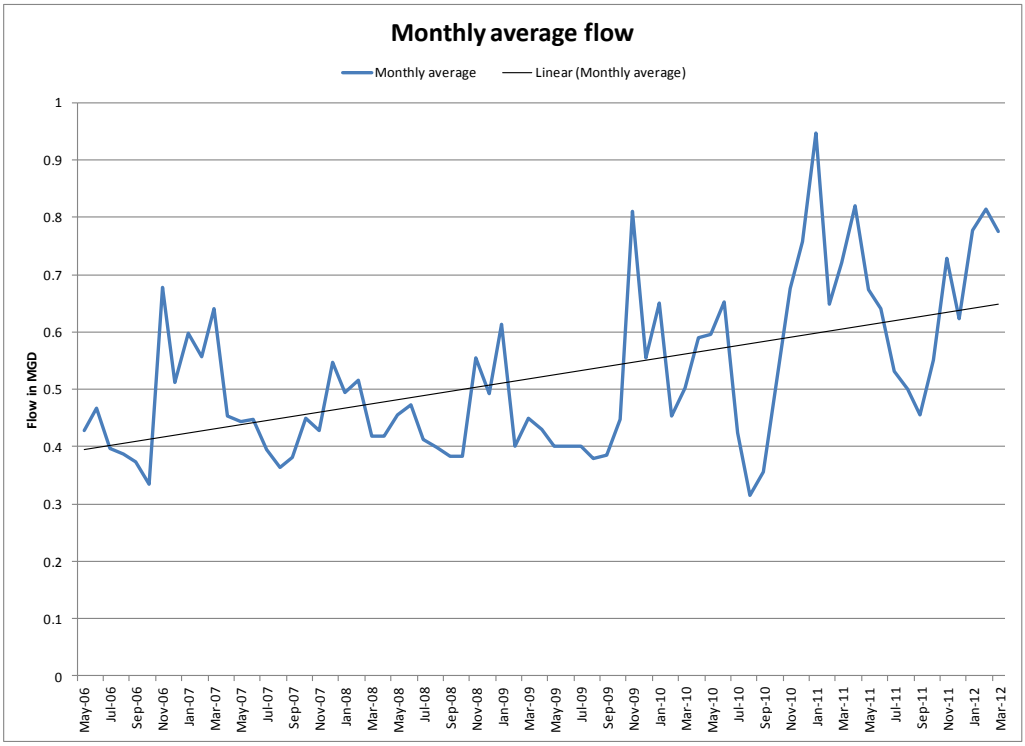


Figure 4. Influent BOD_5 Loading

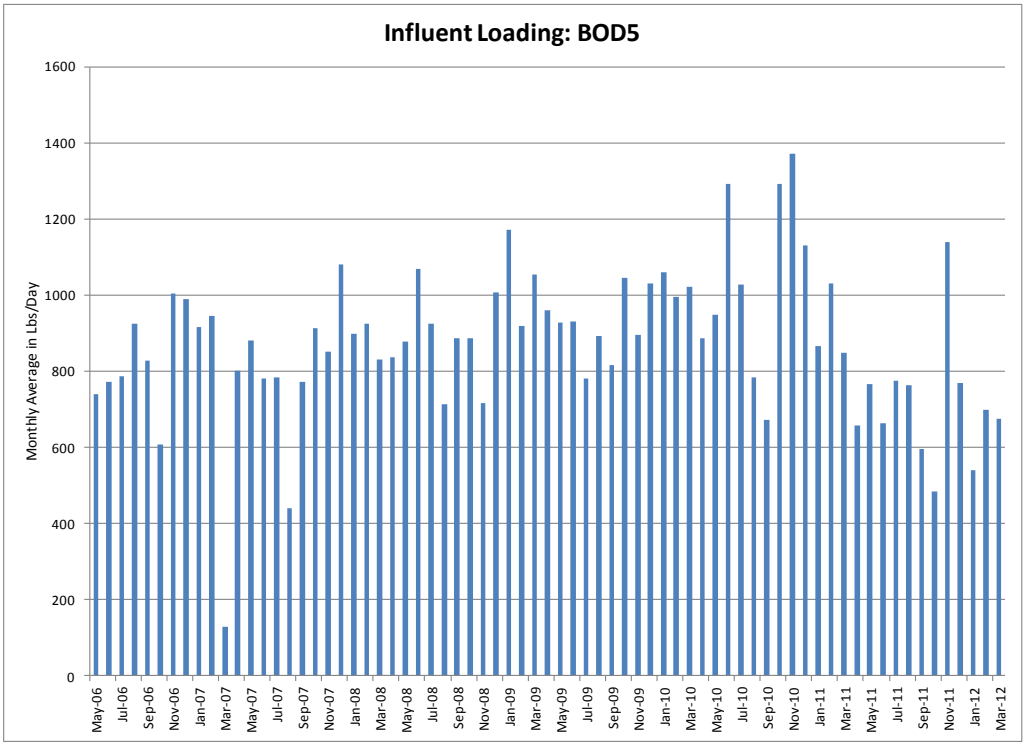
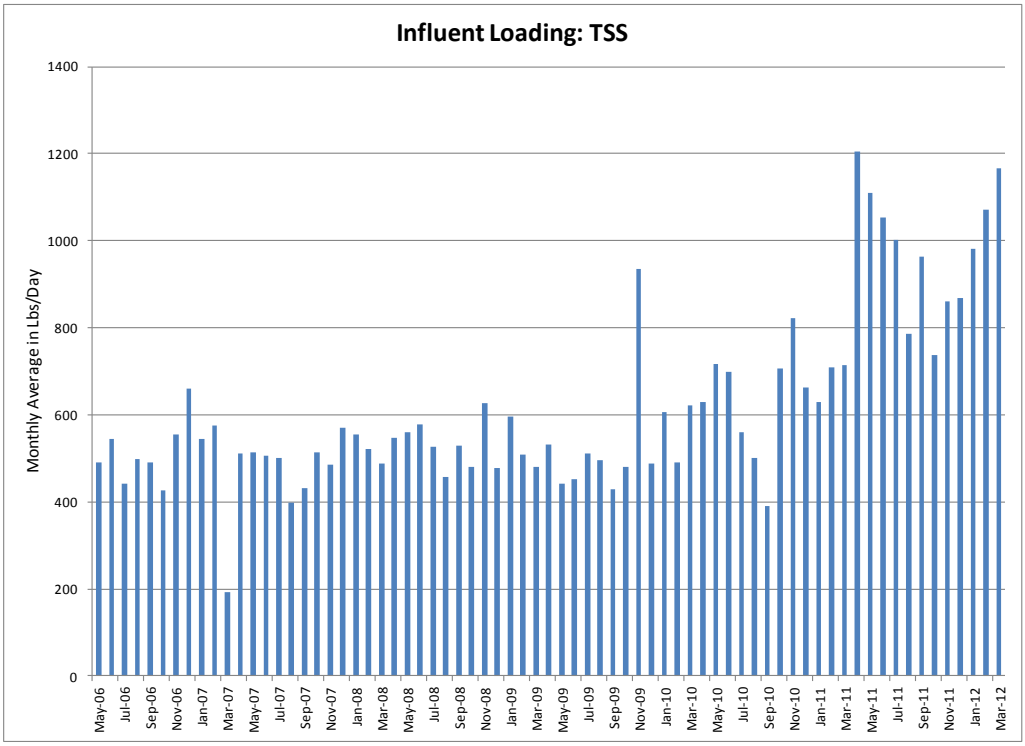


Figure 5. Influent TSS Loading



D. Wastewater effluent characterization

The City of North Bend reported the concentration of pollutants in the discharge in the permit application and in discharge monitoring reports. The wastewater effluent is characterized as follows:

Table 4. Wastewater Effluent Characterization (DMR Data, May 2006 – March 2012)

Parameter	Units	Value	Statistic
Ammonia	lbs/day	6.34 82.7	Average Maximum day
Ammonia	mg/L	1.85 12.3	Average 95th percentile
$CBOD_5$	lbs/day	15.3 116	Average Highest week
$CBOD_5$	mg/L	3.5 14	Average Highest week
Fecal Coliform	#/100 mL	14.4 198	Average monthly geometric mean Highest weekly geometric mean
Temperature	°C	14.3 22.7	Average Highest 7-DADMax
pH	std. units	7.8 6.0	95th percentile 5th percentile
TSS	lbs/day	22.4 395	Average Highest week
TSS	mg/L	4.7 43	Average Highest week

Table 5. Additional Effluent Testing Data (March 2010 – April 2012)

Parameter	Units	# of Samples	Value	Statistic
Total Kjeldahl Nitrogen (TKN)	mg/L	2	0.677	Maximum
Nitrate plus nitrate nitrogen	mg/L	2	5.5	Maximum
Oil and grease	mg/L	2	1.4	Maximum
Phosphorus (total)	mg/L	2	3.3	Maximum
Total Dissolved Solids (TDS)	mg/L	2	240	Maximum
Hardness	mg/L	3	60	Average
Antimony	µg/L	4	.52	Maximum
Arsenic	µg/L	4	6.79	Maximum
Chromium	µg/L	4	0.43	Maximum
Copper	µg/L	24	5.73	95th percentile
Lead	µg/L	4	0.80	Maximum
Mercury	µg/L	52	0.0159	95th percentile
Nickel	µg/L	4	1.04	Maximum
Selenium	µg/L	4	1.17	Maximum
Silver	µg/L	24	0.22	95th percentile
Zinc	µg/L	24	75.8	95th percentile

The previous permit required acute and chronic whole effluent toxicity (WET) testing. The test results show that the effluent met the acute performance standard outlined in WAC 174-205-050(2)(a)(i), a median of 80 percent survival in 100 percent effluent and not any single test less than 65 percent survival. The tests also met the chronic performance standard of no toxicity in a sample diluted to the acute critical effluent concentration (67% effluent).

E. Summary of compliance with previous permit issued April 7, 2006

The previous permit placed effluent limits on $CBOD_5$, TSS, Fecal Coliform, pH, Total Ammonia, and Mercury. The North Bend WWTP has not consistently complied with the effluent limits and permit conditions throughout the duration of the permit. Ecology assessed compliance based on its review of the facility's discharge monitoring reports (DMRs) and on inspections. The North Bend WWTP received an "Outstanding Wastewater Treatment Plant Award" for full compliance in 2007.

The following table summarizes the violations and permit triggers that occurred during the permit term.

Table 6. Violations

Date	Parameter	Statistical Base	Value	Limit	Violation
August 2008	Ammonia	mg/L lbs/day			Analysis not conducted
September 2008	Ammonia	mg/L lbs/day			Analysis not conducted
August 2009	Ammonia	mg/L lbs/day			Analysis not conducted
October 2010					Late submittal of DMR
November 2010					Late submittal of DMR
January 2011	pH	Minimum	5.4	6.0	Numeric effluent violation
January 2011	TSS	Minimum Percent removal	81.5	85	Numeric effluent violation
April 2011					Late submittal of DMR
May 2011					Late submittal of DMR
June 2011					Late submittal of DMR
August 2011	Ammonia	Average lbs/day	25.99	8.4	Numeric effluent violation
August 2011	Ammonia	Maximum lbs/day	51.7	20.25	Numeric effluent violation
September 2011					Late submittal of DMR
October 2011	Ammonia	Average lbs/day	50.01	8.4	Numeric effluent violation
October 2011	Ammonia	Maximum lbs/day	82.7	20.25	Numeric effluent violation
October 2011					Late submittal of DMR
December 2011					Late submittal of DMR

F. State environmental policy act (SEPA) compliance

State law exempts reissuance or modification of any wastewater discharge permit from the SEPA process as long as the permit contains conditions are no less stringent than federal and state rules and regulations (RCW 43.21C.0383). The exemption applies only to existing discharges, not to new discharges.

III. Proposed Permit Limits

Federal and state regulations require that effluent limits in an NPDES permit must be either technology- or water quality-based.

- Technology-based limits are based upon the treatment methods available to treat specific pollutants. Technology-based limits are set by the EPA and published as a regulation, or Ecology develops the limit on a case-by-case basis (40 CFR 125.3, and chapter 173-220 WAC).
- Water quality-based limits are calculated so that the effluent will comply with the Surface Water Quality Standards (chapter 173-201A WAC), Ground Water Standards (chapter 173-200 WAC), Sediment Quality Standards (chapter 173-204 WAC), or the National Toxics Rule (40 CFR 131.36).
- Ecology must apply the most stringent of these limits to each parameter of concern. These limits are described below.

The limits in this permit reflect information received in the application and from supporting reports (engineering, hydrogeology, etc.). Ecology evaluated the permit application and determined the limits needed to comply with the rules adopted by the state of Washington. Ecology does not develop effluent limits for all reported pollutants. Some pollutants are not treatable at the concentrations reported, are not controllable at the source, are not listed in regulation, and do not have a reasonable potential to cause a water quality violation.

Ecology does not usually develop limits for pollutants not reported in the permit application but may be present in the discharge. The permit does not authorize discharge of the non-reported pollutants. During the five-year permit term, the facility's effluent discharge conditions may change from those conditions reported in the permit application. The facility must notify Ecology if significant changes occur in any constituent [40 CFR 122.42(a)]. Until Ecology modifies the permit to reflect additional discharge of pollutants, a permitted facility could be violating its permit.

A. Design criteria

Under WAC 173-220-150 (1)(g), flows and waste loadings must not exceed approved design criteria. Ecology approved design criteria for this facility's treatment plant in the *Engineering Report* (Earth Tech, 1996; approved July 22, 1997) and in the *Final Comprehensive Sewer Plan* (Earth Tech, 2001; approved June 29, 2005). The table below includes design criteria for BOD_5 and TSS from the Engineering Report.

The previous permit limited influent flow to the hydraulic capacity of the influent pumps, 2.4 MGD. These pumps were replaced with higher capacity pumps in 2011. The limiting flow capacity is now based on the maximum month flow for the secondary clarifier from Table 8-2 of the *Final Comprehensive Sewer Plan* (revised 6/14/2005).

Table 7. Design Criteria for City of North Bend WWTP

Parameter	Design Quantity
Maximum Month Design Flow (MMDF)	2.58 MGD
BOD_5 Loading for Maximum Month	2805 lb/day
TSS Loading for Maximum Month	2304 lb/day

B. Technology-based effluent limits

Federal and state regulations define technology-based effluent limits for municipal wastewater treatment plants. These effluent limits are given in 40 CFR Part 133 (federal) and in chapter 173-221 WAC (state). These regulations are performance standards that constitute all known, available, and reasonable methods of prevention, control, and treatment (AKART) for municipal wastewater.

The table below identifies technology-based limits for pH, fecal coliform, $CBOD_5$, and TSS, as listed in chapter 173-221 WAC. The proposed fact sheet describes water quality-based limits in Section III.F.

Table 8. Technology-based Limits

Parameter	Average Monthly Limit	Average Weekly Limit
$CBOD_5$ (concentration)	25 mg/L	40 mg/L
$CBOD_5$ (concentration)	In addition, the $CBOD_5$ effluent concentration must not exceed fifteen percent (15%) of the average influent concentration.	
TSS (concentration)	30 mg/L	45 mg/L
TSS (concentration)	In addition, the TSS effluent concentration must not exceed fifteen percent (15%) of the average influent concentration.	

Parameter	Monthly Geometric Mean Limit	Weekly Geometric Mean Limit
Fecal Coliform Bacteria	200 organisms/100 mL	400 organisms/100 mL

Parameter	Daily Minimum	Daily Maximum
pH	6.0 standard units	9.0 standard units

Technology-based mass limits are based on WAC 173-220-130(3)(b) and 173-221-030(11)(b). Ecology calculated the monthly and weekly average mass limits for $CBOD_5$ and Total Suspended Solids as follows:

Mass Limit = CL x DF x CF

where:

CL = Technology-based concentration limits listed in Table 9

DF = Maximum Monthly Average Design flow (2.58 MGD)

CF = Conversion factor of 8.34

Technology-based mass limits for $CBOD_5$ apply during the months of November through July. $CBOD_5$ mass limits for August through October are water quality (TMDL) based, as discussed in the next section of this fact sheet. Technology-based mass limits for TSS are based on the maximum month design flow for the months of November through July, and on the maximum estimated dry weather flow of 1.4 MGD for the months of August through October.

Table 9. Technology-based Mass Limits

Parameter	Concentration Limit (mg/L)	Mass Limit (lbs/day) November-July	Mass Limit (lbs/day) August-October
$CBOD_5$ Monthly Average	25	538	WQ-based limit
$CBOD_5$ Weekly Average	40	861	WQ-based limit
TSS Monthly Average	30	646	350
TSS Weekly Average	45	968	525

C. Surface water quality-based effluent limits

The Washington State surface water quality standards (chapter 173-201A WAC) are designed to protect existing water quality and preserve the beneficial uses of Washington's surface waters. Waste discharge permits must include conditions that ensure the discharge will meet the surface water quality standards (WAC 173-201A-510). Water quality-based effluent limits may be based on an individual waste load allocation or on a waste load allocation developed during a basin wide total maximum daily load study (TMDL).

Numerical criteria for the protection of aquatic life and recreation

Numerical water quality criteria are listed in the water quality standards for surface waters (chapter 173-201A WAC). They specify the maximum levels of pollutants allowed in receiving water to protect aquatic life and recreation in and on the water. Ecology uses numerical criteria along with chemical and physical data for the wastewater and receiving water to derive the effluent limits in the discharge permit. When surface water quality-based limits are more stringent or potentially more stringent than technology-based limits, the discharge must meet the water quality-based limits.

Numerical criteria for the protection of human health

The U.S. EPA has published 91 numeric water quality criteria for the protection of human health that are applicable to dischargers in Washington State (EPA, 1992). These criteria are designed to protect humans from exposure to pollutants linked to cancer and other diseases, based on consuming fish and shellfish and drinking contaminated surface waters. The water quality standards also include radionuclide criteria to protect humans from the effects of radioactive substances.

Narrative criteria

Narrative water quality criteria (e.g., WAC 173-201A-240(1); 2006) limit the toxic, radioactive, or other deleterious material concentrations that the facility may discharge to levels below those which have the potential to:

- Adversely affect designated water uses.
- Cause acute or chronic toxicity to biota.
- Impair aesthetic values.
- Adversely affect human health.

Narrative criteria protect the specific designated uses of all fresh waters (WAC 173-201A-200, 2006) and of all marine waters (WAC 173-201A-210, 2006) in the state of Washington.

Antidegradation

Description--The purpose of Washington's Antidegradation Policy (WAC 173-201A-300-330; 2006) is to:

- Restore and maintain the highest possible quality of the surface waters of Washington.
- Describe situations under which water quality may be lowered from its current condition.
- Apply to human activities that are likely to have an impact on the water quality of surface water.
- Ensure that all human activities likely to contribute to a lowering of water quality, at a minimum, apply all known, available, and reasonable methods of prevention, control, and treatment (AKART).
- Apply three tiers of protection (described below) for surface waters of the state.

Tier I ensures existing and designated uses are maintained and protected and applies to all waters and all sources of pollutions. Tier II ensures that waters of a higher quality than the criteria assigned are not degraded unless such lowering of water quality is necessary and in the overriding public interest. Tier II applies only to a specific list of polluting activities. Tier III prevents the degradation of waters formally listed as "outstanding resource waters," and applies to all sources of pollution.

A facility must prepare a Tier II analysis when all three of the following conditions are met:

- The facility is planning a new or expanded action.
- Ecology regulates or authorizes the action.
- The action has the potential to cause measurable degradation to existing water quality at the edge of a chronic mixing zone.

Facility Specific Requirements--This facility must meet Tier I requirements.

- Dischargers must maintain and protect existing and designated uses. Ecology must not allow any degradation that will interfere with, or become injurious to, existing or designated uses, except as provided for in chapter 173-201A WAC.
- For waters that do not meet assigned criteria, or protect existing or designated uses, Ecology will take appropriate and definitive steps to bring the water quality back into compliance with the water quality standards. Ecology completed a Total Maximum Daily Load (TMDL) study for BOD_5, ammonia, and fecal coliform in the Snoqualmie River in 1994. Ecology completed a TMDL for temperature in the Snoqualmie River in 2011. Conditions in the proposed permit reflect the waste load allocations assigned by these TMDL studies.

Ecology’s analysis described in this section of the fact sheet demonstrates that the proposed permit conditions will protect existing and designated uses of the receiving water.

Mixing zones

A mixing zone is the defined area in the receiving water surrounding the discharge port(s), where wastewater mixes with receiving water. Within mixing zones the pollutant concentrations may exceed water quality numeric standards, so long as the discharge doesn't interfere with designated uses of the receiving water body (for example, recreation, water supply, and aquatic life and wildlife habitat, etc.) The pollutant concentrations outside of the mixing zones must meet water quality numeric standards.

State and federal rules allow mixing zones because the concentrations and effects of most pollutants diminish rapidly after discharge, due to dilution. Ecology defines mixing zone sizes to limit the amount of time any exposure to the end-of-pipe discharge could harm water quality, plants, or fish.

The state's water quality standards allow Ecology to authorize mixing zones for the facility's permitted wastewater discharges only if those discharges already receive all known, available, and reasonable methods of prevention, control, and treatment (AKART). Mixing zones typically require compliance with water quality criteria within a specified distance from the point of discharge and must not use more than 25% of the available width of the water body for dilution [WAC 173-201A-400 (7)(a)(ii-iii)].

Ecology uses modeling to estimate the amount of mixing within the mixing zone. Through modeling Ecology determines the potential for violating the water quality standards at the edge of the mixing zone and derives any necessary effluent limits. Steady-state models are the most frequently used tools for conducting mixing zone analyses. Ecology chooses values for each effluent and for receiving water variables that correspond to the time period when the most critical condition is likely to occur (see Ecology's *Permit Writer's Manual*). Each critical condition parameter, by itself, has a low probability of occurrence and the resulting dilution factor is conservative. The term "reasonable worst-case" applies to these values.

The mixing zone analysis produces a numerical value called a dilution factor (DF). A dilution factor represents the amount of mixing of effluent and receiving water that occurs at the boundary of the mixing zone. For example, a dilution factor of 10 means the effluent is 10% and the receiving water is 90% of the total volume of water at the boundary of the mixing zone. Ecology uses dilution factors with the water quality criteria to calculate reasonable potentials and effluent limits. Water quality standards include both aquatic life-based criteria and human health-based criteria. The former are applied at both the acute and chronic mixing zone boundaries; the latter are applied only at the chronic boundary. The concentration of pollutants at the boundaries of any of these mixing zones may not exceed the numerical criteria for that zone.

Each aquatic life *acute* criterion is based on the assumption that organisms are not exposed to that concentration for more than one hour and more often than one exposure in three years. Each aquatic life *chronic* criterion is based on the assumption that organisms are not exposed to that concentration for more than four consecutive days and more often than once in three years.

The two types of human health-based water quality criteria distinguish between those pollutants linked to non-cancer effects (non-carcinogenic) and those linked to cancer effects (carcinogenic). The human health-based water quality criteria incorporate several exposure and risk assumptions. These assumptions include:

- A 70-year lifetime of daily exposures.
- An ingestion rate for fish or shellfish measured in kg/day.
- An ingestion rate of two liters/day for drinking water.
- A one-in-one-million cancer risk for carcinogenic chemicals.

This permit authorizes a small acute mixing zone, surrounded by a chronic mixing zone around the point of discharge (WAC 173-201A-400). The water quality standards impose certain conditions before allowing the discharger a mixing zone:

1. **Ecology must specify both the allowed size and location in a permit.**

   The proposed permit specifies the size and location of the allowed mixing zone (as specified below).

2. **The facility must fully apply "all known, available, and reasonable methods of prevention, control and treatment" (AKART) to its discharge.**

   Ecology has determined that the treatment provided at the North Bend WWTP meets the requirements of AKART (see "Technology-based Limits").

3. **Ecology must consider critical discharge conditions.**

   Surface water quality-based limits are derived for the water body's critical condition (the receiving water and waste discharge condition with the highest potential for adverse impact on the aquatic biota, human health, and existing or designated waterbody uses). The critical discharge condition is often pollutant-specific or waterbody-specific.

   Critical discharge conditions are those conditions that result in reduced dilution or increased effect of the pollutant. Factors affecting dilution include the depth of water, the density stratification in the water column, the currents, and the rate of discharge. Ecology's *Permit Writer's Manual* describes additional guidance on criteria/design conditions for determining dilution factors. The manual can be obtained from Ecology's website at: http://www.ecy.wa.gov/biblio/92109.html.

   Ecology obtained data for critical conditions in the vicinity of the outfall from the *Evaluation of Water Quality-Based NPDES Permit Limitations* (Cosmopolitan, March 2005), the *Snoqualmie River Basin Temperature TMDL Water Quality Improvement Report and Implementation Plan* (June 2011), USGS data for gauging Station 12144000. Critical effluent flows are based on DMR data from 2009-2011 according to Ecology's Permit Writer's Manual. Detailed information on critical conditions, modeling and dilution factors is presented in Appendix E.

4. **Supporting information must clearly indicate the mixing zone would not:**

   - Have a reasonable potential to cause the loss of sensitive or important habitat.
   - Substantially interfere with the existing or characteristic uses.

- Result in damage to the ecosystem.
- Adversely affect public health.

Ecology established Washington State water quality criteria for toxic chemicals using EPA criteria. EPA developed the criteria using toxicity tests with numerous organisms and set the criteria to generally protect the species tested and to fully protect all commercially and recreationally important species.

EPA sets acute criteria for toxic chemicals assuming organisms are exposed to the pollutant at the criteria concentration for one hour. They set chronic standards assuming organisms are exposed to the pollutant at the criteria concentration for four days. Dilution modeling under critical conditions generally shows that both acute and chronic criteria concentrations are reached within minutes of discharge.

The discharge plume does not impact drifting and non-strong swimming organisms because they cannot stay in the plume close to the outfall long enough to be affected. Strong swimming fish could maintain a position within the plume, but they can also avoid the discharge by swimming away. Mixing zones generally do not affect benthic organisms (bottom dwellers) because the buoyant plume rises in the water column. Ecology has additionally determined that the effluent will not exceed 33 degrees C for more than two seconds after discharge; and that the temperature of the water will not create lethal conditions or blockages to fish migration.

Ecology evaluates the cumulative toxicity of an effluent by testing the discharge with whole effluent toxicity (WET) testing.

Because this is a domestic wastewater discharge, the effluent contains fecal coliform bacteria. Ecology developed the water quality criteria for fecal coliform (discussed below) to assure that people swimming (primary contact recreation) in water meeting the criteria would not develop gastro enteric illnesses. Ecology has authorized a mixing zone for this discharge; however, the discharge is subject to a technology-based effluent limit of 200 colony forming units/100mL. This means the effluent meets the water quality criteria at the point of discharge and doesn't need dilution to meet the water quality criteria.

Ecology reviewed the above information, the specific information on the characteristics of the discharge, the receiving water characteristics, and the discharge location. Based on this review, Ecology concluded that the discharge does not have a reasonable potential to cause the loss of sensitive or important habitat, substantially interfere with existing or characteristics uses, result in damage to the ecosystem, or adversely affect public health if the permit limits are met.

5. The discharge/receiving water mixture must not exceed water quality criteria outside the boundary of a mixing zone.

Ecology conducted a reasonable potential analysis, using procedures established by the EPA and by Ecology, for each pollutant and concluded the discharge/receiving water mixture will not violate water quality criteria outside the boundary of the mixing zone if permit limits are met.

6. The size of the mixing zone and the concentrations of the pollutants must be minimized.

At any given time, the effluent plume uses only a portion of the acute and chronic mixing zone, which minimizes the volume of water involved in mixing. The plume mixes as it rises through the water column therefore much of the receiving water volume at lower depths in the mixing zone is not mixed with discharge. Similarly, because the discharge may stop rising at some depth due to density stratification, waters above that depth will not mix with the discharge. Ecology determined it is impractical to specify in the permit the actual, much more limited volume in which the dilution occurs as the plume rises and moves with the current.

Ecology minimizes the size of mixing zones by requiring dischargers to install diffusers when they are appropriate to the discharge and the specific receiving waterbody. When a diffuser is installed, the discharge is more completely mixed with the receiving water in a shorter time. Ecology also minimizes the size of the mixing zone (in the form of the dilution factor) using design criteria with a low probability of occurrence. For example, Ecology uses the expected 95th percentile pollutant concentration, the 90th percentile background concentration, the centerline dilution factor, and the lowest flow occurring once in every ten years to perform the reasonable potential analysis.

Because of the above reasons, Ecology has effectively minimized the size of the mixing zone authorized in the proposed permit.

7. Maximum size of mixing zone.

The authorized mixing zone for aquatic life and human health criteria does not exceed the maximum size restriction.

The authorized mixing zone for temperature criteria exceeds the maximum size restriction on width (the dilution factor for 25% of critical river flow exceeds the modeled dilution factor for 25% of critical river width). An exception to the numeric size criteria for mixing zones is allowed by WAC 173-201A-400(12) when the discharge existed prior to November 24, 1992. Before Ecology may allow such an exception, it must be demonstrated that:

1. AKART appropriate to the discharge is being fully applied;
2. All siting, technological, and managerial options which would result in full or significantly closer compliance that are economically achievable are being utilized; and
3. Supporting information clearly indicates the mixing zone would not have a reasonable potential to cause a loss of sensitive or important habitat, substantially interfere with the existing or characteristic uses of the water body, result in damage to the ecosystem, or adversely affect public health as determined by Ecology.

Ecology concluded that this discharge meets the requirements for an exception to the rule that the mixing zone must occupy less than 25% of the river width, for the following reasons:

1. Chapter 173-221 WAC defines AKART for domestic wastewater facilities for the parameters of BOD_5, TSS, pH, and fecal coliform. Limits for these parameters are included in the proposed permit. No regulatory definition of AKART for temperature exists.
2. Some siting, technological, and managerial options may exist to reduce the temperature of the discharge or remove it from the river during the critical period. The proposed permit requires City of North Bend to evaluate the feasibility and costs of these options.
3. Supporting information on the habitat, characteristic uses, and ecosystem of the Snoqualmie River and its tributaries is provided in the Snoqualmie River Basin Temperature TMDL (2011). This study concluded that appropriate limits for municipal treatment plant point sources should be based on a mixing zone calculated with 25% of critical river flow. The primary solution identified in the TMDL for high water temperatures in the Snoqualmie River Basin is increased shade to be provided by trees. No impact to public health will be caused by this temperature mixing zone.

8. Acute mixing zone.

- **The discharge/receiving water mixture must comply with acute criteria as near to the point of discharge as practicably attainable.**

  Ecology determined the acute criteria will be met at 10% of the volume fraction of the chronic mixing zone at the ten year low flow.

- **The pollutant concentration, duration, and frequency of exposure to the discharge will not create a barrier to migration or translocation of indigenous organisms to a degree that has the potential to cause damage to the ecosystem.**

  As described above, the toxicity of any pollutant depends upon the exposure, the pollutant concentration, and the time the organism is exposed to that concentration. Authorizing a limited acute mixing zone for this discharge assures that it will not create a barrier to migration. The effluent from this discharge will rise as it enters the receiving water, assuring that the rising effluent will not cause translocation of indigenous organisms near the point of discharge (below the rising effluent).

- **Comply with size restrictions.**

  The mixing zone authorized for this discharge complies with the size restrictions published in chapter 173-201A WAC.

9. Overlap of mixing zones.

This mixing zone does not overlap another mixing zone.

D. Designated uses and surface water quality criteria

Applicable designated uses and surface water quality criteria are defined in chapter 173-201A WAC. In addition, the U.S. EPA set human health criteria for toxic pollutants (EPA 1992). The tables included below summarize the criteria applicable to the receiving water's designated uses.

- Aquatic Life Uses are designated based on the presence of, or the intent to provide protection for the key uses. All indigenous fish and non-fish aquatic species must be protected in waters of the state in addition to the key species. The Aquatic Life Uses for this receiving water are identified below.

Table 10. Freshwater Aquatic Life Uses and Associated Criteria

Core Summer Salmonid Habitat	
Temperature Criteria – Highest 7-DAD MAX	16°C (60.8°F)
Dissolved Oxygen Criteria	9.5 mg/L
Turbidity Criteria	• 5 NTU over background when the background is 50 NTU or less; or • A 10 percent increase in turbidity when the background turbidity is more than 50 NTU.
Total Dissolved Gas Criteria	Total dissolved gas must not exceed 110 percent of saturation at any point of sample collection.
pH Criteria	The pH must measure within the range of 6.5 to 8.5, with a human-caused variation within the above range of less than 0.2 units.

- The *recreational uses* for this receiving water are identified below.

Table 11. Recreational Uses and Associated Criteria

Recreational Use	**Criteria**
Primary Contact Recreation	Fecal coliform organism levels must not exceed a geometric mean value of 100 colonies /100 mL, with not more than 10 percent of all samples (or any single sample when less than ten sample points exist) obtained for calculating the geometric mean value exceeding 200 colonies /100 mL.

- The *water supply uses* are domestic, agricultural, industrial, and stock watering.
- The *miscellaneous freshwater uses* are wildlife habitat, harvesting, commerce and navigation, boating, and aesthetics.

E. Water quality impairments

The Snoqualmie River Total Maximum Daily Load (TMDL) Study (1994) limits ammonia, $CBOD_5$ and fecal coliform bacteria discharges to the Snoqualmie River during the low flow months of August, September, and October. The TMDL study evaluated options which included wastewater discharges at Fall City and Carnation, in addition to the existing plants at North Bend, Snoqualmie, and Duvall. The Carnation WWTP began operating in 2008. The proposed permit is based on the 5-plant scenario. The City of North Bend allocation for $CBOD_5$ is 175 lbs/day and the allocation for ammonia is 58.2 lbs/day during the months of August, September, and October. Compliance with the technology-based standards for fecal coliform will meet the requirements of the TMDL.

The Snoqualmie River Basin Temperature TMDL (2011) includes temperature waste load allocations for the WWTPs at North Bend, Snoqualmie, Carnation, and Duvall, as well as load allocations for stream shading throughout the watershed. The TMDL temperature allocation for the North Bend WWTP limits effluent temperature to an increase of 0.3 °C

above the temperature criterion of 16 °C at the edge of a mixing zone based on 25% of the 7Q10 low flow. The specific temperature allocation depends on effluent dilution factors and must be calculated each permit cycle. If critical season flow or effluent temperature increases, future permits may include effluent temperature or flow limits based on the TMDL. This allocation applies during the months of June through September.

F. Evaluation of surface water quality-based effluent limits for numeric criteria

Pollutants in an effluent may affect the aquatic environment near the point of discharge (near-field) or at a considerable distance from the point of discharge (far-field). Toxic pollutants, for example, are near-field pollutants; their adverse effects diminish rapidly with mixing in the receiving water. Conversely, a pollutant such as biochemical oxygen demand (BOD_5) is a far-field pollutant whose adverse effect occurs away from the discharge even after dilution has occurred. Thus, the method of calculating surface water quality-based effluent limits varies with the point at which the pollutant has its maximum effect.

With technology-based controls (AKART), predicted pollutant concentrations in the discharge exceed water quality criteria. Ecology therefore authorizes a mixing zone in accordance with the geometric configuration, flow restriction, and other restrictions imposed on mixing zones by chapter 173-201A WAC.

Wastewater effluent leaving the plant enters a 21-inch pipe that extends 445 feet to an 8-foot diameter diffusion manhole located near the east bank of the river. The diffusion manhole is exposed at low river flow, with wastewater effluent flowing across an exposed gravel bar before it reaches the river.

Chronic Mixing Zone – WAC 173-201A-400(7)(a) specifies that mixing zones must not extend in a downstream direction from the discharge ports for a distance greater than 300 feet plus the depth of water over the discharge ports or extend upstream for a distance of over 100 feet, not utilize greater than 25% of the flow, and not occupy greater than 25% of the width of the water body.

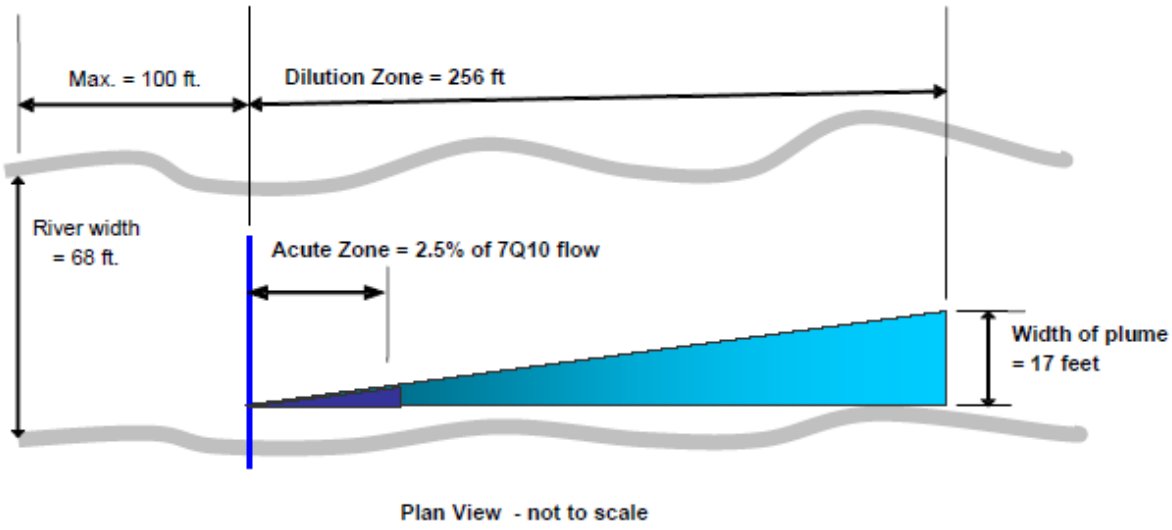
The horizontal distance of the chronic mixing zone is limited by the restriction to 25% of the river width. This plume width occurs 256 feet downstream of the diffuser at critical flow. The dilution factors for chronic aquatic life and human health criteria are based on this distance.

Chronic Mixing Zone for Temperature – The mixing zone for temperature is based on 25% of the river flow at critical (7Q10) conditions.

Acute Mixing Zone – WAC 173-201A-400(8)(a) specifies that in rivers and streams a zone where acute toxics criteria may be exceeded must not extend beyond 10% of the distance towards the upstream and downstream boundaries of the chronic zone, not use greater than 2.5% of the flow and not occupy greater than 25% of the width of the water body.

The flow volume restriction resulted in a smaller acute dilution factor than the distance downstream. The dilution factor for acute aquatic life criteria is based on 2.5% of the river flow at critical (7Q10) conditions.

Figure 6. Mixing Zone Schematic



Ecology's calculations and models used to determine the dilution factors that occur within these zones at the critical condition are in Appendix E of this fact sheet. The dilution factors are listed below.

Table 12. Dilution Factors (DF)

Criteria	Acute	Chronic
Aquatic Life	2.8	14.8
Human Health, Carcinogen		60.7
Human Health, Non-carcinogen		18.4
Temperature		20.9

Ecology determined the impacts of dissolved oxygen deficiency, pH, fecal coliform, ammonia, metals, other toxics, and temperature as described below, using the dilution factors in the above table. The derivation of surface water quality-based limits also takes into account the variability of pollutant concentrations in both the effluent and the receiving water.

Dissolved Oxygen – BOD_5 and Ammonia Effects – Natural decomposition of organic material in wastewater effluent impacts dissolved oxygen in the receiving water at distances far outside of the regulated mixing zone. The 5-day Biochemical Oxygen Demand (BOD_5) of an effluent sample indicates the amount of biodegradable material in the wastewater and estimates the magnitude of oxygen consumption the wastewater will generate in the receiving water. The amount of ammonia-based nitrogen in the wastewater also provides an indication of oxygen demand potential in the receiving water.

Ecology has completed a dissolved oxygen TMDL (*Snoqualmie River Total Maximum Daily Load Study* (1994)) and established waste load allocations (WLAs) for carbonaceous biochemical oxygen demand ($CBOD_5$) and ammonia. The proposed permit includes effluent limits for $CBOD_5$ and ammonia derived from the completed TMDL. The TMDL waste load allocations for North Bend during the months of August through October are:

- 175 lbs/day $CBOD_5$
- 58.2 lbs/day Ammonia (N)

Because the combination of $CBOD_5$ and ammonia determines the effluent's oxygen demand, different combinations of the two parameters can also meet the TMDL allocation. For the South Fork Snoqualmie River, 2.155 pounds of $CBOD_5$ is equivalent to 1 pound of ammonia (from 2006 NPDES fact sheet). The total WLA can be expressed as a combined parameter, which Ecology calls "NBOD+CBOD".

NBOD+CBOD lbs/day = (2.155*ammonia lbs/day) + $CBOD_5$ lbs/day

WLA = (2.155 * 58.2) + 175 = 300 lbs/day NBOD+CBOD

The WLA is the maximum daily limit (MDL). According to federal NPDES regulations, all permit limits must be expressed as both average monthly and maximum daily limits. The average monthly limit (AML) is calculated according to the method in EPA's *Technical Support Document for Water Quality-based Toxics Control* (1991). See Appendix D for detailed calculations.

MDL = WLA = 300 lbs/day NBOD+CBOD

AML = 164 lbs/day NBOD+CBOD

pH – Ecology modeled the impact of the effluent pH on the receiving water using the calculations from EPA, 1988, and the chronic dilution factor tabulated above. Appendix D includes the model results.

Ecology predicts no violation of the pH criteria under critical conditions. Therefore, the proposed permit includes technology-based effluent limits for pH.

Fecal Coliform – Ecology modeled the numbers of fecal coliform by simple mixing analysis using the technology-based limit of 400 organisms per 100 ml and a dilution factor of 14.8.

Under critical conditions, modeling predicts no violation of the water quality criterion for fecal coliform. Therefore, the proposed permit includes the technology-based effluent limits for fecal coliform bacteria.

Turbidity – Ecology used total suspended solids as a surrogate because domestic wastewater dischargers do not routinely measure turbidity. Ecology expects no violations of the turbidity criteria outside the designated mixing zone provided the facility meets its technology-based total suspended solids permit limits.

Toxic Pollutants – Federal regulations (40 CFR 122.44) require Ecology to place limits in NPDES permits on toxic chemicals in an effluent whenever there is a reasonable potential for those chemicals to exceed the surface water quality criteria. Ecology does not exempt facilities with technology-based effluent limits from meeting the surface water quality standards.

The following toxic pollutants are present in the discharge: ammonia, arsenic, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc. Ecology conducted a reasonable potential analysis (See Appendix D) on these parameters to determine whether it would require effluent limits in this permit.

Ammonia's toxicity depends on that portion which is available in the un-ionized form. The amount of un-ionized ammonia depends on the temperature and pH in the receiving freshwater. To evaluate ammonia toxicity, Ecology used the available receiving water information for ambient station 07M070 and Ecology spreadsheet tools.

Valid ambient background data were available for the pollutants listed above (See Table 2). Ecology used all applicable data to evaluate reasonable potential for this discharge to cause a violation of water quality standards.

Ecology determined that the pollutants listed above pose no reasonable potential to exceed the water quality criteria at the critical condition using procedures given in EPA, 1991 (Appendix D) and as described above. Ecology's determination assumes that this facility meets the other effluent limits of this permit.

Temperature – The state temperature standards [WAC 173-201A-200-210 and 600-612] include multiple elements:

- Annual summer maximum threshold criteria (June 15 to September 15).
- Supplemental spawning and rearing season criteria (September 15 to June 15).
- Incremental warming restrictions.
- Protections against acute effects.

Ecology evaluates each criterion independently to determine reasonable potential and derive permit limits.

- Annual summer maximum and supplementary spawning/rearing criteria

  The South Fork Snoqualmie River has an annual maximum temperature criterion of 16°C [WAC 173-201A-200(1)(c), 210(1)(c), and Table 602]. The threshold criterion protects specific categories of aquatic life by controlling the effect of human actions on summer temperatures.

  The threshold criterion applies at the edge of the chronic mixing zone. Criteria for most fresh waters are expressed as the highest 7-Day average of daily maximum temperature (7-DADMax). The 7-DADMax temperature is the arithmetic average of seven consecutive measures of daily maximum temperatures.

- Incremental warming criteria

  The water quality standards limit the amount of warming human sources can cause under specific situations [WAC 173-201A-200(1)(c)(i)-(ii), 210(1)(c)(i)-(ii)]. The incremental warming criteria apply at the edge of the chronic mixing zone.

  At locations and times when background temperatures are cooler than the assigned threshold criterion, point sources are permitted to warm the water by only a defined increment. These increments are permitted only to the extent doing so does not cause temperatures to exceed either the annual maximum or supplemental spawning criteria.

At locations and times when a threshold criterion is being exceeded due to natural conditions, all human sources, considered cumulatively, must not warm the water more than 0.3°C above the naturally warm condition.

Because Ecology has completed a TMDL, our policy allows each point source to warm water at the edge of the chronic mixing zone by 0.3°C based on a background temperature that meets the maximum temperature criterion (16°C). Allowing a 0.3°C warming for each point source is reasonable and protective where the dilution factor is based on 25% or less of the critical flow. This is because the fully mixed effect on temperature will only be a fraction of the 0.3°C cumulative allowance (0.075°C or less) for all human sources combined.

- Protections for temperature acute effects

  Instantaneous lethality to passing fish: The upper 99th percentile daily maximum effluent temperature must not exceed 33°C, unless a dilution analysis indicates ambient temperatures will not exceed 33°C two seconds after discharge.

  General lethality and migration blockage: Measurable (0.3°C) increases in temperature at the edge of a chronic mixing zone are not allowed when the receiving water temperature exceeds either a 1DMax of 23°C or a 7DADMax of 22°C.

  Lethality to incubating fish: Human actions must not cause a measurable (0.3°C) warming above 17.5°C at locations where eggs are incubating.

Reasonable Potential Analysis

Annual summer maximum and incremental warming criteria: Ecology calculated the reasonable potential for the discharge to exceed the annual summer maximum and the incremental warming criteria (See temperature calculations in Appendix D).

The discharge is only allowed to warm the water by a defined increment when the background (ambient) temperature is cooler or warmer than the assigned threshold criterion. Ecology allows warming increments only when they do not cause temperatures to exceed either the annual maximum or supplemental spawning criteria.

The incremental increase for this discharge is within the allowable amount. Therefore, the proposed permit does not include a temperature limit.

Because the incremental increase for this discharge is very close to the allowable amount, and flows are expected to increase with population growth, the permit requires additional monitoring of effluent temperatures and a temperature reduction study. Ecology will reevaluate the reasonable potential during the next permit renewal.

General lethality and migration blockage: The receiving water conditions are listed in Table 2 of the fact sheet. The South Fork Snoqualmie River does not exceed a 1DMax of 23°C or a 7DADMax of 22°C.

G. Human health

Washington's water quality standards include 91 numeric human health-based criteria that Ecology must consider when writing NPDES permits. These criteria were established in 1992 by the U.S. EPA in its National Toxics Rule (40 CFR 131.36). The National Toxics Rule allows states to use mixing zones to evaluate whether discharges comply with human health criteria.

Based on effluent testing data, Ecology determined the effluent may contain the following chemicals of concern for human health: antimony, mercury, nickel, and selenium.

Ecology evaluated the discharge's potential to violate the water quality standards as required by 40 CFR 122.44(d) by following the procedures published in the *Technical Support Document for Water Quality-Based Toxics Control* (EPA/505/2-90-001) and Ecology's *Permit Writer's Manual* to make a reasonable potential determination (Appendix D). The evaluation showed that the discharge has no reasonable potential to cause a violation of water quality standards, and an effluent limit is not needed.

H. Sediment quality

The aquatic sediment standards (chapter 173-204 WAC) protect aquatic biota and human health. Under these standards Ecology may require a facility to evaluate the potential for its discharge to cause a violation of sediment standards (WAC 173-204-400). You can obtain additional information about sediments at the Aquatic Lands Cleanup Unit website. http://www.ecy.wa.gov/programs/tcp/smu/sediment.html

Through a review of the discharger characteristics and of the effluent characteristics, Ecology determined that this discharge has no reasonable potential to violate the sediment management standards.

I. Whole effluent toxicity

The water quality standards for surface waters forbid discharge of effluent that has the potential to cause toxic effects in the receiving waters. Many toxic pollutants cannot be measured by commonly available detection methods. However, laboratory tests can measure toxicity directly by exposing living organisms to the wastewater and measuring their responses. These tests measure the aggregate toxicity of the whole effluent, so this approach is called whole effluent toxicity (WET) testing. Some WET tests measure acute toxicity and other WET tests measure chronic toxicity.

- *Acute toxicity tests measure mortality as the significant response* to the toxicity of the effluent. Dischargers who monitor their wastewater with acute toxicity tests find early indications of any potential lethal effect of the effluent on organisms in the receiving water.
- *Chronic toxicity tests measure various sublethal toxic responses*, such as reduced growth or reproduction. Chronic toxicity tests often involve either a complete life cycle test on an organism with an extremely short life cycle, or a partial life cycle test during a critical stage of a test organism's life. Some chronic toxicity tests also measure organism survival.

Laboratories accredited by Ecology for WET testing know how to use the proper WET testing protocols, fulfill the data requirements, and submit results in the correct reporting format. Accredited laboratory staff know about WET testing and how to calculate an NOEC, LC50, EC50, IC25, etc. Ecology gives all accredited labs the most recent version of Ecology Publication No. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria* (http://www.ecy.wa.gov/biblio/9580.html), which is referenced in the permit. Ecology recommends that the City of North Bend send a copy of the acute or chronic toxicity sections(s) of its NPDES permit to the laboratory.

WET testing conducted during effluent characterization showed no reasonable potential for effluent discharges to cause receiving water acute toxicity or chronic toxicity. The proposed permit will not include an acute or chronic WET limit. The City of North Bend must retest the effluent before submitting an application for permit renewal.

- If this facility makes process or material changes which, in Ecology's opinion, increase the potential for effluent toxicity, then Ecology may (in a regulatory order, by permit modification, or in the permit renewal) require the facility to conduct additional effluent characterization. The City of North Bend may demonstrate to Ecology that effluent toxicity has not increased by performing additional WET testing and/or chemical analyses after the process or material changes have been made. Ecology recommends that the City of North Bend check with it first to make sure that Ecology will consider the demonstration adequate to support a decision to not require an additional effluent characterization.
- If WET testing conducted for submittal with a permit application fails to meet the performance standards in WAC 173-205-020, Ecology will assume that effluent toxicity has increased.

J. Ground water quality limits

The ground water quality standards (chapter 173-200 WAC) protect beneficial uses of ground water. Permits issued by Ecology must not allow violations of those standards (WAC 173-200-100).

The City of North Bend does not discharge wastewater to the ground. No permit limits are required to protect ground water.

K. Comparison of effluent limits with the previous permit issued April 7, 2006

Table 13. Comparison of Previous and Proposed Effluent Limits

		Previous Effluent Limits: Outfall # 001		Proposed Effluent Limits: Outfall # 001	
Parameter	**Basis of Limit**	**Average Monthly**	**Average Weekly**	**Average Monthly**	**Average Weekly**
November through July only					
$CBOD_5$	Technology	25 mg/L 500 lbs/day 85% removal	40 mg/L 801 lbs/day	25 mg/L 538 lbs/day 85% removal	40 mg/L 861 lbs/day
TSS	Technology	30 mg/L 600 lbs/day 85% removal	45 mg/L 901 lbs/day	30 mg/L 646 lbs/day 85% removal	45 mg/L 968 lbs/day
August through October only					
$CBOD_5$	Technology	25 mg/L 85% removal	40 mg/L	25 mg/L 85% removal	40 mg/L
TSS	Technology	30 mg/L 293 lbs/day 85% removal	45 mg/L 439 lbs/day	30 mg/L 350 lbs/day 85% removal	45 mg/L 525 lbs/day

Parameter		Monthly Geometric Mean Limit	Weekly Geometric Mean Limit	Monthly Geometric Mean Limit	Weekly Geometric Mean Limit
Fecal Coliform Bacteria	Technology	200/100 mL	400/100 mL	No change	

Parameter		Limit	Limit
pH	Technology	6.0-9.0	No change

Parameter		Average Monthly	Maximum Daily	Average Monthly	Maximum Daily
Mercury	WQ	0.2 µg/L	0.4 µg/L	No limit; no reasonable potential based on improved test methods	
August through October only					
$CBOD_5$	WQ-TMDL	150 lbs/day	257 lbs/day	Replaced with NBOD+CBOD	
Ammonia	WQ-TMDL	8.4 lbs/day	20.25 lbs/day		
NBOD+CBOD	WQ-TMDL	NA	NA	164 lbs/day	300 lbs/day

IV. Monitoring Requirements

Ecology requires monitoring, recording, and reporting (WAC 173-220-210 and 40 CFR 122.41) to verify that the treatment process is functioning correctly and that the discharge complies with the permit's effluent limits.

A. Lab accreditation

Ecology requires that facilities must use a laboratory registered or accredited under the provisions of chapter 173-50 WAC, Accreditation of Environmental Laboratories, to prepare all monitoring data (with the exception of certain parameters). Ecology accredited the laboratory at this facility for the parameters listed in Table 14.

If a facility uses a contract laboratory to monitor wastewater, it must ensure that the laboratory uses the methods and meets or exceeds the method detection levels required by the permit. The permit describes when facilities may use alternative methods. It also describes what to do in certain situations when the laboratory encounters matrix effects. When a facility uses an alternative method as allowed by the permit, it must report the test method, DL, and QL on the discharge monitoring report or in the required report.

Table 14. Accredited Parameters

General Chemistry				
Parameter name	**Analyte code**	**Method description**	**NELAC code**	**Matrix ***
Biochemical Oxygen Demand	1530	SM 5210 B-01	20135006	N
Dissolved Oxygen	1880	SM 4500-O G-01	20121408	N
pH	1900	SM 4500-H+ B-00	20105219	N
Solids, Total Suspended	1960	SM 2540 D-97	20051201	N
Microbiology				
Parameter name	**Analyte code**	**Method description**	**NELAC code**	**Matrix ***
Fecal coliform-count	2530	SM 9222 D (m-FC)-97	20210008	N
* Matrix key: D = drinking water; N = non-potable water; S = solids/chem materials; A = air				

B. Wastewater monitoring

The monitoring schedule is detailed in the proposed permit under Special Condition S.2. Specified monitoring frequencies take into account the quantity and variability of the discharge, the treatment method, past compliance, significance of pollutants, and cost of monitoring. The required monitoring frequency is consistent with agency guidance given in the current version of Ecology's *Permit Writer's Manual* (Publication Number 92-09) for oxidation ditches.

Ecology has included some additional monitoring of nutrients in the proposed permit to establish a baseline for this discharger. It will use this data in the future as it develops or updates TMDLs and establishes WLAs for nutrients.

Monitoring of sludge quantity and quality is necessary to determine the appropriate uses of the sludge. Biosolids monitoring is required by the current state and local solid waste management program and also by EPA under 40 CFR 503.

V. Other Permit Conditions

A. Reporting and record keeping

Ecology based Special Condition S3 on its authority to specify any appropriate reporting and record keeping requirements to prevent and control waste discharges (WAC 173-220-210).

B. Prevention of facility overloading

Overloading of the treatment plant is a violation of the terms and conditions of the permit. To prevent this from occurring, RCW 90.48.110 and WAC 173-220-150 require the City of North Bend to:

- Take the actions detailed in proposed permit Special Condition S.4.

- Plan plant expansions or modifications before the treatment plant reaches existing capacity.
- Report and correct conditions that could result in new or increased discharges of pollutants.

Special Condition S.4 restricts the amount of flow.

If a municipality intends to apply for Ecology-administered funding for the design or construction of a facility project, the plan must meet the standard of a "Facility Plan", as defined in WAC 173-98-030. A complete "Facility Plan" includes all elements of an "Engineering Report" along with State Environmental Review Process (SERP) documentation to demonstrate compliance with 40 CFR 35.3140 and 40 CFR 35.3145, and a cost effectiveness analysis as required by WAC 173-98-730. The municipality should contact Ecology's regional office as early as practical before planning a project that may include Ecology-administered funding.

C. Operation and maintenance

The proposed permit contains Special Condition S.5 as authorized under RCW 90.48.110, WAC 173-220-150, chapter 173-230 WAC, and WAC 173-240-080. Ecology included it to ensure proper operation and regular maintenance of equipment, and to ensure that the City of North Bend takes adequate safeguards so that it uses constructed facilities to their optimum potential in terms of pollutant capture and treatment.

D. Pretreatment

Duty to enforce discharge prohibitions

This provision prohibits the publicly owned treatment works (POTW) from authorizing or permitting an industrial discharger to discharge certain types of waste into the sanitary sewer.

- The first section of the pretreatment requirements prohibits the POTW from accepting pollutants which causes "pass-through" or "interference". This general prohibition is from 40 CFR §403.5(a). Appendix C of this fact sheet defines these terms.
- The second section reinforces a number of specific state and federal pretreatment prohibitions found in WAC 173-216-060 and 40 CFR §403.5(b). These reinforce that the POTW may not accept certain wastes, which:
    a. Are prohibited due to dangerous waste rules.
    b. Are explosive or flammable.
    c. Have too high or low of a pH (too corrosive, acidic or basic).
    d. May cause a blockage such as grease, sand, rocks, or viscous materials.
    e. Are hot enough to cause a problem.
    f. Are of sufficient strength or volume to interfere with treatment.
    g. Contain too much petroleum-based oils, mineral oil, or cutting fluid.
    h. Create noxious or toxic gases at any point.

40 CFR Part 403 contains the regulatory basis for these prohibitions, with the exception of the pH provisions which are based on WAC 173-216-060.

- The third section of pretreatment conditions reflects state prohibitions on the POTW accepting certain types of discharges unless the discharge has received prior written authorization from Ecology. These discharges include:
  a. Cooling water in significant volumes.
  b. Stormwater and other direct inflow sources.
  c. Wastewaters significantly affecting system hydraulic loading, which do not require treatment.

Federal and state pretreatment program requirements

Ecology administers the Pretreatment Program under the terms of the addendum to the "Memorandum of Understanding between Washington Department of Ecology and the United States Environmental Protection Agency, Region 10" (1986) and 40 CFR, part 403. Under this delegation of authority, Ecology issues wastewater discharge permits for significant industrial users (SIUs) discharging to POTWs which have not been delegated authority to issue wastewater discharge permits. Ecology must approve, condition, or deny new discharges or a significant increase in the discharge for existing significant industrial users (SIUs) [40 CFR 403.8 (f)(1)(i) and(iii)].

Industrial dischargers must obtain a permit from Ecology before discharging waste to the North Bend WWTP [WAC 173-216-110(5)]. Industries discharging wastewater that is similar in character to domestic wastewater do not require a permit.

Routine identification and reporting of industrial users

The permit requires non-delegated POTWs to take "continuous, routine measures to identify all existing, new, and proposed significant industrial users (SIUs) and potential significant industrial users (PSIUs)" discharging to their sewer system. Examples of such routine measures include regular review of water and sewer billing records, business license and building permit applications, advertisements, and personal reconnaissance. System maintenance personnel should be trained on what to look for so they can identify and report new industrial dischargers in the course of performing their jobs. The POTW may not allow SIUs to discharge prior to receiving a permit, and must notify all industrial dischargers (significant or not) in writing of their responsibility to apply for a State Waste Discharge Permit. The POTW must send a copy of this notification to Ecology.

Industrial user survey update

This provision requires the POTW to submit an updated list of existing and proposed significant industrial users (SIUs) and potential significant industrial users (PSIUs). This provides Ecology with notice of any new or proposed industrial users in the POTW's service area without a more rigorous "complete" industrial user survey. This level of effort is often sufficient for small municipalities which have not seen any adverse effects potentially attributable to industries, have loadings commensurate with domestic flows, and have a small proportion of industrial flow.

E. Solid wastes

To prevent water quality problems the facility is required in permit Special Condition S7 to store and handle all residual solids (grit, screenings, scum, sludge, and other solid waste) in accordance with the requirements of RCW 90.48.080 and state water quality standards.

The final use and disposal of sewage sludge from this facility is regulated by U.S. EPA under 40 CFR 503, and by Ecology under chapter 70.95J RCW, chapter 173-308 WAC "Biosolids Management," and chapter 173-350 WAC "Solid Waste Handling Standards." The disposal of other solid waste is under the jurisdiction of the King County Health Department.

F. Outfall evaluation

The proposed permit requires the City of North Bend to conduct an outfall inspection and submit a report detailing the findings of that inspection (Special Condition S.11). The inspection must evaluate the physical condition of the discharge pipe and diffusers, and evaluate the extent of sediment accumulations in the vicinity of the outfall.

G. Temperature reduction study

To ensure that North Bend is able to comply with the Snoqualmie River Basin Temperature TMDL (2011) as flows increase, the proposed permit requires the City of North Bend to conduct a study of options to reduce effluent temperatures during the critical period.

H. General conditions

Ecology bases the standardized General Conditions on state and federal law and regulations. They are included in all individual domestic wastewater NPDES permits issued by Ecology.

VI. Permit Issuance Procedures

A. Permit modifications

Ecology may modify this permit to impose numerical limits, if necessary to comply with water quality standards for surface waters, with sediment quality standards, or with water quality standards for ground waters, based on new information from sources such as inspections, effluent monitoring, outfall studies, and effluent mixing studies.

Ecology may also modify this permit to comply with new or amended state or federal regulations.

B. Proposed permit issuance

This proposed permit meets all statutory requirements for Ecology to authorize a wastewater discharge. The permit includes limits and conditions to protect human health and aquatic life, and the beneficial uses of waters of the state of Washington. Ecology proposes to issue this permit for a term of five years.

VII. References for Text and Appendices

City of North Bend

2007. Comprehensive Plan, Chapter 6 – Capital Facilities Element.

Cosmopolitan Engineering Group

March 2005. *Evaluation of Water Quality-Based NPDES Permit Limitations*. (Ecology-approved revision).

October 2004. *Evaluation of Water Quality-Based NPDES Permit Limitations*.

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July 2001. *City of North Bend Final Comprehensive Sewer Plan*.

December 1996. *City of North Bend Final Engineering Report/Facility Plan/Wastewater Treatment Plan*.

Environmental Protection Agency (EPA)

1992. National Toxics Rule. Federal Register, V. 57, No. 246, Tuesday, December 22, 1992.

1991. *Technical Support Document for Water Quality-based Toxics Control*. EPA/505/2-90-001.

1988. *Technical Guidance on Supplementary Stream Design Conditions for Steady State Modeling*. USEPA Office of Water, Washington, D.C.

1985. *Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants in Surface and Ground Water*. EPA/600/6-85/002a.

1983. *Water Quality Standards Handbook*. USEPA Office of Water, Washington, D.C.

Tsivoglou, E.C., and J.R. Wallace.

1972. *Characterization of Stream Reaeration Capacity*. EPA-R3-72-012. (Cited in EPA 1985 op.cit.)

Washington State Department of Ecology.

Laws and Regulations (http://www.ecy.wa.gov/laws-rules/index.html)

Permit and Wastewater Related Information (http://www.ecy.wa.gov/programs/wq/wastewater/index.html)

2011. *Permit Writer's Manual*. Publication Number 92-109 (http://www.ecy.wa.gov/biblio/92109.html)

June 2011. *Snoqualmie River Basin Temperature Total Maximum Daily Load Water Quality Improvement Report and Implementation Plan*. Publication No. 11-10-041.

May 1994. *Snoqualmie River Total Maximum Daily Load Study*. Ecology Report #94-71.

April 1991. *Snoqualmie River Low Flow Water Quality Assessment, July-September 1989.*

Wright, R.M., and A.J. McDonnell.

1979. *In-stream Deoxygenation Rate Prediction*. Journal Environmental Engineering Division, ASCE. 105(EE2). (Cited in EPA 1985 op.cit.)

Appendix A – Public Involvement Information

Ecology proposes to reissue a permit to the City of North Bend Wastewater Treatment Plant. The permit includes wastewater discharge limits and other conditions. This fact sheet describes the facility and Ecology's reasons for requiring permit conditions.

Ecology placed a Public Notice of Draft on April 3, 2013, in the *Snoqualmie Valley Record* to inform the public and to invite comment on the proposed draft National Pollutant Discharge Elimination System permit and fact sheet.

The notice:

- Told where copies of the draft permit and fact sheet were available for public evaluation (a local public library, the closest regional or field office, posted on our website).
- Offered to provide the documents in an alternate format to accommodate special needs.
- Asked people to tell us how well the proposed permit would protect the receiving water.
- Invited people to suggest fairer conditions, limits, and requirements for the permit.
- Invited comments on Ecology's determination of compliance with antidegradation rules.
- Urged people to submit their comments, in writing, before the end of the comment period.
- Told how to request a public hearing about the proposed NPDES permit.
- Explained the next step(s) in the permitting process.

Ecology has published a document entitled *Frequently Asked Questions about Effective Public Commenting*, which is available on our website at http://www.ecy.wa.gov/biblio/0307023.html.

You may obtain further information from Ecology by telephone, (425) 649-7201, or by writing to the address listed below.

Water Quality Permit Coordinator
Department of Ecology
Northwest Regional Office
3190 160th Avenue SE
Bellevue, WA 98008-5452

The primary author of this permit and fact sheet is Laura Fricke, P.E.

Appendix B – Your Right to Appeal

You have a right to appeal this permit to the Pollution Control Hearing Board (PCHB) within 30 days of the date of receipt of the final permit. 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) (see glossary).

To appeal you must do the following within 30 days of the date of receipt of this permit:

- File your appeal and a copy of this permit 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 permit 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.

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 1111 Israel RD SW STE 301 Tumwater, WA 98501	**Pollution Control Hearings Board** PO Box 40903 Olympia, WA 98504-0903

Appendix C – Glossary

1-DMax or 1-day maximum temperature -- The highest water temperature reached on any given day. This measure can be obtained using calibrated maximum/minimum thermometers or continuous monitoring probes having sampling intervals of thirty minutes or less.

7-DADMax or 7-day average of the daily maximum temperatures -- The arithmetic average of seven consecutive measures of daily maximum temperatures. The 7-DADMax for any individual day is calculated by averaging that day's daily maximum temperature with the daily maximum temperatures of the three days prior and the three days after that date.

Acute toxicity --The lethal effect of a compound on an organism that occurs in a short time period, usually 48 to 96 hours.

AKART -- The acronym for "all known, available, and reasonable methods of prevention, control and treatment." AKART is a technology-based approach to limiting pollutants from wastewater discharges, which requires an engineering judgment and an economic judgment. AKART must be applied to all wastes and contaminants prior to entry into waters of the state in accordance with RCW 90.48.010 and 520, WAC 173-200-030(2)(c)(ii), and WAC 173-216-110(1)(a).

Alternate point of compliance -- An alternative location in the ground water from the point of compliance where compliance with the ground water standards is measured. It may be established in the ground water at locations some distance from the discharge source, up to, but not exceeding the property boundary and is determined on a site specific basis following an AKART analysis. An "early warning value" must be used when an alternate point is established. An alternate point of compliance must be determined and approved in accordance with WAC 173-200-060(2).

Ambient water quality -- The existing environmental condition of the water in a receiving water body.

Ammonia -- Ammonia is produced by the breakdown of nitrogenous materials in wastewater. Ammonia is toxic to aquatic organisms, exerts an oxygen demand, and contributes to eutrophication. It also increases the amount of chlorine needed to disinfect wastewater.

Annual average design flow (AADF) -- The average of the daily flow volumes anticipated to occur over a calendar year.

Average monthly discharge limit -- The average of the measured values obtained over a calendar month's time.

Background water quality -- The concentrations of chemical, physical, biological or radiological constituents or other characteristics in or of ground water at a particular point in time upgradient of an activity that has not been affected by that activity, [WAC 173-200-020(3)]. Background water quality for any parameter is statistically defined as the 95% upper tolerance interval with a 95% confidence based on at least eight hydraulically upgradient water quality samples. The eight samples are collected over a period of at least one year, with no more than one sample collected during any month in a single calendar year.

Best management practices (BMPs) -- Schedules of activities, prohibitions of practices, maintenance procedures, and other physical, structural and/or managerial practices to prevent

or reduce the pollution of waters of the state. BMPs include treatment systems, operating procedures, and practices to control: plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage. BMPs may be further categorized as operational, source control, erosion and sediment control, and treatment BMPs.

BOD5 -- Determining the five-day Biochemical Oxygen Demand of an effluent is an indirect way of measuring the quantity of organic material present in an effluent that is utilized by bacteria. The BOD5 is used in modeling to measure the reduction of dissolved oxygen in receiving waters after effluent is discharged. Stress caused by reduced dissolved oxygen levels makes organisms less competitive and less able to sustain their species in the aquatic environment. Although BOD_5 is not a specific compound, it is defined as a conventional pollutant under the federal Clean Water Act.

Bypass -- The intentional diversion of waste streams from any portion of a treatment facility.

Categorical pretreatment standards -- National pretreatment standards specifying quantities or concentrations of pollutants or pollutant properties, which may be discharged to a POTW by existing or new industrial users in specific industrial subcategories.

Chlorine -- A chemical used to disinfect wastewaters of pathogens harmful to human health. It is also extremely toxic to aquatic life.

Chronic toxicity -- The effect of a compound on an organism over a relatively long time, often 1/10 of an organism's lifespan or more. Chronic toxicity can measure survival, reproduction or growth rates, or other parameters to measure the toxic effects of a compound or combination of compounds.

Clean water act (CWA -- The federal Water Pollution Control Act enacted by Public Law 92-500, as amended by Public Laws 95-217, 95-576, 96-483, 97-117; USC 1251 et seq.

Compliance inspection-without sampling -- A site visit for the purpose of determining the compliance of a facility with the terms and conditions of its permit or with applicable statutes and regulations.

Compliance inspection-with sampling -- A site visit for the purpose of determining the compliance of a facility with the terms and conditions of its permit or with applicable statutes and regulations. In addition it includes as a minimum, sampling and analysis for all parameters with limits in the permit to ascertain compliance with those limits; and, for municipal facilities, sampling of influent to ascertain compliance with the 85 percent removal requirement. Ecology may conduct additional sampling.

Composite sample -- A mixture of grab samples collected at the same sampling point at different times, formed either by continuous sampling or by mixing discrete samples. May be "time-composite" (collected at constant time intervals) or "flow-proportional" (collected either as a constant sample volume at time intervals proportional to stream flow, or collected by increasing the volume of each aliquot as the flow increased while maintaining a constant time interval between the aliquots).

Construction activity -- Clearing, grading, excavation, and any other activity, which disturbs the surface of the land. Such activities may include road building; construction of residential houses, office buildings, or industrial buildings; and demolition activity.

Continuous monitoring -- Uninterrupted, unless otherwise noted in the permit.

Critical condition -- The time during which the combination of receiving water and waste discharge conditions have the highest potential for causing toxicity in the receiving water environment. This situation usually occurs when the flow within a water body is low, thus, its ability to dilute effluent is reduced.

Date of receipt – This is defined in RCW 43.21B.001(2) as five business days after the date of mailing; or the date of actual receipt, when the actual receipt date can be proven by a preponderance of the evidence. The recipient's sworn affidavit or declaration indicating the date of receipt, which is unchallenged by the agency, constitutes sufficient evidence of actual receipt. The date of actual receipt, however, may not exceed forty-five days from the date of mailing.

Detection limit -- See Method Detection Level.

Dilution factor (DF) -- A measure of the amount of mixing of effluent and receiving water that occurs at the boundary of the mixing zone. Expressed as the inverse of the percent effluent fraction, for example, a dilution factor of 10 means the effluent comprises 10% by volume and the receiving water 90%.

Distribution uniformity -- The uniformity of infiltration (or application in the case of sprinkle or trickle irrigation) throughout the field expressed as a percent relating to the average depth infiltrated in the lowest one-quarter of the area to the average depth of water infiltrated.

Early warning value -- The concentration of a pollutant set in accordance with WAC 173-200-070 that is a percentage of an enforcement limit. It may be established in the effluent, ground water, surface water, the vadose zone or within the treatment process. This value acts as a trigger to detect and respond to increasing contaminant concentrations prior to the degradation of a beneficial use.

Enforcement limit -- The concentration assigned to a contaminant in the ground water at the point of compliance for the purpose of regulation, [WAC 173-200-020(11)]. This limit assures that a ground water criterion will not be exceeded and that background water quality will be protected.

Engineering report -- A document that thoroughly examines the engineering and administrative aspects of a particular domestic or industrial wastewater facility. The report must contain the appropriate information required in WAC 173-240-060 or 173-240-130.

Fecal coliform bacteria -- Fecal coliform bacteria are used as indicators of pathogenic bacteria in the effluent that are harmful to humans. Pathogenic bacteria in wastewater discharges are controlled by disinfecting the wastewater. The presence of high numbers of fecal coliform bacteria in a water body can indicate the recent release of untreated wastewater and/or the presence of animal feces.

Grab sample -- A single sample or measurement taken at a specific time or over as short a period of time as is feasible.

Ground water -- Water in a saturated zone or stratum beneath the surface of land or below a surface water body.

Industrial user -- A discharger of wastewater to the sanitary sewer that is not sanitary wastewater or is not equivalent to sanitary wastewater in character.

Industrial wastewater -- Water or liquid-carried waste from industrial or commercial processes, as distinct from domestic wastewater. These wastes may result from any process or activity of industry, manufacture, trade or business; from the development of any natural resource; or from animal operations such as feed lots, poultry houses, or dairies. The term includes contaminated storm water and, also, leachate from solid waste facilities.

Interference -- A discharge which, alone or in conjunction with a discharge or discharges from other sources, both:

- Inhibits or disrupts the POTW, its treatment processes or operations, or its sludge processes, use or disposal; and
- Therefore is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation) or of the prevention of sewage sludge use or disposal in compliance with the following statutory provisions and regulations or permits issued thereunder (or more stringent State or local regulations): Section 405 of the Clean Water Act, the Solid Waste Disposal Act (SWDA) (including title II, more commonly referred to as the Resource Conservation and Recovery Act (RCRA), and including State regulations contained in any State sludge management plan prepared pursuant to subtitle D of the SWDA), sludge regulations appearing in 40 CFR Part 507, the Clean Air Act, the Toxic Substances Control Act, and the Marine Protection, Research and Sanctuaries Act.

Local limits -- Specific prohibitions or limits on pollutants or pollutant parameters developed by a POTW.

Major facility -- A facility discharging to surface water with an EPA rating score of > 80 points based on such factors as flow volume, toxic pollutant potential, and public health impact.

Maximum daily discharge limit -- The highest allowable daily discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. The daily discharge is calculated as the average measurement of the pollutant over the day.

Maximum day design flow (MDDF) -- The largest volume of flow anticipated to occur during a one-day period, expressed as a daily average.

Maximum month design flow (MMDF) -- The largest volume of flow anticipated to occur during a continuous 30-day period, expressed as a daily average.

Maximum week design flow (MWDF) -- The largest volume of flow anticipated to occur during a continuous 7-day period, expressed as a daily average.

Method detection level (MDL) -- The minimum concentration of a substance that can be measured and reported with 99 percent confidence that the pollutant concentration is above zero and is determined from analysis of a sample in a given matrix containing the pollutant.

Minor facility -- A facility discharging to surface water with an EPA rating score of < 80 points based on such factors as flow volume, toxic pollutant potential, and public health impact.

Mixing zone -- An area that surrounds an effluent discharge within which water quality criteria may be exceeded. The permit specifies the area of the authorized mixing zone that Ecology defines following procedures outlined in state regulations (chapter 173-201A WAC).

National pollutant discharge elimination system (NPDES) -- The NPDES (Section 402 of the Clean Water Act) is the federal wastewater permitting system for discharges to navigable waters of the United States. Many states, including the state of Washington, have been delegated the authority to issue these permits. NPDES permits issued by Washington State permit writers are joint NPDES/State permits issued under both state and federal laws.

pH -- The pH of a liquid measures its acidity or alkalinity. It is the negative logarithm of the hydrogen ion concentration. A pH of 7 is defined as neutral and large variations above or below this value are considered harmful to most aquatic life.

Pass-through -- A discharge which exits the POTW into waters of the State in quantities or concentrations which, alone or in conjunction with a discharge or discharges from other sources, is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation), or which is a cause of a violation of State water quality standards.

Peak hour design flow (PHDF) -- The largest volume of flow anticipated to occur during a one-hour period, expressed as a daily or hourly average.

Peak instantaneous design flow (PIDF) -- The maximum anticipated instantaneous flow.

Point of compliance -- The location in the ground water where the enforcement limit must not be exceeded and a facility must comply with the Ground Water Quality Standards. Ecology determines this limit on a site-specific basis. Ecology locates the point of compliance in the ground water as near and directly downgradient from the pollutant source as technically, hydrogeologically, and geographically feasible, unless it approves an alternative point of compliance.

Potential significant industrial user (PSIU) --A potential significant industrial user is defined as an Industrial User that does not meet the criteria for a Significant Industrial User, but which discharges wastewater meeting one or more of the following criteria:

a. Exceeds 0.5 % of treatment plant design capacity criteria and discharges <25,000 gallons per day; or

b. Is a member of a group of similar industrial users which, taken together, have the potential to cause pass through or interference at the POTW (e.g. facilities which develop photographic film or paper, and car washes).

Ecology may determine that a discharger initially classified as a potential significant industrial user should be managed as a significant industrial user.

Quantitation level (QL) -- Also known as Minimum Level of Quantitation (ML) – The lowest level at which the entire analytical system must give a recognizable signal and acceptable calibration point for the analyte. It is equivalent to the concentration of the lowest calibration standard, assuming that the lab has used all method-specified sample weights, volumes, and cleanup procedures. The QL is calculated by multiplying the MDL by 3.18 and rounding the result to the number nearest to (1, 2, or 5) x 10^n, where n is an integer (64 FR 30417).
ALSO GIVEN AS:
The smallest detectable concentration of analyte greater than the Detection Limit (DL) where the accuracy (precision & bias) achieves the objectives of the intended purpose. (Report of the Federal Advisory Committee on Detection and Quantitation Approaches and Uses in Clean Water Act Programs Submitted to the US Environmental Protection Agency December 2007).

Reasonable potential -- A reasonable potential to cause a water quality violation, or loss of sensitive and/or important habitat.

Responsible corporate officer -- A president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy- or decision-making functions for the corporation, or the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or have gross annual sales or expenditures exceeding $25 million (in second quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures (40 CFR 122.22).

Significant industrial user (SIU) --

1) All industrial users subject to Categorical Pretreatment Standards under 40 CFR 403.6 and 40 CFR Chapter I, Subchapter N; and

2) Any other industrial user that: discharges an average of 25,000 gallons per day or more of process wastewater to the POTW (excluding sanitary, noncontact cooling, and boiler blow-down wastewater); contributes a process wastestream that makes up 5 percent or more of the average dry weather hydraulic or organic capacity of the POTW treatment plant; or is designated as such by the Control Authority* on the basis that the industrial user has a reasonable potential for adversely affecting the POTW's operation or for violating any pretreatment standard or requirement [in accordance with 40 CFR 403.8(f)(6)].

   Upon finding that the industrial user meeting the criteria in paragraph 2, above, has no reasonable potential for adversely affecting the POTW's operation or for violating any pretreatment standard or requirement, the Control Authority* may at any time, on its own initiative or in response to a petition received from an industrial user or POTW, and in accordance with 40 CFR 403.8(f)(6), determine that such industrial user is not a significant industrial user.

   *The term "Control Authority" refers to the Washington State Department of Ecology in the case of non-delegated POTWs or to the POTW in the case of delegated POTWs.

Slug discharge -- Any discharge of a non-routine, episodic nature, including but not limited to an accidental spill or a non-customary batch discharge to the POTW. This may include any pollutant released at a flow rate that may cause interference or pass through with the POTW or in any way violate the permit conditions or the POTW's regulations and local limits.

Soil scientist -- An individual who is registered as a Certified or Registered Professional Soil Scientist or as a Certified Professional Soil Specialist by the American Registry of Certified Professionals in Agronomy, Crops, and Soils or by the National Society of Consulting Scientists or who has the credentials for membership. Minimum requirements for eligibility are: possession of a baccalaureate, masters, or doctorate degree from a U.S. or Canadian institution with a minimum of 30 semester hours or 45 quarter hours professional core courses in agronomy, crops or soils, and have 5, 3, or 1 year(s), respectively, of professional experience working in the area of agronomy, crops, or soils.

Solid waste -- All putrescible and non-putrescible solid and semisolid wastes including, but not limited to, garbage, rubbish, ashes, industrial wastes, swill, sewage sludge, demolition and construction wastes, abandoned vehicles or parts thereof, contaminated soils and contaminated dredged material, and recyclable materials.

Soluble BOD_5 -- Determining the soluble fraction of Biochemical Oxygen Demand of an effluent is an indirect way of measuring the quantity of soluble organic material present in an effluent that is utilized by bacteria. Although the soluble BOD_5 test is not specifically described in Standard Methods, filtering the raw sample through at least a 1.2 um filter prior to running the standard BOD_5 test is sufficient to remove the particulate organic fraction.

State waters -- Lakes, rivers, ponds, streams, inland waters, underground waters, salt waters, and all other surface waters and watercourses within the jurisdiction of the state of Washington.

Stormwater--That portion of precipitation that does not naturally percolate into the ground or evaporate, but flows via overland flow, interflow, pipes, and other features of a storm water drainage system into a defined surface water body, or a constructed infiltration facility.

Technology-based effluent limit -- A permit limit based on the ability of a treatment method to reduce the pollutant.

Total coliform bacteria--A microbiological test, which detects and enumerates the total coliform group of bacteria in water samples.

Total dissolved solids--That portion of total solids in water or wastewater that passes through a specific filter.

Total suspended solids (TSS) -- Total suspended solids is the particulate material in an effluent. Large quantities of TSS discharged to a receiving water may result in solids accumulation. Apart from any toxic effects attributable to substances leached out by water, suspended solids may kill fish, shellfish, and other aquatic organisms by causing abrasive injuries and by clogging the gills and respiratory passages of various aquatic fauna. Indirectly, suspended solids can screen out light and can promote and maintain the development of noxious conditions through oxygen depletion.

Upset -- An exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limits because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, lack of preventative maintenance, or careless or improper operation.

Water quality-based effluent limit -- A limit imposed on the concentration of an effluent parameter to prevent the concentration of that parameter from exceeding its water quality criterion after discharge into receiving waters.

Appendix D – Technical Calculations

Several of the Excel® spreadsheet tools used to evaluate a discharger's ability to meet Washington State water quality standards can be found on Ecology's homepage at http://www.ecy.wa.gov/programs/eap/pwspread/pwspread.html.

You can retrieve detailed data on discharge monitoring, permit records, compliance, inspections and enforcement from Ecology's Permitting and Reporting Information System (PARIS) at https://fortress.wa.gov/ecy/wqreports/public/f?p=publicparis.

Table 15. Reasonable Potential Calculation

Water Body Type	Freshwater

Facility: North Bend WWTP

Dilution Factors:	Acute	Chronic
Aquatic Life	2.8	14.8
Human Health Carcinogenic		60.7
Human Health Non-Carcinogenic		18.4

Receiving Water Hardness = 21.3 mg/L

Pollutant, CAS No. & NPDES Application Ref. No.			AMMONIA, Criteria as Total NH3	ANTIMONY (INORGANIC) 7440360 1M	ARSENIC (dissolved) 7440382 2M	CHROMIUM(TRI) -16065831 5M Hardness dependent	COPPER - 744058 6M Hardness dependent	LEAD - 7439921 7M Dependent on hardness	MERCURY 7439976 8M	NICKEL - 7440020 9M - Dependent on hardness	SELENIUM 7782492 10M	SILVER - 7740224 11M dependent on hardness.	ZINC- 7440666 13M hardness dependent		
Effluent Data	# of Samples (n)		66	4	4	4	24	4	52	4	4	24	24		
	Coeff of Variation (Cv)		2.1	0.6	0.6	0.6	0.51	0.6	0.85	0.6	0.6	2.56	0.45		
	Effluent Concentration, ug/L (Max. or 95th Percentile)		12,250	0.52	6.79	0.43	5.73	0.8	0.0159	1.04	1.17	0.22	75.8		
	Calculated 50th percentile Effluent Conc. (when n>10)		.						0.0035						
Receiving Water Data	90th Percentile Conc., ug/L		0.012		0.776	0	1.2	0	0.0005	0.32	0	0	9.9		
	Geo Mean, ug/L			0					0	0.185	0				
Water Quality Criteria	Aquatic Life Criteria, ug/L	Acute	21,945	-	360	232.91	6.349	20.332	2.1	584.03	20	0.5704	47.159		
		Chronic	1,605	-	190	55.152	3.3427	0.5146	0.012	46.858	5	-	31.095		
	WQ Criteria for Protection of Human Health, ug/L		-	14	-	-	-	-	0.14	610	170	-	-		
	Metal Criteria Translator, decimal	Acute	-	-	1	-	0.996	0.466	0.85	0.998	-	0.85	0.996		
		Chronic	-	-	1	-	0.996	0.466	-	0.997	-	-	0.996		
	Carcinogen?		N	N	Y	N	N	N	N	N	N	N	N		

Aquatic Life Reasonable Potential

s		1.299		0.555	0.555	0.481	0.555	0.737	0.555	0.555	1.422	0.429	
Pn		0.956		0.473	0.473	0.883	0.473	0.944	0.473	0.473	0.883	0.883	
Multiplier		1.00		2.59	2.59	1.00	2.59	1.00	2.59	2.59	1.00	1.00	
Max concentration (ug/L) at edge of...	Acute	4,375		6.769	0.397	2.810	0.344	0.005	1.164	1.080	0.067	33.327	
	Chronic	828		1.910	0.075	1.505	0.065	0.002	0.480	0.204	0.015	14.332	
Reasonable Potential? Limit Required?		**NO**		**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	

Human Health Reasonable Potential

s			0.555					0.7374	0.5545	0.5545			
Pn			0.473					0.944	0.473	0.473			
Multiplier			1.038					0.3097	1.0385	1.0385			
Dilution Factor			18.4					18.4	18.4	18.4			
Max Conc. at edge of Chronic Zone, ug/L			0.029					1.9E-04	2.3E-01	6.6E-02			
Reasonable Potential? Limit Required?			**NO**					**NO**	**NO**	**NO**			

Comments/Notes:

References: WAC 173-201A,

Technical Support Document for Water Quality-based Toxics Control, US EPA, March 1991, EPA/505/2-90-001, pages 56/99

Table 16. Calculation of pH

Calculation of pH of a Mixture of Two Flows

Based on the procedure in EPA's DESCON program (EPA, 1988. Technical Guidance on Supplementary Stream Design Conditions for Steady State Modeling. USEPA Office of Water, Washington D.C.)

INPUT	
1. Dilution Factor at Mixing Zone Boundary	14.800
2. Ambient/Upstream/Background Conditions	
Temperature (deg C):	18.80
pH:	7.10
Alkalinity (mg CaCO3/L):	50.00
3. Effluent Characteristics	
Temperature (deg C):	22.70
pH:	6.00
Alkalinity (mg CaCO3/L):	150.00
OUTPUT	
1. Ionization Constants	
Upstream/Background pKa:	6.39
Effluent pKa:	6.36
2. Ionization Fractions	
Upstream/Background Ionization Fraction:	0.84
Effluent Ionization Fraction:	0.30
3. Total Inorganic Carbon	
Upstream/Background Total Inorganic Carbon (mg CaCO3/L):	60
Effluent Total Inorganic Carbon (mg CaCO3/L):	497
4. Conditions at Mixing Zone Boundary	
Temperature (deg C):	19.06
Alkalinity (mg CaCO3/L):	56.76
Total Inorganic Carbon (mg CaCO3/L):	89.29
pKa:	6.39
RESULTS	
pH at Mixing Zone Boundary:	**6.63**

Table 17. Calculation of Fecal Coliform Mixing

Calculation of Fecal Coliform at Chronic Mixing Zone

INPUT	
Chronic Dilution Factor	14.80
Ambient Fecal Coliform, #/100 ml	
Effluent Fecal Coliform - worst case, #/100 ml	400
Surface Water Criteria, #/100 ml	*100*
OUTPUT	
Fecal Coliform at Mixing Zone Boundary, #/100 ml	**25**
Difference between mixed and ambient, #/100 ml	25

Conclusion: At design flow, the discharge has no reasonable potential to violate water quality standards for fecal coliform.

Table 18. Freshwater Ammonia Criteria

Freshwater Un-ionized Ammonia Criteria Calculation

Based on Chapter 173-201A WAC, amended November 20, 2006

INPUT	
1. Receiving Water Temperature (deg C):	18.8
2. Receiving Water pH:	7.1
3. Is salmonid habitat an existing or designated use?	Yes
4. Are non-salmonid early life stages present or absent?	Present
OUTPUT	
1. Unionized ammonia NH3 criteria (mg NH3/L)	
Acute:	0.121
Chronic:	0.009
Total ammonia nitrogen criteria (mg N/L):	
Acute:	21.945
Chronic:	1.605

Table 19. Temperature Reasonable Potential

Freshwater Temperature Reasonable Potential and Limit Calculation

Based on WAC 173-201A-200(1)(c)(i)--(ii) and the Water Quality Program Guidance. All data inputs must meet WQ guidelines. The Water Quality temperature guidance document may be found at: http://www.ecy.wa.gov/biblio/0610100.html

	Core Summer Critera
INPUT	**June-Sept.**
1. Chronic Dilution Factor at Mixing Zone Boundary	20.9
2. 7DADMax Ambient Temperature (T) (Upstream Background 90th percentile)	16.0 °C
3. 7DADMax Effluent Temperature (95th percentile)	22.7 °C
4. Aquatic Life Temperature WQ Criterion in Fresh Water	16.0 °C
OUTPUT	
5. Temperature at Chronic Mixing Zone Boundary:	16.3 °C
6. Incremental Temperature Increase or decrease:	0.3 °C
7. Maximum Allowable Incremental Temperature Increase:	0.3 °C
8. Maximum Allowable Temperature at Mixing Zone Boundary:	16.3 °C
A. If ambient temp is warmer than WQ criterion	
9. Does temp fall within this warmer temp range?	YES
10. Temperature Limit if Required:	NO LIMIT
B. If ambient temp is cooler than WQ criterion but within 28/(T_{amb}+7) and within 0.3 °C of the criterion	
11. Does temp fall within this incremental temp. range?	---
12. Temp increase allowed at mixing zone boundary, if required:	---
C. If ambient temp is cooler than (WQ criterion-0.3) but within 28/(T_{amb}+7) of the criterion	
13. Does temp fall within this Incremental temp. range?	---
14. Temp increase allowed at mixing zone boundary, if required:	---
D. If ambient temp is cooler than (WQ criterion - 28/(T_{amb}+7))	
15. Does temp fall within this Incremental temp. range?	---
16. Temp increase allowed at mixing zone boundary, if required:	---
RESULTS	
17. Do any of the above cells show a temp increase?	**NO**
18. Temperature Limit if Required?	**NO LIMIT**

Table 20. Calculation of NBOD+CBOD Average Monthly Limit

NBOD+CBOD				
Calculation of Permit Limits Based on Wasteload Allocation				
Source:	*EPA Technical Support Document for Water Quality-based Toxics Control*			
Input	**Definition**	**Formula**	**Result**	**Units**
MDL	Maximum Daily Limit	=Daily WLA	**300**	lb/day
CV	Coefficient of Variation	Calc. std. dev/mean	0.403	
n	Number of samples	per month	8	
Variables				
σ	Standard Deviation	$\text{sqrt}\{\ln(CV^2+1)\}$	0.388	
σ^2	Standard Deviation	$\ln(CV^2+1)$	0.150	
σ_n		$\ln(CV/n+1)$	0.142	
σ^2_n		$\ln(CV^2/n+1)$	0.020	
z (99th)	99th Percentile Occurrence		2.326	
z (95th)	95th Percentile Occurrence		1.645	
Output				
LTAc	Chronic Long-term average	$MDL/\exp(z_{99}\sigma-0.5\sigma^2)$	131.2	lb/day
AML	Average Monthly Limit	$LTAc*\exp(z_{95}\sigma_n-0.5\sigma_n^2)$	**164.0**	lb/day

Appendix E – Dilution Factor Calculations

Ecology approved dilution factors for the previous permit based on the approved mixing zone study, Evaluation of Water Quality-Based NPDES Permit Limitations (Cosmopolitan, March 2005). Because effluent flows have increased since the report was drafted in 2004, Ecology must re-evaluate the dilution factors. This appendix documents the basis for the proposed permit dilution factors.

Low flows

The 7Q10 is a statistical estimate of the lowest 7-day average flow that can be expected to occur once every ten years on average. The 7Q10 flow is commonly used to represent the critical flow condition in a water body and is typically calculated from long-term flow data. These low flows usually occur in September in the Snoqualmie River watershed. The Cosmopolitan (2005) study used a 7Q10 flow value of 85 cfs for the South Fork Snoqualmie River. Cosmopolitan based this number on USGS data for gauging Station 12144000 from 1963-2003. The Snoqualmie River Basin Temperature TMDL (June 2011) used a 7Q10 flow of 78 cfs based on records from 1907-2008.

Ecology NWRO staff retrieved the most recent USGS data and used EPA's DFLOW program to calculate a 7Q10 flow of 80.3 cfs, a 30Q5 flow of 97.3 cfs, and a harmonic mean flow of 297 cfs for the proposed permit. The data includes the years 1909-2011.

Critical effluent flows are based on DMR data from 2009-2011 according to Ecology's *Permit Writer's Manual.*

Channel geometry

In the previous permit, Ecology used dilution factors based on the Cosmopolitan (2005) study, with chronic dilution limited by the mixing zone restriction to 25% of the width of the river. Cosmopolitan (2005) used the model RIVPLUM5; Ecology currently uses the updated version RiverPlume6. The dilution model uses stream depth, width, flow velocity, and slope to predict dilution.

An earlier version of the Cosmopolitan (2005) study used 51.5 feet as the river width, while the final version used 68 feet in the RIVPLUM model. The width of 68 feet came from the 1999 NPDES permit. In the 2006 permit, Ecology used 51.5 feet to limit the chronic mixing zone, but approved the modeling in the Cosmopolitan study. More recently, Ecology took field measurements of river width while developing the temperature TMDL. The field measurements from the South Fork are shown in Table E-1 below. The measured widths are variable, and flows are higher than the 7Q10, but it appears that 68 feet is a better estimate of river width at critical conditions.

Width restriction: 25% of river width = .25 x 68 ft = 17 ft

Table 21. South Fork TMDL Field Data (from Temperature TMDL Study, 2011)

Date	Q	Wet Width	Avg V	Avg Depth
7/26/2006	179	93	1.16	1.65
8/16/2006(1)	143	60	1.79	1.33
8/16/2006(2)	139	90	1.68	.93
9/22/2006	241	79	1.38	2.21
10/19/2006	183	77	1.33	1.8

The Cosmopolitan (2005) study used a depth of 1.0 feet and velocity of 1.68 ft/s, which is consistent with the field measurements. However, to simulate the 7Q10 flow, the Q = (depth) x (width) x (velocity) used in the dilution model should equal the 7Q10. The Ecology reviewer (Anise Ahmed) of the Cosmopolitan study asked for this adjustment but it was not included in the final report. A velocity of 1.18 ft/s makes the flow volume match the 7Q10 and is consistent with the velocities measured in the field.

1.0 ft x 68 ft x 1.18 ft/s = 80.24 cfs

Using the RiverPlume6 model, I adjusted the "Distance Downstream to Point of Interest" until the result for plume width equaled 25% of the river width, or 17 ft. At effluent flows of 0.85-1.01 cfs, the effluent plume reaches a width of 17 ft at a downstream distance of 256 ft.

Table 22. Critical Conditions Used to Model the Discharge

Critical Condition **Critical period for Acute and Chronic Aquatic Toxicity and Human Health: August through October** **Critical period for Temperature: June through September**	Value
Seven-day-average low river flow with a recurrence interval of ten years (7Q10)	80.3 cfs [51.9 MGD]
Thirty-day low river flow with a recurrence interval of five years (30Q5)	97.3 cfs [62.9 MGD]
Harmonic mean flow for August-October critical period	297 cfs
July-August 7Q10 (from the Temperature TMDL)	101 cfs [65.3 MGD]
River depth at the 7Q10 period	1.0 feet
River velocity	1.18 ft per second
Slope	0.0024
Channel width	68 feet
Maximum daily flow for acute mixing zone (August-October critical period for DO and toxic pollutants)	0.72 MGD [1.11 cfs]
Maximum average monthly effluent flow for chronic and human health non-carcinogen (August-October critical period)	0.55 MGD [0.85 cfs]
Maximum average monthly effluent flow for temperature (June-September critical period)	0.65 MGD [1.01 cfs]
Annual average flow for human health carcinogen	0.58 MGD [0.90 cfs]

Dilution Factors

Flow-based and modeled dilution factor calculations are shown in the following tables. To model the flows for human health criteria, which are higher than the 7Q10, I proportionately increased the stream depth and velocity.

Table 23. Calculation of Flow-Based Dilution Factors

Calculation of Flow-Based Dilution Factors

Input	
River Flow (Qa)	
7Q10 (Aquatic Life)	80.3
Harmonic mean flow (Human Health carcinogen)	297.0
30Q5 (Human Health non-carcinogen)	97.3
Effluent Flow (Qe)	
Maximum day (acute)	1.11
Maximum monthly average (chronic and human health non-carcinogen)	0.85
Annual average (human health carcinogen)	0.90
Maximum monthly average (temperature)	1.01
Allowed fraction of flow (acute)	0.025
Allowed fraction of flow (chronic, human health, and temperature)	0.25
Results	
Dilution (Qa+Qe)/Qe	
Acute Aquatic Life	**2.8**
Chronic Aquatic Life	**24.6**
Human Health carcinogen	**83.5**
Human Health non-carcinogen	**29.6**
Temperature	**20.9**

Table 24. RiverPlume6: Acute Aquatic Toxicity

Spread of a Plume from a Point Source in a River with Boundary Effects from the Shoreline

Based on the method of Fischer et al. (1979) with correction for the effective origin of effluent.

INPUT	
1. Effluent Discharge Rate (cfs):	1.11
2. Receiving Water Characteristics Downstream From Waste Input	
Stream Depth (ft):	1.00
Stream Velocity (fps):	1.18
Channel Width (ft):	68.00
Stream Slope (ft/ft) or Manning roughness "n":	0.0024
0 if slope or 1 if Manning "n" in previous cell:	0
3. Discharge Distance From Nearest Shoreline (ft):	0
4. Location of Point of Interest to Estimate Dilution	
Distance Downstream to Point of Interest (ft):	30
Distance From Nearest Shoreline (ft):	0
5. Transverse Mixing Coefficient Constant (usually 0.6):	0.6
6. Original Fischer Method (enter 0) or Effective Origin Modification (enter 1)	0
OUTPUT	
1. Source Conservative Mass Input Rate	
Concentration of Conservative Substance (%):	100.00
Source Conservative Mass Input Rate (cfs*%):	111.00
2. Shear Velocity	
Shear Velocity based on slope (ft/sec):	0.278
Shear Velocity based on Manning "n" (using Prasuhn equations 8-26 and 8-54 assuming hydraulic radius equals depth for wide channel):	
Darcy-Weisbach friction factor "f":	#N/A
Shear Velocity from Darcy-Weisbach "f" (ft/sec):	#N/A
Selected Shear Velocity for next step (ft/sec):	0.278
3. Transverse Mixing Coefficient (ft2/sec):	0.167
4. Plume Characteristics Accounting for Shoreline Effect (Fischer et al., 1979)	
Co	1.38E+00
x'	9.17E-04
y'o	0.00E+00
y' at point of interest	0.00E+00
Solution using superposition equation (Fischer eqn 5.9)	
Term for n= -2	0.00E+00
Term for n= -1	0.00E+00
Term for n= 0	2.00E+00
Term for n= 1	0.00E+00
Term for n= 2	0.00E+00
Upstream Distance from Outfall to Effective Origin of Effluent Source (ft)	#N/A
Effective Distance Downstream from Effluent to Point of Interest (ft)	30.00
x' Adjusted for Effective Origin	9.17E-04
C/Co (dimensionless)	1.86E+01
Concentration at Point of Interest (Fischer Eqn 5.9)	2.58E+01
Unbounded Plume Width at Point of Interest (ft)	11.649
Unbounded Plume half-width (ft)	5.824
Distance from near shore to discharge point (ft)	0.00
Distance from far shore to discharge point (ft)	68.00
Plume width bounded by shoreline (ft)	5.82
RESULTS	
Approximate Downstream Distance to Complete Mix (ft)	**13,085**
Theoretical Dilution Factor at Complete Mix	**72.288**
Calculated Flux-Average Dilution Factor Across Entire Plume Width	**6.192**
Calculated Dilution Factor at Point of Interest	**3.880**

Table 25. RiverPlume6: Chronic Aquatic Toxicity

Spread of a Plume from a Point Source in a River with Boundary Effects from the Shoreline

Based on the method of Fischer et al. (1979) with correction for the effective origin of effluent.

INPUT	
1. Effluent Discharge Rate (cfs):	0.85
2. Receiving Water Characteristics Downstream From Waste Input	
Stream Depth (ft):	1.00
Stream Velocity (fps):	1.18
Channel Width (ft):	68.00
Stream Slope (ft/ft) or Manning roughness "n":	0.0024
0 if slope or 1 if Manning "n" in previous cell:	0
3. Discharge Distance From Nearest Shoreline (ft):	0
4. Location of Point of Interest to Estimate Dilution	
Distance Downstream to Point of Interest (ft):	256
Distance From Nearest Shoreline (ft):	0
5. Transverse Mixing Coefficient Constant (usually 0.6):	0.6
6. Original Fischer Method (enter 0) or Effective Origin Modification (enter 1)	0
OUTPUT	
1. Source Conservative Mass Input Rate	
Concentration of Conservative Substance (%):	100.00
Source Conservative Mass Input Rate (cfs*%):	85.00
2. Shear Velocity	
Shear Velocity based on slope (ft/sec):	0.278
Shear Velocity based on Manning "n" (using Prasuhn equations 8-26 and 8-54 assuming hydraulic radius equals depth for wide channel):	
Darcy-Weisbach friction factor "f":	#N/A
Shear Velocity from Darcy-Weisbach "f" (ft/sec):	#N/A
Selected Shear Velocity for next step (ft/sec):	0.278
3. Transverse Mixing Coefficient (ft2/sec):	0.167
4. Plume Characteristics Accounting for Shoreline Effect (Fischer et al., 1979)	
Co	1.06E+00
x'	7.83E-03
y'o	0.00E+00
y' at point of interest	0.00E+00
Solution using superposition equation (Fischer eqn 5.9)	
Term for n= -2	2.08E-222
Term for n= -1	6.39E-56
Term for n= 0	2.00E+00
Term for n= 1	6.39E-56
Term for n= 2	2.08E-222
Upstream Distance from Outfall to Effective Origin of Effluent Source (ft)	#N/A
Effective Distance Downstream from Effluent to Point of Interest (ft)	256.00
x' Adjusted for Effective Origin	7.83E-03
C/Co (dimensionless)	6.38E+00
Concentration at Point of Interest (Fischer Eqn 5.9)	6.76E+00
Unbounded Plume Width at Point of Interest (ft)	34.029
Unbounded Plume half-width (ft)	17.014
Distance from near shore to discharge point (ft)	0.00
Distance from far shore to discharge point (ft)	68.00
Plume width bounded by shoreline (ft)	17.01
RESULTS	
Approximate Downstream Distance to Complete Mix (ft)	**13,085**
Theoretical Dilution Factor at Complete Mix	**94.400**
Calculated Flux-Average Dilution Factor Across Entire Plume Width	**23.620**
Calculated Dilution Factor at Point of Interest	**14.802**

Table 26. RiverPlume6: Human Health Carcinogen

Spread of a Plume from a Point Source in a River with Boundary Effects from the Shoreline

Based on the method of Fischer et al. (1979) with correction for the effective origin of effluent.

INPUT	
1. Effluent Discharge Rate (cfs):	0.90
2. Receiving Water Characteristics Downstream From Waste Input	
Stream Depth (ft):	1.92
Stream Velocity (fps):	2.27
Channel Width (ft):	68.00
Stream Slope (ft/ft) or Manning roughness "n":	0.0024
0 if slope or 1 if Manning "n" in previous cell:	0
3. Discharge Distance From Nearest Shoreline (ft):	0
4. Location of Point of Interest to Estimate Dilution	
Distance Downstream to Point of Interest (ft):	256
Distance From Nearest Shoreline (ft):	0
5. Transverse Mixing Coefficient Constant (usually 0.6):	0.6
6. Original Fischer Method (enter 0) or Effective Origin Modification (enter 1)	0
OUTPUT	
1. Source Conservative Mass Input Rate	
Concentration of Conservative Substance (%):	100.00
Source Conservative Mass Input Rate (cfs*%):	90.00
2. Shear Velocity	
Shear Velocity based on slope (ft/sec):	0.385
Shear Velocity based on Manning "n" (using Prasuhn equations 8-26 and 8-54 assuming hydraulic radius equals depth for wide channel):	
Darcy-Weisbach friction factor "f":	#N/A
Shear Velocity from Darcy-Weisbach "f" (ft/sec):	#N/A
Selected Shear Velocity for next step (ft/sec):	0.385
3. Transverse Mixing Coefficient (ft2/sec):	0.444
4. Plume Characteristics Accounting for Shoreline Effect (Fischer et al., 1979)	
Co	3.04E-01
x'	1.08E-02
y'o	0.00E+00
y' at point of interest	0.00E+00
Solution using superposition equation (Fischer eqn 5.9)	
Term for n= -2	6.13E-161
Term for n= -1	1.49E-40
Term for n= 0	2.00E+00
Term for n= 1	1.49E-40
Term for n= 2	6.13E-161
Upstream Distance from Outfall to Effective Origin of Effluent Source (ft)	#N/A
Effective Distance Downstream from Effluent to Point of Interest (ft)	256.00
x' Adjusted for Effective Origin	1.08E-02
C/Co (dimensionless)	5.42E+00
Concentration at Point of Interest (Fischer Eqn 5.9)	1.65E+00
Unbounded Plume Width at Point of Interest (ft)	40.018
Unbounded Plume half-width (ft)	20.009
Distance from near shore to discharge point (ft)	0.00
Distance from far shore to discharge point (ft)	68.00
Plume width bounded by shoreline (ft)	20.01
RESULTS	
Approximate Downstream Distance to Complete Mix (ft)	**9,462**
Theoretical Dilution Factor at Complete Mix	**329.301**
Calculated Flux-Average Dilution Factor Across Entire Plume Width	**96.896**
Calculated Dilution Factor at Point of Interest	**60.720**

Table 27. RiverPlume6: Human Health Non-Carcinogen

Spread of a Plume from a Point Source in a River with Boundary Effects from the Shoreline

Based on the method of Fischer et al. (1979) with correction for the effective origin of effluent.

INPUT	
1. Effluent Discharge Rate (cfs):	0.85
2. Receiving Water Characteristics Downstream From Waste Input	
Stream Depth (ft):	1.10
Stream Velocity (fps):	1.30
Channel Width (ft):	68.00
Stream Slope (ft/ft) or Manning roughness "n":	0.0024
0 if slope or 1 if Manning "n" in previous cell:	0
3. Discharge Distance From Nearest Shoreline (ft):	0
4. Location of Point of Interest to Estimate Dilution	
Distance Downstream to Point of Interest (ft):	256
Distance From Nearest Shoreline (ft):	0
5. Transverse Mixing Coefficient Constant (usually 0.6):	0.6
6. Original Fischer Method (enter 0) or Effective Origin Modification (enter 1)	0
OUTPUT	
1. Source Conservative Mass Input Rate	
Concentration of Conservative Substance (%):	100.00
Source Conservative Mass Input Rate (cfs*%):	85.00
2. Shear Velocity	
Shear Velocity based on slope (ft/sec):	0.292
Shear Velocity based on Manning "n" (using Prasuhn equations 8-26 and 8-54 assuming hydraulic radius equals depth for wide channel):	
Darcy-Weisbach friction factor "f":	#N/A
Shear Velocity from Darcy-Weisbach "f" (ft/sec):	#N/A
Selected Shear Velocity for next step (ft/sec):	0.292
3. Transverse Mixing Coefficient (ft2/sec):	0.192
4. Plume Characteristics Accounting for Shoreline Effect (Fischer et al., 1979)	
Co	8.74E-01
x'	8.20E-03
y'o	0.00E+00
y' at point of interest	0.00E+00
Solution using superposition equation (Fischer eqn 5.9)	
Term for n= -2	2.10E-212
Term for n= -1	2.02E-53
Term for n= 0	2.00E+00
Term for n= 1	2.02E-53
Term for n= 2	2.10E-212
Upstream Distance from Outfall to Effective Origin of Effluent Source (ft)	#N/A
Effective Distance Downstream from Effluent to Point of Interest (ft)	256.00
x' Adjusted for Effective Origin	8.20E-03
C/Co (dimensionless)	6.23E+00
Concentration at Point of Interest (Fischer Eqn 5.9)	5.45E+00
Unbounded Plume Width at Point of Interest (ft)	34.823
Unbounded Plume half-width (ft)	17.411
Distance from near shore to discharge point (ft)	0.00
Distance from far shore to discharge point (ft)	68.00
Plume width bounded by shoreline (ft)	17.41
RESULTS	
Approximate Downstream Distance to Complete Mix (ft)	**12,495**
Theoretical Dilution Factor at Complete Mix	**114.400**
Calculated Flux-Average Dilution Factor Across Entire Plume Width	**29.292**
Calculated Dilution Factor at Point of Interest	**18.356**

Table 28. Summary of Dilution Factors

WQ Standards	Flow-Based Dilution	Modeled Dilution	Dilution Factor – Previous Permit	Dilution Factor – Proposed Permit
Acute Aquatic Life	2.8	3.9	3.25	2.8
Chronic Aquatic Life	24.6	14.8	18.7	14.8
Human Health Carcinogen	83.5	60.7	18.7	60.7
Human Health Non-Carcinogen	29.6	18.4	18.7	18.4
Temperature	20.9	N/A	N/A	20.9

Appendix F – Response to Comments

City of North Bend Comments

The City of North Bend submitted comments on their initial review of the permit and fact sheet. See the letter from Tetra Tech on the following pages. Ecology's response to the comments is as follows:

1. Ecology made changes to clarify and expand the summary section.
2. Ecology made the suggested corrections.
3. Ecology made the suggested corrections.
4. Ecology made the suggested corrections.
5. The comment is correct that 1.17 MGD is not a "design flow" and it is not listed as such in Section S4 of the permit or corresponding sections of the fact sheet. It is an estimated dry weather flow. The TSS limits based on this flow are technology-based limits determined on a "best professional judgment" (BPJ) basis in the previous permit.

   In general, Ecology may not reissue an existing NPDES permit with effluent limits that are less stringent (anti-backsliding). Exceptions to this rule are found in CWA 402(o), CWA 303(d)(4), and 40 CFR 122.44(l). Ecology may increase technology-based limits determined on a BPJ basis if Ecology made a mistake when it calculated limits or when it interpreted law or regulation when it issued the permit.

   The highest monthly average flow recorded to date for the months of August-October is 0.55 MGD, and TSS levels during these months are generally low. However, North Bend requested that the technology-based limits for TSS during these months be based on a future dry weather monthly average flow of 1.4 MGD, because 1.17 MGD was an estimated flow for 2010, not accounting for future growth projections.

   It appears that the original use of 1.17 MGD was in error and is not consistent with the maximum month design flow used to calculate technology-based limits for the November-July period. Ecology made the requested change in the TSS limits.
6. The NBOD+CBOD limit in the draft permit was based on a coefficient of variation (CV) of 0.6, which is a default value used when effluent data is insufficient to calculate a CV. Ecology agrees that the high ammonia values in August and October, 2011, are anomalous and not representative of the normal performance of the treatment plant. Excluding those three values leaves enough data to calculate a CV of 0.4. The approach suggested by the comment is reasonable, and Ecology made this change. This calculation will be re-evaluated at the next permit renewal.
7. Ecology made changes to this table according to the comments above.
8. The additional nutrient testing in the proposed permit is required in all current permits.

   There is no plan at present for a new or updated TMDL for the Snoqualmie River.

   Ecology removed the UV transmittance monitoring; that requirement is primarily used in membrane bioreactor (MBR) plants to verify disinfection when fecal coliform in the effluent is close to zero.

   A continuous record of effluent temperature is critical during the season identified in the temperature TMDL (June-September). Once the equipment to do this monitoring is installed,

such as a combined pH/temperature probe, it should be relatively easy to monitor for temperature year round. Water quality standards for temperature apply throughout the year, not only during the TMDL critical period.

9. Ecology made these changes.
10. Ecology made the suggested correction.

TETRA TECH

February 14, 2013

Frank Page, P.E., Public Works Director/City Engineer
City of North Bend
1155 E. North Bend Way
North Bend, WA 98045

Subject: Review of Draft Fact Sheet and NPDES Permit for the City's Wastewater Treatment Plant.

Dear Frank:

This letter presents our comments and concerns regarding the subject documents. Our comments and concerns are as follows:

1. Fact Sheet page 1, Summary section, second paragraph. The second and third sentences sentence should be replaced with the following:
   The proposed permit revises mass limits for total suspended solids (TSS) year around and the 5-day carbonaceous biochemical oxygen demand ($CBOD_5$) for the months November through July based on the increased hydraulic capacity of the treatment plant. The permit eliminates the discrete mass limits for $CBOD_5$ and total ammonia and establishes mass limits for a combined parameter (NBOD and CBOD) for the months of August through October to achieve consistency with CBOD and ammonia mass allocations established for the five municipal wastewater treatment plant scenario presented in the Snoqualmie River Total Maximum Daily Load (TMDL) Study (1994).
2. Fact Sheet page 6, II. Background Information. Under Facility Information, please replace "Ronald Garrow" with "Frank Page, P.E.". Under Inspection Status, please enter the day in November 2012 that the facility was inspected by DOE.
3. Fact Sheet page 8, A. Facility Description, History, In the last sentence of the paragraph, replace the word "dryers" with "dewatering and drying system,".
4. Fact Sheet page 9, A. Facility Description, Solids Wastes; In the first sentence delete the word "grit" since the treatment plant does not have a grit removal process; grit removal is incidental and associated with manual cleaning of wet wells and channels. In the second sentence replace the words "belt filter press" with "centrifuge". Replace the last sentence of the paragraph with "The North Bend WWTP disposes of and provides for reuse of the dried biosolids at Bolder Park Inc. located in Douglas County, WA. Screenings are washed and compacted and then disposed of as solid waste along with incidental grit, rags and scum at the Roosevelt Landfill through a contract with Republic Services, Inc.
5. Fact Sheet page 18, Article III B. last paragraph, sentence makes reference to a maximum month design flow rate for the months of August through October as being 1.17 MGD. The City commented on October 28, 2005 in reference to the previous permit that this value is

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NOT a design criteria but a prediction of what the average flow rate was expected to be in 2010. A flow rate of 2.16 cfs (1.4 mgd) is identified in Table 5 of the TMDL study to be the dry weather monthly average flow rate for the North Bend WWTP projected growth scenario. The technology-based effluent for total suspended solids applied to this flow result in a monthly average of mass limit of 350 lbs/day and a weekly limit of 525 lbs/day for the months of August through October. The values shown in Table 9 should be adjusted accordingly.

6. Fact Sheet page 28, Article III F. Evaluation of surface water quality-based effluent limits for numeric criteria. The average monthly limit for NBOD+CBOD should be based on the coefficient of variance (CV) resulting from calculation of the NBOD+CBOD parameter for the period August through October using the DMR data between August 1, 2006 through October 12, 2011. Review of the data indicates that the ammonia mass discharge reported for August 2 and 15, 2011 and October 12, 2011 are greater than an order of magnitude greater than average of the ammonia mass discharge rate and therefore outliers. When these values are excluded from the data set the CV is 0.40. Based on the methodology presented in the Appendix D of the fact sheet (pages 28-29 of the Fact Sheet) with the MDL equal to 300, CV of 0.40, and 8 samples, then the AML for NBOD+CBOD is 164 lbs/day as shown in Attachment A. This value is also in good agreement with the individual AML mass limits established in the previous permit (i.e., CBOD = 150 mg/L and Total Ammonia 8.4 mg/L), which would correspond to an AML for NBOD+CBOD of 168 lbs/day.

7. Fact Sheet pages 33 and 34, Article III K. Comparison of effluent limits with the previous permit issued April 7, 2006. Table 13.

   For the period August through October only (page 33), replace the Proposed Effluent limits Outfall # 001 mass limit for TSS: average monthly from 293 lbs/day to 350 lbs/day and Average weekly from 439 lbs/day to 525 lbs/day to maintain consistency with comment 7 above.

   For the period August through October only (page 34), replace the Proposed Effluent limits Outfall # 001 mass limit for NBOD+CBOD: average monthly from 133 lbs/day to 164 lbs/day to maintain consistency with comment 6 above.

8. Fact Sheet pages 35, Article IV Monitoring Requirements B. Wastewater Monitoring. The monitoring schedule proposed under S2 in the permit is significantly more extensive than required in the previous permit. The Fact Sheet suggests that Ecology is planning to develop or update TMDLs and establish WLAs for nutrients in the Snoqualmie River. Additional explanation should be provided to justify the reason(s) for making daily measurements of the percent transmittance of UV light in the final effluent. Ecology should provide an explanation for requiring continuous monitoring of temperature in the final effluent year around; continuous monitoring of temperature is appropriate to evaluate the temperature impact on the Snoqualmie River during critical season for water temperature, which is reported to be June through September in the Snoqualmie River TMDL (page 113). What is the justification for requiring continuous temperature monitoring during the non-critical (temperature/flow) period?

9. Draft Permit page 5 S1.A.

   In the table for Effluent limits Outfall # 001 replace the mass limit for TSS: average monthly from 293 lbs/day to 350 lbs/day and Average weekly from 439 lbs/day to 525 lbs/day to maintain consistency with comment 5 above.

In the table for Effluent limits Outfall # 001 replace the mass limit for NBOD+CBOD: average monthly from 133 lbs/day to 164 lbs/day to maintain consistency with comment 6 above.

10. Draft Permit page 26, S10. Temperature reduction study. The critical period identified in the permit is different from that stated in the Snoqualmie River Basin Temperature Total Maximum Daily Load Water Quality Improvement Report and Implementation Plan. The referenced TMDL Report indicates that the critical period is June through September, but the draft permit indicates the period is July through September. We would recommend that the critical time period be consistent with the TMDL report to avoid confusion.

We hope that you find out comments useful and constructive. If you have any questions please contact me at (206)883-9370 or Jim Santroch at (206)883-9410

Sincerely,
Tetra Tech, Inc.

John A. Markus, P.E., BCEE
Senior Project Manager, Engineering & Consulting Services

JAM:jam

Attachment A
c: Central File

Jim Santroch

#135-63037-11001-04

Attachment A

	Total Ammonia	CBOD5	unfiltered data NBOD+CBOD	outliers removed NBOD+CBOD		
	lbs/d	lbs/d	lbs/d	lbs/d		
date						
8/1/2006	0.33	16.68	17.39115	17.39115	MDL	300
8/8/2006	0.47	14.34	15.35285	15.35285	CV	0.403
8/16/2006	0.53	9.26	10.40215	10.40215	n	8
8/22/2006	0.48	6.01	7.0444	7.0444		
8/29/2006	0.34	8.51	9.2427	9.2427	sigma	0.388158
9/6/2006	0.25	15.43	15.96875	15.96875	sigma2	0.150667
9/19/2006	0.32	9.51	10.1996	10.1996	sigman	0.141853
10/3/2006	1.7	11.34	15.0035	15.0035	sigman2	0.020122
10/10/2006	0.22	12.09	12.5641	12.5641		
10/17/2006	0.96	9.34	11.4088	11.4088	Z99	2.326
8/1/2007	1.3	9.01	11.8115	11.8115	Z95	1.645
8/8/2007	0.48	14.18	15.2144	15.2144		
8/15/2007	0.25	2.84	3.37875	3.37875	LTAc	131.1392
8/22/2007	0.23	2.84	3.33565	3.33565	AML	163.9476
9/19/2007	0.37	14.18	14.97735	14.97735		
9/25/2007	2.1	12.01	16.5355	16.5355		
10/9/2007	0.44	11.01	11.9582	11.9582		
10/23/2007	0.44	8.01	8.9582	8.9582		
10/28/2007	0.292	3.17	3.79926	3.79926		
9/2/2008	0.33	5.84	6.55115	6.55115		
9/8/2008	0.37	6.34	7.13735	7.13735		
9/22/2008	0.41	9.76	10.64355	10.64355		
10/6/2008	0.48	16.26	17.2944	17.2944		
10/28/2009	0.62	11.01	12.3461	12.3461		
8/3/2010	1.9	5	9.0945	9.0945		
8/10/2010	1.21	2.5	5.10755	5.10755		
8/17/2010	1.57	5.17	8.55335	8.55335		
9/28/2010	2.79	6.17	12.18245	12.18245		
10/5/2010	0.35	14.34	15.09425	15.09425		
10/26/2010	0.78	20.35	22.0309	22.0309		
8/2/2011	37.78	4.17	85.5859			
8/15/2011	51.71	25.02	136.4551			
8/30/2011	5.65	4	16.17575	16.17575		
9/27/2011	6.88	4.17	18.9964	18.9964		
10/12/2011	82.72	29.02	207.2816			
average	5.92	10.25	23.0022	11.74233		
st dev	17.00	6.23	40.40214	4.735075		
count	35	35	35	32		
CV	2.87	0.607	1.756	0.403		

= data outliers

U.S. Environmental Protection Agency Comments

The EPA submitted review comments during the public notice period. The comments and Ecology's responses are as follows:

EPA Comment #1:

The permit authorized less stringent limits for total suspended solids (TSS) and carbonaceous biochemical oxygen demand ($CBOD_5$), and removes mercury limits. The permit and fact sheet must demonstrate that the proposed effluent limitations meet antidegradation and antibacksliding provisions of the Clean Water Act, sections 402(o) and 303(d)(4). Refer to the EPA's NPDES Permit Writers' Manual (http:I/www.epa.gov/npdes/pubs/pwm 2010.pdf), section 7.2, for guidance in addressing these requirements.

Response:

In general, Ecology may not renew, reissue or modify an existing NPDES with effluent limits that are less stringent. The requirements and exceptions are found in CWA 402(o), CWA 303(d)(4), and 40 CFR 122.44(l).

TSS and $CBOD_5$, November-July: Ecology may increase technology-based limits based on applicable EPA effluent guidelines if material and substantial alterations to the permitted facility occurred after permit issuance justifying the application of a less stringent effluent limitation. North Bend constructed a new influent headworks and added new influent pumps in 2011, increasing the hydraulic capacity of the treatment plant.

TSS, August-October: The TSS limits in the previous permit for the months of August-October were technology-based limits determined on a "best professional judgment" (BPJ) basis. Ecology based these limits on an estimated dry weather flow of 1.17 MGD. Ecology may increase technology-based limits determined on a BPJ basis if Ecology made a mistake when it calculated limits or when it interpreted law or regulation when it issued the permit. North Bend requested that the technology-based limits for TSS during these months be based on a future dry weather monthly average flow of 1.4 MGD, because 1.17 MGD was an estimated flow for 2010, not accounting for future growth projections. It appears that the original use of 1.17 MGD was in error.

Mercury: Ecology may propose less stringent water quality-based effluent limits if information, not available at the time of permit issuance (other than revised regulations, guidance, or test methods), would have justified applying a less stringent effluent limit at the time of permit issuance. Information which was not available at the time of the last permit issuance includes 52 samples for mercury using a more accurate and sensitive test method. This data demonstrates that North Bend's effluent has no reasonable potential to exceed the water quality standards for mercury. If this data had been available at the time of the previous permit issuance, Ecology would not have imposed the former limit for mercury.

Antidegradation: The proposed permit revisions do not trigger the Tier II Antidegradation analysis requirements. All TSS and $CBOD_5$ limit changes are based on previously approved design capacity for this treatment plant.

EPA Comment #2:

The fact sheet indicates that there is an approved TMDL for temperature. The fact sheet describes that the proposed permit reflects the wasteload allocation assigned by the TMDL; however, the permit does not incorporate temperature limits. The NPDES regulations at §122.44(d)(1)(vii)(B) require that NPDES permits include effluent limitations developed consistent with the assumptions and requirements of any WLA that has been assigned to the discharge as part of an approved TMDL. Please explain how the proposed permit is consistent with the approved TMDL.

Response:

The Snoqualmie River Basin Temperature TMDL (2011) includes temperature waste load allocations for the WWTPs at North Bend, Snoqualmie, Carnation, and Duvall, as well as load allocations for stream shading throughout the watershed. The TMDL temperature allocation for the North Bend WWTP limits effluent temperature to an increase of 0.3 °C above the temperature criterion of 16 °C at the edge of a mixing zone based on 25% of the 7Q10 low flow. The specific temperature limit depends on effluent characteristics and dilution factors and must be calculated each permit cycle. Ecology incorporated the TMDL temperature allocation in the calculation of reasonable potential for temperature (Fact Sheet Appendix D, Table 19) by using the temperature criterion of 16 °C as the background temperature instead of the actual ambient background temperature. Because there is no reasonable potential at this time for the effluent to cause an increase of more than 0.3 °C, Ecology did not include a temperature limit in the permit. If the effluent flow or temperature increases during the critical season, future permits may include effluent temperature or flow limits based on the TMDL. This process is consistent with Ecology's guidance manual, Procedures to Implement the State's Temperature Standards through NPDES Permits (Publication 06-10-100, October 2010).

APPENDIX C

OUTFALL MIXING ZONE ANALYSIS

Mixing Zone Analysis Results
Existing Conditions

Dilution Factor Calculations and Receiving Water Critical Conditions

Step 1: Enter Waterbody Type

Water Body Type	Freshwater

Facility Name	North Bend WWTP
Receiving Water	S. Fork Snoqualmie R.

Step 2: Enter Dilution Factors -OR- Calculate DFs by entering Facility/Receiving Water Flow Data

Do you want to enter dilution factors -or- flow data?	Flow Data

	Annual Average	Max Monthly Average	Daily Max
Facility Flow, MGD	1.8	1.2	1.7
Facility Flow, cfs (calculated)	2.78	1.86	2.63

	Condition	Receiving Water Flow, cfs	Allowable % of river flow	Max Dilution Factor Allowed
Aquatic Life - Acute	7Q10	80.3	0.025	**1.76**
Aquatic Life - Chronic	7Q10	80.3	0.25	**11.8**
HH-Non-Carcinogen	30Q5	97.3	0.25	**14.1**
HH-Carcinogen	Harmonic Mean	297	0.25	**27.7**
Whole river at 7Q10	7Q10		1	**1.0**

Step 3: Enter Critical Data

	Effluent	Receiving Water
Temp, °C	22.7	18.8
pH, s.u.	6	7.1
Alkalinity, mg/L as CaCO3	52	50
Hardness, mg/L CaCO3	60	21.3
Salinity, psu		
Receiving water TSS, mg/L (leave blank if unknown)		
If TSS is annual data, enter 'A'; if from critical period, enter 'S'; If no TSS, leave blank		

Step 4: Specifiy if using 'Mixed' values for hardness, temperature, and pH

	Use 'Mixed Hardness' (Y/N)	Use 'Mixed Max Temp' (Y/N)	Use 'Mixed pH (Y/N)
	Y	Y	Y
Acute Zone Boundary	43.2	21.0	6.2
Chronic Zone Boundary	24.6	19.1	6.8
Whole river at 7Q10	60.0	22.7	6.0

Reasonable Potential Calculation

Dilution Factors:	Acute	Chronic
Aquatic Life	1.8	6.8
Human Health Carcinogenic		6.1
Human Health Non-Carcinogenic		8.2

Facility	North Bend WWTP
Water Body Type	Freshwater
Rec. Water Hardness	Acute=43.2, Chronic=24.6 mg/L

Pollutant, CAS No. & NPDES Application Ref. No.			AMMONIA, Criteria as Total NH3	ANTIMONY (INORGANIC) 7440360 1M	ARSENIC (dissolved) 7440382 2M	CHROMIUM(TRI) -16065831 5M Hardness dependent	COPPER - 744058 6M Hardness dependent	LEAD - 7439921 7M Dependent on hardness	MERCURY 7439976 8M	NICKEL - 7440020 9M - Dependent on hardness	SELENIUM 7782492 10M	SILVER - 7740224 11M dependent on hardness.	ZINC- 7440666 13M hardness dependent
Effluent Data	# of Samples (n)		66	4	4	4	24	4	52	4	4	24	24
	Coeff of Variation (Cv)		0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
	Effluent Concentration, ug/L (Max. or 95th Percentile)		1000	0.52	6.79	0.43	5.73	0.8	0.0159	1.04	1.17	0.22	75.8
	Calculated 50th percentile Effluent Conc. (when n>10)						0		0.0035				
Receiving Water Data	90th Percentile Conc., ug/L		0.012		0.776	0	1.2	0	0.0005	0.32	0	0	9.9
	Geo Mean, ug/L			0			0		0	0.185	0		
Water Quality Criteria	Aquatic Life Criteria, ug/L	Acute	21,945	-	360	276.19	7.72435	25.6473	2.1	696.47	20	0.816	56.254
		Chronic	1,605	-	190	56.397	3.42152	0.53064	0.012	47.951	5	-	31.822
	WQ Criteria for Protection of Human Health, ug/L		-	14	-	-		-	0.14	610	170	-	-
	Metal Criteria Translator, decimal	Acute	-	-	1	0.316	0.996	0.466	0.85	0.998	-	0.85	0.996
		Chronic	-	-	1	0.86	0.996	0.466	-	0.997	-	-	0.996
	Carcinogen?		N	N	Y	N	N	N	N	N	N	N	N

Aquatic Life Reasonable Potential

Effluent percentile value			0.950		0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950
s	$s^2=\ln(CV^2+1)$		0.555		0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555
Pn	$Pn=(1\text{-confidence level})^{1/n}$		0.956		0.473	0.473	0.883	0.473	0.944	0.473	0.473	0.883	0.883
Multiplier			1.00		2.59	2.59	1.00	2.59	1.00	2.59	2.59	1.00	1.00
Max concentration (ug/L) at edge of…		Acute	567		10.291	0.199	3.756	0.547	0.008	1.660	1.715	0.106	47.100
		Chronic	148		3.260	0.142	1.867	0.143	0.003	0.669	0.448	0.033	19.611
Reasonable Potential? Limit Required?			**NO**		**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Human Health Reasonable Potential

s	$s^2=\ln(CV^2+1)$	0.55451		0.55451	0.5545	0.5545	
Pn	Pn=(1-confidence level)1/n	0.473		0.944	0.473	0.473	
Multiplier		1.03846		0.41422	1.0385	1.0385	
Dilution Factor		8.16605		8.16605	8.166	8.166	
Max Conc. at edge of Chronic Zone, ug/L		0.06613		4.3E-04	0.2946	0.1488	
Reasonable Potential? Limit Required?		**NO**		**NO**	**NO**	**NO**	

Comments/Notes:

References: WAC 173-201A.

Technical Support Document for Water Quality-based Toxics Control, US EPA, March 1991, EPA/505/2-90-001, pages 56/99

Spread of a Plume from a Point Source in a River with Boundary Effects from the Shoreline

Based on the method of Fischer et al. (1979) with correction for the effective origin of effluent.

	Chronic	Acute	HH Non-Carcinogen	HH Carcinogen
INPUT				
1. Effluent Discharge Rate (MGD)	1.20	1.70	1.20	1.70
or, Effluent Discharge Rate (cfs)	1.86	2.63	1.86	2.63
2. Receiving Water Characteristics Downstream from Discharge:				
Stream Depth (ft)	1.00	1.00	1.21	1.00
Stream Flow (cfs) (7Q10 chronic & acute, 30Q5 for non-carc, harm. mean for carc)	80.3	80.3	97.3	297
% of stream flow allowed for Dilution Factor (e.g., 25% for chronic & 2.5% for acute)	25	2.5	25.0	25.0
Stream Velocity (fps)	1.18	1.18	1.18	1.50
Channel Width (ft)	68.00	68.00	68.00	68.00
Stream Slope (ft/ft) or Manning roughness "n"	0.00097	0.00097	0.00097	0.00097
0 if slope or 1 if Manning "n" in previous cell	0	0	0	0
3. Discharge Distance from Nearest Shoreline (ft)	0	0	0	0
4. Location of Point of Interest to Estimate Dilution:				
Distance Downstream to Point of Interest (ft)	400	400	300	510
Distance From Nearest Shoreline (ft)	0	0	0	0
5. Transverse Mixing Coefficient Constant (usually 0.6):	0.6	0.6	0.6	0.6
6. Original Fischer Method (enter 0) or Effective Origin Modification (enter 1)	0	0	0	0
7. Is the Plume bounded by the shoreline?	Yes	Yes	Yes	Yes
OUTPUT				
1. Source Conservative Mass Input Rate:				
Concentration of Conservative Substance (%)	100.00	100.00	100.00	100.00
Source Conservative Mass Input Rate (cfs*%)	185.64	262.99	185.64	262.99
2. Shear Velocity based on slope (ft/sec)	0.177	0.177	0.194	0.177
Shear Velocity based on Manning "n" (using Prasuhn equations 8-26 and 8-54 assuming hydraulic radius equals depth for wide channel):				
Darcy-Weisbach friction factor "f"	#N/A	#N/A	#N/A	#N/A
Shear Velocity from Darcy-Weisbach "f" (ft/sec)	#N/A	#N/A	#N/A	#N/A
Selected Shear Velocity for next step (ft/sec)	0.177	0.177	0.194	0.177
3. Transverse Mixing Coefficient (ft2/sec)	0.106	0.106	0.141	0.106
4. Plume Characteristics Accounting for Shoreline Effect (Fischer et al., 1979):				
Co	2.31E+00	3.28E+00	1.91E+00	2.58E+00
x'	7.77E-03	7.77E-03	7.76E-03	7.80E-03
y'o	0.00E+00	0.00E+00	0.00E+00	0.00E+00
y' at point of interest	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Solution using superposition equation (Fischer eqn 5.9):				
Term for n= -2	6.78E-224	6.78E-224	2.75E-224	3.16E-223
Term for n= -1	2.71E-56	2.71E-56	2.17E-56	3.99E-56
Term for n= 0	2.00E+00	2.00E+00	2.00E+00	2.00E+00
Term for n= 1	2.71E-56	2.71E-56	2.17E-56	3.99E-56
Term for n= 2	6.78E-224	6.78E-224	2.75E-224	3.16E-223
Upstream Distance from Outfall to Effective Origin of Effluent Source (ft)	#N/A	#N/A	#N/A	#N/A
Effective Distance Downstream from Effluent to Point of Interest (ft)	400.0	400.0	300.0	510.0
x' Adjusted for Effective Origin	7.77E-03	7.77E-03	7.76E-03	7.80E-03
C/Co (dimensionless)	6.40E+00	6.40E+00	6.40E+00	6.39E+00
Concentration at Point of Interest (Fischer Eqn 5.9)	1.48E+01	2.10E+01	1.22E+01	1.65E+01
Unbounded Plume half-width (ft)	17.0	17.0	16.9	17.0
Distance from near shore to discharge point (ft)	0.0	0.0	0.0	0.0
Distance from far shore to discharge point (ft)	68.0	68.0	68.0	68.0
RESULTS				
W, Plume width bounded by shoreline (ft)	**17.0**	**17.0**	**16.9**	**17.0**
W, Unbounded Plume Width at Point of Interest (ft)	**33.9**	**33.9**	**33.9**	**34.0**
Approximate Downstream Distance to Complete Mix (ft)	**20,582**	**20,582**	**15,464**	**26,164**
Theoretical Dilution Factor at Complete Mix	**43**	**31**	**52**	**39**
Calculated Flux-Average Dilution Factor Across Entire Plume Width	**11**	**8**	**13**	**10**
Calculated Dilution Factor at Point of Interest	**6.75**	**5**	**8**	**6**

Regulatory Max Plume Widths and Dilution Factors

Wmax, Regulatory Max Plume Width (ft)	17.0	17.0	17.0	17.0
Regulatory Max Dilution Factor (e.g, effluent well-mixed with 25% of 7Q10 flow)	12	1.76	14.10	29.23

Most Restrictive Dilution Factor	**6.75**	**1.76**	**8.17**	**6.07**

Calculation of pH of a Mixture of Two Flows

Based on the procedure in EPA's DESCON program (EPA, 1988. Technical Guidance on Supplementary Stream Design Conditions for Steady State Modeling. USEPA Office of Water, Washington D.C.)

INPUT			
	@ Acute Boundary	**@ Chronic Boundary**	**@ Whole River**
1. Dilution Factor at Mixing Zone Boundary	1.8	11.8	1.0
2. Ambient/Upstream/Background Conditions			
Temperature (deg C):	18.80	18.80	18.80
pH:	7.10	7.10	7.10
Alkalinity (mg CaCO3/L):	50.00	50.00	50.00
3. Effluent Characteristics			
Temperature (deg C):	22.70	22.70	22.70
pH:	6.00	6.00	6.00
Alkalinity (mg CaCO3/L):	52.00	52.00	52.00
OUTPUT			
1. Ionization Constants			
Upstream/Background pKa:	6.39	6.39	6.39
Effluent pKa:	6.36	6.36	6.36
2. Ionization Fractions			
Upstream/Background Ionization Fraction:	0.84	0.84	0.84
Effluent Ionization Fraction:	0.30	0.30	0.30
3. Total Inorganic Carbon			
Upstream/Background Total Inorganic Carbon (mg CaCO3/L):	60	60	60
Effluent Total Inorganic Carbon (mg CaCO3/L):	172	172	172
4. Condtions at Mixing Zone Boundary			
Temperature (deg C):	21.01	19.13	22.70
Alkalinity (mg CaCO3/L):	51.13	50.17	52.00
Total Inorganic Carbon (mg CaCO3/L):	123.54	69.28	172.22
pKa:	6.38	6.39	6.36
RESULTS			
pH at Mixing Zone Boundary:	**6.22**	**6.81**	**6.00**

Calculation of Fecal Coliform at Chronic Mixing Zone

INPUT	
Chronic Dilution Factor	11.8
Receiving Water Fecal Coliform, #/100 ml	
Effluent Fecal Coliform - worst case, #/100 ml	400
Surface Water Criteria, #/100 ml	*100*
OUTPUT	
Fecal Coliform at Mixing Zone Boundary, #/100 ml	**34**
Difference between mixed and ambient, #/100 ml	34

Conclusion: At design flow, the discharge has no reasonable potential to violate water quality standards for fecal coliform.

Freshwater Un-ionized Ammonia Criteria Calculation

Based on Chapter 173-201A WAC, amended November 20, 2006

		mixed @ Acute Boundary	mixed @ Chronic Boundary	mixed @ Whole River
INPUT				
1. Receiving Water Temperature (deg C):	18.8	21.0	19.1	22.7
2. Receiving Water pH:	7.1	6.2	6.8	6.0
3. Is salmonid habitat an existing or designated use?	Yes	Yes	Yes	Yes
4. Are non-salmonid early life stages present or absent?	Present	Present	Present	Present
OUTPUT				
Using mixed temp and pH at mixing zone boundaries?	no			
Ratio	26.915	H Out of Range	32.183	H Out of Range
FT	1.400	1.400	1.400	1.400
FPH	2.396	H Out of Range	3.932	H Out of Range
pKa	9.441	9.371	9.430	9.318
Unionized Fraction	0.005	0.001	0.002	0.000
Unionized ammonia NH3 criteria (mg/L as NH_3)				
Acute:	0.121	0.031	0.000	0.021
Chronic:	0.009	#VALUE!	0.005	#VALUE!
RESULTS				
Total ammonia nitrogen criteria (mg/L as N):				
Acute:	21.945	**35.329**		36.721
Chronic:	1.605		**1.563**	#VALUE!

Data source:

Freshwater Temperature Reasonable Potential and Limit Calculation

Based on WAC 173-201A-200(1)(c)(i)--(ii) and the Water Quality Program Guidance. All data inputs must meet WQ guidelines. The Water Quality temperature guidance document may be found at: https://fortress.wa.gov/ecy/publications/summarypages/0610100.html

	Core Summer Critera	Supplemental Criteria
INPUT	**July 1-Sept 14**	**Sept 15-July 1**
1. Chronic Dilution Factor at Mixing Zone Boundary	11.8	11.8
2. 7DADMax Ambient Temperature (T) (Upstream Background 90th percentile)	16.0 °C	
3. 7DADMax Effluent Temperature (95th percentile)	22.7 °C	
4. Aquatic Life Temperature WQ Criterion in Fresh Water	16.0 °C	
OUTPUT		
5. Temperature at Chronic Mixing Zone Boundary:	16.6 °C	0.0 °C
6. Incremental Temperature Increase or decrease:	0.6 °C	0.0 °C
7. Maximum Allowable Incremental Temperature Increase:	0.3 °C	0.3 °C
8. Maximum Allowable Temperature at Mixing Zone Boundary:	16.3 °C	0.3 °C
A. If ambient temp is warmer than WQ criterion		
9. Does temp fall within this warmer temp range?	YES	YES
10. Temperature Limit if Required:	0.3	NO LIMIT
B. If ambient temp is cooler than WQ criterion but within 28/(T_{amb}+7) and within 0.3 °C of the criterion		
11. Does temp fall within this incremental temp. range?	no	---
12. Temp increase allowed at mixing zone boundary, if required:	---	---
C. If ambient temp is cooler than (WQ criterion-0.3) but within 28/(T_{amb}+7) of the criterion		
13. Does temp fall within this Incremental temp. range?	no	---
14. Temp increase allowed at mixing zone boundary, if required:	---	---
D. If ambient temp is cooler than (WQ criterion - 28/(T_{amb}+7))		
15. Does temp fall within this Incremental temp. range?	no	---
16. Temp increase allowed at mixing zone boundary, if required:	---	---
RESULTS		
17. Do any of the above cells show a temp increase?	**YES**	**NO**
18. Temperature Limit if Required?	**19.2 °C**	**NO LIMIT**

Mixing Zone Analysis Results
Future Conditions

Dilution Factor Calculations and Receiving Water Critical Conditions

Step 1: Enter Waterbody Type

Water Body Type	Freshwater

Facility Name	North Bend WWTP
Receiving Water	S. Fork Snoqualmie R.

Step 2: Enter Dilution Factors -OR- Calculate DFs by entering Facility/Receiving Water Flow Data

Do you want to enter dilution factors -or- flow data?	Flow Data

	Annual Average	Max Monthly Average	Daily Max
Facility Flow, MGD	1.8	2.2	3
Facility Flow, cfs (calculated)	2.78	3.40	4.64

	Condition	Receiving Water Flow, cfs	Allowable % of river flow	Max Dilution Factor Allowed
Aquatic Life - Acute	7Q10	80.3	0.025	**1.43**
Aquatic Life - Chronic	7Q10	80.3	0.25	**6.9**
HH-Non-Carcinogen	30Q5	97.3	0.25	**8.1**
HH-Carcinogen	Harmonic Mean	297	0.25	**27.7**
Whole river at 7Q10	7Q10		1	**1.0**

Step 3: Enter Critical Data

	Effluent	Receiving Water
Temp, °C	22.7	18.8
pH, s.u.	6	7.1
Alkalinity, mg/L as CaCO3	52	50
Hardness, mg/L CaCO3	60	21.3
Salinity, psu		
Receiving water TSS, mg/L (leave blank if unknown)		
If TSS is annual data, enter 'A'; if from critical period, enter 'S'; If no TSS, leave blank		

Step 4: Specifiy if using 'Mixed' values for hardness, temperature, and pH

	Use 'Mixed Hardness' (Y/N)	Use 'Mixed Max Temp' (Y/N)	Use 'Mixed pH (Y/N)
	Y	Y	Y
Acute Zone Boundary	48.3	21.5	6.1
Chronic Zone Boundary	26.9	19.4	6.7
Whole river at 7Q10	60.0	22.7	6.0

Reasonable Potential Calculation

Facility	North Bend WWTP
Water Body Type	Freshwater
Rec. Water Hardness	Acute=48.3, Chronic=26.9 mg/L

Dilution Factors:	Acute	Chronic
Aquatic Life	1.4	3.7
Human Health Carcinogenic		3.4
Human Health Non-Carcinogenic		4.5

Pollutant, CAS No. & NPDES Application Ref. No.			AMMONIA, Criteria as Total NH3	ANTIMONY (INORGANIC) 7440360 1M	ARSENIC (dissolved) 7440382 2M	CHROMIUM(TRI) -16065831 5M Hardness dependent	COPPER - 744058 6M Hardness dependent	LEAD - 7439921 7M Dependent on hardness	MERCURY 7439976 8M	NICKEL - 7440020 9M - Dependent on hardness	SELENIUM 7782492 10M	SILVER - 7740224 11M dependent on hardness.	ZINC- 7440666 13M hardness dependent
Effluent Data	# of Samples (n)		66	4	4	4	24	4	52	4	4	24	24
	Coeff of Variation (Cv)		0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
	Effluent Concentration, ug/L (Max. or 95th Percentile)		1000	0.52	6.79	0.43	5.73	0.8	0.0159	1.04	1.17	0.22	75.8
	Calculated 50th percentile Effluent Conc. (when n>10)								0.0035				
Receiving Water Data	90th Percentile Conc., ug/L		0.012		0.776	0	1.2	0	0.0005	0.32	0	0	9.9
	Geo Mean, ug/L			0					0	0.185	0		
Water Quality Criteria	Aquatic Life Criteria, ug/L	Acute	21,945	-	360	302.43	8.57438	29.0104	2.1	764.91	20	0.9873	61.791
		Chronic	1,605	-	190	60.748	3.69734	0.5877	0.012	51.777	5	-	34.365
	WQ Criteria for Protection of Human Health, ug/L		-	14	-	-		-	0.14	610	170	-	-
	Metal Criteria Translator, decimal	Acute	-	-	1	0.316	0.996	0.466	0.85	0.998	-	0.85	0.996
		Chronic	-	-	1	0.86	0.996	0.466	-	0.997	-	-	0.996
	Carcinogen?		N	N	Y	N	N	N	N	N	N	N	N

Aquatic Life Reasonable Potential

Effluent percentile value			0.950		0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950
s	$s^2=\ln(CV^2+1)$		0.555		0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555
Pn	$Pn=(1\text{-confidence level})^{1/n}$		0.956		0.473	0.473	0.883	0.473	0.944	0.473	0.473	0.883	0.883
Multiplier			1.00		2.59	2.59	1.00	2.59	1.00	2.59	2.59	1.00	1.00
Max concentration (ug/L) at edge of…		Acute	698		12.488	0.245	4.346	0.673	0.010	1.970	2.111	0.131	55.690
		Chronic	271		5.330	0.259	2.423	0.262	0.005	0.961	0.821	0.060	27.704
Reasonable Potential? Limit Required?			**NO**		**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Human Health Reasonable Potential

s	$s^2=\ln(CV^2+1)$	0.55451		0.55451	0.5545	0.5545	
Pn	Pn=(1-confidence level)1/n	0.473		0.944	0.473	0.473	
Multiplier		1.03846		0.41422	1.0385	1.0385	
Dilution Factor		4.45421		4.45421	4.4542	4.4542	
Max Conc. at edge of Chronic Zone, ug/L		0.12123		7.9E-04	0.3859	0.2728	
Reasonable Potential? Limit Required?		**NO**		**NO**	**NO**	**NO**	

Comments/Notes:

References: WAC 173-201A.

Technical Support Document for Water Quality-based Toxics Control, US EPA, March 1991, EPA/505/2-90-001, pages 56/99

Spread of a Plume from a Point Source in a River with Boundary Effects from the Shoreline

Based on the method of Fischer et al. (1979) with correction for the effective origin of effluent.

	Chronic	Acute	HH Non-Carcinogen	HH Carcinogen
INPUT				
1. Effluent Discharge Rate (MGD)	2.20	3.00	2.20	3.00
or, Effluent Discharge Rate (cfs)	3.40	4.64	3.40	4.64
2. Receiving Water Characteristics Downstream from Discharge:				
Stream Depth (ft)	1.00	1.00	1.21	1.00
Stream Flow (cfs) (7Q10 chronic & acute, 30Q5 for non-carc, harm. mean for carc)	80.3	80.3	97.3	297
% of stream flow allowed for Dilution Factor (e.g., 25% for chronic & 2.5% for acute)	25	2.5	25.0	25.0
Stream Velocity (fps)	1.18	1.18	1.18	1.50
Channel Width (ft)	68.00	68.00	68.00	68.00
Stream Slope (ft/ft) or Manning roughness "n"	0.00097	0.00097	0.00097	0.00097
0 if slope or 1 if Manning "n" in previous cell	0	0	0	0
3. Discharge Distance from Nearest Shoreline (ft)	0	0	0	0
4. Location of Point of Interest to Estimate Dilution:				
Distance Downstream to Point of Interest (ft)	400	400	300	510
Distance From Nearest Shoreline (ft)	0	0	0	0
5. Transverse Mixing Coefficient Constant (usually 0.6):	0.6	0.6	0.6	0.6
6. Original Fischer Method (enter 0) or Effective Origin Modification (enter 1)	0	0	0	0
7. Is the Plume bounded by the shoreline?	Yes	Yes	Yes	Yes
OUTPUT				
1. Source Conservative Mass Input Rate:				
Concentration of Conservative Substance (%)	100.00	100.00	100.00	100.00
Source Conservative Mass Input Rate (cfs*%)	340.34	464.10	340.34	464.10
2. Shear Velocity based on slope (ft/sec)	0.177	0.177	0.194	0.177
Shear Velocity based on Manning "n" (using Prasuhn equations 8-26 and 8-54 assuming hydraulic radius equals depth for wide channel):				
Darcy-Weisbach friction factor "f"	#N/A	#N/A	#N/A	#N/A
Shear Velocity from Darcy-Weisbach "f" (ft/sec)	#N/A	#N/A	#N/A	#N/A
Selected Shear Velocity for next step (ft/sec)	0.177	0.177	0.194	0.177
3. Transverse Mixing Coefficient (ft2/sec)	0.106	0.106	0.141	0.106
4. Plume Characteristics Accounting for Shoreline Effect (Fischer et al., 1979):				
Co	4.24E+00	5.78E+00	3.51E+00	4.55E+00
x'	7.77E-03	7.77E-03	7.76E-03	7.80E-03
y'o	0.00E+00	0.00E+00	0.00E+00	0.00E+00
y' at point of interest	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Solution using superposition equation (Fischer eqn 5.9):				
Term for n= -2	6.78E-224	6.78E-224	2.75E-224	3.16E-223
Term for n= -1	2.71E-56	2.71E-56	2.17E-56	3.99E-56
Term for n= 0	2.00E+00	2.00E+00	2.00E+00	2.00E+00
Term for n= 1	2.71E-56	2.71E-56	2.17E-56	3.99E-56
Term for n= 2	6.78E-224	6.78E-224	2.75E-224	3.16E-223
Upstream Distance from Outfall to Effective Origin of Effluent Source (ft)	#N/A	#N/A	#N/A	#N/A
Effective Distance Downstream from Effluent to Point of Interest (ft)	400.0	400.0	300.0	510.0
x' Adjusted for Effective Origin	7.77E-03	7.77E-03	7.76E-03	7.80E-03
C/Co (dimensionless)	6.40E+00	6.40E+00	6.40E+00	6.39E+00
Concentration at Point of Interest (Fischer Eqn 5.9)	2.71E+01	3.70E+01	2.25E+01	2.91E+01
Unbounded Plume half-width (ft)	17.0	17.0	16.9	17.0
Distance from near shore to discharge point (ft)	0.0	0.0	0.0	0.0
Distance from far shore to discharge point (ft)	68.0	68.0	68.0	68.0
RESULTS				
W, Plume width bounded by shoreline (ft)	**17.0**	**17.0**	**16.9**	**17.0**
W, Unbounded Plume Width at Point of Interest (ft)	**33.9**	**33.9**	**33.9**	**34.0**
Approximate Downstream Distance to Complete Mix (ft)	**20,582**	**20,582**	**15,464**	**26,164**
Theoretical Dilution Factor at Complete Mix	**24**	**17**	**29**	**22**
Calculated Flux-Average Dilution Factor Across Entire Plume Width	**6**	**4**	**7**	**5**
Calculated Dilution Factor at Point of Interest	**3.68**	**3**	**4**	**3**

Regulatory Max Plume Widths and Dilution Factors

Wmax, Regulatory Max Plume Width (ft)	17.0	17.0	17.0	17.0
Regulatory Max Dilution Factor (e.g, effluent well-mixed with 25% of 7Q10 flow)	7	1.43	8.15	17.00

Most Restrictive Dilution Factor	**3.68**	**1.43**	**4.45**	**3.44**

Calculation of pH of a Mixture of Two Flows

Based on the procedure in EPA's DESCON program (EPA, 1988. Technical Guidance on Supplementary Stream Design Conditions for Steady State Modeling. USEPA Office of Water, Washington D.C.)

INPUT			
	@ Acute Boundary	@ Chronic Boundary	@ Whole River
1. Dilution Factor at Mixing Zone Boundary	1.4	6.9	1.0
2. Ambient/Upstream/Background Conditions			
Temperature (deg C):	18.80	18.80	18.80
pH:	7.10	7.10	7.10
Alkalinity (mg CaCO3/L):	50.00	50.00	50.00
3. Effluent Characteristics			
Temperature (deg C):	22.70	22.70	22.70
pH:	6.00	6.00	6.00
Alkalinity (mg CaCO3/L):	52.00	52.00	52.00
OUTPUT			
1. Ionization Constants			
Upstream/Background pKa:	6.39	6.39	6.39
Effluent pKa:	6.36	6.36	6.36
2. Ionization Fractions			
Upstream/Background Ionization Fraction:	0.84	0.84	0.84
Effluent Ionization Fraction:	0.30	0.30	0.30
3. Total Inorganic Carbon			
Upstream/Background Total Inorganic Carbon (mg CaCO3/L):	60	60	60
Effluent Total Inorganic Carbon (mg CaCO3/L):	172	172	172
4. Condtions at Mixing Zone Boundary			
Temperature (deg C):	21.52	19.37	22.70
Alkalinity (mg CaCO3/L):	51.40	50.29	52.00
Total Inorganic Carbon (mg CaCO3/L):	138.26	76.06	172.22
pKa:	6.37	6.39	6.36
RESULTS			
pH at Mixing Zone Boundary:	**6.14**	**6.68**	**6.00**

Calculation of Fecal Coliform at Chronic Mixing Zone

INPUT	
Chronic Dilution Factor	6.9
Receiving Water Fecal Coliform, #/100 ml	
Effluent Fecal Coliform - worst case, #/100 ml	400
Surface Water Criteria, #/100 ml	*100*
OUTPUT	
Fecal Coliform at Mixing Zone Boundary, #/100 ml	**58**
Difference between mixed and ambient, #/100 ml	58

Conclusion: At design flow, the discharge has no reasonable potential to violate water quality standards for fecal coliform.

Freshwater Un-ionized Ammonia Criteria Calculation

Based on Chapter 173-201A WAC, amended November 20, 2006

		mixed @ Acute Boundary	mixed @ Chronic Boundary	mixed @ Whole River
INPUT				
1. Receiving Water Temperature (deg C):	18.8	21.5	19.4	22.7
2. Receiving Water pH:	7.1	6.1	6.7	6.0
3. Is salmonid habitat an existing or designated use?	Yes	Yes	Yes	Yes
4. Are non-salmonid early life stages present or absent?	Present	Present	Present	Present
OUTPUT				
Using mixed temp and pH at mixing zone boundaries?	no			
Ratio	26.915	H Out of Range	33.977	H Out of Range
FT	1.400	1.400	1.400	1.400
FPH	2.396	H Out of Range	5.030	H Out of Range
pKa	9.441	9.354	9.423	9.318
Unionized Fraction	0.005	0.001	0.002	0.000
Unionized ammonia NH3 criteria (mg/L as NH_3)				
Acute:	0.121	0.027	0.000	0.021
Chronic:	0.009	#VALUE!	0.003	#VALUE!
RESULTS				
Total ammonia nitrogen criteria (mg/L as N):				
Acute:	21.945	**35.899**		36.721
Chronic:	1.605		**1.535**	#VALUE!

Data source:

Freshwater Temperature Reasonable Potential and Limit Calculation

Based on WAC 173-201A-200(1)(c)(i)--(ii) and the Water Quality Program Guidance. All data inputs must meet WQ guidelines. The Water Quality temperature guidance document may be found at: https://fortress.wa.gov/ecy/publications/summarypages/0610100.html

	Core Summer Critera	Supplemental Criteria
INPUT	**July 1-Sept 14**	**Sept 15-July 1**
1. Chronic Dilution Factor at Mixing Zone Boundary	6.9	6.9
2. 7DADMax Ambient Temperature (T) (Upstream Background 90th percentile)	16.0 °C	
3. 7DADMax Effluent Temperature (95th percentile)	22.7 °C	
4. Aquatic Life Temperature WQ Criterion in Fresh Water	16.0 °C	
OUTPUT		
5. Temperature at Chronic Mixing Zone Boundary:	17.0 °C	0.0 °C
6. Incremental Temperature Increase or decrease:	1.0 °C	0.0 °C
7. Maximum Allowable Incremental Temperature Increase:	0.3 °C	0.3 °C
8. Maximum Allowable Temperature at Mixing Zone Boundary:	16.3 °C	0.3 °C
A. If ambient temp is warmer than WQ criterion		
9. Does temp fall within this warmer temp range?	YES	YES
10. Temperature Limit if Required:	0.3	NO LIMIT
B. If ambient temp is cooler than WQ criterion but within 28/(T_{amb}+7) and within 0.3 °C of the criterion		
11. Does temp fall within this incremental temp. range?	no	---
12. Temp increase allowed at mixing zone boundary, if required:	---	---
C. If ambient temp is cooler than (WQ criterion-0.3) but within 28/(T_{amb}+7) of the criterion		
13. Does temp fall within this Incremental temp. range?	no	---
14. Temp increase allowed at mixing zone boundary, if required:	---	---
D. If ambient temp is cooler than (WQ criterion - 28/(T_{amb}+7))		
15. Does temp fall within this Incremental temp. range?	no	---
16. Temp increase allowed at mixing zone boundary, if required:	---	---
RESULTS		
17. Do any of the above cells show a temp increase?	**YES**	**NO**
18. Temperature Limit if Required?	**17.8 °C**	**NO LIMIT**

APPENDIX D

EXISTING AND FUTURE COLLECTION SYSTEM DATA

APPENDIX D

EXISTING AND FUTURE COLLECTION SYSTEM DATA

SEWER SYSTEM EXTENSION METHODOLOGY

Proposed layouts for extending the City sewage collection system were developed as described in the following sections.

SEWER EXTENSION AREAS

The future City and UGA sewer service areas were subdivided into sewer extension areas based on location, topography and proximity to existing sewers that could accept additional flow.

FLOW ANALYSIS

Peak sewage flows for each drainage within the extension areas were obtained from the collection system capacity analysis developed for the project.

DISCHARGE MANHOLE INFORMATION

The elevation of the existing manhole that will receive the flow from the respective expansion area was obtained from City GIS records.

GRAVITY SEWER SERVICE

Provisional alignments for gravity sewer service were developed where feasible. Lift stations and force mains were used when gravity sewer was not possible.

- Sewers alignments within the public right of way were preferred. Only where judged necessary were alignments developed across private property. Sewer alignments that cross private property will require temporary construction easements, and smaller permanent operation and maintenance easements.

- Alignments are based on topography adapted from King County's imap web site, which provides 5-foot contour intervals.

Once provisional alignments were obtained, a representative sewer line in the area was reviewed in more detail. A profile along the alignment of the representative sewer was obtained from geoprocessing of the 5-foot contour information using the Arcview GIS 3D analyst module.

The minimum sewer pipe size to convey peak flows was determined based on the following minimum allowable slopes (from Ecology's Orange Book, assuming full flow):

- Minimum slope = 0.40 for 8-inch pipe
- Minimum slope = 0.28 for 10-inch pipe
- Minimum slope = 0.22 for 12-inch pipe
- Minimum slope = 0.17 for 14-inch pipe
- Minimum slope = 0.15 for 15-inch pipe
- Minimum slope = 0.14 for 16-inch pipe
- Minimum slope = 0.12 for 18-inch pipe
- Minimum slope = 0.10 for 21-inch pipe

From critical points in the representative sewer profile, it was investigated whether the pipe/slope combination would allow connection to the downstream discharge manhole at a suitable depth to allow connection of new users along the new alignment without the need for private pumping systems:

- At the upstream end, a minimum cover of 5 feet was required so that side sewer service could be provided to the properties.

- The maximum practical construction depth was assumed to about 15 feet due to high groundwater conditions and a soil matrix that could make dewatering for construction prohibitively expensive.

- Where crossing river or creek channels, it was assumed that 3 to 4 feet of cover would be required. It was recognized that the derived profiles would be unlikely to provide information on channel bottom elevations.

Where needed to enable gravity sewer service, larger pipe diameters (up to two nominal size increases) were used to enable installation with reduced slope. It was recognized that use of slightly oversized pipes could reduce potential for self-cleaning velocities within the pipe and require additional flushing by City maintenance staff. Flatter slopes also lead to longer residence times, which can contribute to hydrogen sulfide issues. This can cause odors and corrosion of the concrete in manholes. This should be considered during design. The impact of periodically flushing the pipelines would be significantly less both on a capital cost and operational cost basis than that for a lift station.

Where gravity sewer service using the provisional alignments was judged to be feasible, no further analysis was undertaken. Where gravity sewer service using the provisional alignments was judged not to be feasible, alternative routings were investigated. Where gravity sewer service was judged to not be feasible, the use of pumped systems was examined.

PUMPED SYSTEMS

Preliminary lift station locations were identified as follows:

- Where City staff were able to confirm likely locations for lift stations, these were used.

- Otherwise, a general location was identified for planning purposes. No property or easement information was obtained for the study, and final siting investigation of lift stations would be needed.

Force main alignment along right of way was determined with the following assumptions:

- The force main would have a minimum cover and could rise and fall to accommodate variation in elevation along its alignment.

- Air vacuum/air release valves would be required at high points in the line and these would require periodic maintenance by City staff. Design should minimize the need for A/V valves. Blow-off valves should be provided at significant low point to allow degritting of force mains. Air release valves should be outfitted with flow detectors in case of valve failure and odor control to prevent emission nuisance odors. Also lift stations should be outfitted with bypass pumping appurtenances.

- Where crossing river or creek channels, it was assumed that the force main could be strapped to existing road bridges, routed over or under creek culverts or routed under a large river through a casing pipe jacked or drilled under the river. This would need to be verified, and additional analysis would be required to confirm the feasibility.

- Lift stations should be located so that entry does not obstruct vehicular or pedestrian traffic. Sites need to be adequate for parking of service vehicles and location of emergency power systems.

DETAILED SYSTEM MAPPING

Detailed maps showing existing and proposed gravity sewers, pump stations, force mains, pipe segment numbers, developer extension areas and clarifying notes presented as Detailed Area Maps 1 through 15 at the end of this appendix; a key map is provided to indicate the location of each area map within the North Bend urban growth area.

PIPE CAPACITY

Tables on the following pages present the size, slope, capacity and pipe segment numbers of each existing and proposed pipe in the City's collection system. Segment numbers correspond to the numbering provided in the detailed area maps at the end of this appendix.

Existing Gravity Sewer Pipe Segments			
Pipe Segment (see Detailed Area Maps)	**Pipe Diameter (inch)**	**Slope**	**Capacity (mgd)**
1	12	2.25%	3.458
2	12	0.47%	1.578
3	12	0.39%	1.446
4	12	1.72%	3.028
5	12	0.84%	2.118
6	12	0.46%	1.558
7	12	0.44%	1.533
8	12	0.79%	2.045
9	12	0.83%	2.096
10	12	0.47%	1.578
11	12	0.44%	1.523
12	12	0.45%	1.551
13	12	0.43%	1.504
14	12	0.63%	1.832
15	12	0.26%	1.172
16	12	0.45%	1.549
17	12	0.51%	1.639
18	12	0.46%	1.559
19	15	0.26%	2.120
21	15	0.23%	1.993
22	8	3.38%	1.439
23	15	0.19%	1.804
24	15	0.06%	0.998
25	8	1.16%	0.844
26	8	1.09%	0.818
27	8	1.04%	0.798
28	8	1.39%	0.922
29	15	0.18%	1.789
30	15	0.23%	1.988
31	15	0.17%	1.739
32	15	0.20%	1.847
33	15	0.17%	1.734
34	15	0.20%	1.856
35	8	1.21%	0.861
36	8	0.68%	0.646
37	8	0.87%	0.730
38	8	0.95%	0.764
39	8	0.45%	0.526
40	8	0.72%	0.662
41	8	0.53%	0.568
42	8	0.48%	0.540
43	8	0.55%	0.580

Existing Gravity Sewer Pipe Segments			
Pipe Segment (see Detailed Area Maps)	**Pipe Diameter (inch)**	**Slope**	**Capacity (mgd)**
44	8	0.51%	0.557
45	8	0.90%	0.743
46	8	0.69%	0.651
47	8	0.71%	0.662
48	8	0.72%	0.664
49	8	0.50%	0.554
50	8	1.08%	0.813
51	15	0.18%	1.784
52	15	0.16%	1.673
53	15	0.16%	1.683
54	15	0.16%	1.688
55	12	0.26%	1.165
56	8	0.57%	0.592
57	12	0.29%	1.236
58	12	0.20%	1.024
59	12	0.33%	1.331
60	15	0.19%	1.813
61	15	0.19%	1.837
62	10	0.30%	0.771
63	10	0.28%	0.746
64	10	0.45%	0.953
65	10	0.38%	0.875
66	8	1.11%	0.825
67	8	2.79%	1.309
68	15	0.29%	2.240
69	15	0.25%	2.070
70	8	0.81%	0.703
71	8	0.93%	0.754
72	15	0.15%	1.620
73	8	1.77%	1.041
74	8	0.95%	0.762
75	8	1.05%	0.802
76	8	0.42%	0.509
77	8	1.26%	0.878
78	8	0.46%	0.532
79	8	0.56%	0.588
80	8	0.46%	0.534
81	8	1.05%	0.801
82	8	1.21%	0.862
83	8	0.12%	0.276
84	8	0.66%	0.635
85	8	0.79%	0.697

Existing Gravity Sewer Pipe Segments			
Pipe Segment (see Detailed Area Maps)	**Pipe Diameter (inch)**	**Slope**	**Capacity (mgd)**
86	15	0.20%	1.856
87	8	0.49%	0.550
88	15	0.16%	1.688
89	10	0.33%	0.812
90	10	0.27%	0.734
91	12	0.40%	1.450
92	8	1.31%	0.897
93	8	2.22%	1.168
94	12	0.19%	1.016
95	12	0.20%	1.034
96	12	0.43%	1.520
97	12	0.81%	2.075
98	21	1.69%	34.415
99	21	11.26%	10.919
100	21	1.13%	8.533
101	21	0.69%	5.929
102	8	0.33%	3.539
103	8	20.41%	0.475
104	8	0.37%	0.483
105	10	0.38%	1.247
106	8	0.77%	0.598
107	8	0.58%	0.388
108	8	0.25%	0.479
109	8	0.37%	0.556
110	8	0.50%	0.334
111	21	0.18%	5.893
112	21	0.33%	6.034
114	21	0.35%	6.608
115	21	0.42%	6.215
117	21	0.37%	5.251
118	21	0.26%	6.927
119	21	0.46%	5.591
120	21	0.30%	6.025
121	21	0.35%	5.628
122	21	0.30%	5.360
123	21	0.27%	5.600
124	21	0.30%	6.315
128	21	0.38%	9.340
129	27	0.83%	14.249
131	27	0.51%	13.891
132	27	0.48%	20.210
133	27	1.02%	15.673

Existing Gravity Sewer Pipe Segments			
Pipe Segment (see Detailed Area Maps)	**Pipe Diameter (inch)**	**Slope**	**Capacity (mgd)**
134	27	0.61%	19.305
135	27	0.93%	20.827
136	8	1.08%	0.571
137	8	0.53%	0.511
138	8	0.43%	1.069
139	15	1.86%	4.506
140	8	1.16%	0.572
142	8	0.53%	0.469
143	8	0.36%	0.816
144	10	1.08%	0.823
145	10	0.34%	1.392
146	12	0.97%	1.407
147	12	0.37%	1.295
148	12	0.32%	1.327
149	15	0.33%	2.347
150	12	0.32%	1.249
151	12	0.29%	1.139
152	12	0.24%	1.272
153	8	0.30%	0.955
154	12	1.49%	1.384
155	8	0.36%	0.568
156	12	0.53%	1.288
157	8	0.31%	0.552
158	10	0.50%	1.058
159	10	0.56%	0.901
160	10	0.40%	0.880
161	10	0.39%	1.729
162	10	1.49%	0.911
163	10	0.41%	1.238
164	8	0.76%	0.509
165	8	0.42%	0.774
166	12	0.98%	1.613
167	12	0.49%	1.151
168	12	0.25%	0.775
169	15	0.11%	2.006
170	15	0.23%	2.045
171	15	0.24%	1.984
172	15	0.23%	1.724
173	15	0.17%	1.988
174	15	0.23%	2.141
175	15	0.26%	1.699
176	15	0.17%	1.774

Existing Gravity Sewer Pipe Segments			
Pipe Segment (see Detailed Area Maps)	**Pipe Diameter (inch)**	**Slope**	**Capacity (mgd)**
177	15	0.18%	1.647
178	15	0.16%	1.537
179	15	0.14%	3.367
180	15	0.65%	4.277
181	15	1.05%	5.690
182	15	1.85%	8.611
183	15	4.24%	2.417
185	15	0.33%	2.442
187	15	0.34%	3.684
188	15	0.78%	1.894
190	15	0.21%	1.997
191	15	0.23%	1.630
192	10	0.15%	3.497
194	10	6.09%	1.046
195	10	0.55%	0.783
196	10	0.31%	1.594
197	10	1.27%	1.980
198	10	1.95%	1.207
199	10	0.73%	1.981
200	10	1.95%	1.366
201	10	0.93%	1.319
202	10	0.87%	1.953
203	8	1.90%	1.361
204	8	3.02%	1.382
205	8	3.11%	1.369
206	8	3.06%	1.000
207	8	1.63%	0.758
208	8	0.94%	0.589
209	8	0.57%	0.731
210	8	0.87%	1.402
211	8	3.20%	1.382
212	8	3.11%	1.339
213	8	2.92%	0.705
214	8	0.81%	1.211
215	8	2.39%	2.270
216	8	8.40%	0.659
217	8	0.71%	1.813
218	8	5.36%	1.308
219	8	2.79%	1.407
220	8	3.23%	0.588
221	8	0.56%	0.585
222	8	0.56%	0.579

Existing Gravity Sewer Pipe Segments			
Pipe Segment (see Detailed Area Maps)	**Pipe Diameter (inch)**	**Slope**	**Capacity (mgd)**
223	8	0.55%	0.807
224	8	1.06%	2.843
226	8	13.17%	0.831
227	8	1.13%	2.757
228	8	12.39%	2.832
229	8	13.07%	0.637
230	8	0.66%	2.689
231	8	11.79%	2.863
232	8	13.36%	0.495
235	8	0.40%	2.618
237	8	11.17%	1.912
238	8	5.96%	2.293
240	8	8.57%	2.566
242	8	10.73%	1.607
243	8	4.21%	1.792
244	8	5.23%	2.700
245	8	11.88%	2.568
246	8	10.75%	2.745
247	8	12.28%	2.500
248	8	10.19%	2.134
249	8	7.42%	1.467
250	8	3.51%	0.588
251	8	0.56%	2.732
252	8	12.16%	1.928
253	8	6.06%	2.337
255	8	8.90%	2.562
256	8	10.70%	1.821
257	8	5.40%	2.424
258	8	9.57%	2.968
259	8	14.36%	0.602
260	8	0.59%	2.027
261	8	6.69%	2.558
262	8	10.66%	2.625
263	8	11.23%	1.851
264	8	5.58%	1.532
265	8	3.82%	1.027
266	8	1.72%	2.957
267	8	14.25%	2.518
268	8	10.33%	2.615
269	8	11.14%	1.659
270	8	4.49%	2.081
271	8	7.06%	0.900

Existing Gravity Sewer Pipe Segments			
Pipe Segment (see Detailed Area Maps)	**Pipe Diameter (inch)**	**Slope**	**Capacity (mgd)**
272	8	1.32%	2.227
274	8	8.08%	1.489
275	8	3.61%	1.694
276	8	4.68%	0.748
277	8	0.91%	0.871
278	8	1.24%	1.911
279	8	5.95%	2.215
280	8	7.99%	2.174
281	8	7.70%	3.232
282	8	17.03%	2.152
283	8	7.54%	1.457
284	8	3.46%	2.011
285	8	6.59%	2.256
286	8	8.29%	2.297
287	8	8.60%	1.593
288	8	4.14%	0.834
289	8	1.13%	1.619
290	8	4.27%	0.661
291	8	0.71%	0.482
292	8	0.38%	0.606
293	8	0.60%	0.489
294	8	0.39%	0.534
295	8	0.46%	0.523
296	8	0.45%	0.511
297	8	0.43%	0.540
298	8	0.48%	0.513
299	8	0.43%	0.535
300	8	0.47%	0.630
301	8	0.65%	0.516
302	8	0.43%	0.476
303	8	0.37%	0.558
304	8	0.51%	0.677
305	8	0.75%	0.426
306	8	0.30%	0.435
307	8	0.31%	0.402
308	8	0.26%	0.469
309	8	0.36%	0.511
310	8	0.43%	0.540
311	8	0.48%	0.540
312	10	0.48%	0.898
313	10	0.40%	0.728
314	8	0.26%	0.811

Existing Gravity Sewer Pipe Segments			
Pipe Segment (see Detailed Area Maps)	**Pipe Diameter (inch)**	**Slope**	**Capacity (mgd)**
315	8	1.07%	0.524
316	8	0.45%	1.603
319	8	4.19%	1.731
320	8	4.88%	1.801
321	8	5.29%	1.664
322	8	4.51%	0.653
323	8	0.69%	0.662
324	8	0.72%	0.653
325	8	0.69%	0.626
326	8	0.64%	1.967
327	8	6.30%	0.595
328	8	0.58%	1.700
329	8	4.71%	2.592
330	8	10.94%	2.629
331	8	11.26%	1.251
332	8	2.55%	2.489
333	8	10.10%	1.855
334	8	5.61%	2.010
335	8	6.58%	1.371
336	8	3.06%	2.520
337	8	10.35%	2.570
338	8	10.77%	3.681
339	8	22.08%	1.207
340	8	2.38%	2.603
341	8	11.04%	2.316
342	8	8.74%	2.639
343	8	11.35%	0.584
344	8	0.56%	0.590
345	8	0.57%	0.807
346	8	1.06%	3.206
347	8	16.75%	0.655
348	8	0.70%	0.754
349	8	0.93%	0.869
350	15	1.23%	2.298
351	8	0.30%	1.083
353	8	1.91%	0.728
354	8	0.86%	0.463
355	8	0.35%	0.819
356	8	1.09%	0.592
357	8	0.57%	0.590
358	8	0.57%	0.518
359	10	0.44%	0.938

Existing Gravity Sewer Pipe Segments			
Pipe Segment (see Detailed Area Maps)	**Pipe Diameter (inch)**	**Slope**	**Capacity (mgd)**
360	8	0.44%	0.920
362	8	1.38%	1.492
363	8	3.63%	0.486
364	8	0.39%	0.478
365	8	0.37%	0.488
366	6	0.39%	0.393
367	6	1.17%	0.406
368	15	1.25%	2.120
369	8	0.26%	0.497
370	8	0.40%	0.453
371	8	0.33%	0.441
372	8	0.32%	1.353
373	8	2.99%	0.553
375	8	0.50%	0.864
376	8	1.22%	0.482
377	8	0.38%	0.601
378	8	0.59%	0.594
379	8	0.57%	0.588
380	8	0.56%	0.588
381	8	0.56%	0.533
383	8	0.46%	0.795
384	8	1.03%	0.535
385	8	0.47%	0.480
386	8	0.38%	0.471
387	8	0.36%	1.527
388	8	3.80%	1.361
389	8	3.02%	1.344
390	8	2.94%	1.173
391	8	2.24%	1.279
392	8	2.67%	0.986
393	8	1.58%	1.317
394	8	2.83%	1.216
395	8	2.41%	1.233
396	8	2.48%	1.139
397	8	2.12%	1.534
398	8	3.84%	1.270
399	8	2.63%	1.258
400	8	2.58%	1.189
402	8	2.31%	1.720
403	8	4.82%	1.376
405	8	3.09%	0.824
406	8	1.11%	0.823

Existing Gravity Sewer Pipe Segments			
Pipe Segment (see Detailed Area Maps)	**Pipe Diameter (inch)**	**Slope**	**Capacity (mgd)**
407	8	1.10%	0.863
408	8	1.22%	0.754
409	8	0.93%	1.652
410	8	4.45%	1.197
411	8	2.34%	1.206
412	8	2.37%	1.213
413	8	2.40%	1.318
414	8	2.83%	1.152
415	8	2.16%	1.436
416	8	3.36%	1.182
417	8	2.28%	1.170
418	8	2.23%	1.423
419	8	3.30%	1.330
420	8	2.88%	1.157
421	8	2.18%	1.340
422	8	2.93%	1.339
423	8	2.92%	1.243
424	8	2.52%	0.568
425	8	0.53%	1.216
426	8	2.41%	1.285
427	8	2.69%	1.119
428	8	2.04%	1.448
429	8	3.42%	1.404
430	8	3.21%	1.470
431	8	3.52%	1.383
432	8	3.12%	0.893
433	8	1.30%	1.603
434	8	4.19%	0.598
435	8	0.58%	0.572
436	8	0.53%	1.467
437	8	3.51%	1.501
438	8	3.67%	0.608
439	8	0.60%	0.739
440	8	0.89%	0.730
441	8	0.87%	0.777
442	8	0.98%	0.536
443	8	0.47%	1.150
444	8	2.15%	1.291
445	8	2.71%	1.510
446	8	3.71%	1.744
447	8	4.96%	0.568
448	8	0.53%	0.615

Existing Gravity Sewer Pipe Segments			
Pipe Segment (see Detailed Area Maps)	**Pipe Diameter (inch)**	**Slope**	**Capacity (mgd)**
449	8	0.62%	0.911
450	8	1.35%	0.892
451	8	1.30%	1.450
452	8	3.43%	1.769
453	8	5.10%	0.932
454	8	1.42%	0.553
455	8	0.50%	0.589
456	8	0.57%	0.682
457	8	0.76%	1.446
458	8	3.41%	1.499
459	8	3.66%	1.495
460	8	3.64%	0.856
461	8	1.20%	0.845
462	8	1.16%	2.144
463	8	7.49%	0.659
464	8	0.71%	0.613
465	8	0.61%	0.567
466	8	0.52%	0.578
467	8	0.54%	0.772
468	8	0.97%	0.631
469	8	0.65%	4.762
470	8	36.95%	0.583
471	8	0.55%	0.570
472	8	0.53%	0.579
473	8	0.55%	0.568
474	8	0.53%	0.605
475	8	0.60%	0.569
476	8	0.53%	0.568
477	8	0.53%	0.716
478	8	0.84%	0.904
479	8	1.33%	0.528
480	8	0.45%	0.520
481	8	0.44%	0.580
482	8	0.55%	1.334
483	8	2.90%	1.091
485	8	1.94%	0.600
486	8	0.59%	1.353
487	8	2.98%	1.393
488	8	3.16%	1.351
489	8	2.98%	1.620
490	8	4.27%	1.024
491	8	1.71%	1.323

Existing Gravity Sewer Pipe Segments			
Pipe Segment (see Detailed Area Maps)	**Pipe Diameter (inch)**	**Slope**	**Capacity (mgd)**
492	8	2.85%	0.587
494	8	0.56%	0.646
495	8	0.68%	1.057
496	8	1.82%	1.916
497	8	5.98%	1.734
498	8	4.90%	1.376
499	8	3.08%	1.768
500	8	5.09%	1.145
501	8	2.14%	1.406
502	8	3.22%	1.043
503	8	1.77%	0.627
504	8	0.64%	0.586
505	8	0.56%	1.561
506	8	3.97%	0.605
507	8	0.60%	0.850
508	8	1.18%	1.486
509	8	3.60%	0.793
510	8	1.03%	0.630
511	10	0.65%	1.192
512	8	0.71%	1.971
513	10	6.33%	1.196
514	10	0.71%	2.294
515	10	2.62%	2.369
516	10	2.80%	3.941
517	12	7.74%	3.316
518	12	2.07%	1.874
519	8	0.66%	1.218
520	8	2.42%	1.217
521	8	2.42%	1.689
522	8	4.65%	1.528
523	8	3.81%	1.596
524	8	4.15%	1.254
525	8	2.56%	0.901
528	8	1.32%	0.872
529	8	1.24%	1.311
530	8	2.80%	0.737
531	8	0.89%	0.922
532	8	1.38%	0.969
533	8	1.53%	0.772
534	8	0.97%	0.770
535	8	0.97%	0.766
536	8	0.96%	0.844

Existing Gravity Sewer Pipe Segments			
Pipe Segment (see Detailed Area Maps)	**Pipe Diameter (inch)**	**Slope**	**Capacity (mgd)**
537	8	1.16%	0.766
538	8	0.96%	0.780
539	8	0.99%	0.793
540	8	1.03%	0.776
541	8	0.98%	1.335
542	8	2.91%	1.318
543	8	2.83%	1.011
544	8	1.66%	0.999
545	8	1.63%	1.016
546	8	1.68%	2.139
547	8	7.46%	1.161
548	8	2.20%	1.233
549	10	2.48%	2.143
550	10	2.29%	2.134
551	10	2.27%	1.957
552	12	1.91%	3.734
553	8	2.62%	1.295
554	8	2.73%	1.315
555	8	2.82%	1.247
556	8	2.53%	1.462
557	12	3.48%	3.665
558	12	2.52%	3.711
559	12	2.59%	3.696
560	12	2.57%	4.984
561	12	4.67%	3.524
562	16	2.33%	7.433
563	15	2.24%	3.504
564	15	0.70%	4.304
565	15	1.06%	2.358
566	18	0.32%	4.323
567	18	0.40%	4.731
568	18	0.48%	4.242
569	18	0.39%	9.106
570	18	1.79%	5.342
571	18	0.62%	8.978
572	18	1.74%	5.710
573	18	0.71%	7.058
574	18	1.08%	4.885
575	21	0.52%	11.923
576	18	1.35%	5.355
577	18	0.62%	7.359
578	18	1.17%	5.402

Existing Gravity Sewer Pipe Segments			
Pipe Segment (see Detailed Area Maps)	**Pipe Diameter (inch)**	**Slope**	**Capacity (mgd)**
579	18	0.63%	5.504
580	18	0.66%	8.296
581	18	1.49%	4.018
582	18	0.35%	9.053
583	18	1.77%	4.470
584	18	0.43%	4.000
585	8	0.35%	0.627
586	8	0.64%	0.583
587	12	0.55%	1.760
588	12	0.58%	1.926
589	21	0.70%	6.735
590	21	0.43%	7.100
591	21	0.48%	9.877
592	21	0.93%	8.321
593	8	0.66%	0.737
594	21	0.88%	12.968
595	8	1.60%	0.598
597	8	0.58%	0.975
598	21	1.55%	6.528
599	21	0.41%	7.203
600	21	0.49%	8.328
601	21	0.66%	10.542
602	21	1.06%	6.688
603	21	0.43%	11.786
604	21	1.32%	8.961
605	8	0.76%	0.631
606	8	0.65%	0.714
607	8	0.83%	0.552
608	8	0.50%	0.776
609	8	0.98%	0.582
610	21	0.55%	6.965
611	21	0.46%	7.433
612	12	0.53%	1.199
613	12	0.27%	1.386
614	12	0.36%	2.937
615	8	1.62%	1.196
616	8	2.33%	1.131
617	8	2.08%	0.683
618	15	0.76%	2.087
619	15	0.25%	2.291
620	15	0.30%	2.474
621	16	0.35%	2.220

Existing Gravity Sewer Pipe Segments			
Pipe Segment (see Detailed Area Maps)	**Pipe Diameter (inch)**	**Slope**	**Capacity (mgd)**
622	15	0.20%	2.091
623	18	0.25%	4.965
624	15	0.53%	3.001
625	27	0.52%	10.105
626	27	0.25%	9.616
627	27	0.23%	12.994
628	27	0.42%	14.707
629	27	0.54%	15.111
630	27	0.57%	16.400
631	8	0.67%	0.888
632	8	1.29%	0.582
633	8	0.55%	0.672
634	10	0.74%	0.754
635	10	0.28%	0.735
636	10	0.27%	1.514
637	10	1.14%	1.477
638	10	1.09%	1.798
639	12	1.61%	1.603
640	12	0.48%	2.218
641	12	0.93%	1.382
642	8	0.36%	1.362
643	12	3.02%	2.763
653	12	1.44%	1.634
654	12	0.50%	1.655
655	12	0.52%	1.598
656	12	0.48%	2.078
658	12	0.81%	2.210
659	12	0.92%	2.295
660	12	0.99%	2.411
661	12	1.09%	2.400
662	12	1.08%	1.329
663	12	0.33%	1.926
664	27	0.70%	10.399
665	27	0.27%	10.125
666	27	0.26%	11.466
667	27	0.33%	13.375
668	27	0.45%	12.729
669	30	0.40%	14.761
670	27	0.31%	11.862
671	27	0.35%	11.588
672	27	0.33%	11.640
673	27	0.34%	11.431

Existing Gravity Sewer Pipe Segments			
Pipe Segment (see Detailed Area Maps)	**Pipe Diameter (inch)**	**Slope**	**Capacity (mgd)**
674	27	0.33%	11.709
675	27	0.34%	13.804
676	27	0.47%	24.777
677	21	1.53%	10.145
679	21	0.98%	22.514
680	27	4.82%	17.945
681	27	0.80%	13.010
682	12	0.42%	7.343
686	8	10.14%	0.615
695	8	0.62%	0.560
696	8	0.51%	0.823
697	8	1.11%	0.578
698	8	0.54%	0.590
699	8	0.57%	0.559
700	8	0.51%	0.616
701	8	0.62%	0.571
702	8	0.53%	0.609
703	8	0.61%	0.591
704	8	0.57%	0.600
705	8	0.59%	0.584
706	8	0.56%	0.583
707	8	0.55%	0.822
708	8	1.10%	0.650
709	8	0.69%	0.831
710	8	1.12%	0.705
711	8	0.81%	0.562
712	8	0.52%	0.617
713	8	0.62%	0.611
714	8	0.61%	0.581
715	8	0.55%	0.987
716	8	1.59%	1.026
717	8	1.72%	0.612
718	8	0.61%	0.559
719	8	0.51%	0.975
720	8	1.55%	0.857
721	8	1.20%	0.899
722	8	1.32%	0.950
723	8	1.47%	0.780
724	8	0.99%	0.612
725	8	0.61%	0.606
726	8	0.60%	0.692
728	8	0.78%	0.659

Existing Gravity Sewer Pipe Segments			
Pipe Segment (see Detailed Area Maps)	**Pipe Diameter (inch)**	**Slope**	**Capacity (mgd)**
729	8	0.71%	0.618
730	8	0.62%	0.584
732	8	0.56%	0.525
733	8	0.45%	0.632
734	8	0.65%	0.807
735	8	1.06%	0.565
736	8	0.52%	0.558
737	8	0.51%	0.588
742	10	0.56%	0.767
743	10	0.29%	0.799
744	10	0.32%	0.848
745	8	0.36%	1.467
746	8	3.51%	1.467
747	8	3.51%	0.790
752	8	1.02%	0.787
753	8	1.01%	0.583
754	8	0.55%	0.639
755	8	0.67%	0.752
757	8	0.92%	0.579
758	8	0.55%	0.584
759	8	0.56%	0.545
761	8	0.48%	0.670
762	8	0.73%	0.604
763	8	0.59%	0.783
764	8	1.00%	0.500
765	8	0.41%	1.017

Existing Force Main Pipe Segments		
Pipe Segment (see Detailed Area Maps)	**Pipe Diameter (inch)**	**Location**
901	8	South Fork PS
902	8	South Fork PS
903	8	South Fork PS
904	8	South Fork PS
905	8	South Fork PS
906	8	South Fork PS
907	8	South Fork PS
908	8	South Fork PS
909	8	South Fork PS
910	8	South Fork PS
911	8	South Fork PS
912	8	South Fork PS
913	8	South Fork PS
914	4	Nintendo PS
915	4	Nintendo PS
916	4	Nintendo PS
917	4	Nintendo PS
918	4	Nintendo PS
919	4	Nintendo PS
920	4	Nintendo PS
921	4	Nintendo PS
922	4	Nintendo PS
923	2	Snoqualm PS
924	NA	E.J. Roberts Park PS
925	NA	Grinder pump in Truck Town
926	NA	Grinder pump in Truck Town

Future Gravity Sewer Pipe Segments				
Pipe Segment (see Detailed Area Maps)	**Pipe Diameter (inch)**	**Slope**	**Length (feet)**	**Capacity (mgd)**
1002	8	0.40%	843	0.495
1003	8	0.40%	1,120	0.495
1004	10	0.28%	528	0.751
1005	8	0.40%	981	0.495
1006	8	0.40%	761	0.495
1007	8	0.40%	1,376	0.495
1008	12	0.22%	1,685	1.082
1009	8	0.40%	781	0.495
1010	8	0.40%	1,795	0.495
1011	8	0.40%	152	0.495
1012	8	0.40%	434	0.495
1013	8	0.40%	203	0.495
1014	8	0.40%	220	0.495
1015	8	0.40%	451	0.495
1017	8	0.40%	652	0.495
1018	8	0.40%	628	0.495
1019	8	0.40%	1,045	0.495
1020	8	0.40%	244	0.495
1021	8	0.40%	99	0.495
1022	8	0.40%	394	0.495
1023	8	0.40%	192	0.495
1024	8	0.40%	420	0.495
1025	8	0.40%	112	0.495
1026	8	0.40%	1,223	0.495
1027	8	0.40%	1,521	0.495
1028	8	0.40%	1,887	0.495
1029	15	0.14%	272	1.565
1030	8	0.40%	2,003	0.495
1031	8	0.40%	189	0.495
1032	8	0.40%	472	0.495
1033	8	0.40%	119	0.495
1034	8	0.40%	175	0.495
1035	8	0.40%	1,048	0.495
1036	8	0.40%	293	0.495
1037	8	0.40%	133	0.495
1038	8	0.40%	119	0.495
1039	8	0.40%	622	0.495
1040	8	0.40%	854	0.495
1041	8	0.40%	384	0.495
1043	8	0.40%	664	0.495
1044	8	0.40%	542	0.495
1045	12	0.22%	1,017	1.082

Future Gravity Sewer Pipe Segments				
Pipe Segment (see Detailed Area Maps)	**Pipe Diameter (inch)**	**Slope**	**Length (feet)**	**Capacity (mgd)**
1046	8	0.40%	467	0.495
1047	12	0.22%	684	1.082
1048	10	0.28%	343	0.751
1049	12	0.22%	1,111	1.082
1050	8	0.40%	373	0.495
1051	12	0.22%	246	1.082
1052	12	0.22%	643	1.082
1053	12	0.22%	768	1.082
1054	8	0.40%	766	0.495
1055	8	0.40%	965	0.495
1056	8	0.40%	130	0.495
1057	8	0.40%	298	0.495
1058	8	0.40%	865	0.495
1059	8	0.40%	754	0.495
1060	8	0.40%	1,302	0.495
1061	8	0.40%	375	0.495
1062	8	0.40%	135	0.495
1063	8	0.40%	778	0.495
1064	8	0.40%	196	0.495
1065	8	0.40%	930	0.495
1067	8	0.40%	1,036	0.495
1068	8	0.40%	408	0.495
1069	8	0.40%	414	0.495
1070	8	0.40%	107	0.495
1071	8	0.40%	509	0.495
1072	8	0.40%	328	0.495
1073	8	0.40%	2,605	0.495
1074	8	0.40%	449	0.495
1075	8	0.40%	340	0.495
1076	8	0.40%	683	0.495
1077	8	0.40%	340	0.495
1078	8	0.40%	182	0.495
1079	8	0.40%	207	0.495
1080	8	0.40%	332	0.495
1081	8	0.40%	426	0.495
1082	8	0.40%	501	0.495
1083	8	0.40%	563	0.495
1084	8	0.40%	188	0.495
1085	8	0.40%	742	0.495
1086	8	0.40%	414	0.495
1087	8	0.40%	344	0.495
1088	8	0.40%	394	0.495

Future Gravity Sewer Pipe Segments				
Pipe Segment (see Detailed Area Maps)	**Pipe Diameter (inch)**	**Slope**	**Length (feet)**	**Capacity (mgd)**
1089	8	0.40%	336	0.495
1090	8	0.40%	312	0.495
1091	8	0.40%	641	0.495
1092	8	0.40%	664	0.495
1093	8	0.40%	1,738	0.495
1095	8	0.40%	483	0.495
1096	8	0.40%	323	0.495
1097	8	0.40%	208	0.495
1098	8	0.40%	217	0.495
1099	8	0.40%	263	0.495
1100	8	0.40%	224	0.495
1101	8	0.40%	238	0.495
1102	8	0.40%	291	0.495
1103	8	0.40%	328	0.495
1104	8	0.40%	302	0.495
1105	8	0.40%	300	0.495
1106	8	0.40%	325	0.495
1107	8	0.40%	295	0.495
1108	8	0.40%	320	0.495
1109	8	0.40%	627	0.495
1110	8	0.40%	293	0.495
1111	8	0.40%	554	0.495
1112	8	0.40%	339	0.495
1113	8	0.40%	343	0.495
1114	8	0.40%	629	0.495
1115	8	0.40%	325	0.495
1116	12	0.22%	329	1.082
1117	12	0.22%	323	1.082
1118	12	0.22%	304	1.082
1120	8	0.40%	283	0.495
1121	8	0.40%	281	0.495
1122	8	0.40%	393	0.495
1123	8	0.40%	127	0.495
1124	8	0.40%	339	0.495
1125	8	0.40%	71	0.495
1126	8	0.40%	1,091	0.495
1127	8	0.40%	516	0.495
1128	8	0.40%	372	0.495
1129	8	0.40%	237	0.495
1130	8	0.40%	1,605	0.495
1131	8	0.40%	316	0.495
1132	8	0.40%	443	0.495

Future Gravity Sewer Pipe Segments				
Pipe Segment (see Detailed Area Maps)	**Pipe Diameter (inch)**	**Slope**	**Length (feet)**	**Capacity (mgd)**
1133	8	0.40%	882	0.495
1134	8	0.40%	444	0.495
1135	8	0.40%	1,047	0.495
1136	8	0.40%	220	0.495
1137	8	0.40%	139	0.495
1138	12	0.22%	1,534	1.082
1139	12	0.22%	442	1.082
1140	12	0.22%	494	1.082
1141	8	0.40%	1,219	0.495
1142	8	0.40%	2,430	0.495
1143	8	0.40%	237	0.495
1144	8	0.40%	304	0.495
1145	10	0.28%	783	0.751
1146	10	0.28%	489	0.751
1147	8	0.40%	188	0.495
1148	12	0.22%	168	1.082
1149	8	0.40%	241	0.495
1150	8	0.40%	111	0.495
1151	8	0.40%	311	0.495
1152	8	0.40%	646	0.495
1153	8	0.40%	215	0.495
1155	8	0.40%	1,660	0.495
1156	8	0.40%	600	0.495
1157	8	0.40%	745	0.495
1158	8	0.40%	1,211	0.495
1159	8	0.40%	956	0.495
1160	8	0.40%	396	0.495
1161	8	0.40%	266	0.495
1162	8	0.40%	1,787	0.495
1163	8	0.40%	963	0.495
1164	8	0.40%	781	0.495
1165	8	0.40%	354	0.495
1166	8	0.40%	495	0.495
1167	8	0.40%	338	0.495
1169	8	0.40%	577	0.495
1170	8	0.40%	1,091	0.495
1171	8	0.40%	729	0.495
1172	12	0.22%	473	1.082
1173	8	0.40%	1,104	0.495
1174	8	0.40%	1,238	0.495
1175	8	0.40%	298	0.495
1181	8	0.40%	1,315	0.495

Future Gravity Sewer Pipe Segments				
Pipe Segment (see Detailed Area Maps)	**Pipe Diameter (inch)**	**Slope**	**Length (feet)**	**Capacity (mgd)**
1182	8	0.40%	165	0.495
1183	8	0.40%	166	0.495
1184	8	0.40%	242	0.495
1185	8	0.40%	195	0.495
1186	8	0.40%	232	0.495
1187	8	0.40%	187	0.495
1188	8	0.40%	396	0.495
1189	8	0.40%	171	0.495
1190	8	0.40%	1,132	0.495
1191	8	0.40%	474	0.495
1192	8	0.40%	890	0.495
1193	8	0.40%	558	0.495
1194	8	0.40%	683	0.495
1195	8	0.40%	327	0.495
1196	10	0.28%	1,342	0.751
1198	8	0.40%	299	0.495
1199	8	0.40%	594	0.495
1200	8	0.40%	376	0.495
1201	8	0.40%	1,110	0.495
1202	8	0.40%	1,105	0.495
1203	8	0.40%	604	0.495
1204	8	0.40%	468	0.495
1206	8	0.40%	517	0.495
1208	8	0.40%	228	0.495

Future Force Main Pipe Segments			
Pipe Segment (see Detailed Area Maps)	**Pipe Diameter (inch)**	**Length (feet)**	**Location**
1001	6	3,488	Future Meadowbrook PS 1
1016	10	5,772	Future Cedar Falls PS 1
1042	6	3,761	Future Meadowbrook PS 2
1066	6	588	Future Mountain View Blvd PS
1094	6	1,065	Future Silver Creek PS
1119	4	472	Future Tanner Rd PS
1154	8	943	Future Cedar Falls PS 2
1168	4	207	Future 437 PL SE PS
1197	6	2,920	Future Quadrant PS
1205	4	178	Future SW Mt SI Blvd PS

N

2,000 1,000 0 2,000 Feet

Legend

- Map key area
- Urban growth boundary
- City limit
- Existing gravity sewer
- Existing lift station & force main
- Temporary lift station & force main
- Future gravity sewer
- Future lift station & force main

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

SE NORTH BEND WAY
SE 102ND ST
SE 103RD PL
SE 104TH ST
SE 106TH ST
SE 108TH ST
NW 14TH ST
NW 8TH ST
NE 8th St
114TH ST
SE 122ND ST
398TH AVE SE
SW 10TH ST
SW 131ST ST
SE 131ST ST
SE 136TH ST
SE 140TH ST
SE 142ND ST
SE 141ST ST
SE 143RD ST
409TH AVE SE
415TH AVE SE
424TH AVE SE
430TH AVE SE
434TH AVE SE
440TH PL SE
441ST AVE SE
446TH AVE SE
448TH AVE SE
452ND AVE SE
456TH DR SE
465TH AVE SE
466TH AVE SE
468TH AVE SE
471ST AVE SE
473RD AVE SE
475TH AVE SE
476TH AVE SE
SE 119TH ST
SE 124TH ST
SE 128TH ST
SE 129TH ST
SE 131ST PL
SE 134TH ST
SE 137TH ST
SE 144TH ST
SE 147TH ST
SE 150TH
SE 149TH ST
SE 149TH PL
SE MOUNTAIN VIEW RD
SE MIDDLE FORK RD
SE GROUSE RIDGE ACCESS RD
RESERVE DR SE
UPLANDS WAY SE
RATTLESNAKE RD SE
I-90 EFWY
RAMP

1

Legend

- Urban growth boundary
- City limit
- River or creek
- Park, open space or public facility
- 364 — Existing gravity sewer
- Existing lift station & force main
- Temporary lift station & force main
- 1041 — Future gravity sewer
- 1002 — Future lift station & force main
- Proposed grinder pump service area

BOALCH AVE NW

Gardiner Creek

NW 14TH ST

1002

1003

1004

1005

1006

1007

1008

1001

1042

1043

1206

Future Meadowbrook Lift Station #1

Future Meadowbrook Lift Station #2

SE 106TH PL

W NORTH BEND WAY

ALM WAY

BENDIGO BLVD N

NW 9TH ST

Ribary Creek

South Fork Snoqualmie River

Force Mains in 42" Casing Under River Next to Bridge

Wastewater Treatment Plant

D-30

Sewer Layout by Developer

Sewer Layout by Developer

N

300 150 0 300

Approximate Scale: 1' = 300'

2

Sewer Layout by Developer

Sewer Layout by Developer

1206

1007

ALM WAY

NW 6TH ST

1043

Future Meadowbrook Lift Station #2

1042

1001

BENDIGO BLVD

Ribary Creek

Wastewater Treatment Plant

Force Mains in 42" Casing Under River Next to Bridge

445 W NORTH BEND WAY

Legend

- Urban growth boundary
- City limit
- River or creek
- Park, open space or public facility
- 364 Existing gravity sewer
- Existing lift station & force main
- Temporary lift station & force main
- 1041 Future gravity sewer
- 1002 Future lift station & force main
- Proposed grinder pump service area

300 150 0 300

Approximate Scale: 1' = 300'

N

Gardiner Creek

I-90 FWY

I-90 FWY

Nintendo Lift Station

315

316

South Fork Snoqualmie River

121

122

120

119

182

181

118

180

117

115

114

112

PARK ST

102

105

104

103

101

100

99

106

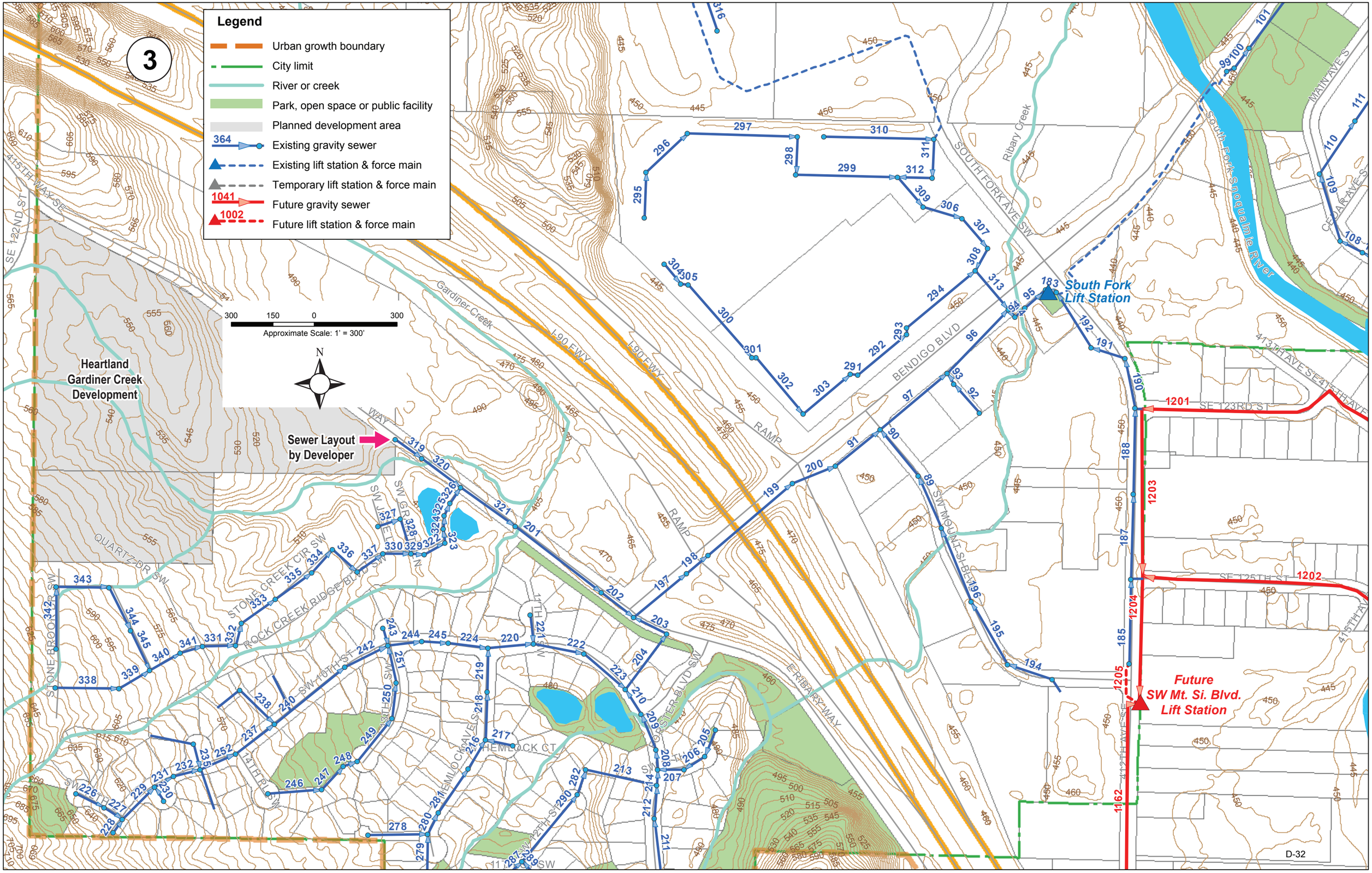
SYDNEY AVE S

TAYLOR AVE

BENDIGO BLVD

MAIN AVE S

111


Legend
Urban growth boundary
City limit
River or creek
Park, open space or public facility
Planned development area
364 Existing gravity sewer
Existing lift station & force main
Temporary lift station & force main
1041 Future gravity sewer
1002 Future lift station & force main
3
300 150 0 300
Approximate Scale: 1' = 300'
N
Heartland
Gardiner Creek
Development
Sewer Layout
by Developer
South Fork
Lift Station
Future
SW Mt. Si. Blvd.
Lift Station
SE 123RD ST
SE 125TH ST
SE 127TH ST
SOUTH FORK AVE SW
BENDIGO BLVD
I-90 FWY
RAMP
Gardiner Creek
Ribary Creek
South Fork Snoqualmie River
MAIN AVE S
CEDAR AVE S
413TH AVE SE
415TH AVE SE
412TH AVE SE
SE 122ND ST
415TH WAY SE
QUARTZ DR SW
STONE BROOK PL SW
STONE CREEK CIR SW
ROCK CREEK RIDGE BLVD SW
SW 10TH ST
SW 12TH ST
SW JULIET LN
SW GRETEL LN
SW MOUNT SI BLVD
SW FOREST BLVD
E RIBARY WAY
14TH PL SW
13TH LN SW
11TH PL SW
HEMLOCK CT
HEMLOCK AVE SW
D-32

4

300 150 0 300

Approximate Scale: 1' = 300'

N

Legend

- Urban growth boundary
- City limit
- River or creek
- Park, open space or public facility
- 364 Existing gravity sewer
- Existing lift station & force main
- Temporary lift station & force main
- 1041 Future gravity sewer
- 1002 Future lift station & force main

SW 14TH ST
SW 13TH PL
SW 15TH PL
SW 17TH PL
HEMLOCK AVE SW
FORSBERG BLVD SW
L1TH CT SW
SE 131ST ST
SE 130TH ST
SE 133RD PL
RAMP
I-90 FWY
412TH AVE SE
415TH WAY SE
400TH AVE SE
South Fork Snoqualmie R.
1162
1163
1200

D-33

5

Wastewater Treatment Plant

Force Mains in 42" Casing Under River Next to Bridge

Bendigo Blvd. N.

ULID#6 Pump Station

Existing CMP to Be Replaced

DETAIL MAP 5A

Sydney Ave. N.

Force Mains in 42" Casing Under River Next to Bridge

Wastewater Treatment Plant

ULID#5 Pump Station

SEE DETAIL MAP 5A

N

300 150 0 300

Approximate Scale: 1' = 300'

Legend

- Urban growth boundary
- City limit
- River or creek
- Park, open space or public facility
- Proposed grinder pump service area
- Existing gravity sewer
- Existing lift station & force main
- Temporary lift station & force main
- Future gravity sewer
- Future lift station & force main

Future Silver Creek Lift Station

Snoqualm Lift Station

Lft Station May Be Needed to Cross Creek

EJ Roberts Park Lift Station

American Homes Development

SE 108TH ST

NE 10TH ST

NE 8TH ST

E 6TH ST

NE 5TH ST

420TH AVE SE

BALLARAT AVE NE

SNOQUALM PL

MERRITT AVE NE

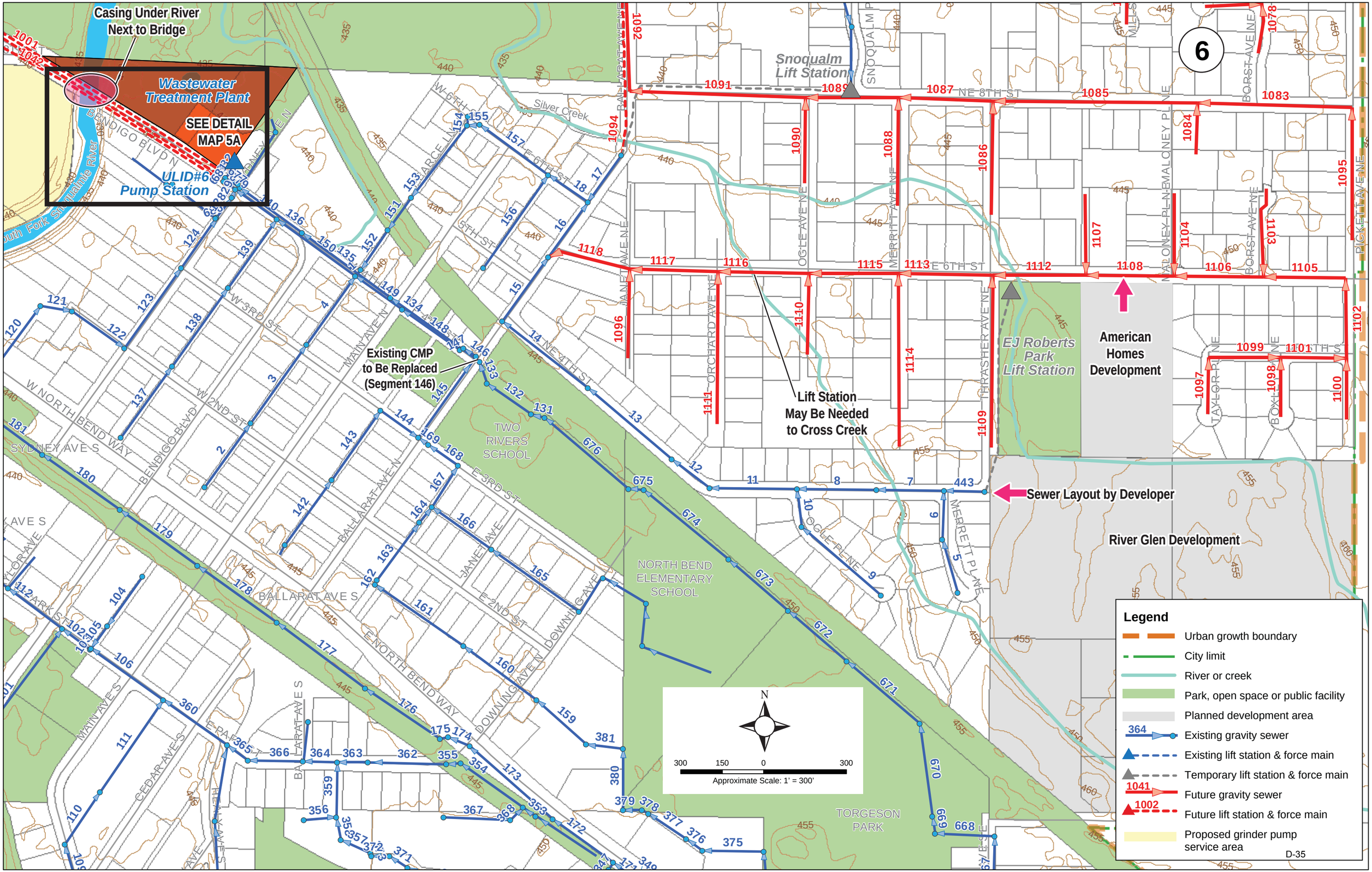
THRASHER AVE NE

MALONEY PL NE

BORST AVE NE

PICKETT AVE NE

TAYLOR PL NE


Casing Under River
Next to Bridge
Wastewater
Treatment Plant
SEE DETAIL
MAP 5A
ULID#6
Pump Station
Existing CMP
to Be Replaced
(Segment 146)
Lift Station
May Be Needed
to Cross Creek
Snoqualmie
Lift Station
EJ Roberts
Park
Lift Station
American
Homes
Development
River Glen Development
Sewer Layout by Developer
6
TWO
RIVERS
SCHOOL
NORTH BEND
ELEMENTARY
SCHOOL
TORGESON
PARK
Silver Creek
South Fork Snoqualmie River
W 6TH ST
5TH ST
W 4TH ST
W 3RD ST
W 2ND ST
W NORTH BEND WAY
NE 4TH ST
E 6TH ST
E 3RD ST
E 2ND ST
E NORTH BEND WAY
NE 8TH ST
BALLARAT AVE N
BALLARAT AVE S
MAIN AVE N
MAIN AVE S
JANET AVE
ORCHARD AVE NE
OGLE AVE NE
MERRITT AVE NE
THRASHER AVE NE
DOWNING AVE N
CEDAR AVE S
SYDNEY AVE S
PARK ST
BORST AVE NE
MALONEY PL NE
TAYLOR PL NE
MERRETT PL NE
PICKETT AVE NE
SNOQUALMIE PKWY
INDIGO BLVD N
INDIGO BLVD S
N
300 150 0 300
Approximate Scale: 1' = 300'
Legend
Urban growth boundary
City limit
River or creek
Park, open space or public facility
Planned development area
Existing gravity sewer
Existing lift station & force main
Temporary lift station & force main
Future gravity sewer
Future lift station & force main
Proposed grinder pump service area

7

Legend

- Urban growth boundary
- City limit
- River or creek
- Park, open space or public facility
- Planned development area
- 364 Existing gravity sewer
- Existing lift station & force main
- Temporary lift station & force main
- 1041 Future gravity sewer
- 1002 Future lift station & force main

N

300 150 0 300

Approximate Scale: 1' = 300'

TORGESON PARK

SE 120TH ST

E NORTH BEND WAY

SE ORCHARD DR

SE MEADOW DR

SE CLIFF VIEW PL

SE 28TH ST

SE 6TH ST

SE 7TH ST

SE 8TH ST

SE 9TH ST

SE 10TH ST

SE 11TH ST

SE CEDAR FALLS WAY

SE MOUNT TENERIFFE PL

MOUNTAIN VIEW BLVD

MALONE GROVE AVE SE

SE SYMMONS

SALISH AVE SE

E PARK

CEDAR AVE S

STOW AVE

HEALY AVE S

BALLARAT

DOGWOOD

E 415TH AVE SE

415TH AVE SE

RIVERSIDE DR SE

SE MAPLE DR

SE CHERRY

SE ALDER DR

SE 424TH AVE SE

South Fork Snoqualmie River

8

N

300 150 0 300

Approximate Scale: 1' = 300'

SE ALDER DR

SE 10TH ST

SE 10TH CIR

SE 10TH PL

SE 11TH PL

SE 11TH ST

SE 12TH PL

SE 13TH PL

SE 131ST ST

MOUNTAIN VIEW BLVD

GAINES AVE SE

MALONE GROVE AVE SE

SE SYMMONS

SE CEDAR FALLS WAY

SE 12TH ST

SE 133RD ST

SE 135TH ST

SE 136TH ST

SE 134TH ST

SE 134TH PL

427TH AVE SE

428TH AVE SE

424TH AVE SE

423RD AVE SE

421ST AVE SE

South Fork Snoqualmie

Future Mountain View Blvd. Lift Station

Cedar Falls South Development

Sunrise View Development

OPSTAD ELEMENTARY SCHOOL

Quadrant Homes Development

Legend

- Urban growth boundary
- City limit
- River or creek
- Park, open space or public facility
- Planned development area
- 364 Existing gravity sewer
- Existing lift station & force main
- Temporary lift station & force main
- 1041 Future gravity sewer
- 1002 Future lift station & force main

9

Cedar Falls South Development

Sunrise View Development

Quadrant Homes Development

Future Quadrant Lift Station

Future 437th Pl. SE Lift Station

Sewer Layout by Developer

OPSTAD ELEMENTARY SCHOOL

PATKANIM AVE SE
SALISH AVE SE
427TH AVE SE
428TH AVE SE
424TH AVE SE
433RD PL SE
435TH PL SE
436TH AVE SE
437TH PL SE
SE 134TH ST
SE 134TH CT
SE 134TH PL
SE 136TH ST
SE 137TH PL
SE 140TH ST
SE 142ND ST
OAK FALLS WAY
SE NORTH BEND WAY
I-90 FWY

Legend

- Urban growth boundary
- City limit
- River or creek
- Park, open space or public facility
- Planned development area
- 364 Existing gravity sewer
- Existing lift station & force main
- Temporary lift station & force main
- 1041 Future gravity sewer
- 1002 Future lift station & force main

N

300 150 0 300

Approximate Scale: 1' = 300'

10

N

300 150 0 300

Approximate Scale: 1' = 300'

Legend

- Urban growth boundary
- City limit
- River or creek
- Park, open space or public facility
- Planned development area
- 364 Existing gravity sewer
- Existing lift station & force main
- Temporary lift station & force main
- 1041 Future gravity sewer
- 1002 Future lift station & force main

SE MOUNT SI RD
SE 128TH PL
440TH PL SE
Middle Fork Snoqualmie River
SE CEDAR FALLS WAY
SE NORTH BEND WAY
TANNER RD
SE FOREST DR
432ND AVE SE
433RD PL SE
433RD AVE SE
435TH PL SE
436TH AVE SE
SE 134TH ST
SE 134TH CT
SE 134TH PL
OPSTAD ELEMENTARY SCHOOL
Quadrant Homes Development

11

Future 437th Pl. SE Lift Station

Future Cedar Falls Lift Station #1

Alternate Route May Be Feasible Under I-90 Interchange

Legend

- Urban growth boundary
- City limit
- River or creek
- Park, open space or public facility
- 364 Existing gravity sewer
- Existing lift station & force main
- Temporary lift station & force main
- 1041 Future gravity sewer
- 1002 Future lift station & force main

N

300 150 0 300

Approximate Scale: 1' = 300'

D-40

12

N

300 150 0 300

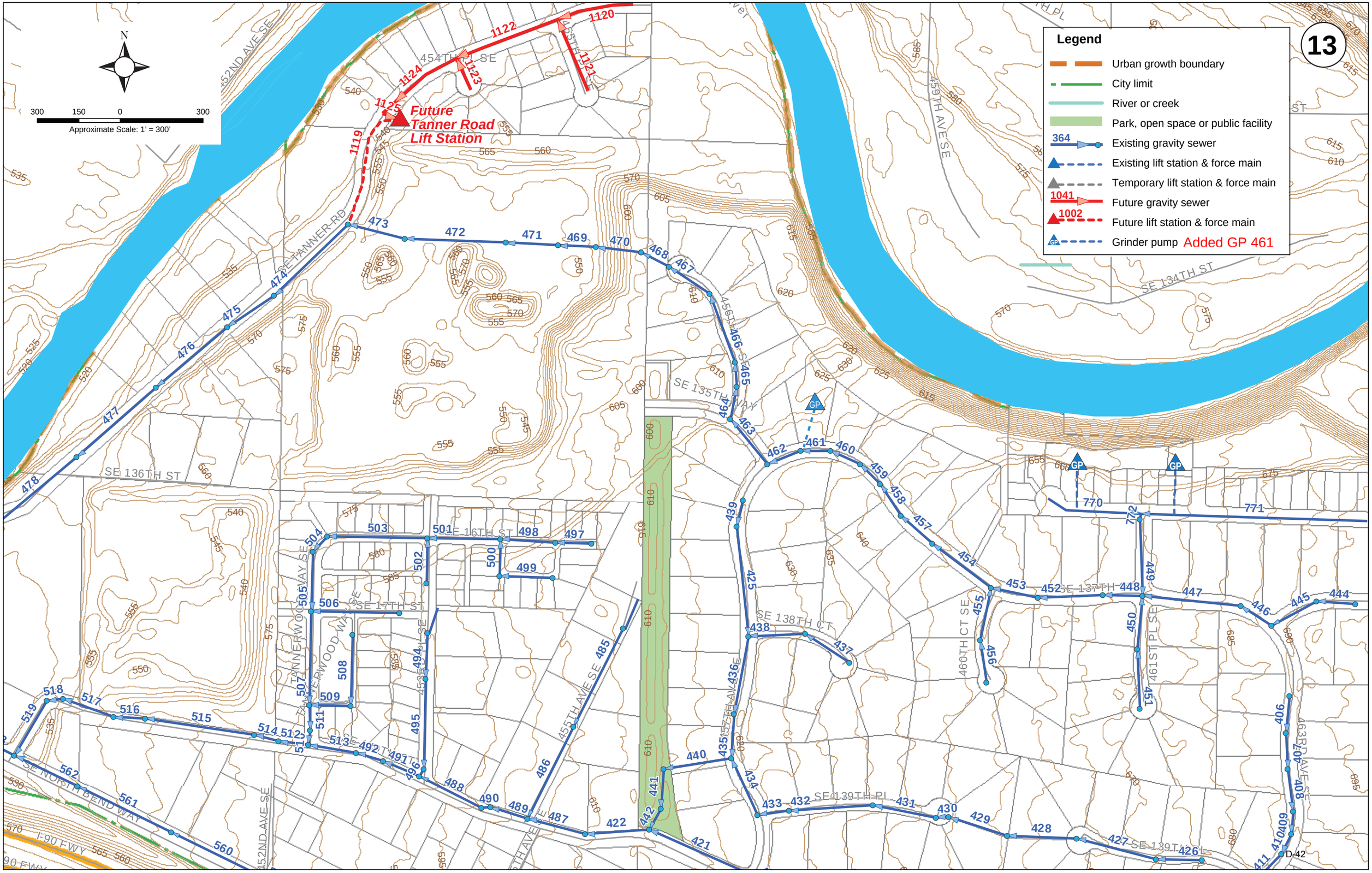
Approximate Scale: 1' = 300'

Legend

- Urban growth boundary
- City limit
- River or creek
- Park, open space or public facility
- 364 Existing gravity sewer
- Existing lift station & force main
- Temporary lift station & force main
- 1041 Future gravity sewer
- 1002 Future lift station & force main
- Proposed grinder pump service area

SE 143RD PL
SE 144TH LN
SE 144TH ST
SE 145TH ST
SE 146TH ST
SE 147TH ST
SE 147TH LN
SE 147TH PL
SE 148TH ST
SE 149TH ST
SE 149TH PL
SE 150TH ST
SE 151ST ST
SE 151ST PL
SE 152ND ST
SE 152ND PL
436TH AVE SE
437TH PL SE
437TH AVE SE
438TH AVE SE
439TH PL SE
440TH AVE SE
441ST AVE SE
442ND AVE SE
443RD AVE SE
444TH AVE SE
445TH AVE SE
446TH AVE SE
447TH AVE SE
448TH AVE SE
449TH AVE SE
CEDAR FALLS WAY SE
South Fork Snoqualmie River

Future Cedar Falls Lift Station #2


N
300 150 0 300
Approximate Scale: 1' = 300'
Future Tanner Road Lift Station
Legend
Urban growth boundary
City limit
River or creek
Park, open space or public facility
Existing gravity sewer
Existing lift station & force main
Temporary lift station & force main
Future gravity sewer
Future lift station & force main
Grinder pump Added GP 461
454TH PL SE
454TH AVE SE
452ND AVE SE
459TH AVE SE
SE 134TH ST
SE TANNER RD
SE 136TH ST
SE 135TH PL
SE 16TH ST
SE 17TH ST
TANNERWOOD WAY SE
SE NORTH BEND WAY
I-90 FWY
455TH AVE SE
457TH AVE SE
SE 138TH CT
460TH CT SE
SE 137TH PL
SE 139TH PL
463RD AVE SE
13
D-42

14

N

300 150 0 300

Approximate Scale: 1' = 300'

Legend

- Urban growth boundary
- City limit
- River or creek
- Park, open space or public facility
- 364 Existing gravity sewer
- Existing lift station & force main
- Temporary lift station & force main
- 1041 Future gravity sewer
- 1002 Future lift station & force main

South Fork Snoqualmie River

I-90 FWY

SE NORTH BEND WAY

SE 150TH ST

SE 146TH ST

SE 147TH ST

SE 141ST ST

SE 139TH PL

452ND AVE SE

455TH AVE SE

457TH AVE SE

449TH AVE SE

446TH PL SE

447TH AVE SE

448TH AVE SE

450TH AVE SE

450TH PL SE

15

Legend

- Urban growth boundary
- City limit
- River or creek
- 364 Existing gravity sewer
- Existing lift station & force main
- Temporary lift station & force main
- 1041 Future gravity sewer
- 1002 Future lift station & force main

SE 139TH PL
SE 140TH ST
SE 144TH ST
SE 146TH ST
SE 150TH ST
SE GROUSE RIDGE
I-90 FWY
I-90 FWY
RAMP
NORTH END WAY
DIE FORK RD
451ST SE
463RD AVE SE
468TH AVE SE
South Fork Snoqualmie River

N

300 150 0 300

Approximate Scale: 1' = 300'

APPENDIX E

COLLECTION SYSTEM MODELING INPUT AND RESULTS

APPENDIX E

COLLECTION SYSTEM MODELING INPUT AND RESULTS

MODELING APPROACH

MODELING ASSUMPTIONS

Basic assumptions used to model the collection system are as follows:

- Residential flow = 48 gpcd
- Peaking factor = 4
- I/I contribution as shown in Tables E-1 and E-2

TABLE E-1

Variation in Peak We-Weather I/I Rate by Sewer Contributing Area

II Category	Contributing Area	Sewer Service Area (acres)	Likely Range of Peak I/I (gpad)	II Unit in Model (gpad)
NEW	Sewers Developed Since 2001	473	1,100 – 2,300	2,000
REHAB ML &SS	Mainline & Side Sewers Rehabilitated to Buildings	10	1,100 – 2,300	2,000
REHAB ML	Mainline & Side Sewers Rehabilitated to Edge of Right-of-Way	42	3,000 – 5,000	4,000
OLD SF	South Fork Lift Station Basin	132	9,000 – 13,000	11,000
OLD CORE	Core Area Not Rehabilitated	139	3,000 – 9,000	6,500
FUTURE	Future	1691	2,300	2,300

TABLE E-2

Potential Contribution to Peak I/I, November 17, 2015

Contributing Area	Estimate 1	Estimate 2	Model Loading
Sewers Developed Since 2001	0.95 mgd @ 2,000 gpad	0.52 mgd @ 1,100 gpad	0.95 mgd @ 2,000 gpad
Mainline & Side Sewers Rehabilitated to Buildings	0.02 mgd @ 2,000 gpad	0.01 mgd @ 1,100 gpad	0.02 mgd @ 2,000 gpad
Mainline & Side Sewers Rehabilitated to Edge of Right-of-Way	0.17 mgd @ 4,000 gpad	0.17 mgd @ 4,000 gpad	0.17 mgd @ 4,000 gpad
South Fork Lift Station Basin	1.39 mgd @ 10,000 gpad	1.45 mgd @ 11,000 gpad	1.452 mgd @ 11,000 gpad
Core Area Not Rehabilitated	0.53 mgd @ 3,800 gpad	0.91 mgd @ 6,500 gpad	0.90 mgd @ 6,500 gpad
Total	**3.06 mgd @ 3,846 gpad**	**3.06 mgd @ 3,846 gpad**	**3.49 mgd @ 4,384**

MODELING FIELDS

Table E-3 shows the data fields imported into the collection system model's junction and conduit layer tables.

TABLE E-3

Data Fields for Basic Model Construction

Data Field	Definition/Comment
Junction Layer Table	
Name	Project assigned numbering
X-Coordinate	Geo-location in east-west orientation
Y-Coordinate	Geo-location in north-south orientation
Invert Elevation	Invert elevation of manhole (a single elevation was used for all pipes entering and exiting)
Depth	Depth from manhole rim elevation
Conduit Layer Table	
Name	Project assigned numbering
Inlet Node	Invert elevation at start of pipe
Outlet Node	Invert elevation at end of pipe
Length	Distance between upstream and downstream manholes
Roughness	Pipe roughness (a Manning's value of 0.013 was used in all cases)
Geom1 (feet)	Internal pipe diameter

MODELED MINI-BASINS

Maps on the following pages show mini-basin delineation and loading for each collection system sub-area.

MODELING RESULTS

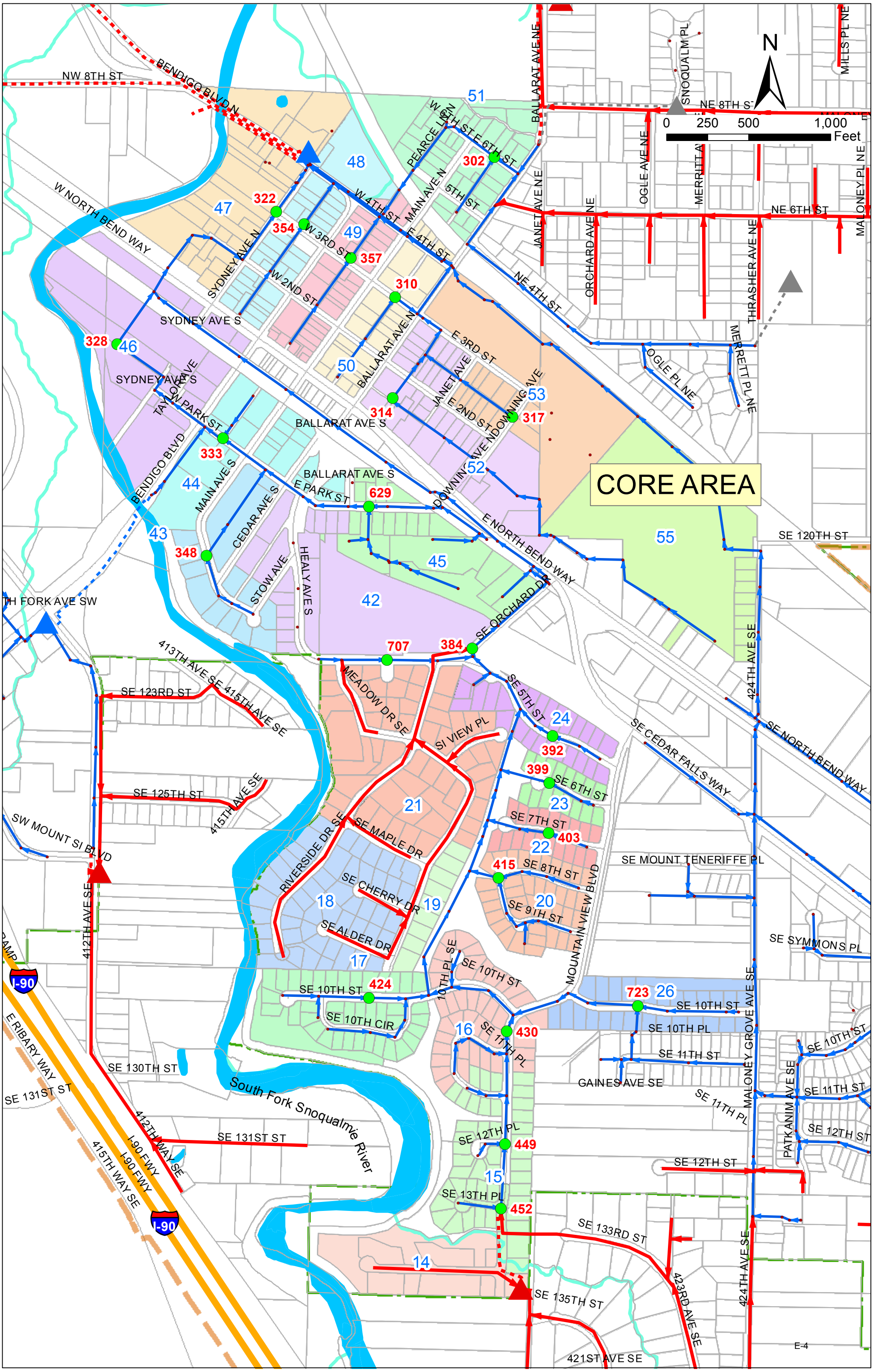
Spreadsheets that follow the mini-basin delineation maps show summary and detailed peak flow loading results.

Modeling Results for Existing Lift Stations

Name	Flow Contribution Basin	Buildout Flow (mgd)	Loading Node in Model
South Fork LS	1-13, 39-41, 129, 132, 204, 205, 301	2.57	Multiple, discharge to 336
Nintendo LS	129	0.07	594

Modeling Results for Proposed Future Lift Stations

Name	Flow Contribution Basin	Buildout Flow (mgd)	Loading Node in Model
Future Meadowbrook LS 1	100-109, 120-124, 130	0.55	653
Future Meadowbrook LS 2	125-127, 131, 133, 134	0.51	653
Future Mountain View Blvd LS	14, 203	0.41	425
Future Silver Creek LS	93-96	0.39	304
Future Tanner Rd LS	70	0.08	202
Future Cedar Falls LS 2	206	0.88	93
Future Cedar Falls LS 1	206, 306	1.29	93
Future SW Mt SI Blvd LS	204, 301	0.27	481
Future 437 PL SE LS	304	0.09	88
Future Quadrant LS	33, 35, 36, 201	0.56	103


N
0 250 500 1,000
Feet
CORE AREA
NW 8TH ST
BENDIGO BLVD N
W NORTH BEND WAY
BALLARAT AVE NE
SNOQUALMI PL
MILLS PL NE
NE 8TH ST
OGLE AVE NE
MERRITT AVE NE
JANET AVE NE
ORCHARD AVE NE
NE 6TH ST
MALONEY PL NE
THRASHER AVE NE
W 6TH ST
E 6TH ST
PEARCE LN
MAIN AVE N
W 4TH ST
E 4TH ST
5TH ST
NE 4TH ST
OGLE PL NE
MERRETT PL NE
W 3RD ST
W 2ND ST
SYDNEY AVE N
SYDNEY AVE S
TAYLOR AVE
W PARK ST
BALLARAT AVE N
E 3RD ST
JANET AVE
E 2ND ST
DOWNING AVE
BALLARAT AVE S
E PARK ST
BENDIGO BLVD S
MAIN AVE S
CEDAR AVE S
STOW AVE
HEALY AVE S
E NORTH BEND WAY
SE ORCHARD DR
SE 120TH ST
TH FORK AVE SW
413TH AVE SE
SE 123RD ST
415TH AVE SE
MEADOW DR SE
SI VIEW PL
SE 5TH ST
SE CEDAR FALLS WAY
424TH AVE SE
SE NORTH BEND WAY
SE 125TH ST
SE 6TH ST
SE 7TH ST
SW MOUNT SI BLVD
SE MAPLE DR
RIVERSIDE DR SE
SE 8TH ST
SE MOUNT TENERIFFE PL
MOUNTAIN VIEW BLVD
SE CHERRY DR
SE ALDER DR
SE 9TH ST
SE SYMMONS PL
412TH AVE SE
SE 10TH ST
10TH PL SE
SE 10TH CIR
SE 11TH PL
SE 10TH PL
SE 11TH ST
GAINES AVE SE
MALONEY GROVE AVE SE
PATKANIM AVE SE
SE 12TH PL
SE 12TH ST
SE 130TH ST
South Fork Snoqualmie River
SE 131ST ST
412TH WAY SE
I-90 FWY
415TH WAY SE
I-90
SE 13TH PL
SE 133RD ST
SE 135TH ST
423RD AVE SE
421ST AVE SE
ERIBARY WAY SE
51
48
47
49
50
46
44
43
42
45
55
52
53
24
23
22
21
20
19
18
17
16
15
14
26
322
354
357
302
310
328
314
317
333
348
629
707
384
392
399
403
415
424
723
430
449
452
E-4

GARDNER CREEK AREA

N

0 250 500 1,000 Feet

I-90 FWY

I-90 FWY

415TH WAY SE

W RIBARY WAY

598

608

617

521

529

518

510

496

499

491

564

511

538

549

132

10

11

9

6

8

5

7

4

12

3

2

13

1

QUARTZ DR SW

STONE CREEK CIR SW

ROCK CREEK RIDGE BLVD SW

SW JADE LN

SW GRANITE LN

STONE BROOK DR SW

SW 10TH ST

11TH CT SW

13TH PL SW

HEMLOCK AVE SW

SW HEMLOCK CT

14TH PL SW

SW 12TH CT

SW 11TH PL

RAMP

BENDIGO BLVD

SW MOUNT

E RIBARY WAY

SW 12TH ST

11TH CT SW

SW 12TH PL

HEMLOCK AVE SW

FORSTER BLVD SW

SW 13TH PL

SW 14TH PL

SW 15TH PL

11TH PL SW

SE 131ST ST

409TH AVE SE

I-90

I-90

MEADOWBROOK AREA

N

0 250 500 1,000 Feet

RAILROAD AVE SE
BOALCH AVE SE
SE 101ST ST
SE 100TH ST
416TH AVE SE
South Fork Snoqualmie River
394TH PL SE
E NORTH BEND WAY
SE 106TH PL
BOALCH AVE NW
NW 14TH ST
BENDIGO BLVD N
ALM WAY
W NORTH BEND WAY
NW 8TH ST
W 4TH
W 3RD ST
W 2ND ST
SYDNEY AVE N
SYDNEY AVE S
MAIN AVE S
TAYLOR AVE
W PARK ST
E PARK ST
BENDIGO BLVD
SOUTH FORK AVE SW
CEDAR AVE S
STOW AVE
HEALY AVE S
SE ORCHARD
SE 123RD ST
413TH AVE SE
412TH AVE SE
SW MOUNT SI BLVD
RAMP
I-90 FWY
I-90
415TH WAY SE
SE 122ND ST
W RIBARY WAY
ROCK CREEK RIDGE BLVD SW
SW JADE LN
SW GRANITE LN
AVE SE

105 107 104 106 108 109 120 102 123 121 124 122 103 125 130 126 127 131 134 129

653 594

E-6

REID SLOUGH AND SILVER CREEK

N

0 250 500 1,000 Feet

SE 100TH ST
SE 101ST ST
416TH AVE SE
422ND LN SE
SE 102ND ST
423RD PL SE
SE 102ND PL
SE 103RD PL
420TH AVE SE
SE 104TH ST
428TH AVE SE
SE 106TH ST
South Fork Snoqualmie River
100
101
95
94
93
96
97
98
99
SE 108TH ST
RACHOR PL NE
BORST AVE NE
NE 10TH ST
BALLARAT AVE NE
MILLS PL NE
SNOQUALM PL
NE 9TH ST
NE 8TH ST
SE 112TH ST
MALONEY PL NE
OGLE AVE NE
JANET AVE NE
ORCHARD AVE NE
MERRITT AVE NE
THRASHER AVE NE
MALONEY PL NE
PICKETT AVE NE
NE 6TH ST
SE 114TH ST
TAYLOR PL NE
BOXLEY PL NE
NE 5TH ST
NE 4TH ST
OGLE PL NE
MERRETT PL NE
SE 120TH ST
304
305
342
346
W 8TH ST
BENDIGO BLVD N
PEARCE LN
W 6TH ST
E 6TH ST
MAIN AVE N
5TH ST
W 4TH ST
E 4TH ST
SYDNEY AVE N
W 3RD ST
W 2ND ST
W NORTH BEND WAY
SYDNEY AVE S
BENDIGO BLVD S
W PARK ST
BALLARAT AVE N
E 3RD ST
JANET AVE
E 2ND ST
DOWNING AVE
BALLARAT AVE S
E PARK ST
E NORTH BEND WAY
MAIN AVE S
CEDAR AVE S
STOW AVE
HEALY AVE S
SE ORCHARD DR
SE CEDAR FALLS WAY
424TH AVE SE
SE NORTH BEND WAY
MEADOW DR SE
RIVERSIDE DR SE
SE 5TH ST
MOUNTAIN VIEW BLVD
SI VIEW PL
413TH AVE SE
415TH AVE SE
23RD ST

SOUTH FORK AREA

N

0 250 500 1,000 Feet

SYDNEY AVE S
W NORTH BEND WAY
SYDNEY AVE N
W 3RD S
W 2ND ST
E 4TH ST
NE 4TH ST
E 3RD ST
TAYLOR AVE
W PARK ST
BALLARAT AVE S
E 2ND ST
DOWNING AVE
MAIN AVE S
BENDIGO BLVD
CEDAR AVE S
STOW AVE
HEALY AVE S
E PARK ST
SOUTH FORK AVE SW
39
572
133
476
460
40
205
SE 123RD ST
SE 125TH ST
415TH AVE SE
413TH AVE SE
South Fork Snoqualmie River
SE ORCHARD DR
SE 5TH ST
MEADOW DR SE
SI VIEW PL
RIVERSIDE DR SE
SE MAPLE DR
SE CHERRY DR
SE ALDER DR
SE 10TH ST
SE 10TH CIR
SE 8T
SE 11
RAMP
I-90
W RIBARY WAY
SW MOUNT SI BLVD
41
481
412TH AVE SE
204
I-90 FWY
SE 130TH ST
SE 131ST ST
412TH WAY SE
301
SE 12TH
SE 13TH PL
MOUNTAIN
SE 133RD PL
409TH AVE SE
415TH WAY SE
GRANITE LN
EEKRIDGE BLVD SW
SW 10TH ST
11TH CT SW
SW HEMLOCK CT
HEMLOCK AVE SW
SW 12TH ST
SW 12TH PL
FORSTER BLVD SW
SW 13TH PL
SW 14TH PL
SW 15TH PL

TANNER AREA

N

0 500 1,000 2,000 Feet

SE 120TH ST
CEDAR AVE S
STOW AVE
HEALY AVE S
SE ORCHARD DR
E NORTH BEND WAY
424TH AVE SE
434TH AVE SE
SE 123RD ST
SE 5TH ST
SI VIEW PL
SE 6TH ST
SE 7TH ST
SE 8TH ST
SE 9TH ST
SE 125TH ST
415TH AVE SE
RIVERSIDE DR SE
SE MAPLE DR
SE ALDER DR
SE 10TH CIR
10TH PL SE
SE 10TH ST
SE 10TH PL
SE 11TH ST
SE 11TH PL
MALONEY GROVE AVE SE
SE CEDAR FALLS WAY
SE SYMMONS PL
SE 128TH PL
SE MOUNT SI RD
439TH PL SE
440TH PL SE
444TH AVE SE
Middle Fork Snoqualmie River
SALISH AVE SE
LA FOREST DR SE
SE 12TH ST
SE 12TH PL
SE 131ST ST
412TH WAY SE
SE 13TH PL
SE 133RD ST
423RD AVE SE
421ST AVE SE
SE 135TH ST
SE 134TH ST
SE 134TH CT
Opstad
435TH PL SE
SE NORTH BEND WAY
SE 130TH ST
444TH AVE SE
SE 132ND ST
446TH AVE SE
415TH WAY SE
South Fork Snoqualmie River
SE 136TH ST
SE 137TH PL
SE 140TH ST
SE 141ST ST
I-90 FWY
I-90 FWY
RAMP
RAMP
RAMP
436TH AVE SE
437TH PL SE
438TH PL SE
440TH PL SE
SE 139TH ST
SE TANNER RD
I-90
I-90

367 54 57 58 56 38 67 25 28 42 27 725 59 46 97 60 73 136 29 75 53 698 684 61 62 25 717 30 31 38 76 102 57 135 32 671 303 37 675 103 63 80 33 34 64 452 302 32 201 83 65 65 652 203 33 35 202 432ND AVE SE 88 66 424TH AVE SE 36 200 93 193 67 304 E-9

TRUCK TOWN AREA

N

0 500 1,000 2,000 Feet

SE 130TH ST
444TH AVE SE
SE 132ND ST
446TH AVE SE
448TH AVE SE
SE MOUNT SI RD
SE 130TH PL
452ND AVE SE
455TH PL SE
459TH AVE SE
SE 130TH PL
SE 130TH ST
461ST AVE SE
SE 131ST ST
464TH AVE SE
SE 129TH ST
469TH PL SE
SE 129TH ST
470TH AVE SE
475TH AVE SE
SE 134T
Middle Fork Snoqualmie River
SE 137TH ST
476TH AVE SE
SE NORTH BEND WAY
SE TANNER RD
SE 136TH ST
453RD PL SE
455TH AVE SE
452ND AVE SE
TANNERWOOD WAY SE
SE 139TH PL
463RD AVE SE
SE 140TH ST
468TH AVE SE
SE MIDDLE FORK RD
I-90
SE 142ND ST
443RD PL SE
SE 142ND PL
446TH PL SE
442ND AVE SE
SE 144TH ST
444TH AVE SE
445TH AVE SE
447TH AVE SE
SE 145TH ST
South Fork Snoqualmie River
SE 146TH ST
SE 147TH ST
446TH AVE SE
450TH AVE SE
450TH PL SE
SE 150TH ST
SE 151ST ST
I-90 FWY
SE 150TH ST
RAMP
SE GROUSE RIDGE ACCESS RD

70 202 207 71 305 69 199 72 212 68 276 81 155 82 73 246 74 75 220 230 76 224 79 83 159 84 115 165 78 238 77 243 80 256 117 86 87 122 125 88 130 89 137 90 187 91 710 92 149

CEDAR FALL AREA

Middle Fork Snoqualmie River

South Fork Snoqualmie River

SE 137TH PL
432ND AVE SE
SE 140TH ST
RAMP
437TH PL SE
SE 139TH ST
439TH PL SE
440TH PL SE
SE 136TH ST
93
SE NORTH BEND WAY
SE TANNER RD
SE 140TH ST
I-90 FWY
I-90
RAMP
SE 142ND ST
436TH AVE SE
SE 143RD PL
439TH AVE SE
SE 143RD ST
442ND AVE SE
443RD PL SE
SE 142ND PL
446TH PL SE
SE 144TH LN
206
SE 144TH ST
445TH AVE SE
447TH AVE SE
448TH AVE SE
SE 145TH ST
SE 146TH ST
SE 147TH PL
438TH AVE SE
439TH PL SE
SE 149TH ST
442ND AVE SE
SE 147TH ST
SE 149TH PL
441ST AVE SE
444TH AVE SE
445TH AVE SE
SE 147TH ST
446TH AVE SE
SE 148TH ST
447TH AVE SE
448TH AVE SE
449TH AVE SE
450TH AVE SE
450TH PL SE
SE 147TH ST
SE 150TH ST
SE 150TH ST
SE 151ST PL
437TH AVE SE
SE 151ST ST
SE 152ND PL
SE 152ND ST
443RD AVE SE
SE 151ST ST
SE 151ST ST
445TH AVE SE
SE 151ST PL
SE 149TH ST
SE 16TH ST
E 17TH ST
153RD PL SE
452ND AVE
455TH AVE SE
455TH AVE SE
N
0 250 500 1,000
Feet

APPENDIX F

CAPITAL COST ESTIMATES

Capital Cost Estimates: Treatment Plant and Lift Station Improvements

	Alternative 1 Oxid Ditch Existing site		Alternative 2 Deep Tank Act Sl Existing site		Alternative 3 MBR Existing site		Alternative 4 Oxid Ditch New Site		Alternative 5 Oxid Ditch Snoqualmie	
	Cost	Wksht #	Cost	Wksht #	Cost	Wksht #	Cost	Wksht #	Cost	Wksht #
Treatment Facility Improvements - Phase 1										
ULID 6 Pump station Improvements	$370,000	1	$370,000	1	$370,000	1	$370,000	1	$370,000	1
Influent and Effluent Sampling System Improvements	$26,000	2	$26,000	2	$26,000	2	$26,000	2	$26,000	2
Headworks - screening	$1,150,000	3	$1,150,000	3	in mbr		$1,150,000	3	$1,700,000	3
Headworks - grit removal	-	-	$600,000	3	in mbr		-	-	$600,000	3
New aeration basins (OD, DTAS or MBR)	$1,900,000	4	$2,490,000	5	$77,100,000	6	$3,800,000	4	$3,500,000	7
Existing Clarifier Repair	$160,000	8	$160,000	8	-	-	-	-	-	-
New Clarifier(s) (or membranes for MBR)	$2,820,000	9	$2,820,000	9	in mbr	-	$5,640,000	6	$5,700,000	7
UV Effluent Facilities										
New UV Effluent Building	$630,000	11	$630,000	11	in mbr	-	$630,000	11	-	-
UV Disinfection System	$730,000	10	$730,000	10	in mbr	-	$730,000	7	$2,300,000	7
UV effluent piping	$350,000	11	$350,000	11	in mbr	-	$350,000	11	-	-
New WWTP Effluent Pumps	$230,000	11	$230,000	11	in mbr	-	$230,000	11	-	-
Relocate 3W water	$170,000	11	$170,000	11	in mbr	-	-	11	-	-
Effluent Flow Meter	$190,000	11	$190,000	11	in mbr	-	$190,000	11	-	-
Effluent Temperature Control	$158,000	12	$158,000	12	in mbr	-	$158,000	12	-	-
Effluent cooling	-	-	$1,113,000	13	$1,113,000	13	-		-	-
Outfall diffuser structure	$300,000	14	$300,000	14	$300,000	14	$300,000	14	-	-
Convert Oxidation Ditch to digester	$700,000	15	$700,000	15	$700,000	15	-	-	-	-
New Aerobic Digester	-	-	-	-	-		$2,400,000	16	$3,500,000	7
Solids Handling Bldg & loading facility	-	-	-	-	$1,400,000	17	$1,400,000	17	$1,400,000	17
Sludge Thickener	-	-	-	-	$390,000	18	$390,000	18	-	-
New Centrifuge	$1,170,000	19	$1,170,000	19	$1,170,000	19	$1,250,000	19	$1,250,000	19
Solids Loading Odor Control	$50,000	20	$50,000	20	$50,000	20	$50,000	20	$50,000	20
New Electrical Buildng and MCC's for tmt plant	$680,000	21	$680,000	21	in mbr	-	$680,000	21	-	
New Standby Generator in building	$1,340,000	22	$1,340,000	22	in mbr	-	$1,340,000	22	$2,100,000	7
3W Water	in new UV bldg	-	in new UV bldg	-	in mbr	-	$800,000	23	$500,000	7
Lab Admin and Maintenance bldg	-	-	-	-	in mbr	-	$1,600,000	24	$1,400,000	7
SCADA upgrade	$330,000	25	$330,000	25	-	-	-	-	-	-
SCADA (a)	-	-	-	-	in mbr	-	$700,000	-	$730,000	-
Lab and Mobile Home Park Sanitary Sewer to ULID#6 PS	$110,000	26	$110,000	26	$110,000	26	$110,000	26	$110,000	26
SHB Pump Station Force Main to Oxidation Ditch	$110,000	27	$110,000	27	-	-	-	-	-	-
Sitework fencing, paving, flood mitigation	$280,000	28	$280,000	28	in mbr	-	$600,000		$600,000	
Site landscaping	$200,000	31	$200,000	31	in mbr	-	$400,000		$400,000	
Demolish existing NB plant (d)	-	-	-	-	$2,000,000	-	$2,000,000		$2,000,000	
Land acquisition (c)	-	-	-	-	$0		$1,500,000		$0	
SUBTOTAL TREATMENT FACILITY PHASE 1	*$14,154,000*		*$16,457,000*		*$84,729,000*		*$28,794,000*		*$28,236,000*	

	Alternative 1 Oxid Ditch Existing site		Alternative 2 Deep Tank Act Sl Existing site		Alternative 3 MBR Existing site		Alternative 4 Oxid Ditch New Site		Alternative 5 Oxid Ditch Snoqualmie	
	Cost	Wksht #	Cost	Wksht #	Cost	Wksht #	Cost	Wksht #	Cost	Wksht #
Treatment Facility Improvements - Phase 2										
Headworks - New Screen & Flow Splitter	$900,000	3	$900,000	3	-		-		-	
Aeration Basins (or MBRs)	$1,900,000	4	$2,490,000	5	-		-		-	
UV Disinfection - add 4th reactor	$290,000	10	$290,000	10	-		-		-	
Phosphorus Removal	$900,000	29	$1,200,000	29	$1,200,000	25	$900,000	25	-	
Sludge Thickening	$390,000	18	$390,000	18	-		-		-	
SCADA (a)	$120,000		$150,000		-		-		-	
Existing Lab Building - flood proofing	$280,000	30	$280,000	30	-		-		-	
Existing Lab Building - add office space in old MCC room	$60,000	30	$60,000	30	-		-		-	
Existing Solids Building- add maint shop in old hopper area	$90,000	30	$90,000	30	-		-		-	
Landscaping	$200,000	31	$200,000	31	-		-		-	
Site work (b)	$250,000		$300,000		$60,000		$50,000		-	
Demolish original treatment building (d)	$80,000		$80,000		-		-		-	
Demolish above grade portion of pump house(d)	$20,000		$20,000		-		-		-	
SUBTOTAL TREATMENT FACILITY PHASE 2	$5,480,000		$6,450,000		$1,260,000		$950,000		$0	
TOTAL TREATMENT FACILITY	$19,634,000		$22,907,000		$85,989,000		$29,744,000		$28,236,000	
Conveyance to new treatment facility site										
Conveyance to Snoqualmie	-	-	-	-	-	-	-	-	$21,800,000	32
Conveyance to new NB site	-	-	-	-	-	-	$10,600,000	33	-	-
Conveyance to NB outfall	-	-	-	-	-	-	$10,000,000	34	-	-
SUBTOTAL CONVEYANCE TO NEW SITE	-		-		-		$20,600,000		$21,800,000	
Collection System Improvements										
South Fork Lift Station Upgrade Phase I	$56,000	35	$56,000	35	$56,000	35	$56,000	35	$56,000	35
Snoqualm Lift Station SCADA system Integration	$55,000	36	$55,000	36	$55,000	36	$55,000	36	$55,000	36
South Fork Lift Station Upgrade Phase I	$404,000	36	$404,000	37	$404,000	36	$404,000	36	$404,000	36
SUBTOTAL COLLECTION IMPROVEMENTS	*$515,000*		*$515,000*		*$515,000*		*$515,000*		*$515,000*	
PHASING COSTS										
Phase 1 costs										
Treatment Facilty	$14,154,000		$16,457,000		$84,729,000		$28,794,000		$28,236,000	
Conveyance to new site	-		-		-		$20,600,000		$21,800,000	
Collection system	$515,000		$515,000		$515,000		$515,000		$515,000	
SUBTOTAL	$14,669,000		$16,972,000		$85,244,000		$49,909,000		$50,551,000	
BUDGET UNESCALATED	*$14,166,253*									
Phase 2 Costs										
Phosphorus Treatment	$900,000		$1,200,000		$1,200,000		$900,000		-	
Capacity Expansion	$4,580,000		$5,250,000		$60,000		$50,000		-	
SUBTOTAL	$5,480,000		$6,450,000		$1,260,000		$950,000		-	
TOTAL CAPITAL COST	**$20,149,000**		**$23,422,000**		**$86,504,000**		**$50,859,000**		**$50,551,000**	

a *SCADA is 3% of the total treatment plant subtotal cost, excluding sitework.*
b *Site work is estimated at 5% of the phase 2 treatment plant subtotal cost*
c *Land acquisition cost based on King County property evaluation on the potential site location*
d *Demolition cost is best professional judgement*

Project
Subject: **Planning Cost Estimate**
Cost Assumptions
By : **Tetra Tech Inc.**
Date : **28-Sep-16**

Item	Value	
Equipment Installation, %	30%	of Equip Cost
Piping & Fittings, %	10%	of Equip Cost
Electrical, %	10%	of Equip Cost
Instrumentation & Control, %	10%	of Equip Cost
Contractor OH, Profit and Mobilization / Demobilization, %	15%	
Escalation to time of construction, %	3%	
Contingency, %	20%	
Sales tax, %	8.2%	
Engineering design, %	13%	
Construction management, %	10%	

City of North Bend, WA
Wastewater Treatment Plant High Priority Improvements
Opinion of Probable Construction Cost
September 28, 2016

1. ULID6 Improvements

1a-Install small pump at ULID 6 influent PST

No	Description	Quantity	Unit Price	Unit	Cost, $
	Small pump at ULID 6 Influent PST	1	$34,050	LS	$34,050
	Equipment installation (% of equipment)	30%	$10,215	LS	$10,215
	Piping & Fittings (% of equipment)	10%	$3,405	LS	$3,405
	Electrical (% of equipment)	10%	$3,405	LS	$3,405
	Subtotal Construction Cost				**$51,075**
	Total Project Cost				**$92,000**

1b-Reprogram pump operation

No	Description	Quantity	Unit Price	Unit	Cost, $
	Reprogramming ULID6 PS Pumps to periodically purge solids	1	$25,000	LS	$25,000
	SHB Recycle line Flow meter	1	$4,000	EA	$4,000
	Equipment installation (% of equipment)	30%	$1,200	LS	$1,200
	Piping & Fittings (% of equipment)	10%	$400	LS	$400
	Electrical (% of equipment)	10%	$400	LS	$400
	Instrumentation & Control --- (% of equipment)	10%	$400	LS	$400
	Subtotal Construction Cost				**$31,400**
	Total Project Cost				**$57,000**

1c-Install bar screen

No	Description	Quantity	Unit Price	Unit	Cost, $
	Bar Rack	1	$5,000	LS	$5,000
	Aluminium ladder without cage	14	$100	LF	$1,400
	Equipment installation (% of equipment)	30%	$1,920	LS	$1,920
	Subtotal Construction Cost				**$8,320**
	Total Project Cost				**$15,000**

1d-install flow baffle

No	Description	Quantity	Unit Price	Unit	Cost, $
	Baffle in Wetwell to reduce air entrainment at the small pump	1	$5,000	LS	$5,000
	Equipment installation (% of equipment)	30%	$1,500	LS	$1,500
	Subtotal Construction Cost				**$6,500**
	Total Project Cost				**$12,000**

1e-install influent isolation gate

No	Description	Quantity	Unit Price	Unit	Cost, $
	Influent isolation gate	1	$6,000	LS	$6,000
	Equipment installation (% of equipment)	30%	$1,800	LS	$1,800
	Subtotal Construction Cost				**$7,800**
	Total Project Cost				**$14,000**

1f-Electrical control panel flood proofing

No	Description	Quantity	Unit Price	Unit	Cost, $
	Steel access platform	1	$50,000	LS	$50,000
	Conduits and wiring to raise control panels	1	$50,000	LS	$50,000
	Subtotal Construction Cost				**$100,000**
	Total Project Cost				**$180,000**

ULID 6 Pump station Improvements

	Total Project Cost	***$370,000***

City of North Bend, WA
Wastewater Treatment Plant Priority Improvements
Opinion of Probable Construction Cost
September 28, 2016

2. Sampling Improvements

2a-Influent Sampling system improvement flow composite interlock

No	Description	Quantity	Unit Price	Unit	Cost, $
	Influent sampler	0	$10,000	LS	$0
	Existing Influent Sampler integration	1	$0		$0
	Equipment installation (% of equipment) (move sampler to new HW)	30%	$10,000	LS	$3,000
	Electrical (% of equipment)	10%	$0	LS	$1,000
	Instrumentation & Control --- (% of equipment)	30%	$0	LS	$3,000
	Subtotal Construction Cost				**$7,000**
	Total Project Cost				**$13,000**

2b-Effluent Sampling system improvement flow composite interlock

No	Description	Quantity	Unit Price	Unit	Cost, $
	Effluent sampler	0	$10,000	LS	$0
	Existing effluent Sampler integration	1	$0		$0
	Equipment installation (% of equipment) (move sampler to new HW)	30%	$10,000	LS	$3,000
	Electrical (% of equipment)	10%	$0	LS	$1,000
	Instrumentation & Control --- (% of equipment)	30%	$0	LS	$3,000
	Subtotal Construction Cost				**$7,000**
	Total Project Cost				**$13,000**

Influent and Effluent Sampling System Improvements
Total Project Cost ***$26,000***

City of North Bend, WA
Wastewater Treatment Plant Priority Improvements
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September 28, 2016

3. Headworks

3a-Headworks with mechanical screen & odor control

No	Description	Quantity	Unit Price	Unit	Cost, $
	Demolition youth activity building	1	$20,000	LS	$20,000
	Headworks with mechanical screen	1	$525,825	EA	$526,000
	Odor Control				
	channel cover, checkered plates	40	$44	SF	$1,740
	10" FA FRP Duct	20	$200.00	LF	$4,000
	Mist Eliminator	1	$5,800.00	EA	$5,800
	Carbon Unit and Fan	1	53,000	EA	$53,000
	Fan Sound Enclosure	1	$7,000.00	EA	$7,000
	VFD for Fan	1	$750.00	EA	$750
	Installation	30%		LS	$21,687
	Piping				
	18" RS	120	$170	LF	$20,400
	18" fittings	8	$6,000	EA	$48,000
	14" RS (for flow meter)	10	$150	LF	$1,500
	14" valves	2	$6,000	EA	$12,000
	14" mag flow meter	1	$10,000	EA	$10,000
	Installation (% of equipment)	30%	$76,550	LS	$22,965
	Electrical (% of equipment)	10%	$76,550	LS	$7,655
	Control (% of equipment)	10%	$76,550	LS	$7,655
	Subtotal Construction Cost				**$639,977**
	Total Project Cost				**$1,150,000**

3b-Headworks - add 6 mgd mechanical screen & 2 gates to existing HW channel

No	Description	Quantity	Unit Price	Unit	Cost, $
	Mechanical screen	1	$200,000	EA	$200,000
	HW Gates	2	$10,000	EA	$20,000
	Installation	30%	$220,000		$66,000
	Subtotal Construction Cost				**$286,000**
	Total Project Cost				**$500,000**

3c-Add splitter box to feed multiple ditches

No	Description	Quantity	Unit Price	Unit	Cost, $
	Flow splitter box	1	$200,000	LS	$200,000
	Subtotal Construction Cost				**$200,000**
	Total Project Cost				**$400,000**

3d-Grit chamber

No	Description	Quantity	Unit Price	Unit	Cost, $
	Canopy	400	$150	SF	$60,000
	Sluice gates	2	$10,000	EA	$20,000
	Grit equipment	1	$150,000	LS	$150,000
	Piping & Fittings, %	10%	$15,000	LS	$15,000
	Installation (% of equipment)	30%	$150,000	LS	$45,000
	Electrical (% of equipment)	10%	$15,000	LS	$15,000
	Control (% of equipment)	10%	$45,000	LS	$45,000
	Subtotal Construction Cost				**$350,000**
	Total Project Cost				**$600,000**

Snoqualmie Headworks - screening

	3a Headworks with mechanical screen & odor control	$639,977
	3b Headworks add gates & 6 mgd mechanical screen to existing HW channel	$286,000
	Subtotal Construction Cost	**$925,977**
	Total Project Cost	**$1,700,000**

City of North Bend, WA
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4. New Oxidation Ditch

No	Description	Quantity	Unit Price	Unit	Cost, $
	Oxidation Ditch				
	Earthwork	2700	$15	CY	$40,500
	Dewatering	1	$60,000	LS	$60,000
	Shoring	1	$50,000	LS	$50,000
	Concrete walls	380	$700	CY	$265,990
	Concrete bottom slab	475	$500	CY	$237,520
	Concrete elevated slab	70	$1,000		$70,000
	Aluminum handrail (2 rails)	116	$158	LF	$18,273
	Oxidation Ditch Equipment				
	Oxidation Ditch Equipment	1	$200,000	LS	$200,000
	DO Probe	1	$2,000	EA	$2,000
	ORP Probe	1	$2,000	EA	$2,000
	Level Transmitter	2	$2,000	EA	$4,000
	Installation (% of equipment)	30%	$208,000		$62,400
	Electrical (% of equipment)	10%	$208,000		$20,800
	Control (% of equipment)	10%	$208,000		$20,800
	Building	0	$200	SF	$0
	Subtotal Construction Cost				**$1,054,282**
	Total Project Cost				**$1,900,000**

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5. Deep Tank Activated Sludge Aeration Basin

5a-Reinforced concrete tank

No	Description	Quantity	Unit Price	Unit	Cost, $
	Aeration Basin				
	Earthwork	3400	$15	CY	$51,000
	Dewatering	1	$60,000	LS	$60,000
	Shoring	1	$50,000	LS	$50,000
	Concrete walls	493	$700	CY	$345,074
	Concrete slab	340	$500	CY	$170,000
	Subtotal Construction Cost				**$676,074**
	Total Project Cost				**$1,219,000**

5b-Aeration system - diffused air

No	Description	Quantity	Unit Price	Unit	Cost, $
	Diffuser System	3008	$70	scfm	$210,561
	3" SS Air Piping	250	$65	LF	$16,250
	Valves & Fittings for Air piping	1	$6,000	LS	$6,000
	Equipment installation (% of equipment)	30%	$63,168	LS	$63,168
	Electrical (% of equipment)	10%	$21,056	LS	$21,056
	Instrumentation & Control --- (% of equipment)	10%	$21,056	LS	$21,056
	Subtotal Construction Cost				**$338,092**
	Total Project Cost				**$610,000**

5c-Aeration Blowers

No	Description	Quantity	Unit Price	Unit	Cost, $
	Aerobic digestor blower	2	$26,378	ea	$52,756
	Equipment installation (% of equipment)	30%	$15,827	LS	$15,827
	Electrical (% of equipment)	10%	$5,276	LS	$5,276
	Instrumentation & Control --- (% of equipment)	10%	$5,276	LS	$5,276
	Subtotal Construction Cost				**$79,130**
	Total Project Cost				**$143,000**

5d-MCCs for Aeration Blowers

VFDs for Blowers	2	$10,000	ea	$20,000
Electrical (% of equipment)	10%	$0	LS	$1,000
Instrumentation & Control --- (% of equipment)	10%	$0	LS	$1,000
Subtotal Construction Cost				**$22,000**
Total Project Cost				**$40,000**

5e-Install disssolved oxygen probes

No	Description	Quantity	Unit Price	Unit	Cost, $
	DO Probe	1	$2,000	EA	$2,000
	Level Transmitter	1	$2,000	EA	$2,000
	Equipment installation (% of equipment)	30%	$1,200	LS	$1,200
	Electrical (% of equipment)	10%	$400	LS	$400
	Subtotal Construction Cost				**$5,600**
	Total Project Cost				**$10,000**

5f-Install oxidation reduction probes

No	Description	Quantity	Unit Price	Unit	Cost, $
	ORP Probe	1	$2,000	EA	$2,000
	Level Transmitter	1	$2,000	EA	$2,000
	Equipment installation (% of equipment)	30%	$1,200	LS	$1,200
	Electrical (% of equipment)	10%	$400	LS	$400
	Subtotal Construction Cost				**$5,600**
	Total Project Cost				**$10,000**

5g- Add new PLC and Wonderware Programming for Mixer, DO, and ORP control

No	Description	Quantity	Unit Price	Unit	Cost, $
	SCADA Programming & Screens (1 person @ 5 days)	1	$6,000	LS	$6,000
	Subtotal Construction Cost				**$6,000**
	Total Project Cost				**$11,000**

5h-Blower Building

No	Description	Quantity	Unit Price	Unit	Cost, $
	Blower building	1250	$200	SF	$250,000
	Subtotal Construction Cost				**$250,000**
	Total Project Cost				**$451,000**

New Deep Tank Active Sludge

Total Project Cost	***$2,490,000***

City of North Bend, WA
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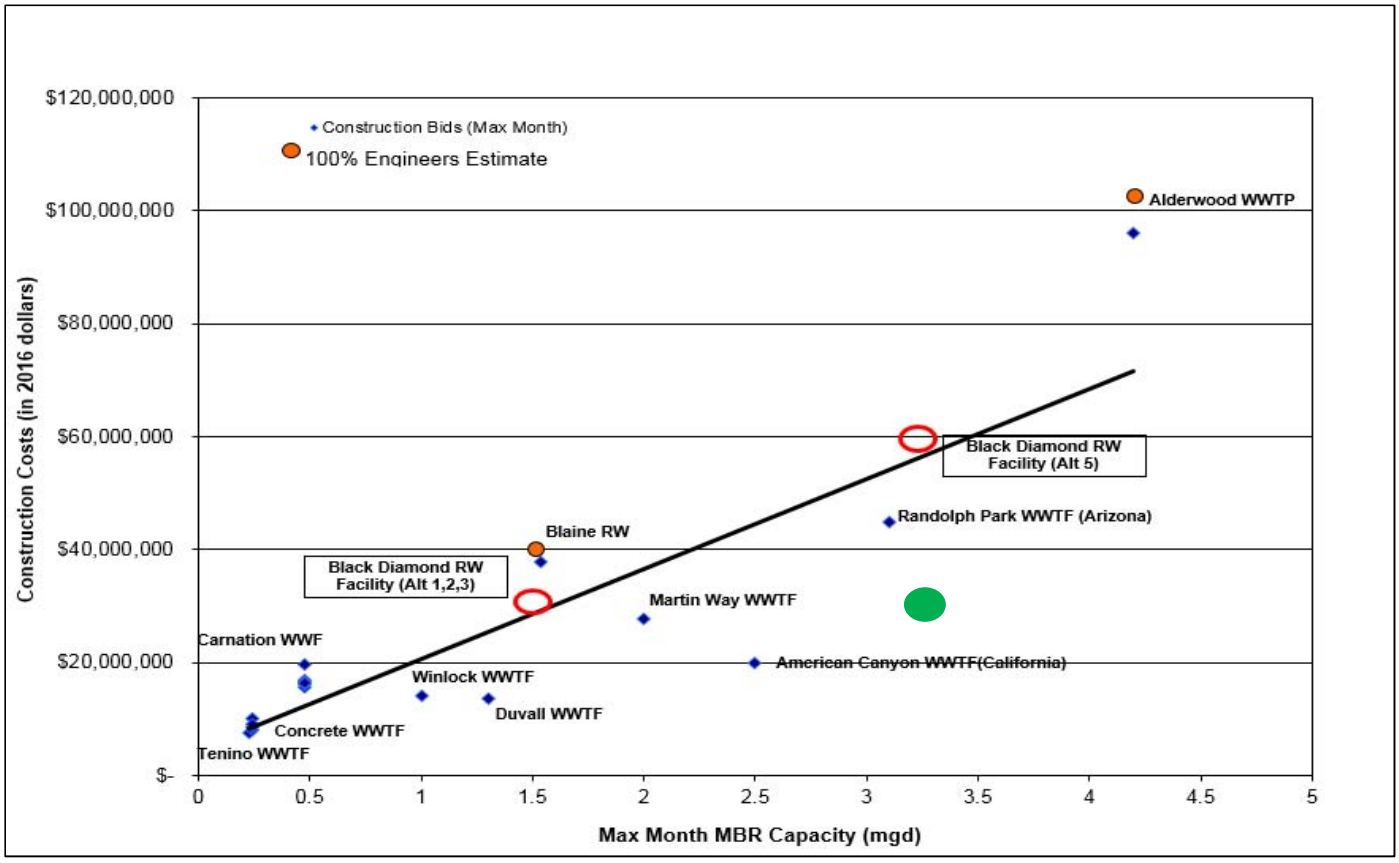
6. Membrane Bioreactor Facility

No	Description	Quantity		Unit Price	Unit		Cost, $
	2.8 MGD MBR Facility	1	$	48,000,000	**LS**	$	48,000,000
	Subtotal Construction Cost					$	48,000,000
	Total Project Cost						**$77,100,000**



City of North Bend, WA
Wastewater Treatment Plant Immediate Improvements
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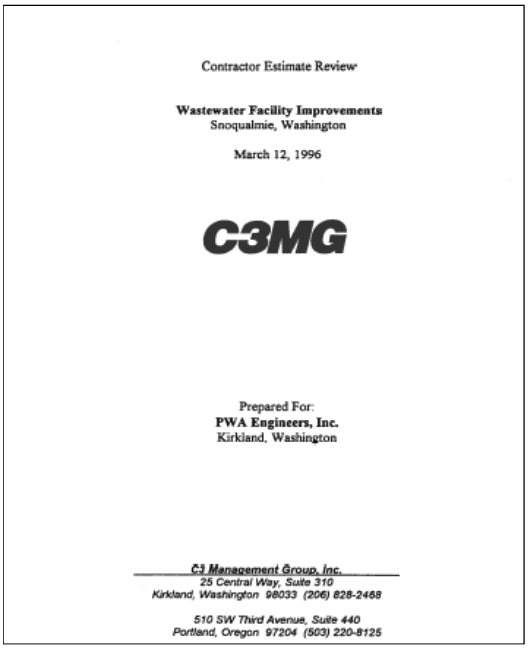
7. Snoqualmie Treatment Process Expansions

7a-Grit Removal

No	Description	Quantity	Unit Price	Unit	Cost, $
	Oxidation Ditch in C3 report	1	$1,065,719	LS	$1,065,719
	Subtotal Construction Cost Ratio to Direct Cost	122%			$1,300,397
	ENR adjustment	172%			$2,231,266
	Subtotal Construction Cost				**$2,231,266**
	Total Project Cost				**$3,500,000**



Contractor Estimate Review

Wastewater Facility Improvements
Snoqualmie, Washington

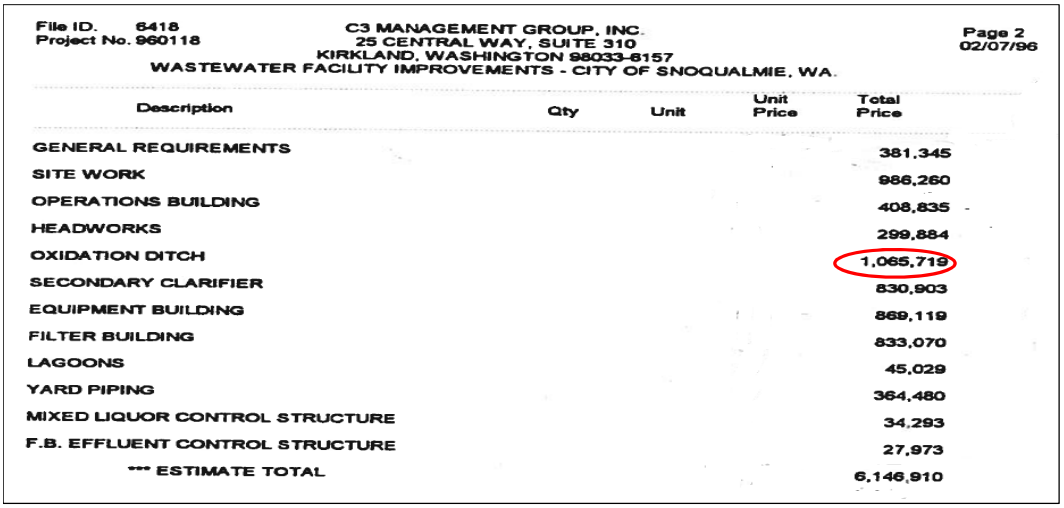
March 12, 1996

C3MG

Prepared For:
PWA Engineers, Inc.
Kirkland, Washington

C3 Management Group, Inc.
25 Central Way, Suite 310
Kirkland, Washington 98033 (206) 828-2468

510 SW Third Avenue, Suite 440
Portland, Oregon 97204 (503) 220-8125



File ID. 5418
Project No. 960118

C3 MANAGEMENT GROUP, INC.
25 CENTRAL WAY, SUITE 310
KIRKLAND, WASHINGTON 98033-6157

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02/07/96

WASTEWATER FACILITY IMPROVEMENTS - CITY OF SNOQUALMIE, WA.

Description	Qty	Unit	Unit Price	Total Price
GENERAL REQUIREMENTS				381,345
SITE WORK				986,260
OPERATIONS BUILDING				408,835
HEADWORKS				299,884
OXIDATION DITCH				1,065,719
SECONDARY CLARIFIER				830,903
EQUIPMENT BUILDING				869,119
FILTER BUILDING				833,070
LAGOONS				45,029
YARD PIPING				364,480
MIXED LIQUOR CONTROL STRUCTURE				34,293
F.B. EFFLUENT CONTROL STRUCTURE				27,973
*** ESTIMATE TOTAL				6,146,910

C3MG

File ID. 6A18
Project No. 960118

C3 MANAGEMENT GROUP, INC.
25 CENTRAL WAY, SUITE 310
KIRKLAND, WASHINGTON 98033-6157
WASTEWATER FACILITY IMPROVEMENTS; CITY OF SNOQUALMIE, WA
REVISION 1.0 *

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03/12/96

ESTIMATE TOTALS

COST SUMMARY

INITIAL DIRECT COSTS 2/03/96		6,146,910
Phase I Earthwork Credit		(173,438)
SUBTOTAL		5,973,472
Labor Adjustment	2.4639%	147,183
Equipment Adjustment	4.4451%	265,530
SUBTOTAL		6,386,185
Mobilization	4.00%	255,447
SUBTOTAL		6,641,632
Escalation to October 1996	3.00%	199,249
TOTAL DIRECT COSTS		6,840,881
Small Tools & Consumables, General	1.1286%	77,223
Small Tools & Consumables, Mechanical	0.59%	40,235
Retail WSST @ 8.2%, Supplies & Equip. Rent.	0.45%	30,900
Bond	0.6890%	47,137
Contractor Markups		
On Labor	3.1333%	214,343
On Equipment	0.502%	34,307
On Materials	2.1573%	147,581
On Supplies	0.2203%	15,071
On Subcontracts	0.7721%	52,821
SUBTOTAL		7,500,499
B & O Tax	0.51%	38,253
SUBTOTAL		7,538,751
WSST	8.20%	618,178
TOTAL ANTICIPATED CONSTRUCTION COST ====>		8,156,929

*Adjustment for phase I earthwork credit and revised markup format to match RCI.

7b-Clarifier

No	Description	Quantity	Unit Price	Unit	Cost, $
	Clarifier Cost in Snoqualmie RH2 report	2	$1,770,000	LS	$3,540,000
	Subtotal Construction Cost				**$3,540,000**
	Total Project Cost				**$5,700,000**

7c-UV Disinfection System

No	Description	Quantity	Unit Price	Unit	Cost, $
	UV Disinfection System Cost in Snoqualmie RH2 report	1	$1,410,832	LS	$1,410,832
	Subtotal Construction Cost				**$1,410,832**
	Total Project Cost				**$2,300,000**

Aerobic Digester

No	Description	Quantity	Unit Price	Unit	Cost, $
	Aerobic Digester Cost in Snoqualmie RH2 report	1	$2,200,000	LS	$2,200,000
	Subtotal Construction Cost				**$2,200,000**
	Total Project Cost				**$3,500,000**

Standby Generator

No	Description	Quantity	Unit Price	Unit	Cost, $
	Standby Generator Cost in Snoqualmie RH2 report	1	$1,278,677	LS	$1,278,677
	Subtotal Construction Cost				**$1,278,677**
	Total Project Cost				**$2,100,000**

Standby Generator

No	Description	Quantity	Unit Price	Unit	Cost, $
	3W Cost in Snoqualmie RH2 report	1	$520,000	LS	$520,000
	Total Project Cost				**$520,000**

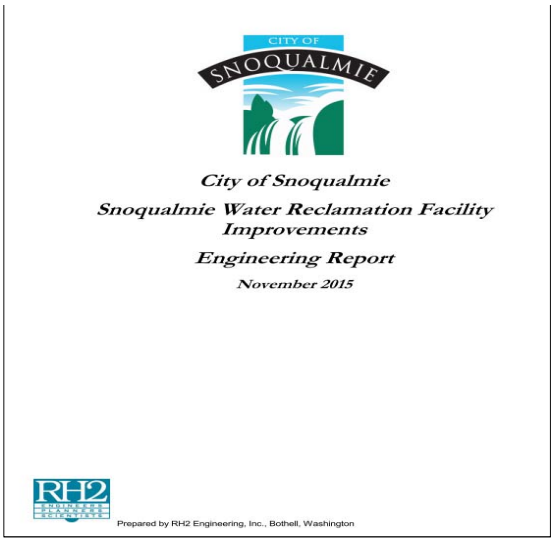

Table 51 – Summary of Estimated Total Probable Project Cost for Third Secondary Clarifier

Cost Category	Cost
Subtotal Probable Construction Costs	$1,770,000
Planning Level Contingency (20%)	$340,000
Sales Tax (8.6%)	$190,000
Total Probable Construction Cost	$2,300,000
Engineering Services (15%)	$350,000
Total Probable Project Cost	$2,650,000

Table 8 – Estimated Project Cost for Proposed UV Disinfection System

Cost Category	Cost
Subtotal Probable Construction Costs	$1,410,832
Planning Level Contingency (20%)	$283,000
Sales Tax (8.6%)	$146,000
Total Probable Construction Costs	$1,840,000
Engineering Services (20%)	$368,000
Total Probable Project Costs	$2,208,000

Table 47 – Estimated Total Probable Project Costs for Proposed Aerobic Digester Facility

Cost Category	Cost
Subtotal Probable Construction Costs	$2,200,000
Planning Level Contingency (15%)	$330,000
Sales Tax (8.6%)	$220,000
Total Probable Construction Cost	$2,750,000
Engineering Services (22%)	$600,000
Total Probable Project Cost	$3,350,000

Standby Generator

Table 16 – Recommended Alternative Project Cost Estimate

Cost Category	Cost
Subtotal Probable Construction Costs	$1,278,677
Planning Level Contingency (15%)	$192,000
Sales Tax (8.6%)	$127,000
Total Probable Construction Costs	$1,598,000
Engineering Services (18%)	$288,000
Total Probable Project Costs	$1,886,000

3W Water

Table 27 – Payback Analysis Summary

Payback Analysis Summary	
Alternative No. 1 Capital Cost	$520,000
Alternative No. 1 Annual O&M Cost	$9,000
Alternative No. 2 Capital Cost	$150,000
Alternative No. 2 Annual O&M Cost	$53,500
Inflation Rate	3%
Payback Period	**10 years**

Lab Admin and Maintenance bldg

No	Description	Quantity	Unit Price	Unit	Cost, $
	Lab Admin and Maintenance bldg Cost in Snoqualmie G&O report	1	$783,500	LS	$783,500
	ENR adjustment	109%			$851,488
	Subtotal Construction Cost				**$851,488**
	Total Project Cost				**$1,400,000**

CITY OF SNOQUALMIE
KING COUNTY WASHINGTON

GENERAL SEWER/WASTEWATER FACILITY PLAN

G&O #11543
NOVEMBER 2012

Gray & Osborne, Inc.
CONSULTING ENGINEERS

City of Snoqualmie
Preliminary Project Cost Estimate
Operations Building and New Garage Construction

NO.	ITEM	QUANTITY		UNIT PRICE	AMOUNT
1	Mobilization and Demobilization	1	LS	$ 71,000	$ 71,000
2	Sitework	1	LS	$ 3,000	$ 3,000
3	New Maintenance Building	4,000	SQFT	$ 118	$ 472,000
4	Special Equipment	1	LS	$ 50,000	$ 50,000
5	Utility Connections	1	LS	$ 2,500	$ 2,500
6	Remodel Existing Operations Building	1,800	SQFT	$ 100	$ 180,000
7	Minor Changes	1	LS	$ 5,000	$ 5,000
	Subtotal:				$ 783,500
	Sales Tax (8.6%):				$ 67,381
	Subtotal:				$ 850,900
	Contingency (20%):				$ 170,200
	TOTAL ESTIMATED CONSTRUCTION COST:				$ 1,021,100
	Engineering and Administrative Costs (25%):				$ 255,300
	TOTAL ESTIMATED PROJECT COST (ROUNDED):				**$ 1,277,000**

ENR CCI=9323.58

City of North Bend, WA
Wastewater Treatment Plant Immediate Improvements
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8. Clarifier Repair

8a-Clarifier mechanism

No	Description	Quantity	Unit Price	Unit	Cost, $
	Main gear	1	$20,000	LS	$20,000
	Equipment installation (% of equipment)	100%	$20,000	LS	$20,000
	Electrical (% of equipment)	10%	$2,000	LS	$2,000
	Instrumentation & Control --- (% of equipment)	10%	$2,000	LS	$2,000
	Subtotal Construction Cost				**$44,000**
	Total Project Cost				**$79,000**

8b-3/8 in bar Screens in launder trough to reduce floatables in effluent

No	Description	Quantity	Unit Price	Unit	Cost, $
	Bar Rack	1	$5,000	LS	$5,000
	Equipment installation (% of equipment)	30%	$1,500	LS	$1,500
	Subtotal Construction Cost				**$6,500**
	Total Project Cost				**$12,000**

8c-Regrout clarifier floor

	Remove existing grout	1	$15,000	LS	$15,000
	New grout topping	30	$800	CY	$24,000
	Subtotal Construction Cost				**$39,000**
	Total Project Cost				**$70,000**

Existing Clarifier Repair

	Total Project Cost	***$160,000***

City of North Bend, WA
Wastewater Treatment Plant Immediate Improvements
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9. New Clarifier

9a-Construct reinforced concrete stucture 80 ft diameter

No	Description	Quantity	Unit Price	Unit	Cost, $
	Slab	205	$800	CY	$164,201
	Walls	151	$1,000	CY	$150,797
	clarifier grout	41	$1,000	LS	$41,050
	Dewatering for clarifier	1	$60,000	LS	$60,000
	Earthwork	3299	$15	CY	$49,480
	Foundation gravel	103	$20	CY	$2,053
	shoring	1	$50,000	LS	$50,000
	painting	1	$50,000	LS	$50,000
	Subtotal Construction Cost			LS	**$567,580**
	Total Project Cost				**$1,024,000**

9b-Clarifier mechanism

No	Description	Quantity	Unit Price	Unit	Cost, $
	Clarifier mechanism	1	$250,000	LS	$250,000
	Equipment installation (% of equipment)	30%	$75,000	LS	$75,000
	Electrical (% of equipment)	10%	$25,000	LS	$25,000
	Instrumentation & Control --- (% of equipment)	10%	$25,000	LS	$25,000
	Subtotal Construction Cost				**$375,000**
	Total Project Cost				**$676,000**

9c-New Scum pit with pump

No	Description	Quantity	Unit Price	Unit	Cost, $
	Scum pump box	8	$1,000	LS	$8,000
	Scum pump	1	$20,000	EA	$20,000
	Equipment installation (% of equipment)	30%	$6,000	LS	$6,000
	Electrical (% of equipment)	10%	$2,000	LS	$2,000
	Instrumentation & Control --- (% of equipment)	10%	$2,000	LS	$2,000
	Subtotal Construction Cost				**$38,000**
	Total Project Cost				**$69,000**

9d-New RAS/WAS Pump Station with pump

No	Description	Quantity	Unit Price	Unit	Cost, $
	RAS pump box	24	$1,000	LS	$24,444
	RAS pumps	2	$30,000	EA	$60,000
	Equipment installation (% of equipment)	30%	$18,000	LS	$18,000
	Electrical (% of equipment)	10%	$6,000	LS	$6,000
	Instrumentation & Control --- (% of equipment)	10%	$6,000	LS	$6,000
	Subtotal Construction Cost				**$114,440**
	Total Project Cost				**$206,000**

9e-New RAS and WAS flow meters

No	Description	Quantity	Unit Price	Unit	Cost, $
	6" RAS meter	1	$10,000	ea	$10,000
	4" WAS meter	1	$6,350	ea	$6,350
	Equipment installation (% of equipment)	30%	$4,905	LS	$4,905
	Electrical (% of equipment)	10%	$1,635	LS	$1,635
	Instrumentation & Control --- (% of equipment)	10%	$1,635	LS	$1,635
	Subtotal Construction Cost				**$24,530**
	Total Project Cost				**$44,000**

9f-MCC with VFDs for clarifier, RAS, and WAS pump

No	Description	Quantity	Unit Price	Unit	Cost, $
	MCC with VFDs for clarifier, RAS, and WAS pump	3	$5,000	ea	$15,000
	Subtotal Construction Cost				**$15,000**
	Total Project Cost				**$27,000**

9g-Splitter Box

No	Description	Quantity	Unit Price	Unit	Cost, $
	Splitter box	60	$1,000	LS	$60,185
	Splitter box gates	4	$10,000	EA	$40,000
	Equipment installation (% of equipment)	30%	$12,000	LS	$12,000
	Electrical (% of equipment)	10%	$4,000	LS	$4,000
	Instrumentation & Control --- (% of equipment)	10%	$4,000	LS	$4,000
	Subtotal Construction Cost				**$120,190**
	Total Project Cost				**$217,000**

9h-Piping and Fitting

No	Description	Quantity	Unit Price	Unit	Cost, $
	30" ML	200	LF	$350	$70,000
	30" SE	80	LF	$351	$28,080
	30" fittings	8	ea	$10,000	$80,000
	14" RAS	320	LF	$150	$48,000
	14" fittings	20	ea	$2,000	$40,000
	12" valves	4	ea	$5,000	$20,000
	4" WAS	60	LF	$42	$2,520
	4" Scum	80	LF	$42	$3,360
	4" fittings	20	ea	$600	$12,000
	4" valves	4	ea	$1,200	$4,800
	Subtotal Construction Cost				$308,760
	Total Project Cost				**$557,000**

New Clarifier, Splitter and Piping

	Total Project Cost				***$2,820,000***

City of North Bend, WA
Wastewater Treatment Plant Immediate Improvements
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10. UV Disinfection System

10a-UV Disinfection System Upgrade-Phase 1

Description	Quantity	Unit Price	Unit	Cost, $
Remove two existing ballast and control panels	1	$2,000	LS	$2,000
Upgrade existing Aquionics UV units (2)	1	$141,367	LS	$141,367
New Aquionics UV unit	1	$99,769	LS	$99,769
UV transmittance meter	1	$16,000	EA	$16,000
Turbidity meter	1	$3,210	EA	$3,210
Equipment installation (% of equipment)	30%	$241,136	LS	$72,341
Electrical (% of equipment)	10%	$241,136	LS	$24,114
Instrumentation & Control --- (% of equipment)	10%	$241,136	LS	$24,114
SCADA ---10% of UV system	10%	$241,136	LS	$24,114
Subtotal Construction Cost				**$407,028**
Total Project Cost				**$730,000**

10b-UV Disinfection System Upgrade-Phase 2

New Aquionics UV unit	1	$99,769	LS	$99,769
SCADA ---10% of uv system	10%	$99,769	LS	$9,977
Equipment installation (% of equipment)	30%	$99,769	LS	$29,931
Electrical (% of equipment)	10%	$99,769	LS	$9,977
Instrumentation & Control --- (% of equipment)	10%	$99,769	LS	$9,977
Subtotal Construction Cost				**$159,630**
Total Project Cost				**$290,000**

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11. UV Effluent Facilities

11a-New UV Effluent Building

No	Description	Quantity	Unit	Unit cost, $	Cost, $
	Concrete Foundation Slab	167	CY	$400	$66,667
	Interior Floor Slab	28	CY	$400	$11,111
	12" CMU	4,620	SF	$22	$101,640
	Structural Steel	5	Tons	$10,000	$50,000
	Metal Roof	2,250	SF	$20	$45,000
	Equipment Overhead Door	1	EA	$10,000	$10,000
	Exterior Door with Hardware	2	EA	$2,000	$4,000
	Aluminum Window	2	EA	$1,200	$2,400
	Interior Painting, Walls & Ceiling	1	LS	$10,000	$10,000
	Stairs and Handrail	1	LS	$5,000	$5,000
	Building Entry	2	LS	$3,000	$6,000
	Interior Lighting	12	EA	$500	$6,000
	Exterior Lighting	4	EA	$1,000	$4,000
	Electrical Power Supply and Distribution for New Building	1	LS	$30,000	$30,000
	Subtotal Construction Cost				**$351,818**
	Total Project Cost				**$630,000**

11b-Effluent pump in New UV Building

No	Description		Quantity	Unit	Unit cost, $	Cost, $
	New effluent pump (3750 gpm capacity each, Gorman Rupps self-priming centrifugal pump T-10A3S-B)		2	EA	$25,000	$50,000
	25 HP VFD		2	EA	$11,500	$23,000
	12" butterfly valve		4	EA	$2,000	$8,000
	12" Spool		4	EA	$1,350	$5,400
	Equipment installation (% of equipment)	30%		LS	$86,400	$25,920
	Electrical (% of equipment)	10%		LS	$73,000	$7,300
	Instrumentation & Control --- (% of equipment)	10%		LS	$73,000	$7,300
	Subtotal Construction Cost					**$126,920**
	Total Project Cost					**$230,000**

11a-New UV Effluent Building

No	Description		Quantity	Unit	Unit cost, $	Cost, $

11c-Relocate 3W Water System

No	Description		Quantity	Unit	Unit cost, $	Cost, $
	50 gal NaOCL Tank with containment		1	$500	EA	$500
	NaOCL Tank containment		1	$500	EA	$500
	Scale		1	$2,500	EA	$2,500
	Level Monitoring System		1	$1,200	EA	$1,200
	SCADA Integration		1	$2,000	LS	$2,000
	0.5" NaOCL PVC Chemical Dosing pipe		10	$19	LF	$193
	0.5" NaOCL PVC Chemical Dosing fittings		2	$30	EA	$60
	0.5" NaOCL Chemical Dosing ball valves		2	$20	EA	$40
	0.5" NaOCL Chemical Dosing ball check valves		1	$72	EA	$72
	0.5" NaOCL Chemical Dosing pressure control valves		1	$310	EA	$310
	3/8" NaOCL PVC Chemical Dosing pipe		15	$19	LF	$289
	3/8" NaOCL PVC Chemical Dosing fittings		2	$30	EA	$60
	3/8" NaOCL Chemical Dosing ball valves		2	$7	EA	$14
	3/8" NaOCL Chemical Dosing ball check valves		1	$72	EA	$72
	3/8" NaOCL Chemical Dosing needle valves		1	$5	EA	$5
	Rotometer		1	$200	EA	$200
	3/8" NaOCL Chemical Dosing strainer		1	$95	EA	$95
	Relocate 3W Water System		1	LS	$50,000	$50,000
	3W Water System Piping (Indoor		1	LS	$20,000	$20,000
	4" 3W (Yard)		150	LF	$38	$5,700
	Installation	30%				$7,710
	Subtotal Construction Cost					**$91,519**
	Total Project Cost					**$170,000**

11d-UV effl site piping

No	Description	Quantity	Unit	Unit cost, $	Cost, $
	Indoor Piping , Fitting				
	30" SE	20	LF	$350	$7,000
	30" FE	20	LF	$350	$7,000
	18" FE	10	LF	$160	$1,600
	8" FE	10	LF	$120	$1,200
	Fittings	10	EA	$5,000	$50,000
	Yard Piping , Fitting and Metering				
	30" SE	200	LF	$350	$70,000
	30" FE	50	LF	$350	$17,500
	8" FE to Clarifier 1&2	100	LF	$75	$7,500
	Fittings	6	LS	$5,000	$30,000
	Subtotal Construction Cost				**$191,800**
	Total Project Cost				**$350,000**

11a-New UV Effluent Building

No	Description		Quantity	Unit	Unit cost, $	Cost, $
11e-Effluent Metering in New UV Building						
No	**Description**		**Quantity**	**Unit**	**Unit cost, $**	**Cost, $**
	8" Flow meter w/ remote indicator transmitter		1	EA	$10,000	$10,000
	18" Flow meter w/ remote indicator transmitter		1	EA	$18,000	$18,000
	8" butterfly valve w/ electric actuator		1	EA	$7,000	$7,000
	18" butterfly valve w/ electric actuator		1	EA	$11,000	$11,000
	30" check valve		1	EA	$20,000	$20,000
	Reducer		2	EA	$2,000	$4,000
	Equipment installation (% of equipment)	30%		LS	$70,000	$21,000
	Electrical (% of equipment)	10%		LS	$46,000	$4,600
	Instrumentation & Control --- (% of equipment)	20%		LS	$46,000	$9,200
	Subtotal Construction Cost					**$104,800**
	Total Project Cost					**$190,000**

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12. Effluent Temperature Equalization

12a-Shade cover for small clarifiers and old Cl2

No	Description	Quantity	Unit Price	Unit	Cost, $
	Effluent structure shade	625	$20	SF	$12,500
	Two 26 ft diameter clarifiers shade	1500	$20	SF	$30,000
	Equipment installation (% of equipment)	30%	$12,750	LS	$12,750
	Subtotal Construction Cost				**$55,250**
	Total Project Cost				**$100,000**

12b-Install thermal return water pumps (in small clarifier)

No	Description	Quantity	Unit Price	Unit	Cost, $
	Submersible pumps in small clarifier	2	$5,000	EA	$10,000
	Equipment installation (% of equipment)	30%	$1,500	LS	$1,500
	Piping & Fittings (% of equipment)	10%	$1,000	LS	$1,000
	Electrical (% of equipment)	10%	$1,000	LS	$1,000
	Instrumentation & Control --- (% of equipment)	10%	$1,000	LS	$1,000
	Subtotal Construction Cost				**$14,500**
	Total Project Cost				**$26,000**

12c-Install discharge piping from drain pumps to clarifier splitter box

No	Description	Quantity	Unit Price	Unit	Cost, $
	4" tee	2	$726	EA	$1,452
	4" DI Pipe	170	$32	LF	$5,440
	4" DI 90 & 45 deg Bends	6	$435	EA	$2,607
	4" check valve	2	$1,200	EA	$2,452
	4" plug valve	4	$1,226	EA	$4,904
	Subtotal Construction Cost				**$16,855**
	Total Project Cost				**$30,000**

12d-Install Temperature probes on effluent and return flow conveyance systems

No	Description	Quantity	Unit Price	Unit	Cost, $
	Temperature probe	2	$344	EA	$688
	Equipment installation (% of equipment)	30%	$206	LS	$206
	Electrical (% of equipment)	10%	$69	LS	$69
	Instrumentation & Control --- (% of equipment)	10%	$69	LS	$69
	Subtotal Construction Cost				**$1,030**
	Total Project Cost				**$2,000**

Effluent Temperature Mitigation
Total Project Cost ***$158,000***

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13. Effluent Chiller

No	Description	Quantity	Unit Price	Unit	Cost, $
	Equipment pads for chiller 2 x 14'x9'x1')	9	CY	$600	$5,600
	Shelter for chiller pumps and heat exchangers	400	SF	$200	$80,000
	Site Piping				
	20"x8" DI MJ Tees	2	EA	$6,900	$13,800
	8" DI MJ Pipe - between heat exchanger, chiller &	100	LF	$75	$7,500
	8" DI MJ fittings	8	EA	$1,250	$10,000
	8" butterfly valves	2	EA	$1,350	$2,700
	6" DI MJ Pipe - between heat exchanger, chiller &	200	LF	$56	$11,200
	6" DI MJ fittings	20	EA	$850	$17,000
	6" butterfly valves	6	EA	$1,025	$6,150
	6" check valves	3	EA	$1,475	$4,425
	Chillers, pumps to HEX, storage tank and controls	2	EA	$103,000	$206,000
	Plate & Frame heat exchangers	2	EA	$5,000	$10,000
	Effluent pumps to heat exchanger	3	EA	$3,240	$9,720
	equipment installation	30%			$67,716
	Miscellaneous Mechanical	20%	of Equip		$58,687
	Electrical	20%	of Equip		$58,687
	Instrumentation and Control	20%	of Equip		$58,687
	Subtotal Construction Cost				**$617,298**
	Total Project Cost				**$1,113,000**

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14-Outfall improvement

No	Description	Quantity	Unit Price	Unit	Cost, $
	Outfall manhole #6 – modify for pressure operation (MH between effluent structure and diffuser structure):	1	$3,000	LS	$3,000
	Existing outfall diffuser structure				
	Remove and replace cobblestone filter	1	$4,000	LS	$4,000
	New precast concrete cover with gratings	1	$5,000	LS	$5,000
	New internal screen wall	1	$10,000	LS	$10,000
	New outfall splitter structure with gates	1	$40,000	LS	$40,000
	New outfall diffuser structure like existing	1	$100,000	LS	$100,000
	Permitting	1	$5,000	LS	$5,000
	Subtotal Construction Cost				**$167,000**
	Total Project Cost				**$300,000**

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15. Convert oxidation ditch to digester

15a-Install disssolved oxygen probes

No	Description	Quantity	Unit Price	Unit	Cost, $
	DO Probe	1	$2,000	EA	$2,000
	Level Transmitter	1	$2,000	EA	$2,000
	Equipment installation (% of equipment)	30%	$1,200	LS	$1,200
	Electrical (% of equipment)	10%	$400	LS	$400
	Subtotal Construction Cost				**$5,600**
	Total Project Cost				**$10,000**

15b-Install oxidation reduction probes

No	Description	Quantity	Unit Price	Unit	Cost, $
	ORP Probe	1	$2,000	EA	$2,000
	Level Transmitter	1	$2,000	EA	$2,000
	Equipment installation (% of equipment)	30%	$1,200	LS	$1,200
	Electrical (% of equipment)	10%	$400	LS	$400
	Subtotal Construction Cost				**$5,600**
	Total Project Cost				**$10,000**

15c-Install flow dispersion baffle on Aerators 201 and 202

No	Description	Quantity	Unit Price	Unit	Cost, $
	Flow dispersion baffle on Aerators 201 and 202	1	$30,522	LS	$30,522
	Equipment installation (% of equipment)	30%	$9,157	LS	$9,157
	Subtotal Construction Cost				**$39,679**
	Total Project Cost				**$72,000**

15d-Add new PLC and Wonderware Programming for DO and ORP control

No	Description	Quantity	Unit Price	Unit	Cost, $
	SCADA Programming & Screens (1 person @ 5 days)	1	$15,000	LS	$15,000
	Subtotal Construction Cost				**$15,000**
	Total Project Cost				**$27,000**

15e-Add rotor walkway and covers

No	Description	Quantity	Unit Price	Unit	Cost, $
	Remove existing aerator access walkways	2	$5,000	EA	$10,000
	Aluminum floor grating platform along aerators (bearing bars @ 1-3/16" O.C., cross bars @ 4" O.C.)	900	$22.5	SF	$20,250
	Aluminum handrail (2 rails)	360	$158	LF	$56,880
	Fiberglass rotor covers	2	$23,000	EA	$46,000
	Equipment installation (% of equipment)	30%	$36,939	LS	$36,939
	Subtotal Construction Cost				**$170,069**
	Total Project Cost				**$307,000**

15f-Convert Oxidation Ditch to Aerobic Digester

No	Description	Quantity	Unit Price	Unit	Cost, $
	4" DI WAS Pipe	200	$51	LF	$10,100
	4" DI WAS Fittings	20	$440	EA	$8,800
	6" Supernatant Pipe	200	$56	LF	$11,200
	6" Supernatant Fittings	6	$560	EA	$3,360
	Sludge Pump from Digester	2	$30,000	EA	$60,000
	Supernatant Pump From Digester	2	$6,000	EA	$12,000
	Pump Installation, electrical and Control	50%			$36,000
	Subtotal Construction Cost				**$141,460**
	Total Project Cost				**$255,000**

15g-Repair brush rotor support

No	Description	Quantity	Unit Price	Unit	Cost, $
	Repair brush rotor support	1	$11,100	LS	$11,100
	Subtotal Construction Cost				**$11,100**
	Total Project Cost				**$20,000**

Oxidation Ditch Modification

Total Project Cost ***$700,000***

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16 Digester on New Site

No	Description	Quantity	Unit Price	Unit	Cost, $
	Reinforced concrete tank				
	Aerobic Digester Wall	300	$700	CY	$210,000
	Aerobic digester slab	241	$500	CY	$120,593
	Aerobic Digester elevated walks	8	$800	CY	$6,519
	Aerobic Digester railings	220	$75	LF	$16,500
	Aerobic Digester auger cast piles diameter, 51 total x30 lf	3960	$100	LF	$396,000
	Aeration system - diffused air				
	Diffuser System	2700	$70	scfm	$189,000
	3" SS Air Piping	250	$65	LF	$16,250
	Valves & Fittings for Air piping	1	$6,000	LS	$6,000
	Equipment installation (% of equipment)	30%	$56,700	LS	$56,700
	Electrical (% of equipment)	10%	$18,900	LS	$18,900
	Instrumentation & Control --- (% of equipment)	10%	$18,900	LS	$18,900
	Aeration Blowers				
	Aerobic digestor blower	2	$26,378	ea	$52,756
	Equipment installation (% of equipment)	30%	$15,827	LS	$15,827
	Electrical (% of equipment)	10%	$5,276	LS	$5,276
	Instrumentation & Control --- (% of equipment)	10%	$5,276	LS	$5,276
	MCCs for Aeration Blowers				
	VFDs for Blowers	2	$10,000	ea	$20,000
	Electrical (% of equipment)	10%	$2,000	LS	$1,000
	Instrumentation & Control --- (% of equipment)	10%	$2,000	LS	$1,000
	Submersible mixers for digester				
	Aerobic Digester Mixers (6@2.5hp)	6	$17,290	EA	$103,740
	Equipment installation (% of equipment)	30%	$31,122	LS	$31,122
	Electrical (% of equipment)	10%	$10,374	LS	$10,374
	Instrumentation & Control --- (% of equipment)	10%	$10,374	LS	$10,374
	Install disssolved oxygen probes				
	DO Probe	1	$2,000	EA	$2,000
	Level Transmitter	1	$2,000	EA	$2,000
	Equipment installation (% of equipment)	30%	$1,200	LS	$1,200
	Electrical (% of equipment)	10%	$400	LS	$400
	Install oxidation reduction probes				
	ORP Probe	1	$2,000	EA	$2,000
	Level Transmitter	1	$2,000	EA	$2,000
	Equipment installation (% of equipment)	30%	$1,200	LS	$1,200
	Electrical (% of equipment)	10%	$400	LS	$400
	Add new PLC and Wonderware Programming for Mixer, DO, and ORP control				
	SCADA Programming & Screens (1 person @ 5 days)	1	$6,000	LS	$6,000
	Subtotal Construction Cost				**$1,329,306**
	Total Project Cost				**$2,400,000**

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17 Solids Handling Building and Loading facility

No	Description	Quantity	Unit Price	Unit	Cost, $
	Solids Handling Building	2500	$200	SF	*$500,000*
	Dewatered Sludge load facility	1	$270,000	LS	*$270,000*
	Subtotal Construction Cost				**$770,000**
	Total Project Cost				**$1,400,000**

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18 Sludge Thickening in Solids handling building

18a-Sludge Thickener

No	Description	Quantity	Unit Price	Unit	Cost, $
	Rotary screen thickener 600 pph	1	EA	$100,000	$100,000
	Thickening Flocculation tank	included w thickener			
	Thickening control panel	included w thickener			
	Thickener access platform	1	EA	$10,400	$10,400
	Subtotal Construction Cost				**$110,400**
	Total Project Cost				**$200,000**

18b-Polymer feed system

No	Description	Quantity	Unit Price	Unit	Cost, $
	3" PVC Piping	57	$37	LF	$2,109
	3" Tee	3	$72	EA	$215
	3" 90° Bend	9	$53	EA	$473
	Injection System	1	$150	EA	$150
	Polymer Dillution/Feed System (Tote to Aging Tank)	1	25000	EA	$25,000
	Polymer Aging Tank w/mixer	1	22000	EA	$22,000
	Polymer transfer Pump (Ageing Tank to Flock Tank)	1	4000	EA	$4,000
	Equipment installation (% of equipment)	30%	$15,300	LS	$15,300
	Electrical (% of equipment)	10%	$5,100	LS	$5,100
	Instrumentation & Control --- (% of equipment)	10%	$5,100	LS	$5,100
	Subtotal Construction Cost				**$103,280**
	Total Project Cost				**$186,282**

18c Thickened sludge pump

	New thickened sludge pump	1	$30,000	ea	$30,000
	Equipment installation (% of equipment)	30%	$9,000	LS	$9,000
	Instrumentation & Control --- (% of equipment)	10%	$3,000	LS	$3,000
	Subtotal Construction Cost				**$42,000**
	Total Project Cost				**$75,754**

Sludge Thickener

	Total Project Cost	***$390,000***

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19. New Centrifuge

19a-Centrifuge

No	Description	Quantity	Unit Price	Unit	Cost, $
	Centrifuge	1	$385,000	EA	$385,000
	Flow Meter	1	$4,000	EA	$4,000
	Equipment installation (% of equipment)	30%	$116,700	LS	$116,700
	Subtotal Construction Cost				**$505,700**
	Total Project Cost				**$912,111**

19b-Polymer feed system

No	Description	Quantity	Unit Price	Unit	Cost, $
	3" PVC Piping	57	$37	LF	$2,109
	3" Tee	3	$72	EA	$215
	3" 90° Bend	9	$53	EA	$473
	Injection System	1	$150	EA	$150
	Polymer Dillution/Feed System (Tote to Ageing Tank)	1	25000	EA	$25,000
	Polymer Ageing Tank w/mixer	1	22000	EA	$22,000
	Polymer transfer Pump (Ageing Tank to Flock Tank)	1	4000	EA	$4,000
	Equipment installation (% of equipment)	30%	$15,300	LS	$15,300
	Electrical (% of equipment)	10%	$5,100	LS	$5,100
	Instrumentation & Control --- (% of equipment)	10%	$5,100	LS	$5,100
	Subtotal Construction Cost				**$103,280**
	Total Project Cost				**$186,282**

19c-Dewatering sludge conveying system

No	Description	Quantity	Unit Price	Unit	Cost, $
	Dewatered Sludge Conveyor to truck load conveyor	16	$1,000	ft	$16,000
	Structural Support Hangers	1	$5,000	LS	$5,000
	Equipment installation (% of equipment)	30%	$4,800	LS	$4,800
	Instrumentation & Control --- (% of equipment)	10%	$1,600	LS	$1,600
	Subtotal Construction Cost				**$27,400**
	Total Project Cost				**$49,420**

19d-Odor Control

No	Description	Quantity	Unit Price	Unit	Cost, $
	New Exhaust Fan	1	$5,000	EA	$5,000
	Equipment installation (% of equipment)	30%	$1,500	LS	$1,500
	Electrical (% of equipment)	10%	$500	LS	$500
	Subtotal Construction Cost				**$7,000**
	Total Project Cost				**$12,626**

19e-Dryer demolition

No	Description	Quantity	Unit Price	Unit	Cost, $
	Dryer demolition	1	$2,000	LS	$5,000
	Subtotal Construction Cost				**$5,000**
	Total Project Cost				**$9,018**

19f- Centrifuge feed pump

New centrifuge sludge feed pump	1	$30,000	ea	$30,000
Equipment installation (% of equipment)	30%	$9,000	LS	$9,000
Instrumentation & Control --- (% of equipment)	10%	$3,000	LS	$3,000
Subtotal Construction Cost				**$42,000**
Total Project Cost				**$75,754**

19g- Centrifuge feed grinder

New centrifuge feed grinder	1	$5,000	ea	$5,000
Equipment installation (% of equipment)	30%	$1,500	LS	$1,500
Instrumentation & Control --- (% of equipment)	10%	$500	LS	$500
Subtotal Construction Cost				**$7,000**
Total Project Cost				**$12,626**

New Centrifuge in existing SHB

16a-Centrifuge	*$912,111*
16b-Polymer feed system	*$186,282*
16c-Dewatering sludge conveying system	*$49,420*
16d-Odor Control	*$12,626*
16e-Dryer demolition	*$9,018*
Total Project Cost	***$1,170,000***

New Centrifuge in new SHB

Total Project Cost	
16a-Centrifuge	*$912,111*
16b-Polymer feed system	*$186,282*
16c-Dewatering sludge conveying system	*$49,420*
16d-Odor Control	*$12,626*
16f- Centrifuge feed pump	*$75,754*
16g- Centrifuge feed grinder	*$12,626*
Total Project Cost	***$1,250,000***

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20-Solids Loading Odor Control

No	Description	Quantity	Unit Price	Unit	Cost, $
	Solids Loading Odor Control	1	$27,500	LS	$27,500
	Subtotal Construction Cost				**$27,500**
	Total Project Cost				**$50,000**

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21-New Electrical Building and MCC's

No	Description	Quantity	Unit Price	Unit	Cost, $
	Service Entrance and MCCs to replace existing and new distribution	1	$150,000	LS	$150,000
	Electrical Building 25 x 35 w HVAC and lighting	875	$200	sf	$175,000
	Equipment installation (% of equipment)	10%	$15,000	LS	$15,000
	Site Raceways and cabling per existing MCC section	11	$2,000	ea	$22,000
	Instrumentation & Control Integration--- (% of equipment)	10%	$15,000	LS	$15,000
	Subtotal Construction Cost				**$377,000**
	Total Project Cost				**$680,000**

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22-New standby generator & ATS

No	Description	Quantity	Unit Price	Unit	Cost, $
	750kW Diesel Driven Genset w/ATS and Day Tank 55 dBA	1	$350,000	LS	$350,000
	Fuel Storage Tank 6000 gallon with fuel piping and fuel polishing	1	$45,000	LS	$45,000
	Emergency Generator Building 25x35	875	$200	sf	$175,000
	Equipment installation (% of equipment)	30%	$105,000	LS	$105,000
	Electrical (% of equipment)	10%	$35,000	LS	$35,000
	Instrumentation & Control --- (% of equipment)	10%	$35,000	LS	$35,000
	Subtotal Construction Cost				**$745,000**
	Total Project Cost				**$1,340,000**

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23-3W water system on new site

No	Description	Quantity	Unit Price	Unit	Cost, $
	Plant Water Piping & valves	1	$195,000	LS	$195,000
	Plant Water Equipment including installation	1	$270,000	LS	$270,000
	Subtotal Construction Cost				**$465,000**
	Total Project Cost				**$800,000**

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24 Lab Admin & Maintenance Bldg including lab & shop equipment

No	Description	Quantity	Unit Price	Unit	Cost, $
	Building	3500	$200	SF	$700,000
	Special equipment	1	$200,000	LS	$200,000
	Subtotal Construction Cost				**$900,000**
	Total Project Cost				**$1,600,000**

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25 WWTP Plant SCADA System Upgrade

25a-Add WIN 911 alarm system and program

No	Description	Quantity	Unit Price	Unit	Cost, $
	WIN 911 alarm software	1	$5,000	EA	$5,000
	WIN 911 programming	40	$150	hr	$6,000
	Subtotal Construction Cost				**$11,000**
	Total Project Cost				**$20,000**

25b-Add new MCP with Allen Bradely PLC network

No	Description	Quantity	Unit Price	Unit	Cost, $
	PLC Control logix with panel	1	$40,000	EA	$40,000
	Programming	40	$150	hr	$6,000
	Equipment installation (% of equipment)	30%	$12,000	LS	$12,000
	Subtotal Construction Cost				**$58,000**
	Total Project Cost				**$105,000**

25c-Add new I/O block for ULID 6 PS

No	Description	Quantity	Unit Price	Unit	Cost, $
	PLC Compact logix	1	$5,000	EA	$5,000
	Programming	30	$150	hr	$4,500
	Equipment installation (% of equipment)	30%	$1,500	LS	$1,500
	Subtotal Construction Cost				**$11,000**
	Total Project Cost				**$20,000**

25d-Add new I/O block for flow equalization

No	Description	Quantity	Unit Price	Unit	Cost, $
	PLC Compact logix	1	$5,000	EA	$5,000
	Programming	100	$150	hr	$15,000
	Equipment installation (% of equipment)	30%	$1,500	LS	$1,500
	Subtotal Construction Cost				**$21,500**
	Total Project Cost				**$39,000**

25e-Add control program for time schedule operation of RAS and WAS

No	Description	Quantity	Unit Price	Unit	Cost, $
	I/O card, 4 input 4 output	1	$3,000	EA	$3,000
	Programming	40	$150	hr	$6,000
	Equipment installation (% of equipment)	30%	$900	LS	$900
	Subtotal Construction Cost				**$9,900**
	Total Project Cost				**$18,000**

25f-Add flow control for RAS and WAS pumping systems

No	Description	Quantity	Unit Price	Unit	Cost, $
	Programming	20	$150	hr	$3,000
	Subtotal Construction Cost				**$3,000**
	Total Project Cost				**$5,000**

25i-Data Historian

No	Description	Quantity	Unit Price	Unit	Cost, $
	Data Historian software, 1000 tags	1	$35,000	LS	$35,000
	Programming, configuration and report templates	80	$150	hr	$12,000
	Subtotal Construction Cost				**$47,000**
	Total Project Cost				**$85,000**

25j-Solids handling building and washwater system integration

No	Description	Quantity	Unit Price	Unit	Cost, $
	Fiber switch for washwater panel	2	$1,000	EA	$2,000
	Conduit, wire and fiber	1	$7,000	LS	$7,000
	Remote I/O block in washwater panel	1	$3,000	EA	$3,000
	Net-ENI for centrifuge	1	$1,500	EA	$1,500
	Programming and HMI screen development	50	$150	hr	$7,500
	Subtotal Construction Cost				**$21,000**
	Total Project Cost				**$38,000**

SCADA System upgrade

Total Project Cost ***$330,000***

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26 -Lab and Mobile Home Park Sanitary sewer flow rerouting to ULID6 LS

No	Description	Quantity	Unit Price	Unit	Cost, $
	Lab and Mobile Home Park Sanitary sewer flow rerouting to ULID6 LS	300	$200	Ft	$60,000
	Subtotal Construction Cost				$60,000
	Total Project Cost				**$110,000**

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27-Route SHB PS force main direct to oxidation ditch and eliminate discharge to original influent pump station

No	Description	Quantity	Unit Price	Unit	Cost, $
	Demoliition				
	Remove sidewalk	400	$1	SF	$400
	Remove asphalt	360	$1	SF	$360
	Concrete cutout	25	$51	CF	$1,263
	Earthwork				
	Excavation for Forcemain	207	$10	CY	$2,070
	6" bedding under new Forcemain	15	$20	CY	$300
	Backfill around new Forcemain	191	$5	CY	$955
	Sidewalk replacement	400	$5	SF	$2,000
	Asphalt replacement	40	$45	SY	$1,782
	Concrete replacement	1	$1,000	CY	$1,000
	Site piping				
	Plug existing forcemain	1	$500	LS	$500
	Caps for existing forcemain	2	$125	EA	$251
	4" DI 90 deg bend	1	$457	EA	$457
	4" DI tee	1	$726	EA	$726
	6"×4" DI reducer	1	$578	EA	$578
	6" DI pipe	208	$42	LF	$8,809
	6" DI 90 deg bend	6	$649	EA	$3,894
	6" DI 45 deg bend	2	$605	EA	$1,210
	4" Mag flow meter and installation, scada, intergration	1	$5,720	EA	$5,720
	Extra cost due to construction difficulty (100% of the demolition, earth work and site piping cost)	100%	$26,553	LS	$26,553
	Subtotal Construction Cost				**$58,826**
	Total Project Cost				**$110,000**

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28-Sitework

No	Description	Quantity	Unit Price	Unit	Cost, $
	Fencing				
	8' chain link fence	750	$45	LF	$33,750
	35' cantilever slide gate-manual operation	35	$150	LF	$5,250
	Paving				
	Remove asphalt	2500	$1	SF	$2,500
	0.5' rock fill under new paving	460	$ 20	CY	$9,200
	6" AC pavement with 6" stone base	25000	$4	SF	$100,000
	Flood mitigation depressions				
	Remove soil equal to structure volume in flood plain	200	$15	CY	$3,000
	Hydro seed disturbedmitigation area	1	$500	Acre	$500
	Subtotal Construction Cost				**$154,200**
	Total Project Cost				**$280,000**

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29 Phosphorus Removal

29a Phosphorus Removal on Oxidation Ditch

No	Description	Quantity	Unit Price	Unit	Cost, $
	Phosphorus Removal	1	$889,145	LS	$889,145
	Capital Cost				**$900,000**

13.2 SEASONAL NUTRIENT REMOVAL

13.2.1 Extended Aeration Plants

Table 13-21 summarizes estimated capital costs and incremental O&M costs (compared to the existing plant) for achieving Objective C seasonally for an extended aeration plant using mechanical aeration. Figures 13-21 and 13-22 show graphs of the capital and O&M costs, respectively. The estimates are given in dollars per gallon per day of plant capacity. Table 13-22 and Figures 13-23 and 13-24 summarize these costs for an extended aeration plant using diffuser aeration. Tables 13-23 and 13-24 present the annualized unit costs for reducing nutrient loads for mechanical aeration and diffuser aeration plants, respectively.

TABLE 13-21.
ESTIMATED COST PER CAPACITY FOR UPGRADING EXTENDED AERATION (MECHANICAL AERATION) PLANT TO ACHIEVE OBJECTIVE C SEASONALLY

	1-mgd Plant	10-mgd Plant	100-mgd Plant
Capital Cost per gpd of Plant Capacity	$0.77	$0.20	$0.21
Incremental Annual O&M Cost per gpd of Plant Capacity	$0.12	$0.08	$0.07

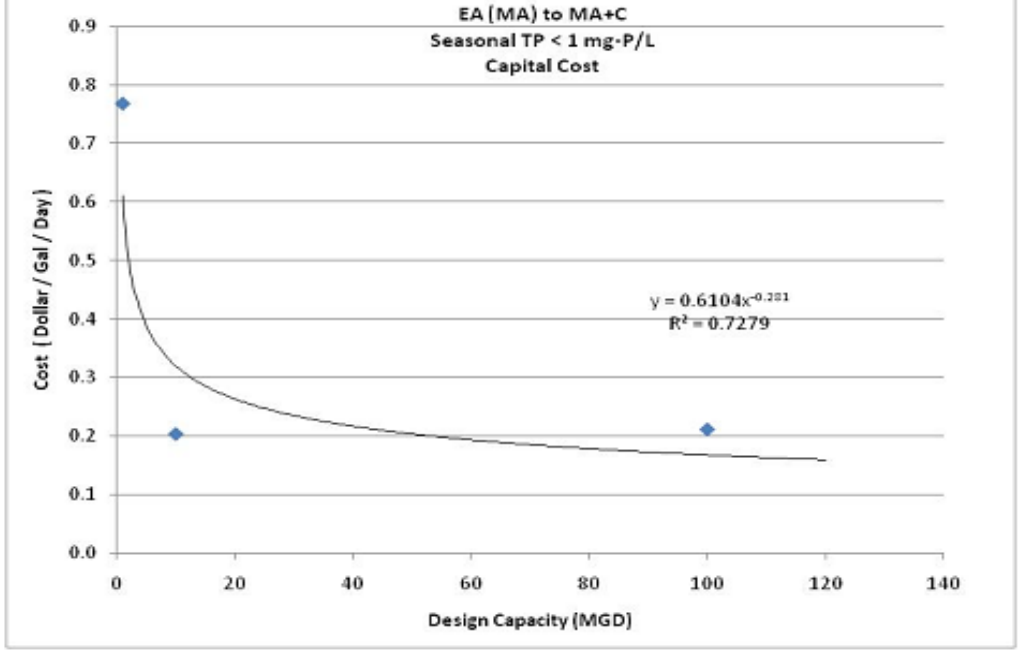

Figure 13-21. Capital Cost per Plant Capacity for Extended Aeration (Mechanical Aeration) Plant Upgraded for Objective C Seasonally

29b Phosphorus Removal on Aeration Tank

No	Description	Quantity	Unit Price	Unit	Cost, $
	Phosphorus Removal	1	$1,166,282	LS	$1,166,282
	Capital Cost				**$1,200,000**

13.2 SEASONAL NUTRIENT REMOVAL

13.2.1 Extended Aeration Plants

Table 13-21 summarizes estimated capital costs and incremental O&M costs (compared to the existing plant) for achieving Objective C seasonally for an extended aeration plant using mechanical aeration. Figures 13-21 and 13-22 show graphs of the capital and O&M costs, respectively. The estimates are given in dollars per gallon per day of plant capacity. Table 13-22 and Figures 13-23 and 13-24 summarize these costs for an extended aeration plant using diffuser aeration. Tables 13-23 and 13-24 present the annualized unit costs for reducing nutrient loads for mechanical aeration and diffuser aeration plants, respectively.

TABLE 13-22.
ESTIMATED COST PER CAPACITY FOR UPGRADING EXTENDED AERATION (DIFFUSER AERATION) PLANT TO ACHIEVE OBJECTIVE C SEASONALLY

	1-mgd Plant	10-mgd Plant	100-mgd Plant
Capital Cost per gpd of Plant Capacity	$1.01	$0.47	$0.30
Incremental Annual O&M Cost per gpd of Plant Capacity	$0.11	$0.06	$0.05

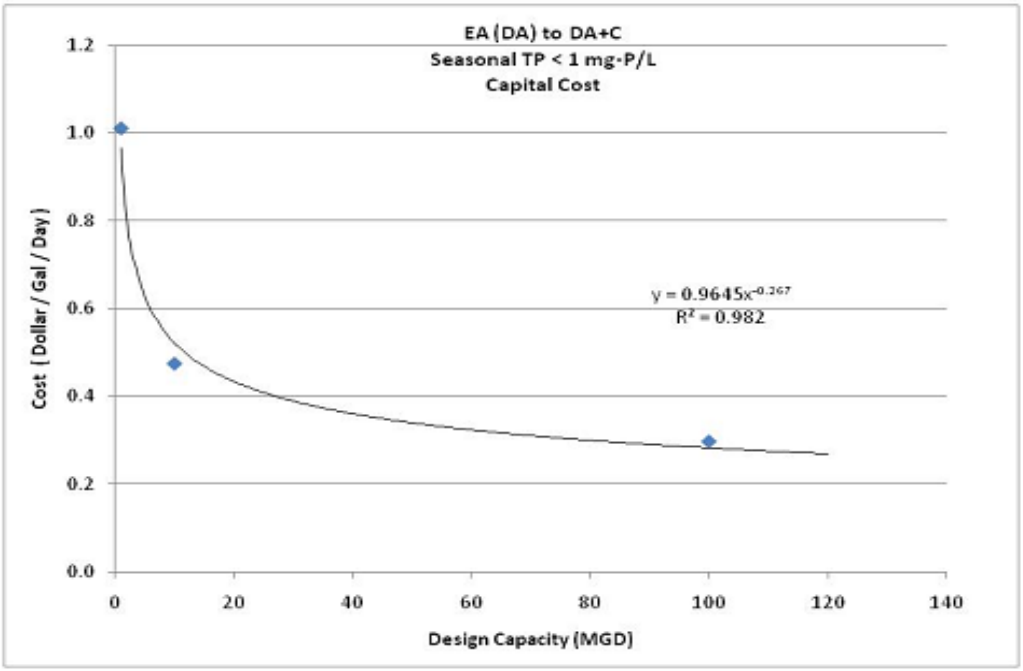

Figure 13-23. Capital Cost per Plant Capacity for Extended Aeration (Diffuser Aeration) Plant Upgraded for Objective C Seasonally

Phosphorus Removal on MBR

No	Description	Quantity	Unit Price	Unit	Cost, $
	Phosphorus REmoval	1	$1,374,134	LS	$1,374,134
	Capital Cost				**$1,400,000**

13.2.5 Membrane Biological Reactor Plants

Table 13-35 summarizes estimated capital costs and incremental O&M costs (compared to the existing plant) for achieving Objective C seasonally for an MBR plant. Figures 13-35 and 13-36 show graphs of the capital and O&M costs, respectively. The estimates are given in dollars per gallon per day of plant capacity. Table 13-36 presents the annualized unit costs for reducing nutrient loads.

TABLE 13-35.
ESTIMATED COST PER CAPACITY FOR UPGRADING MBR PLANT TO ACHIEVE OBJECTIVE C SEASONALLY

	1-mgd Plant	10-mgd Plant	100-mgd Plant
Capital Cost per gpd of Plant Capacity	$1.19	$0.27	$0.07
Incremental Annual O&M Cost per gpd of Plant Capacity	$0.15	$0.07	$0.04

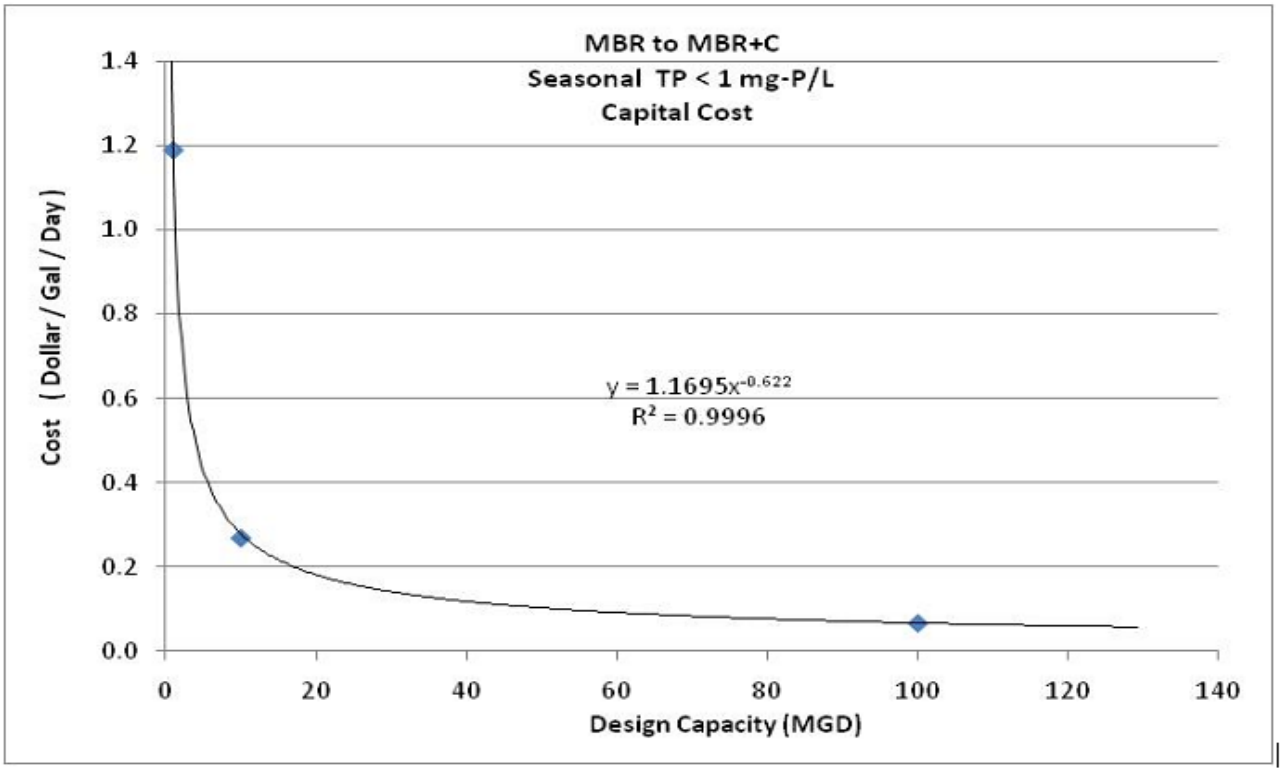

Figure 13-35. Capital Cost per Plant Capacity for MBR Plant Upgraded for Objective C Seasonally

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30-Existing building improvements

No	Description	Quantity	Unit Price	Unit	Cost, $
Existing Lab Control Building - floodproofing					
	Floodproofing- raise building 4 feet	1	$155,000	LS	$155,000
	Subtotal Construction Cost				**$155,000**
	Total Project Cost				**$280,000**
Existing Lab Control Building -office remodel					
	Remodel MCC room to offices	350	$100	SF	$35,000
	Subtotal Construction Cost				**$35,000**
	Total Project Cost				**$60,000**
Existing Solids Handling Building - maintenance shop					
	Remodel sludge hopper area to maintenance shop	500	$100	SF	$50,000
	Subtotal Construction Cost				**$50,000**
	Total Project Cost				**$90,000**

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31-WWTP LandscapingImprovments

No	Description	Quantity	Unit Price	Unit	Cost, $
	WWTP Landscaping	1	$111,000	LS	$111,000
	Subtotal Construction Cost				**$111,000**
	Total Project Cost				***$200,000***

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32 Convey Wastewater from North Bend WWTP to Snoqualmie WWTP

No	Description	Quantity	Unit Price	Unit	Cost, $
Direct Construction Costs					
1	24" ID HDPE conveyance piping from NB WWTP to Snoqualmie WWTP	22,000	$388	FT	$8,540,000
2	24" Micro Tunnel under South Fork of Snoqualmie River	200	$5,000	FT	$1,000,000
3	24" Micro Tunnel under Snoqualmie River	300	$4,000	LS	$1,200,000
4	ULID 6 Influent Pump Station Upgrade	12	$287,000	MGD	$3,440,000
	Subtotal Direct Construction Costs (DCC)				**$14,180,000**
Indirect Construction Costs					
6	Permitting and Environmental Assessment	1%	$14,180,000	DCC	$140,000
7	Design Engineering	12%	$14,180,000	DCC	$1,700,000
8	Construction Management and Inspection	13%	$14,180,000	DCC	$1,840,000
	Subtotal Indirect Cost				**$3,680,000**
	Project Contingency	15%	$17,860,000	DCC+IDC	$2,680,000
	Sales Tax on DCC	8.9%	$14,180,000	DCC	$1,260,000
	OPINION OF PROBABLE TOTAL PROJECT COST				**$21,800,000**

Project year: 2016

The estimated construction cost below, which includes contractor overhead and profit, is for planning purposes only. The output does NOT include contingency, sales tax, or allied costs (design, permitting, construction management, etc.).

Assumptions

Construction Year: 2016
Length: 22000 ft
Conduit Type: Force Main
Depth of Cover: 4 ft
Trench Backfill Type: Native
Disposal Type: No Disposal Cost
Manhole Spacing: None
Existing Utilities: Average
Dewatering: Minimal
Pavement Restoration: Trench Width
Traffic: Light
Land Acquisition: None
Required Easements: None
Land Adjustment Factor: King County Average
Trench Safety: Standard
Pipe Diameter: 24 in.

Geometry

Outer Diameter	2.15 ft
Trench Width	5.3 ft
Excavation Depth	7.15 ft
Complete Surface Rest. Width	7.3 ft

Unit Costs (Basis 2008)

Item	Quantity	Unit	Unit Cost	Item Cost
Excavation	30,800.0	CY	13.00	401,000
Backfill	12,900.0	CY	6.00	77,700
Complete Pavement Restoration	17,800.0	SY	86.00	1,530,000
Trench Safety	315,000.0	SF	0.53	167,000
Spoil Load and Haul	17,900.0	CY	16.00	286,000
Pipe Unit Material Cost	22,000.0	lf	114.00	2,510,000
Pipe Installation	22,000.0	lf	33.00	726,000
Place Pipe Zone Fill	14,900.0	CY	34.00	508,000
Existing Utilities	22,000.0	lf	5.00	110,000
Dewatering	22,000.0	lf	24.00	528,000
Traffic Control	22,000.0	lf	12.00	264,000

Year 2008 Subtotal	$7,110,000
Mobilization/Demobilization at 6%	1.06
Multiplier from ENRCCI 8815 (2008) to 10000 (2016)	1.13
Effective Multiplier	1.20
Construction Year 2016 Subtotal	$8,550,000

Project year: 2016

The estimated construction cost below, which includes contractor overhead and profit, is for planning purposes only. The output does NOT include contingency, sales tax, or allied costs (design, permitting, construction management, etc.). Unless added as an Additional Costs item in the estimate, this cost does NOT include land acquisition costs.

Assumptions

Construction Year: 2016
Inside Diameter: 24 in.
Length: 300 ft
Dewatering: Significant
Launch Shaft Existing Utilities: None
Launch Shaft Excavation Depth: 30 ft
Launch Shaft Surface Restoration: Hydroseed
Retrieval Shaft Excavation Depth: 25 ft
Retrieval Shaft Surface Restoration: Hydroseed
Retrieval Shaft Existing Utilities: None
Tunnel Easement Length: 0 ft
Easement Type: None
Traffic: None
Casing Required: false
Number of Intermediate Shafts: 0
Land Adjustment Factor: North Bend
Intermediate Shaft Existing Utilities: Average
Intermediate Shaft Excavation Depth: 40 ft
Intermediate Shaft Surface Restoration: Hydroseed

Tunnel Geometry

Outer Diameter	2.5 ft
Spoils Volume	54.5 CY
Casing Pipe Diameter	N/A in

Launch Shaft Geometry

Width	17 ft
Length	30 ft
Footprint	510 SF
Volume	567 CY
Easement Footprint	5,360 SF

Retrieval Shaft Geometry

Width	21 ft
Length	21 ft
Footprint	441 SF
Volume	408 CY
Easement Footprint	5,040 SF

Miscellaneous

Spoils Loads	6 loads

Intermediate Shaft Geometry

Width	17 ft
Length	30 ft
Footprint	510 SF
Volume	567 CY
Easement Footprint	5,360 SF

Unit Costs (Basis 2008)

Item	Quantity	Unit	Unit Cost	Item Cost
Spoils Haul	54.5	CY	33.0	1,800
Launch Shaft Excavation	567.0	CY	25.0	14,200
Launch Shaft Shoring	2,820.0	SF	65.5	185,000
Launch Shaft Backfill	567.0	CY	4.0	2,270
Launch Shaft Surface Restoration	56.7	SY	3.0	170
Retrieval Shaft Excavation	408.0	CY	25.0	10,200
Retrieval Shaft Shoring	2,100.0	SF	56.3	118,000
Retrieval Shaft Backfill	408.0	CY	4.0	1,630
Retrieval Shaft Surface Restoration	49.0	SY	3.0	147
MTBM Fixed Costs	1.0	LS	264,000.0	264,000
Microtunnel Boring	300.0	ft	733.0	220,000
Tunnel Dewatering	1.0	LS	55,300.0	55,300
			Year 2008 Subtotal	$873,000

Mobilization/Demobilization at 6%	1.06
Multiplier from ENRCCI 8815 (2008) to 10000 (2016)	1.13
Effective Multiplier	1.20
Construction Year 2016 Subtotal	$1,050,000

Year 2016 Total: $1,050,000

Project year: 2016

The estimated construction cost below, which includes contractor overhead and profit, is for planning purposes only. The output does NOT include contingency, sales tax, or allied costs (design, permitting, construction management, etc.). Unless added as an Additional Costs item in the estimate, this cost does NOT include land acquisition costs.

Assumptions

Construction Year: 2016
Inside Diameter: 24 in.
Length: 400 ft
Dewatering: Significant
Launch Shaft Existing Utilities: Average
Launch Shaft Excavation Depth: 30 ft
Launch Shaft Surface Restoration: Hydroseed
Retrieval Shaft Excavation Depth: 25 ft
Retrieval Shaft Surface Restoration: Hydroseed
Retrieval Shaft Existing Utilities: Average
Tunnel Easement Length: 0 ft
Easement Type: None
Traffic: Light
Casing Required: false
Number of Intermediate Shafts: 0
Land Adjustment Factor: King County Average
Intermediate Shaft Existing Utilities: Average
Intermediate Shaft Excavation Depth: 40 ft
Intermediate Shaft Surface Restoration: Hydroseed

Tunnel Geometry

Outer Diameter	2.5 ft
Spoils Volume	72.7 CY
Casing Pipe Diameter	N/A in

Launch Shaft Geometry

Width	17 ft
Length	30 ft
Footprint	510 SF
Volume	567 CY
Easement Footprint	5,360 SF

Retrieval Shaft Geometry

Width	21 ft

Length	21 ft
Footprint	441 SF
Volume	408 CY
Easement Footprint	5,040 SF

Miscellaneous

Spoils Loads	8 loads

Intermediate Shaft Geometry

Width	17 ft
Length	30 ft
Footprint	510 SF
Volume	567 CY
Easement Footprint	5,360 SF

Unit Costs (Basis 2008)

Item	Quantity	Unit	Unit Cost	Item Cost
Spoils Haul	72.7	CY	33.0	2,400
Launch Shaft Excavation	567.0	CY	25.0	14,200
Launch Shaft Shoring	2,820.0	SF	65.5	185,000
Launch Shaft Existing Utilities	510.0	SF	6.0	3,060
Launch Shaft Backfill	567.0	CY	4.0	2,270
Launch Shaft Surface Restoration	56.7	SY	3.0	170
Retrieval Shaft Excavation	408.0	CY	25.0	10,200
Retrieval Shaft Shoring	2,100.0	SF	56.3	118,000
Retrieval Shaft Existing Utilities	441.0	SF	6.0	2,650
Retrieval Shaft Backfill	408.0	CY	4.0	1,630
Retrieval Shaft Surface Restoration	49.0	SY	3.0	147
MTBM Fixed Costs	1.0	LS	264,000.0	264,000
Microtunnel Boring	400.0	ft	733.0	293,000
Tunnel Dewatering	1.0	LS	55,300.0	55,300
Traffic Control	2.0	shaft	15,300.0	30,600
			Year 2008 Subtotal	$983,000

Mobilization/Demobilization at 6%	1.06
Multiplier from ENRCCI 8815 (2008) to 10000 (2016)	1.13
Effective Multiplier	1.20
Construction Year 2016 Subtotal	$1,180,000

Year 2016 Total: $1,180,000

Project year: 2016

The estimated construction cost below, which includes contractor overhead and profit, is for planning purposes only. The output does NOT include contingency, sales tax, or allied costs (design, permitting, construction management, etc.). Unless added as an Additional Costs item in the estimate, this cost does NOT include land acquisition costs.

Assumptions

Construction Year: 2016
Capacity: 12 mgd
Total Dynamic Head: 100 ft
Excavation Depth: 20 ft

Calculated Parameters

Required Pump Power	413 Hp
Base Architectural/Structural Unit Cost	147,000 $/mgd
Architectural/Structural Unit Cost Adjustment	-44,100 $/mgd
Base Mechanical Unit Cost	75,600 $/mgd
Mechanical Unit Cost Adjustment	-11,300 $/mgd

Unit Costs (Basis 2008)

Item	Quantity	Unit	Unit Cost	Item Cost
Site/Civil	1.0	LS	726,000	726,000
Electrical/Instrumentation	1.0	LS	952,000	952,000
Architectural/Structural	12.0	mgd	103,000	1,240,000
Mechanical	12.0	mgd	64,300	771,000
Odor Control - Bioxide chemical metering	1	LS	20,000	20,000
Chemical Building	1	LS	50,000	50,000
Credit for existing wet well	1	LS	-726,000	-726,000
			Year 2008 Subtotal	$3,030,000

Multiplier from ENRCCI 8815 (2008) to 10000 (2016)	1.13
Construction Year 2016 Subtotal	$3,440,000

Year 2016 Total: $3,440,000

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33 Conveyance to new site

No	Description	Quantity	Unit Price	Unit	Cost, $
	11 MGD Pump	1	$3,160,000	EA	$3,160,000
	21in, 300lf river crossing microtunnel	1	$996,000	LS	$996,000
	20in, 4700lf forcemain	1	$1,590,000	LS	$1,590,000
	Subtotal Construction Cost				**$5,746,000**
	Total Project Cost				**$10,600,000**

Cost Calculations for Pump Station: **Pump Station**

Printed date : 04/18/2016

Project year: 2016

The estimated construction cost below, which includes contractor overhead and profit, is for planning purposes only. The output does NOT include contingency, sales tax, or allied costs (design, permitting, construction management, etc.). Unless added as an Additional Costs item in the estimate, this cost does NOT include land acquisition costs.

Assumptions

Construction Year: 2016
Capacity: 11 mgd
Total Dynamic Head: 100 ft
Excavation Depth: 20 ft

Calculated Parameters

Required Pump Power	379 Hp
Base Architectural/Structural Unit Cost	148,000 $/mgd
Architectural/Structural Unit Cost Adjustment	-44,500 $/mgd
Base Mechanical Unit Cost	77,500 $/mgd
Mechanical Unit Cost Adjustment	-11,300 $/mgd

Unit Costs (Basis 2008)

Item	Quantity	Unit	Unit Cost	Item Cost
Site/Civil	1.0	LS	672,000	672,000
Electrical/Instrumentation	1.0	LS	896,000	896,000
Architectural/Structural	11.0	mgd	104,000	1,140,000
Mechanical	11.0	mgd	66,200	728,000
Odor Control - Bioxide chemical metering	1	LS	20,000	20,000
Chemical Building	1	LS	50,000	50,000
Credit for existing wet well	1	LS	-726,000	-726,000
			Year 2008 Subtotal	$2,780,000
Multiplier from ENRCCI 8815 (2008) to 10000 (2016)				1.13
			Construction Year 2016 Subtotal	$3,160,000

Year 2016 Total: $3,160,000

Construction Year: 2016
Inside Diameter: 21 in.
Length: 300 ft
Dewatering: Significant
Launch Shaft Existing Utilities: None
Launch Shaft Excavation Depth: 30 ft
Launch Shaft Surface Restoration: Hydroseed
Retrieval Shaft Excavation Depth: 25 ft
Retrieval Shaft Surface Restoration: Hydroseed
Retrieval Shaft Existing Utilities: None
Tunnel Easement Length: 0 ft
Easement Type: None
Traffic: None
Casing Required: false
Number of Intermediate Shafts: 0
Land Adjustment Factor: North Bend
Intermediate Shaft Existing Utilities: Average
Intermediate Shaft Excavation Depth: 40 ft
Intermediate Shaft Surface Restoration: Hydroseed

Tunnel Geometry

Outer Diameter	2.2 ft
Spoils Volume	42.2 CY
Casing Pipe Diameter	N/A in

Launch Shaft Geometry

Width	17 ft
Length	30 ft
Footprint	510 SF
Volume	567 CY
Easement Footprint	5,360 SF

Retrieval Shaft Geometry

Width	21 ft
Length	21 ft
Footprint	441 SF
Volume	408 CY
Easement Footprint	5,040 SF

Miscellaneous

Spoils Loads	5 loads

Intermediate Shaft Geometry

Width	17 ft
Length	30 ft
Footprint	510 SF
Volume	567 CY
Easement Footprint	5,360 SF

Unit Costs (Basis 2008)

Item	Quantity	Unit	Unit Cost	Item Cost
Spoils Haul	42.2	CY	33.0	1,390
Launch Shaft Excavation	567.0	CY	25.0	14,200
Launch Shaft Shoring	2,820.0	SF	65.5	185,000
Launch Shaft Backfill	567.0	CY	4.0	2,270
Launch Shaft Surface Restoration	56.7	SY	3.0	170
Retrieval Shaft Excavation	408.0	CY	25.0	10,200
Retrieval Shaft Shoring	2,100.0	SF	56.3	118,000
Retrieval Shaft Backfill	408.0	CY	4.0	1,630
Retrieval Shaft Surface Restoration	49.0	SY	3.0	147
MTBM Fixed Costs	1.0	LS	231,000.0	231,000
Microtunnel Boring	300.0	ft	697.0	209,000
Tunnel Dewatering	1.0	LS	55,300.0	55,300
			Year 2008 Subtotal	$828,000
Mobilization/Demobilization at 6%				1.06
Multiplier from ENRCCI 8815 (2008) to 10000 (2016)				1.13
			Effective Multiplier	1.20
			Construction Year 2016 Subtotal	$996,000

Project year: 2016

The estimated construction cost below, which includes contractor overhead and profit, is for planning purposes only. The output does NOT include contingency, sales tax, or allied costs (design, permitting, construction management, etc.).

Assumptions

Construction Year: 2016
Length: 4700 ft
Conduit Type: Force Main
Depth of Cover: 4 ft
Trench Backfill Type: Native
Disposal Type: No Disposal Cost
Manhole Spacing: None
Existing Utilities: Average
Dewatering: Minimal
Pavement Restoration: Trench Width
Traffic: Light
Land Acquisition: None
Required Easements: None
Land Adjustment Factor: King County Average
Trench Safety: Standard
Pipe Diameter: 20 in.

Geometry

Outer Diameter	1.8 ft
Trench Width	4.84 ft
Excavation Depth	6.8 ft
Complete Surface Rest. Width	6.84 ft

Unit Costs (Basis 2008)

Item	Quantity	Unit	Unit Cost	Item Cost
Excavation	5,730.0	CY	13.00	74,500
Backfill	2,530.0	CY	6.00	15,200
Complete Pavement Restoration	3,570.0	SY	86.00	307,000
Trench Safety	63,900.0	SF	0.53	33,900
Spoil Load and Haul	3,200.0	CY	16.00	51,200
Pipe Unit Material Cost	4,700.0	lf	91.00	428,000
Pipe Installation	4,700.0	lf	30.00	141,000
Place Pipe Zone Fill	2,760.0	CY	34.00	93,800
Existing Utilities	4,700.0	lf	5.00	23,500
Dewatering	4,700.0	lf	24.00	113,000
Traffic Control	4,700.0	lf	8.00	37,600
			Year 2008 Subtotal	$1,320,000
Mobilization/Demobilization at 6%				1.06
Multiplier from ENRCCI 8815 (2008) to 10000 (2016)				1.13
			Effective Multiplier	1.20
			Construction Year 2016 Subtotal	$1,590,000

Year 2016 Total: $1,590,000

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34 Conveyance from new NB site to outfall on S Fork

No	Description	Quantity	Unit Price	Unit	Cost, $	Source
	11 MGD Pump	1	$3,240,000	EA	$3,981,000	Tabular
	20in, 4500lf forcemain	1	$2,610,000	LS	$1,590,000	Tabular
	Subtotal Construction Cost				**$5,571,000**	
	Total Project Cost				**$10,000,000**	

Project year: 2016

The estimated construction cost below, which includes contractor overhead and profit, is for planning purposes only. The output does NOT include contingency, sales tax, or allied costs (design, permitting, construction management, etc.).

Assumptions

Construction Year: 2016
Length: 4700 ft
Conduit Type: Force Main
Depth of Cover: 4 ft
Trench Backfill Type: Native
Disposal Type: No Disposal Cost
Manhole Spacing: None
Existing Utilities: Average
Dewatering: Minimal
Pavement Restoration: Trench Width
Traffic: Light
Land Acquisition: None
Required Easements: None
Land Adjustment Factor: King County Average
Trench Safety: Standard
Pipe Diameter: 20 in.

Geometry

Outer Diameter	1.8 ft
Trench Width	4.84 ft
Excavation Depth	6.8 ft
Complete Surface Rest. Width	6.84 ft

Unit Costs (Basis 2008)

Item	Quantity	Unit	Unit Cost	Item Cost
Excavation	5,730.0	CY	13.00	74,500
Backfill	2,530.0	CY	6.00	15,200
Complete Pavement Restoration	3,570.0	SY	86.00	307,000
Trench Safety	63,900.0	SF	0.53	33,900
Spoil Load and Haul	3,200.0	CY	16.00	51,200
Pipe Unit Material Cost	4,700.0	lf	91.00	428,000
Pipe Installation	4,700.0	lf	30.00	141,000
Place Pipe Zone Fill	2,760.0	CY	34.00	93,800
Existing Utilities	4,700.0	lf	5.00	23,500
Dewatering	4,700.0	lf	24.00	113,000
Traffic Control	4,700.0	lf	8.00	37,600
			Year 2008 Subtotal	$1,320,000

Mobilization/Demobilization at 6%	1.06
Multiplier from ENRCCI 8815 (2008) to 10000 (2016)	1.13
Effective Multiplier	1.20
Construction Year 2016 Subtotal	$1,590,000

Year 2016 Total: $1,590,000

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35-South Fork Lift Station Upgrade

No	Description	Quantity	Unit Price	Unit	Phase 1 Cost, $	Phase 2 Cost, $
	Upgrade PLC W/integration with WWTP	1	$9,000	EA	$9,000	
	Pump control programming and integration with ATS	1	$4,000	EA	$4,000	
	Upgrade Existing Pumps	2	$35,000	EA		$70,000
	Upgrade Drywell entry personnel and equipment access	1	$57,000	LS		$57,000
	Wet well and Dry well ventilation system and Foul air treatment	1	$35,000	LS		$35,000
	Equipment installation (% of equipment)	30%	$52,500	LS		$15,750
	Electrical (% of equipment)	10%	$17,500	LS		$17,500
	Instrumentation & Control --- (% of equipment)	10%	$17,500	LS	$17,500	
	South fork Bypass Pumping	1	$29,000	LS		$29,000
	Subtotal Construction Cost				**$31,000**	**$224,000**
	Total Project Cost				**$56,000**	**$404,000**

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36-Snoqualm Lift Station Upgrade

No	Description	Quantity	Unit Price	Unit	Cost, $
	Radio Telemetry System w/integration with WWTP HMI	1	$6,000	EA	$6,000
	UPS for instrumentation and RT system	1	$2,000	EA	$2,000
	Control panel upgrade to meet code	1	$5,000	EA	$5,000
	Equipment installation (% of equipment)	30%	$3,900	LS	$3,900
	Electrical (% of equipment)	10%	$1,300	LS	$1,300
	Instrumentation & Control --- (% of equipment)	10%	$1,300	LS	$1,300
	Snoqualm Bypass Pumping	1		LS	$11,000
	Subtotal Construction Cost				**$30,500**
	Total Project Cost				**$55,000**

Capital Cost Estimates: Future Sewer Extension Projects

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Collection System Unit Cost Basis

	Unit Cost		Gravity Sewers									Force Mains					
			Diameter 8	Qnty	$	Diameter 10	Qnty	$	Diameter 12	Qnty	$	Diameter 4	Qnty	$	Diameter 6	Qnty	$
			X Units			X Units			X Units								
Excavation & Backfill																	
Trench Length			1000			1000			1000			1000			1000		
Average Trench Width			4			4.5			5			3			3		
Average Trench Depth			15			15			15			6			6		
Tons	$ 5	Ton		3733	$ 18,667		4200	21,000		4667	23,333		1120	5,600		1120	5,600
Shoring	$ 5.00	l.f.		1000	$ 5,000		1000	5,000		1000	5,000		1000	5,000		1000	5,000
Dewatering (based on 12-inch sewer)	$ 30.00	l.f.		1000	$ 24,495		1000	$ 27,386		1000	$ 30,000		500	$ 8,660		500	$ 10,607
TESC (Assuming in existing roadways, or part of wider development cost)	$ 4.00			1000	$ 3,266		1000	$ 3,651		1000	$ 4,000		1000	$ 2,309		1000	$ 2,828
Pipe - $X/l.f. (PVC)	varies	l.f.	8	1000	$ 8,000	10	1000	$ 10,000	13	1000	$ 13,000	4	1000	$ 4,000	6	1000	$ 6,000
Bedding, Backfill, Gravel	$ 25	Ton	100%	3733	$ 93,333	100%	4200	105,000	100%	4667	116,667	100%	1120	28,000	100%	1120	28,000
Manholes - X per 1000 feet, 15 feet deep	$ 8,000	Ea	4	4	$ 32,000	4	4	32,000	4	4	32,000	0	0	0	0	0	0
Traffic Control - 2 flaggers, 8 hours/day, X ft Pipe/day	$ 40	hr	50	320	$ 12,800	50	320	$ 12,800	50	320	$ 12,800	100	160	$ 6,400	100	160	$ 6,400
Sawcutting - Single line at centerline, full length	$ 3	l.f.		1000	$ 3,000		1000	$ 3,000		1000	$ 3,000		1000	$ 3,000		1000	$ 3,000
Removal, Haul, Disposal ACP - trench width, 6-inch depth	$ 14	Ton	8	326	$ 4,563	9	367	$ 5,133	9	367	$ 5,133	10	407	$ 5,704	11	448	$ 6,274
Crushed Surfacing - Full Length, 6-inch depth, width X	$ 25	Ton	8	267	$ 6,667	9	300	$ 7,500	9	300	$ 7,500	10	333	$ 8,333	11	367	$ 9,167
Trench Patch - Full Length, 4-inch depth, width X	$ 110	Ton	8	217	$ 23,901	8.5	231	$ 25,395	9	244	$ 26,889	10	272	$ 29,877	11	299	$ 32,864
Overlay - Full Length, 2-inch, Width X	$ 110	Ton	12	163	$ 17,926	12	163	$ 17,926	12	163	$ 17,926	12	163	$ 17,926	12	163	$ 17,926
Curb, gutter replacement - X l.f. per 1000 ft	$ 13	l.f.	0	0	$ -	0	0	$ -	400	400	$ 5,200	0	0	$ -	200	200	$ 2,600
Sidewalk replacement - X l.f., 4 ft wide, 4-inch depth	$ 125	SY	0	0	$ -	0	0	$ -	400	178	$ 22,222	0	0	$ -	200	89	$ 11,111
Driveway Replacement - 15 feet by 6 ft every X ft	$ 100	SY	150	0	$ -	150	0	$ -	150	0	$ -	150	67	$ 6,667	150	0	$ -
Subtotal (excluding Side Sewers & Mob)					$ 253,618			$ 275,792			$ 324,670			$ 131,476			$ 147,377
Subtotal (excluding Side Sewers, Mob, OH&P)	15%				$ 215,575			$ 234,423			$ 275,970			$ 111,754			$ 125,270
Per lf without Side Sewers, Mob, OH&P				$ / l.f.	$ 216		$ / l.f.	$ 234		$ / l.f.	$ 276		$ / l.f.	$ 112		$ / l.f.	$ 125
Side Sewer - (excluding Mob)	$ 14,000	Ea															
Side Sewer - (excluding Mob, OH&P)	$ 11,900																

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Silver Creek Area

No	Description	Quantity	Unit Price	Unit	2016 Cost
1	8-inch sewers	20183	$216	LF	$4,359,528
2	12-inch sewers	955	$276	LF	$263,580
3	Side sewers (from sewer main to building)	300	$11,900	EA	$3,570,000
4	Lift Station: 0.39 mgd w/stnby generator and ATS	1	$677,000	LS	$677,000
5	6-inch force main	1100	$125	LF	$137,500
	Subtotal Construction Cost				**$9,008,000**
	Contractor OH, Profit and Mobilization / Demobilization	15%			
	Contingency	20%			
	Sales tax	8.2%			
	Engineering design	13%			
	Construction management	10%			
	Total Project Cost				**$16,247,000**

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Riverside Area

No	Description	Quantity	Unit Price	Unit	2016 Cost
1	8-inch sewers	1382	$216	LF	$298,512
2	10-inch sewers	342	$234	LF	$80,028
3	12-inch sewers	4469	$276	EA	$1,233,444
4	Side sewers (from sewer main to building)	1	$11,900	LS	$11,900
	Subtotal Construction Cost				**$1,624,000**
	Contractor OH, Profit and Mobilization / Demobilization	15%			
	Contingency	20%			
	Sales tax	8.2%			
	Engineering design	13%			
	Construction management	10%			
	Total Project Cost				**$2,929,000**

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SE 12th Area

No	Description	Quantity	Unit Price	Unit	2016 Cost
1	8-inch sewers	1005	$216	LF	$217,080
2	Side sewers (from sewer main to building)	5	$11,900	LS	$59,500
	Subtotal Construction Cost				**$277,000**
	Contractor OH, Profit and Mobilization / Demobilization	15%			
	Contingency	20%			
	Sales tax	8.2%			
	Engineering design	13%			
	Construction management	10%			
	Total Project Cost				**$500,000**

City of North Bend, WA
Sewer Extensions
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Laforest Holme Area

No	Description	Quantity	Unit Price	Unit	2016 Cost
1	8-inch sewers	1730	$216	LF	$373,680
2	Side sewers (from sewer main to building)	28	$11,900	LS	$333,200
	Subtotal Construction Cost				**$707,000**
	Contractor OH, Profit and Mobilization / Demobilization	15%			
	Contingency	20%			
	Sales tax	8.2%			
	Engineering design	13%			
	Construction management	10%			
	Total Project Cost				**$1,275,000**

City of North Bend, WA
Sewer Extensions
Opinion of Probable Construction Cost
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SE Tanner Road Area

No	Description	Quantity	Unit Price	Unit	2016 Cost
1	8-inch sewers	493	$216	LF	$106,488
2	Side sewers (from sewer main to building)	33	$11,900	LS	$392,700
4	Lift Station: 0.2 mgd w/stnby generator and ATS	1	$430,000	LS	$430,000
5	4-inch force main	500	$112	LF	$56,000
	Subtotal Construction Cost				**$985,000**
	Contractor OH, Profit and Mobilization / Demobilization	15%			
	Contingency	20%			
	Sales tax	8.2%			
	Engineering design	13%			
	Construction management	10%			
	Total Project Cost				**$1,777,000**

APPENDIX G

BIOWIN MODELING RESULTS FOR RECOMMENDED TREATMENT PLANT IMPROVEMENTS

BioWin user and configuration data

Project details

Project name: Aerobic Digester Model Development **Project ref.: 60037-15001**

Plant name: North Bend **User name: Markus**

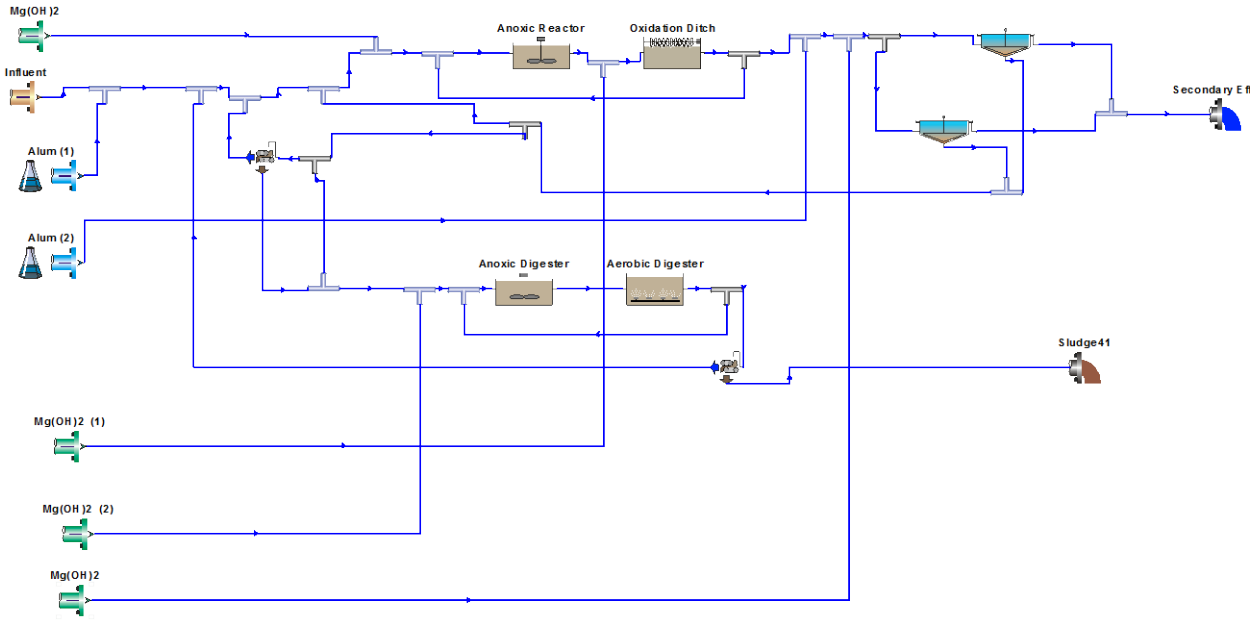
Created: 3/1/2001 **Saved: 5/6/2016**

Steady state solution

SRT: 20.31

Temperature: 20.0

Flowsheet



Configuration information for all Bioreactor units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers
Aerobic Digester	0.3000	2673.6113	15.000	606
Anoxic Digester	0.3000	2673.6113	15.000	Un-aerated

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint [mg/L]
Aerobic Digester	2.0
Anoxic Digester	0

Aeration equipment parameters

Element name	k1 in C = k1(PC)^0.25 + k2	k2 in C = k1(PC)^0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	% of tank area covered by diffusers [%]
Aerobic Digester	2.5656	0.0432	0.8200	0.0410	10.0000
Anoxic Digester	2.5656	0.0432	0.8200	0.0410	10.0000

Configuration information for all BOD Influent units

Operating data Average (flow/time weighted as required)

Element name	Influent
Flow	0.860869992486947
Total Carbonaceous BOD mgBOD/L	328.00
Volatile suspended solids mgVSS/L	328.00
Total suspended solids mgTSS/L	386.00
Total Kjeldahl Nitrogen mgN/L	97.00
Total P mgP/L	9.70
Nitrate N mgN/L	0
pH	7.00
Alkalinity mmol/L	1.17
Calcium mg/L	4.40
Magnesium mg/L	1.80
Dissolved oxygen mg/L	0

Element name	Influent
Fbs - Readily biodegradable (including Acetate) [gCOD/g of total COD]	0.1600
Fac - Acetate [gCOD/g of readily biodegradable COD]	0.1500
Fxsp - Non-colloidal slowly biodegradable [gCOD/g of slowly degradable COD]	0.9397
Fus - Unbiodegradable soluble [gCOD/g of total COD]	0.0500
Fup - Unbiodegradable particulate [gCOD/g of total COD]	0.1300
Fna - Ammonia [gNH3-N/gTKN]	0.6600
Fnox - Particulate organic nitrogen [gN/g Organic N]	0.5000
Fnus - Soluble unbiodegradable TKN [gN/gTKN]	0.0200
FupN - N:COD ratio for unbiodegradable part. COD [gN/gCOD]	0.0350
Fpo4 - Phosphate [gPO4-P/gTP]	0.6300
FupP - P:COD ratio for unbiodegradable part. COD [gP/gCOD]	0.0110
FZbh - Non-poly-P heterotrophs [gCOD/g of total COD]	0.0001

FZbm - Anoxic methanol utilizers [gCOD/g of total COD]	0.0001
FZaob - Ammonia oxidizers [gCOD/g of total COD]	0.0001
FZnob - Nitrite oxidizers [gCOD/g of total COD]	0.0001
FZamob - Anaerobic ammonia oxidizers [gCOD/g of total COD]	0.0001
FZbp - PAOs [gCOD/g of total COD]	0.0001
FZbpa - Propionic acetogens [gCOD/g of total COD]	0.0001
FZbam - Acetoclastic methanogens [gCOD/g of total COD]	0.0001
FZbhm - H2-utilizing methanogens [gCOD/g of total COD]	0.0001

Configuration information for all Model clarifier units

Physical data

Element name	Volume[Mil. Gal]	Area[ft2]	Depth[ft]	Number of layers	Top feed layer	Feed Layers
Secondary Clariifer 2	0.5025	5024.0000	13.370	10	6	1
Secondary Clarifier No 1	5.2833	53819.5520	13.123	10	6	1

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Secondary Clariifer 2	Ratio	0.40
Secondary Clarifier No 1	Ratio	0.40

Element name	Average Temperature	Reactive
Secondary Clariifer 2	Uses global setting	No

Secondary Clarifier No 1	Uses global setting	No

Configuration information for all Effluent units

Configuration information for all Media Bioreactor units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers
Anoxic Reactor	0.2000	2673.6113	10.000	Un-aerated

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint
Anoxic Reactor	0

Aeration equipment parameters

Element name	k1 in C = k1(PC)^0.25 + k2	k2 in C = k1(PC)^0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	% of tank area covered by diffusers [%]
Anoxic Reactor	2.5656	0.0432	0.8200	0.0410	10.0000

Configuration information for all Metal addition units

Operating data Average (flow/time weighted as required)

Element name	Alum (1)	Alum (2)
Non-polyP heterotrophs mgCOD/L	0	0
Anoxic methanol utilizers mgCOD/L	0	0
Ammonia oxidizing biomass mgCOD/L	0	0
Nitrite oxidizing biomass mgCOD/L	0	0
Anaerobic ammonia oxidizers mgCOD/L	0	0
PolyP heterotrophs mgCOD/L	0	0
Propionic acetogens mgCOD/L	0	0
Acetoclastic methanogens mgCOD/L	0	0
Hydrogenotrophic methanogens mgCOD/L	0	0
Endogenous products mgCOD/L	0	0
Slowly bio. COD (part.) mgCOD/L	0	0
Slowly bio. COD (colloid.) mgCOD/L	0	0
Part. inert. COD mgCOD/L	0	0
Part. bio. org. N mgN/L	0	0
Part. bio. org. P mgP/L	0	0
Part. inert N mgN/L	0	0
Part. inert P mgP/L	0	0
Stored PHA mgCOD/L	0	0
Releasable stored polyP mgP/L	0	0
Fixed stored polyP mgP/L	0	0
PolyP bound cations mg/L	0	0
Readily bio. COD (complex) mgCOD/L	0	0
Acetate mgCOD/L	0	0
Propionate mgCOD/L	0	0
Methanol mgCOD/L	0	0

Dissolved H2 mgCOD/L	0	0
Dissolved methane mg/L	0	0
Ammonia N mgN/L	0	0
Sol. bio. org. N mgN/L	0	0
Nitrite N mgN/L	0	0
Nitrate N mgN/L	0	0
Dissolved nitrogen gas mgN/L	0	0
PO4-P (Sol. & Me Complexed) mgP/L	0	0
Sol. inert COD mgCOD/L	0	0
Sol. inert TKN mgN/L	0	0
Inorganic S.S. mgISS/L	0	0
Struvite mgISS/L	0	0
Hydroxy-dicalcium-phosphate mgISS/L	0	0
Hydroxy-apatite mgISS/L	0	0
Magnesium mg/L	0	0
Calcium mg/L	0	0
Metal mg/L	0.00	57700.00
Other Cations (strong bases) meq/L	5.00	5.00
Other Anions (strong acids) meq/L	15.81	6434.89
Total CO2 mmol/L	7.00	7.00
User defined 1 mg/L	0	0
User defined 2 mg/L	0	0
User defined 3 mgVSS/L	0	0
User defined 4 mgISS/L	0	0
Dissolved oxygen mg/L	0	0
Flow	0	7E-5

Configuration information for all Dewatering unit units

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Dewatering Unit	Ratio	0.20
Dewatering Unit	Ratio	0.14

Element name	Percent removal
Dewatering Unit	100.00
Dewatering Unit	90.00

Configuration information for all Sludge units

Configuration information for all Splitter units

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Two way splitter6	Flowrate [Side]	0.035
Splitter23	Flowrate [Side]	0.02
Splitter1	Ratio	4.00
Splitter24	Ratio	0.00
Splitter73	Ratio	6.00

Configuration information for all Influent (SV) units

Operating data Average (flow/time weighted as required)

Element name	Mg(OH)2	Mg(OH)2 (1)	Mg(OH)2 (2)	Mg(OH)2
Non-polyP heterotrophs mgCOD/L	0	0	0	0
Anoxic methanol utilizers mgCOD/L	0	0	0	0
Ammonia oxidizing biomass mgCOD/L	0	0	0	0
Nitrite oxidizing biomass mgCOD/L	0	0	0	0
Anaerobic ammonia oxidizers mgCOD/L	0	0	0	0
PolyP heterotrophs mgCOD/L	0	0	0	0
Propionic acetogens mgCOD/L	0	0	0	0
Acetoclastic methanogens mgCOD/L	0	0	0	0
Hydrogenotrophic methanogens mgCOD/L	0	0	0	0
Endogenous products mgCOD/L	0	0	0	0
Slowly bio. COD (part.) mgCOD/L	0	0	0	0
Slowly bio. COD (colloid.) mgCOD/L	0	0	0	0
Part. inert. COD mgCOD/L	0	0	0	0
Part. bio. org. N mgN/L	0	0	0	0
Part. bio. org. P mgP/L	0	0	0	0
Part. inert N mgN/L	0	0	0	0
Part. inert P mgP/L	0	0	0	0
Stored PHA mgCOD/L	0	0	0	0
Releasable stored polyP mgP/L	0	0	0	0
Fixed stored polyP mgP/L	0	0	0	0
PolyP bound cations mg/L	0	0	0	0
Readily bio. COD (complex) mgCOD/L	0	0	0	0
Acetate mgCOD/L	0	0	0	0
Propionate mgCOD/L	0	0	0	0
Methanol mgCOD/L	0	0	0	0
Dissolved H2 mgCOD/L	0	0	0	0

Dissolved methane mg/L	0	0	0	0
Ammonia N mgN/L	0	0	0	0
Sol. bio. org. N mgN/L	0	0	0	0
Nitrite N mgN/L	0	0	0	0
Nitrate N mgN/L	0	0	0	0
Dissolved nitrogen gas mgN/L	0	0	0	0
PO4-P (Sol. & Me Complexed) mgP/L	0	0	0	0
Sol. inert COD mgCOD/L	0	0	0	0
Sol. inert TKN mgN/L	0	0	0	0
Inorganic S.S. mgISS/L	0	0	0	0
Struvite mgISS/L	0	0	0	0
Hydroxy-dicalcium-phosphate mgISS/L	0	0	0	0
Hydroxy-apatite mgISS/L	0	0	0	0
Magnesium mg/L	0	0	0	0
Calcium mg/L	0	0	0	0
Metal mg/L	0	0	0	0
Other Cations (strong bases) meq/L	14500.00	14500.00	14500.00	14500.00
Other Anions (strong acids) meq/L	0	0	0	0
Total CO2 mmol/L	0	0	0	0
User defined 1 mg/L	0	0	0	0
User defined 2 mg/L	0	0	0	0
User defined 3 mgVSS/L	0	0	0	0
User defined 4 mgISS/L	0	0	0	0
Dissolved oxygen mg/L	0	0	0	0
Flow	0	0.00035	2E-5	1E-5

Configuration information for all Bioreactor (brush aerators) units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]
Oxidation Ditch	0.4000	5347.2225	10.000

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint
Oxidation Ditch	1.5

Aeration equipment parameters

Element name	Surface aerator Std. oxygen transfer rate [lb O /(hp hr)]	Maximum power per rotor [hp]
Oxidation Ditch	2.4670	26.8097

BioWin Album

Album page - Aerobic Digester

No element
toomanycolumns

Parameters	Value	Units

Album page - Aerobic Digester

Album page - Aeration Basin

No element

toomanycolumns

Parameters	Value	Units

Album page - Effluent

Secondary Effluent			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
Volatile suspended solids	0.16	1.17	
Total suspended solids	0.24	1.69	
Particulate COD	0.24	1.73	
Filtered COD	37.00	265.11	
Total COD	37.24	266.84	
Soluble PO4-P	0.01	0.07	
Total P	0.02	0.12	
Filtered TKN	5.22	37.44	
Particulate TKN	0.01	0.10	
Total Kjeldahl Nitrogen	5.24	37.54	
Filtered Carbonaceous BOD	1.44	10.31	
Total Carbonaceous BOD	1.52	10.87	
Nitrite + Nitrate	26.85	192.40	

Total N	32.09	229.94	
Total inorganic N	28.56	204.68	
Alkalinity	0.93	3.03	mmol/L and kmol/d
pH	6.67		
Volatile fatty acids	0.00	0.01	
Total precipitated solids	0.02	0.13	
Total inorganic suspended solids	0.07	0.53	
Ammonia N	1.71	12.28	
Nitrate N	14.31	102.57	

Parameters	Value	Units

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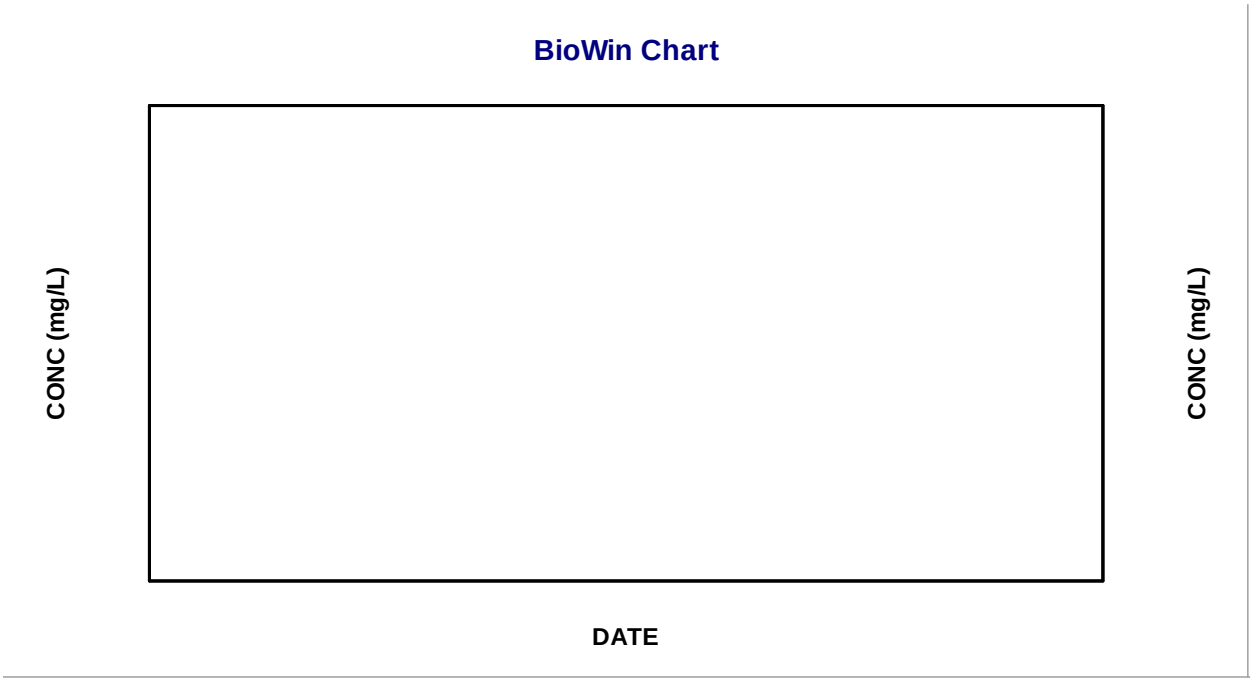

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Sidestream Mixer52

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
Volatile suspended solids	0.16	1.17	
Total suspended solids	0.24	1.69	
Particulate COD	0.24	1.73	
Filtered COD	37.00	265.11	
Total COD	37.24	266.84	
Soluble PO4-P	0.01	0.07	
Total P	0.02	0.12	
Filtered TKN	5.22	37.44	
Particulate TKN	0.01	0.10	
Total Kjeldahl Nitrogen	5.24	37.54	
Filtered Carbonaceous BOD	1.44	10.31	
Total Carbonaceous BOD	1.52	10.87	
Nitrite + Nitrate	26.85	192.40	
Total N	32.09	229.94	
Total inorganic N	28.56	204.68	
Alkalinity	0.93	3.03	mmol/L and kmol/d
pH	6.67		
Volatile fatty acids	0.00	0.01	
Total precipitated solids	0.02	0.13	
Total inorganic suspended solids	0.07	0.53	
Ammonia N	1.71	12.28	
Nitrate N	14.31	102.57	

Parameters	Value	Units

Album page - Page 6

Sidestream Mixer14

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
Volatile suspended solids	5738.62	16448.50	
Total suspended solids	8315.48	23834.53	
Particulate COD	8474.44	24290.14	
Filtered COD	37.00	106.04	
Total COD	8511.43	24396.19	
Soluble PO4-P	0.01	0.03	
Total P	264.66	758.59	
Filtered TKN	5.22	14.97	
Particulate TKN	497.97	1427.32	
Total Kjeldahl Nitrogen	503.19	1442.30	
Filtered Carbonaceous BOD	1.44	4.12	
Total Carbonaceous BOD	2754.24	7894.44	
Nitrite + Nitrate	26.85	76.96	
Total N	530.04	1519.26	
Total inorganic N	28.56	81.87	
Alkalinity	1.13	1.47	mmol/L and kmol/d
pH	6.67		
Volatile fatty acids	0.00	0.00	
Total precipitated solids	651.18	1866.46	
Total inorganic suspended solids	2576.87	7386.03	
Ammonia N	1.71	4.91	
Nitrate N	14.31	41.03	

Parameters	Value	Units

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Sidestream Mixer9

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
Volatile suspended solids	8918.81	1676.19	
Total suspended solids	12486.56	2346.71	
Particulate COD	13170.75	2475.29	
Filtered COD	36.96	6.95	
Total COD	13207.71	2482.24	
Soluble PO4-P	169.31	31.82	
Total P	411.32	77.30	
Filtered TKN	5.22	0.98	
Particulate TKN	773.93	145.45	
Total Kjeldahl Nitrogen	779.15	146.43	
Filtered Carbonaceous BOD	1.44	0.27	
Total Carbonaceous BOD	4279.77	804.33	
Nitrite + Nitrate	26.83	5.04	
Total N	805.98	151.47	
Total inorganic N	28.54	5.36	
Alkalinity	14.09	1.20	mmol/L and kmol/d
pH	10.41		
Volatile fatty acids	0.00	0.00	
Total precipitated solids	574.89	108.04	
Total inorganic suspended solids	3567.75	670.52	
Ammonia N	1.71	0.32	
Nitrate N	14.30	2.69	

Parameters	Value	Units

Global Parameters

AOB

Name	Default	Value	
Max. spec. growth rate [1/d]	0.90000	0.90000	1.0720
Substrate (NH4) half sat. [mgN/L]	0.70000	0.70000	1.0000
Aerobic decay rate [1/d]	0.17000	0.17000	1.0290
Anoxic/anaerobic decay rate [1/d]	0.08000	0.08000	1.0290
KiHNO2 [mmol/L]	0.00500	0.00500	1.0000

NOB

Name	Default	Value	
Max. spec. growth rate [1/d]	0.70000	0.70000	1.0600
Substrate (NO2) half sat. [mgN/L]	0.10000	0.10000	1.0000
Aerobic decay rate [1/d]	0.17000	0.17000	1.0290
Anoxic/anaerobic decay rate [1/d]	0.08000	0.08000	1.0290
KiNH3 [mmol/L]	0.07500	0.07500	1.0000

ANAMMOX

Name	Default	Value	
Max. spec. growth rate [1/d]	0.10000	0.10000	1.1000
Substrate (NH4) half sat. [mgN/L]	2.00000	2.00000	1.0000
Substrate (NO2) half sat. [mgN/L]	1.00000	1.00000	1.0000
Aerobic decay rate [1/d]	0.01900	0.01900	1.0290
Anoxic/anaerobic decay rate [1/d]	0.00950	0.00950	1.0290
Ki Nitrite [mgN/L]	1000.00000	1000.00000	1.0000
Nitrite sensitivity constant [L / (d mgN)]	0.01600	0.01600	1.0000

OHOs

Name	Default	Value	
Max. spec. growth rate [1/d]	3.20000	3.20000	1.0290
Substrate half sat. [mgCOD/L]	5.00000	5.00000	1.0000
Anoxic growth factor [-]	0.50000	0.50000	1.0000
Aerobic decay [1/d]	0.62000	0.62000	1.0290
Anoxic/anaerobic decay [1/d]	0.30000	0.30000	1.0290
Hydrolysis rate (AS) [1/d]	2.10000	2.10000	1.0290
Hydrolysis half sat. (AS) [-]	0.06000	0.06000	1.0000
Anoxic hydrolysis factor [-]	0.28000	0.28000	1.0000
Anaerobic hydrolysis factor [-]	0.50000	0.50000	1.0000
Adsorption rate of colloids [L/(mgCOD d)]	0.80000	0.80000	1.0290
Ammonification rate [L/(mgN d)]	0.04000	0.04000	1.0290
Assimilative nitrate/nitrite reduction rate [1/d]	0.50000	0.50000	1.0000
Fermentation rate [1/d]	3.20000	3.20000	1.0290
Fermentation half sat. [mgCOD/L]	5.00000	5.00000	1.0000
Anaerobic growth factor (AS) [-]	0.12500	0.12500	1.0000
Hydrolysis rate (AD) [1/d]	0.10000	0.10000	1.0500
Hydrolysis half sat. (AD) [mgCOD/L]	0.15000	0.15000	1.0000

Methylotrophs

Name	Default	Value	
Max. spec. growth rate of methanol utilizers [1/d]	1.30000	1.30000	1.0720
Methanol half sat. [mgCOD/L]	0.50000	0.50000	1.0000
Aerobic decay rate of methanol utilizers [1/d]	0.04000	0.04000	1.0290
Anoxic/anaerobic decay rate of methanol utilizers [1/d]	0.03000	0.03000	1.0290

PAOs

Name	Default	Value	
Max. spec. growth rate [1/d]	0.95000	0.95000	1.0000
Max. spec. growth rate, P-limited [1/d]	0.42000	0.42000	1.0000
Substrate half sat. [mgCOD(PHB)/mgCOD(Zbp)]	0.10000	0.10000	1.0000
Substrate half sat., P-limited [mgCOD(PHB)/mgCOD(Zbp)]	0.05000	0.05000	1.0000
Magnesium half sat. [mgMg/L]	0.10000	0.10000	1.0000
Cation half sat. [mmol/L]	0.10000	0.10000	1.0000
Calcium half sat. [mgCa/L]	0.10000	0.10000	1.0000
Aerobic decay rate [1/d]	0.10000	0.10000	1.0000
Anaerobic decay rate [1/d]	0.04000	0.04000	1.0000
Sequestration rate [1/d]	6.00000	6.00000	1.0000
Anoxic growth factor NO3 [-]	0.33000	0.33000	1.0000
Anoxic growth factor NO2 [-]	0.33000	0.33000	1.0000

Acetogens

Name	Default	Value	
Max. spec. growth rate [1/d]	0.25000	0.25000	1.0290
Substrate half sat. [mgCOD/L]	10.00000	10.00000	1.0000
Acetate inhibition [mgCOD/L]	10000.00000	10000.00000	1.0000
Decay rate [1/d]	0.05000	0.05000	1.0290
Aerobic decay rate [1/d]	0.52000	0.52000	1.0290

Methanogens

Name	Default	Value	
Acetoclastic Mu Max [1/d]	0.30000	0.30000	1.0290
H2-utilizing Mu Max [1/d]	1.40000	1.40000	1.0290
Acetoclastic Ks [mgCOD/L]	100.00000	100.00000	1.0000
Acetoclastic methanol Ks [mgCOD/L]	0.50000	0.50000	1.0000
H2-utilizing CO2 half sat. [mmol/L]	0.10000	0.10000	1.0000
H2-utilizing Ks [mgCOD/L]	0.10000	0.10000	1.0000
H2-utilizing methanol Ks [mgCOD/L]	0.50000	0.50000	1.0000
Acetoclastic propionic inhibition [mgCOD/L]	10000.00000	10000.00000	1.0000
Acetoclastic decay rate [1/d]	0.13000	0.13000	1.0290
Acetoclastic aerobic decay rate [1/d]	0.60000	0.60000	1.0290
H2-utilizing decay rate [1/d]	0.13000	0.13000	1.0290
H2-utilizing aerobic decay rate [1/d]	0.60000	0.60000	1.0290

pH

Name	Default	Value

Heterotrophs low pH limit [-]	4.00000	4.00000
Heterotrophs high pH limit [-]	10.00000	10.00000
Methanol utilizers low pH limit [-]	4.00000	4.00000
Methanol utilizers high pH limit [-]	10.00000	10.00000
Autotrophs low pH limit [-]	5.50000	5.50000
Autotrophs high pH limit [-]	9.50000	9.50000
PolyP heterotrophs low pH limit [-]	4.00000	4.00000
Poly P heterotrophs high pH limit [-]	10.00000	10.00000
Heterotrophs low pH limit (anaerobic) [-]	5.50000	5.50000
Heterotrophs high pH limit (anaerobic) [-]	8.50000	8.50000
Propionic acetogens low pH limit [-]	4.00000	4.00000
Propionic acetogens high pH limit [-]	10.00000	10.00000
Acetoclastic methanogens low pH limit [-]	5.00000	5.00000
Acetoclastic methanogens high pH limit [-]	9.00000	9.00000
H2-utilizing methanogens low pH limit [-]	5.00000	5.00000
H2-utilizing methanogens high pH limit [-]	9.00000	9.00000

Switches

Name	Default	Value
Heterotrophic DO half sat. [mgO2/L]	0.05000	0.05000
Aerobic denit. DO half sat. [mgO2/L]	0.05000	0.05000
Ammonia oxidizer DO half sat. [mgO2/L]	0.25000	0.25000
Nitrite oxidizer DO half sat. [mgO2/L]	0.50000	0.50000
Anaerobic ammonia oxidizer DO half sat. [mgO2/L]	0.01000	0.01000
Anoxic NO3 half sat. [mgN/L]	0.10000	0.10000
Anoxic NO2 half sat. (mgN/L)	0.01000	0.01000
NH3 nutrient half sat. [mgN/L]	1.0000E-4	1.0000E-4
PolyP half sat. [mgP/L]	0.01000	0.01000

VFA sequestration half sat. [mgCOD/L]	5.00000	5.00000
P uptake half sat. [mgP/L]	0.15000	0.15000
P nutrient half sat. [mgP/L]	0.00100	0.00100
Autotroph CO2 half sat. [mmol/L]	0.10000	0.10000
Heterotrophic Hydrogen half sat. [mgCOD/L]	1.00000	1.00000
Propionic acetogens Hydrogen half sat. [mgCOD/L]	5.00000	5.00000
Synthesis anion/cation half sat. [meq/L]	0.01000	0.01000

Common

Name	Default	Value
N in endogenous residue [mgN/mgCOD]	0.07000	0.07000
P in endogenous residue [mgP/mgCOD]	0.02200	0.02200
Endogenous residue COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
Particulate substrate COD:VSS ratio [mgCOD/mgVSS]	1.60000	1.60000
Particulate inert COD:VSS ratio [mgCOD/mgVSS]	1.60000	1.60000

AOB

Name	Default	Value
Yield [mgCOD/mgN]	0.15000	0.15000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

NOB

Name	Default	Value
Yield [mgCOD/mgN]	0.09000	0.09000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

ANAMMOX

Name	Default	Value
Yield [mgCOD/mgN]	0.11400	0.11400
Nitrate production [mgN/mgBiomassCOD]	2.28000	2.28000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

OHOs

Name	Default	Value
Yield (aerobic) [-]	0.66600	0.66600
Yield (fermentation, low H2) [-]	0.10000	0.10000
Yield (fermentation, high H2) [-]	0.10000	0.10000
H2 yield (fermentation low H2) [-]	0.35000	0.35000

H2 yield (fermentation high H2) [-]	0	0
Propionate yield (fermentation, low H2) [-]	0	0
Propionate yield (fermentation, high H2) [-]	0.70000	0.70000
CO2 yield (fermentation, low H2) [-]	0.70000	0.70000
CO2 yield (fermentation, high H2) [-]	0	0
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
Yield (anoxic) [-]	0.54000	0.54000
Yield propionic (aerobic) [-]	0.64000	0.64000
Yield propionic (anoxic) [-]	0.46000	0.46000
Yield acetic (aerobic) [-]	0.60000	0.60000
Yield acetic (anoxic) [-]	0.43000	0.43000
Yield methanol (aerobic) [-]	0.50000	0.50000
Adsorp. max. [-]	1.00000	1.00000

Methylotrophs

Name	Default	Value
Yield (anoxic) [-]	0.40000	0.40000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

PAOs

Name	Default	Value
Yield (aerobic) [-]	0.63900	0.63900
Yield (anoxic) [-]	0.52000	0.52000
Aerobic P/PHA uptake [mgP/mgCOD]	0.95000	0.95000
Anoxic P/PHA uptake [mgP/mgCOD]	0.35000	0.35000
Yield of PHA on sequestration [-]	0.88900	0.88900
N in biomass [mgN/mgCOD]	0.07000	0.07000
N in sol. inert [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous part. [-]	0.25000	0.25000
Inert fraction of endogenous sol. [-]	0.20000	0.20000
P/Ac release ratio [mgP/mgCOD]	0.49000	0.49000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
Yield of low PP [-]	0.94000	0.94000

Acetogens

Name	Default	Value
Yield [-]	0.10000	0.10000
H2 yield [-]	0.40000	0.40000
CO2 yield [-]	1.00000	1.00000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

Methanogens

Name	Default	Value
Acetoclastic yield [-]	0.10000	0.10000
Methanol acetoclastic yield [-]	0.10000	0.10000
H2-utilizing yield [-]	0.10000	0.10000
Methanol H2-utilizing yield [-]	0.10000	0.10000
N in acetoclastic biomass [mgN/mgCOD]	0.07000	0.07000
N in H2-utilizing biomass [mgN/mgCOD]	0.07000	0.07000
P in acetoclastic biomass [mgP/mgCOD]	0.02200	0.02200
P in H2-utilizing biomass [mgP/mgCOD]	0.02200	0.02200
Acetoclastic fraction to endog. residue [-]	0.08000	0.08000
H2-utilizing fraction to endog. residue [-]	0.08000	0.08000
Acetoclastic COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
H2-utilizing COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

General

Name	Default	Value
Ash content of biomass (synthesis ISS) [%]	8.00000	8.00000
Molecular weight of other anions [mg/mmol]	35.50000	35.50000
Molecular weight of other cations [mg/mmol]	39.10000	39.10000
Mg to P mole ratio in polyphosphate [mmolMg/mmolP]	0.30000	0.30000
Cation to P mole ratio in polyphosphate [meq/mmolP]	0.30000	0.30000
Ca to P mole ratio in polyphosphate [mmolCa/mmolP]	0.05000	0.05000
Cation to P mole ratio in organic phosphate [meq/mmolP]	0.01000	0.01000
Bubble rise velocity (anaerobic digester) [cm/s]	23.90000	23.90000
Bubble Sauter mean diameter (anaerobic digester) [cm]	0.35000	0.35000
Anaerobic digester gas hold-up factor []	1.00000	1.00000
Tank head loss per metre of length (from flow) [m/m]	0.00250	0.00250

Mass transfer

Name	Default	Value	
Kl for H2 [m/d]	17.00000	17.00000	1.0240
Kl for CO2 [m/d]	10.00000	10.00000	1.0240
Kl for NH3 [m/d]	1.00000	1.00000	1.0240
Kl for CH4 [m/d]	8.00000	8.00000	1.0240
Kl for N2 [m/d]	15.00000	15.00000	1.0240
Kl for O2 [m/d]	13.00000	13.00000	1.0240

Physico-chemical rates

Name	Default	Value	
Struvite precipitation rate [1/d]	3.0000E+10	3.0000E+10	1.0240
Struvite redissolution rate [1/d]	3.0000E+11	3.0000E+11	1.0240
Struvite half sat. [mgTSS/L]	1.00000	1.00000	1.0000
HDP precipitation rate [L/(molP d)]	1.0000E+8	1.0000E+8	1.0000
HDP redissolution rate [L/(mol P d)]	1.0000E+8	1.0000E+8	1.0000
HAP precipitation rate [molHDP/(L d)]	5.0000E-4	5.0000E-4	1.0000

Physico-chemical constants

Name	Default	Value
Struvite solubility constant [mol/L]	6.9180E-14	6.9180E-14
HDP solubility product [mol/L]	2.7500E-22	2.7500E-22

HDP half sat. [mgTSS/L]	1.00000	1.00000
Equilibrium soluble PO4 with Al dosing at pH 7 [mgP/L]	0.01000	0.01000
Al to P ratio [molAl/molP]	0.80000	0.80000
Al(OH)3 solubility product [mol/L]	1.2590E+9	1.2590E+9
AlHPO4+ dissociation constant [mol/L]	7.9430E-13	7.9430E-13
Equilibrium soluble PO4 with Fe dosing at pH 7 [mgP/L]	0.01000	0.01000
Fe to P ratio [molFe/molP]	1.60000	1.60000
Fe(OH)3 solubility product [mol/L]	0.05000	0.05000
FeH2PO4++ dissociation constant [mol/L]	5.0120E-22	5.0120E-22

Aeration

Name	Default	Value
Alpha (surf) OR Alpha F (diff) [-]	0.50000	0.50000
Beta [-]	0.95000	0.95000
Surface pressure [kPa]	101.32500	101.32500
Fractional effective saturation depth (Fed) [-]	0.32500	0.32500
Supply gas CO2 content [vol. %]	0.03500	0.03500
Supply gas O2 [vol. %]	20.95000	20.95000
Off-gas CO2 [vol. %]	2.00000	2.00000
Off-gas O2 [vol. %]	18.80000	18.80000
Off-gas H2 [vol. %]	0	0
Off-gas NH3 [vol. %]	0	0
Off-gas CH4 [vol. %]	0	0
Surface turbulence factor [-]	2.00000	2.00000
Set point controller gain []	1.00000	1.00000

Modified Vesilind

Name	Default	Value
Maximum Vesilind settling velocity (Vo) [ft/min]	0.3873	0.3873
Vesilind hindered zone settling parameter (K) [L/g]	0.3700	0.3700
Clarification switching function [mg/L]	100.0000	100.0000
Specified TSS conc.for height calc. [mg/L]	2500.0000	2500.0000
Maximum compactability constant [mg/L]	15000.0000	15000.0000

Double exponential

Name	Default	Value
Maximum Vesilind settling velocity (Vo) [ft/min]	0.9341	0.9341
Maximum (practical) settling velocity (Vo') [ft/min]	0.6152	0.6152
Hindered zone settling parameter (Kh) [L/g]	0.4000	0.4000
Flocculent zone settling parameter (Kf) [L/g]	2.5000	2.5000
Maximum non-settleable TSS [mg/L]	20.0000	20.0000
Non-settleable fraction [-]	0.0010	0.0010
Specified TSS conc. for height calc. [mg/L]	2500.0000	2500.0000

Biofilm general

Name	Default	Value	
Attachment rate [g / (m2 d)]	80.00000	80.00000	1.0000
Attachment TSS half sat. [mg/L]	100.00000	100.00000	1.0000
Detachment rate [g/(m3 d)]	8.0000E+4	8.0000E+4	1.0000
Solids movement factor []	10.00000	10.00000	1.0000
Diffusion neta []	0.80000	0.80000	1.0000

Thin film limit [mm]	0.50000	0.50000	1.0000
Thick film limit [mm]	3.00000	3.00000	1.0000
Assumed Film thickness for tank volume correction (temp independant) [mm]	0.75000	0.75000	1.0000
Film surface area to media area ratio - Max.[ ]	1.00000	1.00000	1.0000
Minimum biofilm conc. for streamer formation [gTSS/m2]	4.00000	4.00000	1.0000

Maximum biofilm concentrations [mg/L]

Name	Default	Value	
Non-polyP heterotrophs	5.0000E+4	5.0000E+4	1.0000
Anoxic methanol utilizers	5.0000E+4	5.0000E+4	1.0000
Ammonia oxidizing biomass	1.0000E+5	1.0000E+5	1.0000
Nitrite oxidizing biomass	1.0000E+5	1.0000E+5	1.0000
Anaerobic ammonia oxidizers	5.0000E+4	5.0000E+4	1.0000
PolyP heterotrophs	5.0000E+4	5.0000E+4	1.0000
Propionic acetogens	5.0000E+4	5.0000E+4	1.0000
Acetoclastic methanogens	5.0000E+4	5.0000E+4	1.0000
Hydrogenotrophic methanogens	5.0000E+4	5.0000E+4	1.0000
Endogenous products	3.0000E+4	3.0000E+4	1.0000
Slowly bio. COD (part.)	5000.00000	5000.00000	1.0000
Slowly bio. COD (colloid.)	0	0	1.0000
Part. inert. COD	5000.00000	5000.00000	1.0000
Part. bio. org. N	0	0	1.0000
Part. bio. org. P	0	0	1.0000
Part. inert N	0	0	1.0000
Part. inert P	0	0	1.0000
Stored PHA	5000.00000	5000.00000	1.0000
Releasable stored polyP	1.1500E+6	1.1500E+6	1.0000
Fixed stored polyP	1.1500E+6	1.1500E+6	1.0000

PolyP bound cations	1.1500E+6	1.1500E+6	1.0000
Readily bio. COD (complex)	0	0	1.0000
Acetate	0	0	1.0000
Propionate	0	0	1.0000
Methanol	0	0	1.0000
Dissolved H2	0	0	1.0000
Dissolved methane	0	0	1.0000
Ammonia N	0	0	1.0000
Sol. bio. org. N	0	0	1.0000
Nitrite N	0	0	1.0000
Nitrate N	0	0	1.0000
Dissolved nitrogen gas	0	0	1.0000
PO4-P (Sol. & Me Complexed)	1.0000E+10	1.0000E+10	1.0000
Sol. inert COD	0	0	1.0000
Sol. inert TKN	0	0	1.0000
Inorganic S.S.	1.3000E+6	1.3000E+6	1.0000
Struvite	8.5000E+5	8.5000E+5	1.0000
Hydroxy-dicalcium-phosphate	1.1500E+6	1.1500E+6	1.0000
Hydroxy-apatite	1.6000E+6	1.6000E+6	1.0000
Magnesium	0	0	1.0000
Calcium	0	0	1.0000
Metal	1.0000E+10	1.0000E+10	1.0000
Other Cations (strong bases)	0	0	1.0000
Other Anions (strong acids)	0	0	1.0000
Total CO2	0	0	1.0000
User defined 1	0	0	1.0000
User defined 2	0	0	1.0000
User defined 3	5.0000E+4	5.0000E+4	1.0000
User defined 4	5.0000E+4	5.0000E+4	1.0000
Dissolved oxygen	0	0	1.0000

Effective diffusivities [m2/s]

Name	Default	Value	
Non-polyP heterotrophs	5.0000E-14	5.0000E-14	1.0290
Anoxic methanol utilizers	5.0000E-14	5.0000E-14	1.0290
Ammonia oxidizing biomass	5.0000E-14	5.0000E-14	1.0290
Nitrite oxidizing biomass	5.0000E-14	5.0000E-14	1.0290
Anaerobic ammonia oxidizers	5.0000E-14	5.0000E-14	1.0290
PolyP heterotrophs	5.0000E-14	5.0000E-14	1.0290
Propionic acetogens	5.0000E-14	5.0000E-14	1.0290
Acetoclastic methanogens	5.0000E-14	5.0000E-14	1.0290
Hydrogenotrophic methanogens	5.0000E-14	5.0000E-14	1.0290
Endogenous products	5.0000E-14	5.0000E-14	1.0290
Slowly bio. COD (part.)	5.0000E-14	5.0000E-14	1.0290
Slowly bio. COD (colloid.)	6.9000E-11	6.9000E-11	1.0290
Part. inert. COD	5.0000E-14	5.0000E-14	1.0290
Part. bio. org. N	5.0000E-14	5.0000E-14	1.0290
Part. bio. org. P	5.0000E-14	5.0000E-14	1.0290
Part. inert N	5.0000E-14	5.0000E-14	1.0290
Part. inert P	5.0000E-14	5.0000E-14	1.0290
Stored PHA	5.0000E-14	5.0000E-14	1.0290
Releasable stored polyP	5.0000E-14	5.0000E-14	1.0290
Fixed stored polyP	5.0000E-14	5.0000E-14	1.0290
PolyP bound cations	5.0000E-14	5.0000E-14	1.0290
Readily bio. COD (complex)	6.9000E-10	6.9000E-10	1.0290
Acetate	1.2400E-9	1.2400E-9	1.0290
Propionate	8.3000E-10	8.3000E-10	1.0290
Methanol	1.6000E-9	1.6000E-9	1.0290
Dissolved H2	5.8500E-9	5.8500E-9	1.0290

Dissolved methane	1.9625E-9	1.9625E-9	1.0290
Ammonia N	2.0000E-9	2.0000E-9	1.0290
Sol. bio. org. N	1.3700E-9	1.3700E-9	1.0290
Nitrite N	2.9800E-9	2.9800E-9	1.0290
Nitrate N	2.9800E-9	2.9800E-9	1.0290
Dissolved nitrogen gas	1.9000E-9	1.9000E-9	1.0290
PO4-P (Sol. & Me Complexed)	2.0000E-9	2.0000E-9	1.0290
Sol. inert COD	6.9000E-10	6.9000E-10	1.0290
Sol. inert TKN	6.8500E-10	6.8500E-10	1.0290
Inorganic S.S.	5.0000E-14	5.0000E-14	1.0290
Struvite	5.0000E-14	5.0000E-14	1.0290
Hydroxy-dicalcium-phosphate	5.0000E-14	5.0000E-14	1.0290
Hydroxy-apatite	5.0000E-14	5.0000E-14	1.0290
Magnesium	7.2000E-10	7.2000E-10	1.0290
Calcium	7.2000E-10	7.2000E-10	1.0290
Metal	4.8000E-10	4.8000E-10	1.0290
Other Cations (strong bases)	1.4400E-9	1.4400E-9	1.0290
Other Anions (strong acids)	1.4400E-9	1.4400E-9	1.0290
Total CO2	1.9600E-9	1.9600E-9	1.0290
User defined 1	6.9000E-10	6.9000E-10	1.0290
User defined 2	6.9000E-10	6.9000E-10	1.0290
User defined 3	5.0000E-14	5.0000E-14	1.0290
User defined 4	5.0000E-14	5.0000E-14	1.0290
Dissolved oxygen	2.5000E-9	2.5000E-9	1.0290

EPS Strength coefficients [ ]

Name	Default	Value	
Non-polyP heterotrophs	1.00000	1.00000	1.0000

Anoxic methanol utilizers	1.00000	1.00000	1.0000
Ammonia oxidizing biomass	1.00000	1.00000	1.0000
Nitrite oxidizing biomass	1.00000	1.00000	1.0000
Anaerobic ammonia oxidizers	1.00000	1.00000	1.0000
PolyP heterotrophs	1.00000	1.00000	1.0000
Propionic acetogens	1.00000	1.00000	1.0000
Acetoclastic methanogens	1.00000	1.00000	1.0000
Hydrogenotrophic methanogens	1.00000	1.00000	1.0000
Endogenous products	1.00000	1.00000	1.0000
Slowly bio. COD (part.)	1.00000	1.00000	1.0000
Slowly bio. COD (colloid.)	0	0	1.0000
Part. inert. COD	1.00000	1.00000	1.0000
Part. bio. org. N	1.00000	1.00000	1.0000
Part. bio. org. P	1.00000	1.00000	1.0000
Part. inert N	1.00000	1.00000	1.0000
Part. inert P	1.00000	1.00000	1.0000
Stored PHA	1.00000	1.00000	1.0000
Releasable stored polyP	1.00000	1.00000	1.0000
Fixed stored polyP	1.00000	1.00000	1.0000
PolyP bound cations	1.00000	1.00000	1.0000
Readily bio. COD (complex)	0	0	1.0000
Acetate	0	0	1.0000
Propionate	0	0	1.0000
Methanol	0	0	1.0000
Dissolved H2	0	0	1.0000
Dissolved methane	0	0	1.0000
Ammonia N	0	0	1.0000
Sol. bio. org. N	0	0	1.0000
Nitrite N	0	0	1.0000
Nitrate N	0	0	1.0000
Dissolved nitrogen gas	0	0	1.0000

PO4-P (Sol. & Me Complexed)	1.00000	1.00000	1.0000
Sol. inert COD	0	0	1.0000
Sol. inert TKN	0	0	1.0000
Inorganic S.S.	0.33000	0.33000	1.0000
Struvite	1.00000	1.00000	1.0000
Hydroxy-dicalcium-phosphate	1.00000	1.00000	1.0000
Hydroxy-apatite	1.00000	1.00000	1.0000
Magnesium	0	0	1.0000
Calcium	0	0	1.0000
Metal	1.00000	1.00000	1.0000
Other Cations (strong bases)	0	0	1.0000
Other Anions (strong acids)	0	0	1.0000
Total CO2	0	0	1.0000
User defined 1	0	0	1.0000
User defined 2	0	0	1.0000
User defined 3	1.00000	1.00000	1.0000
User defined 4	1.00000	1.00000	1.0000
Dissolved oxygen	0	0	1.0000

BioWin user and configuration data

Project details

Project name: Aerobic Digester Model Development **Project ref.: 60037-15001**

Plant name: North Bend **User name: Markus**

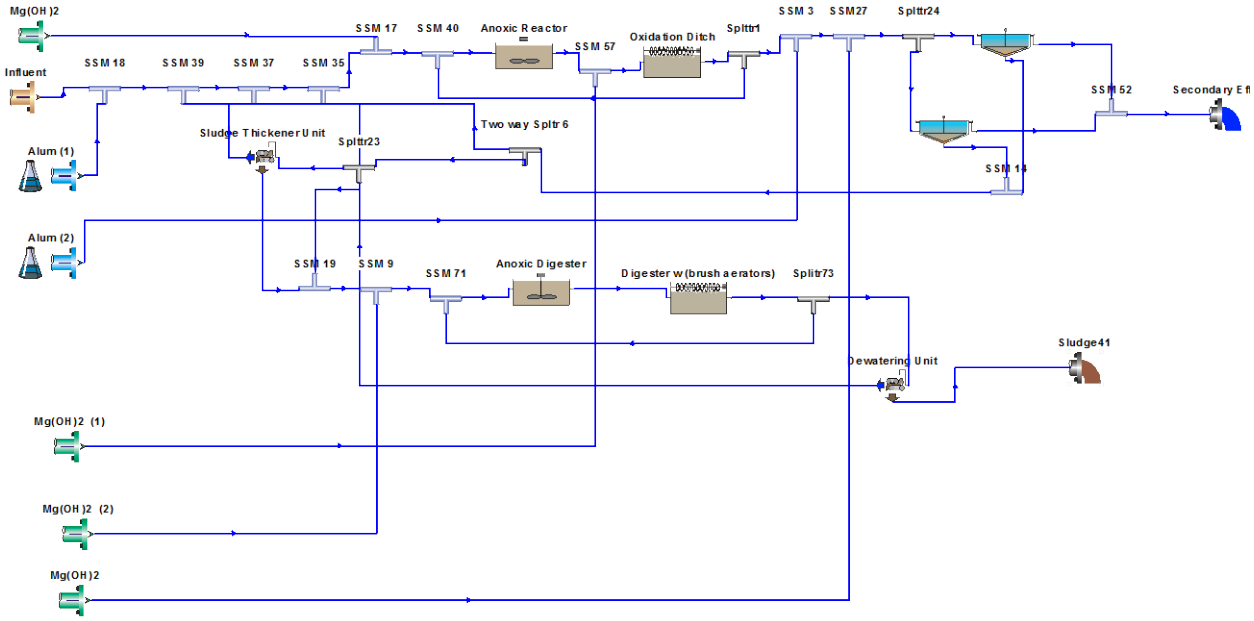
Created: 3/1/2001 **Saved: 9/5/2016**

Steady state solution

SRT: 7.59

Temperature: 20.0

Flowsheet



Configuration information for all Bioreactor units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers
Anoxic Digester	0.3000	2673.6113	15.000	Un-aerated

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint [mg/L]
Anoxic Digester	0

Aeration equipment parameters

Element name	k1 in C = k1(PC)^0.25 + k2	k2 in C = k1(PC)^0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	% of tank area covered by diffusers [%]
Anoxic Digester	2.5656	0.0432	0.8200	0.0410	10.0000

Configuration information for all BOD Influent units

Operating data Average (flow/time weighted as required)

Element name	Influent
Flow	0.860869992486947
TCBOD mgBOD/L	328.00
VSS mgVSS/L	328.00
TSS mgTSS/L	386.00
TKN mgN/L	97.00
TP mgP/L	9.70
S_NO3 mgN/L	0
pH	7.00
Alk mmol/L	1.17
S_CA mg/L	4.40
S_MG mg/L	1.80
S_O2 mg/L	0

Element name	Influent
Fbs - Readily biodegradable (including Acetate) [gCOD/g of total COD]	0.1600
Fac - Acetate [gCOD/g of readily biodegradable COD]	0.1500
Fxsp - Non-colloidal slowly biodegradable [gCOD/g of slowly degradable COD]	0.9397
Fus - Unbiodegradable soluble [gCOD/g of total COD]	0.0500
Fup - Unbiodegradable particulate [gCOD/g of total COD]	0.1300
Fna - Ammonia [gNH3-N/gTKN]	0.6600
Fnox - Particulate organic nitrogen [gN/g Organic N]	0.5000
Fnus - Soluble unbiodegradable TKN [gN/gTKN]	0.0200
FupN - N:COD ratio for unbiodegradable part. COD [gN/gCOD]	0.0350
Fpo4 - Phosphate [gPO4-P/gTP]	0.6300
FupP - P:COD ratio for unbiodegradable part. COD [gP/gCOD]	0.0110
FZbh - Non-poly-P heterotrophs [gCOD/g of total COD]	0.0001
FZbm - Anoxic methanol utilizers [gCOD/g of total COD]	0.0001
FZaob - Ammonia oxidizers [gCOD/g of total COD]	0.0001

FZnob - Nitrite oxidizers [gCOD/g of total COD]	0.0001
FZamob - Anaerobic ammonia oxidizers [gCOD/g of total COD]	0.0001
FZbp - PAOs [gCOD/g of total COD]	0.0001
FZbpa - Propionic acetogens [gCOD/g of total COD]	0.0001
FZbam - Acetoclastic methanogens [gCOD/g of total COD]	0.0001
FZbhm - H2-utilizing methanogens [gCOD/g of total COD]	0.0001

Configuration information for all Model clarifier units

Physical data

Element name	Volume[Mil. Gal]	Area[ft2]	Depth[ft]	Number of layers	Top feed layer	Feed Layers
Secondary Clariifer 2	0.5025	5024.0000	13.370	10	6	1
Secondary Clarifier No 1	0.5025	5024.0000	13.370	10	6	1

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Secondary Clariifer 2	Ratio	0.40
Secondary Clarifier No 1	Ratio	0.40

Element name	Average Temperature	Reactive
Secondary Clariifer 2	Uses global setting	No
Secondary Clarifier No 1	Uses global setting	No

Configuration information for all Effluent units

Configuration information for all Media Bioreactor units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers
Anoxic Reactor	0.1500	2005.2084	10.000	Un-aerated

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint
Anoxic Reactor	0

Aeration equipment parameters

Element name	k1 in C = k1(PC)^0.25 + k2	k2 in C = k1(PC)^0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	% of tank area covered by diffusers [%]
Anoxic Reactor	2.5656	0.0432	0.8200	0.0410	10.0000

Configuration information for all Metal addition units

Operating data Average (flow/time weighted as required)

Element name	Alum (1)	Alum (2)
X_OHO mgCOD/L	0	0
X_MEOLO mgCOD/L	0	0
X_AOO mgCOD/L	0	0
X_NOO mgCOD/L	0	0
X_AMO mgCOD/L	0	0
X_PAO mgCOD/L	0	0
X_PRO mgCOD/L	0	0
X_ACO mgCOD/L	0	0
X_HMO mgCOD/L	0	0
X_U_E mgCOD/L	0	0
X_B mgCOD/L	0	0
C_B mgCOD/L	0	0
X_U_INF mgCOD/L	0	0
X_B_ORG_N mgN/L	0	0
X_B_ORG_P mgP/L	0	0
X_U_ORG_N mgN/L	0	0
X_U_ORG_P mgP/L	0	0
X_PAO_PHA mgCOD/L	0	0
X_PAO_PPL mgP/L	0	0
X_PAO_PPH mgP/L	0	0
X_PAO_PP_CAT mg/L	0	0
S_F mgCOD/L	0	0
S_AC mgCOD/L	0	0
S_PR mgCOD/L	0	0
S_MEOL mgCOD/L	0	0
S_H2 mgCOD/L	0	0
S_CH4 mg/L	0	0

S_NHx mgN/L	0	0
S_B_ORG_N mgN/L	0	0
S_NO2 mgN/L	0	0
S_NO3 mgN/L	0	0
S_N2 mgN/L	0	0
T_PO4 mgP/L	0	0
S_U mgCOD/L	0	0
S_U_ORG_N mgN/L	0	0
X_IG_INF mgISS/L	0	0
X_MAP mgISS/L	0	0
X_HDP mgISS/L	0	0
X_HAP mgISS/L	0	0
S_MG mg/L	0	0
S_CA mg/L	0	0
S_ME mg/L	0.00	57700.00
S_CAT meq/L	5.00	5.00
S_AN meq/L	15.81	6434.89
S_CO2 mmol/L	7.00	7.00
S_UD1 mg/L	0	0
S_UD2 mg/L	0	0
X_UD3 mgVSS/L	0	0
X_UD4_IG mgISS/L	0	0
S_O2 mg/L	0	0
Flow	0	0

Configuration information for all Sidestream Mixer units

Configuration information for all Dewatering unit units

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Sludge Thickener Unit	Ratio	0.20
Dewatering Unit	Ratio	0.14

Element name	Percent removal
Sludge Thickener Unit	100.00
Dewatering Unit	90.00

Configuration information for all Sludge units

Configuration information for all Splitter units

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Two way Spltr 6	Flowrate [Side]	0.03
Splttr23	Flowrate [Side]	0.01
Splttr1	Ratio	2.50
Splttr24	Ratio	0.00
Splitr73	Ratio	6.00

Configuration information for all Influent (SV) units

Operating data Average (flow/time weighted as required)

Element name	Mg(OH)2	Mg(OH)2 (1)	Mg(OH)2 (2)	Mg(OH)2
X_OHO mgCOD/L	0	0	0	0
X_MEOLO mgCOD/L	0	0	0	0
X_AOO mgCOD/L	0	0	0	0
X_NOO mgCOD/L	0	0	0	0
X_AMO mgCOD/L	0	0	0	0
X_PAO mgCOD/L	0	0	0	0
X_PRO mgCOD/L	0	0	0	0
X_ACO mgCOD/L	0	0	0	0
X_HMO mgCOD/L	0	0	0	0
X_U_E mgCOD/L	0	0	0	0
X_B mgCOD/L	0	0	0	0
C_B mgCOD/L	0	0	0	0
X_U_INF mgCOD/L	0	0	0	0
X_B_ORG_N mgN/L	0	0	0	0
X_B_ORG_P mgP/L	0	0	0	0
X_U_ORG_N mgN/L	0	0	0	0
X_U_ORG_P mgP/L	0	0	0	0
X_PAO_PHA mgCOD/L	0	0	0	0
X_PAO_PPL mgP/L	0	0	0	0
X_PAO_PPH mgP/L	0	0	0	0
X_PAO_PP_CAT mg/L	0	0	0	0
S_F mgCOD/L	0	0	0	0
S_AC mgCOD/L	0	0	0	0
S_PR mgCOD/L	0	0	0	0
S_MEOL mgCOD/L	0	0	0	0
S_H2 mgCOD/L	0	0	0	0

S_CH4 mg/L	0	0	0	0
S_NHx mgN/L	0	0	0	0
S_B_ORG_N mgN/L	0	0	0	0
S_NO2 mgN/L	0	0	0	0
S_NO3 mgN/L	0	0	0	0
S_N2 mgN/L	0	0	0	0
T_PO4 mgP/L	0	0	0	0
S_U mgCOD/L	0	0	0	0
S_U_ORG_N mgN/L	0	0	0	0
X_IG_INF mgISS/L	0	0	0	0
X_MAP mgISS/L	0	0	0	0
X_HDP mgISS/L	0	0	0	0
X_HAP mgISS/L	0	0	0	0
S_MG mg/L	0	0	0	0
S_CA mg/L	0	0	0	0
S_ME mg/L	0	0	0	0
S_CAT meq/L	14500.00	14500.00	14500.00	14500.00
S_AN meq/L	0	0	0	0
S_CO2 mmol/L	0	0	0	0
S_UD1 mg/L	0	0	0	0
S_UD2 mg/L	0	0	0	0
X_UD3 mgVSS/L	0	0	0	0
X_UD4_IG mgISS/L	0	0	0	0
S_O2 mg/L	0	0	0	0
Flow	0	0.00035	2E-5	5E-6

Configuration information for all Bioreactor (brush aerators) units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]
Oxidation Ditch	0.4500	6015.6253	10.000
Digester w (brush aerators)	0.3000	2673.6113	15.000

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint
Oxidation Ditch	0.5
Digester w (brush aerators)	0.5

Aeration equipment parameters

Element name	Surface aerator Std. oxygen transfer rate [lb O /(hp hr)]	Maximum power per rotor [hp]
Oxidation Ditch	2.4670	26.8097
Digester w (brush aerators)	2.4670	26.8097

BioWin Album

Album page - Aerobic Digester

No element
toomanycolumns

Parameters	Value	Units

Album page - Aerobic Digester

Album page - Aeration Basin

No element

toomanycolumns

Parameters	Value	Units

Album page - Effluent

Secondary Effluent			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	1.88	13.47	
TSS	2.55	18.29	
XCOD	2.78	19.91	
SCOD	37.11	266.22	
TCOD	39.88	286.13	
SPO4	6.37	45.71	
TP	6.42	46.08	
STKN	4.88	35.00	
XTKN	0.16	1.16	

TKN	5.04	36.17	
SCBOD	1.20	8.62	
TCBOD	2.05	14.70	
NOx	13.71	98.36	
TN	18.75	134.53	
TIN	15.16	108.79	
Alk	2.11	6.85	mmol/L and kmol/d
pH	7.39		
VFA	0.02	0.14	
XPrec	0	0.00	
TISS	0.67	4.82	
S_NHx	1.45	10.43	
S_NO3	1.47	10.52	

Parameters	Value	Units

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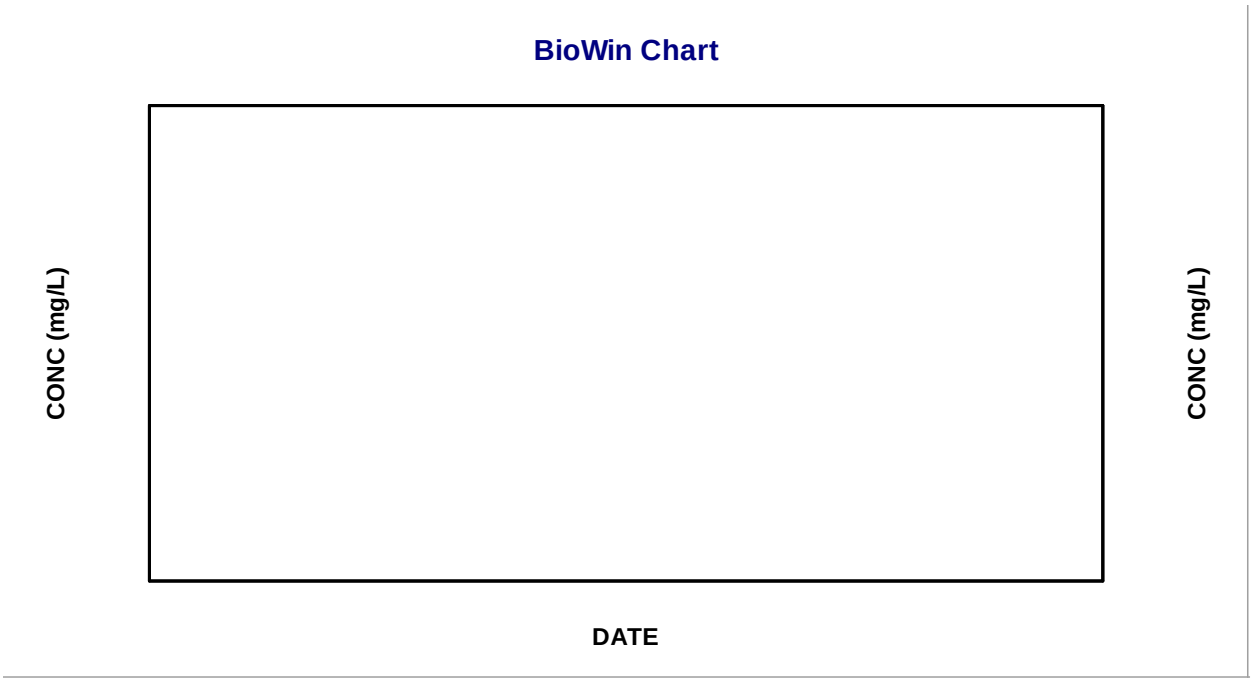

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SSM 52			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	1.88	13.47	
TSS	2.55	18.29	
XCOD	2.78	19.91	
SCOD	37.11	266.22	
TCOD	39.88	286.13	
SPO4	6.37	45.71	
TP	6.42	46.08	
STKN	4.88	35.00	
XTKN	0.16	1.16	
TKN	5.04	36.17	
SCBOD	1.20	8.62	
TCBOD	2.05	14.70	

NOx	13.71	98.36	
TN	18.75	134.53	
TIN	15.16	108.79	
Alk	2.11	6.85	mmol/L and kmol/d
pH	7.39		
VFA	0.02	0.14	
XPrec	0	0.00	
TISS	0.67	4.82	
S_NHx	1.45	10.43	
S_NO3	1.47	10.52	

Parameters	Value	Units

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SSM 14			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	6182.22	17740.96	
TSS	8393.23	24085.83	
XCOD	9139.43	26227.17	
SCOD	37.11	106.49	
TCOD	9176.54	26333.66	
SPO4	6.37	18.28	
TP	178.41	511.98	
STKN	4.88	14.00	
XTKN	532.79	1528.94	
TKN	537.67	1542.94	
SCBOD	1.20	3.45	

TCBOD	2792.47	8013.48	
NOx	13.71	39.34	
TN	551.38	1582.29	
TIN	15.16	43.52	
Alk	2.11	2.74	mmol/L and kmol/d
pH	7.39		
VFA	0.02	0.05	
XPrec	0	0.00	
TISS	2211.01	6344.87	
S_NHx	1.45	4.17	
S_NO3	1.47	4.21	

Parameters	Value	Units

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SSM 9			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	13889.17	1547.79	
TSS	18856.48	2101.35	
XCOD	20532.91	2288.17	
SCOD	37.05	4.13	
TCOD	20569.96	2292.30	
SPO4	6.36	0.71	
TP	392.87	43.78	
STKN	4.87	0.54	
XTKN	1196.99	133.39	
TKN	1201.86	133.93	

SCBOD	1.20	0.13	
TCBOD	6272.15	698.96	
NOx	13.69	1.53	
TN	1215.55	135.46	
TIN	15.14	1.69	
Alk	23.82	1.20	mmol/L and kmol/d
pH	12.38		
VFA	0.02	0.00	
XPrec	0.00	0	
TISS	4967.32	553.55	
S_NHx	1.45	0.16	
S_NO3	1.46	0.16	

Parameters	Value	Units

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SSM 17

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	1856.20	18637.94	
TSS	2479.52	24896.64	
XCOD	2772.89	27842.30	
SCOD	135.76	1363.14	
TCOD	2908.65	29205.44	
SPO4	7.90	79.30	
TP	55.58	558.06	
STKN	58.53	587.69	
XTKN	151.92	1525.46	

TKN	210.45	2113.15	
SCBOD	70.95	712.41	
TCBOD	963.81	9677.55	
NOx	4.40	44.19	
TN	214.86	2157.34	
TIN	50.61	508.15	
Alk	1.56	7.10	mmol/L and kmol/d
pH	7.16		
VFA	12.02	120.66	
XPrec	0	0.00	
TISS	623.32	6258.70	
S_NHx	46.21	463.96	
S_NO3	1.04	10.41	

Parameters	Value	Units

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SSM 18			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	328.00	2356.45	
TSS	386.06	2773.58	
XCOD	524.72	3769.75	
SCOD	174.69	1255.06	
TCOD	699.41	5024.81	
SPO4	6.11	43.90	
TP	9.70	69.69	
STKN	79.87	573.79	

XTKN	17.13	123.09	
TKN	97.00	696.88	
SCBOD	98.69	709.02	
TCBOD	328.00	2356.45	
NOx	0	0	
TN	97.00	696.88	
TIN	64.02	459.94	
Alk	1.17	3.81	mmol/L and kmol/d
pH	6.98		
VFA	16.79	120.60	
XPrec	0	0	
TISS	58.06	417.13	
S_NHx	64.02	459.94	
S_NO3	0	0	

Parameters	Value	Units

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SSM 18			
State variable	Conc. (mg/L)	Mass rate (lb/d)	Notes
X_OHO	0.07	0.50	
X_MEOLO	0.07	0.50	
X_AOO	0.07	0.50	
X_NOO	0.07	0.50	
X_AMO	0.07	0.50	
X_PAO	0.07	0.50	
X_PRO	0.07	0.50	

X_ACO	0.07	0.50
X_HMO	0.07	0.50
X_U_E	0	0
X_B	433.17	3112.00
C_B	27.82	199.85
X_U_INF	90.92	653.23
X_B_ORG_N	13.91	99.91
X_B_ORG_P	2.57	18.45
X_U_ORG_N	3.18	22.86
X_U_ORG_P	1.00	7.19
X_PAO_PHA	0	0
X_PAO_PPL	0.01	0.05
X_PAO_PPH	0	0
X_PAO_PP_CAT	0.01	0.04
S_F	95.12	683.37
S_AC	16.79	120.60
S_PR	0	0
S_MEOL	0	0
S_H2	0	0
S_CH4	0	0
S_NHx	64.02	459.94
S_B_ORG_N	13.91	99.91
S_NO2	0	0
S_NO3	0	0
S_N2	16.00	114.95
T_PO4	6.11	43.90
S_U	34.97	251.24
S_U_ORG_N	1.94	13.94
X_IG_INF	58.00	416.69
X_MAP	0	0
X_HDP	0	0

X_HAP	0	0	
S_MG	1.80	12.93	
S_CA	4.40	31.61	
S_ME	0	0	
S_CAT	5.00	16.29	meq/L and keq/d
S_AN	8.45	27.53	meq/L and keq/d
S_CO2	1.14	3.70	mmol/L and kmol/d
S_UD1	0	0	
S_UD2	0	0	
X_UD3	0	0	
X_UD4_IG	0	0	
S_O2	0	0	

Parameters	Value	Units

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Influent			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	328.00	2356.45	
TSS	386.06	2773.58	
XCOD	524.72	3769.75	
SCOD	174.69	1255.06	
TCOD	699.41	5024.81	
SPO4	6.11	43.90	
TP	9.70	69.69	
STKN	79.87	573.79	
XTKN	17.13	123.09	

TKN	97.00	696.88	
SCBOD	98.69	709.02	
TCBOD	328.00	2356.45	
NOx	0	0	
TN	97.00	696.88	
TIN	64.02	459.94	
Alk	1.17	3.81	mmol/L and kmol/d
pH	7.00		
VFA	16.79	120.60	
XPrec	0	0	
TISS	58.06	417.13	
S_NHx	64.02	459.94	
S_NO3	0	0	

Parameters	Value	Units

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Influent			
State variable	Conc. (mg/L)	Mass rate (lb/d)	Notes
X_OHO	0.07	0.50	
X_MEOLO	0.07	0.50	
X_AOO	0.07	0.50	
X_NOO	0.07	0.50	
X_AMO	0.07	0.50	
X_PAO	0.07	0.50	
X_PRO	0.07	0.50	
X_ACO	0.07	0.50	

X_HMO	0.07	0.50
X_U_E	0	0
X_B	433.17	3112.00
C_B	27.82	199.85
X_U_INF	90.92	653.23
X_B_ORG_N	13.91	99.91
X_B_ORG_P	2.57	18.45
X_U_ORG_N	3.18	22.86
X_U_ORG_P	1.00	7.19
X_PAO_PHA	0	0
X_PAO_PPL	0.01	0.05
X_PAO_PPH	0	0
X_PAO_PP_CAT	0.01	0.04
S_F	95.12	683.37
S_AC	16.79	120.60
S_PR	0	0
S_MEOL	0	0
S_H2	0	0
S_CH4	0	0
S_NHx	64.02	459.94
S_B_ORG_N	13.91	99.91
S_NO2	0	0
S_NO3	0	0
S_N2	16.00	114.95
T_PO4	6.11	43.90
S_U	34.97	251.24
S_U_ORG_N	1.94	13.94
X_IG_INF	58.00	416.69
X_MAP	0	0
X_HDP	0	0
X_HAP	0	0

S_MG	1.80	12.93	
S_CA	4.40	31.61	
S_ME	0	0	
S_CAT	5.00	16.29	meq/L and keq/d
S_AN	8.45	27.53	meq/L and keq/d
S_CO2	1.14	3.70	mmol/L and kmol/d
S_UD1	0	0	
S_UD2	0	0	
X_UD3	0	0	
X_UD4_IG	0	0	
S_O2	0	0	

Parameters	Value	Units

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Alum (1)			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	0	0	
TSS	0	0	
XCOD	0	0	
SCOD	0	0	
TCOD	0	0	
SPO4	0	0	
TP	0	0	
STKN	0	0	
XTKN	0	0	
TKN	0	0	

SCBOD	0	0	
TCBOD	0	0	
NOx	0	0	
TN	0	0	
TIN	0	0	
Alk	-10.81	0	mmol/L and kmol/d
pH	2.00		
VFA	0	0	
XPrec	0	0	
TISS	0	0	
S_NHx	0	0	
S_NO3	0	0	

Parameters	Value	Units

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Alum (1)			
State variable	Conc. (mg/L)	Mass rate (lb/d)	Notes
X_OHO	0	0	
X_MEOLO	0	0	
X_AOO	0	0	
X_NOO	0	0	
X_AMO	0	0	
X_PAO	0	0	
X_PRO	0	0	
X_ACO	0	0	
X_HMO	0	0	

X_U_E	0	0
X_B	0	0
C_B	0	0
X_U_INF	0	0
X_B_ORG_N	0	0
X_B_ORG_P	0	0
X_U_ORG_N	0	0
X_U_ORG_P	0	0
X_PAO_PHA	0	0
X_PAO_PPL	0	0
X_PAO_PPH	0	0
X_PAO_PP_CAT	0	0
S_F	0	0
S_AC	0	0
S_PR	0	0
S_MEOL	0	0
S_H2	0	0
S_CH4	0	0
S_NHx	0	0
S_B_ORG_N	0	0
S_NO2	0	0
S_NO3	0	0
S_N2	0	0
T_PO4	0	0
S_U	0	0
S_U_ORG_N	0	0
X_IG_INF	0	0
X_MAP	0	0
X_HDP	0	0
X_HAP	0	0
S_MG	0	0

S_CA	0	0	
S_ME	0.00	0	
S_CAT	5.00	0	meq/L and keq/d
S_AN	15.81	0	meq/L and keq/d
S_CO2	7.00	0	mmol/L and kmol/d
S_UD1	0	0	
S_UD2	0	0	
X_UD3	0	0	
X_UD4_IG	0	0	
S_O2	0	0	

Parameters	Value	Units

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Alum (2)			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	0	0	
TSS	0	0	
XCOD	0	0	
SCOD	0	0	
TCOD	0	0	
SPO4	0	0	
TP	0	0	
STKN	0	0	
XTKN	0	0	
TKN	0	0	
SCBOD	0	0	

TCBOD	0	0	
NOx	0	0	
TN	0	0	
TIN	0	0	
Alk	-14.39	0	mmol/L and kmol/d
pH	2.00		
VFA	0	0	
XPrec	0	0	
TISS	0	0	
S_NHx	0	0	
S_NO3	0	0	

Parameters	Value	Units

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Alum (2)			
State variable	Conc. (mg/L)	Mass rate (lb/d)	Notes
X_OHO	0	0	
X_MEOLO	0	0	
X_AOO	0	0	
X_NOO	0	0	
X_AMO	0	0	
X_PAO	0	0	
X_PRO	0	0	
X_ACO	0	0	
X_HMO	0	0	
X_U_E	0	0	

X_B	0	0
C_B	0	0
X_U_INF	0	0
X_B_ORG_N	0	0
X_B_ORG_P	0	0
X_U_ORG_N	0	0
X_U_ORG_P	0	0
X_PAO_PHA	0	0
X_PAO_PPL	0	0
X_PAO_PPH	0	0
X_PAO_PP_CAT	0	0
S_F	0	0
S_AC	0	0
S_PR	0	0
S_MEOL	0	0
S_H2	0	0
S_CH4	0	0
S_NHx	0	0
S_B_ORG_N	0	0
S_NO2	0	0
S_NO3	0	0
S_N2	0	0
T_PO4	0	0
S_U	0	0
S_U_ORG_N	0	0
X_IG_INF	0	0
X_MAP	0	0
X_HDP	0	0
X_HAP	0	0
S_MG	0	0
S_CA	0	0

S_ME	57700.00	0	
S_CAT	5.00	0	meq/L and keq/d
S_AN	6434.89	0	meq/L and keq/d
S_CO2	7.00	0	mmol/L and kmol/d
S_UD1	0	0	
S_UD2	0	0	
X_UD3	0	0	
X_UD4_IG	0	0	
S_O2	0	0	

Parameters	Value	Units

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Mg(OH)2 (1)

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	0	0	
TSS	0	0	
XCOD	0	0	
SCOD	0	0	
TCOD	0	0	
SPO4	0	0	
TP	0	0	
STKN	0	0	
XTKN	0	0	
TKN	0	0	
SCBOD	0	0	
TCBOD	0	0	

NOx	0	0	
TN	0	0	
TIN	0	0	
Alk	14500.05	19.21	mmol/L and kmol/d
pH	15.17		
VFA	0	0	
XPrec	0	0	
TISS	0	0	
S_NHx	0	0	
S_NO3	0	0	

Parameters	Value	Units

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Mg(OH)2 (1)

State variable	Conc. (mg/L)	Mass rate (lb/d)	Notes
X_OHO	0	0	
X_MEOLO	0	0	
X_AOO	0	0	
X_NOO	0	0	
X_AMO	0	0	
X_PAO	0	0	
X_PRO	0	0	
X_ACO	0	0	
X_HMO	0	0	
X_U_E	0	0	
X_B	0	0	

C_B	0	0
X_U_INF	0	0
X_B_ORG_N	0	0
X_B_ORG_P	0	0
X_U_ORG_N	0	0
X_U_ORG_P	0	0
X_PAO_PHA	0	0
X_PAO_PPL	0	0
X_PAO_PPH	0	0
X_PAO_PP_CAT	0	0
S_F	0	0
S_AC	0	0
S_PR	0	0
S_MEOL	0	0
S_H2	0	0
S_CH4	0	0
S_NHx	0	0
S_B_ORG_N	0	0
S_NO2	0	0
S_NO3	0	0
S_N2	0	0
T_PO4	0	0
S_U	0	0
S_U_ORG_N	0	0
X_IG_INF	0	0
X_MAP	0	0
X_HDP	0	0
X_HAP	0	0
S_MG	0	0
S_CA	0	0
S_ME	0	0

S_CAT	14500.00	19.21	meq/L and keq/d
S_AN	0	0	meq/L and keq/d
S_CO2	0	0	mmol/L and kmol/d
S_UD1	0	0	
S_UD2	0	0	
X_UD3	0	0	
X_UD4_IG	0	0	
S_O2	0	0	

Parameters	Value	Units

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Mg(OH)2 (2)

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	0	0	
TSS	0	0	
XCOD	0	0	
SCOD	0	0	
TCOD	0	0	
SPO4	0	0	
TP	0	0	
STKN	0	0	
XTKN	0	0	
TKN	0	0	
SCBOD	0	0	
TCBOD	0	0	
NOx	0	0	

TN	0	0	
TIN	0	0	
Alk	14500.05	1.10	mmol/L and kmol/d
pH	15.17		
VFA	0	0	
XPrec	0	0	
TISS	0	0	
S_NHx	0	0	
S_NO3	0	0	

Parameters	Value	Units

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Mg(OH)2 (2)			
State variable	Conc. (mg/L)	Mass rate (lb/d)	Notes
X_OHO	0	0	
X_MEOLO	0	0	
X_AOO	0	0	
X_NOO	0	0	
X_AMO	0	0	
X_PAO	0	0	
X_PRO	0	0	
X_ACO	0	0	
X_HMO	0	0	
X_U_E	0	0	
X_B	0	0	
C_B	0	0	

X_U_INF	0	0	
X_B_ORG_N	0	0	
X_B_ORG_P	0	0	
X_U_ORG_N	0	0	
X_U_ORG_P	0	0	
X_PAO_PHA	0	0	
X_PAO_PPL	0	0	
X_PAO_PPH	0	0	
X_PAO_PP_CAT	0	0	
S_F	0	0	
S_AC	0	0	
S_PR	0	0	
S_MEOL	0	0	
S_H2	0	0	
S_CH4	0	0	
S_NHx	0	0	
S_B_ORG_N	0	0	
S_NO2	0	0	
S_NO3	0	0	
S_N2	0	0	
T_PO4	0	0	
S_U	0	0	
S_U_ORG_N	0	0	
X_IG_INF	0	0	
X_MAP	0	0	
X_HDP	0	0	
X_HAP	0	0	
S_MG	0	0	
S_CA	0	0	
S_ME	0	0	
S_CAT	14500.00	1.10	meq/L and keq/d

S_AN	0	0	meq/L and keq/d
S_CO2	0	0	mmol/L and kmol/d
S_UD1	0	0	
S_UD2	0	0	
X_UD3	0	0	
X_UD4_IG	0	0	
S_O2	0	0	

Parameters	Value	Units

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Mg(OH)2

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	0	0	
TSS	0	0	
XCOD	0	0	
SCOD	0	0	
TCOD	0	0	
SPO4	0	0	
TP	0	0	
STKN	0	0	
XTKN	0	0	
TKN	0	0	
SCBOD	0	0	
TCBOD	0	0	
NOx	0	0	
TN	0	0	

TIN	0	0	
Alk	14500.05	0.27	mmol/L and kmol/d
pH	15.17		
VFA	0	0	
XPrec	0	0	
TISS	0	0	
S_NHx	0	0	
S_NO3	0	0	

Parameters	Value	Units

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Mg(OH)2			
State variable	Conc. (mg/L)	Mass rate (lb/d)	Notes
X_OHO	0	0	
X_MEOLO	0	0	
X_AOO	0	0	
X_NOO	0	0	
X_AMO	0	0	
X_PAO	0	0	
X_PRO	0	0	
X_ACO	0	0	
X_HMO	0	0	
X_U_E	0	0	
X_B	0	0	
C_B	0	0	
X_U_INF	0	0	

X_B_ORG_N	0	0	
X_B_ORG_P	0	0	
X_U_ORG_N	0	0	
X_U_ORG_P	0	0	
X_PAO_PHA	0	0	
X_PAO_PPL	0	0	
X_PAO_PPH	0	0	
X_PAO_PP_CAT	0	0	
S_F	0	0	
S_AC	0	0	
S_PR	0	0	
S_MEOL	0	0	
S_H2	0	0	
S_CH4	0	0	
S_NHx	0	0	
S_B_ORG_N	0	0	
S_NO2	0	0	
S_NO3	0	0	
S_N2	0	0	
T_PO4	0	0	
S_U	0	0	
S_U_ORG_N	0	0	
X_IG_INF	0	0	
X_MAP	0	0	
X_HDP	0	0	
X_HAP	0	0	
S_MG	0	0	
S_CA	0	0	
S_ME	0	0	
S_CAT	14500.00	0.27	meq/L and keq/d
S_AN	0	0	meq/L and keq/d

S_CO2	0	0	mmol/L and kmol/d
S_UD1	0	0	
S_UD2	0	0	
X_UD3	0	0	
X_UD4_IG	0	0	
S_O2	0	0	

Parameters	Value	Units

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Anoxic Reactor			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	1792.76	63016.42	
TSS	2422.78	85161.84	
XCOD	2657.18	93400.99	
SCOD	45.76	1608.58	
TCOD	2702.94	95009.58	
SPO4	6.71	236.02	
TP	55.57	1953.22	
STKN	19.85	697.90	
XTKN	152.55	5362.28	
TKN	172.41	6060.19	
SCBOD	5.89	206.93	
TCBOD	829.89	29170.96	
NOx	0.04	1.40	
TN	172.45	6061.59	
TIN	16.04	563.66	

Alk	2.84	45.29	mmol/L and kmol/d
pH	7.99		
VFA	2.04	71.73	
XPrec	0	0.00	
TISS	630.02	22145.43	
S_NHx	16.00	562.26	
S_NO3	0.02	0.69	

Parameters	Value	Units
HRT	0.9	hours
Flow	4.21	mgd
MLSS	2422.78	mg/L
Mass TSS	3032.86	lb
TRBCOD	8.14	mg/L
OUR	0.47	mgO/L/hr
COUR	0.41	mgO/L/hr
NOUR	0.06	mgO/L/hr
Net. NH3-RR	-2.06	mgN/L/hr
NO3-PR	0.00	mgN/L/hr
NO2-PR	1.57	mgN/L/hr
NO3-RR	1.55	mgN/L/hr
NO2-RR	12.90	mgN/L/hr
Net. NO3-PR	-1.55	mgN/L/hr
Net. NO2-PR	-11.33	
N2-PR	12.90	
OTE	100.00	%
OTR	0	lb/hr
SOTE	100.00	%
SOTR	0	lb/hr
Q Air	0	ft3/min (20C, 1 atm)

Q Air/diff	0	ft3/min (20C, 1 atm)
# of diff	0	
Qoffgas (dry)	0.90	ft3/min
% O2	0	%
% CO2	5.38	%
% NH3	0.47	%
C*inf	8.36	mg/L
VSS/Area	0	g/m2
TSS/Area	0	g/m2
Net. NH3-RR / m2	-0.07	gN/m2/hr
Net. NO3-PR / m2	-0.05	gN/m2/hr
Net. NO2-PR / m2	-0.36	gN/m2/hr
N2-PR / m2	0.41	gN/m2/hr
Thick.	0	mm
Vel. Grad.	74.34	1/s

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Anoxic Reactor			
State variable	Conc. (mg/L)	Mass rate (lb/d)	Notes
X_OHO	1251.98	44007.79	
X_MEOLO	0.49	17.14	
X_AOO	52.60	1848.83	
X_NOO	3.86	135.51	
X_AMO	0.32	11.12	
X_PAO	3.68	129.43	
X_PRO	0.19	6.81	
X_ACO	0.17	5.96	
X_HMO	0.26	8.98	

X_U_E	352.93	12405.62
X_B	169.33	5952.19
C_B	0.19	6.85
X_U_INF	821.05	28860.41
X_B_ORG_N	7.16	251.77
X_B_ORG_P	1.79	62.90
X_U_ORG_N	28.74	1010.11
X_U_ORG_P	9.03	317.46
X_PAO_PHA	0.32	11.23
X_PAO_PPL	1.09	38.47
X_PAO_PPH	0.28	9.67
X_PAO_PP_CAT	0.94	32.87
S_F	6.10	214.39
S_AC	0.74	26.04
S_PR	1.30	45.69
S_MEOL	0	0.00
S_H2	2.14	75.31
S_CH4	0.01	0.25
S_NHx	16.00	562.26
S_B_ORG_N	1.90	66.67
S_NO2	0.02	0.71
S_NO3	0.02	0.69
S_N2	24.36	856.16
T_PO4	6.71	236.02
S_U	35.29	1240.30
S_U_ORG_N	1.96	68.97
X_IG_INF	523.75	18409.94
X_MAP	0	0.00
X_HDP	0	0.00
X_HAP	0	0.00
S_MG	1.77	62.23

S_CA	4.39	154.33	
S_ME	0	0.00	
S_CAT	9.96	158.73	meq/L and keq/d
S_AN	8.39	133.85	meq/L and keq/d
S_CO2	2.63	42.00	mmol/L and kmol/d
S_UD1	0	0.00	
S_UD2	0	0.00	
X_UD3	0	0.00	
X_UD4_IG	0	0.00	
S_O2	0.00	0.01	

Parameters	Value	Units
HRT	0.9	hours
Flow	4.21	mgd
MLSS	2422.78	mg/L
Mass TSS	3032.86	lb
TRBCOD	8.14	mg/L
OUR	0.47	mgO/L/hr
COUR	0.41	mgO/L/hr
NOUR	0.06	mgO/L/hr
Net. NH3-RR	-2.06	mgN/L/hr
NO3-PR	0.00	mgN/L/hr
NO2-PR	1.57	mgN/L/hr
NO3-RR	1.55	mgN/L/hr
NO2-RR	12.90	mgN/L/hr
Net. NO3-PR	-1.55	mgN/L/hr
Net. NO2-PR	-11.33	
N2-PR	12.90	
OTE	100.00	%
OTR	0	lb/hr

SOTE	100.00	%
SOTR	0	lb/hr
Q Air	0	ft3/min (20C, 1 atm)
Q Air/diff	0	ft3/min (20C, 1 atm)
# of diff	0	
Qoffgas (dry)	0.90	ft3/min
% O2	0	%
% CO2	5.38	%
% NH3	0.47	%
C*inf	8.36	mg/L
VSS/Area	0	g/m2
TSS/Area	0	g/m2
Net. NH3-RR / m2	-0.07	gN/m2/hr
Net. NO3-PR / m2	-0.05	gN/m2/hr
Net. NO2-PR / m2	-0.36	gN/m2/hr
N2-PR / m2	0.41	gN/m2/hr
Thick.	0	mm
Vel. Grad.	74.34	1/s

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Oxidation Ditch

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	1767.70	62140.51	
TSS	2399.90	84364.41	
XCOD	2613.26	91864.80	
SCOD	37.11	1304.46	
TCOD	2650.37	93169.26	
SPO4	6.37	223.97	

TP	55.56	1953.22	
STKN	4.88	171.52	
XTKN	152.34	5355.35	
TKN	157.22	5526.88	
SCBOD	1.20	42.24	
TCBOD	799.32	28098.63	
NOx	13.71	481.97	
TN	170.93	6008.85	
TIN	15.16	533.09	
Alk	2.05	32.62	mmol/L and kmol/d
pH	7.28		
VFA	0.02	0.67	
XPrec	0	0.00	
TISS	632.20	22223.90	
S_NHx	1.45	51.12	
S_NO3	1.47	51.53	

Parameters	Value	Units
HRT	2.56	hours
Flow	4.21	mgd
MLSS	2399.90	mg/L
DO	0.50	mg/L
TRBCOD	1.70	mg/L
OUR	39.55	mgO/L/hr
COUR	19.51	mgO/L/hr
NOUR	20.04	mgO/L/hr
NO3-RR	0.06	mgN/L/hr
Net. NH3-RR	5.67	mgN/L/hr
N2-PR	0.58	mgN/L/hr
SN2-PR-VSS	0.33	mgN/gVSS/hr

SN2-PR-VASS	0.62	mgN/gVASS/hr
Net. NO3-PR	0.56	mgN/L/hr
OTR	149.25	lb/hr
SOTR	333.74	lb/hr
Tot. Power	135.28	hp
Power/aerator	22.55	hp
# of aerators	6.00	
C*inf	8.55	mg/L

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Oxidation Ditch			
State variable	Conc. (mg/L)	Mass rate (lb/d)	Notes
X_OHO	1274.03	44786.31	
X_MEOLO	0.49	17.07	
X_AOO	54.06	1900.39	
X_NOO	3.95	138.70	
X_AMO	0.31	10.88	
X_PAO	3.74	131.58	
X_PRO	0.18	6.48	
X_ACO	0.16	5.62	
X_HMO	0.24	8.47	
X_U_E	359.42	12634.67	
X_B	95.53	3358.33	
C_B	0.00	0.07	
X_U_INF	820.99	28860.41	
X_B_ORG_N	4.85	170.43	
X_B_ORG_P	1.34	47.22	
X_U_ORG_N	28.73	1010.11	

X_U_ORG_P	9.03	317.46	
X_PAO_PHA	0.17	5.88	
X_PAO_PPL	1.21	42.61	
X_PAO_PPH	0.28	9.87	
X_PAO_PP_CAT	1.02	35.82	
S_F	1.68	59.06	
S_AC	0.01	0.19	
S_PR	0.01	0.49	
S_MEOL	0	0.00	
S_H2	0.12	4.16	
S_CH4	0.00	0.03	
S_NHx	1.45	51.12	
S_B_ORG_N	1.46	51.41	
S_NO2	12.24	430.44	
S_NO3	1.47	51.53	
S_N2	14.89	523.50	
T_PO4	6.37	223.97	
S_U	35.29	1240.50	
S_U_ORG_N	1.96	68.99	
X_IG_INF	523.70	18409.94	
X_MAP	0	0.00	
X_HDP	0	0.00	
X_HAP	0	0.00	
S_MG	1.74	61.21	
S_CA	4.38	154.05	
S_ME	0	0.00	
S_CAT	11.13	177.52	meq/L and keq/d
S_AN	8.37	133.45	meq/L and keq/d
S_CO2	2.13	34.02	mmol/L and kmol/d
S_UD1	0	0.00	
S_UD2	0	0.00	

X_UD3	0	0.00
X_UD4_IG	0	0.00
S_O2	0.50	17.58

Parameters	Value	Units
HRT	2.56	hours
Flow	4.21	mgd
MLSS	2399.90	mg/L
DO	0.50	mg/L
TRBCOD	1.70	mg/L
OUR	39.55	mgO/L/hr
COUR	19.51	mgO/L/hr
NOUR	20.04	mgO/L/hr
NO3-RR	0.06	mgN/L/hr
Net. NH3-RR	5.67	mgN/L/hr
N2-PR	0.58	mgN/L/hr
SN2-PR-VSS	0.33	mgN/gVSS/hr
SN2-PR-VASS	0.62	mgN/gVASS/hr
Net. NO3-PR	0.56	mgN/L/hr
OTR	149.25	lb/hr
SOTR	333.74	lb/hr
Tot. Power	135.28	hp
Power/aerator	22.55	hp
# of aerators	6.00	
C*inf	8.55	mg/L

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Splttr1

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	1767.70	17754.43	
TSS	2399.90	24104.12	
XCOD	2613.26	26247.08	
SCOD	37.11	372.70	
TCOD	2650.37	26619.79	
SPO4	6.37	63.99	
TP	55.56	558.06	
STKN	4.88	49.01	
XTKN	152.34	1530.10	
TKN	157.22	1579.11	
SCBOD	1.20	12.07	
TCBOD	799.32	8028.18	
NOx	13.71	137.71	
TN	170.93	1716.81	
TIN	15.16	152.31	
Alk	2.05	9.32	mmol/L and kmol/d
pH	7.28		
VFA	0.02	0.19	
XPrec	0	0.00	
TISS	632.20	6349.69	
S_NHx	1.45	14.61	
S_NO3	1.47	14.72	

Parameters	Value	Units

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Splttr1			
State variable	Conc. (mg/L)	Mass rate (lb/d)	Notes
X_OHO	1274.03	12796.09	
X_MEOLO	0.49	4.88	
X_AOO	54.06	542.97	
X_NOO	3.95	39.63	
X_AMO	0.31	3.11	
X_PAO	3.74	37.59	
X_PRO	0.18	1.85	
X_ACO	0.16	1.61	
X_HMO	0.24	2.42	
X_U_E	359.42	3609.90	
X_B	95.53	959.52	
C_B	0.00	0.02	
X_U_INF	820.99	8245.83	
X_B_ORG_N	4.85	48.69	
X_B_ORG_P	1.34	13.49	
X_U_ORG_N	28.73	288.60	
X_U_ORG_P	9.03	90.70	
X_PAO_PHA	0.17	1.68	
X_PAO_PPL	1.21	12.18	
X_PAO_PPH	0.28	2.82	
X_PAO_PP_CAT	1.02	10.24	
S_F	1.68	16.87	
S_AC	0.01	0.05	
S_PR	0.01	0.14	
S_MEOL	0	0.00	
S_H2	0.12	1.19	
S_CH4	0.00	0.01	
S_NHx	1.45	14.61	

S_B_ORG_N	1.46	14.69	
S_NO2	12.24	122.98	
S_NO3	1.47	14.72	
S_N2	14.89	149.57	
T_PO4	6.37	63.99	
S_U	35.29	354.43	
S_U_ORG_N	1.96	19.71	
X_IG_INF	523.70	5259.98	
X_MAP	0	0.00	
X_HDP	0	0.00	
X_HAP	0	0.00	
S_MG	1.74	17.49	
S_CA	4.38	44.01	
S_ME	0	0.00	
S_CAT	11.13	50.72	meq/L and keq/d
S_AN	8.37	38.13	meq/L and keq/d
S_CO2	2.13	9.72	mmol/L and kmol/d
S_UD1	0	0.00	
S_UD2	0	0.00	
X_UD3	0	0.00	
X_UD4_IG	0	0.00	
S_O2	0.50	5.02	

Parameters	Value	Units

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Spltr24

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	1767.69	17754.43	
TSS	2399.89	24104.12	
XCOD	2613.25	26247.08	
SCOD	37.11	372.70	
TCOD	2650.36	26619.78	
SPO4	6.37	63.99	
TP	55.56	558.06	
STKN	4.88	49.01	
XTKN	152.34	1530.10	
TKN	157.22	1579.11	
SCBOD	1.20	12.07	
TCBOD	799.31	8028.18	
NOx	13.71	137.71	
TN	170.93	1716.81	
TIN	15.16	152.31	
Alk	2.11	9.59	mmol/L and kmol/d
pH	7.39		
VFA	0.02	0.19	
XPrec	0	0.00	
TISS	632.20	6349.69	
S_NHx	1.45	14.61	
S_NO3	1.47	14.72	

Parameters	Value	Units

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Splttr24			
State variable	Conc. (mg/L)	Mass rate (lb/d)	Notes
X_OHO	1274.02	12796.09	
X_MEOLO	0.49	4.88	
X_AOO	54.06	542.97	
X_NOO	3.95	39.63	
X_AMO	0.31	3.11	
X_PAO	3.74	37.59	
X_PRO	0.18	1.85	
X_ACO	0.16	1.61	
X_HMO	0.24	2.42	
X_U_E	359.41	3609.90	
X_B	95.53	959.52	
C_B	0.00	0.02	
X_U_INF	820.98	8245.83	
X_B_ORG_N	4.85	48.69	
X_B_ORG_P	1.34	13.49	
X_U_ORG_N	28.73	288.60	
X_U_ORG_P	9.03	90.70	
X_PAO_PHA	0.17	1.68	
X_PAO_PPL	1.21	12.18	
X_PAO_PPH	0.28	2.82	
X_PAO_PP_CAT	1.02	10.24	
S_F	1.68	16.87	
S_AC	0.01	0.05	
S_PR	0.01	0.14	
S_MEOL	0	0.00	
S_H2	0.12	1.19	
S_CH4	0.00	0.01	
S_NHx	1.45	14.61	
S_B_ORG_N	1.46	14.69	

S_NO2	12.24	122.98	
S_NO3	1.47	14.72	
S_N2	14.89	149.57	
T_PO4	6.37	63.99	
S_U	35.29	354.43	
S_U_ORG_N	1.96	19.71	
X_IG_INF	523.70	5259.98	
X_MAP	0	0.00	
X_HDP	0	0.00	
X_HAP	0	0.00	
S_MG	1.74	17.49	
S_CA	4.38	44.01	
S_ME	0	0.00	
S_CAT	11.19	50.99	meq/L and keq/d
S_AN	8.37	38.13	meq/L and keq/d
S_CO2	2.13	9.72	mmol/L and kmol/d
S_UD1	0	0.00	
S_UD2	0	0.00	
X_UD3	0	0.00	
X_UD4_IG	0	0.00	
S_O2	0.50	5.02	

Parameters	Value	Units

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Secondary Clarifier No 1			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes

VSS	1.88	13.47	
TSS	2.55	18.29	
XCOD	2.78	19.91	
SCOD	37.11	266.22	
TCOD	39.88	286.13	
SPO4	6.37	45.71	
TP	6.42	46.08	
STKN	4.88	35.00	
XTKN	0.16	1.16	
TKN	5.04	36.17	
SCBOD	1.20	8.62	
TCBOD	2.05	14.70	
NOx	13.71	98.36	
TN	18.75	134.53	
TIN	15.16	108.79	
Alk	2.11	6.85	mmol/L and kmol/d
pH	7.39		
VFA	0.02	0.14	
XPrec	0	0.00	
TISS	0.67	4.82	
S_NHx	1.45	10.43	
S_NO3	1.47	10.52	

Parameters	Value	Units
HRT	10.02	hours
Qeff	0.86	mgd
Qras	0.34	mgd
Conc. H	1.54	ft
XRAS	8393.23	mg/L
Xeff	2.55	mg/L

SLR	4.80	lb/(ft2 d)
SOR	171.11	gal/(ft2 d)
Mass TSS	3902.28	lb

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Secondary Clarifier No 1			
State variable	Conc. (mg/L)	Mass rate (lb/d)	Notes
X_OHO	1.35	9.71	
X_MEOLO	0.00	0.00	
X_AOO	0.06	0.41	
X_NOO	0.00	0.03	
X_AMO	0.00	0.00	
X_PAO	0.00	0.03	
X_PRO	0.00	0.00	
X_ACO	0.00	0.00	
X_HMO	0.00	0.00	
X_U_E	0.38	2.74	
X_B	0.10	0.73	
C_B	0.00	0.01	
X_U_INF	0.87	6.26	
X_B_ORG_N	0.01	0.04	
X_B_ORG_P	0.00	0.01	
X_U_ORG_N	0.03	0.22	
X_U_ORG_P	0.01	0.07	
X_PAO_PHA	0.00	0.00	
X_PAO_PPL	0.00	0.01	
X_PAO_PPH	0.00	0.00	
X_PAO_PP_CAT	0.00	0.01	

S_F	1.68	12.05	
S_AC	0.01	0.04	
S_PR	0.01	0.10	
S_MEOL	0	0.00	
S_H2	0.12	0.85	
S_CH4	0.00	0.01	
S_NHx	1.45	10.43	
S_B_ORG_N	1.46	10.49	
S_NO2	12.24	87.84	
S_NO3	1.47	10.52	
S_N2	14.89	106.84	
T_PO4	6.37	45.71	
S_U	35.29	253.16	
S_U_ORG_N	1.96	14.08	
X_IG_INF	0.56	3.99	
X_MAP	0	0.00	
X_HDP	0	0.00	
X_HAP	0	0.00	
S_MG	1.74	12.49	
S_CA	4.38	31.44	
S_ME	0	0.00	
S_CAT	11.19	36.42	meq/L and keq/d
S_AN	8.37	27.23	meq/L and keq/d
S_CO2	2.13	6.94	mmol/L and kmol/d
S_UD1	0	0.00	
S_UD2	0	0.00	
X_UD3	0	0.00	
X_UD4_IG	0	0.00	
S_O2	0.50	3.59	

Parameters	Value	Units
HRT	10.02	hours
Qeff	0.86	mgd
Qras	0.34	mgd
Conc. H	1.54	ft
XRAS	8393.23	mg/L
Xeff	2.55	mg/L
SLR	4.80	lb/(ft2 d)
SOR	171.11	gal/(ft2 d)
Mass TSS	3902.28	lb

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Secondary Clariifer 2			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	0.00	0.00	
TSS	0.00	0.00	
XCOD	0.00	0.00	
SCOD	37.11	0.00	
TCOD	37.11	0.00	
SPO4	6.37	0.00	
TP	6.37	0.00	
STKN	4.88	0.00	
XTKN	0.00	0.00	
TKN	4.88	0.00	
SCBOD	1.20	0.00	
TCBOD	1.20	0.00	
NOx	13.71	0.00	
TN	18.59	0.00	

TIN	15.16	0.00	
Alk	2.11	0.00	mmol/L and kmol/d
pH	7.39		
VFA	0.02	0.00	
XPrec	0	0	
TISS	0.00	0.00	
S_NHx	1.45	0.00	
S_NO3	1.47	0.00	

Parameters	Value	Units
HRT	1.0020075E08	hours
Qeff	0.00	mgd
Qras	0.00	mgd
Conc. H	1.52	ft
XRAS	8399.60	mg/L
Xeff	0.00	mg/L
SLR	0.00	lb/(ft2 d)
SOR	0.00	gal/(ft2 d)
Mass TSS	3522.30	lb

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Secondary Clariifer 2			
State variable	Conc. (mg/L)	Mass rate (lb/d)	Notes
X_OHO	0.00	0.00	
X_MEOLO	0.00	0.00	
X_AOO	0.00	0.00	
X_NOO	0.00	0.00	

X_AMO	0.00	0.00
X_PAO	0.00	0.00
X_PRO	0.00	0.00
X_ACO	0.00	0.00
X_HMO	0.00	0.00
X_U_E	0.00	0.00
X_B	0.00	0.00
C_B	0.00	0.00
X_U_INF	0.00	0.00
X_B_ORG_N	0.00	0.00
X_B_ORG_P	0.00	0.00
X_U_ORG_N	0.00	0.00
X_U_ORG_P	0.00	0.00
X_PAO_PHA	0.00	0.00
X_PAO_PPL	0.00	0.00
X_PAO_PPH	0.00	0.00
X_PAO_PP_CAT	0.00	0.00
S_F	1.68	0.00
S_AC	0.01	0.00
S_PR	0.01	0.00
S_MEOL	0	0
S_H2	0.12	0.00
S_CH4	0.00	0.00
S_NHx	1.45	0.00
S_B_ORG_N	1.46	0.00
S_NO2	12.24	0.00
S_NO3	1.47	0.00
S_N2	14.89	0.00
T_PO4	6.37	0.00
S_U	35.29	0.00
S_U_ORG_N	1.96	0.00

X_IG_INF	0.00	0.00	
X_MAP	0	0	
X_HDP	0	0	
X_HAP	0	0	
S_MG	1.74	0.00	
S_CA	4.38	0.00	
S_ME	0	0	
S_CAT	11.19	0.00	meq/L and keq/d
S_AN	8.37	0.00	meq/L and keq/d
S_CO2	2.13	0.00	mmol/L and kmol/d
S_UD1	0	0	
S_UD2	0	0	
X_UD3	0	0	
X_UD4_IG	0	0	
S_O2	0.50	0.00	

Parameters	Value	Units
HRT	1.0020075E08	hours
Qeff	0.00	mgd
Qras	0.00	mgd
Conc. H	1.52	ft
XRAS	8399.60	mg/L
Xeff	0.00	mg/L
SLR	0.00	lb/(ft2 d)
SOR	0.00	gal/(ft2 d)
Mass TSS	3522.30	lb

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Two way Spltr 6

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	6182.22	16193.17	
TSS	8393.23	21984.48	
XCOD	9139.43	23939.00	
SCOD	37.11	97.20	
TCOD	9176.54	24036.20	
SPO4	6.37	16.69	
TP	178.41	467.31	
STKN	4.88	12.78	
XTKN	532.79	1395.55	
TKN	537.67	1408.33	
SCBOD	1.20	3.15	
TCBOD	2792.47	7314.35	
NOx	13.71	35.91	
TN	551.38	1444.24	
TIN	15.16	39.72	
Alk	2.11	2.50	mmol/L and kmol/d
pH	7.39		
VFA	0.02	0.05	
XPrec	0	0.00	
TISS	2211.01	5791.32	
S_NHx	1.45	3.81	
S_NO3	1.47	3.84	

Parameters	Value	Units

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Two way Spltr 6

State variable	Conc. (mg/L)	Mass rate (lb/d)	Notes
X_OHO	4455.69	11670.84	
X_MEOLO	1.70	4.45	
X_AOO	189.07	495.22	
X_NOO	13.80	36.14	
X_AMO	1.08	2.84	
X_PAO	13.09	34.29	
X_PRO	0.64	1.69	
X_ACO	0.56	1.47	
X_HMO	0.84	2.21	
X_U_E	1257.00	3292.46	
X_B	334.11	875.15	
C_B	0.00	0.01	
X_U_INF	2871.26	7520.72	
X_B_ORG_N	16.96	44.41	
X_B_ORG_P	4.70	12.30	
X_U_ORG_N	100.49	263.23	
X_U_ORG_P	31.58	82.73	
X_PAO_PHA	0.59	1.53	
X_PAO_PPL	4.24	11.10	
X_PAO_PPH	0.98	2.57	
X_PAO_PP_CAT	3.56	9.34	
S_F	1.68	4.40	
S_AC	0.01	0.01	
S_PR	0.01	0.04	
S_MEOL	0	0	
S_H2	0.12	0.31	

S_CH4	0.00	0.00	
S_NHx	1.45	3.81	
S_B_ORG_N	1.46	3.83	
S_NO2	12.24	32.07	
S_NO3	1.47	3.84	
S_N2	14.89	39.01	
T_PO4	6.37	16.69	
S_U	35.29	92.43	
S_U_ORG_N	1.96	5.14	
X_IG_INF	1831.56	4797.44	
X_MAP	0	0	
X_HDP	0	0	
X_HAP	0	0	
S_MG	1.74	4.56	
S_CA	4.38	11.48	
S_ME	0	0	
S_CAT	11.19	13.30	meq/L and keq/d
S_AN	8.37	9.94	meq/L and keq/d
S_CO2	2.13	2.54	mmol/L and kmol/d
S_UD1	0	0	
S_UD2	0	0	
X_UD3	0	0	
X_UD4_IG	0	0	
S_O2	0.50	1.31	

Parameters	Value	Units

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Splttr23			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	6182.22	1031.86	
TSS	8393.23	1400.90	
XCOD	9139.43	1525.44	
SCOD	37.11	6.19	
TCOD	9176.54	1531.64	
SPO4	6.37	1.06	
TP	178.41	29.78	
STKN	4.88	0.81	
XTKN	532.79	88.93	
TKN	537.67	89.74	
SCBOD	1.20	0.20	
TCBOD	2792.47	466.09	
NOx	13.71	2.29	
TN	551.38	92.03	
TIN	15.16	2.53	
Alk	2.11	0.16	mmol/L and kmol/d
pH	7.39		
VFA	0.02	0.00	
XPrec	0	0	
TISS	2211.01	369.03	
S_NHx	1.45	0.24	
S_NO3	1.47	0.24	

Parameters	Value	Units

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Splttr23

State variable	Conc. (mg/L)	Mass rate (lb/d)	Notes
X_OHO	4455.69	743.69	
X_MEOLO	1.70	0.28	
X_AOO	189.07	31.56	
X_NOO	13.80	2.30	
X_AMO	1.08	0.18	
X_PAO	13.09	2.18	
X_PRO	0.64	0.11	
X_ACO	0.56	0.09	
X_HMO	0.84	0.14	
X_U_E	1257.00	209.80	
X_B	334.11	55.77	
C_B	0.00	0.00	
X_U_INF	2871.26	479.24	
X_B_ORG_N	16.96	2.83	
X_B_ORG_P	4.70	0.78	
X_U_ORG_N	100.49	16.77	
X_U_ORG_P	31.58	5.27	
X_PAO_PHA	0.59	0.10	
X_PAO_PPL	4.24	0.71	
X_PAO_PPH	0.98	0.16	
X_PAO_PP_CAT	3.56	0.59	
S_F	1.68	0.28	
S_AC	0.01	0.00	
S_PR	0.01	0.00	
S_MEOL	0	0	
S_H2	0.12	0.02	

S_CH4	0.00	0.00	
S_NHx	1.45	0.24	
S_B_ORG_N	1.46	0.24	
S_NO2	12.24	2.04	
S_NO3	1.47	0.24	
S_N2	14.89	2.49	
T_PO4	6.37	1.06	
S_U	35.29	5.89	
S_U_ORG_N	1.96	0.33	
X_IG_INF	1831.56	305.70	
X_MAP	0	0	
X_HDP	0	0	
X_HAP	0	0	
S_MG	1.74	0.29	
S_CA	4.38	0.73	
S_ME	0	0	
S_CAT	11.19	0.85	meq/L and keq/d
S_AN	8.37	0.63	meq/L and keq/d
S_CO2	2.13	0.16	mmol/L and kmol/d
S_UD1	0	0	
S_UD2	0	0	
X_UD3	0	0	
X_UD4_IG	0	0	
S_O2	0.50	0.08	

Parameters	Value	Units

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Sludge Thickener Unit			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	0	0	
TSS	0	0	
XCOD	0	0	
SCOD	37.11	5.16	
TCOD	37.11	5.16	
SPO4	6.37	0.89	
TP	6.37	0.89	
STKN	4.88	0.68	
XTKN	0	0	
TKN	4.88	0.68	
SCBOD	1.20	0.17	
TCBOD	1.20	0.17	
NOx	13.71	1.91	
TN	18.59	2.59	
TIN	15.16	2.11	
Alk	2.11	0.13	mmol/L and kmol/d
pH	7.39		
VFA	0.02	0.00	
XPrec	0	0	
TISS	0	0	
S_NHx	1.45	0.20	
S_NO3	1.47	0.20	

Parameters	Value	Units
% Rem.	100.00	%

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Sludge Thickener Unit			
State variable	Conc. (mg/L)	Mass rate (lb/d)	Notes
X_OHO	0	0	
X_MEOLO	0	0	
X_AOO	0	0	
X_NOO	0	0	
X_AMO	0	0	
X_PAO	0	0	
X_PRO	0	0	
X_ACO	0	0	
X_HMO	0	0	
X_U_E	0	0	
X_B	0	0	
C_B	0.00	0.00	
X_U_INF	0	0	
X_B_ORG_N	0	0	
X_B_ORG_P	0	0	
X_U_ORG_N	0	0	
X_U_ORG_P	0	0	
X_PAO_PHA	0	0	
X_PAO_PPL	0	0	
X_PAO_PPH	0	0	
X_PAO_PP_CAT	0	0	
S_F	1.68	0.23	
S_AC	0.01	0.00	
S_PR	0.01	0.00	
S_MEOL	0	0	

S_H2	0.12	0.02	
S_CH4	0.00	0.00	
S_NHx	1.45	0.20	
S_B_ORG_N	1.46	0.20	
S_NO2	12.24	1.70	
S_NO3	1.47	0.20	
S_N2	14.89	2.07	
T_PO4	6.37	0.89	
S_U	35.29	4.91	
S_U_ORG_N	1.96	0.27	
X_IG_INF	0	0	
X_MAP	0	0	
X_HDP	0	0	
X_HAP	0	0	
S_MG	1.74	0.24	
S_CA	4.38	0.61	
S_ME	0	0	
S_CAT	11.19	0.71	meq/L and keq/d
S_AN	8.37	0.53	meq/L and keq/d
S_CO2	2.13	0.13	mmol/L and kmol/d
S_UD1	0	0	
S_UD2	0	0	
X_UD3	0	0	
X_UD4_IG	0	0	
S_O2	0.50	0.07	

Parameters	Value	Units
% Rem.	100.00	%

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Anoxic Digester

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	8137.87	6348.13	
TSS	12617.47	9842.54	
XCOD	12288.58	9585.98	
SCOD	425.32	331.78	
TCOD	12713.89	9917.76	
SPO4	190.61	148.69	
TP	392.87	306.47	
STKN	66.72	52.05	
XTKN	632.12	493.10	
TKN	698.84	545.15	
SCBOD	261.58	204.05	
TCBOD	1092.38	852.14	
NOx	0.00	0.00	
TN	698.84	545.15	
TIN	62.87	49.04	
Alk	22.28	7.88	mmol/L and kmol/d
pH	7.99		
VFA	369.78	288.46	
XPrec	0	0	
TISS	4479.60	3494.41	
S_NHx	62.87	49.04	
S_NO3	0.00	0.00	

Parameters	Value	Units
HRT	77.0	hours

Flow	0.09	mgd
MLSS	12617.47	mg/L
Mass TSS	31589.36	lb
TRBCOD	370.34	mg/L
OUR	0.01	mgO/L/hr
COUR	0.01	mgO/L/hr
NOUR	0.00	mgO/L/hr
Net. NH3-RR	-0.81	mgN/L/hr
NO3-PR	0.00	mgN/L/hr
NO2-PR	0.72	mgN/L/hr
NO3-RR	0.72	mgN/L/hr
NO2-RR	0.75	mgN/L/hr
Net. NO3-PR	-0.72	mgN/L/hr
Net. NO2-PR	-0.02	mgN/L/hr
N2-PR	0.75	mgN/L/hr
SN2-PR-VSS	0.09	mgN/gVSS/hr
SN2-PR-VASS	0.74	mgN/gVASS/hr
OTE	100.00	%
OTR	0	lb/hr
SOTE	100.00	%
SOTR	0	lb/hr
Q Air	0	ft3/min (20C, 1 atm)
Q Air/diff	0	ft3/min (20C, 1 atm)
# of diff	0	
Qoffgas (dry)	1.82	ft3/min
% O2	0	%
% CO2	18.52	%
% NH3	1.11	%
C*inf	8.74	mg/L
Vel. Grad.	72.62	1/s

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Anoxic Digester			
State variable	Conc. (mg/L)	Mass rate (lb/d)	Notes
X_OHO	1224.40	955.12	
X_MEOLO	1.63	1.27	
X_AOO	102.60	80.04	
X_NOO	14.08	10.98	
X_AMO	1.49	1.16	
X_PAO	43.02	33.56	
X_PRO	0.46	0.36	
X_ACO	0.41	0.32	
X_HMO	38.31	29.88	
X_U_E	4348.37	3392.04	
X_B	30.89	24.09	
C_B	0.00	0.00	
X_U_INF	6450.66	5031.98	
X_B_ORG_N	2.11	1.65	
X_B_ORG_P	0.66	0.51	
X_U_ORG_N	225.77	176.12	
X_U_ORG_P	70.96	55.35	
X_PAO_PHA	32.26	25.17	
X_PAO_PPL	0.01	0.01	
X_PAO_PPH	3.59	2.80	
X_PAO_PP_CAT	2.49	1.94	
S_F	0.56	0.43	
S_AC	359.22	280.22	
S_PR	10.56	8.24	
S_MEOL	0	0	

S_H2	0.04	0.03	
S_CH4	14.52	11.33	
S_NHx	62.87	49.04	
S_B_ORG_N	0.52	0.40	
S_NO2	0.00	0.00	
S_NO3	0.00	0.00	
S_N2	19.19	14.97	
T_PO4	190.61	148.69	
S_U	54.94	42.86	
S_U_ORG_N	3.34	2.60	
X_IG_INF	4114.85	3209.88	
X_MAP	0	0	
X_HDP	0	0	
X_HAP	0	0	
S_MG	3.65	2.85	
S_CA	4.90	3.82	
S_ME	0	0	
S_CAT	39.23	13.88	meq/L and keq/d
S_AN	14.56	5.15	meq/L and keq/d
S_CO2	12.24	4.33	mmol/L and kmol/d
S_UD1	0	0	
S_UD2	0	0	
X_UD3	0	0	
X_UD4_IG	0	0	
S_O2	0.00	0.00	

Parameters	Value	Units
HRT	77.0	hours
Flow	0.09	mgd
MLSS	12617.47	mg/L

Mass TSS	31589.36	lb
TRBCOD	370.34	mg/L
OUR	0.01	mgO/L/hr
COUR	0.01	mgO/L/hr
NOUR	0.00	mgO/L/hr
Net. NH3-RR	-0.81	mgN/L/hr
NO3-PR	0.00	mgN/L/hr
NO2-PR	0.72	mgN/L/hr
NO3-RR	0.72	mgN/L/hr
NO2-RR	0.75	mgN/L/hr
Net. NO3-PR	-0.72	mgN/L/hr
Net. NO2-PR	-0.02	mgN/L/hr
N2-PR	0.75	mgN/L/hr
SN2-PR-VSS	0.09	mgN/gVSS/hr
SN2-PR-VASS	0.74	mgN/gVASS/hr
OTE	100.00	%
OTR	0	lb/hr
SOTE	100.00	%
SOTR	0	lb/hr
Q Air	0	ft3/min (20C, 1 atm)
Q Air/diff	0	ft3/min (20C, 1 atm)
# of diff	0	
Qoffgas (dry)	1.82	ft3/min
% O2	0	%
% CO2	18.52	%
% NH3	1.11	%
C*inf	8.74	mg/L
Vel. Grad.	72.62	1/s

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Digester w (brush aerators)			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	7925.22	6182.25	
TSS	12435.28	9700.42	
XCOD	11983.35	9347.89	
SCOD	58.28	45.47	
TCOD	12041.64	9393.35	
SPO4	181.51	141.59	
TP	392.87	306.47	
STKN	4.50	3.51	
XTKN	612.10	477.48	
TKN	616.60	481.00	
SCBOD	0.71	0.55	
TCBOD	584.57	456.01	
NOx	64.94	50.66	
TN	681.54	531.65	
TIN	65.00	50.71	
Alk	14.27	5.05	mmol/L and kmol/d
pH	7.86		
VFA	0.14	0.11	
XPrec	0	0	
TISS	4510.06	3518.17	
S_NHx	0.06	0.05	
S_NO3	64.86	50.60	

Parameters	Value	Units
HRT	77.03	hours
Flow	0.09	mgd
MLSS	12435.28	mg/L

DO	0.50	mg/L
TRBCOD	1.00	mg/L
OUR	13.05	mgO/L/hr
COUR	8.26	mgO/L/hr
NOUR	4.79	mgO/L/hr
NO3-RR	0.26	mgN/L/hr
Net. NH3-RR	0.82	mgN/L/hr
N2-PR	0.22	mgN/L/hr
SN2-PR-VSS	0.03	mgN/gVSS/hr
SN2-PR-VASS	0.31	mgN/gVASS/hr
Net. NO3-PR	0.84	mgN/L/hr
OTR	32.70	lb/hr
SOTR	73.12	lb/hr
Tot. Power	29.64	hp
Power/aerator	14.82	hp
# of aerators	2.00	
C*inf	8.55	mg/L

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Digester w (brush aerators)			
State variable	Conc. (mg/L)	Mass rate (lb/d)	Notes
X_OHO	849.12	662.38	
X_MEOLO	1.45	1.13	
X_AOO	79.64	62.12	
X_NOO	15.48	12.08	
X_AMO	1.44	1.12	
X_PAO	50.91	39.71	
X_PRO	0.18	0.14	

X_ACO	0.15	0.11
X_HMO	13.74	10.72
X_U_E	4486.45	3499.75
X_B	20.42	15.93
C_B	0.00	0.00
X_U_INF	6450.66	5031.98
X_B_ORG_N	1.43	1.11
X_B_ORG_P	0.45	0.35
X_U_ORG_N	225.77	176.12
X_U_ORG_P	70.96	55.35
X_PAO_PHA	13.72	10.70
X_PAO_PPL	14.67	11.44
X_PAO_PPH	4.32	3.37
X_PAO_PP_CAT	12.94	10.09
S_F	0.86	0.67
S_AC	0.12	0.10
S_PR	0.02	0.02
S_MEOL	0	0
S_H2	0.03	0.02
S_CH4	0.17	0.14
S_NHx	0.06	0.05
S_B_ORG_N	0.94	0.73
S_NO2	0.08	0.06
S_NO3	64.86	50.60
S_N2	14.31	11.16
T_PO4	181.51	141.59
S_U	57.26	44.66
S_U_ORG_N	3.50	2.73
X_IG_INF	4114.85	3209.88
X_MAP	0	0
X_HDP	0	0

X_HAP	0	0	
S_MG	0.03	0.02	
S_CA	3.91	3.05	
S_ME	0	0	
S_CAT	39.31	13.91	meq/L and keq/d
S_AN	14.79	5.23	meq/L and keq/d
S_CO2	9.22	3.26	mmol/L and kmol/d
S_UD1	0	0	
S_UD2	0	0	
X_UD3	0	0	
X_UD4_IG	0	0	
S_O2	0.50	0.39	

Parameters	Value	Units
HRT	77.03	hours
Flow	0.09	mgd
MLSS	12435.28	mg/L
DO	0.50	mg/L
TRBCOD	1.00	mg/L
OUR	13.05	mgO/L/hr
COUR	8.26	mgO/L/hr
NOUR	4.79	mgO/L/hr
NO3-RR	0.26	mgN/L/hr
Net. NH3-RR	0.82	mgN/L/hr
N2-PR	0.22	mgN/L/hr
SN2-PR-VSS	0.03	mgN/gVSS/hr
SN2-PR-VASS	0.31	mgN/gVASS/hr
Net. NO3-PR	0.84	mgN/L/hr
OTR	32.70	lb/hr
SOTR	73.12	lb/hr

Tot. Power	29.64	hp
Power/aerator	14.82	hp
# of aerators	2.00	
C*inf	8.55	mg/L

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Splitr73

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	7925.22	883.18	
TSS	12435.28	1385.77	
XCOD	11983.35	1335.41	
SCOD	58.28	6.50	
TCOD	12041.64	1341.91	
SPO4	181.51	20.23	
TP	392.87	43.78	
STKN	4.50	0.50	
XTKN	612.10	68.21	
TKN	616.60	68.71	
SCBOD	0.71	0.08	
TCBOD	584.57	65.14	
NOx	64.94	7.24	
TN	681.54	75.95	
TIN	65.00	7.24	
Alk	14.27	0.72	mmol/L and kmol/d
pH	7.86		
VFA	0.14	0.02	
XPrec	0	0	
TISS	4510.06	502.60	

S_NHx	0.06	0.01
S_NO3	64.86	7.23

Parameters	Value	Units

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Splitr73

State variable	Conc. (mg/L)	Mass rate (lb/d)	Notes
X_OHO	849.12	94.63	
X_MEOLO	1.45	0.16	
X_AOO	79.64	8.87	
X_NOO	15.48	1.73	
X_AMO	1.44	0.16	
X_PAO	50.91	5.67	
X_PRO	0.18	0.02	
X_ACO	0.15	0.02	
X_HMO	13.74	1.53	
X_U_E	4486.45	499.96	
X_B	20.42	2.28	
C_B	0.00	0.00	
X_U_INF	6450.66	718.85	
X_B_ORG_N	1.43	0.16	
X_B_ORG_P	0.45	0.05	
X_U_ORG_N	225.77	25.16	
X_U_ORG_P	70.96	7.91	
X_PAO_PHA	13.72	1.53	
X_PAO_PPL	14.67	1.63	

X_PAO_PPH	4.32	0.48	
X_PAO_PP_CAT	12.94	1.44	
S_F	0.86	0.10	
S_AC	0.12	0.01	
S_PR	0.02	0.00	
S_MEOL	0	0	
S_H2	0.03	0.00	
S_CH4	0.17	0.02	
S_NHx	0.06	0.01	
S_B_ORG_N	0.94	0.10	
S_NO2	0.08	0.01	
S_NO3	64.86	7.23	
S_N2	14.31	1.59	
T_PO4	181.51	20.23	
S_U	57.26	6.38	
S_U_ORG_N	3.50	0.39	
X_IG_INF	4114.85	458.55	
X_MAP	0	0	
X_HDP	0	0	
X_HAP	0	0	
S_MG	0.03	0.00	
S_CA	3.91	0.44	
S_ME	0	0	
S_CAT	39.31	1.99	meq/L and keq/d
S_AN	14.79	0.75	meq/L and keq/d
S_CO2	9.22	0.47	mmol/L and kmol/d
S_UD1	0	0	
S_UD2	0	0	
X_UD3	0	0	
X_UD4_IG	0	0	
S_O2	0.50	0.06	

Parameters	Value	Units

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Dewatering Unit			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	899.51	88.32	
TSS	1411.40	138.58	
XCOD	1360.11	133.54	
SCOD	58.28	5.72	
TCOD	1418.39	139.26	
SPO4	181.51	17.82	
TP	205.50	20.18	
STKN	4.50	0.44	
XTKN	69.47	6.82	
TKN	73.98	7.26	
SCBOD	0.71	0.07	
TCBOD	66.98	6.58	
NOx	64.94	6.38	
TN	138.92	13.64	
TIN	65.00	6.38	
Alk	14.27	0.64	mmol/L and kmol/d
pH	7.86		
VFA	0.14	0.01	
XPrec	0	0	
TISS	511.89	50.26	
S_NHx	0.06	0.01	

S_NO3	64.86	6.37

Parameters	Value	Units
% Rem.	90.00	%

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Dewatering Unit			
State variable	Conc. (mg/L)	Mass rate (lb/d)	Notes
X_OHO	96.38	9.46	
X_MEOLO	0.16	0.02	
X_AOO	9.04	0.89	
X_NOO	1.76	0.17	
X_AMO	0.16	0.02	
X_PAO	5.78	0.57	
X_PRO	0.02	0.00	
X_ACO	0.02	0.00	
X_HMO	1.56	0.15	
X_U_E	509.21	50.00	
X_B	2.32	0.23	
C_B	0.00	0.00	
X_U_INF	732.15	71.89	
X_B_ORG_N	0.16	0.02	
X_B_ORG_P	0.05	0.01	
X_U_ORG_N	25.63	2.52	
X_U_ORG_P	8.05	0.79	
X_PAO_PHA	1.56	0.15	
X_PAO_PPL	1.66	0.16	

X_PAO_PPH	0.49	0.05	
X_PAO_PP_CAT	1.47	0.14	
S_F	0.86	0.08	
S_AC	0.12	0.01	
S_PR	0.02	0.00	
S_MEOL	0	0	
S_H2	0.03	0.00	
S_CH4	0.17	0.02	
S_NHx	0.06	0.01	
S_B_ORG_N	0.94	0.09	
S_NO2	0.08	0.01	
S_NO3	64.86	6.37	
S_N2	14.31	1.41	
T_PO4	181.51	17.82	
S_U	57.26	5.62	
S_U_ORG_N	3.50	0.34	
X_IG_INF	467.04	45.86	
X_MAP	0	0	
X_HDP	0	0	
X_HAP	0	0	
S_MG	0.03	0.00	
S_CA	3.91	0.38	
S_ME	0	0	
S_CAT	39.31	1.75	meq/L and keq/d
S_AN	14.79	0.66	meq/L and keq/d
S_CO2	9.22	0.41	mmol/L and kmol/d
S_UD1	0	0	
S_UD2	0	0	
X_UD3	0	0	
X_UD4_IG	0	0	
S_O2	0.50	0.05	

Parameters	Value	Units
% Rem.	90.00	%

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Sludge41			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	59967.49	794.86	
TSS	94093.61	1247.20	
XCOD	90674.03	1201.87	
SCOD	58.28	0.77	
TCOD	90732.31	1202.64	
SPO4	181.51	2.41	
TP	1780.79	23.60	
STKN	4.50	0.06	
XTKN	4631.56	61.39	
TKN	4636.06	61.45	
SCBOD	0.71	0.01	
TCBOD	4418.58	58.57	
NOx	64.94	0.86	
TN	4701.00	62.31	
TIN	65.00	0.86	
Alk	14.27	0.09	mmol/L and kmol/d
pH	7.86		
VFA	0.14	0.00	
XPrec	0.00	0	
TISS	34126.11	452.34	

S_NHx	0.06	0.00
S_NO3	64.86	0.86

Parameters	Value	Units

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Sludge41

State variable	Conc. (mg/L)	Mass rate (lb/d)	Notes
X_OHO	6425.02	85.16	
X_MEOLO	10.95	0.15	
X_AOO	602.60	7.99	
X_NOO	117.13	1.55	
X_AMO	10.91	0.14	
X_PAO	385.22	5.11	
X_PRO	1.38	0.02	
X_ACO	1.11	0.01	
X_HMO	103.95	1.38	
X_U_E	33947.44	449.97	
X_B	154.54	2.05	
C_B	0.00	0.00	
X_U_INF	48809.96	646.97	
X_B_ORG_N	10.81	0.14	
X_B_ORG_P	3.40	0.05	
X_U_ORG_N	1708.35	22.64	
X_U_ORG_P	536.91	7.12	
X_PAO_PHA	103.81	1.38	
X_PAO_PPL	110.97	1.47	

X_PAO_PPH	32.68	0.43	
X_PAO_PP_CAT	97.88	1.30	
S_F	0.86	0.01	
S_AC	0.12	0.00	
S_PR	0.02	0.00	
S_MEOL	0	0	
S_H2	0.03	0.00	
S_CH4	0.17	0.00	
S_NHx	0.06	0.00	
S_B_ORG_N	0.94	0.01	
S_NO2	0.08	0.00	
S_NO3	64.86	0.86	
S_N2	14.31	0.19	
T_PO4	181.51	2.41	
S_U	57.26	0.76	
S_U_ORG_N	3.50	0.05	
X_IG_INF	31135.68	412.70	
X_MAP	0.00	0	
X_HDP	0.00	0	
X_HAP	0.00	0	
S_MG	0.03	0.00	
S_CA	3.91	0.05	
S_ME	0	0	
S_CAT	39.31	0.24	meq/L and keq/d
S_AN	14.79	0.09	meq/L and keq/d
S_CO2	9.22	0.06	mmol/L and kmol/d
S_UD1	0	0	
S_UD2	0	0	
X_UD3	0.00	0	
X_UD4_IG	0.00	0	
S_O2	0.50	0.01	

Parameters	Value	Units

Global Parameters

AOB

Name	Default	Value	
Max. spec. growth rate [1/d]	0.90000	0.90000	1.0720
Substrate (NH4) half sat. [mgN/L]	0.70000	0.70000	1.0000
Aerobic decay rate [1/d]	0.17000	0.17000	1.0290
Anoxic/anaerobic decay rate [1/d]	0.08000	0.08000	1.0290
KiHNO2 [mmol/L]	0.00500	0.00500	1.0000

NOB

Name	Default	Value	
Max. spec. growth rate [1/d]	0.70000	0.70000	1.0600
Substrate (NO2) half sat. [mgN/L]	0.10000	0.10000	1.0000
Aerobic decay rate [1/d]	0.17000	0.17000	1.0290
Anoxic/anaerobic decay rate [1/d]	0.08000	0.08000	1.0290
KiNH3 [mmol/L]	0.07500	0.07500	1.0000

ANAMMOX

Name	Default	Value	
Max. spec. growth rate [1/d]	0.10000	0.10000	1.1000
Substrate (NH4) half sat. [mgN/L]	2.00000	2.00000	1.0000
Substrate (NO2) half sat. [mgN/L]	1.00000	1.00000	1.0000
Aerobic decay rate [1/d]	0.01900	0.01900	1.0290
Anoxic/anaerobic decay rate [1/d]	0.00950	0.00950	1.0290
Ki Nitrite [mgN/L]	1000.00000	1000.00000	1.0000
Nitrite sensitivity constant [L / (d mgN)]	0.01600	0.01600	1.0000

OHOs

Name	Default	Value	
Max. spec. growth rate [1/d]	3.20000	3.20000	1.0290
Substrate half sat. [mgCOD/L]	5.00000	5.00000	1.0000
Anoxic growth factor [-]	0.50000	0.50000	1.0000
Aerobic decay [1/d]	0.62000	0.62000	1.0290
Anoxic/anaerobic decay [1/d]	0.30000	0.30000	1.0290
Hydrolysis rate (AS) [1/d]	2.10000	2.10000	1.0290
Hydrolysis half sat. (AS) [-]	0.06000	0.06000	1.0000
Anoxic hydrolysis factor [-]	0.28000	0.28000	1.0000
Anaerobic hydrolysis factor [-]	0.50000	0.50000	1.0000
Adsorption rate of colloids [L/(mgCOD d)]	0.80000	0.80000	1.0290
Ammonification rate [L/(mgN d)]	0.04000	0.04000	1.0290
Assimilative nitrate/nitrite reduction rate [1/d]	0.50000	0.50000	1.0000
Fermentation rate [1/d]	3.20000	3.20000	1.0290
Fermentation half sat. [mgCOD/L]	5.00000	5.00000	1.0000
Anaerobic growth factor (AS) [-]	0.12500	0.12500	1.0000
Hydrolysis rate (AD) [1/d]	0.10000	0.10000	1.0500

Hydrolysis half sat. (AD) [mgCOD/L]	0.15000	0.15000	1.0000

Methylotrophs

Name	Default	Value	
Max. spec. growth rate of methanol utilizers [1/d]	1.30000	1.30000	1.0720
Methanol half sat. [mgCOD/L]	0.50000	0.50000	1.0000
Aerobic decay rate of methanol utilizers [1/d]	0.04000	0.04000	1.0290
Anoxic/anaerobic decay rate of methanol utilizers [1/d]	0.03000	0.03000	1.0290

PAOs

Name	Default	Value	
Max. spec. growth rate [1/d]	0.95000	0.95000	1.0000
Max. spec. growth rate, P-limited [1/d]	0.42000	0.42000	1.0000
Substrate half sat. [mgCOD(PHB)/mgCOD(Zbp)]	0.10000	0.10000	1.0000
Substrate half sat., P-limited [mgCOD(PHB)/mgCOD(Zbp)]	0.05000	0.05000	1.0000
Magnesium half sat. [mgMg/L]	0.10000	0.10000	1.0000
Cation half sat. [mmol/L]	0.10000	0.10000	1.0000
Calcium half sat. [mgCa/L]	0.10000	0.10000	1.0000
Aerobic decay rate [1/d]	0.10000	0.10000	1.0000
Anaerobic decay rate [1/d]	0.04000	0.04000	1.0000
Sequestration rate [1/d]	6.00000	6.00000	1.0000
Anoxic growth factor NO3 [-]	0.33000	0.33000	1.0000
Anoxic growth factor NO2 [-]	0.33000	0.33000	1.0000

Acetogens

Name	Default	Value	
Max. spec. growth rate [1/d]	0.25000	0.25000	1.0290
Substrate half sat. [mgCOD/L]	10.00000	10.00000	1.0000
Acetate inhibition [mgCOD/L]	10000.00000	10000.00000	1.0000
Decay rate [1/d]	0.05000	0.05000	1.0290
Aerobic decay rate [1/d]	0.52000	0.52000	1.0290

Methanogens

Name	Default	Value	
Acetoclastic Mu Max [1/d]	0.30000	0.30000	1.0290
H2-utilizing Mu Max [1/d]	1.40000	1.40000	1.0290
Acetoclastic Ks [mgCOD/L]	100.00000	100.00000	1.0000
Acetoclastic methanol Ks [mgCOD/L]	0.50000	0.50000	1.0000
H2-utilizing CO2 half sat. [mmol/L]	0.10000	0.10000	1.0000
H2-utilizing Ks [mgCOD/L]	0.10000	0.10000	1.0000
H2-utilizing methanol Ks [mgCOD/L]	0.50000	0.50000	1.0000
Acetoclastic propionic inhibition [mgCOD/L]	10000.00000	10000.00000	1.0000
Acetoclastic decay rate [1/d]	0.13000	0.13000	1.0290
Acetoclastic aerobic decay rate [1/d]	0.60000	0.60000	1.0290
H2-utilizing decay rate [1/d]	0.13000	0.13000	1.0290
H2-utilizing aerobic decay rate [1/d]	0.60000	0.60000	1.0290

pH

Name	Default	Value
Heterotrophs low pH limit [-]	4.00000	4.00000
Heterotrophs high pH limit [-]	10.00000	10.00000
Methanol utilizers low pH limit [-]	4.00000	4.00000
Methanol utilizers high pH limit [-]	10.00000	10.00000
Autotrophs low pH limit [-]	5.50000	5.50000
Autotrophs high pH limit [-]	9.50000	9.50000
PolyP heterotrophs low pH limit [-]	4.00000	4.00000
Poly P heterotrophs high pH limit [-]	10.00000	10.00000
Heterotrophs low pH limit (anaerobic) [-]	5.50000	5.50000
Heterotrophs high pH limit (anaerobic) [-]	8.50000	8.50000
Propionic acetogens low pH limit [-]	4.00000	4.00000
Propionic acetogens high pH limit [-]	10.00000	10.00000
Acetoclastic methanogens low pH limit [-]	5.00000	5.00000
Acetoclastic methanogens high pH limit [-]	9.00000	9.00000
H2-utilizing methanogens low pH limit [-]	5.00000	5.00000
H2-utilizing methanogens high pH limit [-]	9.00000	9.00000

Switches

Name	Default	Value
Heterotrophic DO half sat. [mgO2/L]	0.05000	0.05000
Aerobic denit. DO half sat. [mgO2/L]	0.05000	0.05000
Ammonia oxidizer DO half sat. [mgO2/L]	0.25000	0.25000
Nitrite oxidizer DO half sat. [mgO2/L]	0.50000	0.50000
Anaerobic ammonia oxidizer DO half sat. [mgO2/L]	0.01000	0.01000
Anoxic NO3 half sat. [mgN/L]	0.10000	0.10000
Anoxic NO2 half sat. (mgN/L)	0.01000	0.01000
NH3 nutrient half sat. [mgN/L]	1.0000E-4	1.0000E-4

PolyP half sat. [mgP/L]	0.01000	0.01000
VFA sequestration half sat. [mgCOD/L]	5.00000	5.00000
P uptake half sat. [mgP/L]	0.15000	0.15000
P nutrient half sat. [mgP/L]	0.00100	0.00100
Autotroph CO2 half sat. [mmol/L]	0.10000	0.10000
Heterotrophic Hydrogen half sat. [mgCOD/L]	1.00000	1.00000
Propionic acetogens Hydrogen half sat. [mgCOD/L]	5.00000	5.00000
Synthesis anion/cation half sat. [meq/L]	0.01000	0.01000

Common

Name	Default	Value
N in endogenous residue [mgN/mgCOD]	0.07000	0.07000
P in endogenous residue [mgP/mgCOD]	0.02200	0.02200
Endogenous residue COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
Particulate substrate COD:VSS ratio [mgCOD/mgVSS]	1.60000	1.60000
Particulate inert COD:VSS ratio [mgCOD/mgVSS]	1.60000	1.60000

AOB

Name	Default	Value
Yield [mgCOD/mgN]	0.15000	0.15000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

NOB

Name	Default	Value
Yield [mgCOD/mgN]	0.09000	0.09000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

ANAMMOX

Name	Default	Value
Yield [mgCOD/mgN]	0.11400	0.11400
Nitrate production [mgN/mgBiomassCOD]	2.28000	2.28000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

OHOs

Name	Default	Value
Yield (aerobic) [-]	0.66600	0.66600
Yield (fermentation, low H2) [-]	0.10000	0.10000
Yield (fermentation, high H2) [-]	0.10000	0.10000

H2 yield (fermentation low H2) [-]	0.35000	0.35000
H2 yield (fermentation high H2) [-]	0	0
Propionate yield (fermentation, low H2) [-]	0	0
Propionate yield (fermentation, high H2) [-]	0.70000	0.70000
CO2 yield (fermentation, low H2) [-]	0.70000	0.70000
CO2 yield (fermentation, high H2) [-]	0	0
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
Yield (anoxic) [-]	0.54000	0.54000
Yield propionic (aerobic) [-]	0.64000	0.64000
Yield propionic (anoxic) [-]	0.46000	0.46000
Yield acetic (aerobic) [-]	0.60000	0.60000
Yield acetic (anoxic) [-]	0.43000	0.43000
Yield methanol (aerobic) [-]	0.50000	0.50000
Adsorp. max. [-]	1.00000	1.00000

Methylotrophs

Name	Default	Value
Yield (anoxic) [-]	0.40000	0.40000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

PAOs

Name	Default	Value
Yield (aerobic) [-]	0.63900	0.63900
Yield (anoxic) [-]	0.52000	0.52000
Aerobic P/PHA uptake [mgP/mgCOD]	0.95000	0.95000
Anoxic P/PHA uptake [mgP/mgCOD]	0.35000	0.35000
Yield of PHA on sequestration [-]	0.88900	0.88900
N in biomass [mgN/mgCOD]	0.07000	0.07000
N in sol. inert [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous part. [-]	0.25000	0.25000
Inert fraction of endogenous sol. [-]	0.20000	0.20000
P/Ac release ratio [mgP/mgCOD]	0.49000	0.49000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
Yield of low PP [-]	0.94000	0.94000

Acetogens

Name	Default	Value
Yield [-]	0.10000	0.10000
H2 yield [-]	0.40000	0.40000
CO2 yield [-]	1.00000	1.00000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

Methanogens

Name	Default	Value
Acetoclastic yield [-]	0.10000	0.10000
Methanol acetoclastic yield [-]	0.10000	0.10000
H2-utilizing yield [-]	0.10000	0.10000
Methanol H2-utilizing yield [-]	0.10000	0.10000
N in acetoclastic biomass [mgN/mgCOD]	0.07000	0.07000
N in H2-utilizing biomass [mgN/mgCOD]	0.07000	0.07000
P in acetoclastic biomass [mgP/mgCOD]	0.02200	0.02200
P in H2-utilizing biomass [mgP/mgCOD]	0.02200	0.02200
Acetoclastic fraction to endog. residue [-]	0.08000	0.08000
H2-utilizing fraction to endog. residue [-]	0.08000	0.08000
Acetoclastic COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
H2-utilizing COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

General

Name	Default	Value
Ash content of biomass (synthesis ISS) [%]	8.00000	8.00000
Molecular weight of other anions [mg/mmol]	35.50000	35.50000
Molecular weight of other cations [mg/mmol]	39.10000	39.10000
Mg to P mole ratio in polyphosphate [mmolMg/mmolP]	0.30000	0.30000
Cation to P mole ratio in polyphosphate [meq/mmolP]	0.30000	0.30000
Ca to P mole ratio in polyphosphate [mmolCa/mmolP]	0.05000	0.05000
Cation to P mole ratio in organic phosphate [meq/mmolP]	0.01000	0.01000
Bubble rise velocity (anaerobic digester) [cm/s]	23.90000	23.90000
Bubble Sauter mean diameter (anaerobic digester) [cm]	0.35000	0.35000
Anaerobic digester gas hold-up factor []	1.00000	1.00000
Tank head loss per metre of length (from flow) [m/m]	0.00250	0.00250

Mass transfer

Name	Default	Value	
Kl for H2 [m/d]	17.00000	17.00000	1.0240
Kl for CO2 [m/d]	10.00000	10.00000	1.0240
Kl for NH3 [m/d]	1.00000	1.00000	1.0240
Kl for CH4 [m/d]	8.00000	8.00000	1.0240
Kl for N2 [m/d]	15.00000	15.00000	1.0240
Kl for O2 [m/d]	13.00000	13.00000	1.0240

Physico-chemical rates

Name	Default	Value	
Struvite precipitation rate [1/d]	3.0000E+10	3.0000E+10	1.0240
Struvite redissolution rate [1/d]	3.0000E+11	3.0000E+11	1.0240
Struvite half sat. [mgTSS/L]	1.00000	1.00000	1.0000
HDP precipitation rate [L/(molP d)]	1.0000E+8	1.0000E+8	1.0000
HDP redissolution rate [L/(mol P d)]	1.0000E+8	1.0000E+8	1.0000
HAP precipitation rate [molHDP/(L d)]	5.0000E-4	5.0000E-4	1.0000

Physico-chemical constants

Name	Default	Value
Struvite solubility constant [mol/L]	6.9180E-14	6.9180E-14

HDP solubility product [mol/L]	2.7500E-22	2.7500E-22
HDP half sat. [mgTSS/L]	1.00000	1.00000
Equilibrium soluble PO4 with Al dosing at pH 7 [mgP/L]	0.01000	0.01000
Al to P ratio [molAl/molP]	0.80000	0.80000
Al(OH)3 solubility product [mol/L]	1.2590E+9	1.2590E+9
AlHPO4+ dissociation constant [mol/L]	7.9430E-13	7.9430E-13
Equilibrium soluble PO4 with Fe dosing at pH 7 [mgP/L]	0.01000	0.01000
Fe to P ratio [molFe/molP]	1.60000	1.60000
Fe(OH)3 solubility product [mol/L]	0.05000	0.05000
FeH2PO4++ dissociation constant [mol/L]	5.0120E-22	5.0120E-22

Aeration

Name	Default	Value
Alpha (surf) OR Alpha F (diff) [-]	0.50000	0.50000
Beta [-]	0.95000	0.95000
Surface pressure [kPa]	101.32500	101.32500
Fractional effective saturation depth (Fed) [-]	0.32500	0.32500
Supply gas CO2 content [vol. %]	0.03500	0.03500
Supply gas O2 [vol. %]	20.95000	20.95000
Off-gas CO2 [vol. %]	2.00000	2.00000
Off-gas O2 [vol. %]	18.80000	18.80000
Off-gas H2 [vol. %]	0	0
Off-gas NH3 [vol. %]	0	0
Off-gas CH4 [vol. %]	0	0
Surface turbulence factor [-]	2.00000	2.00000
Set point controller gain []	1.00000	1.00000

Modified Vesilind

Name	Default	Value
Maximum Vesilind settling velocity (Vo) [ft/min]	0.3873	0.3873
Vesilind hindered zone settling parameter (K) [L/g]	0.3700	0.3700
Clarification switching function [mg/L]	100.0000	100.0000
Specified TSS conc.for height calc. [mg/L]	2500.0000	2500.0000
Maximum compactability constant [mg/L]	15000.0000	15000.0000

Double exponential

Name	Default	Value
Maximum Vesilind settling velocity (Vo) [ft/min]	0.9341	0.9341
Maximum (practical) settling velocity (Vo') [ft/min]	0.6152	0.6152
Hindered zone settling parameter (Kh) [L/g]	0.4000	0.4000
Flocculent zone settling parameter (Kf) [L/g]	2.5000	2.5000
Maximum non-settleable TSS [mg/L]	20.0000	20.0000
Non-settleable fraction [-]	0.0010	0.0010
Specified TSS conc. for height calc. [mg/L]	2500.0000	2500.0000

Biofilm general

Name	Default	Value	
Attachment rate [g / (m2 d)]	80.00000	80.00000	1.0000
Attachment TSS half sat. [mg/L]	100.00000	100.00000	1.0000
Detachment rate [g/(m3 d)]	8.0000E+4	8.0000E+4	1.0000

Solids movement factor []	10.00000	10.00000	1.0000
Diffusion neta []	0.80000	0.80000	1.0000
Thin film limit [mm]	0.50000	0.50000	1.0000
Thick film limit [mm]	3.00000	3.00000	1.0000
Assumed Film thickness for tank volume correction (temp independant) [mm]	0.75000	0.75000	1.0000
Film surface area to media area ratio - Max.[ ]	1.00000	1.00000	1.0000
Minimum biofilm conc. for streamer formation [gTSS/m2]	4.00000	4.00000	1.0000

Maximum biofilm concentrations [mg/L]

Name	Default	Value	
Zbh	5.0000E+4	5.0000E+4	1.0000
Zbmeth	5.0000E+4	5.0000E+4	1.0000
Zaob	1.0000E+5	1.0000E+5	1.0000
Znob	1.0000E+5	1.0000E+5	1.0000
Zamox	5.0000E+4	5.0000E+4	1.0000
Zbp	5.0000E+4	5.0000E+4	1.0000
Zbpa	5.0000E+4	5.0000E+4	1.0000
Zbam	5.0000E+4	5.0000E+4	1.0000
Zbhm	5.0000E+4	5.0000E+4	1.0000
Ze	3.0000E+4	3.0000E+4	1.0000
Xsp	5000.00000	5000.00000	1.0000
Xsc	0	0	1.0000
Xi	5000.00000	5000.00000	1.0000
Xon	0	0	1.0000
Xop	0	0	1.0000
Xin	0	0	1.0000
Xip	0	0	1.0000
Spha	5000.00000	5000.00000	1.0000

PP-lo	1.1500E+6	1.1500E+6	1.0000
PP-hi	1.1500E+6	1.1500E+6	1.0000
XPPCat	1.1500E+6	1.1500E+6	1.0000
Sbsc	0	0	1.0000
Sbsa	0	0	1.0000
Sbsp	0	0	1.0000
Sbmeth	0	0	1.0000
SbH2	0	0	1.0000
CH4	0	0	1.0000
NH3-N	0	0	1.0000
Nos	0	0	1.0000
NO2-N	0	0	1.0000
NO3-N	0	0	1.0000
N2	0	0	1.0000
PO4-P (incl. MeP)	1.0000E+10	1.0000E+10	1.0000
Sus	0	0	1.0000
Nus	0	0	1.0000
ISS	1.3000E+6	1.3000E+6	1.0000
XStru	8.5000E+5	8.5000E+5	1.0000
XHDP	1.1500E+6	1.1500E+6	1.0000
XHAP	1.6000E+6	1.6000E+6	1.0000
SMg	0	0	1.0000
SCa	0	0	1.0000
Me	1.0000E+10	1.0000E+10	1.0000
SCat	0	0	1.0000
SAn	0	0	1.0000
SCO2	0	0	1.0000
UD1	0	0	1.0000
UD2	0	0	1.0000
UD3	5.0000E+4	5.0000E+4	1.0000
UD4	5.0000E+4	5.0000E+4	1.0000

DO	0	0	1.0000

Effective diffusivities [m2/s]

Name	Default	Value	
Zbh	5.0000E-14	5.0000E-14	1.0290
Zbmeth	5.0000E-14	5.0000E-14	1.0290
Zaob	5.0000E-14	5.0000E-14	1.0290
Znob	5.0000E-14	5.0000E-14	1.0290
Zamox	5.0000E-14	5.0000E-14	1.0290
Zbp	5.0000E-14	5.0000E-14	1.0290
Zbpa	5.0000E-14	5.0000E-14	1.0290
Zbam	5.0000E-14	5.0000E-14	1.0290
Zbhm	5.0000E-14	5.0000E-14	1.0290
Ze	5.0000E-14	5.0000E-14	1.0290
Xsp	5.0000E-14	5.0000E-14	1.0290
Xsc	6.9000E-11	6.9000E-11	1.0290
Xi	5.0000E-14	5.0000E-14	1.0290
Xon	5.0000E-14	5.0000E-14	1.0290
Xop	5.0000E-14	5.0000E-14	1.0290
Xin	5.0000E-14	5.0000E-14	1.0290
Xip	5.0000E-14	5.0000E-14	1.0290
Spha	5.0000E-14	5.0000E-14	1.0290
PP-lo	5.0000E-14	5.0000E-14	1.0290
PP-hi	5.0000E-14	5.0000E-14	1.0290
XPPCat	5.0000E-14	5.0000E-14	1.0290
Sbsc	6.9000E-10	6.9000E-10	1.0290
Sbsa	1.2400E-9	1.2400E-9	1.0290
Sbsp	8.3000E-10	8.3000E-10	1.0290

Sbmeth	1.6000E-9	1.6000E-9	1.0290
SbH2	5.8500E-9	5.8500E-9	1.0290
CH4	1.9625E-9	1.9625E-9	1.0290
NH3-N	2.0000E-9	2.0000E-9	1.0290
Nos	1.3700E-9	1.3700E-9	1.0290
NO2-N	2.9800E-9	2.9800E-9	1.0290
NO3-N	2.9800E-9	2.9800E-9	1.0290
N2	1.9000E-9	1.9000E-9	1.0290
PO4-P (incl. MeP)	2.0000E-9	2.0000E-9	1.0290
Sus	6.9000E-10	6.9000E-10	1.0290
Nus	6.8500E-10	6.8500E-10	1.0290
ISS	5.0000E-14	5.0000E-14	1.0290
XStru	5.0000E-14	5.0000E-14	1.0290
XHDP	5.0000E-14	5.0000E-14	1.0290
XHAP	5.0000E-14	5.0000E-14	1.0290
SMg	7.2000E-10	7.2000E-10	1.0290
SCa	7.2000E-10	7.2000E-10	1.0290
Me	4.8000E-10	4.8000E-10	1.0290
SCat	1.4400E-9	1.4400E-9	1.0290
SAn	1.4400E-9	1.4400E-9	1.0290
SCO2	1.9600E-9	1.9600E-9	1.0290
UD1	6.9000E-10	6.9000E-10	1.0290
UD2	6.9000E-10	6.9000E-10	1.0290
UD3	5.0000E-14	5.0000E-14	1.0290
UD4	5.0000E-14	5.0000E-14	1.0290
DO	2.5000E-9	2.5000E-9	1.0290

EPS Strength coefficients [ ]

Name	Default	Value	
Zbh	1.00000	1.00000	1.0000
Zbmeth	1.00000	1.00000	1.0000
Zaob	1.00000	1.00000	1.0000
Znob	1.00000	1.00000	1.0000
Zamox	1.00000	1.00000	1.0000
Zbp	1.00000	1.00000	1.0000
Zbpa	1.00000	1.00000	1.0000
Zbam	1.00000	1.00000	1.0000
Zbhm	1.00000	1.00000	1.0000
Ze	1.00000	1.00000	1.0000
Xsp	1.00000	1.00000	1.0000
Xsc	0	0	1.0000
Xi	1.00000	1.00000	1.0000
Xon	1.00000	1.00000	1.0000
Xop	1.00000	1.00000	1.0000
Xin	1.00000	1.00000	1.0000
Xip	1.00000	1.00000	1.0000
Spha	1.00000	1.00000	1.0000
PP-lo	1.00000	1.00000	1.0000
PP-hi	1.00000	1.00000	1.0000
XPPCat	1.00000	1.00000	1.0000
Sbsc	0	0	1.0000
Sbsa	0	0	1.0000
Sbsp	0	0	1.0000
Sbmeth	0	0	1.0000
SbH2	0	0	1.0000
CH4	0	0	1.0000
NH3-N	0	0	1.0000
Nos	0	0	1.0000
NO2-N	0	0	1.0000

NO3-N	0	0	1.0000
N2	0	0	1.0000
PO4-P (incl. MeP)	1.00000	1.00000	1.0000
Sus	0	0	1.0000
Nus	0	0	1.0000
ISS	0.33000	0.33000	1.0000
XStru	1.00000	1.00000	1.0000
XHDP	1.00000	1.00000	1.0000
XHAP	1.00000	1.00000	1.0000
SMg	0	0	1.0000
SCa	0	0	1.0000
Me	1.00000	1.00000	1.0000
SCat	0	0	1.0000
SAn	0	0	1.0000
SCO2	0	0	1.0000
UD1	0	0	1.0000
UD2	0	0	1.0000
UD3	1.00000	1.00000	1.0000
UD4	1.00000	1.00000	1.0000
DO	0	0	1.0000

BioWin user and configuration data

Project details

Project name: Aerobic Digester Model Development **Project ref.: 60037-15001**

Plant name: North Bend **User name: Markus**

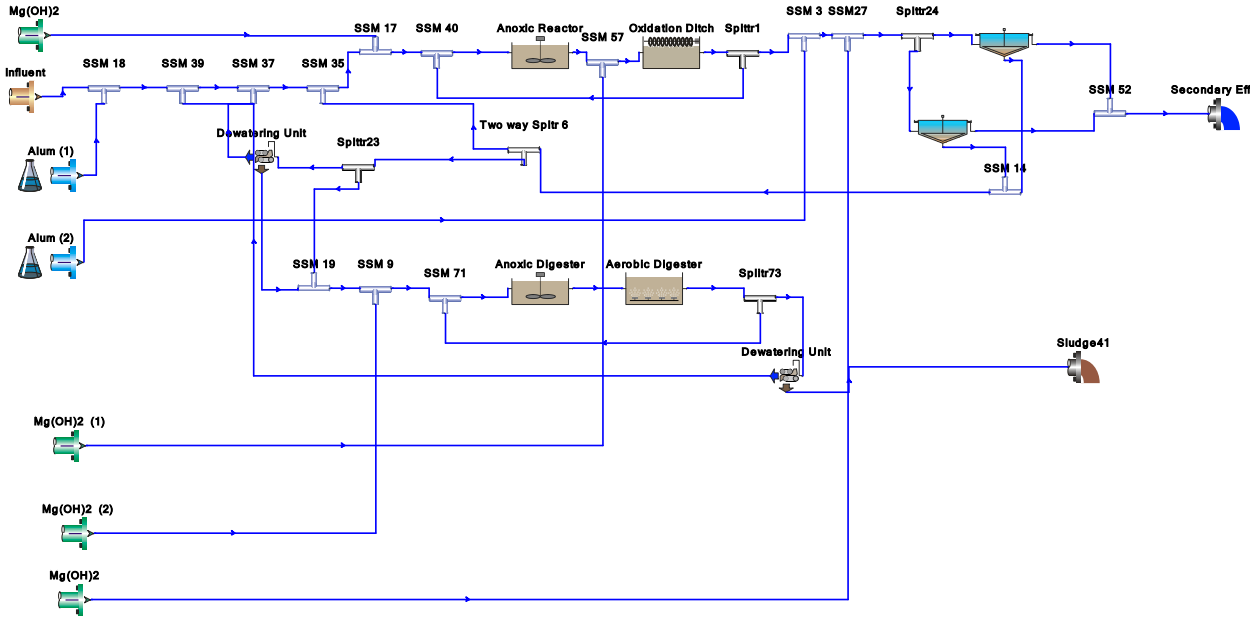
Created: 3/1/2001 **Saved: 9/5/2016**

Steady state solution

SRT: 7.59

Temperature: 20.0

Flowsheet



Configuration information for all Bioreactor units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers
Aerobic Digester	0.3000	2673.6113	15.000	606
Anoxic Digester	0.3000	2673.6113	15.000	Un-aerated

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint [mg/L]
Aerobic Digester	2.0
Anoxic Digester	0

Aeration equipment parameters

Element name	k1 in C = k1(PC)^0.25 + k2	k2 in C = k1(PC)^0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	% of tank area covered by diffusers [%]
Aerobic Digester	2.5656	0.0432	0.8200	0.0410	10.0000
Anoxic Digester	2.5656	0.0432	0.8200	0.0410	10.0000

Configuration information for all BOD Influent units

Operating data Average (flow/time weighted as required)

Element name	Influent
Flow	0.860869992486947
TCBOD mgBOD/L	328.00
VSS mgVSS/L	328.00
TSS mgTSS/L	386.00
TKN mgN/L	97.00
TP mgP/L	9.70
S_NO3 mgN/L	0
pH	7.00
Alk mmol/L	1.17
S_CA mg/L	4.40
S_MG mg/L	1.80
S_O2 mg/L	0

Element name	Influent
Fbs - Readily biodegradable (including Acetate) [gCOD/g of total COD]	0.1600
Fac - Acetate [gCOD/g of readily biodegradable COD]	0.1500
Fxsp - Non-colloidal slowly biodegradable [gCOD/g of slowly degradable COD]	0.9397
Fus - Unbiodegradable soluble [gCOD/g of total COD]	0.0500
Fup - Unbiodegradable particulate [gCOD/g of total COD]	0.1300
Fna - Ammonia [gNH3-N/gTKN]	0.6600
Fnox - Particulate organic nitrogen [gN/g Organic N]	0.5000
Fnus - Soluble unbiodegradable TKN [gN/gTKN]	0.0200
FupN - N:COD ratio for unbiodegradable part. COD [gN/gCOD]	0.0350
Fpo4 - Phosphate [gPO4-P/gTP]	0.6300
FupP - P:COD ratio for unbiodegradable part. COD [gP/gCOD]	0.0110
FZbh - Non-poly-P heterotrophs [gCOD/g of total COD]	0.0001

FZbm - Anoxic methanol utilizers [gCOD/g of total COD]	0.0001
FZaob - Ammonia oxidizers [gCOD/g of total COD]	0.0001
FZnob - Nitrite oxidizers [gCOD/g of total COD]	0.0001
FZamob - Anaerobic ammonia oxidizers [gCOD/g of total COD]	0.0001
FZbp - PAOs [gCOD/g of total COD]	0.0001
FZbpa - Propionic acetogens [gCOD/g of total COD]	0.0001
FZbam - Acetoclastic methanogens [gCOD/g of total COD]	0.0001
FZbhm - H2-utilizing methanogens [gCOD/g of total COD]	0.0001

Configuration information for all Model clarifier units

Physical data

Element name	Volume[Mil. Gal]	Area[ft2]	Depth[ft]	Number of layers	Top feed layer	Feed Layers
Secondary Clariifer 2	0.5025	5024.0000	13.370	10	6	1
Secondary Clarifier No 1	0.5025	5024.0000	13.370	10	6	1

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Secondary Clariifer 2	Ratio	0.40
Secondary Clarifier No 1	Ratio	0.40

Element name	Average Temperature	Reactive
Secondary Clariifer 2	Uses global setting	No

Secondary Clarifier No 1	Uses global setting	No

Configuration information for all Effluent units

Configuration information for all Media Bioreactor units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers
Anoxic Reactor	0.2000	2673.6113	10.000	Un-aerated

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint
Anoxic Reactor	0

Aeration equipment parameters

Element name	k1 in C = k1(PC)^0.25 + k2	k2 in C = k1(PC)^0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	% of tank area covered by diffusers [%]
Anoxic Reactor	2.5656	0.0432	0.8200	0.0410	10.0000

Configuration information for all Metal addition units

Operating data Average (flow/time weighted as required)

Element name	Alum (1)	Alum (2)
X_OHO mgCOD/L	0	0
X_MEOLO mgCOD/L	0	0
X_AOO mgCOD/L	0	0
X_NOO mgCOD/L	0	0
X_AMO mgCOD/L	0	0
X_PAO mgCOD/L	0	0
X_PRO mgCOD/L	0	0
X_ACO mgCOD/L	0	0
X_HMO mgCOD/L	0	0
X_U_E mgCOD/L	0	0
X_B mgCOD/L	0	0
C_B mgCOD/L	0	0
X_U_INF mgCOD/L	0	0
X_B_ORG_N mgN/L	0	0
X_B_ORG_P mgP/L	0	0
X_U_ORG_N mgN/L	0	0
X_U_ORG_P mgP/L	0	0
X_PAO_PHA mgCOD/L	0	0
X_PAO_PPL mgP/L	0	0
X_PAO_PPH mgP/L	0	0
X_PAO_PP_CAT mg/L	0	0
S_F mgCOD/L	0	0
S_AC mgCOD/L	0	0
S_PR mgCOD/L	0	0
S_MEOL mgCOD/L	0	0

S_H2 mgCOD/L	0	0
S_CH4 mg/L	0	0
S_NHx mgN/L	0	0
S_B_ORG_N mgN/L	0	0
S_NO2 mgN/L	0	0
S_NO3 mgN/L	0	0
S_N2 mgN/L	0	0
T_PO4 mgP/L	0	0
S_U mgCOD/L	0	0
S_U_ORG_N mgN/L	0	0
X_IG_INF mgISS/L	0	0
X_MAP mgISS/L	0	0
X_HDP mgISS/L	0	0
X_HAP mgISS/L	0	0
S_MG mg/L	0	0
S_CA mg/L	0	0
S_ME mg/L	0.00	57700.00
S_CAT meq/L	5.00	5.00
S_AN meq/L	15.81	6434.89
S_CO2 mmol/L	7.00	7.00
S_UD1 mg/L	0	0
S_UD2 mg/L	0	0
X_UD3 mgVSS/L	0	0
X_UD4_IG mgISS/L	0	0
S_O2 mg/L	0	0
Flow	0	0

Configuration information for all Sidestream Mixer units

Configuration information for all Dewatering unit units

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Dewatering Unit	Ratio	0.20
Dewatering Unit	Ratio	0.14

Element name	Percent removal
Dewatering Unit	100.00
Dewatering Unit	90.00

Configuration information for all Sludge units

Configuration information for all Splitter units

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Two way Spltr 6	Flowrate [Side]	0.03
Splttr23	Flowrate [Side]	0.02
Splttr1	Ratio	4.00
Splttr24	Ratio	0.00
Splitr73	Ratio	6.00

Configuration information for all Influent (SV) units

Operating data Average (flow/time weighted as required)

Element name	Mg(OH)2	Mg(OH)2 (1)	Mg(OH)2 (2)	Mg(OH)2
X_OHO mgCOD/L	0	0	0	0
X_MEOLO mgCOD/L	0	0	0	0
X_AOO mgCOD/L	0	0	0	0
X_NOO mgCOD/L	0	0	0	0
X_AMO mgCOD/L	0	0	0	0
X_PAO mgCOD/L	0	0	0	0
X_PRO mgCOD/L	0	0	0	0
X_ACO mgCOD/L	0	0	0	0
X_HMO mgCOD/L	0	0	0	0
X_U_E mgCOD/L	0	0	0	0
X_B mgCOD/L	0	0	0	0
C_B mgCOD/L	0	0	0	0
X_U_INF mgCOD/L	0	0	0	0
X_B_ORG_N mgN/L	0	0	0	0
X_B_ORG_P mgP/L	0	0	0	0
X_U_ORG_N mgN/L	0	0	0	0
X_U_ORG_P mgP/L	0	0	0	0
X_PAO_PHA mgCOD/L	0	0	0	0
X_PAO_PPL mgP/L	0	0	0	0
X_PAO_PPH mgP/L	0	0	0	0
X_PAO_PP_CAT mg/L	0	0	0	0
S_F mgCOD/L	0	0	0	0
S_AC mgCOD/L	0	0	0	0
S_PR mgCOD/L	0	0	0	0

S_MEOL mgCOD/L	0	0	0	0
S_H2 mgCOD/L	0	0	0	0
S_CH4 mg/L	0	0	0	0
S_NHx mgN/L	0	0	0	0
S_B_ORG_N mgN/L	0	0	0	0
S_NO2 mgN/L	0	0	0	0
S_NO3 mgN/L	0	0	0	0
S_N2 mgN/L	0	0	0	0
T_PO4 mgP/L	0	0	0	0
S_U mgCOD/L	0	0	0	0
S_U_ORG_N mgN/L	0	0	0	0
X_IG_INF mgISS/L	0	0	0	0
X_MAP mgISS/L	0	0	0	0
X_HDP mgISS/L	0	0	0	0
X_HAP mgISS/L	0	0	0	0
S_MG mg/L	0	0	0	0
S_CA mg/L	0	0	0	0
S_ME mg/L	0	0	0	0
S_CAT meq/L	14500.00	14500.00	14500.00	14500.00
S_AN meq/L	0	0	0	0
S_CO2 mmol/L	0	0	0	0
S_UD1 mg/L	0	0	0	0
S_UD2 mg/L	0	0	0	0
X_UD3 mgVSS/L	0	0	0	0
X_UD4_IG mgISS/L	0	0	0	0
S_O2 mg/L	0	0	0	0
Flow	0	0.00035	2E-5	5E-6

Configuration information for all Bioreactor (brush aerators) units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]
Oxidation Ditch	0.4000	5347.2225	10.000

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint
Oxidation Ditch	1.5

Aeration equipment parameters

Element name	Surface aerator Std. oxygen transfer rate [lb O /(hp hr)]	Maximum power per rotor [hp]
Oxidation Ditch	2.4670	26.8097

BioWin Album

Album page - Aerobic Digester

No element
toomanycolumns

Parameters	Value	Units

Album page - Aerobic Digester

Album page - Aeration Basin

No element

toomanycolumns

Parameters	Value	Units

Album page - Effluent

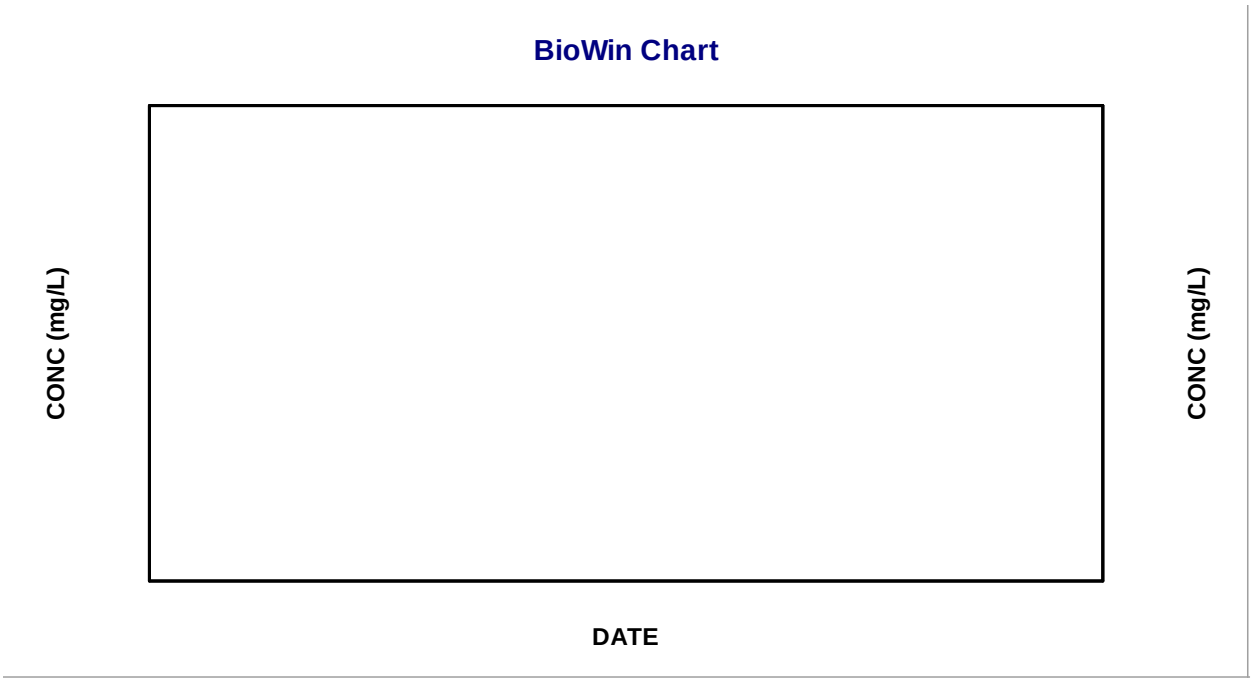
Secondary Effluent

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	1.90	13.61	
TSS	2.55	18.29	
XCOD	2.81	20.10	
SCOD	36.82	263.82	
TCOD	39.62	283.92	
SPO4	6.23	44.61	
TP	6.28	44.98	
STKN	4.59	32.89	
XTKN	0.16	1.18	
TKN	4.75	34.07	

SCBOD	1.23	8.78	
TCBOD	2.10	15.07	
NOx	34.07	244.15	
TN	38.83	278.22	
TIN	35.18	252.10	
Alk	0.63	2.06	mmol/L and kmol/d
pH	6.91		
VFA	0.00	0.01	
XPrec	0.00	0.00	
TISS	0.65	4.68	
S_NHx	1.11	7.94	
S_NO3	33.33	238.86	

Parameters	Value	Units

Album page - Page 4



Album page - Page 5

SSM 52			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	1.90	13.61	
TSS	2.55	18.29	
XCOD	2.81	20.10	
SCOD	36.82	263.82	
TCOD	39.62	283.92	
SPO4	6.23	44.61	
TP	6.28	44.98	
STKN	4.59	32.89	
XTKN	0.16	1.18	
TKN	4.75	34.07	
SCBOD	1.23	8.78	
TCBOD	2.10	15.07	

NOx	34.07	244.15	
TN	38.83	278.22	
TIN	35.18	252.10	
Alk	0.63	2.06	mmol/L and kmol/d
pH	6.91		
VFA	0.00	0.01	
XPrec	0.00	0.00	
TISS	0.65	4.68	
S_NHx	1.11	7.94	
S_NO3	33.33	238.86	

Parameters	Value	Units

Album page - Page 6

SSM 14			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	6438.92	18456.29	
TSS	8654.82	24807.86	
XCOD	9511.92	27264.62	
SCOD	36.82	105.53	
TCOD	9548.73	27370.15	
SPO4	6.23	17.85	
TP	181.28	519.62	
STKN	4.59	13.16	
XTKN	557.42	1597.77	
TKN	562.01	1610.93	
SCBOD	1.23	3.51	

TCBOD	2977.67	8535.08	
NOx	34.07	97.66	
TN	596.08	1708.59	
TIN	35.18	100.84	
Alk	0.63	0.83	mmol/L and kmol/d
pH	6.91		
VFA	0.00	0.00	
XPrec	0.00	0.00	
TISS	2215.90	6351.57	
S_NHx	1.11	3.18	
S_NO3	33.33	95.54	

Parameters	Value	Units

Album page - Page 7

SSM 9			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	8907.20	1612.06	
TSS	11972.54	2166.84	
XCOD	13158.20	2381.42	
SCOD	36.78	6.66	
TCOD	13194.98	2388.08	
SPO4	6.22	1.13	
TP	248.38	44.95	
STKN	4.59	0.83	
XTKN	771.10	139.56	
TKN	775.69	140.39	

SCBOD	1.22	0.22	
TCBOD	4118.65	745.41	
NOx	34.04	6.16	
TN	809.73	146.55	
TIN	35.15	6.36	
Alk	14.01	1.15	mmol/L and kmol/d
pH	12.19		
VFA	0.00	0.00	
XPrec	0.00	0.00	
TISS	3065.34	554.78	
S_NHx	1.11	0.20	
S_NO3	33.30	6.03	

Parameters	Value	Units

Global Parameters

AOB

Name	Default	Value	
Max. spec. growth rate [1/d]	0.90000	0.90000	1.0720
Substrate (NH4) half sat. [mgN/L]	0.70000	0.70000	1.0000
Aerobic decay rate [1/d]	0.17000	0.17000	1.0290
Anoxic/anaerobic decay rate [1/d]	0.08000	0.08000	1.0290
KiHNO2 [mmol/L]	0.00500	0.00500	1.0000

NOB

Name	Default	Value	
Max. spec. growth rate [1/d]	0.70000	0.70000	1.0600
Substrate (NO2) half sat. [mgN/L]	0.10000	0.10000	1.0000
Aerobic decay rate [1/d]	0.17000	0.17000	1.0290
Anoxic/anaerobic decay rate [1/d]	0.08000	0.08000	1.0290
KiNH3 [mmol/L]	0.07500	0.07500	1.0000

ANAMMOX

Name	Default	Value	
Max. spec. growth rate [1/d]	0.10000	0.10000	1.1000
Substrate (NH4) half sat. [mgN/L]	2.00000	2.00000	1.0000
Substrate (NO2) half sat. [mgN/L]	1.00000	1.00000	1.0000
Aerobic decay rate [1/d]	0.01900	0.01900	1.0290
Anoxic/anaerobic decay rate [1/d]	0.00950	0.00950	1.0290
Ki Nitrite [mgN/L]	1000.00000	1000.00000	1.0000
Nitrite sensitivity constant [L / (d mgN)]	0.01600	0.01600	1.0000

OHOs

Name	Default	Value	
Max. spec. growth rate [1/d]	3.20000	3.20000	1.0290
Substrate half sat. [mgCOD/L]	5.00000	5.00000	1.0000
Anoxic growth factor [-]	0.50000	0.50000	1.0000

Aerobic decay [1/d]	0.62000	0.62000	1.0290
Anoxic/anaerobic decay [1/d]	0.30000	0.30000	1.0290
Hydrolysis rate (AS) [1/d]	2.10000	2.10000	1.0290
Hydrolysis half sat. (AS) [-]	0.06000	0.06000	1.0000
Anoxic hydrolysis factor [-]	0.28000	0.28000	1.0000
Anaerobic hydrolysis factor [-]	0.50000	0.50000	1.0000
Adsorption rate of colloids [L/(mgCOD d)]	0.80000	0.80000	1.0290
Ammonification rate [L/(mgN d)]	0.04000	0.04000	1.0290
Assimilative nitrate/nitrite reduction rate [1/d]	0.50000	0.50000	1.0000
Fermentation rate [1/d]	3.20000	3.20000	1.0290
Fermentation half sat. [mgCOD/L]	5.00000	5.00000	1.0000
Anaerobic growth factor (AS) [-]	0.12500	0.12500	1.0000
Hydrolysis rate (AD) [1/d]	0.10000	0.10000	1.0500
Hydrolysis half sat. (AD) [mgCOD/L]	0.15000	0.15000	1.0000

Methylotrophs

Name	Default	Value	
Max. spec. growth rate of methanol utilizers [1/d]	1.30000	1.30000	1.0720
Methanol half sat. [mgCOD/L]	0.50000	0.50000	1.0000
Aerobic decay rate of methanol utilizers [1/d]	0.04000	0.04000	1.0290
Anoxic/anaerobic decay rate of methanol utilizers [1/d]	0.03000	0.03000	1.0290

PAOs

Name	Default	Value	
Max. spec. growth rate [1/d]	0.95000	0.95000	1.0000

Max. spec. growth rate, P-limited [1/d]	0.42000	0.42000	1.0000
Substrate half sat. [mgCOD(PHB)/mgCOD(Zbp)]	0.10000	0.10000	1.0000
Substrate half sat., P-limited [mgCOD(PHB)/mgCOD(Zbp)]	0.05000	0.05000	1.0000
Magnesium half sat. [mgMg/L]	0.10000	0.10000	1.0000
Cation half sat. [mmol/L]	0.10000	0.10000	1.0000
Calcium half sat. [mgCa/L]	0.10000	0.10000	1.0000
Aerobic decay rate [1/d]	0.10000	0.10000	1.0000
Anaerobic decay rate [1/d]	0.04000	0.04000	1.0000
Sequestration rate [1/d]	6.00000	6.00000	1.0000
Anoxic growth factor NO3 [-]	0.33000	0.33000	1.0000
Anoxic growth factor NO2 [-]	0.33000	0.33000	1.0000

Acetogens

Name	Default	Value	
Max. spec. growth rate [1/d]	0.25000	0.25000	1.0290
Substrate half sat. [mgCOD/L]	10.00000	10.00000	1.0000
Acetate inhibition [mgCOD/L]	10000.00000	10000.00000	1.0000
Decay rate [1/d]	0.05000	0.05000	1.0290
Aerobic decay rate [1/d]	0.52000	0.52000	1.0290

Methanogens

Name	Default	Value	
Acetoclastic Mu Max [1/d]	0.30000	0.30000	1.0290
H2-utilizing Mu Max [1/d]	1.40000	1.40000	1.0290
Acetoclastic Ks [mgCOD/L]	100.00000	100.00000	1.0000

Acetoclastic methanol Ks [mgCOD/L]	0.50000	0.50000	1.0000
H2-utilizing CO2 half sat. [mmol/L]	0.10000	0.10000	1.0000
H2-utilizing Ks [mgCOD/L]	0.10000	0.10000	1.0000
H2-utilizing methanol Ks [mgCOD/L]	0.50000	0.50000	1.0000
Acetoclastic propionic inhibition [mgCOD/L]	10000.00000	10000.00000	1.0000
Acetoclastic decay rate [1/d]	0.13000	0.13000	1.0290
Acetoclastic aerobic decay rate [1/d]	0.60000	0.60000	1.0290
H2-utilizing decay rate [1/d]	0.13000	0.13000	1.0290
H2-utilizing aerobic decay rate [1/d]	0.60000	0.60000	1.0290

pH

Name	Default	Value
Heterotrophs low pH limit [-]	4.00000	4.00000
Heterotrophs high pH limit [-]	10.00000	10.00000
Methanol utilizers low pH limit [-]	4.00000	4.00000
Methanol utilizers high pH limit [-]	10.00000	10.00000
Autotrophs low pH limit [-]	5.50000	5.50000
Autotrophs high pH limit [-]	9.50000	9.50000
PolyP heterotrophs low pH limit [-]	4.00000	4.00000
Poly P heterotrophs high pH limit [-]	10.00000	10.00000
Heterotrophs low pH limit (anaerobic) [-]	5.50000	5.50000
Heterotrophs high pH limit (anaerobic) [-]	8.50000	8.50000
Propionic acetogens low pH limit [-]	4.00000	4.00000
Propionic acetogens high pH limit [-]	10.00000	10.00000
Acetoclastic methanogens low pH limit [-]	5.00000	5.00000
Acetoclastic methanogens high pH limit [-]	9.00000	9.00000
H2-utilizing methanogens low pH limit [-]	5.00000	5.00000
H2-utilizing methanogens high pH limit [-]	9.00000	9.00000

Switches

Name	Default	Value
Heterotrophic DO half sat. [mgO2/L]	0.05000	0.05000
Aerobic denit. DO half sat. [mgO2/L]	0.05000	0.05000
Ammonia oxidizer DO half sat. [mgO2/L]	0.25000	0.25000
Nitrite oxidizer DO half sat. [mgO2/L]	0.50000	0.50000
Anaerobic ammonia oxidizer DO half sat. [mgO2/L]	0.01000	0.01000
Anoxic NO3 half sat. [mgN/L]	0.10000	0.10000
Anoxic NO2 half sat. (mgN/L)	0.01000	0.01000
NH3 nutrient half sat. [mgN/L]	1.0000E-4	1.0000E-4
PolyP half sat. [mgP/L]	0.01000	0.01000
VFA sequestration half sat. [mgCOD/L]	5.00000	5.00000
P uptake half sat. [mgP/L]	0.15000	0.15000
P nutrient half sat. [mgP/L]	0.00100	0.00100
Autotroph CO2 half sat. [mmol/L]	0.10000	0.10000
Heterotrophic Hydrogen half sat. [mgCOD/L]	1.00000	1.00000
Propionic acetogens Hydrogen half sat. [mgCOD/L]	5.00000	5.00000
Synthesis anion/cation half sat. [meq/L]	0.01000	0.01000

Common

Name	Default	Value
N in endogenous residue [mgN/mgCOD]	0.07000	0.07000
P in endogenous residue [mgP/mgCOD]	0.02200	0.02200
Endogenous residue COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

Particulate substrate COD:VSS ratio [mgCOD/mgVSS]	1.60000	1.60000
Particulate inert COD:VSS ratio [mgCOD/mgVSS]	1.60000	1.60000

AOB

Name	Default	Value
Yield [mgCOD/mgN]	0.15000	0.15000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

NOB

Name	Default	Value
Yield [mgCOD/mgN]	0.09000	0.09000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

ANAMMOX

Name	Default	Value
Yield [mgCOD/mgN]	0.11400	0.11400

Nitrate production [mgN/mgBiomassCOD]	2.28000	2.28000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

OHOs

Name	Default	Value
Yield (aerobic) [-]	0.66600	0.66600
Yield (fermentation, low H2) [-]	0.10000	0.10000
Yield (fermentation, high H2) [-]	0.10000	0.10000
H2 yield (fermentation low H2) [-]	0.35000	0.35000
H2 yield (fermentation high H2) [-]	0	0
Propionate yield (fermentation, low H2) [-]	0	0
Propionate yield (fermentation, high H2) [-]	0.70000	0.70000
CO2 yield (fermentation, low H2) [-]	0.70000	0.70000
CO2 yield (fermentation, high H2) [-]	0	0
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
Yield (anoxic) [-]	0.54000	0.54000
Yield propionic (aerobic) [-]	0.64000	0.64000
Yield propionic (anoxic) [-]	0.46000	0.46000
Yield acetic (aerobic) [-]	0.60000	0.60000
Yield acetic (anoxic) [-]	0.43000	0.43000
Yield methanol (aerobic) [-]	0.50000	0.50000
Adsorp. max. [-]	1.00000	1.00000

Methylotrophs

Name	Default	Value
Yield (anoxic) [-]	0.40000	0.40000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

PAOs

Name	Default	Value
Yield (aerobic) [-]	0.63900	0.63900
Yield (anoxic) [-]	0.52000	0.52000
Aerobic P/PHA uptake [mgP/mgCOD]	0.95000	0.95000
Anoxic P/PHA uptake [mgP/mgCOD]	0.35000	0.35000
Yield of PHA on sequestration [-]	0.88900	0.88900
N in biomass [mgN/mgCOD]	0.07000	0.07000
N in sol. inert [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous part. [-]	0.25000	0.25000
Inert fraction of endogenous sol. [-]	0.20000	0.20000
P/Ac release ratio [mgP/mgCOD]	0.49000	0.49000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
Yield of low PP [-]	0.94000	0.94000

Acetogens

Name	Default	Value
Yield [-]	0.10000	0.10000
H2 yield [-]	0.40000	0.40000
CO2 yield [-]	1.00000	1.00000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

Methanogens

Name	Default	Value
Acetoclastic yield [-]	0.10000	0.10000
Methanol acetoclastic yield [-]	0.10000	0.10000
H2-utilizing yield [-]	0.10000	0.10000
Methanol H2-utilizing yield [-]	0.10000	0.10000
N in acetoclastic biomass [mgN/mgCOD]	0.07000	0.07000
N in H2-utilizing biomass [mgN/mgCOD]	0.07000	0.07000
P in acetoclastic biomass [mgP/mgCOD]	0.02200	0.02200
P in H2-utilizing biomass [mgP/mgCOD]	0.02200	0.02200
Acetoclastic fraction to endog. residue [-]	0.08000	0.08000
H2-utilizing fraction to endog. residue [-]	0.08000	0.08000
Acetoclastic COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
H2-utilizing COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

General

Name	Default	Value
Ash content of biomass (synthesis ISS) [%]	8.00000	8.00000
Molecular weight of other anions [mg/mmol]	35.50000	35.50000
Molecular weight of other cations [mg/mmol]	39.10000	39.10000
Mg to P mole ratio in polyphosphate [mmolMg/mmolP]	0.30000	0.30000
Cation to P mole ratio in polyphosphate [meq/mmolP]	0.30000	0.30000
Ca to P mole ratio in polyphosphate [mmolCa/mmolP]	0.05000	0.05000
Cation to P mole ratio in organic phosphate [meq/mmolP]	0.01000	0.01000
Bubble rise velocity (anaerobic digester) [cm/s]	23.90000	23.90000
Bubble Sauter mean diameter (anaerobic digester) [cm]	0.35000	0.35000
Anaerobic digester gas hold-up factor []	1.00000	1.00000
Tank head loss per metre of length (from flow) [m/m]	0.00250	0.00250

Mass transfer

Name	Default	Value	
Kl for H2 [m/d]	17.00000	17.00000	1.0240
Kl for CO2 [m/d]	10.00000	10.00000	1.0240
Kl for NH3 [m/d]	1.00000	1.00000	1.0240
Kl for CH4 [m/d]	8.00000	8.00000	1.0240
Kl for N2 [m/d]	15.00000	15.00000	1.0240
Kl for O2 [m/d]	13.00000	13.00000	1.0240

Physico-chemical rates

Name	Default	Value	
Struvite precipitation rate [1/d]	3.0000E+10	3.0000E+10	1.0240
Struvite redissolution rate [1/d]	3.0000E+11	3.0000E+11	1.0240
Struvite half sat. [mgTSS/L]	1.00000	1.00000	1.0000
HDP precipitation rate [L/(molP d)]	1.0000E+8	1.0000E+8	1.0000
HDP redissolution rate [L/(mol P d)]	1.0000E+8	1.0000E+8	1.0000
HAP precipitation rate [molHDP/(L d)]	5.0000E-4	5.0000E-4	1.0000

Physico-chemical constants

Name	Default	Value
Struvite solubility constant [mol/L]	6.9180E-14	6.9180E-14
HDP solubility product [mol/L]	2.7500E-22	2.7500E-22
HDP half sat. [mgTSS/L]	1.00000	1.00000
Equilibrium soluble PO4 with Al dosing at pH 7 [mgP/L]	0.01000	0.01000
Al to P ratio [molAl/molP]	0.80000	0.80000
Al(OH)3 solubility product [mol/L]	1.2590E+9	1.2590E+9
AlHPO4+ dissociation constant [mol/L]	7.9430E-13	7.9430E-13
Equilibrium soluble PO4 with Fe dosing at pH 7 [mgP/L]	0.01000	0.01000
Fe to P ratio [molFe/molP]	1.60000	1.60000
Fe(OH)3 solubility product [mol/L]	0.05000	0.05000
FeH2PO4++ dissociation constant [mol/L]	5.0120E-22	5.0120E-22

Aeration

Name	Default	Value

Alpha (surf) OR Alpha F (diff) [-]	0.50000	0.50000
Beta [-]	0.95000	0.95000
Surface pressure [kPa]	101.32500	101.32500
Fractional effective saturation depth (Fed) [-]	0.32500	0.32500
Supply gas CO2 content [vol. %]	0.03500	0.03500
Supply gas O2 [vol. %]	20.95000	20.95000
Off-gas CO2 [vol. %]	2.00000	2.00000
Off-gas O2 [vol. %]	18.80000	18.80000
Off-gas H2 [vol. %]	0	0
Off-gas NH3 [vol. %]	0	0
Off-gas CH4 [vol. %]	0	0
Surface turbulence factor [-]	2.00000	2.00000
Set point controller gain []	1.00000	1.00000

Modified Vesilind

Name	Default	Value
Maximum Vesilind settling velocity (Vo) [ft/min]	0.3873	0.3873
Vesilind hindered zone settling parameter (K) [L/g]	0.3700	0.3700
Clarification switching function [mg/L]	100.0000	100.0000
Specified TSS conc.for height calc. [mg/L]	2500.0000	2500.0000
Maximum compactability constant [mg/L]	15000.0000	15000.0000

Double exponential

Name	Default	Value
Maximum Vesilind settling velocity (Vo) [ft/min]	0.9341	0.9341

Maximum (practical) settling velocity (Vo') [ft/min]	0.6152	0.6152
Hindered zone settling parameter (Kh) [L/g]	0.4000	0.4000
Flocculent zone settling parameter (Kf) [L/g]	2.5000	2.5000
Maximum non-settleable TSS [mg/L]	20.0000	20.0000
Non-settleable fraction [-]	0.0010	0.0010
Specified TSS conc. for height calc. [mg/L]	2500.0000	2500.0000

Biofilm general

Name	Default	Value	
Attachment rate [g / (m2 d)]	80.00000	80.00000	1.0000
Attachment TSS half sat. [mg/L]	100.00000	100.00000	1.0000
Detachment rate [g/(m3 d)]	8.0000E+4	8.0000E+4	1.0000
Solids movement factor []	10.00000	10.00000	1.0000
Diffusion neta []	0.80000	0.80000	1.0000
Thin film limit [mm]	0.50000	0.50000	1.0000
Thick film limit [mm]	3.00000	3.00000	1.0000
Assumed Film thickness for tank volume correction (temp independant) [mm]	0.75000	0.75000	1.0000
Film surface area to media area ratio - Max.[ ]	1.00000	1.00000	1.0000
Minimum biofilm conc. for streamer formation [gTSS/m2]	4.00000	4.00000	1.0000

Maximum biofilm concentrations [mg/L]

Name	Default	Value	
Zbh	5.0000E+4	5.0000E+4	1.0000
Zbmeth	5.0000E+4	5.0000E+4	1.0000
Zaob	1.0000E+5	1.0000E+5	1.0000

Znob	1.0000E+5	1.0000E+5	1.0000
Zamox	5.0000E+4	5.0000E+4	1.0000
Zbp	5.0000E+4	5.0000E+4	1.0000
Zbpa	5.0000E+4	5.0000E+4	1.0000
Zbam	5.0000E+4	5.0000E+4	1.0000
Zbhm	5.0000E+4	5.0000E+4	1.0000
Ze	3.0000E+4	3.0000E+4	1.0000
Xsp	5000.00000	5000.00000	1.0000
Xsc	0	0	1.0000
Xi	5000.00000	5000.00000	1.0000
Xon	0	0	1.0000
Xop	0	0	1.0000
Xin	0	0	1.0000
Xip	0	0	1.0000
Spha	5000.00000	5000.00000	1.0000
PP-lo	1.1500E+6	1.1500E+6	1.0000
PP-hi	1.1500E+6	1.1500E+6	1.0000
XPPCat	1.1500E+6	1.1500E+6	1.0000
Sbsc	0	0	1.0000
Sbsa	0	0	1.0000
Sbsp	0	0	1.0000
Sbmeth	0	0	1.0000
SbH2	0	0	1.0000
CH4	0	0	1.0000
NH3-N	0	0	1.0000
Nos	0	0	1.0000
NO2-N	0	0	1.0000
NO3-N	0	0	1.0000
N2	0	0	1.0000
PO4-P (incl. MeP)	1.0000E+10	1.0000E+10	1.0000
Sus	0	0	1.0000

Nus	0	0	1.0000
ISS	1.3000E+6	1.3000E+6	1.0000
XStru	8.5000E+5	8.5000E+5	1.0000
XHDP	1.1500E+6	1.1500E+6	1.0000
XHAP	1.6000E+6	1.6000E+6	1.0000
SMg	0	0	1.0000
SCa	0	0	1.0000
Me	1.0000E+10	1.0000E+10	1.0000
SCat	0	0	1.0000
SAn	0	0	1.0000
SCO2	0	0	1.0000
UD1	0	0	1.0000
UD2	0	0	1.0000
UD3	5.0000E+4	5.0000E+4	1.0000
UD4	5.0000E+4	5.0000E+4	1.0000
DO	0	0	1.0000

Effective diffusivities [m2/s]

Name	Default	Value	
Zbh	5.0000E-14	5.0000E-14	1.0290
Zbmeth	5.0000E-14	5.0000E-14	1.0290
Zaob	5.0000E-14	5.0000E-14	1.0290
Znob	5.0000E-14	5.0000E-14	1.0290
Zamox	5.0000E-14	5.0000E-14	1.0290
Zbp	5.0000E-14	5.0000E-14	1.0290
Zbpa	5.0000E-14	5.0000E-14	1.0290
Zbam	5.0000E-14	5.0000E-14	1.0290
Zbhm	5.0000E-14	5.0000E-14	1.0290

Ze	5.0000E-14	5.0000E-14	1.0290
Xsp	5.0000E-14	5.0000E-14	1.0290
Xsc	6.9000E-11	6.9000E-11	1.0290
Xi	5.0000E-14	5.0000E-14	1.0290
Xon	5.0000E-14	5.0000E-14	1.0290
Xop	5.0000E-14	5.0000E-14	1.0290
Xin	5.0000E-14	5.0000E-14	1.0290
Xip	5.0000E-14	5.0000E-14	1.0290
Spha	5.0000E-14	5.0000E-14	1.0290
PP-lo	5.0000E-14	5.0000E-14	1.0290
PP-hi	5.0000E-14	5.0000E-14	1.0290
XPPCat	5.0000E-14	5.0000E-14	1.0290
Sbsc	6.9000E-10	6.9000E-10	1.0290
Sbsa	1.2400E-9	1.2400E-9	1.0290
Sbsp	8.3000E-10	8.3000E-10	1.0290
Sbmeth	1.6000E-9	1.6000E-9	1.0290
SbH2	5.8500E-9	5.8500E-9	1.0290
CH4	1.9625E-9	1.9625E-9	1.0290
NH3-N	2.0000E-9	2.0000E-9	1.0290
Nos	1.3700E-9	1.3700E-9	1.0290
NO2-N	2.9800E-9	2.9800E-9	1.0290
NO3-N	2.9800E-9	2.9800E-9	1.0290
N2	1.9000E-9	1.9000E-9	1.0290
PO4-P (incl. MeP)	2.0000E-9	2.0000E-9	1.0290
Sus	6.9000E-10	6.9000E-10	1.0290
Nus	6.8500E-10	6.8500E-10	1.0290
ISS	5.0000E-14	5.0000E-14	1.0290
XStru	5.0000E-14	5.0000E-14	1.0290
XHDP	5.0000E-14	5.0000E-14	1.0290
XHAP	5.0000E-14	5.0000E-14	1.0290
SMg	7.2000E-10	7.2000E-10	1.0290

SCa	7.2000E-10	7.2000E-10	1.0290
Me	4.8000E-10	4.8000E-10	1.0290
SCat	1.4400E-9	1.4400E-9	1.0290
SAn	1.4400E-9	1.4400E-9	1.0290
SCO2	1.9600E-9	1.9600E-9	1.0290
UD1	6.9000E-10	6.9000E-10	1.0290
UD2	6.9000E-10	6.9000E-10	1.0290
UD3	5.0000E-14	5.0000E-14	1.0290
UD4	5.0000E-14	5.0000E-14	1.0290
DO	2.5000E-9	2.5000E-9	1.0290

EPS Strength coefficients [ ]

Name	Default	Value	
Zbh	1.00000	1.00000	1.0000
Zbmeth	1.00000	1.00000	1.0000
Zaob	1.00000	1.00000	1.0000
Znob	1.00000	1.00000	1.0000
Zamox	1.00000	1.00000	1.0000
Zbp	1.00000	1.00000	1.0000
Zbpa	1.00000	1.00000	1.0000
Zbam	1.00000	1.00000	1.0000
Zbhm	1.00000	1.00000	1.0000
Ze	1.00000	1.00000	1.0000
Xsp	1.00000	1.00000	1.0000
Xsc	0	0	1.0000
Xi	1.00000	1.00000	1.0000
Xon	1.00000	1.00000	1.0000
Xop	1.00000	1.00000	1.0000

Xin	1.00000	1.00000	1.0000
Xip	1.00000	1.00000	1.0000
Spha	1.00000	1.00000	1.0000
PP-lo	1.00000	1.00000	1.0000
PP-hi	1.00000	1.00000	1.0000
XPPCat	1.00000	1.00000	1.0000
Sbsc	0	0	1.0000
Sbsa	0	0	1.0000
Sbsp	0	0	1.0000
Sbmeth	0	0	1.0000
SbH2	0	0	1.0000
CH4	0	0	1.0000
NH3-N	0	0	1.0000
Nos	0	0	1.0000
NO2-N	0	0	1.0000
NO3-N	0	0	1.0000
N2	0	0	1.0000
PO4-P (incl. MeP)	1.00000	1.00000	1.0000
Sus	0	0	1.0000
Nus	0	0	1.0000
ISS	0.33000	0.33000	1.0000
XStru	1.00000	1.00000	1.0000
XHDP	1.00000	1.00000	1.0000
XHAP	1.00000	1.00000	1.0000
SMg	0	0	1.0000
SCa	0	0	1.0000
Me	1.00000	1.00000	1.0000
SCat	0	0	1.0000
SAn	0	0	1.0000
SCO2	0	0	1.0000
UD1	0	0	1.0000

UD2	0	0	1.0000
UD3	1.00000	1.00000	1.0000
UD4	1.00000	1.00000	1.0000
DO	0	0	1.0000

BioWin user and configuration data

Project details

Project name: Aerobic Digester Model Development **Project ref.: 60037-15001**

Plant name: North Bend **User name: Markus**

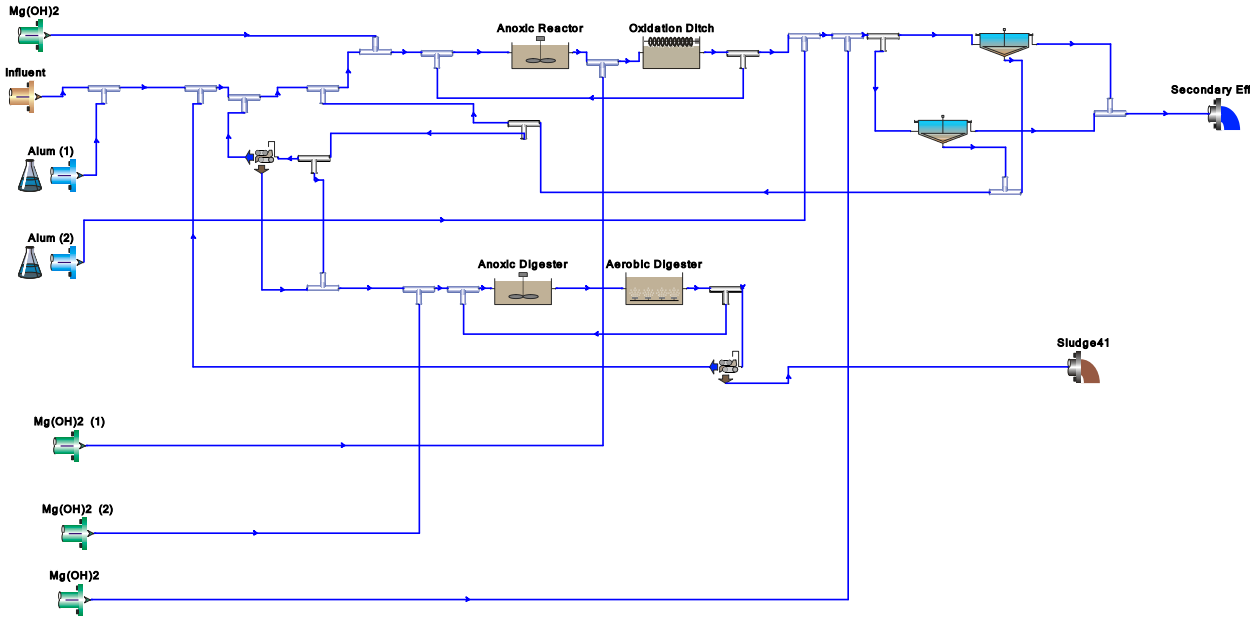
Created: 3/1/2001 **Saved: 5/6/2016**

Steady state solution

SRT: 23.71

Temperature: 20.0

Flowsheet



Configuration information for all Bioreactor units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers
Aerobic Digester	0.3000	2673.6113	15.000	606
Anoxic Digester	0.3000	2673.6113	15.000	Un-aerated

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint [mg/L]
Aerobic Digester	2.0
Anoxic Digester	0

Aeration equipment parameters

Element name	k1 in C = k1(PC)^0.25 + k2	k2 in C = k1(PC)^0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	% of tank area covered by diffusers [%]
Aerobic Digester	2.5656	0.0432	0.8200	0.0410	10.0000
Anoxic Digester	2.5656	0.0432	0.8200	0.0410	10.0000

Configuration information for all BOD Influent units

Operating data Average (flow/time weighted as required)

Element name	Influent
Flow	0.860869992486947
Total Carbonaceous BOD mgBOD/L	328.00
Volatile suspended solids mgVSS/L	328.00
Total suspended solids mgTSS/L	386.00
Total Kjeldahl Nitrogen mgN/L	97.00
Total P mgP/L	9.70
Nitrate N mgN/L	0
pH	7.00
Alkalinity mmol/L	1.17
Calcium mg/L	4.40
Magnesium mg/L	1.80
Dissolved oxygen mg/L	0

Element name	Influent
Fbs - Readily biodegradable (including Acetate) [gCOD/g of total COD]	0.1600
Fac - Acetate [gCOD/g of readily biodegradable COD]	0.1500
Fxsp - Non-colloidal slowly biodegradable [gCOD/g of slowly degradable COD]	0.9397
Fus - Unbiodegradable soluble [gCOD/g of total COD]	0.0500
Fup - Unbiodegradable particulate [gCOD/g of total COD]	0.1300
Fna - Ammonia [gNH3-N/gTKN]	0.6600
Fnox - Particulate organic nitrogen [gN/g Organic N]	0.5000
Fnus - Soluble unbiodegradable TKN [gN/gTKN]	0.0200
FupN - N:COD ratio for unbiodegradable part. COD [gN/gCOD]	0.0350
Fpo4 - Phosphate [gPO4-P/gTP]	0.6300
FupP - P:COD ratio for unbiodegradable part. COD [gP/gCOD]	0.0110
FZbh - Non-poly-P heterotrophs [gCOD/g of total COD]	0.0001

FZbm - Anoxic methanol utilizers [gCOD/g of total COD]	0.0001
FZaob - Ammonia oxidizers [gCOD/g of total COD]	0.0001
FZnob - Nitrite oxidizers [gCOD/g of total COD]	0.0001
FZamob - Anaerobic ammonia oxidizers [gCOD/g of total COD]	0.0001
FZbp - PAOs [gCOD/g of total COD]	0.0001
FZbpa - Propionic acetogens [gCOD/g of total COD]	0.0001
FZbam - Acetoclastic methanogens [gCOD/g of total COD]	0.0001
FZbhm - H2-utilizing methanogens [gCOD/g of total COD]	0.0001

Configuration information for all Model clarifier units

Physical data

Element name	Volume[Mil. Gal]	Area[ft2]	Depth[ft]	Number of layers	Top feed layer	Feed Layers
Secondary Clariifer 2	0.5025	5024.0000	13.370	10	6	1
Secondary Clarifier No 1	5.2833	53819.5520	13.123	10	6	1

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Secondary Clariifer 2	Ratio	0.40
Secondary Clarifier No 1	Ratio	0.40

Element name	Average Temperature	Reactive
Secondary Clariifer 2	Uses global setting	No

Secondary Clarifier No 1	Uses global setting	No

Configuration information for all Effluent units

Configuration information for all Media Bioreactor units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers
Anoxic Reactor	0.2000	2673.6113	10.000	Un-aerated

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint
Anoxic Reactor	0

Aeration equipment parameters

Element name	k1 in C = k1(PC)^0.25 + k2	k2 in C = k1(PC)^0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	% of tank area covered by diffusers [%]
Anoxic Reactor	2.5656	0.0432	0.8200	0.0410	10.0000

Configuration information for all Metal addition units

Operating data Average (flow/time weighted as required)

Element name	Alum (1)	Alum (2)
Non-polyP heterotrophs mgCOD/L	0	0
Anoxic methanol utilizers mgCOD/L	0	0
Ammonia oxidizing biomass mgCOD/L	0	0
Nitrite oxidizing biomass mgCOD/L	0	0
Anaerobic ammonia oxidizers mgCOD/L	0	0
PolyP heterotrophs mgCOD/L	0	0
Propionic acetogens mgCOD/L	0	0
Acetoclastic methanogens mgCOD/L	0	0
Hydrogenotrophic methanogens mgCOD/L	0	0
Endogenous products mgCOD/L	0	0
Slowly bio. COD (part.) mgCOD/L	0	0
Slowly bio. COD (colloid.) mgCOD/L	0	0
Part. inert. COD mgCOD/L	0	0
Part. bio. org. N mgN/L	0	0
Part. bio. org. P mgP/L	0	0
Part. inert N mgN/L	0	0
Part. inert P mgP/L	0	0
Stored PHA mgCOD/L	0	0
Releasable stored polyP mgP/L	0	0
Fixed stored polyP mgP/L	0	0
PolyP bound cations mg/L	0	0
Readily bio. COD (complex) mgCOD/L	0	0
Acetate mgCOD/L	0	0
Propionate mgCOD/L	0	0
Methanol mgCOD/L	0	0

Dissolved H2 mgCOD/L	0	0
Dissolved methane mg/L	0	0
Ammonia N mgN/L	0	0
Sol. bio. org. N mgN/L	0	0
Nitrite N mgN/L	0	0
Nitrate N mgN/L	0	0
Dissolved nitrogen gas mgN/L	0	0
PO4-P (Sol. & Me Complexed) mgP/L	0	0
Sol. inert COD mgCOD/L	0	0
Sol. inert TKN mgN/L	0	0
Inorganic S.S. mgISS/L	0	0
Struvite mgISS/L	0	0
Hydroxy-dicalcium-phosphate mgISS/L	0	0
Hydroxy-apatite mgISS/L	0	0
Magnesium mg/L	0	0
Calcium mg/L	0	0
Metal mg/L	0.00	57700.00
Other Cations (strong bases) meq/L	5.00	5.00
Other Anions (strong acids) meq/L	15.81	6434.89
Total CO2 mmol/L	7.00	7.00
User defined 1 mg/L	0	0
User defined 2 mg/L	0	0
User defined 3 mgVSS/L	0	0
User defined 4 mgISS/L	0	0
Dissolved oxygen mg/L	0	0
Flow	0	0

Configuration information for all Dewatering unit units

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Dewatering Unit	Ratio	0.20
Dewatering Unit	Ratio	0.14

Element name	Percent removal
Dewatering Unit	100.00
Dewatering Unit	90.00

Configuration information for all Sludge units

Configuration information for all Splitter units

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Two way splitter6	Flowrate [Side]	0.03
Splitter23	Flowrate [Side]	0.02
Splitter1	Ratio	4.00
Splitter24	Ratio	0.00
Splitter73	Ratio	6.00

Configuration information for all Influent (SV) units

Operating data Average (flow/time weighted as required)

Element name	Mg(OH)2	Mg(OH)2 (1)	Mg(OH)2 (2)	Mg(OH)2
Non-polyP heterotrophs mgCOD/L	0	0	0	0
Anoxic methanol utilizers mgCOD/L	0	0	0	0
Ammonia oxidizing biomass mgCOD/L	0	0	0	0
Nitrite oxidizing biomass mgCOD/L	0	0	0	0
Anaerobic ammonia oxidizers mgCOD/L	0	0	0	0
PolyP heterotrophs mgCOD/L	0	0	0	0
Propionic acetogens mgCOD/L	0	0	0	0
Acetoclastic methanogens mgCOD/L	0	0	0	0
Hydrogenotrophic methanogens mgCOD/L	0	0	0	0
Endogenous products mgCOD/L	0	0	0	0
Slowly bio. COD (part.) mgCOD/L	0	0	0	0
Slowly bio. COD (colloid.) mgCOD/L	0	0	0	0
Part. inert. COD mgCOD/L	0	0	0	0
Part. bio. org. N mgN/L	0	0	0	0
Part. bio. org. P mgP/L	0	0	0	0
Part. inert N mgN/L	0	0	0	0
Part. inert P mgP/L	0	0	0	0
Stored PHA mgCOD/L	0	0	0	0
Releasable stored polyP mgP/L	0	0	0	0
Fixed stored polyP mgP/L	0	0	0	0
PolyP bound cations mg/L	0	0	0	0
Readily bio. COD (complex) mgCOD/L	0	0	0	0
Acetate mgCOD/L	0	0	0	0
Propionate mgCOD/L	0	0	0	0
Methanol mgCOD/L	0	0	0	0
Dissolved H2 mgCOD/L	0	0	0	0

Dissolved methane mg/L	0	0	0	0
Ammonia N mgN/L	0	0	0	0
Sol. bio. org. N mgN/L	0	0	0	0
Nitrite N mgN/L	0	0	0	0
Nitrate N mgN/L	0	0	0	0
Dissolved nitrogen gas mgN/L	0	0	0	0
PO4-P (Sol. & Me Complexed) mgP/L	0	0	0	0
Sol. inert COD mgCOD/L	0	0	0	0
Sol. inert TKN mgN/L	0	0	0	0
Inorganic S.S. mgISS/L	0	0	0	0
Struvite mgISS/L	0	0	0	0
Hydroxy-dicalcium-phosphate mgISS/L	0	0	0	0
Hydroxy-apatite mgISS/L	0	0	0	0
Magnesium mg/L	0	0	0	0
Calcium mg/L	0	0	0	0
Metal mg/L	0	0	0	0
Other Cations (strong bases) meq/L	14500.00	14500.00	14500.00	14500.00
Other Anions (strong acids) meq/L	0	0	0	0
Total CO2 mmol/L	0	0	0	0
User defined 1 mg/L	0	0	0	0
User defined 2 mg/L	0	0	0	0
User defined 3 mgVSS/L	0	0	0	0
User defined 4 mgISS/L	0	0	0	0
Dissolved oxygen mg/L	0	0	0	0
Flow	0	0.00035	2E-5	5E-6

Configuration information for all Bioreactor (brush aerators) units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]
Oxidation Ditch	0.4000	5347.2225	10.000

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint
Oxidation Ditch	1.5

Aeration equipment parameters

Element name	Surface aerator Std. oxygen transfer rate [lb O /(hp hr)]	Maximum power per rotor [hp]
Oxidation Ditch	2.4670	26.8097

BioWin Album

Album page - Aerobic Digester

No element
toomanycolumns

Parameters	Value	Units

Album page - Aerobic Digester

Album page - Aeration Basin

No element

toomanycolumns

Parameters	Value	Units

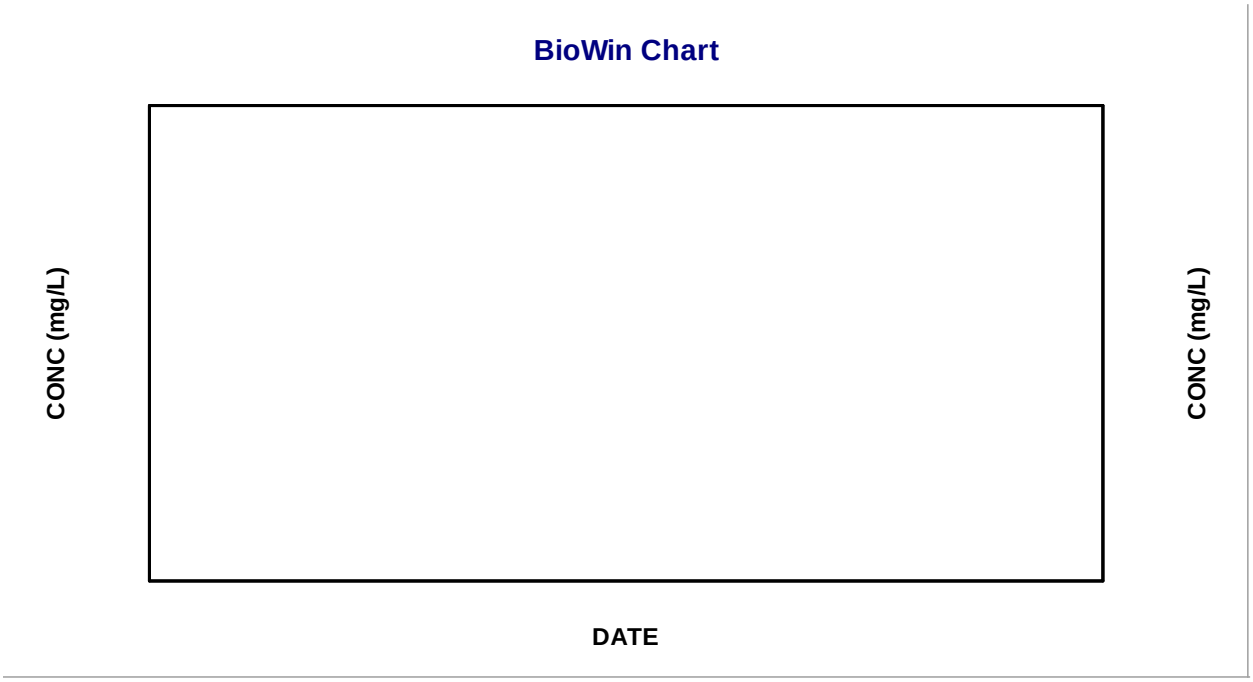
Album page - Effluent

Secondary Effluent			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
Volatile suspended solids	0.18	1.26	
Total suspended solids	0.24	1.70	
Particulate COD	0.26	1.87	
Filtered COD	36.81	263.79	
Total COD	37.07	265.66	
Soluble PO4-P	6.25	44.77	
Total P	6.25	44.80	
Filtered TKN	4.58	32.80	
Particulate TKN	0.02	0.11	
Total Kjeldahl Nitrogen	4.59	32.91	
Filtered Carbonaceous BOD	1.22	8.76	
Total Carbonaceous BOD	1.30	9.35	
Nitrite + Nitrate	34.09	244.25	

Total N	38.68	277.16	
Total inorganic N	35.18	252.12	
Alkalinity	0.63	2.06	mmol/L and kmol/d
pH	6.91		
Volatile fatty acids	0.00	0.01	
Total precipitated solids	0.00	0.00	
Total inorganic suspended solids	0.06	0.44	
Ammonia N	1.10	7.86	
Nitrate N	33.37	239.12	

Parameters	Value	Units

Album page - Page 4



Album page - Page 5

Sidestream Mixer52

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
Volatile suspended solids	0.18	1.26	
Total suspended solids	0.24	1.70	
Particulate COD	0.26	1.87	
Filtered COD	36.81	263.79	
Total COD	37.07	265.66	
Soluble PO4-P	6.25	44.77	
Total P	6.25	44.80	
Filtered TKN	4.58	32.80	
Particulate TKN	0.02	0.11	
Total Kjeldahl Nitrogen	4.59	32.91	
Filtered Carbonaceous BOD	1.22	8.76	
Total Carbonaceous BOD	1.30	9.35	
Nitrite + Nitrate	34.09	244.25	
Total N	38.68	277.16	
Total inorganic N	35.18	252.12	
Alkalinity	0.63	2.06	mmol/L and kmol/d
pH	6.91		
Volatile fatty acids	0.00	0.01	
Total precipitated solids	0.00	0.00	
Total inorganic suspended solids	0.06	0.44	
Ammonia N	1.10	7.86	
Nitrate N	33.37	239.12	

Parameters	Value	Units

Album page - Page 6

Sidestream Mixer14			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
Volatile suspended solids	6479.94	18573.88	
Total suspended solids	8713.68	24976.57	
Particulate COD	9572.93	27439.50	
Filtered COD	36.81	105.52	
Total COD	9609.74	27545.01	
Soluble PO4-P	6.25	17.91	
Total P	182.39	522.79	
Filtered TKN	4.58	13.12	
Particulate TKN	560.85	1607.61	
Total Kjeldahl Nitrogen	565.43	1620.73	
Filtered Carbonaceous BOD	1.22	3.51	
Total Carbonaceous BOD	2989.39	8568.68	
Nitrite + Nitrate	34.09	97.70	
Total N	599.52	1718.43	
Total inorganic N	35.18	100.85	
Alkalinity	0.63	0.82	mmol/L and kmol/d
pH	6.91		
Volatile fatty acids	0.00	0.00	
Total precipitated solids	0.00	0.00	
Total inorganic suspended solids	2233.73	6402.69	
Ammonia N	1.10	3.15	
Nitrate N	33.37	95.65	

Parameters	Value	Units

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Sidestream Mixer9

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
Volatile suspended solids	8963.96	1622.33	
Total suspended solids	12053.96	2181.57	
Particulate COD	13242.60	2396.70	
Filtered COD	36.78	6.66	
Total COD	13279.38	2403.35	
Soluble PO4-P	6.24	1.13	
Total P	249.90	45.23	
Filtered TKN	4.57	0.83	
Particulate TKN	775.85	140.42	
Total Kjeldahl Nitrogen	780.42	141.24	
Filtered Carbonaceous BOD	1.22	0.22	
Total Carbonaceous BOD	4134.87	748.34	
Nitrite + Nitrate	34.05	6.16	
Total N	814.48	147.41	
Total inorganic N	35.15	6.36	
Alkalinity	14.00	1.15	mmol/L and kmol/d
pH	12.19		
Volatile fatty acids	0.00	0.00	
Total precipitated solids	0.00	0.00	
Total inorganic suspended solids	3090.01	559.24	
Ammonia N	1.10	0.20	
Nitrate N	33.34	6.03	

Parameters	Value	Units

Global Parameters

AOB

Name	Default	Value	
Max. spec. growth rate [1/d]	0.90000	0.90000	1.0720
Substrate (NH4) half sat. [mgN/L]	0.70000	0.70000	1.0000
Aerobic decay rate [1/d]	0.17000	0.17000	1.0290
Anoxic/anaerobic decay rate [1/d]	0.08000	0.08000	1.0290
KiHNO2 [mmol/L]	0.00500	0.00500	1.0000

NOB

Name	Default	Value	
Max. spec. growth rate [1/d]	0.70000	0.70000	1.0600
Substrate (NO2) half sat. [mgN/L]	0.10000	0.10000	1.0000
Aerobic decay rate [1/d]	0.17000	0.17000	1.0290
Anoxic/anaerobic decay rate [1/d]	0.08000	0.08000	1.0290
KiNH3 [mmol/L]	0.07500	0.07500	1.0000

ANAMMOX

Name	Default	Value	
Max. spec. growth rate [1/d]	0.10000	0.10000	1.1000
Substrate (NH4) half sat. [mgN/L]	2.00000	2.00000	1.0000
Substrate (NO2) half sat. [mgN/L]	1.00000	1.00000	1.0000
Aerobic decay rate [1/d]	0.01900	0.01900	1.0290
Anoxic/anaerobic decay rate [1/d]	0.00950	0.00950	1.0290
Ki Nitrite [mgN/L]	1000.00000	1000.00000	1.0000
Nitrite sensitivity constant [L / (d mgN)]	0.01600	0.01600	1.0000

OHOs

Name	Default	Value	
Max. spec. growth rate [1/d]	3.20000	3.20000	1.0290
Substrate half sat. [mgCOD/L]	5.00000	5.00000	1.0000
Anoxic growth factor [-]	0.50000	0.50000	1.0000
Aerobic decay [1/d]	0.62000	0.62000	1.0290
Anoxic/anaerobic decay [1/d]	0.30000	0.30000	1.0290
Hydrolysis rate (AS) [1/d]	2.10000	2.10000	1.0290
Hydrolysis half sat. (AS) [-]	0.06000	0.06000	1.0000
Anoxic hydrolysis factor [-]	0.28000	0.28000	1.0000
Anaerobic hydrolysis factor [-]	0.50000	0.50000	1.0000
Adsorption rate of colloids [L/(mgCOD d)]	0.80000	0.80000	1.0290
Ammonification rate [L/(mgN d)]	0.04000	0.04000	1.0290
Assimilative nitrate/nitrite reduction rate [1/d]	0.50000	0.50000	1.0000
Fermentation rate [1/d]	3.20000	3.20000	1.0290
Fermentation half sat. [mgCOD/L]	5.00000	5.00000	1.0000
Anaerobic growth factor (AS) [-]	0.12500	0.12500	1.0000
Hydrolysis rate (AD) [1/d]	0.10000	0.10000	1.0500
Hydrolysis half sat. (AD) [mgCOD/L]	0.15000	0.15000	1.0000

Methylotrophs

Name	Default	Value	
Max. spec. growth rate of methanol utilizers [1/d]	1.30000	1.30000	1.0720
Methanol half sat. [mgCOD/L]	0.50000	0.50000	1.0000
Aerobic decay rate of methanol utilizers [1/d]	0.04000	0.04000	1.0290
Anoxic/anaerobic decay rate of methanol utilizers [1/d]	0.03000	0.03000	1.0290

PAOs

Name	Default	Value	
Max. spec. growth rate [1/d]	0.95000	0.95000	1.0000
Max. spec. growth rate, P-limited [1/d]	0.42000	0.42000	1.0000
Substrate half sat. [mgCOD(PHB)/mgCOD(Zbp)]	0.10000	0.10000	1.0000
Substrate half sat., P-limited [mgCOD(PHB)/mgCOD(Zbp)]	0.05000	0.05000	1.0000
Magnesium half sat. [mgMg/L]	0.10000	0.10000	1.0000
Cation half sat. [mmol/L]	0.10000	0.10000	1.0000
Calcium half sat. [mgCa/L]	0.10000	0.10000	1.0000
Aerobic decay rate [1/d]	0.10000	0.10000	1.0000
Anaerobic decay rate [1/d]	0.04000	0.04000	1.0000
Sequestration rate [1/d]	6.00000	6.00000	1.0000
Anoxic growth factor NO3 [-]	0.33000	0.33000	1.0000
Anoxic growth factor NO2 [-]	0.33000	0.33000	1.0000

Acetogens

Name	Default	Value	
Max. spec. growth rate [1/d]	0.25000	0.25000	1.0290
Substrate half sat. [mgCOD/L]	10.00000	10.00000	1.0000
Acetate inhibition [mgCOD/L]	10000.00000	10000.00000	1.0000
Decay rate [1/d]	0.05000	0.05000	1.0290
Aerobic decay rate [1/d]	0.52000	0.52000	1.0290

Methanogens

Name	Default	Value	
Acetoclastic Mu Max [1/d]	0.30000	0.30000	1.0290
H2-utilizing Mu Max [1/d]	1.40000	1.40000	1.0290
Acetoclastic Ks [mgCOD/L]	100.00000	100.00000	1.0000
Acetoclastic methanol Ks [mgCOD/L]	0.50000	0.50000	1.0000
H2-utilizing CO2 half sat. [mmol/L]	0.10000	0.10000	1.0000
H2-utilizing Ks [mgCOD/L]	0.10000	0.10000	1.0000
H2-utilizing methanol Ks [mgCOD/L]	0.50000	0.50000	1.0000
Acetoclastic propionic inhibition [mgCOD/L]	10000.00000	10000.00000	1.0000
Acetoclastic decay rate [1/d]	0.13000	0.13000	1.0290
Acetoclastic aerobic decay rate [1/d]	0.60000	0.60000	1.0290
H2-utilizing decay rate [1/d]	0.13000	0.13000	1.0290
H2-utilizing aerobic decay rate [1/d]	0.60000	0.60000	1.0290

pH

Name	Default	Value

Heterotrophs low pH limit [-]	4.00000	4.00000
Heterotrophs high pH limit [-]	10.00000	10.00000
Methanol utilizers low pH limit [-]	4.00000	4.00000
Methanol utilizers high pH limit [-]	10.00000	10.00000
Autotrophs low pH limit [-]	5.50000	5.50000
Autotrophs high pH limit [-]	9.50000	9.50000
PolyP heterotrophs low pH limit [-]	4.00000	4.00000
Poly P heterotrophs high pH limit [-]	10.00000	10.00000
Heterotrophs low pH limit (anaerobic) [-]	5.50000	5.50000
Heterotrophs high pH limit (anaerobic) [-]	8.50000	8.50000
Propionic acetogens low pH limit [-]	4.00000	4.00000
Propionic acetogens high pH limit [-]	10.00000	10.00000
Acetoclastic methanogens low pH limit [-]	5.00000	5.00000
Acetoclastic methanogens high pH limit [-]	9.00000	9.00000
H2-utilizing methanogens low pH limit [-]	5.00000	5.00000
H2-utilizing methanogens high pH limit [-]	9.00000	9.00000

Switches

Name	Default	Value
Heterotrophic DO half sat. [mgO2/L]	0.05000	0.05000
Aerobic denit. DO half sat. [mgO2/L]	0.05000	0.05000
Ammonia oxidizer DO half sat. [mgO2/L]	0.25000	0.25000
Nitrite oxidizer DO half sat. [mgO2/L]	0.50000	0.50000
Anaerobic ammonia oxidizer DO half sat. [mgO2/L]	0.01000	0.01000
Anoxic NO3 half sat. [mgN/L]	0.10000	0.10000
Anoxic NO2 half sat. (mgN/L)	0.01000	0.01000
NH3 nutrient half sat. [mgN/L]	1.0000E-4	1.0000E-4
PolyP half sat. [mgP/L]	0.01000	0.01000

VFA sequestration half sat. [mgCOD/L]	5.00000	5.00000
P uptake half sat. [mgP/L]	0.15000	0.15000
P nutrient half sat. [mgP/L]	0.00100	0.00100
Autotroph CO2 half sat. [mmol/L]	0.10000	0.10000
Heterotrophic Hydrogen half sat. [mgCOD/L]	1.00000	1.00000
Propionic acetogens Hydrogen half sat. [mgCOD/L]	5.00000	5.00000
Synthesis anion/cation half sat. [meq/L]	0.01000	0.01000

Common

Name	Default	Value
N in endogenous residue [mgN/mgCOD]	0.07000	0.07000
P in endogenous residue [mgP/mgCOD]	0.02200	0.02200
Endogenous residue COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
Particulate substrate COD:VSS ratio [mgCOD/mgVSS]	1.60000	1.60000
Particulate inert COD:VSS ratio [mgCOD/mgVSS]	1.60000	1.60000

AOB

Name	Default	Value
Yield [mgCOD/mgN]	0.15000	0.15000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

NOB

Name	Default	Value
Yield [mgCOD/mgN]	0.09000	0.09000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

ANAMMOX

Name	Default	Value
Yield [mgCOD/mgN]	0.11400	0.11400
Nitrate production [mgN/mgBiomassCOD]	2.28000	2.28000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

OHOs

Name	Default	Value
Yield (aerobic) [-]	0.66600	0.66600
Yield (fermentation, low H2) [-]	0.10000	0.10000
Yield (fermentation, high H2) [-]	0.10000	0.10000
H2 yield (fermentation low H2) [-]	0.35000	0.35000

H2 yield (fermentation high H2) [-]	0	0
Propionate yield (fermentation, low H2) [-]	0	0
Propionate yield (fermentation, high H2) [-]	0.70000	0.70000
CO2 yield (fermentation, low H2) [-]	0.70000	0.70000
CO2 yield (fermentation, high H2) [-]	0	0
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
Yield (anoxic) [-]	0.54000	0.54000
Yield propionic (aerobic) [-]	0.64000	0.64000
Yield propionic (anoxic) [-]	0.46000	0.46000
Yield acetic (aerobic) [-]	0.60000	0.60000
Yield acetic (anoxic) [-]	0.43000	0.43000
Yield methanol (aerobic) [-]	0.50000	0.50000
Adsorp. max. [-]	1.00000	1.00000

Methylotrophs

Name	Default	Value
Yield (anoxic) [-]	0.40000	0.40000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

PAOs

Name	Default	Value
Yield (aerobic) [-]	0.63900	0.63900
Yield (anoxic) [-]	0.52000	0.52000
Aerobic P/PHA uptake [mgP/mgCOD]	0.95000	0.95000
Anoxic P/PHA uptake [mgP/mgCOD]	0.35000	0.35000
Yield of PHA on sequestration [-]	0.88900	0.88900
N in biomass [mgN/mgCOD]	0.07000	0.07000
N in sol. inert [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous part. [-]	0.25000	0.25000
Inert fraction of endogenous sol. [-]	0.20000	0.20000
P/Ac release ratio [mgP/mgCOD]	0.49000	0.49000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
Yield of low PP [-]	0.94000	0.94000

Acetogens

Name	Default	Value
Yield [-]	0.10000	0.10000
H2 yield [-]	0.40000	0.40000
CO2 yield [-]	1.00000	1.00000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

Methanogens

Name	Default	Value
Acetoclastic yield [-]	0.10000	0.10000
Methanol acetoclastic yield [-]	0.10000	0.10000
H2-utilizing yield [-]	0.10000	0.10000
Methanol H2-utilizing yield [-]	0.10000	0.10000
N in acetoclastic biomass [mgN/mgCOD]	0.07000	0.07000
N in H2-utilizing biomass [mgN/mgCOD]	0.07000	0.07000
P in acetoclastic biomass [mgP/mgCOD]	0.02200	0.02200
P in H2-utilizing biomass [mgP/mgCOD]	0.02200	0.02200
Acetoclastic fraction to endog. residue [-]	0.08000	0.08000
H2-utilizing fraction to endog. residue [-]	0.08000	0.08000
Acetoclastic COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
H2-utilizing COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

General

Name	Default	Value
Ash content of biomass (synthesis ISS) [%]	8.00000	8.00000
Molecular weight of other anions [mg/mmol]	35.50000	35.50000
Molecular weight of other cations [mg/mmol]	39.10000	39.10000
Mg to P mole ratio in polyphosphate [mmolMg/mmolP]	0.30000	0.30000
Cation to P mole ratio in polyphosphate [meq/mmolP]	0.30000	0.30000
Ca to P mole ratio in polyphosphate [mmolCa/mmolP]	0.05000	0.05000
Cation to P mole ratio in organic phosphate [meq/mmolP]	0.01000	0.01000
Bubble rise velocity (anaerobic digester) [cm/s]	23.90000	23.90000
Bubble Sauter mean diameter (anaerobic digester) [cm]	0.35000	0.35000
Anaerobic digester gas hold-up factor []	1.00000	1.00000
Tank head loss per metre of length (from flow) [m/m]	0.00250	0.00250

Mass transfer

Name	Default	Value	
Kl for H2 [m/d]	17.00000	17.00000	1.0240
Kl for CO2 [m/d]	10.00000	10.00000	1.0240
Kl for NH3 [m/d]	1.00000	1.00000	1.0240
Kl for CH4 [m/d]	8.00000	8.00000	1.0240
Kl for N2 [m/d]	15.00000	15.00000	1.0240
Kl for O2 [m/d]	13.00000	13.00000	1.0240

Physico-chemical rates

Name	Default	Value	
Struvite precipitation rate [1/d]	3.0000E+10	3.0000E+10	1.0240
Struvite redissolution rate [1/d]	3.0000E+11	3.0000E+11	1.0240
Struvite half sat. [mgTSS/L]	1.00000	1.00000	1.0000
HDP precipitation rate [L/(molP d)]	1.0000E+8	1.0000E+8	1.0000
HDP redissolution rate [L/(mol P d)]	1.0000E+8	1.0000E+8	1.0000
HAP precipitation rate [molHDP/(L d)]	5.0000E-4	5.0000E-4	1.0000

Physico-chemical constants

Name	Default	Value
Struvite solubility constant [mol/L]	6.9180E-14	6.9180E-14
HDP solubility product [mol/L]	2.7500E-22	2.7500E-22

HDP half sat. [mgTSS/L]	1.00000	1.00000
Equilibrium soluble PO4 with Al dosing at pH 7 [mgP/L]	0.01000	0.01000
Al to P ratio [molAl/molP]	0.80000	0.80000
Al(OH)3 solubility product [mol/L]	1.2590E+9	1.2590E+9
AlHPO4+ dissociation constant [mol/L]	7.9430E-13	7.9430E-13
Equilibrium soluble PO4 with Fe dosing at pH 7 [mgP/L]	0.01000	0.01000
Fe to P ratio [molFe/molP]	1.60000	1.60000
Fe(OH)3 solubility product [mol/L]	0.05000	0.05000
FeH2PO4++ dissociation constant [mol/L]	5.0120E-22	5.0120E-22

Aeration

Name	Default	Value
Alpha (surf) OR Alpha F (diff) [-]	0.50000	0.50000
Beta [-]	0.95000	0.95000
Surface pressure [kPa]	101.32500	101.32500
Fractional effective saturation depth (Fed) [-]	0.32500	0.32500
Supply gas CO2 content [vol. %]	0.03500	0.03500
Supply gas O2 [vol. %]	20.95000	20.95000
Off-gas CO2 [vol. %]	2.00000	2.00000
Off-gas O2 [vol. %]	18.80000	18.80000
Off-gas H2 [vol. %]	0	0
Off-gas NH3 [vol. %]	0	0
Off-gas CH4 [vol. %]	0	0
Surface turbulence factor [-]	2.00000	2.00000
Set point controller gain []	1.00000	1.00000

Modified Vesilind

Name	Default	Value
Maximum Vesilind settling velocity (Vo) [ft/min]	0.3873	0.3873
Vesilind hindered zone settling parameter (K) [L/g]	0.3700	0.3700
Clarification switching function [mg/L]	100.0000	100.0000
Specified TSS conc.for height calc. [mg/L]	2500.0000	2500.0000
Maximum compactability constant [mg/L]	15000.0000	15000.0000

Double exponential

Name	Default	Value
Maximum Vesilind settling velocity (Vo) [ft/min]	0.9341	0.9341
Maximum (practical) settling velocity (Vo') [ft/min]	0.6152	0.6152
Hindered zone settling parameter (Kh) [L/g]	0.4000	0.4000
Flocculent zone settling parameter (Kf) [L/g]	2.5000	2.5000
Maximum non-settleable TSS [mg/L]	20.0000	20.0000
Non-settleable fraction [-]	0.0010	0.0010
Specified TSS conc. for height calc. [mg/L]	2500.0000	2500.0000

Biofilm general

Name	Default	Value	
Attachment rate [g / (m2 d)]	80.00000	80.00000	1.0000
Attachment TSS half sat. [mg/L]	100.00000	100.00000	1.0000
Detachment rate [g/(m3 d)]	8.0000E+4	8.0000E+4	1.0000
Solids movement factor []	10.00000	10.00000	1.0000
Diffusion neta []	0.80000	0.80000	1.0000

Thin film limit [mm]	0.50000	0.50000	1.0000
Thick film limit [mm]	3.00000	3.00000	1.0000
Assumed Film thickness for tank volume correction (temp independant) [mm]	0.75000	0.75000	1.0000
Film surface area to media area ratio - Max.[ ]	1.00000	1.00000	1.0000
Minimum biofilm conc. for streamer formation [gTSS/m2]	4.00000	4.00000	1.0000

Maximum biofilm concentrations [mg/L]

Name	Default	Value	
Non-polyP heterotrophs	5.0000E+4	5.0000E+4	1.0000
Anoxic methanol utilizers	5.0000E+4	5.0000E+4	1.0000
Ammonia oxidizing biomass	1.0000E+5	1.0000E+5	1.0000
Nitrite oxidizing biomass	1.0000E+5	1.0000E+5	1.0000
Anaerobic ammonia oxidizers	5.0000E+4	5.0000E+4	1.0000
PolyP heterotrophs	5.0000E+4	5.0000E+4	1.0000
Propionic acetogens	5.0000E+4	5.0000E+4	1.0000
Acetoclastic methanogens	5.0000E+4	5.0000E+4	1.0000
Hydrogenotrophic methanogens	5.0000E+4	5.0000E+4	1.0000
Endogenous products	3.0000E+4	3.0000E+4	1.0000
Slowly bio. COD (part.)	5000.00000	5000.00000	1.0000
Slowly bio. COD (colloid.)	0	0	1.0000
Part. inert. COD	5000.00000	5000.00000	1.0000
Part. bio. org. N	0	0	1.0000
Part. bio. org. P	0	0	1.0000
Part. inert N	0	0	1.0000
Part. inert P	0	0	1.0000
Stored PHA	5000.00000	5000.00000	1.0000
Releasable stored polyP	1.1500E+6	1.1500E+6	1.0000
Fixed stored polyP	1.1500E+6	1.1500E+6	1.0000

PolyP bound cations	1.1500E+6	1.1500E+6	1.0000
Readily bio. COD (complex)	0	0	1.0000
Acetate	0	0	1.0000
Propionate	0	0	1.0000
Methanol	0	0	1.0000
Dissolved H2	0	0	1.0000
Dissolved methane	0	0	1.0000
Ammonia N	0	0	1.0000
Sol. bio. org. N	0	0	1.0000
Nitrite N	0	0	1.0000
Nitrate N	0	0	1.0000
Dissolved nitrogen gas	0	0	1.0000
PO4-P (Sol. & Me Complexed)	1.0000E+10	1.0000E+10	1.0000
Sol. inert COD	0	0	1.0000
Sol. inert TKN	0	0	1.0000
Inorganic S.S.	1.3000E+6	1.3000E+6	1.0000
Struvite	8.5000E+5	8.5000E+5	1.0000
Hydroxy-dicalcium-phosphate	1.1500E+6	1.1500E+6	1.0000
Hydroxy-apatite	1.6000E+6	1.6000E+6	1.0000
Magnesium	0	0	1.0000
Calcium	0	0	1.0000
Metal	1.0000E+10	1.0000E+10	1.0000
Other Cations (strong bases)	0	0	1.0000
Other Anions (strong acids)	0	0	1.0000
Total CO2	0	0	1.0000
User defined 1	0	0	1.0000
User defined 2	0	0	1.0000
User defined 3	5.0000E+4	5.0000E+4	1.0000
User defined 4	5.0000E+4	5.0000E+4	1.0000
Dissolved oxygen	0	0	1.0000

Effective diffusivities [m2/s]

Name	Default	Value	
Non-polyP heterotrophs	5.0000E-14	5.0000E-14	1.0290
Anoxic methanol utilizers	5.0000E-14	5.0000E-14	1.0290
Ammonia oxidizing biomass	5.0000E-14	5.0000E-14	1.0290
Nitrite oxidizing biomass	5.0000E-14	5.0000E-14	1.0290
Anaerobic ammonia oxidizers	5.0000E-14	5.0000E-14	1.0290
PolyP heterotrophs	5.0000E-14	5.0000E-14	1.0290
Propionic acetogens	5.0000E-14	5.0000E-14	1.0290
Acetoclastic methanogens	5.0000E-14	5.0000E-14	1.0290
Hydrogenotrophic methanogens	5.0000E-14	5.0000E-14	1.0290
Endogenous products	5.0000E-14	5.0000E-14	1.0290
Slowly bio. COD (part.)	5.0000E-14	5.0000E-14	1.0290
Slowly bio. COD (colloid.)	6.9000E-11	6.9000E-11	1.0290
Part. inert. COD	5.0000E-14	5.0000E-14	1.0290
Part. bio. org. N	5.0000E-14	5.0000E-14	1.0290
Part. bio. org. P	5.0000E-14	5.0000E-14	1.0290
Part. inert N	5.0000E-14	5.0000E-14	1.0290
Part. inert P	5.0000E-14	5.0000E-14	1.0290
Stored PHA	5.0000E-14	5.0000E-14	1.0290
Releasable stored polyP	5.0000E-14	5.0000E-14	1.0290
Fixed stored polyP	5.0000E-14	5.0000E-14	1.0290
PolyP bound cations	5.0000E-14	5.0000E-14	1.0290
Readily bio. COD (complex)	6.9000E-10	6.9000E-10	1.0290
Acetate	1.2400E-9	1.2400E-9	1.0290
Propionate	8.3000E-10	8.3000E-10	1.0290
Methanol	1.6000E-9	1.6000E-9	1.0290
Dissolved H2	5.8500E-9	5.8500E-9	1.0290

Dissolved methane	1.9625E-9	1.9625E-9	1.0290
Ammonia N	2.0000E-9	2.0000E-9	1.0290
Sol. bio. org. N	1.3700E-9	1.3700E-9	1.0290
Nitrite N	2.9800E-9	2.9800E-9	1.0290
Nitrate N	2.9800E-9	2.9800E-9	1.0290
Dissolved nitrogen gas	1.9000E-9	1.9000E-9	1.0290
PO4-P (Sol. & Me Complexed)	2.0000E-9	2.0000E-9	1.0290
Sol. inert COD	6.9000E-10	6.9000E-10	1.0290
Sol. inert TKN	6.8500E-10	6.8500E-10	1.0290
Inorganic S.S.	5.0000E-14	5.0000E-14	1.0290
Struvite	5.0000E-14	5.0000E-14	1.0290
Hydroxy-dicalcium-phosphate	5.0000E-14	5.0000E-14	1.0290
Hydroxy-apatite	5.0000E-14	5.0000E-14	1.0290
Magnesium	7.2000E-10	7.2000E-10	1.0290
Calcium	7.2000E-10	7.2000E-10	1.0290
Metal	4.8000E-10	4.8000E-10	1.0290
Other Cations (strong bases)	1.4400E-9	1.4400E-9	1.0290
Other Anions (strong acids)	1.4400E-9	1.4400E-9	1.0290
Total CO2	1.9600E-9	1.9600E-9	1.0290
User defined 1	6.9000E-10	6.9000E-10	1.0290
User defined 2	6.9000E-10	6.9000E-10	1.0290
User defined 3	5.0000E-14	5.0000E-14	1.0290
User defined 4	5.0000E-14	5.0000E-14	1.0290
Dissolved oxygen	2.5000E-9	2.5000E-9	1.0290

EPS Strength coefficients [ ]

Name	Default	Value	
Non-polyP heterotrophs	1.00000	1.00000	1.0000

Anoxic methanol utilizers	1.00000	1.00000	1.0000
Ammonia oxidizing biomass	1.00000	1.00000	1.0000
Nitrite oxidizing biomass	1.00000	1.00000	1.0000
Anaerobic ammonia oxidizers	1.00000	1.00000	1.0000
PolyP heterotrophs	1.00000	1.00000	1.0000
Propionic acetogens	1.00000	1.00000	1.0000
Acetoclastic methanogens	1.00000	1.00000	1.0000
Hydrogenotrophic methanogens	1.00000	1.00000	1.0000
Endogenous products	1.00000	1.00000	1.0000
Slowly bio. COD (part.)	1.00000	1.00000	1.0000
Slowly bio. COD (colloid.)	0	0	1.0000
Part. inert. COD	1.00000	1.00000	1.0000
Part. bio. org. N	1.00000	1.00000	1.0000
Part. bio. org. P	1.00000	1.00000	1.0000
Part. inert N	1.00000	1.00000	1.0000
Part. inert P	1.00000	1.00000	1.0000
Stored PHA	1.00000	1.00000	1.0000
Releasable stored polyP	1.00000	1.00000	1.0000
Fixed stored polyP	1.00000	1.00000	1.0000
PolyP bound cations	1.00000	1.00000	1.0000
Readily bio. COD (complex)	0	0	1.0000
Acetate	0	0	1.0000
Propionate	0	0	1.0000
Methanol	0	0	1.0000
Dissolved H2	0	0	1.0000
Dissolved methane	0	0	1.0000
Ammonia N	0	0	1.0000
Sol. bio. org. N	0	0	1.0000
Nitrite N	0	0	1.0000
Nitrate N	0	0	1.0000
Dissolved nitrogen gas	0	0	1.0000

PO4-P (Sol. & Me Complexed)	1.00000	1.00000	1.0000
Sol. inert COD	0	0	1.0000
Sol. inert TKN	0	0	1.0000
Inorganic S.S.	0.33000	0.33000	1.0000
Struvite	1.00000	1.00000	1.0000
Hydroxy-dicalcium-phosphate	1.00000	1.00000	1.0000
Hydroxy-apatite	1.00000	1.00000	1.0000
Magnesium	0	0	1.0000
Calcium	0	0	1.0000
Metal	1.00000	1.00000	1.0000
Other Cations (strong bases)	0	0	1.0000
Other Anions (strong acids)	0	0	1.0000
Total CO2	0	0	1.0000
User defined 1	0	0	1.0000
User defined 2	0	0	1.0000
User defined 3	1.00000	1.00000	1.0000
User defined 4	1.00000	1.00000	1.0000
Dissolved oxygen	0	0	1.0000

BioWin user and configuration data

Project details

Project name: Aerobic Digester Model Development **Project ref.: 60037-15001**

Plant name: North Bend **User name: Markus**

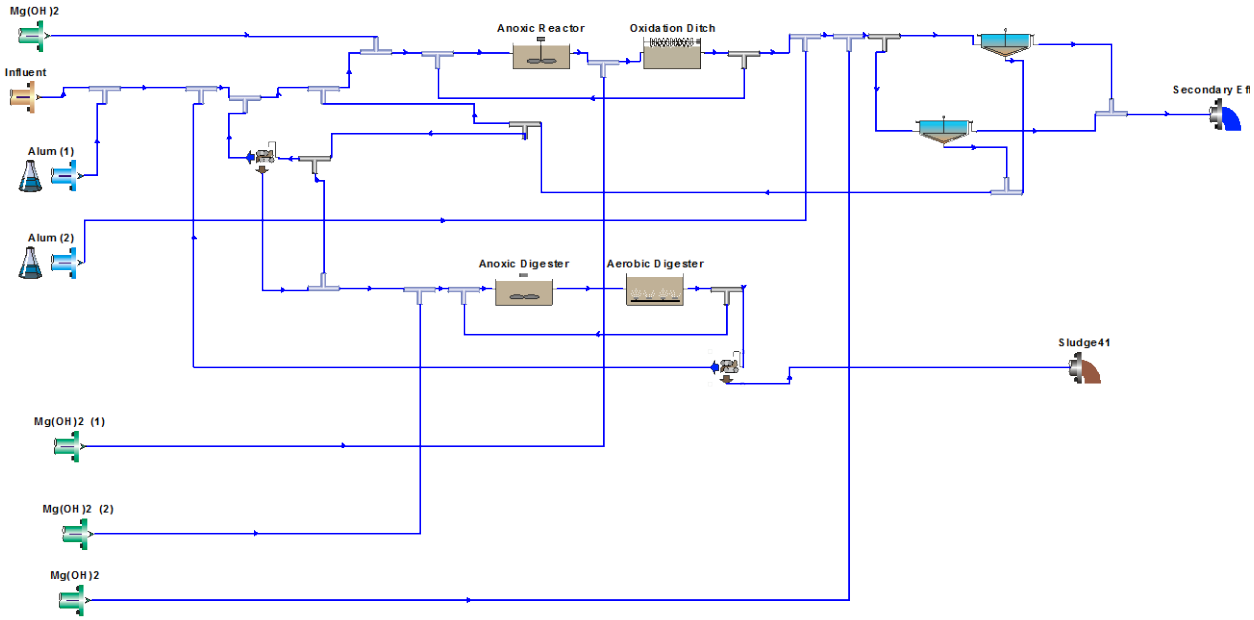
Created: 3/1/2001 **Saved: 5/9/2016**

Steady state solution

SRT: 6.46

Temperature: 20.0

Flowsheet



Configuration information for all Bioreactor units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers
Aerobic Digester	0.3000	2673.6113	15.000	606
Anoxic Digester	0.3000	2673.6113	15.000	Un-aerated

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint [mg/L]
Aerobic Digester	2.0
Anoxic Digester	0

Aeration equipment parameters

Element name	k1 in C = k1(PC)^0.25 + k2	k2 in C = k1(PC)^0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	% of tank area covered by diffusers [%]
Aerobic Digester	2.5656	0.0432	0.8200	0.0410	10.0000
Anoxic Digester	2.5656	0.0432	0.8200	0.0410	10.0000

Configuration information for all BOD Influent units

Operating data Average (flow/time weighted as required)

Element name	Influent
Flow	0.860869992486947
Total Carbonaceous BOD mgBOD/L	328.00
Volatile suspended solids mgVSS/L	328.00
Total suspended solids mgTSS/L	386.00
Total Kjeldahl Nitrogen mgN/L	97.00
Total P mgP/L	9.70
Nitrate N mgN/L	0
pH	7.00
Alkalinity mmol/L	1.17
Calcium mg/L	4.40
Magnesium mg/L	1.80
Dissolved oxygen mg/L	0

Element name	Influent
Fbs - Readily biodegradable (including Acetate) [gCOD/g of total COD]	0.1600
Fac - Acetate [gCOD/g of readily biodegradable COD]	0.1500
Fxsp - Non-colloidal slowly biodegradable [gCOD/g of slowly degradable COD]	0.9397
Fus - Unbiodegradable soluble [gCOD/g of total COD]	0.0500
Fup - Unbiodegradable particulate [gCOD/g of total COD]	0.1300
Fna - Ammonia [gNH3-N/gTKN]	0.6600
Fnox - Particulate organic nitrogen [gN/g Organic N]	0.5000
Fnus - Soluble unbiodegradable TKN [gN/gTKN]	0.0200
FupN - N:COD ratio for unbiodegradable part. COD [gN/gCOD]	0.0350
Fpo4 - Phosphate [gPO4-P/gTP]	0.6300
FupP - P:COD ratio for unbiodegradable part. COD [gP/gCOD]	0.0110
FZbh - Non-poly-P heterotrophs [gCOD/g of total COD]	0.0001

FZbm - Anoxic methanol utilizers [gCOD/g of total COD]	0.0001
FZaob - Ammonia oxidizers [gCOD/g of total COD]	0.0001
FZnob - Nitrite oxidizers [gCOD/g of total COD]	0.0001
FZamob - Anaerobic ammonia oxidizers [gCOD/g of total COD]	0.0001
FZbp - PAOs [gCOD/g of total COD]	0.0001
FZbpa - Propionic acetogens [gCOD/g of total COD]	0.0001
FZbam - Acetoclastic methanogens [gCOD/g of total COD]	0.0001
FZbhm - H2-utilizing methanogens [gCOD/g of total COD]	0.0001

Configuration information for all Model clarifier units

Physical data

Element name	Volume[Mil. Gal]	Area[ft2]	Depth[ft]	Number of layers	Top feed layer	Feed Layers
Secondary Clariifer 2	0.5025	5024.0000	13.370	10	6	1
Secondary Clarifier No 1	0.4937	5029.0000	13.123	10	6	1

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Secondary Clariifer 2	Ratio	0.40
Secondary Clarifier No 1	Ratio	0.40

Element name	Average Temperature	Reactive
Secondary Clariifer 2	Uses global setting	No

Secondary Clarifier No 1	Uses global setting	No

Configuration information for all Effluent units

Configuration information for all Media Bioreactor units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers
Anoxic Reactor	0.2000	2673.6113	10.000	Un-aerated

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint
Anoxic Reactor	0

Aeration equipment parameters

Element name	k1 in C = k1(PC)^0.25 + k2	k2 in C = k1(PC)^0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	% of tank area covered by diffusers [%]
Anoxic Reactor	2.5656	0.0432	0.8200	0.0410	10.0000

Configuration information for all Metal addition units

Operating data Average (flow/time weighted as required)

Element name	Alum (1)	Alum (2)
Non-polyP heterotrophs mgCOD/L	0	0
Anoxic methanol utilizers mgCOD/L	0	0
Ammonia oxidizing biomass mgCOD/L	0	0
Nitrite oxidizing biomass mgCOD/L	0	0
Anaerobic ammonia oxidizers mgCOD/L	0	0
PolyP heterotrophs mgCOD/L	0	0
Propionic acetogens mgCOD/L	0	0
Acetoclastic methanogens mgCOD/L	0	0
Hydrogenotrophic methanogens mgCOD/L	0	0
Endogenous products mgCOD/L	0	0
Slowly bio. COD (part.) mgCOD/L	0	0
Slowly bio. COD (colloid.) mgCOD/L	0	0
Part. inert. COD mgCOD/L	0	0
Part. bio. org. N mgN/L	0	0
Part. bio. org. P mgP/L	0	0
Part. inert N mgN/L	0	0
Part. inert P mgP/L	0	0
Stored PHA mgCOD/L	0	0
Releasable stored polyP mgP/L	0	0
Fixed stored polyP mgP/L	0	0
PolyP bound cations mg/L	0	0
Readily bio. COD (complex) mgCOD/L	0	0
Acetate mgCOD/L	0	0
Propionate mgCOD/L	0	0
Methanol mgCOD/L	0	0

Dissolved H2 mgCOD/L	0	0
Dissolved methane mg/L	0	0
Ammonia N mgN/L	0	0
Sol. bio. org. N mgN/L	0	0
Nitrite N mgN/L	0	0
Nitrate N mgN/L	0	0
Dissolved nitrogen gas mgN/L	0	0
PO4-P (Sol. & Me Complexed) mgP/L	0	0
Sol. inert COD mgCOD/L	0	0
Sol. inert TKN mgN/L	0	0
Inorganic S.S. mgISS/L	0	0
Struvite mgISS/L	0	0
Hydroxy-dicalcium-phosphate mgISS/L	0	0
Hydroxy-apatite mgISS/L	0	0
Magnesium mg/L	0	0
Calcium mg/L	0	0
Metal mg/L	0.00	57700.00
Other Cations (strong bases) meq/L	5.00	5.00
Other Anions (strong acids) meq/L	15.81	6434.89
Total CO2 mmol/L	7.00	7.00
User defined 1 mg/L	0	0
User defined 2 mg/L	0	0
User defined 3 mgVSS/L	0	0
User defined 4 mgISS/L	0	0
Dissolved oxygen mg/L	0	0
Flow	0	7E-5

Configuration information for all Dewatering unit units

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Dewatering Unit	Ratio	0.20
Dewatering Unit	Fraction	0.05

Element name	Percent removal
Dewatering Unit	100.00
Dewatering Unit	90.00

Configuration information for all Sludge units

Configuration information for all Splitter units

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Two way splitter6	Flowrate [Side]	0.035
Splitter23	Flowrate [Side]	0.02
Splitter1	Ratio	4.00
Splitter24	Ratio	0.00
Splitter73	Ratio	6.00

Configuration information for all Influent (SV) units

Operating data Average (flow/time weighted as required)

Element name	Mg(OH)2	Mg(OH)2 (1)	Mg(OH)2 (2)	Mg(OH)2
Non-polyP heterotrophs mgCOD/L	0	0	0	0
Anoxic methanol utilizers mgCOD/L	0	0	0	0
Ammonia oxidizing biomass mgCOD/L	0	0	0	0
Nitrite oxidizing biomass mgCOD/L	0	0	0	0
Anaerobic ammonia oxidizers mgCOD/L	0	0	0	0
PolyP heterotrophs mgCOD/L	0	0	0	0
Propionic acetogens mgCOD/L	0	0	0	0
Acetoclastic methanogens mgCOD/L	0	0	0	0
Hydrogenotrophic methanogens mgCOD/L	0	0	0	0
Endogenous products mgCOD/L	0	0	0	0
Slowly bio. COD (part.) mgCOD/L	0	0	0	0
Slowly bio. COD (colloid.) mgCOD/L	0	0	0	0
Part. inert. COD mgCOD/L	0	0	0	0
Part. bio. org. N mgN/L	0	0	0	0
Part. bio. org. P mgP/L	0	0	0	0
Part. inert N mgN/L	0	0	0	0
Part. inert P mgP/L	0	0	0	0
Stored PHA mgCOD/L	0	0	0	0
Releasable stored polyP mgP/L	0	0	0	0
Fixed stored polyP mgP/L	0	0	0	0
PolyP bound cations mg/L	0	0	0	0
Readily bio. COD (complex) mgCOD/L	0	0	0	0
Acetate mgCOD/L	0	0	0	0
Propionate mgCOD/L	0	0	0	0
Methanol mgCOD/L	0	0	0	0
Dissolved H2 mgCOD/L	0	0	0	0

Dissolved methane mg/L	0	0	0	0
Ammonia N mgN/L	0	0	0	0
Sol. bio. org. N mgN/L	0	0	0	0
Nitrite N mgN/L	0	0	0	0
Nitrate N mgN/L	0	0	0	0
Dissolved nitrogen gas mgN/L	0	0	0	0
PO4-P (Sol. & Me Complexed) mgP/L	0	0	0	0
Sol. inert COD mgCOD/L	0	0	0	0
Sol. inert TKN mgN/L	0	0	0	0
Inorganic S.S. mgISS/L	0	0	0	0
Struvite mgISS/L	0	0	0	0
Hydroxy-dicalcium-phosphate mgISS/L	0	0	0	0
Hydroxy-apatite mgISS/L	0	0	0	0
Magnesium mg/L	0	0	0	0
Calcium mg/L	0	0	0	0
Metal mg/L	0	0	0	0
Other Cations (strong bases) meq/L	14500.00	14500.00	14500.00	14500.00
Other Anions (strong acids) meq/L	0	0	0	0
Total CO2 mmol/L	0	0	0	0
User defined 1 mg/L	0	0	0	0
User defined 2 mg/L	0	0	0	0
User defined 3 mgVSS/L	0	0	0	0
User defined 4 mgISS/L	0	0	0	0
Dissolved oxygen mg/L	0	0	0	0
Flow	0	0.00035	2E-5	1E-5

Configuration information for all Bioreactor (brush aerators) units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]
Oxidation Ditch	0.4000	5347.2225	10.000

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint
Oxidation Ditch	1.5

Aeration equipment parameters

Element name	Surface aerator Std. oxygen transfer rate [lb O /(hp hr)]	Maximum power per rotor [hp]
Oxidation Ditch	2.4670	26.8097

BioWin Album

Album page - Aerobic Digester

No element
toomanycolumns

Parameters	Value	Units

Album page - Aerobic Digester

Album page - Aeration Basin

No element

toomanycolumns

Parameters	Value	Units

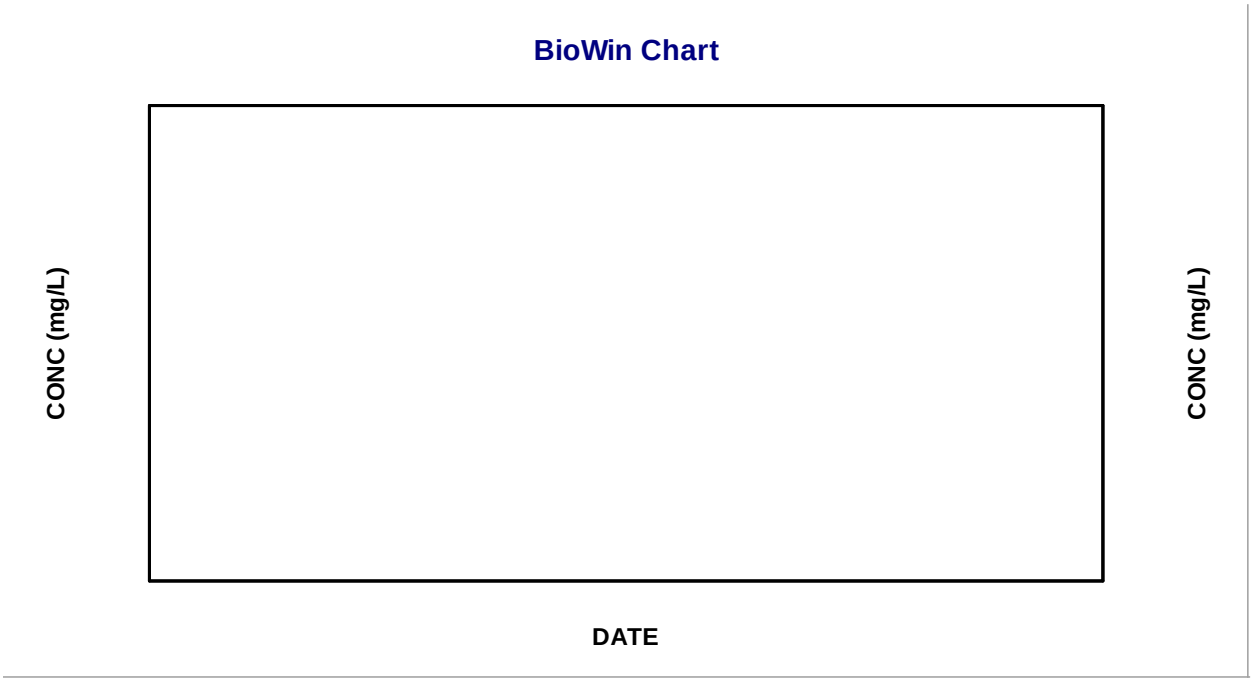
Album page - Effluent

Secondary Effluent			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
Volatile suspended solids	1.76	12.62	
Total suspended solids	2.55	18.27	
Particulate COD	2.60	18.63	
Filtered COD	37.00	265.58	
Total COD	39.59	284.21	
Soluble PO4-P	0.01	0.07	
Total P	0.09	0.65	
Filtered TKN	5.23	37.54	
Particulate TKN	0.15	1.09	
Total Kjeldahl Nitrogen	5.38	38.64	
Filtered Carbonaceous BOD	1.44	10.32	
Total Carbonaceous BOD	2.28	16.38	
Nitrite + Nitrate	26.63	191.18	

Total N	32.01	229.82	
Total inorganic N	28.35	203.51	
Alkalinity	1.00	3.25	mmol/L and kmol/d
pH	6.69		
Volatile fatty acids	0.00	0.01	
Total precipitated solids	0.20	1.43	
Total inorganic suspended solids	0.79	5.65	
Ammonia N	1.72	12.33	
Nitrate N	13.77	98.84	

Parameters	Value	Units

Album page - Page 4



Album page - Page 5

Sidestream Mixer52

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
Volatile suspended solids	1.76	12.62	
Total suspended solids	2.55	18.27	
Particulate COD	2.60	18.63	
Filtered COD	37.00	265.58	
Total COD	39.59	284.21	
Soluble PO4-P	0.01	0.07	
Total P	0.09	0.65	
Filtered TKN	5.23	37.54	
Particulate TKN	0.15	1.09	
Total Kjeldahl Nitrogen	5.38	38.64	
Filtered Carbonaceous BOD	1.44	10.32	
Total Carbonaceous BOD	2.28	16.38	
Nitrite + Nitrate	26.63	191.18	
Total N	32.01	229.82	
Total inorganic N	28.35	203.51	
Alkalinity	1.00	3.25	mmol/L and kmol/d
pH	6.69		
Volatile fatty acids	0.00	0.01	
Total precipitated solids	0.20	1.43	
Total inorganic suspended solids	0.79	5.65	
Ammonia N	1.72	12.33	
Nitrate N	13.77	98.84	

Parameters	Value	Units

Album page - Page 6

Sidestream Mixer14			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
Volatile suspended solids	5704.90	16381.43	
Total suspended solids	8262.22	23724.69	
Particulate COD	8424.45	24190.52	
Filtered COD	37.00	106.23	
Total COD	8461.44	24296.75	
Soluble PO4-P	0.01	0.03	
Total P	262.65	754.18	
Filtered TKN	5.23	15.02	
Particulate TKN	495.09	1421.65	
Total Kjeldahl Nitrogen	500.32	1436.67	
Filtered Carbonaceous BOD	1.44	4.13	
Total Carbonaceous BOD	2743.21	7877.03	
Nitrite + Nitrate	26.63	76.47	
Total N	526.96	1513.14	
Total inorganic N	28.35	81.40	
Alkalinity	1.17	1.53	mmol/L and kmol/d
pH	6.69		
Volatile fatty acids	0.00	0.00	
Total precipitated solids	645.54	1853.65	
Total inorganic suspended solids	2557.32	7343.26	
Ammonia N	1.72	4.93	
Nitrate N	13.77	39.54	

Parameters	Value	Units

Album page - Page 7

Sidestream Mixer9

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
Volatile suspended solids	8866.41	1666.34	
Total suspended solids	12408.21	2331.98	
Particulate COD	13093.06	2460.69	
Filtered COD	36.96	6.95	
Total COD	13130.02	2467.64	
Soluble PO4-P	167.59	31.50	
Total P	408.19	76.72	
Filtered TKN	5.23	0.98	
Particulate TKN	769.46	144.61	
Total Kjeldahl Nitrogen	774.69	145.59	
Filtered Carbonaceous BOD	1.44	0.27	
Total Carbonaceous BOD	4262.63	801.11	
Nitrite + Nitrate	26.61	5.00	
Total N	801.30	150.59	
Total inorganic N	28.32	5.32	
Alkalinity	14.14	1.21	mmol/L and kmol/d
pH	10.45		
Volatile fatty acids	0.00	0.00	
Total precipitated solids	570.57	107.23	
Total inorganic suspended solids	3541.81	665.64	
Ammonia N	1.72	0.32	
Nitrate N	13.76	2.59	

Parameters	Value	Units

Global Parameters

AOB

Name	Default	Value	
Max. spec. growth rate [1/d]	0.90000	0.90000	1.0720
Substrate (NH4) half sat. [mgN/L]	0.70000	0.70000	1.0000
Aerobic decay rate [1/d]	0.17000	0.17000	1.0290
Anoxic/anaerobic decay rate [1/d]	0.08000	0.08000	1.0290
KiHNO2 [mmol/L]	0.00500	0.00500	1.0000

NOB

Name	Default	Value	
Max. spec. growth rate [1/d]	0.70000	0.70000	1.0600
Substrate (NO2) half sat. [mgN/L]	0.10000	0.10000	1.0000
Aerobic decay rate [1/d]	0.17000	0.17000	1.0290
Anoxic/anaerobic decay rate [1/d]	0.08000	0.08000	1.0290
KiNH3 [mmol/L]	0.07500	0.07500	1.0000

ANAMMOX

Name	Default	Value	
Max. spec. growth rate [1/d]	0.10000	0.10000	1.1000
Substrate (NH4) half sat. [mgN/L]	2.00000	2.00000	1.0000
Substrate (NO2) half sat. [mgN/L]	1.00000	1.00000	1.0000
Aerobic decay rate [1/d]	0.01900	0.01900	1.0290
Anoxic/anaerobic decay rate [1/d]	0.00950	0.00950	1.0290
Ki Nitrite [mgN/L]	1000.00000	1000.00000	1.0000
Nitrite sensitivity constant [L / (d mgN)]	0.01600	0.01600	1.0000

OHOs

Name	Default	Value	
Max. spec. growth rate [1/d]	3.20000	3.20000	1.0290
Substrate half sat. [mgCOD/L]	5.00000	5.00000	1.0000
Anoxic growth factor [-]	0.50000	0.50000	1.0000
Aerobic decay [1/d]	0.62000	0.62000	1.0290
Anoxic/anaerobic decay [1/d]	0.30000	0.30000	1.0290
Hydrolysis rate (AS) [1/d]	2.10000	2.10000	1.0290
Hydrolysis half sat. (AS) [-]	0.06000	0.06000	1.0000
Anoxic hydrolysis factor [-]	0.28000	0.28000	1.0000
Anaerobic hydrolysis factor [-]	0.50000	0.50000	1.0000
Adsorption rate of colloids [L/(mgCOD d)]	0.80000	0.80000	1.0290
Ammonification rate [L/(mgN d)]	0.04000	0.04000	1.0290
Assimilative nitrate/nitrite reduction rate [1/d]	0.50000	0.50000	1.0000
Fermentation rate [1/d]	3.20000	3.20000	1.0290
Fermentation half sat. [mgCOD/L]	5.00000	5.00000	1.0000
Anaerobic growth factor (AS) [-]	0.12500	0.12500	1.0000
Hydrolysis rate (AD) [1/d]	0.10000	0.10000	1.0500
Hydrolysis half sat. (AD) [mgCOD/L]	0.15000	0.15000	1.0000

Methylotrophs

Name	Default	Value	
Max. spec. growth rate of methanol utilizers [1/d]	1.30000	1.30000	1.0720
Methanol half sat. [mgCOD/L]	0.50000	0.50000	1.0000
Aerobic decay rate of methanol utilizers [1/d]	0.04000	0.04000	1.0290
Anoxic/anaerobic decay rate of methanol utilizers [1/d]	0.03000	0.03000	1.0290

PAOs

Name	Default	Value	
Max. spec. growth rate [1/d]	0.95000	0.95000	1.0000
Max. spec. growth rate, P-limited [1/d]	0.42000	0.42000	1.0000
Substrate half sat. [mgCOD(PHB)/mgCOD(Zbp)]	0.10000	0.10000	1.0000
Substrate half sat., P-limited [mgCOD(PHB)/mgCOD(Zbp)]	0.05000	0.05000	1.0000
Magnesium half sat. [mgMg/L]	0.10000	0.10000	1.0000
Cation half sat. [mmol/L]	0.10000	0.10000	1.0000
Calcium half sat. [mgCa/L]	0.10000	0.10000	1.0000
Aerobic decay rate [1/d]	0.10000	0.10000	1.0000
Anaerobic decay rate [1/d]	0.04000	0.04000	1.0000
Sequestration rate [1/d]	6.00000	6.00000	1.0000
Anoxic growth factor NO3 [-]	0.33000	0.33000	1.0000
Anoxic growth factor NO2 [-]	0.33000	0.33000	1.0000

Acetogens

Name	Default	Value	
Max. spec. growth rate [1/d]	0.25000	0.25000	1.0290
Substrate half sat. [mgCOD/L]	10.00000	10.00000	1.0000
Acetate inhibition [mgCOD/L]	10000.00000	10000.00000	1.0000
Decay rate [1/d]	0.05000	0.05000	1.0290
Aerobic decay rate [1/d]	0.52000	0.52000	1.0290

Methanogens

Name	Default	Value	
Acetoclastic Mu Max [1/d]	0.30000	0.30000	1.0290
H2-utilizing Mu Max [1/d]	1.40000	1.40000	1.0290
Acetoclastic Ks [mgCOD/L]	100.00000	100.00000	1.0000
Acetoclastic methanol Ks [mgCOD/L]	0.50000	0.50000	1.0000
H2-utilizing CO2 half sat. [mmol/L]	0.10000	0.10000	1.0000
H2-utilizing Ks [mgCOD/L]	0.10000	0.10000	1.0000
H2-utilizing methanol Ks [mgCOD/L]	0.50000	0.50000	1.0000
Acetoclastic propionic inhibition [mgCOD/L]	10000.00000	10000.00000	1.0000
Acetoclastic decay rate [1/d]	0.13000	0.13000	1.0290
Acetoclastic aerobic decay rate [1/d]	0.60000	0.60000	1.0290
H2-utilizing decay rate [1/d]	0.13000	0.13000	1.0290
H2-utilizing aerobic decay rate [1/d]	0.60000	0.60000	1.0290

pH

Name	Default	Value

Heterotrophs low pH limit [-]	4.00000	4.00000
Heterotrophs high pH limit [-]	10.00000	10.00000
Methanol utilizers low pH limit [-]	4.00000	4.00000
Methanol utilizers high pH limit [-]	10.00000	10.00000
Autotrophs low pH limit [-]	5.50000	5.50000
Autotrophs high pH limit [-]	9.50000	9.50000
PolyP heterotrophs low pH limit [-]	4.00000	4.00000
Poly P heterotrophs high pH limit [-]	10.00000	10.00000
Heterotrophs low pH limit (anaerobic) [-]	5.50000	5.50000
Heterotrophs high pH limit (anaerobic) [-]	8.50000	8.50000
Propionic acetogens low pH limit [-]	4.00000	4.00000
Propionic acetogens high pH limit [-]	10.00000	10.00000
Acetoclastic methanogens low pH limit [-]	5.00000	5.00000
Acetoclastic methanogens high pH limit [-]	9.00000	9.00000
H2-utilizing methanogens low pH limit [-]	5.00000	5.00000
H2-utilizing methanogens high pH limit [-]	9.00000	9.00000

Switches

Name	Default	Value
Heterotrophic DO half sat. [mgO2/L]	0.05000	0.05000
Aerobic denit. DO half sat. [mgO2/L]	0.05000	0.05000
Ammonia oxidizer DO half sat. [mgO2/L]	0.25000	0.25000
Nitrite oxidizer DO half sat. [mgO2/L]	0.50000	0.50000
Anaerobic ammonia oxidizer DO half sat. [mgO2/L]	0.01000	0.01000
Anoxic NO3 half sat. [mgN/L]	0.10000	0.10000
Anoxic NO2 half sat. (mgN/L)	0.01000	0.01000
NH3 nutrient half sat. [mgN/L]	1.0000E-4	1.0000E-4
PolyP half sat. [mgP/L]	0.01000	0.01000

VFA sequestration half sat. [mgCOD/L]	5.00000	5.00000
P uptake half sat. [mgP/L]	0.15000	0.15000
P nutrient half sat. [mgP/L]	0.00100	0.00100
Autotroph CO2 half sat. [mmol/L]	0.10000	0.10000
Heterotrophic Hydrogen half sat. [mgCOD/L]	1.00000	1.00000
Propionic acetogens Hydrogen half sat. [mgCOD/L]	5.00000	5.00000
Synthesis anion/cation half sat. [meq/L]	0.01000	0.01000

Common

Name	Default	Value
N in endogenous residue [mgN/mgCOD]	0.07000	0.07000
P in endogenous residue [mgP/mgCOD]	0.02200	0.02200
Endogenous residue COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
Particulate substrate COD:VSS ratio [mgCOD/mgVSS]	1.60000	1.60000
Particulate inert COD:VSS ratio [mgCOD/mgVSS]	1.60000	1.60000

AOB

Name	Default	Value
Yield [mgCOD/mgN]	0.15000	0.15000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

NOB

Name	Default	Value
Yield [mgCOD/mgN]	0.09000	0.09000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

ANAMMOX

Name	Default	Value
Yield [mgCOD/mgN]	0.11400	0.11400
Nitrate production [mgN/mgBiomassCOD]	2.28000	2.28000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

OHOs

Name	Default	Value
Yield (aerobic) [-]	0.66600	0.66600
Yield (fermentation, low H2) [-]	0.10000	0.10000
Yield (fermentation, high H2) [-]	0.10000	0.10000
H2 yield (fermentation low H2) [-]	0.35000	0.35000

H2 yield (fermentation high H2) [-]	0	0
Propionate yield (fermentation, low H2) [-]	0	0
Propionate yield (fermentation, high H2) [-]	0.70000	0.70000
CO2 yield (fermentation, low H2) [-]	0.70000	0.70000
CO2 yield (fermentation, high H2) [-]	0	0
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
Yield (anoxic) [-]	0.54000	0.54000
Yield propionic (aerobic) [-]	0.64000	0.64000
Yield propionic (anoxic) [-]	0.46000	0.46000
Yield acetic (aerobic) [-]	0.60000	0.60000
Yield acetic (anoxic) [-]	0.43000	0.43000
Yield methanol (aerobic) [-]	0.50000	0.50000
Adsorp. max. [-]	1.00000	1.00000

Methylotrophs

Name	Default	Value
Yield (anoxic) [-]	0.40000	0.40000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

PAOs

Name	Default	Value
Yield (aerobic) [-]	0.63900	0.63900
Yield (anoxic) [-]	0.52000	0.52000
Aerobic P/PHA uptake [mgP/mgCOD]	0.95000	0.95000
Anoxic P/PHA uptake [mgP/mgCOD]	0.35000	0.35000
Yield of PHA on sequestration [-]	0.88900	0.88900
N in biomass [mgN/mgCOD]	0.07000	0.07000
N in sol. inert [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous part. [-]	0.25000	0.25000
Inert fraction of endogenous sol. [-]	0.20000	0.20000
P/Ac release ratio [mgP/mgCOD]	0.49000	0.49000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
Yield of low PP [-]	0.94000	0.94000

Acetogens

Name	Default	Value
Yield [-]	0.10000	0.10000
H2 yield [-]	0.40000	0.40000
CO2 yield [-]	1.00000	1.00000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

Methanogens

Name	Default	Value
Acetoclastic yield [-]	0.10000	0.10000
Methanol acetoclastic yield [-]	0.10000	0.10000
H2-utilizing yield [-]	0.10000	0.10000
Methanol H2-utilizing yield [-]	0.10000	0.10000
N in acetoclastic biomass [mgN/mgCOD]	0.07000	0.07000
N in H2-utilizing biomass [mgN/mgCOD]	0.07000	0.07000
P in acetoclastic biomass [mgP/mgCOD]	0.02200	0.02200
P in H2-utilizing biomass [mgP/mgCOD]	0.02200	0.02200
Acetoclastic fraction to endog. residue [-]	0.08000	0.08000
H2-utilizing fraction to endog. residue [-]	0.08000	0.08000
Acetoclastic COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
H2-utilizing COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

General

Name	Default	Value
Ash content of biomass (synthesis ISS) [%]	8.00000	8.00000
Molecular weight of other anions [mg/mmol]	35.50000	35.50000
Molecular weight of other cations [mg/mmol]	39.10000	39.10000
Mg to P mole ratio in polyphosphate [mmolMg/mmolP]	0.30000	0.30000
Cation to P mole ratio in polyphosphate [meq/mmolP]	0.30000	0.30000
Ca to P mole ratio in polyphosphate [mmolCa/mmolP]	0.05000	0.05000
Cation to P mole ratio in organic phosphate [meq/mmolP]	0.01000	0.01000
Bubble rise velocity (anaerobic digester) [cm/s]	23.90000	23.90000
Bubble Sauter mean diameter (anaerobic digester) [cm]	0.35000	0.35000
Anaerobic digester gas hold-up factor []	1.00000	1.00000
Tank head loss per metre of length (from flow) [m/m]	0.00250	0.00250

Mass transfer

Name	Default	Value	
Kl for H2 [m/d]	17.00000	17.00000	1.0240
Kl for CO2 [m/d]	10.00000	10.00000	1.0240
Kl for NH3 [m/d]	1.00000	1.00000	1.0240
Kl for CH4 [m/d]	8.00000	8.00000	1.0240
Kl for N2 [m/d]	15.00000	15.00000	1.0240
Kl for O2 [m/d]	13.00000	13.00000	1.0240

Physico-chemical rates

Name	Default	Value	
Struvite precipitation rate [1/d]	3.0000E+10	3.0000E+10	1.0240
Struvite redissolution rate [1/d]	3.0000E+11	3.0000E+11	1.0240
Struvite half sat. [mgTSS/L]	1.00000	1.00000	1.0000
HDP precipitation rate [L/(molP d)]	1.0000E+8	1.0000E+8	1.0000
HDP redissolution rate [L/(mol P d)]	1.0000E+8	1.0000E+8	1.0000
HAP precipitation rate [molHDP/(L d)]	5.0000E-4	5.0000E-4	1.0000

Physico-chemical constants

Name	Default	Value
Struvite solubility constant [mol/L]	6.9180E-14	6.9180E-14
HDP solubility product [mol/L]	2.7500E-22	2.7500E-22

HDP half sat. [mgTSS/L]	1.00000	1.00000
Equilibrium soluble PO4 with Al dosing at pH 7 [mgP/L]	0.01000	0.01000
Al to P ratio [molAl/molP]	0.80000	0.80000
Al(OH)3 solubility product [mol/L]	1.2590E+9	1.2590E+9
AlHPO4+ dissociation constant [mol/L]	7.9430E-13	7.9430E-13
Equilibrium soluble PO4 with Fe dosing at pH 7 [mgP/L]	0.01000	0.01000
Fe to P ratio [molFe/molP]	1.60000	1.60000
Fe(OH)3 solubility product [mol/L]	0.05000	0.05000
FeH2PO4++ dissociation constant [mol/L]	5.0120E-22	5.0120E-22

Aeration

Name	Default	Value
Alpha (surf) OR Alpha F (diff) [-]	0.50000	0.50000
Beta [-]	0.95000	0.95000
Surface pressure [kPa]	101.32500	101.32500
Fractional effective saturation depth (Fed) [-]	0.32500	0.32500
Supply gas CO2 content [vol. %]	0.03500	0.03500
Supply gas O2 [vol. %]	20.95000	20.95000
Off-gas CO2 [vol. %]	2.00000	2.00000
Off-gas O2 [vol. %]	18.80000	18.80000
Off-gas H2 [vol. %]	0	0
Off-gas NH3 [vol. %]	0	0
Off-gas CH4 [vol. %]	0	0
Surface turbulence factor [-]	2.00000	2.00000
Set point controller gain []	1.00000	1.00000

Modified Vesilind

Name	Default	Value
Maximum Vesilind settling velocity (Vo) [ft/min]	0.3873	0.3873
Vesilind hindered zone settling parameter (K) [L/g]	0.3700	0.3700
Clarification switching function [mg/L]	100.0000	100.0000
Specified TSS conc.for height calc. [mg/L]	2500.0000	2500.0000
Maximum compactability constant [mg/L]	15000.0000	15000.0000

Double exponential

Name	Default	Value
Maximum Vesilind settling velocity (Vo) [ft/min]	0.9341	0.9341
Maximum (practical) settling velocity (Vo') [ft/min]	0.6152	0.6152
Hindered zone settling parameter (Kh) [L/g]	0.4000	0.4000
Flocculent zone settling parameter (Kf) [L/g]	2.5000	2.5000
Maximum non-settleable TSS [mg/L]	20.0000	20.0000
Non-settleable fraction [-]	0.0010	0.0010
Specified TSS conc. for height calc. [mg/L]	2500.0000	2500.0000

Biofilm general

Name	Default	Value	
Attachment rate [g / (m2 d)]	80.00000	80.00000	1.0000
Attachment TSS half sat. [mg/L]	100.00000	100.00000	1.0000
Detachment rate [g/(m3 d)]	8.0000E+4	8.0000E+4	1.0000
Solids movement factor []	10.00000	10.00000	1.0000
Diffusion neta []	0.80000	0.80000	1.0000

Thin film limit [mm]	0.50000	0.50000	1.0000
Thick film limit [mm]	3.00000	3.00000	1.0000
Assumed Film thickness for tank volume correction (temp independant) [mm]	0.75000	0.75000	1.0000
Film surface area to media area ratio - Max.[ ]	1.00000	1.00000	1.0000
Minimum biofilm conc. for streamer formation [gTSS/m2]	4.00000	4.00000	1.0000

Maximum biofilm concentrations [mg/L]

Name	Default	Value	
Non-polyP heterotrophs	5.0000E+4	5.0000E+4	1.0000
Anoxic methanol utilizers	5.0000E+4	5.0000E+4	1.0000
Ammonia oxidizing biomass	1.0000E+5	1.0000E+5	1.0000
Nitrite oxidizing biomass	1.0000E+5	1.0000E+5	1.0000
Anaerobic ammonia oxidizers	5.0000E+4	5.0000E+4	1.0000
PolyP heterotrophs	5.0000E+4	5.0000E+4	1.0000
Propionic acetogens	5.0000E+4	5.0000E+4	1.0000
Acetoclastic methanogens	5.0000E+4	5.0000E+4	1.0000
Hydrogenotrophic methanogens	5.0000E+4	5.0000E+4	1.0000
Endogenous products	3.0000E+4	3.0000E+4	1.0000
Slowly bio. COD (part.)	5000.00000	5000.00000	1.0000
Slowly bio. COD (colloid.)	0	0	1.0000
Part. inert. COD	5000.00000	5000.00000	1.0000
Part. bio. org. N	0	0	1.0000
Part. bio. org. P	0	0	1.0000
Part. inert N	0	0	1.0000
Part. inert P	0	0	1.0000
Stored PHA	5000.00000	5000.00000	1.0000
Releasable stored polyP	1.1500E+6	1.1500E+6	1.0000
Fixed stored polyP	1.1500E+6	1.1500E+6	1.0000

PolyP bound cations	1.1500E+6	1.1500E+6	1.0000
Readily bio. COD (complex)	0	0	1.0000
Acetate	0	0	1.0000
Propionate	0	0	1.0000
Methanol	0	0	1.0000
Dissolved H2	0	0	1.0000
Dissolved methane	0	0	1.0000
Ammonia N	0	0	1.0000
Sol. bio. org. N	0	0	1.0000
Nitrite N	0	0	1.0000
Nitrate N	0	0	1.0000
Dissolved nitrogen gas	0	0	1.0000
PO4-P (Sol. & Me Complexed)	1.0000E+10	1.0000E+10	1.0000
Sol. inert COD	0	0	1.0000
Sol. inert TKN	0	0	1.0000
Inorganic S.S.	1.3000E+6	1.3000E+6	1.0000
Struvite	8.5000E+5	8.5000E+5	1.0000
Hydroxy-dicalcium-phosphate	1.1500E+6	1.1500E+6	1.0000
Hydroxy-apatite	1.6000E+6	1.6000E+6	1.0000
Magnesium	0	0	1.0000
Calcium	0	0	1.0000
Metal	1.0000E+10	1.0000E+10	1.0000
Other Cations (strong bases)	0	0	1.0000
Other Anions (strong acids)	0	0	1.0000
Total CO2	0	0	1.0000
User defined 1	0	0	1.0000
User defined 2	0	0	1.0000
User defined 3	5.0000E+4	5.0000E+4	1.0000
User defined 4	5.0000E+4	5.0000E+4	1.0000
Dissolved oxygen	0	0	1.0000

Effective diffusivities [m2/s]

Name	Default	Value	
Non-polyP heterotrophs	5.0000E-14	5.0000E-14	1.0290
Anoxic methanol utilizers	5.0000E-14	5.0000E-14	1.0290
Ammonia oxidizing biomass	5.0000E-14	5.0000E-14	1.0290
Nitrite oxidizing biomass	5.0000E-14	5.0000E-14	1.0290
Anaerobic ammonia oxidizers	5.0000E-14	5.0000E-14	1.0290
PolyP heterotrophs	5.0000E-14	5.0000E-14	1.0290
Propionic acetogens	5.0000E-14	5.0000E-14	1.0290
Acetoclastic methanogens	5.0000E-14	5.0000E-14	1.0290
Hydrogenotrophic methanogens	5.0000E-14	5.0000E-14	1.0290
Endogenous products	5.0000E-14	5.0000E-14	1.0290
Slowly bio. COD (part.)	5.0000E-14	5.0000E-14	1.0290
Slowly bio. COD (colloid.)	6.9000E-11	6.9000E-11	1.0290
Part. inert. COD	5.0000E-14	5.0000E-14	1.0290
Part. bio. org. N	5.0000E-14	5.0000E-14	1.0290
Part. bio. org. P	5.0000E-14	5.0000E-14	1.0290
Part. inert N	5.0000E-14	5.0000E-14	1.0290
Part. inert P	5.0000E-14	5.0000E-14	1.0290
Stored PHA	5.0000E-14	5.0000E-14	1.0290
Releasable stored polyP	5.0000E-14	5.0000E-14	1.0290
Fixed stored polyP	5.0000E-14	5.0000E-14	1.0290
PolyP bound cations	5.0000E-14	5.0000E-14	1.0290
Readily bio. COD (complex)	6.9000E-10	6.9000E-10	1.0290
Acetate	1.2400E-9	1.2400E-9	1.0290
Propionate	8.3000E-10	8.3000E-10	1.0290
Methanol	1.6000E-9	1.6000E-9	1.0290
Dissolved H2	5.8500E-9	5.8500E-9	1.0290

Dissolved methane	1.9625E-9	1.9625E-9	1.0290
Ammonia N	2.0000E-9	2.0000E-9	1.0290
Sol. bio. org. N	1.3700E-9	1.3700E-9	1.0290
Nitrite N	2.9800E-9	2.9800E-9	1.0290
Nitrate N	2.9800E-9	2.9800E-9	1.0290
Dissolved nitrogen gas	1.9000E-9	1.9000E-9	1.0290
PO4-P (Sol. & Me Complexed)	2.0000E-9	2.0000E-9	1.0290
Sol. inert COD	6.9000E-10	6.9000E-10	1.0290
Sol. inert TKN	6.8500E-10	6.8500E-10	1.0290
Inorganic S.S.	5.0000E-14	5.0000E-14	1.0290
Struvite	5.0000E-14	5.0000E-14	1.0290
Hydroxy-dicalcium-phosphate	5.0000E-14	5.0000E-14	1.0290
Hydroxy-apatite	5.0000E-14	5.0000E-14	1.0290
Magnesium	7.2000E-10	7.2000E-10	1.0290
Calcium	7.2000E-10	7.2000E-10	1.0290
Metal	4.8000E-10	4.8000E-10	1.0290
Other Cations (strong bases)	1.4400E-9	1.4400E-9	1.0290
Other Anions (strong acids)	1.4400E-9	1.4400E-9	1.0290
Total CO2	1.9600E-9	1.9600E-9	1.0290
User defined 1	6.9000E-10	6.9000E-10	1.0290
User defined 2	6.9000E-10	6.9000E-10	1.0290
User defined 3	5.0000E-14	5.0000E-14	1.0290
User defined 4	5.0000E-14	5.0000E-14	1.0290
Dissolved oxygen	2.5000E-9	2.5000E-9	1.0290

EPS Strength coefficients [ ]

Name	Default	Value	
Non-polyP heterotrophs	1.00000	1.00000	1.0000

Anoxic methanol utilizers	1.00000	1.00000	1.0000
Ammonia oxidizing biomass	1.00000	1.00000	1.0000
Nitrite oxidizing biomass	1.00000	1.00000	1.0000
Anaerobic ammonia oxidizers	1.00000	1.00000	1.0000
PolyP heterotrophs	1.00000	1.00000	1.0000
Propionic acetogens	1.00000	1.00000	1.0000
Acetoclastic methanogens	1.00000	1.00000	1.0000
Hydrogenotrophic methanogens	1.00000	1.00000	1.0000
Endogenous products	1.00000	1.00000	1.0000
Slowly bio. COD (part.)	1.00000	1.00000	1.0000
Slowly bio. COD (colloid.)	0	0	1.0000
Part. inert. COD	1.00000	1.00000	1.0000
Part. bio. org. N	1.00000	1.00000	1.0000
Part. bio. org. P	1.00000	1.00000	1.0000
Part. inert N	1.00000	1.00000	1.0000
Part. inert P	1.00000	1.00000	1.0000
Stored PHA	1.00000	1.00000	1.0000
Releasable stored polyP	1.00000	1.00000	1.0000
Fixed stored polyP	1.00000	1.00000	1.0000
PolyP bound cations	1.00000	1.00000	1.0000
Readily bio. COD (complex)	0	0	1.0000
Acetate	0	0	1.0000
Propionate	0	0	1.0000
Methanol	0	0	1.0000
Dissolved H2	0	0	1.0000
Dissolved methane	0	0	1.0000
Ammonia N	0	0	1.0000
Sol. bio. org. N	0	0	1.0000
Nitrite N	0	0	1.0000
Nitrate N	0	0	1.0000
Dissolved nitrogen gas	0	0	1.0000

PO4-P (Sol. & Me Complexed)	1.00000	1.00000	1.0000
Sol. inert COD	0	0	1.0000
Sol. inert TKN	0	0	1.0000
Inorganic S.S.	0.33000	0.33000	1.0000
Struvite	1.00000	1.00000	1.0000
Hydroxy-dicalcium-phosphate	1.00000	1.00000	1.0000
Hydroxy-apatite	1.00000	1.00000	1.0000
Magnesium	0	0	1.0000
Calcium	0	0	1.0000
Metal	1.00000	1.00000	1.0000
Other Cations (strong bases)	0	0	1.0000
Other Anions (strong acids)	0	0	1.0000
Total CO2	0	0	1.0000
User defined 1	0	0	1.0000
User defined 2	0	0	1.0000
User defined 3	1.00000	1.00000	1.0000
User defined 4	1.00000	1.00000	1.0000
Dissolved oxygen	0	0	1.0000

BioWin user and configuration data

Project details

Project name: Aerobic Digester Model Development **Project ref.: 60037-15001**

Plant name: North Bend **User name: Markus**

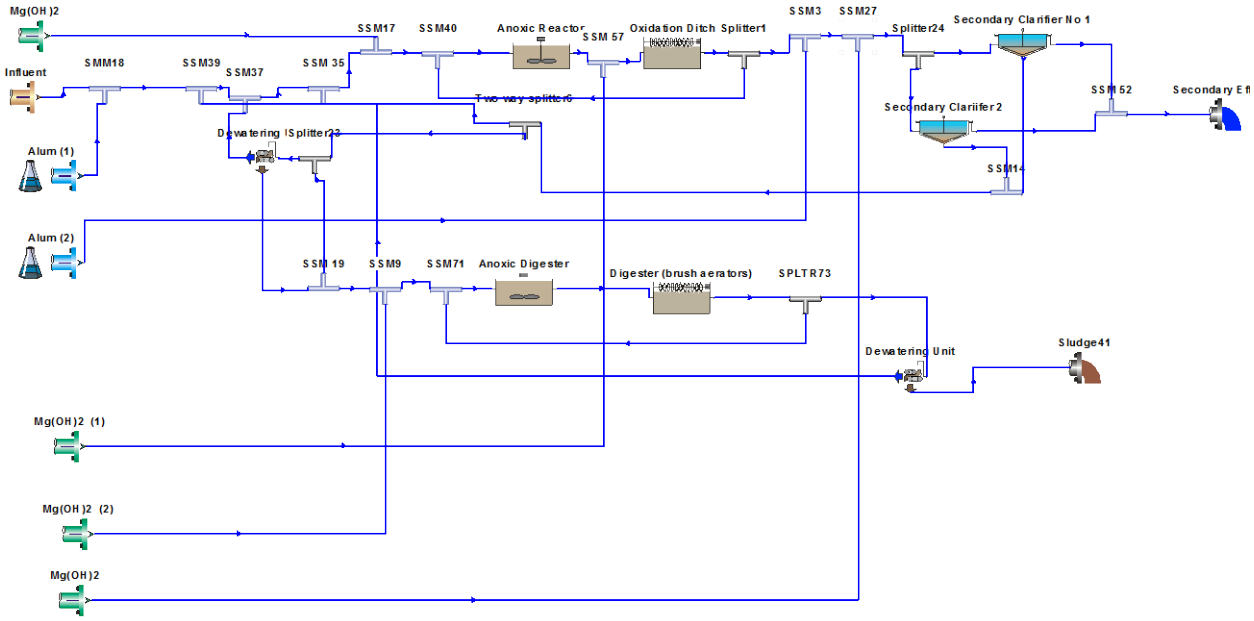
Created: 3/1/2001 **Saved: 9/6/2016**

Steady state solution

SRT: 6.43

Temperature: 20.0

Flowsheet



Configuration information for all Bioreactor units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers
Anoxic Digester	0.3000	2673.6113	15.000	Un-aerated

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint [mg/L]
Anoxic Digester	0

Aeration equipment parameters

Element name	k1 in C = k1(PC)^0.25 + k2	k2 in C = k1(PC)^0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	% of tank area covered by diffusers [%]
Anoxic Digester	2.5656	0.0432	0.8200	0.0410	10.0000

Configuration information for all BOD Influent units

Operating data Average (flow/time weighted as required)

Element name	Influent
Flow	0.860869992486947
TCBOD mgBOD/L	328.00
VSS mgVSS/L	328.00
TSS mgTSS/L	386.00
TKN mgN/L	97.00
TP mgP/L	9.70
S_NO3 mgN/L	0
pH	7.00
Alk mmol/L	1.17
S_CA mg/L	4.40
S_MG mg/L	1.80
S_O2 mg/L	0

Element name	Influent
Fbs - Readily biodegradable (including Acetate) [gCOD/g of total COD]	0.1600
Fac - Acetate [gCOD/g of readily biodegradable COD]	0.1500
Fxsp - Non-colloidal slowly biodegradable [gCOD/g of slowly degradable COD]	0.9397
Fus - Unbiodegradable soluble [gCOD/g of total COD]	0.0500
Fup - Unbiodegradable particulate [gCOD/g of total COD]	0.1300
Fna - Ammonia [gNH3-N/gTKN]	0.6600
Fnox - Particulate organic nitrogen [gN/g Organic N]	0.5000
Fnus - Soluble unbiodegradable TKN [gN/gTKN]	0.0200
FupN - N:COD ratio for unbiodegradable part. COD [gN/gCOD]	0.0350
Fpo4 - Phosphate [gPO4-P/gTP]	0.6300
FupP - P:COD ratio for unbiodegradable part. COD [gP/gCOD]	0.0110
FZbh - Non-poly-P heterotrophs [gCOD/g of total COD]	0.0001
FZbm - Anoxic methanol utilizers [gCOD/g of total COD]	0.0001
FZaob - Ammonia oxidizers [gCOD/g of total COD]	0.0001

FZnob - Nitrite oxidizers [gCOD/g of total COD]	0.0001
FZamob - Anaerobic ammonia oxidizers [gCOD/g of total COD]	0.0001
FZbp - PAOs [gCOD/g of total COD]	0.0001
FZbpa - Propionic acetogens [gCOD/g of total COD]	0.0001
FZbam - Acetoclastic methanogens [gCOD/g of total COD]	0.0001
FZbhm - H2-utilizing methanogens [gCOD/g of total COD]	0.0001

Configuration information for all Model clarifier units

Physical data

Element name	Volume[Mil. Gal]	Area[ft2]	Depth[ft]	Number of layers	Top feed layer	Feed Layers
Secondary Clariifer 2	0.5025	5024.0000	13.370	10	6	1
Secondary Clarifier No 1	0.4937	5029.0000	13.123	10	6	1

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Secondary Clariifer 2	Ratio	0.40
Secondary Clarifier No 1	Ratio	0.40

Element name	Average Temperature	Reactive
Secondary Clariifer 2	Uses global setting	No
Secondary Clarifier No 1	Uses global setting	No

Configuration information for all Effluent units

Configuration information for all Media Bioreactor units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers
Anoxic Reactor	0.2000	2673.6113	10.000	Un-aerated

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint
Anoxic Reactor	0

Aeration equipment parameters

Element name	k1 in C = k1(PC)^0.25 + k2	k2 in C = k1(PC)^0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	% of tank area covered by diffusers [%]
Anoxic Reactor	2.5656	0.0432	0.8200	0.0410	10.0000

Configuration information for all Metal addition units

Operating data Average (flow/time weighted as required)

Element name	Alum (1)	Alum (2)
X_OHO mgCOD/L	0	0
X_MEOLO mgCOD/L	0	0
X_AOO mgCOD/L	0	0
X_NOO mgCOD/L	0	0
X_AMO mgCOD/L	0	0
X_PAO mgCOD/L	0	0
X_PRO mgCOD/L	0	0
X_ACO mgCOD/L	0	0
X_HMO mgCOD/L	0	0
X_U_E mgCOD/L	0	0
X_B mgCOD/L	0	0
C_B mgCOD/L	0	0
X_U_INF mgCOD/L	0	0
X_B_ORG_N mgN/L	0	0
X_B_ORG_P mgP/L	0	0
X_U_ORG_N mgN/L	0	0
X_U_ORG_P mgP/L	0	0
X_PAO_PHA mgCOD/L	0	0
X_PAO_PPL mgP/L	0	0
X_PAO_PPH mgP/L	0	0
X_PAO_PP_CAT mg/L	0	0
S_F mgCOD/L	0	0
S_AC mgCOD/L	0	0
S_PR mgCOD/L	0	0
S_MEOL mgCOD/L	0	0
S_H2 mgCOD/L	0	0
S_CH4 mg/L	0	0

S_NHx mgN/L	0	0
S_B_ORG_N mgN/L	0	0
S_NO2 mgN/L	0	0
S_NO3 mgN/L	0	0
S_N2 mgN/L	0	0
T_PO4 mgP/L	0	0
S_U mgCOD/L	0	0
S_U_ORG_N mgN/L	0	0
X_IG_INF mgISS/L	0	0
X_MAP mgISS/L	0	0
X_HDP mgISS/L	0	0
X_HAP mgISS/L	0	0
S_MG mg/L	0	0
S_CA mg/L	0	0
S_ME mg/L	0.00	57700.00
S_CAT meq/L	5.00	5.00
S_AN meq/L	15.81	6434.89
S_CO2 mmol/L	7.00	7.00
S_UD1 mg/L	0	0
S_UD2 mg/L	0	0
X_UD3 mgVSS/L	0	0
X_UD4_IG mgISS/L	0	0
S_O2 mg/L	0	0
Flow	0	7E-5

Configuration information for all Sidestream Mixer units

Configuration information for all Dewatering unit units

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Dewatering Unit	Ratio	0.20
Dewatering Unit	Fraction	0.05

Element name	Percent removal
Dewatering Unit	100.00
Dewatering Unit	90.00

Configuration information for all Sludge units

Configuration information for all Splitter units

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Two way splitter6	Flowrate [Side]	0.035
Splitter23	Flowrate [Side]	0.02
Splitter1	Ratio	4.00
Splitter24	Ratio	0.00
SPLTR73	Ratio	6.00

Configuration information for all Influent (SV) units

Operating data Average (flow/time weighted as required)

Element name	Mg(OH)2	Mg(OH)2 (1)	Mg(OH)2 (2)	Mg(OH)2
X_OHO mgCOD/L	0	0	0	0
X_MEOLO mgCOD/L	0	0	0	0
X_AOO mgCOD/L	0	0	0	0
X_NOO mgCOD/L	0	0	0	0
X_AMO mgCOD/L	0	0	0	0
X_PAO mgCOD/L	0	0	0	0
X_PRO mgCOD/L	0	0	0	0
X_ACO mgCOD/L	0	0	0	0
X_HMO mgCOD/L	0	0	0	0
X_U_E mgCOD/L	0	0	0	0
X_B mgCOD/L	0	0	0	0
C_B mgCOD/L	0	0	0	0
X_U_INF mgCOD/L	0	0	0	0
X_B_ORG_N mgN/L	0	0	0	0
X_B_ORG_P mgP/L	0	0	0	0
X_U_ORG_N mgN/L	0	0	0	0
X_U_ORG_P mgP/L	0	0	0	0
X_PAO_PHA mgCOD/L	0	0	0	0
X_PAO_PPL mgP/L	0	0	0	0
X_PAO_PPH mgP/L	0	0	0	0
X_PAO_PP_CAT mg/L	0	0	0	0
S_F mgCOD/L	0	0	0	0
S_AC mgCOD/L	0	0	0	0
S_PR mgCOD/L	0	0	0	0
S_MEOL mgCOD/L	0	0	0	0
S_H2 mgCOD/L	0	0	0	0

S_CH4 mg/L	0	0	0	0
S_NHx mgN/L	0	0	0	0
S_B_ORG_N mgN/L	0	0	0	0
S_NO2 mgN/L	0	0	0	0
S_NO3 mgN/L	0	0	0	0
S_N2 mgN/L	0	0	0	0
T_PO4 mgP/L	0	0	0	0
S_U mgCOD/L	0	0	0	0
S_U_ORG_N mgN/L	0	0	0	0
X_IG_INF mgISS/L	0	0	0	0
X_MAP mgISS/L	0	0	0	0
X_HDP mgISS/L	0	0	0	0
X_HAP mgISS/L	0	0	0	0
S_MG mg/L	0	0	0	0
S_CA mg/L	0	0	0	0
S_ME mg/L	0	0	0	0
S_CAT meq/L	14500.00	14500.00	14500.00	14500.00
S_AN meq/L	0	0	0	0
S_CO2 mmol/L	0	0	0	0
S_UD1 mg/L	0	0	0	0
S_UD2 mg/L	0	0	0	0
X_UD3 mgVSS/L	0	0	0	0
X_UD4_IG mgISS/L	0	0	0	0
S_O2 mg/L	0	0	0	0
Flow	0	0.00035	2E-5	1E-5

Configuration information for all Bioreactor (brush aerators) units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]
Oxidation Ditch	0.4000	5347.2225	10.000
Digester (brush aerators)	5.2834	47839.6020	14.764

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint
Oxidation Ditch	1.5
Digester (brush aerators)	2.0

Aeration equipment parameters

Element name	Surface aerator Std. oxygen transfer rate [lb O /(hp hr)]	Maximum power per rotor [hp]
Oxidation Ditch	2.4670	26.8097
Digester (brush aerators)	2.4670	26.8097

BioWin Album

Album page - Effluent

Secondary Effluent			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	1.72	12.36	

TSS	2.55	18.31	
XCOD	2.54	18.25	
SCOD	36.80	264.20	
TCOD	39.35	282.45	
SPO4	0.15	1.08	
TP	0.25	1.81	
STKN	5.03	36.13	
XTKN	0.15	1.07	
TKN	5.18	37.21	
SCBOD	1.30	9.33	
TCBOD	2.13	15.26	
NOx	32.98	236.73	
TN	38.16	273.93	
TIN	34.49	247.60	
Alk	0.53	1.72	mmol/L and kmol/d
pH	6.69		
VFA	0.00	0.01	
XPrec	0.25	1.81	
TISS	0.83	5.95	
S_NHx	1.51	10.87	
S_NO3	29.40	211.02	

Parameters	Value	Units

Album page - Sidestream Mixer 52

SSM 52			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes

VSS	1.72	12.36	
TSS	2.55	18.31	
XCOD	2.54	18.25	
SCOD	36.80	264.20	
TCOD	39.35	282.45	
SPO4	0.15	1.08	
TP	0.25	1.81	
STKN	5.03	36.13	
XTKN	0.15	1.07	
TKN	5.18	37.21	
SCBOD	1.30	9.33	
TCBOD	2.13	15.26	
NOx	32.98	236.73	
TN	38.16	273.93	
TIN	34.49	247.60	
Alk	0.53	1.72	mmol/L and kmol/d
pH	6.69		
VFA	0.00	0.01	
XPrec	0.25	1.81	
TISS	0.83	5.95	
S_NHx	1.51	10.87	
S_NO3	29.40	211.02	

Parameters	Value	Units

Album page - SideStream mixer 14

SSM14

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	5720.09	16425.05	
TSS	8472.08	24327.28	
XCOD	8446.25	24253.14	
SCOD	36.80	105.68	
TCOD	8483.06	24358.82	
SPO4	0.15	0.43	
TP	337.88	970.22	
STKN	5.03	14.45	
XTKN	496.55	1425.83	
TKN	501.59	1440.29	
SCBOD	1.30	3.73	
TCBOD	2745.33	7883.13	
NOx	32.98	94.69	
TN	534.56	1534.98	
TIN	34.49	99.04	
Alk	-999.00	-1301.17	mmol/L and kmol/d
pH	6.69		
VFA	0.00	0.00	
XPrec	838.50	2407.73	
TISS	2751.99	7902.23	
S_NHx	1.51	4.35	
S_NO3	29.40	84.41	

Parameters	Value	Units

Album page - Side Stream Mixer 9

SSM9			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	8890.02	1670.78	
TSS	12668.69	2380.93	
XCOD	13126.95	2467.06	
SCOD	36.77	6.91	
TCOD	13163.72	2473.97	
SPO4	193.17	36.30	
TP	525.05	98.68	
STKN	5.03	0.95	
XTKN	771.73	145.04	
TKN	776.76	145.98	
SCBOD	1.30	0.24	
TCBOD	4266.00	801.75	
NOx	32.95	6.19	
TN	809.70	152.17	
TIN	34.46	6.48	
Alk	-999.00	-85.16	mmol/L and kmol/d
pH	9.38		
VFA	0.00	0.00	
XPrec	804.78	151.25	
TISS	3778.67	710.16	
S_NHx	1.51	0.28	
S_NO3	29.37	5.52	

Parameters	Value	Units

Album page - Influent

Influent			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	328.00	2356.45	
TSS	386.06	2773.58	
XCOD	524.72	3769.75	
SCOD	174.69	1255.06	
TCOD	699.41	5024.81	
SPO4	6.11	43.90	
TP	9.70	69.69	
STKN	79.87	573.79	
XTKN	17.13	123.09	
TKN	97.00	696.88	
SCBOD	98.69	709.02	
TCBOD	328.00	2356.45	
NOx	0	0	
TN	97.00	696.88	
TIN	64.02	459.94	
Alk	1.17	3.81	mmol/L and kmol/d
pH	7.00		
VFA	16.79	120.60	
XPrec	0	0	
TISS	58.06	417.13	
S_NHx	64.02	459.94	
S_NO3	0	0	

Parameters	Value	Units

Album page - Page 10

Anoxic Reactor

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	1653.69	83088.76	
TSS	2417.05	121443.12	
XCOD	2447.15	122955.62	
SCOD	37.21	1869.74	
TCOD	2484.36	124825.36	
SPO4	5.12	257.33	
TP	96.73	4860.19	
STKN	15.16	761.67	
XTKN	142.14	7141.87	
TKN	157.30	7903.54	
SCBOD	1.59	79.65	
TCBOD	804.60	40426.41	
NOx	23.05	1157.91	
TN	180.35	9061.45	
TIN	34.66	1741.28	
Alk	-999.00	-22767.69	mmol/L and kmol/d
pH	7.13		
VFA	0.08	4.10	
XPrec	217.67	10936.54	
TISS	763.36	38354.37	
S_NHx	11.61	583.37	
S_NO3	20.53	1031.57	

Parameters	Value	Units
HRT	0.8	hours

Flow	6.02	mgd
MLSS	2417.05	mg/L
Mass TSS	4034.25	lb
TRBCOD	2.09	mg/L
OUR	1.61	mgO/L/hr
COUR	1.21	mgO/L/hr
NOUR	0.41	mgO/L/hr
Net. NH3-RR	-1.46	mgN/L/hr
NO3-PR	0.04	mgN/L/hr
NO2-PR	6.12	mgN/L/hr
NO3-RR	6.01	mgN/L/hr
NO2-RR	6.80	mgN/L/hr
Net. NO3-PR	-5.97	mgN/L/hr
Net. NO2-PR	-0.68	
N2-PR	6.77	
OTE	100.00	%
OTR	0	lb/hr
SOTE	100.00	%
SOTR	0	lb/hr
Q Air	0	ft3/min (20C, 1 atm)
Q Air/diff	0	ft3/min (20C, 1 atm)
# of diff	0	
Qoffgas (dry)	0.65	ft3/min
% O2	0	%
% CO2	37.73	%
% NH3	0.09	%
C*inf	8.36	mg/L
VSS/Area	0	g/m2
TSS/Area	0	g/m2
Net. NH3-RR / m2	-0.05	gN/m2/hr
Net. NO3-PR / m2	-0.19	gN/m2/hr

Net. NO2-PR / m2	-0.02	gN/m2/hr
N2-PR / m2	0.22	gN/m2/hr
Thick.	0	mm
Vel. Grad.	75.08	1/s

Album page - Page 11

Oxidation Ditch			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	1635.65	82187.04	
TSS	2400.46	120616.70	
XCOD	2415.19	121356.93	
SCOD	36.81	1849.41	
TCOD	2452.00	123206.34	
SPO4	4.96	249.33	
TP	96.73	4860.19	
STKN	5.03	252.94	
XTKN	141.99	7134.53	
TKN	147.02	7387.46	
SCBOD	1.30	65.28	
TCBOD	785.95	39491.94	
NOx	32.98	1657.09	
TN	180.00	9044.56	
TIN	34.49	1733.18	
Alk	-999.00	-22769.01	mmol/L and kmol/d
pH	6.81		
VFA	0.00	0.05	
XPrec	217.65	10936.45	
TISS	764.81	38429.67	

S_NHx	1.51	76.08
S_NO3	29.40	1477.16

Parameters	Value	Units
HRT	1.59	hours
Flow	6.02	mgd
MLSS	2400.46	mg/L
DO	1.50	mg/L
TRBCOD	1.84	mg/L
OUR	48.28	mgO/L/hr
COUR	21.12	mgO/L/hr
NOUR	27.16	mgO/L/hr
NO3-RR	0.19	mgN/L/hr
Net. NH3-RR	6.33	mgN/L/hr
N2-PR	0.21	mgN/L/hr
SN2-PR-VSS	0.13	mgN/gVSS/hr
SN2-PR-VASS	0.23	mgN/gVASS/hr
Net. NO3-PR	5.56	mgN/L/hr
OTR	164.30	lb/hr
SOTR	419.51	lb/hr
Tot. Power	170.05	hp
Power/aerator	24.29	hp
# of aerators	7.00	
C*inf	8.55	mg/L

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Anoxic Digester

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	4991.69	6566.91	
TSS	8963.02	11791.48	
XCOD	7521.59	9895.18	
SCOD	70.97	93.36	
TCOD	7592.56	9988.54	
SPO4	118.25	155.56	
TP	525.05	690.74	
STKN	21.22	27.92	
XTKN	392.36	516.18	
TKN	413.59	544.10	
SCBOD	24.98	32.87	
TCBOD	500.75	658.77	
NOx	0.01	0.01	
TN	413.59	544.11	
TIN	18.71	24.61	
Alk	-999.00	-596.14	mmol/L and kmol/d
pH	8.77		
VFA	33.72	44.37	
XPrec	1303.19	1714.44	
TISS	3971.33	5224.57	
S_NHx	18.70	24.61	
S_NO3	0.01	0.01	

Parameters	Value	Units
HRT	45.7	hours
Flow	0.16	mgd
MLSS	8963.02	mg/L
Mass TSS	22440.01	lb
TRBCOD	35.37	mg/L

OUR	0.04	mgO/L/hr
COUR	0.04	mgO/L/hr
NOUR	0.00	mgO/L/hr
Net. NH3-RR	-0.40	mgN/L/hr
NO3-PR	0.00	mgN/L/hr
NO2-PR	1.16	mgN/L/hr
NO3-RR	1.16	mgN/L/hr
NO2-RR	1.17	mgN/L/hr
Net. NO3-PR	-1.16	mgN/L/hr
Net. NO2-PR	-0.01	mgN/L/hr
N2-PR	1.17	mgN/L/hr
SN2-PR-VSS	0.23	mgN/gVSS/hr
SN2-PR-VASS	2.01	mgN/gVASS/hr
OTE	100.00	%
OTR	0	lb/hr
SOTE	100.00	%
SOTR	0	lb/hr
Q Air	0	ft3/min (20C, 1 atm)
Q Air/diff	0	ft3/min (20C, 1 atm)
# of diff	0	
Qoffgas (dry)	1.15	ft3/min
% O2	0	%
% CO2	1.98	%
% NH3	2.78	%
C*inf	8.74	mg/L
Vel. Grad.	72.64	1/s

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Secondary Clarifier No 1			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	1.72	12.36	
TSS	2.55	18.31	
XCOD	2.54	18.25	
SCOD	36.80	264.20	
TCOD	39.35	282.45	
SPO4	0.15	1.08	
TP	0.25	1.81	
STKN	5.03	36.13	
XTKN	0.15	1.07	
TKN	5.18	37.21	
SCBOD	1.30	9.33	
TCBOD	2.13	15.26	
NOx	32.98	236.73	
TN	38.16	273.93	
TIN	34.49	247.60	
Alk	0.51	1.65	mmol/L and kmol/d
pH	6.69		
VFA	0.00	0.01	
XPrec	0.25	1.81	
TISS	0.83	5.95	
S_NHx	1.51	10.87	
S_NO3	29.40	211.02	

Parameters	Value	Units
HRT	9.84	hours
Qeff	0.86	mgd
Qras	0.34	mgd
Conc. H	1.51	ft

XRAS	8472.07	mg/L
Xeff	2.55	mg/L
SLR	4.84	lb/(ft2 d)
SOR	171.05	gal/(ft2 d)
Mass TSS	3869.12	lb

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Secondary Clariifer 2			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	0.00	0.00	
TSS	0.00	0.00	
XCOD	0.00	0.00	
SCOD	36.80	0.00	
TCOD	36.80	0.00	
SPO4	0.11	0.00	
TP	0.11	0.00	
STKN	5.03	0.00	
XTKN	0.00	0.00	
TKN	5.03	0.00	
SCBOD	1.30	0.00	
TCBOD	1.30	0.00	
NOx	32.98	0.00	
TN	38.01	0.00	
TIN	34.49	0.00	
Alk	0.53	0.00	mmol/L and kmol/d
pH	6.70		
VFA	0.00	0.00	
XPrec	0.00	0	

TISS	0.00	0.00
S_NHx	1.51	0.00
S_NO3	29.40	0.00

Parameters	Value	Units
HRT	1.0013816E08	hours
Qeff	0.00	mgd
Qras	0.00	mgd
Conc. H	1.66	ft
XRAS	14635.09	mg/L
Xeff	0.00	mg/L
SLR	0.00	lb/(ft2 d)
SOR	0.00	gal/(ft2 d)
Mass TSS	6185.52	lb

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Anoxic Digester			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	4991.69	6566.91	
TSS	8963.02	11791.48	
XCOD	7521.59	9895.18	
SCOD	70.97	93.36	
TCOD	7592.56	9988.54	
SPO4	118.25	155.56	
TP	525.05	690.74	
STKN	21.22	27.92	
XTKN	392.36	516.18	

TKN	413.59	544.10	
SCBOD	24.98	32.87	
TCBOD	500.75	658.77	
NOx	0.01	0.01	
TN	413.59	544.11	
TIN	18.71	24.61	
Alk	-999.00	-596.14	mmol/L and kmol/d
pH	8.77		
VFA	33.72	44.37	
XPrec	1303.19	1714.44	
TISS	3971.33	5224.57	
S_NHx	18.70	24.61	
S_NO3	0.01	0.01	

Parameters	Value	Units
HRT	45.7	hours
Flow	0.16	mgd
MLSS	8963.02	mg/L
Mass TSS	22440.01	lb
TRBCOD	35.37	mg/L
OUR	0.04	mgO/L/hr
COUR	0.04	mgO/L/hr
NOUR	0.00	mgO/L/hr
Net. NH3-RR	-0.40	mgN/L/hr
NO3-PR	0.00	mgN/L/hr
NO2-PR	1.16	mgN/L/hr
NO3-RR	1.16	mgN/L/hr
NO2-RR	1.17	mgN/L/hr
Net. NO3-PR	-1.16	mgN/L/hr
Net. NO2-PR	-0.01	mgN/L/hr

N2-PR	1.17	mgN/L/hr
SN2-PR-VSS	0.23	mgN/gVSS/hr
SN2-PR-VASS	2.01	mgN/gVASS/hr
OTE	100.00	%
OTR	0	lb/hr
SOTE	100.00	%
SOTR	0	lb/hr
Q Air	0	ft3/min (20C, 1 atm)
Q Air/diff	0	ft3/min (20C, 1 atm)
# of diff	0	
Qoffgas (dry)	1.15	ft3/min
% O2	0	%
% CO2	1.98	%
% NH3	2.78	%
C*inf	8.74	mg/L
Vel. Grad.	72.64	1/s

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No element
toomanycolumns

Parameters	Value	Units

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Sludge41			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
VSS	82475.03	775.01	
TSS	153337.55	1440.90	
XCOD	124875.76	1173.45	
SCOD	36.03	0.34	
TCOD	124911.79	1173.79	
SPO4	131.05	1.23	
TP	7223.02	67.87	
STKN	3.03	0.03	
XTKN	6328.12	59.46	
TKN	6331.15	59.49	
SCBOD	0.53	0.00	
TCBOD	1094.45	10.28	
NOx	56.94	0.54	
TN	6388.09	60.03	
TIN	56.98	0.54	
Alk	-999.00	-4.26	mmol/L and kmol/d
pH	7.73		
VFA	0.01	0.00	
XPrec	23457.41	220.43	
TISS	70862.53	665.89	
S_NHx	0.04	0.00	
S_NO3	56.93	0.54	
Parameters	Value	Units	

Global Parameters

AOB

Name	Default	Value	
Max. spec. growth rate [1/d]	0.90000	0.90000	1.0720
Substrate (NH4) half sat. [mgN/L]	0.70000	0.70000	1.0000
Aerobic decay rate [1/d]	0.17000	0.17000	1.0290
Anoxic/anaerobic decay rate [1/d]	0.08000	0.08000	1.0290
KiHNO2 [mmol/L]	0.00500	0.00500	1.0000

NOB

Name	Default	Value	
Max. spec. growth rate [1/d]	0.70000	0.70000	1.0600
Substrate (NO2) half sat. [mgN/L]	0.10000	0.10000	1.0000
Aerobic decay rate [1/d]	0.17000	0.17000	1.0290
Anoxic/anaerobic decay rate [1/d]	0.08000	0.08000	1.0290
KiNH3 [mmol/L]	0.07500	0.07500	1.0000

ANAMMOX

Name	Default	Value	
Max. spec. growth rate [1/d]	0.10000	0.10000	1.1000
Substrate (NH4) half sat. [mgN/L]	2.00000	2.00000	1.0000
Substrate (NO2) half sat. [mgN/L]	1.00000	1.00000	1.0000
Aerobic decay rate [1/d]	0.01900	0.01900	1.0290

Anoxic/anaerobic decay rate [1/d]	0.00950	0.00950	1.0290
Ki Nitrite [mgN/L]	1000.00000	1000.00000	1.0000
Nitrite sensitivity constant [L / (d mgN)]	0.01600	0.01600	1.0000

OHOs

Name	Default	Value	
Max. spec. growth rate [1/d]	3.20000	3.20000	1.0290
Substrate half sat. [mgCOD/L]	5.00000	5.00000	1.0000
Anoxic growth factor [-]	0.50000	0.50000	1.0000
Aerobic decay [1/d]	0.62000	0.62000	1.0290
Anoxic/anaerobic decay [1/d]	0.30000	0.30000	1.0290
Hydrolysis rate (AS) [1/d]	2.10000	2.10000	1.0290
Hydrolysis half sat. (AS) [-]	0.06000	0.06000	1.0000
Anoxic hydrolysis factor [-]	0.28000	0.28000	1.0000
Anaerobic hydrolysis factor [-]	0.50000	0.50000	1.0000
Adsorption rate of colloids [L/(mgCOD d)]	0.80000	0.80000	1.0290
Ammonification rate [L/(mgN d)]	0.04000	0.04000	1.0290
Assimilative nitrate/nitrite reduction rate [1/d]	0.50000	0.50000	1.0000
Fermentation rate [1/d]	3.20000	3.20000	1.0290
Fermentation half sat. [mgCOD/L]	5.00000	5.00000	1.0000
Anaerobic growth factor (AS) [-]	0.12500	0.12500	1.0000
Hydrolysis rate (AD) [1/d]	0.10000	0.10000	1.0500
Hydrolysis half sat. (AD) [mgCOD/L]	0.15000	0.15000	1.0000

Methylotrophs

Name	Default	Value	
Max. spec. growth rate of methanol utilizers [1/d]	1.30000	1.30000	1.0720
Methanol half sat. [mgCOD/L]	0.50000	0.50000	1.0000
Aerobic decay rate of methanol utilizers [1/d]	0.04000	0.04000	1.0290
Anoxic/anaerobic decay rate of methanol utilizers [1/d]	0.03000	0.03000	1.0290

PAOs

Name	Default	Value	
Max. spec. growth rate [1/d]	0.95000	0.95000	1.0000
Max. spec. growth rate, P-limited [1/d]	0.42000	0.42000	1.0000
Substrate half sat. [mgCOD(PHB)/mgCOD(Zbp)]	0.10000	0.10000	1.0000
Substrate half sat., P-limited [mgCOD(PHB)/mgCOD(Zbp)]	0.05000	0.05000	1.0000
Magnesium half sat. [mgMg/L]	0.10000	0.10000	1.0000
Cation half sat. [mmol/L]	0.10000	0.10000	1.0000
Calcium half sat. [mgCa/L]	0.10000	0.10000	1.0000
Aerobic decay rate [1/d]	0.10000	0.10000	1.0000
Anaerobic decay rate [1/d]	0.04000	0.04000	1.0000
Sequestration rate [1/d]	6.00000	6.00000	1.0000
Anoxic growth factor NO3 [-]	0.33000	0.33000	1.0000
Anoxic growth factor NO2 [-]	0.33000	0.33000	1.0000

Acetogens

Name	Default	Value	
Max. spec. growth rate [1/d]	0.25000	0.25000	1.0290
Substrate half sat. [mgCOD/L]	10.00000	10.00000	1.0000

Acetate inhibition [mgCOD/L]	10000.00000	10000.00000	1.0000
Decay rate [1/d]	0.05000	0.05000	1.0290
Aerobic decay rate [1/d]	0.52000	0.52000	1.0290

Methanogens

Name	Default	Value	
Acetoclastic Mu Max [1/d]	0.30000	0.30000	1.0290
H2-utilizing Mu Max [1/d]	1.40000	1.40000	1.0290
Acetoclastic Ks [mgCOD/L]	100.00000	100.00000	1.0000
Acetoclastic methanol Ks [mgCOD/L]	0.50000	0.50000	1.0000
H2-utilizing CO2 half sat. [mmol/L]	0.10000	0.10000	1.0000
H2-utilizing Ks [mgCOD/L]	0.10000	0.10000	1.0000
H2-utilizing methanol Ks [mgCOD/L]	0.50000	0.50000	1.0000
Acetoclastic propionic inhibition [mgCOD/L]	10000.00000	10000.00000	1.0000
Acetoclastic decay rate [1/d]	0.13000	0.13000	1.0290
Acetoclastic aerobic decay rate [1/d]	0.60000	0.60000	1.0290
H2-utilizing decay rate [1/d]	0.13000	0.13000	1.0290
H2-utilizing aerobic decay rate [1/d]	0.60000	0.60000	1.0290

pH

Name	Default	Value
Heterotrophs low pH limit [-]	4.00000	4.00000
Heterotrophs high pH limit [-]	10.00000	10.00000
Methanol utilizers low pH limit [-]	4.00000	4.00000
Methanol utilizers high pH limit [-]	10.00000	10.00000

Autotrophs low pH limit [-]	5.50000	5.50000
Autotrophs high pH limit [-]	9.50000	9.50000
PolyP heterotrophs low pH limit [-]	4.00000	4.00000
Poly P heterotrophs high pH limit [-]	10.00000	10.00000
Heterotrophs low pH limit (anaerobic) [-]	5.50000	5.50000
Heterotrophs high pH limit (anaerobic) [-]	8.50000	8.50000
Propionic acetogens low pH limit [-]	4.00000	4.00000
Propionic acetogens high pH limit [-]	10.00000	10.00000
Acetoclastic methanogens low pH limit [-]	5.00000	5.00000
Acetoclastic methanogens high pH limit [-]	9.00000	9.00000
H2-utilizing methanogens low pH limit [-]	5.00000	5.00000
H2-utilizing methanogens high pH limit [-]	9.00000	9.00000

Switches

Name	Default	Value
Heterotrophic DO half sat. [mgO2/L]	0.05000	0.05000
Aerobic denit. DO half sat. [mgO2/L]	0.05000	0.05000
Ammonia oxidizer DO half sat. [mgO2/L]	0.25000	0.25000
Nitrite oxidizer DO half sat. [mgO2/L]	0.50000	0.50000
Anaerobic ammonia oxidizer DO half sat. [mgO2/L]	0.01000	0.01000
Anoxic NO3 half sat. [mgN/L]	0.10000	0.10000
Anoxic NO2 half sat. (mgN/L)	0.01000	0.01000
NH3 nutrient half sat. [mgN/L]	1.0000E-4	1.0000E-4
PolyP half sat. [mgP/L]	0.01000	0.01000
VFA sequestration half sat. [mgCOD/L]	5.00000	5.00000
P uptake half sat. [mgP/L]	0.15000	0.15000
P nutrient half sat. [mgP/L]	0.00100	0.00100
Autotroph CO2 half sat. [mmol/L]	0.10000	0.10000

Heterotrophic Hydrogen half sat. [mgCOD/L]	1.00000	1.00000
Propionic acetogens Hydrogen half sat. [mgCOD/L]	5.00000	5.00000
Synthesis anion/cation half sat. [meq/L]	0.01000	0.01000

Common

Name	Default	Value
N in endogenous residue [mgN/mgCOD]	0.07000	0.07000
P in endogenous residue [mgP/mgCOD]	0.02200	0.02200
Endogenous residue COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
Particulate substrate COD:VSS ratio [mgCOD/mgVSS]	1.60000	1.60000
Particulate inert COD:VSS ratio [mgCOD/mgVSS]	1.60000	1.60000

AOB

Name	Default	Value
Yield [mgCOD/mgN]	0.15000	0.15000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

NOB

Name	Default	Value

Yield [mgCOD/mgN]	0.09000	0.09000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

ANAMMOX

Name	Default	Value
Yield [mgCOD/mgN]	0.11400	0.11400
Nitrate production [mgN/mgBiomassCOD]	2.28000	2.28000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

OHOs

Name	Default	Value
Yield (aerobic) [-]	0.66600	0.66600
Yield (fermentation, low H2) [-]	0.10000	0.10000
Yield (fermentation, high H2) [-]	0.10000	0.10000
H2 yield (fermentation low H2) [-]	0.35000	0.35000
H2 yield (fermentation high H2) [-]	0	0
Propionate yield (fermentation, low H2) [-]	0	0
Propionate yield (fermentation, high H2) [-]	0.70000	0.70000
CO2 yield (fermentation, low H2) [-]	0.70000	0.70000

CO2 yield (fermentation, high H2) [-]	0	0
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
Yield (anoxic) [-]	0.54000	0.54000
Yield propionic (aerobic) [-]	0.64000	0.64000
Yield propionic (anoxic) [-]	0.46000	0.46000
Yield acetic (aerobic) [-]	0.60000	0.60000
Yield acetic (anoxic) [-]	0.43000	0.43000
Yield methanol (aerobic) [-]	0.50000	0.50000
Adsorp. max. [-]	1.00000	1.00000

Methylotrophs

Name	Default	Value
Yield (anoxic) [-]	0.40000	0.40000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

PAOs

Name	Default	Value
Yield (aerobic) [-]	0.63900	0.63900
Yield (anoxic) [-]	0.52000	0.52000

Aerobic P/PHA uptake [mgP/mgCOD]	0.95000	0.95000
Anoxic P/PHA uptake [mgP/mgCOD]	0.35000	0.35000
Yield of PHA on sequestration [-]	0.88900	0.88900
N in biomass [mgN/mgCOD]	0.07000	0.07000
N in sol. inert [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous part. [-]	0.25000	0.25000
Inert fraction of endogenous sol. [-]	0.20000	0.20000
P/Ac release ratio [mgP/mgCOD]	0.49000	0.49000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
Yield of low PP [-]	0.94000	0.94000

Acetogens

Name	Default	Value
Yield [-]	0.10000	0.10000
H2 yield [-]	0.40000	0.40000
CO2 yield [-]	1.00000	1.00000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

Methanogens

Name	Default	Value
Acetoclastic yield [-]	0.10000	0.10000

Methanol acetoclastic yield [-]	0.10000	0.10000
H2-utilizing yield [-]	0.10000	0.10000
Methanol H2-utilizing yield [-]	0.10000	0.10000
N in acetoclastic biomass [mgN/mgCOD]	0.07000	0.07000
N in H2-utilizing biomass [mgN/mgCOD]	0.07000	0.07000
P in acetoclastic biomass [mgP/mgCOD]	0.02200	0.02200
P in H2-utilizing biomass [mgP/mgCOD]	0.02200	0.02200
Acetoclastic fraction to endog. residue [-]	0.08000	0.08000
H2-utilizing fraction to endog. residue [-]	0.08000	0.08000
Acetoclastic COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
H2-utilizing COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

General

Name	Default	Value
Ash content of biomass (synthesis ISS) [%]	8.00000	8.00000
Molecular weight of other anions [mg/mmol]	35.50000	35.50000
Molecular weight of other cations [mg/mmol]	39.10000	39.10000
Mg to P mole ratio in polyphosphate [mmolMg/mmolP]	0.30000	0.30000
Cation to P mole ratio in polyphosphate [meq/mmolP]	0.30000	0.30000
Ca to P mole ratio in polyphosphate [mmolCa/mmolP]	0.05000	0.05000
Cation to P mole ratio in organic phosphate [meq/mmolP]	0.01000	0.01000
Bubble rise velocity (anaerobic digester) [cm/s]	23.90000	23.90000
Bubble Sauter mean diameter (anaerobic digester) [cm]	0.35000	0.35000
Anaerobic digester gas hold-up factor []	1.00000	1.00000
Tank head loss per metre of length (from flow) [m/m]	0.00250	0.00250

Mass transfer

Name	Default	Value	
Kl for H2 [m/d]	17.00000	17.00000	1.0240
Kl for CO2 [m/d]	10.00000	10.00000	1.0240
Kl for NH3 [m/d]	1.00000	1.00000	1.0240
Kl for CH4 [m/d]	8.00000	8.00000	1.0240
Kl for N2 [m/d]	15.00000	15.00000	1.0240
Kl for O2 [m/d]	13.00000	13.00000	1.0240

Physico-chemical rates

Name	Default	Value	
Struvite precipitation rate [1/d]	3.0000E+10	3.0000E+10	1.0240
Struvite redissolution rate [1/d]	3.0000E+11	3.0000E+11	1.0240
Struvite half sat. [mgTSS/L]	1.00000	1.00000	1.0000
HDP precipitation rate [L/(molP d)]	1.0000E+8	1.0000E+8	1.0000
HDP redissolution rate [L/(mol P d)]	1.0000E+8	1.0000E+8	1.0000
HAP precipitation rate [molHDP/(L d)]	5.0000E-4	5.0000E-4	1.0000

Physico-chemical constants

Name	Default	Value
Struvite solubility constant [mol/L]	6.9180E-14	6.9180E-14
HDP solubility product [mol/L]	2.7500E-22	2.7500E-22
HDP half sat. [mgTSS/L]	1.00000	1.00000
Equilibrium soluble PO4 with Al dosing at pH 7 [mgP/L]	0.01000	0.01000
Al to P ratio [molAl/molP]	0.80000	0.80000

Al(OH)3 solubility product [mol/L]	1.2590E+9	1.2590E+9
AlHPO4+ dissociation constant [mol/L]	7.9430E-13	7.9430E-13
Equilibrium soluble PO4 with Fe dosing at pH 7 [mgP/L]	0.01000	0.01000
Fe to P ratio [molFe/molP]	1.60000	1.60000
Fe(OH)3 solubility product [mol/L]	0.05000	0.05000
FeH2PO4++ dissociation constant [mol/L]	5.0120E-22	5.0120E-22

Aeration

Name	Default	Value
Alpha (surf) OR Alpha F (diff) [-]	0.50000	0.50000
Beta [-]	0.95000	0.95000
Surface pressure [kPa]	101.32500	101.32500
Fractional effective saturation depth (Fed) [-]	0.32500	0.32500
Supply gas CO2 content [vol. %]	0.03500	0.03500
Supply gas O2 [vol. %]	20.95000	20.95000
Off-gas CO2 [vol. %]	2.00000	2.00000
Off-gas O2 [vol. %]	18.80000	18.80000
Off-gas H2 [vol. %]	0	0
Off-gas NH3 [vol. %]	0	0
Off-gas CH4 [vol. %]	0	0
Surface turbulence factor [-]	2.00000	2.00000
Set point controller gain []	1.00000	1.00000

Modified Vesilind

Name	Default	Value

Maximum Vesilind settling velocity (Vo) [ft/min]	0.3873	0.3873
Vesilind hindered zone settling parameter (K) [L/g]	0.3700	0.3700
Clarification switching function [mg/L]	100.0000	100.0000
Specified TSS conc.for height calc. [mg/L]	2500.0000	2500.0000
Maximum compactability constant [mg/L]	15000.0000	15000.0000

Double exponential

Name	Default	Value
Maximum Vesilind settling velocity (Vo) [ft/min]	0.9341	0.9341
Maximum (practical) settling velocity (Vo') [ft/min]	0.6152	0.6152
Hindered zone settling parameter (Kh) [L/g]	0.4000	0.4000
Flocculent zone settling parameter (Kf) [L/g]	2.5000	2.5000
Maximum non-settleable TSS [mg/L]	20.0000	20.0000
Non-settleable fraction [-]	0.0010	0.0010
Specified TSS conc. for height calc. [mg/L]	2500.0000	2500.0000

Biofilm general

Name	Default	Value	
Attachment rate [g / (m2 d)]	80.00000	80.00000	1.0000
Attachment TSS half sat. [mg/L]	100.00000	100.00000	1.0000
Detachment rate [g/(m3 d)]	8.0000E+4	8.0000E+4	1.0000
Solids movement factor []	10.00000	10.00000	1.0000
Diffusion neta []	0.80000	0.80000	1.0000
Thin film limit [mm]	0.50000	0.50000	1.0000
Thick film limit [mm]	3.00000	3.00000	1.0000

Assumed Film thickness for tank volume correction (temp independant) [mm]	0.75000	0.75000	1.0000
Film surface area to media area ratio - Max.[ ]	1.00000	1.00000	1.0000
Minimum biofilm conc. for streamer formation [gTSS/m2]	4.00000	4.00000	1.0000

Maximum biofilm concentrations [mg/L]

Name	Default	Value	
Zbh	5.0000E+4	5.0000E+4	1.0000
Zbmeth	5.0000E+4	5.0000E+4	1.0000
Zaob	1.0000E+5	1.0000E+5	1.0000
Znob	1.0000E+5	1.0000E+5	1.0000
Zamox	5.0000E+4	5.0000E+4	1.0000
Zbp	5.0000E+4	5.0000E+4	1.0000
Zbpa	5.0000E+4	5.0000E+4	1.0000
Zbam	5.0000E+4	5.0000E+4	1.0000
Zbhm	5.0000E+4	5.0000E+4	1.0000
Ze	3.0000E+4	3.0000E+4	1.0000
Xsp	5000.00000	5000.00000	1.0000
Xsc	0	0	1.0000
Xi	5000.00000	5000.00000	1.0000
Xon	0	0	1.0000
Xop	0	0	1.0000
Xin	0	0	1.0000
Xip	0	0	1.0000
Spha	5000.00000	5000.00000	1.0000
PP-lo	1.1500E+6	1.1500E+6	1.0000
PP-hi	1.1500E+6	1.1500E+6	1.0000
XPPCat	1.1500E+6	1.1500E+6	1.0000
Sbsc	0	0	1.0000

Sbsa	0	0	1.0000
Sbsp	0	0	1.0000
Sbmeth	0	0	1.0000
SbH2	0	0	1.0000
CH4	0	0	1.0000
NH3-N	0	0	1.0000
Nos	0	0	1.0000
NO2-N	0	0	1.0000
NO3-N	0	0	1.0000
N2	0	0	1.0000
PO4-P (incl. MeP)	1.0000E+10	1.0000E+10	1.0000
Sus	0	0	1.0000
Nus	0	0	1.0000
ISS	1.3000E+6	1.3000E+6	1.0000
XStru	8.5000E+5	8.5000E+5	1.0000
XHDP	1.1500E+6	1.1500E+6	1.0000
XHAP	1.6000E+6	1.6000E+6	1.0000
SMg	0	0	1.0000
SCa	0	0	1.0000
Me	1.0000E+10	1.0000E+10	1.0000
SCat	0	0	1.0000
SAn	0	0	1.0000
SCO2	0	0	1.0000
UD1	0	0	1.0000
UD2	0	0	1.0000
UD3	5.0000E+4	5.0000E+4	1.0000
UD4	5.0000E+4	5.0000E+4	1.0000
DO	0	0	1.0000

Effective diffusivities [m2/s]

Name	Default	Value	
Zbh	5.0000E-14	5.0000E-14	1.0290
Zbmeth	5.0000E-14	5.0000E-14	1.0290
Zaob	5.0000E-14	5.0000E-14	1.0290
Znob	5.0000E-14	5.0000E-14	1.0290
Zamox	5.0000E-14	5.0000E-14	1.0290
Zbp	5.0000E-14	5.0000E-14	1.0290
Zbpa	5.0000E-14	5.0000E-14	1.0290
Zbam	5.0000E-14	5.0000E-14	1.0290
Zbhm	5.0000E-14	5.0000E-14	1.0290
Ze	5.0000E-14	5.0000E-14	1.0290
Xsp	5.0000E-14	5.0000E-14	1.0290
Xsc	6.9000E-11	6.9000E-11	1.0290
Xi	5.0000E-14	5.0000E-14	1.0290
Xon	5.0000E-14	5.0000E-14	1.0290
Xop	5.0000E-14	5.0000E-14	1.0290
Xin	5.0000E-14	5.0000E-14	1.0290
Xip	5.0000E-14	5.0000E-14	1.0290
Spha	5.0000E-14	5.0000E-14	1.0290
PP-lo	5.0000E-14	5.0000E-14	1.0290
PP-hi	5.0000E-14	5.0000E-14	1.0290
XPPCat	5.0000E-14	5.0000E-14	1.0290
Sbsc	6.9000E-10	6.9000E-10	1.0290
Sbsa	1.2400E-9	1.2400E-9	1.0290
Sbsp	8.3000E-10	8.3000E-10	1.0290
Sbmeth	1.6000E-9	1.6000E-9	1.0290
SbH2	5.8500E-9	5.8500E-9	1.0290
CH4	1.9625E-9	1.9625E-9	1.0290
NH3-N	2.0000E-9	2.0000E-9	1.0290
Nos	1.3700E-9	1.3700E-9	1.0290

NO2-N	2.9800E-9	2.9800E-9	1.0290
NO3-N	2.9800E-9	2.9800E-9	1.0290
N2	1.9000E-9	1.9000E-9	1.0290
PO4-P (incl. MeP)	2.0000E-9	2.0000E-9	1.0290
Sus	6.9000E-10	6.9000E-10	1.0290
Nus	6.8500E-10	6.8500E-10	1.0290
ISS	5.0000E-14	5.0000E-14	1.0290
XStru	5.0000E-14	5.0000E-14	1.0290
XHDP	5.0000E-14	5.0000E-14	1.0290
XHAP	5.0000E-14	5.0000E-14	1.0290
SMg	7.2000E-10	7.2000E-10	1.0290
SCa	7.2000E-10	7.2000E-10	1.0290
Me	4.8000E-10	4.8000E-10	1.0290
SCat	1.4400E-9	1.4400E-9	1.0290
SAn	1.4400E-9	1.4400E-9	1.0290
SCO2	1.9600E-9	1.9600E-9	1.0290
UD1	6.9000E-10	6.9000E-10	1.0290
UD2	6.9000E-10	6.9000E-10	1.0290
UD3	5.0000E-14	5.0000E-14	1.0290
UD4	5.0000E-14	5.0000E-14	1.0290
DO	2.5000E-9	2.5000E-9	1.0290

EPS Strength coefficients [ ]

Name	Default	Value	
Zbh	1.00000	1.00000	1.0000
Zbmeth	1.00000	1.00000	1.0000
Zaob	1.00000	1.00000	1.0000
Znob	1.00000	1.00000	1.0000

Zamox	1.00000	1.00000	1.0000
Zbp	1.00000	1.00000	1.0000
Zbpa	1.00000	1.00000	1.0000
Zbam	1.00000	1.00000	1.0000
Zbhm	1.00000	1.00000	1.0000
Ze	1.00000	1.00000	1.0000
Xsp	1.00000	1.00000	1.0000
Xsc	0	0	1.0000
Xi	1.00000	1.00000	1.0000
Xon	1.00000	1.00000	1.0000
Xop	1.00000	1.00000	1.0000
Xin	1.00000	1.00000	1.0000
Xip	1.00000	1.00000	1.0000
Spha	1.00000	1.00000	1.0000
PP-lo	1.00000	1.00000	1.0000
PP-hi	1.00000	1.00000	1.0000
XPPCat	1.00000	1.00000	1.0000
Sbsc	0	0	1.0000
Sbsa	0	0	1.0000
Sbsp	0	0	1.0000
Sbmeth	0	0	1.0000
SbH2	0	0	1.0000
CH4	0	0	1.0000
NH3-N	0	0	1.0000
Nos	0	0	1.0000
NO2-N	0	0	1.0000
NO3-N	0	0	1.0000
N2	0	0	1.0000
PO4-P (incl. MeP)	1.00000	1.00000	1.0000
Sus	0	0	1.0000
Nus	0	0	1.0000

ISS	0.33000	0.33000	1.0000
XStru	1.00000	1.00000	1.0000
XHDP	1.00000	1.00000	1.0000
XHAP	1.00000	1.00000	1.0000
SMg	0	0	1.0000
SCa	0	0	1.0000
Me	1.00000	1.00000	1.0000
SCat	0	0	1.0000
SAn	0	0	1.0000
SCO2	0	0	1.0000
UD1	0	0	1.0000
UD2	0	0	1.0000
UD3	1.00000	1.00000	1.0000
UD4	1.00000	1.00000	1.0000
DO	0	0	1.0000

BioWin user and configuration data

Project details

Project name: Aerobic Digester Model Development **Project ref.: 60037-15001**

Plant name: North Bend **User name: Markus**

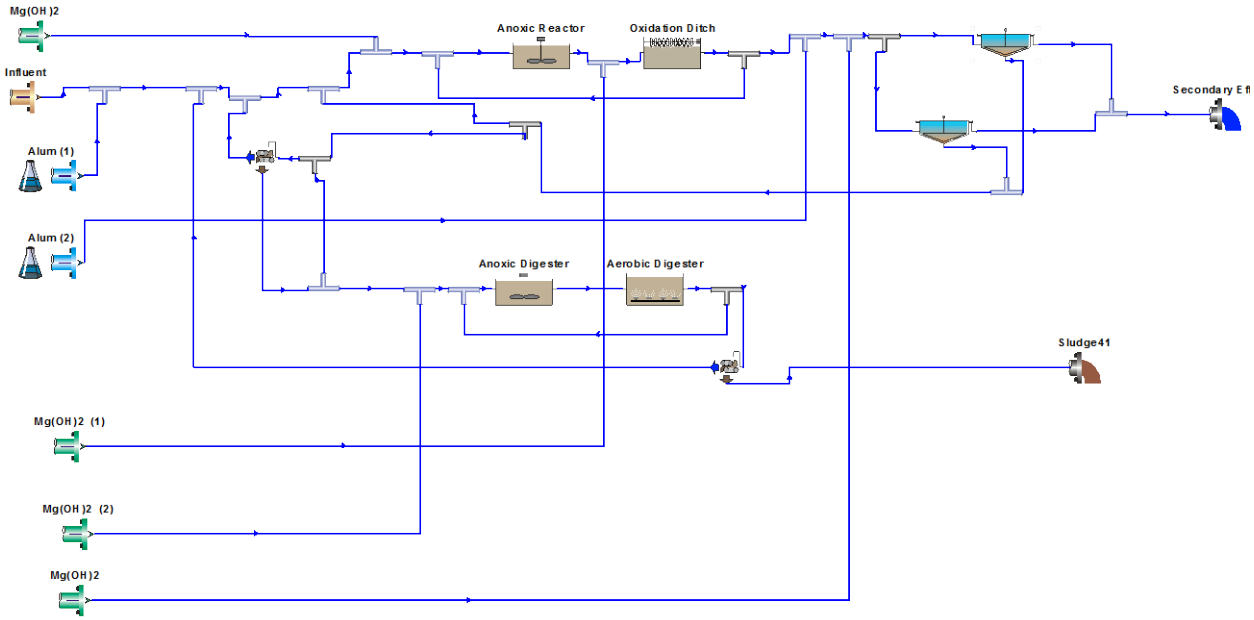
Created: 3/1/2001 **Saved: 5/9/2016**

Steady state solution

SRT: 6.39

Temperature: 20.0

Flowsheet



Configuration information for all Bioreactor units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers
Aerobic Digester	0.3000	2673.6113	15.000	606
Anoxic Digester	0.3000	2673.6113	15.000	Un-aerated

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint [mg/L]
Aerobic Digester	2.0
Anoxic Digester	0

Aeration equipment parameters

Element name	k1 in C = k1(PC)^0.25 + k2	k2 in C = k1(PC)^0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	% of tank area covered by diffusers [%]
Aerobic Digester	2.5656	0.0432	0.8200	0.0410	10.0000
Anoxic Digester	2.5656	0.0432	0.8200	0.0410	10.0000

Configuration information for all BOD Influent units

Operating data Average (flow/time weighted as required)

Element name	Influent
Flow	0.860869992486947
Total Carbonaceous BOD mgBOD/L	328.00
Volatile suspended solids mgVSS/L	328.00
Total suspended solids mgTSS/L	386.00
Total Kjeldahl Nitrogen mgN/L	97.00
Total P mgP/L	9.70
Nitrate N mgN/L	0
pH	7.00
Alkalinity mmol/L	1.17
Calcium mg/L	4.40
Magnesium mg/L	1.80
Dissolved oxygen mg/L	0

Element name	Influent
Fbs - Readily biodegradable (including Acetate) [gCOD/g of total COD]	0.1600
Fac - Acetate [gCOD/g of readily biodegradable COD]	0.1500
Fxsp - Non-colloidal slowly biodegradable [gCOD/g of slowly degradable COD]	0.9397
Fus - Unbiodegradable soluble [gCOD/g of total COD]	0.0500
Fup - Unbiodegradable particulate [gCOD/g of total COD]	0.1300
Fna - Ammonia [gNH3-N/gTKN]	0.6600
Fnox - Particulate organic nitrogen [gN/g Organic N]	0.5000
Fnus - Soluble unbiodegradable TKN [gN/gTKN]	0.0200
FupN - N:COD ratio for unbiodegradable part. COD [gN/gCOD]	0.0350
Fpo4 - Phosphate [gPO4-P/gTP]	0.6300
FupP - P:COD ratio for unbiodegradable part. COD [gP/gCOD]	0.0110
FZbh - Non-poly-P heterotrophs [gCOD/g of total COD]	0.0001

FZbm - Anoxic methanol utilizers [gCOD/g of total COD]	0.0001
FZaob - Ammonia oxidizers [gCOD/g of total COD]	0.0001
FZnob - Nitrite oxidizers [gCOD/g of total COD]	0.0001
FZamob - Anaerobic ammonia oxidizers [gCOD/g of total COD]	0.0001
FZbp - PAOs [gCOD/g of total COD]	0.0001
FZbpa - Propionic acetogens [gCOD/g of total COD]	0.0001
FZbam - Acetoclastic methanogens [gCOD/g of total COD]	0.0001
FZbhm - H2-utilizing methanogens [gCOD/g of total COD]	0.0001

Configuration information for all Model clarifier units

Physical data

Element name	Volume[Mil. Gal]	Area[ft2]	Depth[ft]	Number of layers	Top feed layer	Feed Layers
Secondary Clariifer 2	0.5025	5024.0000	13.370	10	6	1
Secondary Clarifier No 1	0.4932	5024.0000	13.123	10	6	1

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Secondary Clariifer 2	Ratio	0.40
Secondary Clarifier No 1	Ratio	0.40

Element name	Average Temperature	Reactive
Secondary Clariifer 2	Uses global setting	No

Secondary Clarifier No 1	Uses global setting	No

Configuration information for all Effluent units

Configuration information for all Media Bioreactor units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers
Anoxic Reactor	0.2000	2673.6113	10.000	Un-aerated

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint
Anoxic Reactor	0

Aeration equipment parameters

Element name	k1 in C = k1(PC)^0.25 + k2	k2 in C = k1(PC)^0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	% of tank area covered by diffusers [%]
Anoxic Reactor	2.5656	0.0432	0.8200	0.0410	10.0000

Configuration information for all Metal addition units

Operating data Average (flow/time weighted as required)

Element name	Alum (1)	Alum (2)
Non-polyP heterotrophs mgCOD/L	0	0
Anoxic methanol utilizers mgCOD/L	0	0
Ammonia oxidizing biomass mgCOD/L	0	0
Nitrite oxidizing biomass mgCOD/L	0	0
Anaerobic ammonia oxidizers mgCOD/L	0	0
PolyP heterotrophs mgCOD/L	0	0
Propionic acetogens mgCOD/L	0	0
Acetoclastic methanogens mgCOD/L	0	0
Hydrogenotrophic methanogens mgCOD/L	0	0
Endogenous products mgCOD/L	0	0
Slowly bio. COD (part.) mgCOD/L	0	0
Slowly bio. COD (colloid.) mgCOD/L	0	0
Part. inert. COD mgCOD/L	0	0
Part. bio. org. N mgN/L	0	0
Part. bio. org. P mgP/L	0	0
Part. inert N mgN/L	0	0
Part. inert P mgP/L	0	0
Stored PHA mgCOD/L	0	0
Releasable stored polyP mgP/L	0	0
Fixed stored polyP mgP/L	0	0
PolyP bound cations mg/L	0	0
Readily bio. COD (complex) mgCOD/L	0	0
Acetate mgCOD/L	0	0
Propionate mgCOD/L	0	0
Methanol mgCOD/L	0	0

Dissolved H2 mgCOD/L	0	0
Dissolved methane mg/L	0	0
Ammonia N mgN/L	0	0
Sol. bio. org. N mgN/L	0	0
Nitrite N mgN/L	0	0
Nitrate N mgN/L	0	0
Dissolved nitrogen gas mgN/L	0	0
PO4-P (Sol. & Me Complexed) mgP/L	0	0
Sol. inert COD mgCOD/L	0	0
Sol. inert TKN mgN/L	0	0
Inorganic S.S. mgISS/L	0	0
Struvite mgISS/L	0	0
Hydroxy-dicalcium-phosphate mgISS/L	0	0
Hydroxy-apatite mgISS/L	0	0
Magnesium mg/L	0	0
Calcium mg/L	0	0
Metal mg/L	0.00	57700.00
Other Cations (strong bases) meq/L	5.00	5.00
Other Anions (strong acids) meq/L	15.81	6434.89
Total CO2 mmol/L	7.00	7.00
User defined 1 mg/L	0	0
User defined 2 mg/L	0	0
User defined 3 mgVSS/L	0	0
User defined 4 mgISS/L	0	0
Dissolved oxygen mg/L	0	0
Flow	0	7E-5

Configuration information for all Dewatering unit units

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Dewatering Unit	Ratio	0.20
Dewatering Unit	Fraction	0.05

Element name	Percent removal
Dewatering Unit	100.00
Dewatering Unit	90.00

Configuration information for all Sludge units

Configuration information for all Splitter units

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Two way splitter6	Flowrate [Side]	0.035
Splitter23	Flowrate [Side]	0.02
Splitter1	Ratio	4.00
Splitter24	Ratio	1.00
Splitter73	Ratio	6.00

Configuration information for all Influent (SV) units

Operating data Average (flow/time weighted as required)

Element name	Mg(OH)2	Mg(OH)2 (1)	Mg(OH)2 (2)	Mg(OH)2
Non-polyP heterotrophs mgCOD/L	0	0	0	0
Anoxic methanol utilizers mgCOD/L	0	0	0	0
Ammonia oxidizing biomass mgCOD/L	0	0	0	0
Nitrite oxidizing biomass mgCOD/L	0	0	0	0
Anaerobic ammonia oxidizers mgCOD/L	0	0	0	0
PolyP heterotrophs mgCOD/L	0	0	0	0
Propionic acetogens mgCOD/L	0	0	0	0
Acetoclastic methanogens mgCOD/L	0	0	0	0
Hydrogenotrophic methanogens mgCOD/L	0	0	0	0
Endogenous products mgCOD/L	0	0	0	0
Slowly bio. COD (part.) mgCOD/L	0	0	0	0
Slowly bio. COD (colloid.) mgCOD/L	0	0	0	0
Part. inert. COD mgCOD/L	0	0	0	0
Part. bio. org. N mgN/L	0	0	0	0
Part. bio. org. P mgP/L	0	0	0	0
Part. inert N mgN/L	0	0	0	0
Part. inert P mgP/L	0	0	0	0
Stored PHA mgCOD/L	0	0	0	0
Releasable stored polyP mgP/L	0	0	0	0
Fixed stored polyP mgP/L	0	0	0	0
PolyP bound cations mg/L	0	0	0	0
Readily bio. COD (complex) mgCOD/L	0	0	0	0
Acetate mgCOD/L	0	0	0	0
Propionate mgCOD/L	0	0	0	0
Methanol mgCOD/L	0	0	0	0
Dissolved H2 mgCOD/L	0	0	0	0

Dissolved methane mg/L	0	0	0	0
Ammonia N mgN/L	0	0	0	0
Sol. bio. org. N mgN/L	0	0	0	0
Nitrite N mgN/L	0	0	0	0
Nitrate N mgN/L	0	0	0	0
Dissolved nitrogen gas mgN/L	0	0	0	0
PO4-P (Sol. & Me Complexed) mgP/L	0	0	0	0
Sol. inert COD mgCOD/L	0	0	0	0
Sol. inert TKN mgN/L	0	0	0	0
Inorganic S.S. mgISS/L	0	0	0	0
Struvite mgISS/L	0	0	0	0
Hydroxy-dicalcium-phosphate mgISS/L	0	0	0	0
Hydroxy-apatite mgISS/L	0	0	0	0
Magnesium mg/L	0	0	0	0
Calcium mg/L	0	0	0	0
Metal mg/L	0	0	0	0
Other Cations (strong bases) meq/L	14500.00	14500.00	14500.00	14500.00
Other Anions (strong acids) meq/L	0	0	0	0
Total CO2 mmol/L	0	0	0	0
User defined 1 mg/L	0	0	0	0
User defined 2 mg/L	0	0	0	0
User defined 3 mgVSS/L	0	0	0	0
User defined 4 mgISS/L	0	0	0	0
Dissolved oxygen mg/L	0	0	0	0
Flow	0	0.00035	2E-5	1E-5

Configuration information for all Bioreactor (brush aerators) units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]
Oxidation Ditch	0.4000	5347.2225	10.000

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint
Oxidation Ditch	1.5

Aeration equipment parameters

Element name	Surface aerator Std. oxygen transfer rate [lb O /(hp hr)]	Maximum power per rotor [hp]
Oxidation Ditch	2.4670	26.8097

BioWin Album

Album page - Aerobic Digester

No element
toomanycolumns

Parameters	Value	Units

Album page - Aerobic Digester

Album page - Aeration Basin

No element

toomanycolumns

Parameters	Value	Units

Album page - Effluent

Secondary Effluent			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
Volatile suspended solids	0.86	6.18	
Total suspended solids	1.25	8.95	
Particulate COD	1.27	9.13	
Filtered COD	37.00	265.58	
Total COD	38.27	274.71	
Soluble PO4-P	0.01	0.07	
Total P	0.05	0.35	
Filtered TKN	5.22	37.50	
Particulate TKN	0.07	0.54	
Total Kjeldahl Nitrogen	5.30	38.04	
Filtered Carbonaceous BOD	1.44	10.32	
Total Carbonaceous BOD	1.85	13.29	
Nitrite + Nitrate	26.88	192.98	

Total N	32.18	231.02	
Total inorganic N	28.59	205.27	
Alkalinity	0.98	3.19	mmol/L and kmol/d
pH	6.68		
Volatile fatty acids	0.00	0.01	
Total precipitated solids	0.10	0.70	
Total inorganic suspended solids	0.39	2.77	
Ammonia N	1.71	12.29	
Nitrate N	14.28	102.52	

Parameters	Value	Units

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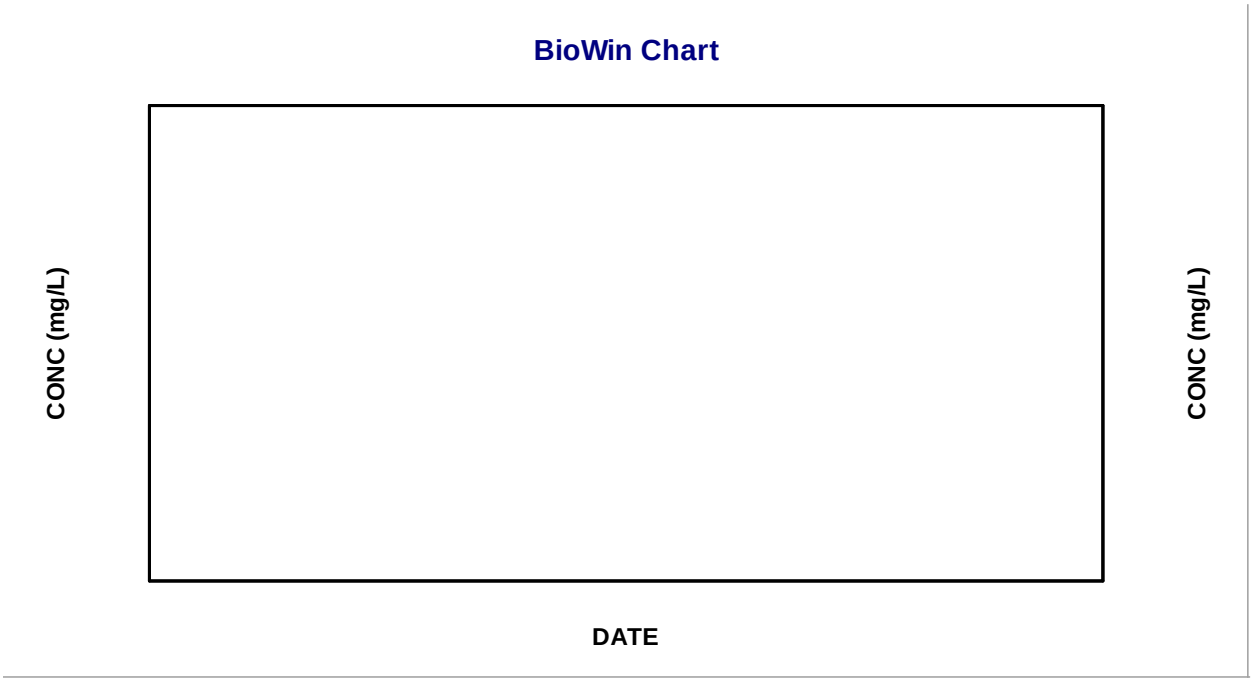

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Sidestream Mixer52

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
Volatile suspended solids	0.86	6.18	
Total suspended solids	1.25	8.95	
Particulate COD	1.27	9.13	
Filtered COD	37.00	265.58	
Total COD	38.27	274.71	
Soluble PO4-P	0.01	0.07	
Total P	0.05	0.35	
Filtered TKN	5.22	37.50	
Particulate TKN	0.07	0.54	
Total Kjeldahl Nitrogen	5.30	38.04	
Filtered Carbonaceous BOD	1.44	10.32	
Total Carbonaceous BOD	1.85	13.29	
Nitrite + Nitrate	26.88	192.98	
Total N	32.18	231.02	
Total inorganic N	28.59	205.27	
Alkalinity	0.98	3.19	mmol/L and kmol/d
pH	6.68		
Volatile fatty acids	0.00	0.01	
Total precipitated solids	0.10	0.70	
Total inorganic suspended solids	0.39	2.77	
Ammonia N	1.71	12.29	
Nitrate N	14.28	102.52	

Parameters	Value	Units

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Sidestream Mixer14			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
Volatile suspended solids	5724.18	16436.79	
Total suspended solids	8292.48	23811.57	
Particulate COD	8453.01	24272.55	
Filtered COD	37.00	106.23	
Total COD	8490.01	24378.78	
Soluble PO4-P	0.01	0.03	
Total P	263.77	757.41	
Filtered TKN	5.22	15.00	
Particulate TKN	496.73	1426.35	
Total Kjeldahl Nitrogen	501.96	1441.35	
Filtered Carbonaceous BOD	1.44	4.13	
Total Carbonaceous BOD	2749.66	7895.55	
Nitrite + Nitrate	26.88	77.19	
Total N	528.84	1518.54	
Total inorganic N	28.59	82.11	
Alkalinity	1.15	1.50	mmol/L and kmol/d
pH	6.68		
Volatile fatty acids	0.00	0.00	
Total precipitated solids	648.68	1862.65	
Total inorganic suspended solids	2568.30	7374.78	
Ammonia N	1.71	4.92	
Nitrate N	14.28	41.01	

Parameters	Value	Units

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Sidestream Mixer9			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
Volatile suspended solids	8896.37	1671.97	
Total suspended solids	12452.80	2340.36	
Particulate COD	13137.46	2469.03	
Filtered COD	36.96	6.95	
Total COD	13174.42	2475.98	
Soluble PO4-P	168.54	31.67	
Total P	409.94	77.04	
Filtered TKN	5.22	0.98	
Particulate TKN	772.01	145.09	
Total Kjeldahl Nitrogen	777.23	146.07	
Filtered Carbonaceous BOD	1.44	0.27	
Total Carbonaceous BOD	4272.65	803.00	
Nitrite + Nitrate	26.86	5.05	
Total N	804.09	151.12	
Total inorganic N	28.57	5.37	
Alkalinity	14.12	1.20	mmol/L and kmol/d
pH	10.43		
Volatile fatty acids	0.00	0.00	
Total precipitated solids	573.00	107.69	
Total inorganic suspended solids	3556.42	668.39	
Ammonia N	1.71	0.32	
Nitrate N	14.27	2.68	

Parameters	Value	Units

Global Parameters

AOB

Name	Default	Value	
Max. spec. growth rate [1/d]	0.90000	0.90000	1.0720
Substrate (NH4) half sat. [mgN/L]	0.70000	0.70000	1.0000
Aerobic decay rate [1/d]	0.17000	0.17000	1.0290
Anoxic/anaerobic decay rate [1/d]	0.08000	0.08000	1.0290
KiHNO2 [mmol/L]	0.00500	0.00500	1.0000

NOB

Name	Default	Value	
Max. spec. growth rate [1/d]	0.70000	0.70000	1.0600
Substrate (NO2) half sat. [mgN/L]	0.10000	0.10000	1.0000
Aerobic decay rate [1/d]	0.17000	0.17000	1.0290
Anoxic/anaerobic decay rate [1/d]	0.08000	0.08000	1.0290
KiNH3 [mmol/L]	0.07500	0.07500	1.0000

ANAMMOX

Name	Default	Value	
Max. spec. growth rate [1/d]	0.10000	0.10000	1.1000
Substrate (NH4) half sat. [mgN/L]	2.00000	2.00000	1.0000
Substrate (NO2) half sat. [mgN/L]	1.00000	1.00000	1.0000
Aerobic decay rate [1/d]	0.01900	0.01900	1.0290
Anoxic/anaerobic decay rate [1/d]	0.00950	0.00950	1.0290
Ki Nitrite [mgN/L]	1000.00000	1000.00000	1.0000
Nitrite sensitivity constant [L / (d mgN)]	0.01600	0.01600	1.0000

OHOs

Name	Default	Value	
Max. spec. growth rate [1/d]	3.20000	3.20000	1.0290
Substrate half sat. [mgCOD/L]	5.00000	5.00000	1.0000
Anoxic growth factor [-]	0.50000	0.50000	1.0000
Aerobic decay [1/d]	0.62000	0.62000	1.0290
Anoxic/anaerobic decay [1/d]	0.30000	0.30000	1.0290
Hydrolysis rate (AS) [1/d]	2.10000	2.10000	1.0290
Hydrolysis half sat. (AS) [-]	0.06000	0.06000	1.0000
Anoxic hydrolysis factor [-]	0.28000	0.28000	1.0000
Anaerobic hydrolysis factor [-]	0.50000	0.50000	1.0000
Adsorption rate of colloids [L/(mgCOD d)]	0.80000	0.80000	1.0290
Ammonification rate [L/(mgN d)]	0.04000	0.04000	1.0290
Assimilative nitrate/nitrite reduction rate [1/d]	0.50000	0.50000	1.0000
Fermentation rate [1/d]	3.20000	3.20000	1.0290
Fermentation half sat. [mgCOD/L]	5.00000	5.00000	1.0000
Anaerobic growth factor (AS) [-]	0.12500	0.12500	1.0000
Hydrolysis rate (AD) [1/d]	0.10000	0.10000	1.0500
Hydrolysis half sat. (AD) [mgCOD/L]	0.15000	0.15000	1.0000

Methylotrophs

Name	Default	Value	
Max. spec. growth rate of methanol utilizers [1/d]	1.30000	1.30000	1.0720
Methanol half sat. [mgCOD/L]	0.50000	0.50000	1.0000
Aerobic decay rate of methanol utilizers [1/d]	0.04000	0.04000	1.0290
Anoxic/anaerobic decay rate of methanol utilizers [1/d]	0.03000	0.03000	1.0290

PAOs

Name	Default	Value	
Max. spec. growth rate [1/d]	0.95000	0.95000	1.0000
Max. spec. growth rate, P-limited [1/d]	0.42000	0.42000	1.0000
Substrate half sat. [mgCOD(PHB)/mgCOD(Zbp)]	0.10000	0.10000	1.0000
Substrate half sat., P-limited [mgCOD(PHB)/mgCOD(Zbp)]	0.05000	0.05000	1.0000
Magnesium half sat. [mgMg/L]	0.10000	0.10000	1.0000
Cation half sat. [mmol/L]	0.10000	0.10000	1.0000
Calcium half sat. [mgCa/L]	0.10000	0.10000	1.0000
Aerobic decay rate [1/d]	0.10000	0.10000	1.0000
Anaerobic decay rate [1/d]	0.04000	0.04000	1.0000
Sequestration rate [1/d]	6.00000	6.00000	1.0000
Anoxic growth factor NO3 [-]	0.33000	0.33000	1.0000
Anoxic growth factor NO2 [-]	0.33000	0.33000	1.0000

Acetogens

Name	Default	Value	
Max. spec. growth rate [1/d]	0.25000	0.25000	1.0290
Substrate half sat. [mgCOD/L]	10.00000	10.00000	1.0000
Acetate inhibition [mgCOD/L]	10000.00000	10000.00000	1.0000
Decay rate [1/d]	0.05000	0.05000	1.0290
Aerobic decay rate [1/d]	0.52000	0.52000	1.0290

Methanogens

Name	Default	Value	
Acetoclastic Mu Max [1/d]	0.30000	0.30000	1.0290
H2-utilizing Mu Max [1/d]	1.40000	1.40000	1.0290
Acetoclastic Ks [mgCOD/L]	100.00000	100.00000	1.0000
Acetoclastic methanol Ks [mgCOD/L]	0.50000	0.50000	1.0000
H2-utilizing CO2 half sat. [mmol/L]	0.10000	0.10000	1.0000
H2-utilizing Ks [mgCOD/L]	0.10000	0.10000	1.0000
H2-utilizing methanol Ks [mgCOD/L]	0.50000	0.50000	1.0000
Acetoclastic propionic inhibition [mgCOD/L]	10000.00000	10000.00000	1.0000
Acetoclastic decay rate [1/d]	0.13000	0.13000	1.0290
Acetoclastic aerobic decay rate [1/d]	0.60000	0.60000	1.0290
H2-utilizing decay rate [1/d]	0.13000	0.13000	1.0290
H2-utilizing aerobic decay rate [1/d]	0.60000	0.60000	1.0290

pH

Name	Default	Value

Heterotrophs low pH limit [-]	4.00000	4.00000
Heterotrophs high pH limit [-]	10.00000	10.00000
Methanol utilizers low pH limit [-]	4.00000	4.00000
Methanol utilizers high pH limit [-]	10.00000	10.00000
Autotrophs low pH limit [-]	5.50000	5.50000
Autotrophs high pH limit [-]	9.50000	9.50000
PolyP heterotrophs low pH limit [-]	4.00000	4.00000
Poly P heterotrophs high pH limit [-]	10.00000	10.00000
Heterotrophs low pH limit (anaerobic) [-]	5.50000	5.50000
Heterotrophs high pH limit (anaerobic) [-]	8.50000	8.50000
Propionic acetogens low pH limit [-]	4.00000	4.00000
Propionic acetogens high pH limit [-]	10.00000	10.00000
Acetoclastic methanogens low pH limit [-]	5.00000	5.00000
Acetoclastic methanogens high pH limit [-]	9.00000	9.00000
H2-utilizing methanogens low pH limit [-]	5.00000	5.00000
H2-utilizing methanogens high pH limit [-]	9.00000	9.00000

Switches

Name	Default	Value
Heterotrophic DO half sat. [mgO2/L]	0.05000	0.05000
Aerobic denit. DO half sat. [mgO2/L]	0.05000	0.05000
Ammonia oxidizer DO half sat. [mgO2/L]	0.25000	0.25000
Nitrite oxidizer DO half sat. [mgO2/L]	0.50000	0.50000
Anaerobic ammonia oxidizer DO half sat. [mgO2/L]	0.01000	0.01000
Anoxic NO3 half sat. [mgN/L]	0.10000	0.10000
Anoxic NO2 half sat. (mgN/L)	0.01000	0.01000
NH3 nutrient half sat. [mgN/L]	1.0000E-4	1.0000E-4
PolyP half sat. [mgP/L]	0.01000	0.01000

VFA sequestration half sat. [mgCOD/L]	5.00000	5.00000
P uptake half sat. [mgP/L]	0.15000	0.15000
P nutrient half sat. [mgP/L]	0.00100	0.00100
Autotroph CO2 half sat. [mmol/L]	0.10000	0.10000
Heterotrophic Hydrogen half sat. [mgCOD/L]	1.00000	1.00000
Propionic acetogens Hydrogen half sat. [mgCOD/L]	5.00000	5.00000
Synthesis anion/cation half sat. [meq/L]	0.01000	0.01000

Common

Name	Default	Value
N in endogenous residue [mgN/mgCOD]	0.07000	0.07000
P in endogenous residue [mgP/mgCOD]	0.02200	0.02200
Endogenous residue COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
Particulate substrate COD:VSS ratio [mgCOD/mgVSS]	1.60000	1.60000
Particulate inert COD:VSS ratio [mgCOD/mgVSS]	1.60000	1.60000

AOB

Name	Default	Value
Yield [mgCOD/mgN]	0.15000	0.15000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

NOB

Name	Default	Value
Yield [mgCOD/mgN]	0.09000	0.09000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

ANAMMOX

Name	Default	Value
Yield [mgCOD/mgN]	0.11400	0.11400
Nitrate production [mgN/mgBiomassCOD]	2.28000	2.28000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

OHOs

Name	Default	Value
Yield (aerobic) [-]	0.66600	0.66600
Yield (fermentation, low H2) [-]	0.10000	0.10000
Yield (fermentation, high H2) [-]	0.10000	0.10000
H2 yield (fermentation low H2) [-]	0.35000	0.35000

H2 yield (fermentation high H2) [-]	0	0
Propionate yield (fermentation, low H2) [-]	0	0
Propionate yield (fermentation, high H2) [-]	0.70000	0.70000
CO2 yield (fermentation, low H2) [-]	0.70000	0.70000
CO2 yield (fermentation, high H2) [-]	0	0
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
Yield (anoxic) [-]	0.54000	0.54000
Yield propionic (aerobic) [-]	0.64000	0.64000
Yield propionic (anoxic) [-]	0.46000	0.46000
Yield acetic (aerobic) [-]	0.60000	0.60000
Yield acetic (anoxic) [-]	0.43000	0.43000
Yield methanol (aerobic) [-]	0.50000	0.50000
Adsorp. max. [-]	1.00000	1.00000

Methylotrophs

Name	Default	Value
Yield (anoxic) [-]	0.40000	0.40000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

PAOs

Name	Default	Value
Yield (aerobic) [-]	0.63900	0.63900
Yield (anoxic) [-]	0.52000	0.52000
Aerobic P/PHA uptake [mgP/mgCOD]	0.95000	0.95000
Anoxic P/PHA uptake [mgP/mgCOD]	0.35000	0.35000
Yield of PHA on sequestration [-]	0.88900	0.88900
N in biomass [mgN/mgCOD]	0.07000	0.07000
N in sol. inert [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous part. [-]	0.25000	0.25000
Inert fraction of endogenous sol. [-]	0.20000	0.20000
P/Ac release ratio [mgP/mgCOD]	0.49000	0.49000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
Yield of low PP [-]	0.94000	0.94000

Acetogens

Name	Default	Value
Yield [-]	0.10000	0.10000
H2 yield [-]	0.40000	0.40000
CO2 yield [-]	1.00000	1.00000
N in biomass [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

Methanogens

Name	Default	Value
Acetoclastic yield [-]	0.10000	0.10000
Methanol acetoclastic yield [-]	0.10000	0.10000
H2-utilizing yield [-]	0.10000	0.10000
Methanol H2-utilizing yield [-]	0.10000	0.10000
N in acetoclastic biomass [mgN/mgCOD]	0.07000	0.07000
N in H2-utilizing biomass [mgN/mgCOD]	0.07000	0.07000
P in acetoclastic biomass [mgP/mgCOD]	0.02200	0.02200
P in H2-utilizing biomass [mgP/mgCOD]	0.02200	0.02200
Acetoclastic fraction to endog. residue [-]	0.08000	0.08000
H2-utilizing fraction to endog. residue [-]	0.08000	0.08000
Acetoclastic COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
H2-utilizing COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

General

Name	Default	Value
Ash content of biomass (synthesis ISS) [%]	8.00000	8.00000
Molecular weight of other anions [mg/mmol]	35.50000	35.50000
Molecular weight of other cations [mg/mmol]	39.10000	39.10000
Mg to P mole ratio in polyphosphate [mmolMg/mmolP]	0.30000	0.30000
Cation to P mole ratio in polyphosphate [meq/mmolP]	0.30000	0.30000
Ca to P mole ratio in polyphosphate [mmolCa/mmolP]	0.05000	0.05000
Cation to P mole ratio in organic phosphate [meq/mmolP]	0.01000	0.01000
Bubble rise velocity (anaerobic digester) [cm/s]	23.90000	23.90000
Bubble Sauter mean diameter (anaerobic digester) [cm]	0.35000	0.35000
Anaerobic digester gas hold-up factor []	1.00000	1.00000
Tank head loss per metre of length (from flow) [m/m]	0.00250	0.00250

Mass transfer

Name	Default	Value	
Kl for H2 [m/d]	17.00000	17.00000	1.0240
Kl for CO2 [m/d]	10.00000	10.00000	1.0240
Kl for NH3 [m/d]	1.00000	1.00000	1.0240
Kl for CH4 [m/d]	8.00000	8.00000	1.0240
Kl for N2 [m/d]	15.00000	15.00000	1.0240
Kl for O2 [m/d]	13.00000	13.00000	1.0240

Physico-chemical rates

Name	Default	Value	
Struvite precipitation rate [1/d]	3.0000E+10	3.0000E+10	1.0240
Struvite redissolution rate [1/d]	3.0000E+11	3.0000E+11	1.0240
Struvite half sat. [mgTSS/L]	1.00000	1.00000	1.0000
HDP precipitation rate [L/(molP d)]	1.0000E+8	1.0000E+8	1.0000
HDP redissolution rate [L/(mol P d)]	1.0000E+8	1.0000E+8	1.0000
HAP precipitation rate [molHDP/(L d)]	5.0000E-4	5.0000E-4	1.0000

Physico-chemical constants

Name	Default	Value
Struvite solubility constant [mol/L]	6.9180E-14	6.9180E-14
HDP solubility product [mol/L]	2.7500E-22	2.7500E-22

HDP half sat. [mgTSS/L]	1.00000	1.00000
Equilibrium soluble PO4 with Al dosing at pH 7 [mgP/L]	0.01000	0.01000
Al to P ratio [molAl/molP]	0.80000	0.80000
Al(OH)3 solubility product [mol/L]	1.2590E+9	1.2590E+9
AlHPO4+ dissociation constant [mol/L]	7.9430E-13	7.9430E-13
Equilibrium soluble PO4 with Fe dosing at pH 7 [mgP/L]	0.01000	0.01000
Fe to P ratio [molFe/molP]	1.60000	1.60000
Fe(OH)3 solubility product [mol/L]	0.05000	0.05000
FeH2PO4++ dissociation constant [mol/L]	5.0120E-22	5.0120E-22

Aeration

Name	Default	Value
Alpha (surf) OR Alpha F (diff) [-]	0.50000	0.50000
Beta [-]	0.95000	0.95000
Surface pressure [kPa]	101.32500	101.32500
Fractional effective saturation depth (Fed) [-]	0.32500	0.32500
Supply gas CO2 content [vol. %]	0.03500	0.03500
Supply gas O2 [vol. %]	20.95000	20.95000
Off-gas CO2 [vol. %]	2.00000	2.00000
Off-gas O2 [vol. %]	18.80000	18.80000
Off-gas H2 [vol. %]	0	0
Off-gas NH3 [vol. %]	0	0
Off-gas CH4 [vol. %]	0	0
Surface turbulence factor [-]	2.00000	2.00000
Set point controller gain []	1.00000	1.00000

Modified Vesilind

Name	Default	Value
Maximum Vesilind settling velocity (Vo) [ft/min]	0.3873	0.3873
Vesilind hindered zone settling parameter (K) [L/g]	0.3700	0.3700
Clarification switching function [mg/L]	100.0000	100.0000
Specified TSS conc.for height calc. [mg/L]	2500.0000	2500.0000
Maximum compactability constant [mg/L]	15000.0000	15000.0000

Double exponential

Name	Default	Value
Maximum Vesilind settling velocity (Vo) [ft/min]	0.9341	0.9341
Maximum (practical) settling velocity (Vo') [ft/min]	0.6152	0.6152
Hindered zone settling parameter (Kh) [L/g]	0.4000	0.4000
Flocculent zone settling parameter (Kf) [L/g]	2.5000	2.5000
Maximum non-settleable TSS [mg/L]	20.0000	20.0000
Non-settleable fraction [-]	0.0010	0.0010
Specified TSS conc. for height calc. [mg/L]	2500.0000	2500.0000

Biofilm general

Name	Default	Value	
Attachment rate [g / (m2 d)]	80.00000	80.00000	1.0000
Attachment TSS half sat. [mg/L]	100.00000	100.00000	1.0000
Detachment rate [g/(m3 d)]	8.0000E+4	8.0000E+4	1.0000
Solids movement factor []	10.00000	10.00000	1.0000
Diffusion neta []	0.80000	0.80000	1.0000

Thin film limit [mm]	0.50000	0.50000	1.0000
Thick film limit [mm]	3.00000	3.00000	1.0000
Assumed Film thickness for tank volume correction (temp independant) [mm]	0.75000	0.75000	1.0000
Film surface area to media area ratio - Max.[ ]	1.00000	1.00000	1.0000
Minimum biofilm conc. for streamer formation [gTSS/m2]	4.00000	4.00000	1.0000

Maximum biofilm concentrations [mg/L]

Name	Default	Value	
Non-polyP heterotrophs	5.0000E+4	5.0000E+4	1.0000
Anoxic methanol utilizers	5.0000E+4	5.0000E+4	1.0000
Ammonia oxidizing biomass	1.0000E+5	1.0000E+5	1.0000
Nitrite oxidizing biomass	1.0000E+5	1.0000E+5	1.0000
Anaerobic ammonia oxidizers	5.0000E+4	5.0000E+4	1.0000
PolyP heterotrophs	5.0000E+4	5.0000E+4	1.0000
Propionic acetogens	5.0000E+4	5.0000E+4	1.0000
Acetoclastic methanogens	5.0000E+4	5.0000E+4	1.0000
Hydrogenotrophic methanogens	5.0000E+4	5.0000E+4	1.0000
Endogenous products	3.0000E+4	3.0000E+4	1.0000
Slowly bio. COD (part.)	5000.00000	5000.00000	1.0000
Slowly bio. COD (colloid.)	0	0	1.0000
Part. inert. COD	5000.00000	5000.00000	1.0000
Part. bio. org. N	0	0	1.0000
Part. bio. org. P	0	0	1.0000
Part. inert N	0	0	1.0000
Part. inert P	0	0	1.0000
Stored PHA	5000.00000	5000.00000	1.0000
Releasable stored polyP	1.1500E+6	1.1500E+6	1.0000
Fixed stored polyP	1.1500E+6	1.1500E+6	1.0000

PolyP bound cations	1.1500E+6	1.1500E+6	1.0000
Readily bio. COD (complex)	0	0	1.0000
Acetate	0	0	1.0000
Propionate	0	0	1.0000
Methanol	0	0	1.0000
Dissolved H2	0	0	1.0000
Dissolved methane	0	0	1.0000
Ammonia N	0	0	1.0000
Sol. bio. org. N	0	0	1.0000
Nitrite N	0	0	1.0000
Nitrate N	0	0	1.0000
Dissolved nitrogen gas	0	0	1.0000
PO4-P (Sol. & Me Complexed)	1.0000E+10	1.0000E+10	1.0000
Sol. inert COD	0	0	1.0000
Sol. inert TKN	0	0	1.0000
Inorganic S.S.	1.3000E+6	1.3000E+6	1.0000
Struvite	8.5000E+5	8.5000E+5	1.0000
Hydroxy-dicalcium-phosphate	1.1500E+6	1.1500E+6	1.0000
Hydroxy-apatite	1.6000E+6	1.6000E+6	1.0000
Magnesium	0	0	1.0000
Calcium	0	0	1.0000
Metal	1.0000E+10	1.0000E+10	1.0000
Other Cations (strong bases)	0	0	1.0000
Other Anions (strong acids)	0	0	1.0000
Total CO2	0	0	1.0000
User defined 1	0	0	1.0000
User defined 2	0	0	1.0000
User defined 3	5.0000E+4	5.0000E+4	1.0000
User defined 4	5.0000E+4	5.0000E+4	1.0000
Dissolved oxygen	0	0	1.0000

Effective diffusivities [m2/s]

Name	Default	Value	
Non-polyP heterotrophs	5.0000E-14	5.0000E-14	1.0290
Anoxic methanol utilizers	5.0000E-14	5.0000E-14	1.0290
Ammonia oxidizing biomass	5.0000E-14	5.0000E-14	1.0290
Nitrite oxidizing biomass	5.0000E-14	5.0000E-14	1.0290
Anaerobic ammonia oxidizers	5.0000E-14	5.0000E-14	1.0290
PolyP heterotrophs	5.0000E-14	5.0000E-14	1.0290
Propionic acetogens	5.0000E-14	5.0000E-14	1.0290
Acetoclastic methanogens	5.0000E-14	5.0000E-14	1.0290
Hydrogenotrophic methanogens	5.0000E-14	5.0000E-14	1.0290
Endogenous products	5.0000E-14	5.0000E-14	1.0290
Slowly bio. COD (part.)	5.0000E-14	5.0000E-14	1.0290
Slowly bio. COD (colloid.)	6.9000E-11	6.9000E-11	1.0290
Part. inert. COD	5.0000E-14	5.0000E-14	1.0290
Part. bio. org. N	5.0000E-14	5.0000E-14	1.0290
Part. bio. org. P	5.0000E-14	5.0000E-14	1.0290
Part. inert N	5.0000E-14	5.0000E-14	1.0290
Part. inert P	5.0000E-14	5.0000E-14	1.0290
Stored PHA	5.0000E-14	5.0000E-14	1.0290
Releasable stored polyP	5.0000E-14	5.0000E-14	1.0290
Fixed stored polyP	5.0000E-14	5.0000E-14	1.0290
PolyP bound cations	5.0000E-14	5.0000E-14	1.0290
Readily bio. COD (complex)	6.9000E-10	6.9000E-10	1.0290
Acetate	1.2400E-9	1.2400E-9	1.0290
Propionate	8.3000E-10	8.3000E-10	1.0290
Methanol	1.6000E-9	1.6000E-9	1.0290
Dissolved H2	5.8500E-9	5.8500E-9	1.0290

Dissolved methane	1.9625E-9	1.9625E-9	1.0290
Ammonia N	2.0000E-9	2.0000E-9	1.0290
Sol. bio. org. N	1.3700E-9	1.3700E-9	1.0290
Nitrite N	2.9800E-9	2.9800E-9	1.0290
Nitrate N	2.9800E-9	2.9800E-9	1.0290
Dissolved nitrogen gas	1.9000E-9	1.9000E-9	1.0290
PO4-P (Sol. & Me Complexed)	2.0000E-9	2.0000E-9	1.0290
Sol. inert COD	6.9000E-10	6.9000E-10	1.0290
Sol. inert TKN	6.8500E-10	6.8500E-10	1.0290
Inorganic S.S.	5.0000E-14	5.0000E-14	1.0290
Struvite	5.0000E-14	5.0000E-14	1.0290
Hydroxy-dicalcium-phosphate	5.0000E-14	5.0000E-14	1.0290
Hydroxy-apatite	5.0000E-14	5.0000E-14	1.0290
Magnesium	7.2000E-10	7.2000E-10	1.0290
Calcium	7.2000E-10	7.2000E-10	1.0290
Metal	4.8000E-10	4.8000E-10	1.0290
Other Cations (strong bases)	1.4400E-9	1.4400E-9	1.0290
Other Anions (strong acids)	1.4400E-9	1.4400E-9	1.0290
Total CO2	1.9600E-9	1.9600E-9	1.0290
User defined 1	6.9000E-10	6.9000E-10	1.0290
User defined 2	6.9000E-10	6.9000E-10	1.0290
User defined 3	5.0000E-14	5.0000E-14	1.0290
User defined 4	5.0000E-14	5.0000E-14	1.0290
Dissolved oxygen	2.5000E-9	2.5000E-9	1.0290

EPS Strength coefficients [ ]

Name	Default	Value	
Non-polyP heterotrophs	1.00000	1.00000	1.0000

Anoxic methanol utilizers	1.00000	1.00000	1.0000
Ammonia oxidizing biomass	1.00000	1.00000	1.0000
Nitrite oxidizing biomass	1.00000	1.00000	1.0000
Anaerobic ammonia oxidizers	1.00000	1.00000	1.0000
PolyP heterotrophs	1.00000	1.00000	1.0000
Propionic acetogens	1.00000	1.00000	1.0000
Acetoclastic methanogens	1.00000	1.00000	1.0000
Hydrogenotrophic methanogens	1.00000	1.00000	1.0000
Endogenous products	1.00000	1.00000	1.0000
Slowly bio. COD (part.)	1.00000	1.00000	1.0000
Slowly bio. COD (colloid.)	0	0	1.0000
Part. inert. COD	1.00000	1.00000	1.0000
Part. bio. org. N	1.00000	1.00000	1.0000
Part. bio. org. P	1.00000	1.00000	1.0000
Part. inert N	1.00000	1.00000	1.0000
Part. inert P	1.00000	1.00000	1.0000
Stored PHA	1.00000	1.00000	1.0000
Releasable stored polyP	1.00000	1.00000	1.0000
Fixed stored polyP	1.00000	1.00000	1.0000
PolyP bound cations	1.00000	1.00000	1.0000
Readily bio. COD (complex)	0	0	1.0000
Acetate	0	0	1.0000
Propionate	0	0	1.0000
Methanol	0	0	1.0000
Dissolved H2	0	0	1.0000
Dissolved methane	0	0	1.0000
Ammonia N	0	0	1.0000
Sol. bio. org. N	0	0	1.0000
Nitrite N	0	0	1.0000
Nitrate N	0	0	1.0000
Dissolved nitrogen gas	0	0	1.0000

PO4-P (Sol. & Me Complexed)	1.00000	1.00000	1.0000
Sol. inert COD	0	0	1.0000
Sol. inert TKN	0	0	1.0000
Inorganic S.S.	0.33000	0.33000	1.0000
Struvite	1.00000	1.00000	1.0000
Hydroxy-dicalcium-phosphate	1.00000	1.00000	1.0000
Hydroxy-apatite	1.00000	1.00000	1.0000
Magnesium	0	0	1.0000
Calcium	0	0	1.0000
Metal	1.00000	1.00000	1.0000
Other Cations (strong bases)	0	0	1.0000
Other Anions (strong acids)	0	0	1.0000
Total CO2	0	0	1.0000
User defined 1	0	0	1.0000
User defined 2	0	0	1.0000
User defined 3	1.00000	1.00000	1.0000
User defined 4	1.00000	1.00000	1.0000
Dissolved oxygen	0	0	1.0000

APPENDIX H

DETAILED FINANCING ANALYSIS AND SEWER RATE REVISION

Sewer Rate Study Memorandum

FCS GROUP
Solutions-Oriented Consulting

Memorandum

To: Don DeBerg, City Engineer **Date:** June 16, 2016

From: Angie Sanchez Virnoche, FCS GROUP Principal

CC: Mark Rigos, City Public Works Director; John Markus and Jim Santroch, Tetra Tech

RE: Sewer Rate Study

FCS GROUP (FCS) is a sub- consultant to Tetra Tech for the City of North Bend Wastewater Facilities Plan (WWFP) and was retained to perform a Sewer Rate Study during the initial phase of the project to recommend changes to existing sewer rates to pay for current and upcoming sewer system costs through the year 2020. The rate study focuses on identifying the appropriate rate adjustments that will be required to ensure that adequate funds are available for operation, maintenance and for implementation of capital improvements to the sewer utility from present through year 2020.

This memorandum discusses the methodology and outcomes of the sewer rate study developed that allow the sewer utility to remain financially viable during the planning period. This study considers the City's current and recommended financial and policy obligations, operation and maintenance needs, and the financial impact of completing the 2016-2020 capital projects identified in the WWFP.

Revenue Requirement

The sewer utility is an enterprise fund, meaning it is self-sufficient and rates and fees collected for sewer service support the financial obligations of the utility. The primary source of funding is derived from ongoing monthly charges for service, developer connection charges and a minor amount of additional revenue coming from interest earnings. The City controls the level of user charges and, subject to statutory authority, can adjust user charges as needed to meet financial objectives. The City maintains a fund structure and implements financial policies that target management of a financially viable and fiscally responsible sewer system.

A revenue requirement analysis forecasts the amount of annual revenue that needs to be generated by user rates in a given year to meet that year's expected financial obligations. The analysis incorporates operating revenues, O&M expenses, debt service payments, rate-funded capital needs, and all other identified revenues or expenses related to operation of the City's wastewater facilities. In addition to annual operating costs, the revenue needs also include debt covenant requirements and specific fiscal policies and financial goals of the City. The objective of the rate study is to evaluate the sufficiency of the current level of rates.

The revenue requirement is developed from 2016 budget documents along with other key factors and assumptions to develop a complete portrayal of the City's annual financial obligations. The following is a list of the key revenue and expense factors and assumptions used in the development of the rate study:

Firm Headquarters
7525 166th Ave. NE., Suite D-215
Redmond, Washington 98052

Locations
Redmond, WA | 425.867.1802
Portland, OR | 503.841.6543

- **Revenue** – The City has two general revenue sources: revenue from charges for service (rate revenue) and miscellaneous (non-rate) revenue. In the event of a forecasted annual shortfall, rate revenue can be increased to meet the annual revenue requirement. The non-rate revenue of interest earnings is forecast based on fund balances and an assumed interest earnings rate.

- **General Facility Charge (GFC) Revenue** – The GFC is a fee imposed as a condition of service on new customers connecting to the system. The current GFC of $5,852 is expected to generate $183,000 in revenue from 32 ERUs in 2016. The GFC has been updated and is expected to increase to $10,222 per ERU for City customers and $7,699 per ERU for ULID customers. An additional $100,000 may be generated in 2016 with an implementation date for new GFCs of August 1, 2016 (estimated 10 units connecting at the City charge).The GFC update is discussed later in this memorandum. Per the City's request, the revenue generated from adoption of the updated GFCs has been included in the rate study. The GFCs are expected to generate revenue in the range of $935,000 to $1.1 million during 2017-2020. Anticipated new ERUs range from 100-113 per year. This revenue source is used to fund the capital improvement program.

- **Growth** – Rate revenue is escalated based on an annual average growth rate of 4.33% beginning in 2017. It is lower than the growth rate included in the WWTP Update to recognize the lower rate of actual growth the City has been experiencing over the last few years and the anticipated level of growth that is anticipated in the future.

- **Expenses** – O&M expense projections are based on the 2016 budget and are forecast to increase with general cost inflation of 2.29 percent, labor cost inflation of 2.87 percent, and benefit cost inflation of 8.0 percent. Budget figures were used for the 2016 taxes; future taxes are calculated based on forecasted revenues and prevailing tax rates.

- **Additional O&M expenses** – The WWTP update identified additional O&M costs associated with power, chemicals, material, labor, lab testing, sludge handling, equipment replacement and collection system asset management. The additional O&M expenses range from $286,000 to $795,000 per year.

- **Existing Debt** – The City currently has a total of five outstanding sewer debt issues related to a 2010 water and sewer refunding revenue bond, 2015 LTGO refunding bonds, I&I SRF Phase I loan, I&I SRF Phase II loan, and a WWTP Phase II SRF loan. Total existing debt obligations range from $390,000 in 2016 decreasing to $324,000 in 2020 with the elimination of the I&I Phase I loan in 2019.

- **Future Debt** – The capital financing strategy developed for this WWFP Update indicates that borrowing will be required. The City will have access to a $3.5 million line of credit to meet short-term capital funding needs during 2016 – 2019. The funds will be rolled into two bond issues – the first in 2017 for $6.9 million and the second in 2019 for $5.1 million. Both revenue bonds are for a 25-year term and have interest rates of 3.87 percent and 4.14 percent, respectively.

- **Capital Funding Plan** - The capital plan developed for the initial five-years of the WWFP Update totals $15.6 million (inflated costs to the year of construction). **Table 1** provides an annual summary of the capital costs.

Table 1. Summary of Annual Capital Costs

Year	Cost
2016	$2,801,000
2017	904,928
2018	4,319,939
2019	2,507,019
2020	5,139,172
Total	$15,672,059

- **Fund Balances** - Operating reserves are designed to provide a liquidity cushion to ensure that adequate cash working capital will be maintained to deal with significant cash balance fluctuations such as seasonal fluctuations in billings and receipts, unanticipated cash expenses, or lower than expected revenue collections. The City's current policy is to maintain a minimum balance in the Operating Fund equal to 90 days of O&M expenses. This balance is maintained throughout the five year time period and ranges from $360,000 to $530,000.

- **Capital Fund** – A capital fund is an amount of cash set aside in case of an emergency should a piece of equipment or a portion of the utility's infrastructure fail unexpectedly. The reserve also could be used for other unanticipated capital needs including capital project cost overruns. Industry practices range from maintaining a balance equal to 1 to 2 percent of fixed assets, an amount equal to a 5-year rolling average of CIP costs, or an amount determined sufficient to fund equipment failure (other than catastrophic failure). The minimum capital fund target for the City has been set at 2 percent of sewer utility asset value ranging from $750,000 to $990,000. The fund balance is maintained above this minimum target level for the five year period under review.

SUMMARY OF REVENUE REQUIREMENT

A revenue requirement analysis enables the City to set utility rate structures which fully recover the total cost of operating the sewer system: capital improvement and replacement, operations, maintenance, general administration, fiscal policy attainment, cash reserve management, and debt repayment. **Table 2** provides a summary of the five-year revenue requirement and rate strategy based on the forecast of revenues, expenditures, fund balances and fiscal policies.

The financial forecast indicates that there is an existing deficiency at current rate levels, and that sewer rates will need to increase to meet the total annual revenue requirement in all years. Rates would need to increase by 12.7 percent in 2016 and 2017, 8.25 percent in 2018 and 2019 and 8.0 percent in 2020.

Table 2. Summary of Annual Revenue Requirements

	2016	2017	2018	2019	2020
Revenues					
Rate Revenues Under Existing Rates	$ 1,780,500	$ 1,857,577	$ 1,937,991	$ 2,021,887	$ 2,109,413
Non-Rate Revenues	2,000	3,955	4,195	4,205	4,255
Total Revenues	**$ 1,782,500**	**$ 1,861,532**	**$ 1,942,186**	**$ 2,026,091**	**$ 2,113,668**
Expenses					
Cash Operating Expenses	$ 1,468,388	$ 1,872,891	$ 1,933,744	$ 2,040,488	$ 2,189,293
Existing Debt Service	390,251	389,722	389,638	326,907	324,071
New Debt Service	23,764	89,096	321,646	621,925	851,750
Rate Funded System Reinvestment	-	-	-	-	-
Total Expenses	**$ 1,882,403**	**$ 2,351,708**	**$ 2,645,028**	**$ 2,989,319**	**$ 3,365,115**
Net Surplus (Deficiency)	**$ (99,903)**	**$ (490,176)**	**$ (702,842)**	**$ (963,228)**	**$ (1,251,447)**
Additions to Meet Coverage	-	-	-	-	-
Total Surplus (Deficiency)	**$ (99,903)**	**$ (490,176)**	**$ (702,842)**	**$ (963,228)**	**$ (1,251,447)**
Annual Rate Adjustment	**12.70%**	**12.70%**	**8.25%**	**8.25%**	**8.00%**
Cumulative Annual Rate Adjustment	**12.70%**	**27.01%**	**37.49%**	**48.83%**	**60.74%**
Rate Revenues After Rate Increase	$ 1,931,249	$ 2,359,363	$ 2,664,573	$ 3,009,265	$ 3,390,698
Additional In-Lieu of Taxes from Rate Increase	$ 2,864	$ 9,534	$ 13,806	$ 18,761	$ 24,345
Net Cash Flow After Rate Increase	**$ 47,982**	**$ 2,075**	**$ 9,933**	**$ 5,389**	**$ 5,493**
Coverage After Rate Increases	**6.16**	**9.21**	**4.55**	**3.11**	**2.70**

It is important that the City revisit the revenue requirement and rate forecast every year when budgets are developed to ensure that the rate projections developed remain adequate. Any significant changes in revenue or expenses from what was included in the plan should be incorporated and future rates should be adjusted as needed.

DEBT SERVICE COVERAGE

Debt service coverage is based on a commitment made by the City when issuing revenue bonds and some other forms of long-term debt. As a security condition of issuance, the City would be required per covenant to agree that the revenue bond debt would have a higher priority for payment (a senior lien) compared to most other expenditures; the only outlays with a higher lien are O&M expenses. Debt service coverage is expressed as a multiplier of the annual revenue bond debt service payment. For example, a 1.25 coverage factor means revenue must be sufficient to pay O&M expenses, annual revenue bond debt service payments, plus an additional 25 percent of annual revenue bond debt service payments. Targeting a higher coverage factor can help the City achieve a better credit rating and provide lower interest rates for future debt issues. The City's current target for debt service coverage is 1.50. As shown in the coverage after rate increases in **Table 2**, the City is well above this established target ratio.

EXISTING AND PROJECTED RATES

The City's existing sewer rate structure consists of a fixed monthly charge that is the same for all classes of service (except Senior/Low Income) and a variable rate per CM. The fixed charge includes 10 CM of

average winter usage (20 CM for Mixed Use customers) per unit for Residential and Multi Family customers and per account for Commercial customers. The variable rate is applied per CM to winter average usage in excess of the 10 CM (20 CM for Mixed Use) allowance. **Table 3** provides a summary of the existing sewer utility rates.

Table 3: Existing Sewer Utility Rates

Individual Classes	2016		
	Fixed	per CM	*Notes:*
Residential	$ 72.94	$ 0.77	*per dwelling unit*
Senior/Low Income	33.46		*per dwelling unit*
Multi-Family	72.94	0.77	*per dwelling unit*
Mixed Use - MF	72.94	2.79	*per dwelling unit*
Mixed Use - Commercial	72.94	2.79	*per account*
Commercial	72.94	2.79	*per account*
Commercial Outside	111.98	3.43	*per account*

Note:

1. Per CM rate is applied to usage over the 10CM (or 20CM for Mixed Use) winter average usage.

The Finance and Administration Committee (F&A) on May 3, 2016 identified that there was an apparent discrepancy in the effective sewer rates being charged to the average residential user as compared to the average commercial /industrial user. The F&A Committee had the following observations:

- The average commercial/industrial user was paying less per cubic meter than the average residential user.
- The existing rate structure did not encourage water conservation in all classes of customers

Based on these observations, the City requested FCS to restructure its sewer rates. Specifically, the City requested FCS to design rates, such that, the average cost per cubic meter (CM) for an average Single Family Residential customer bill and an average Commercial customer bill would be equal. The requested rate structure is not based on a traditional cost of service analysis but rather is based on accomplishing the F&A Committee policy objectives.

Table 4 presents a simplified sensitivity analysis to show the effect of the existing sewer rate structure as compared to the alternative rate structure on both residential and commercial customers from a spectrum of monthly wastewater volume discharges. The alternative rate combines all classes of service into one rate schedule and maintains the existing approach to billing the variable rate to winter average use in excess of the 10 CM (20 CM for Mixed Use) allowance. The cost differences show only the change associated with moving from the existing rate structure to the alternative rate structure and do not incorporate any rate increases needed to implement the 5 year CIP and future operations costs.

Table 4: Impact on Rates of Alternative Rate Structure

RESIDENTIAL

Monthly CM	Existing		Alternative		$	%	
	Bill	$/CM	Bill	$/CM	Difference	Difference	*Notes:*
7.05	$ 72.94	$ 10.35	$ 49.20	$ 6.98	$ (23.74)	-32.55%	*Half the average use*
14.09	**76.09**	**5.40**	**69.34**	**4.92**	**(6.75)**	**-8.87%**	***Average Use***
28.19	86.94	3.08	138.68	4.92	51.73	59.50%	*Double the average use*
42.28	97.80	2.31	208.02	4.92	110.22	112.71%	*Three times the average use*

COMMERCIAL

Monthly CM	Existing		Alternative		$	%	
	Bill	$/CM	Bill	$/CM	Difference	Difference	*Notes:*
29.68	$ 127.86	$ 4.31	$ 146.05	$ 4.92	$ 18.19	14.23%	*Half the average use*
59.37	**210.68**	**3.55**	**292.10**	**4.92**	**81.42**	**38.64%**	***Average Use***
118.74	376.32	3.17	584.20	4.92	207.88	55.24%	*Double the average use*
178.11	541.97	3.04	876.30	4.92	334.33	61.69%	*Three times the average use*

The average monthly use for a residential customer is 14.09 CM. The breakeven usage level between the existing and alternative Residential rate structure is 15.7 CM per month. Under the alternative rate structure, all Residential (non Multi Family) customers using less than 15.7 CM per month show a reduced monthly bill. Customers using above 15.7 CM will experience an increase in their monthly bill. A customer using three (3) times the average would experience a 112.7 percent increase.

For commercial customers, the alternative structure increases most customers' bills compared to the existing structure. The average customer will experience an increase of 38.6 percent. Unlike Residential customers, the Commercial customer class is less homogenous in its usage behavior due to the different nature of each account (e.g. large grocery store versus a small business). This means usage will vary by individual customer and can deviate further from the average compared to the Residential class. A commercial customer using three (3) times the average would experience a 61.7 percent increase.

Table 5 shows the monthly rates under the alternative rate structure requested for the 2016-2020 time period. The rates are set to incorporate the proposed overall annual system increases of 12.7 percent in 2016-2017, 8.25 percent in 2018 and 2019 and 8 percent in 2020. The rate increases are required to meet the sewer system's overall financial obligations and provide sufficient revenue to implement the five-year capital improvement program.

Table 5: Monthly Sewer Utility Rates

Description	Alternative	2016	2017	2018	2019	2020
Proposed Increases		**12.70%**	**12.70%**	**8.25%**	**8.25%**	**8.00%**
Monthly Fixed Charges (Includes 10 CM)						
Single Family (per account)	$ 49.20	$ 55.45	$ 62.49	$ 67.65	$ 73.23	$ 79.09
Senior/ Disabled (per account)	22.57	25.43	28.66	31.02	33.58	36.27
Multi Family (per unit)	49.20	55.45	62.49	67.65	73.23	79.09
Commercial (per account)	49.20	55.45	62.49	67.65	73.23	79.09
Mixed Use						
Commercial (per account)	49.20	55.45	62.49	67.65	73.23	79.09
Per Residential (per unit)	49.20	55.45	62.49	67.65	73.23	79.09
Outside City	73.80	83.17	93.73	101.46	109.83	118.62
Volume Charges (per CM > 10 CM)						
Single Family	$ 4.92	$ 5.54	$ 6.24	$ 6.75	$ 7.31	$ 7.89
Senior/ Disabled	n/a	n/a	n/a	n/a	n/a	n/a
Multi Family	4.92	5.54	6.24	6.75	7.31	7.89
Commercial	4.92	5.54	6.24	6.75	7.31	7.89
Mixed Use*	4.92	5.54	6.24	6.75	7.31	7.89
Outside City	7.38	8.32	9.38	10.15	10.99	11.87

Table 6 provides both a residential and commercial bill comparison incorporating the 2016 rate increase of 12.7 percent and applying the alternative rate structure

Table 6: Bill Comparison – Existing to 2016 Rates (Alternative Rate Structure)

RESIDENTIAL

Monthly CM	Existing		Alternative		$	%	
	Bill	$/CM	Bill	$/CM	Difference	Difference	*Notes:*
7.05	$ 72.94	$ 10.35	$ 55.45	$ 7.87	$ (17.49)	-23.98%	*Half the average use*
14.09	**76.09**	**5.40**	**78.13**	**5.54**	**2.04**	**2.67%**	***Average Use***
28.19	86.94	3.08	156.20	5.54	69.26	79.66%	*Double the average use*
42.28	97.80	2.31	234.28	5.54	136.49	139.56%	*Three times the average use*

COMMERCIAL

Monthly CM	Existing		Alternative		$	%	
	Bill	$/CM	Bill	$/CM	Difference	Difference	*Notes:*
29.68	$ 127.86	$ 4.31	$ 164.50	$ 5.54	$ 36.64	28.66%	*Half the average use*
59.37	**210.68**	**3.55**	**328.96**	**5.54**	**118.28**	**56.14%**	***Average Use***
118.74	376.32	3.17	657.87	5.54	281.54	74.81%	*Double the average use*
178.11	541.97	3.04	986.78	5.54	444.81	82.07%	*Three times the average use*

GENERAL FACILITY CHARGES

The general facility charge is imposed as a condition of service on new customers connecting to the system. Revised Code of Washington 35.92.025 grants the authority to fix rates and charges for connecting to water and sewer systems. In addition to any other costs related to physically connecting a customer to the system, the connection fee is typically based on a blend of historical and planned future capital investments in system infrastructure

.

The purpose of the connection fee is two-fold: 1) to provide a source for capital financing and 2) to equitably recover a proportionate share of utility plant-in-service costs from new customers. In the absence of connection fees, growth-related costs would be borne in large part by existing customers. The cost of the system to be recovered by connection fees can be defined in two parts: an existing cost portion based on historical investments in existing infrastructure, and a future cost portion that recovers costs related to planned capital projects.

The existing cost basis is intended to recognize the current ratepayers' net investment in the original cost of system assets. The total cost of the sewer system reflects:

- ***Utility Plant-In-Service:*** The existing cost basis is composed of the original cost of plant-in-service, as documented in the City's 2015 fixed asset schedule.
- ***Less: Contributed Capital:*** Assets funded by developers or grants are excluded from the cost basis on the premise that the connection fee should only recover costs actually incurred by the City. Assets funded by special assessments are also excluded from the cost basis to avoid double charging customers for assets that were funded through those assessments. Of specific note is ULID No. 6 capital contributions.
- ***Plus: Interest on Utility-Funded Assets***: RCW 35.92.025 and subsequent legal interpretations provide a guideline for connection charges which suggests that such charges can include interest on an asset at the rate applicable during the time of construction. Using the historical Bond Buyer Index for 20-year term bonds, interest can accumulate for a maximum of ten years from the date of construction for any particular asset, and cannot exceed an interest earnings rate above 10% in any given year. Conceptually, this interest provision attempts to account for opportunity costs that the City's customers incurred by supporting investments in infrastructure rather than having it available for investment or other uses.
- ***Less: Net Debt Principal Outstanding:*** Another adjustment to the existing system cost basis is to deduct the net liability of outstanding utility debt, recognizing that new customers will bear a proportionate share of this debt related to existing assets through their utility rates. Therefore, the cost of those assets charged to new development is offset to some degree by the remaining debt liability. Since the utility typically has cash resources that are not included in the system cost basis, the net debt load is defined as total debt minus outstanding cash and investments.

Table 7 summarizes the key components of the existing cost basis.

Table 7: Existing Cost Basis

EXISTING COST BASIS	TREATMENT	COLLECTION	GENERAL	TOTAL
Plant in service	$ 12,505,821	$ 19,853,929	$ 1,361,110	**$ 33,720,860**
less: ULID #6 share	(2,224,558)	(15,239,703)		**(17,464,261)**
Plant net of ULID #6 share	**$ 10,281,263**	**$ 4,614,226**	**$ 1,361,110**	**16,256,599**
less: CIAC (City)	(1,090,956)	(125,331)	-	**(1,216,287)**
plus: Interest (City)	3,598,664	2,508,171	687,679	**6,794,514**
less: Net debt principal outstanding	(1,020,508)	(558,337)	(163,485)	**(1,742,331)**
TOTAL EXISTING COST BASIS	**$ 11,768,463**	**$ 6,438,728**	**$ 1,885,304**	**$ 20,092,496**

The future cost basis can include utility capital projects planned for construction and identified in the WWFP Update for the next five years. Each project in the capital improvement program was allocated as either "growth/expansion" or "repair/replacement."

- ***Total Future Capital*:** Total capital costs for the 2016 through 2020 time period in 2016 dollars.
- ***Repair and Replacement (R&R) Projects:*** Projects costs allocated to the repair/replacement category are excluded from the cost basis. The cost of the utility asset being replaced is included in the existing cost basis. Excluding repair/replacements avoids double-counting the cost of a utility asset by including it in both existing and future cost totals.

Table 8 summarizes the key components of the future cost basis.

Table 8: Existing Cost Basis

FUTURE COST BASIS	TREATMENT	COLLECTION	GENERAL	TOTAL
Total future capital	$ 12,250,000	$ 1,289,000	$ 625,000	**$ 14,164,000**
less: R&R	(2,372,350)	(615,450)	(251,750)	**(3,239,550)**
TOTAL FUTURE COST BASIS	**$ 9,877,650**	**$ 673,550**	**$ 373,250**	**$ 10,924,450**

In order to calculate an equitable share of the system costs for new connections, the GFC cost basis is divided by the number of equivalent residential units (ERUs) the system can serve when the five-year CIP is complete. The total GFC cost basis, divided by total capacity served by the system, determines the equitable unit cost of system buy-in as a basis for setting the GFC. The engineering analysis indicated that the five-year CIP would support a capacity of 4,492 ERUs estimated to be reached in 2029.

The general facility charge calculation is summarized in **Table 9**. The charge was split between City and ULID as all customers share in the treatment and general costs, however the ULID is not charged for collection infrastructure as it is recovered through the ULID No.6 assessment.

Table 9: Existing Cost Basis

GENERAL FACILITY CHARGE	TREATMENT	COLLECTION	GENERAL	TOTAL
EXISTING COST BASIS				
Combined Share				
Existing cost basis	$ 11,768,463		$ 1,885,304	**$ 13,653,768**
Allocable base (ERUs)	4,492		4,492	
Combined Share Existing Cost Basis Charge	**$ 2,620**	**$ -**	**$ 420**	**$ 3,040**
City Only Share				
Existing cost basis		$ 6,438,728		**$ 6,438,728**
Allocable base (MCEs)		3,298		
City Only Share Eixsting Cost Basis Charge	**$ -**	**$ 1,952**	**$ -**	**$ 1,952**
FUTURE COST BASIS				
Combined Share				
Future cost basis	$ 9,877,650		$ 373,250	**$ 10,924,450**
Allocable base (MCEs)	2,200		2,200	
Combined Share Future Cost Basis Charge	**$ 4,490**	**$ -**	**$ 170**	**$ 4,659**
City Only Share				
Future cost basis		$ 673,550		**$ -**
Allocable base (MCEs)		1,180		
City Only Share Future Cost Basis Charge	**$ -**	**$ 571**	**$ -**	**$ 571**
TOTAL GENERAL FACILITY CHARGE - CITY	$ 7,110	$ 2,523	$ 589	**$ 10,222**
TOTAL GENERAL FACILITY CHARGE - ULID	$ 7,110	$ -	$ 589	**$ 7,699**

The updated GFC is $10,222 per ERU for City customers and $7,699 per ERU for ULID customers. The current charge is $5,852 and is based on the water meter size of new customers. The updated charge has changed this assessment to be based on an ERU equivalent. One ERU is defined as 2.57 persons per household.

It is anticipated that the GFC will be updated automatically increased each year on January 1st, compared to the prior year, by the percentage reflected in the Seattle ENR Construction Cost Index (CCI).

SUMMARY

The results of this analysis indicate that rate increases are necessary to fund ongoing operating needs and future debt requirements to fund the five-year CIP, as well as meet financial policy targets. Implementation of a 12.7 percent rate increase in 2016 and 2017, 8.25 percent annually in 2018 and 2019 and 8% in 2020 should provide for continued financial viability of the sewer system.

The alternative rate structure presented incorporate the overall system rate increases and adjust rates so that an average Residential user bill and average Commercial user bill results in an equal per CM unit rate. In addition, the rates accomplish the F&A Committee policy objectives of having an equal per CM rate for an average residential user bill and commercial/industrial user bill and enhance the water conservation signal by charging for use at a higher variable rate.

It is important to remember that the analysis performed in this memorandum assumes an annual growth rate of 4.33. If the future growth rates change, the proposed annual rate increases will need to be updated

and revised as the anticipated revenue may not be realized if growth is slower than estimated. If growth occurs at a greater rate than estimated, revenue targets will likely be exceeded therefore allowing less debt to be required in the future for capital projects and/or reducing future anticipated rate increases.

It is recommended that the City regularly review and update the key underlying assumptions that compose the multi-year rate plan to ensure that adequate revenues are collected to meet the City's total financial obligations.

City Council Agenda Bill for Sewer Rate and General Facilities Charge Revisions

City Council Agenda Bill

SUBJECT:	Agenda Date: July 19, 2016 AB16-076	
Continuation of Public Hearing and Ordinance Updating Sewer Utility Rates and General Facilities Charges	Department/Committee/Individual	
	Mayor Ken Hearing	
	City Administrator – Londi Lindell	X
	City Attorney - Mike Kenyon	
	City Clerk – Susie Oppedal	
	Community & Economic Development – Gina Estep	
Cost Impact: N/A	Finance – Dawn Masko	X
Fund Source: N/A	Public Works – Mark Rigos, P.E.	X
Timeline: Immediate		

Attachments: Ordinance; FCSG June 16, 2016 Sewer Rate Report; Sewer Rate Comparison Chart; July 7, 2016 Town Hall Power Point Presentation; Town Hall Sign Up Sheet; June 21, 2016 FCSG Power Point Presentation; List of $15.6M Sewer Plant Capital Projects; 6% Utility Tax Impact on Residential Ratepayer, Written Public Comments; Public Hearing Notice

SUMMARY STATEMENT:

Background

In 2013 then Public Works Director Frank Page and consultant John Markus with Tetra Tech identified numerous problems at the City of North Bend's aging 1950s Wastewater Treatment Plant ("Sewer Plant") and presented a list of 29 proposed Sewer Plant improvements to the City Council. The Council approved an emergency contract in 2014 and early 2015 to solve 3 of those problems. Since then, the condition of the remaining 26 issues at the Sewer Plant have continued to degrade. The City Council has invested approximately $3 million into both improvements and analyzing the best long term solution to the problem during the last 3 years.

Capital Facilities Plan-Sewer Comprehensive Plan

Because of the growing list of needs at the Sewer Plant and unprecedented growth in the City and in order to comply with the City's permit requirements, the City Council authorized a contract with Tetra Tech for the preparation of a Wastewater Capital Facilities Plan, Sewer Comprehensive Plan, and Sewer Rate Study to study the best long term solution to handling the citizen's sewer needs. Council directed that consistent with Council's policy direction that "growth pay for growth" new development must pay its proportional share of the Sewer Plant upgrades to insure that rate payers are not subsidizing any portion of such development. The Capital Facilities Plan studied 3 alternatives and ultimately both Council and the citizens who attended the public meetings supported the least expensive option of remodeling the existing Sewer Plant ($27 Million) as opposed to building a new plant in a different location in North Bend ($53 Million) or contracting with a regional provider ($63 Million). The benefit of a Capital Facilities Plan is it will allow the City to implement future capital improvements expeditiously through Department of Ecology without needing individual design reports which are a lengthy permit requirement. Once Ecology has approved the City's Capital Facility Plan, the door to low-interest loans and potential grant funding will be available to North Bend.

Why Must Rates and GFCs Increase?

A sewer utility is an enterprise fund which means it must be self-supporting. The two primary forms of revenue for this fund are from existing rate payers who pay a monthly fee and from new users who wish to hook up to the system and pay a one-time connection fee which is called a General Facility Charge ("GFC"). The Capital Facilities Plan has clearly identified and documented the capital needs of the Sewer Plant through 2036. The List of Capital Projects totally $15.6 million attached to this Agenda Bill are proposed to be made at the Sewer Plant during the next 5 years after the rate increase and under the Capital Facilities Plan these will be all the necessary improvements for the Sewer Plant through the year

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2029. In addition, there will be increases to the Operation and Maintenance (O&M) at the plant as a result of the construction of these new capital improvements at the Sewer Plant (e.g. power, chemicals, sludge handling). Further, due to regulatory requirements and in order to deal with issues associated with Inflow and Infiltration (I&I), new employees will be added to inspect the aging and failing sewer collection and manhole system which feeds into the Sewer Plant. Both the capital improvements and the new O&M costs will be paid for with the proposed increase in rates and GFCs.

How Were Increases in the Sewer Rates and GFC Calculated?
FCS Group of Redmond, WA was selected to complete a rate study on the City's sewer rates. FCSG studied the Capital Facilities Plan prepared by Tetra Tech, the need for $15.6 million dollars in capital improvements, the need for various increases in Operation and Maintenance (O&M) and presented suggested increases in monthly sewer rates and GFCs to first Council Committees and ultimately the entire City Council.

On May 3rd staff presented a proposed rate increase to the Finance and Administration Committee (F&A) which followed the City's existing rate structure – a simple across the board percentage increase to the base charge and usage charge, with no change to the generally flat rate structure. The F&A Committee did not agree with staff's recommendation and asked the consultant to prepare new rates as follows:

1. Provide rate equality between the residential customers and the commercial customers because residential customers had been subsidizing commercial uses under the old rate structure;
2. Lower the base fixed charge rate and increase the variable usage charge in order to encourage water conservation; and
3. If possible, keep the average single-family residential bill below $100 per month at the end of 5 years.

The consultant was able to achieve the first two objectives but not the third objective and a revised rate structure was then presented to the F&A Committee on June 7, 2016 and to the Transportation and Public Works Council Committee on June 8, 2016. Upon review of the revised rate structure, the F&A Committee requested that the rates and GFCs be further adjusted to better align with the Council's goal that "growth pay for growth". Tetra Tech, FCSG, and City staff subsequently further adjusted the revenues between the rates and the GFCs.

The attached June 16, 2016 FCSG Report and power point presentation describes in detail the assumptions, findings and calculations for the new rate structure. In short, the fixed fee has been reduced for all users and the variable fee (usage charge) has been raised. See page 19 of the July 7, 2016 Town Hall Power Point Presentation to see the division between the base rate and variable rate for a typical residential rate payer. This rate structure will encourage water conservation for all users. If Council adopts the attached Ordinance, the below shows the impact on an average rate payer over the next 5 years:

Date	Sewer Rate
Today	$76.09
9-1-16	$78.11
1-1-17	$88.01
1-1-18	$95.26
1-1-19	$103.13
1-1-20	$111.36

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In addition to the sewer rates, FCSG performed a study of the General Facilities Charges (GFCs). The current connection fee or GFC to hook up to the Sewer Plant is $5,840. In calculating the new GFCs, FCSG took into account the improvements necessary for the growth of the community and the assessments that Utility Local Improvement District ("ULID") customers are already obligated to pay. FCSG recommended a variable GFC charge, with ULID customers paying less ($7,699) than non-ULID customers ($10,222).

Public Hearing

On June 21, 2016, the City Council opened the public hearing and staff made a presentation during which time staff strongly recommended revising the sewer rates and GFCs as attached in order to fund the improvements necessary to the sewer system, which will affect repairs to inadequate or damaged equipment, as well as providing funding for needed future capacity improvements within the Sewer Plant. Following the public hearing, Council requested staff conduct a Town Hall Meeting and provide additional opportunity for citizens to learn more about the reasons for the sewer rate increases. Staff provided an optional Sewer Plant tour and a Town Hall Meeting on July 7, 2016. Approximately 25 to 30 people attended the meeting (not all persons signed the Sign Up Sheet) and approximately 8 people attended the tour. A slight majority of persons who signed the "Sign Up Sheet" were currently on septic and would not be affected by the rate increase unless they later elected to connect to public sewer. Staff will present a condensed version of the attached Town Hall Power Point presentation to the City Council during the continued Public Hearing and summarize some of the issues raised at the Town Hall Meeting as follows:

- Winter Averaging. A number of citizens asked the City to consider winter averaging. Staff advised the citizens that the proposed ordinance contains the following specific language: "For the months of April through October, consumption amounts for sewer services will be based on the average water consumption during the months of November through March, so as not to penalize sewer customers using water for lawn and garden irrigation and other summer activities." This resolved the citizen's concerns about this issue as the City does perform winter averaging and accordingly a citizen is not penalized for watering their lawn or washing their car as incorrectly reported in social media.
- Comparable City/Districts Sewer Rates. One citizen asked that the Council consider comparable sewer rates from surrounding jurisdictions and then set North Bend's sewer rate based upon such comparable rates. Councilmember Volken who is also a member of the F&A Committee mentioned that his committee considered this comparable data (attached) but that this information is not significantly relevant in determining a necessary rate for purposes of the Sewer Plant. Councilmember Volken mentioned the attached chart showed a large variable of over $100 a month (Seattle, Shelton and Chehalis) to as low as under $28 a month (Edmonds) and that such variables appeared related to circumstances associated with each plant such as large regional providers (e.g. Metro and Brightwater) may have efficiencies of scale which North Bend does not have and also that each sewer utility is unique. Mr. Volken also mentioned the deferred maintenance of the City's Sewer Plant (collection system and treatment plant) as a unique circumstance justifying the rate increases.
- Cut Other City Services. One citizen suggested the City Council closely review its entire budget to look for savings and consider zero based budgeting. During the last 10 years, Council has only taken the 1% property tax increase twice and has consistently conservatively reviewed the budget seeking programming and staff savings. This type of review is more appropriate during the Biennial Budget process. Staff discussed legal limitations surrounding a utility fund as an enterprise fund and how this fund needs to be self-supporting and be funded from a combination of rates and GFCs.
- Equipment Replacement Fund. One citizen asked why there were not funds in an equipment

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replacement fund to pay for the $27 million dollars of improvements being recommended by the Capital Facilities Plan. Mayor Ken Hearing discussed a prior City Council's decision to reduce equipment replacement reserves due to the 10 year water moratorium but how this Council was slowly building back up such equipment reserves.

- Utility Tax. One citizen suggested the City eliminate the 6% utility tax on all sewer bills. The attached slide entitled Impact on Typical Residential Ratepayer has been revised to include a new orange bar showing the addition of the 6% utility tax, as requested by this citizen. State law authorizes cities such as North Bend to impose a uniform utility tax on all utility services (private and public utilities such as water, sewer, cable TV, phone, internet, gas, power, etc.) under RCW 35A.82.020 which is the enabling provision for a code city such as North Bend. The North Bend City Council adopted such a utility tax in 2003 and this has been an important component of funding a significant portion of your General Fund. See Chapter 5.06 of the North Bend Municipal Code. The majority of the City's General Fund covers the City Council's number one governmental priority - public safety for police and fire services. The City collects approximately $1 million dollars a year in utility taxes to fund its $7.6 million General Fund from these various private and public utility entities (including the City of North Bend sewer enterprise fund). There are constitutional requirements for uniform taxation so it is difficult to selectively remove a utility tax from one utility but leave it in place for all other utilities. The General Fund could simply not survive a million dollar reduction in revenue and still continue to deliver the necessary public safety services you have identified as basic government services.
- Design/Build/Operate Option. One citizen suggested that the City should study this option not only in connection with the actual construction of various phases of the necessary capital improvements identified in the Capital Facilities Plan but that the City should have advertised the entire Sewer Plant and all staffing needs for such Sewer Plant as a "Design/Build/Operate" option in connection with the options studied as part of the Capital Facilities Plan. Our consultant from Tetra Tech correctly stated that these types of design/build/ for the construction portion of public projects (not including privatization of the work force) generally did not pencil out unless they were a minimum dollar amount which generally exceeded our $27 million dollar price tag. Although not mentioned by Tetra Tech, the nature of our proposed improvements is that they will be advertised and bid in phases over an approximately 5 year period of time and by various subcontractors based upon the nature of the work (See attached list of capital improvements). Accordingly, the City project would not be of a dollar amount and scope compatible with a typical design/build project. Tetra Tech did share at the Town Hall meeting that the City had attempted the design/build option in connection with the purchase of the UV equipment for the Sewer Plant this year but after the promised savings turned out to be false returned to the traditional bid process in purchasing the equipment and constructing the project. As Council may recall, the City also studied this option in connection with our Civic Center and again, we learned the purchase price for the Civic Center was not sufficient to generate interest for such an option. We are happy to consider this method in pursuing construction of various portions of these capital projects if we believe we can generate cost savings.

Tonight, Council has continued the June 21, 2016 public hearing in order to provide an additional opportunity for additional public comment and input to these increasing sewer rates and GFCs.

Conclusion

The City has been aware of significant deficiencies at its Sewer Plant for almost 4 years and has been studying the best long term solution with its consultant in consultation with Department of Ecology. The final draft of North Bend's Capital Facilities Plan has identified $15.6 million in improvements through the year 2029 to address various regulatory problems, inflow and infiltration issues, collection system

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issues, staffing issues, O&M and accordingly, it is time to increase sewer rates and the City's connection fee or GFC to fully fund the improvements and ongoing operation costs. Staff encourages Council to adopt the attached Ordinance providing for this additional revenue.
COMMITTEE REVIEW AND RECOMMENDATION: This item was reviewed by the Finance and Administration Committee at their June 7, 2016 meeting who recommended revisions. This item represents the revisions recommended.
RECOMMENDED ACTION: **MOTION to approve AB16-076, an ordinance setting new Sewer Rates and General Facilities Charges and amending the Taxes, Rates & Fees Schedule, as a first and final reading.**

RECORD OF COUNCIL ACTION

Meeting Date	*Action*	*Vote*
June 21, 2016	AB16-070 Continued to July 19, 2016	
July 19, 2016		

Sewer Rate Revision Ordinance

ORDINANCE

AN ORDINANCE OF THE CITY OF NORTH BEND, WASHINGTON, INCREASING SEWER UTILITY RATES AND SEWER GENERAL FACILITY CHARGES AND AMENDING THE TAXES, RATES, AND FEES SCHEDULE

WHEREAS, the City of North Bend ("City") operates a sewer and stormwater utility as authorized by Chapter 35.67 RCW; and

WHEREAS, general facilities charges ("GFCs") are collected by the City for each new Equivalent Residential Unit added to the sewer utility, and those GFCs are designated to pay for a proportionate share of the existing sewer infrastructure as well as a proportionate share of future capital projects over a five-year period; and

WHEREAS, the City's existing sewer customers are responsible for paying for repairs to existing infrastructure within the sewer system; and

WHEREAS, the City Council adopted Ordinance 1084, the Taxes, Rates and Fees Schedule, effective November 2, 1999; and

WHEREAS, the Taxes, Rates and Fees Schedule, which includes sewer rates and GFCs, was last amended by Ordinance 1586, effective May 16, 2016; and

WHEREAS, the City last studied and adjusted sewer rates and GFCs in 2012; and

WHEREAS, the cost of operations to process sewer has increased at a rate equal to or higher than inflation; and

WHEREAS, numerous needs have been identified at the wastewater treatment plant (WWTP) in order to continue providing sewer service in the City; and

WHEREAS, the City contracted with Tetra Tech, Inc. to develop a Sewer Capital Facilities Plan, Sewer Comprehensive Plan, and Sewer Rate Study; and

WHEREAS, Tetra Tech, Inc. has identified approximately $15 million worth of capital improvement projects at the WWTP to be accomplished within the next five years; and

WHEREAS, the City's sewer rates and GFCs have been re-calculated to recover costs necessary to make improvements to repair those existing deficiencies identified during the planning process with Tetra Tech, Inc.; and

WHEREAS, the City Council desires to revise the sewer rate structure such that all classes of customers are subject to the same base rate and usage fees, except seniors, low-income, and those customers outside the City limits; and

WHEREAS, the City Council desires to revise the sewer rate structure to encourage water conservation practices by lowering the base fixed fee and raising the variable usage fee; and

WHEREAS, the City Council finds it appropriate to the amend Taxes, Rates and Fees Schedule to reflect increased costs associated with providing sewer services as well as sewer public facilities and infrastructure;

NOW, THEREFORE, THE CITY COUNCIL OF THE CITY OF NORTH BEND, WASHINGTON, DOES HEREBY ORDAIN AS FOLLOWS:

Section 1. Sewer Rates. The Taxes, Rates, and Fees Schedule as adopted by Ordinance 1084 and last amended by Ordinance 1586, is amended in part by repealing Section 13.36, *Sewer Rates*, and replacing it with a new Section 13.36, *Sewer Rates*, to read as follows:

13.36	**Sewer Rates**	
13.36.190	Sewer Permits – Application Fee, Review & Inspection	$50 plus actual cost for application review and installation inspection

13.36.270(A)

DESCRIPTION		TAX, RATE, OR FEE	TAX, RATE, OR FEE	TAX, RATE, OR FEE	TAX, RATE, OR FEE	TAX, RATE, OR FEE
		Effective 9/1/2016	**Effective 1/1/2017**	**Effective 1/1/2018**	**Effective 1/1/2019**	**Effective 1/1/2020**
Single-family Residential Units (inside City limits) including duplexes, triplexes, apartment houses, condominiums, trailer courts & other multifamily, **provided each unit is supplied with a separate water meter**		$ 55.45	$ 62.49	$ 67.65	$ 73.23	$ 79.09
PLUS						
per cubic meter of water usage		$ 5.54	$ 6.24	$ 6.75	$ 7.31	$ 7.89

	over the first **ten** CM						
	Senior/Low Income Rate		$ 25.43	$ 28.66	$ 31.02	$ 33.58	$ 36.27
13.36.270(B)			**Effective 9/1/2016**	**Effective 1/1/2017**	**Effective 1/1/2018**	**Effective 1/1/2019**	**Effective 1/1/2020**
	Multi-family Residential: single family, duplexes, triplexes, apartment houses, condominiums, trailer courts & other multi-family dwellings(**inside City limits**) **served jointly by one water meter,** *per unit*		$ 55.45	$ 62.49	$ 67.65	$ 73.23	$ 79.09
	PLUS						
	per cubic meter of water usage over the first **ten** CM		$ 5.54	$ 6.24	$ 6.75	$ 7.31	$ 7.89
13.36.270(C)			**Effective 9/1/2016**	**Effective 1/1/2017**	**Effective 1/1/2018**	**Effective 1/1/2019**	**Effective 1/1/2020**
	Mixed Use (residential/commercial) **(inside City limits)***served by one water meter*:						
	One Commercial Base Charge		$ 55.45	$ 62.49	$ 67.65	$ 73.23	$ 79.09
	PLUS						
	MultiFamily Charge *(per each Residential unit)*		$ 55.45	$ 62.49	$ 67.65	$ 73.23	$ 79.09
	PLUS						
	per cubic meter of water usage (at Commercial Rate) over the first **twenty** CM		$ 5.54	$ 6.24	$ 6.75	$ 7.31	$ 7.89
13.36.270(D)			**Effective 9/1/2016**	**Effective 1/1/2017**	**Effective 1/1/2018**	**Effective 1/1/2019**	**Effective 1/1/2020**

	Commercial and All Other Users (inside City limits)	$ 55.45	$ 62.49	$ 67.65	$ 73.23	$ 79.09
	PLUS					
	per cubic meter of water usage over the first **ten** CM	$ 5.54	$ 6.24	$ 6.75	$ 7.31	$ 7.89
13.36.270(E)		**Effective 9/1/2016**	**Effective 1/1/2017**	**Effective 1/1/2018**	**Effective 1/1/2019**	**Effective 1/1/2020**
	Commercial and All Other Users (**outside** City limits)	$ 83.17	$ 93.73	$ 101.46	$ 109.83	$ 118.62
	PLUS					
	per cubic meter of water usage over the first **ten** CM	$ 8.32	$ 9.38	$ 10.15	$ 10.99	$ 11.87

13.36.270(F) If any user, by reason of the user's activities, in in two or more of the above classifications, the rate charged shall be the highest rate.

13.36.270(G) Sewer Charge – Independent Water Purveyor

13.36.270(H) Sewer Charge – Private Source

13.36.270(J) Sewer Service Surcharge 6% of Total Monthly Charges

The rates published are effective as of the dates noted; provided, that the last-effective published rates will be automatically increased/decreased based on CPI-W Index for Seattle/Tacoma area (August to August comparison) for each subsequent year beginning January 1, 2021. For the months of April through October, consumption amounts for sewer services will be based on the average water consumption during the months of November through March, so as not to penalize sewer customers using water for lawn and garden irrigation and other summer activities.

Section 2. General Facilities Charges: The Taxes, Rates and Fees Schedule as adopted by Ordinance 1084 and last amended by Ordinance 1586, is amended in part by repealing Section 13.38.040(A) and replacing it with a new Section 13.38.040(A) to read as follows:

13.38.040(A)

	Effective 09/01/16*		
Equivalent Residential Unit (ERU) Based on water meter size:	**ERUs**	**Charge Non-ULID #6**	**Charge ULID #6**
5/8" or 3/4"	1	$ 10,222.00	$ 7,699.00

1"	2.5	$ 25,555.00	$ 19,247.50
1-1/2"	5	$ 51,110.00	$ 38,495.00
2"	8	$ 81,776.00	$ 61,592.00
3"	16	$ 163,552.00	$ 123,184.00
4"	25	$ 255,550.00	$ 192,475.00

*The charges in this table will be automatically increased each year on January 1st, compared to the prior year, by the percentage reflected in the Seattle ENR Construction Cost Index (CCI).

Section 3. Severability: Should any section, paragraph, sentence, clause or phrase of this ordinance, or its application to any person or circumstance, be declared unconstitutional or otherwise invalid for any reason, or should any portion of this ordinance be pre-empted by state or federal law or regulation, such decision or pre-emption shall not affect the validity of the remaining portions of this ordinance or its application to other persons or circumstances.

Section 4. Effective Date: This ordinance shall be published in the official newspaper of the City, and shall take effect and be in full force on September 1, 2016.

ADOPTED BY THE CITY COUNCIL OF THE CITY OF NORTH BEND, WASHINGTON, AT A REGULAR MEETING THEREOF, THIS 19TH DAY OF JULY, 2016.

CITY OF NORTH BEND:

_____

Kenneth G. Hearing, Mayor

APPROVED AS TO FORM:

_____

Michael R. Kenyon, City Attorney

ATTEST/AUTHENTICATED:

_____

Susie Oppedal, City Clerk

Published:
Effective: September 1, 2016

Sewer Rate Change
Frequently Asked Questions

NORTH BEND
easy to reach. . .hard to leave

NOTICE: OCTOBER BILL WILL REFLECT CHANGE IN SEWER RATES
FAQs

1. *Why is my sewer bill increasing?*
   Many of the processes at the wastewater treatment plant are in need of repair or replacement and are a risk to human health and the environment during intense wet weather conditions. Many sewer bills may increase because of the sewer rate change, however if you choose to conserve water, then it's possible that your sewer bill could reduce or be nearly equivalent.

2. *Are sewer rates increasing for businesses and homes?*
   Yes.

3. *What are these rates going toward?*
   These rates are going only towards our Sewer Utility, which is an Enterprise Fund, and must be self-supporting. The funds derived from this rate increase will pay for the necessary improvements to insure that the sewage that is conveyed to the wastewater treatment plant is treated and discharged in a safe, consistent and reliable manner.

4. *Do I get charged for additional sewer costs for watering my lawn?*
   No. During the months of April through October, water consumption amounts for sewer services are based on the average water consumption during the months of November through March, so as not to penalize sewer customers for using water for their lawn, garden irrigation and other summer activities.

5. *I have heard there are problems at the City's Wastewater Treatment Plant. Is this money going to the WWTP?*
   Yes. Several of the pumping systems in the wastewater collection system and processes at the WWTP have reached their design life and upgrades are needed. Other upgrades are also needed to achieve compliance with current regulations from WA State Department of Ecology including but not limited to the process system redundancy (having backup systems), process controls and alarming systems, effluent temperature limitations, odors, nitrogen and phosphorus loads contained in the treated effluent discharged to the river, and beneficial reuse of biosolids, and additional operations and maintenance costs needed to maintain existing and new assets.

6. *Why can't we build a new WWTP instead?*
   We can, but it would cost North Bend ratepayers more than double, so sewer rates would increase more than double the current increase. The City's consultant estimated that a new WWTP would cost approximately $53 million including land acquisition, which would be far more than the 15.6 million to construct the improvements at the existing WWTP over the next 5 years. There is also the possible addition of $11 million in other projects that could start to be incurred beginning in 2027.

7. *Are developers paying their fair share?*
   Yes, developers are paying their fair share. The City's sewer GFC (general facility charge) nearly doubled from $5,840 to $10,222 for new sewer connections that are not part of ULID #6. A GFC for a customer that is in ULID #6 increased from $5,840 to $7,699. Existing ratepayers are not subsidizing the cost of upgrading the collection or treatment plant infrastructure for new housing or commercial development. Our policy is to ensure that "growth pays for growth".

8. *Where can I get more information?*
   You can get more information about the rate increase by calling the City's Public Works Department at (425) 888-0486. Additional information is also included in various City Council Meeting packets, available on the City of North Bend Website under the "Document Center".

Minutes of City Council Meeting Adopting Sewer Rate Revision

NORTH BEND CITY COUNCIL MINUTES
July 19, 2016
Senior Center, 411 Main Ave. S., North Bend, Washington

CALL TO ORDER, ROLL CALL:

Mayor Hearing called the regular meeting to order at 7:00 p.m.

Councilmembers Present: Elwood, Gothelf, Kostanich, Loudenback, Pettersen, Rosen and Volken.

CONSENT AGENDA:

Minutes – Council Meeting of June 21, 2016
Payroll – June 20, 2016 – 27486 through **27492,** in the amount of **$153,779.61**
July 5, 2016 – 27493 through **27499,** in the amount of **$196,848.09**
Checks – July 5, 2016 – 62962 through **63023,** in the amount of **$823,782.55**
July 19, 2016 – 63024 through **63086,** in the amount of **$189,382.92**
AB16-074 – Resolution 1717 Awarding Ribary Creek Sediment Removal Project to Fury Site Work
AB16-075 – Motion Authorizing Bill of Sale for Torguson Park Picnic Shelter

Councilmember Rosen **MOVED,** seconded by Councilmember Loudenback to approve the consent agenda as presented. The motion **PASSED** 7-0.

CITIZEN'S COMMENTS:

Dave Olson, 440 Main Avenue S, provided an update on Kiwanis activities and the upcoming Night on a Dark Trail Event.

Presentation – Police Services Mid-Year Update **Audio: 4:30**

Interim Police Chief Schaffer provided a mid-year update on police services which included the following items: staffing, calls for service, patrol statistics, community oriented policing events, records/evidence, and 2016 challenges and goals.

COMMISSION AND COMMITTEE REPORTS:

Events Coordinator Cepeda provided a report on July 16th Downtown Block Party & July 17th Legends Car Show.

Planning Commission
A report of the July 14th meeting was provided.

Parks Commission
No report. The next meeting is scheduled for July 20, 2016.

Economic Development Commission
No report.

Community & Economic Development Committee – Councilmember Pettersen, Chair
A report of the July 19th meeting was provided.

Finance & Administration Committee – Councilmember Rosen, Chair
No report. The next meeting is scheduled for August 2, 2016.

Public Health & Safety Committee – Councilmember Gothelf, Chair
A report of the July 12th meeting was provided.

Transportation & Public Works Committee – Councilmember Loudenback, Chair
A report of the July 13th meeting was provided.

Council Workstudy – Mayor Pro Tem Loudenback
A report of the June 28th Council Workstudy was provided.

Eastside Fire & Rescue Board Meeting – Councilmember Gothelf
A report of the July 14th meeting was provided.

INTRODUCTIONS:

AB16-076 – Public Hearing Cont., Ordinance 1592 Amending Taxes, Rates & Fees Schedule RE Sewer Rates & GFC's **Audio: 46:03**

City Administrator Lindell provided the staff report.

Mayor Hearing announced the Public Hearing on an Ordinance Amending Taxes, Rates & Fees Schedule RE Sewer Rates & GFC's was opened at the June 21, 2016 City Council meeting and continued to tonight's meeting.

The following spoke regarding the Sewer Rates & GFC's:

Garret Parsons, 1095 Patkanim Ave SE

John Krauss, 425 SE 7th Street

Mayor Hearing closed the Public Hearing at 8:18 p.m.

Councilmember Loudenback **MOVED,** seconded by Councilmember Gothelf to approve AB16-076, an ordinance setting new Sewer Rates and General Facilities Charges and amending the Taxes, Rates & Fees Schedule, as a first and final reading. The motion **PASSED** 6-1 (Elwood).

AB16-077 – Ordinance 1593 Establishing Line of Credit for WWTP Projects **Audio: 1:40:03**

City Administrator Lindell provided the staff report.

Councilmember Rosen **MOVED,** seconded by Councilmember Gothelf to approve AB16-077, an ordinance establishing a line of credit and providing for the issuance and sale of a Limited Tax General Obligation Bond in the principal amount not to exceed $3,500,000, as a first and final reading. The motion **PASSED** 7-0.

AB16-078 – Ordinance 1594 Amending NBMC 14.12 RE Floodplain Management **Audio: 1:43:01**

Senior Planner McCarty provided the staff report.

Councilmember Pettersen **MOVED,** seconded by Councilmember Loudenback to approve AB16-078, an ordinance amending NBMC 14.12 relating to Floodplain Management, as a first and final reading.

Due to technical difficulties with the video recording equipment, Mayor Hearing recessed the City Council meeting for a five minute break at 8:49 p.m.

Mayor Hearing called the meeting back to order at 8:55 p.m.

Councilmember Pettersen **MOVED,** seconded by Councilmember Loudenback to include language in the ordinance amending NBMC 14.12 which would waive the permit fees for structures under 200 square feet. The motion **PASSED** 7-0.

The main motion then **PASSED AS AMENDED** 7-0.

AB16-079 – Ordinance 1595 Adopting NBMC 17.40 RE Impact Fee Deferral **Audio: 1:56:11**

Community & Economic Development Director Estep provided the staff report.

Councilmember Pettersen **MOVED,** seconded by Councilmember Rosen to approve AB16-079, an ordinance adopting North Bend Municipal Code Chapter 17.40 to establishing an Impact Fee Deferral Process, as a first and final reading. The motion **PASSED** 7-0.

AB16-080 – Resolution 1718 Setting Administrative Fee RE Impact Fee Deferral Process **Audio: 2:04:08**

Community & Economic Development Director Estep provided the staff report.

Councilmember Pettersen **MOVED,** seconded by Councilmember Loudenback to approve AB16-080, a resolution setting an administrative fee for requests to defer impact fees for single family detached and attached residential construction in accordance with NBMC 17.40.030. The motion **PASSED** 7-0.

AB16-081 – Motion Authorizing Contract with Downtown Association **Audio: 2:07:49**

Community & Economic Development Director Estep provided the staff report.

Councilmember Pettersen **MOVED,** seconded by Councilmember Rosen to approve AB16-081, authorizing a contract for services with the North Bend Downtown Foundation to operate and manage the North Bend Visitor Information Center for 2016, in a form and content acceptable to the City Attorney. The motion **PASSED** 7-0.

AB16-082 – Resolution 1719 Awarding 2016 Pavement Overlay Project to Lakeridge Paving **Audio: 02:11:15**

Public Works Director Rigos provided the staff report.

Nela Cumming, Executive Director of Encompass, 1407 Boalch Avenue NW, spoke in support of the additive bid for NW 14th Street improvements.

Councilmember Loudenback **MOVED,** seconded by Councilmember Elwood to approve AB16-082, a resolution awarding a contract for the 2016 Overlay Project to Lakeridge Paving Company, LLC, for the Base Bid with Bid Additive, in the amount of $387,236.50, in a form and content acceptable to the City Attorney. The motion **PASSED** 7-0.

MAYOR, COUNCIL, AND ADMINISTRATOR CONCERNS AND INITIATIVES:

Councilmember Gothelf thanked staff for all of their hard work on the Downtown Block Party and acknowledged Nela Cumming for her involvement in the Fire Strategic Plan.

Councilmember Elwood encouraged those invited to attend an upcoming event for Meadowbrook Farm and noted tickets were still available for Valley Center Stage's production of Alice's Adventures in Wonderland.

Councilmember Kostanich echoed Councilmember Gothelf comments regarding the Block Party and thanked staff for their efforts pertaining to the sewer rate increase.

Councilmember Volken commented he was looking forward to the candidate interviews

for the Economic Development Commission.

City Administrator Lindell thanked staff for their hard work and citizens for providing input regarding the sewer rate increase. Additionally, she thanked Community & Economic Development Director Estep and her staff for their efforts regarding the Torguson Park Picnic Shelter.

Mayor Hearing spoke regarding the following items:

- $100,000 collected during July 9th & 10th Relay for Life Fundraising Event
- July 16th & 17th Downtown Block Party & Legends Car Show
- National Night Out – August 2nd 6 – 8 p.m. at Snoqualmie Community Park
- Community Shred Event – August 6th – 8 a.m. to Noon at City Hall

ADJOURNMENT:

Councilmember Gothelf **MOVED** to adjourn, seconded by Councilmember Rosen. The motion **PASSED** 7-0.

The meeting adjourned at 9:35 p.m.

ATTEST:

Kenneth G. Hearing, Mayor

Susie Oppedal, City Clerk

APPENDIX I

STATE ENVIRONMENTAL POLICY ACT DOCUMENTATION

LEGAL NOTICE OF SEPA DNS
CITY OF NORTH BEND, KING COUNTY
2016 Wastewater System Facilities Plan
Notice of SEPA DNS: January 25, 2017

The Wastewater Facilities Plan present recommendations for the collection and treatment of wastewater within the service area boundaries. Specifically included in this report are the forecasted population growth and projected sewer flows within the service area boundaries, evaluation of the existing collection system and wastewater treatment plant, proposed system expansion for the collection system, and improvements to the existing wastewater treatment plant necessary to provide continued sewer treatment to the customers that live within the planning area boundaries.

There are numerous improvements necessary to the wastewater treatment plant (WWTP). These improvements are presented in a multi-phased approach to be implemented over the course of several years. The facilities are currently operating within their design capacity, however many of them are aging and failing. Additionally, with the continued growth in the service area, capacity improvements will be necessary to provide continued sewer service in the future. The improvements presented are necessary to meet the requirements of the NPDES permit and to satisfy future growth demands.

The list of improvements is detailed in the report and include improvements to both the ULID 6 and South Fork lift stations, the oxidation ditch, the existing secondary clarifier, the ultraviolet (UV) disinfection system, construction of a new effluent building to house the UV system, effluent pumps, and flow metering equipment, construction of a new secondary clarifier, effluent temperature mitigation strategies, wash water system improvements, flood proofing of the existing control building and ULID 6 pump station controls, construction of a new electrical building and motor control center, construction of a new oxidation ditch, construction of a new aerobic digester and sludge feed building, construction of a new standby generator, a new outfall diffuser manhole, and miscellaneous electrical, piping, and SCADA system improvements.

Responsible Official:
Gina Estep, Community and Economic Development Director
Threshold Determination: State Environmental Policy Act (SEPA) Determination of Non-Significance (DNS)

The City of North Bend (lead agency for this proposal) has determined that this proposal does not have a probable significant adverse impact on the environment that cannot be mitigated through compliance with the conditions of the North Bend Municipal Code and other applicable regulations. An environmental impact statement (EIS) is not required under RCW 43.21C.030(2)(c). This decision was made after review of a completed environmental checklist on file with the lead agency. This information is available to the public on request at the offices of the North Bend CED Department located at 126 E. 4th St., North Bend, WA.

This DNS is issued under WAC 197-11-340(2); the lead agency will not act on this proposal for 15 days from the date of publication of this notice, allowing time for public comment.

The issuance of this DNS should not be interpreted as acceptance or approval of this proposal as presented. The City of North Bend reserves the right to deny or approve said proposal subject to conditions if it is determined to be in the best interest of the City and/or necessary for the general health, safety, and welfare of the public.

For More Information: Contact Senior Planner, Jamie Burrell at (425) 888-7642, or via email to jburrell@northbendwa.gov

Public Comment: Public comment on the SEPA DNS may be submitted before 4:30 on February 9, 2017 via mail to Jamie Burrell at the North Bend CED Department, PO Box 896, North Bend, WA, 98045, hand delivery to 126 E. 4th Street, or via email to the address above.

Published in the Snoqualmie Valley Record: January 25, 2017

STATE OF WASHINGTON, COUNTY OF KING }
AFFIDAVIT OF PUBLICATION

VEND.#	INV.#	INV. DATE

PUBLIC NOTICE
Linda M Mills, being first duly sworn on oath that she is the Legal Advertising Representative of the

Snoqualmie Valley Record

a weekly newspaper, which newspaper is a legal newspaper of general circulation and is now and has been for more than six months prior to the date of publication hereinafter referred to, published in the English language continuously as a weekly newspaper in King County, Washington. The Snoqualmie Valley Record has been approved as a Legal Newspaper by order of the Superior Court of the State of Washington for King County.
The notice in the exact form annexed was published in regular issues of the Snoqualmie Valley Record (and not in supplement form) which was regularly distributed to its subscribers during the below stated period. The annexed notice, a:

Public Notice

was published on January 25, 2017.

The full amount of the fee charged for said foregoing publication is the sum of $203.24.

Linda Mills
Legal Advertising Representative, Snoqualmie Valley Record
Subscribed and sworn to me this 25th day of January, 2017.

Gale Gwin, Notary Public for the State of Washington, Residing in Covington, Washington

GALE GWIN NOTARY PUBLIC STATE OF WASHINGTON COMMISSION EXPIRES 09-13-2019

PUBLIC NOTICE #1793275
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CITY OF NORTH BEND, KING COUNTY
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Notice of SEPA DNS: January 25, 2017

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Purpose of checklist: SEPA ENVIRONMENTAL CHECKLIST

Governmental agencies use this checklist to help determine whether the environmental impacts of your proposal are significant. This information is also helpful to determine if available avoidance, minimization or compensatory mitigation measures will address the probable significant impacts or if an environmental impact statement will be prepared to further analyze the proposal.

Instructions for applicants: [help]

This environmental checklist asks you to describe some basic information about your proposal. Please answer each question accurately and carefully, to the best of your knowledge. You may need to consult with an agency specialist or private consultant for some questions. You may use "not applicable" or "does not apply" only when you can explain why it does not apply and not when the answer is unknown. You may also attach or incorporate by reference additional studies reports. Complete and accurate answers to these questions often avoid delays with the SEPA process as well as later in the decision-making process.

The checklist questions apply to all parts of your proposal, even if you plan to do them over a period of time or on different parcels of land. Attach any additional information that will help describe your proposal or its environmental effects. The agency to which you submit this checklist may ask you to explain your answers or provide additional information reasonably related to determining if there may be significant adverse impact.

Instructions for Lead Agencies:
Additional information may be necessary to evaluate the existing environment, all interrelated aspects of the proposal and an analysis of adverse impacts. The checklist is considered the first but not necessarily the only source of information needed to make an adequate threshold determination. Once a threshold determination is made, the lead agency is responsible for the completeness and accuracy of the checklist and other supporting documents.

Use of checklist for nonproject proposals: [help]

For nonproject proposals (such as ordinances, regulations, plans and programs), complete the applicable parts of sections A and B plus the SUPPLEMENTAL SHEET FOR NONPROJECT ACTIONS (part D). Please completely answer all questions that apply and note that the words "project," "applicant," and "property or site" should be read as "proposal," "proponent," and "affected geographic area," respectively. The lead agency may exclude (for non-projects) questions in Part B - Environmental Elements –that do not contribute meaningfully to the analysis of the proposal.

A. BACKGROUND [help]

1. Name of proposed project, if applicable: [help]
   2016 Wastewater System Facilities Plan, City of North Bend, Washington
2. Name of applicant: [help]
   City of North Bend
3. Address and phone number of applicant and contact person: [help]
   City of North Bend
   P.O. Box 896
   North Bend, WA 98045
   Contact: Donald DeBerg, PE
   City Engineer
   (425) 888-7652
4. Date checklist prepared: [help]
   August 30, 2016
5. Agency requesting checklist: [help]
   City of North Bend, Department of Ecology

6. Proposed timing or schedule (including phasing, if applicable): [help]
City Council adoption anticipated October 2016

7. Do you have any plans for future additions, expansion, or further activity related to or connected with this proposal? If yes, explain. [help]
Yes. The Wastewater System Facilities Plan is the pre-design planning document and, consequently, the implementation of the recommendations contained in this document will be designed, bid and, subsequently, constructed. Specific projects identified within this Wastewater System Facilities Plan could and may be implemented in order to provide sewer service and treatment for development within the planning area boundary. Each project that results from the recommendations contained in this document will be subject to a separate SEPA review unless they are specifically found to be exempt from the SEPA process.

8. List any environmental information you know about that has been prepared, or will be prepared, directly related to this proposal. [help]
A Cultural Resources Assessment was performed to investigate the site for potential resources of historical significance. The report is titled "City of North Bend Wastewater Facility Improvement Projects, North Bend, King County, Washington Cultural Resource Assessment", published in June 2016 and was authored by Bryan Hoyt, Katherine F. Wilson, M.A., Chris Lockwood, Ph.D., and Alicia Valentino, Ph. D, all of Environmental Science Associates (ESA). A copy of the report is attached for review. No other documents have been prepared in conjunction with this proposal.

9. Do you know whether applications are pending for governmental approvals of other proposals directly affecting the property covered by your proposal? If yes, explain. [help]
None directly related to this proposal. Within the service area there are a number of residential, commercial, and industrial projects under review at any given time.

10. List any government approvals or permits that will be needed for your proposal, if known. [help]
Department of Ecology Approval, City Council Acceptance of the plan

11. Give brief, complete description of your proposal, including the proposed uses and the size of the project and site. There are several questions later in this checklist that ask you to describe certain aspects of your proposal. You do not need to repeat those answers on this page. (Lead agencies may modify this form to include additional specific information on project description.) [help]
City of North Bend, 2016 Wastewater System Facilities Plan

This proposal is a non-project action.

The Wastewater Facilities Plan presents recommendations for the collection and treatment of wastewater within the service area boundaries. Specifically included in this report are the forecasted population growth and projected sewer flows within the service area boundaries, evaluation of the existing collection system and wastewater treatment plant, proposed system expansion for the collection system, and improvements to the existing wastewater treatment plant necessary to provide continued sewer treatment to the customers that live within the planning area boundaries.

There are numerous improvements necessary to the wastewater treatment plant (WWTP). These improvements are presented in a multi-phased approach to be implemented over the course of several years. The facilities are currently operating within their design capacity, however many of them are aging and failing. Additionally, with the continued growth in the service area, capacity improvements will be necessary to provide continued sewer service in the future. The improvements presented are necessary to meet the requirements of the NPDES permit and to satisfy future growth demands.

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new effluent building to house the UV system, effluent pumps, and flow metering equipment, construction of a new secondary clarifier, effluent temperature mitigation strategies, wash water system improvements, floodproofing of the existing control building and ULID 6 pump station controls, construction of a new electrical building and motor control center, construction of a new oxidation ditch, construction of a new aerobic digester and sludge feed building, construction of a new standby generator, a new outfall diffuser manhole, and miscellaneous electrical, piping, and SCADA system improvements.

12. Location of the proposal. Give sufficient information for a person to understand the precise location of your proposed project, including a street address, if any, and section, township, and range, if known. If a proposal would occur over a range of area, provide the range or boundaries of the site(s). Provide a legal description, site plan, vicinity map, and topographic map, if reasonably available. While you should submit any plans required by the agency, you are not required to duplicate maps or detailed plans submitted with any permit applications related to this checklist. [help]

The service area used in the 2016 Wastewater System Facilities Plan is identical to the previously identified planning area from both the 1996 and 2001 Comprehensive Sewer Plans. This area includes all of the City Limits and UGA boundaries, which includes portions of Sections 3, 4, 5, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 21, 22, 23, and 24, Township 23 North, Range 8 East, Willamette Meridian, in King County, Washington.

The City's wastewater treatment plant is located at the intersection of West 4th Street and Sydney Avenue North, North Bend, Washington

B. ENVIRONMENTAL ELEMENTS [help]

1. Earth

a. General description of the site [help]
(circle one): Flat, rolling, hilly, steep slopes, mountainous,
other _____

This proposal is a non-project action and does not affect a specific site. The planning area is relatively flat with surrounding hillsides, including steep slopes and foothills. The area at the Wastewater Treatment Plant has been filled and graded during previous improvements to the plant. The current site is flat. Expansion of the plant will require additional earthwork. If fill is necessary, an equivalent amount of material will be removed at a hydraulically connected location to provide for compensatory storage for floodplain impacts.

b. What is the steepest slope on the site (approximate percent slope)? [help]

This proposal is a non-project action and does not affect a specific site. The majority of the area has slopes from 0% to 10% with some slopes of the surrounding hillsides estimated to be as steep as 50%. The Wastewater System Facilities Plan includes an area south of the main downtown area known as Forster Woods. This area has a slope of approximately 10% to 15%, however, this area is currently provided with sewer service and is not slated for an additional sewer system extension. The Wastewater Treatment Plant site is flat with slopes less than 5%. The outfall diffuser manhole at the plant is located within a fill slope in a levee adjacent to the South Fork of the Snoqualmie River. The slope in this area is approximately 50%.

c. What general types of soils are found on the site (for example, clay, sand, gravel, peat, muck)? If you know the classification of agricultural soils, specify them and note any agricultural land of long-term commercial significance and whether the proposal results in removing any of these soils. [help]

This proposal is a non-project action and does not affect a specific site. The majority of the soils in the service area are of the Orida – Seattle – Woodinville Association and the Everett Association and include silty loam, loamy fine sand, gravelly sandy loam, silty clay loam, river wash. Farmland and agricultural use is found in the northwestern portion of the service area.

The Wastewater Treatment Plant site consists primarily of Salal silt loam with a small area of Nooksack silt loam in the northwest corner. More detail can be found in the Cultural Resources Assessment.

d. Are there surface indications or history of unstable soils in the immediate vicinity? If so, describe. [help]
This proposal is a non-project action and does not affect a specific site. On some of the hillsides on the perimeter of the proposed service area, steep slopes with shallow soil depths to fractured rock make for unstable soil conditions.

The wastewater treatment plant site shows no indication of unstable soils.

e. Describe the purpose, type, total area, and approximate quantities and total affected area of any filling, excavation, and grading proposed. Indicate source of fill. [help]
Does not apply. This proposal is a non-project action.

f. Could erosion occur as a result of clearing, construction, or use? If so, generally describe. [help]
Does not apply. This proposal is a non-project action.

g. About what percent of the site will be covered with impervious surfaces after project construction (for example, asphalt or buildings)? [help]
Does not apply. This proposal is a non-project action.

h. Proposed measures to reduce or control erosion, or other impacts to the earth, if any: [help]
Does not apply. This proposal is a non-project action. Individual projects will use industry standard BMPs at the time of design and construction per the King County Surface Water Design Manual.

2. Air

a. What types of emissions to the air would result from the proposal during construction, operation, and maintenance when the project is completed? If any, generally describe and give approximate quantities if known. [help]
Does not apply. This proposal is a non-project action. However, many of the projects in the Wastewater System Facilities Plan contain odor control elements that should serve to reduce or eliminate nuisance odors from the facilities.

The City falls within the jurisdictional boundary of the Puget Sound Clean Air Agency and future projects will adhere to the limitations set by the PSCAA.

b. Are there any off-site sources of emissions or odor that may affect your proposal? If so, generally describe. [help]
None known.

c. Proposed measures to reduce or control emissions or other impacts to air, if any: [help]
Does not apply. This proposal is a non-project action. However, as stated above, many of the projects will contain an odor control element to reduce nuisance odors.

3. **Water**

a. Surface Water: [help]

1) Is there any surface water body on or in the immediate vicinity of the site(including year-round and seasonal streams, saltwater, lakes, ponds, wetlands)? If yes, describe type and provide names. If appropriate, state what stream or river it flows into. [help]

The South and Middle Forks of the Snoqualmie River run through the project area. Both are Type S streams. Additionally, Ribary Creek, Gardiner Creek, Silver Creek, and Clough Creek are within the planning area, all of which are partially or wholly classified as Type F streams. There are also numerous smaller streams and drainage channels within the planning area.

2) Will the project require any work over, in, or adjacent to (within 200 feet) the described waters? If yes, please describe and attach available plans. [help]

No. This proposal is a non-project action. However, some of the projects recommended in the Wastewater System Facilities Plan include work adjacent to or within 200 feet of the waters of the state, including the WWTP outfall diffuser manhole, South Fork Lift Station improvements, and numerous collection system improvements. Each of these projects will be evaluated during their respective design.

3) Estimate the amount of fill and dredge material that would be placed in or removed from surface water or wetlands and indicate the area of the site that would be affected. Indicate the source of fill material. [help]

Does not apply. This proposal is a non-project action.

4) Will the proposal require surface water withdrawals or diversions? Give general description, purpose, and approximate quantities if known. [help]

No. This proposal is a non-project action.

5) Does the proposal lie within a 100-year floodplain? If so, note location on the site plan. [help]

This proposal is a non-project action that does not affect a specific site. However, a substantial portion of the proposal area lies within the 100-year floodplain.

6) Does the proposal involve any discharges of waste materials to surface waters? If so, describe the type of waste and anticipated volume of discharge. [help]

No. This proposal is a non-project action. However, treated wastewater is currently discharged to the South Fork of the Snoqualmie River under an existing NPDES permit. The current maximum month volume of wastewater permitted to be discharged is 2.58 million gallons per day.

b. Ground Water:

1) Will groundwater be withdrawn from a well for drinking water or other purposes? If so, give a general description of the well, proposed uses and approximate quantities withdrawn from the well. Will water be discharged to groundwater? Give general description, purpose, and approximate quantities if known. [help]

No. This proposal is a non-project action and the plan has no recommendations for new groundwater withdraws or injections.

2) Describe waste material that will be discharged into the ground from septic tanks or

other sources, if any (for example: Domestic sewage; industrial, containing the following chemicals. . . ; agricultural; etc.). Describe the general size of the system, the number of such systems, the number of houses to be served (if applicable), or the number of animals or humans the system(s) are expected to serve. [help]

None. This proposal is a non-project action. The recommendations included in this plan involve extending sewers throughout the service area. Many of the proposed extensions that lie within currently undeveloped areas will be designed and constructed by those wishing to develop the properties. Those extensions within currently developed areas will likely be designed and constructed by the City. Actual implantation of the recommendations will be addressed in separate environmental actions.

c. Water runoff (including stormwater):

1) Describe the source of runoff (including storm water) and method of collection and disposal, if any (include quantities, if known). Where will this water flow? Will this water flow into other waters? If so, describe. [help]
Does not apply. This proposal is a non-project action.

2) Could waste materials enter ground or surface waters? If so, generally describe. [help]
No. This proposal is a non-project action.

3) Does the proposal alter or otherwise affect drainage patterns in the vicinity of the site? If so, describe.
No. This proposal is a non-project action.

d. Proposed measures to reduce or control surface, ground, and runoff water, and drainage pattern impacts, if any:

Does not apply. This proposal is a non-project action. Upon construction of the recommendations, BMPS will be used per the King County Surface Water Design Manual.

4. **Plants** [help]

a. Check the types of vegetation found on the site: [help]

X ___deciduous tree: alder, maple, aspen, other
X ___evergreen tree: fir, cedar, pine, other
X ___shrubs
X ___grass
X ___pasture
X ___crop or grain
X ___Orchards, vineyards or other permanent crops.
X ___wet soil plants: cattail, buttercup, bullrush, skunk cabbage, other
X ___water plants: water lily, eelgrass, milfoil, other
X ___other types of vegetation – occasional weed

b. What kind and amount of vegetation will be removed or altered? [help]
None. This proposal is a non-project action.

c. List threatened and endangered species known to be on or near the site. [help]
None known. USFWS's Environmental Conservation Online System shows no known threatened or endangered species with range in the service area. Investigations for the presence of threatened and endangered species will

be performed as part of the permitting process related to individual projects.

d. Proposed landscaping, use of native plants, or other measures to preserve or enhance vegetation on the site, if any: [help]

Does not apply. This proposal is a non-project action. However, each individual project will be required to comply with City of North Bend standards regarding vegetation protection and re-establishment.

e. List all noxious weeds and invasive species known to be on or near the site.

Bohemian knotweed (Polygonum bohemicum), Tansy Ragwort (Senecio jacobaea), Diffuse Knapweed (Centaurea diffusa), Spotted Knapweed (Centaurea stoebe), Orange Hackweed (Hieracium aurantiacum), Garden Loosestrife (Lysimachia vulgaris), Scotch Broom (Cytisus scoparius), Himalayan Blackberry (Rubus armeniacus), Garlic Mustard (Alliaria petiolata)

5. **Animals**

a. List any birds and other animals which have been observed on or near the site or are known to be on or near the site. Examples include: [help]

birds: hawk, heron, eagle, songbirds, other:
mammals: deer, bear, elk, beaver, other:
fish: bass, salmon, trout, herring, shellfish, other _____

b. List any threatened and endangered species known to be on or near the site. [help]

The City is situated upstream of Snoqualmie Falls, which is an impassible barrier to the upstream migration of anadromous fish in the Snoqualmie River. No anadromous fish are found in the South Fork and Middle Fork Snoqualmie River or its tributaries within the North Bend Urban Growth Area (KCM 1999). As a result, the urban growth area is less affected by listing of Chinook salmon under the Endangered Species Act as it relates to habitat, but the City is affected as it relates to water quality and quantity impacts on downstream areas where habitat exists.

Bull trout (Salvelinus confluentus) may occur in the planning area. Information on the historical and current distribution of bull trout throughout the Puget Sound area is poorly understood, because comprehensive data is lacking. An extensive two-year survey on the North Fork Snoqualmie River and its tributaries have not found any bull trout in this drainage basin. No native char have been observed by Washington Department of Fish and Wildlife biologists above Snoqualmie Falls within the last 10 years, nor by the U.S. Army CORPS of Engineers during surveys conducted in the early and mid-1990's (R2 Consultants 2000). The U.S. Fish and Wildlife Service does not report bull trout presence in the North Bend area (Chan 2000 personal communication).

The South and Middle Fork Snoqualmie River and associated riparian areas provide habitat for federally threatened bald eagles, state endangered peregrine falcons and several species of concern, and state priority species. There are no known bald eagle nest sites within or near the urban growth area. However, bald eagles are observed throughout the year foraging within the Snoqualmie river corridor (URS Greiner 2000). A pair of peregrine falcons reportedly nests approximately one mile outside the urban growth area on the west face of Mount Si. No data are available on the home range or foraging territory for this pair. However, peregrine falcons forage over wide areas, and their territory can extend up to eight miles from a nest site (URS Greiner).

c. Is the site part of a migration route? If so, explain. [help]

The City of North Bend area is part of the Greater Pacific Flyway, a migration route for migratory birds. Additionally, there are numerous known migration corridors for the resident elk throughout the urban growth area.

d. Proposed measures to preserve or enhance wildlife, if any: [help]

Does not apply. This proposal is a non-project action.

e. List any invasive animal species known to be on or near the site.

The following may be present on or near the planning area, however, definitive information is scarce: Bullfrog (Rana catesbeiana), Exotic Leafrollers (many species).

6. **Energy and natural resources**

a. What kinds of energy (electric, natural gas, oil, wood stove, solar) will be used to meet the completed project's energy needs? Describe whether it will be used for heating, manufacturing, etc. [help]

None. This proposal is a non-project action. Diesel fuel and gasoline will be required to power machinery during construction of the recommended improvements. The completed collection system and treatment plant will require external sources of energy for operation, including electricity, natural gas, and diesel fuel and gasoline for backup generators.

b. Would your project affect the potential use of solar energy by adjacent properties? If so, generally describe. [help]

This proposal is a non-project action. Typically, sewer facilities are located underground and will have no impact on potential use of solar energy. The proposed lift stations and wastewater treatment plant improvements will be built in conformance with applicable building height limitations and will have no greater impact on potential use of solar energy than any other potential land use.

c. What kinds of energy conservation features are included in the plans of this proposal? List other proposed measures to reduce or control energy impacts, if any: [help]

This proposal is a non-project action. Energy conservation measures are designed into the specific energy systems and project elements, including selection of carefully sized, energy efficient pumps at the lift stations and motors used at the wastewater treatment plant.

7. **Environmental health**

a. Are there any environmental health hazards, including exposure to toxic chemicals, risk of fire and explosion, spill, or hazardous waste, that could occur as a result of this proposal? If so, describe. [help]

No. This proposal is a non-project action.

Describe any known or possible contamination at the site from present or past uses.

1) Describe existing hazardous chemicals/conditions that might affect project development and design. This includes underground hazardous liquid and gas transmission pipelines located within the project area and in the vicinity.

None. This proposal is a non-project action. There is one known area of contamination within the study area and multiple sources of potential contamination including, but not limited to, fuel stations, dry cleaners, car dealerships, etc. No major liquid or gas transmission pipelines are known to exist within the study area. More thorough investigations of site conditions will be performed prior to constructing the recommended projects.

2) Describe any toxic or hazardous chemicals that might be stored, used, or produced during the project's development or construction, or at any time during the operating life of the project.

None. This proposal is a non-project action. Diesel fuel, gasoline, or propane may be stored at proposed lift station site to fuel backup generators. Multiple chemicals may be required at the

wastewater treatment plant for equipment maintenance, backup power, and treatment processes. These will be evaluated during the design of the recommended projects.

3) Describe special emergency services that might be required.
None. This is a non-project proposal.

4) Proposed measures to reduce or control environmental health hazards, if any:
None. This is a non-project proposal. However, the recommendations, if and when implemented, will reduce septic tank usage.

b. **Noise**

1) What types of noise exist in the area which may affect your project (for example: traffic, equipment, operation, other)? [help]

This proposal is a non-project action. Noise in the area, primarily related to traffic and other urban activities, will not affect the proposed project.

2) What types and levels of noise would be created by or associated with the project on a short-term or a long-term basis (for example: traffic, construction, operation, other)? Indicate what hours noise would come from the site. [help]

This proposal is a non-project action. Implementation of the recommended projects will result in temporary construction noise. On a short-term basis construction of structural measures would generate noise from heavy construction equipment. During construction hours (7:00 am to 6:00 pm), noise levels could reach as high as 90 decibels for short periods of time within 50 feet of the noise source. On a long-term basis, proposed measures would not result in significant additional noise.

3) Proposed measures to reduce or control noise impacts, if any: [help]

This proposal is a non-project action. With respect to construction noise, the following measures are proposed:

Limiting construction activity to between 7:00 am and 6:00 pm (For installation of structural improvements along major transportation corridors, the timing may be altered to alleviate traffic congestion.),

Use of pneumatic tools with pre-fitted mufflers,

Use of mufflers on other internal combustion engine-driven equipment, and

Turning off idling equipment.

8. **Land and shoreline use**

a. What is the current use of the site and adjacent properties? Will the proposal affect current land uses on nearby or adjacent properties? If so, describe. [help]

This proposal is a non-project action and does not affect a specific site. Land uses in the proposal and adjacent areas are residential, commercial, industrial, transportation, utility, institutional, and open space. All land uses referenced in this plan are consistent with the Land Use Element of the City's Comprehensive Plan.

b. Has the project site been used as working farmlands or working forest lands? If so, describe. How much agricultural or forest land of long-term commercial significance will be converted to other uses as a result of the proposal, if any? If resource lands have not been designated, how many acres in farmland or forest land tax status will be converted to nonfarm or non-forest use? [help]

This proposal is a non-project action and does not affect a specific site. Portions of the study area have been and are currently being used for agriculture. Agricultural areas in the study area are primarily outside the city limits, but within the urban growth area.

1) Will the proposal affect or be affected by surrounding working farm or forest land normal business operations, such as oversize equipment access, the application of pesticides, tilling, and harvesting? If so, how:

This proposal is a non-project action. The recommended actions contained within this document will not be affected by working farm or forest lands.

c. Describe any structures on the site. [help]

Does not apply. This proposal is a non-project action and does not affect a specific site. However, there are a variety of structures that are associated with the treatment and conveyance of the wastewater.

d. Will any structures be demolished? If so, what? [help]

This proposal is a non-project action. The recommended actions suggest demolition of multiple structures at the wastewater treatment plant site, including the existing structure that houses the ultraviolet disinfection system, the old headworks and control building, the effluent tower, the abandoned Snoqualmie Valley Youth Center building, a foundation on the west side of the site that used to house the public works shop, and a storage trailer on the south side of the site.

e. What is the current zoning classification of the site? [help]

Does not apply. This proposal is a non-project action and does not affect a specific site. The plan does not alter the current land zoning within the city limits or urban growth area.

f. What is the current comprehensive plan designation of the site? [help]

This proposal is a non-project action and does not affect a specific site. There are thirteen land use designations established in the 2015 Update of the Land Use Element of the Comprehensive Plan for the sewer area: Constrained Low Density Residential (CLDR), Cottage Residential (CR), Low Density Residential (LDR), High Density Residential (HDR), High Density Residential with Density Restrictions (HDR), Downtown Commercial (DC), Interchange Commercial (IC), Interchange Mixed-Use (IMU), Neighborhood Business (NB), Employment Park 1 (EP-1), Employment Park 2 (EP-2), Park/Open Space/Public Facilities (POSPF), and Unzoned (Right of way/river).

The wastewater treatment plant site is currently zoned POSPF.

g. If applicable, what is the current shoreline master program designation of the site? [help]

This proposal is a non-project action and does not affect a specific site. The City's shoreline master program applies to activities within a 200-foot wide area along the shores and floodway of the South and Middle Forks of the Snoqualmie River. The City's shoreline master program includes five designations: Natural, Urban Conservancy, Commercial Conservancy, Shoreline Residential, and Aquatic.

h. Has any part of the site been classified as a critical area by the city or county? If so, specify. [help]

This proposal is a non-project action and does not affect a specific site. Major parts of the proposal area are classified as environmentally sensitive areas, including: Aquifer recharge areas and seismic hazard areas which cover all of the valley floor in the area; rivers, streams, floodways, flood plains, and associated wetlands on the valley floor and hills; and steep slope areas south of Interstate 90 on the foothills of Rattlesnake Ridge.

i. Approximately how many people would reside or work in the completed project? [help]

This proposal is a non-project action and does not affect a specific site. The estimated population and job build out analysis can be found in the Land Use Element of the City's Comprehensive Plan.

j. Approximately how many people would the completed project displace? [help]

This proposal is a non-project action and does not affect a specific site. No persons are anticipated to be displaced as a result of the recommended improvements.

k. Proposed measures to avoid or reduce displacement impacts, if any: [help]

This proposal is a non-project action. This project is not anticipated to produce any displacement impacts, therefore, no mitigation is necessary.

l. Proposed measures to ensure the proposal is compatible with existing and projected land uses and plans, if any: [help]

This proposal is a non-project action. However, the proposal will be consistent with zoning and development regulations and the City's Comprehensive Plan.

m. Proposed measures to ensure the proposal is compatible with nearby agricultural and forest lands of long-term commercial significance, if any:

This proposal is a non-project action. The proposal will not affect agricultural or forest lands of long-term significance as the recommended improvements are all located in areas that are currently developed or will be installed concurrent with appropriately permitted development.

9. **Housing**

a. Approximately how many units would be provided, if any? Indicate whether high, middle, or low-income housing. [help]

None. This proposal is a non-project action.

b. Approximately how many units, if any, would be eliminated? Indicate whether high, middle, or low-income housing. [help]

None. This proposal is a non-project action.

c. Proposed measures to reduce or control housing impacts, if any: [help]

Does not apply. This proposal is a non-project action.

10. **Aesthetics**

a. What is the tallest height of any proposed structure(s), not including antennas; what is the principal exterior building material(s) proposed? [help]

This proposal is a non-project action. Structures recommended in the plan will generally be at, near, or below ground level. Those proposed structures that will be above ground level will meet all requirements of the applicable zoning designation.

b. What views in the immediate vicinity would be altered or obstructed? [help]

This proposal is a non-project action. The majority of improvements will be either at or below ground level and will not disturb views from adjacent properties. Those improvements that are above ground will meet all requirements of the applicable zoning designation.

c. Proposed measures to reduce or control aesthetic impacts, if any: [help]

This proposal is a non-project action. The areas disturbed by construction will be repaved or replanted with appropriate materials.

11. **Light and glare**

a. What type of light or glare will the proposal produce? What time of day would it mainly occur? [help]

This proposal is a non-project action. Additional lighting will likely be installed at lift stations and the wastewater treatment plant. Those lights will be on at night for security and worker safety purposes.

b. Could light or glare from the finished project be a safety hazard or interfere with views? [help]

This proposal is a non-project action. All lighting systems will be designed such that they will not be hazardous and will have a minimal impact on views. Lighting structures will be full cut-off and dark sky compliant.

c. What existing off-site sources of light or glare may affect your proposal? [help]

This proposal is a non-project action. The proposed improvements will not be affected by any off-site sources of light or glare.

d. Proposed measures to reduce or control light and glare impacts, if any: [help]

This proposal is a non-project action. All lighting systems will be designed such that they will not be hazardous and will have a minimal impact on views. Lighting structures will be full cut-off and dark sky compliant.

12. **Recreation**

a. What designated and informal recreational opportunities are in the immediate vicinity? [help]

Many indoor and outdoor, active and passive recreation opportunities, both designated and informal, of all types. Designated parks in North Bend include Torguson Park, E.J. Roberts Park, Gardiner Weeks Memorial, William Henry Taylor Park, Railroad Park, Si View Park, Tollgate Farm Park, Meadowbrook Farm, multiple neighborhood parks, and Tanner Trail. Also, the South Fork and Middle Fork of the Snoqualmie River provide numerous informal recreational opportunities.

b. Would the proposed project displace any existing recreational uses? If so, describe. [help]

No. This proposal is a non-project action. Recreational uses would not be displaced as a result of any of the recommended improvements.

c. Proposed measures to reduce or control impacts on recreation, including recreation opportunities to be provided by the project or applicant, if any: [help]

This proposal is a non-project action. Impacts to recreation are not anticipated, therefore mitigation measures have not been developed.

13. **Historic and cultural preservation**

a. Are there any buildings, structures, or sites, located on or near the site that are over 45 years old listed in or eligible for listing in national, state, or local preservation registers located on or near the site? If so, specifically describe. [help]

This proposal is a non-project action and does not affect a specific site. The following historic properties are listed in the Land Use Element of the City's Comprehensive Plan: Tollgate Farm, Si View Park Buildings, Fort Smalley, Meadowbrook Farm, Milwaukee Railroad Bridge (since removed), Downtown Commercial Historic District, Snoqualmie Tribe "Swing Rock", and the Forest Service Complex. Some of these are listed on King County's Historic Preservation Program and there are efforts to identify other historic sites and to list these with King County's program.

Per the Cultural Resources Assessment, there are 5 structures on the wastewater treatment plant site that are over 50 years old. None of these are currently listed and the authors recommend "Not Eligible" for all of the structures. The structures are the Snoqualmie Valley Youth Center, the two treatment plant clarifiers, the original treatment plant headworks, the existing oxidation ditch, and the treatment plant dried solids storage/UV disinfection building.

b. Are there any landmarks, features, or other evidence of Indian or historic use or occupation? This may include human burials or old cemeteries. Are there any material evidence, artifacts, or areas of cultural importance on or near the site? Please list any professional studies conducted at the site to identify such resources. [help]

This proposal is a non-project action and does not affect a specific site. The City of North Bend includes some landmarks or evidence of historic, archaeological, scientific, or cultural importance; however no known specific sites are affected by this proposal.

c. Describe the methods used to assess the potential impacts to cultural and historic resources on or near the project site. Examples include consultation with tribes and the department of archeology and historic preservation, archaeological surveys, historic maps, GIS data, etc. [help]

Future projects will adhere to and comply with all local, State, and Federal historical and archaeological preservation laws, should any artifacts or items be discovered during construction. Washington cultural resource laws (RCW 27.53) state that no known archaeological resources or site can knowingly be damaged without obtaining a certified permit from the Washington State Office of Archaeology and Historic Preservation (OAHP). Also under Washington State law, all archaeological sites and resources are protected on private and public lands (RCW 27.53). Section 106 of the National Historic Preservation Act of 1996, as amended, stipulates early, often, and continuous consultation with the project's Federal/State lead agency and affected Native American Tribe(s) depending on the jurisdiction of the proposed project. If any significant archaeological resources are discovered during project related construction excavation and/or operation/maintenance, all activities must stop in the immediate area. A professional archaeologist should be contacted to inspect and assess the disturbed archaeological deposits. If necessary, OAHP and the affected Native American Tribe(s) would be contacted to further assess the damaged cultural resources. Future site-specific project actions would be subject to further environmental review on a case-by-case basis.

A Cultural Resources Assessment was performed by Environmental Science Associates on the wastewater treatment plant site. Their report is attached.

d. Proposed measures to avoid, minimize, or compensate for loss, changes to, and disturbance to resources. Please include plans for the above and any permits that may be required.

See response in c. above.

14. **Transportation**

a. Identify public streets and highways serving the site or affected geographic area and describe proposed access to the existing street system. Show on site plans, if any. [help]

This proposal is a non-project action. Specific collection system sites have only been conceptually identified, but the wastewater treatment plant location is known. The proposed service area is served by a variety of streets and highways. Public streets and highways will not be affected by implementation of the Wastewater Treatment Plant portion of the Facilities Plan. Many of the conceptual collection system locations are along city streets and will result in temporary impacts.

b. Is the site or affected geographic area currently served by public transit? If so, generally describe. If not, what is the approximate distance to the nearest transit stop? [help]

Yes. The service area is served by King County Transit (metro).

c. How many additional parking spaces would the completed project or non-project proposal have? How many would the project or proposal eliminate? [help]

This proposal is a non-project action. The proposal would not add or eliminate parking spaces.

d. Will the proposal require any new or improvements to existing roads, streets, pedestrian, bicycle or state transportation facilities, not including driveways? If so, generally describe (indicate whether public or private). [help]

This proposal is a non-project action. New sewer collection facilities will typically be constructed in existing rights-of-way or within easements. Improvements, including lift stations, new pipe, and pipe replacements may require partial reconstruction along affected roadways. Temporary traffic control may be required. Disruption of roadways will be temporary and all reconstruction will be conducted according to City of North Bend, King County, and/or Washington State Department of Transportation design standards.

e. Will the project or proposal use (or occur in the immediate vicinity of) water, rail, or air transportation? If so, generally describe. [help]

This proposal is a non-project action. None of the recommended project will occur near any active water, rail, or air transportation routes or hubs.

f. How many vehicular trips per day would be generated by the completed project or proposal? If known, indicate when peak volumes would occur and what percentage of the volume would be trucks (such as commercial and nonpassenger vehicles). What data or transportation models were used to make these estimates? [help]

This proposal is a non-project action. Few additional trips will be generated by the collection system or WWTP recommended improvements. Regular maintenance vehicles will be used to perform periodic inspections and maintenance of the collection system components, such as lift stations and pipes. The frequency of the inspections will vary.

During construction of the collection system and WWTP, traffic will increase in the local area, but the increases will be temporary. Localized slowdowns will likely occur as materials and equipment are transported to construction sites. These effects will be short-term in nature.

g. Will the proposal interfere with, affect or be affected by the movement of agricultural and forest products on roads or streets in the area? If so, generally describe.

This proposal is a non-project action. There will likely be delays to the movement of agricultural and forest products on roads or streets during the construction of the recommended collection system improvements. These delays should be minimal and will be short-term in nature.

h. Proposed measures to reduce or control transportation impacts, if any: [help]

This proposal is a non-project action. Construction will be scheduled to avoid peak hour impacts to major arterials. Traffic control plans will be developed and approved by the City of North Bend, King County, and/or Washington State Department of Transportation to minimize any impacts to local neighborhoods and commercial areas. No long-term transportation impacts are anticipated as a result of this proposal.

15. **Public services**

a. Would the project result in an increased need for public services (for example: fire protection, police protection, public transit, health care, schools, other)? If so, generally describe. [help]

This proposal is a non-project action. Implementation of the recommended plan will require an estimated capital budget of approximately $20,249,000 in 2016 dollars, including construction overhead cost, over a 20-year period.

b. Proposed measures to reduce or control direct impacts on public services, if any. [help]

This proposal is a non-project action. The recommended improvements are designed to help control sanitary impacts associated with new development and improve groundwater quality within the service area. Therefore, the overall need for public health protection services will likely be reduced in the long term.

16. **Utilities**

a. Circle utilities currently available at the site: [help]
electricity, natural gas, water, refuse service, telephone, sanitary sewer, septic system, other _____

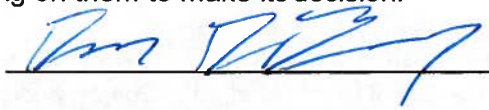
This proposal is a non-project action and does not affect a specific site. However, all utilities listed above are available in most of the proposal area.

b. Describe the utilities that are proposed for the project, the utility providing the service, and the general construction activities on the site or in the immediate vicinity which might be needed. [help]

This proposal is a non-project action. Sewer collection and treatment facilities developed pursuant to this plan will require electricity to operate and other utility services to support the operation of the sewer system.

C. SIGNATURE [HELP]

The above answers are true and complete to the best of my knowledge. I understand that the lead agency is relying on them to make its decision.

Signature: 

Name of signee Donald DeBerg

Position and Agency/Organization City Engineer, City of North Bend

Date Submitted: 1/13/17

D. **SUPPLEMENTAL SHEET FOR NONPROJECT ACTIONS** [help]

(**IT IS NOT NECESSARY** to use this sheet for project actions)

Because these questions are very general, it may be helpful to read them in conjunction with the list of the elements of the environment.

When answering these questions, be aware of the extent the proposal, or the types of activities likely to result from the proposal, would affect the item at a greater intensity or at a faster rate than if the proposal were not implemented. Respond briefly and in general terms.

1. How would the proposal be likely to increase discharge to water; emissions to air; production, storage, or release of toxic or hazardous substances; or production of noise?
The Wastewater System Facilities Plan, alone, does not result in an increased discharge to water, emissions to air, production, storage, or release of toxic or hazardous substances, or production of noise. Construction and operation of the wastewater treatment plant and sewage collection system will result in increased stormwater runoff from impervious surfaces and discharge of treated effluent to the South Fork of the Snoqualmie River.

Proposed measures to avoid or reduce such increases are:
Projects that are subject to SEPA will be reviewed to identify environmental impacts and mitigation measures. Further, all projects will comply with local, state, and federal regulations related to environmental impacts. Stormwater runoff impact will be mitigated consistent with the standards in the version of the King County Surface Water Design Manual that the City has adopted at the time of design. Wastewater Treatment Plant effluent will be treated to comply with the standards set forth in the then current version of the City's National Pollutant Discharge Elimination System permit.

2. How would the proposal be likely to affect plants, animals, fish, or marine life?
The Wastewater System Facilities Plan, alone, does not result in any impacts on plants, animals, fish, or marine life. Project development applications would, however, result in increased impervious surfaces and runoff quantities. Further, providing sewer service to existing developments that presently use septic systems and new developments will result in the extension of new sewer collection lines and expansion of the wastewater treatment plant. Sewer collected from these developments would be conveyed to the wastewater treatment plant and discharged to the South Fork of the Snoqualmie River following treatment.

Proposed measures to protect or conserve plants, animals, fish, or marine life are:
Projects that are subject to SEPA will be reviewed to identify environmental impacts and mitigation measures. Furthermore, all projects will comply with local, state, and federal regulations related to environmental impacts. Stormwater runoff impact will be mitigated consistent with the standards in the version of the King County Surface Water Design Manual that the City has adopted at the time of design. Wastewater Treatment Plant effluent will be treated to comply with the standards set forth in the then current version of the City's National Pollutant Discharge Elimination System permit.

3. How would the proposal be likely to deplete energy or natural resources?
The Wastewater System Facilities Plan, alone, does not result in any effects on energy or natural resources. Subsequent construction and operation of the gravity sewer system and wastewater treatment plant will result in increased energy demand and usage.

Proposed measures to protect or conserve energy and natural resources are:

Subsequent project applications will be reviewed for compliance with applicable standards for energy efficiency and natural resource conservation.

4. How would the proposal be likely to use or affect environmentally sensitive areas or areas designated (or eligible or under study) for governmental protection; such as parks, wilderness, wild and scenic rivers, threatened or endangered species habitat, historic or cultural sites, wetlands, floodplains, or prime farmlands?

The Wastewater System Facilities Plan, alone, does not result in any direct impacts on sensitive areas or areas designated for governmental protection such as parks, wilderness, wild and scenic rivers, threatened or endangered species, historic or cultural sites, wetlands, floodplains, or prime farmlands. Subsequent developments would be required to satisfy current local, state, and federal regulations governing these aforementioned areas of concern. Expansion of the wastewater treatment plant will require work to occur near the South Fork of the Snoqualmie River. Such expansions or modifications to the wastewater treatment plant will be subject to environmental regulations and review.

Proposed measures to protect such resources or to avoid or reduce impacts are:
Projects that are required to satisfy SEPA requirements will be thoroughly screened and reviewed for environmental compliance. Furthermore, all projects will be required to comply with local, state, and federal regulations related to environmental impacts. The extension of sewer and modifications to the wastewater treatment plant will be designed to minimize, to the greatest extent reasonably possible, the impact on the river and wetlands.

5. How would the proposal be likely to affect land and shoreline use, including whether it would allow or encourage land or shoreline uses incompatible with existing plans?

The Wastewater System Facilities Plan, alone, does not result in any direct impacts to land and shoreline use. Project developments will be required to comply with all local, state, and federal regulations. Expansion or modification to the existing wastewater treatment plant is not expected to reduce the public use of these areas. Effluent discharge, depending on the alternative selected, may require additional lands for the disposal of the wastewater effluent.

Proposed measures to avoid or reduce shoreline and land use impacts are:
Projects that are required to satisfy SEPA requirements will be thoroughly screened and reviewed for environmental compliance. Furthermore, all projects will be required to comply with local, state, and federal regulations related to environmental impacts. Any modification to the wastewater treatment plant will be required to obtain all local, state, and federal permits before initiating construction.

6. How would the proposal be likely to increase demands on transportation or public services and utilities?

The Wastewater System Facilities Plan, alone, does not result in any direct impacts to transportation or public services and utilities. However, subsequent project-specific proposals may result in temporary construction related traffic impacts and long-term demand for public services necessary to operate the collection and treatment systems.

Proposed measures to reduce or respond to such demand(s) are:
Construction associated with the sewer collection system will be scheduled to avoid peak hour impacts to major arterials. Traffic control plans will be developed and approved by the City of North Bend, King County, and/or WSDOT to minimize any impacts to local neighborhoods and commercial areas. No long-term transportation impacts are anticipated as a result of this proposal.

Energy conservation measures will be designed into the specific energy systems and project elements including selection of carefully sized, energy efficient pumps at the proposed lift stations and motors used at the wastewater treatment plant.

7. Identify, if possible, whether the proposal may conflict with local, state, or federal laws or requirements for the protection of the environment.
   The Wastewater System Facilities Plan, alone, does not result in any direct impacts and is being done to comply with state and federal laws. Implementation of the Wastewater System Facilities Plan is to be done in a manner consistent with local, state, and federal laws and requirements for the protection of the environment.

APPENDIX J

CULTURAL RESOURCE ASSESSMENT

CULTURAL RESOURCES REPORT COVER SHEET

Author: Bryan Hoyt, Katherine F. Wilson, M.A., Chris Lockwood, Ph.D., and Alicia Valentino, Ph.D.

Title of Report: City Of North Bend Wastewater Facility Improvement Project, North Bend, King County, Washington

Date of Report: October 2017

County(ies): King Section: 9 Township: 23N Range: 8E

Quad: North Bend Acres: 4.9

PDF of report submitted (REQUIRED) ☒ Yes

Historic Property Inventory Forms to be Approved Online? ☒ Yes ☐ No

Archaeological Site(s)/Isolate(s) Found or Amended? ☐ Yes ☒ No

TCP(s) found? ☐ Yes ☒ No

Replace a draft? ☐ Yes ☒ No

Satisfy a DAHP Archaeological Excavation Permit requirement? ☐ Yes # ☒ No

Were Human Remains Found? ☐ Yes DAHP Case # ☒ No

DAHP Archaeological Site #:

_____
_____
_____
_____
_____
_____
_____
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_____

- Submission of PDFs is required.
- Please be sure that any PDF submitted to DAHP has its cover sheet, figures, graphics, appendices, attachments, correspondence, etc., compiled into one single PDF file.
- Please check that the PDF displays correctly when opened.

CITY OF NORTH BEND WASTEWATER FACILITY IMPROVEMENT PROJECT, NORTH BEND, KING COUNTY, WASHINGTON

Cultural Resources Assessment

Prepared for

City of North Bend

October 2017

Prepared for
City of North Bend

Prepared by
Bryan Hoyt, Katherine F. Wilson, M.A., Chris Lockwood, Ph.D., and Alicia Valentino, Ph.D.

This report is exempt from public distribution and disclosure
(RCW 42.56.300)

ESA Project Number D150250
DAHP Project 2016-06-4101

ABSTRACT

ESA was retained by Tetra Tech, Inc., on behalf of the City of North Bend (City), to conduct a cultural resources assessment for the North Bend Wastewater Facility Improvement Projects. The City is evaluating improvements to its existing wastewater facility between 2016 and 2036, including an Outfall Diffuser Manhole, Clarifiers, Street Sweeper Dump Station, Aerobic Digester, Electrical/Blower Building, Headworks, Aeration Basins, and Sludge Thickener/Mechanical Equipment Building. New piping would be required during each of the construction phases, but precise location of piping is unknown at this time.

Previous construction and expansion of the wastewater facility has caused extensive, deep disturbance across the Area of Interest (AOI). Because intact archaeological remains (if present) could be encountered in discrete pockets not disturbed by previous construction, ESA recommends that the City create and implement a Cultural Resources Inadvertent Discovery Plan (IDP) to be used during any further site investigations and construction.

The Project Area contains two buildings – the former Snoqualmie Valley Youth Center, and the Old Influent Pump Station and Sludge Holding Tank – that are older than 50 years. ESA documented both buildings at the reconnaissance level on DAHP Historic Property Inventory Forms. Both buildings would eventually be demolished. ESA recommends that both buildings be determined *Not Eligible* for Register-listing.

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1.0 INTRODUCTION

Environmental Science Associates (ESA) was retained by Tetra Tech, Inc., on behalf of the City of North Bend (City), to conduct a cultural resources assessment in North Bend, King County, Washington. The City is evaluating making improvements to its North Bend Wastewater Treatment Facility (Facility). The Area of Interest (AOI) is located at the intersection State Route 202 and Sydney Avenue North in the NW ¼ of Section 9, Township 23 North, Range 8 East, Willamette Meridian on the North Bend, Washington 7.5' series topographic map (Figure 1).

2.0 PROJECT DESCRIPTION

The City is evaluating improvements to its existing North Bend Wastewater Treatment Facility (Facility) at the intersection of State Route 202 and Sydney Avenue North. Improvements would be phased between 2016 and 2036 or beyond. The Project is in the conceptual phase, but the location and timing of major improvements are depicted in Figure 2.

Between 2016 and 2017, the Project proposes the installation of an Outfall Diffuser Manhole on the riverbank (Figure 2). This would be 30-by-30 feet and extend to a depth of 15 feet below surface (fbs). Improvements scheduled for 2018 include the construction of an 83-foot diameter Clarifier (to a depth of 15 fbs) and a 20-by-40 foot Street Sweeper dump station.

Improvements in 2020 include the construction of an Aerobic Digester (45-by-155 feet to a depth of 20 fbs), and an Electrical / Blower Building (40-by-70 feet to a depth of 5 fbs). A new Headworks (30-by-60 feet and 5 fbs), Aeration Basin (45-by-155 feet to 20 fbs), and Sludge Thickener / Mechanical Equipment Building (40-by-70 fbs to 5 fbs) are proposed for 2029. Finally, a second Aeration Basin (45-by-155 feet to 20 fbs) and Clarifier (83-foot diameter to 15 fbs) are proposed for construction after 2036.

New piping would be required during each construction phase, but the precise location of piping is unknown at this time.

3.0 REGULATORY ENVIRONMENT

It is anticipated that the Project would receive funding from the Environmental Protection Agency (EPA) through a Clean Water State Revolving Fund (SRF) grant issued to the Washington State Department of Ecology (Ecology). If Federal funding is received, the Project would be required to comply with Section 106 of the National Historic Preservation Act ("Section 106"). Section 106 would require that EPA (the Lead Federal agency) consider the effects of this undertaking upon Historic Properties within the project's Area of Potential Effects (APE). Federal code implementing Section 106, found at 36 CFR 800, includes a requirement that an effort be made to identify Historic Properties. The City is currently considering alternative approaches to meeting its wastewater management goals; therefore, the Area of Potential Effects has not yet been defined.

Additional laws that apply to archaeological projects conducted within the State of Washington include: Archaeological Sites and Resources (RCW 27.53), Indian Graves and Records (RCW 27.44), Human Remains (RCW 68.50), and Abandoned and Historic Cemeteries and Historic Graves (RCW 68.60).

4.0 AREA OF INTEREST

The Area of Interest (AOI) is the entirety of the existing wastewater facility on King County parcels 857090-0081, 857090-0082, 857090-0083, and 857090-0079. All parcels are owned by the City. The AOI is 4.9 acres, but much of this is covered by existing buildings, structures, vaults, piping and paved surfaces. Depending upon the wastewater management approach that is selected, the AOI may (or may not) accurately represent the eventual APE.

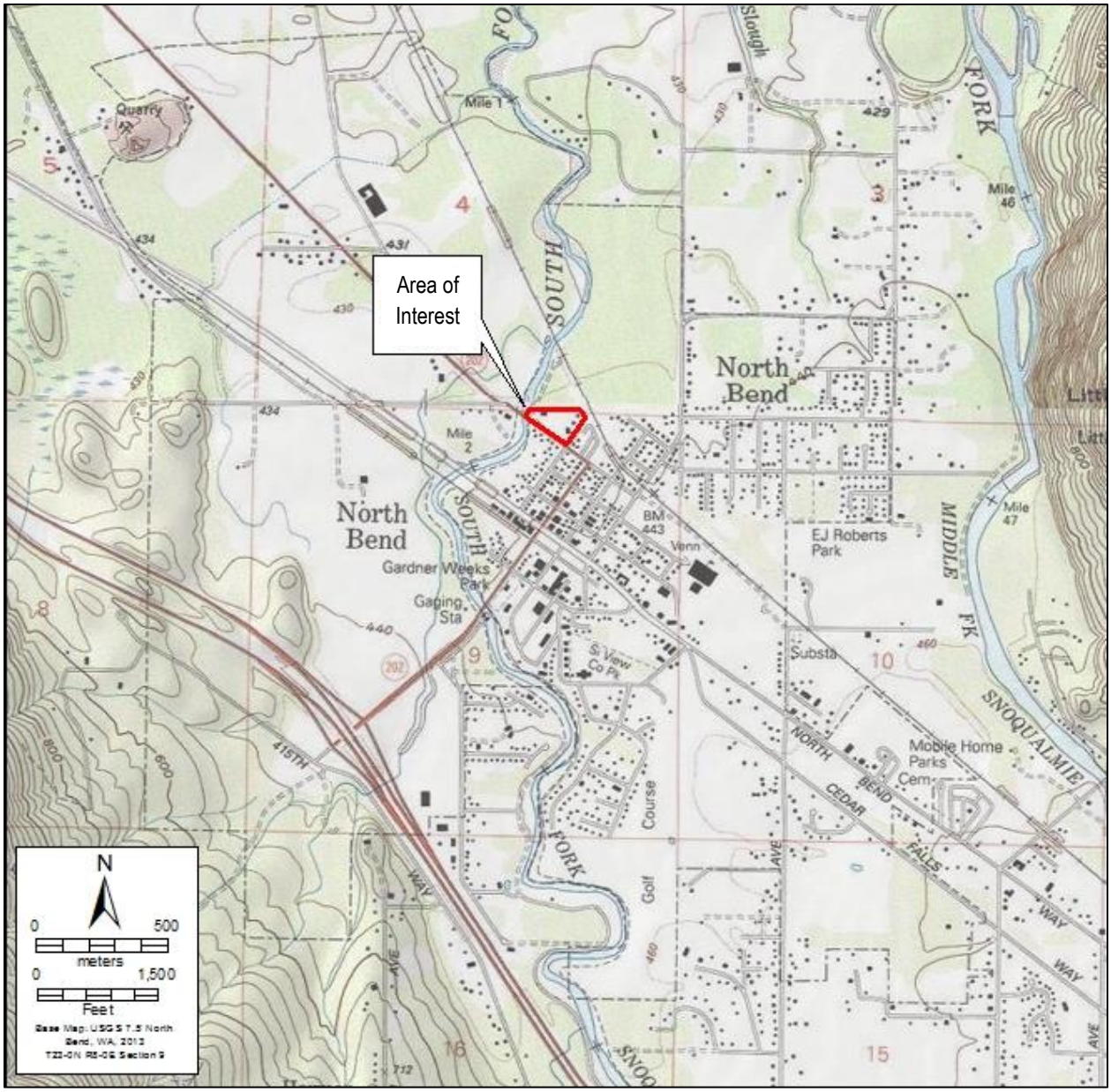

Figure 1. North Bend Wastewater Facility Area of Interest.

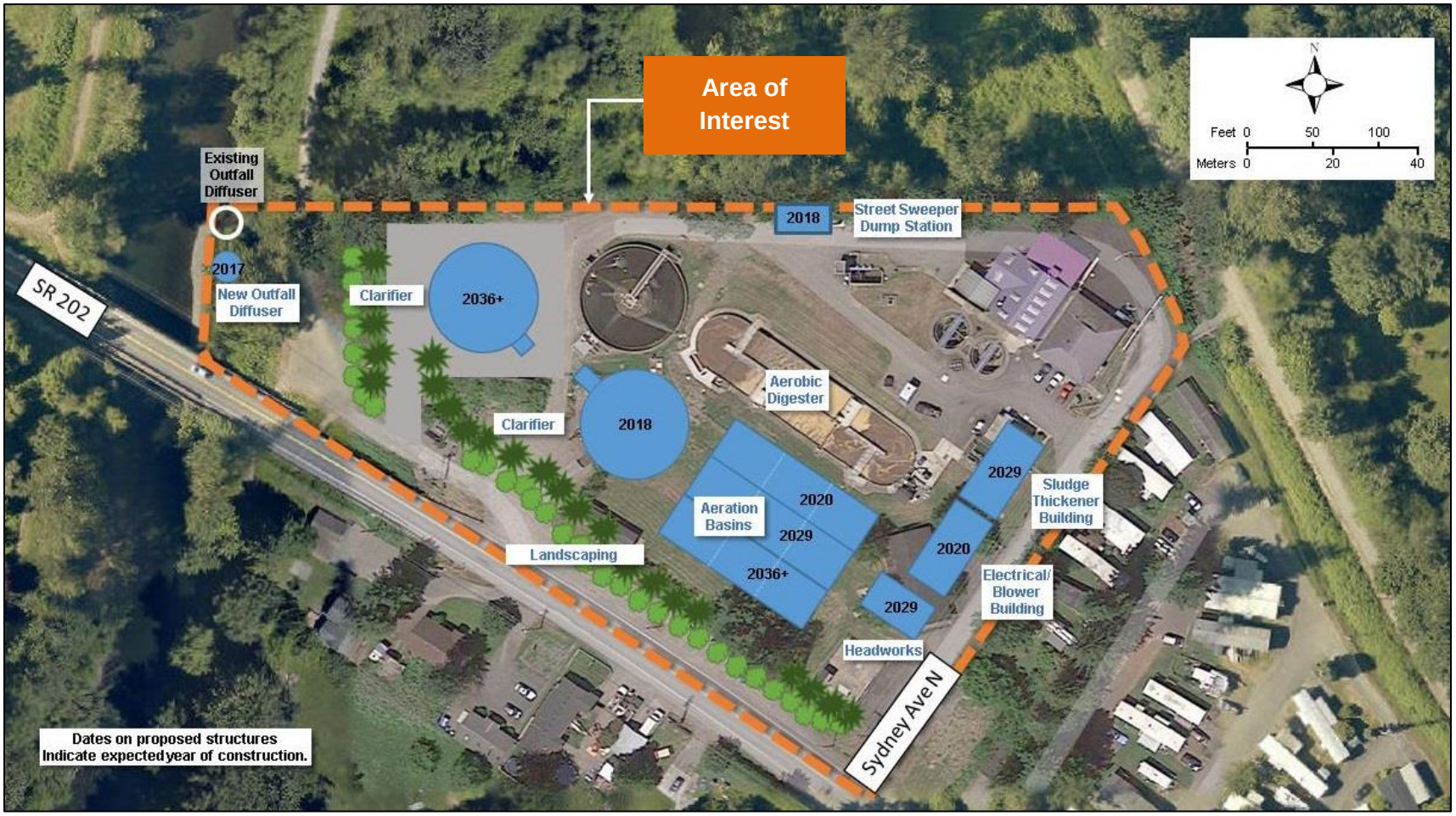

Figure 2. Conceptual Work Plan. Dates on proposed structures indicate expected year of construction.

5.0 BACKGROUND RESEARCH METHODS

ESA conducted a literature review of the Project extending one mile in every direction from the footprint of the AOI. Information reviewed included previous archaeological survey reports, ethnographic studies, historical maps, government landowner records, aerial photographs, regional histories, geological maps, soils surveys, and environmental reports. These records were reviewed in order to determine the presence of any potentially significant cultural resources, including Traditional Cultural Properties (TCPs), within the AOI. Relevant documents were examined at the Washington State Department of Archaeology and Historic Preservation (DAHP), the University of Washington Libraries, online, and ESA's research library.

6.0 ENVIRONMENTAL SETTING

6.1 Geologic Setting

The AOI is located along the right (east) bank of the South Fork Snoqualmie River. The AOI is situated approximately 5.5 miles upstream from Snoqualmie Falls, which marks the boundary between the elevated North Cascade geologic province and the low-lying Puget Lowland geologic province. Geomorphology within the region is largely the result of a series of glacial advances and retreats during the Pleistocene. During the most recent glacial advance – the Vashon stade of the Fraser glaciation – the front of the Puget lobe of the Cordilleran ice sheet advanced into the region by approximately 17,400 B.P. (years before present), rapidly extended to the vicinity of Olympia, and then retreated by approximately 16,400 B.P. (Troost and Booth 2008). It is estimated that the area around Rattlesnake Mountain was at one point covered by as much as 600 to 800 feet of ice associated with the Puget Lobe (Haugerud and Tabor 2009). It should also be noted that alpine glaciers originating on the peaks of the nearby Cascades followed a similar trajectory of advance followed by retreat as the climate cooled and then warmed.

Retreating glacial ice unleashed vast quantities of meltwater mixed with sediment and rock fragments, which was deposited as recessional outwash. Lacking a spillway, the meltwater became impounded in the Puget Lowland but did not overtop the level of Snoqualmie Falls.

Alluvial conditions dominated throughout the Holocene. The Snoqualmie River is characterized by lateral channel migration through cut-and-fill processes, leading to sinuous channels with abundant oxbows, sloughs, and meander scars evident within the floodplain. The AOI is mapped exclusively as Quaternary alluvium (*Qa*) (Figure 3), dating to the Holocene.

6.2 Soils

The AOI is mapped primarily as Salal silt loam with a small area of Nooksack silt loam in the northwest corner (Figure 4; NRCS 2016). The Salal series consists of very deep, well-drained soils formed in recent alluvium on flat floodplains and low river terraces. The typical Salal soil

series profile consists of a silt loam A-horizon (Ap1/A1/A2, 0-33 inches below surface), overlying a transitional AC silt loam horizon (33-50 inches below surface), overlying silt loam parent material (C, 50-60 inches below surface). The absence of a soil B-horizon is consistent with recent deposition of the soil parent material. Because Salal soils are well-drained and moderately permeable, as well as being subject to slow runoff, these soils area favored for cropland.

6.3 Flora and Fauna

The AOI is classified under the *Tsuga heterophylla* vegetation zone, which encompasses most of western Washington (Franklin and Dyrness 1988). Native vegetation of areas containing Salal silt loam soils includes Douglas fir, western red cedar, and red alder, with an understory of trailing blackberry, salmonberry, western sword fern, Oregon grape, and red elderberry (NRCS 2016). Native fauna include deer, cougar, elk, bear, coyote, beaver, skunk, quail, grouse, weasel, and muskrat. Anadromous fish do not travel above Snoqualmie Falls, but cutthroat, rainbow, and brook can be found above the Falls (Solomon and Boles 2002).

Figure 3. Geological map of AOI.

Figure 4. Soils map of AOI.

7.0 ETHNOGRAPHIC BACKGROUND

7.1 Overview

The Ethnographic Period is generally defined in the Puget Sound region as spanning between 1792 when Captain Vancouver's expedition occurred to 1850 when Seattle founders arrived. During this time period, indigenous people suffered from exposure to a series of smallpox, malaria, and measles epidemics that caused an estimated loss of half of their populations (Boyd 1990:146).

The AOI is located within the traditional territory of the *sduk^{w}álbix^{w}* (Snoqualmie people) whose members are part of the larger Southern Coast Salish group; the Southern Coast Salish share a common dialect of the Southern Lushootseed language (Miller 2014; Suttles and Lane 1990:485). Much of the early accounts of indigenous culture were misinterpreted; later studies provide more accurate descriptions of lifeways and will be relied upon here (Miller 2014; Suttles and Lane 1990:485). Snoqualmie villages traditionally consisted of a grouping of cedar plank houses, where communities aggregated at the close of the growing season. Local hunting and fishing was practiced during the lean winter months, while the group shared supplies of preserved food, including smoked fish and shellfish and dried berries. Smaller groups moved seasonally during the warmer months, providing a broad subsistence base including shellfish, marine and freshwater fish, land game, waterfowl, sprouts, roots and bulbs, berries, and nuts (Miller 2014; Suttles and Lane 1990). Food resources acquired during the spring, summer, and fall were used for winter supplies and trade, as well as immediate consumption. The vicinity of the AOI would have provided terrestrial game such as deer, elk, and small mammals whose meat was eaten fresh or dried for storage. A wide variety of plant resources were exploited for medicinal and other uses. Western red cedar was used for rope, baskets, and numerous household items; tules and cattails were collected near streams and marshes and used for making mats (Suttles and Lane 1990:490).

Prior to the influence of missionaries and belowground burial practices, Southern Coast Salish people predominantly practiced aboveground tree burials whereby the deceased was placed in a canoe or wood box, which was then elevated on tree branches or on a raised wooden platform (Suttles and Lane 1990:496). Often, as the canoe or platform decayed and collapsed, the human remains would come to rest on the ground below.

Impacts on Native Americans in Puget Sound increased after 1850 when treaties were signed between the United States and Native peoples and the reservation system was established. Today's concept of distinct tribes was an outcome of these treaties and the reservation system. The Snoqualmie were signatories of the Treaty of Point Elliot in 1855, but they were not given their own distinct reservation lands. It is reported that the US Government assigned the Snoqualmie to move to the Tulalip and Muckleshoot Reservations along with members of the Snohomish (BIA 2003). Some Snoqualmie relocated and enrolled as members of the Tulalip

Tribes while others remained in their traditional territory and enrolled in the Snoqualmie Tribe (BIA 1997).

7.2 Ethnographic Resources within the Project Vicinity

During the Ethnographic Period, the Snoqualmie lived above and below the Snoqualmie Falls, within the Upper and Lower Snoqualmie River Valleys. *Ba'xab* (Snoqualmie Prairie) is where the main Upper Snoqualmie village was located and is also the location of several named places (Table 1). These include Mt. Si (*q̓əlbc̓)* and a knoll on the Prairie (*yiʔduʔad*), which both feature in the Snoqualmie's origin story known as the "Star Husband" (Evans 1990; Hilbert et al. 2001:178).

There are eight named places within one mile of the AOI (Hilbert et al. 2001:176; Miller 2014). These include locations on the rivers, villages, and locations with religious importance.

It should be noted that Snoqualmie Falls, while a little more than three miles downriver (west) of the AOI, has religious importance and is a recorded Traditional Cultural Property.

Table 1. Recorded ethnographic place names within one mile of the AOI.

Name	Description	Citation[1]
Xa'tcu (lake / lagoon)	Where the river has two channels	Hilbert et al. 2001:178 (#35)
baqʷab / *Ba'xab* (prairie)	A village on the Snoqualmie Prairie	Hilbert et al. 2001:178 (#36); Miller 2014
Yi³do³ad (swing)	A knoll on the southwest edge of the Snoqualmie Prairie where a portion of an important oral tradition story known as "Star Husband" took place.	Hilbert et al. 2001:178 (#37)
Daxc1'dabc (footprints)	A location on Rattlesnake Mountain where a portion of an important oral tradition story known as "Star Husband/Star Child" took place.	Hilbert et al. 2001:178 (#38) Miller 2014:215
Qoa'l³qo (confluence)	Where the South Fork Snoqualmie River joins the main course of the Snoqualmie River.	Hilbert et al. 2001:178 (#39)
Saq³o'qo	A location one mile below North Bend on the west bank of the South Fork Snoqualmie River. This was used for ceremonial gatherings.	Hilbert et al. 2001:178 (#40)
Tutsuwa'dEb (no translation known)	A location between the South and Middle Fork Snoqualmie River; the expression is now used of a person dying of tuberculosis.	Hilbert et al. 2001:179 (#41)
q̓əlbc̓ / *Q³Elbts* (no translation known)	Mt. Si. A location on Mt. Si was used for observing elements of the "Star Husband / Star Child" oral tradition story.	Hilbert et al. 2001:179 (#42); Miller 2014:215)

[1]Parenthetical number refers to mapped location in published resource

8.0 HISTORICAL BACKGROUND

8.1 Overview

The AOI is within the boundaries of today's City of North Bend, northwest of the town's historic core (Lentz 1998). This community formed along a historic Native American trail and later a wagon road route across the Cascade Mountains via the Snoqualmie Pass. The earliest recorded Non-Native settler to this area was Jeremiah Borst, who arrived in 1858 (Lentz 1998). By 1867 the wagon road across the Snoqualmie Pass was completed; this road followed the same route as the former Native American trail used by western and eastern Washington groups (Prater 1981).

The town of North Bend was platted in 1889 and incorporated in 1909. The settlement was known as Snoqualmie, Mountain View, South Fork, and finally North Bend (Evans 1990:26-27).

Two railroad grades pass by the AOI; neither is still in service. To the north is the former grade of the Chicago, Milwaukee, St. Paul, and Pacific Railroad (CMSP&P or "Milwaukee Road"), constructed in 1910 (Corley 1969; USGS 1921). The grade has been converted into King County's Snoqualmie Valley Trail.

To the south of the AOI is the former grade of the Seattle, Lake Shore & Eastern Railroad (SLS&E). The railroad's Fall City to Salal Prairie line reached North Bend in 1888 (Robertson 1995:266). The SLS&E changed its name to the Seattle & International Railway Company in 1896 and was purchased by the Northern Pacific Railway Company in 1901 (Robertson 1995:261). In 1970 the Northern Pacific Railroad merged with Burlington Northern & Santa Fe Railroad (BNSF). In 1974 BNSF abandoned this segment of the SLS&E.

8.2 Historic Resources within the Study Area

When first surveyed by the US Government in 1866, a wagon road passed in close proximity to the AOI; this road was identified by the surveyor as the "Peoples crooked wagon road leading over the Cascade Mountains via Snoqualmie Pass" (US Surveyor General 1866). The South Fork Snoqualmie River was known at this time as Kemball's River and a prairie, referred to by surveyors as Rangers Prairie, was mapped northwest of the AOI. The homesteads of Matts Peterson and Peter Peterson were located southeast of the AOI near the river (Anderson Map Company 1889). The AOI is located within Matts Peterson's 1874 land patent.

Matts Peterson was a Danish immigrant who arrived in North Bend in 1865 (Evan 1990:7-8). He is said to have served in the British Navy and arrived in Puget Sound after jumping ship in Victoria, British Columbia. While homesteading in North Bend he married a woman living with the neighboring Wilder family and then sold his property to Jeremiah Borst in 1879 before moving to Walla Walla. Borst later sold the property to William H. Taylor, who is considered by some to be the founder of North Bend (Anderson Map Company 1907; Evans 1990:8).

By 1912 the original Peterson land claim was subdivided (Kroll Map Company 1912). Development of the lands south/southeast of the AOI continued during the 20th century as the town of North Bend-Snoqualmie expanded (Kroll Map Company 1926; Metsker Map Company 1936). Historic topographic maps document the foundations of some buildings within the AOI, but due to scale provide no additional information regarding the AOI (USGS 1913, 1953, 1968, 1993).

The wastewater facility was started in 1950, and aerial photographs taken between 1952 and 2013 document its development over time (HistoricAerials.com). Access roads and associated buildings were present within the AOI in 1952 and the proposed location of the aeration basins and clarifiers was cleared and graded. Additional buildings were added in 1969, 1980, and 1998.

Currently, there are five buildings or structures within the AOI older than 50 years (Snoqualmie Valley Youth Center, Clarifiers, Old Influent Pump Station and Sludge Holding Tank).

9.0 CULTURAL RESOURCES BACKGROUND

In preparation for this project, ESA conducted a records search of DAHP's online Washington Information System for Architectural and Archaeological Records Data (WISAARD) on June 8, 2016. The records search resulted in the identification of 18 prior cultural resources assessments (Table 2) and five recorded sites (Table 3) within one mile of the proposed project. In addition, there are four historic register-listed properties (Table 4).

9.1 Previous Cultural Resources Assessments

No cultural resources assessments have been conducted within the AOI. There are 18 prior cultural resources within one mile of the AOI. These range in purpose between new commercial and residential development, transportation and trail improvements, park improvements, transmission and fiber optic line installations, and a historic resources survey of the City of North Bend.

Table 2. Previous cultural resources assessments within one mile of the AOI.

Survey Type	Cultural Resources Identified	Project	Citation
Historic Property	Multiple Historic Properties	Historic Resource Survey of Downtown North Bend	Lentz 1998
Historic Property	Multiple Historic Properties	Historic Resources in the Cities of North Bend and Snoqualmie	Quackenbush 2003
Monitoring	45-KI-455	Archaeological Monitoring for the Tollgate Farmhouse Electrical Project	Shong and Miss 2011

Survey Type	Cultural Resources Identified	Project	Citation
Monitoring	45-KI-455	Monitoring for Tollgate Farm Park Project	Lockwood and Hoyt 2015
Monitoring	---	Worldcom Seattle to Salt Lake City Fiber Optic Line, Part 4, Washington	Sharp et al. 1997
Pedestrian	None	Proposed Park-and-Ride Facilities	McDaniel 2006
Pedestrian	None	Snoqualmie River PL-84-99 Levee Rehabilitation Projects	Kent and Kelly 2008
Subsurface	None	8th St Bridge	Kopperl 2005a
Subsurface	None	BPA Tanner Tap Transmission Line Project	Thompson 2000
Subsurface	None	I-90 Eastbound Ramps to SR 202 Roundabout	Earley 2006
Subsurface	None	Mt. Si Senior Center	Kopperl 2005b
Subsurface	None	New Sky LLC Project	Chambers and Baldwin 2013
Subsurface	45-KI-451	North Bend Way/Cedar Falls Way Intersection Improvement Project	LeTourneau and Cowan 2006
Subsurface	45-KI-454, 45-KI-455	Proposed Tollgate Farm Development	Podzorski and Blukis Onat 1998
Subsurface	45-KI-455	Ribary Creek Revegetation Project, Tollgate Farm	Kopperl 2006
Subsurface	45-KI-451	Tanner Trail Improvements	Norman and Nelson 2001
Subsurface	45-KI-455	Tollgate Farm Park Project	Lockwood and Hoyt 2013
Subsurface	None	Torguson Park Cultural Resource Survey	Stipe 2015

9.2 Recorded Archaeological Sites

There are no recorded archaeological sites within the AOI. Five have been recorded within one mile, all of which are less than 0.50 miles away. These include historic farms, Precontact camps, historic railroad grades, and historic roads. The boundary of multi-component archaeological site (45-KI-455, the Tollgate Farm Site) is adjacent to the northern boundary of the AOI. Known archaeological remains at Tollgate Farm are on the opposite (west) side of the Snoqualmie River, and at least 0.33 mile (0.5 km) west/northwest of the AOI.

Table 3. Recorded archaeological sites within one mile of the AOI.

NRHP / WHR Status*	Site Number	Site Name	Site Type	Description
Determined Not Eligible	45-KI-451	Seattle, Lake Shore & Eastern Railroad	Historic Railroad	Portion of the Seattle, Lake Shore & Eastern Railroad (later Northern Pacific Railroad)
Not Evaluated	45-KI-454	Tollgate Farm Survey Site #1	Precontact Lithics and Fire Modified Rock	Precontact artifacts identified within 0-50 cm below surface.
Not Evaluated	45-KI-455	Ft. Smalley-Fares' Homestead – Tollgate Farm – Fisk House	Historic Fort, Historic Homestead	Precontact and Historic Era site, including the location of an 1856 blockhouse and later a toll-road station along the Snoqualmie Pass Wagon Road. The location also once featured residences, a store, hotel, and farmlands.
Not Evaluated	45-KI-540	---	Historic Road	Bridge segments and culvert associated with Sunset Highway (Hwy 10)
Not Evaluated	45-KI-986	---	Historic Railroad	Embankment, railroad grade and road grade, c. pre-1946

*NRHP = National Register of Historic Places, WHR = Washington Heritage Register

9.3 Historic Register-Listed Properties

There are four properties listed on historic registers within one mile of the AOI. Three are listed on both the National Register of Historic Places and the Washington Heritage Register. One is only listed on the Washington Heritage Register.

Table 4. Historic register-listed properties within one mile of the AOI.

NRHP / WHR Status*	Site Number	Site Name	Site Type	Description
Listed - WHR & NRHP	45-KI-648	North Bend Ranger Station – Mt. Baker-Snoqualmie National Forest	Historic District	Constructed 1933-1942; complex of 10 historic government buildings
Listed – WHR & NRHP	45-KI-658	McGrath Café and Hotel	Historic Building	Constructed 1922

NRHP / WHR Status*	Site Number	Site Name	Site Type	Description
Listed – WHR & NRHP	45-KI-1219	Si View Park	Historic Landscape	Constructed 1941; park includes WPA-era architecture.
Listed - WHR	45-KI-566	Covered RR Bridge – North Bend	Historic Bridge	Constructed 1910 by the Chicago, Milwaukee, St. Paul & Pacific Railroad Company

*NRHP = National Register of Historic Places, WHR = Washington Heritage Register

9.4 Expectations

According to DAHP's Statewide Predictive Model (DAHP 2010), the AOI varies from Moderate to High Risk for buried precontact archaeological sites. Based upon the archival research discussed above, ESA considers there to be a moderate probability that historical resources associated with past agricultural, transportation, and residential use are present.

10.0 FIELD ASSESSMENT METHODS

ESA Archaeologists Chris Lockwood, Bryan Hoyt, and Patrick Elliot conducted the surface survey, subsurface survey, and historic property survey of the North Bend Wastewater Facility AOI on June 1, 2016. Weather conditions at the time of the survey included warm temperatures and clear skies.

10.1 Surface Survey

The surface survey consisted of multiple walking transects across the AOI focusing on unpaved areas. Notes and photographs of vegetation, surface sediments, and surface disturbances were made.

10.2 Subsurface Survey

Prior to survey, ESA designed a subsurface survey approach that included excavation of up to eight mechanical test pits and up to eight shovel/auger probes. This approach was contingent upon actual field conditions including the presence of existing subsurface utility corridors and vaults, and feasibility of excavating safely and successfully in proximity to this infrastructure. In consultation with City personnel, ESA determined that five mechanical test pits and four shovel/auger probes could be safely and productively excavated.

Mechanical test pits were excavated by track hoe under the supervision of an archaeologist. Test pits averaged 0.6 m (2 feet) wide, 2.4 m (8 feet) long, and 2.1 m (7 feet) deep trench. Cuttings were side cast and visually inspected for the presence of artifacts and other potential cultural

indicators, such as dense charcoal, fire modified rocks, or burned soils. Notes and photographs were taken regarding the presence/absence of cultural material, degree of disturbance, and stratigraphic sequence.

Probes were excavated with a round nose shovel to an average depth of 1.0 m (3.3 feet) below surface (bs), with an approximate diameter of 40 cm (16 inches). Probes were then extended to a terminal depth of approximately 2 m (6.6 feet) bs with a 4-inch diameter auger. Probe spoils were screened through ¼-inch mesh, and then backfilled. Notes were recorded regarding observations, probe locations, stratigraphy, and content. Probe locations were mapped with using GPS.

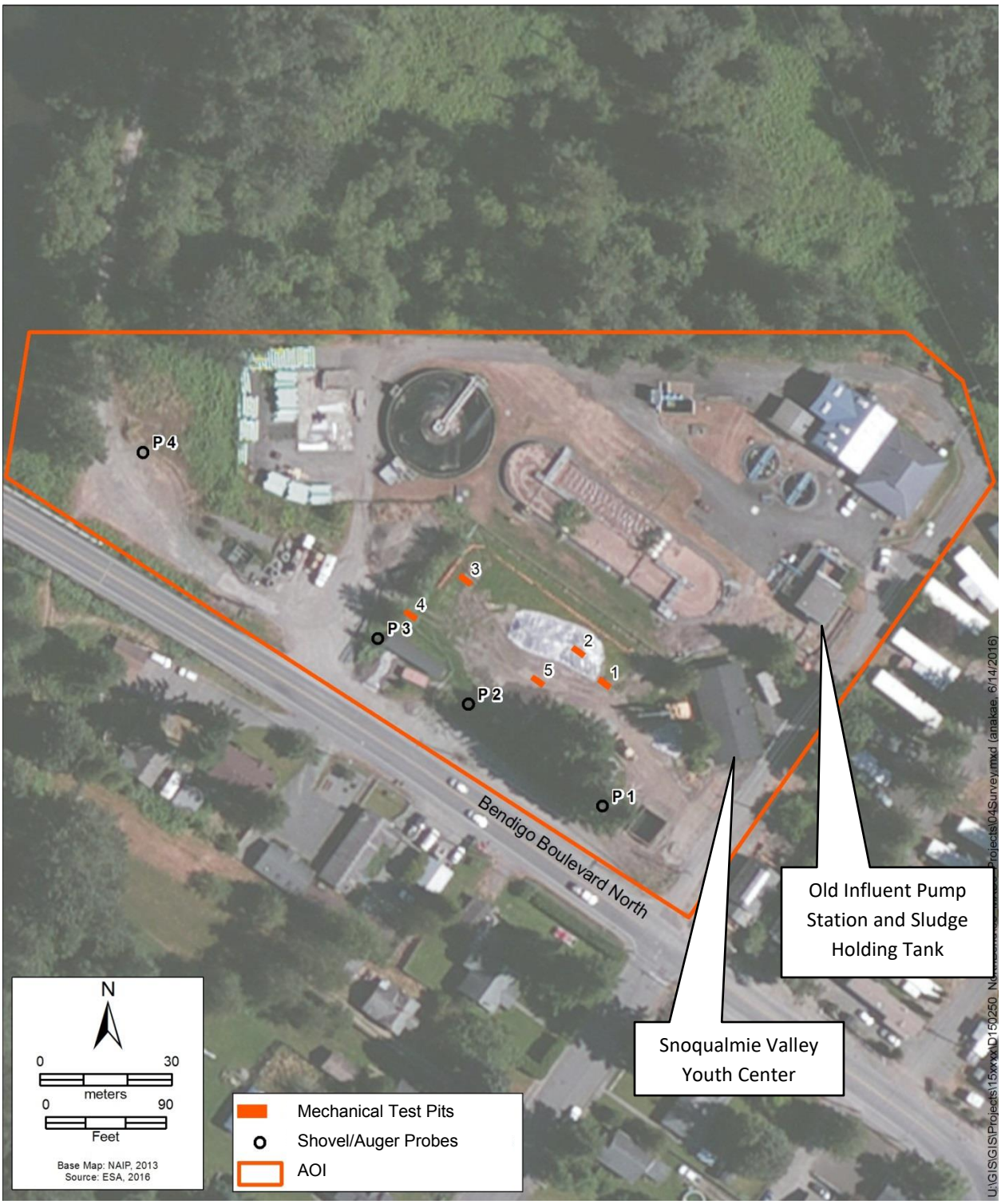

Figure 5. Aerial image depicting the AOI boundary, Mechanical Test Pit locations, and Shovel/Auger Probe locations, and Historic Buildings (older the 50 years) Inventoried.

10.3 Historic Property Survey

ESA examined all buildings and structures on the North Bend Wastewater Facility. Field documentation included photography and field descriptions. ESA researched the ages of different buildings and structures using King County Tax Assessor records and historic maps. ESA recorded all (two) buildings older than 50 years in the Washington State Historic Property Inventory (HPI), specifically the former Snoqualmie Valley Youth Center, and the Old Influent Pump Station and Sludge Holding Tank.

11.0 RESULTS

No precontact or historic archaeological resources, or environmental indicators of past cultural activities, were observed. ESA inventoried the former Snoqualmie Valley Youth Center, and the Old Influent Pump Station and Sludge Holding Tank on DAHP HPI forms.

11.1 Pedestrian Survey

The AOI sits on a low floodplain terrace, which has been extensively modified and armored. The northern half of the AOI contains extensive wastewater treatment structures, utility corridors, subsurface vaults, and paved surfaces (Figure 5). The existing Aerobic Digester and Clarifier structures are built upon an elevated ground surface, approximately 1.5 meters (4 feet) higher than the surrounding ground surface.

The southern half of the AOI consists of a grass field (Figure 6) bounded by large firs to the south (along SR 202) and the Aerobic Digester to the north. Utility installations are located at the eastern and southern end of the field. A mobile storage container covered by an expedient wooden roof is currently located in the western end of the field, near SR 202.

The western end of the AOI consists of gravel roads and pathways, and areas of brambles, between the western end of the wastewater facility and the edge of the Snoqualmie River. A low, built levee extends along the edge of the river (Figure 7). A fenced natural gas structure is located between the existing wastewater facility and the river. Conditions along the western end of the AOI consists of imported gravel and crushed rock, blackberry brambles, and firs and cottonwoods along the river bank. Surface visibility across the AOI was poor.

Figure 6. Northwest facing view of the grass field in the southern half of the AOI. Mobile storage container in left background of frame.

Figure 7. Northwest facing view of gravel/crushed rock area in the western end of the AOI.

11.2 Subsurface Survey

Due to the presence of widespread, adverse field conditions (buildings, structures, vaults and piping, and pavement) within the northern half of the AOI, all mechanical test pits and shovel/auger probes were excavated within the southern half of the AOI. Results for each mechanical test pit and probe are presented in Appendix A.

Observed soils exhibited a high degree of disturbance and filling. The southern half of the AOI contained up to 1.5 m (4.8 feet) of dark brown, very gravelly, silt loam, with occasional organics and common construction debris (including concrete, metal, and plastic). Beneath this layer is grayish-brown, loamy silt to fine sand with sparse charcoal flecks, decomposing grasses, and occasional modern debris (plastics and metal). The upper layer is interpreted as a mixture of heavily disturbed native alluvium and imported fill materials associated with on-going construction and maintenance of the facility. The lower layer is interpreted as native alluvium, which, based upon the presence of modern trash, also appears disturbed, but less so than the overlying layer.

In the easternmost test pit (Test Pit 1) and probe (Probe 1), ESA observed probable evidence for a buried soil A-horizon (paleosol) at the top of alluvial layer. Paleosols denote periods of relative landform stability during which soil formation has occurred on a former ground surface. The paleosol in Test Pit1 consisted of dark brown sandy loam with organics, trace charcoal (and charcoal staining), few gravels, and weak subangular ped structure, between 0.9 to 1.2 m (3-4 feet) bs (Figure 8). The paleosol was shallower in Probe 1 (0.4-0.7 m, 1.4-2.3 feet). The absence of a paleosol west of Test Pit 1 and Probe 1 likely attests to the cumulative effects of a series of construction disturbances visible in aerial photos dating back to the 1950s.

Figure 8. North facing view of Mechanical Test Pit 1 profile; red dashed lines indicate the paleosol at the top of the alluvium.

11.2.1 Historic Property Survey

ESA recorded all (two) buildings older than 50 years in the Washington State Historic Property Inventory (HPI), specifically the former Snoqualmie Valley Youth Center, and the Old Influent Pump Station and Sludge Holding Tank. The HPIs are available on DAHP's WISAARD database.

xxxx Bendigo Boulevard N / Snoqualmie Valley Youth Center (DAHP #7059841)

This structure is a rectangular building located near the northwest corner of Bendigo Boulevard N and Sydney Avenue N (Figure 9). The building was constructed in 1964, has end-gables with wide eaves, and its main entrance is at the southeast corner. The building is clad in T1-11 along the body of the building, and horizontal wood siding at the gables. The east elevation has a single, horizontal, aluminum sash window. The south elevation has 10 small windowpanes (one covered with plywood), and two doors. The west elevation has no fenestration, while the north elevation has three horizontal, aluminum sash windows, a single setback door, and a single doublewide door. There is a brick chimney in the center of the structure and the roof has asphalt

shingle roofing. The foundation appears to be poured concrete. There are no obvious alterations to the exterior of the building.

Statement of Significance

The original architect and engineer are unknown. The building's integrity is considered good, but it does not appear to embody stylistic characteristics or a method of construction that would warrant special recognition. It is also not located in a cohesive grouping of similar building types. Therefore, the property is recommended **Not Eligible** for listing in the NRHP based on its architectural qualities or associations.

Figure 9. Snoqualmie Valley Youth Center, east elevation (2016).

400 Bendigo Boulevard N / North Bend Sewage Treatment Plant Old Influent Pump Station and Solids Holding Tank (DAHP #705978)

This structure is an irregularly shaped building located at 400 Bendigo Boulevard N (Figure 10). The Old Influent Pump Station and Solids Holding Tank were constructed in 1950, and expanded in 1980 to include headworks, laboratory and control building, and standby electric generator room. This functional building is primarily poured concrete, but additions to it have been done with metal siding and brick. The roof is both flat with eaves and flat with parapet, and the primary entrance is on the north elevation. The first story is brick with a one-over-two hung window, and an entrance that has been bricked-off. The second story, which sits on the formers flat roof with eave, is metal vertical shingle with square plate window at the northeast corner. Also on the east elevation, setback from the brick elevation, is a one-and-a-half story poured concrete part of the building.

The west elevation has a square plate glass window at the northeast corner of the building on the second story, and there is a metal stairway leading to a platform. There is a six-foot tall ventilation grate, next to a metal leading into the poured concrete portion of the building. The south elevation is two stories (the bottom story being half-underground due to slope of the surrounding ground), with a stairway leading to the second story portion. The first story, which is poured concrete, has two ventilation grates. The roof of that building serves as a walkway to the second story which has a door, large sash window, and horizontal sash hung window.

Statement of Significance

The original architect and engineer are unknown. The building's integrity is considered poor, and it does not appear to embody stylistic characteristics or a method of construction that would warrant special recognition. Therefore, the property is recommended **Not Eligible** for listing in the NRHP based on its architectural qualities or associations.

Figure 10. North Bend Sewage Treatment Plant Headworks Building, east elevation (2016).

12.0 ASSESSMENT OF EFFECTS ON HISTORIC PROPERTIES

If a property is considered eligible to the NRHP, the lead federal agency must determine if the project will affect the property, and whether that would be an Adverse Effect. Each of the two properties inventoried for the Project are recommended **Not Eligible** for listing in the NRHP, therefore, the project will have **No Adverse Effect** to historic properties

13.0 RECOMMENDATIONS

Previous construction and expansion of the wastewater facility has caused extensive, deep disturbance across the AOI. However, because intact archaeological remains (if present) could be encountered in discrete pockets not disturbed by previous construction, ESA recommends that the City create and implement a Cultural Resources Inadvertent Discovery Plan (IDP) to be used during any further site investigations and construction.

ESA recommends the City request the Department of Archaeology and Historic Preservation to determine the Youth Center and Old Influent Pump Station and Solids Holding Tank **Not Eligible** for Register-listing.

The findings and professional opinions included in this report are based on standard archaeological techniques including pedestrian survey, mechanical test pits, and subsurface probing; however each has its limitations. It is possible that unanticipated cultural resource materials may be encountered during construction. In the event that cultural resources are

observed during implementation of the project then work should be temporarily suspended at that location and a professional archaeologist should be consulted.

Pursuant to RCWs 68.50.645, 27.44.055, and 68.60.055, if ground disturbing activities encounter human skeletal remains during the course of construction, then all activity will cease that may cause further disturbance to those remains. The area of the find will be secured and protected from further disturbance. The finding of human skeletal remains will be reported to the county medical examiner/coroner and local law enforcement in the most expeditious manner possible. The remains will not be touched, moved, or further disturbed. The county medical examiner/coroner will assume jurisdiction over the human skeletal remains and make a determination of whether those remains are forensic or non-forensic. If the county medical examiner/coroner determines the remains are non-forensic, then they will report that finding to the Department of Archaeology and Historic Preservation (DAHP) who will then take jurisdiction over the remains. The DAHP will notify any appropriate cemeteries and all affected tribes of the find. The State Physical Anthropologist will make a determination of whether the remains are Indian or Non-Indian and report that finding to any appropriate cemeteries and the affected tribes. The DAHP will then handle all consultation with the affected parties as to the future preservation, excavation, and disposition of the remains.

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APPENDIX A: SUBSURFACE DATA

Probe / Trench	Layer	Top	Bottom	Color	Texture	% Gravel	Horizon	Charcoal	Organic	Archaeological	Modern Trash
Probe 1	1	0	34	brown	Silt loam	35to<60	Fill	No	Yes	No	Yes
Probe 1	2	34	44	redbrown	Loamy sand	<5	Fill	Trace	Yes	No	No
Probe 1	3	44	69	darkbrown	Silt loam	<5	A	Trace	Yes	No	No
Probe 1	4	69	105	yellowbrown	Loamy sand	<5	B	Trace	Yes	No	No
Probe 1	5	105	130	yellowbrown	Sand	<5	C	Trace	Yes	No	No
Probe 2	1	0	70	darkbrown	Silt loam	60<90	Fill	Trace	Yes	No	Yes
Probe 3	1	0	85	darkbrown	Silt loam	60<90	Fill	No	Yes	No	Yes
Probe 4	1	0	38	brown	Loamy sand	>=90	Fill	No	No	No	Yes
Probe 4	2	38	42	graybrown	Silt loam	60<90	Fill	No	Yes	No	Yes
Trench 1	1	0	20	darkbrown	Sandy loam	15to35	Fill	Trace	Yes	No	Yes
Trench 1	2	20	92	brown	Sandy loam	15to35	Fill	Trace	Yes	No	Yes
Trench 1	3	92	122	darkbrown	Sandy loam		A	Trace	No	No	No
Trench 1	3	122	137	graybrown	Sandy loam	5to15	C	No	No	No	No
Trench 1	5	137	183	brown	Sand	15to35	C	No	No	No	No
Trench 2	1	0	22	darkbrown	Sandy loam	15to35	Fill	Trace	Yes	No	Yes
Trench 2	2	22	204	brown	Sandy loam	35to<60	Fill	No	No	No	Yes
Trench 3	1	0	20	darkbrown	Sandy loam	15to35	Fill	Trace	Yes	No	Yes
Trench 3	2	22	132	brown	Sandy loam	15to35	Fill	Trace	Yes	No	Yes
Trench 3	3	132	225	gray	Sand	<5	C	No	Yes	No	No
Trench 4	1	0	22	brown	Sandy loam	15to35	Fill	Trace	Yes	No	Yes
Trench 4	2	22	147	brown	Sandy loam	15to35	Fill	Trace	Yes	No	Yes
Trench 4	3	147	214	graybrown	Silt loam	<5	C	No	Yes	No	Yes
Trench 5	1	0	22	darkbrown	Sandy loam	15to35	Fill	Trace	Yes	No	Yes
Trench 5	2	22	112	brown	Sandy loam	15to35	Fill	Trace	Yes	No	Yes
Trench 5	3	112	168	redbrown	Sand	60<90	C	No	No	No	No

NORTH BEND
easy to reach. . .hard to leave

5/17/16

Mr. Steven Mullen-Moses, Cultural Resource Director
Snoqualmie Nation
8130 Railroad Avenue, Suite 103
Snoqualmie, WA 98065

RE: City of North Bend Wastewater Facility Improvement Project

Dear Mr. Mullen-Moses:

This correspondence is intended to provide information regarding the City of North Bend's proposed Wastewater Facility Improvement Project ("Project"). The City is proposing to make improvements at an existing wastewater facility located at the intersection of SR 202 and Sydney Avenue in North Bend, King County, Washington. The Project Area is in the NE ¼ of Section 9, Township 23 North, Range 8 East on the North Bend, Washington topographic map (Figure 1). The Project encompasses parcels (# 857090-0081, 857090-0082, 857090-0083, 857090-0079) owned by the City.

The Project is still in the concept stage, but it would be completed over several phases between 2016 and 2036 (Figure 2). In 2017, the Project proposes to install an Outfall Diffuser Manhole along the east bank of the Snoqualmie River; dimensions of the manhole will be approximately 30-by-30 feet and extend to a maximum depth of 15 feet below surface (fbs). Improvements scheduled for 2018 include the construction of an 80-foot diameter Clarifier (to a depth of 15 fbs) and a 20-by-40 foot Street Sweeper dump station. Improvements in 2020 include the construction of an Aerobic Digester (45-by-155 feet to a depth of 20 fbs), and an Electrical / Blower Building (40-by-70 feet to a depth of 5 fbs). A new Headworks (30-by-60 feet and 5 fbs), Aeration Basin (45-by-155 feet to 20 fbs), and Sludge Thickener / Mechanical Equipment Building (40-by-70 fbs to 5 fbs) are proposed for 2029. Finally, a second Aeration Basin (45-by-155 feet to 20 fbs) and Clarifier (80-foot diameter to 15 fbs) are proposed for construction after 2036. Additionally, various buried utilities and site piping elements and landscaping features will be constructed between 2016 and 2029, and in 2036 and beyond; these would occur across much of the Project Area and reach a maximum depth of about 8 fbs.

The City is planning to apply for funding from the Clean Water State Revolving Fund (CWSRF), which utilizes both Federal and State funds. If CWSRF funding is received, the Project would be subject to compliance with Section 106 of the National Historic Preservation Act ("Section 106"), as well as the State of Washington's Executive Order 05-05 ("EO 05-05"). This letter is not intended to constitute consultation under either Section 106 or EO 05-05.

The City has retained Environmental Science Associates (ESA) to assist with compliance with relevant cultural resources requirements. ESA's preliminary background research reveals that the Washington Department of Archaeology and Historic Preservation's Statewide Predictive Model classifies the Project Area as moderate to high risk for precontact archaeological resources. No Historic Properties (i.e., archaeological sites or historic buildings) have been previously recorded within the Project Area. However, assessor data indicates the Project Area contains a circa-1950 control building built during

City of North Bend Public Works
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original construction of the wastewater facility, as well as a circa-1964 commercial building formerly used by a community organization; both buildings would be demolished during the Project. One multi-component archaeological site (45-KI-455, the Tollgate Farm Site) is adjacent to the northern boundary of the Project Area. Archaeological remains associated with precontact and historic occupation at Tollgate Farm have been mapped on the opposite side (west) of the Snoqualmie River, and at least 0.33 miles (0.5 km) WNW of the Project Area.

In anticipation of its application for funding, the City has requested ESA to conduct an archaeological field survey of the Project Area on June 1, 2016. The City invites representatives of the Snoqualmie Nation to be present during the survey. If you have any questions or need additional information please contact Donald DeBerg, City of North Bend City Engineer at (425) 888-7652.

Sincerely,

Donald DeBerg
City Engineer
City of North Bend

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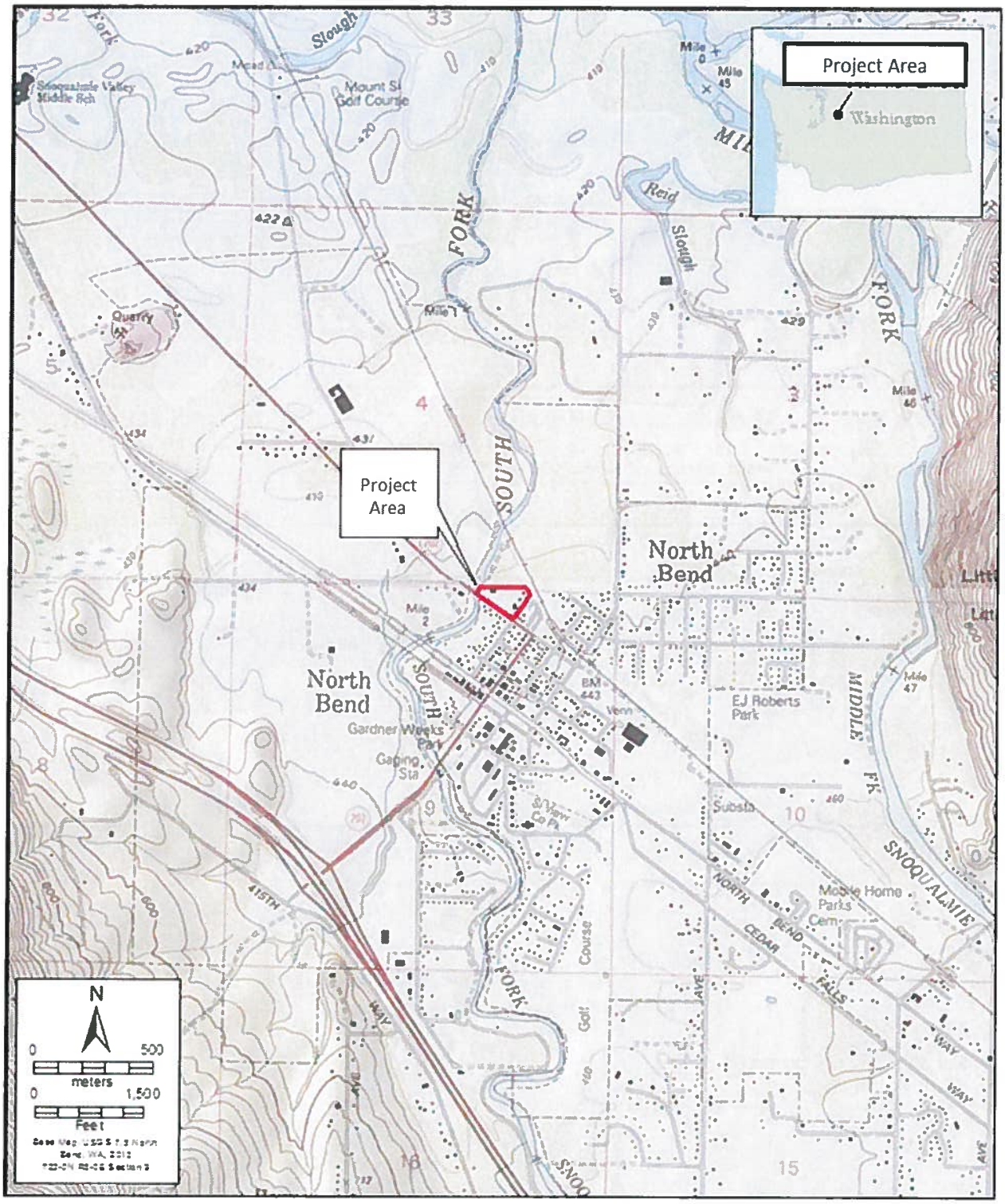

Figure 1. City of North Bend Wastewater Facility Improvement Project Area.

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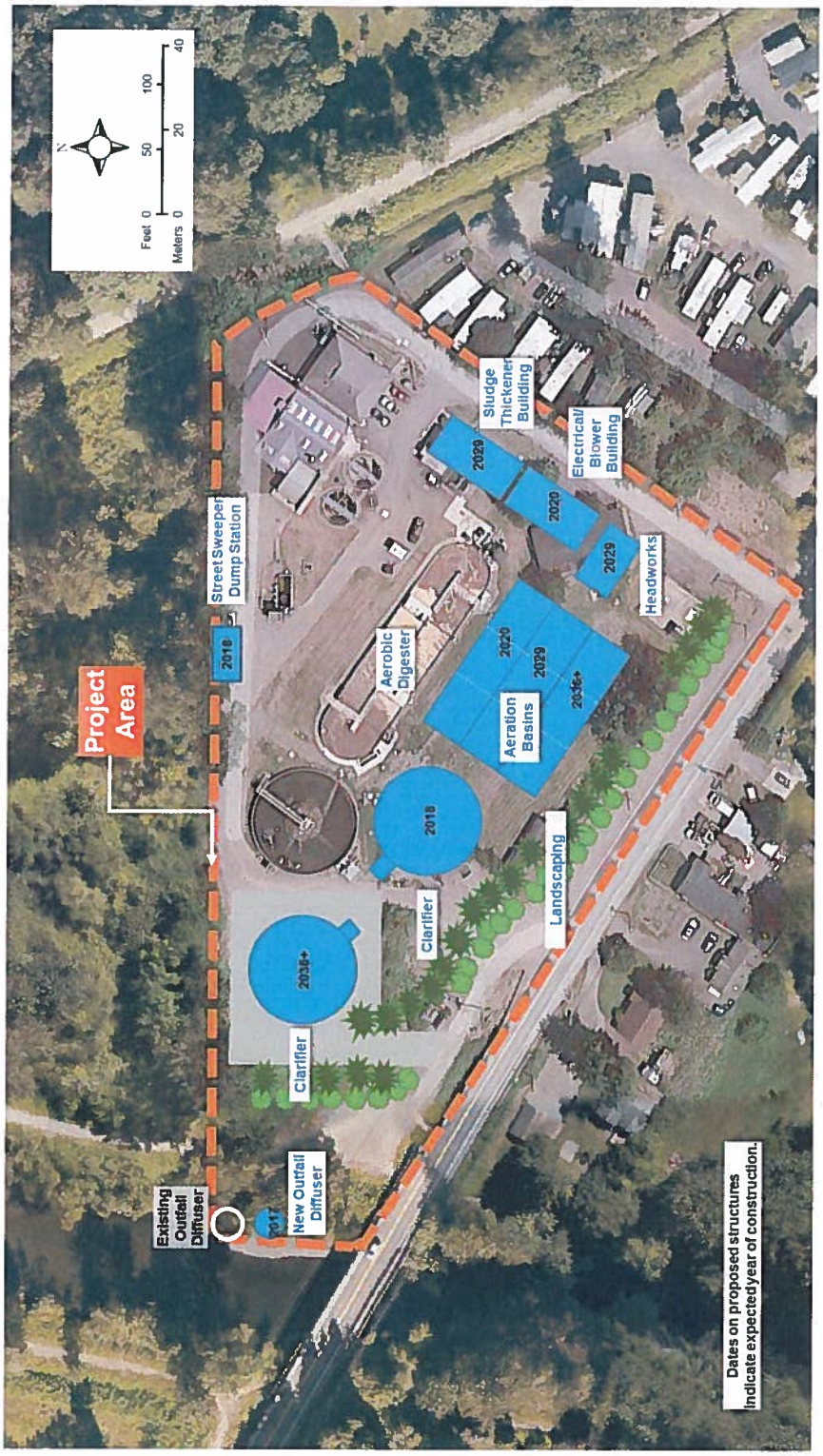

Figure 2. City of North Bend Wastewater Facility Improvement Project -- Conceptual Plan for Construction.

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APPENDIX K

WASTEWATER FACILITIES PLAN
PUBLIC INVOLVEMENT DOCUMENTATION

City of North Bend

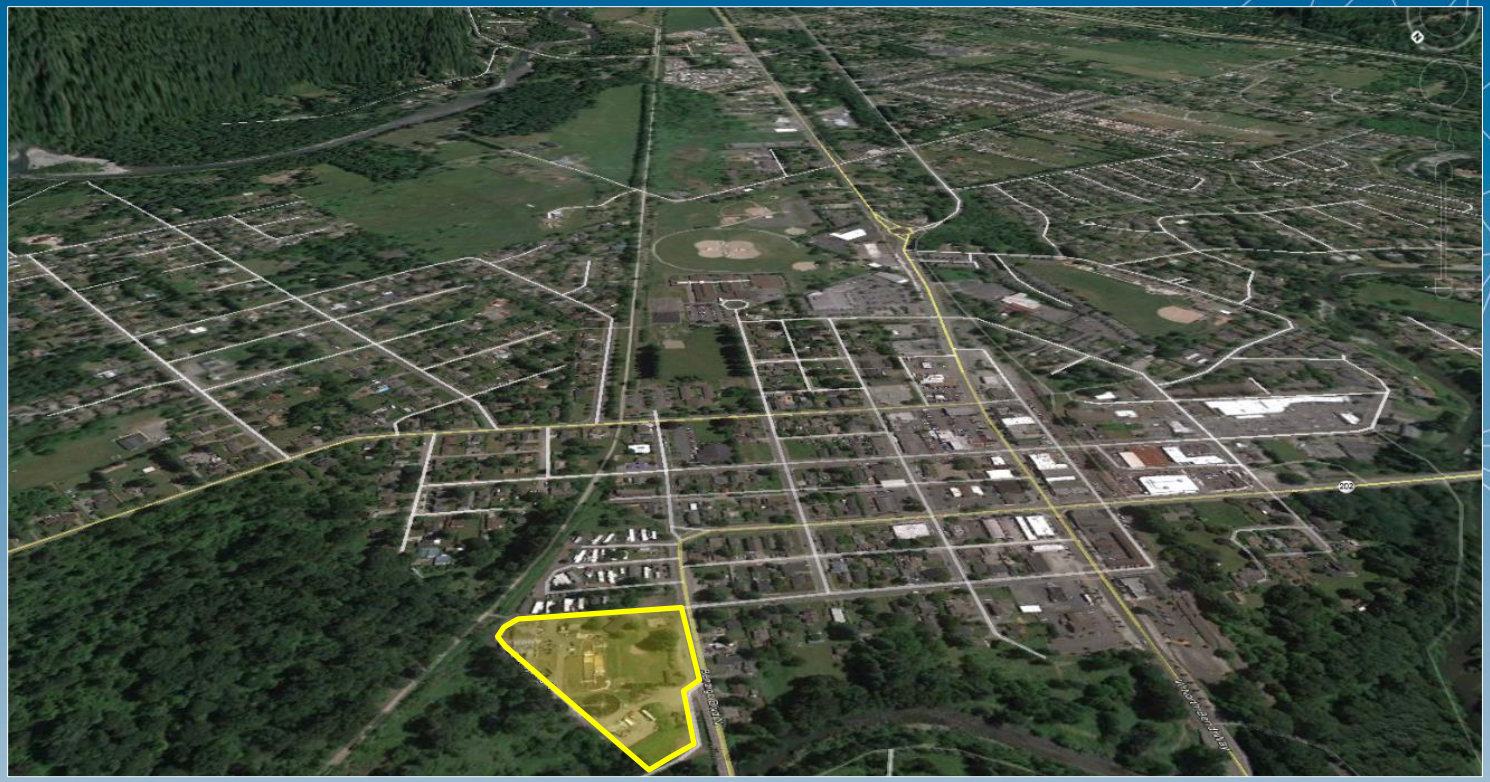
Wastewater Facilities Plan Public Meeting Documents

April 26, 2016

TETRA TECH

North Bend Wastewater Facility Plan

Public Meeting 4/26/16



Agenda

- **Introductions**
  - City – Don DeBerg, PE, City Engineer
  - Tetra Tech – John Markus, PE, Project Manager
  - FCSG – Angie Sanchez, Financing and Rates
- **Purpose and Goals**
- **Background**
- **Wastewater Alternatives Analysis**
- **Environmental Review**
- **Financing and Rates**
- **Discussion /Questions**

Project Team

- **City**
  - Engineering Services Department
  - Public Works Department
  - Planning Department
  - Finance Department
- **Tetra Tech**
  - Tt - Wastewater Facilities Analysis
  - ESA – Environmental Review
  - FCSG – Rates and Financing

Purpose and Goals of Meeting

- Present alternatives
- Review advantages and disadvantages
- Take questions and comments
- Discuss Preferences
- Present Draft Plan at next public meeting

Wastewater Facility Plan – Why?

- Required by WAC 173-240 for modifying wastewater facilities
- Prescribed, methodical approach for planning
- 20-year planning period
- Plan fixes for existing deficiencies
- Plan for meeting more stringent effluent limits to improve Water Quality of the South Fork
- Plan for expected growth

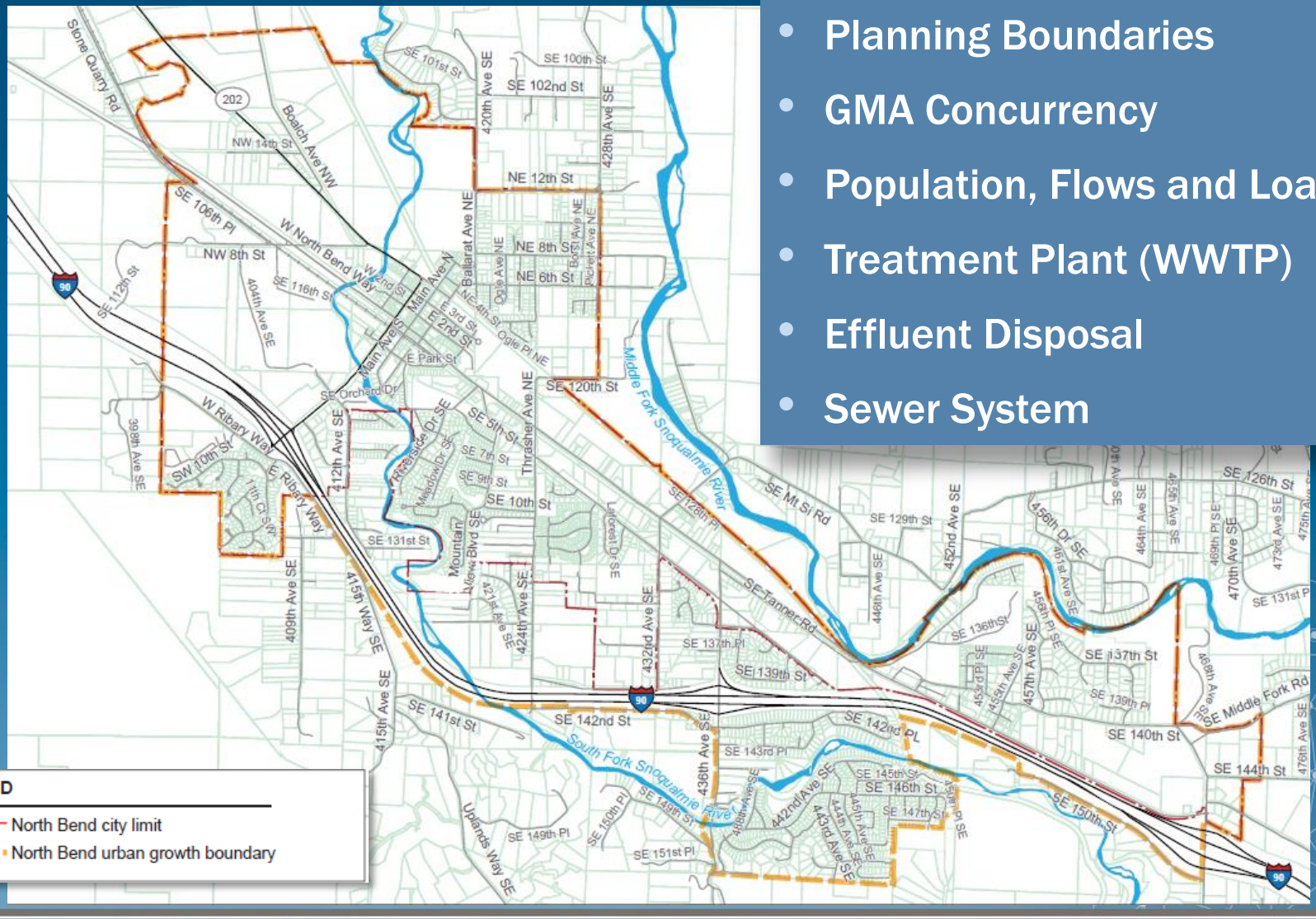
Schedule

- **2016 Facility Plan**
  - Public Meeting #1- alternatives - April
  - Public Meeting #2- draft plan - June
  - City & Ecology Review - July
  - Finalize & Approve Plan - August
- **2016 to 2020 - Phase 1 Improvements**
- **2026 Phase 2 Facility Plan Update**
- **2027 to 2029 – Phase 2 Improvements**

Facility Plan – General Elements

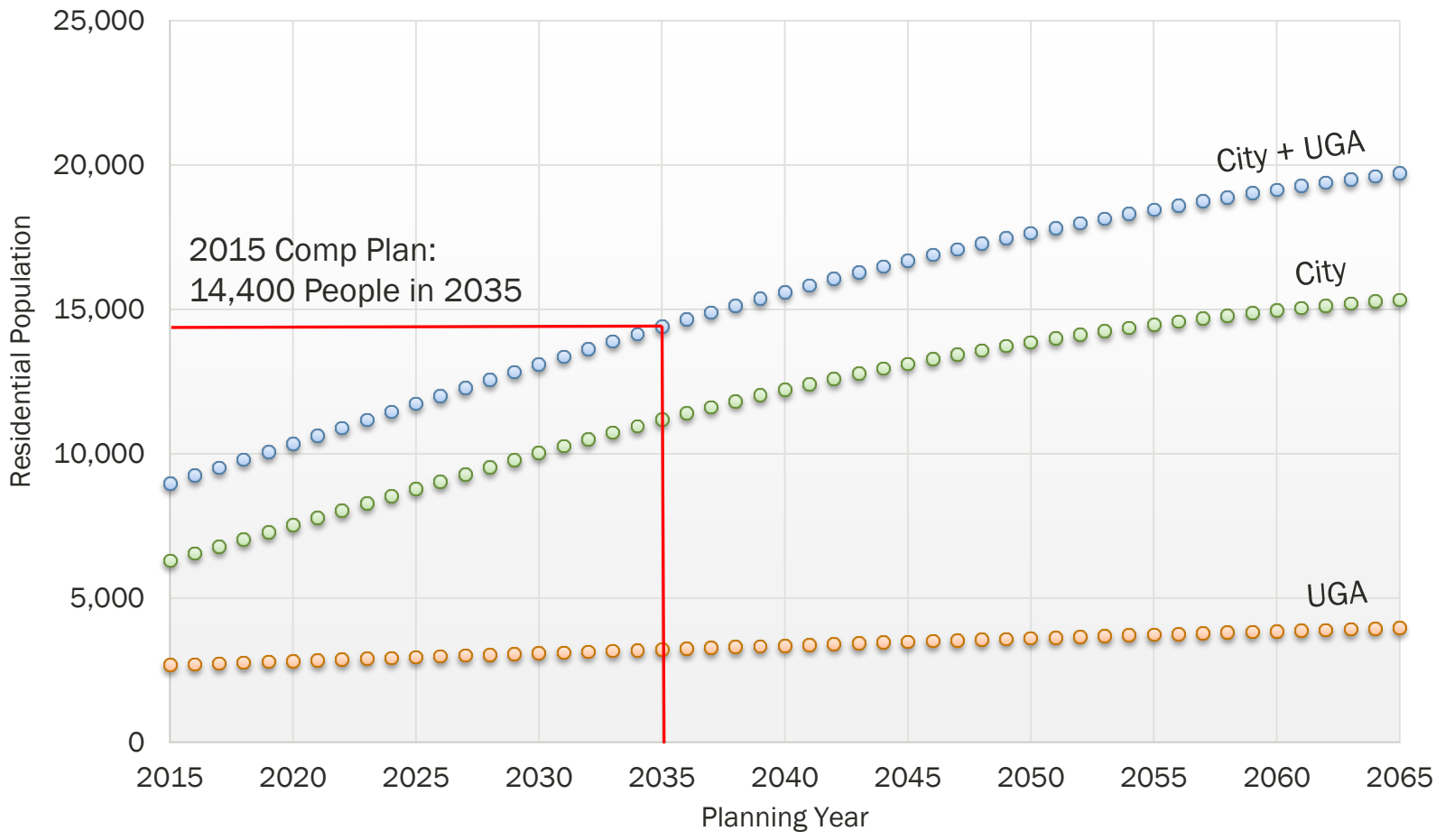
- Regulations, Policies and Standards
- Cost Effective Analysis
- Implementation Plan
- Funding & Rate analysis
- Environmental Review
- Public Outreach
- Review and Approval Process
  - City
  - Ecology

Facility Plan – Technical Elements

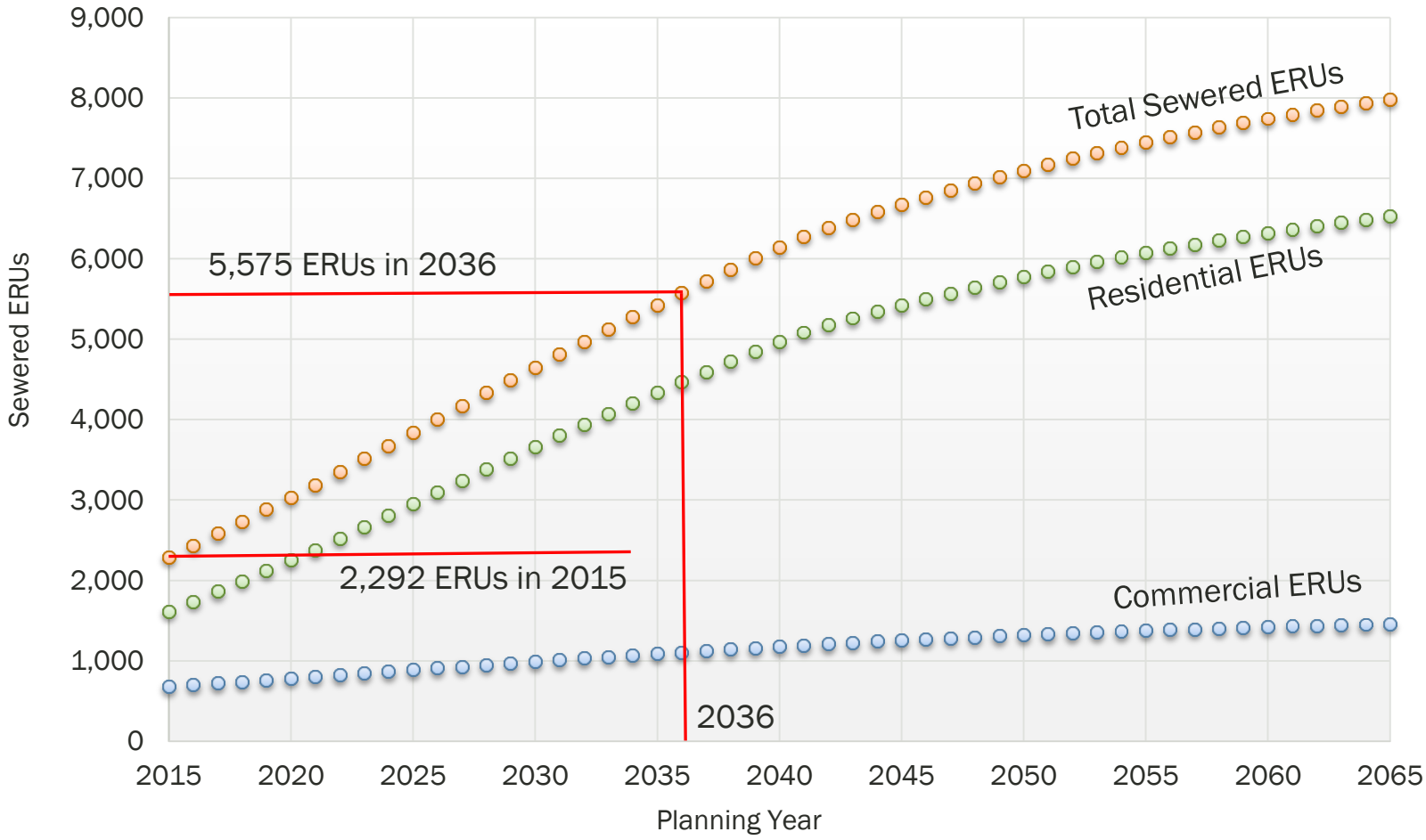


- Planning Boundaries
- GMA Concurrency
- Population, Flows and Loads
- Treatment Plant (WWTP)
- Effluent Disposal
- Sewer System

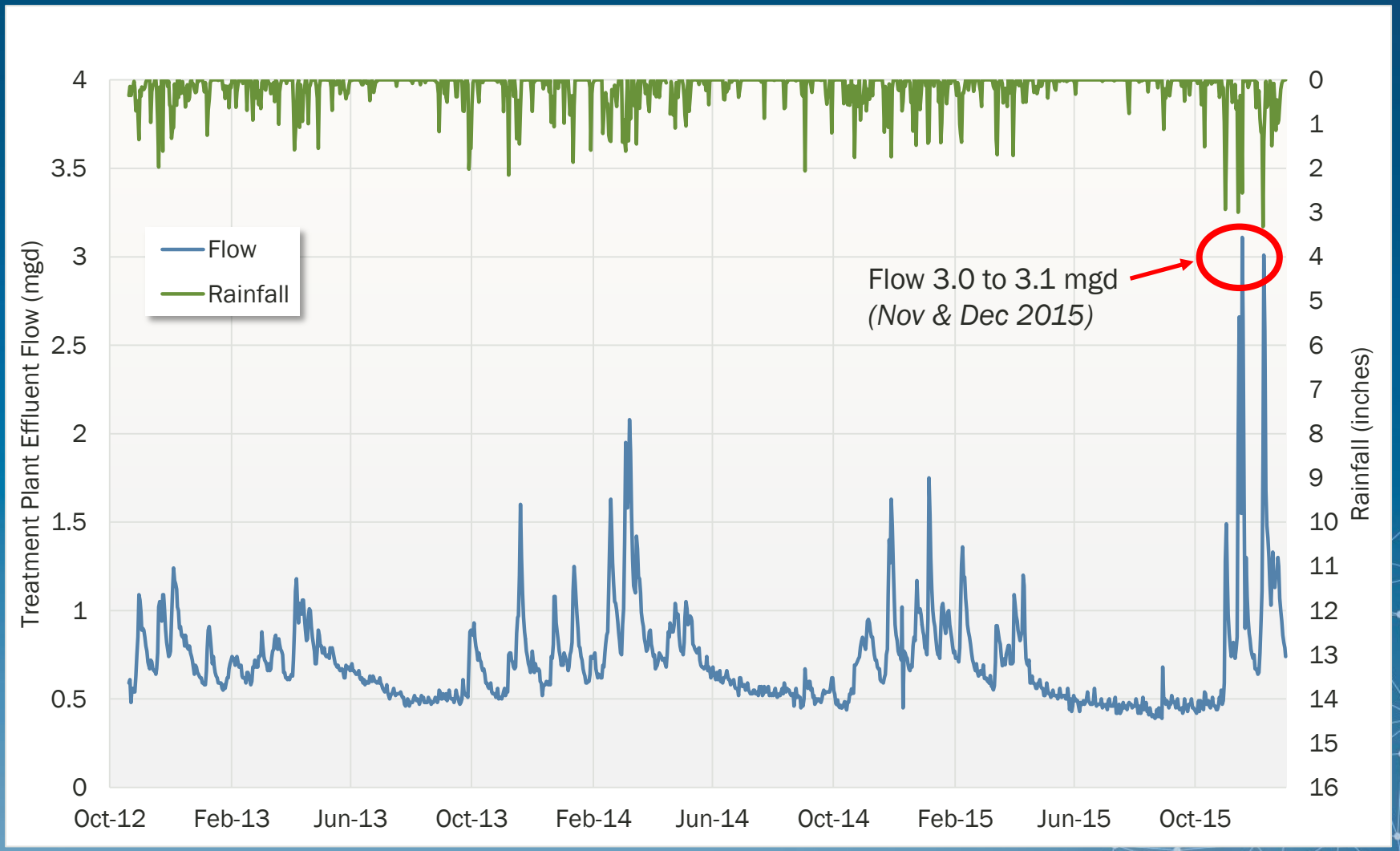
Residential Population Growth



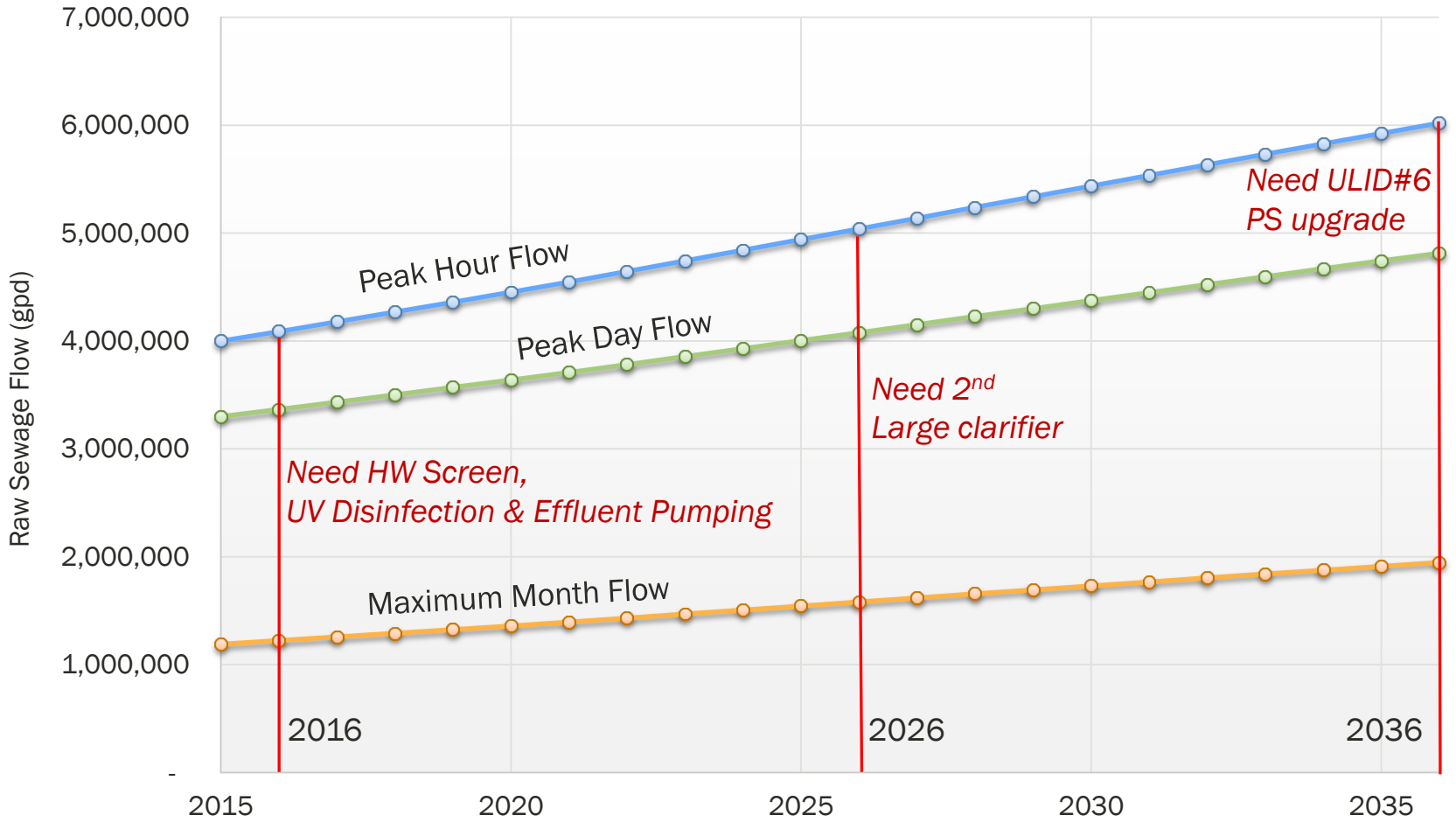
Projected ERUs on Sewer System



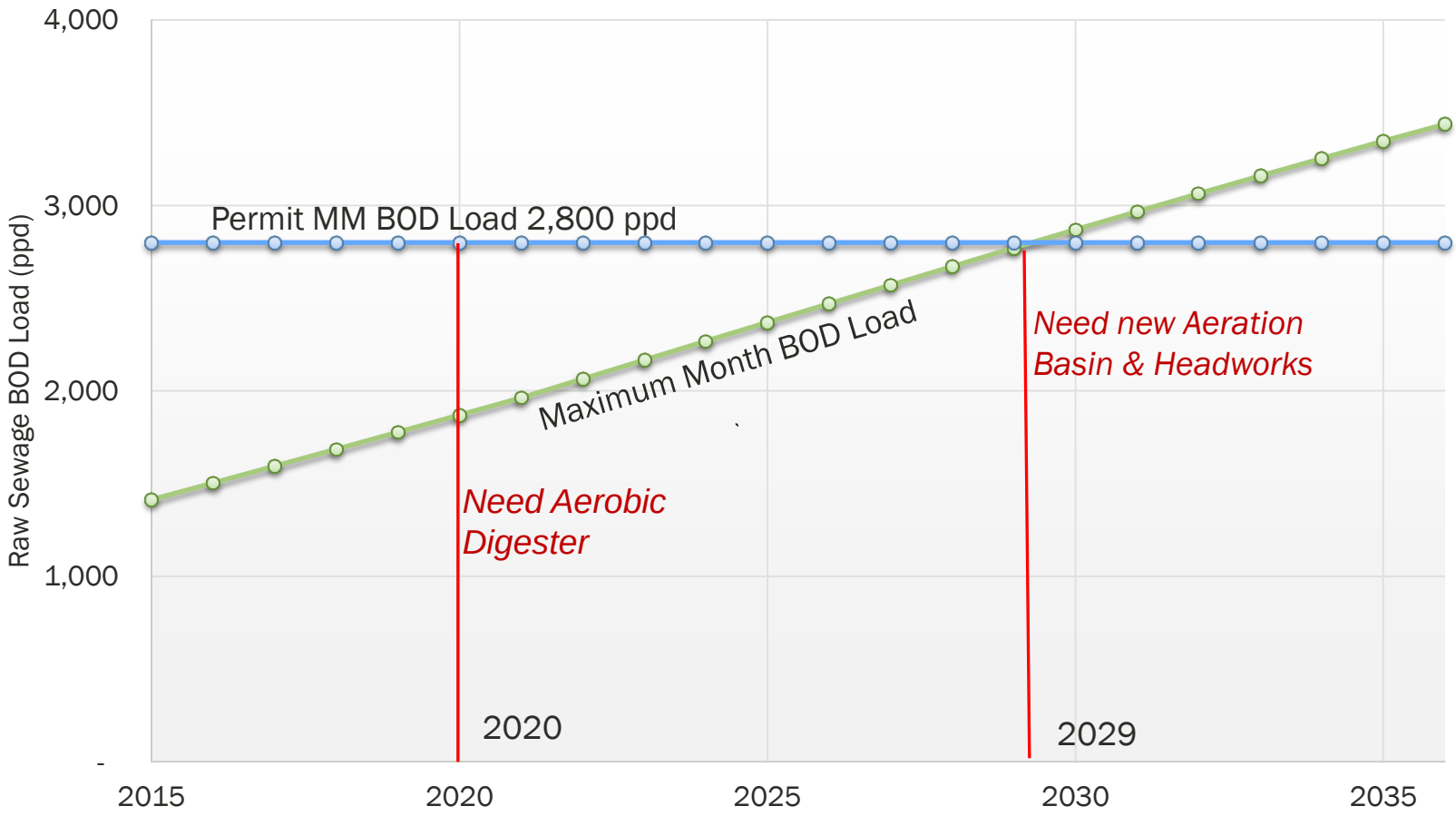
WWTP Peak-Day Flows



WWTP Flows & Limitations



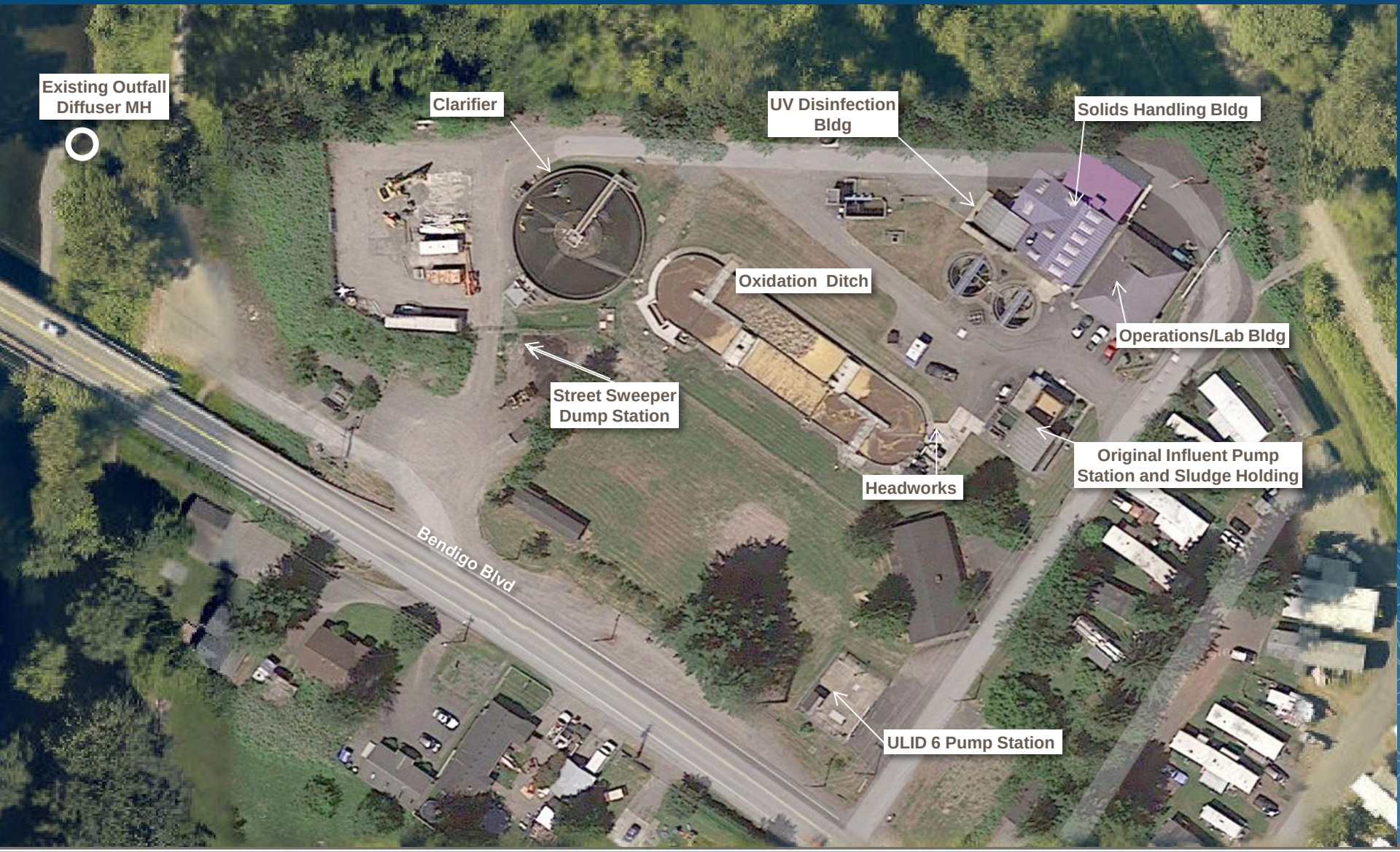
WWTP BOD Loads & Limitations



Treatment Plant History

- 1950 Primary treatment
- 1980 Secondary treatment
- 1995 Control building (after fire)
- 1998 - 2004 Capacity Improvements
  - Clarifier #3, 3W water, UV disinfection, Sludge Dryer, Brush Aerators
- 2006 NPDES permit
  - BOD capacity increase: from 1000 to 2800 ppd
- 2011 Headworks & Influent Pump Station (by ULID#6)
- 2014 - 2015 Corrective Improvements
  - Sludge truck loading (sludge dryer failed)
  - Oxidation ditch weir and pipe (flow exceeded capacity)
  - Brush aerators (aerators failed)
- 2015–2016 Continuing problems
  - Hydraulic capacity, Clarifier Drive, UV failure, Controls, Class B sludge

Existing Treatment Plant

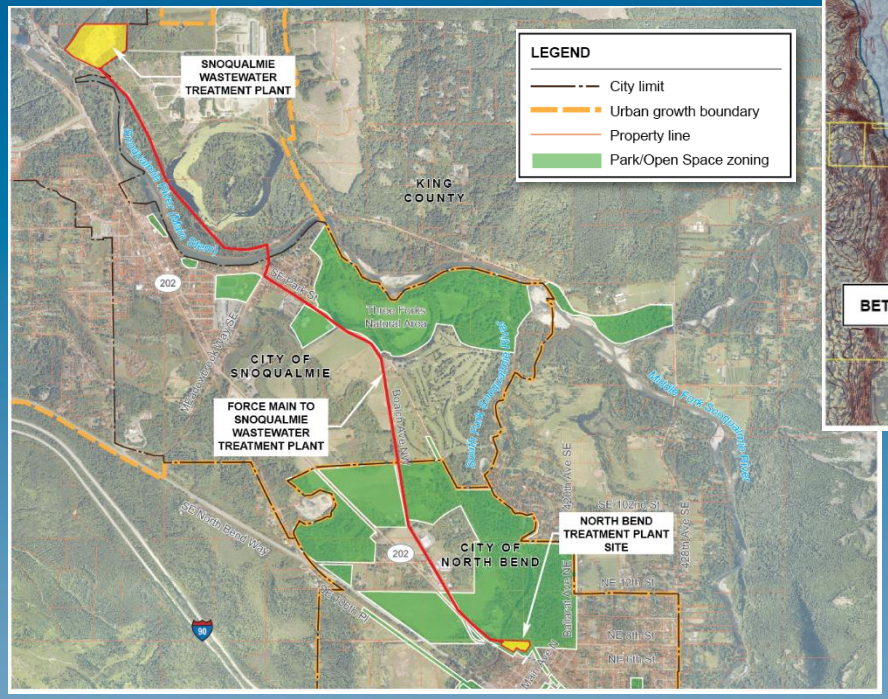


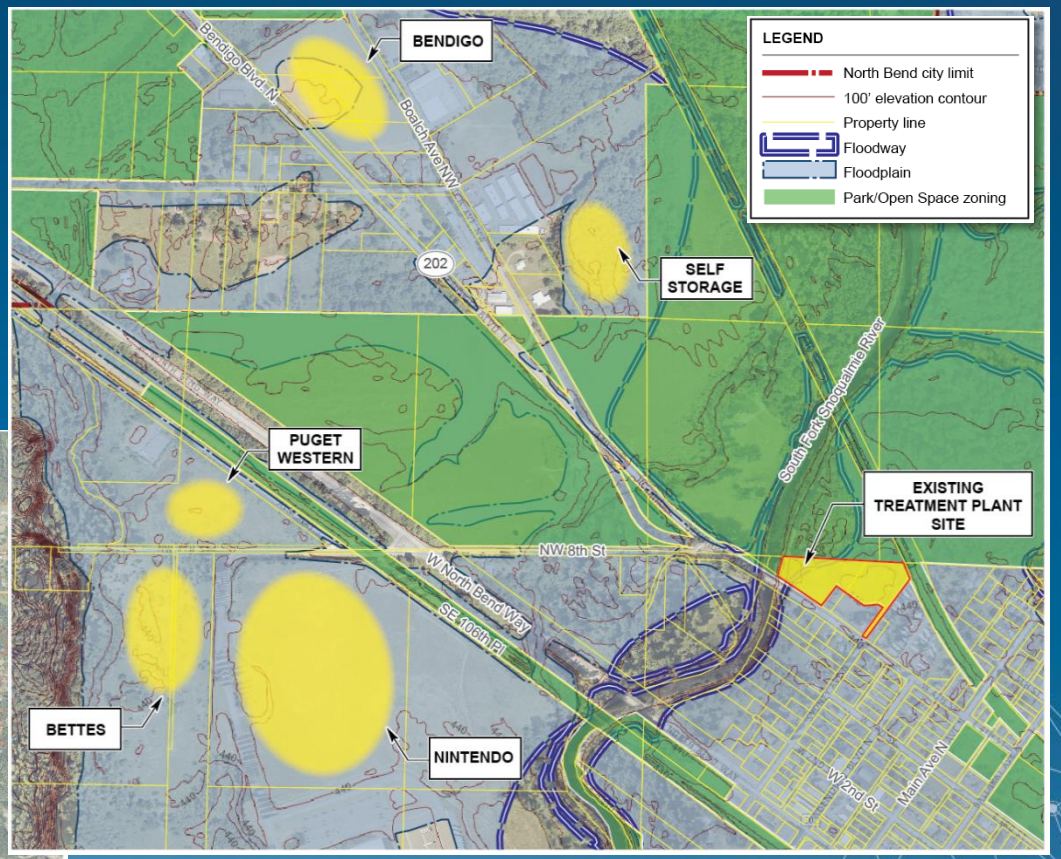
Treatment Plant - Analysis

- **Deficiencies**
  - No Redundancy
  - Hydraulic Bottleneck
  - Old, worn out equipment & controls
  - Foul odors & poor appearance
- **Assets**
  - Functional treatment process
  - Serviceable structures
  - Location minimizes conveyance costs
  - Room for future expansion
  - Adaptable to regulatory changes

Treatment Plant Location Alternatives

- Existing Site
- New Site in North Bend
- Regional Plant in Snoqualmie





WWTP Location & I/I Control Alternatives

Capital Costs

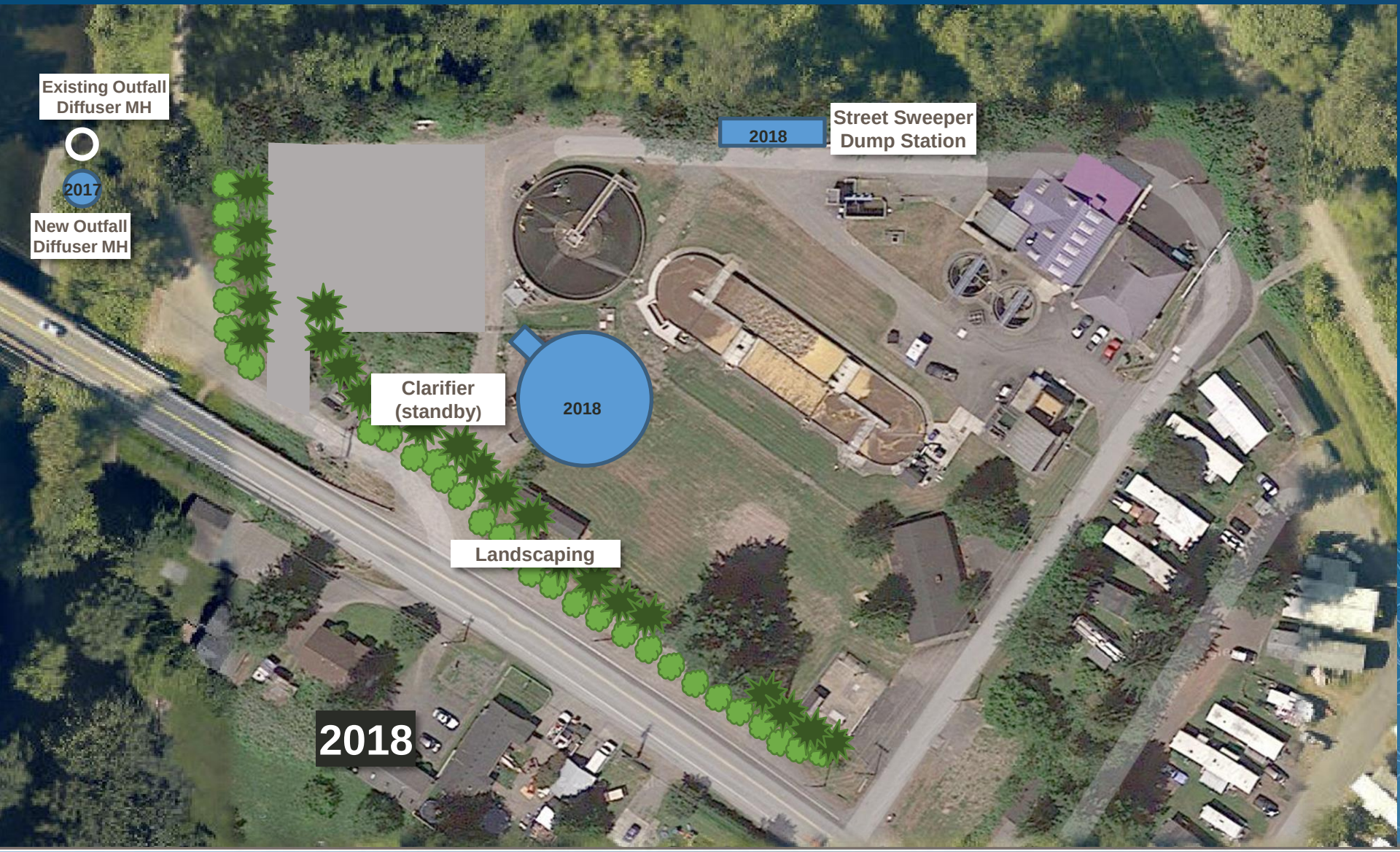
	Existing Site	New North Bend Site	Snoqualmie Site
With Full I&I Control	$37 M	$69 M	$68 M
With Pilot I&I Control	$27 M	$59 M	$58 M
With Ongoing I&I Control	$25 M	$57 M	$56 M

Treatment Plant Alternatives & Capital Costs

(with ongoing I/I control)

	1. Oxidation Ditch (OD) at existing site	2, Deep Tank Act. Sludge (DTAS) at existing site	3. Membrane Bioreactor (MBR) at existing site	4. Oxidation Ditch (OD) at new site	5. Regional plant (OD) at Snoqualmie
Phase 1 - 2016-2020					
Existing WWTP	$12.5 M	$13.0 M	$2.1 M	$2.1 M	$ 2.1 M
New WWTP	na	na	$80.9 M	$33.1 M	$31.9 M
Conveyance to WWTP & outfall	na	na	na	$20.9 M	$21.8 M
SUBTOTAL	$12.5 M	$13.0 M	$83.0 M	$56.1 M	$55.8 M
Phase 2 - 2021-2029					
Phosphorus Tmt	$0.9 M	$1.2 M	$1.4 M	$0.9 M	na
WWTP expansion	$7.2 M	$10.1 M	na	na	na
SUBTOTAL	$8.1 m	$11.3 M	$1.4 M	$0.9 M	na
TOTAL	**$20.6 M**	**$24.3 M**	**$84.4 M**	**$57.0 M**	**$56.0 M**

WWTP @ 2018 with Phase 1 improvements



View of Existing Plant

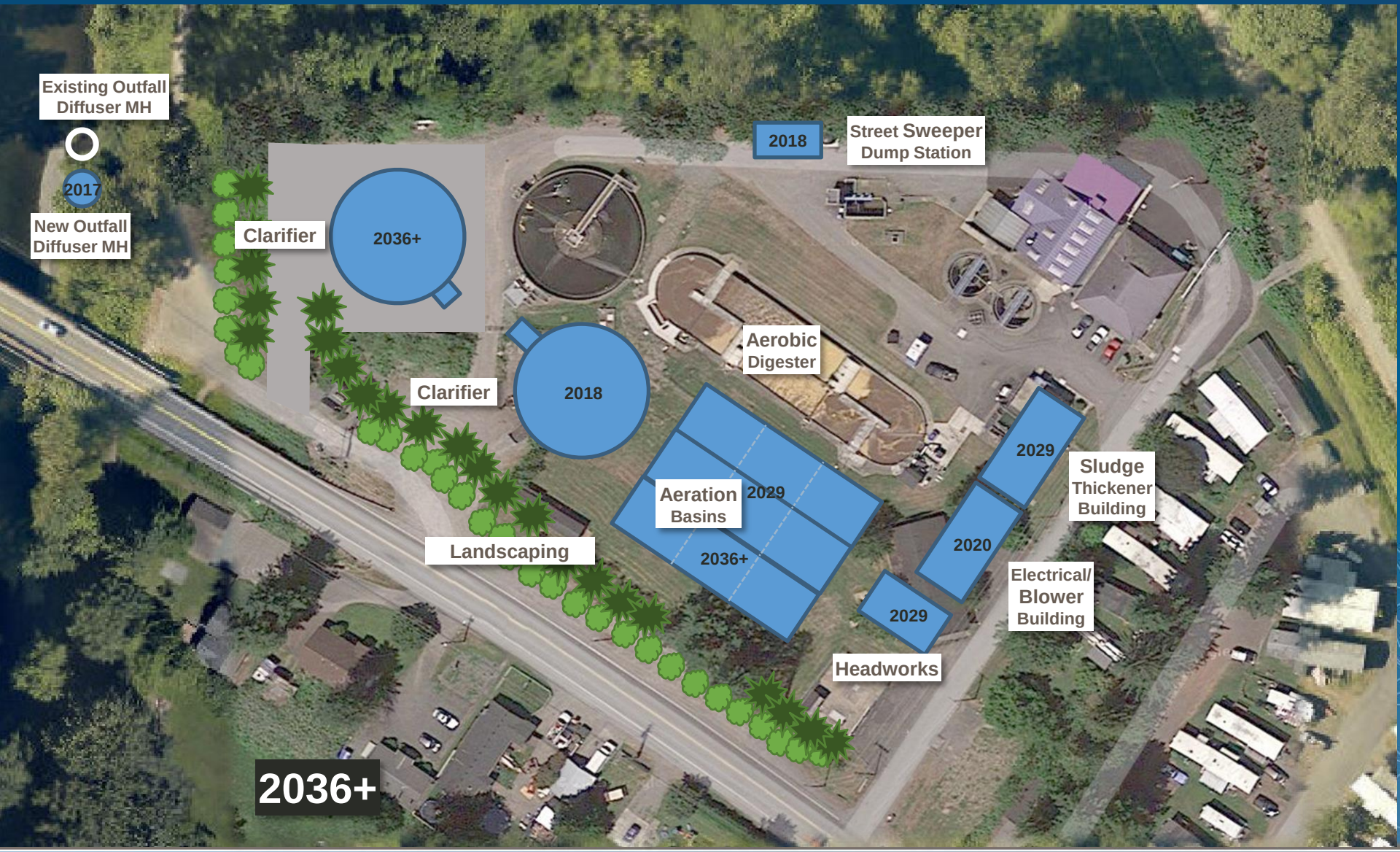
View of Plant after Phase 1 Landscaping

TETRA TECH

WWTP @ 2020 with Phase 1 Improvements

Phase 2 WWTP (Alt 2 DTAS) @ 2029

Future DTAS WWTP After 2036



Effluent Disposal History

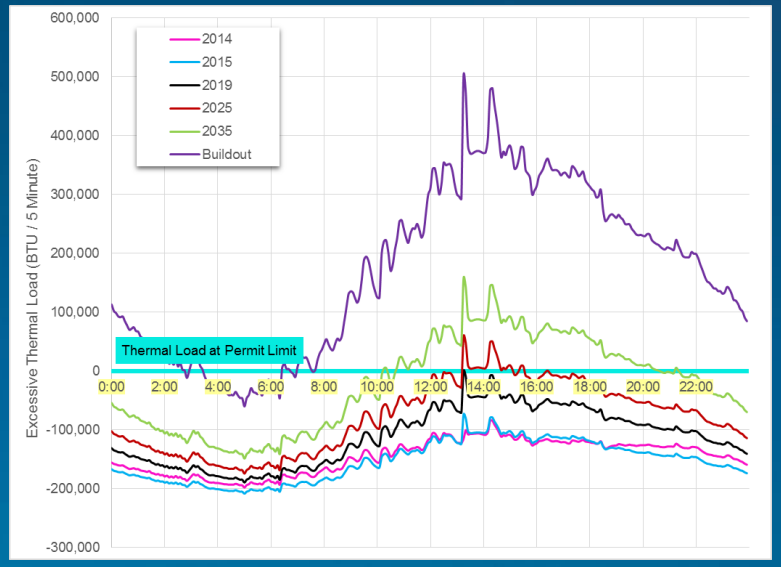
- 1950 Outfall Pipe
- 1980 Outall Diffuser MH
- 1994 TMDL 02, NH3, draft P limits
- 2000 Effluent Improvements
  - Flow meter
  - Effluent structure
- 2011 TMDL – Temperature limits
- 2014 Diffuser MH Inspection & cleaning
- 2015 Diffuser MH & sewage tanks overflow

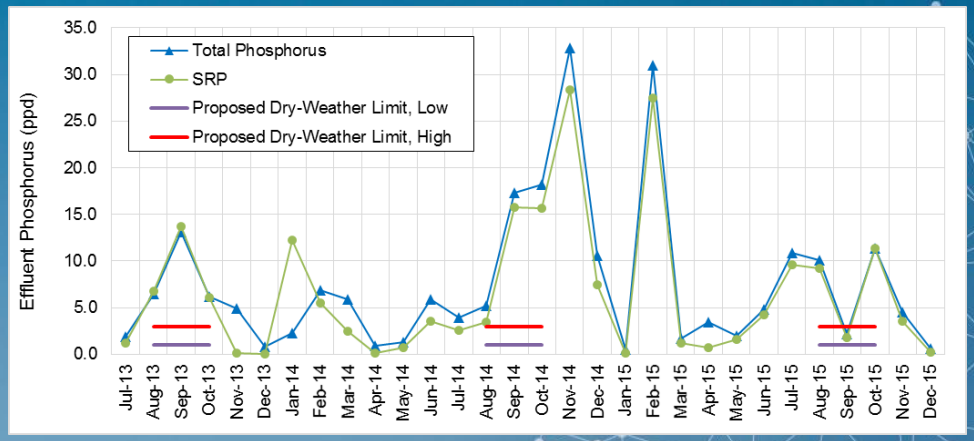
Effluent Disposal – Existing System

- River bank discharge
- Diffuser Manhole
- Gravity discharge
- Effluent pumping structure

Effluent Disposal – Analysis

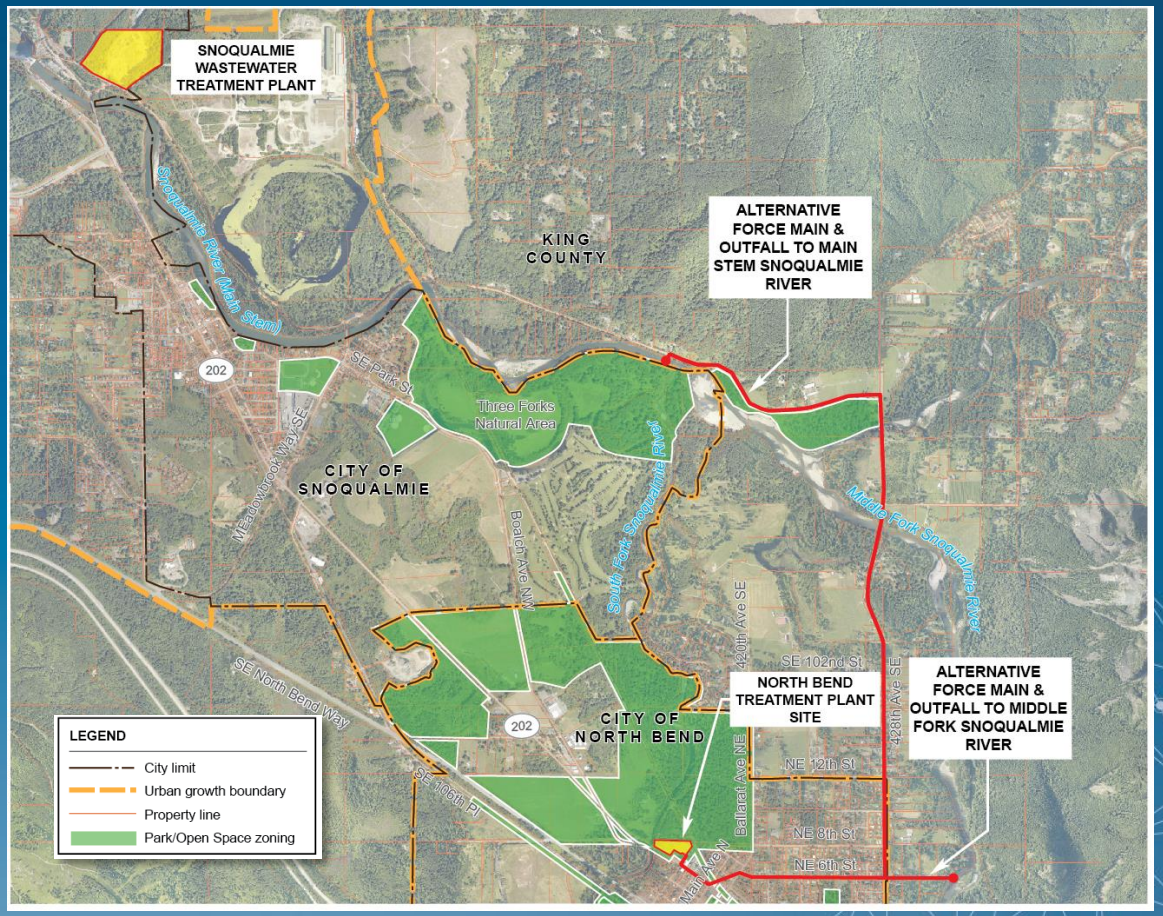
- **Need to meet water quality standards**
  - 20 year planning period - to 2036
  - Future - beyond 2036
- **Need upgrade for high flows**
  - Effluent Pumping
  - Additional Diffuser Manhole
  - Effluent Flow Meter
- **Need upgrade for TMDLs**
  - NBOD limits
  - Temperature limits
  - Phosphorus limits





Effluent Disposal Alternatives

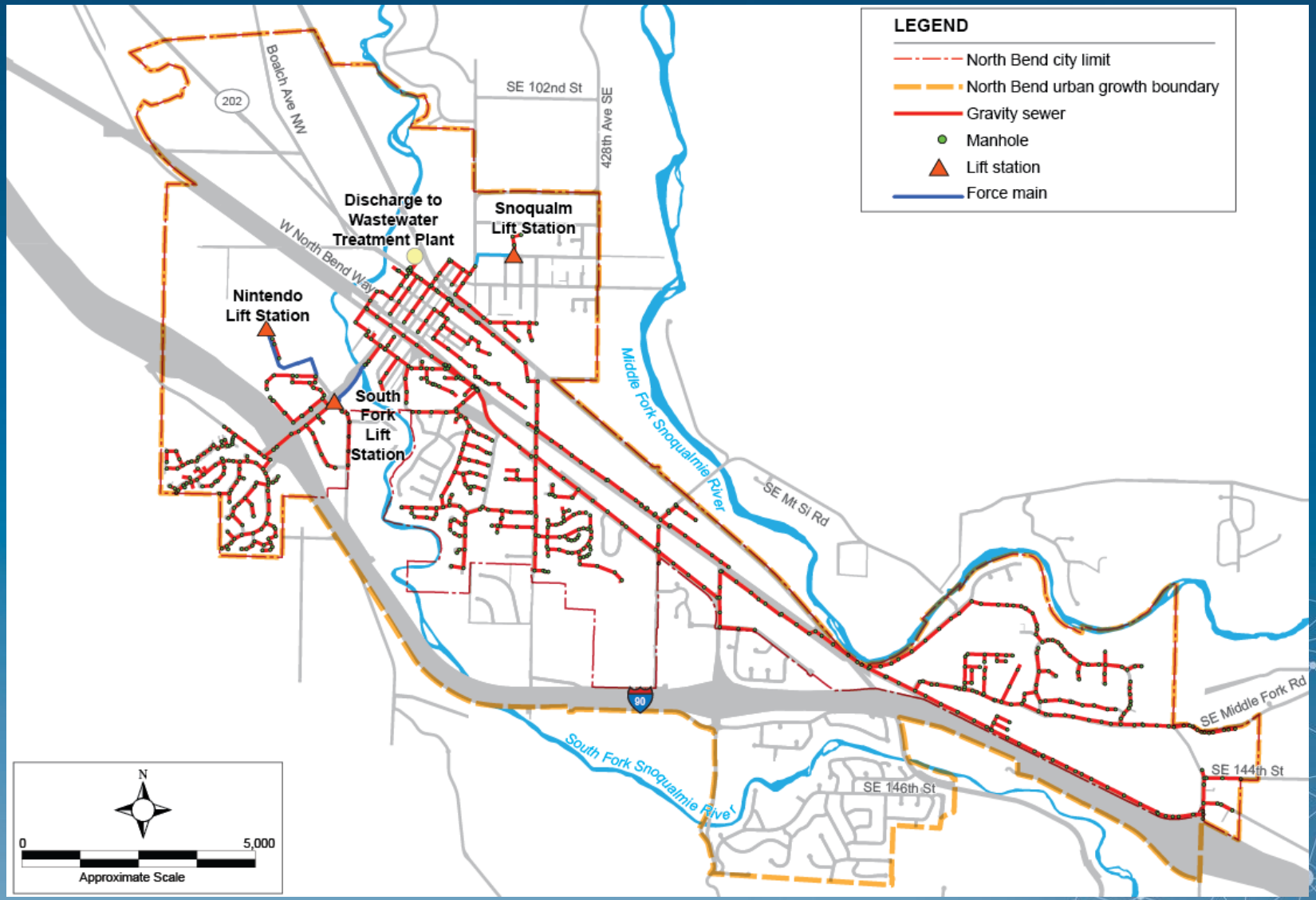
- **Outfall Options**
  - South Fork (existing)
  - Middle Fork (new)
  - Main stem (new)
- **Reuse Options**
  - Restricted by water rights
  - Non-consumptive use at WWTP
- **Conclusion: Use South Fork Outfall**



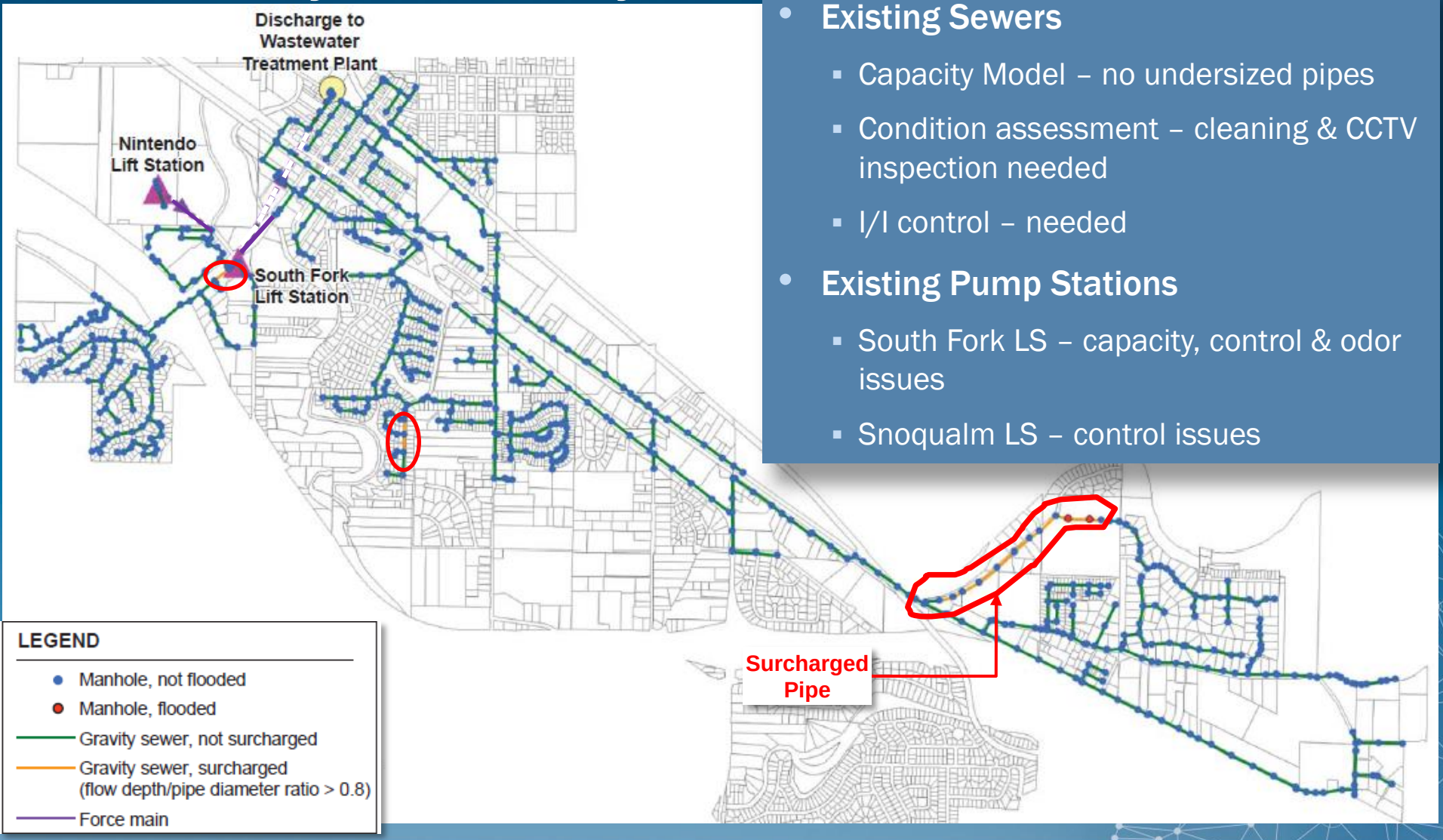
Sewer System - History

- 1950 First sanitary sewers
- 1996-1997 Infiltration & Inflow consent decree & report
- 1998-2003 Infiltration & Inflow sewer replacements
- 2001 Sewer Plan recommends vacuum sewers
- 2011 ULID#6 gravity sewers & influent pump station
- 2015 Highest infiltration & inflow since 1998
- 2015-2016 Pump Station problems
  - South Fork Lift Station
  - Snoqualm Lift Station

Existing Sewer System

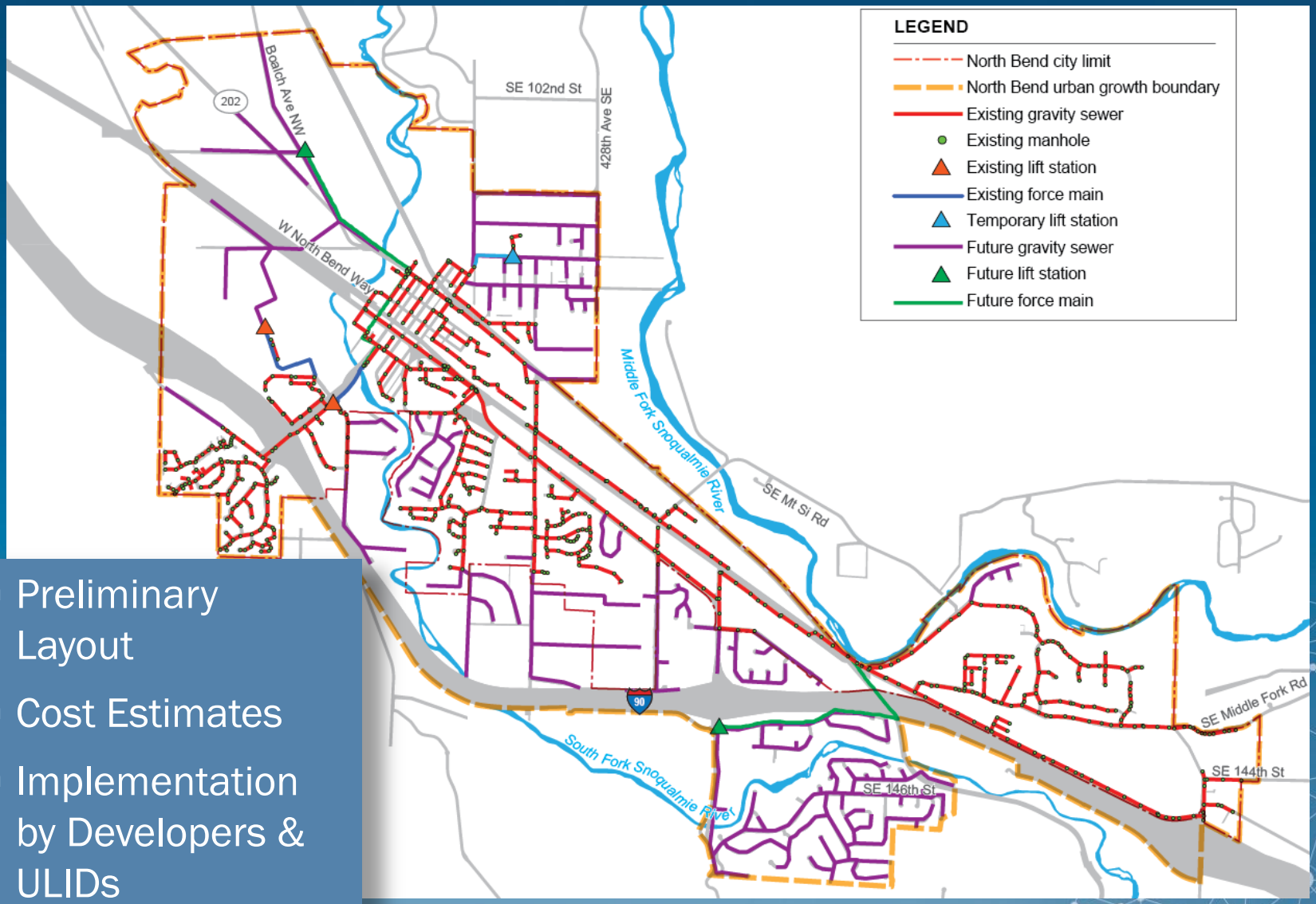


Sewer System-Analysis



- **Existing Sewers**
  - Capacity Model – no undersized pipes
  - Condition assessment – cleaning & CCTV inspection needed
  - I/I control – needed
- **Existing Pump Stations**
  - South Fork LS – capacity, control & odor issues
  - Snoqualm LS – control issues

Sewer System Future Expansion Plan



- Preliminary Layout
- Cost Estimates
- Implementation by Developers & ULIDs

Sewer System - Improvement Plan

- **Phase 1 - Capital Improvements - 2016-2018**
  - South Fork LS – controls, pumps, odor control $413,000
  - Snoqualm LS - controls $36,000
- **Phase 1 - O&M Improvements for 5 years**
  - Add 1 full time staff person $100,000/yr
  - Add Cleaning, CCTV & repairs $330,000/yr
- **Phase 2 - Capital Improvements – as needed**
  - Utility Local Improvement Districts (ULID's) No City $
  - Developer Extensions No City $

Wastewater Facilities Summary

- **20 year plan**
  - Service population increases 240% by 2036
- **Sewer System**
  - Pipes adequate for growth
  - Pump stations need upgrades
  - Improve maintenance

Wastewater Facilities Summary

- **Treatment Plant**
  - After Phase 1, capacity adequate to 2029
  - Phase 1 (2016-2020) – Correct deficiencies and Temperature-TMDL
  - Phase 2 (2021-2029) – P-TMDL & Expand for growth
  - Existing site
    - adequate for future
    - more cost effective than regional treatment
    - more cost effective than a new North Bend plant site

Wastewater Facilities Summary

- **Effluent Disposal**
  - Phase 1 (2016-2020)
    - Increase capacity for peak flows
    - Comply with Temperature TMDL
  - Existing outfall
    - adequate for future
    - new outfall less cost effective

Environmental Review - ESA

- **SEPA Checklist (WAC 197-11)**
- **State Environmental Review Process (SERP)**
  - Federal Cross-cutter Review
  - Compliance with 12 Federal Acts including:
    - Endangered Species Act
    - National Historic Preservation Act
    - Safe Drinking Water Act

Financing - FCSG

- **Existing Sewer System Budget**
  - Debt
  - Annual Costs
- **Funding Options**
  - Grants
  - Loans
  - Bonds
- **Sewer Rate Impacts**
  - User Charges
  - System Development Charges

Discussion/Questions?

TETRA TECH

REFERENCE (ONLY) SLIDES FOLLOW

Treatment Plant Alternatives 1 & 2
Phase 1 - fix existing deficiencies (2016-2020)

Improvements	Capital Cost
ULID6 Pump Station & Headworks	$504,000
Liquid Treatment Processes	$4,245,000
Solids Handling Processes	$4,148,000
Power Supply, Controls, and SCADA	$2,419,000
Effluent Disposal	$1,260,000
Landscaping	$399,000
SUBTOTAL	$12,975,000

TETRA TECH

Treatment Plant Alternatives 1 & 2
Phase 1 - fix existing deficiencies (2016-2020)

Project Summary Description	2016	2017	2018	2019	2020
ULID#6 Pump Station Improvements	$192,000				
Influent and Effluent Sampling System Improvements	$14,000				
UV Disinfection System Improvements	$784,000				
SCADA System Improvements	$367,000				
Effluent Flow Metering and Outfall Improvements	$551,000				
New Effluent Pump Station	$385,000				
Existing Clarifier Improvements			$87,000		
New Clarifier		$257,000	$2,261,000		
New Aerobic Digester and Sludge Feed Building				$293,000	$2,574,000
New Standby Generator and Load Center				$139,000	$1,224,000
New Electrical Building and MCCs				$70,000	$619,000
Solids Handling Building Pump Station Force Main Rerouting	$11,000	$97,000			
RAS Force Main Rerouting	$6,000	$49,000			
Effluent Temperature Mitigation	$33,000	$291,000			
Washwater System Improvements		$15,000			
Treatment Plant Landscaping and Aesthetics Improvements		$41,000	$358,000		
Original Influent Pump Station Improvements			$243,000		
Reroute Lab and Mobile Home Sanitary Sewer Flow to ULID#6 Pump Station			$110,000		
Headworks Improvements			$30,000	$268,000	
Oxidation Ditch Improvements			$33,000	$292,000	
New Centrifuge			$131,000	$1,150,000	
Total by year	$2.343,000	$750,000	$3,253,000	$2,212,000	$4,417,000
Total					$12,975,000

Treatment Plant Alternatives 1 & 2
Phase 2- Expand for Growth (2026-2029)

Phase 2 Improvements	Alternative 1 Oxidation Ditch on existing site	Alternative 2 Deep Tank Activated Sludge on existing site
Liquid Treatment Processes	$7,300,000	$7,300,000
Grit Removal	na	$700,000
Mechanical Cooling	na	$1,000,000
Mechanical Thickener	$500,000	$500,000
SUBTOTAL	$7,800,000	$9,500,000

Effluent Disposal- Improvement Plan

- **Phase 1 - Improvements 2016-2018**
  - Flow metering and outfall diffuser MH $551,000
  - Effluent pumping $385,000
  - Temperature mitigation $324,000
- **Phase 2 - Improvements 2021-2023**
  - Phosphorus removal $1,000,000

SIGN IN SHEET

ALL ATTENDEES PLEASE SIGN IN

April 26, 2016

NAME	ADDRESS	EMAIL	PHONE
WARD + VICKI BETTES	225 Sydney Ave. S. NB	vickibettes@comcast.net	8-1337
Bob + Vicky Ballgardt	630 NE 8th St. NB		888-4345
Dave Kirchert	1110 Ballarat NE	alaskanguypsyl@hotmail.com	888-2859
Peg TRAVIS	1116 Ballarat Ave NE		888-2859
Jim GRAHAM	681 E Northbend Way	Jgraham454@gmail.com	888 1349
Kathy McKay	815 Borst AVE NE N.B.		
Lee KORSMO	815 BORST AVE N.E NB	leekorsmo@gmail.com	
KATTY Stockton	900 NE 8TH NB	L.Stockton@comcast.NET	
Roland Erdmann	311 NE 12TH	rolando1@centurytel.net	
Ann Erdmann	311 NE 12th st	grace2420@gmail.com	
Cyndi Sun	447 Meadow Dr. SE	cyndisun@gmail.com	
CHRIS LODAHL	435 SE MAPLE DR.	PAULALODAHL@COMCAST.NET	888-3387
Jeff KING	466 MEADOW DR SE		888-0953
Valerie King	✓ — —		/
DAVID Olson	440 MAIN AVE S	dJolson89@Hotmail.com	888-0678

Sewer Comprehensive / Capital Facility Plan

City of North Bend

Public Meeting on Sewer Comprehensive Plan and Capital Facility Plan

APRIL 26, 2016

City of North Bend would like to hear from you. Thank you for your time.

Citizen Name:	Address	How did you hear about this meeting?
Larry Stockton	900 NE 8th Street	Paper

Preferred contact information: (either email or phone)
L.Stockton@comcast.Net

Questions / Comments / Concerns:

1) Odor control – The current WWTP often violates air quality standards. This needs to be fixed ASAP. Please add odor control to the next phase of the WWTP.

2) Aesthetics – The WWTP needs to be screened from view of the state highway consistent with the city landscaping & design guidelines ASAP. Please add Landscape screening in the next Phase of the WWTP.

3) Treatment Alternatives – Please ~~add~~ evaluate maintaining septic WWT in existing Silver creek & old Si View neighborhood. The city has the authority to fund a ~~os~~ utility function via its Stormwater utility (Water Quality Nexus). This approach would conserve ~~exp~~ high cost WWTP capacity and address WQ concerns w/o the expense of central WWTP.

FEEL FREE TO MAIL QUESTIONS OR COMMENTS BACK TO:

City of North Bend
PO Box 896
North Bend, WA 98045
Attn: Don DeBerg

Or email to ddeberg@northbendwa.gov

Don DeBerg

From: Don DeBerg
Sent: Wednesday, April 27, 2016 8:27 AM
To: John Markus (john.markus@tetratech.com); Santroch, Jim
Cc: Mark Fogle; Mark Rigos
Subject: RE: Sewer Comp Plan Public Meeting

Gents,
One more thing that I forgot to put in the original email. One of the gentlemen that attended the meeting last night approached me afterwards and stated that he currently doesn't have access to a pipe without crossing another parcel and obtaining an easement (see Jim Graham on the sign-in sheet). His property is located at 681 East North Bend Way. He requested that we evaluate installing a sewer main in NBW in front of his property to provide easy access to sewer.
Thanks,
Don

From: Don DeBerg
Sent: Wednesday, April 27, 2016 8:05 AM
To: John Markus (john.markus@tetratech.com); Santroch, Jim
Cc: Mark Fogle; Mark Rigos; Londi Lindell
Subject: Sewer Comp Plan Public Meeting

Gentlemen,
Outstanding job on your presentation last night! You guys got through all of the information quickly and thoroughly and managed to keep the audience engaged even when the subject matter was less than enticing. We managed to get all 17 people to sign in, which is a miracle in and of itself. Attached are the sign in sheet and the single comment sheet we have received thus far (from Larry Stockton). I'll be sure to forward any additional comments I get for inclusion in the report appendices.
Thanks,
Don

Donald DeBerg, PE
City Engineer
City of North Bend
1155 East North Bend Way
PO Box 896
North Bend, WA 98045
(425)888-7652

Don DeBerg

From: Valerie King <dontlikecomputers@yahoo.com>
Sent: Friday, April 29, 2016 12:04 PM
To: Don DeBerg
Subject: Re: Public meeting on Sewer Comprehensive Plan... feedback & questions

Thank you very much for your quick AND thorough reply! You did a great job explaining the situation to me. Thank you, thank you, thank you!

Valerie King

From: Don DeBerg <DDEBERG@NORTHBENDWA.GOV>
To: 'Valerie King' <dontlikecomputers@yahoo.com>
Cc: Mark Rigos <MRIGOS@NORTHBENDWA.GOV>; "John Markus (john.markus@tetratech.com)" <john.markus@tetratech.com>; "Santroch, Jim" <Jim.Santroch@tetratech.com>
Sent: Friday, April 29, 2016 9:44 AM
Subject: RE: Public meeting on Sewer Comprehensive Plan... feedback & questions

Ms. King,

Thank you for your comments. I'll be sure to pass along the kudos to Jim and John.

In response to your questions below, the water fund and sewer fund are two completely separate entities and, thus, must fully fund themselves through the rates and General Facilities Charges (GFCs), except when City Council authorizes an inter-fund loan. We are not planning on doing that as we have a strong water fund right now and don't want to jeopardize it. That said, when that is done, state law requires that the grantee of the loan pay back the grantor with interest, just like if you were to go get a bank loan for your car or house. In short, you will not see an increase in your water rates due to the improvements necessary at the WWTP.

The answer to your second question is more multi-faceted and I will do my best to provide you a concise, but thorough answer. Washington State has a law called the Growth Management Act (GMA), the intent of which was to prevent urban sprawl by focusing development into existing cities and preventing development in unincorporated areas. To comply with this, cities are mandated to plan for and accept new growth. Under the GMA, the only way cities are allowed to prohibit growth is if they have a real problem that prevents it (i.e. insufficient water rights). In that case, they are mandated to solve the issues that prevent growth (i.e. obtain new water rights, or in this case plan for and implement expansion of the WWTP). The City Council only has so much control here.

The City Council has stated time and again that they want growth to pay for growth. This is accomplished in a few different ways. In the case of sewer, every new house that hooks up to the sewer system, whether simply converting from septic to sewer, or a new home being built, are required to pay GFCs. The money brought in from those fees are applied to expansion of the sewer system, in other words, capacity adding projects. These could include upsizing a sewer main, building a new clarifier, upsizing the centrifuge, or any other number of capacity improvements. These growth fees are not limited to just sewer. There are growth fees for streets, water, sewer, parks, schools, and fire. In this manner, developers are paying their fair share of their impacts to the community.

Developers are also required to make improvements necessary to ensure that the existing infrastructure, including water, sewer, streets, stormwater, etc., has adequate capacity to serve their development. They are responsible for constructing all of the infrastructure needed for their development at no cost to the City or

taxpayers. Additionally, if existing infrastructure is inadequate to serve their development (i.e. if the sewer line leaving their site is too small to handle the additional flows), they can be required to correct that deficiency at their cost.

In closing, yes, the City Council has been made aware of the issues at the WWTP and they have tasked staff with devising a rate structure that is fair for both the existing taxpayers and the developers. City staff are currently working with consultants, lending institutions, and Council to ensure that the rate increases are as minimal as possible while still providing the necessary capital to construct the needed improvements in the sewer system.

I hope this answers your questions and again, thank you for your comments! Please feel free to contact me if you have any further questions.

Don

From: Valerie King [mailto:dontlikecomputers@yahoo.com]
Sent: Thursday, April 28, 2016 9:52 PM
To: Don DeBerg
Subject: Public meeting on Sewer Comprehensive Plan... feedback & questions

Dear Mr. DeBerg:

This past Tuesday I had the opportunity to attend your meeting about the Sewer Comprehensive Plan and Capital Facility Plan. It was one of those experiences that showed me that "when you are ignorant, you don't know just how ignorant you are!"

The information presented by Jim Santroch was so informative that it taught me that we, the general public, are totally clueless about all that is involved in everything that goes on with our wastewater facility. When I think that what was presented was probably just the tip of the iceberg, it proves that the more one learns the more one realizes how little one knows!

Please let Jim know that I think he did a terrific job in his presentation. It was easy to follow, and like I said, very informative.

I do have 2 questions now.

1. Thinking that the minimum cost plan is $25 million, and imagining how the City is going to need to squeeze 25 million dollars out of this community, I can see, like you said, "Rates will be going up." So my question is, **for the households that are on septic, not on sewer (mine being one), are we going to have to pay for the sewer upgrade improvements by the City increasing our water rates?** Or is that totally separate? Will we maybe end up being charged some other kind of assessment to help the City pay the $25 million?

2. This meeting turned out to not be what I expected it to be at all. I thought it was going to be a discussion about whether septic households are going to have to hook up to the sewer. But in light of what I learned, my question is, **was the City Council told all this information BEFORE they approved all the development plans that they are rolling out?** $24 million is a lot to expect our small community to fork out! And when I think that all the additional households will also add to our SCHOOL DISTRICT, and we have already been socked with 2 property tax increases already, it infuriates me that the City is allowing all this development to happen and going to try to squeeze this money out of us!

Thank you for your time to put on the meeting, and for your time to answer my inquiry.

City of North Bend

Wastewater Facilities Plan Public Meeting Documents

June 21, 2016

City Council Agenda Bill

SUBJECT:	Agenda Date: June 21, 2016 AB16-070	
Public Hearing and Ordinance Updating Sewer Utility Rates and General Facilities Charges	Department/Committee/Individual	
	Mayor Ken Hearing	
	City Administrator – Londi Lindell	
	City Attorney - Mike Kenyon	
	City Clerk – Susie Oppedal	
	Community & Economic Development – Gina Estep	
Cost Impact: N/A	Finance – Dawn Masko	X
Fund Source: N/A	Public Works – Mark Rigos, P.E.	X
Timeline: Immediate		

Attachments: Ordinance, Rate and GFC Presentation, Rate Comparison, Public Hearing Notice

SUMMARY STATEMENT:

In 2013 then Public Works Director Frank Page and Wastewater Treatment Plant (WWTP) consultant John Markus with Tetra Tech identified numerous problems at the WWTP and presented to the City Council a list of 29 proposed improvements to remedy the problems identified. Three of those problems were addressed via an emergency contract in 2014 and early 2015. Since then, the condition of the other 26 problems at the WWTP has continued to degrade. There is no "silver bullet" to remedying all of these problems in just 1 to 2 years. It will take more time. Additionally, the City is in the midst of its largest growth boom, likely since its incorporation. Because of this unprecedented growth and the growing list of needs at the plant, the City Council authorized a contract with Tetra Tech, Inc. for the preparation of a Wastewater Capital Facilities Plan, Sewer Comprehensive Plan, and Sewer Rate Study to finance the improvements needed at the WWTP and throughout the sewer collection system and to insure that new development paid its proportional share of plant upgrades. The preparation of this plan will save time implementing the projects as individual design reports will not be required by the Department of Ecology for each project as would be the case without the planning document. Approval of the document by Ecology will also open the door to low-interest loans and potential grant funding that the City would not be eligible for without such a plan.

The planning process is nearly complete and the revenue needs for the sewer system and WWTP have been identified and documented. FCS Group of Redmond, WA was selected as a sub-consultant to Tetra Tech to complete the rate study portion of the project. The results of a preliminary study by FCSG were presented to the Finance and Administration Committee on May 3, 2016. The increases proposed at that time were simply percentage increases to the base charge and usage charge, with no change to the rate structure proposed. The F&A committee evaluated the results and recommended the rate structure be changed such that:

1. The per unit rate for the average residential customer and average commercial customer were approximately equal at the end of the bill.
2. The base, fixed charge be lowered and the usage charge be raised to encourage conservation of water.
3. If possible, keep the average single-family residential bill below $100 per month at the end of the 5-year rate planning period (2022).

A revised rate structure was presented to the Finance and Administration Committee on June 7, 2016. Upon review of the revised rate structure, the committee requested that the rates and GFCs be further adjusted to better align with the Council's goal that "growth pay for growth". Tetra Tech, FCSG, and City staff subsequently re-balanced the revenues between the rates and the GFCs. This re-balancing effort is now being presented with a staff recommendation for approval.

Attached is a report authored by FCSG describing the process in detail and describing the findings and

City Council Agenda Bill

calculations for the new rate structure. In short, the fixed fee will be reduced for all users and the variable fee (usage charge) will be raised. This rate structure will encourage water conservation for all users while still supplying adequate revenue to perform the projects necessary to repair the WWTP.

In addition to the sewer rates, FCSG performed a study of the General Facilities Charges (GFCs). In calculating the new GFCs, FCSG took into account the improvements necessary for the growth of the community and the assessments that ULID customers are already subject to. Because of this, FCSG is recommending a variable GFC charge, where ULID customers will pay less than non-ULID customers. Attached is a memorandum authored by FCSG describing the methodology for those calculations as well.

Staff strongly recommends revising the sewer rates and GFCs as attached in order to fund the improvements necessary to the sewer system, which will affect repairs to inadequate or damaged equipment, as well as providing funding for needed future capacity improvements within the sewer system and WWTP.

COMMITTEE REVIEW AND RECOMMENDATION: This item was reviewed by the Finance and Administration Committee at their June 7, 2016 meeting who recommended revisions. This item represents the revisions recommended.

RECOMMENDED ACTION: **MOTION to approve AB16-070, an ordinance setting new Sewer Rates and General Facilities Charges and amending the Taxes, Rates & Fees Schedule, as a first and final reading.**

RECORD OF COUNCIL ACTION

Meeting Date	*Action*	*Vote*
June 21, 2016		

ORDINANCE

AN ORDINANCE OF THE CITY OF NORTH BEND, WASHINGTON, INCREASING SEWER UTILITY RATES AND SEWER GENERAL FACILITY CHARGES AND AMENDING THE TAXES, RATES, AND FEES SCHEDULE

WHEREAS, the City of North Bend ("City") operates a sewer and stormwater utility as authorized by Chapter 35.67 RCW; and

WHEREAS, general facilities charges ("GFCs") are collected by the City for each new Equivalent Residential Unit added to the sewer utility, and those GFCs are designated to pay for a proportionate share of the existing sewer infrastructure as well as a proportionate share of future capital projects over a five-year period; and

WHEREAS, the City's existing sewer customers are responsible for paying for repairs to existing infrastructure within the sewer system; and

WHEREAS, the City Council adopted Ordinance 1084, the Taxes, Rates and Fees Schedule, effective November 2, 1999; and

WHEREAS, the Taxes, Rates and Fees Schedule, which includes sewer rates and GFCs, was last amended by Ordinance 1586, effective May 16, 2016; and

WHEREAS, the City last studied and adjusted sewer rates and GFCs in 2012; and

WHEREAS, the cost of operations to process sewer has increased at a rate equal to or higher than inflation; and

WHEREAS, numerous needs have been identified at the wastewater treatment plant (WWTP) in order to continue providing sewer service in the City; and

WHEREAS, the City contracted with Tetra Tech, Inc. to develop a Sewer Capital Facilities Plan, Sewer Comprehensive Plan, and Sewer Rate Study; and

WHEREAS, Tetra Tech, Inc. has identified approximately $14 million worth of capital improvement projects at the WWTP to be accomplished within the next five years; and

WHEREAS, the City's sewer rates and GFCs have been re-calculated to recover costs necessary to make improvements to repair those existing deficiencies identified during the planning process with Tetra Tech, Inc.; and

WHEREAS, the City Council desires to revise the sewer rate structure such that all classes of customers are subject to the same base rate and usage fees, except seniors, low-income, and those customers outside the City limits; and

WHEREAS, the City Council desires to revise the sewer rate structure to encourage water conservation practices by lowering the base fixed fee and raising the variable usage fee; and

WHEREAS, the City Council finds it appropriate to the amend Taxes, Rates and Fees Schedule to reflect increased costs associated with providing sewer services as well as sewer public facilities and infrastructure;

NOW, THEREFORE, THE CITY COUNCIL OF THE CITY OF NORTH BEND, WASHINGTON, DOES HEREBY ORDAIN AS FOLLOWS:

Section 1. Sewer Rates. The Taxes, Rates, and Fees Schedule as adopted by Ordinance 1084 and last amended by Ordinance 1586, is amended in part by repealing Section 13.36, *Sewer Rates*, and replacing it with a new Section 13.36, *Sewer Rates*, to read as follows:

13.36	**Sewer Rates**	
13.36.190	Sewer Permits – Application Fee, Review & Inspection	$50 plus actual cost for application review and installation inspection

13.36.270(A)

DESCRIPTION		TAX, RATE, OR FEE	TAX, RATE, OR FEE	TAX, RATE, OR FEE	TAX, RATE, OR FEE	TAX, RATE, OR FEE
		Effective 8/1/2016	**Effective 1/1/2017**	**Effective 1/1/2018**	**Effective 1/1/2019**	**Effective 1/1/2020**
Single-family Residential Units (inside City limits) including duplexes, triplexes, apartment houses, condominiums, trailer courts & other multifamily, **provided each unit is supplied with a separate water meter**		$ 55.45	$ 62.49	$ 67.65	$ 73.23	$ 79.09
PLUS						
per cubic meter of water usage		$ 5.54	$ 6.24	$ 6.75	$ 7.31	$ 7.89

	over the first **ten** CM						
	Senior/Low Income Rate		$ 25.43	$ 28.66	$ 31.02	$ 33.58	$ 36.27
13.36.270(B)			**Effective 8/1/2016**	**Effective 1/1/2017**	**Effective 1/1/2018**	**Effective 1/1/2019**	**Effective 1/1/2020**
	Multi-family Residential: single family, duplexes, triplexes, apartment houses, condominiums, trailer courts & other multi-family dwellings(**inside City limits**) **served jointly by one water meter,** *per unit*		$ 55.45	$ 62.49	$ 67.65	$ 73.23	$ 79.09
	PLUS						
	per cubic meter of water usage over the first **ten** CM		$ 5.54	$ 6.24	$ 6.75	$ 7.31	$ 7.89
13.36.270(C)			**Effective 8/1/2016**	**Effective 1/1/2017**	**Effective 1/1/2018**	**Effective 1/1/2019**	**Effective 1/1/2020**
	Mixed Use (residential/commercial) **(inside City limits)***served by one water meter*:						
	One Commercial Base Charge		$ 55.45	$ 62.49	$ 67.65	$ 73.23	$ 79.09
	PLUS						
	MultiFamily Charge *(per each Residential unit)*		$ 55.45	$ 62.49	$ 67.65	$ 73.23	$ 79.09
	PLUS						
	per cubic meter of water usage (at Commercial Rate) over the first **twenty** CM		$ 5.54	$ 6.24	$ 6.75	$ 7.31	$ 7.89
13.36.270(D)			**Effective 8/1/2016**	**Effective 1/1/2017**	**Effective 1/1/2018**	**Effective 1/1/2019**	**Effective 1/1/2020**

	Commercial and All Other Users (inside City limits)	$ 55.45	$ 62.49	$ 67.65	$ 73.23	$ 79.09
	PLUS					
	per cubic meter of water usage over the first **ten** CM	$ 5.54	$ 6.24	$ 6.75	$ 7.31	$ 7.89
13.36.270(E)		**Effective 8/1/2016**	**Effective 1/1/2017**	**Effective 1/1/2018**	**Effective 1/1/2019**	**Effective 1/1/2020**
	Commercial and All Other Users (**outside** City limits)	$ 83.17	$ 93.73	$ 101.46	$ 109.83	$ 118.62
	PLUS					
	per cubic meter of water usage over the first **ten** CM	$ 8.32	$ 9.38	$ 10.15	$ 10.99	$ 11.87

13.36.270(F) If any user, by reason of the user's activities, in in two or more of the above classifications, the rate charged shall be the highest rate.

13.36.270(G) Sewer Charge – Independent Water Purveyor

13.36.270(H) Sewer Charge – Private Source

13.36.270(J) Sewer Service Surcharge 6% of Total Monthly Charges

The rates published are effective as of the dates noted; provided, that the last-effective published rates will be automatically increased/decreased based on CPI-W Index for Seattle/Tacoma area (August to August comparison) for each subsequent year beginning January 1, 2021. For the months of April through October, consumption amounts for sewer services will be based on the average water consumption during the months of November through March, so as not to penalize sewer customers using water for lawn and garden irrigation and other summer activities.

Section 2. General Facilities Charges: The Taxes, Rates and Fees Schedule as adopted by Ordinance 1084 and last amended by Ordinance 1586, is amended in part by repealing Section 13.38.040(A) and replacing it with a new Section 13.38.040(A) to read as follows:

13.38.040(A)

	Effective 08/01/16*		
Equivalent Residential Unit (ERU) Based on water meter size:	**ERUs**	**Charge Non-ULID #6**	**Charge ULID #6**
5/8" or 3/4"	1	$ 10,222.00	$ 7,699.00

1"	2.5	$ 25,555.00	$ 19,247.50
1-1/2"	5	$ 51,110.00	$ 38,495.00
2"	8	$ 81,776.00	$ 61,592.00
3"	16	$ 163,552.00	$ 123,184.00
4"	25	$ 255,550.00	$ 192,475.00

*The charges in this table will be automatically increased each year on January 1st, compared to the prior year, by the percentage reflected in the Seattle ENR Construction Cost Index (CCI).

Section 3. Severability: Should any section, paragraph, sentence, clause or phrase of this ordinance, or its application to any person or circumstance, be declared unconstitutional or otherwise invalid for any reason, or should any portion of this ordinance be pre-empted by state or federal law or regulation, such decision or pre-emption shall not affect the validity of the remaining portions of this ordinance or its application to other persons or circumstances.

Section 4. Effective Date: This ordinance shall be published in the official newspaper of the City, and shall take effect and be in full force on August 1, 2016.

ADOPTED BY THE CITY COUNCIL OF THE CITY OF NORTH BEND, WASHINGTON, AT A REGULAR MEETING THEREOF, THIS 21ST DAY OF JUNE, 2016.

CITY OF NORTH BEND:

_____
Kenneth G. Hearing, Mayor

APPROVED AS TO FORM:

_____
Michael R. Kenyon, City Attorney

ATTEST/AUTHENTICATED:

_____
Susie Oppedal, City Clerk

Published:
Effective: August 1, 2016

City Council Meeting

Wastewater Facilities Plan: Rate Study and GFC Update

Angie Sanchez Virnoche, Principal

June 21, 2016

FCS GROUP
Solutions-Oriented Consulting

Agenda Ho
Council Packet June 21, 2016

Overview

- Rate study completed as initial phase of Wastewater Facility Plan Update
- Focus was on meeting operating and capital needs for 2016 – 2020
- Multi-year rate implementation strategy developed for monthly user rates
- Updated general facility charges
- Met with Finance and Administration (F&A) Committee
  - May 3rd
  - June 7th

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Council Packet June 21, 2016

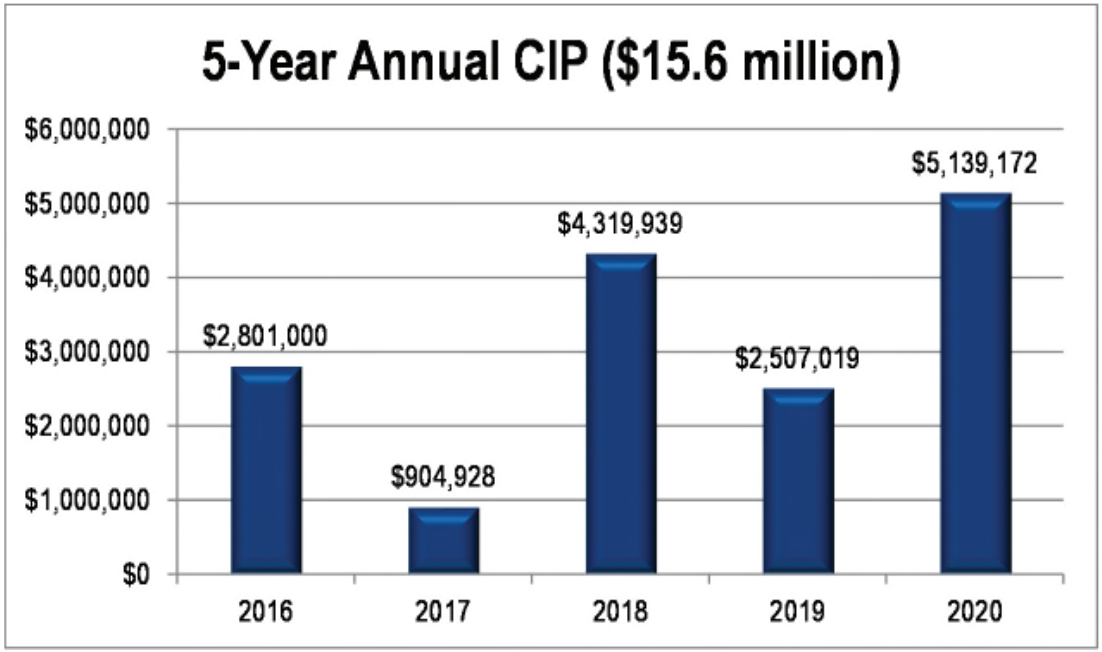
Rate Study Key Assumptions (operating)

- **Study period 2016-2020**
  - Assumes 4.3% average annual growth
- **2016 budget used as baseline**
  - Facilities plan O&M additions of $286,000 to $795,000 per year
- **Existing debt of $390,000-$324,000 per year**
- **Fiscal policies**
  - Operating: 90 day of O&M
  - Debt Service Coverage: 1.50 (revenue bonds only)

Agenda Ho

Council Packet June 21, 2016

Rate Study Key Assumptions (capital)



- **Funding plan:**
  - Existing reserves, GFCs and rates
  - Revenue bonds:
    - 2017 issue: $6.9 million (25-year term, 3.87% interest)
    - 2019 issue: $5.1 million (25-year term, 4.14% interest)
    - Assumes line of credit as interim financing
    - Annual debt service ($24K to $852K per year)

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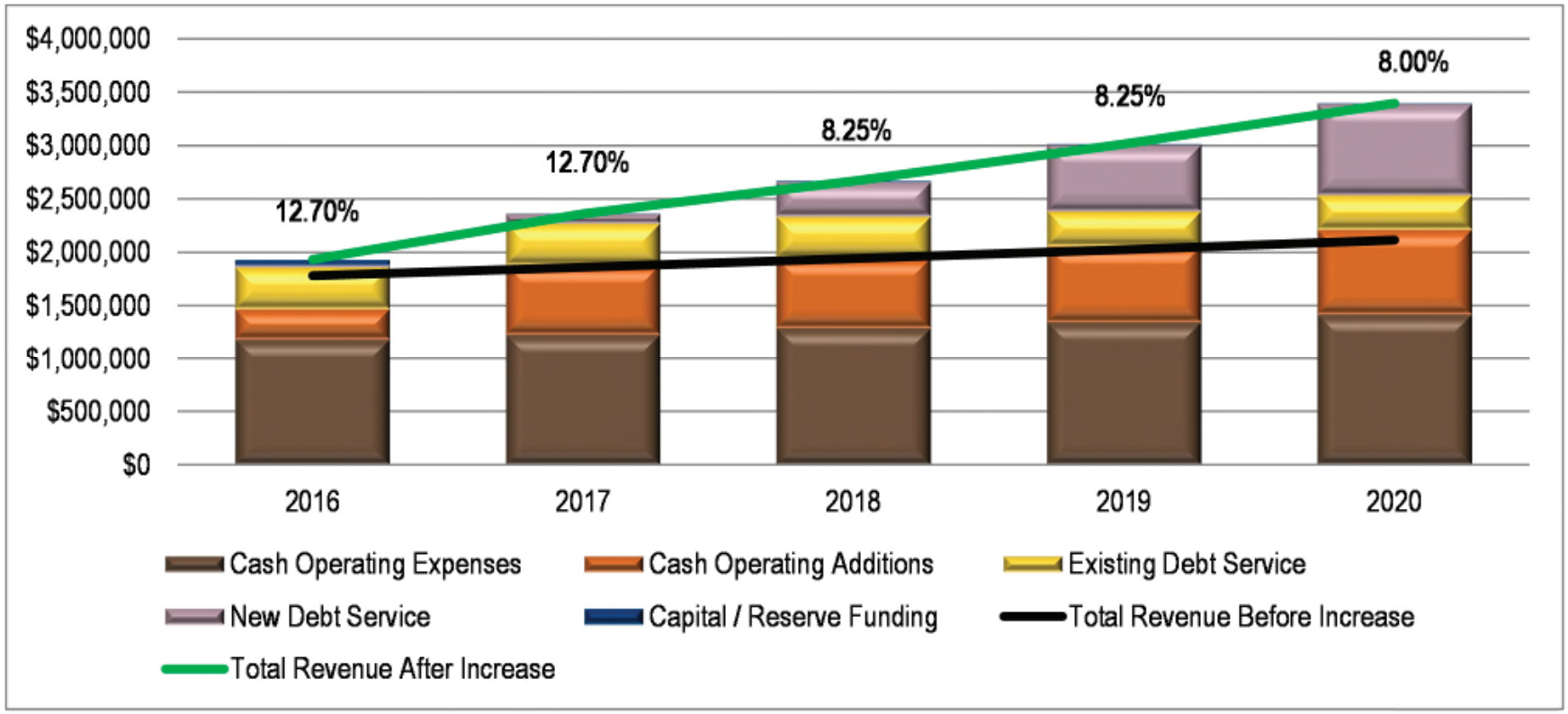
Council Packet June 21, 2016

Summary: Facilities Plan Impacts



- **Includes:**
  - O&M additions
  - Facilities plan CIP & new debt service

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Council Packet June 21, 2016

Rate Design

- **Rate design determines how revenue is to be collected by customers**
  - Fixed and/or variable charges
- **On May 3rd the F&A Committee requested the following modifications to the existing rate structure:**
  - Average per cubic meter (CM) rate for an average Residential and Commercial/ Industrial customer bill to be equal
  - Modified structure should encourage conservation compared to the existing structure
- **Example rate designs are based on the 4.33% growth rate**

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Council Packet June 21, 2016

Existing and Alternative Rate Structure

Class	Existing	Alternative
Monthly Fixed Charges	**Inc. 10 CM**	**Inc. 10 CM**
Single Family (per account)	$72.94	$49.20
Senior/ Disabled (per account)	33.46	22.57
Multi Family (per unit)	72.94	49.20
Commercial (per account)	72.94	49.20
Mixed Use		
Commercial (per account)	72.94	49.20
Per Residential (per unit)	72.94	49.20
Outside City	111.98	73.80
Volume Charges	**>10 CM**	**>10 CM**
Single Family	$0.77	$4.92
Senior/ Disabled	n/a	n/a
Multi Family	0.77	4.92
Commercial	2.79	4.92
Mixed Use*	2.79	4.92
Outside City	3.43	7.38

*Mixed use volume rate applies after 20CM

Alternative rate structure applies to all classes of service

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Council Packet June 21, 2016

Impacts of Rate Structure Change

RESIDENTIAL

Monthly CM	Existing		Alternative		$ Difference	% Difference	Notes:
	Bill	$/CM	Bill	$/CM			
7.05	$ 72.94	$ 10.35	$ 49.20	$ 6.98	$ (23.74)	-32.55%	*Half the average use*
14.09	**76.09**	**5.40**	**69.34**	**4.92**	**(6.75)**	**-8.87%**	***Average Use***
28.19	86.94	3.08	138.68	4.92	51.73	59.50%	*Double the average use*
42.28	97.80	2.31	208.02	4.92	110.22	112.71%	*Three times the average use*

COMMERCIAL

Monthly CM	Existing		Alternative		$ Difference	% Difference	Notes:
	Bill	$/CM	Bill	$/CM			
29.68	$ 127.86	$ 4.31	$ 146.05	$ 4.92	$ 18.19	14.23%	*Half the average use*
59.37	**210.68**	**3.55**	**292.10**	**4.92**	**81.42**	**38.64%**	***Average Use***
118.74	376.32	3.17	584.20	4.92	207.88	55.24%	*Double the average use*
178.11	541.97	3.04	876.30	4.92	334.33	61.69%	*Three times the average use*

Rate increase is in addition to rate structure change noted above

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Council Packet June 21, 2016

5-Year Rates

Description	Alternative	2016	2017	2018	2019	2020
Proposed Increases		**12.70%**	**12.70%**	**8.25%**	**8.25%**	**8.00%**
Monthly Fixed Charges (Includes 10 CM)						
Single Family (per account)	$ 49.20	$ 55.45	$ 62.49	$ 67.65	$ 73.23	$ 79.09
Senior/ Disabled (per account)	22.57	25.43	28.66	31.02	33.58	36.27
Multi Family (per unit)	49.20	55.45	62.49	67.65	73.23	79.09
Commercial (per account)	49.20	55.45	62.49	67.65	73.23	79.09
Mixed Use						
Commercial (per account)	49.20	55.45	62.49	67.65	73.23	79.09
Per Residential (per unit)	49.20	55.45	62.49	67.65	73.23	79.09
Outside City	73.80	83.17	93.73	101.46	109.83	118.62
Volume Charges (per CM > 10 CM)						
Single Family	$ 4.92	$ 5.54	$ 6.24	$ 6.75	$ 7.31	$ 7.89
Senior/ Disabled	n/a	n/a	n/a	n/a	n/a	n/a
Multi Family	4.92	5.54	6.24	6.75	7.31	7.89
Commercial	4.92	5.54	6.24	6.75	7.31	7.89
Mixed Use*	4.92	5.54	6.24	6.75	7.31	7.89
Outside City	7.38	8.32	9.38	10.15	10.99	11.87

*Mixed use volume rate applies after 20CM

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Council Packet June 21, 2016

GFC Overview & Methodology

- **Revised Code of Washington RCW 35.92.025 grants authority to fix rates and charges for connecting to water and sewer systems**
- **Charged to new development as a condition of service**
- **Based on the cost of system infrastructure**
- **Represents a proportionate share of capital investment**

Existing Costs

- ✓ Existing assets (original cost)
- ✓ Less: Contributions (developer/grants)
- ✓ Less: Net debt principal outstanding
- ✓ Plus: Interest (maximum 10 years)

Future Costs

- ✓ Future growth related capial
- ✓ Less: Developer donations
- ✓ Less: Repair & replacement

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Council Packet June 21, 2016

GFC Methodology

Treatment and General Assets

$$\frac{\text{EXISTING COST BASIS}}{\text{CURRENT \& FUTURE CUSTOMERS (City \& ULID)}} + \frac{\text{FUTURE COST BASIS}}{\text{FUTURE CUSTOMERS (City \& ULID)}} = \text{GFC (Treatment)}$$

Collection Assets

$$\frac{\text{EXISTING COST BASIS}}{\text{CURRENT \& FUTURE CUSTOMERS (City Only)}} + \frac{\text{FUTURE COST BASIS}}{\text{FUTURE CUSTOMERS (City Only)}} = \text{GFC (Collection)}$$

Description	Treatment	Collection	General	GFC
City Only Customers	$ 7,110	$ 2,523	$ 589	**$ 10,222**
ULID Customers	$ 7,110	$ -	$ 589	**$ 7,699**

Notes:

- Charges are per Equivalent Residential Unit (ERU)
- ERU is 2.57 people per household

Agenda Ho

Council Packet June 21, 2016

5-Year General Facility Charge Projection

Description	2016	2017	2018	2019	2020
General Facility Charges (GFC) per ERU					
GFC per ERU - City [1],[2],[3]	$ 10,222	$ 10,222	$ 10,462	$ 10,707	$ 10,958
GFC per ERU - ULID [1],[2],[3]	$ 7,699	$ 7,699	$ 7,879	$ 8,064	$ 8,253

[1] General facility charges (GFC) currently escalated by historical 10-year 20-City Engineering News Record Construction Cost Index (2.35%); Fee should be updated annually with actual index values.

[2] GFC based on Equivalent Residential Unit (ERU); changed from current meter size assessment

[3] GFC defined as 2.57 people per household

Agenda Ho

Council Packet June 21, 2016

Questions/Discussion

Wastewater Rate Comparison

	2014	2012	% Increase*	Rate Type	2014 Rank	2012 Rank
Tamoshan	$115.70	$110.19	2.5%	Flat	1	1
City of Seattle	$105.75	$96.12	5.0%	Volume	2	3
City of Chehalis (within city limits)	$105.09	$99.03	3.1%	Volume	3	2
City of Shelton	$103.02	$74.62	19.0%	Volume	4	8
City of Tenino	$94.00	$94.00	0.0%	Flat	5	4
Olympic View	$82.68	$78.44	2.7%	Flat	6	7
City of Centralia (within city limits)	$82.58	$79.23	2.1%	Volume	7	6
Boston Harbor	$82.14	$79.75	1.5%	Flat	8	5
City of Bellevue	$79.03	$68.33	7.8%	Volume	9	13
City of Sumner	$76.09	$58.78	14.7%	Volume	10	14
Grand Mound	$75.81	$68.76	5.1%	Flat	11	12
City of Bonney Lake	$75.78	$70.04	4.1%	Volume	12	10
City of Longview (within city limits)	$75.69	$71.98	2.6%	Volume	13	9
City of Bremerton (within city limits)	$71.08	$68.97	1.5%	Volume	14	11
City of Auburn	$62.91	$55.20	7.0%	Flat	15	17
City of Puyallup	$61.63	$58.53	2.6%	Volume	16	15
City of Mount Vernon	$56.30	$55.40	0.8%	Volume	17	16
City of Renton	$55.73	$50.55	5.1%	Flat	18	20
City of Tacoma	$54.66	$49.88	4.8%	Volume	19	21
City of Kelso	$54.48	$52.22	2.2%	Flat	20	18
City of Olympia (LOTT)	**$54.29**	**$51.54**	**2.7%**	**Flat**	**21**	**19**
City of Yelm	$53.04	$48.39	4.8%	Flat	22	23
City of Lacey (LOTT)	**$52.51**	**$49.00**	**3.6%**	**Flat**	**23**	**22**
Lakehaven Sewer District (KC Metro)	$50.78	$48.39	2.5%	Volume	24	24
City of Tumwater (LOTT)	**$50.03**	**$47.62**	**2.5%**	**Flat**	**25**	**25**
City of Everett	$49.50	$46.70	3.0%	Flat	26	26
Lakehaven Sewer District (Pierce Co.)	$48.26	$40.65	9.4%	Volume	27	28
City of Vancouver	$43.97	$41.96	2.4%	Volume	28	27
Pierce County Sewer	$42.82	$37.83	6.6%	Flat	29	30
City of Snoqualmie	$42.16	$38.40	4.9%	Flat	30	29
City of Orting	$40.15	$35.00	7.4%	Flat	31	32
City of Hoquiam	$38.14	$36.59	2.1%	Flat	32	31
City of Bellingham (within city limits)	$35.07	$33.23	2.8%	Flat	33	34
Lakehaven Sewer District	$34.85	$33.99	1.3%	Volume	34	33
City of Aberdeen	$34.68	$30.16	7.5%	Flat	35	35
City of Edmonds	$27.73	$25.90	3.5%	Flat	36	36
Rate Average	**$63.00**	**$57.93**	**4.5%**			

* Percentage increase annualized over a two-year period.

LEGAL NOTICE
CITY OF NORTH BEND
King County, Washington

NOTICE OF PUBLIC HEARING

NOTICE IS HEREBY GIVEN that the North Bend City Council has scheduled a hearing to solicit public input and comments on proposed Sewer and Sewer General Facility Charge rate increases. The public hearing will take place during the Council Meeting on Tuesday, June 21, 2016, at 7:00 PM at the Mt. Si Senior Center, 411 Main Ave. S., North Bend, WA.

Comments may be presented orally at the public hearing or submitted in writing to the City Clerk at P.O. Box 896, North Bend, WA, 98045, or by e-mail to: soppedal@northbendwa.gov prior to 5:00 PM, Monday, June 20, 2016. For additional information please contact City Hall at (425) 888-1211.

Posted: June 1, 2016
Published in the Snoqualmie Valley Record: June 1, 2016

Don DeBerg

From: mthomas@bangstick.net
Sent: Tuesday, June 21, 2016 11:17 AM
To: Mark Rigos; Susie Oppedal
Cc: Council; Don DeBerg; Londi Lindell; Ken Hearing
Subject: RE: Comments on Sewer Rate and GFC Increase 6/21
Attachments: Winter Quarter Average (Sewer) _ Plano, TX - Official Website.pdf

Mark,

Thanks for the response.

On #1 where I am headed is that the sewerage charges to users that have a single meter are based on their winter water consumption based on the previous year's usage during the winter months. So for example, if a residence used an average of 15 cu.meters during the winter months, their sewerage charges are based on their winter usage and not any higher, even if their actual usage is higher during the summer, e.g., say 30 cu. meters of water... so the user is billed for 15 cu meters of sewerage and 30 cu meters of water. The rates as proposed by North Bend simply charge based on usage in excess of 10 cu. meters. A city where I used to live did this practice of winter quarter averaging which incents consumers to reduce usage during winter months and to also provide a fair way of billing for water usage during the summer that doesn't go into the sewer system and is used for lawn care or home gardening. The following link describes this practice: http://www.plano.gov/1265/Winter-Quarter-Average-Sewer (and the page is attached for your reference).

On the response to #2, it is still not clear what parts of our rate increases and GFCs are due to non-capacity related improvements and repairs versus increasing capacity. Are you saying that all of the rate increase (not GFC increase) is due to repairs or improvements not related to capacity?

On the response to #3, it sounds as if the capacity is being doubled. This seems to be out of line with the growth required for the UGA to 2030. Under section H.4 of the comprehensive plan in the land use section at best 771 new housing units are needed to meet UGA to 2035... so we need to plan for that (+771 ERU).

On #4, what is the capacity we actually *require* to meet the reasonable sewerage treatment demand we have? (say to 2020? say to 2030? say to 2040?) On the capacity #s, 2300 ERU = sewer treatment for 5911 people. Our urban population is about 4798, total pop 6578 with some homes tho within city limits being on septic. In any case, I do believe we are approaching the capacity we have so I don't dispute that we need more, but how much more do we need and when do we need it? Is it fair to ask people to pay for all the needed capacity in a 5 year timeframe?

4492 ERU (11.5k people) seems well in excess of the demand to 2021.

This amount of capacity increase is excessive would be my conclusion.

Michael

> -------- Original Message --------
> Subject: RE: Comments on Sewer Rate and GFC Increase 6/21
> From: Mark Rigos <MRIGOS@NORTHBENDWA.GOV>
> Date: Tue, June 21, 2016 9:56 am
> To: "mthomas@bangstick.net" <mthomas@bangstick.net>, Susie Oppedal <SOPPEDAL@NORTHBENDWA.GOV>

Cc: Council <Council@northbendwa.gov>, Don DeBerg <DDEBERG@NORTHBENDWA.GOV>, Londi Lindell <LLINDELL@NORTHBENDWA.GOV>, Ken Hearing <KHEARING@NORTHBENDWA.GOV>

Hi Michael,

Thank you for providing input. Answers to your questions are as follows:

1. Yes, the rates were calculated based on a 5-month average, from November through March.

2. An Allocation Table was prepared and vetted by 4-5 licensed Professional civil engineers (PEs) by the State of Washington including 2 PhDs for allocating proportional costs into capacity or non-capacity facilities. Total cost of the 5-year improvements is estimated to be approximately $15 million. Adjustment of the current GFC rates distributes the fair costs for upgrading the currently unallocated "rated" capacity of plant.

3. The existing City wastewater facilities currently provides conveyance, treatment and disposal for about 2,300 ERUs (equivalent residential units). One ERU is by definition equal to the flow and load attributable to the average single family residence (~2.57 people). With the implementation of the 5-year capital improvement program, the City wastewater facilities will have a "true" rated capacity capable of providing reliable conveyance, treatment and disposal for 4,492 ERUs.

4. Neither me nor my consultant understand what is being asked. However, all of the improvements in the 5-year plan are needed to bring the plant up to its rated capacity. The improvements are needed to replace equipment and systems that are being operated beyond their design service life, to bring the plant into conformance with its rated capacity, current City flood management regulations, current state and federal redundancy and reliability standards, and state biosolids management regulations.

5. For irrigation meters, sewer rate charges do not apply to water used for irrigation purposes.

Hope that helps.

Sincerely,
Mark Rigos, P.E.
Public Works Director
City of North Bend
PO Box 896
1155 East North Bend Way
North Bend, WA 98045
(425) 888-7650

From: mthomas@bangstick.net [mailto:mthomas@bangstick.net]
Sent: Monday, June 20, 2016 4:05 PM
To: Susie Oppedal
Cc: Mark Rigos; Council
Subject: Comments on Sewer Rate and GFC Increase 6/21

Hello,

I am a resident of North Bend at 1231 LaForest Drive SE North Bend WA 98045 and wish to submit comments and questions for the record for the 6/21 hearing on the sewer rate and GFC increase.

I oppose the rate increase both in terms of both the general rate and GFC rate increase at this time. I would like to see an extended period for public comment on the proposal, certainly 4 business days notice of a rate increase does not provide the public sufficient time to comment on such a massive rate increase... although the city has known about this for months (with the original notice dating to April), citizens have not had the details until last week.

I would also like to see more details as to the plans for improvements and costs differentiated by improvements versus capacity expansion. There are no details provided in the city council packet justifying the rate increase or details such that the public can understand what components are for new development versus for upgrade or repair. The city has already exceeded its UGA growth targets to 2030... it's not clear how much capacity is actually required and whether the new plan exceeds the UGA target.

I have the following questions:

1) Was "winter quarter averaging" for establishing the basis for sewer charges evaluated? Obviously summer water usage for many homeowners and property owners also includes water that is used to maintain lawns and grow food for home gardens or farms within city limits and this water does not go into the sewer system for treatment. I believe winter usage is perhaps more reflective of actual usage that is apt to require sewer treatment. I view the old rate structure of a higher base charge but a very low variable rate charge is meant to reflect this. It would make sense that the winter water usage for properties with a single meter (without a separate meter for irrigation) would be most reflective of usage that requires sewer treatment. Reducing winter water usage that requires sewer treatment during the wettest months helps reduce the volume due to people and when infiltration in the system is greatest due to aging pipes, improper drain connections, etc. I am surprised North Bend has not considered winter quarter averaging to base sewer charges on what is usage that requires treatment vs. usage that doesn't (e.g., lawncare, gardening).

Winter quarter averaging would help those owners "maintain the rural look and feel" and small town character of their properties by providing a reasonable way to charge for water usage that requires sewer treatment and to maintain their lawns and landscaping.

2) Of the rate increases to both the GFC and monthly rate structure how much is due to capacity expansion vs. not capacity expansion (e.g., upgrades or required repairs)?

3) How many single family residences does the current system support and how many residences will be supported with the proposed capacity expansions? If this changes over time please elaborate the capacity changes over time.

4) What is the minimum capacity increase required (in terms of # of single-family residences)?

5) How are charges handled for properties with a separate meter for irrigation handled? The new ordinance rate structure does not elaborate on usage for irrigation or differentiate consumption for residential use vs. irrigation.

Please include my comments and questions for the public record.

Regards
Michael Thomas

Don DeBerg

From: Londi Lindell
Sent: Tuesday, June 28, 2016 6:24 PM
To: mthomas@bangstick.net
Cc: Ken Hearing; Mark Rigos; Don DeBerg; Dawn Masko; John Markus (john.markus@tetratech.com) (john.markus@tetratech.com); Angie Sanchez Virnoche (AngieS@fcsgroup.com) (AngieS@fcsgroup.com); tyallan@outlook.com; Mark Fogle; Council
Subject: FW: Comments and additional questions on 6/21 City Council Meeting

Mr. Thomas, your below emails to the City Council were forwarded to me and Council requested I provide responses. Please be advised that there are two additional opportunities for public comment on Thursday, July 7th (with an optional tour of our Sewer Plant at 6:00PM-limited spaces so please RSVP if you are interested) and Tuesday, July 19th,. Both of these meetings are being held at the Senior Center @ 7:00 PM. Although I understand you currently are connected to a septic system you pose a significant number of questions regarding our proposed sewer rate increase affecting our sewer rate payers and we are hopeful you are interested in connecting to our sewer system at some future date. Please see the City's responses in red below. If you have further questions, please bring them to a future public forum. Thank you for becoming involved in this important issue for the City and I trust the below responses are helpful in better understanding the need for an increase in our sewer rates. We hope you are able to attend one of the upcoming public meetings or hearings. Thank you. Londi Lindell

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From: mthomas@bangstick.net [mthomas@bangstick.net]
Sent: Thursday, June 23, 2016 12:30 AM
To: Council
Cc: Mark Rigos; Susie Oppedal
Subject: Comments and additional questions on 6/21 City Council Meeting

Dear Council Members,

Thank you for not approving the rate increase and giving more time for public Q&A and also for good additional questions.

I personally am having a hard time resolving why it is necessary to double the capacity and in such short order.

Response:
The principal driving force for doing the work at the treatment plant is repair and replacement due to the Plant being almost 70 years old and NOT to provide new capacity for new homes as you have suggested during your testimony and throughout this email. There are no new capacity improvements being made during the 5 year capital improvements. There is existing unallocated capacity at the Sewer Plant. The capacity element is a consequence of the currently unused or unallocated capacity of the plant that will benefit from implementation of the capital improvement plan.

This seems far out of line with our existing population and residential property growth, even the City's own comprehensive plan and UGA requirements would not use all the capacity growth proposed (+771 residences/1982 people) to *2035*.

Response:
As the City grows, there will be an increase in residential population but also growth in the commercial sector. Wastewater derived from the commercial represents about 30% of the existing capacity needs for

wastewater treatment. Currently there are about 2150 people living in residences (~836 ERUs) within the City who are on private on-site septic systems such as yourself that are not connected to the City's wastewater collection and treatment system. In 2036 it is estimated that there will only be 420 residents (163 ERUs) within the City that will remain on private on-site septic systems. As King County Public Health adopts more stringent regulations on septic and as pollution control laws and Growth Management laws requires cities' to deliver urban sewer services, existing septic systems will eventually be eliminated within urban growth areas. This is set forth in state law and is consistent with the Growth Management Act.

The city leadership regularly cite the need to support the UGA and required growth as justification for development, the city needs to explain why then it is NOT following its own comprehensive plan and overbuilding capacity.

Response:
The City is following its own Comprehensive Plan and is not "overbuilding". You have made estimates that this plan allows for over 11,000+ additional homes or persons to move to our town based upon the available ERUs and this is incorrect. The 5-Year Wastewater CIP plan that the proposed rate increase is based upon is consistent with the City comprehensive plan. The rate model estimates growth of approximately 100 new homes a year during the next 5 years. Based on the growth model in the wastewater facility plan and the City's comprehensive plan, additional or new "capacity" improvements at the treatment plant will not be required until 2029. Again the work identified in the 5 year CIP for the years 2016 -2020 are needed to allow the existing treatment plant *to reliably and consistently at a level that will assure compliance the City's NPDES discharge permit* because it's a 70 year old sewer plant**. Only about half of the existing plant capacity is allocated** so improvements aren't needed to add capacity at this time. Capital Costs associated with the unallocated portion of the plant will be recovered from development through a connection or hookup fee charged when a new home connects to the system which is also called the General Facilities Charge (GFC).

Has the city considered plans that do not double capacity?

Response:
Again, your assumption is incorrect - The 5-year plan does not double the existing plant capacity it only allows the existing rated capacity of the plant to be used and allows the Plant to function in compliance with our permit.

Has the city considered plans that decrease load? (such as by encouraging and providing $ to residents and businesses to install low flow fixtures, water conserving toilets, front-loading washing machines, commercial dishwashing water recycling systems, etc.)?

Response:
Reducing the hydraulic load discharge by any specific class of user through water conservation would not eliminate the need or significantly reduce the costs for the 5 year capital improvement plan. The reason for this is because of the high amount of extraneous flow that enters the wastewater collection system due to inflow and infiltration because the collection system is also almost 70 years old so there are many cracks and breaks in the lines so we have a problem called I & I or inflow and infiltration. Inflow and infiltration is the dominate factor in determining the required hydraulic capacity of the plant. *On an annual basis more than half of the wastewater conveyed and treatment by the North Bend Wastewater Facilities is attributable to I&I. During a severe rainfall/snow melt event such as that experienced in November and December 2015, I&I accounted for over 85% of the daily hydraulic flow (load) conveyed and treated by the City's wastewater facilities.* Even with this high amount of I&I it remains cost effective to enhance the existing treatment plant as compared to cost and difficulty of implementing corrective action including replacement of private side sewers.

How about the unthinkable... that the city needs to allow septic systems to avoid increased loading and to encourage people on OSS to stay on them longer. (Septic users consume no capacity). There are still properties more than 200 ft. from city sewer that are blocked from adding OSS.

Response:
As mentioned above, that is not allowed by state law. The City of North Bend is within an UGA and is mandated to deliver urban services such as water and sewer. As such we do not allow new septic systems with new construction in order to avoid pollution of rivers and water drinking sources. Further, most of North Bend is in the flood plain and is characterized by groundwater at or slightly below the ground surface during extended wet weather conditions. Under these conditions, a conventional septic tank drain field does not provide the necessary treatment to protect the environment and the public health and safety.

FCS' testimony at the 6/21 hearing indicated ratepayers would be paying $3.4M as a result of capacity expansion.

Response:
Existing rate payers will be responsible for paying their fair share of the 5 year capital improvement program for permit compliance, redundancy, etc which is around that $3.4M figure. The balance of the costs for implementing the improvements will be paid by future development.

If I'm not mistaken rate increases cannot be used to pay for capacity expansion, only maintenance, repair, and upkeep. Isn't using funds marked for O&M/repair an unlawful use when those funds are used for capacity expansion? Folks need to go back and propose additional revenues related to new development... higher new development charges to pay for such. In any case it is not following the philosophy of "growth pay for growth".

Response:
The program does require growth to pay for growth. The need for implementing the 5 year capital improvement plan is not growth as stated earlier. Cost associated with implementation of the 5 year capital improvement plan that are associated with the current unallocated capacity of the existing plant will be recovered through the GFCs. The faster development occurs the faster the City can recover capital for the existing plant improvements through developer paid GFCs and new city sewer customers through payment of monthly sewer rates.

I also have additional questions regarding the assumptions on revenues. Mark's reply to me indicated that rainy season water consumption was used as the basis for rate increases. It is common sense that many residential users will increase their consumption in the summer to maintain their homes lawns and to garden/grow food--certainly in line with "preserving the rural character of North Bend". Wouldn't a rate design that assumes winter usage of water overshoot and collect too much money during summer months? I'd like to get more details as to the design of the rate increase and revenue projections to ensure that we've looked at multi-year consumption... at least a full 12 months or more (certainly there are fluctuations for dry and wet years)... considering North Bend is asking for an astronomical rate increase folks seriously need to examine how to bring down the increase.

Response:
The City uses the average monthly water consumption rate during the period of November through March to establish the average daily sewage flow for the “drier” months of the year, April through October). Actual residential water consumption from April through October does not come into the equation for computation of sewer rates or calculation of the sewer bill. The monthly residential sewer bill for the months of April through October is equal to the average of the preceding 5 months of sewer bills during “wet weather” (November through March).

Both myself and another citizen at the meeting proposed an alternative sewer consumption charging structure... one proposed a flat rate for residents, I had proposed basing sewer charges on winter consumption. Certainly the winter strategy incents conservation... people are incented to reduce household water use during winter months--and that is usage that does go into city sewer and at the worst time, rainy season where inflows are highest due to water leaking into the system or improper drainage connections to sewer.

Response:
The City's prior sewer rate was based upon a flat rate but a flat rate fees does not encourage water or wastewater conservation, which are key objectives identified by the City Council. A volume based fee that is constant or increases concomitant with increased consumption/discharge encourages conservation. The proposed rate structure is volume based with a constant volume charge.

I'd also ask that the city examine other ways of paying for new development aside from GFC. Homes that are on septic at some point will be going to city sewer and simply increasing the GFCs makes migration to sewer even less attractive... and even major repairs are apt to cost less than a $10k GFC (and that's before considering another $10k-$25k or more for a resident to connect from their home to the city sewer connection)... and then the resident has another $100 or more in sewer consumption charges they did not have before (relative to pumping every 3-5 years at $750 plus occasional maintenance costs, screen cleans and miscellaneous repairs). Did not Silver Creek just reject city sewer? What is the city doing to make connecting to sewer a more attractive option?

Response:
The City can apply for grant and loan funding from the Washington State Department of Ecology to reduce sewer rate increases associated with extending city sewer into existing neighborhood not currently served by the City's wastewater collection system. Centennial Clean Water Grant funds have been generally available to "buy down" the cost of the project so that the new customer's total sewer bill does not exceed 2% of the median household income. In 2015 median household income (MHI)for the Silver Creek has been reported to be $84,432. Two percent of this equates to a threshold sewer rate cost of $140.72. If the City applied and offered grant funding for the project then residents the average residential customers sewer rate would be set at 2% of the median household income. The grant would be provided to provide the necessary funds to buy down the capital obligation for the project. Also Ecology does provide additional financial aid through lowering the interest rates on loans that result in sewer rates that are in the range of 80 to 100 percent of the sewer rate threshold (2% of MHI). However, the City's position has been that it is up to the neighborhood to decide if they wish to form a ULID to extend sewer to their neighborhood and busy City staff are not prepared to spend limited staff resources applying for such grants unless a neighborhood indicates a significant interest in such a ULID by initiating a ULID through a Petition. Although a Town Hall Meeting was conducted for the Silver Creek Community due to Ty Allen's inquiries (who I am copying on this email due to his interest in septic), the majority of homeowners who responded to the survey were not in favor of proceeding with connection to the City's sewer system in Silver Creek.

Last the upgrades/repairs and changes for "improvements" need to be examined closer to ensure there are no "shadow" capacity changes there. A good cross check is to re-run the system design "as if" no capacity changes were done and then compare the costs against the plan that increases the capacity... the difference is the cost of improvements/repairs/maintenance due to system capacity increase... and all those costs should be passed to new development.

Response:
It is essential to understand that the *improvements identified are principally replacement, repair, and additions for critical process redundancy* (e.g. the addition of a second clarifier, third UV reactor, and centrifuge) and for achieving compliance with the state biosolids regulations (i.e. , construction and operation of an aerobic

digester for production of Class B Biosolids to allow for beneficial use for what currently is un-stabilized sewage sludge). In other words, even if another house was never built in North Bend our permit requires this level of redundancy for safety and compliance with current regulations.

I am also concerned with statements during the meeting that the plan/design is only "80%" done. So what else is left and what is the risk the costs go up?

Response:
The proposed rate increases are based on planning level estimates. Actual costs will vary but should be generally covered within +/- 30% of the estimated cost. Estimated costs are generally updated during and at the end of design phase. The construction market place sets the actual cost of construction may differ from the engineers estimate due to the cost of materials , labor and overall bidding climate at the time of bidding.

There was also a statement (I believe by the city administrator made it) that another $12-$14m in revenues will be needed for O&M to 2029... so ratepayers will be faced with that as well.... this should also be put out as the rate increases clearly won't end in 2020... that is almost as expensive as the entire improvement and capacity expansion plan being put forward now. I'd certainly like to see more details on this.

Response:
There is no capacity expansion in the 5-year Capital Improvement Plan as stated previously. Yes, operation and maintenance costs will increase over current levels because city needs to be more proactive rather than a reactive position to operating and maintaining the City's wastewater facility assets. The proposed rates include the cost for increased O&M and implementation of the 5-year capital improvement program.

I would like to understand when the system capacity changes and when we need certain levels of capacity. What capacity do we need and when do we need it? Perhaps present a table of the required capacity every year for the next 5-10-20 years.

Response:
Treatment plant capacity increases are not anticipated before 2029 based on the City's comprehensive plan and the draft wastewater facilities plan. Again the 5 year capital improvement program is needed to repair and replace equipment and systems that have failed or likely to fail because they have reached their design service life, and to bring the plant into compliance with the State and Federal standards for redundancy and reliability to assure compliance with the City's NPDES permit and to provide the City with the needed improvements to meet the State's Biosolids Management Regulations and General Permits for Biosolids, and to resolve nuisance odor issues associated with the plant.

Three additional suggestions given customers need notice of rate changes: 1) The new consumption rates to be included in a mailing for sewer charges and also a notice on the customer's bill of the date of the new rate plan 2) The rate plan takes effect the first billing cycle 6 months from adoption of the new rate plan. 3) Subsequent rate plan changes are spaced 12 months from the bill the first rate increase occurs.

On outreach: 1) The city needs to do a better job in social media... I see nothing wrong with a member of city government to post key announcements to popular facebook groups (such as the North Bend Political Forum or the North Bend News and Trading post)... those groups have 350 and more than 3000 members each. The city doesn't have to monitor these, only post. The city is still providing the required public notices anyway, posts are additional outreach. 2) Key facts the city wishes to highlight need to be in the email announcement not buried 80 pages in a PDF document... consider putting this information as an attachment or even better 1-3 pages as HTML in the email--consider that most people now get their email on a mobile device... reading a PDF on a mobile screen doesn't cut it 3) Simpler terms and clarity are needed... FCS presentation did little to explain this in terms the population can understand, and as well

the engineering information on capacity requires some translation (perhaps to homes or population to translate treatment capacity from ERUs to something laypeople can understand). Similarly a clearer presentation of the cost of repairs/maintenance/upkeep and cost of capacity doubling. $X million for repair/upkeep/maintenance $Y million for capacity upgrade.

The City has been discussing the need for these capital improvements for 4 years at various public meetings and the need for the corresponding rate increases at various public meetings. The Capital Facilities Plan meeting describing in detail improvements you wish to discuss above was advertised and public meetings were conducted on March 15, 16 and April 26, 2016 (you incorrectly testified that this was the Silver Creek sewer meeting, which it was not). The rates were discussed in public Council Committee meetings on May 3, 11 and June 7 and 8, 2016. A public hearing before the City Council was opened on June 21st and continued until July 19th providing over a month for citizens to provide written or verbal comments to their elected officials. In addition, we added a Town Hall meeting on July 7th with our consultants and staff with an optional tour of the plant to answer questions. Finally we have posted all this information on the official City's Facebook Page, Twitter account, City's Web page, and posted official notices with the two local newspapers (Snoqualmie Valley Record and Snoqualmie Star) and the local blog (Living Snoqualmie). We also sent the notice/press release to all persons who have signed up for "Notify Me" through the official City Web Page seeking notice of City News and Highlights. The upcoming meetings are listed on the City Calendar and the press release is listed under the City's News and Highlights. We have also sent this information out to the local Yahoo Group. We have never found the utility billing notices to be an effective tool for communication particularly of upcoming meetings. We also are unwilling to start trying to distribute this information to certain private social media closed groups as you have suggested. The two Facebook groups you suggest are both closed and require membership and the City of North Bend is not a member .

Michael Thomas

> -------- Original Message --------
> Subject: Request to oppose city sewer rate increase
> From: <mthomas@bangstick.net>
> Date: Tue, June 21, 2016 4:42 pm
> To: "Council" <Council@northbendwa.gov>
>
> Dear City Council,
>
> I believe more time is in order to understand the nature of the rate increase and why such a massive capacity increase is required in such a short order... expanding the capacity to 11.5k people seems out of order within the next 5 years, even the UGA only requires us to build an additional 771 residences (+1982 people) to 2035 in the City's own most recent comprehensive plan.
>
> I also suspect that a good part of the improvements are not for maintenance or upgrades but are cloaks for capacity expansion and that is not an appropriate use for a rate increase.
>
> Citizens being given only 4 business days to review the rate increase and to ask questions, come up with alternative ideas, etc. is not good governance.
>
> I urge the council to oppose this. I am not necessarily opposed to capacity expansion or needed rate increases, Mark's numbers do indicate we are close to the existing capacity and such an expansion may be warranted... the question is how much is needed and when? Is there an alternative plan? What are the minimum necessary repairs & maintenance and what is the capacity expansion needed and when?

Michael Thomas

-------- Original Message --------
Subject: RE: Comments on Sewer Rate and GFC Increase 6/21
From: Mark Rigos <MRIGOS@NORTHBENDWA.GOV>
Date: Tue, June 21, 2016 9:56 am
To: "mthomas@bangstick.net" <mthomas@bangstick.net>, Susie Oppedal <SOPPEDAL@NORTHBENDWA.GOV>
Cc: Council <Council@northbendwa.gov>, Don DeBerg <DDEBERG@NORTHBENDWA.GOV>, Londi Lindell <LLINDELL@NORTHBENDWA.GOV>, Ken
Hearing <KHEARING@NORTHBENDWA.GOV>

Hi Michael,

Thank you for providing input. Answers to your questions are as follows:

1. Yes, the rates were calculated based on a 5-month average, from November through March.

2. An Allocation Table was prepared and vetted by 4-5 licensed Professional civil engineers (PEs) by the State of Washington including 2 PhDs for allocating proportional costs into capacity or non-capacity facilities. Total cost of the 5-year improvements is estimated to be approximately $15 million. Adjustment of the current GFC rates distributes the fair costs for upgrading the currently unallocated "rated" capacity of plant.

3. The existing City wastewater facilities currently provides conveyance, treatment and disposal for about 2,300 ERUs (equivalent residential units). One ERU is by definition equal to the flow and load attributable to the average single family residence (~2.57 people). With the implementation of the 5-year capital improvement program, the City wastewater facilities will have a "true" rated capacity capable of providing reliable conveyance, treatment and disposal for 4,492 ERUs.

4. Neither me nor my consultant understand what is being asked. However, all of the improvements in the 5-year plan are needed to bring the plant up to its rated capacity. The improvements are needed to replace equipment and systems that are being operated beyond their design service life, to bring the plant into conformance with its rated capacity, current City flood management regulations, current state and federal redundancy and reliability standards, and state biosolids management regulations.

5. For irrigation meters, sewer rate charges do not apply to water used for irrigation purposes.

Hope that helps.

Sincerely,
Mark Rigos, P.E.
Public Works Director

City of North Bend
PO Box 896
1155 East North Bend Way
North Bend, WA 98045
(425) 888-7650

From: mthomas@bangstick.net [mailto:mthomas@bangstick.net]
Sent: Monday, June 20, 2016 4:05 PM
To: Susie Oppedal
Cc: Mark Rigos; Council
Subject: Comments on Sewer Rate and GFC Increase 6/21

Hello,

I am a resident of North Bend at 1231 LaForest Drive SE North Bend WA 98045 and wish to submit comments and questions for the record for the 6/21 hearing on the sewer rate and GFC increase.

I oppose the rate increase both in terms of both the general rate and GFC rate increase at this time. I would like to see an extended period for public comment on the proposal, certainly 4 business days notice of a rate increase does not provide the public sufficient time to comment on such a massive rate increase... although the city has known about this for months (with the original notice dating to April), citizens have not had the details until last week.

I would also like to see more details as to the plans for improvements and costs differentiated by improvements versus capacity expansion. There are no details provided in the city council packet justifying the rate increase or details such that the public can understand what components are for new development versus for upgrade or repair. The city has already exceeded its UGA growth targets to 2030... it's not clear how much capacity is actually required and whether the new plan exceeds the UGA target.

I have the following questions:

1) Was "winter quarter averaging" for establishing the basis for sewer charges evaluated? Obviously summer water usage for many homeowners and property owners also includes water that is used to maintain lawns and grow food for home gardens or farms within city limits and this water does not go into the sewer system for treatment. I believe winter usage is perhaps more reflective of actual usage that is apt to require sewer treatment. I view the old rate structure of a higher base charge but a very low variable rate charge is meant to reflect this. It would make sense that the winter water usage for properties with a single meter (without a separate meter for irrigation) would be most reflective of usage that requires sewer treatment. Reducing winter water usage that requires sewer treatment during the wettest months helps reduce the volume due to people and when infiltration in the system is greatest due to aging pipes, improper drain connections, etc. I am surprised North Bend has not considered winter quarter averaging to base sewer charges on what is usage that requires treatment vs. usage that doesn't (e.g., lawncare, gardening).

Winter quarter averaging would help those owners "maintain the rural look and feel" and small town character of their properties by providing a reasonable way to charge for water usage that requires sewer treatment and to maintain their lawns and landscaping.

2) Of the rate increases to both the GFC and monthly rate structure how much is due to capacity expansion vs. not capacity expansion (e.g., upgrades or required repairs)?

3) How many single family residences does the current system support and how many residences will be supported with the proposed capacity expansions? If this changes over time please elaborate the capacity changes over time.

4) What is the minimum capacity increase required (in terms of # of single-family residences)?

5) How are charges handled for properties with a separate meter for irrigation handled? The new ordinance rate structure does not elaborate on usage for irrigation or differentiate consumption for residential use vs. irrigation.

Please include my comments and questions for the public record.

Regards
Michael Thomas

Don DeBerg

From: mthomas@bangstick.net
Sent: Wednesday, June 29, 2016 4:29 PM
To: Londi Lindell
Cc: Ken Hearing; Mark Rigos; Don DeBerg; Dawn Masko; John Markus (john.markus@tetratech.com) (john.markus@tetratech.com); Angie Sanchez Virnoche (AngieS@fcsgroup.com) (AngieS@fcsgroup.com); tyallan@outlook.com; Mark Fogle; Council
Subject: RE: FW: Comments and additional questions on 6/21 City Council Meeting
Attachments: North Bend WWTP~Final Permit~05-23-13.pdf; Chapter 3 - Housing Element Adopted December 8, 2015.pdf

Thanks for the responses and also to city council for directing a response to my questions.

I am concerned about the characterization of capacity... certainly Mark's responses suggest we are increasing the effective capacity of the plant. The response provided by you says otherwise.

If we are exceeding 85% of the inflow design in winter we need to do something according to our permit, and 3 consecutive months would have required such a review. We are also adding homes at a high rate, certainly we've added many since 2014 and there are over 100 in construction (Pulte and others in Tannerwood and scattered throughout the city)... our growth rate and the ERUs suggest we would exceed the effective capacity soon or perhaps exceeded it, and that also requires permit review. The city is also advocating OSS owners switch to sewer... Silver Creek... but I must wonder if North Bend would have had the capacity to address such. What is the effective capacity of the present system?

Interesting data may be the actual flow the plant during summer and winter months... summer months perhaps are representative of the minimum flow and residential/commercial input minus what leaks into the ground from leaking public and private piping; winter months representative of I&I plus residential/commercial input would be good data to have about the plant. Perhaps one of the plant engineers can answer that.

I am supportive of changes to the plant and increasing capacity, I am questioning the amount of the capacity increase and the timing of the increase. I am concerned about affordability for people in our city and long term costs. Folks also just their new property valuation assessments, certainly +10-14% is going to hurt (but perhaps city governments such as North Bend are celebrating property owners misery).

As I also am keeping up with OSS issues, King County BoH just withdrew its plan for enhanced monitoring due to massive OSS owner turnout and pushback, I was at the King County Board of Health meeting last night in Fall City. Seattle Times had an article that Seattle is discharging 1.1 B gallons of untreated sewerage into the Sound each year... it's quite suspect folks are going after OSS folks when cities such as Seattle are such obvious sources of pollution. I'd wonder OSS built in the past 30 years or newer are doing a better job in protecting groundwater than North Bend's 70 year old plant and aging private and public piping. I somewhat wonder that perhaps folks need to be also looking at smaller towns and cities sewer treatment and sewer infrastructure as a source of river pollution... North Bend, Snoqualmie, Fall City... certainly there is a lot of growth and aged infrastructure to consider. I believe it's important to start directing the King County Board of Health to look for other sewerage hazards in the area; but looking at municipal treatment is not within their domain... but perhaps WA ecology is the proper body to look to at this time. When I consider the staggering 1.1B number just for Seattle alone, that's equivalent to 40k people's worth of sewerage a year... and HALF of all the OSSes in King County.

I would be interested in going to city sewer but the fees and sewer rates plus construction and decommissioning costs are coming in far far above even what it would cost to do a major repair on an OSS... the proposed GFC of $10k would pay for a major OSS repair, and that's ahead of OSS

decommissioning costs, construction costs on the resident side of the sewer demarc, and permitting costs. I did take a look at LaForest and a few other nearby neighborhoods on King County iMap, LaForest is not within 500 year FEMA floodplain, within 100 ft of a well, or recharge areas so I'm not seeing the environmental justification to compel going to public sewer.

Mike

-------- Original Message --------
Subject: FW: Comments and additional questions on 6/21 City Council Meeting
From: Londi Lindell <LLINDELL@NORTHBENDWA.GOV>
Date: Tue, June 28, 2016 6:24 pm
To: "mthomas@bangstick.net" <mthomas@bangstick.net>
Cc: Ken Hearing <KHEARING@NORTHBENDWA.GOV>, Mark Rigos <MRIGOS@NORTHBENDWA.GOV>, Don DeBerg <DDEBERG@NORTHBENDWA.GOV>, Dawn Masko <DMASKO@NORTHBENDWA.GOV>, "John Markus (john.markus@tetratech.com) (john.markus@tetratech.com)" <john.markus@tetratech.com>, "Angie Sanchez Virnoche (AngieS@fcsgroup.com) (AngieS@fcsgroup.com)" <AngieS@fcsgroup.com>, "tyallan@outlook.com" <tyallan@outlook.com>, Mark Fogle <MFOGLE@NORTHBENDWA.GOV>, Council <Council@northbendwa.gov>

Mr. Thomas, your below emails to the City Council were forwarded to me and Council requested I provide responses. Please be advised that there are two additional opportunities for public comment on Thursday, July 7th (with an optional tour of our Sewer Plant at 6:00PM-limited spaces so please RSVP if you are interested) and Tuesday, July 19th,. Both of these meetings are being held at the Senior Center @ 7:00 PM. Although I understand you currently are connected to a septic system you pose a significant number of questions regarding our proposed sewer rate increase affecting our sewer rate payers and we are hopeful you are interested in connecting to our sewer system at some future date. Please see the City's responses in red below. If you have further questions, please bring them to a future public forum. Thank you for becoming involved in this important issue for the City and I trust the below responses are helpful in better understanding the need for an increase in our sewer rates. We hope you are able to attend one of the upcoming public meetings or hearings. Thank you. Londi Lindell

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From: mthomas@bangstick.net [mthomas@bangstick.net]
Sent: Thursday, June 23, 2016 12:30 AM
To: Council
Cc: Mark Rigos; Susie Oppedal
Subject: Comments and additional questions on 6/21 City Council Meeting

Dear Council Members,

Thank you for not approving the rate increase and giving more time for public Q&A and also for good additional questions.

I personally am having a hard time resolving why it is necessary to double the capacity and in such short order.

Response:
The principal driving force for doing the work at the treatment plant is repair and replacement due to the Plant being almost 70 years old and NOT to provide new capacity for new homes as you have suggested during your testimony and throughout this email. There are no new capacity improvements being made during the 5 year capital improvements. There is existing unallocated capacity at the Sewer Plant. The capacity element is a consequence of the currently unused or

unallocated capacity of the plant that will benefit from implementation of the capital improvement plan.

This seems far out of line with our existing population and residential property growth, even the City's own comprehensive plan and UGA requirements would not use all the capacity growth proposed (+771 residences/1982 people) to *2035*.

Response:
As the City grows, there will be an increase in residential population but also growth in the commercial sector. Wastewater derived from the commercial represents about 30% of the existing capacity needs for wastewater treatment. Currently there are about 2150 people living in residences (~836 ERUs) within the City who are on private on-site septic systems such as yourself that are not connected to the City's wastewater collection and treatment system. In 2036 it is estimated that there will only be 420 residents (163 ERUs) within the City that will remain on private on-site septic systems. As King County Public Health adopts more stringent regulations on septic and as pollution control laws and Growth Management laws requires cities' to deliver urban sewer services, existing septic systems will eventually be eliminated within urban growth areas. This is set forth in state law and is consistent with the Growth Management Act.

The city leadership regularly cite the need to support the UGA and required growth as justification for development, the city needs to explain why then it is NOT following its own comprehensive plan and overbuilding capacity.

Response:
The City is following its own Comprehensive Plan and is not "overbuilding". You have made estimates that this plan allows for over 11,000+ additional homes or persons to move to our town based upon the available ERUs and this is incorrect. The 5-Year Wastewater CIP plan that the proposed rate increase is based upon is consistent with the City comprehensive plan. The rate model estimates growth of approximately 100 new homes a year during the next 5 years. Based on the growth model in the wastewater facility plan and the City's comprehensive plan, additional or new "capacity" improvements at the treatment plant will not be required until 2029. Again the work identified in the 5 year CIP for the years 2016 -2020 are needed to allow the existing treatment plant *to reliably and consistently at a level that will assure compliance the City's NPDES discharge permit* because it's a 70 year old sewer plant**. Only about half of the existing plant capacity is allocated** so improvements aren't needed to add capacity at this time. Capital Costs associated with the unallocated portion of the plant will be recovered from development through a connection or hookup fee charged when a new home connects to the system which is also called the General Facilities Charge (GFC).

Has the city considered plans that do not double capacity?

Response:
Again, your assumption is incorrect - The 5-year plan does not double the existing plant capacity it only allows the existing rated capacity of the plant to be used and allows the Plant to function in compliance with our permit.

Has the city considered plans that decrease load? (such as by encouraging and providing $ to residents and businesses to install low flow fixtures, water conserving toilets, front-loading washing machines, commercial dishwashing water recycling systems, etc.)?

Response:

Reducing the hydraulic load discharge by any specific class of user through water conservation would not eliminate the need or significantly reduce the costs for the 5 year capital improvement plan. The reason for this is because of the high amount of extraneous flow that enters the wastewater collection system due to inflow and infiltration because the collection system is also almost 70 years old so there are many cracks and breaks in the lines so we have a problem called I & I or inflow and infiltration. Inflow and infiltration is the dominate factor in determining the required hydraulic capacity of the plant. *On an annual basis more than half of the wastewater conveyed and treatment by the North Bend Wastewater Facilities is attributable to I&I. During a severe rainfall/snow melt event such as that experienced in November and December 2015, I&I accounted for over 85% of the daily hydraulic flow (load) conveyed and treated by the City's wastewater facilities.* Even with this high amount of I&I it remains cost effective to enhance the existing treatment plant as compared to cost and difficulty of implementing corrective action including replacement of private side sewers.

How about the unthinkable... that the city needs to allow septic systems to avoid increased loading and to encourage people on OSS to stay on them longer. (Septic users consume no capacity). There are still properties more than 200 ft. from city sewer that are blocked from adding OSS.

Response:
As mentioned above, that is not allowed by state law. The City of North Bend is within an UGA and is mandated to deliver urban services such as water and sewer. As such we do not allow new septic systems with new construction in order to avoid pollution of rivers and water drinking sources. Further, most of North Bend is in the flood plain and is characterized by groundwater at or slightly below the ground surface during extended wet weather conditions. Under these conditions, a conventional septic tank drain field does not provide the necessary treatment to protect the environment and the public health and safety.

FCS' testimony at the 6/21 hearing indicated ratepayers would be paying $3.4M as a result of capacity expansion.

Response:
Existing rate payers will be responsible for paying their fair share of the 5 year capital improvement program for permit compliance, redundancy, etc which is around that $3.4M figure. The balance of the costs for implementing the improvements will be paid by future development.

If I'm not mistaken rate increases cannot be used to pay for capacity expansion, only maintenance, repair, and upkeep. Isn't using funds marked for O&M/repair an unlawful use when those funds are used for capacity expansion? Folks need to go back and propose additional revenues related to new development... higher new development charges to pay for such. In any case it is not following the philosophy of "growth pay for growth".

Response:
The program does require growth to pay for growth. The need for implementing the 5 year capital improvement plan is not growth as stated earlier. Cost associated with implementation of the 5 year capital improvement plan that are associated with the current unallocated capacity of the existing plant will be recovered through the GFCs. The faster development occurs the faster the City can recover capital for the existing plant improvements through developer paid GFCs and new city sewer customers through payment of monthly sewer rates.

I also have additional questions regarding the assumptions on revenues. Mark's reply to me indicated that rainy season water consumption was used as the basis for rate increases. It is common sense that many residential users will increase their consumption in the summer to maintain their homes lawns and to garden/grow food--certainly in line with "preserving the rural character of North Bend". Wouldn't a rate design that assumes winter usage of water overshoot and collect too much money during summer months? I'd like to get more details as to the design of the rate increase and revenue projections to ensure that we've looked at multi-year consumption... at least a full 12 months or more (certainly there are fluctuations for dry and wet years)... considering North Bend is asking for an astronomical rate increase folks seriously need to examine how to bring down the increase.

Response:
The City uses the average monthly water consumption rate during the period of November through March to establish the average daily sewage flow for the "drier" months of the year, April through October). Actual residential water consumption from April through October does not come into the equation for computation of sewer rates or calculation of the sewer bill. The monthly residential sewer bill for the months of April through October is equal to the average of the preceding 5 months of sewer bills during "wet weather" (November through March).

Both myself and another citizen at the meeting proposed an alternative sewer consumption charging structure... one proposed a flat rate for residents, I had proposed basing sewer charges on winter consumption. Certainly the winter strategy incents conservation... people are incented to reduce household water use during winter months--and that is usage that does go into city sewer and at the worst time, rainy season where inflows are highest due to water leaking into the system or improper drainage connections to sewer.

Response:
The City's prior sewer rate was based upon a flat rate but a flat rate fees does not encourage water or wastewater conservation, which are key objectives identified by the City Council. A volume based fee that is constant or increases concomitant with increased consumption/discharge encourages conservation. The proposed rate structure is volume based with a constant volume charge.

I'd also ask that the city examine other ways of paying for new development aside from GFC. Homes that are on septic at some point will be going to city sewer and simply increasing the GFCs makes migration to sewer even less attractive... and even major repairs are apt to cost less than a $10k GFC (and that's before considering another $10k-$25k or more for a resident to connect from their home to the city sewer connection)... and then the resident has another $100 or more in sewer consumption charges they did not have before (relative to pumping every 3-5 years at $750 plus occasional maintenance costs, screen cleans and miscellaneous repairs). Did not Silver Creek just reject city sewer? What is the city doing to make connecting to sewer a more attractive option?

Response:
The City can apply for grant and loan funding from the Washington State Department of Ecology to reduce sewer rate increases associated with extending city sewer into existing neighborhood not currently served by the City's wastewater collection system. Centennial Clean Water Grant funds have been generally available to "buy down" the cost of the project so that the new customer's total sewer bill does not exceed 2% of the median household income. In 2015 median household income (MHI)for the Silver Creek has been reported to be $84,432. Two percent of this equates to a threshold sewer rate cost of $140.72. If the City applied and offered grant funding for the project then residents the average residential customers sewer rate would be set at 2% of the median household income. The grant would be provided to provide the necessary funds to buy down the capital obligation for the project. Also Ecology does provide additional financial aid through lowering

the interest rates on loans that result in sewer rates that are in the range of 80 to 100 percent of the sewer rate threshold (2% of MHI). However, the City's position has been that it is up to the neighborhood to decide if they wish to form a ULID to extend sewer to their neighborhood and busy City staff are not prepared to spend limited staff resources applying for such grants unless a neighborhood indicates a significant interest in such a ULID by initiating a ULID through a Petition. Although a Town Hall Meeting was conducted for the Silver Creek Community due to Ty Allen's inquiries (who I am copying on this email due to his interest in septic), the majority of homeowners who responded to the survey were not in favor of proceeding with connection to the City's sewer system in Silver Creek.

Last the upgrades/repairs and changes for "improvements" need to be examined closer to ensure there are no "shadow" capacity changes there. A good cross check is to re-run the system design "as if" no capacity changes were done and then compare the costs against the plan that increases the capacity... the difference is the cost of improvements/repairs/maintenance due to system capacity increase... and all those costs should be passed to new development.

Response:
It is essential to understand that the *improvements identified are principally replacement, repair, and additions for critical process redundancy* (e.g. the addition of a second clarifier, third UV reactor, and centrifuge) and for achieving compliance with the state biosolids regulations (i.e. , construction and operation of an aerobic digester for production of Class B Biosolids to allow for beneficial use for what currently is un-stabilized sewage sludge). In other words, even if another house was never built in North Bend our permit requires this level of redundancy for safety and compliance with current regulations.

I am also concerned with statements during the meeting that the plan/design is only "80%" done. So what else is left and what is the risk the costs go up?

Response:
The proposed rate increases are based on planning level estimates. Actual costs will vary but should be generally covered within +/- 30% of the estimated cost. Estimated costs are generally updated during and at the end of design phase. The construction market place sets the actual cost of construction may differ from the engineers estimate due to the cost of materials , labor and overall bidding climate at the time of bidding.

There was also a statement (I believe by the city administrator made it) that another $12-$14m in revenues will be needed for O&M to 2029... so ratepayers will be faced with that as well.... this should also be put out as the rate increases clearly won't end in 2020... that is almost as expensive as the entire improvement and capacity expansion plan being put forward now. I'd certainly like to see more details on this.

Response:
There is no capacity expansion in the 5-year Capital Improvement Plan as stated previously. Yes, operation and maintenance costs will increase over current levels because city needs to be more proactive rather than a reactive position to operating and maintaining the City's wastewater facility assets. The proposed rates include the cost for increased O&M and implementation of the 5-year capital improvement program.

I would like to understand when the system capacity changes and when we need certain levels of capacity. What capacity do we need and when do we need it? Perhaps present a table of the required capacity every year for the next 5-10-20 years.

Response:
Treatment plant capacity increases are not anticipated before 2029 based on the City's comprehensive plan and the draft wastewater facilities plan. Again the 5 year capital improvement program is needed to repair and replace equipment and systems that have failed or likely to fail because they have reached their design service life, and to bring the plant into compliance with the State and Federal standards for redundancy and reliability to assure compliance with the City's NPDES permit and to provide the City with the needed improvements to meet the State's Biosolids Management Regulations and General Permits for Biosolids, and to resolve nuisance odor issues associated with the plant.

Three additional suggestions given customers need notice of rate changes: 1) The new consumption rates to be included in a mailing for sewer charges and also a notice on the customer's bill of the date of the new rate plan 2) The rate plan takes effect the first billing cycle 6 months from adoption of the new rate plan. 3) Subsequent rate plan changes are spaced 12 months from the bill the first rate increase occurs.

On outreach: 1) The city needs to do a better job in social media... I see nothing wrong with a member of city government to post key announcements to popular facebook groups (such as the North Bend Political Forum or the North Bend News and Trading post)... those groups have 350 and more than 3000 members each. The city doesn't have to monitor these, only post. The city is still providing the required public notices anyway, posts are additional outreach. 2) Key facts the city wishes to highlight need to be in the email announcement not buried 80 pages in a PDF document... consider putting this information as an attachment or even better 1-3 pages as HTML in the email--consider that most people now get their email on a mobile device... reading a PDF on a mobile screen doesn't cut it 3) Simpler terms and clarity are needed... FCS presentation did little to explain this in terms the population can understand, and as well the engineering information on capacity requires some translation (perhaps to homes or population to translate treatment capacity from ERUs to something laypeople can understand). Similarly a clearer presentation of the cost of repairs/maintenance/upkeep and cost of capacity doubling. $X million for repair/upkeep/maintenance $Y million for capacity upgrade.

The City has been discussing the need for these capital improvements for 4 years at various public meetings and the need for the corresponding rate increases at various public meetings. The Capital Facilities Plan meeting describing in detail improvements you wish to discuss above was advertised and public meetings were conducted on March 15, 16 and April 26, 2016 (you incorrectly testified that this was the Silver Creek sewer meeting, which it was not). The rates were discussed in public Council Committee meetings on May 3, 11 and June 7 and 8, 2016. A public hearing before the City Council was opened on June 21st and continued until July 19th providing over a month for citizens to provide written or verbal comments to their elected officials. In addition, we added a Town Hall meeting on July 7th with our consultants and staff with an optional tour of the plant to answer questions. Finally we have posted all this information on the official City's Facebook Page, Twitter account, City's Web page, and posted official notices with the two local newspapers (Snoqualmie Valley Record and Snoqualmie Star) and the local blog (Living Snoqualmie). We also sent the notice/press release to all persons who have signed up for "Notify Me" through the official City Web Page seeking notice of City News and Highlights. The upcoming meetings are listed on the City Calendar and the press release is listed under the City's News and Highlights. We have also sent this information out to the local Yahoo Group. We have never found the utility billing notices to be an effective tool for communication particularly of upcoming meetings. We also are unwilling to start trying to distribute this information to certain private social media closed groups as you have suggested. The two Facebook groups you suggest are both closed and require membership and the City of North Bend is not a member .

Michael Thomas

-------- Original Message --------
Subject: Request to oppose city sewer rate increase
From: <mthomas@bangstick.net>
Date: Tue, June 21, 2016 4:42 pm
To: "Council" <Council@northbendwa.gov>

Dear City Council,

I believe more time is in order to understand the nature of the rate increase and why such a massive capacity increase is required in such a short order... expanding the capacity to 11.5k people seems out of order within the next 5 years, even the UGA only requires us to build an additional 771 residences (+1982 people) to 2035 in the City's own most recent comprehensive plan.

I also suspect that a good part of the improvements are not for maintenance or upgrades but are cloaks for capacity expansion and that is not an appropriate use for a rate increase.

Citizens being given only 4 business days to review the rate increase and to ask questions, come up with alternative ideas, etc. is not good governance.

I urge the council to oppose this. I am not necessarily opposed to capacity expansion or needed rate increases, Mark's numbers do indicate we are close to the existing capacity and such an expansion may be warranted... the question is how much is needed and when? Is there an alternative plan? What are the minimum necessary repairs & maintenance and what is the capacity expansion needed and when?

Michael Thomas

-------- Original Message --------
Subject: RE: Comments on Sewer Rate and GFC Increase 6/21
From: Mark Rigos <MRIGOS@NORTHBENDWA.GOV>
Date: Tue, June 21, 2016 9:56 am
To: "mthomas@bangstick.net" <mthomas@bangstick.net>, Susie Oppedal <SOPPEDAL@NORTHBENDWA.GOV>
Cc: Council <Council@northbendwa.gov>, Don DeBerg <DDEBERG@NORTHBENDWA.GOV>, Londi Lindell <LLINDELL@NORTHBENDWA.GOV>, Ken Hearing <KHEARING@NORTHBENDWA.GOV>

Hi Michael,

Thank you for providing input. Answers to your questions are as follows:

1. Yes, the rates were calculated based on a 5-month average, from November through March.

2. An Allocation Table was prepared and vetted by 4-5 licensed Professional civil engineers (PEs) by the State of Washington including 2 PhDs for allocating proportional costs into capacity or non-capacity facilities. Total cost of the 5-year improvements is estimated to be approximately $15

million. Adjustment of the current GFC rates distributes the fair costs for upgrading the currently unallocated "rated" capacity of plant.

3. The existing City wastewater facilities currently provides conveyance, treatment and disposal for about 2,300 ERUs (equivalent residential units). One ERU is by definition equal to the flow and load attributable to the average single family residence (~2.57 people). With the implementation of the 5-year capital improvement program, the City wastewater facilities will have a "true" rated capacity capable of providing reliable conveyance, treatment and disposal for 4,492 ERUs.

4. Neither me nor my consultant understand what is being asked. However, all of the improvements in the 5-year plan are needed to bring the plant up to its rated capacity. The improvements are needed to replace equipment and systems that are being operated beyond their design service life, to bring the plant into conformance with its rated capacity, current City flood management regulations, current state and federal redundancy and reliability standards, and state biosolids management regulations.

5. For irrigation meters, sewer rate charges do not apply to water used for irrigation purposes.

Hope that helps.

Sincerely,
Mark Rigos, P.E.
Public Works Director
City of North Bend
PO Box 896
1155 East North Bend Way
North Bend, WA 98045
(425) 888-7650

From: mthomas@bangstick.net [mailto:mthomas@bangstick.net]
Sent: Monday, June 20, 2016 4:05 PM
To: Susie Oppedal
Cc: Mark Rigos; Council
Subject: Comments on Sewer Rate and GFC Increase 6/21

Hello,

I am a resident of North Bend at 1231 LaForest Drive SE North Bend WA 98045 and wish to submit comments and questions for the record for the 6/21 hearing on the sewer rate and GFC increase.

I oppose the rate increase both in terms of both the general rate and GFC rate increase at this time. I would like to see an extended period for public comment on the proposal, certainly 4 business days notice of a rate increase does not provide the public sufficient time to comment on such a massive rate increase...

although the city has known about this for months (with the original notice dating to April), citizens have not had the details until last week.

I would also like to see more details as to the plans for improvements and costs differentiated by improvements versus capacity expansion. There are no details provided in the city council packet justifying the rate increase or details such that the public can understand what components are for new development versus for upgrade or repair. The city has already exceeded its UGA growth targets to 2030... it's not clear how much capacity is actually required and whether the new plan exceeds the UGA target.

I have the following questions:

1) Was "winter quarter averaging" for establishing the basis for sewer charges evaluated? Obviously summer water usage for many homeowners and property owners also includes water that is used to maintain lawns and grow food for home gardens or farms within city limits and this water does not go into the sewer system for treatment. I believe winter usage is perhaps more reflective of actual usage that is apt to require sewer treatment. I view the old rate structure of a higher base charge but a very low variable rate charge is meant to reflect this. It would make sense that the winter water usage for properties with a single meter (without a separate meter for irrigation) would be most reflective of usage that requires sewer treatment. Reducing winter water usage that requires sewer treatment during the wettest months helps reduce the volume due to people and when infiltration in the system is greatest due to aging pipes, improper drain connections, etc. I am surprised North Bend has not considered winter quarter averaging to base sewer charges on what is usage that requires treatment vs. usage that doesn't (e.g., lawncare, gardening).

Winter quarter averaging would help those owners "maintain the rural look and feel" and small town character of their properties by providing a reasonable way to charge for water usage that requires sewer treatment and to maintain their lawns and landscaping.

2) Of the rate increases to both the GFC and monthly rate structure how much is due to capacity expansion vs. not capacity expansion (e.g., upgrades or required repairs)?

3) How many single family residences does the current system support and how many residences will be supported with the proposed capacity expansions? If this changes over time please elaborate the capacity changes over time.

4) What is the minimum capacity increase required (in terms of # of single-family residences)?

5) How are charges handled for properties with a separate meter for irrigation handled? The new ordinance rate structure does not elaborate on usage for irrigation or differentiate consumption for residential use vs. irrigation.

Please include my comments and questions for the public record.

Regards
Michael Thomas

Don DeBerg

From: Ty Allan <tyallan@outlook.com>
Sent: Wednesday, June 29, 2016 8:30 AM
To: Londi Lindell
Cc: Ken Hearing; Mark Rigos; Don DeBerg; Dawn Masko; Council; mthomas@bangstick.net
Subject: RE: Comments and additional questions on 6/21 City Council Meeting

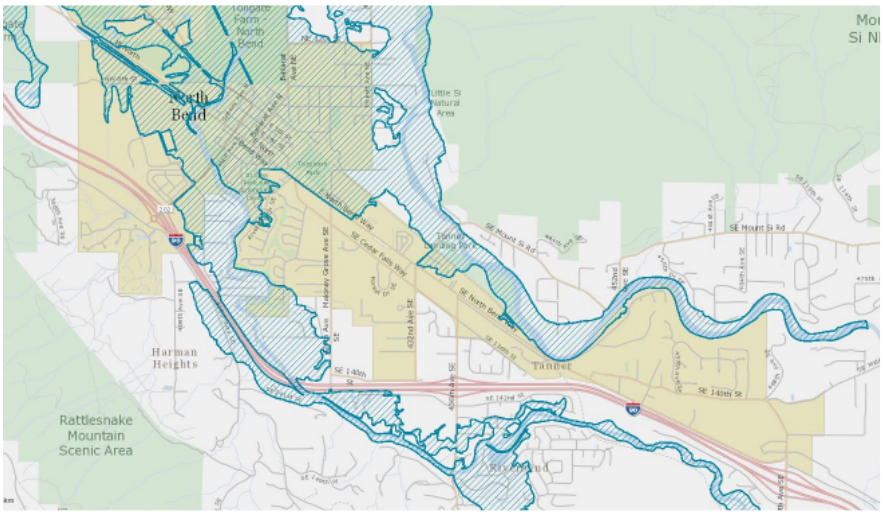
Ms Lindell,

You stated in the below email to Mr. Thomas this comment.

"As mentioned above, that is not allowed by state law. The City of North Bend is within an UGA and is mandated to deliver urban services such as water and sewer. As such we do not allow new septic systems with new construction in order to avoid pollution of rivers and water drinking sources. Further, most of North Bend is in the floodplain and is characterized by groundwater at or slightly below the ground surface during extended wet weather conditions. Under these conditions, a conventional septic tank drain field does not provide the necessary treatment to protect the environment and the public health and safety."

Can you please direct me to where in the state code or law you are referencing in the above statement? If that is so, why is King County allowed to have septic systems written into its code? In all of the conversation that I have had with the city, this is the first mention of it to be a requirement of the UGA or state code. If a city is mandated to deliver urban services like sewer why is the city not providing this infrastructure instead of passing the cost on to the residents that can not afford it. If groundwater Pollution is such an issue, why per King County code is it acceptable to have a well within 100 feet of your septic system? People have had wells next to septic systems for 100+ years, and now it's just becoming a pollution issue?

As for the Flood plain issue, isn't that quite factual. Only the Silver Creek and Downtown areas within the Fema Flood plain as shown on the map below. Where Mr. Thomas lives in not in the floodplain, as your comment could mislead someone to think all of North Bend is in a Floodplain, just rough estimation I would say that at least well over half, if not more, of the city is not in the floodplain. Surrounded by a flood plains, yes, but not in it.



In regards to your comment below about sewering Silver Creek,
"the majority of homeowners who responded to the survey were not in favor of proceeding with connection to the City's sewer system in Silver Creek"

Only 93 people were polled out of the 271 parcels in Silver Creek not on sewer. That is only 34% of the homeowners, so I would not call that a Majority. Not saying that the city is responsible for residents not participating, but still these numbers are askew.

Here were the results of the 93 residents polled:

-36% = Yes, definitely or Leaning towards yes

-44% = Leaning towards no or Definitely not

-20% = Not sure – need more information

Maybe if we got the 20% more info they needed, or even discussed it at all after the meeting then maybe it would be possible. I understand that the city does not have the resources to take these kind of polls, but If the residents are going to pay for the entire infrastructure for the city, the city could at least do its best to poll the residents to get an actual result, or at least reach out to residents to help coach on what to do to take a poll.

Regards,
Ty Allan

From: LLINDELL@NORTHBENDWA.GOV
To: mthomas@bangstick.net
CC: KHEARING@NORTHBENDWA.GOV; MRIGOS@NORTHBENDWA.GOV; DDEBERG@NORTHBENDWA.GOV; DMASKO@NORTHBENDWA.GOV; john.markus@tetratech.com; AngieS@fcsgroup.com; tyallan@outlook.com; MFOGLE@NORTHBENDWA.GOV; Council@northbendwa.gov
Subject: FW: Comments and additional questions on 6/21 City Council Meeting
Date: Wed, 29 Jun 2016 01:24:00 +0000

Mr. Thomas, your below emails to the City Council were forwarded to me and Council requested I provide responses. Please be advised that there are two additional opportunities for public comment on Thursday, July 7th (with an optional tour of our Sewer Plant at 6:00PM-limited spaces so please RSVP if you are interested) and Tuesday, July 19th,. Both of these meetings are being held at the Senior Center @ 7:00 PM. Although I understand you currently are connected to a septic system you pose a significant number of questions regarding our proposed sewer rate increase affecting our sewer rate payers and we are hopeful you are interested in connecting to our sewer system at some future date. Please see the City's responses in red below. If you have further questions, please bring them to a future public forum. Thank you for becoming involved in this important issue for the City and I trust the below responses are helpful

in better understanding the need for an increase in our sewer rates. We hope you are able to attend one of the upcoming public meetings or hearings. Thank you. Londi Lindell

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From: mthomas@bangstick.net [mthomas@bangstick.net]
Sent: Thursday, June 23, 2016 12:30 AM
To: Council
Cc: Mark Rigos; Susie Oppedal
Subject: Comments and additional questions on 6/21 City Council Meeting

Dear Council Members,

Thank you for not approving the rate increase and giving more time for public Q&A and also for good additional questions.

I personally am having a hard time resolving why it is necessary to double the capacity and in such short order.

Response:
The principal driving force for doing the work at the treatment plant is repair and replacement due to the Plant being almost 70 years old and NOT to provide new capacity for new homes as you have suggested during your testimony and throughout this email. There are no new capacity improvements being made during the 5 year capital improvements. There is existing unallocated capacity at the Sewer Plant. The capacity element is a consequence of the currently unused or unallocated capacity of the plant that will benefit from implementation of the capital improvement plan.

This seems far out of line with our existing population and residential property growth, even the City's own comprehensive plan and UGA requirements would not use all the capacity growth proposed (+771 residences/1982 people) to *2035*.

Response:
As the City grows, there will be an increase in residential population but also growth in the commercial sector. Wastewater derived from the commercial represents about 30% of the existing capacity needs for wastewater treatment. Currently there are about 2150 people living in residences (~836 ERUs) within the City who are on private on-site septic systems such as yourself that are not connected to the City's wastewater collection and treatment system. In 2036 it is estimated that there will only be 420 residents (163 ERUs) within the City that will remain on private on-site septic systems. As King County Public Health adopts more stringent regulations on septic and as pollution control laws and Growth Management laws requires cities' to deliver urban sewer services, existing septic systems will eventually be eliminated within urban growth areas. This is set forth in state law and is consistent with the Growth Management Act.

The city leadership regularly cite the need to support the UGA and required growth as justification for development, the city needs to explain why then it is NOT following its own comprehensive plan and overbuilding capacity.

Response:
The City is following its own Comprehensive Plan and is not "overbuilding". You have made estimates that this plan allows for over 11,000+ additional homes or persons to move to our town based upon the available ERUs and this is incorrect. The 5-Year Wastewater CIP plan that the proposed rate increase is based upon is consistent with the City comprehensive plan. The rate model estimates growth of approximately 100 new homes a year during the next 5 years. Based on the growth model in the wastewater facility plan and the City's comprehensive plan, additional or new "capacity" improvements at the treatment plant will not be required until 2029. Again the work identified in the 5 year CIP for the years 2016 -2020 are needed to allow the existing treatment plant *to reliably and consistently at a level that will assure compliance the City's NPDES*

discharge permit because it's a 70 year old sewer plant**. Only about half of the existing plant capacity is allocated** so improvements aren't needed to add capacity at this time. Capital Costs associated with the unallocated portion of the plant will be recovered from development through a connection or hookup fee charged when a new home connects to the system which is also called the General Facilities Charge (GFC).

Has the city considered plans that do not double capacity?

Response:
Again, your assumption is incorrect - The 5-year plan does not double the existing plant capacity it only allows the existing rated capacity of the plant to be used and allows the Plant to function in compliance with our permit.

Has the city considered plans that decrease load? (such as by encouraging and providing $ to residents and businesses to install low flow fixtures, water conserving toilets, front-loading washing machines, commercial dishwashing water recycling systems, etc.)?

Response:
Reducing the hydraulic load discharge by any specific class of user through water conservation would not eliminate the need or significantly reduce the costs for the 5 year capital improvement plan. The reason for this is because of the high amount of extraneous flow that enters the wastewater collection system due to inflow and infiltration because the collection system is also almost 70 years old so there are many cracks and breaks in the lines so we have a problem called I & I or inflow and infiltration. Inflow and infiltration is the dominate factor in determining the required hydraulic capacity of the plant. *On an annual basis more than half of the wastewater conveyed and treatment by the North Bend Wastewater Facilities is attributable to I&I. During a severe rainfall/snow melt event such as that experienced in November and December 2015, I&I accounted for over 85% of the daily hydraulic flow (load) conveyed and treated by the City's wastewater facilities.* Even with this high amount of I&I it remains cost effective to enhance the existing treatment plant as compared to cost and difficulty of implementing corrective action including replacement of private side sewers.

How about the unthinkable... that the city needs to allow septic systems to avoid increased loading and to encourage people on OSS to stay on them longer. (Septic users consume no capacity). There are still properties more than 200 ft. from city sewer that are blocked from adding OSS.

Response:
As mentioned above, that is not allowed by state law. The City of North Bend is within an UGA and is mandated to deliver urban services such as water and sewer. As such we do not allow new septic systems with new construction in order to avoid pollution of rivers and water drinking sources. Further, most of North Bend is in the flood plain and is characterized by groundwater at or slightly below the ground surface during extended wet weather conditions. Under these conditions, a conventional septic tank drain field does not provide the necessary treatment to protect the environment and the public health and safety.

FCS' testimony at the 6/21 hearing indicated ratepayers would be paying $3.4M as a result of capacity expansion.

Response:
Existing rate payers will be responsible for paying their fair share of the 5 year capital improvement program for permit compliance, redundancy, etc which is around that $3.4M figure. The balance of the costs for implementing the improvements will be paid by future development.

If I'm not mistaken rate increases cannot be used to pay for capacity expansion, only maintenance, repair, and upkeep. Isn't using funds marked for O&M/repair an unlawful use when those funds are used for capacity expansion? Folks need to go back and propose additional revenues related to new development... higher new development charges to pay for such. In any case it is not following the philosophy of "growth pay for growth".

Response:
The program does require growth to pay for growth. The need for implementing the 5 year capital improvement plan is not growth as stated earlier. Cost associated with implementation of the 5 year capital improvement plan that are associated with the current unallocated capacity of the existing plant will be recovered through the GFCs. The faster development occurs the faster the City can recover capital for the existing plant improvements through developer paid GFCs and new city sewer customers through payment of monthly sewer rates.

I also have additional questions regarding the assumptions on revenues. Mark's reply to me indicated that rainy season water consumption was used as the basis for rate increases. It is common sense that many residential users will increase their consumption in the summer to maintain their homes lawns and to garden/grow food--certainly in line with "preserving the rural character of North Bend". Wouldn't a rate design that assumes winter usage of water overshoot and collect too much money during summer months? I'd like to get more details as to the design of the rate increase and revenue projections to ensure that we've looked at multi-year consumption... at least a full 12 months or more (certainly there are fluctuations for dry and wet years)... considering North Bend is asking for an astronomical rate increase folks seriously need to examine how to bring down the increase.

Response:
The City uses the average monthly water consumption rate during the period of November through March to establish the average daily sewage flow for the “drier” months of the year, April through October). Actual residential water consumption from April through October does not come into the equation for computation of sewer rates or calculation of the sewer bill. The monthly residential sewer bill for the months of April through October is equal to the average of the preceding 5 months of sewer bills during “wet weather” (November through March).

Both myself and another citizen at the meeting proposed an alternative sewer consumption charging structure... one proposed a flat rate for residents, I had proposed basing sewer charges on winter consumption. Certainly the winter strategy incents conservation... people are incented to reduce household water use during winter months--and that is usage that does go into city sewer and at the worst time, rainy season where inflows are highest due to water leaking into the system or improper drainage connections to sewer.

Response:
The City’s prior sewer rate was based upon a flat rate but a flat rate fees does not encourage water or wastewater conservation, which are key objectives identified by the City Council. A volume based fee that is constant or increases concomitant with increased consumption/discharge encourages conservation. The proposed rate structure is volume based with a constant volume charge.

I'd also ask that the city examine other ways of paying for new development aside from GFC. Homes that are on septic at some point will be going to city sewer and simply increasing the GFCs makes migration to sewer even less attractive... and even major repairs are apt to cost less than a $10k GFC (and that's before considering another $10k-$25k or more for a resident to connect from their home to the city sewer connection)... and then the resident has another $100 or more in sewer consumption charges they did not have before (relative to pumping every 3-5 years at $750 plus occasional maintenance costs, screen cleans and miscellaneous repairs). Did not Silver Creek just reject city sewer? What is the city doing to make connecting to sewer a more attractive option?

Response:
The City can apply for grant and loan funding from the Washington State Department of Ecology to reduce sewer rate increases associated with extending city sewer into existing neighborhood not currently served by the City's wastewater collection system. Centennial Clean Water Grant funds have been generally available to "buy down" the cost of the project so that the new customer's total sewer bill does not exceed 2% of the median household income. In 2015 median household income (MHI)for the Silver Creek has been reported to be $84,432. Two percent of this equates to a threshold sewer rate cost of $140.72. If the City applied and offered grant funding for the project then residents the average residential customers sewer rate would be set at 2% of the median household income. The grant would be provided to provide the necessary funds to buy down the capital obligation for the project. Also Ecology does provide additional financial aid through lowering the interest rates on loans that result in sewer rates that are in the range of 80 to 100 percent of the sewer rate threshold (2% of MHI). However, the City's position has been that it is up to the neighborhood to decide if they wish to form a ULID to extend sewer to their neighborhood and busy City staff are not prepared to spend limited staff resources applying for such grants unless a neighborhood indicates a significant interest in such a ULID by initiating a ULID through a Petition. Although a Town Hall Meeting was conducted for the Silver Creek Community due to Ty Allen's inquiries (who I am copying on this email due to his interest in septic), the majority of homeowners who responded to the survey were not in favor of proceeding with connection to the City's sewer system in Silver Creek.

Last the upgrades/repairs and changes for "improvements" need to be examined closer to ensure there are no "shadow" capacity changes there. A good cross check is to re-run the system design "as if" no capacity changes were done and then compare the costs against the plan that increases the capacity... the difference is the cost of improvements/repairs/maintenance due to system capacity increase... and all those costs should be passed to new development.

Response:
It is essential to understand that the *improvements identified are principally replacement, repair, and additions for critical process redundancy* (e.g. the addition of a second clarifier, third UV reactor, and centrifuge) and for achieving compliance with the state biosolids regulations (i.e. , construction and operation of an aerobic digester for production of Class B Biosolids to allow for beneficial use for what currently is un-stabilized sewage sludge). In other words, even if another house was never built in North Bend our permit requires this level of redundancy for safety and compliance with current regulations.

I am also concerned with statements during the meeting that the plan/design is only "80%" done. So what else is left and what is the risk the costs go up?

Response:
The proposed rate increases are based on planning level estimates. Actual costs will vary but should be generally covered within +/- 30% of the estimated cost. Estimated costs are generally updated during and at the end of design phase. The construction market place sets the actual cost of construction may differ from the engineers estimate due to the cost of materials , labor and overall bidding climate at the time of bidding.

There was also a statement (I believe by the city administrator made it) that another $12-$14m in revenues will be needed for O&M to 2029... so ratepayers will be faced with that as well.... this should also be put out as the rate increases clearly won't end in 2020... that is almost as expensive as the entire improvement and capacity expansion plan being put forward now. I'd certainly like to see more details on this.

Response:
There is no capacity expansion in the 5-year Capital Improvement Plan as stated previously. Yes, operation and maintenance costs will increase over current levels because city needs to be more proactive rather than a

reactive position to operating and maintaining the City's wastewater facility assets. The proposed rates include the cost for increased O&M and implementation of the 5-year capital improvement program.

I would like to understand when the system capacity changes and when we need certain levels of capacity. What capacity do we need and when do we need it? Perhaps present a table of the required capacity every year for the next 5-10-20 years.

Response:
Treatment plant capacity increases are not anticipated before 2029 based on the City's comprehensive plan and the draft wastewater facilities plan. Again the 5 year capital improvement program is needed to repair and replace equipment and systems that have failed or likely to fail because they have reached their design service life, and to bring the plant into compliance with the State and Federal standards for redundancy and reliability to assure compliance with the City's NPDES permit and to provide the City with the needed improvements to meet the State's Biosolids Management Regulations and General Permits for Biosolids, and to resolve nuisance odor issues associated with the plant.

Three additional suggestions given customers need notice of rate changes: 1) The new consumption rates to be included in a mailing for sewer charges and also a notice on the customer's bill of the date of the new rate plan 2) The rate plan takes effect the first billing cycle 6 months from adoption of the new rate plan. 3) Subsequent rate plan changes are spaced 12 months from the bill the first rate increase occurs.

On outreach: 1) The city needs to do a better job in social media... I see nothing wrong with a member of city government to post key announcements to popular facebook groups (such as the North Bend Political Forum or the North Bend News and Trading post)... those groups have 350 and more than 3000 members each. The city doesn't have to monitor these, only post. The city is still providing the required public notices anyway, posts are additional outreach. 2) Key facts the city wishes to highlight need to be in the email announcement not buried 80 pages in a PDF document... consider putting this information as an attachment or even better 1-3 pages as HTML in the email--consider that most people now get their email on a mobile device... reading a PDF on a mobile screen doesn't cut it 3) Simpler terms and clarity are needed... FCS presentation did little to explain this in terms the population can understand, and as well the engineering information on capacity requires some translation (perhaps to homes or population to translate treatment capacity from ERUs to something laypeople can understand). Similarly a clearer presentation of the cost of repairs/maintenance/upkeep and cost of capacity doubling. $X million for repair/upkeep/maintenance $Y million for capacity upgrade.

The City has been discussing the need for these capital improvements for 4 years at various public meetings and the need for the corresponding rate increases at various public meetings. The Capital Facilities Plan meeting describing in detail improvements you wish to discuss above was advertised and public meetings were conducted on March 15, 16 and April 26, 2016 (you incorrectly testified that this was the Silver Creek sewer meeting, which it was not). The rates were discussed in public Council Committee meetings on May 3, 11 and June 7 and 8, 2016. A public hearing before the City Council was opened on June 21st and continued until July 19th providing over a month for citizens to provide written or verbal comments to their elected officials. In addition, we added a Town Hall meeting on July 7th with our consultants and staff with an optional tour of the plant to answer questions. Finally we have posted all this information on the official City's Facebook Page, Twitter account, City's Web page, and posted official notices with the two local newspapers (Snoqualmie Valley Record and Snoqualmie Star) and the local blog (Living Snoqualmie). We also sent the notice/press release to all persons who have signed up for "Notify Me" through the official City Web Page seeking notice of City News and Highlights. The upcoming meetings are listed on the City Calendar and the press release is listed under the City's News and Highlights. We have also sent this information out to the local Yahoo Group. We have never found the utility billing notices to be an effective tool for communication particularly of upcoming meetings. We also are unwilling to start trying to distribute this information to

certain private social media closed groups as you have suggested. The two Facebook groups you suggest are both closed and require membership and the City of North Bend is not a member .

Michael Thomas

> -------- Original Message --------
> Subject: Request to oppose city sewer rate increase
> From: <mthomas@bangstick.net>
> Date: Tue, June 21, 2016 4:42 pm
> To: "Council" <Council@northbendwa.gov>
> Dear City Council,
>
> I believe more time is in order to understand the nature of the rate increase and why such a massive capacity increase is required in such a short order... expanding the capacity to 11.5k people seems out of order within the next 5 years, even the UGA only requires us to build an additional 771 residences (+1982 people) to 2035 in the City's own most recent comprehensive plan.
>
> I also suspect that a good part of the improvements are not for maintenance or upgrades but are cloaks for capacity expansion and that is not an appropriate use for a rate increase.
>
> Citizens being given only 4 business days to review the rate increase and to ask questions, come up with alternative ideas, etc. is not good governance.
>
> I urge the council to oppose this. I am not necessarily opposed to capacity expansion or needed rate increases, Mark's numbers do indicate we are close to the existing capacity and such an expansion may be warranted... the question is how much is needed and when? Is there an alternative plan? What are the minimum necessary repairs & maintenance and what is the capacity expansion needed and when?
>
> Michael Thomas
>
> > -------- Original Message --------
> > Subject: RE: Comments on Sewer Rate and GFC Increase 6/21
> > From: Mark Rigos <MRIGOS@NORTHBENDWA.GOV>
> > Date: Tue, June 21, 2016 9:56 am
> > To: "mthomas@bangstick.net" <mthomas@bangstick.net>, Susie Oppedal <SOPPEDAL@NORTHBENDWA.GOV>
> > Cc: Council <Council@northbendwa.gov>, Don DeBerg <DDEBERG@NORTHBENDWA.GOV>, Londi Lindell <LLINDELL@NORTHBENDWA.GOV>, Ken Hearing <KHEARING@NORTHBENDWA.GOV>
> > Hi Michael,
> >
> > Thank you for providing input. Answers to your questions are as follows:
> >
> > 1. Yes, the rates were calculated based on a 5-month average, from November through March.
> >
> > 2. An Allocation Table was prepared and vetted by 4-5 licensed Professional civil engineers (PEs) by the State of Washington including 2 PhDs for allocating proportional costs into capacity or non-capacity

facilities. Total cost of the 5-year improvements is estimated to be approximately $15 million. Adjustment of the current GFC rates distributes the fair costs for upgrading the currently unallocated "rated" capacity of plant.

3. The existing City wastewater facilities currently provides conveyance, treatment and disposal for about 2,300 ERUs (equivalent residential units). One ERU is by definition equal to the flow and load attributable to the average single family residence (~2.57 people). With the implementation of the 5-year capital improvement program, the City wastewater facilities will have a "true" rated capacity capable of providing reliable conveyance, treatment and disposal for 4,492 ERUs.

4. Neither me nor my consultant understand what is being asked. However, all of the improvements in the 5-year plan are needed to bring the plant up to its rated capacity. The improvements are needed to replace equipment and systems that are being operated beyond their design service life, to bring the plant into conformance with its rated capacity, current City flood management regulations, current state and federal redundancy and reliability standards, and state biosolids management regulations.

5. For irrigation meters, sewer rate charges do not apply to water used for irrigation purposes.

Hope that helps.

Sincerely,
Mark Rigos, P.E.
Public Works Director
City of North Bend
PO Box 896
1155 East North Bend Way
North Bend, WA 98045
(425) 888-7650

From: mthomas@bangstick.net [mailto:mthomas@bangstick.net]
Sent: Monday, June 20, 2016 4:05 PM
To: Susie Oppedal
Cc: Mark Rigos; Council
Subject: Comments on Sewer Rate and GFC Increase 6/21

Hello,

I am a resident of North Bend at 1231 LaForest Drive SE North Bend WA 98045 and wish to submit comments and questions for the record for the 6/21 hearing on the sewer rate and GFC increase.

I oppose the rate increase both in terms of both the general rate and GFC rate increase at this time. I would like to see an extended period for public

comment on the proposal, certainly 4 business days notice of a rate increase does not provide the public sufficient time to comment on such a massive rate increase... although the city has known about this for months (with the original notice dating to April), citizens have not had the details until last week.

I would also like to see more details as to the plans for improvements and costs differentiated by improvements versus capacity expansion. There are no details provided in the city council packet justifying the rate increase or details such that the public can understand what components are for new development versus for upgrade or repair. The city has already exceeded its UGA growth targets to 2030... it's not clear how much capacity is actually required and whether the new plan exceeds the UGA target.

I have the following questions:

1) Was "winter quarter averaging" for establishing the basis for sewer charges evaluated? Obviously summer water usage for many homeowners and property owners also includes water that is used to maintain lawns and grow food for home gardens or farms within city limits and this water does not go into the sewer system for treatment. I believe winter usage is perhaps more reflective of actual usage that is apt to require sewer treatment. I view the old rate structure of a higher base charge but a very low variable rate charge is meant to reflect this. It would make sense that the winter water usage for properties with a single meter (without a separate meter for irrigation) would be most reflective of usage that requires sewer treatment. Reducing winter water usage that requires sewer treatment during the wettest months helps reduce the volume due to people and when infiltration in the system is greatest due to aging pipes, improper drain connections, etc. I am surprised North Bend has not considered winter quarter averaging to base sewer charges on what is usage that requires treatment vs. usage that doesn't (e.g., lawncare, gardening).

Winter quarter averaging would help those owners "maintain the rural look and feel" and small town character of their properties by providing a reasonable way to charge for water usage that requires sewer treatment and to maintain their lawns and landscaping.

2) Of the rate increases to both the GFC and monthly rate structure how much is due to capacity expansion vs. not capacity expansion (e.g., upgrades or required repairs)?

3) How many single family residences does the current system support and how many residences will be supported with the proposed capacity expansions? If this changes over time please elaborate the capacity changes over time.

4) What is the minimum capacity increase required (in terms of # of single-family residences)?

5) How are charges handled for properties with a separate meter for irrigation handled? The new ordinance rate structure does not elaborate on usage for irrigation or differentiate consumption for residential use vs. irrigation.

Please include my comments and questions for the public record.

Regards
Michael Thomas

Don DeBerg

From: Londi Lindell
Sent: Wednesday, June 29, 2016 1:31 PM
To: Ty Allan
Cc: Ken Hearing; Mark Rigos; Don DeBerg; Dawn Masko; Council; Carrie Lee
Subject: RE: Comments and additional questions on 6/21 City Council Meeting

Ty, I would encourage you to come to the public forum if you have further questions. However, I will briefly answer your questions.

Cities and counties are treated differently regarding the installation of new septic systems due to a state law called the Growth Management Act – what you often hear people refer to as the "GMA". This law was codified in 1990s and was adopted in an effort to stop sprawl and intensify growth in certain areas called urban growth areas or UGAs and slow growth in unincorporated counties. Thus, there are rules for rural counties under GMA and different rules for cities. North Bend is within an UGA and is a city. King County is obviously a county under the GMA. See Chapter 36.70A RCW. The specific laws regarding the requirements to deliver water and sewer are based upon RCW 36.70A.110(4) and various case law interpreting what "urban government services" and the delivery thereof means. For example, cities have been prohibited from extending their sewer lines outside of these UGAs into rural unincorporated counties because this has been deemed a violation of GMA. Similarly, cities are required to deliver this higher level of urban services by having sewer systems once they are within a UGA.

In response to your question as to why the city is passing the cost on to the residents if the city is mandated to provide sewer, I direct you to Chapter 35.67RCW. This is a state law that describes the formation of sewer utilities. A sewer utility is an enterprise fund which basically means it must be self supporting – the rate payers or users must fully pay for it. Thus, the "city" or general fund cannot pay to extend this service to your neighborhood. The other taxpayers cannot subsidize the delivery of this service to your neighborhood because this violates this type of enterprise fund. This is why you will need to get your neighbors to agree to a Local Improvement District or other financing tool in order to deliver sewer to your neighborhood. I did send that last email to you because there are in fact grants available which we think your neighborhood could be good candidates for but as a starting point you would need to get at least 60% of your owners to agree with you that this is something they want to pursue.

My statements below regarding a "majority" of Silver Creek neighbors not being interested in proceeding with sewer was in reference to those *attending the public meeting Ty and filling out the survey.* If you are interested in determining the sentiment of the entire neighborhood I understand Mark Rigos has suggested and I will again suggest that a logical next step is to get a group of interested neighbors together to start going door to door and collecting signatures on a Petition for a ULID. I am copying Carrie Lee as we either have a Petition Form at Public Works or we would be happy to ask our City Attorney to assist you in getting such a form together if you are interested in undertaking this work to ascertain the interest of your entire neighborhood. You know the City supports your neighborhood connecting to our sewer system but we simply don't have the staff resources to do this work for you. Good luck.

From: Ty Allan [mailto:tyallan@outlook.com]
Sent: Wednesday, June 29, 2016 8:30 AM
To: Londi Lindell
Cc: Ken Hearing; Mark Rigos; Don DeBerg; Dawn Masko; Council; mthomas@bangstick.net
Subject: RE: Comments and additional questions on 6/21 City Council Meeting

Ms Lindell,

You stated in the below email to Mr. Thomas this comment.

"As mentioned above, that is not allowed by state law. The City of North Bend is within an UGA and is mandated to deliver urban services such as water and sewer. As such we do not allow new septic systems with new construction in order to avoid pollution of rivers and water drinking sources. Further, most of North Bend is in the floodplain and is characterized by groundwater at or slightly below the ground surface during extended wet weather conditions. Under these conditions, a conventional septic tank drain field does not provide the necessary treatment to protect the environment and the public health and safety."

Can you please direct me to where in the state code or law you are referencing in the above statement? If that is so, why is King County allowed to have septic systems written into its code? In all of the conversation that I have had with the city, this is the first mention of it to be a requirement of the UGA or state code. If a city is mandated to deliver urban services like sewer why is the city not providing this infrastructure instead of passing the cost on to the residents that can not afford it. If groundwater Pollution is such an issue, why per King County code is it acceptable to have a well within 100 feet of your septic system? People have had wells next to septic systems for 100+ years, and now it's just becoming a pollution issue?

As for the Flood plain issue, isn't that quite factual. Only the Silver Creek and Downtown areas within the Fema Flood plain as shown on the map below. Where Mr. Thomas lives in not in the floodplain, as your comment could mislead someone to think all of North Bend is in a Floodplain, just rough estimation I would say that at least well over half, if not more, of the city is not in the floodplain. Surrounded by a flood plains, yes, but not in it.

In regards to your comment below about sewering Silver Creek,
"the majority of homeowners who responded to the survey were not in favor of proceeding with connection to the City's sewer system in Silver Creek"

Only 93 people were polled out of the 271 parcels in Silver Creek not on sewer. That is only 34% of the homeowners, so I would not call that a Majority. Not saying that the city is responsible for residents not participating, but still these numbers are askew.

Here were the results of the 93 residents polled:

-36% = Yes, definitely or Leaning towards yes

-44% = Leaning towards no or Definitely not

-20% = Not sure – need more information

Maybe if we got the 20% more info they needed, or even discussed it at all after the meeting then maybe it would be possible. I understand that the city does not have the resources to take these kind of polls, but If the residents are going to pay for the entire infrastructure for the city, the city could at least do its best to poll the residents to get an actual result, or at least reach out to residents to help coach on what to do to take a poll.

Regards,
Ty Allan

From: LLINDELL@NORTHBENDWA.GOV
To: mthomas@bangstick.net
CC: KHEARING@NORTHBENDWA.GOV; MRIGOS@NORTHBENDWA.GOV; DDEBERG@NORTHBENDWA.GOV; DMASKO@NORTHBENDWA.GOV; john.markus@tetratech.com; AngieS@fcsgroup.com; tyallan@outlook.com; MFOGLE@NORTHBENDWA.GOV; Council@northbendwa.gov
Subject: FW: Comments and additional questions on 6/21 City Council Meeting
Date: Wed, 29 Jun 2016 01:24:00 +0000

Mr. Thomas, your below emails to the City Council were forwarded to me and Council requested I provide responses. Please be advised that there are two additional opportunities for public comment on Thursday, July 7th (with an optional tour of our Sewer Plant at 6:00PM-limited spaces so please RSVP if you are interested) and Tuesday, July 19th,. Both of these meetings are being held at the Senior Center @ 7:00 PM. Although I understand you currently are connected to a septic system you pose a significant number of questions regarding our proposed sewer rate increase affecting our sewer rate payers and we are hopeful you are interested in connecting to our sewer system at some future date. Please see the City's responses in red below. If you have further questions, please bring them to a future public forum. Thank you for becoming involved in this important issue for the City and I trust the below responses are helpful in better understanding the need for an increase in our sewer rates. We hope you are able to attend one of the upcoming public meetings or hearings. Thank you. Londi Lindell

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From: mthomas@bangstick.net [mthomas@bangstick.net]
Sent: Thursday, June 23, 2016 12:30 AM
To: Council
Cc: Mark Rigos; Susie Oppedal
Subject: Comments and additional questions on 6/21 City Council Meeting
Dear Council Members,

Thank you for not approving the rate increase and giving more time for public Q&A and also for good additional questions.

I personally am having a hard time resolving why it is necessary to double the capacity and in such short order.

Response:
The principal driving force for doing the work at the treatment plant is repair and replacement due to the Plant being almost 70 years old and NOT to provide new capacity for new homes as you have suggested during your testimony and throughout this email. There are no new capacity improvements being made during the 5 year capital improvements. There is existing unallocated capacity at the Sewer Plant. The capacity element is a consequence of the currently unused or unallocated capacity of the plant that will benefit from implementation of the capital improvement plan.

This seems far out of line with our existing population and residential property growth, even the City's own comprehensive plan and UGA requirements would not use all the capacity growth proposed (+771 residences/1982 people) to *2035*.

Response:
As the City grows, there will be an increase in residential population but also growth in the commercial sector. Wastewater derived from the commercial represents about 30% of the existing capacity needs for wastewater treatment. Currently there are about 2150 people living in residences (~836 ERUs) within the City who are on private on-site septic systems such as yourself that are not connected to the City's wastewater collection and treatment system. In 2036 it is estimated that there will only be 420 residents (163 ERUs) within the City that will remain on private on-site septic systems. As King County Public Health adopts more stringent regulations on septic and as pollution control laws and Growth Management laws requires cities' to deliver urban sewer services, existing septic systems will eventually be eliminated within urban growth areas. This is set forth in state law and is consistent with the Growth Management Act.

The city leadership regularly cite the need to support the UGA and required growth as justification for development, the city needs to explain why then it is NOT following its own comprehensive plan and overbuilding capacity.

Response:
The City is following its own Comprehensive Plan and is not "overbuilding". You have made estimates that this plan allows for over 11,000+ additional homes or persons to move to our town based upon the available ERUs and this is incorrect. The 5-Year Wastewater CIP plan that the proposed rate increase is based upon is consistent with the City comprehensive plan. The rate model estimates growth of approximately 100 new homes a year during the next 5 years. Based on the growth model in the wastewater facility plan and the City's comprehensive plan, additional or new "capacity" improvements at the treatment plant will not be required until 2029. Again the work identified in the 5 year CIP for the years 2016 -2020 are needed to allow the existing treatment plant *to reliably and consistently at a level that will assure compliance the City's NPDES discharge permit* because it's a 70 year old sewer plant**. Only about half of the existing plant capacity is allocated** so improvements aren't needed to add capacity at this time. Capital Costs associated with the unallocated portion of the plant will be recovered from development through a connection or hookup fee charged when a new home connects to the system which is also called the General Facilities Charge (GFC).

Has the city considered plans that do not double capacity?

Response:
Again, your assumption is incorrect - The 5-year plan does not double the existing plant capacity it only allows the existing rated capacity of the plant to be used and allows the Plant to function in compliance with our permit.

Has the city considered plans that decrease load? (such as by encouraging and providing $ to residents and businesses to install low flow fixtures, water conserving toilets, front-loading washing machines, commercial dishwashing water recycling systems, etc.)?

Response:
Reducing the hydraulic load discharge by any specific class of user through water conservation would not eliminate the need or significantly reduce the costs for the 5 year capital improvement plan. The reason for this is because of the high amount of extraneous flow that enters the wastewater collection system due to inflow and infiltration because the collection system is also almost 70 years old so there are many cracks and breaks in the lines so we have a problem called I & I or inflow and infiltration. Inflow and infiltration is the dominate factor in determining the required hydraulic capacity of the plant. *On an annual basis more than half of the wastewater conveyed and treatment by the North Bend Wastewater Facilities is attributable to I&I. During a severe rainfall/snow melt event such as that experienced in November and December 2015, I&I accounted for over 85% of the daily hydraulic flow (load) conveyed and treated by the City's wastewater facilities.* Even with this high amount of I&I it remains cost effective to enhance the existing treatment plant as compared to cost and difficulty of implementing corrective action including replacement of private side sewers.

How about the unthinkable... that the city needs to allow septic systems to avoid increased loading and to encourage people on OSS to stay on them longer. (Septic users consume no capacity). There are still properties more than 200 ft. from city sewer that are blocked from adding OSS.

Response:
As mentioned above, that is not allowed by state law. The City of North Bend is within an UGA and is mandated to deliver urban services such as water and sewer. As such we do not allow new septic systems with new construction in order to avoid pollution of rivers and water drinking sources. Further, most of North Bend is in the flood plain and is characterized by groundwater at or slightly below the ground surface during extended wet weather conditions. Under these conditions, a conventional septic tank drain field does not provide the necessary treatment to protect the environment and the public health and safety.

FCS' testimony at the 6/21 hearing indicated ratepayers would be paying $3.4M as a result of capacity expansion.

Response:
Existing rate payers will be responsible for paying their fair share of the 5 year capital improvement program for permit compliance, redundancy, etc which is around that $3.4M figure. The balance of the costs for implementing the improvements will be paid by future development.

If I'm not mistaken rate increases cannot be used to pay for capacity expansion, only maintenance, repair, and upkeep. Isn't using funds marked for O&M/repair an unlawful use when those funds are used for capacity expansion? Folks need to go back and propose additional revenues related to new development... higher new development charges to pay for such. In any case it is not following the philosophy of "growth pay for growth".

Response:
The program does require growth to pay for growth. The need for implementing the 5 year capital improvement plan is not growth as stated earlier. Cost associated with implementation of the 5 year capital improvement plan that are associated with the current unallocated capacity of the existing plant will be recovered through the GFCs. The faster development occurs the faster the City can recover capital for the

existing plant improvements through developer paid GFCs and new city sewer customers through payment of monthly sewer rates.

I also have additional questions regarding the assumptions on revenues. Mark's reply to me indicated that rainy season water consumption was used as the basis for rate increases. It is common sense that many residential users will increase their consumption in the summer to maintain their homes lawns and to garden/grow food--certainly in line with "preserving the rural character of North Bend". Wouldn't a rate design that assumes winter usage of water overshoot and collect too much money during summer months? I'd like to get more details as to the design of the rate increase and revenue projections to ensure that we've looked at multi-year consumption... at least a full 12 months or more (certainly there are fluctuations for dry and wet years)... considering North Bend is asking for an astronomical rate increase folks seriously need to examine how to bring down the increase.

Response:
The City uses the average monthly water consumption rate during the period of November through March to establish the average daily sewage flow for the "drier" months of the year, April through October). Actual residential water consumption from April through October does not come into the equation for computation of sewer rates or calculation of the sewer bill. The monthly residential sewer bill for the months of April through October is equal to the average of the preceding 5 months of sewer bills during "wet weather" (November through March).

Both myself and another citizen at the meeting proposed an alternative sewer consumption charging structure... one proposed a flat rate for residents, I had proposed basing sewer charges on winter consumption. Certainly the winter strategy incents conservation... people are incented to reduce household water use during winter months--and that is usage that does go into city sewer and at the worst time, rainy season where inflows are highest due to water leaking into the system or improper drainage connections to sewer.

Response:
The City's prior sewer rate was based upon a flat rate but a flat rate fees does not encourage water or wastewater conservation, which are key objectives identified by the City Council. A volume based fee that is constant or increases concomitant with increased consumption/discharge encourages conservation. The proposed rate structure is volume based with a constant volume charge.

I'd also ask that the city examine other ways of paying for new development aside from GFC. Homes that are on septic at some point will be going to city sewer and simply increasing the GFCs makes migration to sewer even less attractive... and even major repairs are apt to cost less than a $10k GFC (and that's before considering another $10k-$25k or more for a resident to connect from their home to the city sewer connection)... and then the resident has another $100 or more in sewer consumption charges they did not have before (relative to pumping every 3-5 years at $750 plus occasional maintenance costs, screen cleans and miscellaneous repairs). Did not Silver Creek just reject city sewer? What is the city doing to make connecting to sewer a more attractive option?

Response:
The City can apply for grant and loan funding from the Washington State Department of Ecology to reduce sewer rate increases associated with extending city sewer into existing neighborhood not currently served by the City's wastewater collection system. Centennial Clean Water Grant funds have been generally available to "buy down" the cost of the project so that the new customer's total sewer bill does not exceed 2% of the median household income. In 2015 median household income (MHI)for the Silver Creek has been reported to be $84,432. Two percent of this equates to a threshold sewer rate cost of $140.72. If the City applied and offered grant funding for the project then residents the average residential customers sewer rate would be set at 2% of the median household income. The grant would be provided to provide the necessary funds to buy down the capital obligation for the project. Also Ecology does provide additional financial aid through

lowering the interest rates on loans that result in sewer rates that are in the range of 80 to 100 percent of the sewer rate threshold (2% of MHI). However, the City's position has been that it is up to the neighborhood to decide if they wish to form a ULID to extend sewer to their neighborhood and busy City staff are not prepared to spend limited staff resources applying for such grants unless a neighborhood indicates a significant interest in such a ULID by initiating a ULID through a Petition. Although a Town Hall Meeting was conducted for the Silver Creek Community due to Ty Allen's inquiries (who I am copying on this email due to his interest in septic), the majority of homeowners who responded to the survey were not in favor of proceeding with connection to the City's sewer system in Silver Creek.

Last the upgrades/repairs and changes for "improvements" need to be examined closer to ensure there are no "shadow" capacity changes there. A good cross check is to re-run the system design "as if" no capacity changes were done and then compare the costs against the plan that increases the capacity... the difference is the cost of improvements/repairs/maintenance due to system capacity increase... and all those costs should be passed to new development.

Response:
It is essential to understand that the *improvements identified are principally replacement, repair, and additions for critical process redundancy* (e.g. the addition of a second clarifier, third UV reactor, and centrifuge) and for achieving compliance with the state biosolids regulations (i.e. , construction and operation of an aerobic digester for production of Class B Biosolids to allow for beneficial use for what currently is un-stabilized sewage sludge). In other words, even if another house was never built in North Bend our permit requires this level of redundancy for safety and compliance with current regulations.

I am also concerned with statements during the meeting that the plan/design is only "80%" done. So what else is left and what is the risk the costs go up?

Response:
The proposed rate increases are based on planning level estimates. Actual costs will vary but should be generally covered within +/- 30% of the estimated cost. Estimated costs are generally updated during and at the end of design phase. The construction market place sets the actual cost of construction may differ from the engineers estimate due to the cost of materials , labor and overall bidding climate at the time of bidding.

There was also a statement (I believe by the city administrator made it) that another $12-$14m in revenues will be needed for O&M to 2029... so ratepayers will be faced with that as well.... this should also be put out as the rate increases clearly won't end in 2020... that is almost as expensive as the entire improvement and capacity expansion plan being put forward now. I'd certainly like to see more details on this.

Response:
There is no capacity expansion in the 5-year Capital Improvement Plan as stated previously. Yes, operation and maintenance costs will increase over current levels because city needs to be more proactive rather than a reactive position to operating and maintaining the City's wastewater facility assets. The proposed rates include the cost for increased O&M and implementation of the 5-year capital improvement program.

I would like to understand when the system capacity changes and when we need certain levels of capacity. What capacity do we need and when do we need it? Perhaps present a table of the required capacity every year for the next 5-10-20 years.

Response:
Treatment plant capacity increases are not anticipated before 2029 based on the City's comprehensive plan and the draft wastewater facilities plan. Again the 5 year capital improvement program is needed to repair

and replace equipment and systems that have failed or likely to fail because they have reached their design service life, and to bring the plant into compliance with the State and Federal standards for redundancy and reliability to assure compliance with the City's NPDES permit and to provide the City with the needed improvements to meet the State's Biosolids Management Regulations and General Permits for Biosolids, and to resolve nuisance odor issues associated with the plant.

Three additional suggestions given customers need notice of rate changes: 1) The new consumption rates to be included in a mailing for sewer charges and also a notice on the customer's bill of the date of the new rate plan 2) The rate plan takes effect the first billing cycle 6 months from adoption of the new rate plan. 3) Subsequent rate plan changes are spaced 12 months from the bill the first rate increase occurs.

On outreach: 1) The city needs to do a better job in social media... I see nothing wrong with a member of city government to post key announcements to popular facebook groups (such as the North Bend Political Forum or the North Bend News and Trading post)... those groups have 350 and more than 3000 members each. The city doesn't have to monitor these, only post. The city is still providing the required public notices anyway, posts are additional outreach. 2) Key facts the city wishes to highlight need to be in the email announcement not buried 80 pages in a PDF document... consider putting this information as an attachment or even better 1-3 pages as HTML in the email--consider that most people now get their email on a mobile device... reading a PDF on a mobile screen doesn't cut it 3) Simpler terms and clarity are needed... FCS presentation did little to explain this in terms the population can understand, and as well the engineering information on capacity requires some translation (perhaps to homes or population to translate treatment capacity from ERUs to something laypeople can understand). Similarly a clearer presentation of the cost of repairs/maintenance/upkeep and cost of capacity doubling. $X million for repair/upkeep/maintenance $Y million for capacity upgrade.

The City has been discussing the need for these capital improvements for 4 years at various public meetings and the need for the corresponding rate increases at various public meetings. The Capital Facilities Plan meeting describing in detail improvements you wish to discuss above was advertised and public meetings were conducted on March 15, 16 and April 26, 2016 (you incorrectly testified that this was the Silver Creek sewer meeting, which it was not). The rates were discussed in public Council Committee meetings on May 3, 11 and June 7 and 8, 2016. A public hearing before the City Council was opened on June 21st and continued until July 19th providing over a month for citizens to provide written or verbal comments to their elected officials. In addition, we added a Town Hall meeting on July 7th with our consultants and staff with an optional tour of the plant to answer questions. Finally we have posted all this information on the official City's Facebook Page, Twitter account, City's Web page, and posted official notices with the two local newspapers (Snoqualmie Valley Record and Snoqualmie Star) and the local blog (Living Snoqualmie). We also sent the notice/press release to all persons who have signed up for "Notify Me" through the official City Web Page seeking notice of City News and Highlights. The upcoming meetings are listed on the City Calendar and the press release is listed under the City's News and Highlights. We have also sent this information out to the local Yahoo Group. We have never found the utility billing notices to be an effective tool for communication particularly of upcoming meetings. We also are unwilling to start trying to distribute this information to certain private social media closed groups as you have suggested. The two Facebook groups you suggest are both closed and require membership and the City of North Bend is not a member .

Michael Thomas

> -------- Original Message --------
> Subject: Request to oppose city sewer rate increase
> From: <mthomas@bangstick.net>

Date: Tue, June 21, 2016 4:42 pm
To: "Council" <Council@northbendwa.gov>
Dear City Council,

I believe more time is in order to understand the nature of the rate increase and why such a massive capacity increase is required in such a short order... expanding the capacity to 11.5k people seems out of order within the next 5 years, even the UGA only requires us to build an additional 771 residences (+1982 people) to 2035 in the City's own most recent comprehensive plan.

I also suspect that a good part of the improvements are not for maintenance or upgrades but are cloaks for capacity expansion and that is not an appropriate use for a rate increase.

Citizens being given only 4 business days to review the rate increase and to ask questions, come up with alternative ideas, etc. is not good governance.

I urge the council to oppose this. I am not necessarily opposed to capacity expansion or needed rate increases, Mark's numbers do indicate we are close to the existing capacity and such an expansion may be warranted... the question is how much is needed and when? Is there an alternative plan? What are the minimum necessary repairs & maintenance and what is the capacity expansion needed and when?

Michael Thomas

> -------- Original Message --------
> Subject: RE: Comments on Sewer Rate and GFC Increase 6/21
> From: Mark Rigos <MRIGOS@NORTHBENDWA.GOV>
> Date: Tue, June 21, 2016 9:56 am
> To: "mthomas@bangstick.net" <mthomas@bangstick.net>, Susie Oppedal <SOPPEDAL@NORTHBENDWA.GOV>
> Cc: Council <Council@northbendwa.gov>, Don DeBerg <DDEBERG@NORTHBENDWA.GOV>, Londi Lindell <LLINDELL@NORTHBENDWA.GOV>, Ken Hearing <KHEARING@NORTHBENDWA.GOV>
>
> Hi Michael,
>
> Thank you for providing input. Answers to your questions are as follows:
>
> 1. Yes, the rates were calculated based on a 5-month average, from November through March.
>
> 2. An Allocation Table was prepared and vetted by 4-5 licensed Professional civil engineers (PEs) by the State of Washington including 2 PhDs for allocating proportional costs into capacity or non-capacity facilities. Total cost of the 5-year improvements is estimated to be approximately $15 million. Adjustment of the current GFC rates distributes the fair costs for upgrading the currently unallocated "rated" capacity of plant.
>
> 3. The existing City wastewater facilities currently provides conveyance, treatment and disposal for about 2,300 ERUs (equivalent residential units). One ERU is by definition equal to the flow and load attributable to the average single family residence (~2.57 people). With the

implementation of the 5-year capital improvement program, the City wastewater facilities will have a "true" rated capacity capable of providing reliable conveyance, treatment and disposal for 4,492 ERUs.

4. Neither me nor my consultant understand what is being asked. However, all of the improvements in the 5-year plan are needed to bring the plant up to its rated capacity. The improvements are needed to replace equipment and systems that are being operated beyond their design service life, to bring the plant into conformance with its rated capacity, current City flood management regulations, current state and federal redundancy and reliability standards, and state biosolids management regulations.

5. For irrigation meters, sewer rate charges do not apply to water used for irrigation purposes.

Hope that helps.

Sincerely,
Mark Rigos, P.E.
Public Works Director
City of North Bend
PO Box 896
1155 East North Bend Way
North Bend, WA 98045
(425) 888-7650

From: mthomas@bangstick.net [mailto:mthomas@bangstick.net]
Sent: Monday, June 20, 2016 4:05 PM
To: Susie Oppedal
Cc: Mark Rigos; Council
Subject: Comments on Sewer Rate and GFC Increase 6/21

Hello,

I am a resident of North Bend at 1231 LaForest Drive SE North Bend WA 98045 and wish to submit comments and questions for the record for the 6/21 hearing on the sewer rate and GFC increase.

I oppose the rate increase both in terms of both the general rate and GFC rate increase at this time. I would like to see an extended period for public comment on the proposal, certainly 4 business days notice of a rate increase does not provide the public sufficient time to comment on such a massive rate increase... although the city has known about this for months (with the original notice dating to April), citizens have not had the details until last week.

I would also like to see more details as to the plans for improvements and costs differentiated by improvements versus capacity expansion. There are no details provided in the city council packet justifying the rate increase or details such that the public can understand what components are for new

development versus for upgrade or repair. The city has already exceeded its UGA growth targets to 2030... it's not clear how much capacity is actually required and whether the new plan exceeds the UGA target.

I have the following questions:

1) Was "winter quarter averaging" for establishing the basis for sewer charges evaluated? Obviously summer water usage for many homeowners and property owners also includes water that is used to maintain lawns and grow food for home gardens or farms within city limits and this water does not go into the sewer system for treatment. I believe winter usage is perhaps more reflective of actual usage that is apt to require sewer treatment. I view the old rate structure of a higher base charge but a very low variable rate charge is meant to reflect this. It would make sense that the winter water usage for properties with a single meter (without a separate meter for irrigation) would be most reflective of usage that requires sewer treatment. Reducing winter water usage that requires sewer treatment during the wettest months helps reduce the volume due to people and when infiltration in the system is greatest due to aging pipes, improper drain connections, etc. I am surprised North Bend has not considered winter quarter averaging to base sewer charges on what is usage that requires treatment vs. usage that doesn't (e.g., lawncare, gardening).

Winter quarter averaging would help those owners "maintain the rural look and feel" and small town character of their properties by providing a reasonable way to charge for water usage that requires sewer treatment and to maintain their lawns and landscaping.

2) Of the rate increases to both the GFC and monthly rate structure how much is due to capacity expansion vs. not capacity expansion (e.g., upgrades or required repairs)?

3) How many single family residences does the current system support and how many residences will be supported with the proposed capacity expansions? If this changes over time please elaborate the capacity changes over time.

4) What is the minimum capacity increase required (in terms of # of single-family residences)?

5) How are charges handled for properties with a separate meter for irrigation handled? The new ordinance rate structure does not elaborate on usage for irrigation or differentiate consumption for residential use vs. irrigation.

Please include my comments and questions for the public record.

Regards
Michael Thomas

City of North Bend

Wastewater Facilities Plan Public Meeting Documents

July 7, 2016

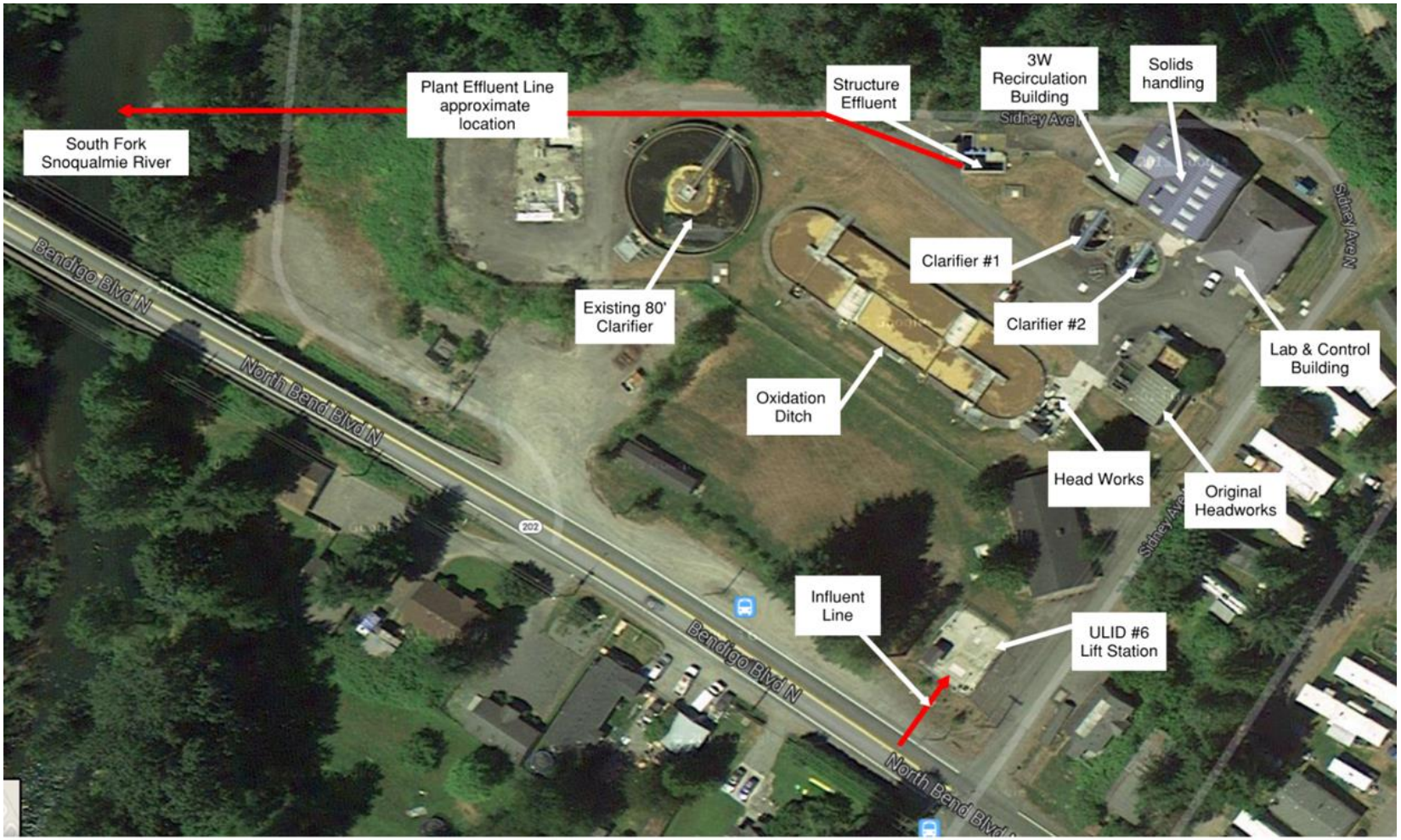
SEWER TOWN HALL MEETING

JULY 7TH, 2016

DISCUSSION OF INCREASING

SEWER RATES

North Bend Sewer Plant



North Bend WWTP

Capital Facilities Plan

City Studied 3 Options:

1. Regional Option – Contract with another provider for sewer = $63 million
2. Build a new Sewer Plant on new Property = $53 million
3. Remodel our existing Sewer Plant = $27 million

Public Participation for Capital Facilities Plan

Public Meetings were Held

1. March 15, 2016 City Council Meeting
2. April 26, 2016 Public Meeting
3. Various Council Committees

Council and public supported least expensive option of remodeling existing Sewer Plant = $27 million

Basics of Sewer Utility

- Enterprise Fund – Self supporting
- Residential and Commercial ratepayers
- Acronyms:
  - General Facility Charges (GFC) = connection fees to hook up to sewer
  - Equivalent Residential Unit (ERU) = typical sewer use in home comprised of 2.57 people

ERUs - Residential vs. Commercial

Residential

One House = 1 ERU

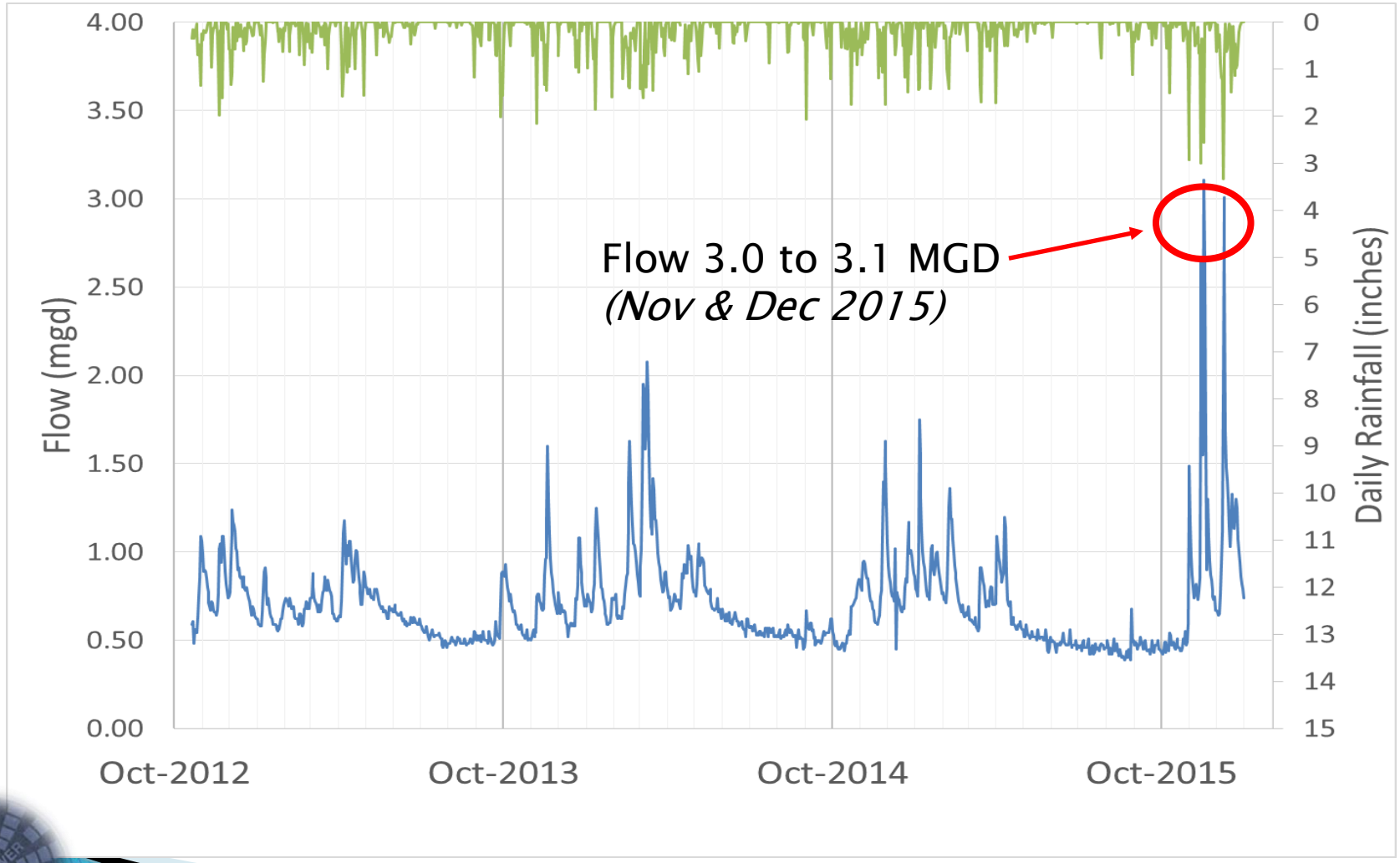
Commercial

Depends on use
(size of water meter)

How Many ERUs Are Available?

- How many ERUs do we have in our plant?
  - The City's Permit allows 2.58 mgd = 4,492 ERUs
- How many ERUs are already being used?
  - 2,292
- How many ERUs are available for new development?
  - You would think the answer would be:
    4,492 – 2,292 = 2,200 but that is **Incorrect.**
  - NOT all 2,200 are available for new development due to Inflow and Infiltration (also called I&I) which eats up sewer capacity.
  - Implementation of the next 3 years of capital improvements will allow most of the 2,200 ERUs to be available.

Impacts of I&I



Impacts of I&I

How many new ERUs are planned?

Does this rate increase mean we are planning for thousands of new homes?

- No. The rate increase is planning for approximately 500 new connections over 5 years.
- ERUs are used by both residential and commercial uses. (e.g. hotel use)

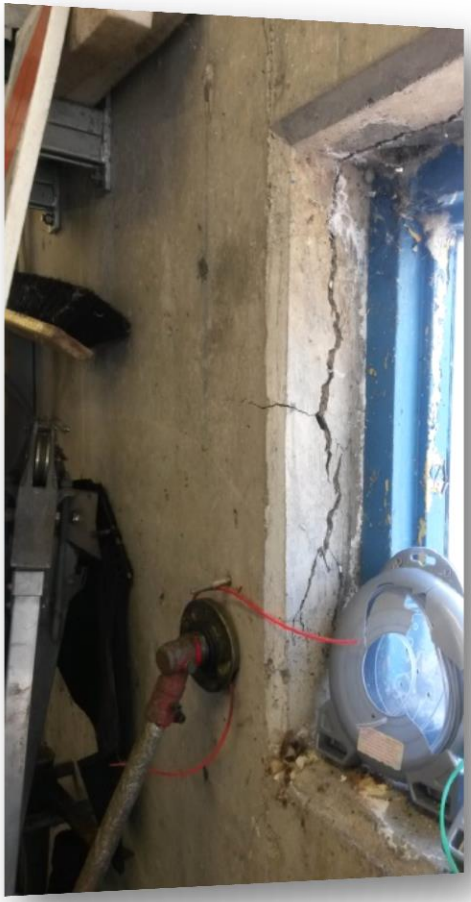
Why Do Rates Need to Increase?

- **Sewer Plant is Old**
  - ✓ Plant was built in 1950's, upgraded several times, and is failing
  - ✓ Plant is violating regulations
  - ✓ No redundancy
  - ✓ Safety violations

- **Growth Management and Property Rights**
  - ✓ City is part of Urban Growth Area
  - ✓ State law identifies City to deliver urban sewer services
  - ✓ City can't ban growth indefinitely unless City buys property

Why Do Rates Need to Increase?

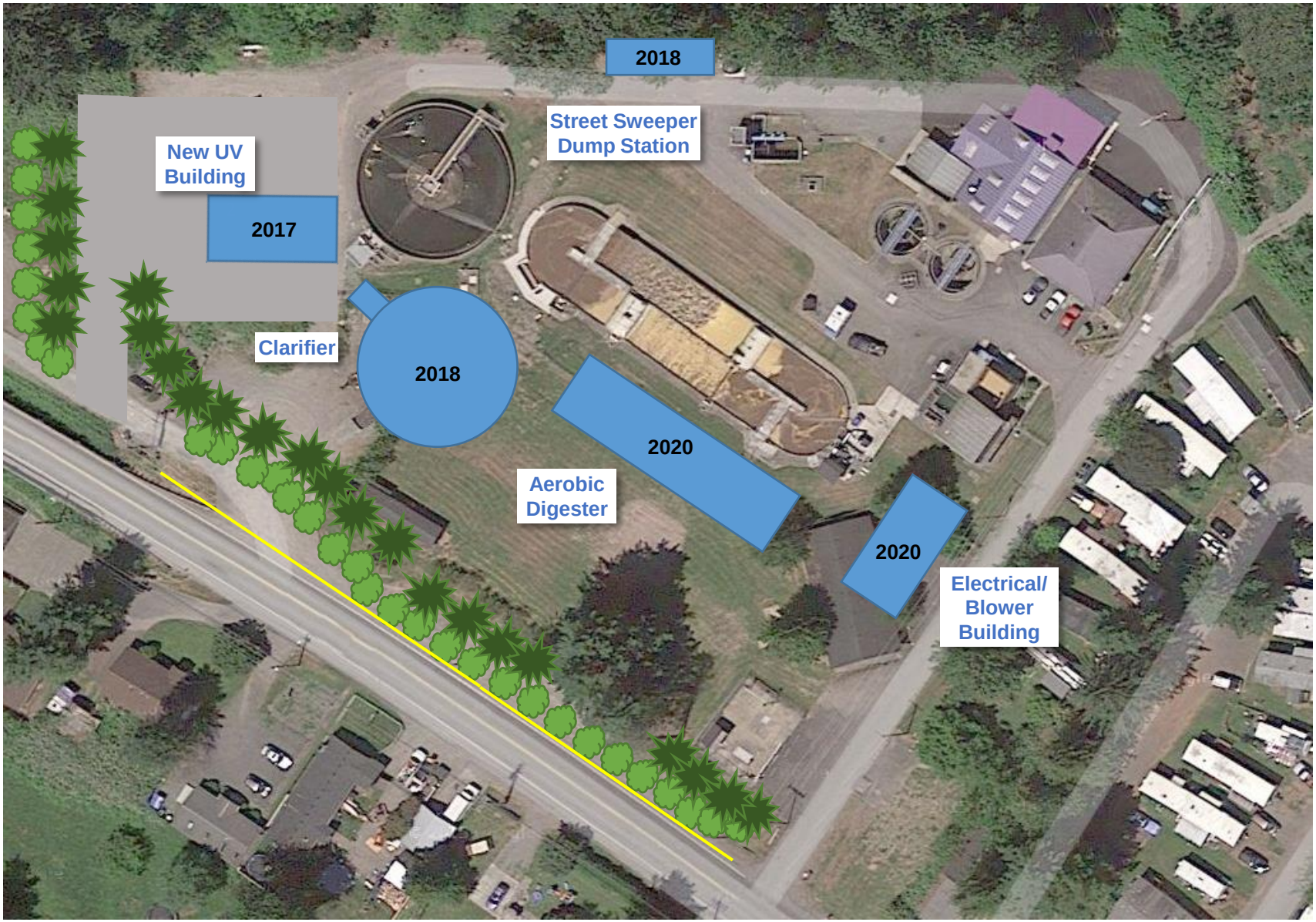
Why Do Rates Need to Increase?



What Are We Paying For?

- Rates are paying to upgrade 1950s Plant
  ($15.6M Improvements + new operating costs)
- Rates are paying to meet new regulations
- An additional $11.4M improvements may be required after 2029 to accommodate growth (if needed) through the end of the 20 year planning period ending 2036. Costs for these growth improvements would be borne by developers.
- Rates are also paying for additional Operating & Maintenance costs needed to maintain existing and new assets.
- Spreading rate increases over time more fairly shares the costs among ratepayers.

What Are We Paying For?



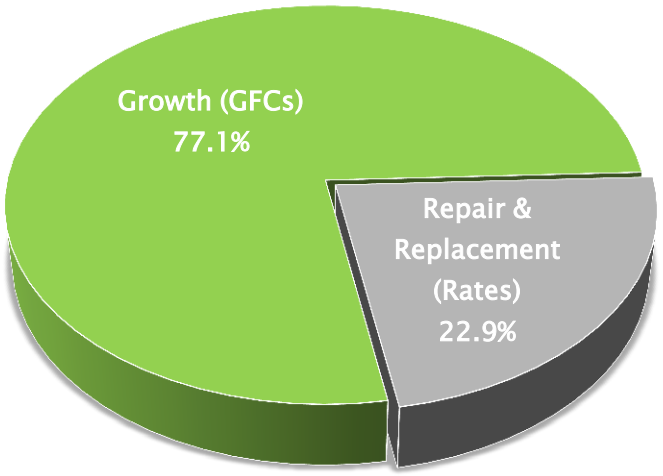
What Are We Not Paying For?

- Residential ratepayers are not subsidizing new housing development. Growth is paying for Growth.

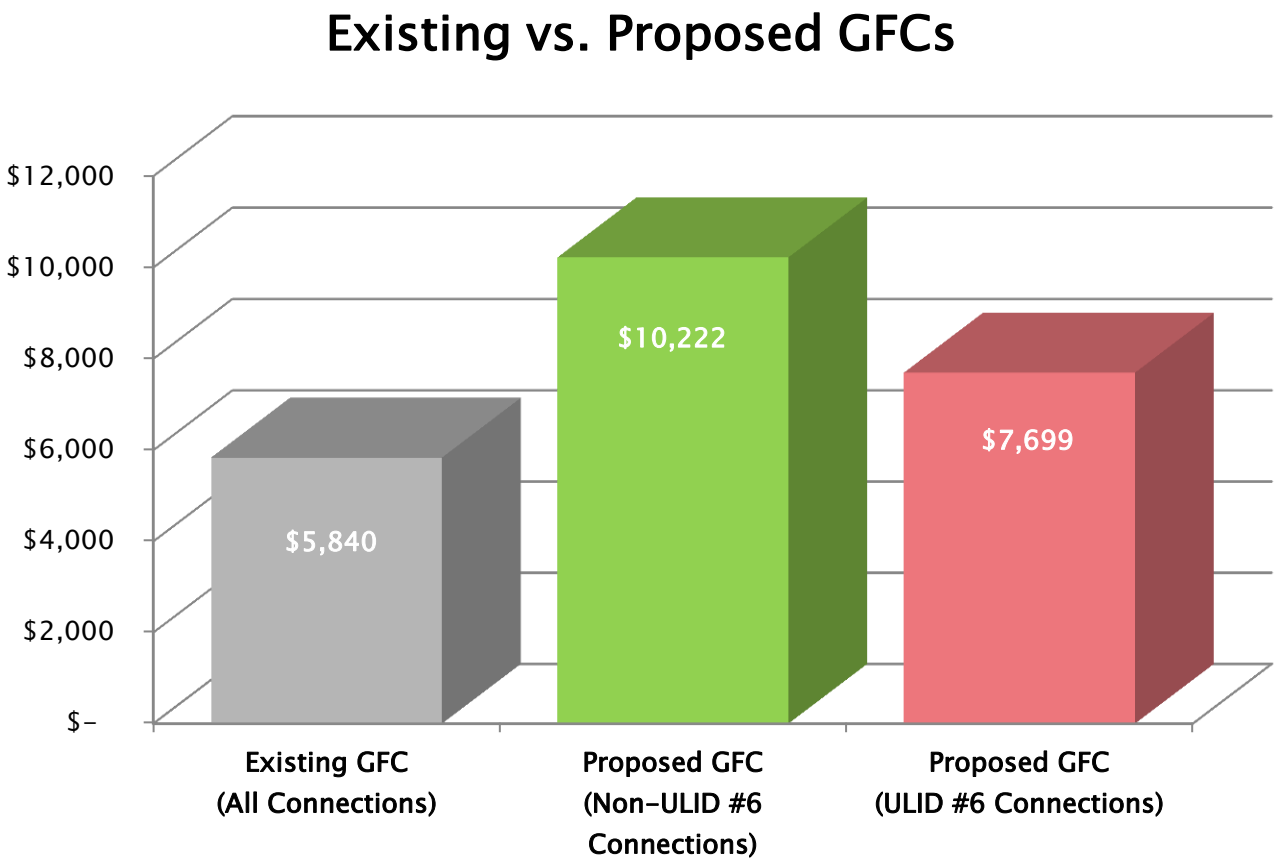
- Not Paying For Other City Operations. Sewer Utility is an Enterprise Fund.

Is Growth Paying for Growth?

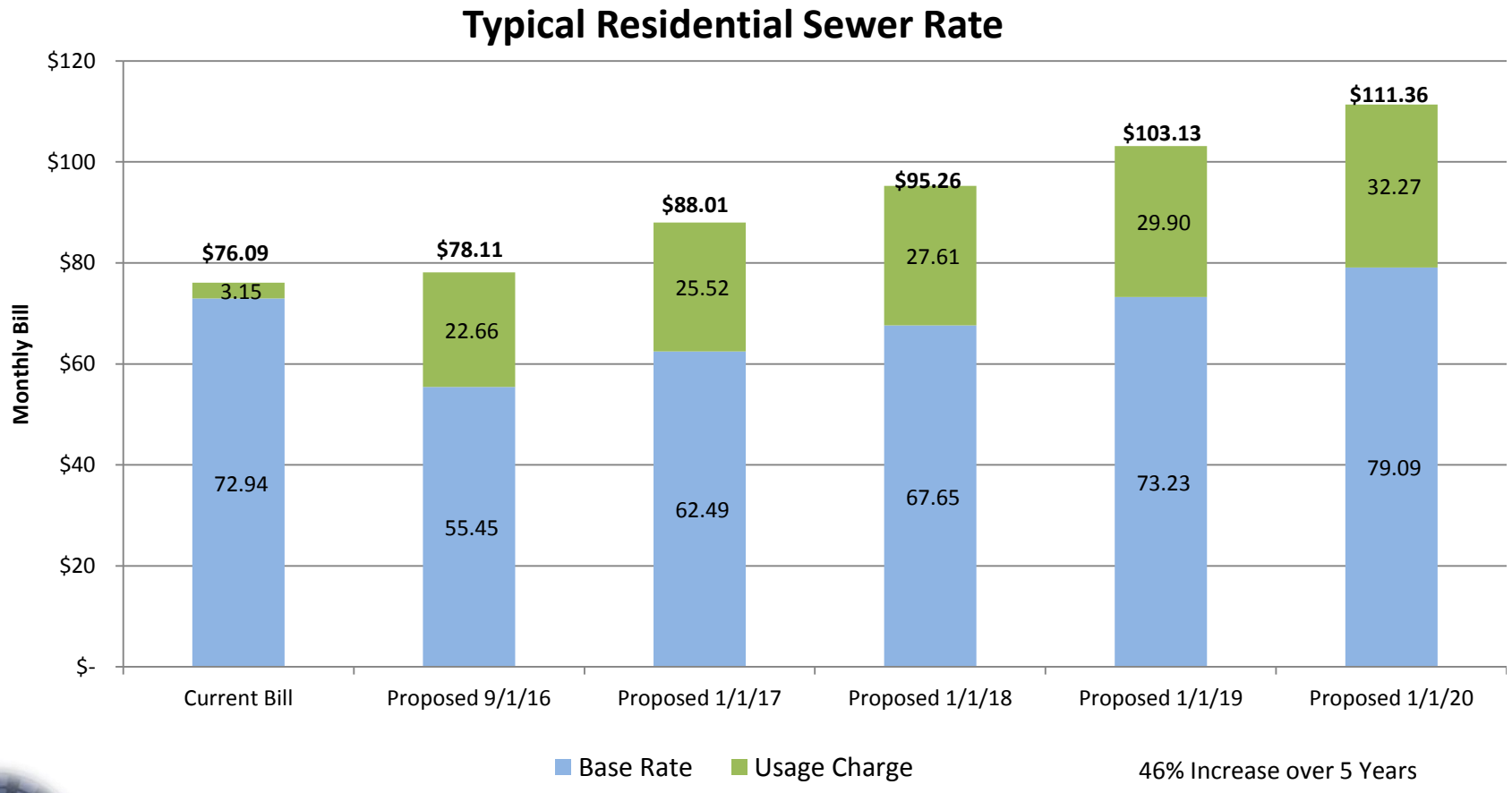
What portion of $15.6m is being paid for by new homes/growth vs. existing ratepayers?



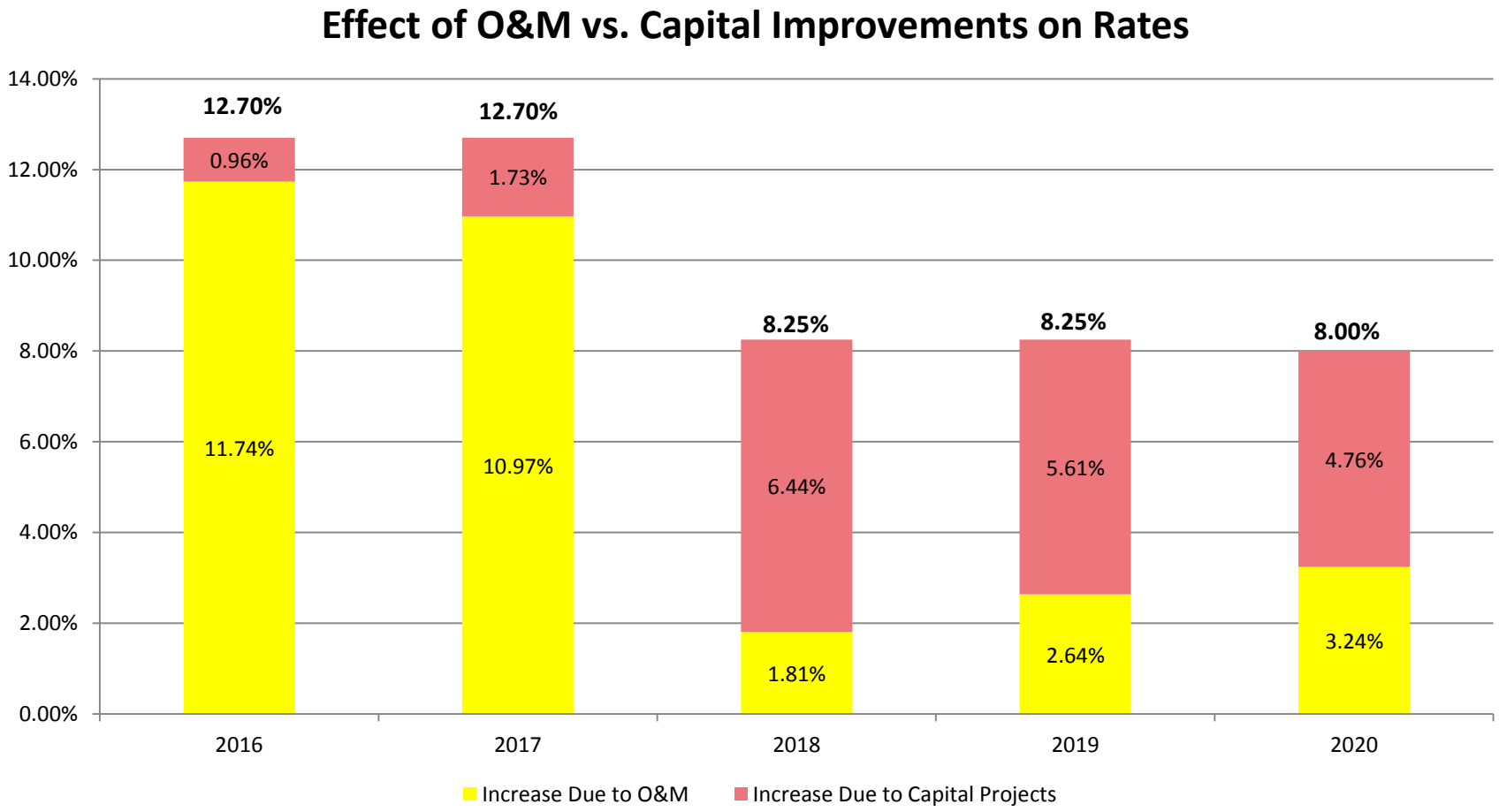
Is Growth Paying for Growth?



Rate Increase on Typical Residential Ratepayer



What Are We Paying For?



New Rate Structure Rewards Water Conservation

- Base Rate –
  - Same rate for all customers (residential and commercial)
  - Includes first 10 cubic meters
- Usage Rate –
  - Same per cubic meter rate for all customers
  - Per cubic meters of water used over the first 10
- Winter Averaging – For the months of April through October, consumption amounts for sewer services will be based on the average water consumption during the months of November through March, so as not to penalize sewer customers using water for lawn and garden irrigation and other summer activities."

Conclusion

- Sewer Utility is Enterprise Fund – Must be Self Supporting and funds cannot be used for other City operations.
- 1950s Sewer Plant is Failing.
- Rates must be increased to pay for improvements and additional Maintenance and Operation costs.
- Next Steps: Continued City Council Public Hearing
  July 19th @ 7:00PM – Senior Center

It's OK to Water Your Lawn!

Winter Averaging - Ordinance Language:

"For the months of April through October, consumption amounts for sewer services will be based on the average water consumption during the months of November through March, so as not to penalize sewer customers using water for lawn and garden irrigation and other summer activities."

STATE OF WASHINGTON, COUNTY OF KING }
AFFIDAVIT OF PUBLICATION

PUBLIC NOTICE
Linda M Mills, being first duly sworn on oath that she is the Legal Advertising Representative of the

Snoqualmie Valley Record

a weekly newspaper, which newspaper is a legal newspaper of general circulation and is now and has been for more than six months prior to the date of publication hereinafter referred to, published in the English language continuously as a weekly newspaper in King County, Washington. The Snoqualmie Valley Record has been approved as a Legal Newspaper by order of the Superior Court of the State of Washington for King County.
The notice in the exact form annexed was published in regular issues of the Snoqualmie Valley Record (and not in supplement form) which was regularly distributed to its subscribers during the below stated period. The annexed notice, a:

Public Notice

was published on July 6, 2016.

The full amount of the fee charged for said foregoing publication is the sum of $92.19.

Linda Mills
Legal Advertising Representative, Snoqualmie Valley Record
Subscribed and sworn to me this 6th day of July, 2016.

Gale Gwin, Notary Public for the State of Washington, Residing in Puyallup, Washington

GALE GWIN
COMMISSION EXPIRES
NOTARY PUBLIC
08-13-2019
STATE OF WASHINGTON

PUBLIC NOTICE #1639269
LEGAL NOTICE
CITY OF NORTH BEND
King County, Washington
NOTICE OF
PUBLIC MEETING

NOTICE IS HEREBY GIVEN that the City of North Bend has scheduled a public meeting regarding proposed Sewer and Sewer General Facility Charge rate increases. The purpose of the meeting is to provide community members the opportunity to learn more about the proposed rate increases, ask questions, and provide comments or concerns. The public meeting will take place on Thursday, July 7, 2016, at 7:00 p.m. at the Mt. Si Senior Center, 411 Main Ave. S., North Bend, WA.

Prior to the meeting, there will be an optional tour of the City of North Bend's Wastewater Treatment Plant at 400 Bendigo Blvd N., North Bend, WA starting at 6:00 p.m. and ending at 6:45 p.m. The tour is limited to fifteen individuals and participants will be required to sign a release. Those interested in participating in the tour will need to contact City Engineer Don DeBerg at 425-888-7652 or ddeberg@northbendwa.gov to reserve a place with the tour group.

Additional public comment will also be accepted during the City Council Meeting being held on July 19, 2016 at 7 p.m. at Mt Si Senior Center. Those unable to attend either meeting or who wish to submit their comments in writing may do so by sending comments to the City Clerk at P.O. Box 896, North Bend, WA, 98045, or by email to: soppedal@northbendwa.gov.

Posted: June 28, 2016
Published in the Snoqualmie Valley Record: July 6, 2016

WWTP Tour Sign Up List

Date: 7/7/2016
Time: 6:00 PM

Number	Name	Address	City	Phone	Email
1	Carol Ladwig, Snoqualmie Valley Record	8124 Falls Ave SE C2	Snoqualmie, WA 98065	425-888-2311	cladwig@valleyrecord.com
✓ 2	Beth Burrows	312 NE 6th	NB	425-88[illegible]	bkburrows@msn.com
✓ 3	Kevin Burrows	↗	"	9323 "	bkburrows@msn.com
4	Garret Parsons Mortenson Construction	1095 Parkplace Ave SE	NB	425.444.4298	garret.parsons@gmail.com
5	Tom Paul Mortenson Construction	10230NE POINTS DR KIRKLAND, WA		4254496444	tom.paul@MORTENSON.COM
6	Stuart Miller SnoValley Star	PO Box 1328	Issaquah, WA 98027	425-392-6434	smiller@snovalleystar.com
7	Steve DuBose	1105 Rachor PL	North Bend	425-888-0818	stevedub@comcast.net
8	Denise DuBose	1105 Rachor PL	North Bend.	425-888-0818	stevedub@comcast.net
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City of North Bend

Wastewater Facilities Plan Public Meeting Documents

July 19, 2016

City Council Agenda Bill

SUBJECT:	Agenda Date: July 19, 2016 AB16-076	
Continuation of Public Hearing and Ordinance Updating Sewer Utility Rates and General Facilities Charges	Department/Committee/Individual	
	Mayor Ken Hearing	
	City Administrator – Londi Lindell	X
	City Attorney - Mike Kenyon	
	City Clerk – Susie Oppedal	
	Community & Economic Development – Gina Estep	
Cost Impact: N/A	Finance – Dawn Masko	X
Fund Source: N/A	Public Works – Mark Rigos, P.E.	X
Timeline: Immediate		

Attachments: Ordinance; FCSG June 16, 2016 Sewer Rate Report; Sewer Rate Comparison Chart; July 7, 2016 Town Hall Power Point Presentation; Town Hall Sign Up Sheet; June 21, 2016 FCSG Power Point Presentation; List of $15.6M Sewer Plant Capital Projects; 6% Utility Tax Impact on Residential Ratepayer, Written Public Comments; Public Hearing Notice

SUMMARY STATEMENT:

Background

In 2013 then Public Works Director Frank Page and consultant John Markus with Tetra Tech identified numerous problems at the City of North Bend's aging 1950s Wastewater Treatment Plant ("Sewer Plant") and presented a list of 29 proposed Sewer Plant improvements to the City Council. The Council approved an emergency contract in 2014 and early 2015 to solve 3 of those problems. Since then, the condition of the remaining 26 issues at the Sewer Plant have continued to degrade. The City Council has invested approximately $3 million into both improvements and analyzing the best long term solution to the problem during the last 3 years.

Capital Facilities Plan-Sewer Comprehensive Plan

Because of the growing list of needs at the Sewer Plant and unprecedented growth in the City and in order to comply with the City's permit requirements, the City Council authorized a contract with Tetra Tech for the preparation of a Wastewater Capital Facilities Plan, Sewer Comprehensive Plan, and Sewer Rate Study to study the best long term solution to handling the citizen's sewer needs. Council directed that consistent with Council's policy direction that "growth pay for growth" new development must pay its proportional share of the Sewer Plant upgrades to insure that rate payers are not subsidizing any portion of such development. The Capital Facilities Plan studied 3 alternatives and ultimately both Council and the citizens who attended the public meetings supported the least expensive option of remodeling the existing Sewer Plant ($27 Million) as opposed to building a new plant in a different location in North Bend ($53 Million) or contracting with a regional provider ($63 Million). The benefit of a Capital Facilities Plan is it will allow the City to implement future capital improvements expeditiously through Department of Ecology without needing individual design reports which are a lengthy permit requirement. Once Ecology has approved the City's Capital Facility Plan, the door to low-interest loans and potential grant funding will be available to North Bend.

Why Must Rates and GFCs Increase?

A sewer utility is an enterprise fund which means it must be self-supporting. The two primary forms of revenue for this fund are from existing rate payers who pay a monthly fee and from new users who wish to hook up to the system and pay a one-time connection fee which is called a General Facility Charge ("GFC"). The Capital Facilities Plan has clearly identified and documented the capital needs of the Sewer Plant through 2036. The List of Capital Projects totally $15.6 million attached to this Agenda Bill are proposed to be made at the Sewer Plant during the next 5 years after the rate increase and under the Capital Facilities Plan these will be all the necessary improvements for the Sewer Plant through the year

City Council Agenda Bill

2029. In addition, there will be increases to the Operation and Maintenance (O&M) at the plant as a result of the construction of these new capital improvements at the Sewer Plant (e.g. power, chemicals, sludge handling). Further, due to regulatory requirements and in order to deal with issues associated with Inflow and Infiltration (I&I), new employees will be added to inspect the aging and failing sewer collection and manhole system which feeds into the Sewer Plant. Both the capital improvements and the new O&M costs will be paid for with the proposed increase in rates and GFCs.

How Were Increases in the Sewer Rates and GFC Calculated?
FCS Group of Redmond, WA was selected to complete a rate study on the City's sewer rates. FCSG studied the Capital Facilities Plan prepared by Tetra Tech, the need for $15.6 million dollars in capital improvements, the need for various increases in Operation and Maintenance (O&M) and presented suggested increases in monthly sewer rates and GFCs to first Council Committees and ultimately the entire City Council.

On May 3rd staff presented a proposed rate increase to the Finance and Administration Committee (F&A) which followed the City's existing rate structure – a simple across the board percentage increase to the base charge and usage charge, with no change to the generally flat rate structure. The F&A Committee did not agree with staff's recommendation and asked the consultant to prepare new rates as follows:

1. Provide rate equality between the residential customers and the commercial customers because residential customers had been subsidizing commercial uses under the old rate structure;
2. Lower the base fixed charge rate and increase the variable usage charge in order to encourage water conservation; and
3. If possible, keep the average single-family residential bill below $100 per month at the end of 5 years.

The consultant was able to achieve the first two objectives but not the third objective and a revised rate structure was then presented to the F&A Committee on June 7, 2016 and to the Transportation and Public Works Council Committee on June 8, 2016. Upon review of the revised rate structure, the F&A Committee requested that the rates and GFCs be further adjusted to better align with the Council's goal that "growth pay for growth". Tetra Tech, FCSG, and City staff subsequently further adjusted the revenues between the rates and the GFCs.

The attached June 16, 2016 FCSG Report and power point presentation describes in detail the assumptions, findings and calculations for the new rate structure. In short, the fixed fee has been reduced for all users and the variable fee (usage charge) has been raised. See page 19 of the July 7, 2016 Town Hall Power Point Presentation to see the division between the base rate and variable rate for a typical residential rate payer. This rate structure will encourage water conservation for all users. If Council adopts the attached Ordinance, the below shows the impact on an average rate payer over the next 5 years:

Date	Sewer Rate
Today	$76.09
9-1-16	$78.11
1-1-17	$88.01
1-1-18	$95.26
1-1-19	$103.13
1-1-20	$111.36

City Council Agenda Bill

In addition to the sewer rates, FCSG performed a study of the General Facilities Charges (GFCs). The current connection fee or GFC to hook up to the Sewer Plant is $5,840. In calculating the new GFCs, FCSG took into account the improvements necessary for the growth of the community and the assessments that Utility Local Improvement District ("ULID") customers are already obligated to pay. FCSG recommended a variable GFC charge, with ULID customers paying less ($7,699) than non-ULID customers ($10,222).

Public Hearing

On June 21, 2016, the City Council opened the public hearing and staff made a presentation during which time staff strongly recommended revising the sewer rates and GFCs as attached in order to fund the improvements necessary to the sewer system, which will affect repairs to inadequate or damaged equipment, as well as providing funding for needed future capacity improvements within the Sewer Plant. Following the public hearing, Council requested staff conduct a Town Hall Meeting and provide additional opportunity for citizens to learn more about the reasons for the sewer rate increases. Staff provided an optional Sewer Plant tour and a Town Hall Meeting on July 7, 2016. Approximately 25 to 30 people attended the meeting (not all persons signed the Sign Up Sheet) and approximately 8 people attended the tour. A slight majority of persons who signed the "Sign Up Sheet" were currently on septic and would not be affected by the rate increase unless they later elected to connect to public sewer. Staff will present a condensed version of the attached Town Hall Power Point presentation to the City Council during the continued Public Hearing and summarize some of the issues raised at the Town Hall Meeting as follows:

- Winter Averaging. A number of citizens asked the City to consider winter averaging. Staff advised the citizens that the proposed ordinance contains the following specific language: "For the months of April through October, consumption amounts for sewer services will be based on the average water consumption during the months of November through March, so as not to penalize sewer customers using water for lawn and garden irrigation and other summer activities." This resolved the citizen's concerns about this issue as the City does perform winter averaging and accordingly a citizen is not penalized for watering their lawn or washing their car as incorrectly reported in social media.
- Comparable City/Districts Sewer Rates. One citizen asked that the Council consider comparable sewer rates from surrounding jurisdictions and then set North Bend's sewer rate based upon such comparable rates. Councilmember Volken who is also a member of the F&A Committee mentioned that his committee considered this comparable data (attached) but that this information is not significantly relevant in determining a necessary rate for purposes of the Sewer Plant. Councilmember Volken mentioned the attached chart showed a large variable of over $100 a month (Seattle, Shelton and Chehalis) to as low as under $28 a month (Edmonds) and that such variables appeared related to circumstances associated with each plant such as large regional providers (e.g. Metro and Brightwater) may have efficiencies of scale which North Bend does not have and also that each sewer utility is unique. Mr. Volken also mentioned the deferred maintenance of the City's Sewer Plant (collection system and treatment plant) as a unique circumstance justifying the rate increases.
- Cut Other City Services. One citizen suggested the City Council closely review its entire budget to look for savings and consider zero based budgeting. During the last 10 years, Council has only taken the 1% property tax increase twice and has consistently conservatively reviewed the budget seeking programming and staff savings. This type of review is more appropriate during the Biennial Budget process. Staff discussed legal limitations surrounding a utility fund as an enterprise fund and how this fund needs to be self-supporting and be funded from a combination of rates and GFCs.
- Equipment Replacement Fund. One citizen asked why there were not funds in an equipment

City Council Agenda Bill

replacement fund to pay for the $27 million dollars of improvements being recommended by the Capital Facilities Plan. Mayor Ken Hearing discussed a prior City Council's decision to reduce equipment replacement reserves due to the 10 year water moratorium but how this Council was slowly building back up such equipment reserves.

- Utility Tax. One citizen suggested the City eliminate the 6% utility tax on all sewer bills. The attached slide entitled Impact on Typical Residential Ratepayer has been revised to include a new orange bar showing the addition of the 6% utility tax, as requested by this citizen. State law authorizes cities such as North Bend to impose a uniform utility tax on all utility services (private and public utilities such as water, sewer, cable TV, phone, internet, gas, power, etc.) under RCW 35A.82.020 which is the enabling provision for a code city such as North Bend. The North Bend City Council adopted such a utility tax in 2003 and this has been an important component of funding a significant portion of your General Fund. See Chapter 5.06 of the North Bend Municipal Code. The majority of the City's General Fund covers the City Council's number one governmental priority - public safety for police and fire services. The City collects approximately $1 million dollars a year in utility taxes to fund its $7.6 million General Fund from these various private and public utility entities (including the City of North Bend sewer enterprise fund). There are constitutional requirements for uniform taxation so it is difficult to selectively remove a utility tax from one utility but leave it in place for all other utilities. The General Fund could simply not survive a million dollar reduction in revenue and still continue to deliver the necessary public safety services you have identified as basic government services.
- Design/Build/Operate Option. One citizen suggested that the City should study this option not only in connection with the actual construction of various phases of the necessary capital improvements identified in the Capital Facilities Plan but that the City should have advertised the entire Sewer Plant and all staffing needs for such Sewer Plant as a "Design/Build/Operate" option in connection with the options studied as part of the Capital Facilities Plan. Our consultant from Tetra Tech correctly stated that these types of design/build/ for the construction portion of public projects (not including privatization of the work force) generally did not pencil out unless they were a minimum dollar amount which generally exceeded our $27 million dollar price tag. Although not mentioned by Tetra Tech, the nature of our proposed improvements is that they will be advertised and bid in phases over an approximately 5 year period of time and by various subcontractors based upon the nature of the work (See attached list of capital improvements). Accordingly, the City project would not be of a dollar amount and scope compatible with a typical design/build project. Tetra Tech did share at the Town Hall meeting that the City had attempted the design/build option in connection with the purchase of the UV equipment for the Sewer Plant this year but after the promised savings turned out to be false returned to the traditional bid process in purchasing the equipment and constructing the project. As Council may recall, the City also studied this option in connection with our Civic Center and again, we learned the purchase price for the Civic Center was not sufficient to generate interest for such an option. We are happy to consider this method in pursuing construction of various portions of these capital projects if we believe we can generate cost savings.

Tonight, Council has continued the June 21, 2016 public hearing in order to provide an additional opportunity for additional public comment and input to these increasing sewer rates and GFCs.

Conclusion

The City has been aware of significant deficiencies at its Sewer Plant for almost 4 years and has been studying the best long term solution with its consultant in consultation with Department of Ecology. The final draft of North Bend's Capital Facilities Plan has identified $15.6 million in improvements through the year 2029 to address various regulatory problems, inflow and infiltration issues, collection system

City Council Agenda Bill

issues, staffing issues, O&M and accordingly, it is time to increase sewer rates and the City's connection fee or GFC to fully fund the improvements and ongoing operation costs. Staff encourages Council to adopt the attached Ordinance providing for this additional revenue.
COMMITTEE REVIEW AND RECOMMENDATION: This item was reviewed by the Finance and Administration Committee at their June 7, 2016 meeting who recommended revisions. This item represents the revisions recommended.
RECOMMENDED ACTION: **MOTION to approve AB16-076, an ordinance setting new Sewer Rates and General Facilities Charges and amending the Taxes, Rates & Fees Schedule, as a first and final reading.**

RECORD OF COUNCIL ACTION

Meeting Date	*Action*	*Vote*
June 21, 2016	AB16-070 Continued to July 19, 2016	
July 19, 2016		

ORDINANCE

AN ORDINANCE OF THE CITY OF NORTH BEND, WASHINGTON, INCREASING SEWER UTILITY RATES AND SEWER GENERAL FACILITY CHARGES AND AMENDING THE TAXES, RATES, AND FEES SCHEDULE

WHEREAS, the City of North Bend ("City") operates a sewer and stormwater utility as authorized by Chapter 35.67 RCW; and

WHEREAS, general facilities charges ("GFCs") are collected by the City for each new Equivalent Residential Unit added to the sewer utility, and those GFCs are designated to pay for a proportionate share of the existing sewer infrastructure as well as a proportionate share of future capital projects over a five-year period; and

WHEREAS, the City's existing sewer customers are responsible for paying for repairs to existing infrastructure within the sewer system; and

WHEREAS, the City Council adopted Ordinance 1084, the Taxes, Rates and Fees Schedule, effective November 2, 1999; and

WHEREAS, the Taxes, Rates and Fees Schedule, which includes sewer rates and GFCs, was last amended by Ordinance 1586, effective May 16, 2016; and

WHEREAS, the City last studied and adjusted sewer rates and GFCs in 2012; and

WHEREAS, the cost of operations to process sewer has increased at a rate equal to or higher than inflation; and

WHEREAS, numerous needs have been identified at the wastewater treatment plant (WWTP) in order to continue providing sewer service in the City; and

WHEREAS, the City contracted with Tetra Tech, Inc. to develop a Sewer Capital Facilities Plan, Sewer Comprehensive Plan, and Sewer Rate Study; and

WHEREAS, Tetra Tech, Inc. has identified approximately $15 million worth of capital improvement projects at the WWTP to be accomplished within the next five years; and

WHEREAS, the City's sewer rates and GFCs have been re-calculated to recover costs necessary to make improvements to repair those existing deficiencies identified during the planning process with Tetra Tech, Inc.; and

WHEREAS, the City Council desires to revise the sewer rate structure such that all classes of customers are subject to the same base rate and usage fees, except seniors, low-income, and those customers outside the City limits; and

WHEREAS, the City Council desires to revise the sewer rate structure to encourage water conservation practices by lowering the base fixed fee and raising the variable usage fee; and

WHEREAS, the City Council finds it appropriate to the amend Taxes, Rates and Fees Schedule to reflect increased costs associated with providing sewer services as well as sewer public facilities and infrastructure;

NOW, THEREFORE, THE CITY COUNCIL OF THE CITY OF NORTH BEND, WASHINGTON, DOES HEREBY ORDAIN AS FOLLOWS:

Section 1. Sewer Rates. The Taxes, Rates, and Fees Schedule as adopted by Ordinance 1084 and last amended by Ordinance 1586, is amended in part by repealing Section 13.36, *Sewer Rates*, and replacing it with a new Section 13.36, *Sewer Rates*, to read as follows:

13.36	**Sewer Rates**	
13.36.190	Sewer Permits – Application Fee, Review & Inspection	$50 plus actual cost for application review and installation inspection

13.36.270(A)

DESCRIPTION		TAX, RATE, OR FEE	TAX, RATE, OR FEE	TAX, RATE, OR FEE	TAX, RATE, OR FEE	TAX, RATE, OR FEE
		Effective 9/1/2016	**Effective 1/1/2017**	**Effective 1/1/2018**	**Effective 1/1/2019**	**Effective 1/1/2020**
Single-family Residential Units (inside City limits) including duplexes, triplexes, apartment houses, condominiums, trailer courts & other multifamily, **provided each unit is supplied with a separate water meter**		$ 55.45	$ 62.49	$ 67.65	$ 73.23	$ 79.09
PLUS						
per cubic meter of water usage		$ 5.54	$ 6.24	$ 6.75	$ 7.31	$ 7.89

	over the first **ten** CM						
	Senior/Low Income Rate		$ 25.43	$ 28.66	$ 31.02	$ 33.58	$ 36.27
13.36.270(B)			**Effective 9/1/2016**	**Effective 1/1/2017**	**Effective 1/1/2018**	**Effective 1/1/2019**	**Effective 1/1/2020**
	Multi-family Residential: single family, duplexes, triplexes, apartment houses, condominiums, trailer courts & other multi-family dwellings(**inside City limits**) **served jointly by one water meter,** *per unit*		$ 55.45	$ 62.49	$ 67.65	$ 73.23	$ 79.09
	PLUS						
	per cubic meter of water usage over the first **ten** CM		$ 5.54	$ 6.24	$ 6.75	$ 7.31	$ 7.89
13.36.270(C)			**Effective 9/1/2016**	**Effective 1/1/2017**	**Effective 1/1/2018**	**Effective 1/1/2019**	**Effective 1/1/2020**
	Mixed Use (residential/commercial) **(inside City limits)***served by one water meter*:						
	One Commercial Base Charge		$ 55.45	$ 62.49	$ 67.65	$ 73.23	$ 79.09
	PLUS						
	MultiFamily Charge *(per each Residential unit)*		$ 55.45	$ 62.49	$ 67.65	$ 73.23	$ 79.09
	PLUS						
	per cubic meter of water usage (at Commercial Rate) over the first **twenty** CM		$ 5.54	$ 6.24	$ 6.75	$ 7.31	$ 7.89
13.36.270(D)			**Effective 9/1/2016**	**Effective 1/1/2017**	**Effective 1/1/2018**	**Effective 1/1/2019**	**Effective 1/1/2020**

13.36.270(E)

Commercial and All Other Users (inside City limits)		$ 55.45	$ 62.49	$ 67.65	$ 73.23	$ 79.09
PLUS						
per cubic meter of water usage over the first **ten** CM		$ 5.54	$ 6.24	$ 6.75	$ 7.31	$ 7.89
		Effective 9/1/2016	**Effective 1/1/2017**	**Effective 1/1/2018**	**Effective 1/1/2019**	**Effective 1/1/2020**
Commercial and All Other Users (**outside** City limits)		$ 83.17	$ 93.73	$ 101.46	$ 109.83	$ 118.62
PLUS						
per cubic meter of water usage over the first **ten** CM		$ 8.32	$ 9.38	$ 10.15	$ 10.99	$ 11.87

13.36.270(F) If any user, by reason of the user's activities, in in two or more of the above classifications, the rate charged shall be the highest rate.

13.36.270(G) Sewer Charge – Independent Water Purveyor

13.36.270(H) Sewer Charge – Private Source

13.36.270(J) Sewer Service Surcharge 6% of Total Monthly Charges

The rates published are effective as of the dates noted; provided, that the last-effective published rates will be automatically increased/decreased based on CPI-W Index for Seattle/Tacoma area (August to August comparison) for each subsequent year beginning January 1, 2021. For the months of April through October, consumption amounts for sewer services will be based on the average water consumption during the months of November through March, so as not to penalize sewer customers using water for lawn and garden irrigation and other summer activities.

Section 2. General Facilities Charges: The Taxes, Rates and Fees Schedule as adopted by Ordinance 1084 and last amended by Ordinance 1586, is amended in part by repealing Section 13.38.040(A) and replacing it with a new Section 13.38.040(A) to read as follows:

13.38.040(A)

	Effective 09/01/16*		
Equivalent Residential Unit (ERU) Based on water meter size:	**ERUs**	**Charge Non-ULID #6**	**Charge ULID #6**
5/8" or 3/4"	1	$ 10,222.00	$ 7,699.00

1"	2.5	$ 25,555.00	$ 19,247.50
1-1/2"	5	$ 51,110.00	$ 38,495.00
2"	8	$ 81,776.00	$ 61,592.00
3"	16	$ 163,552.00	$ 123,184.00
4"	25	$ 255,550.00	$ 192,475.00

*The charges in this table will be automatically increased each year on January 1st, compared to the prior year, by the percentage reflected in the Seattle ENR Construction Cost Index (CCI).

Section 3. Severability: Should any section, paragraph, sentence, clause or phrase of this ordinance, or its application to any person or circumstance, be declared unconstitutional or otherwise invalid for any reason, or should any portion of this ordinance be pre-empted by state or federal law or regulation, such decision or pre-emption shall not affect the validity of the remaining portions of this ordinance or its application to other persons or circumstances.

Section 4. Effective Date: This ordinance shall be published in the official newspaper of the City, and shall take effect and be in full force on September 1, 2016.

ADOPTED BY THE CITY COUNCIL OF THE CITY OF NORTH BEND, WASHINGTON, AT A REGULAR MEETING THEREOF, THIS 19TH DAY OF JULY, 2016.

CITY OF NORTH BEND:

_____

Kenneth G. Hearing, Mayor

APPROVED AS TO FORM:

_____

Michael R. Kenyon, City Attorney

ATTEST/AUTHENTICATED:

_____

Susie Oppedal, City Clerk

Published:
Effective: September 1, 2016

FCS GROUP
Solutions-Oriented Consulting

Memorandum

To: Don DeBerg, City Engineer **Date:** June 16, 2016

From: Angie Sanchez Virnoche, FCS GROUP Principal

CC: Mark Rigos, City Public Works Director; John Markus and Jim Santroch, Tetra Tech

RE: Sewer Rate Study

FCS GROUP (FCS) is a sub- consultant to Tetra Tech for the City of North Bend Wastewater Facilities Plan (WWFP) and was retained to perform a Sewer Rate Study during the initial phase of the project to recommend changes to existing sewer rates to pay for current and upcoming sewer system costs through the year 2020. The rate study focuses on identifying the appropriate rate adjustments that will be required to ensure that adequate funds are available for operation, maintenance and for implementation of capital improvements to the sewer utility from present through year 2020.

This memorandum discusses the methodology and outcomes of the sewer rate study developed that allow the sewer utility to remain financially viable during the planning period. This study considers the City's current and recommended financial and policy obligations, operation and maintenance needs, and the financial impact of completing the 2016-2020 capital projects identified in the WWFP.

Revenue Requirement

The sewer utility is an enterprise fund, meaning it is self-sufficient and rates and fees collected for sewer service support the financial obligations of the utility. The primary source of funding is derived from ongoing monthly charges for service, developer connection charges and a minor amount of additional revenue coming from interest earnings. The City controls the level of user charges and, subject to statutory authority, can adjust user charges as needed to meet financial objectives. The City maintains a fund structure and implements financial policies that target management of a financially viable and fiscally responsible sewer system.

A revenue requirement analysis forecasts the amount of annual revenue that needs to be generated by user rates in a given year to meet that year's expected financial obligations. The analysis incorporates operating revenues, O&M expenses, debt service payments, rate-funded capital needs, and all other identified revenues or expenses related to operation of the City's wastewater facilities. In addition to annual operating costs, the revenue needs also include debt covenant requirements and specific fiscal policies and financial goals of the City. The objective of the rate study is to evaluate the sufficiency of the current level of rates.

The revenue requirement is developed from 2016 budget documents along with other key factors and assumptions to develop a complete portrayal of the City's annual financial obligations. The following is a list of the key revenue and expense factors and assumptions used in the development of the rate study:

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- **Revenue** – The City has two general revenue sources: revenue from charges for service (rate revenue) and miscellaneous (non-rate) revenue. In the event of a forecasted annual shortfall, rate revenue can be increased to meet the annual revenue requirement. The non-rate revenue of interest earnings is forecast based on fund balances and an assumed interest earnings rate.

- **General Facility Charge (GFC) Revenue** – The GFC is a fee imposed as a condition of service on new customers connecting to the system. The current GFC of $5,852 is expected to generate $183,000 in revenue from 32 ERUs in 2016. The GFC has been updated and is expected to increase to $10,222 per ERU for City customers and $7,699 per ERU for ULID customers. An additional $100,000 may be generated in 2016 with an implementation date for new GFCs of August 1, 2016 (estimated 10 units connecting at the City charge).The GFC update is discussed later in this memorandum. Per the City's request, the revenue generated from adoption of the updated GFCs has been included in the rate study. The GFCs are expected to generate revenue in the range of $935,000 to $1.1 million during 2017-2020. Anticipated new ERUs range from 100-113 per year. This revenue source is used to fund the capital improvement program.

- **Growth** – Rate revenue is escalated based on an annual average growth rate of 4.33% beginning in 2017. It is lower than the growth rate included in the WWTP Update to recognize the lower rate of actual growth the City has been experiencing over the last few years and the anticipated level of growth that is anticipated in the future.

- **Expenses** – O&M expense projections are based on the 2016 budget and are forecast to increase with general cost inflation of 2.29 percent, labor cost inflation of 2.87 percent, and benefit cost inflation of 8.0 percent. Budget figures were used for the 2016 taxes; future taxes are calculated based on forecasted revenues and prevailing tax rates.

- **Additional O&M expenses** – The WWTP update identified additional O&M costs associated with power, chemicals, material, labor, lab testing, sludge handling, equipment replacement and collection system asset management. The additional O&M expenses range from $286,000 to $795,000 per year.

- **Existing Debt** – The City currently has a total of five outstanding sewer debt issues related to a 2010 water and sewer refunding revenue bond, 2015 LTGO refunding bonds, I&I SRF Phase I loan, I&I SRF Phase II loan, and a WWTP Phase II SRF loan. Total existing debt obligations range from $390,000 in 2016 decreasing to $324,000 in 2020 with the elimination of the I&I Phase I loan in 2019.

- **Future Debt** – The capital financing strategy developed for this WWFP Update indicates that borrowing will be required. The City will have access to a $3.5 million line of credit to meet short-term capital funding needs during 2016 – 2019. The funds will be rolled into two bond issues – the first in 2017 for $6.9 million and the second in 2019 for $5.1 million. Both revenue bonds are for a 25-year term and have interest rates of 3.87 percent and 4.14 percent, respectively.

- **Capital Funding Plan** - The capital plan developed for the initial five-years of the WWFP Update totals $15.6 million (inflated costs to the year of construction). **Table 1** provides an annual summary of the capital costs.

Table 1. Summary of Annual Capital Costs

Year	Cost
2016	$2,801,000
2017	904,928
2018	4,319,939
2019	2,507,019
2020	5,139,172
Total	$15,672,059

- **Fund Balances** - Operating reserves are designed to provide a liquidity cushion to ensure that adequate cash working capital will be maintained to deal with significant cash balance fluctuations such as seasonal fluctuations in billings and receipts, unanticipated cash expenses, or lower than expected revenue collections. The City's current policy is to maintain a minimum balance in the Operating Fund equal to 90 days of O&M expenses. This balance is maintained throughout the five year time period and ranges from $360,000 to $530,000.

- **Capital Fund** – A capital fund is an amount of cash set aside in case of an emergency should a piece of equipment or a portion of the utility's infrastructure fail unexpectedly. The reserve also could be used for other unanticipated capital needs including capital project cost overruns. Industry practices range from maintaining a balance equal to 1 to 2 percent of fixed assets, an amount equal to a 5-year rolling average of CIP costs, or an amount determined sufficient to fund equipment failure (other than catastrophic failure). The minimum capital fund target for the City has been set at 2 percent of sewer utility asset value ranging from $750,000 to $990,000. The fund balance is maintained above this minimum target level for the five year period under review.

SUMMARY OF REVENUE REQUIREMENT

A revenue requirement analysis enables the City to set utility rate structures which fully recover the total cost of operating the sewer system: capital improvement and replacement, operations, maintenance, general administration, fiscal policy attainment, cash reserve management, and debt repayment. **Table 2** provides a summary of the five-year revenue requirement and rate strategy based on the forecast of revenues, expenditures, fund balances and fiscal policies.

The financial forecast indicates that there is an existing deficiency at current rate levels, and that sewer rates will need to increase to meet the total annual revenue requirement in all years. Rates would need to increase by 12.7 percent in 2016 and 2017, 8.25 percent in 2018 and 2019 and 8.0 percent in 2020.

Table 2. Summary of Annual Revenue Requirements

	2016	2017	2018	2019	2020
Revenues					
Rate Revenues Under Existing Rates	$ 1,780,500	$ 1,857,577	$ 1,937,991	$ 2,021,887	$ 2,109,413
Non-Rate Revenues	2,000	3,955	4,195	4,205	4,255
Total Revenues	**$ 1,782,500**	**$ 1,861,532**	**$ 1,942,186**	**$ 2,026,091**	**$ 2,113,668**
Expenses					
Cash Operating Expenses	$ 1,468,388	$ 1,872,891	$ 1,933,744	$ 2,040,488	$ 2,189,293
Existing Debt Service	390,251	389,722	389,638	326,907	324,071
New Debt Service	23,764	89,096	321,646	621,925	851,750
Rate Funded System Reinvestment	-	-	-	-	-
Total Expenses	**$ 1,882,403**	**$ 2,351,708**	**$ 2,645,028**	**$ 2,989,319**	**$ 3,365,115**
Net Surplus (Deficiency)	**$ (99,903)**	**$ (490,176)**	**$ (702,842)**	**$ (963,228)**	**$ (1,251,447)**
Additions to Meet Coverage	-	-	-	-	-
Total Surplus (Deficiency)	**$ (99,903)**	**$ (490,176)**	**$ (702,842)**	**$ (963,228)**	**$ (1,251,447)**
Annual Rate Adjustment	**12.70%**	**12.70%**	**8.25%**	**8.25%**	**8.00%**
Cumulative Annual Rate Adjustment	**12.70%**	**27.01%**	**37.49%**	**48.83%**	**60.74%**
Rate Revenues After Rate Increase	$ 1,931,249	$ 2,359,363	$ 2,664,573	$ 3,009,265	$ 3,390,698
Additional In-Lieu of Taxes from Rate Increase	$ 2,864	$ 9,534	$ 13,806	$ 18,761	$ 24,345
Net Cash Flow After Rate Increase	**$ 47,982**	**$ 2,075**	**$ 9,933**	**$ 5,389**	**$ 5,493**
Coverage After Rate Increases	**6.16**	**9.21**	**4.55**	**3.11**	**2.70**

It is important that the City revisit the revenue requirement and rate forecast every year when budgets are developed to ensure that the rate projections developed remain adequate. Any significant changes in revenue or expenses from what was included in the plan should be incorporated and future rates should be adjusted as needed.

DEBT SERVICE COVERAGE

Debt service coverage is based on a commitment made by the City when issuing revenue bonds and some other forms of long-term debt. As a security condition of issuance, the City would be required per covenant to agree that the revenue bond debt would have a higher priority for payment (a senior lien) compared to most other expenditures; the only outlays with a higher lien are O&M expenses. Debt service coverage is expressed as a multiplier of the annual revenue bond debt service payment. For example, a 1.25 coverage factor means revenue must be sufficient to pay O&M expenses, annual revenue bond debt service payments, plus an additional 25 percent of annual revenue bond debt service payments. Targeting a higher coverage factor can help the City achieve a better credit rating and provide lower interest rates for future debt issues. The City's current target for debt service coverage is 1.50. As shown in the coverage after rate increases in **Table 2**, the City is well above this established target ratio.

EXISTING AND PROJECTED RATES

The City's existing sewer rate structure consists of a fixed monthly charge that is the same for all classes of service (except Senior/Low Income) and a variable rate per CM. The fixed charge includes 10 CM of

average winter usage (20 CM for Mixed Use customers) per unit for Residential and Multi Family customers and per account for Commercial customers. The variable rate is applied per CM to winter average usage in excess of the 10 CM (20 CM for Mixed Use) allowance. **Table 3** provides a summary of the existing sewer utility rates.

Table 3: Existing Sewer Utility Rates

Individual Classes	2016		
	Fixed	per CM	*Notes:*
Residential	$ 72.94	$ 0.77	*per dwelling unit*
Senior/Low Income	33.46		*per dwelling unit*
Multi-Family	72.94	0.77	*per dwelling unit*
Mixed Use - MF	72.94	2.79	*per dwelling unit*
Mixed Use - Commercial	72.94	2.79	*per account*
Commercial	72.94	2.79	*per account*
Commercial Outside	111.98	3.43	*per account*

Note:

1. Per CM rate is applied to usage over the 10CM (or 20CM for Mixed Use) winter average usage.

The Finance and Administration Committee (F&A) on May 3, 2016 identified that there was an apparent discrepancy in the effective sewer rates being charged to the average residential user as compared to the average commercial /industrial user. The F&A Committee had the following observations:

- The average commercial/industrial user was paying less per cubic meter than the average residential user.
- The existing rate structure did not encourage water conservation in all classes of customers

Based on these observations, the City requested FCS to restructure its sewer rates. Specifically, the City requested FCS to design rates, such that, the average cost per cubic meter (CM) for an average Single Family Residential customer bill and an average Commercial customer bill would be equal. The requested rate structure is not based on a traditional cost of service analysis but rather is based on accomplishing the F&A Committee policy objectives.

Table 4 presents a simplified sensitivity analysis to show the effect of the existing sewer rate structure as compared to the alternative rate structure on both residential and commercial customers from a spectrum of monthly wastewater volume discharges. The alternative rate combines all classes of service into one rate schedule and maintains the existing approach to billing the variable rate to winter average use in excess of the 10 CM (20 CM for Mixed Use) allowance. The cost differences show only the change associated with moving from the existing rate structure to the alternative rate structure and do not incorporate any rate increases needed to implement the 5 year CIP and future operations costs.

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Table 4: Impact on Rates of Alternative Rate Structure

RESIDENTIAL

Monthly CM	Existing		Alternative		$	%	
	Bill	$/CM	Bill	$/CM	Difference	Difference	Notes:
7.05	$ 72.94	$ 10.35	$ 49.20	$ 6.98	$ (23.74)	-32.55%	*Half the average use*
14.09	**76.09**	**5.40**	**69.34**	**4.92**	**(6.75)**	**-8.87%**	***Average Use***
28.19	86.94	3.08	138.68	4.92	51.73	59.50%	*Double the average use*
42.28	97.80	2.31	208.02	4.92	110.22	112.71%	*Three times the average use*

COMMERCIAL

Monthly CM	Existing		Alternative		$	%	
	Bill	$/CM	Bill	$/CM	Difference	Difference	Notes:
29.68	$ 127.86	$ 4.31	$ 146.05	$ 4.92	$ 18.19	14.23%	*Half the average use*
59.37	**210.68**	**3.55**	**292.10**	**4.92**	**81.42**	**38.64%**	***Average Use***
118.74	376.32	3.17	584.20	4.92	207.88	55.24%	*Double the average use*
178.11	541.97	3.04	876.30	4.92	334.33	61.69%	*Three times the average use*

The average monthly use for a residential customer is 14.09 CM. The breakeven usage level between the existing and alternative Residential rate structure is 15.7 CM per month. Under the alternative rate structure, all Residential (non Multi Family) customers using less than 15.7 CM per month show a reduced monthly bill. Customers using above 15.7 CM will experience an increase in their monthly bill. A customer using three (3) times the average would experience a 112.7 percent increase.

For commercial customers, the alternative structure increases most customers' bills compared to the existing structure. The average customer will experience an increase of 38.6 percent. Unlike Residential customers, the Commercial customer class is less homogenous in its usage behavior due to the different nature of each account (e.g. large grocery store versus a small business). This means usage will vary by individual customer and can deviate further from the average compared to the Residential class. A commercial customer using three (3) times the average would experience a 61.7 percent increase.

Table 5 shows the monthly rates under the alternative rate structure requested for the 2016-2020 time period. The rates are set to incorporate the proposed overall annual system increases of 12.7 percent in 2016-2017, 8.25 percent in 2018 and 2019 and 8 percent in 2020. The rate increases are required to meet the sewer system's overall financial obligations and provide sufficient revenue to implement the five-year capital improvement program.

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Table 5: Monthly Sewer Utility Rates

Description	Alternative	2016	2017	2018	2019	2020
Proposed Increases		**12.70%**	**12.70%**	**8.25%**	**8.25%**	**8.00%**
Monthly Fixed Charges (Includes 10 CM)						
Single Family (per account)	$ 49.20	$ 55.45	$ 62.49	$ 67.65	$ 73.23	$ 79.09
Senior/ Disabled (per account)	22.57	25.43	28.66	31.02	33.58	36.27
Multi Family (per unit)	49.20	55.45	62.49	67.65	73.23	79.09
Commercial (per account)	49.20	55.45	62.49	67.65	73.23	79.09
Mixed Use						
Commercial (per account)	49.20	55.45	62.49	67.65	73.23	79.09
Per Residential (per unit)	49.20	55.45	62.49	67.65	73.23	79.09
Outside City	73.80	83.17	93.73	101.46	109.83	118.62
Volume Charges (per CM > 10 CM)						
Single Family	$ 4.92	$ 5.54	$ 6.24	$ 6.75	$ 7.31	$ 7.89
Senior/ Disabled	n/a	n/a	n/a	n/a	n/a	n/a
Multi Family	4.92	5.54	6.24	6.75	7.31	7.89
Commercial	4.92	5.54	6.24	6.75	7.31	7.89
Mixed Use*	4.92	5.54	6.24	6.75	7.31	7.89
Outside City	7.38	8.32	9.38	10.15	10.99	11.87

Table 6 provides both a residential and commercial bill comparison incorporating the 2016 rate increase of 12.7 percent and applying the alternative rate structure

Table 6: Bill Comparison – Existing to 2016 Rates (Alternative Rate Structure)

RESIDENTIAL

Monthly CM	Existing		Alternative		$	%	
	Bill	$/CM	Bill	$/CM	Difference	Difference	*Notes:*
7.05	$ 72.94	$ 10.35	$ 55.45	$ 7.87	$ (17.49)	-23.98%	*Half the average use*
14.09	**76.09**	**5.40**	**78.13**	**5.54**	**2.04**	**2.67%**	***Average Use***
28.19	86.94	3.08	156.20	5.54	69.26	79.66%	*Double the average use*
42.28	97.80	2.31	234.28	5.54	136.49	139.56%	*Three times the average use*

COMMERCIAL

Monthly CM	Existing		Alternative		$	%	
	Bill	$/CM	Bill	$/CM	Difference	Difference	*Notes:*
29.68	$ 127.86	$ 4.31	$ 164.50	$ 5.54	$ 36.64	28.66%	*Half the average use*
59.37	**210.68**	**3.55**	**328.96**	**5.54**	**118.28**	**56.14%**	***Average Use***
118.74	376.32	3.17	657.87	5.54	281.54	74.81%	*Double the average use*
178.11	541.97	3.04	986.78	5.54	444.81	82.07%	*Three times the average use*

GENERAL FACILITY CHARGES

The general facility charge is imposed as a condition of service on new customers connecting to the system. Revised Code of Washington 35.92.025 grants the authority to fix rates and charges for connecting to water and sewer systems. In addition to any other costs related to physically connecting a customer to the system, the connection fee is typically based on a blend of historical and planned future capital investments in system infrastructure

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The purpose of the connection fee is two-fold: 1) to provide a source for capital financing and 2) to equitably recover a proportionate share of utility plant-in-service costs from new customers. In the absence of connection fees, growth-related costs would be borne in large part by existing customers. The cost of the system to be recovered by connection fees can be defined in two parts: an existing cost portion based on historical investments in existing infrastructure, and a future cost portion that recovers costs related to planned capital projects.

The existing cost basis is intended to recognize the current ratepayers' net investment in the original cost of system assets. The total cost of the sewer system reflects:

- ***Utility Plant-In-Service:*** The existing cost basis is composed of the original cost of plant-in-service, as documented in the City's 2015 fixed asset schedule.
- ***Less: Contributed Capital:*** Assets funded by developers or grants are excluded from the cost basis on the premise that the connection fee should only recover costs actually incurred by the City. Assets funded by special assessments are also excluded from the cost basis to avoid double charging customers for assets that were funded through those assessments. Of specific note is ULID No. 6 capital contributions.
- ***Plus: Interest on Utility-Funded Assets***: RCW 35.92.025 and subsequent legal interpretations provide a guideline for connection charges which suggests that such charges can include interest on an asset at the rate applicable during the time of construction. Using the historical Bond Buyer Index for 20-year term bonds, interest can accumulate for a maximum of ten years from the date of construction for any particular asset, and cannot exceed an interest earnings rate above 10% in any given year. Conceptually, this interest provision attempts to account for opportunity costs that the City's customers incurred by supporting investments in infrastructure rather than having it available for investment or other uses.
- ***Less: Net Debt Principal Outstanding:*** Another adjustment to the existing system cost basis is to deduct the net liability of outstanding utility debt, recognizing that new customers will bear a proportionate share of this debt related to existing assets through their utility rates. Therefore, the cost of those assets charged to new development is offset to some degree by the remaining debt liability. Since the utility typically has cash resources that are not included in the system cost basis, the net debt load is defined as total debt minus outstanding cash and investments.

Table 7 summarizes the key components of the existing cost basis.

Table 7: Existing Cost Basis

EXISTING COST BASIS	TREATMENT	COLLECTION	GENERAL	TOTAL
Plant in service	$ 12,505,821	$ 19,853,929	$ 1,361,110	**$ 33,720,860**
less: ULID #6 share	(2,224,558)	(15,239,703)		**(17,464,261)**
Plant net of ULID #6 share	**$ 10,281,263**	**$ 4,614,226**	**$ 1,361,110**	**16,256,599**
less: CIAC (City)	(1,090,956)	(125,331)	-	**(1,216,287)**
plus: Interest (City)	3,598,664	2,508,171	687,679	**6,794,514**
less: Net debt principal outstanding	(1,020,508)	(558,337)	(163,485)	**(1,742,331)**
TOTAL EXISTING COST BASIS	**$ 11,768,463**	**$ 6,438,728**	**$ 1,885,304**	**$ 20,092,496**

The future cost basis can include utility capital projects planned for construction and identified in the WWFP Update for the next five years. Each project in the capital improvement program was allocated as either "growth/expansion" or "repair/replacement."

- ***Total Future Capital*:** Total capital costs for the 2016 through 2020 time period in 2016 dollars.
- ***Repair and Replacement (R&R) Projects:*** Projects costs allocated to the repair/replacement category are excluded from the cost basis. The cost of the utility asset being replaced is included in the existing cost basis. Excluding repair/replacements avoids double-counting the cost of a utility asset by including it in both existing and future cost totals.

Table 8 summarizes the key components of the future cost basis.

Table 8: Existing Cost Basis

FUTURE COST BASIS	TREATMENT	COLLECTION	GENERAL	TOTAL
Total future capital	$ 12,250,000	$ 1,289,000	$ 625,000	**$ 14,164,000**
less: R&R	(2,372,350)	(615,450)	(251,750)	**(3,239,550)**
TOTAL FUTURE COST BASIS	**$ 9,877,650**	**$ 673,550**	**$ 373,250**	**$ 10,924,450**

In order to calculate an equitable share of the system costs for new connections, the GFC cost basis is divided by the number of equivalent residential units (ERUs) the system can serve when the five-year CIP is complete. The total GFC cost basis, divided by total capacity served by the system, determines the equitable unit cost of system buy-in as a basis for setting the GFC. The engineering analysis indicated that the five-year CIP would support a capacity of 4,492 ERUs estimated to be reached in 2029.

The general facility charge calculation is summarized in **Table 9**. The charge was split between City and ULID as all customers share in the treatment and general costs, however the ULID is not charged for collection infrastructure as it is recovered through the ULID No.6 assessment.

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Table 9: Existing Cost Basis

GENERAL FACILITY CHARGE	TREATMENT	COLLECTION	GENERAL	TOTAL
EXISTING COST BASIS				
Combined Share				
Existing cost basis	$ 11,768,463		$ 1,885,304	**$ 13,653,768**
Allocable base (ERUs)	4,492		4,492	
Combined Share Existing Cost Basis Charge	**$ 2,620**	**$ -**	**$ 420**	**$ 3,040**
City Only Share				
Existing cost basis		$ 6,438,728		**$ 6,438,728**
Allocable base (MCEs)		3,298		
City Only Share Eixsting Cost Basis Charge	**$ -**	**$ 1,952**	**$ -**	**$ 1,952**
FUTURE COST BASIS				
Combined Share				
Future cost basis	$ 9,877,650		$ 373,250	**$ 10,924,450**
Allocable base (MCEs)	2,200		2,200	
Combined Share Future Cost Basis Charge	**$ 4,490**	**$ -**	**$ 170**	**$ 4,659**
City Only Share				
Future cost basis		$ 673,550		**$ -**
Allocable base (MCEs)		1,180		
City Only Share Future Cost Basis Charge	**$ -**	**$ 571**	**$ -**	**$ 571**
TOTAL GENERAL FACILITY CHARGE - CITY	$ 7,110	$ 2,523	$ 589	**$ 10,222**
TOTAL GENERAL FACILITY CHARGE - ULID	$ 7,110	$ -	$ 589	**$ 7,699**

The updated GFC is $10,222 per ERU for City customers and $7,699 per ERU for ULID customers. The current charge is $5,852 and is based on the water meter size of new customers. The updated charge has changed this assessment to be based on an ERU equivalent. One ERU is defined as 2.57 persons per household.

It is anticipated that the GFC will be updated automatically increased each year on January 1st, compared to the prior year, by the percentage reflected in the Seattle ENR Construction Cost Index (CCI).

SUMMARY

The results of this analysis indicate that rate increases are necessary to fund ongoing operating needs and future debt requirements to fund the five-year CIP, as well as meet financial policy targets. Implementation of a 12.7 percent rate increase in 2016 and 2017, 8.25 percent annually in 2018 and 2019 and 8% in 2020 should provide for continued financial viability of the sewer system.

The alternative rate structure presented incorporate the overall system rate increases and adjust rates so that an average Residential user bill and average Commercial user bill results in an equal per CM unit rate. In addition, the rates accomplish the F&A Committee policy objectives of having an equal per CM rate for an average residential user bill and commercial/industrial user bill and enhance the water conservation signal by charging for use at a higher variable rate.

It is important to remember that the analysis performed in this memorandum assumes an annual growth rate of 4.33. If the future growth rates change, the proposed annual rate increases will need to be updated

and revised as the anticipated revenue may not be realized if growth is slower than estimated. If growth occurs at a greater rate than estimated, revenue targets will likely be exceeded therefore allowing less debt to be required in the future for capital projects and/or reducing future anticipated rate increases.

It is recommended that the City regularly review and update the key underlying assumptions that compose the multi-year rate plan to ensure that adequate revenues are collected to meet the City's total financial obligations.

Wastewater Rate Comparison

	2014	2012	% Increase*	Rate Type	2014 Rank	2012 Rank
Tamoshan	$115.70	$110.19	2.5%	Flat	1	1
City of Seattle	$105.75	$96.12	5.0%	Volume	2	3
City of Chehalis (within city limits)	$105.09	$99.03	3.1%	Volume	3	2
City of Shelton	$103.02	$74.62	19.0%	Volume	4	8
City of Tenino	$94.00	$94.00	0.0%	Flat	5	4
Olympic View	$82.68	$78.44	2.7%	Flat	6	7
City of Centralia (within city limits)	$82.58	$79.23	2.1%	Volume	7	6
Boston Harbor	$82.14	$79.75	1.5%	Flat	8	5
City of Bellevue	$79.03	$68.33	7.8%	Volume	9	13
City of Sumner	$76.09	$58.78	14.7%	Volume	10	14
Grand Mound	$75.81	$68.76	5.1%	Flat	11	12
City of Bonney Lake	$75.78	$70.04	4.1%	Volume	12	10
City of Longview (within city limits)	$75.69	$71.98	2.6%	Volume	13	9
City of Bremerton (within city limits)	$71.08	$68.97	1.5%	Volume	14	11
City of Auburn	$62.91	$55.20	7.0%	Flat	15	17
City of Puyallup	$61.63	$58.53	2.6%	Volume	16	15
City of Mount Vernon	$56.30	$55.40	0.8%	Volume	17	16
City of Renton	$55.73	$50.55	5.1%	Flat	18	20
City of Tacoma	$54.66	$49.88	4.8%	Volume	19	21
City of Kelso	$54.48	$52.22	2.2%	Flat	20	18
City of Olympia (LOTT)	**$54.29**	**$51.54**	**2.7%**	**Flat**	**21**	**19**
City of Yelm	$53.04	$48.39	4.8%	Flat	22	23
City of Lacey (LOTT)	**$52.51**	**$49.00**	**3.6%**	**Flat**	**23**	**22**
Lakehaven Sewer District (KC Metro)	$50.78	$48.39	2.5%	Volume	24	24
City of Tumwater (LOTT)	**$50.03**	**$47.62**	**2.5%**	**Flat**	**25**	**25**
City of Everett	$49.50	$46.70	3.0%	Flat	26	26
Lakehaven Sewer District (Pierce Co.)	$48.26	$40.65	9.4%	Volume	27	28
City of Vancouver	$43.97	$41.96	2.4%	Volume	28	27
Pierce County Sewer	$42.82	$37.83	6.6%	Flat	29	30
City of Snoqualmie	$42.16	$38.40	4.9%	Flat	30	29
City of Orting	$40.15	$35.00	7.4%	Flat	31	32
City of Hoquiam	$38.14	$36.59	2.1%	Flat	32	31
City of Bellingham (within city limits)	$35.07	$33.23	2.8%	Flat	33	34
Lakehaven Sewer District	$34.85	$33.99	1.3%	Volume	34	33
City of Aberdeen	$34.68	$30.16	7.5%	Flat	35	35
City of Edmonds	$27.73	$25.90	3.5%	Flat	36	36
Rate Average	**$63.00**	**$57.93**	**4.5%**			

* Percentage increase annualized over a two-year period.

SEWER TOWN HALL MEETING

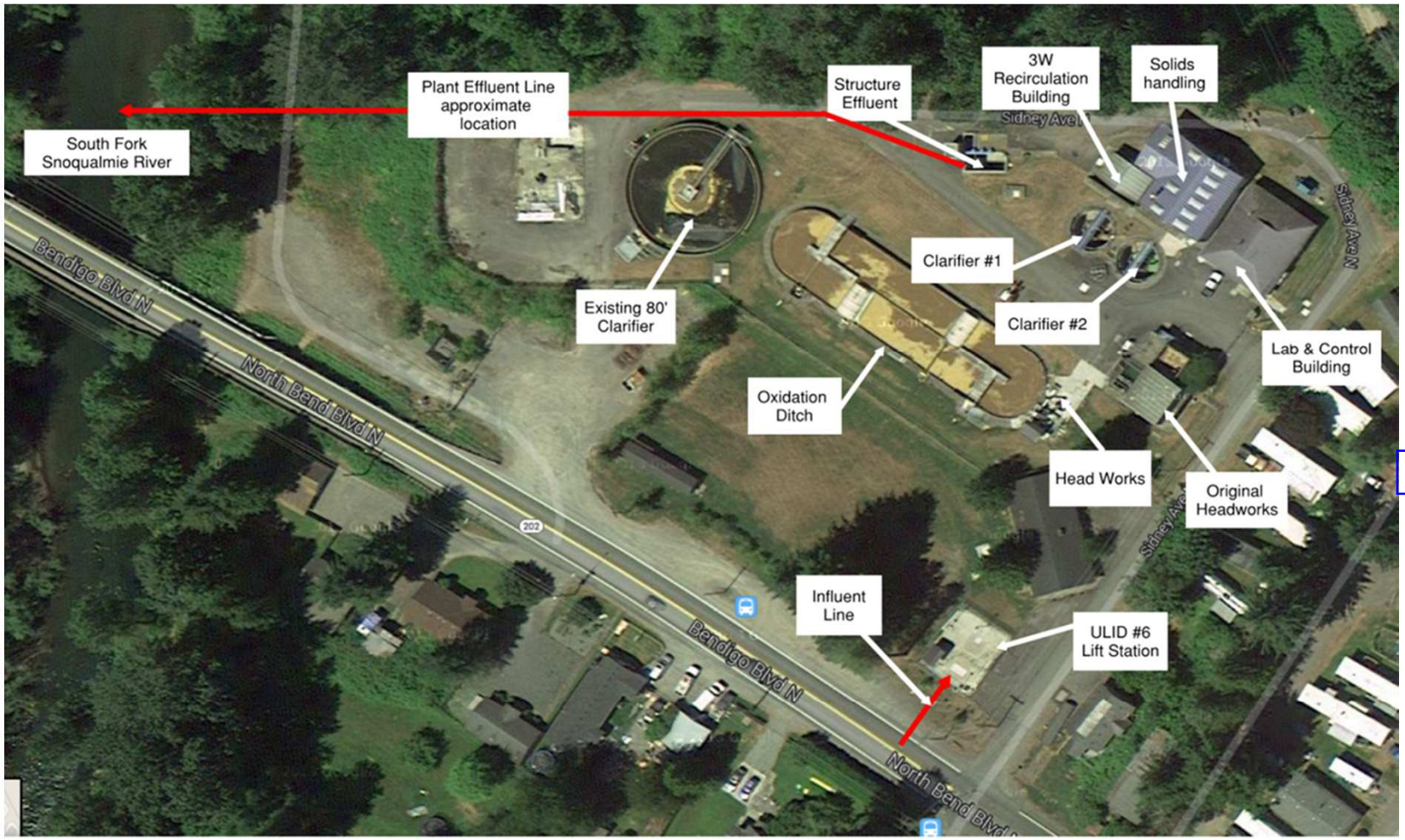
JULY 7TH, 2016

DISCUSSION OF INCREASING SEWER RATES

Agenda Ho

Council Packet

North Bend Sewer Plant



North Bend WWTP

Agenda Ho

Council Packet July 19, 2016

Capital Facilities Plan

City Studied 3 Options:

1. Regional Option – Contract with another provider for sewer = $63 million
2. Build a new Sewer Plant on new Property = $53 million
3. Remodel our existing Sewer Plant = $27 million

Agenda Ho
Council Packet July 19, 2016

Public Participation for Capital Facilities Plan

Public Meetings were Held

1. March 15, 2016 City Council Meeting
2. April 26, 2016 Public Meeting
3. Various Council Committees

Council and public supported least expensive option of remodeling existing Sewer Plant = $27 million

Agenda Ho
Council Packet July 19, 2016

Basics of Sewer Utility

- Enterprise Fund – Self supporting
- Residential and Commercial ratepayers
- Acronyms:
  - General Facility Charges (GFC) = connection fees to hook up to sewer
  - Equivalent Residential Unit (ERU) = typical sewer use in home comprised of 2.57 people

Agenda Ho
Council Packet July 19, 2016

ERUs - Residential vs. Commercial

Residential

One House = 1 ERU

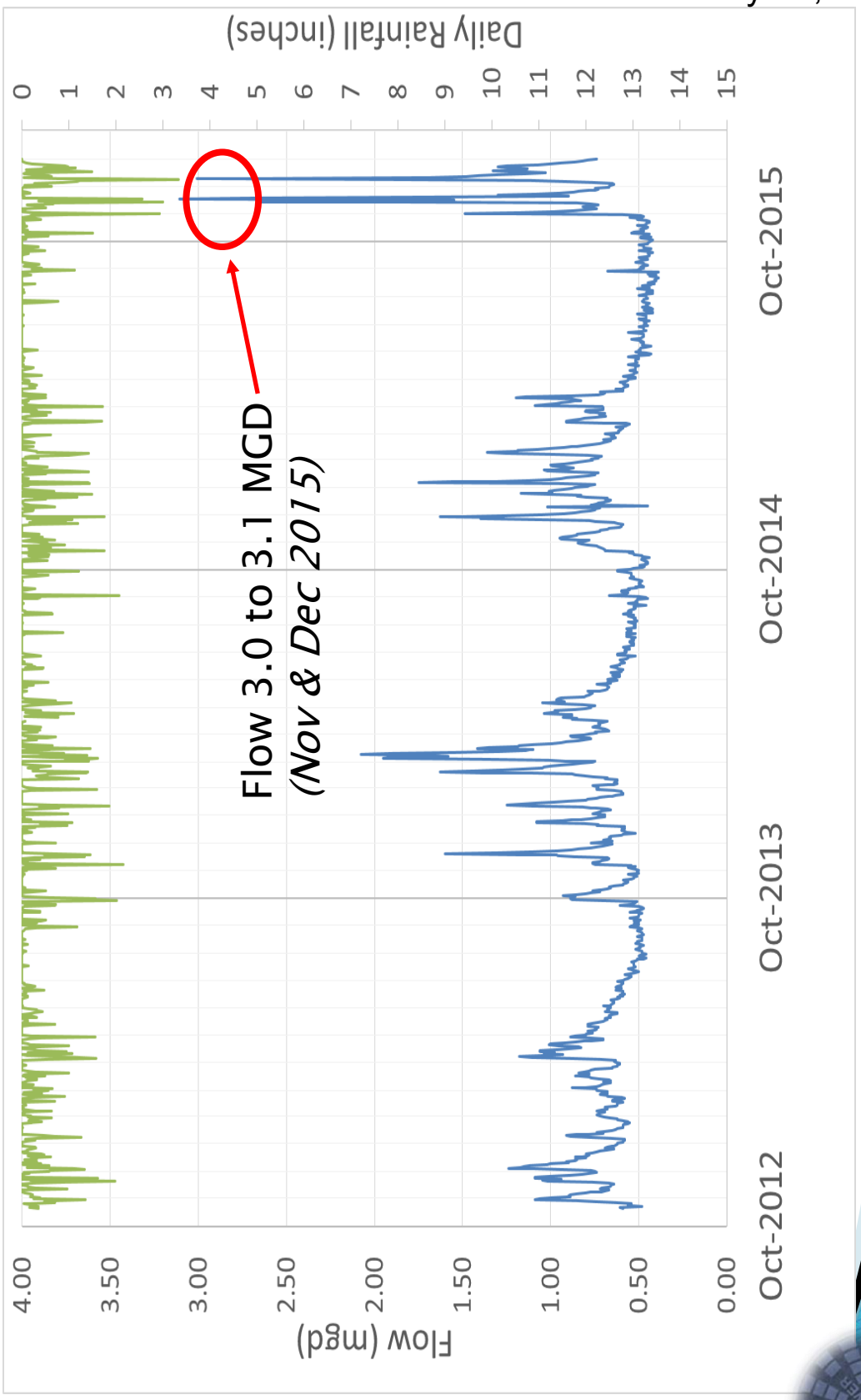
Commercial

Depends on use
(size of water meter)

How Many ERUs Are Available?

- How many ERUs do we have in our plant?
  - The City's Permit allows 2.58 mgd = 4,492 ERUs
- How many ERUs are already being used?
  - 2,292
- How many ERUs are available for new development?
  - You would think the answer would be:
    4,492 – 2,292 = 2,200 but that is **Incorrect.**
  - NOT all 2,200 are available for new development due to Inflow and Infiltration (also called I&I) which eats up sewer capacity.
  - Implementation of the next 3 years of capital improvements will allow most of the 2,200 ERUs to be available.

Impacts of I&I



Impacts of I&I

How many new ERUs are planned?

Does this rate increase mean we are planning for thousands of new homes?

- No. The rate increase is planning for approximately 500 new connections over 5 years.
- ERUs are used by both residential and commercial uses. (e.g. hotel use)

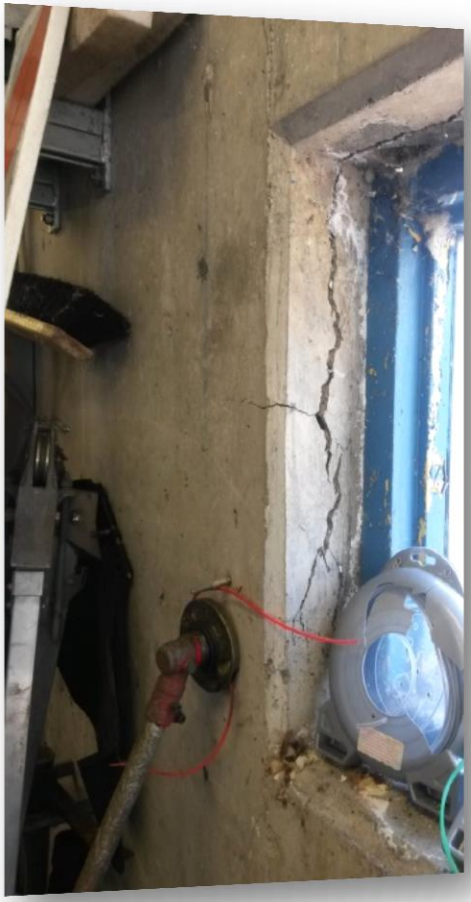
Why Do Rates Need to Increase?

- **Sewer Plant is Old**
  - ✓ Plant was built in 1950's, upgraded several times, and is failing
  - ✓ Plant is violating regulations
  - ✓ No redundancy
  - ✓ Safety violations

- **Growth Management and Property Rights**
  - ✓ City is part of Urban Growth Area
  - ✓ State law identifies City to deliver urban sewer services
  - ✓ City can't ban growth indefinitely unless City buys property

Why Do Rates Need to Increase?

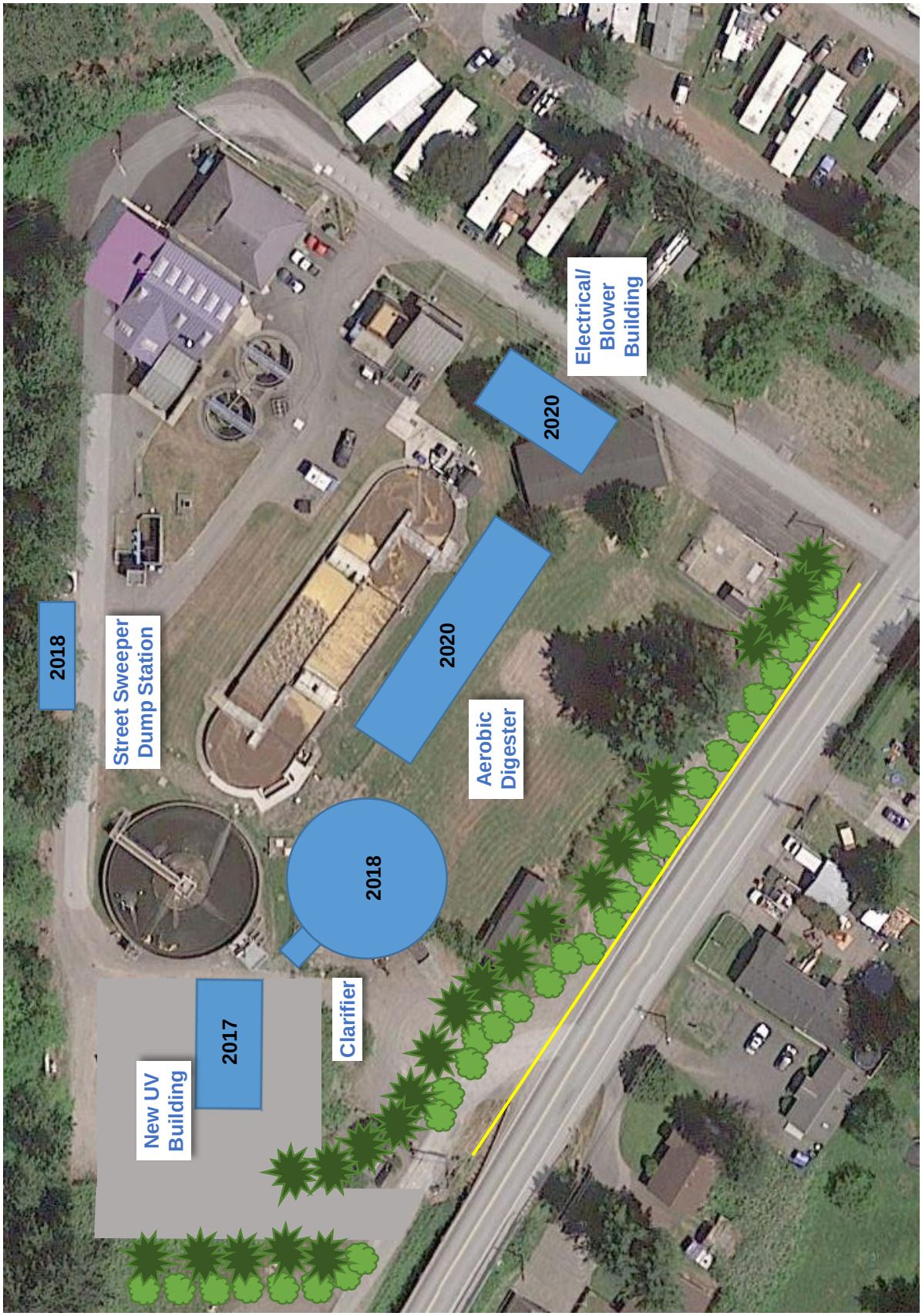
Why Do Rates Need to Increase?



What Are We Paying For?

- Rates are paying to upgrade 1950s Plant
  ($15.6M Improvements + new operating costs)
- Rates are paying to meet new regulations
- An additional $11.4M improvements may be required after 2029 to accommodate growth (if needed) through the end of the 20 year planning period ending 2036. Costs for these growth improvements would be borne by developers.
- Rates are also paying for additional Operating & Maintenance costs needed to maintain existing and new assets.
- Spreading rate increases over time more fairly shares the costs among ratepayers.

What Are We Paying For?



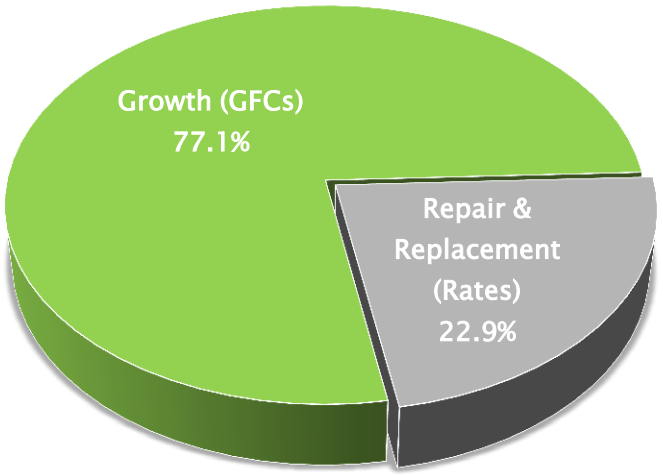
What Are We Not Paying For?

- Residential ratepayers are not subsidizing new housing development. Growth is paying for Growth.

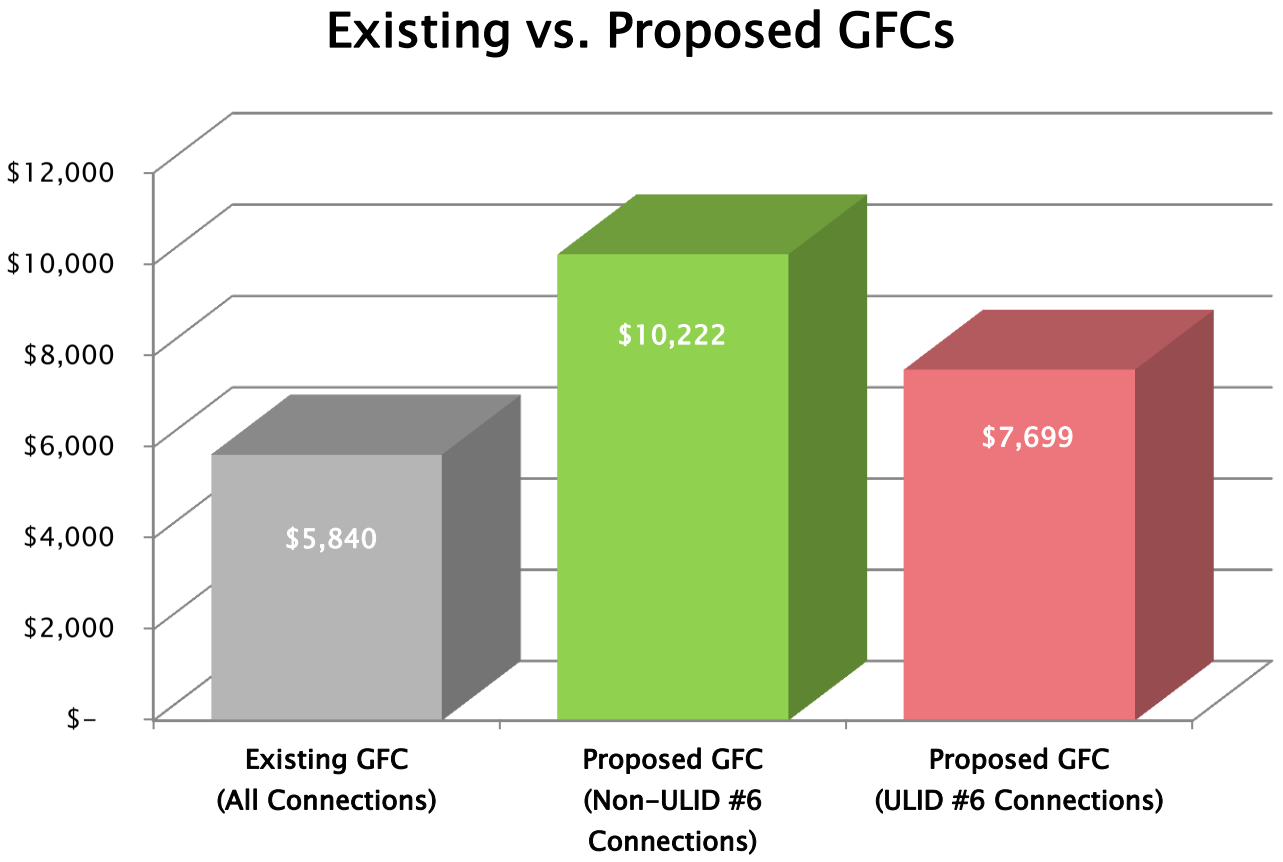
- Not Paying For Other City Operations. Sewer Utility is an Enterprise Fund.

Is Growth Paying for Growth?

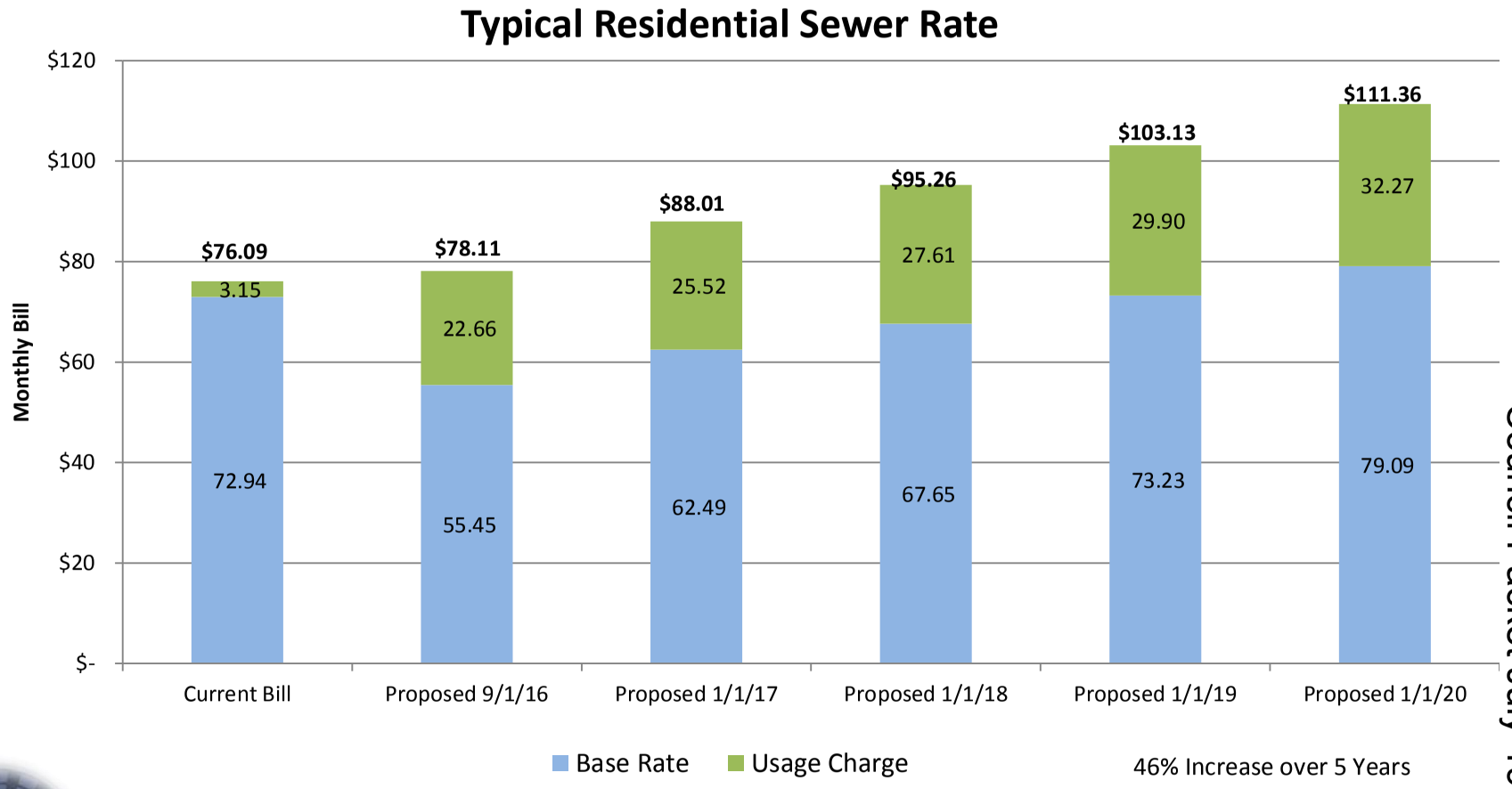
What portion of $15.6m is being paid for by new homes/growth vs. existing ratepayers?



Is Growth Paying for Growth?

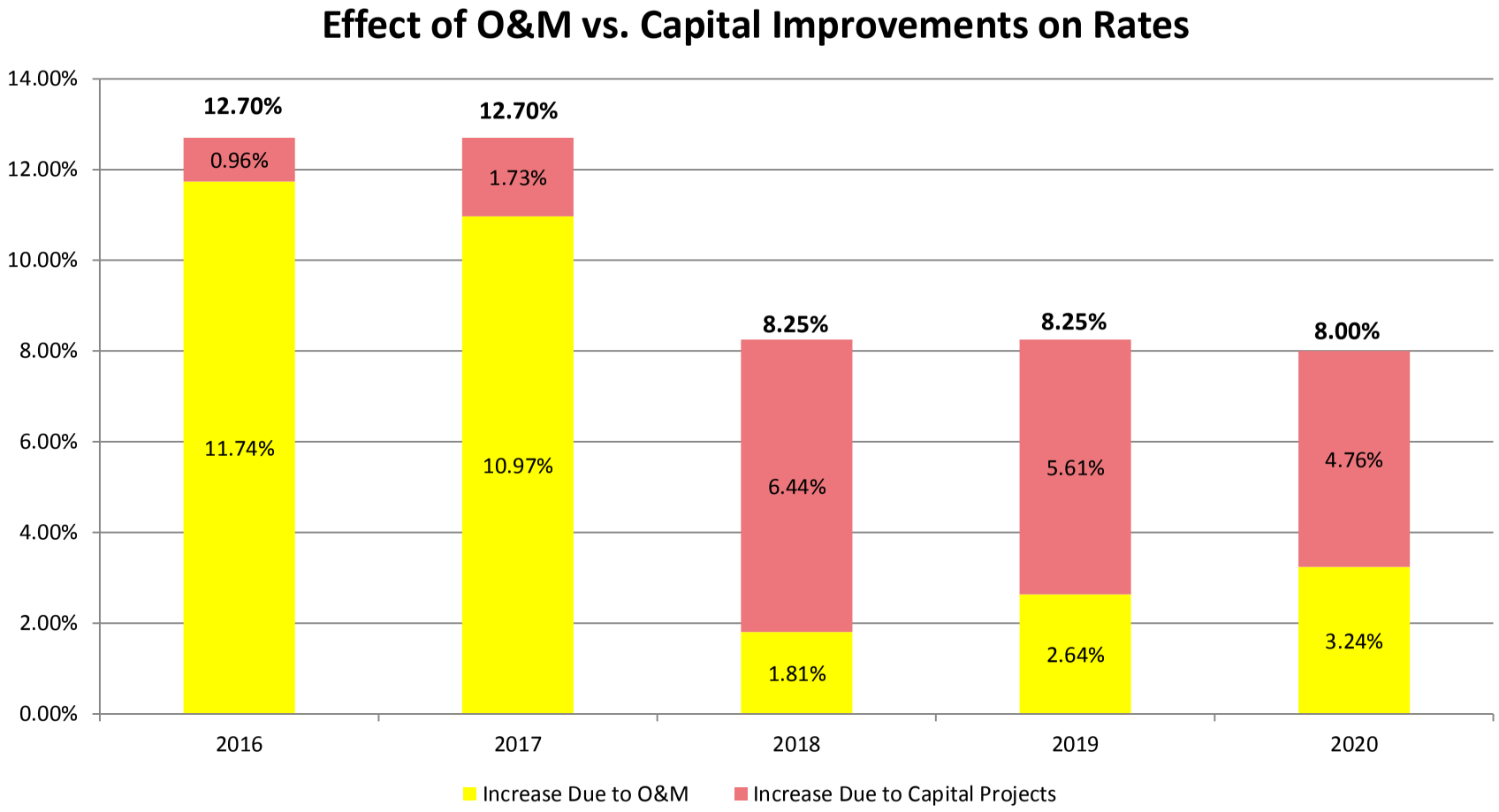


Rate Increase on Typical Residential Ratepayer



Council Packet July 19, 2016

What Are We Paying For?



New Rate Structure Rewards Water Conservation

- Base Rate –
  - Same rate for all customers (residential and commercial)
  - Includes first 10 cubic meters
- Usage Rate –
  - Same per cubic meter rate for all customers
  - Per cubic meters of water used over the first 10
- Winter Averaging – For the months of April through October, consumption amounts for sewer services will be based on the average water consumption during the months of November through March, so as not to penalize sewer customers using water for lawn and garden irrigation and other summer activities."

Conclusion

- Sewer Utility is Enterprise Fund – Must be Self Supporting and funds cannot be used for other City operations.
- 1950s Sewer Plant is Failing.
- Rates must be increased to pay for improvements and additional Maintenance and Operation costs.
- Next Steps: Continued City Council Public Hearing
  July 19th @ 7:00PM – Senior Center

It's OK to Water Your Lawn!

Winter Averaging - Ordinance Language:

"For the months of April through October, consumption amounts for sewer services will be based on the average water consumption during the months of November through March, so as not to penalize sewer customers using water for lawn and garden irrigation and other summer activities."

Sewer Rate Town Hall Meeting
Sign Up Sheet

NAME	ADDRESS	SEWER √	SEPTIC √
1. Nani Fischer	444 SE Maple Dr N. Bend		—
2. TY ALLAN	908 Ballarat Ave NE		X
3. Mike Jackman	505 - SE 8th St.	X	
4. Steve DuBois	1105 Rachon PL		X
5. Denise R. Bro	1105 Rachon PL		X
6. Chic Nessly	809 NE 10th ST		X
7. Shelly Inman	45554 SE N Bend Way	✓	
8. Mary Judd	" "	✓	
9. Eric Thorpe	319 NE 6th ST		✓
10. Garret Parrens	1095 Parkdale Ave SE		
11. TOM PAUL	10230 NE POINTS DR KIRKLAND	✓	
12. ED & JESSICA MOLENDARE	405 SE 13th PL	✓	
13. Joel / JUDY Bilanko	145 THRASHER Ave NE.		✓
14. Lee Korsmo Kathy McKay	815 Borst AVE NE		
15. Matt CHILDS	1315 11th Ct SW	✓	
16. Jay Krauss	425 S.E. 7th St		
17.			
18.			
19.			

City Council Meeting

Wastewater Facilities Plan: Rate Study and GFC Update

Agenda Ho

Angie Sanchez Virnoche, Principal

June 21, 2016

FCS GROUP
Solutions-Oriented Consulting

Overview

- Rate study completed as initial phase of Wastewater Facility Plan Update
- Focus was on meeting operating and capital needs for 2016 – 2020
- Multi-year rate implementation strategy developed for monthly user rates
- Updated general facility charges
- Met with Finance and Administration (F&A) Committee
  - May 3rd
  - June 7th

Agenda Ho

Council Packet July 19, 2016

Rate Study Key Assumptions (operating)

- **Study period 2016-2020**
  - Assumes 4.3% average annual growth
- **2016 budget used as baseline**
  - Facilities plan O&M additions of $286,000 to $795,000 per year
- **Existing debt of $390,000-$324,000 per year**
- **Fiscal policies**
  - Operating: 90 day of O&M
  - Debt Service Coverage: 1.50 (revenue bonds only)

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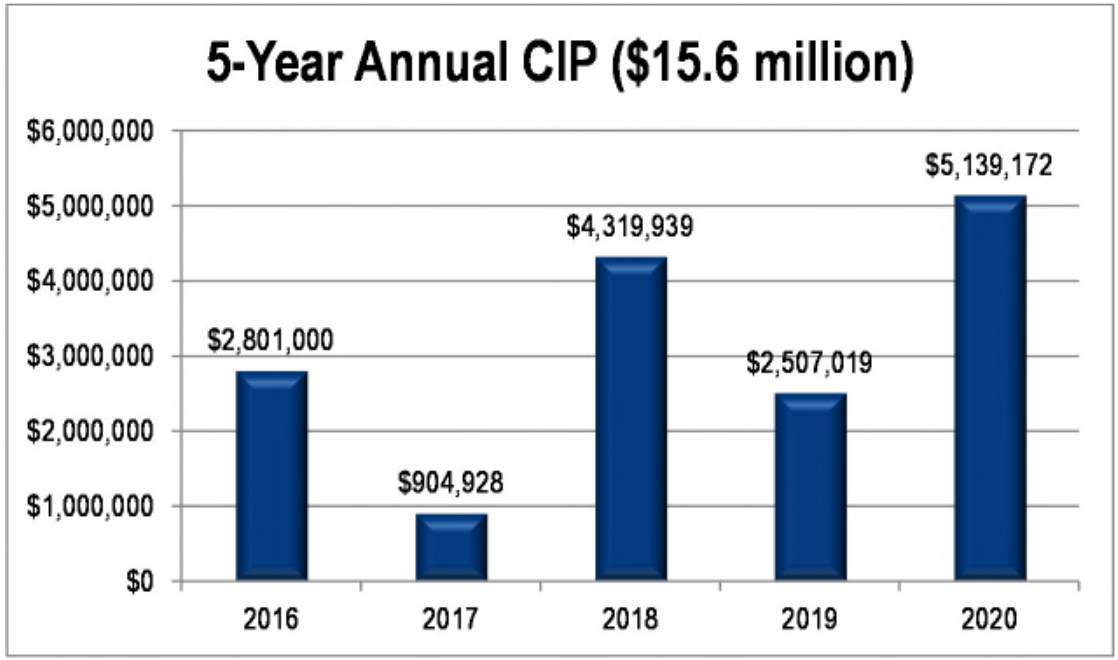
Council Packet July 19, 2016

Rate Study Key Assumptions (capital)



- **Funding plan:**
  - Existing reserves, GFCs and rates
  - Revenue bonds:
    - 2017 issue: $6.9 million (25-year term, 3.87% interest)
    - 2019 issue: $5.1 million (25-year term, 4.14% interest)
    - Assumes line of credit as interim financing
    - Annual debt service ($24K to $852K per year)

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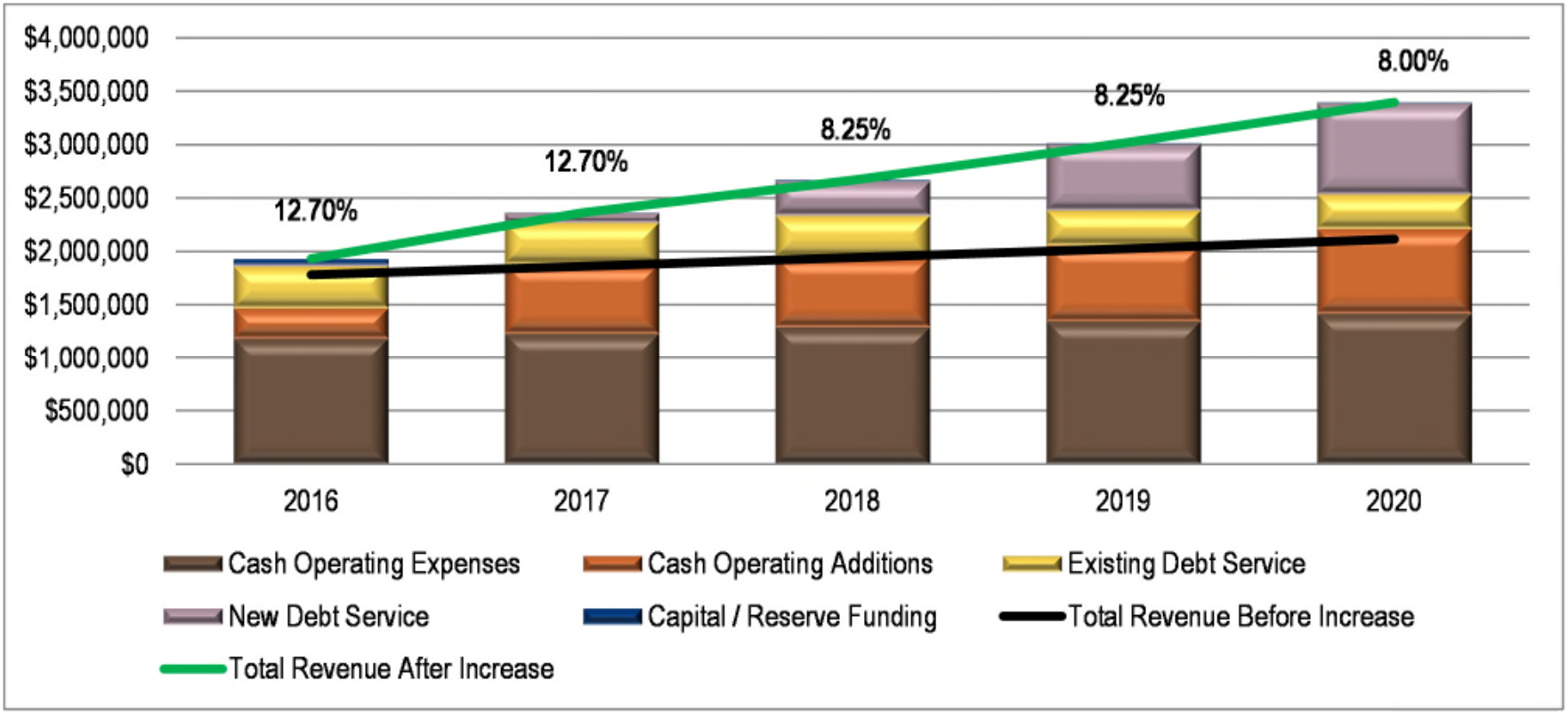
Council Packet July 19, 2016

Summary: Facilities Plan Impacts



- **Includes**:
  - O&M additions
  - Facilities plan CIP & new debt service

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Council Packet July 19, 2016

Rate Design

- **Rate design determines how revenue is to be collected by customers**
  - Fixed and/or variable charges
- **On May 3rd the F&A Committee requested the following modifications to the existing rate structure:**
  - Average per cubic meter (CM) rate for an average Residential and Commercial/ Industrial customer bill to be equal
  - Modified structure should encourage conservation compared to the existing structure
- **Example rate designs are based on the 4.33% growth rate**

Agenda Ho

Council Packet July 19, 2016

Existing and Alternative Rate Structure

Class	Existing	Alternative
Monthly Fixed Charges	**Inc. 10 CM**	**Inc. 10 CM**
Single Family (per account)	$72.94	$49.20
Senior/ Disabled (per account)	33.46	22.57
Multi Family (per unit)	72.94	49.20
Commercial (per account)	72.94	49.20
Mixed Use		
Commercial (per account)	72.94	49.20
Per Residential (per unit)	72.94	49.20
Outside City	111.98	73.80
Volume Charges	**>10 CM**	**>10 CM**
Single Family	$0.77	$4.92
Senior/ Disabled	n/a	n/a
Multi Family	0.77	4.92
Commercial	2.79	4.92
Mixed Use*	2.79	4.92
Outside City	3.43	7.38

*Mixed use volume rate applies after 20CM

Alternative rate structure applies to all classes of service

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Council Packet July 19, 2016

Impacts of Rate Structure Change

RESIDENTIAL

Monthly CM	Existing		Alternative		$	%	
	Bill	$/CM	Bill	$/CM	Difference	Difference	*Notes:*
7.05	$ 72.94	$ 10.35	$ 49.20	$ 6.98	$ (23.74)	-32.55%	*Half the average use*
14.09	**76.09**	**5.40**	**69.34**	**4.92**	**(6.75)**	**-8.87%**	***Average Use***
28.19	86.94	3.08	138.68	4.92	51.73	59.50%	*Double the average use*
42.28	97.80	2.31	208.02	4.92	110.22	112.71%	*Three times the average use*

COMMERCIAL

Monthly CM	Existing		Alternative		$	%	
	Bill	$/CM	Bill	$/CM	Difference	Difference	*Notes:*
29.68	$ 127.86	$ 4.31	$ 146.05	$ 4.92	$ 18.19	14.23%	*Half the average use*
59.37	**210.68**	**3.55**	**292.10**	**4.92**	**81.42**	**38.64%**	***Average Use***
118.74	376.32	3.17	584.20	4.92	207.88	55.24%	*Double the average use*
178.11	541.97	3.04	876.30	4.92	334.33	61.69%	*Three times the average use*

Rate increase is in addition to rate structure change noted above

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5-Year Rates

Description	Alternative	2016	2017	2018	2019	2020
Proposed Increases		**12.70%**	**12.70%**	**8.25%**	**8.25%**	**8.00%**
Monthly Fixed Charges (Includes 10 CM)						
Single Family (per account)	$ 49.20	$ 55.45	$ 62.49	$ 67.65	$ 73.23	$ 79.09
Senior/ Disabled (per account)	22.57	25.43	28.66	31.02	33.58	36.27
Multi Family (per unit)	49.20	55.45	62.49	67.65	73.23	79.09
Commercial (per account)	49.20	55.45	62.49	67.65	73.23	79.09
Mixed Use						
Commercial (per account)	49.20	55.45	62.49	67.65	73.23	79.09
Per Residential (per unit)	49.20	55.45	62.49	67.65	73.23	79.09
Outside City	73.80	83.17	93.73	101.46	109.83	118.62
Volume Charges (per CM > 10 CM)						
Single Family	$ 4.92	$ 5.54	$ 6.24	$ 6.75	$ 7.31	$ 7.89
Senior/ Disabled	n/a	n/a	n/a	n/a	n/a	n/a
Multi Family	4.92	5.54	6.24	6.75	7.31	7.89
Commercial	4.92	5.54	6.24	6.75	7.31	7.89
Mixed Use*	4.92	5.54	6.24	6.75	7.31	7.89
Outside City	7.38	8.32	9.38	10.15	10.99	11.87

*Mixed use volume rate applies after 20CM

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Council Packet July 19, 2016

GFC Overview & Methodology

- **Revised Code of Washington RCW 35.92.025 grants authority to fix rates and charges for connecting to water and sewer systems**
- **Charged to new development as a condition of service**
- **Based on the cost of system infrastructure**
- **Represents a proportionate share of capital investment**

Existing Costs

- ✓ Existing assets (original cost)
- ✓ Less: Contributions (developer/grants)
- ✓ Less: Net debt principal outstanding
- ✓ Plus: Interest (maximum 10 years)

Future Costs

- ✓ Future growth related capial
- ✓ Less: Developer donations
- ✓ Less: Repair & replacement

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Council Packet July 19, 2016

GFC Methodology

Treatment and General Assets

$$\frac{\text{EXISTING COST BASIS}}{\text{CURRENT \& FUTURE CUSTOMERS (City \& ULID)}} + \frac{\text{FUTURE COST BASIS}}{\text{FUTURE CUSTOMERS (City \& ULID)}} = \text{GFC (Treatment)}$$

Collection Assets

$$\frac{\text{EXISTING COST BASIS}}{\text{CURRENT \& FUTURE CUSTOMERS (City Only)}} + \frac{\text{FUTURE COST BASIS}}{\text{FUTURE CUSTOMERS (City Only)}} = \text{GFC (Collection)}$$

Description	Treatment	Collection	General	GFC
City Only Customers	$ 7,110	$ 2,523	$ 589	**$ 10,222**
ULID Customers	$ 7,110	$ -	$ 589	**$ 7,699**

Notes:

- Charges are per Equivalent Residential Unit (ERU)
- ERU is 2.57 people per household

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Council Packet July 19, 2016

5-Year General Facility Charge Projection

Description	2016	2017	2018	2019	2020
General Facility Charges (GFC) per ERU					
GFC per ERU - City [1],[2],[3]	$ 10,222	$ 10,222	$ 10,462	$ 10,707	$ 10,958
GFC per ERU - ULID [1],[2],[3]	$ 7,699	$ 7,699	$ 7,879	$ 8,064	$ 8,253

[1] General facility charges (GFC) currently escalated by historical 10-year 20-City Engineering News Record Construction Cost Index (2.35%); Fee should be updated annually with actual index values.

[2] GFC based on Equivalent Residential Unit (ERU); changed from current meter size assessment

[3] GFC defined as 2.57 people per household

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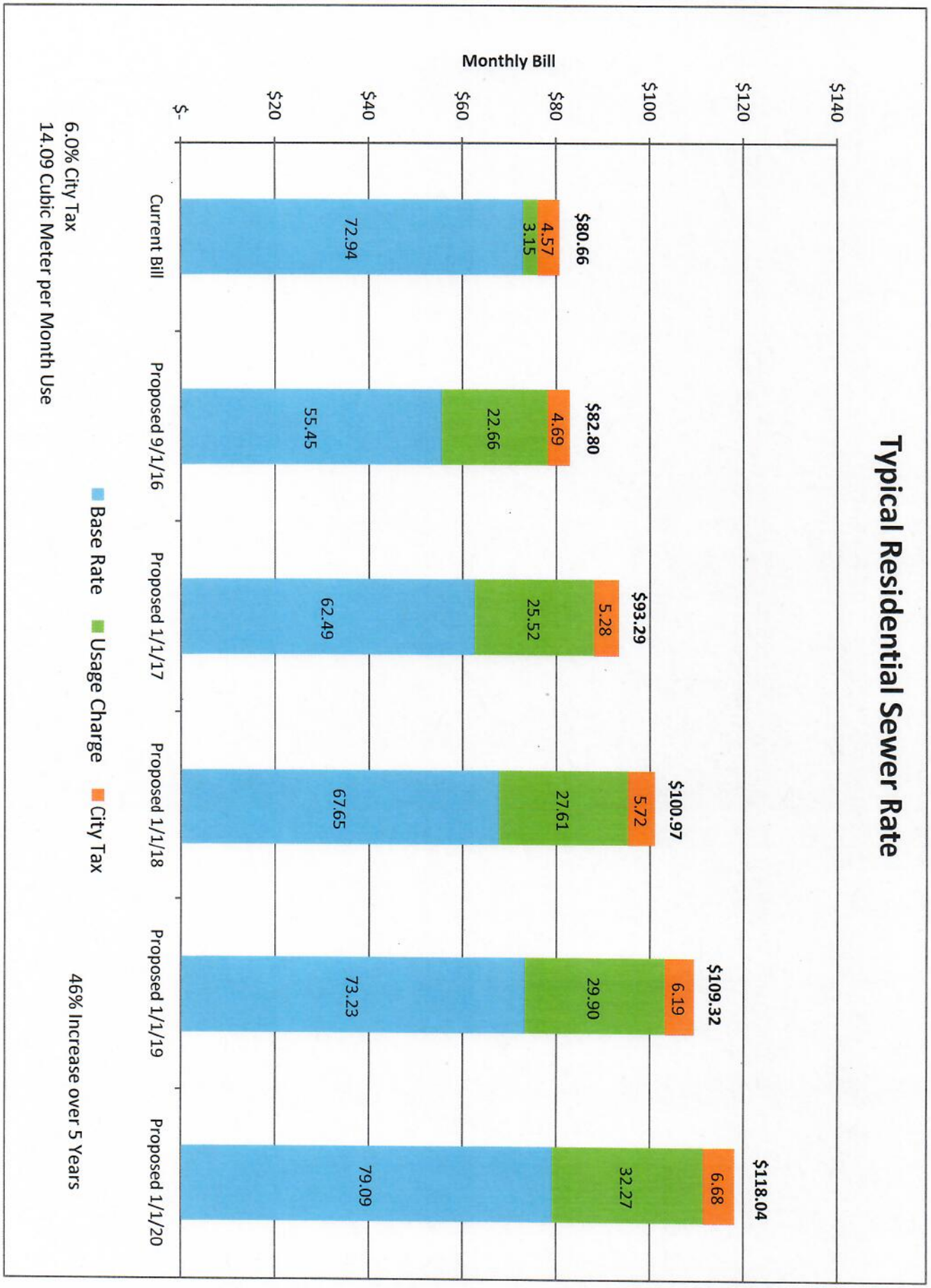
Council Packet July 19, 2016

Questions/Discussion

North Bend WWTP 5-Year Capital Improvements List

Description	Total
ULID 6 Pump station Improvements	$ 192,000
South Fork Pump Station Upgrade Phase I	$ 56,000
Snoqualm Lift Station SCADA system Integration	$ 36,000
SHB Pump Station Force main	$ 112,000
Oxidation Ditch brush rotor (ar204) support repair	$ 20,000
Secondary clarifier skimming system rehabilitation	$ 15,000
RAS Force main	$ 57,000
Pump house building ground floor replacement and flood proofing	$ 200,000
UV Disinfection System Upgrade	$ 784,000
Effluent flow metering and outfall improvement	$ 551,000
New WWTP Effluent Pump Station	$ 385,000
Influent and Effluent Sampling System Improvements	$ 14,000
Solids handling odor control improvements	$ 50,000
Effluent Temperature Mitigation	$ 336,000
SCADA System upgrade	$ 367,000
ULID 6 PS electrical and control panels flood proofing - design	$ 26,000
South Fork Pump Station Upgrade Phase II	$ 386,000
New Clarifier	$ 2,714,000
Wash water System Improvements	$ 16,000
Control and laboratory building flood proofing - design	$ 32,000
WWTP Landscaping and Aesthetics Improvements	$ 431,000
Lab and Trailer Park Sanitary Sewer Flow Rerouting to ULID6 PS	$ 119,000
ULID 6 PS electrical and control panels flood proofing - construction	$ 163,000
Old Influent Pump Station	$ 263,000
Headworks Improvements	$ 335,000
Oxidation Ditch	$ 365,000
Existing Clarifier Repair	$ 95,000
New Centrifuge	$ 1,436,000
Control and laboratory building flood proofing - construction	$ 271,000
New Aerobic Digester and Sludge Feed Building	$ 3,342,000
New Standby Genset to Replace Existing 250KW & New Load Center	$ 1,589,000
New Electrical Building and MCC for Plant	$ 804,000
Total	$ 15,562,000


Typical Residential Sewer Rate
Monthly Bill
$140
$120
$100
$80
$60
$40
$20
$-
$80.66
$82.80
$93.29
$100.97
$109.32
$118.04
4.57
3.15
72.94
4.69
22.66
55.45
5.28
25.52
62.49
5.72
27.61
67.65
6.19
29.90
73.23
6.68
32.27
79.09
Current Bill
Proposed 9/1/16
Proposed 1/1/17
Proposed 1/1/18
Proposed 1/1/19
Proposed 1/1/20
Base Rate
Usage Charge
City Tax
6.0% City Tax
14.09 Cubic Meter per Month Use
46% Increase over 5 Years

Susie Oppedal

From:	mthomas@bangstick.net
Sent:	Wednesday, June 29, 2016 4:29 PM
To:	Londi Lindell
Cc:	Ken Hearing; Mark Rigos; Don DeBerg; Dawn Masko; John Markus (john.markus@tetratech.com) (john.markus@tetratech.com); Angie Sanchez Virnoche (AngieS@fcsgroup.com) (AngieS@fcsgroup.com); tyallan@outlook.com; Mark Fogle; Council
Subject:	RE: FW: Comments and additional questions on 6/21 City Council Meeting
Attachments:	North Bend WWTP~Final Permit~05-23-13.pdf; Chapter 3 - Housing Element Adopted December 8, 2015.pdf

Thanks for the responses and also to city council for directing a response to my questions.

I am concerned about the characterization of capacity... certainly Mark's responses suggest we are increasing the effective capacity of the plant. The response provided by you says otherwise.

If we are exceeding 85% of the inflow design in winter we need to do something according to our permit, and 3 consecutive months would have required such a review. We are also adding homes at a high rate, certainly we've added many since 2014 and there are over 100 in construction (Pulte and others in Tannerwood and scattered throughout the city)... our growth rate and the ERUs suggest we would exceed the effective capacity soon or perhaps exceeded it, and that also requires permit review. The city is also advocating OSS owners switch to sewer... Silver Creek... but I must wonder if North Bend would have had the capacity to address such. What is the effective capacity of the present system?

Interesting data may be the actual flow the plant during summer and winter months... summer months perhaps are representative of the minimum flow and residential/commercial input minus what leaks into the ground from leaking public and private piping; winter months representative of I&I plus residential/commercial input would be good data to have about the plant. Perhaps one of the plant engineers can answer that.

I am supportive of changes to the plant and increasing capacity, I am questioning the amount of the capacity increase and the timing of the increase. I am concerned about affordability for people in our city and long term costs. Folks also just their new property valuation assessments, certainly +10-14% is going to hurt (but perhaps city governments such as North Bend are celebrating property owners misery).

As I also am keeping up with OSS issues, King County BoH just withdrew its plan for enhanced monitoring due to massive OSS owner turnout and pushback, I was at the King County Board of Health meeting last night in Fall City. Seattle Times had an article that Seattle is discharging 1.1 B gallons of untreated sewerage into the Sound each year... it's quite suspect folks are going after OSS folks when cities such as Seattle are such obvious sources of pollution. I'd wonder OSS built in the past 30 years or newer are doing a better job in protecting groundwater than North Bend's 70 year old plant and aging private and public piping. I somewhat wonder that perhaps folks need to be also looking at smaller towns and cities sewer treatment and sewer infrastructure as a source of river pollution... North Bend, Snoqualmie, Fall City... certainly there is a lot of growth and aged infrastructure to consider. I believe it's important to start directing the King County Board of Health to look for other sewerage hazards in the area; but looking at municipal treatment is not within their domain... but perhaps WA ecology is the proper body to look to at this time. When I consider the staggering 1.1B number just for Seattle alone, that's equivalent to 40k people's worth of sewerage a year... and HALF of all the OSSes in King County.

I would be interested in going to city sewer but the fees and sewer rates plus construction and decommissioning costs are coming in far far above even what it would cost to do a major repair on an OSS... the proposed GFC of $10k would pay for a major OSS repair, and that's ahead of OSS

decommissioning costs, construction costs on the resident side of the sewer demarc, and permitting costs. I did take a look at LaForest and a few other nearby neighborhoods on King County iMap, LaForest is not within 500 year FEMA floodplain, within 100 ft of a well, or recharge areas so I'm not seeing the environmental justification to compel going to public sewer.

Mike

-------- Original Message --------
Subject: FW: Comments and additional questions on 6/21 City Council Meeting
From: Londi Lindell <LLINDELL@NORTHBENDWA.GOV>
Date: Tue, June 28, 2016 6:24 pm
To: "mthomas@bangstick.net" <mthomas@bangstick.net>
Cc: Ken Hearing <KHEARING@NORTHBENDWA.GOV>, Mark Rigos <MRIGOS@NORTHBENDWA.GOV>, Don DeBerg <DDEBERG@NORTHBENDWA.GOV>, Dawn Masko <DMASKO@NORTHBENDWA.GOV>, "John Markus (john.markus@tetratech.com) (john.markus@tetratech.com)" <john.markus@tetratech.com>, "Angie Sanchez Virnoche (AngieS@fcsgroup.com) (AngieS@fcsgroup.com)" <AngieS@fcsgroup.com>, "tyallan@outlook.com" <tyallan@outlook.com>, Mark Fogle <MFOGLE@NORTHBENDWA.GOV>, Council <Council@northbendwa.gov>

Mr. Thomas, your below emails to the City Council were forwarded to me and Council requested I provide responses. Please be advised that there are two additional opportunities for public comment on Thursday, July 7th (with an optional tour of our Sewer Plant at 6:00PM-limited spaces so please RSVP if you are interested) and Tuesday, July 19th,. Both of these meetings are being held at the Senior Center @ 7:00 PM. Although I understand you currently are connected to a septic system you pose a significant number of questions regarding our proposed sewer rate increase affecting our sewer rate payers and we are hopeful you are interested in connecting to our sewer system at some future date. Please see the City's responses in red below. If you have further questions, please bring them to a future public forum. Thank you for becoming involved in this important issue for the City and I trust the below responses are helpful in better understanding the need for an increase in our sewer rates. We hope you are able to attend one of the upcoming public meetings or hearings. Thank you. Londi Lindell

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From: mthomas@bangstick.net [mthomas@bangstick.net]
Sent: Thursday, June 23, 2016 12:30 AM
To: Council
Cc: Mark Rigos; Susie Oppedal
Subject: Comments and additional questions on 6/21 City Council Meeting

Dear Council Members,

Thank you for not approving the rate increase and giving more time for public Q&A and also for good additional questions.

I personally am having a hard time resolving why it is necessary to double the capacity and in such short order.

Response:
The principal driving force for doing the work at the treatment plant is repair and replacement due to the Plant being almost 70 years old and NOT to provide new capacity for new homes as you have suggested during your testimony and throughout this email. There are no new capacity improvements being made during the 5 year capital improvements. There is existing unallocated capacity at the Sewer Plant. The capacity element is a consequence of the currently unused or

unallocated capacity of the plant that will benefit from implementation of the capital improvement plan.

This seems far out of line with our existing population and residential property growth, even the City's own comprehensive plan and UGA requirements would not use all the capacity growth proposed (+771 residences/1982 people) to *2035*.

Response:
As the City grows, there will be an increase in residential population but also growth in the commercial sector. Wastewater derived from the commercial represents about 30% of the existing capacity needs for wastewater treatment. Currently there are about 2150 people living in residences (~836 ERUs) within the City who are on private on-site septic systems such as yourself that are not connected to the City's wastewater collection and treatment system. In 2036 it is estimated that there will only be 420 residents (163 ERUs) within the City that will remain on private on-site septic systems. As King County Public Health adopts more stringent regulations on septic and as pollution control laws and Growth Management laws requires cities' to deliver urban sewer services, existing septic systems will eventually be eliminated within urban growth areas. This is set forth in state law and is consistent with the Growth Management Act.

The city leadership regularly cite the need to support the UGA and required growth as justification for development, the city needs to explain why then it is NOT following its own comprehensive plan and overbuilding capacity.

Response:
The City is following its own Comprehensive Plan and is not "overbuilding". You have made estimates that this plan allows for over 11,000+ additional homes or persons to move to our town based upon the available ERUs and this is incorrect. The 5-Year Wastewater CIP plan that the proposed rate increase is based upon is consistent with the City comprehensive plan. The rate model estimates growth of approximately 100 new homes a year during the next 5 years. Based on the growth model in the wastewater facility plan and the City's comprehensive plan, additional or new "capacity" improvements at the treatment plant will not be required until 2029. Again the work identified in the 5 year CIP for the years 2016 -2020 are needed to allow the existing treatment plant *to reliably and consistently at a level that will assure compliance the City's NPDES discharge permit* because it's a 70 year old sewer plant. **Only about half of the existing plant capacity is allocated** so improvements aren't needed to add capacity at this time. Capital Costs associated with the unallocated portion of the plant will be recovered from development through a connection or hookup fee charged when a new home connects to the system which is also called the General Facilities Charge (GFC).

Has the city considered plans that do not double capacity?

Response:
Again, your assumption is incorrect - The 5-year plan does not double the existing plant capacity it only allows the existing rated capacity of the plant to be used and allows the Plant to function in compliance with our permit.

Has the city considered plans that decrease load? (such as by encouraging and providing $ to residents and businesses to install low flow fixtures, water conserving toilets, front-loading washing machines, commercial dishwashing water recycling systems, etc.)?

Response:

Reducing the hydraulic load discharge by any specific class of user through water conservation would not eliminate the need or significantly reduce the costs for the 5 year capital improvement plan. The reason for this is because of the high amount of extraneous flow that enters the wastewater collection system due to inflow and infiltration because the collection system is also almost 70 years old so there are many cracks and breaks in the lines so we have a problem called I & I or inflow and infiltration. Inflow and infiltration is the dominate factor in determining the required hydraulic capacity of the plant. *On an annual basis more than half of the wastewater conveyed and treatment by the North Bend Wastewater Facilities is attributable to I&I. During a severe rainfall/snow melt event such as that experienced in November and December 2015, I&I accounted for over 85% of the daily hydraulic flow (load) conveyed and treated by the City's wastewater facilities.* Even with this high amount of I&I it remains cost effective to enhance the existing treatment plant as compared to cost and difficulty of implementing corrective action including replacement of private side sewers.

How about the unthinkable... that the city needs to allow septic systems to avoid increased loading and to encourage people on OSS to stay on them longer. (Septic users consume no capacity). There are still properties more than 200 ft. from city sewer that are blocked from adding OSS.

Response:
As mentioned above, that is not allowed by state law. The City of North Bend is within an UGA and is mandated to deliver urban services such as water and sewer. As such we do not allow new septic systems with new construction in order to avoid pollution of rivers and water drinking sources. Further, most of North Bend is in the flood plain and is characterized by groundwater at or slightly below the ground surface during extended wet weather conditions. Under these conditions, a conventional septic tank drain field does not provide the necessary treatment to protect the environment and the public health and safety.

FCS' testimony at the 6/21 hearing indicated ratepayers would be paying $3.4M as a result of capacity expansion.

Response:
Existing rate payers will be responsible for paying their fair share of the 5 year capital improvement program for permit compliance, redundancy, etc which is around that $3.4M figure. The balance of the costs for implementing the improvements will be paid by future development.

If I'm not mistaken rate increases cannot be used to pay for capacity expansion, only maintenance, repair, and upkeep. Isn't using funds marked for O&M/repair an unlawful use when those funds are used for capacity expansion? Folks need to go back and propose additional revenues related to new development... higher new development charges to pay for such. In any case it is not following the philosophy of "growth pay for growth".

Response:
The program does require growth to pay for growth. The need for implementing the 5 year capital improvement plan is not growth as stated earlier. Cost associated with implementation of the 5 year capital improvement plan that are associated with the current unallocated capacity of the existing plant will be recovered through the GFCs. The faster development occurs the faster the City can recover capital for the existing plant improvements through developer paid GFCs and new city sewer customers through payment of monthly sewer rates.

I also have additional questions regarding the assumptions on revenues. Mark's reply to me indicated that rainy season water consumption was used as the basis for rate increases. It is common sense that many residential users will increase their consumption in the summer to maintain their homes lawns and to garden/grow food--certainly in line with "preserving the rural character of North Bend". Wouldn't a rate design that assumes winter usage of water overshoot and collect too much money during summer months? I'd like to get more details as to the design of the rate increase and revenue projections to ensure that we've looked at multi-year consumption... at least a full 12 months or more (certainly there are fluctuations for dry and wet years)... considering North Bend is asking for an astronomical rate increase folks seriously need to examine how to bring down the increase.

Response:
The City uses the average monthly water consumption rate during the period of November through March to establish the average daily sewage flow for the "drier" months of the year, April through October). Actual residential water consumption from April through October does not come into the equation for computation of sewer rates or calculation of the sewer bill. The monthly residential sewer bill for the months of April through October is equal to the average of the preceding 5 months of sewer bills during "wet weather" (November through March).

Both myself and another citizen at the meeting proposed an alternative sewer consumption charging structure... one proposed a flat rate for residents, I had proposed basing sewer charges on winter consumption. Certainly the winter strategy incents conservation... people are incented to reduce household water use during winter months--and that is usage that does go into city sewer and at the worst time, rainy season where inflows are highest due to water leaking into the system or improper drainage connections to sewer.

Response:
The City's prior sewer rate was based upon a flat rate but a flat rate fees does not encourage water or wastewater conservation, which are key objectives identified by the City Council. A volume based fee that is constant or increases concomitant with increased consumption/discharge encourages conservation. The proposed rate structure is volume based with a constant volume charge.

I'd also ask that the city examine other ways of paying for new development aside from GFC. Homes that are on septic at some point will be going to city sewer and simply increasing the GFCs makes migration to sewer even less attractive... and even major repairs are apt to cost less than a $10k GFC (and that's before considering another $10k-$25k or more for a resident to connect from their home to the city sewer connection)... and then the resident has another $100 or more in sewer consumption charges they did not have before (relative to pumping every 3-5 years at $750 plus occasional maintenance costs, screen cleans and miscellaneous repairs). Did not Silver Creek just reject city sewer? What is the city doing to make connecting to sewer a more attractive option?

Response:
The City can apply for grant and loan funding from the Washington State Department of Ecology to reduce sewer rate increases associated with extending city sewer into existing neighborhood not currently served by the City's wastewater collection system. Centennial Clean Water Grant funds have been generally available to "buy down" the cost of the project so that the new customer's total sewer bill does not exceed 2% of the median household income. In 2015 median household income (MHI)for the Silver Creek has been reported to be $84,432. Two percent of this equates to a threshold sewer rate cost of $140.72. If the City applied and offered grant funding for the project then residents the average residential customers sewer rate would be set at 2% of the median household income. The grant would be provided to provide the necessary funds to buy down the capital obligation for the project. Also Ecology does provide additional financial aid through lowering

the interest rates on loans that result in sewer rates that are in the range of 80 to 100 percent of the sewer rate threshold (2% of MHI). However, the City's position has been that it is up to the neighborhood to decide if they wish to form a ULID to extend sewer to their neighborhood and busy City staff are not prepared to spend limited staff resources applying for such grants unless a neighborhood indicates a significant interest in such a ULID by initiating a ULID through a Petition. Although a Town Hall Meeting was conducted for the Silver Creek Community due to Ty Allen's inquiries (who I am copying on this email due to his interest in septic), the majority of homeowners who responded to the survey were not in favor of proceeding with connection to the City's sewer system in Silver Creek.

Last the upgrades/repairs and changes for "improvements" need to be examined closer to ensure there are no "shadow" capacity changes there. A good cross check is to re-run the system design "as if" no capacity changes were done and then compare the costs against the plan that increases the capacity... the difference is the cost of improvements/repairs/maintenance due to system capacity increase... and all those costs should be passed to new development.

Response:
It is essential to understand that the *improvements identified are principally replacement, repair, and additions for critical process redundancy* (e.g. the addition of a second clarifier, third UV reactor, and centrifuge) and for achieving compliance with the state biosolids regulations (i.e. , construction and operation of an aerobic digester for production of Class B Biosolids to allow for beneficial use for what currently is un-stabilized sewage sludge). In other words, even if another house was never built in North Bend our permit requires this level of redundancy for safety and compliance with current regulations.

I am also concerned with statements during the meeting that the plan/design is only "80%" done. So what else is left and what is the risk the costs go up?

Response:
The proposed rate increases are based on planning level estimates. Actual costs will vary but should be generally covered within +/- 30% of the estimated cost. Estimated costs are generally updated during and at the end of design phase. The construction market place sets the actual cost of construction may differ from the engineers estimate due to the cost of materials , labor and overall bidding climate at the time of bidding.

There was also a statement (I believe by the city administrator made it) that another $12-$14m in revenues will be needed for O&M to 2029... so ratepayers will be faced with that as well.... this should also be put out as the rate increases clearly won't end in 2020... that is almost as expensive as the entire improvement and capacity expansion plan being put forward now. I'd certainly like to see more details on this.

Response:
There is no capacity expansion in the 5-year Capital Improvement Plan as stated previously. Yes, operation and maintenance costs will increase over current levels because city needs to be more proactive rather than a reactive position to operating and maintaining the City's wastewater facility assets. The proposed rates include the cost for increased O&M and implementation of the 5-year capital improvement program.

I would like to understand when the system capacity changes and when we need certain levels of capacity. What capacity do we need and when do we need it? Perhaps present a table of the required capacity every year for the next 5-10-20 years.

Response:
Treatment plant capacity increases are not anticipated before 2029 based on the City's comprehensive plan and the draft wastewater facilities plan. Again the 5 year capital improvement program is needed to repair and replace equipment and systems that have failed or likely to fail because they have reached their design service life, and to bring the plant into compliance with the State and Federal standards for redundancy and reliability to assure compliance with the City's NPDES permit and to provide the City with the needed improvements to meet the State's Biosolids Management Regulations and General Permits for Biosolids, and to resolve nuisance odor issues associated with the plant.

Three additional suggestions given customers need notice of rate changes: 1) The new consumption rates to be included in a mailing for sewer charges and also a notice on the customer's bill of the date of the new rate plan 2) The rate plan takes effect the first billing cycle 6 months from adoption of the new rate plan. 3) Subsequent rate plan changes are spaced 12 months from the bill the first rate increase occurs.

On outreach: 1) The city needs to do a better job in social media... I see nothing wrong with a member of city government to post key announcements to popular facebook groups (such as the North Bend Political Forum or the North Bend News and Trading post)... those groups have 350 and more than 3000 members each. The city doesn't have to monitor these, only post. The city is still providing the required public notices anyway, posts are additional outreach. 2) Key facts the city wishes to highlight need to be in the email announcement not buried 80 pages in a PDF document... consider putting this information as an attachment or even better 1-3 pages as HTML in the email--consider that most people now get their email on a mobile device... reading a PDF on a mobile screen doesn't cut it 3) Simpler terms and clarity are needed... FCS presentation did little to explain this in terms the population can understand, and as well the engineering information on capacity requires some translation (perhaps to homes or population to translate treatment capacity from ERUs to something laypeople can understand). Similarly a clearer presentation of the cost of repairs/maintenance/upkeep and cost of capacity doubling. $X million for repair/upkeep/maintenance $Y million for capacity upgrade.

The City has been discussing the need for these capital improvements for 4 years at various public meetings and the need for the corresponding rate increases at various public meetings. The Capital Facilities Plan meeting describing in detail improvements you wish to discuss above was advertised and public meetings were conducted on March 15, 16 and April 26, 2016 (you incorrectly testified that this was the Silver Creek sewer meeting, which it was not). The rates were discussed in public Council Committee meetings on May 3, 11 and June 7 and 8, 2016. A public hearing before the City Council was opened on June 21st and continued until July 19th providing over a month for citizens to provide written or verbal comments to their elected officials. In addition, we added a Town Hall meeting on July 7th with our consultants and staff with an optional tour of the plant to answer questions. Finally we have posted all this information on the official City's Facebook Page, Twitter account, City's Web page, and posted official notices with the two local newspapers (Snoqualmie Valley Record and Snoqualmie Star) and the local blog (Living Snoqualmie). We also sent the notice/press release to all persons who have signed up for "Notify Me" through the official City Web Page seeking notice of City News and Highlights. The upcoming meetings are listed on the City Calendar and the press release is listed under the City's News and Highlights. We have also sent this information out to the local Yahoo Group. We have never found the utility billing notices to be an effective tool for communication particularly of upcoming meetings. We also are unwilling to start trying to distribute this information to certain private social media closed groups as you have suggested. The two Facebook groups you suggest are both closed and require membership and the City of North Bend is not a member .

Michael Thomas

-------- Original Message --------
Subject: Request to oppose city sewer rate increase
From: <mthomas@bangstick.net>
Date: Tue, June 21, 2016 4:42 pm
To: "Council" <Council@northbendwa.gov>

Dear City Council,

I believe more time is in order to understand the nature of the rate increase and why such a massive capacity increase is required in such a short order... expanding the capacity to 11.5k people seems out of order within the next 5 years, even the UGA only requires us to build an additional 771 residences (+1982 people) to 2035 in the City's own most recent comprehensive plan.

I also suspect that a good part of the improvements are not for maintenance or upgrades but are cloaks for capacity expansion and that is not an appropriate use for a rate increase.

Citizens being given only 4 business days to review the rate increase and to ask questions, come up with alternative ideas, etc. is not good governance.

I urge the council to oppose this. I am not necessarily opposed to capacity expansion or needed rate increases, Mark's numbers do indicate we are close to the existing capacity and such an expansion may be warranted... the question is how much is needed and when? Is there an alternative plan? What are the minimum necessary repairs & maintenance and what is the capacity expansion needed and when?

Michael Thomas

-------- Original Message --------
Subject: RE: Comments on Sewer Rate and GFC Increase 6/21
From: Mark Rigos <MRIGOS@NORTHBENDWA.GOV>
Date: Tue, June 21, 2016 9:56 am
To: "mthomas@bangstick.net" <mthomas@bangstick.net>, Susie Oppedal <SOPPEDAL@NORTHBENDWA.GOV>
Cc: Council <Council@northbendwa.gov>, Don DeBerg <DDEBERG@NORTHBENDWA.GOV>, Londi Lindell <LLINDELL@NORTHBENDWA.GOV>, Ken Hearing <KHEARING@NORTHBENDWA.GOV>

Hi Michael,

Thank you for providing input. Answers to your questions are as follows:

1. Yes, the rates were calculated based on a 5-month average, from November through March.

2. An Allocation Table was prepared and vetted by 4-5 licensed Professional civil engineers (PEs) by the State of Washington including 2 PhDs for allocating proportional costs into capacity or non-capacity facilities. Total cost of the 5-year improvements is estimated to be approximately $15

million. Adjustment of the current GFC rates distributes the fair costs for upgrading the currently unallocated "rated" capacity of plant.

3. The existing City wastewater facilities currently provides conveyance, treatment and disposal for about 2,300 ERUs (equivalent residential units). One ERU is by definition equal to the flow and load attributable to the average single family residence (~2.57 people). With the implementation of the 5-year capital improvement program, the City wastewater facilities will have a "true" rated capacity capable of providing reliable conveyance, treatment and disposal for 4,492 ERUs.

4. Neither me nor my consultant understand what is being asked. However, all of the improvements in the 5-year plan are needed to bring the plant up to its rated capacity. The improvements are needed to replace equipment and systems that are being operated beyond their design service life, to bring the plant into conformance with its rated capacity, current City flood management regulations, current state and federal redundancy and reliability standards, and state biosolids management regulations.

5. For irrigation meters, sewer rate charges do not apply to water used for irrigation purposes.

Hope that helps.

Sincerely,
Mark Rigos, P.E.
Public Works Director
City of North Bend
PO Box 896
1155 East North Bend Way
North Bend, WA 98045
(425) 888-7650

From: mthomas@bangstick.net [mailto:mthomas@bangstick.net]
Sent: Monday, June 20, 2016 4:05 PM
To: Susie Oppedal
Cc: Mark Rigos; Council
Subject: Comments on Sewer Rate and GFC Increase 6/21

Hello,

I am a resident of North Bend at 1231 LaForest Drive SE North Bend WA 98045 and wish to submit comments and questions for the record for the 6/21 hearing on the sewer rate and GFC increase.

I oppose the rate increase both in terms of both the general rate and GFC rate increase at this time. I would like to see an extended period for public comment on the proposal, certainly 4 business days notice of a rate increase does not provide the public sufficient time to comment on such a massive rate increase...

although the city has known about this for months (with the original notice dating to April), citizens have not had the details until last week.

I would also like to see more details as to the plans for improvements and costs differentiated by improvements versus capacity expansion. There are no details provided in the city council packet justifying the rate increase or details such that the public can understand what components are for new development versus for upgrade or repair. The city has already exceeded its UGA growth targets to 2030... it's not clear how much capacity is actually required and whether the new plan exceeds the UGA target.

I have the following questions:

1) Was "winter quarter averaging" for establishing the basis for sewer charges evaluated? Obviously summer water usage for many homeowners and property owners also includes water that is used to maintain lawns and grow food for home gardens or farms within city limits and this water does not go into the sewer system for treatment. I believe winter usage is perhaps more reflective of actual usage that is apt to require sewer treatment. I view the old rate structure of a higher base charge but a very low variable rate charge is meant to reflect this. It would make sense that the winter water usage for properties with a single meter (without a separate meter for irrigation) would be most reflective of usage that requires sewer treatment. Reducing winter water usage that requires sewer treatment during the wettest months helps reduce the volume due to people and when infiltration in the system is greatest due to aging pipes, improper drain connections, etc. I am surprised North Bend has not considered winter quarter averaging to base sewer charges on what is usage that requires treatment vs. usage that doesn't (e.g., lawncare, gardening).

Winter quarter averaging would help those owners "maintain the rural look and feel" and small town character of their properties by providing a reasonable way to charge for water usage that requires sewer treatment and to maintain their lawns and landscaping.

2) Of the rate increases to both the GFC and monthly rate structure how much is due to capacity expansion vs. not capacity expansion (e.g., upgrades or required repairs)?

3) How many single family residences does the current system support and how many residences will be supported with the proposed capacity expansions? If this changes over time please elaborate the capacity changes over time.

4) What is the minimum capacity increase required (in terms of # of single-family residences)?

5) How are charges handled for properties with a separate meter for irrigation handled? The new ordinance rate structure does not elaborate on usage for irrigation or differentiate consumption for residential use vs. irrigation.

Please include my comments and questions for the public record.

Regards
Michael Thomas

Agenda Ho

Issuance Date: May 23, 2013
Effective Date: July 1, 2013
Expiration Date: June 30, 2018

National Pollutant Discharge Elimination System
Waste Discharge Permit No. WA0029351

State of Washington
DEPARTMENT OF ECOLOGY
Northwest Regional Office
3190 160th Avenue SE
Bellevue, WA 98008-5452

In compliance with the provisions of
The State of Washington Water Pollution Control Law
Chapter 90.48 Revised Code of Washington
and
The Federal Water Pollution Control Act
(The Clean Water Act)
Title 33 United States Code, Section 1342 et seq.

CITY OF NORTH BEND
P.O. Box 896
North Bend, WA 98045

is authorized to discharge in accordance with the Special and General Conditions that follow.

Plant Location: 400 Bendigo Blvd. N. North Bend, WA 98045	Receiving Water: Snoqualmie River, South Fork
Treatment Type: Oxidation Ditch	Discharge Location, Outfall 001: Latitude: 47.499589 Longitude: -121.787731

Kevin C. Fitzpatrick
Water Quality Section Manager
Northwest Regional Office
Washington State Department of Ecology

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Summary of Permit Report Submittals

Refer to the Special and General Conditions of this permit for additional submittal requirements.

Permit Section	Submittal	Frequency	First Submittal Date
S3.A	Discharge Monitoring Report	Monthly	August 15, 2013
S3.E	Reporting Permit Violations	As necessary	
S3.F	Other Reporting	As necessary	
S4.B	Plans for Maintaining Adequate Capacity	As necessary	
S4.D	Notification of New or Altered Sources	As necessary	
S5.F	Bypass Notification	As necessary	
S5.G	Operations and Maintenance Manual Update	1/permit cycle	July 31, 2014
S6.E	Industrial User Survey Submittal	1/permit cycle	December 31, 2017
S8	Acute Toxicity Effluent Test Results	2/permit cycle	October 31, 2016 April 30, 2017
S9	Chronic Toxicity Effluent Test Results	2/permit cycle	January 31, 2017 July 31, 2017
S10	Temperature Reduction Study Scope of Work	1/permit cycle	July 31, 2014
S10	Temperature Reduction Study Report	1/permit cycle	July 31, 2015
S10	Temperature Reduction Implementation Letter	1/permit cycle	July 31, 2016
S11	Outfall Evaluation	1/permit cycle	October 31, 2014
S12	Application for Permit Renewal	1/permit cycle	December 31, 2017
G1	Notice of Change in Authorization	As necessary	
G4	Reporting Planned Changes	As necessary	
G5	Engineering Report for Construction or Modification Activities	As necessary	
G7	Notice of Permit Transfer	As necessary	
G10	Duty to Provide Information	As necessary	
G13	Payment of Fees	As assessed	
G20	Compliance Schedules	As necessary	
G21	Contract Submittal	As necessary	

Special Conditions

S1. Discharge limits

All discharges and activities authorized by this permit must comply 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 violates the terms and conditions of this permit.

S1.A. Effluent limits, August through October

Beginning on the effective date of this permit, the Permittee may discharge treated municipal wastewater to the Snoqualmie River during August, September, and October at the permitted location subject to compliance with the following limits:

Effluent Limits: Outfall 001 Latitude 47.499589 Longitude -121.787731		
Parameter	**Average Monthly [a]**	**Average Weekly [b]**
Carbonaceous Biochemical Oxygen Demand (5-day) ($CBOD_5$)	25 milligrams/liter (mg/L) 85% removal of influent $CBOD_5$	40 mg/L
Total Suspended Solids (TSS)	30 mg/L 350 lbs/day 85% removal of influent TSS	45 mg/L 525 lbs/day
Parameter	**Daily Minimum**	**Daily Maximum**
pH	6.0 standard units	9.0 standard units
Parameter	**Monthly Geometric Mean**	**7-day Geometric Mean**
Fecal Coliform Bacteria [c]	200/100 milliliter (mL)	400/100 mL
Parameter	**Average Monthly**	**Maximum Daily [d]**
NBOD+CBOD [e]	164 lbs/day	300 lbs/day

a	Average monthly effluent limit means the highest allowable average of daily discharges over a calendar month. To calculate the discharge value to compare to the limit, you add the value of each daily discharge measured during a calendar month and divide this sum by the total number of daily discharges measured. See footnote c for fecal coliform calculations.
b	Average weekly discharge limit means the highest allowable average of "daily discharges" over a calendar week, calculated as the sum of all "daily discharges" measured during a calendar week divided by the number of "daily discharges" measured during that week. See footnote c for fecal coliform calculations.
c	Ecology provides directions to calculate the monthly and the 7-day geometric mean in publication No. 04-10-020, *Information Manual for Treatment Plant Operators* available at: http://www.ecy.wa.gov/pubs/0410020.pdf
d	Maximum daily effluent limit is the highest allowable daily discharge. The daily discharge is the average discharge of a pollutant measured during a calendar day. For pollutants with limits expressed in units of mass, calculate the daily discharge as the total mass of the pollutant discharged over the day. This does not apply to pH or temperature.
e	NBOD+CBOD means **N**itrogenous + **C**arbonaceous **B**iochemical **O**xygen **D**emand (5-day) NBOD+CBOD is defined by the following equation: **NBOD+CBOD (lbs/day) = (2.155 * ammonia-N (lbs/day)) + $CBOD_5$ (lbs/day)** Where total ammonia (as N) and $CBOD_5$ are measurements from the same daily composite sample.

S1.B. Effluent limits, November through July

Beginning on the effective date of this permit, the Permittee may discharge treated municipal wastewater to the Snoqualmie River during November through July at the permitted location subject to compliance with the following limits:

Effluent Limits: Outfall 001 Latitude 47.499589 Longitude -121.787731		
Parameter	**Average Monthly [a]**	**Average Weekly [b]**
Carbonaceous Biochemical Oxygen Demand (5-day) ($CBOD_5$)	25 milligrams/liter (mg/L) 538 pounds/day (lbs/day) 85% removal of influent $CBOD_5$	40 mg/L 861 lbs/day
Total Suspended Solids (TSS)	30 mg/L 646 lbs/day 85% removal of influent TSS	45 mg/L 968 lbs/day
Parameter	**Daily Minimum**	**Daily Maximum**
pH	6.0 standard units	9.0 standard units
Parameter	**Monthly Geometric Mean**	**7-day Geometric Mean**
Fecal Coliform Bacteria [c]	200/100 milliliter (mL)	400/100 mL

a	Average monthly effluent limit means the highest allowable average of daily discharges over a calendar month. To calculate the discharge value to compare to the limit, you add the value of each daily discharge measured during a calendar month and divide this sum by the total number of daily discharges measured. See footnote c for fecal coliform calculations.
b	Average weekly discharge limitation means the highest allowable average of "daily discharges" over a calendar week, calculated as the sum of all "daily discharges" measured during a calendar week divided by the number of "daily discharges" measured during that week. See footnote c for fecal coliform calculations.
c	Ecology provides directions to calculate the monthly and the 7-day geometric mean in publication No. 04-10-020, Information Manual for Treatment Plant Operators available at: http://www.ecy.wa.gov/pubs/0410020.pdf

S1.C. Mixing zone authorization for Outfall 001

The paragraphs below define the maximum boundaries of the mixing zones.

Chronic mixing zone

The width of the chronic mixing zone is limited to a distance of 17 feet. The length of the chronic mixing zone extends 100 feet upstream and 256 feet downstream of the outfall. The mixing zone extends from the discharge ports to the top of the water surface. The concentration of pollutants at the edge of the chronic zone must meet chronic aquatic life criteria and human health criteria.

Chronic mixing zone – temperature only

The river flow available for chronic dilution in the mixing zone is limited to 25% of the 7Q10 flow.

Acute mixing zone

The river flow available for acute dilution in the mixing zone is limited to 2.5% of the 7Q10 flow. The concentration of pollutants at the edge of the acute zone must meet acute aquatic life criteria.

Available Dilution (dilution factor)	
Acute Aquatic Life Criteria	2.8
Chronic Aquatic Life Criteria	14.8
Temperature	20.9
Human Health Criteria - Carcinogen	60.7
Human Health Criteria - Non-carcinogen	18.4

S2. Monitoring requirements

S2.A. Monitoring schedule

The Permittee must monitor in accordance with the following schedule and the requirements specified in Appendix A.

Parameter	Units & Speciation	Minimum Sampling Frequency	Sample Type
(1) Wastewater Influent			
Wastewater Influent means the raw sewage flow from the collection system into the treatment facility. Sample the wastewater entering the headworks of the treatment plant excluding any side-stream returns from inside the plant.			
Biochemical Oxygen Demand (BOD_5)	mg/L	1/week	24-hour composite [a]
BOD_5	lbs/day	1/week	Calculated [b]
Carbonaceous Biochemical Oxygen Demand ($CBOD_5$)	mg/L	2/week	24-hour composite
Total Suspended Solids (TSS)	mg/L	2/week	24-hour composite
TSS	lbs/day	2/week	Calculated
(2) Final Wastewater Effluent			
Final Wastewater Effluent means wastewater exiting the last treatment process or operation.			
Flow	MGD	Continuous [c]	Metered/recorded
$CBOD_5$	mg/L	2/week	24-hour composite
$CBOD_5$	lbs/day	2/week	Calculated
$CBOD_5$	% removal [d]	1/month	Calculated
TSS	mg/L	2/week	24-hour composite
TSS	lbs/day	2/week	Calculated
TSS	% removal	1/month	Calculated
Fecal Coliform [e]	#Organisms /100 ml	2/week	Grab [f]
pH [g]	Standard Units	1/day	Grab
Temperature [h]	Degrees centigrade (°C)	Continuous	Measurement
7-DAD Max Temperature [i]	°C	1/day	Calculated

Parameter	Units & Speciation	Minimum Sampling Frequency	Sample Type
(3) Final Wastewater Effluent – August, September, & October only			
Total Ammonia	mg/L as N	2/week	24-hour composite
Total Ammonia	lbs/day	2/week	Calculated
NBOD+CBOD [j]	lbs/day	2/week	Calculated
(4) Whole Effluent Toxicity Testing – Final Wastewater Effluent			
Acute Toxicity Testing	See Section S8	2/permit cycle August 2016 February 2017	24-hour composite
Chronic Toxicity Testing	See Section S9	2/permit cycle November 2016 May 2017	24-hour composite
(5) Effluent Characterization – Final Wastewater Effluent			
Total Ammonia	mg/L as N	1/month (November through July only)	24-hour composite
Total Phosphorus	mg/L as P	1/month	24-hour composite
Soluble Reactive Phosphorus (as P)	mg/L as P	1/month	24-hour composite
Nitrate plus Nitrite Nitrogen	mg/L as N	1/month	24-hour composite
Total Kjeldahl Nitrogen (TKN)	mg/L as N	1/month	24-hour composite
(6) Permit Renewal Application Requirements – Final Wastewater Effluent [k]			
The Permittee must record and report the wastewater treatment plant flow discharged on the day it collects the sample for priority pollutant testing with the discharge monitoring report.			
Dissolved Oxygen	mg/L	4/permit cycle July 2016 October 2016 January 2017 April 2017	Grab
Oil and Grease	mg/L	"	Grab
Total Dissolved Solids	mg/L	"	24-hour composite
Total Hardness	mg/L	"	24-hour composite
Cyanide	micrograms/liter (µg/L)	"	Grab
Total Phenolic Compounds	µg/L	"	Grab
Priority Pollutants (PP) – Metals	µg/L; nanograms(ng/L) for mercury	"	24-Hour composite Grab for mercury
PP – Volatile Compounds	µg/L	"	Grab
PP – Acid Compounds	µg/L	"	24-Hour composite
PP – Base/Neutral Compounds	µg/L	"	24-Hour composite

a	24-hour composite means a series of individual samples collected over a 24-hour period into a single container, and analyzed as one sample.
b	Calculation means figured concurrently with the respective sample, using the following formula: Concentration (in mg/L) X Flow (in MGD) X Conversion Factor (8.34) = lbs/day
c	Continuous means uninterrupted except for brief lengths of time for calibration, for power failure, or for unanticipated equipment repair or maintenance.

Parameter	Units & Speciation	Minimum Sampling Frequency	Sample Type
d	% removal = $\frac{\text{(Influent concentration (mg/L) – Effluent concentration (mg/L))}}{\text{Influent concentration (mg/L)}}$ x 100 Calculate the percent (%) removal of $CBOD_5$ and TSS using the above equation.		
e	Report a numerical value for fecal coliforms following the procedures in Ecology's *Information Manual for Wastewater Treatment Plant Operators*, Publication Number 04-10-020 available at: http://www.ecy.wa.gov/programs/wq/permits/guidance.html . Do not report a result as too numerous to count (TNTC).		
f	Grab means an individual sample collected over a fifteen (15) minute, or less, period.		
g	Report the daily minimum and maximum pH.		
h	The Permittee must determine and report a daily maximum from half-hour measurements in a 24-hour period. Continuous monitoring instruments must achieve an accuracy of 0.2 degrees C and the Permittee must verify accuracy annually.		
i	Calculate a 7-DAD Max for each day by averaging each day's maximum temperature value with the values from the six (6) preceding days.		
j	NBOD+CBOD is defined by the following equation: **NBOD+CBOD (lbs/day) = (2.155 x ammonia-N (lbs/day)) + $CBOD_5$ (lbs/day)** Where total ammonia-N and $CBOD_5$ are measurements from the same daily composite sample.		
k	See Appendix A for the required detection (DL) or quantitation (QL) levels. Report single analytical values below detection as "less than (detection level)" where (detection level) is the numeric value specified in attachment A. Report single analytical values between the agency-required detection and quantitation levels with qualifier code of j following the value. To calculate the average value (monthly average): • Use the reported numeric value for all parameters measured between the agency-required detection value and the agency-required quantitation value. • For values reported below detection, use one-half the detection value if the lab detected the parameter in another sample for the reporting period. • For values reported below detection, use zero if the lab did not detect the parameter in another sample for the reporting period. If the Permittee is unable to obtain the required DL and QL in its effluent due to matrix effects, the Permittee must submit a matrix-specific detection limit (MDL) and a quantitation limit (QL) to Ecology with appropriate laboratory documentation.		

S2.B. Sampling and analytical procedures

Samples and measurements taken to meet the requirements of this permit must represent the volume and nature of the monitored parameters. The Permittee must conduct representative sampling of any unusual discharge or discharge condition, including bypasses, upsets, and maintenance-related conditions that may affect effluent quality.

Sampling and analytical methods used to meet the monitoring requirements specified in this permit must conform to the latest revision of the *Guidelines Establishing Test Procedures for the Analysis of Pollutants* contained in 40 CFR Part 136.

S2.C. Flow measurement, field measurement, and continuous monitoring devices

The Permittee must:

1. Select and use appropriate flow measurement, field measurement, and continuous monitoring devices and methods consistent with accepted scientific practices.
2. Install, calibrate, and maintain these devices to ensure the accuracy of the measurements is consistent with the accepted industry standard and the manufacturer's recommendation for that type of device.
3. Calibrate micro-recording temperature devices, known as thermistors, using protocols from Ecology's Quality Assurance Project Plan Development Tool (*Continuous Temperature Sampling Protocols for the Environmental Monitoring and Trends*). This document is available online at: http://www.ecy.wa.gov/programs/eap/qa/docs/QAPPtool/Mod6%20Ecology%20SOPs/Protocols/ContinuousTemperatureSampling.pdf
   Calibration as specified in this document is not required if the Permittee uses recording devices certified by the manufacturer.
4. Use field measurement devices as directed by the manufacturer and do not use reagents beyond their expiration dates.
5. Calibrate these devices at the frequency recommended by the manufacturer.
6. Maintain calibration records for at least three years.

S2.D. Laboratory accreditation

The Permittee must ensure that all monitoring data required by Ecology is prepared by a laboratory registered or accredited under the provisions of chapter 173-50 WAC, Accreditation of Environmental Laboratories. Flow, temperature, pH, and internal process control parameters are exempt from this requirement. The Permittee must obtain accreditation for pH if it must receive accreditation or registration for other parameters.

S2.E. Request for reduction in monitoring

The Permittee may request a reduction of the sampling frequency after twelve (12) months of monitoring. Ecology will review each request and at its discretion grant the request when it reissues the permit or by a permit modification.

The Permittee must:

1. Provide a written request.
2. Clearly state the parameters for which it is requesting reduced monitoring.
3. Clearly state the justification for the reduction.

S3. Reporting and recording requirements

The Permittee must monitor and report in accordance with the following conditions. Falsification of information submitted to Ecology is a violation of the terms and conditions of this permit.

S3.A. Reporting

The first monitoring period begins on the effective date of the permit. The Permittee must:

1. Summarize, report, and submit monitoring data obtained during each monitoring period on the electronic Discharge Monitoring Report (DMR) form provided by Ecology within WQWebDMR. Include data for each of the parameters tabulated in Special Condition S2 and as required by the form. Report a value for each day sampling occurred (unless specifically exempted in the permit) and for the summary values (when applicable) included on the electronic form.

   To find out more information and to sign up for WAWebDMR go to: http://www.ecy.wa.gov/programs/wq/permits/paris/webdmr.html

   If unable to submit electronically (for example, if you do not have an internet connection), the Permittee must contact Ecology to request a waiver and obtain instructions on how to obtain a paper copy DMR.

   The Permittee may submit DMRs on the paper form provided by Ecology until October 1, 2013.

2. Enter the "no discharge" reporting code for an entire DMR, for a specific monitoring point, or for a specific parameter as appropriate, if the Permittee did not discharge wastewater or a specific pollutant during a given monitoring period.

3. Report single analytical values below detection as "less than the detection level (DL)" by entering < followed by the numeric value of the detection level (e.g. < 2.0) on the DMR. If the method used did not meet the minimum DL and quantitation level (QL) identified in the permit, report the actual QL and DL in the comments or in the location provided.

4. Calculate average values (unless otherwise specified in the permit) using:

   a. The reported numeric value for all parameters measured between the agency-required detection value and the agency-required quantitation value.

   b. One-half the detection value (for values reported below detection) if the lab detected the parameter in another sample for the reporting period.

   c. Zero (for values reported below detection) if the lab did not detect the parameter in another sample for the reporting period.

5. Report single-sample grouped parameters (for example priority pollutants, PAHs, pulp and paper chlorophenolics, TTOs) on the WAWebDMR form and include: sample date, concentration detected, detection limit (DL) (as necessary), and laboratory quantitation level (QL) (as necessary). The Permittee must also submit an electronic PDF copy of the laboratory report using WAWebDMR.

If the Permittee has obtained a waiver from electronic reporting or if submitting prior to the compliance date, the Permittee must submit a paper copy of the laboratory report providing the following information: date sampled, sample location, date of analysis, parameter name, CAS number, analytical method/number, detection limit (DL), laboratory quantitation level (QL), reporting units, and concentration detected.

The contract laboratory reports must also include information on the chain of custody, QA/QC results, and documentation of accreditation for the parameter.

6. Ensure that DMRs are electronically submitted no later than the dates specified below, unless otherwise specified in this permit.

   Until the compliance date identified in S3.A.1 or if the Permittee has obtained a waiver, it must ensure that paper forms are postmarked or received by Ecology no later than the dates specified below, unless otherwise specified in this permit.

7. Submit DMRs for parameters with the monitoring frequencies specified in S2. The Permittee must submit monthly DMRs by the 15th day of the following month.

8. Submit reports to Ecology online using Ecology's electronic WQWebDMR submittal forms (electronic DMRs) as required above. Send reports to Ecology at:

   Water Quality Permit Coordinator
   Department of Ecology
   Northwest Regional Office
   3190 160th Avenue SE
   Bellevue, WA 98008-5452

S3.B. Records retention

The Permittee must retain records of all monitoring information for a minimum of three (3) years. Such information must include all calibration and maintenance records and all original recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit. The Permittee must extend this period of retention during the course of any unresolved litigation regarding the discharge of pollutants by the Permittee or when requested by Ecology.

S3.C. Recording of results

For each measurement or sample taken, the Permittee must record the following information:

1. The date, exact place, method, and time of sampling or measurement.
2. The individual who performed the sampling or measurement.
3. The dates the analyses were performed.

4. The individual who performed the analyses.
5. The analytical techniques or methods used.
6. The results of all analyses.

S3.D. Additional monitoring by the Permittee

If the Permittee monitors any pollutant more frequently than required by Condition S2 of this permit, then the Permittee must include the results of such monitoring in the calculation and reporting of the data submitted in the Permittee's DMR.

S3.E. Reporting permit violations

The Permittee must take the following actions when it violates or is unable to comply with any permit condition:

1. Immediately take action to stop, contain, and cleanup unauthorized discharges or otherwise stop the noncompliance and correct the problem.
2. If applicable, immediately repeat sampling and analysis. Submit the results of any repeat sampling to Ecology within thirty (30) days of sampling.

a. Immediate reporting

The Permittee must immediately report to Ecology and the Local Health Jurisdiction (at the numbers listed below), all:

- Failures of the disinfection system.
- Collection system overflows.
- Plant bypasses resulting in a discharge.
- Any other failures of the sewage system (pipe breaks, etc).

Northwest Regional Office	425-649-7000
King County Environmental Health Services	206-205-4394

b. Twenty-four-hour reporting

The Permittee must report the following occurrences of noncompliance by telephone, to Ecology at the telephone numbers listed above, within 24 hours from the time the Permittee becomes aware of any of the following circumstances:

1. Any noncompliance that may endanger health or the environment, unless previously reported under immediate reporting requirements.
2. Any unanticipated bypass that causes an exceedance of an effluent limit in the permit (See Part S5.F, "Bypass Procedures").
3. Any upset that causes an exceedance of an effluent limit in the permit (See G.15, "Upset").

4. Any violation of a maximum daily or instantaneous maximum discharge limit for any of the pollutants in Section S1.A and S1.B of this permit.
5. Any overflow prior to the treatment works, whether or not such overflow endangers health or the environment or exceeds any effluent limit in the permit.

c. Report within five days

The Permittee must also provide a written submission within five days of the time that the Permittee becomes aware of any reportable event under subparts a or b, above. The written submission must contain:

1. A description of the noncompliance and its cause.
2. The period of noncompliance, including exact dates and times.
3. The estimated time the Permittee expects the noncompliance to continue if not yet corrected.
4. Steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance.
5. If the noncompliance involves an overflow prior to the treatment works, an estimate of the quantity (in gallons) of untreated overflow.

d. Waiver of written reports

Ecology may waive the written report required in subpart c, above, on a case-by-case basis upon request if the Permittee has submitted a timely oral report.

e. All other permit violation reporting

The Permittee must report all permit violations, which do not require immediate or within 24 hours reporting, when it submits monitoring reports for S3.A ("Reporting"). The reports must contain the information listed in subpart c, above. Compliance with these requirements does not relieve the Permittee from responsibility to maintain continuous compliance with the terms and conditions of this permit or the resulting liability for failure to comply.

f. Report submittal

The Permittee must submit reports to the address listed in S3.A.

S3.F. Other reporting

The Permittee must report a spill of oil or hazardous materials in accordance with the requirements of RCW 90.56.280 and chapter 173-303-145. You can obtain further instructions at the following website:
http://www.ecy.wa.gov/programs/spills/other/reportaspill.htm.

Where the Permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application, or in any report to Ecology, it must submit such facts or information promptly.

S3.G. Maintaining a copy of this permit

The Permittee must keep a copy of this permit at the facility and make it available upon request to Ecology inspectors.

S4. Facility loading

S4.A. Design criteria

The flows or waste loads for the permitted facility must not exceed the following design criteria:

Maximum Month Design Flow (MMDF)	2.58 MGD
BOD_5 Influent Loading for Maximum Month	2,805 lb/day
TSS Influent Loading for Maximum Month	2,304 lb/day

S4.B. Plans for maintaining adequate capacity

a. Conditions triggering plan submittal

The Permittee must submit a plan and a schedule for continuing to maintain capacity to Ecology when:

1. The actual flow or waste load reaches 85 percent of any one of the design criteria in S4.A for three consecutive months; or
2. The projected plant flow or loading would reach design capacity within five years.

b. Plan and schedule content

The plan and schedule must identify the actions necessary to maintain adequate capacity for the expected population growth and to meet the limits and requirements of the permit. The Permittee must consider the following topics and actions in its plan.

1. Analysis of the present design and proposed process modifications
2. Reduction or elimination of excessive infiltration and inflow of uncontaminated ground and surface water into the sewer system
3. Limits on future sewer extensions or connections or additional waste loads
4. Modification or expansion of facilities
5. Reduction of industrial or commercial flows or waste loads

Engineering documents associated with the plan must meet the requirements of WAC 173-240-060, "Engineering Report," and be approved by Ecology prior to any construction.

S4.C. Duty to mitigate

The Permittee must take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this permit that has a reasonable likelihood of adversely affecting human health or the environment.

S4.D. Notification of new or altered sources

1. The Permittee must submit written notice to Ecology whenever any new discharge or a substantial change in volume or character of an existing discharge into the wastewater treatment plant is proposed which:
   a. Would interfere with the operation of, or exceed the design capacity of, any portion of the wastewater treatment plant.
   b. Is not part of an approved general sewer plan or approved plans and specifications.
   c. Is subject to pretreatment standards under 40 CFR Part 403 and Section 307(b) of the Clean Water Act.
2. This notice must include an evaluation of the wastewater treatment plant's ability to adequately transport and treat the added flow and/or waste load, the quality and volume of effluent to be discharged to the treatment plant, and the anticipated impact on the Permittee's effluent [40 CFR 122.42(b)].

S5. Operation and maintenance

The Permittee must at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances), which are installed to achieve compliance with the terms and conditions of this permit. Proper operation and maintenance also includes keeping a daily operation logbook (paper or electronic), adequate laboratory controls, and appropriate quality assurance procedures. This provision of the permit requires the Permittee to operate backup or auxiliary facilities or similar systems only when the operation is necessary to achieve compliance with the conditions of this permit.

S5.A. Certified operator

This permitted facility must be operated by an operator certified by the state of Washington for at least a Class II plant. This operator must be in responsible charge of the day-to-day operation of the wastewater treatment plant. An operator certified for at least a Class I plant must be in charge during all regularly scheduled shifts.

S5.B. Operation and maintenance program

The Permittee must:

1. Institute an adequate operation and maintenance program for the entire sewage system.
2. Keep maintenance records on all major electrical and mechanical components of the treatment plant, as well as the sewage system and pumping stations. Such records must clearly specify the frequency and type of maintenance recommended by the manufacturer and must show the frequency and type of maintenance performed.
3. Make maintenance records available for inspection at all times.

S5.C. Short-term reduction

The Permittee must schedule any facility maintenance, which might require interruption of wastewater treatment and degrade effluent quality, during non-critical water quality periods and carry this maintenance out in a manner approved by Ecology.

If a Permittee contemplates a reduction in the level of treatment that would cause a violation of permit discharge limits on a short-term basis for any reason, and such reduction cannot be avoided, the Permittee must:

1. Give written notification to Ecology, if possible, thirty (30) days prior to such activities.
2. Detail the reasons for, length of time of, and the potential effects of the reduced level of treatment.

This notification does not relieve the Permittee of its obligations under this permit.

S5.D. Electrical power failure

The Permittee must ensure that adequate safeguards prevent the discharge of untreated wastes or wastes not treated in accordance with the requirements of this permit during electrical power failure at the treatment plant and/or sewage lift stations. Adequate safeguards include, but are not limited to, alternate power sources, standby generator(s), or retention of inadequately treated wastes.

The Permittee must maintain Reliability Class II (EPA 430/9-74-001) at the wastewater treatment plant. Reliability Class II requires a backup power source sufficient to operate all vital components and critical lighting and ventilation during peak wastewater flow conditions. Vital components used to support the secondary processes (i.e., mechanical aerators or aeration basin air compressors) need not be operable to full levels of treatment, but must be sufficient to maintain the biota.

S5.E. Prevent connection of inflow

The Permittee must strictly enforce its sewer ordinances and not allow the connection of inflow (roof drains, foundation drains, etc.) to the sanitary sewer system.

S5.F. Bypass procedures

This permit prohibits a bypass, which is the intentional diversion of waste streams from any portion of a treatment facility. Ecology may take enforcement action against a Permittee for a bypass unless one of the following circumstances (1, 2, or 3) applies.

1. Bypass for essential maintenance without the potential to cause violation of permit limits or conditions.

   This permit authorizes a bypass if it allows for essential maintenance and does not have the potential to cause violations of limits or other conditions of this permit, or adversely impact public health as determined by Ecology prior to the bypass. The Permittee must submit prior notice, if possible, at least ten (10) days before the date of the bypass.

2. Bypass which is unavoidable, unanticipated, and results in noncompliance of this permit.

   This permit authorizes such a bypass only if:

   a. Bypass is unavoidable to prevent loss of life, personal injury, or severe property damage. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which would cause them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass.

   b. No feasible alternatives to the bypass exist, such as:

      - The use of auxiliary treatment facilities.
      - Retention of untreated wastes.
      - Maintenance during normal periods of equipment downtime, but not if the Permittee should have installed adequate backup equipment in the exercise of reasonable engineering judgment to prevent a bypass.
      - Transport of untreated wastes to another treatment facility or preventative maintenance), or transport of untreated wastes to another treatment facility.

   c. Ecology is properly notified of the bypass as required in Condition S3.E of this permit.

3. If bypass is anticipated and has the potential to result in noncompliance of this permit.

   a. The Permittee must notify Ecology at least thirty (30) days before the planned date of bypass. The notice must contain:

      - A description of the bypass and its cause.
      - An analysis of all known alternatives which would eliminate, reduce, or mitigate the need for bypassing.
      - A cost-effectiveness analysis of alternatives including comparative resource damage assessment.
      - The minimum and maximum duration of bypass under each alternative.
      - A recommendation as to the preferred alternative for conducting the bypass.
      - The projected date of bypass initiation.
      - A statement of compliance with SEPA.
      - A request for modification of water quality standards as provided for in WAC 173-201A-410, if an exceedance of any water quality standard is anticipated.
      - Details of the steps taken or planned to reduce, eliminate, and prevent reoccurrence of the bypass.

b. For probable construction bypasses, the Permittee must notify Ecology of the need to bypass as early in the planning process as possible. The Permittee must consider the analysis required above during preparation of the engineering report or facilities plan and plans and specifications and must include these to the extent practical. In cases where the Permittee determines the probable need to bypass early, the Permittee must continue to analyze conditions up to and including the construction period in an effort to minimize or eliminate the bypass.

c. Ecology will consider the following prior to issuing an administrative order for this type of bypass:

- If the bypass is necessary to perform construction or maintenance-related activities essential to meet the requirements of this permit.
- If feasible alternatives to bypass exist, such as the use of auxiliary treatment facilities, retention of untreated wastes, stopping production, maintenance during normal periods of equipment down time, or transport of untreated wastes to another treatment facility.
- If the Permittee planned and scheduled the bypass to minimize adverse effects on the public and the environment.

After consideration of the above and the adverse effects of the proposed bypass and any other relevant factors, Ecology will approve or deny the request. Ecology will give the public an opportunity to comment on bypass incidents of significant duration, to the extent feasible. Ecology will approve a request to bypass by issuing an administrative order under RCW 90.48.120.

S5.G. Operations and maintenance (O&M) manual

a. O&M manual requirements

The Permittee must:

1. Update the Operations and Maintenance (O&M) Manual to meet the requirements of 173-240-150 WAC and submit it to Ecology for approval by July 31, 2014. The Permittee must submit a paper copy and an electronic copy (preferably as a PDF).
2. Submit to Ecology for review substantial changes or updates to the O&M Manual whenever it incorporates them into the manual. The Permittee must submit a paper copy and an electronic copy (preferably as a PDF).
3. Keep the approved O&M Manual at the permitted facility.
4. Follow the instructions and procedures of this manual.

b. O&M manual components

In addition to the requirements of WAC 173-240-080 (1) through (5), the O&M Manual must include:

1. Emergency procedures for cleanup in the event of wastewater system upset or failure.
2. A review of system components which if failed could pollute surface water or could impact human health. Provide a procedure for a routine schedule of checking the function of these components.
3. Wastewater system maintenance procedures that contribute to the generation of process wastewater.
4. Reporting protocols for submitting reports to Ecology to comply with the reporting requirements in the discharge permit.
5. Any directions to maintenance staff when cleaning or maintaining other equipment or performing other tasks which are necessary to protect the operation of the wastewater system (for example, defining maximum allowable discharge rate for draining a tank, blocking all floor drains before beginning the overhaul of a stationary engine).
6. The treatment plant process control monitoring schedule.
7. Minimum staffing and certification levels adequate to operate and maintain the treatment processes and carry out compliance monitoring required by the permit.

S6. Pretreatment

S6.A. General requirements

The Permittee must work with Ecology to ensure that all commercial and industrial users of the publicly owned treatment works (POTW) comply with the pretreatment regulations in 40 CFR Part 403 and any additional regulations that the Environmental Protection Agency (U.S. EPA) may promulgate under Section 307(b) (pretreatment) and 308 (reporting) of the Federal Clean Water Act.

S6.B. Duty to enforce discharge prohibitions

1. Under federal regulations (40 CFR 403.5(a) and (b)), the Permittee must not authorize or knowingly allow the discharge of any pollutants into its POTW which may be reasonably expected to cause pass through or interference, or which otherwise violate general or specific discharge prohibitions contained in 40 CFR Part 403.5 or WAC-173-216-060.
2. The Permittee must not authorize or knowingly allow the introduction of any of the following into their treatment works:
   a. Pollutants which create a fire or explosion hazard in the POTW (including, but not limited to waste streams with a closed cup flashpoint of less than 140 degrees Fahrenheit or 60 degrees Centigrade using the test methods specified in 40 CFR 261.21).

b. Pollutants which will cause corrosive structural damage to the POTW, but in no case discharges with pH lower than 5.0, or greater than 11.0 standard units, unless the works are specifically designed to accommodate such discharges.

c. Solid or viscous pollutants in amounts that could cause obstruction to the flow in sewers or otherwise interfere with the operation of the POTW.

d. Any pollutant, including oxygen-demanding pollutants, (BOD_5, etc.) released in a discharge at a flow rate and/or pollutant concentration which will cause interference with the POTW.

e. Petroleum oil, non-biodegradable cutting oil, or products of mineral origin in amounts that will cause interference or pass through.

f. Pollutants which result in the presence of toxic gases, vapors, or fumes within the POTW in a quantity which may cause acute worker health and safety problems.

g. Heat in amounts that will inhibit biological activity in the POTW resulting in interference but in no case heat in such quantities such that the temperature at the POTW headworks exceeds 40 degrees Centigrade (104 degrees Fahrenheit) unless Ecology, upon request of the Permittee, approves, in writing, alternate temperature limits.

h. Any trucked or hauled pollutants, except at discharge points designated by the Permittee.

i. Wastewaters prohibited to be discharged to the POTW by the Dangerous Waste Regulations (chapter 173-303 WAC), unless authorized under the Domestic Sewage Exclusion (WAC 173-303-071).

3. The Permittee must also not allow the following discharges to the POTW unless approved in writing by Ecology:

   a. Noncontact cooling water in significant volumes.

   b. Stormwater and other direct inflow sources.

   c. Wastewaters significantly affecting system hydraulic loading, which do not require treatment, or would not be afforded a significant degree of treatment by the system.

4. The Permittee must notify Ecology if any industrial user violates the prohibitions listed in this section (S6.B), and initiate enforcement action to promptly curtail any such discharge.

S6.C. Wastewater discharge permit required

The Permittee must

1. Establish a process for authorizing non-domestic wastewater discharges that ensures all SIUs in all tributary areas meet the applicable state waste discharge permit (SWDP) requirements in accordance with chapter 90.48 RCW and chapter 173-216 WAC.

2. Immediately notify Ecology of any proposed discharge of wastewater from a source, which may be a significant industrial user (SIU) [see fact sheet definitions or refer to 40 CFR 403.3(t)(i)(ii)].
3. Require all SIUs to obtain a SWDP from Ecology prior to accepting their non-domestic wastewater, or require proof that Ecology has determined they do not require a permit.
4. Require the documentation as described in S6.C.3 at the earliest practicable date as a condition of continuing to accept non-domestic wastewater discharges from a previously undiscovered, currently discharging and unpermitted SIU.
5. Require sources of non-domestic wastewater, which do not qualify as SIUs but merit a degree of oversight, to apply for a SWDP and provide it a copy of the application and any Ecology responses.
6. Keep all records documenting that its users have met the requirements of S6.C.

S6.D. Identification and reporting of existing, new, and proposed industrial users

1. The Permittee must take continuous, routine measures to identify all existing, new, and proposed SIUs and potential significant industrial users (PSIUs) discharging or proposing to discharge to the Permittee's sewer system (see Appendix C of the fact sheet for definitions).
2. Within 30 days of becoming aware of an unpermitted existing, new, or proposed industrial user who may be a significant industrial user (SIU), the Permittee must notify such user by registered mail that, if classified as an SIU, they must apply to Ecology and obtain a State Waste Discharge Permit. The Permittee must send a copy of this notification letter to Ecology within this same 30-day period.
3. The Permittee must also notify all Potential SIUs (PSIUs), as they are identified, that if their classification should change to an SIU, they must apply to Ecology for a State Waste Discharge Permit within 30 days of such change.

S6.E. Industrial user survey

The Permittee must complete an industrial user survey listing all SIUs and potential significant industrial users (PSIUs) discharging to the POTW. The Permittee must submit the survey to Ecology by December 31, 2017. At a minimum, the Permittee must develop the list of SIUs and PSIUs by means of a telephone book search, a water utility billing records search, and a physical reconnaissance of the service area. Information on PSIUs must include, at a minimum, the business name, telephone number, address, description of the industrial process(s), and the known wastewater volumes and characteristics.

S7. Solid wastes

The Permittee must handle and dispose of all solid waste material in such a manner as to prevent its entry into state ground or surface water.

S8. Acute toxicity

S8.A. Testing when there is no permit limit for acute toxicity

The Permittee must:

1. Conduct acute toxicity testing on final effluent during August 2016 and February 2017.
2. Submit the results to Ecology by October 31, 2016 and April 30, 2017.
3. Conduct acute toxicity testing on a series of at least five concentrations of effluent, including 100% effluent and a control.
4. Use each of the following species and protocols for each acute toxicity test:

Acute Toxicity Tests	Species	Method
Fathead minnow 96-hour static-renewal test	*Pimephales promelas*	EPA-821-R-02-012
Daphnid 48-hour static test	*Ceriodaphnia dubia*, *Daphnia pulex*, or *Daphnia magna*	EPA-821-R-02-012

S8.B. Sampling and reporting requirements

1. The Permittee must submit all reports for toxicity testing in accordance with the most recent version of Ecology Publication No. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*. Reports must contain bench sheets and reference toxicant results for test methods. If the lab provides the toxicity test data in electronic format for entry into Ecology's database, then the Permittee must send the data to Ecology along with the test report, bench sheets, and reference toxicant results.
2. The Permittee must collect 24-hour composite effluent samples for toxicity testing. The Permittee must cool the samples to 0 - 6 degrees Celsius during collection and send them to the lab immediately upon completion. The lab must begin the toxicity testing as soon as possible but no later than 36 hours after sampling was completed.
3. The laboratory must conduct water quality measurements on all samples and test solutions for toxicity testing, as specified in the most recent version of Ecology Publication No. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*.
4. All toxicity tests must meet quality assurance criteria and test conditions specified in the most recent versions of the EPA methods listed in Subsection A and the Ecology Publication No. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*. If Ecology determines any test results to be invalid or anomalous, the Permittee must repeat the testing with freshly collected effluent.
5. The laboratory must use control water and dilution water meeting the requirements of the EPA methods listed in Section A or pristine natural water of sufficient quality for good control performance.

6. The Permittee must conduct whole effluent toxicity tests on an unmodified sample of final effluent.
7. The Permittee may choose to conduct a full dilution series test during compliance testing in order to determine dose response. In this case, the series must have a minimum of five effluent concentrations and a control. The series of concentrations must include the acute critical effluent concentration (ACEC). The ACEC equals 36% effluent.
8. All whole effluent toxicity tests, effluent screening tests, and rapid screening tests that involve hypothesis testing must comply with the acute statistical power standard of 29% as defined in WAC 173-205-020. If the test does not meet the power standard, the Permittee must repeat the test on a fresh sample with an increased number of replicates to increase the power.

S9. Chronic toxicity

S.A. Testing when there is no permit limit for chronic toxicity

The Permittee must:

1. Conduct chronic toxicity testing on final effluent during November 2016 and May 2017.
2. Submit the results to Ecology by January 31, 2017 and July 31, 2017.
3. Conduct chronic toxicity testing on a series of at least five concentrations of effluent and a control. This series of dilutions must include the acute critical effluent concentration (ACEC). The ACEC equals 36% effluent. The series of dilutions should also contain the CCEC of 6.8% effluent.
4. Compare the ACEC to the control using hypothesis testing at the 0.05 level of significance as described in Appendix H, EPA/600/4-89/001.
5. Perform chronic toxicity tests with all of the following species and the most recent version of the following protocols:

Freshwater Chronic Test	Species	Method
Fathead minnow survival and growth	*Pimephales promelas*	EPA-821-R-02-013
Daphnid survival and reproduction	*Ceriodaphnia dubia*	EPA-821-R-02-013

S.B. Sampling and reporting requirements

1. The Permittee must submit all reports for toxicity testing in accordance with the most recent version of Ecology Publication No. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*. Reports must contain bench sheets and reference toxicant results for test methods. If the lab provides the toxicity test data in electronic format for entry into Ecology's database, then the Permittee must send the data to Ecology along with the test report, bench sheets, and reference toxicant results.
2. The Permittee must collect 24-hour composite effluent samples for toxicity testing. The Permittee must cool the samples to 0 - 6 degrees Celsius during

collection and send them to the lab immediately upon completion. The lab must begin the toxicity testing as soon as possible but no later than 36 hours after sampling was completed.

3. The laboratory must conduct water quality measurements on all samples and test solutions for toxicity testing, as specified in the most recent version of Ecology Publication No. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria.*
4. All toxicity tests must meet quality assurance criteria and test conditions specified in the most recent versions of the EPA methods listed in Section A. and the Ecology Publication no. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria.* If Ecology determines any test results to be invalid or anomalous, the Permittee must repeat the testing with freshly collected effluent.
5. The laboratory must use control water and dilution water meeting the requirements of the EPA methods listed in Subsection A. or pristine natural water of sufficient quality for good control performance.
6. The Permittee must conduct whole effluent toxicity tests on an unmodified sample of final effluent.
7. The Permittee may choose to conduct a full dilution series test during compliance testing in order to determine dose response. In this case, the series must have a minimum of five effluent concentrations and a control. The series of concentrations must include the CCEC and the ACEC. The CCEC and the ACEC may either substitute for the effluent concentrations that are closest to them in the dilution series or be extra effluent concentrations. The CCEC equals 6.8% effluent. The ACEC equals 36% effluent.
8. All whole effluent toxicity tests that involve hypothesis testing must comply with the chronic statistical power standard of 39% as defined in WAC 173-205-020. If the test does not meet the power standard, the Permittee must repeat the test on a fresh sample with an increased number of replicates to increase the power.

S10. Temperature reduction study

The Permittee must prepare a study of potential management methods (Best Management Practices, BMPs) and equipment that may be used to reduce the temperature of the effluent or remove it from the river (outfall relocation, water re-use) during the critical period (June through September). The study must include identification of alternatives and associated costs. The Permittee must:

1. Submit a scope of work for the study to Ecology by July 31, 2014.
2. Submit the completed temperature reduction study to Ecology by July 31, 2015.
3. Implement any best management practices and initiate low-cost technology (such as tree planting or shading) identified by the temperature reduction study by July 31, 2016.

4. Submit a letter to Ecology by July 31, 2016, summarizing the BMPs and/or technologies implemented. This letter must also include a schedule for design and construction of any longer-term projects identified by the temperature reduction study.

S11. Outfall evaluation

The Permittee must inspect the submerged portion of the outfall line and diffuser to document its integrity and continued function. If conditions allow for a photographic verification, the Permittee must include such verification in the report. If damage is found, the report must include a plan for completing repairs. The Permittee must submit the inspection report to Ecology by October 31, 2014.

The inspector must at minimum:

- Assess the physical condition of the outfall pipe, diffuser, and associated couplings.
- Describe the effluent and river flow patterns and gravel bar accumulation in the vicinity of the diffuser.
- Ensure diffuser ports are free of obstructions and are allowing uniform flow.
- Confirm physical location (latitude/longitude) of the diffuser section of the outfall.

S12. Application for permit renewal or modification for facility changes

The Permittee must submit an application for renewal of this permit by December 31, 2017. The Permittee must submit a paper copy and an electronic copy (preferably as a PDF).

The Permittee must also submit a new application or supplement at least one hundred eighty (180) days prior to commencement of discharges, resulting from the activities listed below, which may result in permit violations. These activities include any facility expansions, production increases, or other planned changes, such as process modifications, in the permitted facility.

GENERAL CONDITIONS

G1. Signatory requirements

1. All applications, reports, or information submitted to Ecology must be signed and certified:

   a. In the case of corporations, by a responsible corporate officer. For the purpose of this section, a responsible corporate officer means:

      - A president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision making functions for the corporation, or

      - The manager of one or more manufacturing, production, or operating facilities, provided, the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long-term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

   b. In the case of a partnership, by a general partner.

   c. In the case of sole proprietorship, by the proprietor.

   d. In the case of a municipal, state, or other public facility, by either a principal executive officer or ranking elected official.

   Applications for permits for domestic wastewater facilities that are either owned or operated by, or under contract to, a public entity shall be submitted by the public entity.

2. All reports required by this permit and other information requested by Ecology must be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

   a. The authorization is made in writing by a person described above and submitted to Ecology.

   b. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility, such as the position of plant manager, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.)

3. Changes to authorization. If an authorization under paragraph 2.b, above, is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph 2.b,

above, must be submitted to Ecology prior to or together with any reports, information, or applications to be signed by an authorized representative

4. Certification. Any person signing a document under this section must make the following certification:

   "I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

G2. Right of inspection and entry

The Permittee must allow an authorized representative of Ecology, upon the presentation of credentials and such other documents as may be required by law:

1. To enter upon the premises where a discharge is located or where any records must be kept under the terms and conditions of this permit.
2. To have access to and copy, at reasonable times and at reasonable cost, any records required to be kept under the terms and conditions of this permit.
3. To inspect, at reasonable times, any facilities, equipment (including monitoring and control equipment), practices, methods, or operations regulated or required under this permit.
4. To sample or monitor, at reasonable times, any substances or parameters at any location for purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act.

G3. Permit actions

This permit may be modified, revoked and reissued, or terminated either at the request of any interested person (including the Permittee) or upon Ecology's initiative. However, the permit may only be modified, revoked and reissued, or terminated for the reasons specified in 40 CFR 122.62, 40 CFR 122.64 or WAC 173-220-150 according to the procedures of 40 CFR 124.5.

1. The following are causes for terminating this permit during its term, or for denying a permit renewal application:
   a. Violation of any permit term or condition.
   b. Obtaining a permit by misrepresentation or failure to disclose all relevant facts.
   c. A material change in quantity or type of waste disposal.

d. A determination that the permitted activity endangers human health or the environment, or contributes to water quality standards violations and can only be regulated to acceptable levels by permit modification or termination.

e. A change in any condition that requires either a temporary or permanent reduction, or elimination of any discharge or sludge use or disposal practice controlled by the permit.

f. Nonpayment of fees assessed pursuant to RCW 90.48.465.

g. Failure or refusal of the Permittee to allow entry as required in RCW 90.48.090.

2. The following are causes for modification but not revocation and reissuance except when the Permittee requests or agrees:

   a. A material change in the condition of the waters of the state.

   b. New information not available at the time of permit issuance that would have justified the application of different permit conditions.

   c. Material and substantial alterations or additions to the permitted facility or activities which occurred after this permit issuance.

   d. Promulgation of new or amended standards or regulations having a direct bearing upon permit conditions, or requiring permit revision.

   e. The Permittee has requested a modification based on other rationale meeting the criteria of 40 CFR Part 122.62.

   f. Ecology has determined that good cause exists for modification of a compliance schedule, and the modification will not violate statutory deadlines.

   g. Incorporation of an approved local pretreatment program into a municipality's permit.

3. The following are causes for modification or alternatively revocation and reissuance:

   a. When cause exists for termination for reasons listed in 1.a through 1.g of this section, and Ecology determines that modification or revocation and reissuance is appropriate.

   b. When Ecology has received notification of a proposed transfer of the permit. A permit may also be modified to reflect a transfer after the effective date of an automatic transfer (General Condition G7) but will not be revoked and reissued after the effective date of the transfer except upon the request of the new Permittee.

G4. Reporting planned changes

The Permittee must, as soon as possible, but no later than sixty (60) days prior to the proposed changes, give notice to Ecology of planned physical alterations or additions to the permitted facility, production increases, or process modification which will result in:

1. The permitted facility being determined to be a new source pursuant to 40 CFR 122.29(b)
2. A significant change in the nature or an increase in quantity of pollutants discharged.
3. A significant change in the Permittee's sludge use or disposal practices. Following such notice, and the submittal of a new application or supplement to the existing application, along with required engineering plans and reports, this permit may be modified, or revoked and reissued pursuant to 40 CFR 122.62(a) to specify and limit any pollutants not previously limited. Until such modification is effective, any new or increased discharge in excess of permit limits or not specifically authorized by this permit constitutes a violation.

G5. Plan review required

Prior to constructing or modifying any wastewater control facilities, an engineering report and detailed plans and specifications must be submitted to Ecology for approval in accordance with chapter 173-240 WAC. Engineering reports, plans, and specifications must be submitted at least one hundred eighty (180) days prior to the planned start of construction unless a shorter time is approved by Ecology. Facilities must be constructed and operated in accordance with the approved plans.

G6. Compliance with other laws and statutes

Nothing in this permit excuses the Permittee from compliance with any applicable federal, state, or local statutes, ordinances, or regulations.

G7. Transfer of this permit

In the event of any change in control or ownership of facilities from which the authorized discharge emanate, the Permittee must notify the succeeding owner or controller of the existence of this permit by letter, a copy of which must be forwarded to Ecology.

1. Transfers by Modification

   Except as provided in paragraph (B) below, this permit may be transferred by the Permittee to a new owner or operator only if this permit has been modified or revoked and reissued under 40 CFR 122.62(b)(2), or a minor modification made under 40 CFR 122.63(d), to identify the new Permittee and incorporate such other requirements as may be necessary under the Clean Water Act.

2. Automatic Transfers

   This permit may be automatically transferred to a new Permittee if:

   a. The Permittee notifies Ecology at least thirty (30) days in advance of the proposed transfer date.

   b. The notice includes a written agreement between the existing and new Permittees containing a specific date transfer of permit responsibility, coverage, and liability between them.

c. Ecology does not notify the existing Permittee and the proposed new Permittee of its intent to modify or revoke and reissue this permit. A modification under this subparagraph may also be minor modification under 40 CFR 122.63. If this notice is not received, the transfer is effective on the date specified in the written agreement.

G8. Reduced production for compliance

The Permittee, in order to maintain compliance with its permit, must control production and/or all discharges upon reduction, loss, failure, or bypass of the treatment facility until the facility is restored or an alternative method of treatment is provided. This requirement applies in the situation where, among other things, the primary source of power of the treatment facility is reduced, lost, or fails.

G9. Removed substances

Collected screenings, grit, solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters must not be resuspended or reintroduced to the final effluent stream for discharge to state waters.

G10. Duty to provide information

The Permittee must submit to Ecology, within a reasonable time, all information which Ecology may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The Permittee must also submit to Ecology upon request, copies of records required to be kept by this permit.

G11. Other requirements of 40 CFR

All other requirements of 40 CFR 122.41 and 122.42 are incorporated in this permit by reference.

G12. Additional monitoring

Ecology may establish specific monitoring requirements in addition to those contained in this permit by administrative order or permit modification.

G13. Payment of fees

The Permittee must submit payment of fees associated with this permit as assessed by Ecology.

G14. Penalties for violating permit conditions

Any person who is found guilty of willfully violating the terms and conditions of this permit is deemed guilty of a crime, and upon conviction thereof must be punished by a fine of up to ten thousand dollars ($10,000) and costs of prosecution, or by imprisonment in the discretion of the court. Each day upon which a willful violation occurs may be deemed a separate and additional violation.

Any person who violates the terms and conditions of a waste discharge permit may incur, in addition to any other penalty as provided by law, a civil penalty in the amount of up to ten thousand dollars ($10,000) for every such violation. Each and every such violation is a separate and distinct offense, and in case of a continuing violation, every day's continuance is deemed to be a separate and distinct violation.

G15. Upset

Definition – "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limits because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limits if the requirements of the following paragraph are met.

A Permittee who wishes to establish the affirmative defense of upset must demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

1. An upset occurred and that the Permittee can identify the cause(s) of the upset.
2. The permitted facility was being properly operated at the time of the upset.
3. The Permittee submitted notice of the upset as required in Condition S3.E.
4. The Permittee complied with any remedial measures required under S4.C of this permit.

In any enforcement action the Permittee seeking to establish the occurrence of an upset has the burden of proof.

G16. Property rights

This permit does not convey any property rights of any sort, or any exclusive privilege.

G17. Duty to comply

The Permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application.

G18. Toxic pollutants

The Permittee must comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if this permit has not yet been modified to incorporate the requirement.

G19. Penalties for tampering

The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit must, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than two (2) years per violation, or by both. If a conviction of a person is for a violation committed after a first conviction of such person under this condition, punishment must be a fine of not more than $20,000 per day of violation, or by imprisonment of not more than four (4) years, or by both.

G20. Compliance schedules

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit must be submitted no later than fourteen (14) days following each schedule date.

G21. Contract review

The Permittee must submit to Ecology any proposed contract for the operation of any wastewater treatment facility covered by this permit. The review is to ensure consistency with chapters 90.46 and 90.48 RCW. In the event that Ecology does not comment within a thirty (30)-day period, the Permittee may assume consistency and proceed with the contract.

Appendix A

LIST OF POLLUTANTS WITH ANALYTICAL METHODS, DETECTION LIMITS AND QUANTITATION LEVELS

The Permittee must use the specified analytical methods, detection limits (DLs) and quantitation levels (QLs) in the following table for permit and application required monitoring unless:

- Another permit condition specifies other methods, detection levels, or quantitation levels.
- The method used produces measurable results in the sample and EPA has listed it as an EPA-approved method in 40 CFR Part 136.

If the Permittee uses an alternative method, not specified in the permit and as allowed above, it must report the test method, DL, and QL on the discharge monitoring report or in the required report.

If the Permittee is unable to obtain the required DL and QL in its effluent due to matrix effects, the Permittee must submit a matrix-specific detection limit (MDL) and a quantitation limit (QL) to Ecology with appropriate laboratory documentation.

When the permit requires the Permittee to measure the base neutral compounds in the list of priority pollutants, it must measure all of the base neutral pollutants listed in the table below. The list includes EPA required base neutral priority pollutants and several additional polynuclear aromatic hydrocarbons (PAHs). The Water Quality Program added several PAHs to the list of base neutrals below from Ecology's Persistent Bioaccumulative Toxics (PBT) List. It only added those PBT parameters of interest to Appendix A that did not increase the overall cost of analysis unreasonably.

Ecology added this appendix to the permit in order to reduce the number of analytical "non-detects" in permit-required monitoring and to measure effluent concentrations near or below criteria values where possible at a reasonable cost.

CONVENTIONAL PARAMETERS

Pollutant & CAS No. *(if available)*	**Recommended Analytical Protocol**	**Detection (DL)[1] µg/L** *unless specified*	**Quantitation Level (QL)[2] µg/L** *unless specified*
Biochemical Oxygen Demand	SM5210-B		2 mg/L
Chemical Oxygen Demand	SM5220-D		10 mg/L
Total Organic Carbon	SM5310-B/C/D		1 mg/L
Total Suspended Solids	SM2540-D		5 mg/L
Total Ammonia (as N)	SM4500-NH3-B and C/D/E/G/H		20
Flow	Calibrated device		
Dissolved oxygen	SM4500-OC/OG		0.2 mg/L
Temperature (max. 7-day avg.)	Analog recorder or Use micro-recording devices known as thermistors		0.2° C
pH	SM4500-H^+ B	N/A	N/A

NONCONVENTIONAL PARAMETERS

Pollutant & CAS No. *(if available)*	**Recommended Analytical Protocol**	**Detection (DL)**[1] *µg/L unless specified*	**Quantitation Level (QL)**[2] *µg/L unless specified*
Total Alkalinity	SM2320-B		5 mg/L as CaCO3
Chlorine, Total Residual	SM4500 Cl G		50.0
Color	SM2120 B/C/E		10 color units
Fecal Coliform	SM 9221E,9222	N/A	Specified in method - sample aliquot dependent
Fluoride (16984-48-8)	SM4500-F E	25	100
Nitrate + Nitrite Nitrogen (as N)	SM4500-NO3- E/F/H		100
Nitrogen, Total Kjeldahl (as N)	SM4500-N_{org}B/C and SM4500NH_3-B/C/D/EF/G/H		300
Soluble Reactive Phosphorus (as P)	SM4500- PE/PF	3	10
Phosphorus, Total (as P)	SM 4500 PB followed by SM4500-PE/PF	3	10
Oil and Grease (HEM)	1664 A or B	1,400	5,000
Salinity	SM2520-B		3 practical salinity units or scale (PSU or PSS)
Settleable Solids	SM2540 -F		100
Sulfate (as mg/L SO_4)	SM4110-B		200
Sulfide (as mg/L S)	SM4500-S^2F/D/E/G		200
Sulfite (as mg/L SO_3)	SM4500-SO3B		2000
Total Coliform	SM 9221B, 9222B, 9223B	N/A	Specified in method - sample aliquot dependent
Total dissolved solids	SM2540 C		20 mg/L
Total Hardness	SM2340B		200 as CaCO3
Aluminum, Total (7429-90-5)	200.8	2.0	10
Barium Total (7440-39-3)	200.8	0.5	2.0
BTEX (benzene +toluene + ethylbenzene + m,o,p xylenes)	EPA SW 846 8021/8260	1	2
Boron Total (7440-42-8)	200.8	2.0	10.0
Cobalt, Total (7440-48-4)	200.8	0.05	0.25
Iron, Total (7439-89-6)	200.7	12.5	50
Magnesium, Total (7439-95-4)	200.7	10	50
Molybdenum, Total (7439-98-7)	200.8	0.1	0.5
Manganese, Total (7439-96-5)	200.8	0.1	0.5
NWTPH Dx	Ecology NWTPH Dx	250	250
NWTPH Gx	Ecology NWTPH Gx	250	250
Tin, Total (7440-31-5)	200.8	0.3	1.5
Titanium, Total (7440-32-6)	200.8	0.5	2.5

PRIORITY POLLUTANTS

Pollutant & CAS No. *(if available)*	Recommended Analytical Protocol	Detection (DL)[1] *µg/L unless specified*	Quantitation Level (QL)[2] *µg/L unless specified*
METALS, CYANIDE & TOTAL PHENOLS			
Antimony, Total (7440-36-0)	200.8	0.3	1.0
Arsenic, Total (7440-38-2)	200.8	0.1	0.5
Beryllium, Total (7440-41-7)	200.8	0.1	0.5
Cadmium, Total (7440-43-9)	200.8	0.05	0.25
Chromium (hex) dissolved (18540-29-9)	SM3500-Cr EC	0.3	1.2
Chromium, Total (7440-47-3)	200.8	0.2	1.0
Copper, Total (7440-50-8)	200.8	0.4	2.0
Lead, Total (7439-92-1)	200.8	0.1	0.5
Mercury, Total (7439-97-6)	1631E	0.0002	0.0005
Nickel, Total (7440-02-0)	200.8	0.1	0.5
Selenium, Total (7782-49-2)	200.8	1.0	1.0
Silver, Total (7440-22-4)	200.8	0.04	0.2
Thallium, Total (7440-28-0)	200.8	0.09	0.36
Zinc, Total (7440-66-6)	200.8	0.5	2.5
Cyanide, Total (57-12-5)	335.4	5	10
Cyanide, Weak Acid Dissociable	SM4500-CN I	5	10
Cyanide, Free Amenable to Chlorination (Available Cyanide)	SM4500-CN G	5	10
Phenols, Total	EPA 420.1		50

Pollutant & CAS No. *(if available)*	Recommended Analytical Protocol	Detection (DL)[1] *µg/L unless specified*	Quantitation Level (QL)[2] *µg/L unless specified*
ACID COMPOUNDS			
2-Chlorophenol (95-57-8)	625	1.0	2.0
2,4-Dichlorophenol (120-83-2)	625	0.5	1.0
2,4-Dimethylphenol (105-67-9)	625	0.5	1.0
4,6-dinitro-o-cresol (534-52-1) (2-methyl-4,6,-dinitrophenol)	625/1625B	1.0	2.0
2,4 dinitrophenol (51-28-5)	625	1.0	2.0
2-Nitrophenol (88-75-5)	625	0.5	1.0
4-nitrophenol (100-02-7)	625	0.5	1.0
Parachlorometa cresol (59-50-7) (4-chloro-3-methylphenol)	625	1.0	2.0
Pentachlorophenol (87-86-5)	625	0.5	1.0
Phenol (108-95-2)	625	2.0	4.0
2,4,6-Trichlorophenol (88-06-2)	625	2.0	4.0

PRIORITY POLLUTANTS (continued)

Pollutant & CAS No. *(if available)*	Recommended Analytical Protocol	Detection (DL)[1] *µg/L unless specified*	Quantitation Level (QL)[2] *µg/L unless specified*
VOLATILE COMPOUNDS			
Acrolein (107-02-8)	624	5	10
Acrylonitrile (107-13-1)	624	1.0	2.0
Benzene (71-43-2)	624	1.0	2.0
Bromoform (75-25-2)	624	1.0	2.0
Carbon tetrachloride (56-23-5)	624/601 or SM6230B	1.0	2.0
Chlorobenzene (108-90-7)	624	1.0	2.0
Chloroethane (75-00-3)	624/601	1.0	2.0
2-Chloroethylvinyl Ether (110-75-8)	624	1.0	2.0
Chloroform (67-66-3)	624 or SM6210B	1.0	2.0
Dibromochloromethane (124-48-1)	624	1.0	2.0
1,2-Dichlorobenzene (95-50-1)	624	1.9	7.6
1,3-Dichlorobenzene (541-73-1)	624	1.9	7.6
1,4-Dichlorobenzene (106-46-7)	624	4.4	17.6
Dichlorobromomethane (75-27-4)	624	1.0	2.0
1,1-Dichloroethane (75-34-3)	624	1.0	2.0
1,2-Dichloroethane (107-06-2)	624	1.0	2.0
1,1-Dichloroethylene (75-35-4)	624	1.0	2.0
1,2-Dichloropropane (78-87-5)	624	1.0	2.0
1,3-dichloropropene (mixed isomers) (1,2-dichloropropylene) (542-75-6)[3]	624	1.0	2.0
Ethylbenzene (100-41-4)	624	1.0	2.0
Methyl bromide (74-83-9) (Bromomethane)	624/601	5.0	10.0
Methyl chloride (74-87-3) (Chloromethane)	624	1.0	2.0
Methylene chloride (75-09-2)	624	5.0	10.0
1,1,2,2-Tetrachloroethane (79-34-5)	624	1.9	2.0
Tetrachloroethylene (127-18-4)	624	1.0	2.0
Toluene (108-88-3)	624	1.0	2.0
1,2-Trans-Dichloroethylene (156-60-5) (Ethylene dichloride)	624	1.0	2.0
1,1,1-Trichloroethane (71-55-6)	624	1.0	2.0
1,1,2-Trichloroethane (79-00-5)	624	1.0	2.0
Trichloroethylene (79-01-6)	624	1.0	2.0
Vinyl chloride (75-01-4)	624/SM6200B	1.0	2.0

PRIORITY POLLUTANTS (continued)

Pollutant & CAS No. *(if available)*	Recommended Analytical Protocol	Detection (DL)[1] *µg/L unless specified*	Quantitation Level (QL)[2] *µg/L unless specified*
BASE/NEUTRAL COMPOUNDS (compounds in bold are Ecology PBTs)			
Acenaphthene (83-32-9)	625	0.2	0.4
Acenaphthylene (208-96-8)	625	0.3	0.6
Anthracene (120-12-7)	625	0.3	0.6
Benzidine (92-87-5)	625	12	24
Benzyl butyl phthalate (85-68-7)	625	0.3	0.6
Benzo(*a*)anthracene (56-55-3)	625	0.3	0.6
Benzo(b)fluoranthene (3,4-benzofluoranthene) (205-99-2)[4]	610/625	0.8	1.6
Benzo(j)fluoranthene (205-82-3)[4]	625	0.5	1.0
Benzo(k)fluoranthene (11,12-benzofluoranthene) (207-08-9)[4]	610/625	0.8	1.6
Benzo(r,s,t)pentaphene (189-55-9)	625	0.5	1.0
Benzo(*a*)pyrene (50-32-8)	610/625	0.5	1.0
Benzo(*ghi*)Perylene (191-24-2)	610/625	0.5	1.0
Bis(2-*chloroethoxy*)methane (111-91-1)	625	5.3	21.2
Bis(2-*chloroethyl*)ether (111-44-4)	611/625	0.3	1.0
Bis(2-*chloroisopropyl*)ether (39638-32-9)	625	0.3	0.6
Bis(2-*ethylhexyl*)phthalate (117-81-7)	625	0.1	0.5
4-Bromophenyl phenyl ether (101-55-3)	625	0.2	0.4
2-Chloronaphthalene (91-58-7)	625	0.3	0.6
4-Chlorophenyl phenyl ether (7005-72-3)	625	0.3	0.5
Chrysene (218-01-9)	610/625	0.3	0.6
Dibenzo (a,h)acridine (226-36-8)	610M/625M	2.5	10.0
Dibenzo (a,j)acridine (224-42-0)	610M/625M	2.5	10.0
Dibenzo(a-*h*)anthracene (53-70-3)(1,2,5,6-dibenzanthracene)	625	0.8	1.6
Dibenzo(a,e)pyrene (192-65-4)	610M/625M	2.5	10.0
Dibenzo(a,h)pyrene (189-64-0)	625M	2.5	10.0
3,3-Dichlorobenzidine (91-94-1)	605/625	0.5	1.0
Diethyl phthalate (84-66-2)	625	1.9	7.6
Dimethyl phthalate (131-11-3)	625	1.6	6.4
Di-n-butyl phthalate (84-74-2)	625	0.5	1.0
2,4-dinitrotoluene (121-14-2)	609/625	0.2	0.4
2,6-dinitrotoluene (606-20-2)	609/625	0.2	0.4

PRIORITY POLLUTANTS (continued)

Pollutant & CAS No. *(if available)*	Recommended Analytical Protocol	Detection (DL)[1] *µg/L unless specified*	Quantitation Level (QL)[2] *µg/L unless specified*
BASE/NEUTRAL COMPOUNDS (compounds in bold are Ecology PBTs)			
Di-n-octyl phthalate (117-84-0)	625	0.3	0.6
1,2-Diphenylhydrazine (*as Azobenzene*) (122-66-7)	1625B	5.0	20
Fluoranthene (206-44-0)	625	0.3	0.6
Fluorene (86-73-7)	625	0.3	0.6
Hexachlorobenzene (118-74-1)	612/625	0.3	0.6
Hexachlorobutadiene (87-68-3)	625	0.5	1.0
Hexachlorocyclopentadiene (77-47-4)	1625B/625	0.5	1.0
Hexachloroethane (67-72-1)	625	0.5	1.0
Indeno(*1,2,3-cd*)Pyrene (193-39-5)	610/625	0.5	1.0
Isophorone (78-59-1)	625	0.5	1.0
3-Methyl cholanthrene (56-49-5)	625	2.0	8.0
Naphthalene (91-20-3)	625	0.3	0.6
Nitrobenzene (98-95-3)	625	0.5	1.0
N-Nitrosodimethylamine (62-75-9)	607/625	2.0	4.0
N-Nitrosodi-n-propylamine (621-64-7)	607/625	0.5	1.0
N-Nitrosodiphenylamine (86-30-6)	625	0.5	1.0
Perylene (198-55-0)	625	1.9	7.6
Phenanthrene (85-01-8)	625	0.3	0.6
Pyrene (129-00-0)	625	0.3	0.6
1,2,4-Trichlorobenzene (120-82-1)	625	0.3	0.6

Pollutant & CAS No. *(if available)*	Recommended Analytical Protocol	Detection (DL)[1] *µg/L unless specified*	Quantitation Level (QL)[2] *µg/L unless specified*
DIOXIN			
2,3,7,8-Tetra-Chlorodibenzo-P-Dioxin (176-40-16) (2,3,7,8 TCDD)	1613B	1.3 pg/L	5 pg/L

PRIORITY POLLUTANTS (continued)

Pollutant & CAS No. *(if available)*	Recommended Analytical Protocol	Detection (DL)[1] *µg/L unless specified*	Quantitation Level (QL)[2] *µg/L unless specified*
PESTICIDES/PCBs			
Aldrin (309-00-2)	608	0.025	0.05
alpha-BHC (319-84-6)	608	0.025	0.05
beta-BHC (319-85-7)	608	0.025	0.05
gamma-BHC (58-89-9)	608	0.025	0.05
delta-BHC (319-86-8)	608	0.025	0.05
Chlordane (57-74-9) [5]	608	0.025	0.05
4,4'-DDT (50-29-3)	608	0.025	0.05
4,4'-DDE (72-55-9)	608	0.025	0.05[10]
4,4' DDD (72-54-8)	608	0.025	0.05
Dieldrin (60-57-1)	608	0.025	0.05
alpha-Endosulfan (959-98-8)	608	0.025	0.05
beta-Endosulfan (33213-65-9)	608	0.025	0.05
Endosulfan Sulfate (1031-07-8)	608	0.025	0.05
Endrin (72-20-8)	608	0.025	0.05
Endrin Aldehyde (7421-93-4)	608	0.025	0.05
Heptachlor (76-44-8)	608	0.025	0.05
Heptachlor Epoxide (1024-57-3)	608	0.025	0.05
PCB-1242 (53469-21-9) [6]	608	0.25	0.5
PCB-1254 (11097-69-1)	608	0.25	0.5
PCB-1221 (11104-28-2)	608	0.25	0.5
PCB-1232 (11141-16-5)	608	0.25	0.5
PCB-1248 (12672-29-6)	608	0.25	0.5
PCB-1260 (11096-82-5)	608	0.13	0.5
PCB-1016 (12674-11-2) [6]	608	0.13	0.5
Toxaphene (8001-35-2)	608	0.24	0.5

1. Detection level (DL) or detection limit means the minimum concentration of an analyte (substance) that can be measured and reported with a 99% confidence that the analyte concentration is greater than zero as determined by the procedure given in 40 CFR part 136, Appendix B.

   Quantitation Level (QL) also known as Minimum Level of Quantitation (ML) – The lowest level at which the entire analytical system must give a recognizable signal and acceptable calibration point for the analyte. It is equivalent to the concentration of the lowest calibration standard, assuming that the lab has used all method-specified sample weights, volumes, and cleanup procedures. The QL is calculated by multiplying the MDL by 3.18 and rounding the result to the number nearest to (1, 2, or 5) x 10^n, where n is an integer. (64 FR 30417).
   ALSO GIVEN AS:
   The smallest detectable concentration of analyte greater than the Detection Limit (DL) where the accuracy (precision & bias) achieves the objectives of the intended purpose. (Report of the Federal Advisory Committee on Detection and Quantitation Approaches and Uses in Clean Water Act Programs Submitted to the US Environmental Protection Agency, December 2007).

2. NWTPH Dx - Northwest Total Petroleum Hydrocarbons Diesel Extended Range – see http://www.ecy.wa.gov/biblio/97602.html
3. NWTPH Gx - Northwest Total Petroleum Hydrocarbons Gasoline Extended Range – see http://www.ecy.wa.gov/biblio/97602.html
4. 1, 3-dichloroproylene (mixed isomers) You may report this parameter as two separate parameters: cis-1, 3-dichlorpropropene (10061-01-5) and trans-1, 3-dichloropropene (10061-02-6).
5. Total Benzofluoranthenes - Because Benzo(b)fluoranthene, Benzo(j)fluoranthene and Benzo(k)fluoranthene co-elute you may report these three isomers as total benzofluoranthenes.
6. Chlordane – You may report alpha-chlordane (5103-71-9) and gamma-chlordane (5103-74-2) in place of chlordane (57-74-9). If you report alpha and gamma-chlordane, the DL/PQLs that apply are 0.025/0.050.

   PCB 1016 & PCB 1242 – You may report these two PCB compounds as one parameter called PCB 1016/1242.

RESOLUTION 1676

A RESOLUTION OF THE CITY OF NORTH BEND, WASHINGTON, AUTHORIZING ADOPTION OF PROPOSED AMENDMENTS TO THE HOUSING ELEMENT OF THE NORTH BEND COMPREHENSIVE PLAN, FOR THE 2015 COMPREHENSIVE PLAN AMENDMENTS

WHEREAS, the City is required to prepare a Comprehensive Plan under the Growth Management Act (GMA) and required to implement the plan with development regulations which are consistent with the plan per RCW 36.70A.040; and

WHEREAS, the City is required to take action to review and, if needed, revise the Comprehensive Plan and development regulations to ensure the Plan and regulations comply with the GMA on a periodic basis per RCW 36.70A.130; and

WHEREAS, on April 15, 2014 the City Council directed staff and the Planning Commission to proceed with certain amendments to the 2015 Comprehensive Plan and public participation plan with passage of Resolution No. 1647; and

WHEREAS, the Planning Commission has implemented the scope of work as directed by Resolution No. 1647 and formulated amendments as necessary to ensure the Comprehensive Plan is in compliance with the current provision of the Growth Management Act and King County Countywide Planning Policies; and

WHEREAS, the Planning Commission held a public hearing on the Housing Element on February 12, 2014, and recommended approval of the Housing Element at the February 12, 2014 meeting; and

WHEREAS, the proposed amendments were submitted to the Washington State Department of Commerce for review on February 25, 2015; and

WHEREAS, a SEPA Determination of Non-Significance will be issued for this element and all other amendments to the Comprehensive Plan prior to approval of the Ordinance adopting the 2015 Comprehensive Plan amendments;

NOW, THEREFORE, THE CITY COUNCIL OF THE CITY OF NORTH BEND, WASHINGTON, DOES HEREBY RESOLVE AS FOLLOWS:

Section 1. Approval of Proposed Amendments: The City Council supports approval of the amendments to the North Bend Comprehensive Plan Housing Element hereto attached as Exhibit A.

Section 2. Authorization of Comprehensive Plan Amendments: The City Council hereby directs that the amendments described in Section 1 be included as part of a future ordinance in which all of the 2015 Comprehensive Plan amendments will be adopted collectively.

PASSED BY THE CITY COUNCIL OF THE CITY OF NORTH BEND, WASHINGTON, AT A REGULAR MEETING THEREOF, THIS 17TH DAY OF MARCH, 2015.

CITY OF NORTH BEND:

Kenneth G. Hearing, Mayor

APPROVED AS TO FORM:

Michael R. Kenyon, City Attorney

ATTEST/AUTHENTICATED:

Susie Oppedal, City Clerk

Effective: March 17, 2015
Posted: March 18, 2015

CHAPTER 3: HOUSING ELEMENT

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INTRODUCTION

The Housing Element of the Comprehensive Plan sets policies that will guide future housing development, by both public and private sectors, to meet the long range housing needs of the community and to respond to the objectives of the Growth Management Act. The policies are written to support opportunities for developing housing for all income groups and for a variety of lifestyle choices. The plan considers the condition of existing housing stock and the provision of a variety of housing types and densities to meet the needs of the population while seeking to retain the small town life style that is so important to the community. The plan also seeks to develop policies that encourage the development of recognizable neighborhoods with supportive amenities such as parks, trail connections and open space.

It is the intention of the City, through its Housing Plan Element policies, to offer its residents a mix of attractive, safe, and well-maintained neighborhoods which contain a variety of housing options that are available without discrimination. Neighborhoods must be appealing, well kept, safe and close to city services, amenities, schools, jobs, and institutions.

The Housing Element was developed in accordance with the Growth Management Act, RCW 36.70A.070, WAC 365-195-310 (Housing Element Requirements), and the King County Countywide Planning Policies.

To fulfill requirements set forth by the Washington Growth Management Act, a Housing Element ensuring the vitality and character of established residential neighborhoods includes the following information:

1. an inventory and analysis of existing and projected housing needs that identifies the number of housing units necessary to manage projected growth;

2. a statement of the goals, policies, objectives, and mandatory provisions for the preservation, improvement, and development of housing including single-family residences;

3. identification of sufficient land for housing, including, but not limited to, government-assisted housing, housing for low-income families, manufactured housing, multifamily housing, and group homes and foster care facilities; and

4. provision for existing and projected housing needs of all economic segments of the population.

King County Countywide Planning Policies (CPPs) provide local direction to implement the GMA's mandate for consideration of affordable housing. Following is a paraphrased listing of the CPP's housing

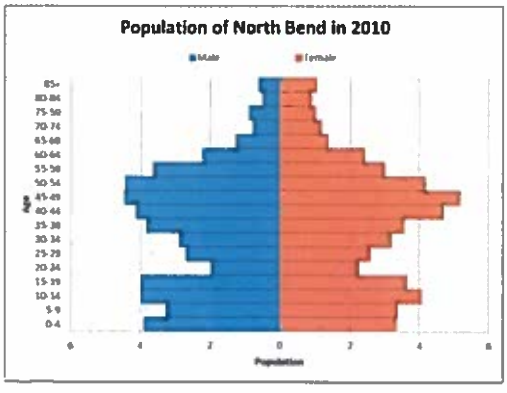
goals with direct applicability to North Bend. The number of each referenced goal is cited. Other CPPs may be indirectly applicable to North Bend. The full list of CPP's is available on the King County DDES website at http://www.kingcounty.gov/property/permits/codes/growth/GMPC/CPPs.aspx.

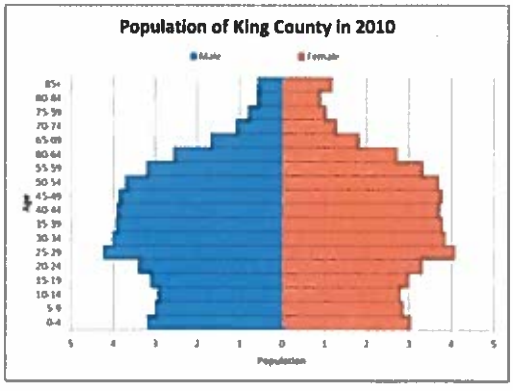
- H-2: Jurisdictions are to address the need for housing affordable to households at less than 30% AMI (very low income), recognizing that this is where the greatest needs exists, and addressing this need will require funding, policies and collaborative actions by all jurisdictions working individually and collectively.
- H-4: Provide zoning capacity within each jurisdiction in the Urban Growth Area for a range of housing types and densities, sufficient to accommodate each jurisdiction's overall housing targets and, where applicable, housing growth targets in designated Urban Centers.
- H-5: Adopt policies, strategies, actions and regulations at the local and countywide levels that promote housing supply, affordability, and diversity, including those that address a significant share of the countywide need for housing affordable to very-low, low, and moderate income households (refer to CPP document for associated strategies)
- H-8: Tailor housing policies and strategies to local needs, conditions and opportunities, recognizing the unique strengths and challenges of different cities and sub-regions.
- H-12: Plan for residential neighborhoods that protect and promote the health and well-being of residents by supporting active living and by reducing exposure to harmful environments.
- H-18: Review and amend, a minimum every five years, the countywide and local housing policies and strategies, especially where monitoring indicates that adopted strategies are not resulting in adequate affordable housing to meet the jurisdiction's share of the countywide need.

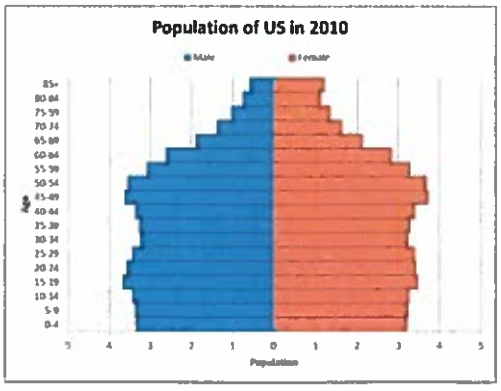
Inventory & Analysis

In order to get the most accurate data the city utilized multiple data sources. Where possible the decennial 2010 Census data was used. The decennial Census is conducted in years ending with '0' and provides very accurate detail, but not the range of data needed at times. When data was needed that is not collected in the decennial data the 5-Year American Community Survey (ACS) was utilized. The 5-Year ACS collects data for 60 months to compile precise and reliable data. It is also the only survey that analyzes small communities, with a population less than 20,000.

Figure 3-1: Population Pyramid for the City of North Bend, King County, and United States in 2010







Agenda Ho

According to the 2010 Census the population of North Bend was 5,731 with 2,348 households within the City limits, an increase of 21% from 2000. There was an average household size of 2.57. Of these 2,348 households 2,210 were occupied leaving 138 vacant. In 2010 there were 1,344 (57.2%) owner occupied 866 (36.7%) renter occupied units.

Table 3-1: City of North Bend Data

Year	Population	Number of Households	# of owner occupied units*	# of renter occupied units
1990	2,578	1,044	572 (54.8%)	471 (45.2%)
2000	4,746	1,954	1,079 (57%)	762 (41%)
2010	5,731	2,348	1,344 (57.2%)	866 (36.7%)

*The percentage of owner/renter occupied units does not add up to 100% due to vacant units.

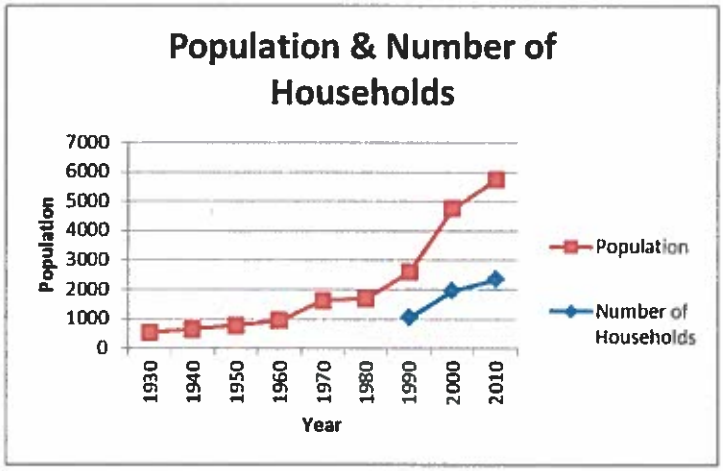


Figure 3-2: Data Source: 2010 U.S. Census

Between 2010 and 2014 there were 241 new housing units constructed. This is a significant increase in new housing compared to the previous decade (Table 3-2). In 2009 North Bend emerged from a 10 year building moratorium. The moratorium was established in 1999 as part of an agreement with Washington State's Department of Ecology when North Bend learned that the city had exceeded its share of water and to avoid fines the city agreed to not allow new residential construction. Ten years later the city secured additional water rights and building was allowed to resume.

Much of the City's housing was constructed prior to 1980. As the housing stock ages, the need will increase for rehabilitation of the oldest structures. Table 3-2 shows the age of the housing stock in the City of North Bend.

TABLE 3-2. AGE OF HOUSING STOCK*

Year Structure Built	Units Constructed	Percent
2010-2014**	241	8.8%
2000-2009	106	3.9%
1990-1999	990	36.5%
1980-1989	547	20.1%
1970-1979	259	9.5%
1960-1969	125	4.6%
1950-1959	145	5.3%
1940-1949	101	3.7%
1939 or earlier	201	7.4%
Total	2715	

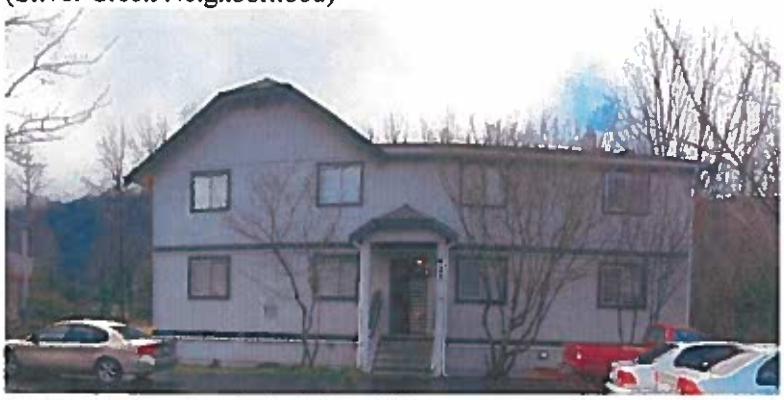
*Data from 2009-2013 ACS 5-Year Survey

**The number of structures from 2010-2014 was derived from building permits issued at North Bend Community and Economic Development Department, therefore it is higher than the 2009-2013 ACS Census that does not include more recent developments.

[1] The Census defines households in two categories: "Family households" consists of a householder and one or more other people related to the householder by birth, marriage or adoption; "Non-family households" consist of people living alone and households which do not have any members related to the householder.

A ranch house built in the 70's.
(Silver Creek Neighborhood)

New single family development built in the late 90's.
(New Si View)



Apartment complex built in late 80's.

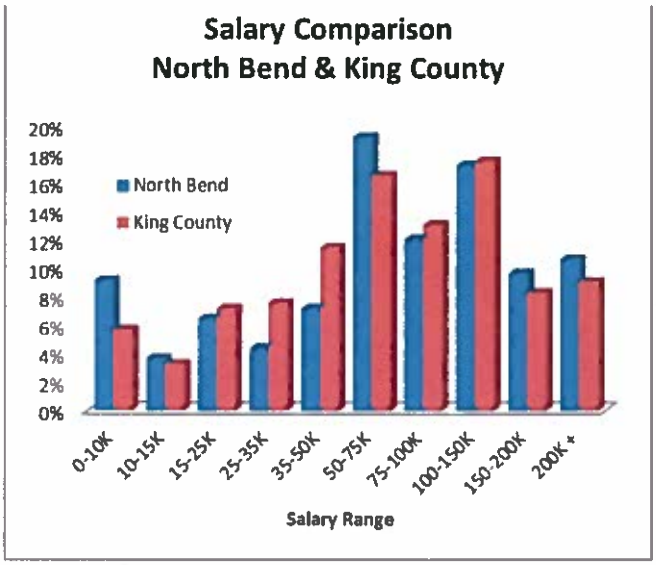
Multi-family housing with variety of housing options (2000).
(Rock Creek Development)

Figure 3-3: Typical existing housing in North Bend.

The median household income in North Bend was $74,788 with 11.2 percent of the families or 13.5 percent of the individuals having incomes below the poverty level.[2] This income level indicates that the City must be responsive to the need of its residents to secure safe, decent, and affordable housing. Working with other housing providers including developers, the County, non-profits, State, or other agencies, the City must ensure that adequate provisions are made so that all economic segments of the community can find the housing it needs.

North Bend can meet the housing needs of its low-income residents by working with housing providers to rehabilitate or develop new housing units that are affordable. The adopted Countywide Planning Policies (CPPs) include affordable housing guidelines based on the median income for King County.

Figure 3-4: Salary Comparison between the City of North Bend and King County (Data Source: 2009-2013 ACS 5-Year Survey)



For the planning period, the City will have to develop multiple affordable strategies that can help generate an adequate supply of units affordable to low income city residents.

[2] 2009-2013 American Community Survey (ACS) 5-Year Estimates

DIRECTION FOR HOUSING POLICIES

The Housing Element of the Comprehensive Plan outlines the City's direction or response to three basic objectives:

1. The need to provide adequate capacity for residential growth to meet regional growth targets;
2. The need to encourage the development of a wide variety of housing alternatives to meet the needs of a diverse population; and
3. The need to foster opportunities that provide affordable housing.

The City can influence the local housing market through a variety of means:

- by directing the location and amount of land available for residential development;
- by amending its ordinances and codes to affect the size, type, and design of new and renovated housing;
- by building amenities that attract quality residential development; and
- by seeking financial resources and partnerships which can help meet the objectives of maintaining the City's existing housing stock and providing affordable housing.

The CPP's require all jurisdictions to have the capacity to accommodate housing and employment targets. North Bend's net housing target for 2012-2031 is 649 new houses. North Bends net job target for 2006-2031 is 1,050 new jobs. While much of the demand for housing will be met by new housing construction, rehabilitation of existing older structures and selective infill development within existing neighborhoods will also help satisfy this future demand.

Some of the future demand for housing will be for persons with special housing needs including those seeking group homes, emergency or transitional housing, senior housing, single room occupancy housing and so on. The City will work with the County to ensure that housing for persons with special needs can be accommodated here. The City will also work with providers of special needs housing to site new facilities or adapt to reuse other residential or non-residential buildings.

The City of North Bend is committed to meeting the future demand for housing through the following strategies:

Expansion of City Limits:

The City of North Bend will accommodate increased population growth through annexations of land within its UGA. The North Bend UGA boundary is shown in Map 1-1 of the Land Use Element, North Bend Land Use Designations. The UGA will permit the City to grow to the south to I-90. These areas contain existing low-density residential and some open rural land uses. The remaining undeveloped land within the UGA will provide additional capacity to meet the City's new housing demand over the next 20 years.

Infill Housing Within Existing Residential Areas:

This strategy would encourage additional housing on remaining lots within the City limits and existing residential areas. This strategy would permit development of smaller lots that are compatible with the

Agenda Ho

existing neighborhood scale and character, helping to maintain and increase the vitality of these neighborhoods over time. Plats of smaller lots located within the existing city limits could allow for innovative housing types such as cottages, that would blend with surrounding homes and be more affordable, as well as other small, fee-simple units.

Mixed-Use Development:

Mixed-use development is a mix of different land uses in an area, on a property or within a single building such as commercial use first floor with residential above. Redevelopment of existing commercial areas would permit the development of housing over retail shops or adjacent to commercial uses. Mixed-use in the downtown will encourage transit by providing increased density to support alternate modes of transportation.

The City permits the creation of low intensity home businesses that encourages entrepreneurship without changing the character of existing neighborhoods. The City promotes concurrent commercial/residential uses in the DC and NB zones that do not negatively impact the quality of life of adjacent neighbors. Mixed-use strategies are encouraged within a number of zoning districts through "Planned Neighborhood Development" review.

Mix of Housing Types:

Mixed-use development may also take the form of a mix of housing types within existing or yet-to-be-established neighborhoods. The goal of creating varied residential developments is to provide housing choices, integrate income and age groups, and encourage affordability. A variety in housing types should be permitted when the existing neighborhood character can be maintained or enhanced. An overall objective of the City is to work towards meeting Countywide Planning Policies on affordability while maintaining an overall single family to multi-family housing ratio of 70 percent to 30 percent. The City is presently at a ratio of 63 percent owner occupied to 37 percent renter occupied. To further encourage diversity, the City established a Cottage Residential (CR) zone that allows smaller lot sizes at higher densities.

Critical to the success of neighborhoods with mixed housing types is attention to scale and neighborhood character, the provision of adequate parking and the concurrent creation of mini parks supported by the homeowners, expansion of existing City parks, or fee in-lieu option for smaller plats to meet the needs of new residents.

Figure 3-1: New LDR Development with attention to open space, scale, parking and neighborhood character.

As North Bend's population changes, so will its demographic profile. To respond to the expected changes in the population, lifestyles, and the rising cost of housing, the City should provide opportunities for a mix of housing types including townhouses, duplexes, small lot single family innovative housing including cottage housing and other alternative types of housing that would blend with surrounding

Agenda Ho

homes and be more affordable, accessory dwelling units and mixed-use residential and commercial development. All new development must both meet the market demand as well as meet the City's goal of retaining its small town charm and rural appeal. Accomplishing this objective will be achieved in part by the creation and retention of integrated systems of open spaces, bikeways and pedestrian paths.

Manufactured and Mobile Homes:

As of 2010 North Bend has 182 mobile homes within the city limits (158 in mobile home parks and 24 stand-alone) based on city records. This is a significant increase from 2000 when there were 53, due to an annexation that included two additional mobile home parks. These structures are located primarily in two mobile home parks located along North Bend Way and one on Bendigo Boulevard N. These mobile home parks provide a source of affordable housing, both rental and owner-occupied. Mobile home parks must demonstrate that they are safe and have adequate utilities and city amenities.

Manufactured homes, which are produced in factory-controlled settings and shipped to a housing site for assembly, can provide an affordable alternative to the conventional site-built single family home. By state law the City must permit manufactured housing that conforms to uniform codes in areas of the City with adequate utility service and capacity where they meet city zoning codes and are placed on permanent foundations.

AFFORDABLE HOUSING

"Housing is a basic need for every individual. Our [region's] success depends on ensuring the availability of a variety of housing types and densities, as well as an adequate supply of housing affordable at all income levels, to meet the diverse needs of both current and future residents." (Puget Sound Regional Council, Vision 2040)

The City of North Bend is committed to providing development opportunities for affordable and low-income housing. Affordable housing is defined as when the total housing costs, including basic utilities, does not exceed 30 percent of the income limit (for renters, 50 percent or less of the county median family income, adjusted for family-size, and for owners, 80 percent or less of the county median family income, adjusted for family size for owners) (WAC 365-196-210(e)(i)(C) (i-v)). Residents need assistance with the escalating cost of housing to ensure they have access to housing which best meets their needs. As shown in Table 3-3, North Bend is slightly under the targeted units for providing housing below 50% Area Medium Income (AMI). North Bend meets and exceeds the goals for 50-80% AMI. Concurrent with the need to provide safe, decent, and affordable housing is the need to ensure that lower income residents have equal access to the provision of social, recreational and community services. North Bend can help meet the needs of lower-income households through the following strategies:

Table 3-3: LOW INCOME HOUSING EXISTING INVENTORY				
CPP Guidelines (AMI*)	**Countywide need (% of total housing supply)**	**North Bend Existing Inventory****		
		Rental Units	**Ownership Units**	**All Housing**
50% to 80% of AMI (moderate)	16%	342 units	147 units	22.1%
30% to 50% of AMI	12%	192 units	70 Units (Under 50% AMI)	9.3%
30% and below AMI (very low)	12%	161 units		9.8%

*Area Medium Income (AMI)
** Overall Housing Affordability data is from King County's 2012 Needs Assessment, based on the 2006-2010 ACS 5-Year Survey data.

Preservation of Existing Affordable Housing:

Older homes in existing neighborhoods, accessory units, mobile homes, shared housing, and existing subsidized housing currently provide affordable housing opportunities for some residents. Preservation of the existing affordable housing stock is critical to maintaining access to those sources. The City will seek ways of maintaining and increasing the availability of low-income housing through pursuit of Community Development Block Grant funds for housing repair and maintenance, developing links with affordable housing providers not currently operating in North Bend, and the consideration of developing a Housing Authority, either alone or in conjunction with other valley cities, that could be charged with meeting residents' housing needs. The City will also work to enforce its building and maintenance codes to ensure that the existing housing stock provides decent, safe, and sanitary housing.

Subsidized Housing:

The City of North Bend currently has approximately 90 units of subsidized housing located in the downtown area. The Sno-Ridge Apartments (39) are exclusively senior housing, the Cascade Park apartments (27) is for seniors and disabled persons under 62 and the Si View Court Apartments (20) are exclusively for families. This housing was developed through federal, state, and King County housing assistance programs. The City will continue to seek housing assistance programs to meet the needs of its low-income population while seeking to preserve its existing stock of subsidized housing.

Figure 3-2: Cascade Park Apartments for seniors and disabled persons under 62.

Zoning Incentives:

Zoning incentives are a key mechanism to encourage the development of affordable housing through the private market. Incentives can include density bonuses, forgiveness or reduction of impact fees or permit costs, and streamlined permit and development review processes. Amendments to the zoning codes can also provide new mechanisms for development to contribute to a low-income housing trust fund for future affordable housing production.

Non-Profit Housing Organizations:

Non-profit housing organizations can provide opportunities for developing low-income housing in the communities they serve. These organizations can assist in preservation and rehabilitation of existing housing or construction of new housing and acquisition of property for housing. The City of North Bend will encourage these organizations to become active housing partners in the North Bend community. The City can act as a catalyst to encourage the organization and participation of these groups and as a conduit through which to seek additional government support.

Accessory Housing and Housing Sharing:

Accessory housing is a means of providing additional affordable residential units. Larger homes can often accommodate a rental unit without causing negative impacts in an existing neighborhood. The City identifies appropriate standards for accessory housing units and has developed the regulatory means to accommodate them. Opportunities for shared housing can be encouraged by promoting local recognition of groups or agencies that assist in linking a housing provider with those seeking housing.

Federal and State law mandates that cities provide the same residential opportunities to individuals of special needs as are available to single family residences. These individuals may be part of group homes and require some assistance in their day-to-day living, such as the physically or mentally disabled, victims of domestic violence, substance abusers, people living with AIDS, youth at risk, and seniors. Family living situations, institutional settings, social service programs and assisted housing, specifically excluding Secure Community Transition Facilities as defined in Washington State law, all serve a portion of those with special needs. The Federal Fair Housing Act (Chapter 151B) includes all individuals with special needs and states that no individual shall be denied the opportunity for safe and independent living. In addition, the Washington Housing Policy Act states that a "decent home in a healthy, safe environment for every resident of the State" shall be provided (RCW 43.185B.009).

The Housing Element supports goals and policies that provide equal and fair housing access for all residents of North Bend, including special needs residents. In order to provide housing opportunities for residents of special needs, the City shall work with public and private agencies to provide opportunities and services that would not be available otherwise to these residents. In addition, the City shall provide for these residences by continuing to support codes and ordinances which allow for a variety of housing opportunities, as well as encouraging the increase of social support services within the city and surrounding area. Adding flexibility to the City's land use code to allow group homes and home-based care is also a significant opportunity available to the City for meeting the demand for special needs housing.

SENIOR HOUSING AND AGING IN PLACE

It is apparent from our population pyramid (Figure 3-1) that within the next 20 years a large portion of North Bend will be over 60. The City will need to accommodate this growing senior population by enabling the development of additional senior and assisted living housing, and by supporting the uses and needs of those residents. There are a rising number of challenges that communities, families and individuals face as the population over 60 increases. Communities can address these challenges by striving to become elderly-friendly. Elderly-friendly communities address the basic needs, optimize health and well-being, promote social and civic engagement, and increase independence for all people, but especially people who are frail or have disabilities.[3] An aging-friendly community is also a community that is livable for all ages. These communities can be created by improving health care quality for older adults and adults with disabilities, addressing basic needs (education, housing, transportation, financial empowerment, and food security) that improve health and well-being, increase independence for older adults, and promote age readiness.

GOALS AND POLICIES

[3] Center for Home Care Policy and Research/Visiting Nurse Service of New York, *The AdvantAge Initiative.*

H - Goal 1: ***Encourage a variety of housing types and densities compatibly located to meet the demands of a diverse population.***

Policies:

H - 1.1 Encourage the development of single-family residential infill that would blend with surrounding homes and be more affordable and be compatible with existing neighborhoods within the city limits.

H - 1.2 Encourage the provision of a diversity of housing types and sizes to meet the needs of a wide range of economic levels, age groups and household make-up.

H - 1.3 Encourage a mix of housing types, models and densities.

H - 1.4 Create incentives for developers to include affordable housing voluntarily in new developments.

H - 1.5 Encourage non-profit housing providers to pursue housing development opportunities that supply affordable housing while providing a high quality residential living environment.

H - 1.6 Work with King County to develop affordable housing opportunities within the Snoqualmie Valley communities.

H - 1.7 Reduce impact fees for residential developments that include affordable housing for those with low or very low-incomes.

H – 1.8 Seek housing assistance programs to meet the needs of low-income or other special-needs city residents, while seeking to preserve the existing subsidized housing currently located within the city.

H - 1.9 Work with the King County Housing Authority and other low income housing providers to provide affordable units to households at or below 80% of median income by the end of the target period (2022).

H – 1.10 Work with other governmental agencies to develop methods that can streamline the residential permit review process to reduce the impact on affordable housing development.

H - Goal 2: ***Promote residential neighborhoods that contain the necessary public amenities and support facilities that contribute to a high quality of life for North Bend residents.***

Policies:

H – 2.1 Consider development of parks and recreational facilities jointly with the School District and Si View Metropolitan Park District.

H – 2.2 Encourage the formation of neighborhood or homeowners associations to help develop a sense of community within a particular neighborhood.

H – 2.3 Seek to create or to retain and protect links to a Citywide Trail System that connects neighborhoods with areas of commerce in an effort to promote alternative transportation systems.

H - Goal 3: ***The City should encourage the preservation and rehabilitation of the existing housing stock as a means of providing affordable housing.***

Policies:

H - 3.1 Enforce building maintenance codes, and health and safety codes for the City's housing stock.

H - 3.2 Encourage the preservation of affordable older residential structures to maintain the available housing stock.

H - 3.3 Work to preserve and physically improve existing mobile home parks as a means of preserving affordable housing.

H - 3.4 Seek ways of maintaining and increasing the availability of low-income housing through pursuit of Community Development Block Grant funds for housing repair and maintenance, developing links with affordable housing providers.

H - Goal 4: ***The City of North Bend should provide adequate land capacity for forecasted population and residential growth within its city limits and Urban Growth Area in order to promote stable housing prices, foster affordability and broaden housing choices.***

Policies:

H – 4.1 Allow for density flexibility in housing development in order to meet population forecasts.

H – 4.2 Promote opportunities for infill housing within the downtown area that provide a mix of housing types, prices, and densities.

H – 4.3 Develop zoning regulations that will provide incentives to implement county wide planning policy targets for housing affordability as new housing development is permitted.

H – 4.4 Provide areas for mixed use and high density housing to support a wide range of housing options at all economic segments for residents.

H – 4.5 Continue to allow accessory units, shared housing, cottage housing, infill development at higher densities outside of "establish" or "constrained areas" and mixed-use development, which includes either a mix of residential densities or a mix of residential and commercial land uses in specifically designated areas.

H- Goal 5: ***Support and provide for the availability of housing for residents of North Bend with special housing needs, excluding Secure Community Transition Facilities as defined in Washington State Law.***

Policies

H – 5.1 Support the preservation and development of special needs housing in North Bend that serves both city residents and those in surrounding communities.

H – 5.2 Encourage and promote partnerships with public and private agencies, as well as developers, that provide funding for housing opportunities for those with special needs.

H – 5.3 Evaluate potential regulatory obstacles and ensure that codes or ordinances do not restrict development of special needs housing within North Bend.

H-Goal 6: ***Support and provide for the ability to age in place safely, independently and comfortably, regardless of age, income or ability level.***

H – 6.1 Empower older adults, their families, and other consumers to make informed decisions and to easily access available services

H – 6.2 Enable older adults to age in their place of choice with appropriate services

H – 6.3 Prepare North Bend for an aging population

H – 6.4 Strive to make the City of North Bend accessible, safe, and inclusive for children, youth, families, adults, and the elderly

H – 6.5 Allow people to age in place, be it in their homes or neighborhoods, by encouraging the development of neighborhoods that provide a mix of housing typologies and sizes to accommodate a broad range of lifestyles and abilities.

NORTH BEND
easy to reach. . .hard to leave

City Council Agenda Bill

SUBJECT:	Agenda Date: May 17, 2015 AB15-026	
A Resolution Authorizing Adoption of Proposed Amendments to the 2015 Comprehensive Plan Pertaining to the Housing Element	Department/Committee/Individual	
	Mayor Ken Hearing	
	City Administrator – Londi Lindell	
	City Attorney - Mike Kenyon	
	City Clerk – Susie Oppedal	
	Finance – Dawn Masko	
	Public Works – Mark Rigos	
Cost Impact: N/A	CED Associate Planner – Lynn Fredenburg	X
Fund Source: N/A		
Timeline: Immediate		

Attachments: Resolution, Exhibit A – Housing Element

SUMMARY STATEMENT:

The City is required to review and revise, if needed, its Comprehensive Plan and development regulations by June 30, 2015 to ensure compliance with the Growth Management Act (GMA) – Chapter 36.70A RCW.

The scope of work included updating the census data, the existing housing stock as well as the targets for future housing needs (included housing for all ages, abilities, and income levels). Language was added to address an aging population under 'Senior Housing and Aging in Place'.

COMMITTEE REVIEW AND RECOMMENDATION: CED Committee reviewed the proposed amendments at their March 11, 2015 meetings and recommended approval.

RECOMMENDED ACTION: MOTION to approve AB15-026, a resolution authorizing adoption of proposed amendments to the 2015 Comprehensive Plan pertaining to the Housing Element.

RECORD OF COUNCIL ACTION

Meeting Date	*Action*	*Vote*
March 17, 2015	Passed Resolution 1676	6-0

Susie Oppedal

From: Ty Allan <tyallan@outlook.com>
Sent: Thursday, June 30, 2016 12:14 PM
To: Londi Lindell
Cc: Ken Hearing; Mark Rigos; Don DeBerg; Dawn Masko; Council; Carrie Lee; mthomas@bangstick.net
Subject: RE: OSS in North Bend limits

Londi,

The code you reference is under the definitions section which states clearly that "Urban Services" are typically provided in Cities, meaning that, yes, the city would be responsible for the design, install and maintenance of a public utility, not a private entity.

At no point does it state that septic systems shall be banned from use, and entire cities shall be put on sewer systems. Nor does it state that the city of North Bend shall be required to force its residents to connect to sewer.

According to the document for the 2040 vision, at no point in this document, that you referenced as the city's governing body, mentions banning septic systems. Infact it has sections such as this:

Page #4, Background - Sanitary Sewer Systems 101
It is important to note that many urbanized areas still have properties served by on-site septic systems. There are many factors for the continued use of septic systems including; soil properties and characteristics, age and type of system, the size of the property and structure being served, and cost of conversion from septic to sewer. These all contribute to the on-going use of septic systems. The use of septic systems typically do not allow for urban levels of density.

Page #5, Planning Considerations
It is noted by many sewer utilities that not all development within a sewer service area are connected to a sewer system. Septic systems exist in many areas. Some utilities anticipate that all septic systems will be converted to a sewer system within the planning horizon, while others consider a significant portion but not 100 percent.

Many considerations are taken into account when planning for ultimate sewer service capacity. Each jurisdiction considers;

- Adjacent sewer service providers,
- Cost-effectiveness,
- Zoning,
- Existing soil conditions,
- Topographical limitations, and
- Septic conversions

Page #7, Barriers to Sewer service Delivery
Sewer utility engineers, planners and administrators take into consideration many factors that may influence the ability to provide sewer service. Each keeps in mind the need to plan for maximum build-out within the

sewer service area for which they are planning. This philosophy is reinforced by the Washington State Department of Ecology policies that allow for a ban on sewer connections if a local or regional sewer utility is nearing the capacity of its system. There are a few recognized barriers to service delivery:

- Capacity,
- Water quality, and
- Cost.

In the four-county area there is evidence of each of these barriers.

Page #9, Barriers to Sewer service Delivery

There are many areas in the four-county region still served by onsite septic systems. The conversion to sewers is very expensive. In some areas, conversion will cost around $15,000 to $20,000 in addition to a monthly sewer rate. Some of these property owners have single-family homes on less than a quarter acre lot and are in an area zoned for single family. This makes it difficult for a single family residence to offset the cost of hooking up to the sewer system without additional revenue from the sale of the excess property or additional units that might be served.

(End of PSRC Document you sent)

I understand that the city "Wants" to provide sewer throughout its jurisdiction, but if sewer is not feasible due to extreme cost or topographic issue, then they city should allow for septic variances throughout its boundaries. The above mentioned comments from the document you sent from the PSRC do not ban the use of septic systems, infact they note that there are barriers, such as cost, that make the point that septics systems are to be allowed. The only mention of banning anything is that "sewer connections" shall be banned if the WWTP is reaching capacity, not unlike our WWP.

You, recently attended and spoke at the PSRC meeting, where you stated that they are overstepping their authority and usurping your authority to control zoning within the city limits. Why would you fight so vehemently about one item, but then blindly follow their septic "suggestions" that clearly call out that there are issues with sewering an entire jurisdiction?

So, in conclusion, there is no specific State/County code the city is referencing that mandates the city of North Bend shall not allow septic systems. In fact, the PSRC recommends septic where sewer services is not feasible. If the sewer system is futher than 200' from the parcel and the property meets the requirements of Washington State Department of Health Standards why would the City of North Bend not allow for septic?

I refer back to my last email, "To me it seems that North Bend enacted this code to force its residents onto the sewer system, to help pay for the ageing/failing WWTP. If not please let me know what is the reason for banning new OSS, whether or not sewer is reasonably available."

Please advise,

From: LLINDELL@NORTHBENDWA.GOV
To: tyallan@outlook.com
CC: KHEARING@NORTHBENDWA.GOV; MRIGOS@NORTHBENDWA.GOV; DDEBERG@NORTHBENDWA.GOV; DMASKO@NORTHBENDWA.GOV; Council@northbendwa.gov; CLEE@NORTHBENDWA.GOV; mthomas@bangstick.net
Subject: RE: OSS in North Bend limits
Date: Wed, 29 Jun 2016 23:33:16 +0000

Ty, I was hoping you might want to learn more about the sanitary sewer system at the public meeting, not discuss septic systems. The state law I referenced is not "vague". If you are referring to my reference to "urban governmental services" and North Bend's statutory obligation to deliver the same, let me direct you to the statutory definition which clearly includes sewer as follows:

RCW36.70A.030(18) "Urban governmental services" or "urban services" include those public services and public facilities at an intensity historically and typically provided in cities, specifically including storm and sanitary sewer systems, domestic water systems, street cleaning services, fire and police protection services, public transit services, and other public utilities associated with urban areas and normally not associated with rural areas.

Here is the link to the state law citation for your viewing pleasure.

http://app.leg.wa.gov/RCW/default.aspx?cite=36.70A.030

There is significant case law surrounding this term "urban services" as it relates to sewer services particularly as it relates to extending beyond city limits for sewer extensions and whether or not a City may extend sewer beyond its corporate boundaries. However a better resource describing our obligations is to review the attached white paper from the Puget Sound Regional Council, which is a regulatory body covering 4 counties (including King County) and the following link describes the delivery of sewer vs septic systems within urban growth areas. City's can elect to allow continued septic systems but as PSRC summarizes "the Growth Management Act has outlined the need for urban services. . .and sanitary sewer is [such] an urban service. North Bend is part of an urban growth area. Thus we are tasked with delivering urban services such as wastewater treatment plant services.

Agenda Ho

http://www.psrc.org/assets/2020/appIF6a-environment-sewers.pdf

Thank you.

From: Ty Allan [mailto:tyallan@outlook.com]
Sent: Wednesday, June 29, 2016 3:56 PM
To: Londi Lindell
Cc: Ken Hearing; Mark Rigos; Don DeBerg; Dawn Masko; Council; Carrie Lee; mthomas@bangstick.net
Subject: OSS in North Bend limits

Londi,

I do believe that if I attended these public forums and asked to speak about On Site Septic systems (OSS), I would be told that these public forums are for discussing the sewer fees, not septic systems, Correct?

I have reviewed and searched the growth management act for any reason that an OSS would not be allowed, and there is absolutely no mention of requiring residents to connect to sewer, and that septic systems are not allowed, as you mentioned in your response below. Please do not reference vague sections of the growth management act to point the blame at different governing bodies. I believe this is a issue with North Bend's code only, and no other entity besides North Bend is dictating it. If otherwise, please reference specific State/County code.

To me it seems that North Bend enacted this code to force its residents onto the sewer system, to help pay for the ageing/failing WWTP. If not please let me know what is the reason for banning new OSS, whether or not sewer is reasonably available.

Please advise,

Ty Allan

From: LLINDELL@NORTHBENDWA.GOV
To: tyallan@outlook.com
CC: KHEARING@NORTHBENDWA.GOV; MRIGOS@NORTHBENDWA.GOV; DDEBERG@NORTHBENDWA.GOV; DMASKO@NORTHBENDWA.GOV; Council@northbendwa.gov; CLEE@NORTHBENDWA.GOV
Subject: RE: Comments and additional questions on 6/21 City Council Meeting
Date: Wed, 29 Jun 2016 20:31:19 +0000

Ty, I would encourage you to come to the public forum if you have further questions. However, I will briefly answer your questions.

Cities and counties are treated differently regarding the installation of new septic systems due to a state law called the Growth Management Act – what you often hear people refer to as the "GMA". This law was codified in 1990s and was adopted in an effort to stop sprawl and intensify growth in certain areas called urban growth areas or UGAs and slow growth in unincorporated counties. Thus, there are rules for rural counties under GMA and different rules for cities. North Bend is within an UGA and is a city. King County is obviously a county under the GMA. See Chapter 36.70A RCW. The specific laws regarding the requirements to deliver water and sewer are based upon RCW 36.70A.110(4) and various case law interpreting what "urban government services" and the delivery thereof means. For example, cities have been prohibited from extending their sewer lines outside of these UGAs into rural unincorporated counties because this has been deemed a violation of GMA. Similarly, cities are required to deliver this higher level of urban services by having sewer systems once they are within a UGA.

In response to your question as to why the city is passing the cost on to the residents if the city is mandated to provide sewer, I direct you to Chapter 35.67RCW. This is a state law that describes the formation of sewer utilities. A sewer utility is an enterprise fund which basically means it must be self supporting – the rate payers or users must fully pay for it. Thus, the "city" or general fund cannot pay to extend this service to your neighborhood. The other taxpayers cannot subsidize the delivery of this service to your neighborhood because this violates this type of enterprise fund. This is why you will need to get your neighbors to agree to a Local Improvement District or other financing tool in order to deliver sewer to your neighborhood. I did send that last email to you because there are in fact grants available which we think your neighborhood could be good candidates for but as a starting point you would need to get at least 60% of your owners to agree with you that this is something they want to pursue.

My statements below regarding a "majority" of Silver Creek neighbors not being interested in proceeding with sewer was in reference to those *attending the public meeting Ty and filling out the survey.* If you are interested in determining the sentiment of the entire neighborhood I understand Mark Rigos has suggested and I will again suggest that a logical next step is to get a group of interested neighbors together to start going door to door and collecting signatures on a Petition for a ULID. I am copying Carrie Lee as we either have a Petition Form at Public Works or we would be happy to ask our City Attorney to assist you in getting such a form together if you are interested in undertaking this work to ascertain the interest of your entire neighborhood. You know the City supports your neighborhood connecting to our sewer system but we simply don't have the staff resources to do this work for you. Good luck.

From: Ty Allan [mailto:tyallan@outlook.com]
Sent: Wednesday, June 29, 2016 8:30 AM
To: Londi Lindell
Cc: Ken Hearing; Mark Rigos; Don DeBerg; Dawn Masko; Council; mthomas@bangstick.net
Subject: RE: Comments and additional questions on 6/21 City Council Meeting

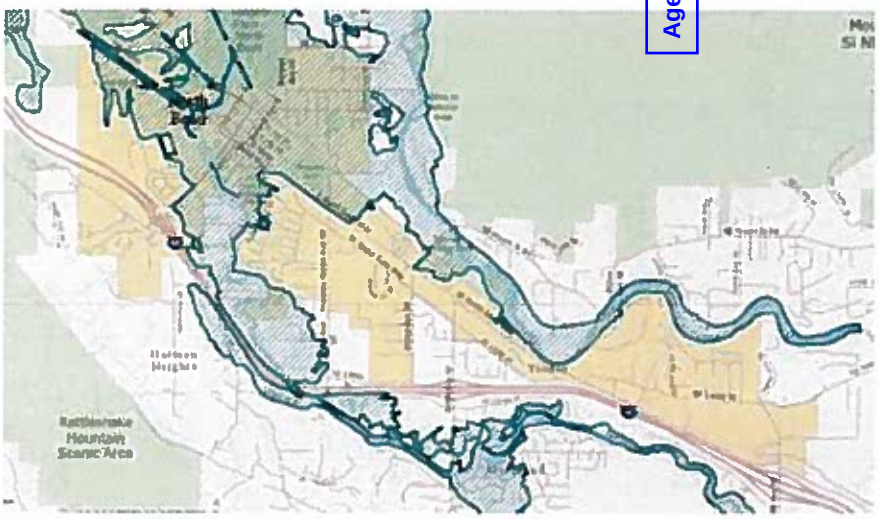
Ms Lindell,

You stated in the below email to Mr. Thomas this comment.

"As mentioned above, that is not allowed by state law. The City of North Bend is within an UGA and is mandated to deliver urban services such as water and sewer. As such we do not allow new septic systems with new construction in order to avoid pollution of rivers and water drinking sources. Further, most of North Bend is in the floodplain and is characterized by groundwater at or slightly below the ground surface during extended wet weather conditions. Under these conditions, a conventional septic tank drain field does not provide the necessary treatment to protect the environment and the public health and safety."

Can you please direct me to where in the state code or law you are referencing in the above statement? If that is so, why is King County allowed to have septic systems written into its code? In all of the conversation that I have had with the city, this is the first mention of it to be a requirement of the UGA or state code. If a city is mandated to deliver urban services like sewer why is the city not providing this infrastructure instead of passing the cost on to the residents that can not afford it. If groundwater Pollution is such an issue, why per King County code is it acceptable to have a well within 100 feet of your septic system? People have had wells next to septic systems for 100+ years, and now it's just becoming a pollution issue?

As for the Flood plain issue, isn't that quite factual. Only the Silver Creek and Downtown areas within the Fema Flood plain as shown on the map below. Where Mr. Thomas lives in not in the floodplain, as your comment could mislead someone to think all of North Bend is in a Floodplain, just rough estimation I would say that at least well over half, if not more, of the city is not in the floodplain. Surrounded by a flood plains, yes, but not in it.



In regards to your comment below about sewering Silver Creek,
"the majority of homeowners who responded to the survey were not in favor of proceeding with connection to the City's sewer system in Silver Creek"

Only 93 people were polled out of the 271 parcels in Silver Creek not on sewer. That is only 34% of the homeowners, so I would not call that a Majority. Not saying that the city is responsible for residents not participating, but still these numbers are askew.

Here were the results of the 93 residents polled:

-36% = Yes, definitely or Leaning towards yes

-44% = Leaning towards no or Definitely not

-20% = Not sure – need more information

Maybe if we got the 20% more info they needed, or even discussed it at all after the meeting then maybe it would be possible. I understand that the city does not have the resources to take these kind of polls, but If the residents are going to pay for the entire infrastructure for the city, the city could at least do its best to poll the residents to get an actual result, or at least reach out to residents to help coach on what to do to take a poll.

Regards,

Ty Allan

From: LLINDELL@NORTHBENDWA.GOV
To: mthomas@bangstick.net
CC: KHEARING@NORTHBENDWA.GOV; MRIGOS@NORTHBENDWA.GOV; DDEBERG@NORTHBENDWA.GOV; DMASKO@NORTHBENDWA.GOV; john.markus@tetratech.com; AngieS@fcsgroup.com; tyallan@outlook.com; MFOGLE@NORTHBENDWA.GOV; Council@northbendwa.gov
Subject: FW: Comments and additional questions on 6/21 City Council Meeting
Date: Wed, 29 Jun 2016 01:24:00 +0000

Mr. Thomas, your below emails to the City Council were forwarded to me and Council requested I provide responses. Please be advised that there are two additional opportunities for public comment on Thursday, July 7th (with an optional tour of our Sewer Plant at 6:00PM-limited spaces so please RSVP if you are interested) and Tuesday, July 19th. Both of these meetings are being held at the Senior Center @ 7:00 PM. Although I understand you currently are connected to a septic system you pose a significant number of questions regarding our proposed sewer rate increase affecting our sewer rate payers and we are hopeful you are interested in connecting to our sewer system at some future date. Please see the City's responses in red below. If you have further questions, please bring them to a future public forum. Thank you for becoming involved in this important issue for the City and I trust the below responses are helpful in better understanding the need for an increase in our sewer rates. We hope you are able to attend one of the upcoming public meetings or hearings. Thank you. Londi Lindell

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From: mthomas@bangstick.net [mthomas@bangstick.net]
Sent: Thursday, June 23, 2016 12:30 AM
To: Council
Cc: Mark Rigos; Susie Oppedal
Subject: Comments and additional questions on 6/21 City Council Meeting

Dear Council Members,

Thank you for not approving the rate increase and giving more time for public Q&A and also for good additional questions.

I personally am having a hard time resolving why it is necessary to double the capacity and in such short order.

Response:

The principal driving force for doing the work at the treatment plant is repair and replacement due to the Plant being almost 70 years old and NOT to provide new capacity for new homes as you have suggested during your testimony and throughout this email. There are no new capacity improvements being made during the 5 year capital improvements. There is existing unallocated capacity at the Sewer Plant. The capacity element is

a consequence of the currently unused or unallocated capacity of the plant that will benefit from implementation of the capital improvement plan.

This seems far out of line with our existing population and residential property growth, even the City's own comprehensive plan and UGA requirements would not use all the capacity growth proposed (+771 residences/1982 people) to *2035*.

Response:

As the City grows, there will be an increase in residential population but also growth in the commercial sector. Wastewater derived from the commercial represents about 30% of the existing capacity needs for wastewater treatment. Currently there are about 2150 people living in residences (~836 ERUs) within the City who are on private on-site septic systems such as yourself that are not connected to the City's wastewater collection and treatment system. In 2036 it is estimated that there will only be 420 residents (163 ERUs) within the City that will remain on private on-site septic systems. As King County Public Health adopts more stringent regulations on septic and as pollution control laws and Growth Management laws requires cities' to deliver urban sewer services, existing septic systems will eventually be eliminated within urban growth areas. This is set forth in state law and is consistent with the Growth Management Act.

The city leadership regularly cite the need to support the UGA and required growth as justification for development, the city needs to explain why then it is NOT following its own comprehensive plan and overbuilding capacity.

Response:

The City is following its own Comprehensive Plan and is not "overbuilding". You have made estimates that this plan allows for over 11,000+ additional homes or persons to move to our town based upon the available ERUs and this is incorrect. The 5-Year Wastewater CIP plan that the proposed rate increase is based upon is consistent with the City comprehensive plan. The rate model estimates growth of approximately 100 new homes a year during the next 5 years. Based on the growth model in the wastewater facility plan and the City's comprehensive plan, additional or new "capacity" improvements at the treatment plant will not be required until 2029. Again the work identified in the 5 year CIP for the years 2016 -2020 are needed to allow the existing treatment plant *to reliably and consistently at a level that will assure compliance the City's NPDES discharge permit* because it's a 70 year old sewer plant. **Only about half of the existing plant capacity is allocated** so improvements aren't needed to add capacity at this time. Capital Costs associated with the unallocated portion of the plant will be recovered from development through a connection or hookup fee charged when a new home connects to the system which is also called the General Facilities Charge (GFC).

Has the city considered plans that do not double capacity?

Response:

Again, your assumption is incorrect - The 5-year plan does not double the existing plant capacity it only allows the existing rated capacity of the plant to be used and allows the Plant to function in compliance with our permit.

Has the city considered plans that decrease load? (such as by encouraging and providing $ to residents and businesses to install low flow fixtures, water conserving toilets, front-loading washing machines, commercial dishwashing water recycling systems, etc.)?

Response:

Reducing the hydraulic load discharge by any specific class of user through water conservation would not eliminate the need or significantly reduce the costs for the 5 year capital improvement plan. The reason for this is because of the high amount of extraneous flow that enters the wastewater collection system due to inflow and infiltration because the collection system is also almost 70 years old so there are many cracks and breaks in the lines so we have a problem called I & I or inflow and infiltration. Inflow and infiltration is the dominate factor in determining the required hydraulic capacity of the plant. *On an annual basis more than half of the wastewater conveyed and treatment by the North Bend Wastewater Facilities is attributable to I&I. During a severe rainfall/snow melt event such as that experienced in November and December 2015, I&I accounted for over 85% of the daily hydraulic flow (load) conveyed and treated by the City's wastewater facilities.* Even with this high amount of I&I it remains cost effective to enhance the existing treatment plant as compared to cost and difficulty of implementing corrective action including replacement of private side sewers.

How about the unthinkable... that the city needs to allow septic systems to avoid increased loading and to encourage people on OSS to stay on them longer. (Septic users consume no capacity). There are still properties more than 200 ft. from city sewer that are blocked from adding OSS.

Response:

As mentioned above, that is not allowed by state law. The City of North Bend is within an UGA and is mandated to deliver urban services such as water and sewer. As such we do not allow new septic systems with new construction in order to avoid pollution of rivers and water drinking sources. Further, most of North Bend is in the flood plain and is characterized by groundwater at or slightly below the ground surface during extended wet weather conditions. Under these conditions, a conventional septic tank drain field does not provide the necessary treatment to protect the environment and the public health and safety.

FCS' testimony at the 6/21 hearing indicated rate payers would be paying $3.4M as a result of capacity expansion.

Response:

Existing rate payers will be responsible for paying their fair share of the 5 year capital improvement program for permit compliance, redundancy, etc which is around that $3.4M figure. The balance of the costs for implementing the improvements will be paid by future development.

If I'm not mistaken rate increases cannot be used to pay for capacity expansion, only maintenance, repair, and upkeep. Isn't using funds marked for O&M/repair an unlawful use when those funds are used for capacity expansion? Folks need to go back and propose additional revenues related to new development... higher new development charges to pay for such. In any case it is not following the philosophy of "growth pay for growth".

Response:

The program does require growth to pay for growth. The need for implementing the 5 year capital improvement plan is not growth as stated earlier. Cost associated with implementation of the 5 year capital improvement plan that are associated with the current unallocated capacity of the existing plant will be recovered through the GFCs. The faster development occurs the faster the City can recover capital for the existing plant improvements through developer paid GFCs and new city sewer customers through payment of monthly sewer rates.

I also have additional questions regarding the assumptions on revenues. Mark's reply to me indicated that rainy season water consumption was used as the basis for rate increases. It is common sense that many residential users will increase their consumption in the summer to maintain their homes lawns and to garden/grow food--certainly in line with "preserving the rural character of North Bend". Wouldn't a rate design that assumes winter usage of water overshoot and collect too much money during summer months? I'd like to get more details as to the design of the rate increase and revenue projections to ensure that we've looked at multi-year consumption... at least a full 12 months or more (certainly there are fluctuations for dry and wet years)... considering North Bend is asking for an astronomical rate increase folks seriously need to examine how to bring down the increase.

Response:

The City uses the average monthly water consumption rate during the period of November through March to establish the average daily sewage flow for the "drier" months of the year, April through October). Actual residential water consumption from April through October does not come into the equation for computation of sewer rates or calculation of the sewer bill. The monthly residential sewer bill for the months of April through October is equal to the average of the preceding 5 months of sewer bills during "wet weather" (November through March).

Both myself and another citizen at the meeting proposed an alternative sewer consumption charging structure... one proposed a flat rate for residents, I had proposed basing sewer charges on winter consumption. Certainly the winter strategy incents conservation... people are incented to reduce household water use during winter months--and that is usage that does go into city sewer and at the worst time, rainy season where inflows are highest due to water leaking into the system or improper drainage connections to sewer.

Response:

The City's prior sewer rate was based upon a flat rate but a flat rate fees does not encourage water or wastewater conservation, which are key objectives identified by the City Council. A volume based fee that is constant or increases concomitant with increased consumption/discharge encourages conservation. The proposed rate structure is volume based with a constant volume charge.

I'd also ask that the city examine other ways of paying for new development aside from GFC. Homes that are on septic at some point will be going to city sewer and simply increasing the GFCs makes migration to sewer even less attractive... and even major repairs are apt to cost less than a $10k GFC (and that's before considering another $10k-$25k or more for a resident to connect from their home to the city sewer connection)... and then the resident has another $100 or more in sewer consumption charges they did not have before (relative to pumping every 3-5 years at $750 plus occasional maintenance costs, screen cleans and miscellaneous repairs). Did not Silver Creek just reject city sewer? What is the city doing to make connecting to sewer a more attractive option?

Response:

The City can apply for grant and loan funding from the Washington State Department of Ecology to reduce sewer rate increases associated with extending city sewer into existing neighborhood not currently served by the City's wastewater collection system. Centennial Clean Water Grant funds have been generally available to "buy down" the cost of the project so that the new customer's total sewer bill does not exceed 2% of the median household income. In 2015 median household income (MHI)for the Silver Creek has been reported to be $84,432. Two percent of this equates to a threshold sewer rate cost of $140.72. If the City applied and offered grant funding for the project then residents the average residential customers sewer rate would be set at 2% of the median household income. The grant would be provided to provide the necessary funds to buy down the capital obligation for the project. Also Ecology does provide additional financial aid through lowering the interest rates on loans that result in sewer rates that are in the range of 80 to 100 percent of the sewer rate threshold (2% of MHI). However, the City's position has been that it is up to the neighborhood to decide if they wish to form a ULID to extend sewer to their neighborhood and busy City staff are not prepared to spend limited staff resources applying for such grants unless a neighborhood indicates a significant interest in such a ULID by initiating a ULID through a Petition. Although a Town Hall Meeting was conducted for the Silver Creek Community due to Ty Allen's inquiries (who I am copying on this email due to his interest in septic), the majority of homeowners who responded to the survey were not in favor of proceeding with connection to the City's sewer system in Silver Creek.

Last the upgrades/repairs and changes for "improvements" need to be examined closer to ensure there are no "shadow" capacity changes there. A good cross check is to re-run the system design "as if" no capacity changes were done and then compare the costs against the plan that increases the capacity... the difference is the cost of improvements/repairs/maintenance due to system capacity increase... and all those costs should be passed to new development.

Response:

It is essential to understand that the *improvements identified are principally replacement, repair, and additions for critical process redundancy* (e.g. the addition of a second clarifier, third UV reactor, and centrifuge) and for achieving compliance with the state biosolids regulations (i.e. , construction and operation of an aerobic digester for production of Class B Biosolids to allow for beneficial use for what currently is un-stabilized sewage sludge). In other words, even if another house was never built in North Bend our permit requires this level of redundancy for safety and compliance with current regulations.

I am also concerned with statements during the meeting that the plan/design is only "80%" done. So what else is left and what is the risk the costs go up?

Response:

The proposed rate increases are based on planning level estimates. Actual costs will vary but should be generally covered within +/- 30% of the estimated cost. Estimated costs are generally updated during and at the end of design phase. The construction market place sets the actual cost of construction may differ from the engineers estimate due to the cost of materials , labor and overall bidding climate at the time of bidding.

There was also a statement (I believe by the city administrator made it) that another $12-$14m in revenues will be needed for O&M to 2029... so ratepayers will be faced with that as well.... this should also be put out as the rate increases clearly won't end in 2020... that is almost as expensive as the entire improvement and capacity expansion plan being put forward now. I'd certainly like to see more details on this.

Response:

There is no capacity expansion in the 5-year Capital Improvement Plan as stated previously. Yes, operation and maintenance costs will increase over current levels because city needs to be more proactive rather than a reactive position to operating and maintaining the City's wastewater facility assets. The proposed rates include the cost for increased O&M and implementation of the 5-year capital improvement program.

I would like to understand when the system capacity changes and when we need certain levels of capacity. What capacity do we need and when do we need it? Perhaps present a table of the required capacity every year for the next 5-10-20 years.

Response:

Treatment plant capacity increases are not anticipated before 2029 based on the City's comprehensive plan and the draft wastewater facilities plan. Again the 5 year capital improvement program is needed to repair and replace equipment and systems that have failed or likely to fail because they have reached their design service life, and to bring the plant into compliance with the State and Federal standards for redundancy and reliability to assure compliance with the City's NPDES permit and to provide the City with the needed improvements to meet the State's Biosolids Management Regulations and General Permits for Biosolids, and to resolve nuisance odor issues associated with the plant.

Three additional suggestions given customers need notice of rate changes: 1) The new consumption rates to be included in a mailing for sewer charges and also a notice on the customer's bill of the date of the new rate plan 2) The rate plan takes effect the first billing cycle 6 months from adoption of the new rate plan. 3) Subsequent rate plan changes are spaced 12 months from the bill the first rate increase occurs.

On outreach: 1) The city needs to do a better job in social media... I see nothing wrong with a member of city government to post key announcements to popular facebook groups (such as the North Bend Political Forum or the North Bend News and Trading post)... those groups have 350 and more than 3000 members each. The city doesn't have to monitor these, only post. The city is still providing the required public notices anyway, posts are additional outreach. 2) Key facts the city wishes to highlight need to be in the email announcement not buried 80 pages in a PDF document... consider putting this information as an attachment or even better 1-3 pages as HTML in the email--consider that most people now get their email on a mobile device... reading a PDF on a mobile screen doesn't cut it 3) Simpler terms and clarity are needed... FCS presentation did little to explain this in terms the population can understand, and as well the engineering information on capacity requires some translation (perhaps to homes or population to translate treatment capacity from ERUs to something laypeople can understand). Similarly a clearer presentation of the cost of repairs/maintenance/upkeep and cost of capacity doubling. $X million for repair/upkeep/maintenance $Y million for capacity upgrade.

The City has been discussing the need for these capital improvements for 4 years at various public meetings and the need for the corresponding rate increases at various public meetings. The Capital Facilities Plan meeting describing in detail improvements you wish to discuss above was advertised and public meetings were conducted on March 15, 16 and April 26, 2016 (you incorrectly testified that this was the Silver Creek sewer meeting, which it was not). The rates were discussed in public Council Committee meetings on May 3, 11 and June 7 and 8, 2016. A public hearing before the City Council was opened on June 21st and continued until July 19th providing over a month for citizens to provide written or verbal comments to their elected officials. In addition, we added a Town Hall meeting on July 7th with our consultants and staff with an optional tour of the plant to answer questions. Finally we have posted all this information on the official City's Facebook Page, Twitter account, City's Web page, and posted official notices with the two local newspapers

(Snoqualmie Valley Record and Snoqualmie Star) and the local blog (Living Snoqualmie). We also sent the notice/press release to all persons who have signed up for "Notify Me" through the official City Web Page seeking notice of City News and Highlights. The upcoming meetings are listed on the City Calendar and the press release is listed under the City's News and Highlights. We have also sent this information out to the local Yahoo Group. We have never found the utility billing notices to be an effective tool for communication particularly of upcoming meetings. We also are unwilling to start trying to distribute this information to certain private social media closed groups as you have suggested. The two Facebook groups you suggest are both closed and require membership and the City of North Bend is not a member .

Michael Thomas

-------- Original Message --------
Subject: Request to oppose city sewer rate increase
From: <mthomas@bangstick.net>
Date: Tue, June 21, 2016 4:42 pm
To: "Council" <Council@northbendwa.gov>

Dear City Council,

I believe more time is in order to understand the nature of the rate increase and why such a massive capacity increase is required in such a short order... expanding the capacity to 11.5k people seems out of order within the next 5 years, even the UGA only requires us to build an additional 771 residences (+1982 people) to 2035 in the City's own most recent comprehensive plan.

I also suspect that a good part of the improvements are not for maintenance or upgrades but are cloaks for capacity expansion and that is not an appropriate use for a rate increase.

Citizens being given only 4 business days to review the rate increase and to ask questions, come up with alternative ideas, etc. is not good governance.

I urge the council to oppose this. I am not necessarily opposed to capacity expansion or needed rate increases, Mark's numbers do indicate we are close to the existing capacity and such an expansion may be warranted... the question is how much is needed and when? Is there an alternative plan? What are the minimum necessary repairs & maintenance and what is the capacity expansion needed and when?

Michael Thomas

-------- Original Message --------
Subject: RE: Comments on Sewer Rate and GFC Increase 6/21
From: Mark Rigos <MRIGOS@NORTHBENDWA.GOV>
Date: Tue, June 21, 2016 9:56 am
To: "mthomas@bangstick.net" <mthomas@bangstick.net>, Susie Oppedal <SOPPEDAL@NORTHBENDWA.GOV>
Cc: Council <Council@northbendwa.gov>, Don DeBerg <DDEBERG@NORTHBENDWA.GOV>, Londi Lindell <LLINDELL@NORTHBENDWA.GOV>, Ken Hearing <KHEARING@NORTHBENDWA.GOV>

Hi Michael,

Thank you for providing input. Answers to your questions are as follows:

1. Yes, the rates were calculated based on a 5-month average, from November through March.

2. An Allocation Table was prepared and vetted by 4-5 licensed Professional civil engineers (PEs) by the State of Washington including 2 PhDs for allocating proportional costs into capacity or non-capacity facilities. Total cost of the 5-year improvements is estimated to be approximately $15 million. Adjustment of the current GFC rates distributes the fair costs for upgrading the currently unallocated "rated" capacity of plant.

3. The existing City wastewater facilities currently provides conveyance, treatment and disposal for about 2,300 ERUs (equivalent residential units). One ERU is by definition equal to the flow and load attributable to the average single family residence (~2.57 people). With the implementation of the 5-year capital improvement program, the City wastewater facilities will have a "true" rated capacity capable of providing reliable conveyance, treatment and disposal for 4,492 ERUs.

4. Neither me nor my consultant understand what is being asked. However, all of the improvements in the 5-year plan are needed to bring the plant up to its rated capacity. The improvements are needed to replace equipment and systems that are being operated

beyond their design service life, to bring the plant into conformance with its rated capacity, current City flood management regulations, current state and federal redundancy and reliability standards, and state biosolids management regulations.

5. For irrigation meters, sewer rate charges do not apply to water used for irrigation purposes.

Hope that helps.

Sincerely,

Mark Rigos, P.E.

Public Works Director

City of North Bend

PO Box 896

1155 East North Bend Way

North Bend, WA 98045

(425) 888-7650

From: mthomas@bangstick.net [mailto:mthomas@bangstick.net]
Sent: Monday, June 20, 2016 4:05 PM
To: Susie Oppedal
Cc: Mark Rigos; Council
Subject: Comments on Sewer Rate and GFC Increase 6/21

Hello,

I am a resident of North Bend at 1231 LaForest Drive SE North Bend WA 98045 and wish to submit comments and questions for the record for the 6/21 hearing on the sewer rate and GFC increase.

I oppose the rate increase both in terms of both the general rate and GFC rate increase at this time. I would like to see an extended period for public comment on the proposal, certainly 4 business days notice of a rate increase does not provide the public sufficient time to comment on such a massive rate increase... although the city has known about this for months (with the original notice dating to April), citizens have not had the details until last week.

I would also like to see more details as to the plans for improvements and costs differentiated by improvements versus capacity expansion. There are no details provided in the city council packet justifying the rate increase or details such that the public can understand what components are for new development versus for upgrade or repair. The city has already exceeded its UGA growth targets to 2030... it's not clear how much capacity is actually required and whether the new plan exceeds the UGA target.

I have the following questions:

1) Was "winter quarter averaging" for establishing the basis for sewer charges evaluated? Obviously summer water usage for many homeowners and property owners also includes water that is used to maintain lawns and grow food for home gardens or farms within city limits and this water does not go into the sewer system for treatment. I believe winter usage is perhaps more reflective of actual usage that is apt to require sewer treatment. I view the old rate structure of a higher base charge but a very low variable rate charge is meant to reflect this. It would make sense that the winter water usage for properties with a single meter (without a separate meter for irrigation) would be most reflective of usage that requires sewer treatment. Reducing winter water usage that requires sewer treatment during the wettest months helps reduce the volume due to people and when infiltration in the system is greatest due to aging pipes, improper drain connections, etc. I am surprised North Bend has not considered winter quarter averaging to base sewer charges on what is usage that requires treatment vs. usage that doesn't (e.g., lawncare, gardening).

Winter quarter averaging would help those owners "maintain the rural look and feel" and small town character of their properties by providing a reasonable way to charge for water usage that requires sewer treatment and to maintain their lawns and landscaping.

2) Of the rate increases to both the GFC and monthly rate structure how much is due to capacity expansion vs. not capacity expansion (e.g., upgrades or required repairs)?

3) How many single family residences does the current system support and how many residences will be supported with the proposed capacity expansions? If this changes over time please elaborate the capacity changes over time.

4) What is the minimum capacity increase required (in terms of # of single-family residences)?

5) How are charges handled for properties with a separate meter for irrigation handled? The new ordinance rate structure does not elaborate on usage for irrigation or differentiate consumption for residential use vs. irrigation.

Please include my comments and questions for the public record.

Regards

Michael Thomas

TO: City of North Bend Mayor & City Council
City of North Bend Public Works Director

FROM: Mike Jackman
505 SE 8th Street
North Bend, WA 98045

Phone:#425-429-5203
Email: Jackman_mike@hotmail.com

Background: 35 years with City of Bellevue Utilities including 2 as Deputy Director and 4 as Assistant Director for Operations & Maintenance (retired 2012)

I am requesting response to the following questions regarding the City of North Bend's proposed sewer rate increases of 46% over 5 years to cover the cost of remodeling the City's wastewater treatment plant:

1) 3 options were studied including remodeling the existing plant, building a new plant, and contracting with a regional wastewater treatment provider. Given that private sector companies can often build and operate these types of facilities at a lessor cost than government institutions, why was a Design, Build, and Operate option not considered and evaluated (for either a remodel or a new plant)?

2) Does North Bend's Utilities Department have a Renewal and Replacement Fund in its budget to plan, save, and pay for infrastructure renewal and replacement projects like this, and to level rate increased over a longer period of time to avoid large rate spikes such as this? If not, why not?

3) North Bend collects a Utilities Tax on its water and sewer charges which is used to fund General Fund expenses, e.g. non-Utilities expenses. This project, and the large rate increases you are proposing to pay for it, would seem to be a "cash cow" for the General Fund. Has there been any consideration for decreasing the Utility Tax since there isn't likely a need for a 46% increase in the revenues the General Fund receives from the Utilities Tax?

4) Sewer charges are based upon water use. However, water use increases in the summer months due to outdoor water use, such as landscape irrigation, that does not go down the sewer. Are North Bend's sewer charges based on average winter water use or on actual water use month by month? If not on average winter water use, why

not? How can you apply sewer charges to water that doesn't go down the sewer? This is particularly important given the proposed rate increases.

5) Given the size of the rate increase under consideration, what other Utilities programs and services have been evaluated and considered to be discontinued, to have service levels decreased, to be outsourced, or to have other cost saving methods implemented in order to offset the proposed rate increases? Options could include cancelling, deferring, or downsizing other capital projects, operations and maintenance programs, administrative and other programs, functions, and staffing levels currently in the Utilities budget. It could also include outsourcing some programs to the private sector where cost efficiencies might be gained. Just because you have always done something does not mean it still needs to be done, done at the same level, or done in the same way.

6) Finally, while this project and proposed rate increases are a focus in the Utilities Budget, have you looked into other City services for cost cuts? I ask because it's not just a matter of Utility rate increases, it's the sum of utility rate increases, property taxes, general services costs, etc. across the board that add up and take their toll on the community. E.g. a nickel here a nickel there and pretty soon it's a hundred dollars, otherwise known as death by a thousand cuts.

Thank-you for your time and consideration of my questions. I look forward to your responses.

LEGAL NOTICE
CITY OF NORTH BEND
King County, Washington

NOTICE OF PUBLIC HEARING

NOTICE IS HEREBY GIVEN that the North Bend City Council has scheduled a hearing to solicit public input and comments on proposed Sewer and Sewer General Facility Charge rate increases. The public hearing will take place during the Council Meeting on Tuesday, June 21, 2016, at 7:00 PM at the Mt. Si Senior Center, 411 Main Ave. S., North Bend, WA.

Comments may be presented orally at the public hearing or submitted in writing to the City Clerk at P.O. Box 896, North Bend, WA, 98045, or by e-mail to: soppedal@northbendwa.gov prior to 5:00 PM, Monday, June 20, 2016. For additional information please contact City Hall at (425) 888-1211.

Posted: June 1, 2016
Published in the Snoqualmie Valley Record: June 1, 2016

APPENDIX L

COMMENT/RESPONSE FORM

City of North Bend General Sewer Plan - Comment/Response Form

Review Phase:	Draft							
Contact:	Don DeBerg				Comment Date:		7/13/2017	
	Mark Fogle, John Markus							

No.	Section	Comment	Reviewer (Last Name, First Name)	Response	Responder	Reviewer Check Off	Implementation	
	Page No. / Paragraph No.						Date	Initials
1	1-9 / Chapter 1, Introduction and Background	Under section 1.3.2 Built Environment, Ecology suggests the following language: "The City of North Bend owns, operates and maintains all portions of its wastewater system."	Ecology (Eleuterio)	Included in the Revised WWFP at Section 1.3.2 . The suggested words have been added to the sentence in the subject paragraph.	City of North Bend (DeBerg and Markus)			
2	1-9 / Chapter 2, Wastewater System Description	Under section 3.4 Lift Station and Force Mains, Ecology recommends the following language: "The City currently owns, operates and maintains four wastewater lift stations in the collection system, as summarized in Table 3-3 and described below." Below is Ecology's position in regards to grinder pumps. Ecology's position on privately-owned and maintained grinder pumps: Per WAC 173-240-104, domestic sewage facilities will not be approved unless ownership and responsibility for operation and maintenance is by a public entity. If a waste discharge permit is required it must be issued to the public entity. Nothing in this rule precludes a public entity from contracting operation and maintenance of domestic sewage facilities. The exception is that ownership by nonpublic entities may be approved if the department determines the ownership in the public interest. To date, Ecology has not been presented with a case in which private ownership would be clearly in the public interest and therefore has not approved private ownership of grinder pumps. Ecology's mission is to protect water quality. History has shown that many homeowners do not take the initiative to properly maintain their on-property sewage systems. Any repair that is negleted by the homeowner can result in a significant health hazard and potential water quality deterioration. In addition, private facilities are not eligible for financial assistance from state or federal funding agencies. It is recommended that the District provide for public ownership and maintenance of the individual grinder pump stations so that Ecology can approve the Sewer Plan.	Ecology (Eleuterio)	This comment is addressed in the Revised WWFP in Section 3.4.5. There are three known individual residential grinder pump systems currently conveying domestic wastewater to the City's collection systems. The City plans to take ownership and assume responsibility for operation and maintenance of these three existing grinder pump installations. The City is currently in the process of amending its development standards and code, so that the City will be responsible for ownership, operation and maintenance, and granted adequate legal access and appropriate permanent easements to all residential wastewater pumping stations including individual residential grinder pumping systems that discharge wastewater into the City wastewater collection system.	City of North Bend (DeBerg and Markus)			
3	2-6 / Chapter 2, Planning Information	Per NPDES permit section S2.A, Wastewater Influent means the raw sewage flow from the collection system into the treatment facility. Can the City install a flowmeter to accurately measure the flow coming from 7 seven neighboring mobile homes? The City has much more than seven mobile homes in the service area. How does the City measure the flows coming from other mobile homes? Can the city also measure the flow coming from the Lab/Control Building?	Ecology (Eleuterio)	This issue is clarified in the addendum. Influent flows conveyed to the wastewater treatment plant are measured by a magnetic flow meter installed on the force main discharge from ULID #6 Lift Station. ULID#6 Lift station collects and conveys all the wastewater flows from the City except for wastewater generated by seven neighboring mobile homes in the mobile home park east of the plant and from WWTP laboratory/control building and potentially contaminated stormwater from approximately 6000 SF of paved are between the laboratory/control building and the old treatment plant building where the sludge holding tank is located. Section 2.2.1, states that these flows are less than 0.3% of total influent flows. Additoinal information is provided in Section 6.2.10 under subheading Internal Pump Systems under the bullet item Old Influent Pump Station. An improvement project is identified on page 9-3 "Pipeline Rerouting" under the Phase 1 improvement program. Construction costs are presented in Table 9-2 under the Treatment Facility Phase 1 "Laboratory and Mobile Home Park Sewers to ULID #6".	City of North Bend (DeBerg and Markus)			
4	2-17 / Chapter 2, Planning Information	Please explain why the BOD loadings during the period from 2010 to July 2014 appeared to be unreliable?	Ecology (Eleuterio)	A detailed explanation is provided in second paragraph of Section 3.3.1 Influent BOD Loads.	City of North Bend (DeBerg and Markus)			
5	2-14 / Chapter 2, Planning Information	Please provide a brief description of the water quality of the Snoqualmie River. What are the pollutants of concern and what are the standards?	Ecology (Eleuterio)	The Revised WWPF provides additional discussion on the water quality of the South Fork of the Snoqualmie River and its relationship to the Snoqualmie River watershed in Section 2.4.	City of North Bend (DeBerg and Markus)			

No.	Section		Comment	Reviewer (Last Name, First Name)	Response	Responder	Reviewer Check Off	Implementation	
	Page No.	Paragraph No.						Date	Initials
6	3-5	Chapter 3, Existing Collection System	What is the City's timeline to replace two sewer line segments located northwest off Sydney Avenue North? Per visual inspections, these lines contribute significantly to I/I.	Ecology (Eleuterio)	The City will conduct a more through investigation to determine the nature and extent of the I/I contribution from these pipelines and plans to replace them as part of the City's annual I/I reduction program as discussed in Section 4.1.4 and Section 5.1.2. The last sentence in paragraph 9.3.1, page 9.15 estimates the nature and extent of the annual sewer system rehabilitation program needed to address I/I. These pipe segments are planned to be repaired or replaced before the end of 2020.	City of North Bend (DeBerg and Markus)			
7	7-16	Chapter 7 - WWTP Evaluation	Per the NPDES Permit# WA0029351, Section S10, the City is required to submit a letter that summarizes the BMP and the technologies implemented to reduce the themal loads to the Snoqualmie River. Please, submit to Ecology a short technical memo or a detailed letter discussing the implementation of the recommended upgrades and an updated version of the schedule for the recommended improvements and related activities as described in the "*WWTP Temperature Reduction Study*".	Ecology (Eleuterio)	The thermal loading characteristics of the plant effluent on the receiving water (South Fork of the Snoqualmie River) is discussed in the Plan and in the Wastewater Treatment Plant Temperature Reduction Study dated July 2015 which was submitted to Ecology in compliance with the NPDES permit. The City submitted a letter on June 28, 2017, that identified the BMP that the City has implemented and a revised schedule for implementation of future longer-term projects presented in the Plan. Ecology responded confirming that the City's response fully addressed Ecology's comment; therefore it is assumed that no further action in regard to this comment is required.	City of North Bend (DeBerg and Markus)			
8	8-1 to 8-17; 9-1 to 9-2	Chapter 8 & 9	Per City's discussion with Ecology on May 26, 2017, the City has two urgent projects: UV System Expansion and Upgrades, and Large Secondary Clarifier Refurbishment. Please provide further engineering details around these two important projects: 1) Discuss the secondary clarifier effluent quality requirements and how they affect the design of the new UV system.	Ecology (Eleuterio)	The Reviased WWFP provides additional discussion of this issue in Sections 6.2.5 and 7.2.6. Additionally Table 9-1 provides the necessary design criteria to advance the final design of the recommended improvements to the City's wastewater treatment plant including but not limited to the upgrade and expansion of the UV disinfection system and the secondary clarification system. 1.) The relationship between the clarification process and the UV disinfection system process is discussed in Section 6.2.5 and 7.2.6.	City of North Bend (DeBerg and Markus)			
			2) Discuss the UV Disinfection System treatment requirements: i) monthly average fecak coliform limit of 200 cfu/100 mL and ii) weekly average limit of 400 cfu/100 mL. Based on the secondary clarifier effluent characteristics and the effluent discharge limits, is the UV system proposed the appropriate method to disinfect the wastewater prior to discharge and protect water quality?		2.) This comment is addressed in the Revsied WWFP at Section 8.3.1 under subsection Liquid Stream Improvements under *UV Dsinfection.* Existing and future permit limits for disinfection and relevant design criteria for the upgrade and expansion of the UV disinfection system are presented in Table 9-1. Alternative disinfection systems were evaluated in the WWTP Temperature Reduction Study dated July 2015. Disinfection systems included: enclosed vessel medium pressure ultra-violet light (MP-UV), which is the technology of the existing system; sodium hypochlorite disinfection and sulfur dioxide gas dechlorination; Open channel Low pressure high intensity ultraviolet light; and peracetic acid. Enclosed vessel MP-UV disinfection is recommended because it has performed well, the technology has advanced with the use of electronic ballasts, which are more efficient and allow turn-down capacity resulting in substantial energy savings resulting in energy consumption rates similar to that provided by low pressure high intensity UV technology. The MP-UV system requires less site foot print, is more easily implemented at the WWTP, and uses far fewer mercury containing bulbs to be disposed of when lamps need to be replaced.	City of North Bend (DeBerg and Markus)			

No.	Page No.	Section Paragraph No.	Comment	Reviewer (Last Name, First Name)	Response	Responder	Reviewer Check Off	Implementation Date	Implementation Initials
			3) Discuss the projected effluent UV transmittance. Is it different from existing (65% at 254 nm)?		3.) The Revised WWFP addresses this issue in Section 6.2.5. The projected transmissivity of the secondary effluent to UV light at 254 nm is 65% which is consistent with the design transmissivity of the existing system. As discussed in Section 7.2.6 the reductions in transmissivity in the effluent are attributable to extended periods of no aeration in the oxidation ditch caused by hydraulic restrictions. Those restrictions were eliminated in 2015 with the construction of the new outlet structure for the oxidation ditch. Operation of the oxidation ditch aeration systems are now no longer impaired by flows within rated design capacity of the plant. Measurements of secondary effluent indicate that the effluent UV transmissivity is consistently greater than 65% when the aeration system is not impaired.	City of North Bend (DeBerg and Markus)			
			4) Discuss the UV system's and Secondary Clarifier's reliability, redundancy and hydraulics.		4.) Reliability and redundancy is discussed in Section 7.2.6 and in Appendix A and in Table A-3. The reliability of the existing clarification system is presented in Section 7.2.5 and the redundancy and reliability of the clarifier system.	City of North Bend (DeBerg and Markus)			
			5) Discuss the UV system construction and controls		5.) A discussion of the UV system construction and controls is presented in the technical memorandum support document for the design for the new UV and Effluent Pumping system. The recommend treatment plant process flow diagram Figure 9-3 coupled with the design criteria in Table 9-1 provide adequate information regarding integration of the plant SCADA system.	City of North Bend (DeBerg and Markus)			
			6) Please provide a brief discussion on the UV system configuration.		6.) The response to this comment is the same as that provided to comment 8-5).	City of North Bend (DeBerg and Markus)			
			7) Identify any modifications to North Bend WWTP due to the projects aforementioned.		7.) All modifications to the plant are identified in the project descriptions presented in Chapter 9 and in the supporting Appendix F.	City of North Bend (DeBerg and Markus)			
9	8-20	Chapter 8 & 9	One of the major requirements of SERP is a Cost Effectiveness Analysis, which is part of the SRF application. Please prepare a cost effective analysis for each project that the City is planning on applying for loan. The cost effective analysis entails: a) description of all appropriate alternatives considered, b) comparison of monetary costs/benefits of each alternative (including capital, operation, maintenance, and replacement costs on 50-year present value basis).	Ecology (Eleuterio)	Description of all alternatives evaluated are presented in Chapter 8. Section 8.3.6 presents a comparison of estimated capital costs and 20 yrs. life cycle costs.	City of North Bend (DeBerg and Markus)			
10	9-20	Chapter 9	Discuss footprint (site) availability. Does the City have enough footprint to accommodate future expansions (2020 and beyond)?	Ecology (Eleuterio)	The layout of the plant with all of the recommended improvements on the existing wastewater treatment plant site is shown on Figure 9-1. The layout presented clearly indicates that there is adequate footprint to accommodate the necessary wastewater treatment processes and support facilities through the 20 year planning period and through buildout of the City urban growth area.	City of North Bend (DeBerg and Markus)			
11	9-20	Chapter 9	Please briefly discuss the City of North Bend WWTP staffing plan. Is the plant properly staffed now? Will the City need additional staff in the future? If so, how many? Will operators be required to upgrade their licenses?	Ecology (Eleuterio)	Additional information addressing this comment is provided in the Revised WWFP in Section 9.3.3. The City's staffing plan is presented in Table 9-3.	City of North Bend (DeBerg and Markus)			
12			SEPA for the two projects (UV system and secondary clarifier) aforementioned is required.	Ecology (Eleuterio)	The Revised WWFP provides the SEPA documentation and the City's Determination of Non-Signficancee with regard to adoption and implementation of the December 2016 Wastewater Facilities Plan. The City will complete a SEPA checklist and related project specific documentation will be submitted to to Ecology as part of the project implementation phase along with the engineering report (predesign report), plans, specifications and Construction Quality Assurance Plan for the UV Disinfection & Effluent Pump Station upgrade project. Additional SEPA documentation will be submitted to Ecology for all other projects identified in the facilities plan as those projects are authorized by the City.	City of North Bend (DeBerg and Markus)			