CITY OF BURLINGTON

SKAGIT COUNTY, WASHINGTON

CITY OF Burlington
SKAGIT COUNTY, WASHINGTON INCORPORATED 1902

WASTEWATER COMPREHENSIVE PLAN

ADAM J. MILLER
STATE OF WASHINGTON
38803
REGISTERED PROFESSIONAL ENGINEER
12/22/11

BJARNE JACOBSEN
STATE OF WASHINGTON
14062
REGISTERED PROFESSIONAL ENGINEER
12/22/11

G&O #10476
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Gray & Osborne, Inc.
CONSULTING ENGINEERS

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LIST OF ABBREVIATIONS

AAF	average annual flow
ac	acre
ACOE	Army Corps of Engineers
ADWF	average dry weather flow
AKART	all known, available, and reasonable technologies
avg.	average
BOD_5	5-day biochemical oxygen demand
BTU	British thermal units
$CaCO_3$	calcium carbonate
$CBOD_5$	5-day carbonaceous biochemical oxygen demand
CCWF	Centennial Clean Water Fund
cf	cubic feet
cfm	cubic feet per minute
CFR	Code of Federal Regulations
cfs	cubic feet per second
CFU	colony-forming units
CIP	Capital Improvement Projects
CM	construction management
CMU	concrete masonry units
COD	chemical oxygen demand
conc.	concentration
constr.	construction
CWA	Clean Water Act
cy	cubic yards
DMR	discharge monitoring reports
DNS	determination of non-significance
DO	dissolved oxygen
DOH	Department of Health
DT	dry tons
EA	each
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ERU	equivalent residential unit
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Maps
F/M	food-to-microorganism ratio
fps	feet per second
ft^2	square feet
FTE	full-time equivalent
gal.	gallons
gfd	gallons per square foot per day

LIST OF ABBREVIATIONS (continued)

GMA	Growth Management Act
gpad	gallons per acre per day
gpcd	gallons per capita per day
gpd	gallons per day
gpd/ft^2	gallons per day per square foot
gph	gallons per hour
gpm	gallons per minute
gpm/ft^2	gallons per minute per square foot
HDPE	high density polyethylene
HMI	Human-Machine Interface
hp	horsepower
HPA	Hydraulic Project Approval
HRT	hydraulic residence time
HVAC	heating, ventilation, and air conditioning
I/I	infiltration and inflow
in.	inches
kVA	kilovolt-amps
kW	kilowatt
kWh	kilowatt hour
lb	pounds
lb/cap/d	pounds per capita per day
lb/d	pounds per day
lb/ft^2/d	pounds per square foot per day
lf	linear foot
LS	lump sum
max.	maximum
MBR	membrane bioreactor
MDF	maximum day flow
mg	milligrams
MG	million gallons
mgd	million gallons per day
mg/L	milligrams per liter
misc.	miscellaneous
mJ/cm^2	millijoules per square centimeter (UV dose measurement)
ml	milliliters
MLSS	mixed liquor suspended solids
mm	millimeter
MM	maximum month
MMF	maximum month flow
MSL	mean sea level
N/A	not applicable

LIST OF ABBREVIATIONS (continued)

NEPA	National Environmental Policy Act
NH_3	ammonia-nitrogen
NMFS	National Marine Fisheries Service
NO_3-N	nitrate - nitrogen
NPDES	National Pollutant Discharge Elimination System
NR	not reported
NRCS	National Resource Conservation Service
NTU	nephelometric turbidity units
NWI	National Wetlands Inventory
OD	outside diameter
OFM	Office of Financial Management
O&M	operation and maintenance
PDF	peak day flow
PFRP	process to further reduce pathogens
pH	negative log hydronium ion concentration
PHF	peak hour flow
PHS	priority habitat and species
PLC	Programmable Logic Controller
PMAC	plan to maintain adequate capacity
P.S.	pump station
psi	pounds per square inch
PSRP	process to significantly reduce pathogens
PWTF	Public Works Trust Fund
Q	flow rate
RAS	return activated sludge
RCW	Revised Code of Washington
ROW	right-of-way
rpm	revolutions per minute
SBR	sequencing batch reactor
scfm	standard cubic feet per minute
SEPA	State Environmental Policy Act
SERP	State Environment Review Process
sf	square feet
S.F.	safety factor
SR	State Route
SRF	State Revolving Fund
SRT	solids retention time
SWD	side water depth
TBD	to be determined
TDH	total dynamic head
TKN	total Kjehldahl nitrogen

LIST OF ABBREVIATIONS (continued)

TMDL	total maximum daily load
TSS	total suspended solids
UGA	Urban Growth Area
USFWS	United States Fish and Wildlife Service
USGS	United States Geologic Survey
UV	ultraviolet radiation
V	volts
VFD	variable frequency drive
VOC	volatile organic compounds
VS	volatile solids
VSS	volatile suspended solids
WAC	Washington Administrative Code
WAS	waste activated sludge
WDFW	Washington State Department of Fish and Wildlife
WT	wet tons
WWTP	wastewater treatment plant
µm	micrometer (micron)

EXECUTIVE SUMMARY

INTRODUCTION

This 2010 *Wastewater Comprehensive Plan* for the City of Burlington addresses the City's comprehensive planning needs for wastewater collection, transmission, treatment, and disposal for a 20-year planning period. Because substantial growth is projected for the Burlington area over the next 20 years, planning for that growth will be essential to properly accommodate new customers within the City and the Urban Growth Area (UGA). It is also important to evaluate the existing wastewater collection and treatment infrastructure, to determine its capability to serve the projected population and to determine equipment replacement needs for the planning period.

The planning period for this *Wastewater Comprehensive Plan* is from 2010 through 2030. This Plan was prepared in accordance with the provisions of the Revised Code of Washington (RCW), Section 90.48, *Water Pollution Control*, and Washington Administrative Code (WAC) Section 173-240-050, *General Sewer Plan.* Development of the Plan has been coordinated with the City's *2005 Comprehensive (Land Use) Plan* and Skagit County and Port of Skagit County planning efforts.

POPULATION PROJECTIONS

The population of the City of Burlington has increased an average of about 2.19 percent per year over the past 10 years. This population increase has been a result of development within the existing city limits as well as annexations, although few annexations occurred during the past 5 years. Several areas within the City are presently undeveloped or are developed at a lower density than allowed by current zoning, but it is considered highly unlikely that all residentially zoned areas in the City of Burlington will be redeveloped over the next 20 years. It is, however, proposed to utilize a population growth rate of 2.25 percent per year (slightly higher than the growth rate over the past 10 years) over the next 20 years to allow for service to developed areas presently outside the city limits, but within the UGA, that are presently served by septic tanks or other types of on-site treatment and disposal. These areas may be annexed to the City, or merely receive sewer service. Table E-1 shows the projected future population receiving sewer service at 5-year increments for the 20-year planning period for the City of Burlington based on a 2.25 percent annual growth rate. A small area adjacent to Anacortes Avenue, south of Gages Slough, it presently not sewered and is included in the 2010 population. This area is assumed to be sewered by the year 2015.

TABLE E-1

City of Burlington Projected Population

Year	City of Burlington Population[(1)]
2010	8,388
2015	9,375
2020	10,978
2025	11,711
2030	13,090

(1) Includes population within city limits and areas that could potentially be annexed by the City.

PROJECTED FLOW AND LOADING RATES

Per the *2005 City Comprehensive Plan*, the City of Burlington has a substantial amount of land that has the potential for new development and redevelopment. In particular, the City contains large acreages of underutilized and vacant commercial and industrial land. The Comprehensive Plan develops strategies for infill of the City that includes the flexibility in development regulations to encourage a variety of uses and businesses to locate in Burlington. In addition, the Western Service Area located in unincorporated Skagit County, and is served by the City of Burlington, includes large areas of vacant and underdeveloped land, including the Bayview Ridge area, which includes large areas of residential and commercial land. The development of the Bayview Ridge area is summarized in the *2008 Bayview Ridge Subarea Plan*. Lastly, the Western Service Area also includes the Port of Skagit County, which contains large areas of commercial and industrial land that are currently vacant or underdeveloped.

The existing (2010) and projected flow and loading rates to the City of Burlington sewer system and WWTP have been estimated for 2010, 2015, 2020, 2025, and 2030 conditions. It is assumed that the rate of infiltration and inflow (I/I) of stormwater into the existing sewer system will remain constant throughout the planning period. As the sewer system expands, newly sewered areas will also produce I/I, although at a lower rate than the existing system. Table E-2 provides the existing and projected wastewater flow and loading rates, and the currently permitted capacity of the wastewater treatment plant (WWTP).

TABLE E-2

NPDES-Permitted Capacity and Current and Projected Flow and Loading Rates for the WWTP

	NPDES Permit Capacity(1)	2010 Existing	Projection			
			2015	2020	2025	2030
Average Annual Flow (mgd)	NI(2)	1.57	1.62	1.79	1.87	2.51
Maximum Month Flow (mgd)	3.79	2.33	2.46	2.55	2.70	3.55
Peak Hour Flow (mgd)	NI(2)	6.43	6.71	6.93	7.19	8.95
Maximum Month BOD_5 Loading (lb/d)	7,356	5,020	5,620	5,900	6,900	10,500
Maximum Month TSS Loading (lb/d)	7,660	5,420	6,170	6,730	7,710	10,500

(1) Condition S4.A of City's NPDES permit (see Appendix A).
(2) NI = Not included in NPDES permit.

WASTEWATER COLLECTION SYSTEM

EXISTING FACILITIES

The City of Burlington wastewater collection system includes approximately 58 miles of gravity sewer pipes varying in size from 4-inch diameter local connections to 27-inch diameter interceptors. Due to the relatively flat terrain, much of the gravity collection system has been constructed at the minimum slope required to prevent solids from settling out during conveyance. In some areas, topography allows for greater slopes; however, an extensive system of pump stations and force main piping has been installed to convey wastewater in areas where topography causes gravity flow sewers to be very deep.

The City owns and operates 21 sewage pump stations. Pump Station No. 8 serves the Western Service Area exclusively and the force main from Pump Station No. 8 conveys the flow from this pump station into two large-diameter interceptors that discharge directly to the wastewater treatment plant. The existing sewer service area includes 28 sewer drainage basins.

WASTEWATER COLLECTION SYSTEM ANALYSIS

Wastewater flows were developed for each of the 28 existing sewer drainage basins as well as 20 potentially new drainage basins to serve areas that currently do not have sewer service. Each drainage basin in the City's wastewater collection system was analyzed for its ability to serve the future population and land use and to handle the projected wastewater flow rates.

This included a capacity analysis tha was performed for all the pump stations and force mains using the existing and future flows for each of the drainage basins and development of a hydraulic model to analyze the capacity of major gravity lines at existing and buildout conditions at peak hour wet weather flow rates. The results of the capacity analysis and hydraulic modeling were used to identify collection system components in need of rehabilitation or replacement. Table E-3 identifies facilities that have inadequate capacity.

TABLE E-3

Collection System: Capacity Deficiencies

Deficient Facilities	Anticipated Year of Deficiency	Description of Deficiency
Pump Station No. 4	2010	Pump station is currently over existing capacity.
Pump Station No. 14	2010	Pump station is currently over existing capacity.
Pump Station No. 6	2010	Pump station is currently slightly over existing capacity; upgrades are scheduled for 2014.
Pump Station No. 10	2030	Pump station is currently near existing capacity; upgrades are scheduled for 2016.
Pump Station No. 4 Force Main	Buildout	Pump station force main is near capacity at buildout flows.
Pump Station No. 6 Force Main	Buildout	Pump station force main is over capacity at buildout flows.
Pump Station No. 10 Force Main	Buildout	Pump station force main is over capacity at buildout flows.
Gravity Sewer	Buildout	Approximately 100 sections of gravity sewer may have the potential to be over capacity under buildout flows.

WASTEWATER TREATMENT PLANT

EXISTING FACILITIES

The City of Burlington wastewater treatment facility (WWTF) located at 900 South Section Street, was constructed on this site in the mid-1970s and has been extensively expanded and upgraded since that time. The WWTF is an activated sludge treatment facility and discharges to the Skagit River. The design capacity is presently 3.79 million gallons per day, peak monthly flow.

The existing WWTF liquid stream treatment processes include influent screening, grit removal, primary settling, biological treatment in aeration basins, secondary settling, and ultraviolet light disinfection. Primary sludge and waste activated sludge are digested in anaerobic digesters. The stabilized sludge is then dewatered by a belt filter press and dried in the sludge dryer. The dried sludge meets the Washington State Department of Ecology's Class A pathogen reduction and exceptional quality (EQ) standards (WAC 173-308) for relatively unrestricted use by the public. The dried sludge is presently picked up by local farmers for use as a soil amendment/fertilizer.

TREATMENT EVALUATION AT PROJECTED FLOW AND LOADING RATES

The capacities of the individual treatment processes to treat the projected flow and loading rates were evaluated. Also, the condition of the existing WWTP processes were evaluated based on visual observation and interviews with City staff. Recommended improvements to the WWTP during the 20-year planning period were developed based on the required capacity, performance, and operation and maintenance needs.

Although only a few immediate improvements are recommended at the wastewater treatment facility, it is recommended that some planning be provided to ensure that the facility has the required capacity when needed. It is recommended that the City complete the following actions to meet future wastewater treatment needs:

Immediate Actions

1. Increase the capacity of the influent pump station to a peak hour flow rate of 9.31 mgd (6,465 gpm). This should provide adequate capacity through 2030.

2. Install a second influent screen. The screen has been budgeted for and ordered by the City and is scheduled for delivery in September 2011.

3. Implement modifications to the digester gas piping and boiler, digester recirculation pumps, and digester piping valves to eliminate excessive moisture in the digester gas.

4. Conduct an assessment to determine the remaining useful life of the mechanisms for Primary Clarifiers 1A and 1B, Secondary Clarifiers 1A and 1B, and the gravity primary sludge thickener.

Actions to be Taken before 2015

1. Refurbish or replace the mechanisms for Primary Clarifiers 1A and 1B, Secondary Clarifiers 1A and 1B, and the gravity primary sludge thickener, if required.

Actions to be Taken during the Period of 2015 to 2020

1. Prepare a Design Report to add a second primary digester.

Actions to be Taken during the Period of 2020 to 2025

1. Design and construct a second primary digester.

2. Prepare a Predesign Report to increase aeration basin capacity.

Actions to be Taken during the Period of 2025 to 2030

1. Design and construct increased aeration basin capacity.

2. Prepare a Predesign Report to increase secondary clarifier capacity and WAS thickening capacity.

WATER RECLAMATION AND REUSE EVALUATION

This Plan presents a brief evaluation of the feasibility of reclaiming effluent from the WWTP and reusing it in the City. Landscape irrigation and sanitary sewer flushing are the most suitable uses of reclaimed water in the City. The estimated capital and operation and maintenance (O&M) costs to provide reclaimed water far exceed the potential revenue from sale or avoided value of City potable water used for these purposes. Other benefits of reclaimed water use may be cost-effective at some time in the future, but additional reclaimed water facilities are not included in the current capital improvement plan recommended in this Plan.

6-YEAR CAPITAL IMPROVEMENT PLAN (CIP)

The Plan contains a list of projects recommended for the City's capital improvement plan for the 6-year planning horizon. These are projects that are currently budgeted and include upgrades to pump stations, gravity sewer pipe, and components of the WWTP. The required capacity and timing of each recommended improvement are given for budgeting and financial projection purposes only. The actual design requirements and criteria should be determined at the design phase of the project. Updated population and flow data should be used when available to ensure that the proposed facilities are adequately sized to convey buildout flows. Additional projects that are not identified as part of the City's current CIP may become necessary to remedy an emergency situation, to address unforeseen problems, or to accommodate improvements proposed or required by other agencies. Due to budgetary constraints, the completion of such projects may require alterations to the recommended CIP. The City retains the flexibility to reschedule, expand, or reduce the projects included in the CIP and to add new projects to the CIP, as best determined by the City Council, when wastewater system emergencies occur, or new information becomes available for review and analysis. The City may reprioritize projects in the future to accommodate other agencies and unforeseen events. The CIP projects that are currently budgeted for construction within the next 6 years are summarized in Table E-4.

TABLE E-4

Budgeted Capital Improvement Projects

Project No.	Year of Construction	Improvement	Estimated Cost	Estimated Total Annual Cost	Paid By
S115	2012	Section Street Sewer	$100,000		COB[1]
	2012	Job 3 Hawthorne Street Sewer	$320,000	$ 420,000	COB
	2013	Rio Vista Sewer	$447,000		COB
S106	2013	Pump Station Landscaping	$ 10,000		COB
	2013	Job 1 – Schedule B: McKinley Street Sewer	$104,000	$ 561,000	COB
S131	2014	WWTP Lab/Admin Building Upgrades	$275,000		COB
S108	2014	Equipment Storage Building	$150,000		COB
S119	2014	Job 1 – Schedule C: Koch Street Sewer	$258,000		COB
S007	2014	Clarifier Drive Upgrade	$100,000	$ 783,000	COB
S007	2015	Clarifier Drive Upgrade	$100,000		COB
S106	2015	Pump Station Landscaping	$ 10,000		COB
S122	2015	Job 4: Regent Street Sewer	$170,000		COB
	2015	Sludge Dewatering Unit	$300,000	$ 580,000	COB
S109	2016	Pump Station No. 6	$900,000		COB
S111	2016	Pump Station No. 9	$175,000		COB
S114	2016	Sewer Line Replacement	$275,000		COB
S112	2016	Pump Station No. 10	$250,000		COB
S007	2016	Clarifier Drive Upgrade	$100,000	$1,700,000	COB
S007	2017	Clarifier Drive Upgrade	$100,000		COB
S112	2017	Pump Station No. 10	$250,000		COB
S114	2017	Sewer Line Replacement	$275,000	$ 625,000	COB

(1) City of Burlington.

OTHER CAPITAL IMPROVEMENT PLAN (CIP)

Table E-5 summarizes additional projects which are not currently budgeted by the City within the 6-year planning period. These projects are recommended for construction if funding becomes available.

TABLE E-5

Additional Capital Improvement Projects

Improvement	Estimated Cost
Pump Station No. 4	$500,000
Pump Station No. 13	$250,000
Pump Station No. 14	$ 50,000
WWTP Influent Pump Station	$ 75,000
Modifications to Digester Gas Piping and Boiler, Digester Recirculation Pumps, and Sludge Piping and Valves	$150,000
Primary Sludge Thickener Drive Upgrade	$100,000
Predesign Report to Add the Second Primary Anaerobic Digester	$ 40,000

CHAPTER 1

INTRODUCTION

GENERAL

This 2010 *Wastewater Comprehensive Plan* (Plan) for the City of Burlington (City) addresses the City's comprehensive planning needs for wastewater collection, transmission, treatment, and disposal for a 20-year planning period. The City of Burlington is located within Skagit County (County) in the State of Washington as shown on Figure 1-1. Because substantial growth is projected for the Burlington area over the next 20 years, planning for that growth will be essential to properly accommodate new customers within the City, the Urban Growth Area, and the sewer service area. It is also important to evaluate the existing wastewater collection and treatment infrastructure to determine its capability to serve the projected population and to determine required system improvement needs for the planning period.

This Plan was prepared in accordance with the provisions of the Revised Code of Washington (RCW), Section 90.48, *Water Pollution Control*, and Washington Administrative Code (WAC) Section 173-240-050, *General Sewer Plan.* Development of the Plan has been coordinated with the City's *2005 Comprehensive (Land Use) Plan* and Skagit County planning efforts; therefore, a planning period of 2010 to 2030 is used.

SCOPE OF WORK

The scope of work for the *Wastewater Comprehensive Plan* includes the following items:

- **Service Area Characterization:** The Plan identifies sewage drainage basins and the land use and zoning designations within each basin. The Plan provides information on the service area including climate, topography, geology, soils, surface water, groundwater, and sensitive areas. The Plan provides maps of these features in a format compatible with the City's existing system.

- **Population Projections:** The Plan estimates the existing population within the service area. The Plan projects populations for 6 years, 20 years, and buildout, for the entire service area and for each drainage basin. The population projections are consistent with the City's *2005 Comprehensive (Land Use) Plan* and Urban Growth Area (UGA) population projections.

- **Existing Wastewater System:** The Plan updates information from the as-built drawings on the sewer invert elevations, manhole rim elevations, pipe diameter, force mains, and pump station information within the collection system service area. The Plan also identifies existing commercial, industrial, institutional, governmental, and recreational site customers; evaluates the condition of the collection system through a review of records, interviews with City staff, and field inspection of significant facilities; determines the capacity of the existing sewer system through a review of existing records, drawdown tests, and engineering reports; provides a discussion on the service area policies or ordinances; and provides a detailed narrative summary and develop a sewer base map of the City's sewer facilities.

- **Wastewater Flow and Loading Projections:** The Plan develops wastewater flow and loading projections based on factors for commercial, industrial, institutional, and residential (per capita) sources; establishes flows, characteristics and loadings of wastewater from outside agencies; develops design flows and loadings for average, maximum month, peak day, and peak hour flows to WWTP, pump stations, and collection system pipelines; and estimates and characterizes the infiltration/inflow (I/I) contribution, based on historical flow monitoring data, pump station run time data, and WWTP data.

- **Wastewater Treatment Plant Analysis:** The Plan describes the existing wastewater treatment and effluent disposal facilities; identifies potential sources for water reuse within the City's service area; evaluates the treatment process capacity to meet the 20-year flow projections and develops conceptual WWTP improvement projects and cost estimates to provide for the increased capacity; and estimates operation and maintenance costs for WWTP and biosolids management.

- **Performance and Design Criteria:** The Plan summarizes the collection system design criteria, as established by the City, surrounding cities, Skagit County, and the Washington State Department of Ecology. The Plan describes how these criteria, standards, and policies will be applied to existing and future wastewater system components and reviews and updates minimum design criteria in relation to Washington State Department of Ecology standards.

- **Hydraulic/Hydrologic Analysis:** The Plan creates a SewerCAD hydraulic model from as-built information for critical parts of the sewer collection system to include 10-inch and larger trunk lines, interceptors, pump stations, and force mains within the service area. The hydraulic model includes existing information on populations, flow meter records, pump station drawdown tests, run time records, and flow monitoring results. The hydraulic model is calibrated to simulate peak hour flows including infiltration and inflow, and uses future populations to identify collection system deficiencies and bottlenecks at future design flows.

- **Capital Improvement Plan:** The Plan develops 6-year and 20-year capital improvement plans for the collection system and WWTP, including expansions to expand service throughout the service area, infiltration/inflow reduction projects, improvements based on the results of the hydraulic model and from interviews with City staff, and improvements to reduce operation and maintenance costs. The Plan identifies improvements to be funded by the City and improvements that can potentially be funded by developers.

- **Financial:** The Plan describes and assesses the current financial status of the sewer system as well as lists and discusses available sources of revenue for system improvements including grant and loan programs. The Plan reviews the existing sewer charge system and recommends modifications as necessary. The sewer utility revenues and expenses are projected for the 6-year planning period based on historical cash flow and planned growth projections. The analysis includes the costs for additional staff and operation and maintenance costs related to CIP projects.

- **Plan Compilation and Distribution:** All of the scope of work information listed above is assembled in the draft Wastewater Comprehensive Plan and a SEPA checklist will be prepared for the Plan.

- **Submit to Agencies for Review:** The draft Wastewater Comprehensive Plan will be submitted to the Department of Ecology, Department of Health, Skagit County, and the various cities and special-purpose districts for comments. Any comments from agencies will be incorporated and the final plan will be submitted to the Department of Ecology for approval.

RELATED PLANNING DOCUMENTS

The following documents summarized below were consulted in the preparation of this *Wastewater Comprehensive Plan*.

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

City of Burlington 2005 Comprehensive Plan, November 2005

The City of Burlington completed a *Comprehensive Plan* in November 2005, in compliance with the Growth Management Act (GMA). This Plan provides a complete update of previous plans, including the 1991 Comprehensive Wastewater Plan, 1994

Comprehensive Plan, and the 1999 Comprehensive Plan update. This document complies with the GMA and is consistent with the planning policies of Skagit County and neighboring jurisdictions. Growth management planning goals, county-wide policies, land use, housing, business areas, commercial areas, industrial areas, special planning areas, capital facilities, surface water management and utilities, water, electric, natural gas, communication utilities, transportation, parks, recreation, open space, environmental areas, and critical areas are all addressed in this document.

Skagit County Bayview Ridge Subarea Plan, Reid Middleton, August 2008

Skagit County developed the *Bayview Ridge Subarea Plan* in 2008 in conjunction with the City of Burlington and the Port of Skagit County. The Plan develops policies for the long-term development of the Bayview Ridge Subarea. The planning was done under the County's Growth Management Act and addresses issues such as land use, business development, housing, transportation, capital facilities, utilities, open space, and public facilities.

WASTEWATER SYSTEM PLANNING

City of Burlington Comprehensive Wastewater Plan, PEI/Barrett Consulting Group, 1991

The 1991 *City of Burlington Comprehensive Wastewater Plan* developed projected population and wastewater production for the City through the year 2010. The service area characteristics and geography were examined and drainage basins were identified. The Plan estimated the infiltration and inflow into the collection system and recommended a program to control I/I. The Plan developed a 10-year Capital Improvement Plan that included the construction of a number of new pump stations and force mains as well as improvements to the WWTP and collection system.

City of Burlington Wastewater Facilities Plan, Gray & Osborne, July 1997

The 1997 *City of Burlington Wastewater Facilities Plan* updated the 1991 Comprehensive Wastewater Plan to account for the GMA and the City's updates to its Comprehensive Plan and in response to population growth in the sewer service area. The Plan provides a list of sewer improvements to extend sewer service throughout the planning area, particularly the Port of Skagit County and the Bayview Ridge areas west of the city limits. The Plan recommended two phases of expansion of the wastewater treatment plant. The Phase 1 expansion increased the capacity of the WWTP from 1.61 mgd to 3.79 mgd to provide capacity through 2015.

Criteria for Sewage Works Design, Washington State Department of Ecology, December 1998

The *Criteria for Sewage Works Design* (Orange Book) serves as a guide for the design of sewer collection, treatment, and reclamation systems. The Orange Book was used to ensure all the recommended improvements to the City's sewer collection and treatment systems were meeting the requirements of the Washington State Department of Ecology and the Washington State Department of Health.

CHAPTER 2

REGULATORY REQUIREMENTS

INTRODUCTION

Wastewater collection system planning includes an analysis of the City's ability to comply with the applicable regulatory requirements while providing a high level of service for existing and future customers. These requirements are outlined in federal, state, and local regulations, and enforced by a number of agencies. This chapter presents the legislation, regulations, permits, agencies, and design standards that may affect City's wastewater operations. The discussion presented here is general in nature; specific issues will be addressed as they occur within the context of following chapters.

LEGISLATION, REGULATIONS, AND PERMITS

In this section, the various state and federal legislation that may affect City's operations are discussed, as well as other relative permits, programs, and regulations.

FEDERAL CLEAN WATER ACT

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

The National Pollutant Discharge Elimination System (NPDES) is established by Section 402 of the CWA and subsequent amendments. The Washington State Department of Ecology (Ecology) administers NPDES permits under the authority of the United States Environmental Protection Agency (EPA). Most NPDES permits are valid for 5 years and place limits on the quantity and quality of pollutants that may be discharged. NPDES permits granted under Phase I of the CWA regulate point source discharges including wastewater discharges to surface water from municipal or industrial wastewater treatment facilities, stormwater discharges from industrial facilities, construction sites of more than 1 acre, and stormwater discharges from separate storm sewers serving populations of more than 100,000. Under Phase II rules, promulgated by EPA in March of 1999, NPDES permits are required for surface water discharges from construction sites greater than 1 acre, municipalities of 10,000 or more, and communities smaller than 10,000 with urban characteristics. The City of Burlington NPDES permit, which has an expiration date of September 30, 2010, is included in Appendix A (Permit No. WA-002015-0). The City is currently in the process of having its NPDES permit renewed. The City's current NPDES permit effluent limits are shown in Table 2-1.

TABLE 2-1

NPDES Permit Effluent Limitations

Effluent Limit		
Parameter	**Average Monthly**	**Average Weekly**
BOD_5	30 mg/L, 948 lb/d	45 mg/L, 1,422 lb/d
TSS	30 mg/L, 948 lb/d	45 mg/L, 1,422 lb/d
Fecal Coliform Bacteria	200/100 ml	400/100 ml
pH	Minimum of 6.2 and Maximum of 9.0	

The 1985 enactment of the Revised Code of Washington (RCW) 90.48.480 and Washington State Administrative Code (WAC) 173-245 required all municipalities with combined sewer overflows (CSOs) to develop a plan to reduce annual CSOs to one event per year. The National CSO Control Strategy (1989, Federal Register 37370) officially classified combined sewer overflows as point source discharges subject to regulation under NPDES and CWA. In 1994, EPA published a CSO Control Policy Strategy (Federal Register 18688) that limits CSOs to four to six events per year depending on the sensitivity of the receiving water.

Section 307 of the CWA established the National Pretreatment Program. This program is designed to protect publicly owned treatment facilities and limits the amount of industrial or other non-residential pollutants discharged to municipal sewer systems.

The City is required to obtain an NPDES Construction Permit for projects greater than 1 acre in size.

A 401 Water Quality Certification is required under the CWA for any activity that may result in discharge to surface water, including excavation activities that occur in streams, wetlands, or other waters of the nation.

Section 404 of the CWA regulates discharges of fill or dredged materials in wetlands, including any related draining, flooding, and excavation. Pipeline and pump station projects in wetlands will require a Section 404 permit in addition to any related local permits. Activities that impact more than 1/3 acre will also require a Section 401 Certification.

CAPACITY, MANAGEMENT, OPERATIONS AND MAINTENANCE

The EPA has drafted an amendment to the NPDES regulations to address Sanitary Sewer Overflows (SSOs). The legal basis for this Capacity, Management, Operations and Maintenance (CMOM) regulation is that nearly all collection systems have unplanned releases at some time and that these releases must be regulated under the jurisdiction of the Clean Water Act. The EPA currently has not set a timetable for CMOM implementation.

The collection system regulatory requirements are as follows:

1. Meet additional general sewer system performance standards including up-to-date system maps, information management systems, and odor control requirements.

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

3. Develop an overflow response plan that can respond to releases in less than 1 hour and is demonstrated to have sufficient and adequate personnel and equipment, etc. Estimated volumes and durations of overflows must be measured and reported to the regulatory agency.

4. Plan for system maintenance and evaluation requirements that will mandate that the entire collection system be cleaned on a scheduled basis (for example, once every 5 years), be regularly inspected through TV work, and that a program for short- and long-term rehabilitation and replacement be generated. EPA has suggested a 1.5 to 2 percent system replacement rate, which implies that an entire collection system is replaced in a 50- to 70-year time period.

5. Develop a capacity assurance and management plan with flow meters to model infiltration and inflow (I/I) and system capacity. Ensure pump stations are metered, and properly operated and maintained.

6. Develop a self-audit program to evaluate and adjust performance.

7. Develop a program to communicate information on problems, costs, and improvements to the public and decision-makers.

This program will issue NPDES permits for tributary collection systems (owned and operated by local governments) that do not have NPDES permits for their own treatment plant(s). These requirements may be issued through a general NPDES permit instead of individual permits. Communities that have NPDES permits through their treatment plants will have these new CMOM requirements added to the existing permits.

There will be some relaxation of these requirements for small communities with design flows less than 1 mgd. However, it is uncertain exactly how streamlining will be applied, and the integrity of the collection system may be more important than size in determining which requirements will apply to a community. Because the underlying legal authority for this program is the federal Clean Water Act, these regulatory requirements will also be subject to citizen lawsuits.

ENDANGERED SPECIES ACT

On March 16, 1999, the National Marine Fisheries Service (NMFS) listed the Puget Sound Chinook as "threatened" under the Endangered Species Act (ESA). In addition, the United States Fish and Wildlife Service (USFWS) listed the Bull Trout as "threatened" on October 28, 1999. ESA listings are expected to significantly impact activities that affect salmon and trout habitat, such as water use, land use, construction activities, and wastewater disposal. Impacts to the City may include longer timelines for permit applications, and more stringent regulation of construction impacts and activities in riparian corridors.

The purpose of the 1972 ESA is to "provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved...." In pursuit of this goal, the ESA authorizes USFWS and NMFS to list species as endangered or threatened, and to identify and protect the critical habitat of listed species. USFWS has jurisdiction over terrestrial and freshwater plants and animals such as bull trout, while NMFS is responsible for protection of marine species including anadromous salmon. Under the ESA, endangered status is conferred upon "any species which is in danger of extinction throughout all or a significant portion of its range…," while threatened status is conferred upon "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." The ESA defines critical habitat as the "geographical area containing physical and biological features essential to the conservation of the species."

Once a species is listed as endangered or threatened, the ESA makes it illegal for the government or individuals to "take" a listed species. "Take" has been interpreted by the federal courts to include "significant modification or degradation of critical habitat" that impairs essential behavior patterns. For species listed as endangered, the blanket prohibitions against "take" are immediate. However, threatened species may be protected through a more flexible Section 4(d) rule describing specific activities that are likely to result in a "take."

In response to existing and proposed ESA listings of salmon, steelhead, and trout species throughout Washington State, Governor Gary Locke established the Office of Salmon Recovery in 1997 to direct the State's salmon recovery efforts. The Office of Salmon Recovery is also supported by the Joint Natural Resources Council in the preparation of the Statewide Strategy to Recover Salmon, entitled "Extinction is Not an Option" (January 1999). The Joint Natural Resources Council is composed of representatives of state natural resource agencies. The goal of the Statewide Strategy is to restore wild salmon, steelhead, and trout populations to harvestable levels. Rather than attempting to avert additional ESA listings, the Statewide Strategy intends to provide local input into, and hopefully maintain some local control over, the salmon recovery regulatory processes that will inevitably affect the majority of Washington State.

NMFS listed the Puget Sound Chinook on March 16, 1999, and promulgated a final Section 4(d) rule in January 2001 which was updated again in August 2003.

The State of Washington has an agreement with NMFS to include model critical areas ordinances and stormwater management programs in the Section 4(d) rule as exempted activities. By adopting these model ordinances and complying with the Section 4(d) rule, local governments are afforded some protection from the possibility of federal prosecution or civil suits under the ESA. City activities will need to comply with any future provisions of the Section 4(d) rule, as well as revised critical areas ordinances.

RECLAIMED WATER STANDARDS

"Reclaimed water" is defined in RCW 90.46.010 as "effluent derived in any part from sewage from a wastewater treatment system that has been adequately and reliably treated, so that as a result of that treatment, it is suitable for a beneficial use or a controlled use that would not otherwise occur, and is no longer considered wastewater." Use of reclaimed water is an alternative to effluent disposal. In the State of Washington, any type of direct beneficial reuse of municipal wastewater is defined as water reuse or reclamation. *Water Reuse and Reclamation Standards* have been issued jointly by the Departments of Health and Ecology. This discussion is based on the current standards dated September 1997, which are adopted by reference in RCW Chapter 90.46, Reclaimed Water Use. Chapter 8 provides additional information on reclaimed water opportunities for the City.

The Water Reclamation and Reuse Standards define the water quality standards for reclaimed water. A Class A reclaimed water treatment facility must meet four minimum requirements, as follows:

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

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

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

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

NATIONAL ENVIRONMENTAL POLICY ACT

The National Environmental Policy Act (NEPA) was established in 1969 and requires federal agencies to determine environmental impacts on all projects requiring federal permits or funding. If the project is determined to be environmentally insignificant, a Finding of No Significant Impact (FONSI) is issued; otherwise, an Environmental Impact Statement (EIS) is required. Obtaining grants and loans from federally funded state programs and federal agencies triggers an environmental report and in some cases a biological assessment. NEPA is not applicable to projects that do not include a federal component that would trigger the NEPA process.

FEDERAL CLEAN AIR ACT

The federal Clean Air Act requires all wastewater facilities to plan to meet the air quality needs of the region. The permitting of facilities is based upon a mass balance being performed to review if a facility is required to seek an air permit from a federal and/or local permitting agency. According to the Northwest Air Pollution Control Agency, other than occasional, very localized industry problems at March's Point, this is an air quality attainment area with no identified long-term problems. Outdoor burning is prohibited in the Burlington city limits and Urban Growth Area by state action. An air quality permit for the City's wastewater treatment plant is not currently required. The City has a registration certificate from the Northwest Air Pollution Control Agency to operate their biosolids dryer.

STATE WATER POLLUTION CONTROL ACT

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

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

Prior to construction or modification of domestic wastewater facilities, engineering reports and plans and specifications must be submitted to and approved by Ecology. This regulation outlines procedures and requirements for the development of an engineering report that thoroughly examines the engineering and administrative aspects of a domestic wastewater facility project. This regulation defines a facility plan as described in federal regulations, 40 CFR Part 35, as an engineering report.

Key provisions of WAC 173-240 are provided below.

- An engineering report for a wastewater facility project must contain everything required for a general sewer plan unless an up-to-date general sewer plan is on file with Ecology.

- An engineering report shall be sufficiently complete so that plans and specifications can be developed from it without substantial changes.

- A wastewater facility engineering report must be prepared under the supervision of a professional engineer.

- The engineering report shall include the following information (letter designations are taken from WAC 173-240-060; requirements that include those found in 40 CFR 35.917 for federal facility plan requirements are noted with an asterisk, "*").

  (a) Name, address, and phone number of owner.
  (b) Project description.
  (c) Current and projected wastewater flows and loadings.
  (d) Treatment standards.
  (e) Receiving water characteristics, including dilution zone.
  (f) Proposed treatment and disposal process, including an evaluation of alternatives.*
  (g) Basic design data and calculations for each unit process.
  (h) Site availability and relationship to 25/100 flood cycles and residential or developed areas.
  (i) Flow diagram with hydraulic profile.
  (j) Discussion of inflow and infiltration.*
  (k) Provisions for treating industrial waste, including pretreatment programs.*
  (l) Outfall analysis.
  (m) Method of final sludge disposal and alternatives considered.
  (n) Provisions for future needs.
  (o) Staffing and testing requirements.

(p) Estimated capital and O&M costs, evaluated in terms of annual costs and present worth.*

(q) A statement regarding compliance with any applicable state or local water quality plans pursuant to the federal Water Pollution Control Act, as amended.

(r) A statement regarding compliance with the State Environmental Policy Act (SEPA) or National Environmental Policy Act (NEPA), as applicable.

Criteria for Sewage Works Design, Washington State Department of Ecology

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

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

Wastewater treatment plant operators are certified by the State Water and Wastewater Operators Certification Board. The operator assigned for the overall responsibility of operation of a wastewater treatment plant is defined by WAC 173-230 as the "operator in responsible charge." This individual must be State certified at or above the classification rating of the plant. The City's WWTP is currently assigned a Class III rating and the operating staff assigned to the plant has the required certification.

WATER QUALITY STANDARDS FOR SURFACE WATERS OF THE STATE OF WASHINGTON, CHAPTER 173-201A WAC

Basis of Regulations

The Washington State Department of Ecology has authority under the federal Water Pollution Control Act, also known as the Clean Water Act (CWA), to establish and administer programs to meet the requirements of the Act. Under RCW 98.40.35, the Washington Department of Ecology has the authority to establish "rules and regulations relating to standards of quality for waters of the state and for substances discharged therein..." The State of Washington also implements the National Pollutant Discharge Elimination System (NPDES) program created under the CWA.

Description of Regulations

WAC 173-201A establishes water quality standards within the State of Washington. The State adopted revised water quality standards on July 1, 2003. The standards are based on two objectives: protection of public health and enjoyment, and protection of fish, shellfish, and wildlife. For each surface water body in the State, the standards assign specific uses, such as aquatic life, recreation, or water supply. Water quality standards have been developed for each use, for parameters such as fecal coliform, dissolved oxygen, temperature, pH, turbidity, and toxic, radioactive, deleterious substances. The water uses that are defined in the standards for fresh water include:

<u>Aquatic Life Uses</u>

- Char spawning and rearing
- Core summer salmonid habitat
- Salmonid spawning, rearing, and migration
- Salmonid rearing and migration only
- Non-anadromous interior redbrand trout
- Indigenous warm water species

<u>Recreational Uses</u>

- Extraordinary primary contact recreation
- Primary contact recreation
- Secondary contact recreation

<u>Water Supply Uses</u>

- Domestic
- Agricultural
- Industrial
- Stock watering

<u>Miscellaneous Uses</u>

- Wildlife habitat
- Harvesting
- Commerce and navigation
- Boating
- Aesthetics

Water Quality Classifications for Fresh Waters

The City's outfall discharges to the Skagit River at mile 18.1. The Skagit River at the outfall discharge location is classified in WAC 173-201A-602 as having the following uses:

- Aquatic Life Uses: Salmonid spawning, rearing, and migration
- Recreation Use: Primary contact recreation
- Water Supply Uses: Domestic water, industrial water, agricultural water, and stock water
- Miscellaneous Uses: Wildlife habitat, harvesting, commerce/navigation, boating, and aesthetics

Water quality criteria for the Skagit River at the City of Burlington WWTP Outfall are shown in Table 2-2.

TABLE 2-2

Water Quality Criteria for Skagit River at the City of Burlington WWTP Outfall

Parameter	Surface Water Criteria Value
Temperature	17.5 degrees C (7-day average of daily maximum temperatures)
Dissolved Oxygen	>8.0 mg/L (lowest 1-day minimum)
Turbidity	<5 NTU over background (background <50 NTU) <10% increase over background (background >50 NTU
Dissolved Gas	<110% of saturation at any point of sample collection
pH	Not outside the range of 7.0 to 8.5 standard units, with no human-caused variation >0.5 standard unit
Bacteria	**Primary Contact Recreation:** Fecal coliform organism levels must not exceed a geometric mean value of 100 colonies/100 ml, with not more than 10% of all samples (or any single sample when less than 10 sample points exist) obtained for calculating the geometric mean value exceeding 200 colonies/100 ml

The water quality standards also have narrative criteria regarding toxic, radioactive, otherwise deleterious materials, or materials that impair aesthetics. These materials are prohibited in concentrations that affect aquatic life, human health, or impair aesthetics.

Numeric criteria for 29 toxic substances are listed in WAC 173-201A-240. Criteria are listed for both an acute and chronic basis and for certain substances (e.g., metals, chlorine, and ammonia), the criteria must be calculated as a function of receiving water pH, hardness, and whether salmonids are present.

Anti-Degradation Policy

The anti-degradation policy aims to maintain the highest possible quality of water in the state by preventing the deterioration of water bodies that currently have higher quality than the water quality standards require. The revised water quality standards define three tiers of waters in the anti-degradation policy.

Tier I water bodies are those with violations of water quality standards, from natural or human-caused conditions. The focus of water quality management is on maintaining or improving current uses, and preventing any further human-caused degradation.

Tier II water bodies are those of higher quality than required by the water quality standards. The focus of the policy is on preventing degradation of the water quality and to preserve the excellent natural qualities of the water body. New or expanded actions are not allowed to cause a "measurable change" in the water quality, unless they are demonstrated to be "necessary and in the overriding public interest."

New or expanded actions that may cause a measurable change in water quality must conduct a Tier II review. For increased wastewater treatment plant discharges, this review will take place as part of the NPDES permit modification process. Measurable change, for the purpose of the anti-degradation policy, is defined as follows:

- Temperature increase greater than 0.3 degree C
- Dissolved oxygen concentration decrease greater than 0.2 mg/L
- Bacteria level increase greater than 2 CFU/100 ml
- pH change greater than 0.1 standard unit
- Turbidity increase greater than 0.5 NTU
- Any detectable change in concentration of toxic or radioactive substances, which include ammonia and chloride

A new or expanded action may be determined by Ecology to be necessary and in the overriding public interest based on a review of the following factors:

- Economic benefits, such as job creation
- Providing or contributing to necessary social services
- Status as a demonstration project using innovative technical or management approaches that produce a significant improvement over AKART
- Prevention or remediation of environmental or public health threats

- Societal or economic benefits of better health protection
- The loss of assimilative capacity for future industry or development
- The loss of benefits associated with the current high water quality, such as fishing or tourism uses

The new or expanded action would be allowed to measurably reduce the water quality only if it is demonstrated that the action has selected the combination of site, technical, and managerial approaches that will minimize the effect on water quality. Alternative approaches that must be evaluated include:

- Pollution prevention or source control to reduce toxic compound discharges
- Reuse or recycling of wastewater
- Water conservation to minimize production of wastewater
- Land application or infiltration to reduce surface water discharges
- Alternative or enhanced treatment technologies
- Improved operation and maintenance of existing facilities
- Seasonal or controlled discharge to avoid critical water quality conditions
- Water quality offsets with another water quality action (point or non-point source), providing no net decrease of water quality

Tier III water bodies are specially designated as outstanding resource waters. The revised standards do not initially define Tier III water bodies; however, the standards allow the public or Ecology to nominate water bodies for inclusion in the Tier III class. There are two classes within Tier III: Tier III(A) prohibits all future degradation, while Tier III(B) allows future degradation that does cause a "measurable change" to occur from well-controlled activities.

Discharge Permits

The primary means for achieving the water quality standards of WAC 173-201A is NPDES permits issued by Ecology and state waste discharge permits issued by both Ecology and the Department of Health (DOH).

Compliance Schedules

When it is not possible to achieve compliance with the standards in WAC 173-201A on an immediate basis, Ecology may issue an order with a compliance schedule to allow for further water quality studies, implementation of best management practices, or construction of necessary treatment capability. Compliance schedules may only be issued for existing discharges.

Assimilative capacity is a term that describes the surface water's ability to accept waste loadings without a permanent degradation of water quality. Ecology is presently conducting waste load capacity studies, also known as total maximum daily load (TMDL) studies, for several major watersheds in the State of Washington. TMDL is a regulatory term in the Clean Water Act which states the maximum allowable daily loading for a particular contaminant to the receiving waters in question.

The EPA, in consultation with Ecology, establishes and maintains a list of impaired water body segments, known as the 303(d) list. TMDL studies will generally be necessary to determine an allotted waste load for any single discharger.

Discharging to surface water requires an NPDES permit issued by Ecology under WAC 173-221. Minimum discharge standards for domestic wastewater facilities discharging to surface water are shown in Table 2-3.

TABLE 2-3

Minimum WWTP Effluent Standards for Surface Water Discharge (Reference WAC 173-221)

Parameter	Monthly Average Limit
Five-day Biochemical Oxygen Demand (BOD_5)	30 mg/L
Total Suspended Solids (TSS)	30 mg/L
Fecal Coliform	200/100 ml

Under WAC 173-201A, State Water Quality Standards, Ecology is authorized to condition NPDES permits so that the discharge meets water quality standards. Therefore, other permit conditions, in addition to or more stringent than the above (as shown in Table 2-1), could be added to ensure that the water quality of the receiving water is not degraded.

STATE ENVIRONMENTAL POLICY ACT

The WAC 173-240-050 requires a statement in all wastewater comprehensive plans regarding proposed projects in compliance with the State Environmental Policy Act (SEPA), if applicable. The City has determined that the 2010 Wastewater Comprehensive Plan builds on past work to provide a comprehensive assessment of the needs for wastewater collection, transmission, treatment, and disposal for the 20-year planning period. The plan was adopted as part of the Final Supplemental Environmental Impact Statement and Preferred Alternative for the 1994 Comprehensive Plan and Zoning Ordinance Amendments as further supplemented in 2005 under WAC 197-11-965. The adoption notice can be found in Appendix B.

GROWTH MANAGEMENT ACT

The Washington State Growth Management Act (GMA) was enacted in 1990 and requires certain local governments to plan for the population growth that will occur over the next 20 years within an established Urban Growth Area. The GMA also requires cities and the county to classify critical areas (wetlands, aquifer recharge areas, fish and wildlife habitat areas, geologically hazardous areas, and frequently flooded areas) and to establish development regulations to protect these areas.

ACCREDITATION OF ENVIRONMENTAL LABORATORIES (WAC 173-050)

The State of Washington recently established a requirement that all laboratories reporting data to comply with NPDES and surface water discharge (SWD) permits must be generated by an accredited laboratory. This accreditation program establishes specific tasks for quality assurance and quality control (QA/QC) that are intended to ensure the integrity of laboratory procedures. Accreditation requirements must be met for any on-site laboratory or outside laboratory used to analyze samples. Only accredited commercial laboratories may be used for analyses reported for compliance with NPDES or SWD permits. In planning for an on-site laboratory, staffing must be sufficient to allow for QA/QC procedures to be performed.

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

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

WETLANDS

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

A U.S. Army Corps of Engineers permit is required when locating a structure, excavating, or discharging dredged or fill material in waters of the United States or transporting dredged material for the purpose of dumping it into ocean waters.

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

Wetlands Executive Order 11990

This order directs federal agencies to minimize degradation of wetlands and enhance and protect the natural and beneficial values of wetlands. The order also mandates avoidance and mitigation of impacts to wetlands, and must be considered before an NPDES permit is issued. Assurances must be provided that the natural and beneficial values of wetlands will be protected and enhanced by the discharge.

SHORELINE SUBSTANTIAL DEVELOPMENT PERMIT

Shoreline substantial development (SSD) permits are required for projects in which the total cost or fair market value, whichever is higher, exceeds $5,000. The Shoreline Management Act of 1971 (RCW 90.58) establishes a broad policy giving preference to shoreline uses that protect water quality and the natural environment, depend on the proximity to the water, and preserve or enhance public access to the water. Specific details about exemptions from this permit are listed in WAC 173-27-040(2) and include development for which the total cost or fair market value, whichever is higher, does not exceed $5,000, normal maintenance or repair of existing structures (including damages by accident), construction of normal protective bulkheads common to single-family residences, emergency construction necessary to protect property from damage by the elements, construction and practices normal for farming and agriculture, construction or modification of navigational aids, single-family development, and the construction of docks for personal and/or community use.

The City of Burlington is exempt from the SSD permit process under WAC 173-27-040(2)(c), which relates to the construction of normal protective bulkheads common to single-family residences.

Shorelines are defined by lakes or reservoirs of 20 acres or greater, streams with a mean annual flow of 20 cubic feet per second or greater, marine waters, and an area inland 200 feet from the ordinary high-water mark. Projects are reviewed by local governments according to state guidelines and a local shoreline master program.

Local shoreline master programs are developed in accordance with guidelines from Ecology. In 2003, Ecology revised these guidelines to reflect new scientific information and the need for integration with the Growth Management Act and Endangered Species Act listings. These revisions were remanded through a court's decision and Ecology is currently in the process of re-evaluating the rules. While the Act's 200-foot statutory jurisdiction has not changed, Ecology has proposed more stringent project review within "Vegetation Management Corridors." Though this rule will mean a varying level of scrutiny within the shoreline area, the purpose is to use "Best Available Science" as required by the Growth Management Act to ensure that regulations are substantively linked to the protection of shoreline functions and values.

FLOODPLAIN DEVELOPMENT PERMIT

Local governments that are participating in the National Flood Insurance Program are required to review projects (including wastewater collection facilities) in a mapped floodplain and impose conditions to reduce potential flood damage from floodwater. A floodplain development permit is required prior to construction.

HYDRAULIC PROJECT APPROVAL (HPA)

Under the Washington State Hydraulic Code (WAC 220-110), the Washington State Department of Fish and Wildlife requires a Hydraulic Project Approval for activities that will "use, divert, obstruct, or change the natural flow or bed" of any waters of the State. For City activities such as pipeline crossings of streams, a Hydraulic Project Approval will be required, and must include provisions necessary to minimize project-specific and cumulative impacts to fish.

Because of ESA listings throughout Washington, the Washington State Department of Fish and Wildlife and NMFS are in the process of revising the Hydraulic Code to protect species listed as threatened or endangered. If NMFS determines that the revisions are sufficient to protect listed species, the State hopes the revised code will constitute an acceptable Habitat Conservation Plan under Section 10 of the ESA. If the acceptable Habitat Conservation Plan is approved, NMFS issues an Incidental Take Permit allowing incidental take of a listed species if the permittee has complied with the Habitat Conservation Plan. This Incidental Take Permit expires after an agreed-upon period of time and may then be revised by NMFS.

REGULATORY AGENCIES

The above regulations, permits, and programs are administered by various local, state, and federal agencies. The history, purpose, and authority of these agencies are discussed below.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (EPA)

The stated mission of the EPA is to protect human health and to safeguard the natural environment upon which life depends. EPA's purpose includes protecting all Americans from significant human health risks, ensuring that national environmental efforts are based on the best available scientific information, ensuring that federal laws are enforced fairly, and that environmental protection contributes to making our communities and ecosystems diverse, sustainable, and economically productive. The Washington State Department of Ecology (Ecology) currently administers NPDES permits and State Revolving Fund (SRF) loans on behalf of the EPA.

UNITED STATES FISH AND WILDLIFE SERVICE (USFWS)

Under the ESA, USFWS is responsible for the protection of all non-marine life, such as bull trout. Though USFWS may choose to invoke the blanket prohibitions of Section 9, the "threatened" status of bull trout allows more flexibility to establish regulations designed to protect these species. These regulations, known collectively as the Section 4(d) Rule, outline activities likely to result in a "take" of a threatened species as well as exempted activities.

NATIONAL MARINE FISHERIES SERVICE (NMFS)

Under the ESA, NMFS is responsible for the protection of marine life, including anadromous salmon such as the Puget Sound Chinook. When a species is listed as "endangered" the prohibitions against "take" of the species are immediate under Section 9 of the ESA. Though NMFS may choose to invoke the blanket prohibitions of Section 9, the "threatened" status of the Puget Sound Chinook allows more flexibility to establish regulations designed to protect these species. These regulations, known collectively as the Section 4(d) Rule, outline activities likely to result in a "take" of a threatened species as well as exempted activities.

UNITED STATES ARMY CORPS OF ENGINEERS

Under the CWA, the U.S. Army Corps of Engineers (Corps) is authorized to regulate discharge of fill and dredged material to waters of the United States, including wetlands. The Corps employs a system of General or Nationwide Permits for blanket authorization of activities, such as utility lines that have minimal adverse impact on the environment. In situations where adverse impact is probable, the Corps may issue an Individual Permit after reviewing an analysis of alternatives. Enforcement actions may be brought by the Corps or the EPA.

WASHINGTON STATE DEPARTMENT OF ECOLOGY

The mission of Ecology's Water Quality Program is to protect, preserve, and enhance surface and ground water quality and to promote the wise management of water for the benefit of current and future generations. Ecology performs various functions under state and federal authority and has both local and regional offices. Ecology is also responsible for awarding low-interest loans for pollution control projects through the SRF, and low-interest loans and grants through the Centennial Clean Water Fund.

Ecology issues permits under the State Water Pollution Control Act, Section 401 Water Quality Certification, and NPDES permits in compliance with the CWA under EPA authority. Ecology also reviews and approves plans for on-site systems exceeding 14,500 gallons per day (gpd), all systems receiving state or federal construction grants under the CWA, and systems using mechanical treatment or lagoons with ultimate design flows above 3,500 gpd. Ecology regulates discharge of waste to the State's groundwater, discharge of industrial or commercial waste to sewers, and the use of reclaimed water through the State Waste Discharge (SWD) Permit program. While City staff has little control over SWD permits, the City can comment on those permits prior to each renewal. Ecology's regional offices issue Temporary Modification of Water Quality Criteria Permits for construction near or in water that might cause short-term water quality violations.

Ecology also regulates the management and disposal of biosolids. The biosolids permit is a general permit that provides coverage for applicants that have conducted the required biosolids analysis. Chapter 7 of this Plan includes an evaluation of the City's biosolids handling process.

WASHINGTON STATE DEPARTMENT OF FISH AND WILDLIFE

Under WAC 220-110 and RCW 75.20, any form of work that uses, diverts, obstructs, or changes the natural flow or bed of any fresh water of the State requires Hydraulic Project Approval from the Department of Fish and Wildlife. Approval would be required for all City construction projects that cross or otherwise take place in streams or on shorelines.

STATE AND LOCAL HEALTH DEPARTMENTS

The Washington State Department of Health was formed in 1989 and is the primary state agency responsible for serving public health. The Washington State Department of Health issues Waste Discharge Permits for reclaimed water use in conjunction with Ecology and approves on-site wastewater disposal systems between 3,500 and 14,500 gpd.

The Skagit County Health Department is the local health department governing the City. In general, local health departments may adopt and enforce local regulations when they are consistent with or more stringent than state regulations. The local health departments have approval authority for on-site systems with design flows of up to 3,500 gpd.

PRETREATMENT REQUIREMENTS

Publicly owned treatment works are subject to local and national pretreatment standards (40 CFR, Part 403). Prohibited discharges could disrupt operations at the WWTP and potentially pass through the treatment process with inadequately treated effluent and discharge to receiving water. Prohibited discharges, at a minimum, include dredged spoils, solid waste, incinerator residue, medical waste, chemical wastes, biological and radioactive materials, heat, wrecked or discharged equipment, rock, sand, cellar dirt, agricultural and industrial wastes, and wastes containing the same characteristics of wastewater (i.e., pH, temperature, TSS, turbidity, color, BOD_5, chemical oxygen demand (COD), toxicity, or odor. A Sanitary Sewer Pretreatment Policy was adopted by the City in 2005 under Ordinance 1583.

GRAVITY SYSTEM

Ecology's design criteria requires that gravity systems be designed large enough to carry peak hourly flows, as well as steep enough to provide a minimum scouring velocity of 2 feet per second when flowing full. The City standard for minimum slope is in accordance with Ecology's standards for the size of sewer pipe. The City also has minimum standards for manhole construction and details specifying trench configuration, depth of cover, bedding materials, and road overlays that meet or exceed Ecology's standards. The current City's design standards for gravity systems are consistent with or exceed those of Ecology.

LIFT STATIONS

Lift stations and force mains must also be designed according to Ecology guidelines. The City plans to address any issues relating to current Ecology standards as a part of the City guidelines and through its capital improvement program.

ON-SITE SEPTIC SYSTEMS

In some cases, wastewater may be treated and disposed of on-site either by individual septic systems or community on-site systems. The City estimates approximately 35 septic systems within the sewer service area. Options for providing sewer service to areas currently unsewered are discussed later in this Plan.

Municipalities, such as cities and counties, are required under the GMA to eventually provide wastewater collection services to all residents of the Urban Growth Area that are currently not connected. On-site septic systems should be designed to meet the DOH design standards. Approval of the systems will be made either by the Skagit County Health Department for systems under 3,500 gallons per day, or DOH for systems less than 14,500 gallons per day but greater than 3,500 gallons per day, or Ecology for systems that are over 14,500 gallons per day in capacity. The State Board of Health statute that provides the authority for DOH to adopt rules for sewage treatment is RCW 43.20.

SEWER ORDINANCES AND PLANNING POLICIES

The City operates its sewer system as described in the City's Municipal Code Chapter 13.04, Sewage Disposal, Chapter 13.08, Sewer Rates, and Chapter 13.12, Septic Tank Sludge. In addition to the City's municipal code, the siting of any wastewater facilities outside of the city limits, such as lift stations, will have to adhere to Skagit County's planning and zoning policies at the time of construction.

CHAPTER 3

LAND USE, POPULATION PROJECTIONS AND SERVICE AREA CHARACTERISTICS

INTRODUCTION

In order to provide wastewater services for future growth, the wastewater system is in need of continuous evaluation and improvement. A planning period for the evaluation of the wastewater utility should be long enough to be useful for an extended period of time, but not so long as to be impractical. The planning period for this *Wastewater Comprehensive Plan* is from 2010 through 2030 to provide consistency with population projections and other planning documents. This chapter will present the population projections for the planning period. In addition, this chapter will review the land use and define the sewer service area and the sewer basins used for evaluation in this Plan. Various natural features of the service area are also discussed, such as topography, geology, soils, climate, sensitive areas, floodplains, wetlands, air quality, and surface and ground water resources. Information on the public utilities available in the area is also presented.

SERVICE AREA LOCATION

The City of Burlington is located in the northwest region of Washington State in Skagit County near the junction of Interstate 5 and Highway 20. The City is located on the Skagit River and can be seen on Figure 1-1.

The City currently provides sewer service to the majority of the area within the current city limits, although some homes within city limits are served by on-site septic systems.

The sewer service area for the City of Burlington (study area for this Plan) consists of the current city limits, the City's Urban Growth Area (UGA), and the sewer service area which includes regions west of the City in unincorporated Skagit County as shown on Figure 3-1. The City of Burlington uses the term UGA to specifically refer to the areas outside of the current city limits that are within the UGA. Skagit County currently has zoning and land use jurisdiction over these unincorporated areas. The city limits encompass approximately 2,803 acres and the UGA consists of 442 acres, for a total of 3,245 acres. The City's sewer service area encompasses an additional 4,748 acres, located in the Western Service Area, for a total sewer service area of 7,993 acres, excluding the area served by the Samish Water District pipeline.

SERVICE AREA HISTORY

The City of Burlington was incorporated in 1902 with a population of 260. The original wastewater treatment plant and collection system were constructed in 1946. In 1977, the City expanded the sanitary sewer system to serve development to the west of the City and constructed a secondary treatment plant located on Section Street, adjacent to the Skagit River.

NATURAL FEATURES OF THE SEWER SERVICE AREA

Various natural features of the service area are discussed below, including climate and precipitation, soils, geology, and site-sensitive areas, such as floodplains, and wetlands. The natural features of the service area will have an impact on the design and siting of wastewater collection and treatment facilities.

TOPOGRAPHY

The geography of the City of Burlington is generally flat, with elevations ranging from 20 to 40 feet within the city limits. Figure 3-2 shows the topography of the Burlington area based on United States Geological Survey (USGS) maps. There are a few higher elevation areas within the City including Burlington Hill, which is located on the north side of the City. The elevations of Burlington Hill are up to 450 feet. In addition, the service area west of the City includes higher elevation areas, with elevations up to 140 feet.

SOILS AND GEOLOGY

Surface geology will determine the stability, strength, and permeability of soils, which impacts the suitability of land for building construction and on-site sewage systems. Figure 3-3 provides a map of the soil types, based on the United States Department of Agriculture, Soils Conservation Service.

CLIMATE

The National Oceanic and Atmospheric Administration (NOAA) collects data from a weather station in Burlington. Climate data from this station averaged over a 30-year period is summarized in Table 3-1. Winters are wet and mild. Snow falls occasionally, but usually melts within a few days.

TABLE 3-1

Average Precipitation and Temperature (1)

Month	Average Precipitation (inches)	Average Normal Temperature (°F)
January	5.83	39.6
February	3.87	42.1
March	4.22	45.6
April	3.77	49.7
May	2.96	55.1
June	2.67	59.5
July	1.55	63.1
August	1.70	63.6
September	2.74	58.8
October	4.29	51.3
November	6.92	44.3
December	5.55	39.6
Annual Total	**46.07**	**N/A**
Annual Average	**N/A**	**51.03**

(1) Climate data is from the Sedro-Wooley weather station, NOAA *Climatological Data, Annual Summary, Washington*, for the years 1970 through 2009.

SURFACE WATER

The primary surface water affected by the Burlington WWTP is the Skagit River. The Skagit River originates in the north Cascades, flowing southwesterly and ending in Skagit Bay. The City of Burlington's wastewater outfall is located in the Skagit River, adjacent to the treatment plant at mile 18.1.

Average monthly flow rates recorded for the Skagit River are shown below in Table 3-2. These flows were recorded from the Mount Vernon gauging station and available from USGS Surface Water Daily Statistics for Washington.

TABLE 3-2

Average Monthly Flow Rates for the Skagit River[1]

Month	Average Flow (cfs)
January	18,900
February	17,300
March	15,600
April	14,800
May	19,000
June	22,400
July	19,300
August	11,700
September	9,120
October	11,100
November	19,600
December	18,600

(1) Flow data is from the Mount Vernon gauging station, USGS Water Daily Statistics for Washington, for the time period January 1, 1970 through September 30, 2009.

SENSITIVE AREAS

In 2002, the City of Burlington updated its Critical Areas Ordinance in accordance with the GMA. These regulations are compliant with the GMA and were developed and adopted using the best available science. Critical areas within the sewer service area include those classified as wetlands, flood hazard areas, fish and wildlife habitat, geologically hazardous areas including steep slopes, and groundwater recharge areas.

Flood hazard areas have been defined by Federal Emergency Management Agency (FEMA) floodplain boundary maps. Sensitive areas within the City of Burlington are shown on Figure 3-4. Much of the City and surrounding area are located within the 100-year floodplain as designated by FEMA.

SEWER DRAINAGE BASINS

The existing sewer service area currently includes 28 sewer drainage basins, as shown on Figure 3-5. The drainage basins will be used for evaluation of projected population and wastewater flow rates. The drainage basins were identified as areas that flow by gravity sewer either to pump stations or the WWTP. Because of the flat nature of much of the City, the majority of the system is served by gravity sewer which drains to pump stations. The majority of the pump stations discharge through a force main to a gravity sewer system which drains to another pump station, eventually draining to the WWTP. A schematic representation of the City's existing lift stations and drainage basins is shown on Figure 3-6. Each drainage basin was assigned a number to help with identification on figures and tables. Table 3-3 provides the existing gravity drainage basins and the existing gravity area which currently drains to each basin.

TABLE 3-3

Sewer Drainage Basin Areas (1)

Drainage Basin No.	Drainage Basin Name	Gravity Area (acres)
1	Pump Station No. 1	76.04
2	Pump Station No. 2	137.25
3	Pump Station No. 3	137.45
4	Pump Station No. 4	134.51
5	Pump Station No. 5	377.29
6	Pump Station No. 6	4.79
7	Pump Station No. 7	68.21
8	Pump Station No. 8	265.17
9	Pump Station No. 9	149.75
10	Pump Station No. 10	837.44
11	Pump Station No. 11	738.58
12	Pump Station No. 12	25.96
13	Pump Station No. 13	214.26
14	Pump Station No. 14	48.93
15	Pump Station No. 15	149.67
16	Pump Station No. 16	334.41
17	Pump Station No. 17	10.17
18	Pump Station No. 18	33.27
19	Pump Station No. 19	82.39
20	Pump Station No. 20	64.25
21	Pump Station No. 21	47.37
22	Gravity to WWTP	235.31
23	PACCAR	242.47
24	Skagit County Recovery Facility	11.04
25	PSE	20.99
27	Dahlstead	51.95
31	Airport Runway 1	601.47
32	Airport Runway 2	57.47

(1) The sewer basin areas may not match values in other tables due to rounding.

Because many of the drainage basins receive flows from pump stations as well as gravity sewer, any flow analysis must include the upstream service areas which pump into the drainage basin. The flows will be developed in Chapter 5. In addition, the Pump Station No. 6 drainage basin also receives flow from the Samish Water District pipeline. This pipeline was originally constructed in 1976 to convey effluent from the Samish Water District wastewater treatment lagoon to the City sewer system for further treatment at the City's wastewater treatment plant. Since its original construction, several other customers have been added to the pipeline. Some of the major customers include the Washington State Department of Transportation rest stop near Alger, Whatcom Meadows Campgrounds, and several businesses near Cook Road. The pipeline also can accept standby capacity from the Casino. A full inventory of customers and pump stations and a map of the pipeline service area are provided in Appendix C. The Samish Water District has contracted for conveyance and treatment of an annual average flow of 250,000 gpd with the City of Burlington. This capacity includes the Samish Water District and all the additional customers, except the Skagit Valley Resort and Casino. The Casino has a separate agreement with the City for the conveyance and treatment of 60,000 gpd annual average flow.

The Casino has recently (2011) initiated construction of its own membrane bioreactor wastewater treatment facility and would, for the most part, discontinue discharge of wastewater to the Samish Water District pipeline. They will, however, maintain and cover the cost for a 60,000 gpd standby capacity in the City of Burlington wastewater conveyance and treatment system.

WATER SYSTEM

The Skagit County PUD operates a water system that supplies potable water to most areas of the City and the UGA as well as additional service areas.

ZONING AND LAND USE

The City has designated zoning classifications for areas within the city limits. Skagit County currently has zoning and land use jurisdiction over unincorporated areas that are provided sewer service by the City, including the areas within the City's UGA. The City and County zoning and land use designations are not identical so each are calculated separately.

EXISTING CITY ZONING

Figure 3-7 provides a map of current City zoning. The breakdown of the existing City zoning can be seen in Table 3-4. Residential zoning makes up about 34 percent of the total land area and approximately 28 percent of the residential zoning consists of single-family residential zones. The existing commercial zoning in Burlington is concentrated along Burlington Boulevard and includes the Cascade Mall as well as a number of factory outlets. Another 15 percent of the total area is for public use or open spaces. This area includes city parks, schools, and highway right-of-way as well as privately owned land that is limited for development, such as in floodplains.

TABLE 3-4

Existing Zoning in City(1)

Land Use Designation	Land Use Category	Acreage	% of Total Acreage
R-1-6.0	Single-Family Residential	122	4.9%
R-1-7.6	Single-Family Residential	70	2.8%
R-1-8.4	Single-Family Residential	299	12.1%
R-1-9.6	Single-Family Residential	292	11.8%
R-2	Two-Family Residential	56	2.3%
R-3	Multifamily Residential	127	5.2%
R-S	Semipublic District	25	1.0%
M-1	Industrial District	241	9.8%
B-P	Business Park District	117	4.8%
C-1	Commercial District	635	25.8%
C-2	Heavy Commercial	344	14.0%
B-1	Business District	13	0.5%
MR-NB	Medium Residential and Neighborhood Business	40	1.6%
OSPA	Open Space, Parks, and Agriculture	55	2.2%
ROW	Right-of-Way	29	1.2%
Total		**2,465**	**100%**

(1) The zoning areas may not match other tables due to rounding.

EXISTING COUNTY ZONING

Figure 3-8 provides a map of current County zoning. The breakdown of the existing County zoning can be seen in Table 3-5. Residential zoning makes up about 20 percent of the total land area. The existing commercial zoning accounts for less than 1 percent of the total land area. Another 1 percent of the total area is for public use or open spaces.

TABLE 3-5

Existing County Zoning in Sewer Service Area(1)(2)

Land Use Designation	Land Use Category	Acreage	% of Total Acreage
AVR	Aviation Related	768	16.0%
Ag-NRL	Agricultural – Natural Resource Lands	361	7.5%
BR-CC	Bayview Ridge Community Center	40	0.8%
BR-HI	Bayview Ridge Heavy Industrial	924	19.2%
BR-LI	Bayview Ridge Light Industrial	1,212	25.2%
BR-R	Bayview Ridge Residential	708	14.7%
BR-URv	Bayview Ridge Urban Reserve	303	6.3%
NRI	Natural Resource Industrial	20	0.4%
RB	Rural Business	4	0.1%
RFS	Rural Freeway Service	1	0.0%
RI	Rural Intermediate	0	0.0%
RRv	Rural Reserve	22	0.5%
SSB	Small Scale Business	21	0.4%
URC-I	Urban Reserve Commercial-Industrial	0	0.0%
URR	Urban Reserve Residential	11	0.2%
WAT	Water	411	8.6%
Total		**4,806**	**100%**

(1) The zoning areas may not match other tables due to rounding.
(2) Excludes rights-of-way.

FUTURE LAND USE

The City of Burlington is located mostly within the 100-year floodplain of the Skagit River and is relatively flat. The sewer service area to the west of the City is located at higher elevations above the 100-year floodplain.

The areas surrounding the City not in the sewer service area are mostly agricultural farmland. The City has worked with Skagit County and other organizations to design a program to protect the agricultural resource land at the edge of the City and to encourage higher density development in the existing city limits, with a focus on the downtown area. In addition, development outside of the city limits in the sewer service area is focused on the Bayview Ridge and Port of Skagit County areas.

The City expects that unincorporated UGAs will be annexed into the City as development occurs. In addition, the City has identified the west end of Gages Slough for incorporation into the City because it is the stormwater outfall for the City and is interested in restoring the wetland buffer and improving water quality. Another priority is to assist the Burlington-Edison School District in locating a site for a new school that has access to urban services.

POPULATION PROJECTIONS

CURRENT POPULATION

The 2010 census data were released in April 2011 and are accounted for in the subsequent tables and calculations. The City Planning Department has provided historical population and new construction information for the years 1989 through 2010 as seen in Table 3-6 and Table 3-7.

TABLE 3-6

City Historical Population 1989 to 2010

Year	Population(1)	Additions/Subtractions	Annual Growth Rate
1989	3,830	0	
1990	4,349	519	14%
1991	4,760	411	9%
1992	4,690 (2)	-70	-1%
1993	4,690	0	0%
1994	5,170	480	10%
1995	5,385	215	4%
1996	5,445	60	1%
1997	5,445	0	0%
1998	5,525	80	1%
1999	5,635	110	2%
2000	6,757	1,122	20%
2001	6,995	238	4%
2002	7,014 (3)	19	0%
2003	7,315	125	4%
2004	7,425	110	2%
2005	7,550	125	2%
2006	8,120	570	8%
2007	8,400	280	3%
2008	8,460	60	1%
2009	8,870	410	5%
2010	8,985 (4)	115	1%
2010	8,388 (5)	-482	-5%
2011	8,420	32	0%

(1) Population inside city limits.
(2) Correction of 1991 population by Washington State OFM.
(3) Based on 2000 Census data (updated November 30, 2001).
(4) Population update by Washington State OFM April 1, 2010.
(5) Based on 2010 Census data (updated April 2011).

TABLE 3-7

City Historical New Construction 1989 to 2010

Year	Commercial and Industrial (ft^2)	Single Family and Duplex (units)	Multifamily (units)
1989	733,029	7	128
1990	188,228	23	169
1991	287,680	8	6
1992	91,091	6	0
1993	287,455	66	40
1994	169,196	45	4
1995	70,229	44	55
1996	140,402	9	0
1997	244,701	15	0
1998	438,873	17	3
1999	334,356	34	11
2000	269,726	98	11
2001	170,061	109	96
2002	208,098	41	0
2003	88,027	82	0
2004	348,337	97	0
2005	503,663	146	8
2006	483,963	28	14
2007	81,140	33	4
2008	192,900	13	0
2009	95,786	25	0
Total	**5,426,941**	**946**	**549**

The population has increased an average of about 2.19 percent per year over the past 10 years. This population increase has been a result of development within the existing city limits as well as annexations, although few annexations occurred during the past 5 years.

PROJECTED FUTURE POPULATION

In the City of Burlington 2010 to 2015 Capital Improvement Plan, it has been estimated that the population will grow by 964 within the city limits during the period from 2009 through 2025 (16 years), corresponding to an annual growth rate of about 0.65 percent per year. This estimate of growth was based on the assumption that all new housing within city limits would be built on vacant land, which means that no land with existing housing would be redeveloped to the density allowed by zoning. Several areas within the city are presently developed at a lower density than what is allowed by the zoning. At a population of 2.74 people per dwelling unit, the current zoning allows for a population of a little more than 17,000 if developed in accordance with existing allowable development densities.

It is considered highly unlikely that all residentially zoned areas in the City of Burlington will be redeveloped over the next 20 years. It is, however, proposed to utilize a population growth rate of 2.25 percent per year (slightly higher than the growth rate over the past 10 years) over the next 20 years to allow for the service to developed areas presently outside the city limits, but within the UGA, that are presently served by septic tanks or other types of on-site treatment and disposal. These areas may be annexed to the City, or merely receive sewer service. Areas that are prime candidates for sewer service by the City of Burlington include the Raspberry Ridge housing development east of the City; an area immediately outside the northeast corner of the City, presently zoned "Urban Reserve Residential" by Skagit County; and an area immediately west of the western part of the City, around Markwood Lane and East of Pulver Road, between Peterson Road and State Highway 20, all zoned "Urban Reserve Residential" by Skagit County.

The 2.25 percent per year growth rate will also allow for providing sewer service to areas within the city limits that are presently not sewered, such as the area along Anacortes Avenue, south of Gages Slough.

Table 3-8 shows the projected future population at 5-year increments for the 20-year planning period for the City of Burlington based on a 2.25 percent annual growth rate.

TABLE 3-8

City of Burlington Projected Population

Year	City Population(1)
2010	8,388
2015	9,375
2020	10,978
2025	11,711
2030	13,090

(1) Includes city limits and areas that could potentially be annexed by the City.

CHAPTER 4

EXISTING FACILITIES

WASTEWATER COLLECTION SYSTEM

INTRODUCTION

The City of Burlington wastewater collection system includes gravity sewers, pump stations, and force mains. The existing sewer system, shown on Figure 4-1, consists of two distinctly separate systems: the City proper system and the Western Service Area system. The City proper system serves the area bounded by the city limits. The Western Service Area system serves the Port of Skagit County Airport and industrial area, the Skagit Golf and Country Club and a residential development around the golf course, and a few additional commercial and industrial customers in the immediate vicinity of the Port. The City of Burlington purchased the Port sewer system from the Port of Skagit County in 2000.

The City of Burlington also receives wastewater from the Samish Water District (District) through a 12-inch-diameter pipeline from the District's pretreatment lagoon at the south end of Lake Samish in Whatcom County, which flows to Pump Station 6 on Peterson Road in the City of Burlington. Effluent from the District's waste stabilization pond is pumped through this force main. Several pump stations along the District's pipeline alignment discharge wastewater to the pipeline, including a Washington State Department of Transportation rest area, the Thousand Trails Campgrounds, and several residential and commercial customers. The Skagit Valley Resort and Casino is also connected to the pipeline as a backup to their new treatment system. The District pipeline and associated pump stations are owned and operated by the District.

There are eleven additional privately owned pump stations which contribute to the Burlington collection system, as follows:

- Clear Snap at 15218 Josh Wilson Road discharging to Manhole 1269
- Burlington RV Park discharging to Manhole 486 in Holmgren Lane
- Skagit Ford at 620 Auto Boulevard discharging to Manhole 466
- Kar Mart Auto Group at 655 Auto Boulevard discharging to Manhole 466
- Kar Mart Auto Group at 660 Auto Boulevard discharging to Manhole 466
- Foothills Toyota at 675 Auto Boulevard discharging to Manhole 466

- Sunrise Lane discharging to Manhole 1073
- Olympic Tank Yard discharging to 6-inch force main in Ovenell Road
- Puget Sound Energy discharging to 6-inch force main in Ovenell Road
- Skagit County Energy Recovery Facility discharging to 6-inch force main in Ovenell Road
- Paccar, west of the Port of Skagit County Regional Airport, discharging to Manhole 1256

A small area within the city limits is served by individual septic tanks and drain fields. This area is located along Anacortes Avenue, south of Gages Slough.

A small farm labor housing development, located outside the city limits at Sanchez Lane (Raspberry Ridge) is served by its own community sewer system. The wastewater is treated in a community septic tank and discharged to a subsurface drain field.

The original wastewater collection system, installed in 1946, consisted of 6-inch through 15-inch diameter concrete mortar joined pipe, which is still in use in places. An 18-inch diameter concrete outfall pipe carried the wastewater to the Skagit River. The original manholes were brick construction. The collection system service area has gradually increased since 1946, with the Western Service Area added as a part of a major sewer system expansion project in 1977. The pipeline from the Samish Water District was also completed in 1977.

GRAVITY SEWERS

The City of Burlington wastewater collection system includes approximately 58 miles of gravity sewer pipes varying in size from 4-inch diameter local connections to 27-inch diameter interceptors. Many types of pipe material have been used in the construction of the system including clay, concrete, polyvinyl chloride (PVC), and ductile iron.

Due to the relatively flat terrain, much of the gravity collection system has been constructed at the minimum slope required to prevent solids from settling out during transport. In some areas, topography allows for greater slopes; however, an extensive system of pump stations and force main piping is required to convey wastewater in areas where topography causes gravity flow sewers to be very deep.

An inventory of the gravity sewer lines is provided in Table 4-1.

TABLE 4-1

Gravity Sewer Inventory

Diameter (inches)	Total Length (feet)	Length (miles)	Portion of System (%)
4	1,970	0.37	0.64
6	34,360	6.51	11.24
8	165,310	31.31	54.09
10	54,030	10.23	17.68
12	36,310	6.88	11.88
15	4,530	0.86	1.48
18	1,610	0.30	0.53
21	6,760	1.28	2.21
27	730	0.14	0.24
Total	**305,610**	**57.88**	**100**

PUMP STATIONS AND FORCE MAINS

The City owns and operates 21 sewage pump stations. Pump Station 8 serves the Western Service Area exclusively, and the force main from Pump Station 8 conveys the flow from this pump station into two large-diameter interceptors that discharge directly to the wastewater treatment plant. Three of the force mains are common force mains which convey flows from more than one pump station. The force main from Pump Station 8, discussed above, also conveys flows from Pump Station 11 and Pump Station 13. The force main from Pump Station 6 also conveys flow from Pump Station 3 and Pump Station 5. The force main from Pump Station 16 also conveys flow from Pump Station 19 and Pump Station 20.

The City is currently in the process of connecting high-priority pump stations to the SCADA system. All others are equipped with an auto dialer that will notify City staff of alarms. Pump station locations are shown on Figure 4-1. Design data for the City's sewage pump stations is included in Table 4-2. Where appropriate, the data has been adjusted based on drawdown tests for each pump station performed by City of Burlington staff during the summer of 2010.

TABLE 4-2

City-Owned Sewage Pump Station Design Data

Pump Station	Location (address)	Installed/ Upgraded	Type	Pumps			
				Qty.	Capacity (gpm)	TDH (ft)	HP
1	115 West Victoria Avenue	1952/2006	Submersible	2	495	22.5	5
2	213 North Spruce Street	1946/2001	Submersible	2	390	15.5	3
3(1)	404 East Rio Vista Avenue	1957/1977/ 2010	Submersible	2	1,500 2,150	62 50	40
4	331 South Section Street	1955/2006	Dry Pit	2	360	15	3
5(1)	Olympia Avenue at Railroad Street	1977	Dry Pit	2	675 915	45 38	15
6(1)	638 Peterson Road	1977	Dry Pit	2	1,400 918	48 63	25
7	18040 Peterson Road	1977/2000/ 2007	Submersible	2	760	68	25
8(2)	17331 Peterson Road	1977/2004	Submersible	2	2,950 3,700	66 60	75
9	16505 Ovenell Road	1977	Submersible	2	645	35	15
10	16059 Ovenell Road	1977	Submersible	2	400	32	10
11(2)	1385 South Burlington Boulevard	1981/2004	Submersible	2	1,283 1,650	47 30	25
12	875 Goldenrod Road	1986	Submersible	2	113	22	5
13(2)	Goldenrod Road at Stevens Road	1992	Submersible	2	290 740	37 27	7-1/2
14	Walton Drive	1993	Submersible	2	130	46	10
15	North Hill Boulevard	1996	Submersible	2	297	22	5
16 (3)	14654 Ovenell Road	2000	Submersible	2	510	118	30
17 (4)	15409 Crosswind Drive	1999	Submersible	2	N/A	N/A	2
18	165 Woollen Road	2003	Submersible	2	194	30	5
19 (3)	14879 Ovenell Road	2003	Submersible	2	140	18	2
20 (3)	14101 Ovenell Road	2005	Submersible	2	305	83	20
21	185 Hanson Place	2007	Submersible	2	120	29.5	5

(1) Pump Stations 3, 5, and 6 discharge to a common force main. The upper numbers in the capacity and TDH columns indicate the conditions when all three pump stations discharge simultaneously to the force main. These numbers represent the rated capacity of the pump station. The lower numbers indicate the condition when each pump station is discharging by itself to the force main. The actual flow rate at any time would be somewhere between the two conditions.

(2) Pump Stations 8, 11, and 13 discharge to a common force main. The upper numbers in the capacity and TDH columns indicate the conditions when all three pump stations discharge simultaneously to the force main. These numbers represent the rated capacity of the pump station. The lower numbers indicate the condition when each pump station is discharging by itself to the force main. The actual flow rate at any time would be somewhere between the two conditions.

(3) Pump Stations 16, 19, and 20 discharge to a common force main. The stated capacities and TDHs for these pump stations have been obtained from drawdown tests and pump curves. No hydraulic analyses have been made on the force main system for these pump stations and it is unknown whether the pumps were operating alone or simultaneously with other pump stations when the drawdown tests were made.

(4) Pump information for Pump Station 17 pumps is not available.

An inventory of the force mains is shown in Table 4-3. Force mains vary in diameter from 4 to 24 inches, and asbestos-cement (AC), PVC, high-density polyethylene (HDPE), cast iron (CI), and ductile iron (DI) pipe materials are used. The force mains are shown on Figure 4-1.

TABLE 4-3

Force Main Inventory

Diameter (inches)	Length (feet)	Length (miles)
3	2,200	0.42
4	3,150	0.59
6	7,946	1.50
8	10,700	2.03
10	4,974	0.94
12	15,449	2.93
14	1,786	0.34
20	16,505	3.13
24	4,324	0.82
Total	**67,034**	**12.70**

WASTEWATER TREATMENT PLANT

INTRODUCTION

The first wastewater treatment plant (WWTP) in the City of Burlington was constructed in 1946. This WWTP was located south of Olympia Avenue, between Railroad Street and Pine Street, approximately where the existing Pump Station 5 is located. The original treatment plant consisted of rectangular primary clarifiers, chlorine disinfection, and anaerobic digestion of biosolids.

In 1976, the construction of a new secondary treatment facility was completed at the location of the existing treatment facility at 900 South Section Street. The original treatment facility at Olympia Avenue was abandoned. The new treatment facility, an activated sludge treatment facility, consisted of an influent pump station, comminutor structure, circular primary clarifiers, aeration basins, circular secondary clarifiers, a chlorine contact chamber, an effluent pump station, and an outfall and diffuser in the Skagit River.

A hydrocyclone and grit classifier removed grit from the primary sludge which was thickened, together with waste activated sludge, in a gravity thickener before it was digested in an aerobic digester. Digested sludge was thickened in a second gravity thickener before being dried in sludge drying beds. Dried biosolids were applied to permitted farmlands.

The facility was designed to treat a design flow (maximum month) of 1.61 million gallons per day (mgd) with an organic loading of 3,181 pounds of BOD_5 per day (lb BOD_5/d) and a solids loading of 3,181 pounds of TSS per day (lb TSS/d).

In the late 1980s to early 1990s, a septage receiving station and a belt filter press for sludge dewatering were added to the treatment plant. The septage receiving station consists of a mechanical bar screen, an underground holding tank, and a pump to meter the septage into the influent pump station. The addition of the septage receiving station allowed the treatment plant to receive septage from nearby communities.

The belt filter press was added to gain more capacity from the sludge drying beds. Polymer was added to the thickened digested sludge and pumped to the belt filter press for dewatering. The dewatered sludge was pumped to the sludge drying beds for air drying and storage before being applied to permitted farmlands.

Beginning in 1995, a major upgrade to the Burlington WWTP was initiated. This upgrade took place in several stages and significantly increased the capacity and effluent quality of the WWTP. The first project, "Influent Pump Station and Aeration Basin Modifications" completed in 1995, resulted in replacement of the constant-speed influent pump station pump controls with variable frequency drives (VFDs), addition of selector zones to the aeration basins, replacement of the mechanical mixing/sparge ring aeration system with a state-of-the art fine-bubble diffuser system, and a temporary extension of the chlorine contact basin into the effluent pump station wet well. These improvements allowed the maximum month flow capacity of the WWTP to be upgraded to 2.0 mgd. The organic loading was upgraded to 3,900 lb BOD_5/d and the solids loading was upgraded to 4,200 lb TSS/d.

The second project, "Headworks Modifications," was completed in 1997 and included the construction of a new headworks structure with a Parshall flume influent flow meter, a fine screen with a bypass channel and space for an additional future fine screen, and a primary clarifier splitter box allowing the flow to be split between the existing primary clarifiers and two future primary clarifiers. This project increased the headworks capacity to a peak hour flow of 9.48 mgd, expandable to a future peak hour flow of 12.6 mgd (these peak hour flows correspond to maximum month flows of 3.79 mgd and 5.05 mgd, respectively).

The third project, "Administration Building," also completed in 1997 added administration office space, a lunchroom, and locker room for the Sewer Department staff.

Finally, the fourth project, "Wastewater Treatment Plant Upgrade," increased the maximum month flow capacity of the entire Burlington WWTP to 3.79 mgd, the organic load capacity to 7,356 lb BOD_5/d and the solids load capacity to 7,660 lb TSS/d. The project also added seasonal nitrification in anticipation of a seasonal effluent ammonia limit. Specific improvements included expansion of the influent pump station; the addition of a primary clarifier, aeration basins, and secondary clarifier with a capacity approximately equal to the existing treatment train; installation of new ultraviolet disinfection facilities to replace the existing chlorine contact tank and chlorination facilities; installation of a new outfall pipe with diffusers to the Skagit River and expansion of the effluent pump station; construction of a new solids handling building, new anaerobic digesters, and sludge storage area. The solids handling building houses a new waste activated sludge rotary screen thickener, the existing belt filter press for digested sludge dewatering, the anaerobic digester boiler and heat exchanger, and various pumps and equipment for the sludge handling process. The sludge drying beds were removed and a new vehicle storage building was constructed in the area left available. The electrical and control systems were upgraded, including a new standby generator. The construction of this project was completed in 2001.

In 2002, the City of Burlington purchased and installed a biosolids dryer that produces Class A biosolids at a solids concentration of 90 percent or more. This treatment allows unrestricted use of the biosolids produced at the Burlington WWTP.

The plant effluent limitations, as indicated in the existing NPDES permit are shown in Table 4-4. The NPDES permit, which was issued in 2005, is included in Appendix A.

TABLE 4-4

Current Treatment Plant Effluent Limits

Parameter	Limit
BOD_5 Monthly Average Concentration	30 mg/L (1)
BOD_5 Monthly Average Load	948 lb/d
BOD_5 Weekly Average Concentration	45 mg/L
BOD_5 Weekly Average Load	1,422 lb/d
TSS Monthly Average Concentration	30 mg/L (1)
TSS Monthly Average Load	948 lb/d
TSS Weekly Average Concentration	45 mg/L
TSS Weekly Average Load	1,422 lb/d
NH_4 Concentration	no limit presently in effect
Fecal Coliform Monthly Average Count	200/100 ml
Fecal Coliform Weekly Average Count	400/100 ml
Daily Minimum pH	$\geq$6.2
Daily Maximum pH	$\leq$9.0

(1) The monthly average concentration limitation for BOD_5 and TSS shall not exceed 30 mg/L or 15 percent of the respective influent concentrations, whichever is more stringent.

The existing treatment plant layout is provided on Figure 4-2 and the plant flow diagram on Figure 4-3.

SEPTAGE RECEIVING STATION

A septage receiving station is located at the wastewater treatment plant. The receiving station consists of a mechanical bar screen, a holding tank, and a pump to meter the septage into the influent pump station of the treatment plant. The treatment plant receives septage from nearby communities. The holding tank is aerated and can be injected with a chlorine solution for odor control.

INLUENT PUMP STATION

The influent pump station is located at the treatment plant site and pumps all sewage collected from the City through two parallel 16-inch force mains to the headworks. The pump station contains one large and two smaller submersible centrifugal variable speed pumps pumping out of a wet well. The rated capacity of the large pump is 4,385 gpm at 43 feet of total dynamic head. The rated capacity of each of the two smaller pumps is 2,300 gpm at 38 feet of total dynamic head. Thus, the nominal capacity of the influent pump station (the capacity with the largest pump out of service) is 4,600 gpm, or 6.624 mgd. An automatic control system maintains a constant liquid level in the wet well by varying the output of the pumps through a variable frequency speed control and an ultrasonic level sensor in the wet well.

HEADWORKS

The headworks contains a Parshall flume flow meter with an ultrasonic level sensor, an automatic mechanical fine screen with a bypass channel, and a third channel available to install a second screen. The Parshall flume has a nominal capacity of 21.4 mgd.

The screen will remove objects larger than 3/8 inches from the wastewater stream and convey them to a dumpster. The dumpster is periodically emptied by the solid waste utility. A manual bar screen is installed in the bypass channel to handle extreme flows or to be utilized when the fine screen is out of service. The influent screen has a capacity of 7.99 mgd.

The primary clarifier splitter box is also a part of the headworks structure. The splitter box distributes the wastewater flow evenly between two primary clarifier treatment trains. It also allows for flow distribution to a future third primary clarifier treatment train. Discharge from the plant drain pump station enters the primary clarifier splitter box.

PRIMARY CLARIFIERS

Primary clarifiers are provided to reduce the loading to the secondary treatment process by removing a portion of the organic material and solids from the wastewater before it enters the aeration basins. Aeration basins and related equipment such as blowers can be reduced in size when primary clarification is provided. Typical removal efficiency across a primary clarifier is 30 to 35 percent BOD_5 and 60 to 70 percent TSS. One of the two primary clarifier treatment trains consists of two older 35-foot-diameter clarifiers operated in parallel. The other primary clarifier treatment train is a single newer 49-foot-diameter clarifier. At a hydraulic overflow rate of 1,000 gallons per day per square foot (gpd/ft^2), the primary clarifiers have a combined capacity of 3.81 mgd peak month flow. Primary clarifiers could operate at overflow rates as high as 3,000 gpd/ft^2 during peak hour flows. This corresponds to a primary clarifier peak hour flow capacity of 11.43 mgd.

All the clarifiers are center fed and peripheral draw-off. The screened wastewater flows through the influent column and enters the clarifier through submerged ports. A feed well surrounding the center column dissipates the velocity of the wastewater and causes it to flow downward. As the wastewater flows downward and outward, the solids settle out on the bottom while the clarified wastewater flows upward and out over a weir into the effluent channel. The clarifiers are equipped with a bottom scraper mechanism to move the settled sludge to the hopper located in the floor at the center of the clarifier. A scum scraper mechanism on the surface removes any floating material including grease. Periodically, the settled sludge is pumped though a grit cyclone to a gravity thickener. The grit cyclone removes the grit from the sludge stream. The centrifugal recessed impeller-type primary sludge pumps are located in the basement of the blower building and have a capacity of 63 gpm for each of two smaller clarifiers, and 125 gpm for the larger clarifier.

AERATION BASINS

The purpose of the activated sludge system is to remove suspended and colloidal solids and dissolved organic matter from the wastewater. This removal is accomplished by the introduction of the wastewater into a biological reactor (aeration basin) containing a high concentration of actively growing microorganisms in the presence of dissolved oxygen. The microorganisms utilize the waste material as a source of food to obtain the energy necessary for their own life processes and growth. The rapid growth of these organisms results in the creation of a flocculant biological mass which can be removed from the liquid stream by sedimentation in the secondary clarifiers, thus creating a clear effluent with a low organic content. In the activated sludge process, the high concentration of active biological mass is maintained by continuously recycling the organisms back into the aeration basins. Effective settling and separation of the biological mass from the liquid stream in the secondary clarifiers is essential to the proper operation of the activated sludge system.

At the City of Burlington wastewater treatment plant, three aeration basin treatment trains are provided. In the aeration basin splitter box, return activated sludge that has settled out in the secondary clarifiers is mixed with the effluent from the primary clarifiers and the combined flow is split between the three treatment trains. One treatment train consists of two older aeration basins operated in parallel. Each of the two older aeration basins has a volume of 21,960 cubic feet. The two other treatment trains each consist of one newer aeration basin with a volume of 43,983 cubic feet. The aeration basin splitter box is configured to add a fourth treatment train. All the aeration basins are complete mixed and aerated with a fine-bubble diffused air aeration system. Three multistage centrifugal blowers provide air for the diffuser system. Each blower is rated at 2,170 cfm at a pressure of 7.15 psi. Each aeration basin is equipped with three selector zones at the inlet to improve the settling characteristics of the activated sludge in the secondary clarifiers.

The capacity of the aeration basins can generally be determined based on a volumetric loading of 40 pounds of BOD_5 per day per 1,000 cubic feet of tank volume. This results in a total capacity of 5,275 pounds of BOD_5 per day in the primary effluent. If a 35 percent BOD_5 removal is assumed in the primary clarifiers, an influent BOD_5 capacity of 8,116 pound per day results, based on peak month loading rates. The BOD_5 removal capacity of aeration basins can be adjusted by operational parameters, such as mixed liquor suspended solids, solids wasting rate, solids retention time, and food-to-microorganism ratio. Therefore, as the BOD_5 removal capacity of the aeration basins approaches, the operational parameters should be reviewed and analyzed to establish appropriate expansion schemes.

Although the City of Burlington does not have ammonia limits at the present time, future requirements for nitrification in the aeration basin will affect the nominal BOD_5 removal capacity of the aeration basins.

SECONDARY CLARIFIERS

After the organic wastes in the influent wastewater have been converted to a bacterial sludge floc in the aeration basins, it is necessary to separate the sludge floc from the liquid stream. This separation and removal phase is accomplished in the secondary clarifiers.

The mixed liquor from the aeration basins flows by gravity to the secondary clarifier splitter box. The splitter box distributes the wastewater flow evenly between two secondary clarifier treatment trains. It also allows for flow distribution to a future third secondary clarifier treatment train. One of the two secondary clarifier treatment trains consists of two older 45-foot-diameter clarifiers operated in parallel. The other secondary clarifier treatment train is a single newer 65-foot-diameter clarifier. All the clarifiers are center fed and peripheral draw-off. The mixed liquor flows through the influent column and enters the clarifier through submerged ports. A feed well surrounding the center column dissipates the velocity of the mixed liquor and causes it to flow downward. As the mixed liquor flows downward and outward, the solids settle out on the bottom while the clarified effluent flows upward and out over a weir into the effluent channel. The clarifiers are equipped with a bottom scraper mechanism to move the settled sludge to the suction device located in the floor at the center of the clarifier. The majority of this sludge is returned to the aeration basins as return activated sludge (RAS). A smaller portion, the waste activated sludge (WAS), is pumped to the rotary drum thickener. A scum scraper mechanism on the surface removes any floating material including grease.

Secondary clarifiers are typically sized based on hydraulic overflow rates and solids loading rates. A typical peak month hydraulic overflow rate for the secondary clarifiers at the Burlington Wastewater Treatment Plant would be 600 gpd/ft^2. Based on this overflow rate, the combined peak month flow capacity for the secondary clarifiers is 3.90 mgd. Based on a typical peak hour flow overflow rate of 1,200 gpd/ft^2, the peak hour flow capacity of the secondary clarifiers is 7.80 mgd. The solids loading rate for the secondary clarifiers will vary with the mixed liquor suspended solids concentration maintained in the aeration basin and with the sludge recycle rate. Therefore, as the hydraulic capacity of the secondary clarifiers approaches, the solids loading rates should be reviewed and analyzed based on appropriate operational schemes.

ULTRAVIOLET DISINFECTION

Prior to discharge to the outfall line, the treated wastewater undergoes disinfection. Disinfection is the inactivation of potentially harmful (pathogenic) microorganisms from the treatment plant effluent. At the Burlington WWTP, disinfection is accomplished through the application of ultraviolet light. Ultraviolet light will disrupt the organisms' genetic material and will prevent them from reproducing. The ultraviolet disinfection facilities consist of a concrete channel with three banks of ultraviolet lamps, each containing 96 lamps. Two of the banks are capable of disinfecting a peak day flow of 6.64 mgd. This peak day flow corresponds to a peak month flow of 3.79 mgd (the design flow for the existing wastewater treatment facility). One of the banks is a redundant unit. A parallel channel has been provided to allow for future expansion of the disinfection facilities. The number of banks that is operating (one or two) is controlled by the effluent flow meter located immediately upstream of the ultraviolet disinfection facilities.

EFFLUENT PUMP STATION

The effluent pump station pumps the treated wastewater to the Skagit River during a flood condition and/or during a high instantaneous flow through the treatment plant. The pumps are located in a sump at the end of the ultraviolet disinfection facilities. The pumps are activated by a high water level in the effluent sump, which also closes a slide gate on the gravity line to prevent backflow into the sump. The pumps are vertical turbine pumps with a rated capacity of 9,900 gpm (14.3 mgd) at 37.5 feet total dynamic head.

Under normal plant flow and river water level conditions, effluent flows by gravity from the pump sump to the outfall and diffusers in the river.

RIVER OUTFALL

The river outfall consists of an outfall structure and three separate 10-inch-diameter diffusers and one 20-inch-diameter diffuser in the Skagit River. The flow is either pumped or flows by gravity to the outfall structure, where it is split between the four diffuser pipes. The current hydraulic capacity of the outfall is about 7,750 gpm (11.2 mgd).

SOLIDS HANDLING SYSTEM

The solids handling system consists of a primary sludge gravity thickener, a waste activated sludge rotary drum thickener, primary and secondary anaerobic digesters, a belt filter press dewatering system, and a sludge dryer. Primary sludge from the primary clarifiers is pumped to the grit cyclone and then to the primary sludge gravity thickener. The thickener concentrates the sludge before it enters the anaerobic digester, thereby reducing the required digester volume while still providing adequate solids retention time. The primary sludge thickener is a 26-foot-diameter circular tank with center feed and peripheral draw off. It is equipped with sludge scrapers on the bottom and a scum scraper on the surface to remove floating materials, similar in design to the clarifiers. At a surface loading rate of 24 pounds per square foot per day, the capacity of the gravity thickener is 12,744 pounds of suspended solids per day, corresponding to a peak month influent suspended solids load of 19,600 pounds per day at a 65 percent suspended solids removal rate through the primary clarifiers. The thickened sludge is pumped to the primary anaerobic digester while the supernatant is pumped to the primary clarifier splitter box.

The WAS rotary drum thickener is located on the ground floor in the solids handling building. WAS is pumped to the rotary drum thickener, where it is mixed with polymer before entering thickener. The thickener flocculates, conditions, and thickens WAS to about 5 percent solids. The thickened WAS is discharged into a hopper and pumped to the primary anaerobic digester. The rotary drum thickener has a rated WAS flow capacity of 250 gpm at a solids concentration of 1.0 percent solids or higher. If the rotary drum thickener is operated 6 hours every workday, the thickener has a WAS load capacity of 5,140 pounds per day, corresponding to a peak month BOD_5 loading of 8,565 pounds per day if a solids yield of 0.6 pound of waste solids per pound of influent BOD_5 is assumed. The filtrate is pumped to the primary clarifier splitter box.

The anaerobic digester system includes a primary anaerobic digester and a secondary digester. The primary digester is mixed by a pumped mixing system and heated to about 95 to 100 degrees Fahrenheit by a boiler and heat exchange system. The boiler can be heated by methane gas produced by the digestion process or by natural gas. The volume of each of the two digesters is 39,100 cubic feet, which will provide a hydraulic detention time of 16 days for each digester. The anaerobic digester system was specifically designed to stabilize sludge generated from peak month treatment plant influent BOD_5 and TSS loads of 7,376 and 7,660 pounds per day, respectively. The primary digester is a fixed cover design, while the secondary digester is a floating cover design, allowing for variations in the water surface elevation as a result of batch removal of digested sludge.

The digested sludge is pumped to a belt filter press dewatering unit located on the ground floor of the solids handling building. The digested sludge is mixed with polymer before dewatering. The belt filter press has a hydraulic capacity of about 120 gpm at a solids concentration of 3 percent. If the belt filter press is operated 6 hours every workday, it would have the capacity to dewater digested sludge generated from peak month treatment plant influent BOD_5 and TSS loads of approximately 14,000 and 14,650 pounds per day, respectively. The press will dewater the sludge to a solids concentration of 20 percent or more. The filtrate is pumped to the primary clarifier splitter box. The belt filter press assembly is equipped with a lime feed and mixer system for lime treatment of the dewatered sludge, although lime stabilization is not currently practiced.

The dewatered sludge is pumped to a sludge drying unit. At this unit, the sludge is heated so that the excess water evaporates and pathogens are reduced. The dried sludge has a solids concentration of 90 percent or more and a fecal coliform count below 1,000 per gram of solids. This process is approved by the regulatory agencies to produce Class A biosolids which allows unrestricted use of the biosolids. The dried sludge is currently picked up by a local farmer and used as soil amendment.

The sludge drying unit has a capacity of 400 pounds of solids per hour and is presently operated for 240 hours (10 days) at a time. It would take a minimum of 24 hours (2 days) for cool-down and preparation for the next run period. If the dryer is operated on a schedule of 240 hours on/72 hours off, it would dry digested and dewatered sludge generated from peak month treatment plant influent BOD_5 and TSS loads of approximately 14,000 and 14,650 pounds per day, respectively, which is the same capacity as the digested sludge dewatering belt filter press.

SUMMARY OF TREATMENT PLANT COMPONENT CAPACITIES

Table 4-5 summarizes the capacities of the major treatment units, as discussed above.

TABLE 4-5

Summary of Treatment Plant Flow Capacity Limits for Individual Equipment

Treatment Unit	Peak Month Flow Capacity (mgd)	Peak Hour Flow Capacity (mgd)	Peak Month BOD_5 Capacity (lb/d)[(1)]	Peak Month TSS Capacity (lb/d)[(1)]
Influent Pump Station	—	6.62	—	—
Influent Flow Meter	—	21.4	—	—
Influent Screen	—	7.99	—	—
Primary Clarifiers	3.81	11.4	—	—
Aeration Basins	—	—	8,116	—
Secondary Clarifiers	3.90	7.80	—	—
UV Disinfection	3.79	—	—	—
Effluent Pump Station	—	14.3	—	—
Outfall	—	11.2	—	—
Gravity Thickener	—	—	—	19,600
WAS Rotary Drum Thickener	—	—	8,565	—
Anaerobic Digesters	—	—	7,356	7,660
Belt Filter Press	—	—	14,000	14,650
Sludge Dryer	—	—	14,000	14,650

(1) These capacities are general guides only. Actual capacities will depend on specific operational parameters in effect at the time, such as aeration basin MLSS, solids retention time, food-to-microorganism ratio, and operational times and frequencies for equipment.

CHAPTER 5

WASTEWATER FLOW AND LOADING PROJECTIONS

INTRODUCTION

Adequate design of wastewater treatment and conveyance facilities requires determination of the quantity and quality of wastewater generated from each of the contributing sources. Municipal wastewater is domestic in origin, with large portions of the flow contributed by commercial and industrial businesses and by institutional facilities such as schools, hospitals, and municipal functions. Infiltration and inflow (I/I) contributions result from groundwater and surface water entering the sewer system during periods of high groundwater levels and rainfall, respectively. In this chapter, wastewater flow and loading generated in the City of Burlington's sewer system and handled by the treatment plant are estimated.

Water consumption data, WWTP daily monitoring reports (DMRs), flow meter records, and lift station run time records from previous years are used to estimate unit quantities for critical parameters related to zoning, land use, and overall land area in the existing service area. These unit quantities are then applied to project future zoning to determine the design criteria for selecting and sizing the facilities required to serve the study area in future years.

DEFINITIONS OF TERMS

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

AVERAGE ANNUAL FLOW

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

AVERAGE DRY WEATHER FLOW

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

BIOCHEMICAL OXYGEN DEMAND (BOD)

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

OTHER CONTAMINANTS OF CONCERN

Contaminants of concern in wastewater, in addition to BOD and suspended solids, include nutrients, priority pollutants, heavy metals, and dissolved organics. The aggregate presence of deleterious priority pollutants, heavy metals, or dissolved organics can be measured through the acute toxicity test. This test determines the acute (short-term) effect of the wastewater effluent on marine species. The City’s discharge permit includes effluent limitations on biodegradable organics (BOD_5), suspended solids, pathogens (fecal coliform), and pH.

Nutrients, such as nitrogen and phosphorus along with carbon, are essential requirements for growth. When discharged to the aquatic environment, these nutrients can lead to the growth of undesirable aquatic life. When discharged in excessive amounts on land, they can also lead to the pollution of groundwater. Additionally, in too high a concentration, nutrients, particularly ammonia, can be toxic to aquatic life. The City’s discharge permit does not include nutrient limits at this time.

Priority pollutants are organic and inorganic compounds selected on the basis of their known or suspected carcinogenicity, mutagenicity, teratogenicity, or high acute toxicity. Many of these compounds are found in wastewater. Inorganic constituents, including heavy metals, are often present in wastewater due to commercial and industrial activities and may have to be removed if the presence of the metals will adversely affect the receiving water, or if the wastewater is to be reused. Some heavy metals (most notably copper) can be present in wastewater due to leaching from drinking water pipes.

DOMESTIC WASTEWATER

Domestic wastewater is wastewater generated from single- and multifamily residences. Domestic wastewater flow is generally expressed as a unit flow based on the average contribution from each person per day. The unit quantity is expressed in terms of gallons per capita per day (gpcd).

EQUIVALENT RESIDENTIAL UNIT (ERU)

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

INFILTRATION

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

INFLOW

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

Treatment plant flow records are utilized to characterize combined infiltration and inflow in the sewer system in terms of peak hour, maximum day, maximum month, and average annual I/I.

MAXIMUM DAY FLOW

Maximum day flow (MDF) is the highest daily flow during a calendar year. The maximum day flow in western Washington usually occurs in response to a significant storm event preceded by prolonged periods of rainfall or snowmelt, which have previously developed a high groundwater table in the service area. Maximum day flow is used in sizing some treatment processes. Maximum day flow is typically determined from treatment plant flow records and projected future flow rates.

MAXIMUM MONTH FLOW (TREATMENT DESIGN FLOW)

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

NON-RESIDENTIAL WASTEWATER

Non-residential wastewater is wastewater generated from commercial or industrial activities, such as restaurants, retail and wholesale stores, service stations, and office buildings. In this Plan, sewage from institutional customers, such as Sierra Pacific Industries and the Cascade Mall, is considered non-residential wastewater. Non-residential wastewater quantities are expressed in this Plan in terms of equivalent residential units (ERUs).

PEAK HOUR FLOW

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

SANITARY WASTEWATER

Sanitary wastewater, also known as base flow, refers to the domestic and non-residential wastewater produced by the sewer customers not including any infiltration or inflow.

SUSPENDED SOLIDS

Suspended solids are the solid matter carried in the waste stream. The total suspended solids (TSS) concentration in a wastewater sample is determined by filtering a known volume of the sample, drying the filter paper, and measuring the increase in weight of the filter paper. TSS is expressed in the same terms as BOD; mg/L for concentration and lb/d for mass load. The amount of TSS in the wastewater is used in the sizing of treatment facilities and provides another measure of the treatment effectiveness. The concentration of TSS in wastewater affects the treatment plant biosolids production rate, treatment and storage requirements, and ultimate disposal requirements.

WASTEWATER

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

EXISTING WASTEWATER FLOW AND LOADING RATES

Wastewater treatment plant (WWTP) records for the 5-year period from 2006 through 2010 were reviewed and analyzed to determine recent wastewater characteristics and influent loading rates. January 2009 records were also used in developing peak flow rates due to exceptionally high precipitation including snowmelt. Recent wastewater flow and loading rates were then used in conjunction with projected population, zoning classifications, and employment data to determine projected future wastewater flow and loading rates.

HISTORICAL WASTEWATER FLOW RATES

Table 5-1 summarizes the average WWTP flow rates for the 5-year period from January 2006 through December 2010, based on the City’s DMRs. Appendix D provides the DMR data for this time period. The reported flow rate is measured on the influent and does not include in-plant recycle flow.

The maximum month WWTP flow rates for each year ranged from 1.73 mgd in 2010 to 2.29 mgd in 2009. The increase in estimated City population from 8,120 to 8,985 people over the period did not appear be responsible for the variations in the flow rates. In fact, the annual average flow has decreased over the past 2 years, which indicates that the ongoing program to reduce the amount of infiltration/inflow has been successful. Precipitation seemed to have a more direct effect on the variations in the peak flow rates.

In January 2006, the Puget Sound region experienced higher-than-average rainfall, which led to large volumes of infiltration and inflow at treatment facilities throughout the region. In January 2006, the monthly average wastewater flow at the Burlington WWTP was 2.01 mgd. In January 2009, heavy rainfall in the beginning of the month followed snowfall and accumulation of snow on the ground during the latter part of the previous month (December 2008). The resulting average monthly flow for January 2009 was 2.29 mgd, the highest on record. Including even the high flows in January 2009, the maximum month flow rates have consistently been well below the discharge permit limitation of 3.79 mgd.

TABLE 5-1

Burlington WWTP Historical Flow Rates

Year	Average Dry Weather Flow[1] (mgd)	Annual Average Flow (mgd)	Maximum Month Flow (mgd)	Maximum Day Flow (mgd)
2006	1.36	1.58	2.01	2.43
2007	1.42	1.60	1.94	2.58
2008	1.44	1.65	1.85	2.66
2009	1.20	1.52	2.29	2.88
2010	1.28	1.46	1.73	2.64
Average	**1.34**	**1.56**	**1.96**	**2.64**
Maximum	**1.44**	**1.65**	**2.29**	**2.88**

(1) July through October.

Figure 5-1 provides a graphical representation of wastewater flow rates measured at the City of Burlington WWTP from 2000 through 2006.

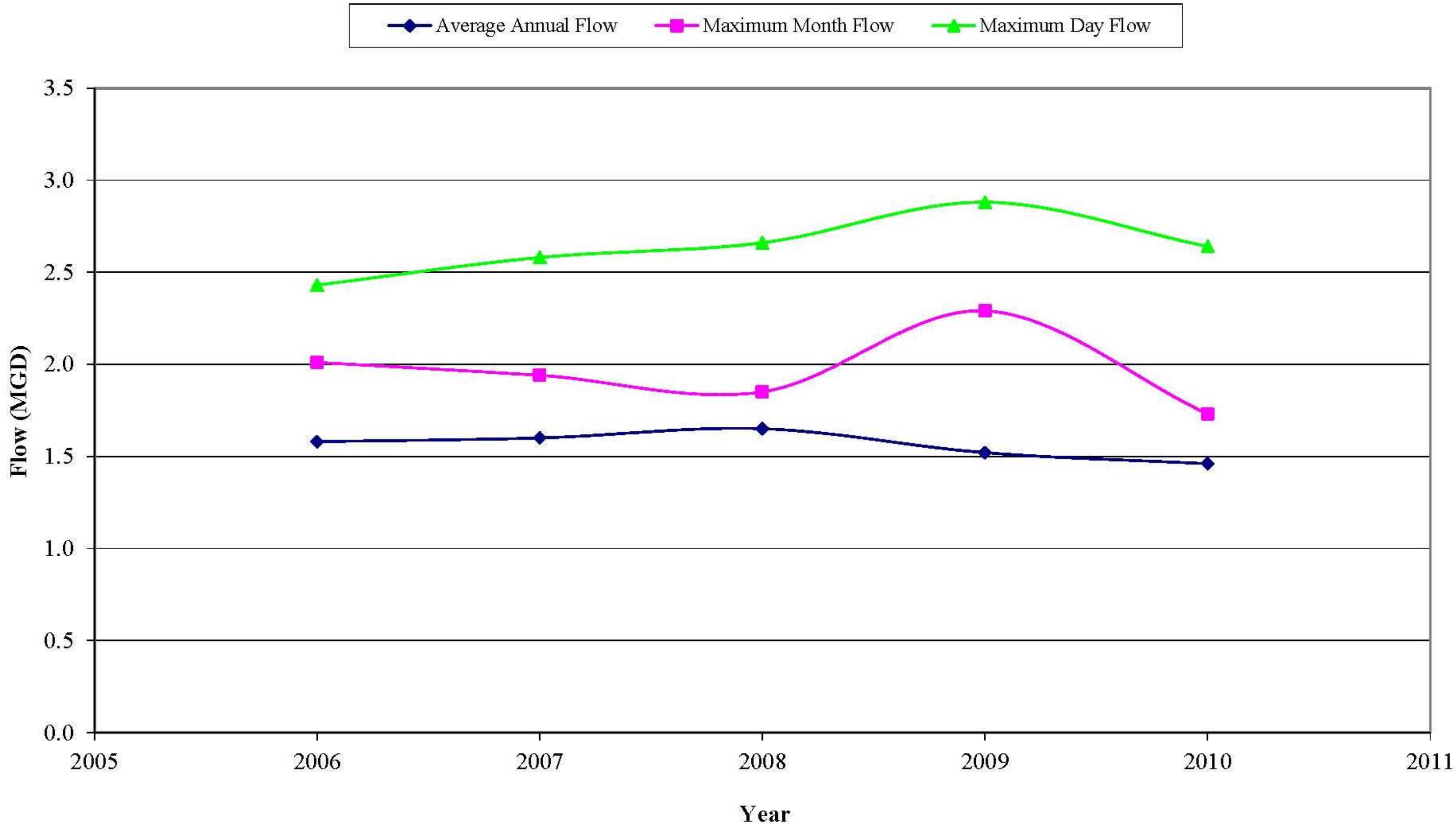

FIGURE 5-1

Burlington WWTP Historical Flow Rates Chart

Historical Flow Rates from the Samish Water District Pipeline

Table 5-2 summarizes the average Samish Water District pipeline flow rates for the period from January 2007 through May 2010, based on readings from a magnetic flow meter on the pipeline as it enters Pump Station 6.

TABLE 5-2

Samish Water District Pipeline Historical Flow Rates (January 2007 through May 2010)

Year	Average Dry Weather Flow[1] (gpd)	Annual Average Flow (gpd)	Maximum Month Flow (gpd)
2007	174,000	201,000	247,000
2008	146,000	187,000	236,000
2009	157,000	200,000	240,000
2010[2]	—	243,000	259,000
Average	**159,000**	**208,000**	**246,000**
Maximum	**174,000**	**243,000**	**259,000**

(1) July through October.
(2) January through May only.

Table 5-3 summarizes the average flow rates from the Skagit Valley Resort and Casino for the 4-year period from January 2007 through December 2010, based on flow meter readings at the Casino.

TABLE 5-3

Skagit Valley Resort and Casino Historical Flow Rates (January 2007 through December 2010)

Year	Average Dry Weather Flow[1] (gpd)	Annual Average Flow (gpd)	Maximum Month Flow (gpd)
2007	41,000	41,000	54,000
2008	35,000	32,000	38,000
2009	20,000[2]	26,000[2]	50,000
2010	47,000	50,000	61,000
Average	**36,000**	**37,000**	**51,000**
Maximum	**47,000**	**50,000**	**61,000**

(1) July through October.
(2) The flow meter was calibrated in October 2009. The flow meter readings were low between January and October 2009

Historical Flow Rates from the Western Service Area

Table 5-4 summarizes the average flow rates from the Western Service Area for the period from January 2008 through May 2010, based on flow meter readings at Pump Station 8.

TABLE 5-4

Western Service Area Historical Flow Rates (January 2007 through December 2010)

Year	Average Dry Weather Flow(1) (gpd)	Annual Average Flow (gpd)	Maximum Month Flow (gpd)
2008	171,000	245,000	348,000
2009	161,000	246,000	482,000
2010(2)	—	264,000	322,000
Average	**166,000**	**252,000**	**384,000**
Maximum	**171,000**	**264,000**	**482,000**

(1) July through October.
(2) January through May.

Septage Flow Rates

Septage from septic tanks in Skagit County, outside the City of Burlington sewer service area, is discharged for treatment at the wastewater treatment plant. Table 5-5 summarizes the average flow rates for septage discharge for the 4-year period from January 2007 through December 2010, based on flow meter readings at the septage receiving station at the wastewater treatment plant.

As can be seen from Table 5-5, the discharge of septage has decreased over the past few years, mostly due to the fact that the Town of LaConner has begun to accept septage at its wastewater treatment facility.

TABLE 5-5

Historical Flow Rates for Discharged Septage at the Burlington WWTP (January 2007 through December 2010)

Year	Average Dry Weather Flow(1) (gpd)	Annual Average Flow (gpd)	Maximum Month Flow (gpd)
2007	2,800	2,500	3,600
2008	2,100	2,000	2,400
2009	1,500	1,700	2,300
2010	1,500	1,300	1,700
Average	**2,000**	**1,900**	**2,500**
Maximum	**2,800**	**2,500**	**3,600**

(1) July through October.

City of Burlington Flow Rates

By subtracting all the wastewater contributors from the total wastewater flows (Table 5-1) the wastewater flows generated within the City of Burlington corporate limits can be determined, as shown in Table 5-6 for the 4-year period from January 2007 through December 2010 (where actual data was not available, average values were used).

TABLE 5-6

Historical Flow Rates for Wastewater Generated within the Burlington City Limits (January 2007 through December 2010)

Year	Average Dry Weather Flow(1) (mgd)	Annual Average Flow (mgd)	Maximum Month Flow (mgd)
2007	1.077	1.145	1.305
2008	1.121	1.216	1.264
2009	0.881	1.072	1.566
2010	0.954	0.952	1.151
Average	**1.008**	**1.096**	**1.322**
Maximum	**1.121**	**1.216**	**1.566**

(1) July through October.

HISTORICAL INFLUENT LOADING RATES

Historical Burlington WWTP Wastewater Loading Rates

The annual average and maximum month BOD_5 and TSS mass loading rates for 2006 through 2010 at the Burlington WWTP are listed in Table 5-7 and shown graphically on Figure 5-2. The influent wastewater is sampled in the channel downstream of the influent pump station. The sampled wastewater does not include the in-plant recycle flow.

TABLE 5-7

Burlington WWTP Historical Influent BOD_5 and TSS Loading Rates

Year	Annual Average BOD_5 Loading (lb/d)	Maximum Month BOD_5 Loading (lb/d)	Annual Average TSS Loading (lb/d)	Maximum Month TSS Loading (lb/d)
2006	3,608	4,242	3,838	4,598
2007	4,204	4,704	4,417	5,221
2008	4,014	5,831	4,335	5,366
2009	4,050	4,898	4,408	5,408
2010	3,829	4,535	3,487	4,321
Average	**3,941**	**4,842**	**4,097**	**4,983**
Maximum	**4,204**	**5,831**	**4,417**	**5,408**

FIGURE 5-2

Burlington WWTP Influent BOD_5 and TSS Loading Rates Chart

Historical Wastewater Loading Rates from the Samish Water District Pipeline

Table 5-8 summarizes the wastewater loading rates from the Samish Water District pipeline from January 2008 through May 2010, based on analysis of samples from an automatic sampler located in Pump Station 6.

TABLE 5-8

Samish Water District Pipeline Historical Loading Rates
(January 2007 through May 2010)

Year	Annual Average BOD_5 Loading (lb/d)	Maximum Month BOD_5 Loading (lb/d)	Annual Average TSS Loading (lb/d)	Maximum Month TSS Loading (lb/d)
2008	172	238	150	207
2009	216	387	166	277
2010	253	340	176	234
Average	**214**	**322**	**164**	**239**
Maximum	**253**	**387**	**176**	**277**

Table 5-9 summarizes the wastewater loading rates from the Skagit Valley Resort and Casino for the 4-year period from January 2008 through December 2010, based on flow meter readings at the Casino.

TABLE 5-9

Skagit Valley Resort and Casino Historical Loading Rates
(January 2008 through December 2010)

Year	Annual Average BOD_5 Loading (lb/d)	Maximum Month BOD_5 Loading (lb/d)	Annual Average TSS Loading (lb/d)	Maximum Month TSS Loading (lb/d)
2008	128	163	107	166
2009	120	260	75	139
2010	232	289	151	182
Average	**160**	**237**	**111**	**162**
Maximum	**232**	**289**	**151**	**182**

Septage Loading Rates

During June and July of 2011, four samples from the septage discharged at the Burlington wastewater treatment plant were analyzed for BOD_5 and TSS. The average

BOD_5 was determined to be 5,900 mg/L, while the maximum BOD_5 was determined to be 6,850 mg/L. The average and maximum TSS were 29,500 mg/L and 44,300 mg/L, respectively.

Table 5-10 summarizes the average loading rates for septage discharge for the 4-year period from January 2007 through December 2010, assuming above analytical results indicate annual average and maximum month values.

TABLE 5-10

Historical Loading Rates for Septage Discharged at the Burlington WWTP (January 2007 through December 2010)

Year	Annual Average BOD_5 Loading (lb/d)	Maximum Month BOD_5 Loading (lb/d)	Annual Average TSS Loading (lb/d)	Maximum Month TSS Loading (lb/d)
2007	123	206	615	1,330
2008	98	137	492	887
2009	84	131	418	850
2010	64	97	320	628
Average	**92**	**143**	**461**	**924**
Maximum	**123**	**206**	**615**	**1,330**

Historical Loading Rates from the Western Service Area

Historical loading rates from the Western Service Area have been estimated by subtracting the loading rates from the Samish Water District and discharge of septage and distributing the remaining loadings based on flows from the Western Service Area and the City of Burlington (based on WWTP flow records less the Samish Water District Pipeline, septage discharge, and the Western Service Area). This procedure assumes that the strength of the wastewater from the Western Service Area is similar to the strength of the wastewater treatment plant influent. This has been substantiated by five samples taken from the influent at Pump Station 8 during June and July 2011. Table 5-11 summarizes the average loading rates estimated to be generated in the Western Service Area for the 4-year period from January 2007 through December 2010.

TABLE 5-11

Historical Loading Rates for the Western Service Area
(January 2007 through December 2010)

Year	Annual Average BOD_5 Loading (lb/d)	Maximum Month BOD_5 Loading (lb/d)	Annual Average TSS Loading (lb/d)	Maximum Month TSS Loading (lb/d)
2007	685	962	673	872
2008	630	1,186	632	1,006
2009	702	1,039	725	1,096
2010	742	902	660	816
Average	**690**	**1,022**	**673**	**948**
Maximum	**742**	**1,186**	**725**	**1,096**

City of Burlington Loading Rates

By subtracting all the wastewater contributors from the total wastewater loadings (Table 5-7), the wastewater loadings generated within the City of Burlington corporate limits can be determined, as shown in Table 5-12 for the 4-year period from January 2007 through December 2010 (where actual data was not available, average values were used).

TABLE 5-12

Historical Loading Rates Generated Within the Burlington Corporate Limits
(January 2007 through December 2010)

Year	Annual Average BOD_5 Loading (lb/d)	Maximum Month BOD_5 Loading (lb/d)	Annual Average TSS Loading (lb/d)	Maximum Month TSS Loading (lb/d)
2007	3,182	3,214	2,965	3,360
2008	3,114	4,270	3,061	3,266
2009	3,048	3,340	3,099	3,185
2010	2,770	3,196	2,268	2,643
Average	**3,029**	**3,505**	**2,848**	**3,114**
Maximum	**3,182**	**4,270**	**3,099**	**3,360**

Discussion of Wastewater Loading Rate Trends

Table 5-7 and Figure 5-2 show that the BOD_5 and TSS loading rates to the WWTP appeared to have peaked in 2008 and have subsequently declined. In fact, the loading rates for 2010 were substantially lower than those for the previous 3 years. The maximum allowable loading rates in the NPDES permit (7,356 lb/d BOD_5 and 7,660 lb/d TSS) have not been exceeded. Table 5-13 shows the WWTP per capita BOD_5 and TSS loading generated by the population within the Burlington City limits, as determined from Burlington population data and Table 5-12.

TABLE 5-13

City per Capita BOD_5 and TSS Loading Rates

Year	Estimated Sewered Population	Per Capita Annual Average BOD_5 Loading (lb/cap/d)	Per Capita Annual Average TSS Loading (lb/cap/d)
2007	8,400	0.38	0.35
2008	8,460	0.37	0.36
2009	8,870	0.34	0.35
2010	8,388	0.33	0.27

The per capita values for BOD_5 and TSS shown in Table 5-13 are considerably higher than typical values for communities shown in the literature (0.2 to 0.25 lb/cap/d for both BOD_5 and TSS). This is most probably due to the large numbers of retail centers and restaurants located in the City. These types of establishments usually have high-strength wastewater and would serve a population that extends far beyond the Burlington corporate limits.

The fact that the per capita loading rates have decreased in the past couple of years is the result of an aggressive industrial pretreatment program that has been implemented by the City of Burlington in recent years. This pretreatment program includes requirements for installation and maintenance of grease traps for restaurants and other industrial or commercial establishments that may discharge fats, oils, and grease (FOG) to the sanitary sewer system. Excess FOG could clog up sewer lines and increase the organic load to the wastewater treatment plant. The City's FOG control program has successfully reduced the organic and solids load to the wastewater treatment plant.

In order to be conservative in the projection of future waste loads, the average of 2009 and 2010 per capita loads will be used. It is recommended that the City's industrial waste pretreatment program, including the FOG control program continue as it has during the past few years to ensure that the per capita waste loads are maintained at the lower levels.

The Western Service Area is expected to generate wastewater with characteristics similar to the City itself. The BOD_5 and TSS concentrations resulting from using the per capita loadings discussed above for the wastewater generated within the City of Burlington will be used to determine the loadings from the Western Service Area.

The Samish Water District is presently under contract with the City of Burlington to discharge an annual average flow of 250,000 gpd to Pump Station 6. The Skagit Valley Resort and Casino, which has historically discharged an annual average flow up to 60,000 gpd through the same pipeline, has commissioned the construction of its own wastewater treatment facility and will not be discharging to Burlington in the future. The Casino has, however, requested that the City of Burlington maintain a standby capacity of an average annual flow of 60,000 gpd in case of emergencies. They will pay a monthly charge for the maintenance of this capacity.

The terms of the contract with the Samish Water District are not expected to change over the next 20 years. The future annual average flows from the Samish Water District will be 250,000 gpd and the loading rates will be calculated from existing data, without the Skagit Valley Resort and Casino. Future peak month conditions will include the Skagit Valley Resort and Casino, with appropriate peak month/annual average peaking factors applied, and loads based on concentrations currently seen.

The discharge of septage to the wastewater treatment plant is expected to increase in the future, to above the levels seen in 2008. Skagit County has recently passed an ordinance requiring homeowners with septic tanks to have tanks pumped out every 3 years. This should greatly increase the amount of septage that has to be treated in Skagit County. This increase cannot be predicted at this time, but for the purpose of this Plan, it is assumed that the amount of septage to be discharged to the Burlington wastewater treatment facility will be double the 2008 level over the next 20 years.

EXISTING EQUIVALENT RESIDENTIAL UNITS

CALCULATION OF EXISTING WASTEWATER ERUS

Equivalent residential units (ERUs) are used to express the amount of water or sewer use by non-residential customers as an equivalent number of residential customers. The *water consumption* ERU value is calculated by dividing the total volume of water utilized by single-family residences (SFRs) by the total number of active single-family residential connections.

The *wastewater* ERU value is calculated based on winter water use and an estimate of how much of that water enters the sewer system. Winter water use is used to estimate the sanitary wastewater flow rate, exclusive of infiltration and inflow, because the amount of winter water consumption typically is nearly equal to sanitary wastewater flow, except for a minor amount of water that does not enter the sewer system (such as winter irrigation flow). Summer water consumption is not used because it may include irrigation water that does not enter the sewer.

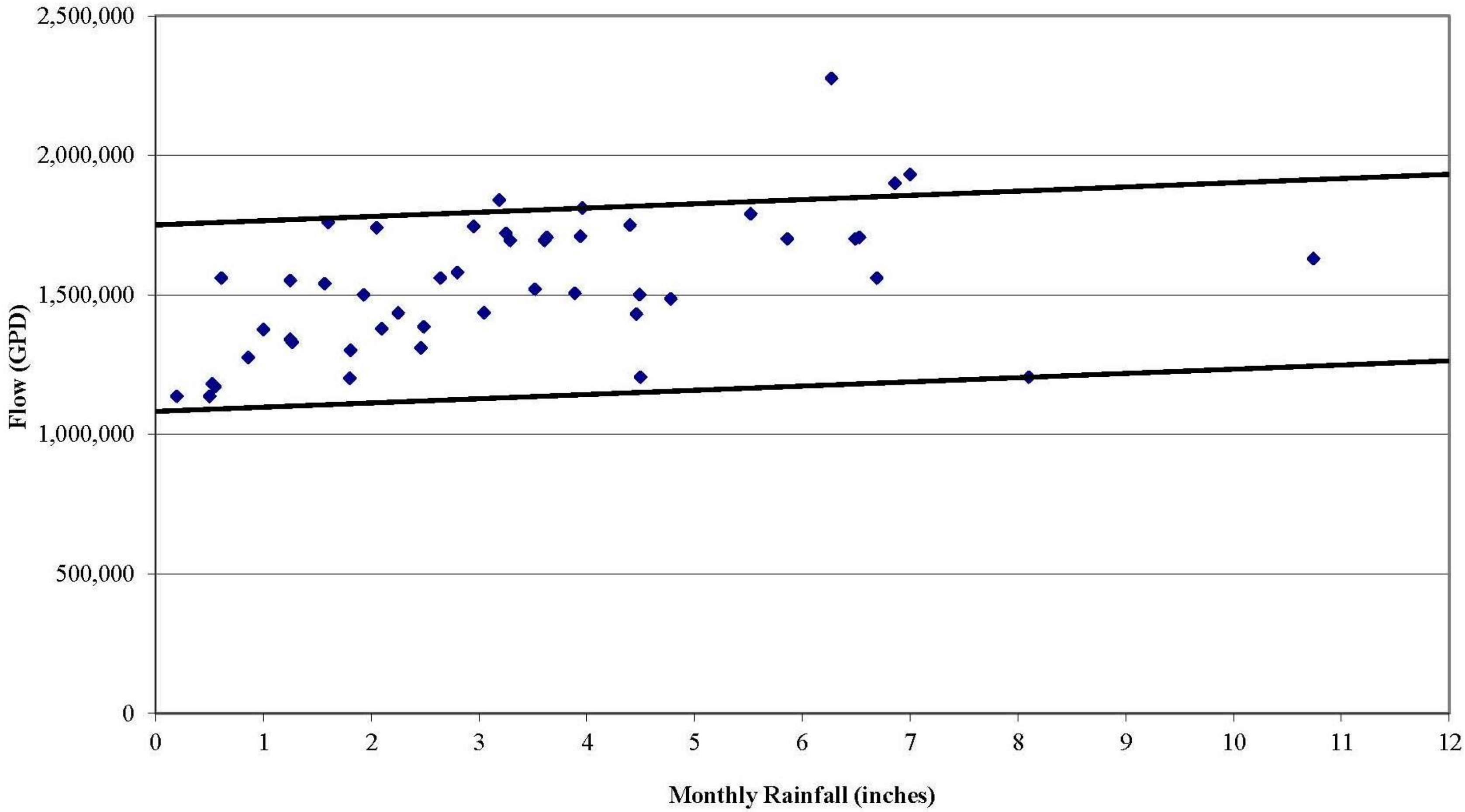

FIGURE 5-3

Variation of Influent Flow with Monthly Rainfall

The water system serving the City of Burlington and the surrounding area is operated by Skagit County PUD. The City receives water use records from Skagit County PUD for wastewater billing. Wastewater billing records were available for the sewered customers both inside the City as well as outside of the City in the Western Service Area. To determine the number of single-family residences with sewer service and their corresponding winter wastewater flows, the City's sewer billing records were reviewed. Table 5-14 summarizes the City's wastewater ERU value based on winter wastewater use for 2010.

As shown in Table 5-14, the average daily single-family residential winter wastewater flow (which is equivalent to one ERU) is 138 gallons per day for the City and 140 gallons per day for the service area outside of the City. For purposes of projecting future demands, the average City single-family winter wastewater flow ERU value of 138.5 gallons per day is used. This assumes all water enters the sewer system and is consistent with City billing.

TABLE 5-14

2010 Residential Wastewater Flows

Category	No. of Units	Flow (gpd)	Flow/Unit (gpd)
Inside City			
R-1 (Single-Family Residential)	1,726	239,029	138.5
R-2 (Two-Family Residential)	72	8,962	124
R-3 (Multifamily Residential)	1,016	118,866	117
Outside City			
R-1 (Single-Family Residential)	625	87,208	140
R-2 (Two-Family Residential)	2	201	100
R-3 (Multifamily Residential)	57	5,017	88

EXISTING NUMBER OF EQUIVALENT RESIDENTIAL UNITS

The existing number of ERUs discharging to the City of Burlington sewer system has been estimated for residential and commercial customer classes. Non-residential ERUs have been estimated based on winter wastewater flow records, flow meter records, and the wastewater ERUs.

Residential ERUs

The number of existing residential ERUs was determined by summarizing the City's wastewater billing records. This method includes multifamily as well as single-family connections. The records indicate 2,814 residential connections for 2,649 ERUs in the City and 684 residential connections for 667 ERUs in the Western Service Area for a total of 3,316 ERUs. The City's 2010 population was estimated at 8,985 people. The population of the Western Service Area is not known. Dividing the City's population by the number of ERUs in the City gives an average household size of 3.36 residents per ERU. Dividing the City's total residential wastewater flow of 366,857 gallons per day by the City's population provides an estimated wastewater flow of 40.8 gallons per person per day. The residential ERU information is summarized in Table 5-15.

TABLE 5-15

2010 Residential ERUs

Customer	ERUs	Flow (gpd)	Population	Flow/Person (gpd)
Residential – Inside City	2,649	366,857	8,985	40.8
Residential – Outside City	667	92,426	N/A	N/A
Total	**3,316**	**459,283**	**N/A**	**N/A**

Commercial ERUs

The commercial customer class includes commercial, mixed-use, industrial, and institutional connections, such as schools and government buildings. The wastewater billing records indicate a commercial flow of 231,243 gallons per day in the City and 11,161 gallons per day outside of the City. In addition to wastewater billing records, some of the larger customers are billed based on flow meter use records. The quantity of commercial ERUs was developed by dividing the average commercial winter wastewater flows by the average residential winter wastewater flow ERU value of 138.5 gallons per day. The commercial ERU information is summarized in Table 5-16.

TABLE 5-16

2010 Commercial ERUs

Customer	Flow (gpd)	ERUs
Commercial – Inside City	231,243	1,670
Commercial – Outside City	11,161	81
Samish Water District (1)	157,256	1,136
Skagit County Recovery Facility	6,352	46
PACCAR	4,090	30
Puget Sound Energy	746	5
Septic Tanks (1)	3,300	24
Seafood	6,929	50
Sierra Pacific	7,680	55
Total	**428,757**	**3,097**

(1) The flows from the Samish Water District and septic tanks contain sewage from both residential and commercial sources. These flows are included in the commercial flows.

Summary of Existing Wastewater ERUs

Table 5-17 summarizes the 2010 wastewater ERUs and ERU ratios for each customer class.

TABLE 5-17

Summary of 2010 ERUs for Each Customer Class

Customer	Flow (gpd)	No. of ERUs	% Total ERUs
Residential	459,283	3,316	51.7%
Commercial	428,757	3,096	48.3%
Total	**888,040**	**6,412**	**100%**

INFILTRATION AND INFLOW

In addition to domestic and industrial flows, sewer systems can carry water from a variety of other sources. During periods of precipitation, increased groundwater levels and surface water flows can contribute significant quantities of water to sanitary sewer systems. This additional flow is termed infiltration and inflow (I/I).

Infiltration refers to groundwater entering a sewer system by means of defective pipes, pipe joints, or manhole walls. High infiltration flows occur when the groundwater levels rise due to significant storm events, prolonged periods of precipitation, or high tides in marine shoreline areas. Infiltration is not associated with any particular water use; it is related not only to groundwater levels, but also to collection system size, condition, and materials. Infiltration is frequently expressed either as gallons per acre served per day (gpad) or as gallons per diameter inch-mile of pipe (gpim).

Inflow refers to surface water entering the sewer system from such sources as yard, roof, and footing drains, cross connections with storm drains, and leaking manhole covers. Peak inflow occurs during heavy storm events when increased flows cause hydraulic backups and local ponding. Particularly high inflow periods may occur when mild weather and heavy rainfall follow a period of heavy snowfall. Inflow is usually expressed in terms of gpad.

There are several ways both to express flows due to I/I and to determine whether this flow is excessive. The primary criteria used to determine whether I/I flows are excessive are established by the EPA. According to the EPA, I/I can be demonstrated to be excessive if the average wet weather domestic flow is less than 120 gpcd and the peak domestic flow during a storm event is less than 275 gpcd.

To determine whether I/I exceeds accepted standards, the population served by the sanitary sewer system must first be established. Although information is available regarding the number and distribution of system hookups, the exact number of persons served by the system is not known. For purposes of this analysis, the City's 2010 population of 8,388 has been used.

The monthly average influent flows to the Burlington wastewater treatment plant have been plotted against monthly precipitation for the period from January 2007 through December 2009. This plot is shown on Figure 5-3. As can be seen, all the individual data points (except one, for January 2009) on the plot fall between two parallel lines. The lower line represents the periods with no or negligible infiltration, while the upper line represents maximum infiltration. Where the upper line intersects the y-axis, representing no precipitation, will indicate the flow to the wastewater treatment plant containing the maximum amount of infiltration and negligible inflow. The flow to the Burlington wastewater treatment plant, based on records from January 2007 through December 2009, is 1,750,000 gpd.

A similar analysis was made on the flow meter records from the Samish Water District pipeline to Pump Station 6 and the flow meter records from Pump Station 8, representing the flow from the Western Service Area. The wastewater flows containing the highest amount of infiltration with negligible amounts of inflow from these sources are 231,000 gpd from the Samish Water District pipeline and 280,000 gpd from the Western Service Area. Subtracting these two sources from the total wastewater flow to the wastewater treatment plant yields a wastewater flow of 1,239,000 gpd originating within the city limits. The 2010 commercial flow within the Burlington corporate limits is 231,000 gpd, as shown in Table 5-16. Subtracting this flow from the wastewater flow generated from within the city limits gives a residential flow of 1,008,000 gpd, including maximum infiltration with negligible inflow. This flow represents a per capita flow of 120 gpcd, which is below the EPA criterion of 125 gpcd. The City of Burlington, therefore, does not have excessive infiltration in accordance with EPA definitions. A similar analysis presented in the City of Burlington Wastewater Facilities Plan (Gray & Osborne, Inc., July 1997) concluded that the average per capita wet weather domestic flow to the Burlington wastewater treatment plant was 128 gpcd. This reduction in the per capita wet weather flow indicates that the City of Burlington infiltration reduction program has been successful.

The highest daily flow recorded at the Burlington wastewater treatment plant occurred on January 8, 2009, and was 2.882 mgd. This flow was the result of heavy rainfall for 2 days preceded by a period of heavy snowfall and low temperatures. Thus, inflow to the sewer system would be caused by both rainfall and snowmelt. These conditions will be used to establish the flows occurring during a storm event. On January 8, 2009, the flow entering the sewer system from the pipeline from the Samish Water District was 426,000 gallons per day. The flow received from the Western Service Area through Pump Station 8 on this day was 863,000 gallons per day. Subtracting these two external wastewater sources as well as the commercial contribution of 231,000 gpd from the peak day wastewater flow of 2.882 mgd yields a residential flow of 1.362 mgd that is generated within the City of Burlington. This corresponds to a per capita flow of 162 gpcd for a population of 8,388, which is below the EPA criterion of 275 gpcd for domestic flow occurring during a storm event. The City of Burlington, therefore, does not have excessive inflow in accordance with EPA definitions. A similar analysis presented in the City of Burlington Wastewater Facilities Plan (Gray & Osborne, Inc., July 1997) concluded that the average per capita domestic flow to the Burlington wastewater treatment plant during a storm event was 203 gpcd. Although the City of Burlington has not had an active program to reduce existing inflow to the sewer system, the City's Sewer Use Ordinance prohibits property owners from connecting inflow sources, such as roof, footing, and area drains, to the sanitary sewer system. The apparent reduction of inflow since 1997 shows that the City has been successful in enforcing this ordinance for new sewer extensions and connections.

Table 5-18 shows a breakdown of the base sewage flow, infiltration, and inflow from the various existing drainage basins in the City of Burlington service area. The various flow components were estimated using the same procedure as for the overall wastewater treatment plant flow shown on Figure 5-3, by plotting the flows from the various drainage areas against the monthly precipitation. The flows from the Samish Water District pipeline, Pump Station 8, Port 1, Port 2, and the wastewater treatment plant are based on actual flow meter readings. The flows from the rest of the pump stations are based on pump drawdown tests and run time meter readings. Caution should be exercised in literal interpretation of the data presented in Table 5-18, as several inaccuracies may be inherent in the data. However, the information presented will indicate areas within the City's service area that may experience high infiltration/inflow which should be targeted for further investigation.

TABLE 5-18

Infiltration/Inflow from the Various Drainage Basins

Drainage Basin	Peak Day Flow (gpd)	Base Flow (gpd)	Infiltration (gpd)	Inflow (gpd)	Basin Area [(1)] (acres)	Infiltration (gpad)	Inflow (gpad)
Pump Station 1	293,000	83,000	54,000	156,000	52.05	1,037	2,997
Pump Station 2	208,000	14,700	53,000	140,300	370.14	143	379
Pump Station 3	799,000	168,000	122,000	509,000	559.64	218	910
Pump Station 4	188,000	30,000	97,000	61,000	134.51	721	453
Pump Station 5	1,357,000	267,000	225,000	518,000	936.93	240	553
Pump Station 6	310,000	163,000	96,000	226,000	N/A[(2)]	N/A[(2)]	N/A[(2)]
Samish Water District Pipeline	426,000	103,000	129,000	197,000	N/A[(2)]	N/A[(2)]	N/A[(2)]
Pump Station 7	201,000	49,000	21,000	131,000	101.48	207	1,291
Pump Station 8	1,976,000	112,000	174,000	1,690,000	1,623.43	107	1,041
Pump Station 9	98,000	22,000	23,000	53,000	130	178	408
Pump Station 10	288,000	27,000	81,000	180,000	359	226	501
Pump Station 11	435,000	223,000	116,000	96,000	775.46	150	124
Pump Station 13	45,000	19,000	6,000	20,000	240.22	25	83
Pump Station 14	79,000	5,000	31,000	43,000	198.61	156	217
Pump Station 15	88,200	3,300	9,500	75,600	149.67	63	583
Pump Station 16	41,000	1,700	22.070	17,230	100	220	172
Pump Station 18	32,800	11,300	9,100	12,400	33.27	274	373
Pump Station 19	1,410	6	630	774	26	24	30
Pump Station 20	915	0	290	625	101	3	6
Port 1	137,000	12,500	65,000	59,500	156	417	381
Port 2	19,900	1,500	6,300	12,200	30	210	407
Wastewater Treatment Plant	2,882,000	1,080,000	650,000	1,152,000	4,060.54[(3)]	128[(4)]	243[(4)]

(1) Drainage basin area includes only the existing developed areas.
(2) The drainage basin for the Samish Water District pipeline service area is unknown.
(3) Excludes area served by the Samish Water District pipeline.
(4) Excludes flows from the Samish Water District pipeline.

One area of interest is the Pump Station 1 drainage area, which appears to be subject to both high infiltration and inflow. Several projects designed to reduce infiltration have been undertaken in this area and several more projects have been designed and are scheduled for construction over the next several years. Inflow, however, has not been addressed. It is recommended that smoke testing be performed in the Pump Station 1 drainage area in order to identify sources of inflow and possible remediation. I/I should be reassessed when the infiltration reduction process has been completed.

Another area of interest is the old downtown area served by gravity by Pump Stations 3, 4, and 5, and to a lesser degree, Pump Station 2 (this can partially be concluded by subtracting the flows to Pump Station 2 from the flows to Pump Station 3 and 5, and subtracting the flows to Pump Station 14 from the flows to Pump Station 2). Again, several projects designed to reduce infiltration have been undertaken in this area and several more projects have been designed and are scheduled for construction over the next several years. It is recommended that smoke testing be performed in the old downtown area in order to identify sources of inflow and possible remediation. I/I should be reassessed when the infiltration reduction process has been completed.

A third area of interest is the Pump Station 7 drainage area, which appears to be subject to high inflow. The Pump Station 18 drainage area, being a part of the Pump Station 7 drainage area, does not appear to contribute significantly to this problem. Smoke testing of the Pump Station 7 drainage area, with the Pump Station 18 drainage area being of a lower priority, is recommended.

A fourth area if interest is the Bayview Ridge residential area which flows by gravity to Pump Station 8. The flows from this area can be estimated by subtracting the flows for Pump Stations 9 and 10 from the flows for Pump Station 8. One interesting aspect of the flows from Pump Station 8 is that, as the peak day flow at the wastewater treatment plant occurred on January 8, 2009, the peak flow from Pump Station 8 occurred on January 10, 2009. The flow from Pump Station 8 was 863,000 gpd on January 8 and 1,976,000 gpd on January 10, 2009, a 229 percent increase over flows of January 8, 2009. These increases were not observed at Pump Stations 9 and 10, which indicate the increased flows are originating in the Bayview Ridge residential area. The City of Burlington has recently cleaned and TV inspected the sewers in this area and no significant sources of infiltration were found. The fact that the flow increases appear to be delayed indicate that they are associated with increased groundwater table elevation and could be originating from footing drains and sump pumps. Some direct connections of roof drains to the sewer system could also be the cause of some of the flow increase. The City of Burlington made a similar analysis as a result of heavy rainfall during the period from December 8 through 14, 2010, and also made the conclusion that a significant amount of inflow originated in the Bayview Ridge residential area. However, during this period, the daily influent flow to the wastewater treatment plant peaked at 2,638,000 gpd on December 13, 2010, while the daily flow to Pump Station 8 peaked at 640,000 gpd on December 14, 2010.

Another recent period when heavy snowfall was followed by warmer temperatures and high rainfall occurred at the end of February/beginning of March in 2011. During this period, the wastewater treatment plant peaked at 2,383,000 gpd on March 1, 2011, while the daily flow to Pump Station 8 peaked at 526,000 gpd, also on March 1, 2011.

Based on the information presented in Table 5-18, which is based on the conditions during January 2009, it appears that 5,000 gpad or higher inflow may be generated in the Bayview Ridge residential area, which would make this area the top priority for smoke testing for identification and remediation of inflow sources. The conditions observed during December 2010 indicate an inflow of about 1,200 gpad, which is still relatively high.

The Pump Station 15 drainage area appears to be subject to moderate inflow and should be smoke tested. Also, the sewers serving the Port of Skagit County, as measured by flow meters (Port 1 and Port 2) appear to be subject to moderate infiltration and inflow.

In summary, the City of Burlington's infiltration reduction program appears to be working well. The City is currently been spending about $150,000 per year on sewer cleaning and TV inspection and sewer line rehabilitation or replacement. In addition, the City is implementing several specific projects designed to upgrade sewer lines and reduce infiltration/inflow. It is recommended that this program will continue for several years. In addition, it is recommended that an additional $50,000 per year be included in the Capital Improvement Plan for inflow control, including smoke testing, wet weather flow monitoring, and physical improvements, including enforcement of the Sewer Use Ordinance. Continued removal of infiltration/inflow will result in additional capacity available in the existing lines and treatment plant for growth.

The following would be the recommended priorities for smoke testing and inflow reduction:

1. Bayview Ridge residential area
2. Pump Station 1 drainage area
3. Pump Station 7 drainage area, except the Pump Station 18 drainage area
4. Old downtown area
5. Pump Station 15 drainage area
6. Port of Skagit County (infiltration reduction)
7. Remainder of the system

PROJECTED WASTEWATER FLOW RATES

Per the 2005 *City Comprehensive Plan*, the City of Burlington has a substantial amount of land that has the potential for new development and redevelopment. In particular, the City contains large acreages of underutilized and vacant commercial and industrial land. The Comprehensive Plan develops strategies for infill of the City that includes the flexibility in development regulations to encourage a variety of uses and businesses to locate in Burlington. In addition, the Western Service Area located in Skagit County includes large areas of vacant and underdeveloped land. The Bayview Ridge area includes large areas of residential and commercial land. The development of the Bayview Ridge area is summarized in the 2008 *Bayview Ridge Subarea Plan*. Lastly, the Western Service Area also includes the Port of Skagit County, which contains large areas of commercial and industrial land that are currently vacant or underdeveloped.

FLOW COMPONENTS

Residential Projections

The City's land use zoning classifications include a minimum lot size per dwelling unit as shown in Table 5-19 below. Flow projections are based on the full development of the residential areas to the densities shown. For purposes of projecting future wastewater demands, the average City single-family winter wastewater flow ERU value of 138 gallons per day is used. The 2008 *Bayview Ridge Subarea Plan* develops a minimum density of four units per acre, with the potential for development of up to six units per acre with contributions to the Farmland Legacy Program. We assumed that all the Bayview Ridge residential areas would be developed at six units per acre which is equivalent to 7,260 square feet per unit. In addition, we assumed that other County zoning designations including the City and Urban Reserve Residential would also be developed at the 7,600 square feet per unit density, as shown in Table 5-19.

TABLE 5-19

Residential Land Development Projections

Land Use	Land Use Category	City/County Zoning	Density (ft^2/unit)
R-1-6.0	Single-Family Residential	City	6,000
R-1-7.6	Single-Family Residential	City	7,600
R-1-8.4	Single-Family Residential	City	8,400
R-1-9.6	Single-Family Residential	City	9,600
R-2	Two-Family Residential	City	3,800
R-3	Multifamily Residential	City	3,000
BR-R	Bayview Ridge Residential	County	7,260
BR-URv	Bayview Ridge Urban Reserve	County	7,260
CITY	City	County	7,600
URR	Urban Reserve Residential	County	7,600

Commercial Projections

Commercial and industrial wastewater flows are typically based on the land area and expressed as the flow unit gallons per acre per day (gpad). For non-residential zoned areas, the previous Comprehensive Plan used an estimated wastewater flow of 1,200 gpad for commercial flows and industrial flows in the eastern portion of the service area, and 500 gpad for industrial flows in the western portion of the service area. However, there are nine non-residential land use zoning classifications within the City of Burlington and an additional 10 non-residential land use zoning classifications within the County service area. To develop more accurate wastewater flows for each of the non-residential land use zoning classifications, we looked at the City's billing records. We attempted to identify existing high water users within each non-residential zoning classification. Where enough records were available, we found the billing records and parcel size for each of these users and calculated an average flow in gpad. The businesses that we used to calculate the flows can be seen on Figure 5-4. The calculated averages were rounded up to the design flow that will be used to calculate commercial and industrial flow projections as seen in Table 5-20. For some of the land use zoning classifications, there were not enough billing records available, so we estimated the design flow based on the 1997 Wastewater Facilities Plan and the flows that were calculated from similar land use zoning classifications.

TABLE 5-20

Non-Residential Wastewater Flow Projections

Land Use	Land Use Category	City/County Zoning	Calculated Avg. Flow (gpad)	Design Flow (gpad)
R-S	Semi-Public District	City	4,585	4,600
M-1	Industrial District	City	1,100	1,100
B-P	Business Park District	City	114	500
C-1	Commercial District	City	1,057	1,100
C-2	Heavy Commercial	City	595	600
B-1	Business District	City	1,553	1,600
MR-NB	Medium Residential & Neighborhood Business	City	N/A	600
OSPA	Open Space, Parks & Agriculture	City	N/A	0
ROW	Right-of-Way	City	N/A	0
AVR	Aviation Related	County	N/A	0
Ag-NRL	Agricultural – Natural Resource Lands	County	N/A	0
BR-CC	Bayview Ridge Community Center	County	N/A	600
BR-HI	Bayview Ridge Heavy Industrial	County	445	500
BR-LI	Bayview Ridge Light Industrial	County	54	500
NRI	Natural Resource Industrial	County	N/A	600
RB	Rural Business	County	N/A	1,200
RI	Rural Intermediate	County	N/A	600
RRv	Rural Reserve	County	321	500
URC-I	Urban Reserve Commercial-Industrial	County	N/A	600

PROJECTED WASTEWATER FLOWS FOR BUILDOUT CONDITIONS

The projected wastewater flow rates developed in this Plan for buildout conditions are based on the full utilization of all the land in the City's wastewater service area. The residential flows are based on full development of residential areas based on the maximum number of lots per acre per the City or County land use zoning. For purposes of projecting future single-family wastewater demands, the average City single-family winter wastewater flow ERU value of 138.5 gallons per day is used. For two-family and multifamily residences, the flow value of 124 gallons per day and 117 gallons per day per unit, respectively, were used. In addition, all commercial and industrial wastewater flows will be based on full development of all the available land based on the City or County land use zoning. The design flows in gpad as calculated or assumed in the previous section will be used for projecting future commercial wastewater flows. The projected flow rates for full utilization to the maximum densities of all the areas within the City's service area can be seen in Table 5-21.

TABLE 5-21

City of Burlington Full Utilization Flow Rate Projections

Land Use	Land Use Category	Total Area (acres)	Density (ft^2/unit)	Flow Rate (gpd/ERU)	Flow Rate (gpad)
R-1-6.0	Single-Family Residence	121.72	6,000	138	—
R-1-7.6	Single-Family Residence	69.75	7,600	138	—
R-1-8.4	Single-Family Residence	299.12	8,400	138	—
R-1-9.6	Single-Family Residence	291.51	9,600	138	—
R-2	Two-Family Residence	55.82	3,800	124	—
R-3	Multifamily Residence	127.09	3,000	117	—
R-S	Semipublic District	25.15	—	—	4,600
M-1	Industrial District	240.81	—	—	1,100
B-P	Business Park District	117.13	—	—	500
C-1	Commercial District	635.00	—	—	1,100
C-2	Heavy Commercial	344.37	—	—	600
B-1	Business District	12.95	—	—	1,600
MR-NB	Medium Residential & Neighborhood Business	39.63	—	—	600
OSPA	Open Space, Parks & Agriculture	54.89	—	—	0
Other	Right-of-Way, etc.	28.72	—	—	0
AVR	Aviation Related	767.84	—	—	0
Ag-NRL	Agricultural-Natural Resource Lands	360.87	—	—	0
BR-CC	Bayview Ridge Community Center	40.11	—	—	600
BR-HI	Bayview Ridge Heavy Industrial	924.11	—	—	500
BR-LI	Bayview Ridge Light Industrial	1,211.04	—	—	500
BR-R	Bayview Ridge Residential	707.89	7,260	138	—
BR-URv	Bayview Ridge Urban Reserve	303.45	7,260	138	—
CITY	City	19.53	7,600	138	—
NRI	Natural Resource Industrial	3.50	—	—	600
RB	Rural Business	0.73	—	—	1,200
RI	Rural Intermediate	22.36	—	—	600
RRv	Rural Reserve	21.30	—	—	500
URC-1	Urban Reserve Commercial-Industrial	11.24	—	—	600
URR	Urban Reserve Residential	411.49	7,600	138	—
Total		**7,269**	—	—	—

DRAINAGE BASINS

A schematic drawing of the City's existing drainage basins can be seen on Figure 5-5. As development continues in areas within the City's sewer service area that are currently unsewered, additional drainage basins will be formed. Figure 5-6 shows the existing sewer service area including the existing City's wastewater drainage basins and the proposed drainage basins within the City's sewer service area. Existing drainage basins can be seen in blue and proposed drainage basins are seen in pink. Figure 5-6 also shows proposed pump stations that will be necessary to serve proposed drainage basins. Each drainage basin was provided a number which corresponds to the numbers seen on the figures. The existing and proposed drainage basins can be seen in Table 5-22.

TABLE 5-22

Existing and Proposed Drainage Basins

Basin No.	Basin Name	Existing/ Proposed	Basin Area(1) (acres)	Buildout Annual Avg.(2) Flow (gpd)
1	Pump Station 1	Existing	76	83,568(3)
2	Pump Station 2	Existing	383	272,627(3)
3	Pump Station 3	Existing	597	489,418
4	Pump Station 4	Existing	426	320,237
5	Pump Station 5	Existing	377	380,710
6	Pump Station 6	Existing	174	366,566(4)
7	Pump Station 7	Existing	169	147,459
8	Pump Station 8	Existing	4,046	1,730,197
9	Pump Station 9	Existing	150	116,293
10	Pump Station 10	Existing	3,045	909,088(5)(6)
11	Pump Station 11	Existing	739	732,807
12	Pump Station 12	Existing	26	29,888
13	Pump Station 13	Existing	454	380,251
14	Pump Station 14	Existing	199	126,752
15	Pump Station 15	Existing	150	84,257
16	Pump Station 16	Existing	796	270,293
17	Pump Station 17	Existing	10	5,085(6)
18	Pump Station 18	Existing	33	24,010
19	Pump Station 19	Existing	93	31,385(5)(6)
20	Pump Station 20	Existing	663	291,285(5)
21	Pump Station 21	Existing	47	51,815
22	WWTP Gravity	Existing	289	207,778(3)
23	PACCAR	Existing	449	224,650(3)
24	Skagit County Recovery Facility	Existing	11	5,519
25	Puget Sound Energy	Existing	21	10,494
26	Ovenell Road	Proposed	66	0(5)
27	Dahlstead	Existing	52	25,976
28	Farm to Market Road	Proposed	207	103,415
29	Bayview Ridge Light Industrial	Proposed	90	44,825
30	Bradshaw Road Pump Station	Proposed	369	72,203(5)
31	Airport 1	Existing	601	0(6)
32	Airport 2	Existing	57	0(6)
33	Bayview Ridge Residential	Proposed	586	485,255
34	Chinook Drive	Proposed	68	53,512
35	Markwood Lane	Proposed	60	47,235
36	Rio Vista Avenue	Proposed	15	11,945

TABLE 5-22 (continued)

Existing and Proposed Drainage Basins

Basin No.	Basin Name	Existing/ Proposed	Basin Area[(1)] (acres)	Buildout Annual Avg.[(2)] Flow (gpd)
37	Cascade Vista Road	Proposed	39	22,134
38	East Fairhaven Pump Station	Proposed	84	66,448
39	Peter Anderson Road Pump Station	Proposed	33	26,420
40	Highway 20 Pump Station	Proposed	89	68,342
41	Gages Slough Pump Station	Proposed	112	88,400
42	North Peacock Lane Pump Station	Proposed	38	29,823
43	Stevens Road Pump Station	Proposed	132	104,609[(7)]
44	McCorquedale Pump Station	Proposed	154	121,824[(7)]
45	Raspberry Ridge 1	Proposed	24	10,350[(8)]
46	Raspberry Ridge 2	Proposed	7	10,350[(8)]
47	Pease Road Pump Station	Proposed	35	38,245
48	Gilkey Road Pump Station	Proposed	17	18,569
WWTP	**All Flows to WWTP**	**Existing**	**7,269**	**4,750,817**

(1) Drainage basin area includes the area of any upstream drainage basins that pump or flow by gravity into the drainage basin.

(2) Buildout average annual flows include the flows from any drainage basins upstream that pump or flow by gravity into the drainage basin.

(3) These flows include records for flows from schools. We assumed that existing schools within this drainage basin will remain schools and not be redeveloped.

(4) The Pump Station 6 drainage basin and any drainage basins which receive flows from Pump Station 6 include an annual average daytime flow of 208,000 gpd from the Samish Water District.

(5) Wetland and wetland buffer areas were identified within this drainage basin. From discussions with the Port of Skagit County, flows assume these wetland and buffer areas will not be developed.

(6) Flows assume that areas within this drainage basin zoned Aviation Related that are currently business related will be redeveloped to maximum capacity, and areas that are currently airport runways and open space will remain undeveloped.

(7) Flows assume that areas within this drainage basin zoned Agricultural will be developed as residential with 7,600 ft^2 size lots.

(8) Flows assume 75 residential units will be allowed to connect in this drainage basin per discussions with City staff.

The flows developed for each drainage basin in this section include the flows from any drainage basins upstream that feed into that drainage basin. For example the Pump Station 2 drainage basin includes the area that drains by gravity to the pump station as well as flows from the Pump Station 21 and Pump Station 14 drainage basins. A schematic drawing of the all the proposed drainage basins and how they will be served can be seen on Figure 5-7. Chapter 6, Collection System Analysis, will evaluate each of the drainage basins and the collection system in more depth.

PROJECTED INFILTRATION AND INFLOW RATES

The projected wastewater flow rates for the City of Burlington WWTP include a sanitary component and an I/I component. The existing I/I received by the Burlington WWTP is primarily due to stormwater connections and defects in the older portions of the sewer system, which includes some areas of the Western Service Area. It is assumed that the excess I/I will be gradually removed as a part of the sewer replacement and I/I control program presently a part of the City of Burlington Capital Improvement Program and as recommended previously in this chapter.

Table 5-23 provides the criteria that will be used to project I/I flow rates from newly sewered as well as rehabilitated areas, based on benchmark values used in other communities.

TABLE 5-23

Projected Infiltration/Inflow Rates

Parameter	I/I Flow Rate (gpad) (1)
Dry Weather Infiltration	60
Annual Average	150
Maximum Month	300
Maximum Day	500
Peak Hour	1,100

(1) Projected I/I flow rates for newly sewered areas are based on benchmarks used by other communities.

PROJECTED TOTAL WASTEWATER FLOW RATES

In order to establish the required capacity of facilities, such as gravity sewer lines and pump stations, peak hour rather than average flow has to be considered. A ratio of peak hour flow to annual average flow is given in *Criteria for Sewage Works Design* (Ecology, 1998). This ratio, termed the "Peaking Factor" (*PF*), is given to be:

$$PF = \frac{18 + \sqrt{P}}{4 + \sqrt{P}}$$

where *P* is the population equivalent in thousands. Since much of the City and Western Service Area include non-residential flow, the commercial and industrial flows need to be converted into an equivalent population. The population equivalent is the total annual average flow divided by the flow per capita per day of 40.8 gallons per capita per day (gpcd).

Using the projected sanitary wastewater flow rates and the I/I flow rates, the total wastewater flow rates are then estimated as follows for each of the drainage basins:

$$Total\ Wastewater\ Peak\ Hour\ Flow\ Rate =$$
$$Annual\ Average\ Wastewater\ Flow\ Rate + Estimated\ Sewer\ System\ I/I\ Flow\ Rate$$

Table 5-24 provides the projected wastewater flow rates including I/I flow.

TABLE 5-24

Projected Wastewater Flow Rates for Existing and Proposed Drainage Basins

Basin No.	Basin Name	Area[(1)] (acres)	Buildout Equivalent Population[(2)]	Buildout Peak Hour Flow (gpd)	Buildout I/I[(3)] (gpd)	Buildout Peak Hour Flow with I/I[(4)] (gpd)
1	Pump Station 1	76	2,047	299,002	82,073	381,075
2	Pump Station 2	383	6,677	852,330	398,556	1,250,886[(5)]
3	Pump Station 3 Gravity	597	11,987	1,407,628	613,325	2,020,953[(5)]
4	Pump Station 4	426	7,843	979,493	467,660	1,447,153
5	Pump Station 5	377	9,324	1,136,348	396,595	1,532,943
6	Pump Station 6 Gravity	174	3,884	2,017,255	191,309	2,208,564[(6)]
7	Pump Station 7 Gravity	169	3,612	497,337	186,046	683,383
8	Pump Station 8 Gravity	4,046	42,376	4,035,005	3,062,139	7,097,143
9	Pump Station 9 Gravity	150	2,848	402,544	164,725	567,269
10	Pump Station 10 Gravity	3,045	22,265	2,368,866	1,961,064	4,329,931[(7)(8)]
11	Pump Station 11 Gravity	739	17,948	1,978,399	797,198	2,775,597
12	Pump Station 12 Gravity	26	732	116,065	28,259	144,324
13	Pump Station 13 Gravity	454	9,313	1,135,174	498,675	1,633,849
14	Pump Station 14 Gravity	199	3,104	434,726	218,454	653,180
15	Pump Station 15 Gravity	150	2,064	301,235	164,627	465,862
16	Pump Station 16 Gravity	796	6,632	847,360	595,745	1,443,105
17	Pump Station 17 Gravity	10	125	21,440	11,187	32,627[(8)]
18	Pump Station 18 Gravity	33	588	94,527	36,592	131,119
19	Pump Station 19 Gravity	93	769	121,484	69,047	190,531[(7)(8)]
20	Pump Station 20 Gravity	663	7,134	902,588	640,826	1,543,414[(7)]
21	Pump Station 21 Gravity	47	1,269	193,318	51,976	245,293
22	WWTP Gravity	289	5,089	672,766	305,083	977,849[(5)]
23	PACCAR	449	5,502	720,282	494,231	1,214,513[(5)]
24	Skagit Co. Recovery Facility	11	135	23,211	12,143	35,353
25	Puget Sound Energy	21	257	43,091	23,087	66,178
26	Ovenell Road	66	0	0	0	0[(7)]
27	Dahlstead	52	636	101,777	57,147	158,924
28	Farm to Market Road	207	2,533	362,347	227,513	589,860
29	Bayview Ridge Light Industrial	90	1,098	169,146	98,614	267,760

TABLE 5-24 (continued)

Projected Wastewater Flow Rates for Existing and Proposed Drainage Basins

Basin No.	Basin Name	Area[(1)] (acres)	Buildout Equivalent Population[(2)]	Buildout Peak Hour Flow (gpd)	Buildout I/I[(3)] (gpd)	Buildout Peak Hour Flow with I/I[(4)] (gpd)
30	Bradshaw Road Pump Station	369	1,768	261,862	158,847	420,709[(7)]
31	Airport 1	601	0	0	0	0[(8)]
32	Airport 2	57	0	0	0	0[(8)]
33	Bayview Ridge Residential	586	11,885	1,397,458	644,662	2,042,120
34	Chinook Drive	68	1,311	199,127	74,420	273,547
35	Markwood Lane	60	1,157	177,523	65,690	243,213
36	Rio Vista Avenue	15	293	48,772	16,612	65,384
37	Cascade Vista Road	39	542	87,559	42,749	130,308
38	East Fairhaven Pump Station	84	1,627	242,779	92,411	335,190
39	Peter Anderson Rd Pump Station	33	647	103,407	36,742	140,149
40	Highway 20 Pump Station	89	1,674	249,081	98,031	347,111
41	Gages Slough Pump Station	112	2,165	314,594	122,940	437,534
42	North Peacock Lane Pump Station	38	730	115,829	41,476	157,305
43	Stevens Road Pump Station	132	2,562	366,100	145,068	511,169[(9)]
44	McCorquedale Pump Station	154	2,984	419,612	169,422	589,034[(9)]
45	Raspberry Ridge 1	24	253	42,525	26,361	68,886[(10)]
46	Raspberry Ridge 2	7	253	42,525	7,788	50,314[(10)]
47	Pease Road Pump Station	35	937	146,024	38,245	184,268
48	Gilkey Road Pump Station	17	455	74,183	18,569	92,752
WWTP	**All Flows to WWTP**	**7,269**	**120,240**	**9,195,167**	**6,515,292**	**15,710,460**

(1) Drainage basin area includes the area of any upstream drainage basins that pump or flow by gravity into the drainage basin.

(2) Equivalent population was calculated by converting commercial flows into populations using a flow rate of 40.8 gpcd as shown in Table 6-15.

(3) Infiltration and inflow was calculated by multiplying the developable area within the drainage basin by 1,100 gpad.

(4) Peak hour flows include the flows from any drainage basins upstream that pump or flow by gravity into the drainage basin.

(5) These flows include records for flows from schools. We assumed that existing schools within this drainage basin will remain schools and not be redeveloped.

(6) The Pump Station 6 drainage basin and any drainage basins which receive flows from Pump Station 6 include an annual average daytime flow of 208,000 gpd from the Samish Water District.

(7) Wetland and wetland buffer areas were identified within this drainage basin. From discussions with the Port of Skagit County, flows assume these wetland and buffer areas will not be developed.

(8) Flows assume that areas within this drainage basin zoned Aviation Related that are currently business related will be redeveloped to maximum capacity and areas that are currently airport runways and open space will remain undeveloped.

(9) Flows assume that areas within this drainage basin zoned Agricultural will be developed as residential with 7,600 ft^2 size lots.

(10) Flows assume 75 residential units will be allowed to connect in this drainage basin per discussions with City staff.

PROJECTED FLOWS FOR THE PLANNING PERIOD

The flow projections up to this point have been made for buildout conditions, which represent the maximum flows to be expected based on the current planning area and zoning classifications within the planning area. Since it is unrealistic to expect buildout conditions to occur over the next 20 years, an attempt has been made to project a realistic increase in wastewater loads during this period. The City of Burlington wastewater service area will be divided into four components:

1. City of Burlington UGA
2. Western Service Area
3. Samish Water District Pipeline
4. Septage Discharge at the Wastewater Treatment Plant

CITY OF BURLINGTON UGA

The City of Burlington UGA consists of the area within the existing Burlington corporate limits and the areas immediately surrounding the City designated by Skagit County to be within the City's UGA. As discussed in Chapter 3, the City of Burlington 2010 to 2015 Capital Improvement Plan estimates that the population within the existing city limits will increase by 0.65 percent per year over the next 16 years, based on development of existing undeveloped properties. For the purpose of this Plan, it is assumed that the population within the existing city limits will increase by 1.3 percent per year over the next 20 years. This growth rate, being twice the rate established by developing vacant properties only, will allow for some redevelopment of areas already developed. Also, for the purpose of this Plan, it is assumed that commercial, industrial, governmental, and institutional activities will increase at the same rate as the population increase; thus, the annual average flows within the existing city limits are estimated to increase by 1.3 percent per year in the following drainage basins:

1. Pump Station 1
2. Pump Station 2
3. Pump Station 3
4. Pump Station 4 (existing sewer service area only)
5. Pump Station 5
6. Pump Station 6 (existing sewer service area only, excluding SWD pipeline)
7. Pump Station 7 (existing sewer service area only)
11. Pump Station 11
13. Pump Station 13 (existing sewer service area only)
14. Pump Station 14
15. Pump Station 15
18. Pump Station 18
22. Wastewater Treatment Plant (existing gravity sewer service area)

Also, as discussed in Chapter 3, it is proposed to utilize a population growth rate of 2.25 percent per year over the next 20 years. The additional 0.95 percent per year increase is estimated to originate in the following unsewered drainage basins:

21. Pump Station 21
34. Chinook Drive
35. Markwood Lane
36. Rio Vista Avenue
37. Cascade Vista Road
38. East Fairhaven Pump Station
39. Peter Anderson Road Pump Station
40. Highway 20 Pump Station
41. Gages Slough Pump Station
42. North Peacock Lane Pump Station
45. Raspberry Ridge 1
46. Raspberry Ridge 2
47. Gilkey Road Pump Station
48. Pease Road Pump Station

Pump Station 21 is an existing pump station serving a drainage area currently within the city limits, but receives no flow at the present time. The Gilkey Road and Pease Road Pump Stations would serve areas without sewer service within the city limits. These three drainage areas will be analyzed as being a part of the 0.95 percent per year growth rate, outside the existing city limits. The flows from these areas will be distributed among the various areas proportionally for the buildout flows as presented in Table 5-22.

Table 5-25 shows the projected annual average sanitary wastewater flows for the various drainage areas within the existing city limits that are subject to the 1.3 percent per year growth rate. Existing flows were estimated utilizing pump station records combined with the water use data presented in Tables 5-15 and 5-16.

TABLE 5-25

Projected Annual Average Sanitary Wastewater Flows from Drainage Areas within Existing City Limits

Drainage Basin	Existing (2010) Annual Avg. Flow (gpd)	2015 Annual Avg. Flow (gpd)	2020 Annual Avg. Flow (gpd)	2025 Annual Avg. Flow (gpd)	2030 Annual Avg. Flow (gpd)
1. Pump Station 1	79,000	83,600	83,600	83,600	83,600
2. Pump Station 2	10,000	10,700	11,500	12,400	13,300
3. Pump Station 3	135,000	143,700	148,200	153,000	158,100
4. Pump Station 4	22,000	23,600	25,400	27,300	29,300
5. Pump Station 5	77,000	82,700	88,800	95,400	102,500
6. Pump Station 6	50,000	53,700	57,700	62,000	66,600
7. Pump Station 7	43,000	46,200	49,600	53,300	57,200
11. Pump Station 11	180,000	193,300	206,800	223,100	239,600
13. Pump Station 13	12,000	12,900	13,800	14,900	16,000
14. Pump Station 14	5,000	5,400	5,800	6,200	6,700
15. Pump Station 15	3,300	3,500	3,800	4,100	4,400
18. Pump Station 18	9,300	10,000	10,700	11,500	12,400
22. Gravity to WWTP	122,000	131,000	140,800	151,200	162,400
Total to WWTP	**598,000**	**640,900**	**681,500**	**726,900**	**774,500**

Table 5-26 shows the projected annual average sanitary wastewater flows for the various drainage areas outside the existing city limits, but inside the UGA, including Pump Station 21 and the Gilkey Road and Pease Road Pump Stations, subject to the 0.95 percent per year growth rate. It is assumed that these drainage areas will be sewered and connected to the existing wastewater collection system according to the following schedule:

Sewer Connections Made Between the Years 2010 to 2015:

21. Pump Station 21
37. Cascade Vista Road
45. Raspberry Ridge 1
46. Raspberry Ridge 2

Sewer Connections Made Between the Years 2015 to 2020:

34. Chinook Drive
36. Rio Vista Avenue
37. East Fairhaven Pump Station
47. Gilkey Road Pump Station
48. Pease Road Pump Station

Sewer Connections Made Between the Years 2020 to 2025:

35. Markwood Lane
39. Peter Anderson Road Pump Station
40. Highway 20 Pump Station
41. Gages Slough Pump Station
42. North Peacock Lane Pump Station

TABLE 5-26

Projected Annual Average Sanitary Wastewater Flows from Drainage Areas within Existing UGA Expected to Be Sewered in the Near Future

Drainage Basin	Existing (2010) Annual Avg. Flow (gpd)	2015 Annual Avg. Flow (gpd)	2020 Annual Avg. Flow (gpd)	2025 Annual Avg. Flow (gpd)	2030 Annual Avg. Flow (gpd)	Buildout Annual Avg. Flow (gpd)
21. Pump Station 21	0	14,000	14,800	15,500	16,300	51,800
34. Chinook Drive	0	0	15,400	16,100	16,900	53,500
35. Markwood Lane	0	0	0	14,200	14,900	47,200
36. Rio Vista Avenue	0	0	3,500	3,600	3,800	11,900
37. Cascade Vista Road	0	13,600	13,800	13,900	14,100	22,100
38. E. Fairhaven Pump Station	0	0	19,000	19,900	20,900	66,400
39. P. Anderson Road Pump Station	0	0	0	7,900	8,300	26,400
40. Highway 20 Pump Station	0	0	0	20,500	21,500	68,300
41. Gages Slough Pump Station	0	0	0	26,600	27,900	88,400
42. N. Peacock Lane Pump Station	0	0	0	9,000	9,400	29,800
45. Raspberry Ridge 1	0	10,400	10,400	10,400	10,400	10,400
46. Raspberry Ridge 2	0	10,400	10,400	10,400	10,400	10,400
47. Gilkey Road Pump Station	0	0	10,900	11,400	12,000	38,200
48. Pease Road Pump Station	0	0	5,400	5,600	5,900	18,600
Total to WWTP	**0**	**38,000**	**87,800**	**152,100**	**158,700**	**458,200**

The flows from all the drainage areas outside the city limits, but within the UGA, will have to pass through one of the drainage areas shown in Table 5-26 to reach the wastewater treatment plant, as follows:

- Area 21, Pump Station 21 flows will pass through Area 2, Pump Station 2 and Area 3, Pump Station 3
- Area 34, Chinook Drive flows will pass through Area 7, Pump Station 7 and Area 6, Pump Station 6
- Area 35, Markwood Lane flows will pass through Area 13, Pump Station 13

- Area 36, Rio Vista Avenue flows will pass through Area 22, Gravity Flows to the Wastewater Treatment Plant

- Area 37, Cascade Vista Road receives flows from Area 45, Raspberry Ridge 1 and the combined flow will pass though Area 22, Gravity Flows to the Wastewater Treatment Plant

- Area 38, East Fairhaven Pump Station flows will pass through Area 4, Pump Station 4

- Area 40, Highway 20 Pump Station receives flows from Area 39, Peter Anderson Road Pump Station and the combined flow will pass through Area 4, Pump Station 4

- Area 41, Gages Slough Pump Station receives flows from Area 42, North Peacock Lane Pump Station and the combined flow will pass through Area 4, Pump Station 4

- Area 46, Raspberry Ridge 2 will flow through Area 4, Pump Station 4

- Area 47, Gilkey Road Pump Station receives flows from Area 48, Pease Road Pump Station and the combined flow will pass through Area 22, Gravity Flows to the Wastewater Treatment Plant

Table 5-27 combines the information presented in Tables 5-25 and 5-26 to show the total flows generated within the Burlington UGA as they pass through the existing facilities in the UGA.

TABLE 5-27

Projected Annual Average Sanitary Wastewater Flows from Drainage Areas within the Burlington UGA

Drainage Basin	Existing (2010) Annual Avg. Flow (gpd)	2015 Annual Avg. Flow (gpd)	2020 Annual Avg. Flow (gpd)	2025 Annual Avg. Flow (gpd)	2030 Annual Avg. Flow (gpd)	Buildout Annual Avg. Flow (gpd)
1. Pump Station 1	79,000	83,600	83,600	83,600	83,600	83,600
2. Pump Station 2	10,000	24,700	26,300	27,900	29,600	272,600
3. Pump Station 3	135,000	157,700	163,000	168,500	174,400	489,400
4. Pump Station 4	22,000	34,000	54,800	104,700	110,000	320,200
5. Pump Station 5	77,000	82,700	88,800	95,400	102,500	380,700
6. Pump Station 6	50,000	53,700	73,100	78,100	83,500	158,600
7. Pump Station 7	43,000	46,200	65,000	69,400	74,100	147,400
11. Pump Station 11	180,000	193,300	206,800	223,100	239,600	732,800
13. Pump Station 13	12,000	12,900	13,800	29,100	30,900	380,300
14. Pump Station 14	5,000	5,400	5,800	6,200	6,700	126,800
15. Pump Station 15	3,300	3,500	3,800	4,100	4,400	84,300
18. Pump Station 18	9,300	10,000	10,700	11,500	12,400	24,000
22. Gravity to WWTP	122,000	144,600	169,000	180,000	192,300	207,800
Total to WWTP	**598,000**	**678,900**	**769,300**	**879,000**	**933,200**	**2,669,800**

The information presented in Tables 5-26 and 5-27 can be utilized to establish the peak hour flow to each of the pump station in the UGA. The peak hour flow is the required capacity of each of the pump station. Table 5-28 shows the peak hour flow for the 5-year increments during the planning period as well as buildout conditions for each of the existing and planned major pump stations within the Burlington UGA. The capacity of the existing pump stations are also shown to establish which pump stations are in need of additional capacity. Pump Station 6 also will receive flow from outside the UGA and is not included in Table 5-28. The required capacity of Pump Station 6 will be discussed later in this chapter.

The conclusions that can be drawn from the information presented in Table 5-28 will be discussed in Chapter 6.

TABLE 5-28

Projected Peak Hour Flow to Each Pump Station within the Burlington UGA

Pump Station	Existing (2010) Peak Hour Flow with I/I (gpm)	2015 Peak Hour Flow with I/I (gpm)	2020 Peak Hour Flow with I/I (gpm)	2025 Peak Hour Flow with I/I (gpm)	2030 Peak Hour Flow with I/I (gpm)	Buildout Peak Hour Flow with I/I (gpm)	Existing Capacity (gpm)(1)
1. Pump Station 1	254	265	265	265	265	265	495
2. Pump Station 2	305	344	348	352	357	869	390
3. Pump Station 3	745	792	803	815	827	1,403	1,500
4. Pump Station 4	385	416	466	579	591	1,005	360
5. Pump Station 5	457	470	484	498	514	1,053	675
7. Pump Station 7	242	250	294	305	315	475	760
11. Pump Station 11	966	992	1,019	1,051	1,083	1,927	1,283
13. Pump Station 13	207	383	385	425	429	1,135	290
14. Pump Station 14	166	167	169	170	171	454	130
15. Pump Station 15	124	125	126	126	127	324	297
18. Pump Station 18	52	54	56	58	61	91	194
21. Pump Station 21	36	75	78	80	82	170	120
38. East Fairhaven Pump Station	—	—	117	119	122	233	—
39. P. Anderson Road Pump Station	—	—	—	48	49	97	—
40. Highway 20 Pump Station	—	—	—	125	127	241	—
41. Gages Slough Pump Station	—	—	—	158	161	304	—
42. N. Peacock Lane Pump Station	—	—	—	55	56	109	—
47. Gilkey Road Pump Station	—	—	58	59	61	128	—
48. Pease Road Pump Station	—	—	29	29	30	64	—

(1) Based on drawdown tests performed by the City of Burlington.

WESTERN SERVICE AREA

The Western Service Area all drains to Pump Station 8, which in turn conveys the flow directly to the large-diameter gravity sewers by the wastewater treatment plant. It is assumed that the Western Service Area generally will grow at the same rate as the City of Burlington, at 2.25 percent per year. It is further assumed that this growth will only take place in existing drainage basins and no new drainage area will be connected during the 20-year planning horizon, except the Bayview Ridge Residential Area (Drainage Basin 33) will be developed and contribute wastewater flows at buildout conditions in 2030, the last year of the planning period. The development of the Bayview Ridge Residential Area would be in addition to the 2.25 percent per year growth assumed for the rest of the Western Service Area. The wastewater from the Bayview Ridge Residential Area would be conveyed directly to the existing 18-inch-diameter plugged gravity sewer stub-out in Peterson Road, draining directly to Pump Station 8, without passing through any other drainage basins.

Table 5-29 shows the projected annual average sanitary wastewater flows for the various drainage areas within the Western Service Area, based on the assumptions stated above. Existing flows were estimated utilizing pump station records combined with the water use data presented in Tables 5-15 and 5-16.

TABLE 5-29

Projected Annual Average Sanitary Wastewater Flows from Drainage Areas within the Western Service Area

Drainage Basin	Existing (2010) Annual Avg. Flow (gpd)	2015 Annual Avg. Flow (gpd)	2020 Annual Avg. Flow (gpd)	2025 Annual Avg. Flow (gpd)	2030 Annual Avg. Flow (gpd)	Buildout Annual Avg. Flow (gpd)
8. Pump Station 8 (1)	112,000	125,200	139,900	156,400	660,000 (2)	1,730,197
9. Pump Station 9	22,000	24,600	27,500	30,700	34,300	116,293
10. Pump Station 10	27,000	30,200	33,700	37,700	42,100	909,088
16. Pump Station 16	2,500	2,800	3,100	3,500	3,900	270,793
19. Pump Station 19	50	60	60	70	80	31,355
20. Pump Station 20	300	340	370	420	470	291,285
33. Bayview Ridge Residential	0	0	0	0	485,255	485,255

(1) Represents total flow to the wastewater treatment plant from the Western Service Area.
(2) Includes Bayview Ridge Residential Area.

The information presented in Table 5-29 can be utilized to establish the peak hour flow to each of the existing pump stations in the Western Service Area. The peak hour flow is the required capacity of each of the pump station. Table 5-30 shows the peak hour flow for the 5-year increments during the planning period as well as buildout conditions for each of the major existing pump stations in the Western Service Area. The capacity of the existing pump stations are also shown to establish which pump stations are in need of additional capacity.

The conclusions that can be drawn from the information presented in Table 5-30 will be discussed in Chapter 6.

TABLE 5-30

Projected Peak Hour Flows from Drainage Areas within the Western Service Area

Drainage Basin	Existing (2010) Peak Hour Flow with I/I (gpm)	2015 Peak Hour Flow with I/I (gpm)	2020 Peak Hour Flow with I/I (gpm)	2025 Peak Hour Flow with I/I (gpm)	2030 Peak Hour Flow with I/I (gpm)	Buildout Peak Hour Flow with I/I (gpm)	Existing Pump Station Capacity (gpm)(2)
8. Pump Station 8 (1)	862	890	921	955	2,298(3)	4,922	2,950
9. Pump Station 9	175	182	189	197	206	394	645
10. Pump Station 10	348	356	365	375	386	3,001	400
16. Pump Station 16	84	85	86	87	87	996	510
19. Pump Station 19	20	20	20	20	20	132	140
20. Pump Station 20	20	20	20	20	20	1,072	305
33. Bayview Ridge Residential	0	0	0	0	1,418	1,418	—

(1) Represents total flow to the wastewater treatment plant from the Western Service Area.
(2) Based on drawdown tests performed by the City of Burlington.
(3) Includes Bayview Ridge Residential Area.

SAMISH WATER DISTRICT PIPELINE

The future flows from the Samish Water District pipeline will be based on based on the existing agreements with the users of this pipeline. The Samish Water District has a contract for discharging an annual average flow of 250,000 gpd to Pump Station 6. This flow includes all dischargers to the pipeline, except the Skagit Valley Resort and Casino (Casino). This agreement is not expected to change over the next 20 years.

The Casino has had a separate agreement with the City of Burlington to discharge an annual average flow of 60,000 gpd to Pump Station 6. However, as this Plan is being written, the Casino is in the process of constructing its own wastewater treatment facility and will discontinue discharging to the City of Burlington sewer system.

The Casino has submitted a request to the City of Burlington, however, for the City to maintain a reserve capacity for the Casino through 2016, in the case of temporary upsets of their new treatment facility, or if they generate wastewater in excess of the capacity of their new treatment facility. Based on these considerations, the existing annual average flow from the Samish Water District pipeline will be 310,000 gpd, but will decrease to 250,000 gpd within the next 5 years. However, the flow from the Casino should be added when peak flows are considered until the end of 2016.

Beginning in 2017, the Casino would no longer have an agreement for disposal of wastewater to the Burlington sewer system. Wastewater from the Casino will not enter the Burlington sewer system at any time after 2017.

Historically, the maximum month flow from the Samish Water District pipeline has been 1.28 times the annual average flow. Thus, the projected maximum month flow from the Samish Water District pipeline until the end of 2016 will be 1.28 x 310,000 gpd = 396,800 gpd. After 2016, the projected maximum flow from the Samish Water District pipeline will be 1.28 x 250,000 = 320,000 gpd.

The Samish Water District has a waste stabilization pond pretreatment system prior to the wastewater being pumped to the Samish Water District pipeline for conveyance to the City of Burlington sewer system. The effluent flows from this treatment system are conveyed to the City of Burlington during night when the wastewater flows are generally low. Peak hour flows, on which the capacities of wastewater pump stations and pipelines are based, normally occur during the daytime hours. Therefore, the flows from the Samish Water District pretreatment system will be subtracted from the total contracted flow in order to estimate peak hour flows to Pump Station 6.

The annual average flow from the Samish Water District pretreatment system for the period of January 2007 through May 2010 was 102,000 gpd. This leaves an annual average flow of 310,000 gpd – 102,000 gpd = 208,000 gpd discharged during daytime until 2016. Applying a peaking factor of 3.24 to this flow (based on the procedure discussed previously in this chapter), a peak hour flow of 673,400 gpd results for flow from the Samish Water District pipeline until 2016. It is assumed that the above flows include infiltration/inflow.

Beginning in 2017, the daytime annual average flow discharged through the Samish Water District pipeline would be 250,000 – 102,000 = 148,000 gpd. The appropriate peaking factor for this annual average flow is 3.37, resulting in a peak hour flow of 498,900 gpd.

As discussed previously, the required capacity of Pump Station 6 depends on the flow from the Samish Water District pipeline, as well as the flows from Pump Station 7. Pump Station 7 has recently been upgraded with new pumps and discharge piping. The capacities of the two pumps in Pump Station 7 have been established to be 874 gpm and 763 gpm for Pump 1 and Pump 2, respectively. Although the expected peak hour flow from the Pump Station 7 drainage basin is 475 gpm at buildout, it is assumed that the existing pumps will remain throughout the planning horizon (through 2030), but will be replaced by pumps sized to match the peak hour flow at buildout after the planning period. Thus, Pump Station 6 will receive a peak hour flow of 874 gpm from Pump Station 7 through 2030 and 475 gpm after 2030.

Table 5-31 shows the peak hour flow for the 5-year increments during the planning period as well as buildout conditions for Pump Station 6, including flows from Pump Station 7, the Samish Water District pipeline, and the local area around Pump Station 6 draining by gravity to this pump station. The capacity of the existing Pump Station 6 is also shown.

The conclusions that can be drawn from the information presented in Table 5-31 will be discussed in Chapter 6.

TABLE 5-31

Projected Peak Hour Flows to Pump Station 6

Drainage Basin	Existing (2010) Peak Hour Flow with I/I (gpm)	2015 Peak Hour Flow with I/I (gpm)	2020 Peak Hour Flow with I/I (gpm)	2025 Peak Hour Flow with I/I (gpm)	2030 Peak Hour Flow with I/I (gpm)	Buildout Peak Hour Flow with I/I (gpm)	Existing Pump Station Capacity (gpm)[(1)]
6. Pump Station 6 [(1)]	1,363	1,367	1,246	1,248	1,250	1,077	918

(1) Based on drawdown tests performed by the City of Burlington.

SEPTAGE

As discussed previously in this chapter, the septage flow rate has decreased over the past couple of years due to the fact that the Town of LaConner has started to accept septage at its wastewater treatment facility. However, the septage volumes generated in Skagit County are expected to increase in the future. Skagit County has recently enacted an ordinance requiring all homeowners served by septic tanks to clean their septic tanks every 3 years. For the purpose of this Plan, it is assumed that existing annual average septage flows are the average of 2007 and 2008 flows, and that the septage volumes will double over the next 20 years. Table 5-32 shows the projected annual average septage flows to the Burlington wastewater treatment plant over the planning period.

TABLE 5-32

Projected Annual Average Septage Flows

Year	Annual Average Septage Flow (gpd)
2010 (Existing)	2,500
2015	3,000
2020	3,500
2025	4,200
2030	5,000
Buildout	5,000

It is assumed that septage flows will not increase significantly beyond 2030 because further development will take place in existing sewered UGAs.

WASTEWATER TREATMENT PLANT FLOWS

Tables 5-33, 5-34, and 5-35 show the derivation of the total annual average, maximum month, and peak hour flows to the wastewater treatment plant, respectively.

TABLE 5-33

Projected Total Annual Average Flows to the Wastewater Treatment Plant

Wastewater Source	Existing (2010) (gpd)	2015 (gpd)	2020 (gpd)	2025 (gpd)	2030 (gpd)	Buildout (gpd)
Burlington UGA						
Sanitary Flow	598,000	678,900	769,300	879,000	933,200	2,669,800
I/I (150 gpad)	435,700	446,100	462,600	462,600	462,600	470,900
Total	1,033,700	1,125,000	1,231,900	1,341,600	1,395,300	3,140,700
Western Service Area						
Sanitary Flow	112,000	125,200	139,900	156,400	660,000	1,730,200
I/I (150 gpad)	116,200	116,200	116,200	116,200	204,200	417,500
Total	228,200	241,400	256,100	272,600	864,200	2,147,700
Samish Water District Pipeline	310,000	250,000	250,000	250,000	250,000	250,000
Septage	2,500	3,000	3,500	4,200	5,000	5,000
Total to WWTP	**1,574,400**	**1,619,400**	**1,741,500**	**1,868,400**	**2,514,500**	**5,543,400**

TABLE 5-34

Projected Total Maximum Month Flows to the Wastewater Treatment Plant

Wastewater Source	Existing (2010) (gpd)	2015 (gpd)	2020 (gpd)	2025 (gpd)	2030 (gpd)	Buildout (gpd)
Burlington UGA						
Sanitary Flow(1)	717,600	814,700	923,200	1,054,800	1,119,800	3,203,800
I/I (300 gpad)	871,400	892,200	925,200	925,200	925,200	941,800
Total	1,589,000	1,706,900	1,848,400	1,980,000	2,045,000	4,145,600
Western Service Area						
Sanitary Flow(1)	134,400	150,200	163,900	187,700	792,000	2,076,200
I/I (300 gpad)	232,400	232,400	232,400	232,400	408,400	835,100
Total	366,800	382,600	400,300	420,100	1,200,400	2,911,300
Samish Water District Pipeline(2)	365,800	365,800	295,000	295,000	295,000	295,000
Septage	3,600	4,300	5,400	6,000	7,200	7,200
Total to WWTP	**2,325,200**	**2,459,600**	**2,549,100**	**2,701,100**	**3,547,600**	**7,359,100**

(1) Based on flow records, maximum month sanitary wastewater flow is taken to be 1.2 x annual average flow.

(2) Based on flow records, maximum month flow is 1.18 x annual average flow, including I/I.

TABLE 5-35

Projected Total Peak Hour Flows to the Wastewater Treatment Plant

Wastewater Source	Existing (2010) (gpd)	2015 (gpd)	2020 (gpd)	2025 (gpd)	2030 (gpd)	Buildout (gpd)
Annual Average Sanitary Wastewater Flow(1)	918,000	1,012,100	1,056,300	1,183,400	1,741,200	4,548,000
Population Equivalent	22,483	24,788	25,871	28,984	42,645	111,389
Peaking Factor	2.60	2.56	2.54	2.49	2.33	1.96
Peak Hour Sanitary Wastewater Flow	2,386,800	2,591,000	2,683,000	2,946,700	4,057,000	8,914,100
I/I (1,100 gpad)	4,047,300	4,123,500	4,244,500	4,244,500	4,889,900	6,515,300
Total to WWTP	**6,434,100**	**6,514,500**	**6,927,500**	**7,191,200**	**8,946,900**	**15,429,400**

(1) Excludes 102,000 gpd from the Samish Water District treatment lagoons, which is discharged at night and will not contribute to peak hour flow. Flows also include 60,000 gpd from Skagit Valley Resort and Casino through 2015.

PROJECTED LOADING RATES FOR THE PLANNING PERIOD

Future WWTP BOD_5 and TSS loading rates are estimated by multiplying the projected population by the respective loading rate per capita developed previously in this chapter. An annual average BOD_5 of 0.335 pounds per capita per day (lb/cap/d) and an annual average TSS of 0.31 lb/cap/d will be used for the City of Burlington UGA. These represents the average of 2009 and 2010 loading rates and are estimated to include residential, commercial, industrial, and institutional loads. Sanitary wastewater from the Western Service Area is estimated to have the same BOD_5 and TSS concentrations as existing levels which were determined by averaging 2009 and 2010 loads. Wastewater loadings contributed by the Samish Water District pipeline and septage are derived from actual historical wastewater strengths. Tables 5-36 and 5-37 show the estimated annual average and maximum BOD_5 loads, respectively, throughout the planning period and for buildout conditions from the various wastewater contributors.

TABLE 5-36

Projected Total Annual Average BOD_5 Loads to the Wastewater Treatment Plant

Wastewater Source	Existing (2010) (lb/d)	2015 (lb/d)	2020 (lb/d)	2025 (lb/d)	2030 (lb/d)	Buildout (lb/d)
Burlington UGA	2,810	3,190	3,610	4,130	4,390	12,550
Western Service Area	720	810	900	1,010	4,250	11,150
Samish Water District Pipeline	340	80	80	80	80	80
Septage	120	140	170	200	240	240
Total to WWTP	**3,990**	**4,220**	**4,760**	**5,420**	**8,960**	**24,020**

TABLE 5-37

Projected Total Maximum Month BOD_5 Loads to the Wastewater Treatment Plant

Wastewater Source	Existing (2010) (lb/d)	2015 (lb/d)	2020 (lb/d)	2025 (lb/d)	2030 (lb/d)	Buildout (lb/d)
Burlington UGA(1)	3,260	3,700	4,190	4,790	5,090	14,560
Western Service Area(2)	1,070	1,200	1,330	1,490	4,930	12,930
Samish Water District Pipeline(3)	510	510	120	120	120	120
Septage(4)	180	210	260	300	360	360
Total to WWTP	**5,020**	**5,620**	**5,900**	**6,700**	**10,500**	**27,970**

(1) Based on historical data, maximum month/annual average BOD_5 is 1.16.
(2) Based on historical data, maximum month/annual average BOD_5 is 1.48, except for 2030 and beyond, the ratio is estimated to be 1.16 (similar to Burlington UGA), because a larger portion of the wastewater will be domestic in origin.
(3) Based on historical data, maximum month/annual average BOD_5 is 1.50.
(4) Based on historical data, maximum month/annual average BOD_5 is 1.51.

Tables 5-38 and 5-39 show the estimated annual average and maximum TSS loads, respectively, throughout the planning period and for buildout conditions from the various wastewater contributors.

TABLE 5-38

Projected Total Annual Average TSS Loads to the Wastewater Treatment Plant

Wastewater Source	Existing (2010) (lb/d)	2015 (lb/d)	2020 (lb/d)	2025 (lb/d)	2030 (lb/d)	Buildout (lb/d)
Burlington UGA	2,600	2,950	3,340	3,820	4,060	11,610
Western Service Area	690	720	860	960	4,070	10,660
Samish Water District Pipeline	260	80	80	80	80	80
Septage	620	740	880	5,900	1,240	1,240
Total to WWTP	**4,170**	**4,540**	**5,260**	**6,750**	**9,450**	**23,590**

TABLE 5-39

Projected Total Maximum Month TSS Loads to the Wastewater Treatment Plant

Wastewater Source	Existing (2010) (lb/d)	2015 (lb/d)	2020 (lb/d)	2025 (lb/d)	2030 (lb/d)	Buildout (lb/d)
Burlington UGA(1)	2,830	3,220	3,640	4,160	4,430	12,650
Western Service Area(2)	970	1,090	1,210	1,350	4,470	11,620
Samish Water District Pipeline(3)	380	380	120	120	120	120
Septage(4)	1,240	1,480	1,760	2,080	2,480	2,480
Total to WWTP	**5,420**	**6,170**	**6,730**	**7,710**	**11,500**	**26,870**

(1) Based on historical data, maximum month/annual average BOD_5 is 1.09.

(2) Based on historical data, maximum month/annual average BOD_5 is 1.41, except for 2030 and beyond, the ratio is estimated to be 1.09 (similar to Burlington UGA), because a larger portion of the wastewater will be domestic in origin.

(3) Based on historical data, maximum month/annual average BOD_5 is 1.46.

(4) Based on historical data, maximum month/annual average BOD_5 is 2.00.

Table 5-40 shows a summary of the estimated hydraulic, BOD_5, and TSS loads to the wastewater treatment plant.

TABLE 5-40

Summary of Projected Totals to the Wastewater Treatment Plant

Parameter	Existing (2010)	2015	2020	2025	2030	Buildout
Annual Average Flow (mgd)	1.57	1.62	1.74	1.87	2.51	5.54
Maximum Month Flow (mgd)	2.33	2.46	2.55	2.70	3.55	7.36
Peak Hour Flow (mgd)	6.43	6.71	6.93	7.19	8.95	15.43
Annual Average BOD_5 (lb/d)	3,990	4,220	4,760	5,420	8,960	24,020
Maximum Month BOD_5 (lb/d)	5,020	5,620	5,900	6,700	10,500	27,970
Annual Average TSS (lb/d)	4,170	4,540	5,260	5,900	9,450	23,590
Maximum Month TSS (lb/d)	5,420	6,170	6,730	7,710	11,500	26,870

CHAPTER 6

COLLECTION SYSTEM ANALYSIS

INTRODUCTION

The City's wastewater collection system was analyzed for its ability to serve the future population and land use presented in Chapter 3, and the projected wastewater flow rates described in Chapter 5. The City's sewer system was organized into three categories for analysis:

- Pump Stations
- Force Mains
- Major Gravity Lines

The physical condition of the existing wastewater collection system was analyzed through review of previous reports, existing City sewer base maps and data, interviews with City staff, and drawdown testing of pump stations. A hydraulic model was developed to analyze the capacity of major gravity lines at buildout conditions at peak hour wet weather flow rates. The pump station and force main capacities were analyzed using the projected flow rates developed in Chapter 5. The results of the capacity analysis and estimates of physical condition were used to identify collection system components in need of rehabilitation or replacement.

EVALUATION OF PUMP STATIONS

The condition of the existing pump stations was evaluated through previous reports, interviews with City staff, run time records, drawdown testing, and projected wastewater flows. The existing pump stations are in serviceable condition. Station upgrades have been designed for Pump Station 6 and Pump Station 10, with the construction scheduled for 2014 and 2015, respectively.

SCADA AND TELEMETRY

All the lift stations are connected to SCADA or an auto-dialer. Most of the pump stations are connected by phone or fiber optic to an auto-dialer. The auto-dialer places a call if the pump station goes into an alarm mode. Five of the pump stations are connected into a supervisory control and data acquisition (SCADA) telemetry system located at the WWTP. The SCADA system offers the ability to monitor more information and to adjust functions and set points remotely. The City is planning to connect the remaining pump stations to the SCADA system.

FLOW METERS

Pump Stations 8 and 3 are equipped with flow meters on the discharge force main. Pump Station 6 has a flow meter on the inlet discharge from the Samish Water District force main. The flows from the remainder of the pump stations are by pump run time meters. In general, City staff record the pump run time hours three times a week for the majority of the pump stations and once a week for a few of the smaller pump stations. It is recommended that the City install flow meters on the remainder of the larger pump station force mains. The flow meters can be connected to the SCADA system when it has been installed. The flow meters will be able to save a considerable amount of staff time spent driving around and recording run time hours. In particular, the City should consider installing flow meters on pump stations which discharge to a common force main.

GENERATORS

Six of the 21 pump stations have on-site standby generators. The remaining pump stations utilize portable generators for standby power. However, all the pump stations have bypass connections which include the ability to install temporary bypass pumps to pump from the wet well into the force main. The planned upgrades to Pump Station 6 and Pump Station 10 include new permanent generators. It is recommended that some of the larger lift stations be provided with on-site generators to increase system reliability. The pump stations and the types of generators can be seen in Table 6-1.

TABLE 6-1

Pump Station Generator Data

Pump Station	Pump Horsepower	Generator Type
1	5	Portable
2	3	Portable
3	40	On-Site
4	3	On-Site
5	15	On-Site
6	25	On-Site
7	25	Portable
8	75	On-Site
9	15	Portable
10	10	Portable
11	25	On-Site
12	5	Portable
13	7.5	Portable
14	10	Portable
15	5	Portable
16	30	Portable
17	2	Portable
18	5	Portable
19	2	Portable
20	20	Portable
21	5	Portable

PUMP EFFICIENCY AND DRAWDOWN TESTING

Drawdown testing was performed by City staff for the majority of the pump stations. The City measured the time to pump down the wet well 1 foot with each pump. In addition, the time to fill the wet well 1 foot was measured. The drawdown capacity for each pump was calculated based on these measurements and the wet well size and volume for 1 foot of wet well height. Table 6-2 provides the pump station design capacities and the drawdown test capacities.

TABLE 6-2

Pump Station Drawdown Test Results

Pump Station	Pump Design Capacity (gpm)	Pump 1 Drawdown Capacity (gpm)	Pump 2 Drawdown Capacity (gpm)
1	495	497	541
2	390	420	392
3[(1)]	1,500 2,150	N/A	N/A
4	360	361	412
5[(1)]	675 915	915	1,061
6[(1)]	1,400 918	965	918
7	760	874	763
8[(2)]	2,950 3,700	N/A	N/A
9	645	725	646
10	400	407	408
11[(2)]	1,283 1,650	1,343	1,283
12	113	211	244
13[(2)]	290 740	384	390
14	130	131	138
15	297	306	297
16[(3)]	510	529	508
17[(4)]	N/A	N/A	N/A
18	194	211	194
19[(3)]	140	185	141
20[(3)]	305	305	305
21	120	N/A	N/A

(1) Pump Stations 3, 5, and 6 discharge to a common force main. The upper numbers in the capacity column indicate the conditions when all three pump stations discharge simultaneously to the force main. This number represents the rated capacity of the pump station. The lower numbers indicate the condition when each pump station is discharging by itself to the force main. The actual flow rate at any time would be somewhere between the two conditions.

(2) Pump Stations 8, 11, and 13 discharge to a common force main. The upper numbers in the capacity column indicate the conditions when all three pump stations discharge simultaneously to the force main. This number represents the rated capacity of the pump station. The lower numbers indicate the condition when each pump station is discharging by itself to the force main. The actual flow rate at any time would be somewhere between the two conditions.

(3) Pump Stations 16, 19, and 20 discharge to a common force main. The stated capacities for these pump stations have been obtained from drawdown tests and pump curves. No hydraulic analyses have been made on the force main system for these pump stations and it is unknown whether the pumps were operation alone or simultaneously with other pump stations when the drawdown tests were made.

(4) Pump information for Pump Station 17 pumps is not available.

The drawdown test results show that the pump capacities are at or above the design capacities. The drawdown pump results show that the Pump Station 13 pumps do not appear to be operating efficiently. The pump curves show these pumps operating near 40 percent efficiency, when they should be operating closer to the 70 to 80 percent efficiency range. It is recommended that more efficient and possibly higher capacity pumps be swapped out for the existing pumps at Pump Station 13. This could be done separately or concurrently with the installation of a permanent generator.

PUMP STATION CAPACITY

The City owns and operates 21 pump stations. An additional eight pump stations are anticipated as drainage basins are connected to the sewer system. The capacity evaluation of the pump stations was conducted by comparing the existing capacities to the projected wastewater flows. The evaluation includes the existing, 2015, 2020, 2025, 2030, and buildout projected peak hour wastewater flows. The existing pump station capacities are summarized in Chapter 4 and the projected wastewater flows are summarized in Chapter 5. The results of the pump station capacity evaluation can be seen in Table 6-3.

TABLE 6-3

Pump Station Capacity Evaluation

Pump Station	Existing (2010) Peak Hour Flow with I/I (gpm)	2015 Peak Hour Flow with I/I (gpm)	2020 Peak Hour Flow with I/I (gpm)	2025 Peak Hour Flow with I/I (gpm)	2030 Peak Hour Flow with I/I (gpm)	Buildout Peak Hour Flow with I/I (gpm)	Existing Capacity (gpm)
1. Pump Station 1	254	265	265	265	265	265	495
2. Pump Station 2	305	376	384	392	401	869	390
3. Pump Station 3	745	818	832	847	863	1,403	1,500
4. Pump Station 4	385	664	690	717	747	1,005	360
5. Pump Station 5	457	470	484	498	514	1,065	675
6. Pump Station 6	1,363	1,367	1,368	1,370	1,372	969	918
7. Pump Station 7	242	315	328	343	358	475	760
8. Pump Station 8	862	900	943	992	2,342	4,929	2,950
9. Pump Station 9	175	184	194	206	219	400	645
10. Pump Station 10	348	359	371	386	402	3,007	400
11. Pump Station 11	966	992	1,019	1,051	1,083	1,927	1,283
12. Pump Station 12	—	—	—	—	—	—	—
13. Pump Station 13	207	445	453	461	470	1,135	290
14. Pump Station 14	166	167	169	170	171	454	130
15. Pump Station 15	124	125	126	126	127	324	297
16. Pump Station 16	84	85	87	88	90	1,002	510
17. Pump Station 17 (1)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
18. Pump Station 18	52	54	56	58	61	91	194
19. Pump Station 19	20	20	20	20	20	132	140
20. Pump Station 20	20	20	20	20	20	1,072	305
21. Pump Station 21	36	109	115	121	128	170	120
38. East Fairhaven Pump Station	—	156	164	172	180	233	—
39. Peter Anderson Road Pump Station	—	64	67	71	74	97	—
40. Highway 20 Pump Station	—	162	170	178	187	241	—
41. Gages Slough Pump Station	—	205	215	225	237	304	—
42. North Peacock Lane Pump Station	—	72	76	80	84	109	—
47. Gilkey Road Pump Station	—	81	86	91	96	128	—
48. Pease Road Pump Station	—	40	43	45	48	64	—
49. Ovenell Road Pump Station	—	—	—	—	—	1,959	—

(1) Pump information for Pump Station 17 pumps is not available.

The analysis shows that Pump Stations 4 and 14 are currently slightly over their existing capacities. Pump Station 6 is also shown to be over capacity and Pump Station 10 is nearing existing capacity. Both Pump Stations 6 and 10 have been designed for upgrades and the projects are currently scheduled to be constructed in 2014 and 2016, respectively. Pump Station 2 is currently under capacity, but is projected to be at capacity between 2020 and 2025. Pump Station 13 is currently under capacity, but is anticipated to be over capacity by 2015 and is currently operating inefficiently as discussed earlier in this chapter. Pump Station 21 is anticipated to be at capacity in 2025. The remaining pump stations have capacity to serve flows until buildout conditions.

EVALUATION OF FORCE MAINS

The capacity of the City's force mains is tied directly to the pump station capacity evaluation. The existing force main capacity is based on a maximum design velocity of 8 feet per second (fps). However, the maximum velocity of 8 fps is not ideal and results in large head losses for longer force mains. The flow to each force main is equal to the flow to the lift stations which pump to that force main. Table 6-4 compares the pumping capacity of each of the pump stations with the force main capacities.

TABLE 6-4

Force Main Capacity Evaluation

Force Main	Existing Force Main Size (inches)	Existing Capacity [(1)] (gpm)	Existing (2010) Peak Hour Flow with I/I (gpm)	Buildout Peak Hour Flow with I/I (gpm)
Pump Station 1 [(2)]	6 8	705 1,253	254	265
Pump Station 2	8	1,253	305	869
Pump Station 4	8	1,253	385	1,005
Pump Station 6 [(3)]	12 14	2,820 3,838	1,363 2,565	969 3,437
Pump Station 7	12	2,820	242	475
Pump Station 8 [(4)]	20 24 14 20	7,832 11,279 3,838 7,832	1,069 2,035 1,018 1,018	6,419 8,346 4,173 4,301
Pump Station 9	10	1,958	175	400
Pump Station 10	12	2,820	348	3,007
Pump Station 12 [(5)]	4	313	—	113
Pump Station 14	6	705	166	454
Pump Station 15	6	705	124	324
Pump Station 16	8	1,253	84	1,002
Pump Station 17 [(5)]	3	176	—	23
Pump Station 18	4	313	52	91
Pump Station 19	6	705	20	132
Pump Station 20	6	705	20	1,072
Pump Station 21	4	313	36	170

(1) Existing capacity is based on a maximum force main velocity of 8 fps.

(2) Pump Station 1 has a 6-inch force main which increases to an 8-inch force main.

(3) Pump Stations 6 and 3 discharge to a 12-inch common force main. The force main increases to 14 inches as Pump Station 5 discharges to the force main.

(4) Pump Stations 8, 13, and the future McCorquedale Pump Station discharge to a 20-inch common force main. The force main increases to 24 inches as Pump Station 11 discharges to the force main. The flow from the 24-inch force main is split evenly between a 14-inch and 20-inch force main at South Anacortes Street. The future Gilkey Road Pump Station discharges into the 20-inch force main after the split.

(5) Existing flows were not calculated for Pump Stations 12 and 17 because of the small drainage basin area and the low flows seen in run time records. Pump information for Pump Station 17 pumps is not available.

The analysis shows that the Pump Station 4 force main will be near capacity under buildout flows. We recommend this force main be upsized to 10 inches when the pump station is upgraded. The 14-inch force main from Pump Station 6 is shown to be over capacity under buildout flows. This force main should be upsized as buildout flows are achieved. The 14-inch force main from Pump Station 8 is shown to be over capacity under buildout flows. However, the analysis splits the flows from the 24-inch force main equally between the 14-inch force main and 20-inch force main at South Anacortes Street. A plug valve on each of the force mains that can be throttled to split the flows to between the two force mains and the combination of both force mains can accept the buildout flows. The Pump Station 10 force main is slightly over capacity under buildout flows. This force main is long, so a larger force main or a parallel force main should be constructed as buildout flows are achieved.

HYDRAULIC MODEL

A hydraulic model of the City's wastewater collection system is presented in this section, including a description of model development and the assumptions used in the model. This model has two main functions: (1) to provide information to develop recommended improvements to convey the projected flow rates, and (2) to evaluate the system with the recommended capital improvements to verify capacity. The model can be updated and maintained for use as a tool to aid in future planning and design.

MODEL DEVELOPMENT

Physical Model

The major gravity sewer lines of the City's sewer system were modeled using SewerCAD. Figure 6-1 shows the sewer lines that were included in the hydraulic model.

The hydraulic model was developed from record drawing information provided by the City. The accuracy of the hydraulic model results depends on the accuracy of the data input to the model. In some cases, reliable invert elevations of manholes were not known, and invert elevations were linearly interpolated between known invert elevations upstream and downstream. Data used in the hydraulic model is shown in Table 6-5.

TABLE 6-5

Sewer System Information from City Data

Category	Gravity Sewers	Manholes
Number	Pipe ID number based on upstream manhole number	Manhole number based on City's numbering convention
Dimension	Length from City records	Not applicable
Elevation	Upstream and downstream pipe invert elevations from City records	Ground elevations from City records
Size	Pipe diameters from City records	Assumed 48-inch manhole size
Flow Criteria	Assumed Manning's roughness coefficient of 0.013 which corresponds to average concrete pipe	Not applicable

Sewage Flow Model

The hydraulic model was used to simulate peak hour flow rates for the projected buildout flow conditions. Sanitary sewer flow projections determined in Chapter 5 were applied for each of the sewer drainage basins.

For the existing sewer drainage basins with 10-inch or larger sewer pipes, the projected buildout flows were distributed within the drainage basins. Flows from pump stations were input at the force main discharge manholes. For proposed drainage basins, flows were input at the anticipated gravity drainage discharge or force main discharge manhole. Only the existing sewer system was modeled and it was assumed that when future drainage basins are connected to the system, new pipes will be sized to receive projected flows. Appendix E provides the distribution and flow rates input into the sewer model.

Model Evaluation Criteria

The buildout model run identifies sewers that may be hydraulically deficient if a peak hour flow event including infiltration and inflow happened with the estimated buildout flow conditions. The criteria for listing a gravity sewer pipe as "deficient" are that at peak hour flow, the flow exceeds the capacity of the pipe. The capacity of the pipe is calculated using Reynold's equation assuming that the pipe is flowing full. The slope of the pipe is calculated using pipe length and the difference between the pipe invert elevations as recorded in the City's record drawing data. Pipes that marginally exceed their capacity may result in an acceptable surcharge, i.e., a surcharge level in the upstream manhole that does not flood.

RESULTS OF HYDRAULIC MODELING ANALYSIS

The model was run with the projected buildout sanitary and I/I flow rates, and the capacities of the existing sewer pipes were compared to the estimated peak hour flow rates. The projected buildout flow rates can be used to size components for new projects; however, they are very conservative. Table 6-6 provides information on all the existing system components with that may have insufficient capacity under buildout conditions and Figure 6-2 shows the locations of the deficient pipes. These include pipes that have acceptable surcharge levels. Full-size maps of the deficient pipes can be seen in Appendix F.

TABLE 6-6

Hydraulic Model Results – Deficiencies at Projected Buildout Conditions

Pipe Label	Wastewater Flow (gpd)	Capacity Exceedance (gpm)	Existing Pipe Size	Pipe Size Required to Accept Flow
P-1177	4,809,600	2,274	10 inch	18 inch
P-1178	4,809,600	2,850	10 inch	21 inch
P-1179	4,809,600	2,794	10 inch	21 inch
P-1180	4,809,600	2,895	10 inch	24 inch
P-1181	4,809,600	2,811	10 inch	21 inch
P-1182	4,809,600	2,855	10 inch	21 inch
P-1183	4,809,600	2,837	10 inch	21 inch
P-1184	4,809,600	2,328	10 inch	18 inch
P-1185	1,512,000	668	8 inch	12 inch
P-1186	1,512,000	442	8 inch	10 inch
P-1187	1,512,000	266	8 inch	10 inch
P-1188	1,512,000	151	8 inch	10 inch
P-1189	1,512,000	130	8 inch	10 inch
P-1190	1,512,000	151	8 inch	10 inch
P-1201	1,356,480	161	8 inch	10 inch
P-1202	1,356,480	165	8 inch	10 inch
P-1203	1,356,480	84	8 inch	10 inch
P-1222	1,356,480	175	8 inch	10 inch
P-1223	1,356,480	339	8 inch	10 inch
P-1225	1,356,480	572	8 inch	12 inch
P-1226	1,045,440	396	8 inch	12 inch
P-1227	1,045,440	482	8 inch	15 inch
P-1236	1,045,440	306	8 inch	12 inch
P-1238	1,045,440	464	8 inch	12 inch
P-1239	1,045,440	391	8 inch	12 inch
P-1240	734,400	115	8 inch	10 inch
P-1241	734,400	113	8 inch	10 inch
P-1242	734,400	111	8 inch	10 inch
P-1245	734,400	117	8 inch	10 inch
P-1246	734,400	138	8 inch	10 inch

TABLE 6-6 (continued)

Hydraulic Model Results – Deficiencies at Projected Buildout Conditions

Pipe Label	Wastewater Flow (gpd)	Capacity Exceedance (gpm)	Existing Pipe Size	Pipe Size Required to Accept Flow
P-1324	882,720	283	10 inch	15 inch
P-1323	882,720	302	10 inch	15 inch
P-1321	462,240	36	10 inch	12 inch
P-278	1,926,720	612	12 inch	18 inch
P-287	1,926,720	533	12 inch	15 inch
P-292	1,926,720	584	12 inch	15 inch
P-293	1,926,720	577	12 inch	15 inch
P-294	1,779,840	166	12 inch	15 inch
P-295	1,779,840	808	10 inch	15 inch
P-448	802,080	211	8 inch	10 inch
P-445	802,080	171	8 inch	10 inch
P-444	594,720	37	8 inch	10 inch
P-443	594,720	61	8 inch	10 inch
P-441	594,720	50	8 inch	10 inch
P-452	584,640	29	8 inch	10 inch
P-453	584,640	95	8 inch	10 inch
P-454	584,640	31	8 inch	10 inch
P-455	584,640	34	8 inch	10 inch
P-456	584,640	53	8 inch	10 inch
P-556	1,388,160	73	12 inch	15 inch
P-555	1,388,160	148	12 inch	15 inch
P-523	1,388,160	292	10 inch	12 inch
P-515	1,110,240	312	10 inch	15 inch
P-506	1,110,240	288	10 inch	12 inch
P-505	1,110,240	147	8 inch	10 inch
P-504	1,110,240	422	8 inch	12 inch
P-500	1,110,240	413	8 inch	12 inch
P-499	1,110,240	170	8 inch	10 inch
P-498	1,110,240	441	8 inch	12 inch
P-538	1,110,240	443	8 inch	12 inch
P-536	555,840	43	8 inch	10 inch
P-535	555,840	64	8 inch	10 inch
P-534	555,840	35	8 inch	10 inch
P-568	1,108,800	77	10 inch	12 inch
P-572	1,108,800	228	10 inch	12 inch
P-588	1,108,800	138	10 inch	12 inch

TABLE 6-6 (continued)

Hydraulic Model Results – Deficiencies at Projected Buildout Conditions

Pipe Label	Wastewater Flow (gpd)	Capacity Exceedance (gpm)	Existing Pipe Size	Pipe Size Required to Accept Flow
P-591	1,108,800	232	10 inch	12 inch
P-595	1,108,800	7	10 inch	12 inch
P-652	554,400	38	8 inch	10 inch
P-670	554,400	29	8 inch	10 inch
P-671	554,400	34	8 inch	10 inch
P-647	554,400	4	8 inch	10 inch
P-646	554,400	28	8 inch	10 inch
P-645	554,400	25	8 inch	10 inch
P-644	554,400	25	8 inch	10 inch
P-643	554,400	31	8 inch	10 inch
P-642	554,400	24	8 inch	10 inch
P-641	554,400	11	8 inch	10 inch
P-683	1,222,560	141	12 inch	15 inch
P-166	1,222,560	164	12 inch	15 inch
P-105	459,360	7	8 inch	10 inch
P-777	8,036,640	4,064	10 inch	18 inch
P-780	2,050,560	277	12 inch	15 inch
P-781	2,050,560	637	12 inch	15 inch
P-786	2,050,560	615	12 inch	15 inch
P-17	1,846,080	263	10 inch	10 inch
P-18	1,447,200	91	12 inch	15 inch
P-718	5,986,080	3,665	10 inch	24 inch
P-314	5,986,080	3,652	10 inch	24 inch
P-714	5,986,080	3,781	10 inch	27 inch
P-712	5,986,080	3,862	10 inch	27 inch
P-709	5,986,080	3,704	10 inch	24 inch
P-707	5,986,080	3,716	10 inch	24 inch
P-705	5,986,080	3,728	10 inch	24 inch
P-703	5,986,080	3,732	10 inch	24 inch
P-697	5,986,080	3,602	10 inch	24 inch
P-691	5,986,080	3,297	12 inch	24 inch
P-774	6,508,800	1,616	21 inch	27 inch
P-773	6,508,800	1,620	21 inch	27 inch
P-770	6,508,800	1,561	21 inch	27 inch
P-769	6,508,800	1,589	21 inch	27 inch
P-764	6,508,800	1,646	21 inch	27 inch

TABLE 6-6 (continued)

Hydraulic Model Results – Deficiencies at Projected Buildout Conditions

Pipe Label	Wastewater Flow (gpd)	Capacity Exceedance (gpm)	Existing Pipe Size	Pipe Size Required to Accept Flow
P-739	6,508,800	1,948	18 inch	24 inch
P-736	6,304,320	2,399	18 inch	27 inch
P-735	6,304,320	2,386	18 inch	27 inch
P-731	6,304,320	1,711	18 inch	24 inch
P-730	6,304,320	313	18 inch	21 inch
P-728	6,304,320	2,222	18 inch	24 inch
P-729	6,304,320	2,238	18 inch	24 inch

The analysis shows that approximately 100 sections of gravity sewer pipe will not have capacity to accept projected buildout sanitary and I/I peak hour wastewater flows. The analysis also shows that the vast majority of these pipe sections only need to be upsized one pipe size to accept the projected flows. For this reason, we do not recommend any immediate upgrades to sewer pipes based on the hydraulic modeling analysis. As future development occurs and new drainage basins are added to the collection system, the projected wastewater flows should be updated and checked in the hydraulic model. As existing sewer pipes are repaired or replaced, the City should consider upsizing these pipes to accept the projected buildout flows. In general, the cost to upsize a gravity sewer pipe by one size is relatively minor.

The analysis also shows that the existing 18-inch and 21-inch gravity sewer pipes on Gilkey Road will not have the capacity accept projected buildout sanitary and I/I peak hour wastewater flows. However, if the plug valve on the Pump Station 8 force main is throttled, more of the flow can be sent to the 21-inch gravity sewer pipe off Skagit Street and the combination of both gravity pipes can accept the projected buildout flows.

INFILTRATION AND INFLOW

Infiltration and inflow rates were developed in Chapter 5 for each of the existing drainage basins within the City of Burlington service area. The City has an ongoing annual I/I reduction program. The program has been successful in identifying pipes in need of repair and reducing the amount of I/I entering the sanitary sewer system. We recommend that the City continue the I/I reduction program. Eliminating excessive I/I flow can reduce the wear and tear and operating costs at the lift stations and for equipment at the WWTP. In addition, upgrades may be delayed for future facilities such as pump stations, force mains, and gravity sewer lines. One of the most cost-effective methods of identifying sources of I/I is through smoke testing. As discussed in Chapter 5, the following are the recommended priorities for smoke testing and inflow reduction:

1. Bayview Ridge Residential Area
2. Pump Station 1 Drainage Area
3. Pump Station 7 Drainage Area, except Pump Station 18 Drainage Area
4. Old Downtown Area
5. Pump Station 15 Drainage Area
6. Port of Skagit County
7. Remainder of system

CHAPTER 7

WASTEWATER TREATMENT PLANT ANALYSIS

INTRODUCTION

The purpose of this chapter is to evaluate the City of Burlington wastewater treatment plant (WWTP) for its ability to meet its treatment objectives based on projected future flow and loading rates. The projected flow and loading rates for the planning period (2010 to 2030) were determined in Chapter 5. The treatment plant effluent quality must meet the requirements in the current National Pollution Discharge Elimination System (NPDES) permit for 5-day biochemical oxygen demand (BOD_5), total suspended solids (TSS), fecal coliform, and pH (Table 4-5) at these projected conditions. Modifications to increase the operational efficiency or performance of the WWTP will also be recommended. The hydraulic capacity of the treatment plant will be evaluated at the projected peak hour flow.

The WWTP has consistently met its permit effluent limits for BOD_5 and TSS removal since the last upgrade (2001).

PROJECTED FLOW AND LOADING RATES

Table 7-1 presents a comparison of the NPDES-permitted capacity for flow and loading with the projected flow and loading rates that were developed in Chapter 5. Based on these projections, the permitted maximum month (MM) BOD_5 and TSS loading rates may be exceeded around 2025 if the City experiences the growth discussed in Chapter 3. The maximum month flow (MMF) rate will not exceed the permitted capacity, even if the Bayview Ridge Residential Area is developed.

The City's NPDES permit (Appendix A) mandates that when the monthly average flow or loading reaches 85 percent of the capacity listed in the permit for 3 consecutive months or it is projected that the facility would reach design capacity within 5 years, the City must submit a plan to maintain adequate capacity (PMAC) to the Washington State Department of Ecology (Ecology). These requirements are typical in NPDES permits because sufficient time is needed to plan, design, and construct additional capacity. The maximum month influent flow, BOD_5, or TSS have never exceeded 85 percent of the NPDES-permitted design criteria during the past 4 years. Due to continued projected growth in the community, the treatment plant may exceed the 85 percent threshold for maximum month BOD_5 within the next 10 to 15 years, and for the maximum month TSS loads within the next 5 to 10 years. It should be emphasized that the existing and projected flows and loads presented in Table 7-1 include the contracted capacities for the Samish Water District and the Skagit Valley Resort and Casino. The actual discharges from these entities rarely approach their contracted capacities at the present time.

TABLE 7-1

Comparison of NPDES-Permitted Capacity to Current and Projected Flow and Loading Rates

	NPDES Permit Capacity(1)	Existing (2010)	Projections			
			2015	2020	2025	2030
Average Annual Flow (mgd)	NI(2)	1.57	1.62	1.79	1.87	2.51
Maximum Month Flow (mgd)	3.79	2.33	2.46	2.55	2.70	3.55
Peak Hour Flow (mgd)	NI	6.43	6.71	6.93	7.19	8.95
Maximum Month BOD_5 Loading (lb/d)	7,356	5,020	5,620	5,900	6,900	10,500
Maximum Month TSS Loading (lb/d)	7,660	5,420	6,170	6,730	7,710	10,500

(1) Condition S4.A of City's NPDES permit (see Appendix A).
(2) NI = Not included in NPDES permit.

TREATMENT EVALUATION AT PROJECTED FLOW AND LOADING RATES

OVERVIEW

This section provides an evaluation of the capacity of the liquid and solids treatment processes to treat the projected flow and loading rates. The resulting process loading rates are compared to accepted design criteria for each treatment process as presented in Table 4-6.

This section also provides a brief analysis of each component and the applicable criteria, and develops recommended improvements. Some of the more detailed capacity analyses were presented in Chapter 4.

INFLUENT PUMP STATION

The capacity of the existing influent pump station will be exceeded within the next few years. Improvements would include the replacement of existing pumps with higher capacity pumps since the structures and piping should have the capacity to accommodate buildout peak hour flows. At the buildout peak hour flow of 15.55 mgd, the velocity in the two 16-inch-diameter force mains would be 8.6 feet per second; it is desirable to keep this velocity at less than 8 feet per second. However, as the influent pumps are equipped with variable frequency drives, this velocity may be acceptable for short periods of time.

HEADWORKS

The existing headworks consist of a Parshall flume flow meter and a fine screen. The Parshall flume influent flow meter has a capacity of 21.4 mgd, which is more than adequate for buildout conditions. The existing influent screen has a rated peak hour flow capacity of 7.99 mgd, which should be adequate until the Bayview Ridge Residential Area is fully developed (assumed to take place in 2030). The City of Burlington, however, plans to add a second influent screen to the headworks in 2011, bringing the total influent screening capacity to 15.98 mgd. This capacity should be adequate through buildout conditions. The existing influent screen is about 14 years old. The installation of a second screen will reduce the wear of the existing screen and increase the life of the installation.

PRIMARY CLARIFIERS

The primary clarifiers have a maximum month flow capacity of 3.81 mgd and a peak hour flow capacity of 11.4 mgd. This will be adequate throughout the 20-year planning horizon. The mechanisms for the two smaller primary clarifiers (1A and 1B) are almost 40 years old. The City of Burlington should consider overhauling or replacing these clarifier mechanisms in the near future.

AERATION BASINS

The existing aeration basins are estimated to have a capacity equivalent to an influent maximum month BOD_5 load of 8,116 pounds per day. This load is estimated take place sometime between 2025 and 2030. Therefore, an expansion of aeration basin capacity is not an immediate concern. However, if major development occurs, a detailed evaluation of the aeration and possible improvements would be warranted.

SECONDARY CLARIFIERS

The capacity of the secondary clarifiers is limited to a peak hour flow of 7.80 mgd based on the cursory analysis presented in Chapter 4. This would be adequate until major development takes place in the Bayview Ridge Residential Area (or elsewhere). It is recommended that when major developments are being planned, a capacity analysis be performed for the secondary clarifiers based on peak solids loading rates and MLSS inventory shifts (storage of MLSS in the secondary clarifiers will result in a lower MLSS in the aeration basins during peak flows, resulting in a lower MLSS in the aeration basins and a possible higher allowable flow rate to the secondary clarifiers). It is possible that simple improvements, such as the installation of Stamford baffles in the existing secondary clarifiers, would increase the allowable loading rates.

As for the primary clarifiers, the mechanisms for the two smaller secondary clarifiers (1A and 1B) are almost 40 years old. The City of Burlington should consider overhauling or replacing these clarifier mechanisms in the near future.

ULTRAVIOLET DISINFECTION SYSTEM

The existing ultraviolet disinfection system was originally designed for a maximum month flow of 3.79 mgd. At this capacity, existing ultraviolet disinfection system should be adequate throughout the planning period. The ultraviolet structure has an unused parallel channel in which future ultraviolet disinfection equipment could be installed, resulting in a doubling of the capacity of the system to a maximum month flow of 7.58 mgd. This is greater than the maximum month flow under buildout conditions.

EFFLUENT PUMP STATION

The existing effluent pump station has a capacity of 14.3 mgd, which is more than adequate for the planning period.

OUTFALL

The outfall piping system has a capacity of about 11.2 mgd. This is more than adequate for the planning period.

GRAVITY THICKENER

The gravity thickener, thickening primary sludge subsequent to grit removal, has an equivalent maximum month TSS load capacity of 19,600 pounds per day, which is more than adequate for the 20-year planning period. However, the mechanism for the thickener is almost 40 years old. The City of Burlington should consider overhauling or replacing the gravity thickener mechanism in the near future.

WASTE ACTIVATED SLUDGE (WAS) ROTARY DRUM THICKENER

The WAS rotary drum thickener has an estimated capacity equivalent to a maximum month BOD_5 load of 8,565 pounds per day. This would be adequate until 2030, when it is estimated that the Bayview Ridge Residential Area develops. When this area develops, the thickener should be replaced with equipment with a capacity to be determined at that time.

ANAEROBIC DIGESTERS

The capacity of the anaerobic digestion system is basically the same at the maximum month permitted BOD_5 and TSS loads to the wastewater treatment plant, 7,356 pounds per day and 7,660 pounds per day, respectively (see Table 7-1). This means that the capacity of the anaerobic digesters may be exceeded sometime around 2025, based on the assumptions regarding growth presented in this Plan. Provisions have been made for the installation of a second primary digester, which would double the capacity of the anaerobic digester system. It is recommended that planning for the installation of this second primary digester be initiated within the next 10 years so that construction of this new digester may be completed before the influent loads reach the limiting capacities of the digestion system.

The anaerobic digestion system is also in need of several other improvements in order to improve maintenance of the system:

- The digested boiler and gas piping should be upgraded to remove moisture in the digester gas. Moisture is highly corrosive to the boiler and results in excessive maintenance and parts replacement.

- The digester recirculation centrifugal pumps should be replaced with positive displacement pumps in order to reduce cavitation due to digester gas being released.

- Some valves on the sludge piping are subject to struvite formation resulting in inoperable valves. These valves should be replaced with glass-lined valves.

These improvements should be implemented as soon as possible.

SLUDGE DEWATERING

The capacity of existing belt filter press used for digested sludge dewatering exceeds projected 2030 wastewater loads.

SLUDGE DRYING

The sludge drying unit producing Class A biosolids would provide adequate capacity if operated approximately 24 hours per day 20 days per month under 2030 maximum month load conditions. This operational schedule will be feasible utilizing the existing sludge dryer.

RECOMMENDED WWTP PLAN

Although only a few immediate improvements are required at the City of Burlington wastewater treatment facility, it is recommended that some planning take place to ensure that the wastewater treatment facility has the required capacity when the need arises. It is recommended that the City of Burlington take the following actions in order to provide for the future wastewater treatment needs for the community:

1. **Immediate Actions:**

   - Increase the capacity of the influent pump station to a peak hour flow rate of 9.31 mgd (6,465 gpm). This should provide adequate capacity through 2030.
   - Install the second influent screen. The screen has already been budgeted for and ordered by the City of Burlington. It is scheduled for delivery in September 2011.
   - Implement modifications to the digester gas piping and boiler, digester recirculation pumps, and digester piping valves.
   - Perform as assessment to determine the remaining useful life of the mechanisms for Primary Clarifiers 1A and 1B, Secondary Clarifiers 1A and 1B, and the gravity primary sludge thickener.

2. **Actions to Be Taken Before 2015:**

   - Refurbish or replace the mechanisms for Primary Clarifiers 1A and 1B, Secondary Clarifiers 1A and 1B, and the gravity primary sludge thickener, if required.

3. **Actions to Be Taken during the Period of 2015 to 2020:**

   - Prepare a Design Report to add the second primary digester.

4. **Actions to Be Taken during the Period of 2020 to 2025:**

   - Design and construct a second primary digester.
   - Prepare a Predesign Report to increase aeration basin capacity.

5. **Actions to Be Taken during the Period of 2025 to 2030:**

   - Design and construct increased aeration basin capacity.
   - Prepare a Predesign Report to increase secondary clarifier capacity and WAS thickening capacity.

WATER RECLAMATION AND REUSE EVALUATION

INTRODUCTION

The State Legislature has declared there is “a primary interest in the development of facilities to provide reclaimed water to replace potable water in non-potable applications, to supplement existing surface and groundwater supplies, and to assist in meeting the future water requirements of the state.” In accordance with this declaration and

RCW 90.48, this Wastewater Comprehensive Plan must evaluate the potential for water reuse.

Wastewater reclamation and reuse can have benefits for a community's water supply and wastewater management. Production of reclaimed water for use in non-potable applications can be especially beneficial to public water systems facing water supply shortages through physical or water rights supply limitations. Reclaimed water can delay or eliminate the need for additional water rights or potable water system capital improvements. The utility may be able to generate additional revenue by selling reclaimed water. Reclaimed water, in some cases, may be stored in the groundwater aquifer and recovered for later use by the utility. Water reclamation may also provide benefits to wastewater disposal responsibilities where receiving water constraints preclude increased discharge into a surface water body. Beyond the benefits to utilities, reclaimed water may provide environmental and aesthetic benefits to the community, such as augmenting stream flow, creating wetlands habitat, or improving recreation facilities.

This chapter presents a brief evaluation of the feasibility of reclaiming effluent from the WWTP and reusing it in the City.

WATER RECLAMATION AND REUSE STANDARDS IN THE STATE OF WASHINGTON

In contrast to effluent disposal, water reclamation (i.e., reuse of treated effluent) is management of integrated water resources. In the State of Washington, any type of direct beneficial reuse of municipal wastewater is defined as water reuse or reclamation. Water Reuse and Reclamation (WRR) Standards have been issued jointly by the Departments of Health (DOH) and Ecology. This discussion is based on the current standards dated September 1997, which are adopted by reference in RCW Chapter 90.46, Reclaimed Water Use.

Reuse standards for the State of Washington were developed following an analysis of similar standards used in the States of California, Arizona, Texas, and Florida where reuse of municipal wastewater has been underway for many years.

The State of Washington reuse standards for municipal wastewater can be broken down into the four following areas:

1. Treatment Standards
2. Allowable Uses of Reclaimed Water
3. Use Area Requirements
4. Operational and Reliability Requirements

A key difference between water reuse and effluent disposal is in the level of reliability required within the treatment process, distribution, and use areas. The State of

Washington's reuse treatment standards call for continuous compliance, meaning that the treatment standard must be met on a constant basis or the treated water cannot be used as reclaimed water.

Treatment Standards

The State of Washington's standards for municipal wastewater reuse have four classifications (Classes A, B, C, and D) based on the type of treatment provided, as shown in Table 7-2. Class A reclaimed water, the highest classification, is generally required for uses with potential for public contact. Under RCW 90.46, Class A reclaimed water means reclaimed water that, at a minimum, is at all times an oxidized, coagulated, filtered, disinfected wastewater. To meet Class A reclaimed water standards, the facility effluent must be coagulated and filtered in order to meet a turbidity standard. Reclaimed water must be disinfected to meet a coliform standard that is much stricter than the standard for secondary effluent.

TABLE 7-2

State of Washington Reclaimed Water Treatment Standards

Reuse Class	Continuously Oxidized (1)	Continuously Coagulated (2)	Continuously Filtered (3)	Disinfection Total Coliform Density(4)	
				7-Day Median Value	Single Sample
D	Yes	No	No	≤ 240/100 ml	no standard
C	Yes	No	No	≤ 23/100 ml	240/100 ml
B	Yes	No	No	≤ 2.2/100 ml	23/100 ml
A	Yes	Yes	Yes	≤ 2.2/100 ml	23/100 ml

(1) Oxidized wastewater is defined as wastewater in which organic matter has been stabilized such that the BOD_5 does not exceed 30 mg/L and the TSS does not exceed 30 mg/L (monthly average basis), is non-putrescable (does not have a foul smell), and contains dissolved oxygen.

(2) Coagulated wastewater is defined as an oxidized wastewater in which colloidal and finely divided suspended matter have been destabilized and agglomerated prior to filtration by the addition of chemicals or an equally effective method.

(3) Filtered wastewater is defined as an oxidized, coagulated wastewater that has been passed through natural undisturbed soils or filter media, such as sand or anthracite, so that the turbidity as determined by an approved laboratory method does not exceed an average operating turbidity of 2 nephelometric turbidity units (NTU), determined monthly, and does not exceed 5 NTU at any time.

(4) Disinfection is a process that destroys pathogenic organisms by physical, chemical, or biological means. The disinfection standards use coliform density as the measure of pathogen destruction. DOH recommends that a chlorine residual of 0.5 mg/L be maintained during conveyance from the reclamation facility to the use area to avoid biological growth.

Allowable Uses of Reclaimed Municipal Wastewater

Allowable water reuse methods are presented in Table 7-3. Most of these methods provide limited potential due to the relatively small quantities and seasonal nature of the reuse method. Two reuse methods that offer the potential for 100 percent reuse on a year-round basis are groundwater recharge and stream flow augmentation.

However, the general basis for the reuse criteria is that when unlimited public access to the reclaimed water is involved, the criteria will require Class A reclaimed water. Essentially, this means that for a water reclamation project to have any degree of flexibility as well as a potential for relatively unrestricted use, the reclaimed water should meet the Class A reuse standard.

TABLE 7-3

Allowable Uses of Reclaimed Water

Use	Class of Reclaimed Water Required			
	A	**B**	**C**	**D**
Irrigation of Non-Food Crops				
Trees and Fodder, Fiber, and Seed Crops	Yes	Yes	Yes	Yes
Sod, Ornamental Plants for Commercial Use, Pasture to Which Milking Cows or Goats Have Access	Yes	Yes	Yes	No
Irrigation of Food Crops				
Spray Irrigation				
All food crops	Yes	No	No	No
Food crops which undergo physical or chemical processing sufficient to destroy all pathogenic agents	Yes	Yes	Yes	Yes
Surface Irrigation				
Crop	Yes	Yes	No	No
Root crops	Yes	No	No	No
Orchards and vineyards	Yes	Yes	Yes	Yes
Landscape Irrigation				
Restricted Access Areas (e.g., cemeteries, freeway landscaping)	Yes	Yes	Yes	No
Open Access Areas (e.g., golf courses, parks, playgrounds, etc.)	Yes	No	No	No
Impoundments				
Landscape Impoundments	Yes	Yes	Yes	No
Restricted Recreational Impoundments	Yes	Yes	No	No
Non-Restricted Recreational Impoundments	Yes	No	No	No
Fish Hatchery Basins	Yes	Yes	No	No
Decorative Fountains	Yes	Yes	No	No
Other Uses				
Flushing of Sanitary Sewers	Yes	Yes	Yes	Yes
Street Cleaning				
Street sweeping, brush dampening	Yes	Yes	Yes	No
Street washing, spray	Yes	No	No	No
Washing of Corporation Yards, Lots, and Sidewalks	Yes	Yes	No	No
Dust Control (dampening unpaved roads, other surfaces)	Yes	Yes	Yes	No

TABLE 7-3 (continued)

Allowable Uses of Reclaimed Water

Use	Class of Reclaimed Water Required			
	A	B	C	D
Other Uses (continued)				
Dampening of Solid for Compaction (construction, landfills, etc.)	Yes	Yes	Yes	No
Water Jetting for Consolidation of Backfill Around Reclaimed Water, Sewage, Storm Drainage, Gas, Electrical Pipelines	Yes	Yes	Yes	No
Fire Fighting Protection				
Dumping from aircraft	Yes	Yes	Yes	No
Hydrants or sprinkler systems in buildings	Yes	No	No	No
Toilet and Urinal Flushing	Yes	No	No	No
Ship Ballast	Yes	Yes	Yes	No
Washing Aggregate and Making Concrete	Yes	Yes	Yes	No
Industrial Boiler Feed	Yes	Yes	Yes	No
Industrial Cooling				
Aerosols or other mist not created	Yes	Yes	Yes	No
Aerosols or other mist created (e.g., cooling towers, spraying)	Yes	No	No	No
Industrial Process				
Without exposure to workers	Yes	Yes	Yes	No
With exposure of workers	Yes	No	No	No

Use Area Requirements

The WRR standards establish criteria for siting and identifying water reclamation projects and their facilities. Water reclamation storage facilities, valves, and piping must be clearly labeled and no cross connections between potable water and reclaimed water lines are allowed. A key area requirement for a water reclamation project is setback distance. Table 7-4 summarizes setback requirements for water reclamation facilities.

TABLE 7-4

Setback Distances for Reclaimed Water in the State of Washington

Reclaimed Water Use/Facility	Minimum Distance to Potable Water Well			
	Class A	**Class B**	**Class C**	**Class D**
Spray or Surface Irrigation	50 feet	50 feet	100 feet	300 feet
Unlined Storage Pond or Impoundment	500 feet	500 feet	500 feet	1,000 feet
Lined Storage Pond or Impoundment	100 feet	100 feet	100 feet	200 feet
Pipeline	50 feet	100 feet	100 feet	300 feet
Minimum Distance Between Irrigation Area and Public Areas	0 foot	50 feet	50 feet	100 feet

Operational and Reliability Requirements

Under the reuse standards there are a number of operational and reliability requirements for a water reclamation facility. Some key requirements are summarized below:

1. Minimum Class III Operator
2. Critical equipment and process failures must be signaled by an alarm
3. Emergency storage/disposal in event of facility failure
4. Operating records provided to DOH as well as Ecology
5. No bypass reuse areas of untreated or partially treated water
6. A standby power supply or long-term disposal or storage facilities

POTENTIAL FOR REUSE IN THE CITY OF BURLINGTON

The potential benefits and uses of reclaimed water were evaluated for applicability to the City of Burlington.

Upland Water Reuse

The Skagit River reach near the City's effluent discharge meets all the applicable water quality standards. Ecology has determined that the City's effluent discharge does not have a reasonable potential to cause exceedances of water quality standards in the Skagit River. Therefore, the City does not have a need to implement water reuse in order to reduce discharge into the Skagit River based on the current NPDES permit and water quality standards.

Offsets to Existing Water Rights

The water system in the City of Burlington is owned and operated by Skagit County PUD, which owns and administers all water rights associated with water supply. The City of Burlington could negotiate water rights agreements with Skagit County PUD.

Substitution of Potable Water Uses

Potable water in the City of Burlington is used for residential, commercial, industrial, municipal, and irrigation uses. Substitution of potable water with reclaimed water for uses not requiring potable water quality reduces the demand on potable water.

Landscape Irrigation

The most visible water application in the City that does not require potable quality water is landscape irrigation of City parks, schools, and other facilities. Landscape irrigation of sites with public access requires Class A reclaimed water. To date in Washington State, reclaimed water has not been supplied for irrigation of residential lawns due to maintenance and cross-connection control concerns.

In 2004, the City of Burlington commissioned an evaluation of utilizing reclaimed water to irrigate the Skagit River Park and the Rotary Park, located south of the existing Burlington wastewater treatment facility. This evaluation, provided in Appendix G, concluded that the most cost-effective alternative to supply irrigation water to these parks was purchasing water from Skagit County PUD. The City of Burlington is already using secondary effluent for landscape irrigation at the wastewater treatment facility site.

Sanitary Sewer Flushing

Another potential use for reclaimed water in Burlington is sanitary sewer flushing. Reclaimed water used for flushing sanitary sewers must at least meet Class D standards.

City of Burlington is already using secondary effluent for sanitary sewer flushing. Secondary effluent meets the criteria for Class D reclaimed water (see Table 7-2).

Recommended Uses

It is recommended that the City of Burlington continue to utilize reclaimed effluent for landscape irrigation on the wastewater treatment plant site and for sanitary sewer flushing. Based on the discussion above, it is also recommended that additional uses for reclaimed water be pursued as opportunities arise.

CHAPTER 8

CAPITAL IMPROVEMENT PLAN

INTRODUCTION

To implement the collection system improvements and wastewater treatment plant improvements discussed in Chapters 6 and 7, it is recommended that the City implement the Capital Improvement Plan (CIP) presented in this chapter. The projects presented here will require City funds to construct.

The required capacity and timing of each recommended improvement are given for budgeting and financial projection purposes only. The actual design parameters should be evaluated at the design phase of the project. Updated population and flow data should be used when available to ensure that the proposed facilities are adequately sized to transport buildout flows.

Additional projects that are not identified as part of the City's CIP may become necessary. Such projects may be required in order to remedy an emergency situation, to address unforeseen problems, or to accommodate improvements proposed or required by other agencies. Due to budgetary constraints, the completion of such projects may require alterations to the recommended CIP. The City retains the flexibility to reschedule, expand, or reduce the projects included in the CIP and to add new projects to the CIP, as best determined by the City Council, when new information becomes available for review and analysis.

BUDGETED CAPITAL IMPROVEMENTS PROJECTS

The City has prepared a preliminary Capital Improvement List for budgeting purposes. The CIP projects that are currently budgeted for construction within the next 6 years are summarized in Table 8-1. The costs presented in Table 8-1 are based on 2011 costs and have been prepared for guidance in project evaluation from the information available at the time of preparation. The final costs of the project will depend on the actual labor and material costs, actual site conditions, competitive market conditions, final project scope, final project schedule, and other variable factors. As a result, the final project costs will vary from the costs presented below. Because of these factors, funding needs must be carefully reviewed prior to making specific financial decisions or establishing final budgets.

TABLE 8-1

Budgeted Capital Improvement Projects

No.	Year	Improvements	Cost	Annual Totals	Financier
S115	2012	Section Street Sewer	$100,000		COB[(1)]
	2012	Job 3 Hawthorne Street Sewer	$320,000	$420,000	COB
	2013	Rio Vista Sewer	$447,000		COB
S106	2013	Pump Station Landscaping	$10,000		COB
	2013	Job 1 Schedule B: McKinley Street Sewer	$104,000	$561,000	COB
S131	2014	WWTP Lab/Admin Building Upgrades	$275,000		COB
S108	2014	Equipment Storage Building	$150,000		COB
S119	2014	Job 1 Schedule C: Koch Street Sewer	$258,000		COB
S007	2014	Clarifier Drive Upgrade	$100,000	$783,000	COB
S007	2015	Clarifier Drive Upgrade	$100,000		COB
S106	2015	Pump Station Landscaping	$10,000		COB
S122	2015	Job 4: Regent Street Sewer	$170,000		COB
	2015	Sludge Dewatering Unit	$300,000	$580,000	COB
S109	2016	Pump Station 6	$900,000		COB
S111	2016	Pump Station 9	$175,000		COB
S114	2016	Sewer Line Replacement	$275,000		COB
S112	2016	Pump Station 10	$250,000		COB
S007	2016	Clarifier Drive Upgrade	$100,000	$1,700,000	COB
S007	2017	Clarifier Drive Upgrade	$100,000		COB
S112	2017	Pump Station 10	$250,000		COB
S114	2017	Sewer Line Replacement	$275,000	$625,000	COB

(1) City of Burlington.

S115 **<u>Section Street Sewer</u>**

Project Details: This project will replace a portion of the concrete sewer pipe in Section Street with new PVC sewer which will have the capacity to accept projected buildout flows. The project will be constructed as a portion of a road and sidewalk improvement project.

Estimated Completion: 2012
Estimated Project Cost: $100,000

<u>Job 3 Hawthorne Street Sewer</u>

Project Details: This project will replace approximately 1,000 linear feet of old concrete sewer pipe with new PVC sewer which will have the capacity to accept projected buildout flows.

Estimated Completion: 2012
Estimated Project Cost: $320,000

Rio Vista Sewer

Project Details: This project will replace approximately 1,400 linear feet of old concrete sewer pipe with new PVC sewer which will have the capacity to accept projected buildout flows.
Estimated Completion: 2013
Estimated Project Cost: $447,000

S106 **Pump Station Landscaping**

Project Details: This project will update and refurbish landscaping at the existing pump stations. Plantings, site clearing, and debris removal will all be accomplished.
Estimated Completion: 2013
Estimated Project Cost: $10,000

Job 1 Schedule B: McKinley Street Sewer

Project Details: This project will replace approximately 400 linear feet of old 6-inch concrete sewer pipe with new 8-inch PVC sewer which will have the capacity to accept projected buildout flows.
Estimated Completion: 2013
Estimated Project Cost: $104,000

S131 **Lab/Admin Building Upgrades**

Project Details: This project would upgrade the existing laboratory and administrative space.
Estimated Completion: 2014
Estimated Project Cost: $275,000

S108 **Equipment Storage Building**

Project Details: This project would upgrade the existing equipment storage space.
Estimated Completion: 2014
Estimated Project Cost: $150,000

S119 **Job 1 Schedule C: Koch Street Sewer**

Project Details: This project will replace approximately 700 linear feet of old 6-inch concrete sewer pipe with new 8-inch PVC sewer which will have the capacity to accept projected buildout flows. The construction will include storm drainage improvements.
Estimated Completion: 2014
Estimated Project Cost: $258,000

S007 **Clarifier Drive Upgrade**

Project Details: This project will assess the condition of the existing mechanisms for the clarifiers constructed in the 1970s and refurbish or replace them, as required.
Estimated Completion: 2014 to 2017
Estimated Project Cost: $400,000

S106 **Pump Station Landscaping**

Project Details: This project will update and refurbish landscaping at the existing pump stations. Plantings, site clearing, and debris removal will all be accomplished.
Estimated Completion: 2015
Estimated Project Cost: $10,000

S122 **Job 4: Regent Street Sewer**

Project Details: This project will replace approximately 1,000 linear feet of old 6-inch concrete sewer pipe with new 8-inch PVC sewer which will have the capacity to accept projected buildout flows.
Estimated Completion: 2015
Estimated Project Cost: $170,000

Sludge Dewatering Unit

Project Details: This project will refurbish or replace the existing digested sludge belt filter press dewatering unit. The existing unit should have adequate capacity for the 20-year planning period, but some parts may be approaching the end of their useful life.
Estimated Completion: 2015
Estimated Project Cost: $300,000

S109 **Pump Station 6**

Project Details: This project is currently designed to upgrade the existing Pump Station 6 from a 900 gpm capacity to a 1,580 gpm capacity pump station.
Estimated Completion: 2016
Estimated Project Cost: $900,000

S111 **Pump Station 9**

Project Details: This project will add a new control panel and a permanent generator to the site.
Estimated Completion: 2016
Estimated Project Cost: $175,000

S114 **Sewer Line Replacement**

Project Details: This project is part of an ongoing replacement program to replace aging and leaky sewer lines and manholes.
Estimated Completion: 2016
Estimated Project Cost: $275,000

S112 **Pump Station 10**

Project Details: This project is currently designed to upgrade the existing Pump Station 10 from a 400 gpm to a 1,575 gpm pump station and add a permanent generator.
Estimated Completion: 2016 to 2017
Estimated Project Cost: $500,000

S114 **Sewer Line Replacement**

Project Details: This project is part of an ongoing replacement program to replace aging and leaky sewer lines and manholes.
Estimated Completion: 2017
Estimated Project Cost: $275,000

S106 **Pump Station Landscaping**

Project Details: This project will update and refurbish landscaping at the existing pump stations. Plantings, site clearing, and debris removal will all be accomplished.
Estimated Completion: 2017
Estimated Project Cost: $10,000

OTHER RECOMMENDED CAPITAL IMPROVEMENTS PROJECTS

Additional projects which are not currently budgeted are recommended within the 6-year planning period. We recommend these projects be constructed if the funding becomes available. We have provided a description of each recommended project and a budgetary project cost.

Pump Station 4

Project Details: Our analysis shows this pump station is currently under capacity. We recommend that the lift station be upgraded to accept projected wastewater flows. The project is currently scheduled for construction in 2018.
Estimated Completion: N/A
Estimated Project Cost: $500,000

Pump Station 13

Project Details: Our analysis shows this pump station is currently under capacity. In addition, the pumps appear to be operating inefficiently. We recommend that the existing pumps be replaced with higher capacity pumps that operate more efficiently. The higher capacity, more efficient pumps will save on energy costs and add capacity to the pump station to avoid pump station upgrade until flows increase. A standby generator should also be added to this pump station.
Estimated Completion: N/A
Estimated Project Cost: $250,000

Pump Station 14

Project Details: Our analysis shows this pump station is currently under capacity. In addition, Pump Station 15, which is upstream of this pump station, pumps at a much higher rate. We recommend that the pump station be upgraded to accept projected wastewater flows.
Estimated Completion: N/A
Estimated Project Cost: $50,000

Wastewater Treatment Plant Influent Pump Station

Project Details: Our analysis shows this pump station will be under capacity within a few years. We recommend that the pump station be upgraded from 4,600 gpm to 6,465 gpm capacity.
Estimated Completion: N/A
Estimated Project Cost: $75,000

Predesign Report to Add the Second Primary Anaerobic Digester

Project Details: Prepare a Predesign Report for adding a second primary anaerobic digester including all appurtenances, such as gas and heating system sludge pumping systems, and piping systems.

Estimated Completion: N/A

Estimated Project Cost: $40,000

CHAPTER 9

FINANCIAL ANALYSIS

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

FINANCIAL STATUS OF EXISTING SEWER UTILITY

CURRENT SEWER RATES

The current rates became effective January 1, 2010. The City of Burlington Municipal Code is included in Appendix H. Burlington charges customers according to three tiers for up to 500 cubic feet of usage, and an additional fee for each additional 100 cubic feet of usage. Rates vary for residents inside and outside the city limits. Sewer bills are collected bimonthly and are based on average winter water use records. Table 9-1 summarizes monthly sewer rates. The base residential fee of $30.56 corresponds to an in-city customer producing less than or equal to 500 cubic feet of low-strength sewage.

TABLE 9-1

Monthly Sewer Rates[1]

	In-City Residential and Commercial [2]			Out-of-City Residential and Commercial [2]		
	2008	**2009**	**2010**	**2008**	**2009**	**2010**
Low Strength						
First 500 cubic feet	$28.81	$29.67	$30.56	$36.01	$37.09	$38.20
Additional 100 cubic feet	$ 4.11	$ 4.23	$ 4.36	$ 5.14	$ 5.29	$ 5.45
Medium Strength						
First 500 cubic feet	$40.98	$42.21	$43.48	$51.23	$52.77	$54.35
Additional 100 cubic feet	$ 6.55	$ 6.75	$ 6.95	$ 8.20	$ 8.44	$ 8.69
High Strength						
First 500 cubic feet	$52.73	$54.31	$55.94	$65.91	$67.89	$69.93
Additional 100 cubic feet	$ 8.89	$ 9.16	$ 9.43	$11.11	$11.45	$11.79

(1) City of Burlington Municipal Code No. 13.08.
(2) Source: http://www.ci.burlington.wa.us/page.asp_Q_navigationid_E_132.

GENERAL FACILITY CHARGES

The City of Burlington imposes a general facility charge (GFC) for all new connections to the sewer system to finance improvements to the wastewater system which are required to service future growth. GFCs are generally established as one-time charges assessed against new sewer customers as a way to recover a part of the cost of additional system capacity constructed for their use.

Typical items of construction financed by the general facility charge are wastewater treatment facilities, pump stations, interceptors, and other general improvements that benefit the entire system.

New residential building customers pay for city inspections associated with connecting to the system, plus a GFC of $3,130 for each unit up to three. Larger residential buildings with more than three units are assessed a GFC of $2,503 per unit. These charges apply only to citizens located within city limits. Customers outside city limits are assessed a GFC of $4,505 for buildings with up to three units and $3,604 for buildings with more than three units. Not included in these GFC charges are costs for main taps and side sewer connections needed to connect to the city system. GFC costs are summarized in Table 9-2 and include the GFC rate plus a $100 permit and inspection fee required for all new connections.

Certain facilities, such as restaurants, are considered high-strength customers because of their high load production potential and are subject to a different connection and service fees. Connection charges for these high-strength customers are calculated by multiplying the number of seats in the facility by 2 pounds of BOD per day per seat, then multiplying this value by $2,057 per pound of BOD per day. Facilities with a well-maintained grease interceptor are also eligible for a connection charge discount of 25 percent. This base connection fee is then added to the number of plumbing fixtures in the facility. The formula is seen below.

TABLE 9-2

City and Surrounding Area General Facility Charges

Location	Cost
Within City Limits	
Commercial (per fixture)	$ 156
Residential (per unit)	
≤ 3 units	$3,130
> 3 units	$2,503
Outside City Limits	
Commercial (per fixture)	$ 226
Residential (per unit)	
≤ 3 units	$4,505
> 3 units	$3,604

HISTORICAL FINANCIAL OPERATIONS

The City of Burlington operates two individual fund sources, the City Sewer Fund and the Sewer Capital Improvements Fund. Historical financial operations for 2007 through 2010 are summarized in Table 9-3. Net revenues are calculated as total revenues minus total expenditures. While the City had surplus funds in 2007, 2008, and 2009, the combined funds showed a deficit of almost $500,000 in 2010.

TABLE 9-3

Sewer Utility Historical Financial Operations (1)

Revenues	2007	2008	2009	2010
Net Cash and Investments	$ 2,731,217	$ 3,901,397	$ 4,512,071	$ 4,577,484
Licenses and Permits	$ 257,292	$ 357,167	$ 204,080	$ 192,668
Sewer Charges	$ 2,990,473	$ 2,963,148	$ 2,963,993	$ 3,197,865
Miscellaneous	$ 188,249	$ 134,587	$ 77,389	$ 57,531
Non Revenues	$ 3,567,765	$ 2,513,582	$ 2,150,372	$ 2,195,684
Other Sources	$ 1,418,175	$ 1,365,000	$ 1,665,000	$ 1,500,000
Total Revenues	**$11,153,171**	**$11,234,881**	**$11,572,905**	**$11,721,232**
Expenses	**2007**	**2008**	**2009**	**2010**
Net Cash and Investments	$ 0	$ 0	$ 4,577,484	$ 4,300,584
Salaries and Wages	$ 524,152	$ 523,221	$ 567,737	$ 624,216
Personnel Benefits	$ 204,399	$ 213,721	$ 233,034	$ 255,367
Supplies	$ 84,225	$ 68,170	$ 86,427	$ 95,752
Other Services	$ 516,422	$ 519,340	$ 642,230	$ 650,266
Non-Expenditures	$ 4,558,188	$ 3,631,536	$ 2,104,894	$ 3,586,549
Other Financing Uses	$ 1,542,125	$ 1,525,000	$ 1,836,200	$ 1,683,420
Debt Service	$ 221,938	$ 197,788	$ 172,888	$ 145,100
Capital Outlay	$ 197,695	$ 539,997	$ 448,760	$ 875,054
Total Expenses	**$ 7,849,144**	**$ 7,218,773**	**$10,669,654**	**$12,216,308**
Combined Net Revenues	**$ 3,304,027**	**$ 4,016,108**	**$ 903,251**	**($ 495,076)**

(1) Values derived from information supplied by the City of Burlington.

PROJECTED GROWTH, REVENUES, EXPENSES, AND RESERVES

Projected Growth

In order to project future revenues, the growth of the number of customers must be estimated. In Chapter 3, sewer service area population was projected to grow approximately 3 percent annually during the 6-year planning period (from 2011 through 2017). In addition, the City estimated a sewer population growth of 2 percent in the 2010 Projected Expenditure Report. The more conservative rate of 2 percent from the Expenditure Report will be used for this financial analysis.

Projected Revenues

Table 9-4 summarizes the projected operating revenues for the years 2011 through 2017. Revenue streams include continual collection of sewer rates, new sewer connections, septage disposal, and investment interest. Monthly sewer charges and new connection charges comprise an average of 95.4 percent of the City's total sewer revenues. Thus, an increase in GFCs and sewer rates will have the largest impact on the City's overall revenue stream.

Projected Expenditures

The projected operating expenses for 2011 through 2017 are summarized in Table 9-5. The values are based on the City's 2010 Projected Expenditure Report. Projections for operation and maintenance expenditures are based on a 4 percent annual increase. Data was taken from values provided by the City and verified using typical projections for population growth (2 percent) and inflation (3.5 percent). Noteworthy is the fact that after 2013, the City will have no debt service expenditures. The City does not plan to add personnel, and salary, wage, and benefits increases are included under operations and maintenance.

Projected Net Revenues

Table 9-6 shows the combined net revenues (revenues minus expenditures) for 2011 through 2017. These data show negative net revenues for each year except 2014 and 2015. Over the 6-year planning period, total net revenues are projected to be ($2,381,613), which is a significant deficit. This deficit leads to a decreasing reserve balance.

Projected Reserves

The projected reserve balance is listed in Table 9-6 and seen on Figure 9-1. This value equals the existing reserve account balance plus combined net revenues. In order to maintain financial solvency as well as being able to deal with unexpected expenses such as emergency maintenance or equipment failure, the City has expressed a desire to maintain a reserve balance of $3 million. As inflation and costs for services increase in the coming years, maintaining sufficient reserves will become increasingly important to pay for incidental and emergency repairs or maintenance.

Figure 9-1 shows a steady decline in the reserve balance until 2017. The reserve balance in 2017 is projected to be $1.34 million, significantly below the City's operational goal of $3 million. The City will be required to increase revenue streams in order to increase net revenues as well as its reserve balance. The most effective method for increasing net revenues is to increase rates and/or GFCs, and these options are discussed in later sections of this chapter.

TABLE 9-4

Projected Revenues for City Combined Sewer Funds

Year	2011	2012	2013	2014	2015	2016	2017
Sewer Services	$3,054,134	$3,084,675	$3,115,522	$3,146,677	$3,178,144	$3,209,926	$3,242,025
Septage Disposal	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 70,000	$ 70,000
Sewer Connections Fees	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 250,000	$ 250,000	$ 250,000
Investment Interest	$ 75,000	$ 80,000	$ 85,000	$ 90,000	$ 95,000	$ 100,000	$ 105,000
Miscellaneous	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000
Total Revenues	**$3,390,134**	**$3,425,675**	**$3,461,522**	**$3,497,677**	**$3,584,144**	**$3,630,926**	**$3,668,025**

TABLE 9-5

Projected Expenses for City Combined Sewer Funds

Projected Combined Fund Expenditures							
Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Sewer Projects	$ 199,000	$ 420,000	$ 560,800	$ 682,900	$ 180,000	$1,735,000	$ 535,000
Equipment Upgrades	$ 325,000	$ 348,000	$ 269,000	$ 435,000	$ 645,000	$ 402,000	$ 425,000
I/I Program	$ 150,000	$ 150,000	$ 150,000	$ 50,000	$ 75,000	$ 200,000	$ 200,000
Personnel	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
Operations and Maintenance	$1,753,242	$1,823,372	$1,896,307	$1,972,159	$2,051,046	$2,133,087	$2,218,411
Engineering	$ 25,000	$ 25,000	$ 110,000	$ 55,000	$ 155,000	$ 95,000	$ 100,000
Debt Service	$1,026,915	$1,027,600	$1,029,600	$ 0	$ 0	$ 0	$ 0
Allocations	$ 178,048	$ 185,170	$ 192,577	$ 200,280	$ 208,291	$ 216,623	$ 225,288
Total Expenditures	**$3,657,205**	**$3,979,142**	**$4,208,284**	**$3,395,339**	**$3,314,337**	**$4,781,710**	**$3,703,699**

TABLE 9-6

Projected Reserves for City Combined Sewer Funds

Year	2011	2012	2013	2014	2015	2016	2017
Total Revenues	$3,390,134	$3,425,675	$3,461,522	$3,497,677	$3,584,144	$3,630,926	$3,668,025
Total Expenditures	$3,657,205	$3,979,142	$4,208,284	$3,395,339	$3,314,337	$4,781,710	$3,703,699
Combined Net Revenues	($ 267,071)	($ 553,467)	($ 746,762)	$ 102,338	$ 269,807	($1,150,784)	($ 35,674)
Reserve Account Balance 2010 = $3,720,969	**$3,453,898**	**$2,900,431**	**$2,153,669**	**$2,256,007**	**$2,525,814**	**$1,375,030**	**$1,339,356**

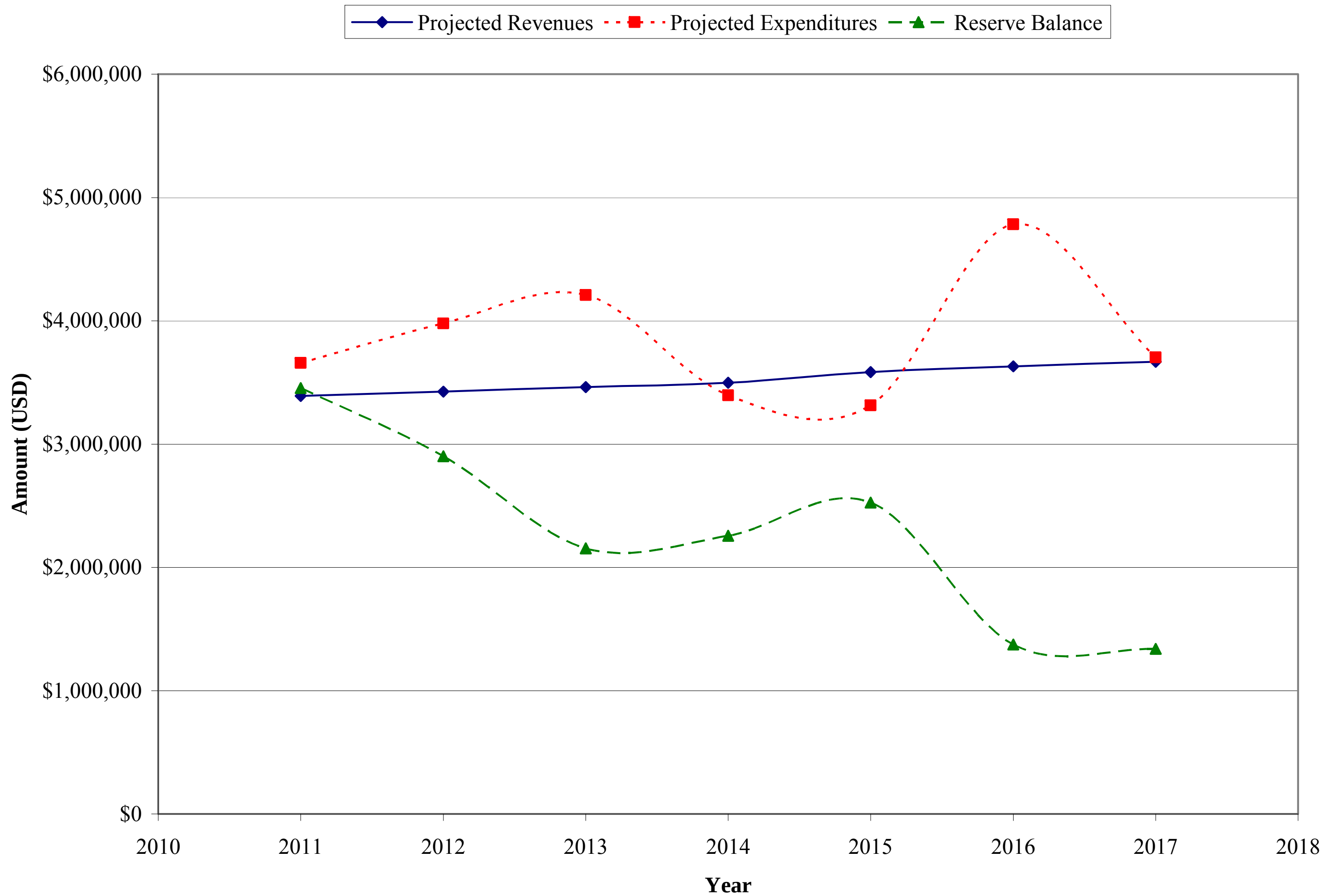

FIGURE 9-1

Projected Revenues, Expenses, and Reserve Balance for 2011 through 2017

Capital Improvement Projects

Capital improvement projects to be funded over the period 2011 through 2017 are described in Chapter 6 and Chapter 7 and are summarized in Table 9-7. These capital improvement projects are meant to repair and upgrade systems to provide better service to customers. These improvements include modifications to pump stations, electrical panel upgrades, generator improvements, and continual sewer line repair/replacement.

TABLE 9-7

Capital Improvement Projects

No.	Year	Improvements	Cost	Annual Totals	Financier
S115	2012	Section Street Sewer	$100,000		COB[1]
	2012	Job 3 Hawthorne Street Sewer	$320,000	$ 420,000	COB
	2013	Rio Vista Sewer	$447,000		COB
S106	2013	Pump Station Landscaping	$ 10,000		COB
	2013	Job 1 Schedule B: McKinley Street Sewer	$104,000	$ 561,000	COB
S131	2014	Lab/Admin Building Upgrades	$275,000		COB
S108	2014	Equipment Storage Building	$150,000		COB
S119	2014	Job 1 Schedule C: Koch Street Sewer	$258,000	$ 683,000	COB
S106	2015	Pump Station Landscaping	$ 10,000		COB
S122	2015	Job 4: Regent Street Sewer	$170,000	$ 180,000	COB
S109	2016	Pump Station 6	$900,000		COB
S111	2016	Pump Station 9	$175,000		COB
S112	2016	Pump Station 10	$250,000		COB
S114	2016	Sewer Line Replacement	$275,000	$1,600,000	COB
S112	2017	Pump Station 10	$250,000		COB
S114	2017	Sewer Line Replacement	$275,000	$ 525,000	COB

(1) City of Burlington.

Maintaining cash reserves at an appropriate level to provide for operations, revenue stabilization, emergency repair or replacement of essential equipment, and for capital maintenance is an element of sound utility management.

In order to fund these capital improvement projects, a combination of grants, loans, and rate increases should be considered. It is unlikely that the City will be able to successfully fund their desired improvement projects as well as maintain a reasonable reserve balance without increased rates for existing sewer customers. To supplement rate increases, the City could increase the number of new connections by providing service to unsewered areas within the UGA. This increase in GFCs would serve to bolster the City's fund balances as well as to help keep rates for existing customers low.

While revenues are projected to increase (Figure 9-1), there is significant risk in this prediction. If the number of customers does not grow as expected, then revenues will not increase as predicted, leaving the City with fewer funds to complete desired projects. Furthermore, any unexpected expenses such as emergency maintenance/repair of sewage systems or equipment failure will incur additional expense. The City must then use reserve funds for this purpose, further decreasing the overall reserve balance.

Recommendations for Funding Capital Improvement Projects

In order to successfully fund the recommended capital improvement projects, as well as maintain sufficient reserve balances, the City should increase sewer rates. Rates were recently increased by 3 percent each year for 3 years beginning in 2008. A similar rate increase schedule beginning in 2012 will both improve sewer revenues and increase the reserve balance. A suggested rate increase schedule is shown in Table 9-8.

TABLE 9-8

Suggested Schedule of Rate Increases

	In-City Residential and Commercial			Out-of-City Residential and Commercial		
	2012	2013	2014	2012	2013	2014
Low Strength						
First 500 cubic feet	$31.48	$32.42	$33.39	$39.35	$40.53	$41.74
Additional 100 cubic feet	$ 4.49	$ 4.63	$ 4.76	$ 5.61	$ 5.78	$ 5.96
Medium Strength						
First 500 cubic feet	$44.78	$46.13	$47.51	$55.98	$57.66	$59.39
Additional 100 cubic feet	$ 7.16	$ 7.37	$ 7.59	$ 8.95	$ 9.22	$ 9.50
High Strength						
First 500 cubic feet	$57.62	$59.35	$61.13	$72.03	$74.19	$76.41
Additional 100 cubic feet	$ 9.71	$10.00	$10.30	$12.14	$12.51	$12.88

Figure 9-2 shows the projected revenues and reserve balance, should this rate increase schedule be enacted. The ending reserve balance would be $4.48 million in 2017, significantly greater than the City's goal of $3 million. This would give the City added flexibility to fund capital improvement projects discussed in Chapter 8, which are not currently budgeted, as well as sewer improvement projects that will be required as the current system ages.

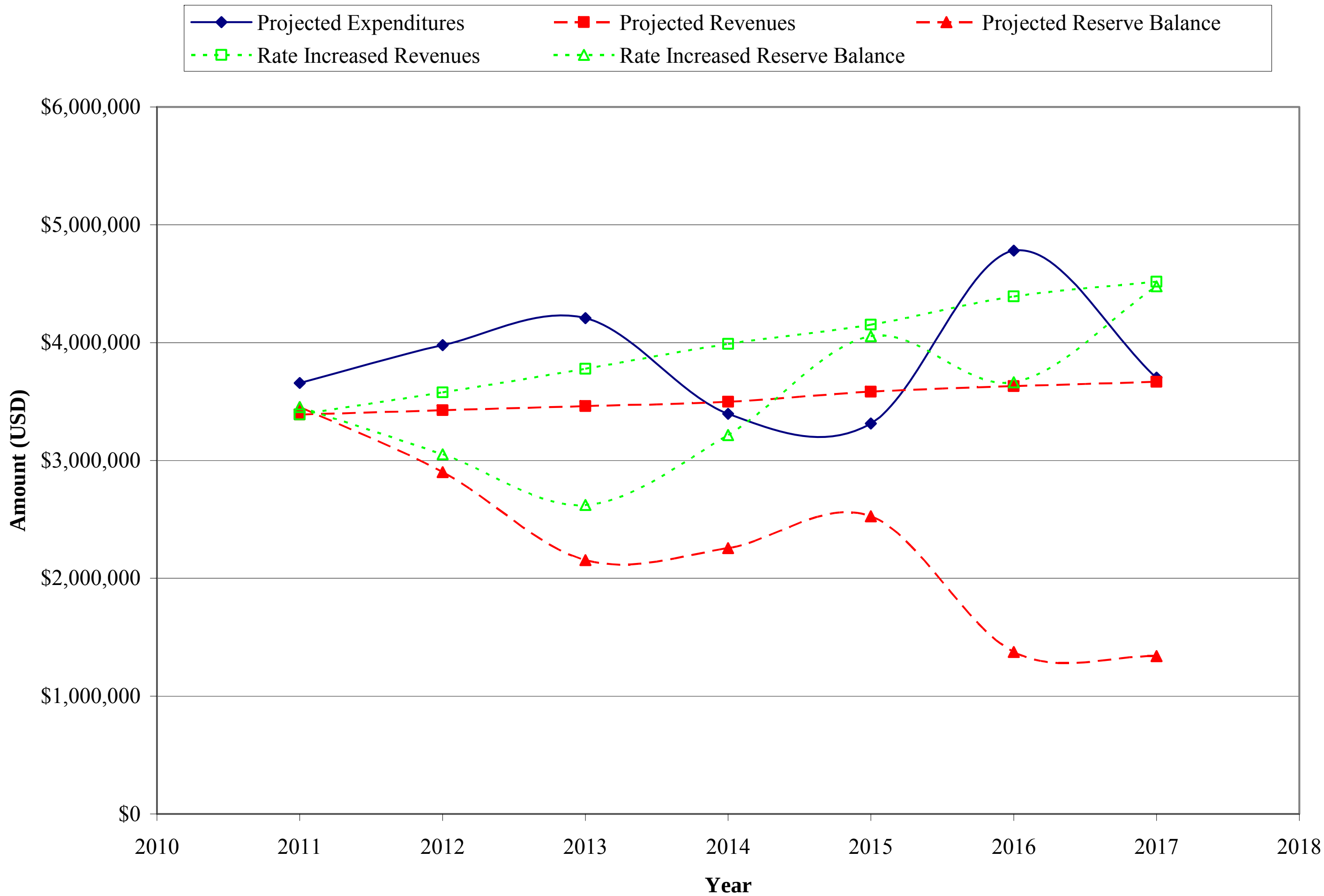

FIGURE 9-2

Projected Revenues and Reserve Balance with Recommended Rate Increases

AVAILABLE FUNDING SOURCES

Grants:	Centennial Clean Water Fund (CCWF) Community Development Block Grant (CDBG) Community Investment Fund (CIF) U.S. Economic Development Administration (US EDA) U.S. EPA State and Tribal Assistance Grant (STAG) USDA Forest Service, Rural Assistance Program (USFS) USDA Rural Development (RD)
Loans:	Water Pollution Control State Revolving Fund (SRF) Public Works Trust Fund (PWTF) Community Economic Revitalization Board (CERB) USDA Rural Development (RD)
Bonds:	Revenue Bonds General Obligation Bonds
Other:	Utility Local Improvement Districts

GRANTS

Centennial Clean Water Fund (CCWF)

The Department of Ecology administers the State Revolving Fund (SRF) and Centennial Clean Water Fund (CCWF) programs that provide low-interest loans for water pollution control projects. CCWF loan and grant terms are dependent upon the average market rate published in the bond buyer's index for tax-exempt municipal bonds for the period from 60 to 30 days prior the annual funding cycle begins. Currently, Ecology offers 20-year loans at 2.75 percent interest rates (60 percent of average market rate) and 5-year loans at 1.35 percent interest rates (30 percent of average market rate). The primary program requirements are to have an approved facilities plan for treatment works and to demonstrate the ability to repay the loan through a dedicated funding source. The loans can be used to finance sewer system replacement for the elimination of excessive infiltration and inflow, and for the construction of facilities with reserve capacities to accommodate flows corresponding to the 20-year projected growth in the service area. Land acquisition is not eligible for SRF funding.

Grant money is available only to those who can document hardship. Where financial hardship is determined, the total eligible project cost cannot exceed $10 million and the grant amount cannot be more than half, or $5 million. Hardship is demonstrated when project costs for construction of facilities result in total cost for debt service and operation and maintenance in excess of between 2.0 and 3.0 percent of the median household income. A project may be phased and receive funds from several cycles to complete the project. In addition, a higher grant amount may be available if the 3-year average local unemployment rate exceeds the 3-year average statewide unemployment rate. Grants require a 50 percent matching fund, which is provided by a mandatory SRF loan.

Community Development Block Grant (CDBG)

The Community Development Block Grant program is a competitive source of federal funding for a broad range of community development projects. A primary requirement of the CDBG program is that the project must principally benefit at least 51 percent of the low-to-moderate income residents of the project area. The State typically receives about $7 million in federal funds per funding cycle. CDBG has two programs including General Purpose and Planning Only. The General Purpose program provides grant funds for the design, construction, or reconstruction of water and sewer systems up to the amount of $750,000. The Planning Only program includes projects such as comprehensive plans, community development plans, capital improvement plans, and other plans such as land use and urban environmental design, economic development, floodplain and wetlands management, transportation, and utilities. Planning Only grants are limited to $24,000 for a single applicant or $40,000 for a joint applicant.

Eligible applicants for the CDBG programs include cities and towns with fewer than 50,000 people or counties with populations of less than 200,000. Though port districts and economic development districts are not eligible to apply directly, a city or county can submit a joint application and include these entities as partners.

Community Investment Fund (CIF)

The Community Investment Fund partners with CDBG to fund projects that benefit at least 51 percent of low-to-moderate income residents. An applicant would first apply to the CDGB General Purpose program and meet the income limits of that program. At the discretion of the Public Works Board and if the applicant is turned down for the General Purpose program, an applicant may be asked to apply to the Community Investment Fund. Additional grant funding, in the amount of approximately $1 million may be obtained.

To qualify for CIF, the project must be rated as one of the top three of the local WA-CERT Priority Rating Process, serve a minimum of 51.5 percent low-to-moderate income residents, and receive at least 65 points with the General Purpose application.

U.S. Economic Development Administration (US EDA)

US EDA offers competitive grants up to $1 million for projects within Region 10. Projects are selected locally by an economic development district and submitted to Congress for competitive selection among other regions in the United States. Similar to CERB, applicants must have an industrial partner ready to proceed or a feasibility study that establishes realistic job creation.

U.S. EPA State and Tribal Assistance Grant (STAG)

Local jurisdictions within the State of Washington can apply to the State and Tribal Assistance Grant program through the office of their local Congressional representative. The Congressional representative will work to add the project as a line item to the VA/HUD Appropriations Bill. Applicants can obtain grant funds up to approximately $2 million.

U.S. Forest Service (USFS)

Forest Service grants are available through the Rural Community Assistance Program to assist rural communities that are dependent on natural resources. Project proposals must show a broad community benefit that result in greater ability to improve economically, socially, or environmentally. The project must have the potential for economic development and/or job creation/retention. An application must be located within 100 miles of a Forest Service office and be able to document a history of at least 15 percent dependency on forest products. Grant funds are available for components of planning and design and are limited to $50,000.

USDA Rural Development (RD)

The RD Rural Utility Service administers water and wastewater loan and grant programs to improve the quality of life and promote economic development in rural areas. RD has both loan, and under certain conditions, grant programs. Grants are awarded when the annual debt service portion of the utility rate exceeds 1.0 percent to 1.5 percent of the municipality's median household income.

In addition, an RD loan program exists for needy communities unable to obtain funding by commercial means through the sale of revenue bonds. This program provides 30- to 40-year loans at an interest rate that is based on federal rates and varies with the commercial market. RD loans are revenue bonds with a 1.1 debt coverage factor.

Eligible projects include the construction, expansion, extension, or improvement of rural water, sanitary sewers, solid waste disposal, storm, and wastewater disposal facilities.

Basic criteria for RD funding are:

- Inability to obtain funds from other sources at reasonable terms.
- A 45 percent grant is available if the median household income of the service area exceeds 80 percent of the statewide non-metropolitan median household income.
- A 75 percent grant is eligible if the median household income for the service area is below either the poverty line or 80 percent of the state

non-metropolitan median household income – whichever is higher. This grant also requires the project to be necessary for health and safety concerns.

Eligible applicants include municipalities; counties; non-profit corporations, associations, or cooperatives; and federally recognized Indian tribes in rural areas with populations of less than 10,000.

LOANS

Public Works Trust Fund (PWTF)

The Public Works Trust Fund is a revolving loan fund designed to help local governments finance public works projects through low-interest loans and technical assistance. The PWTF, established in 1985 by legislative action, offers loans substantially below market rates, payable over periods ranging up to 20 years. To be eligible for the PWTF programs, an applicant must be a local government such as a city, county, or a special purpose utility district.

PWTF has four loan programs including Construction, Preconstruction, Planning, and Emergency. PWTF loan terms are summarized in Table 9-9.

TABLE 9-9

Public Works Trust Fund Loan Types and Terms

Loan Type	Local Match	Interest Rate	Term	Loan Limit
Construction	15%	0.50%	20 years	$10,000,000
	10%	1.00%	20 years	$10,000,000
	5%	2.00%	20 years	$10,000,000
Preconstruction(1)	15%	0.50%	20 years	$ 1,000,000
	10%	1.00%	20 years	$ 1,000,000
	5%	2.00%	20 years	$ 1,000,000
Planning(2)	0%	0.00%	6 years	$ 50,000
Emergency(2)	0%	4.00%	20 years	$ 500,000

(1) Preconstruction loans can be refinanced to a 20-year term, if the applicant obtains a subsequent PWTF construction loan.

(2) While a match is not required, it is recommended.

The Construction program accepts applications once per year in the spring, and money is available in approximately one year. The Preconstruction and Planning programs are open year-round and must be submitted to the Public Works Board prior to the 15th of the month for review at the next board meeting. These funds become available shortly after the Public Works Board makes their final decision as to the award. Emergency projects must have a locally declared emergency and are applied for on an open cycle depending on the availability of funds. Project expenditures are reimbursable from the date of the declared emergency.

An applicant must have a long-term plan for financing its public works needs. If the applicant is a county or city, it must adopt the 1/4 percent real estate excise tax that is dedicated to public works construction projects. Eligible public works projects include streets, roads, bridges, storm sewers, sanitary sewer collection and treatment systems, and domestic water. Loans are presently offered only for purposes of repair, replacement, rehabilitation, reconstruction, or improvement of existing eligible public works systems. Eligible project costs can include expenses related to serving 20-year forecasted growth as identified in growth management comprehensive plans.

Since limited trust fund dollars are available, local jurisdictions must compete for the funds. The applications are carefully evaluated, and the Public Works Board submits a prioritized list of those projects to the legislature that are recommended to receive low-interest financing. The legislature reviews the list and indicates its approval through the passage of an appropriation from the Public Works Assistance Account to cover the cost of the proposed loans. Once the Governor has signed the appropriation bill into law (an action that usually occurs by the following April), those local governments recommended to receive loans are offered a formal loan agreement with appropriate interest rates and terms as determined by the Public Works Board.

Community Economic Revitalization Board (CERB)

The Community Economic Revitalization Board's prime mission is to partner with business and private industry and local governments to maintain and create jobs. Established by the Legislature in 1982, CERB provides low-interest loans, and in unique circumstances grants, to help finance local public infrastructure necessary to develop or retain stable business and industrial activities. Projects eligible for funding include roads, domestic and industrial water systems, sanitary and storm sewers, port facilities, and general-purpose industrial buildings.

CERB provides loans up to $1 million and where applicable, grants in the amount of $300,000. The interest rate is tied to the current cost of a 10-year bond and a local match of 10 percent is required.

Eligible applicants include Washington State subdivisions in partnership with private enterprise. If there is no economic partner, a local government can produce a feasibility study that documents realistic job retention or creation. Applications must be submitted 45 days prior to a regularly scheduled CERB meeting, typically in January, March, July, and November.

BONDS

Revenue Bonds

The most common source of funds for construction of major utility improvements is the sale of revenue bonds. These are tax-free bonds issued by a city. The major source of funds for debt service on revenue bonds is from monthly sewer service charges. In order to sell revenue bonds marketable to investors, they typically have contractual provisions requiring minimum debt coverage amounts. The entity must show that its annual net operating income (gross income less operation and maintenance expenses) is equal to or greater than a factor, typically 1.2 to 1.4 times the annual debt service on all par debt. If a coverage factor has not been specified, it will be determined at the time of any future bond issues.

General Obligation Bonds

A city may by council action or special election issue general obligation bonds to finance almost any project of general benefit to the city. The bonds are repaid by tax assessments levied against all privately owned properties within the city. This includes vacant property that would not otherwise contribute to the cost of the specific improvements. This type of bond issue is usually reserved for municipal improvements that are of general benefit to the public, such as arterial streets, bridges, lighting, municipal buildings, firefighting equipment, parks, and water and wastewater facilities. General obligation bonds are the most attractive bonds to investors because they are backed by the municipality's full taxing authority and carry the lowest rate of interest of any type of bond that a city may issue.

Disadvantages of general obligation bonds include the following:

- Voter approval is often required. The city will incur the legal costs of drafting a ballot measure and pay for the cost of holding a special election. Additional costs include investing staff time toward public education of the need for the project.

- There are legal and practical limits on the amount of general obligation debt a city can issue. Financing capital improvements through general obligation debt reduces the ability of the city to issue additional general obligation debt, which is often the only source of outside financing for many general government facilities.

OTHER

Utility Local Improvement Districts

Another potential source of funds for improvements can be obtained through the formation of Utility Local Improvement Districts (ULIDs) involving a special assessment made against properties benefiting by the improvements. ULID bonds are further backed by a legal claim to the revenues generated by the utility, similar to revenue bonds.

Sewer system expansion is a frequent application of ULID financing. Typically, ULIDs are formed by the city at the written request (by petition) of the property owners within a specific section of the city's service area. Upon receipt of a sufficient number of signatures on petitions and acceptance by the city council, the local improvement area is formed. Therefore, a sewer system is designed for that particular area in accordance with the city's sewer comprehensive plan. Each separate property in the ULID is assessed in accordance with the special benefits the property receives from the water or wastewater system improvements. A citywide ULID could form part of a financing package for large-scale capital projects such as sewer line extensions or replacements that benefit all residents in the service area. The assessment places a lien on the property that must be paid in full upon sale of the property. ULID participants have the option of paying their assessment immediately upon receipt, thereby reducing the portion of the costs financed by the ULID bonds.

The advantages of ULID financing over rate financing include:

- The ability to avoid interest costs by early payment of assessments.
- If the ULID assessment is paid in installments, it may be eligible to be deducted from federal income taxes.
- Low-income senior citizens may be able to defer assessment payments until the property is sold.
- Some Community Block Grant funds are available to property owners with incomes near or below poverty level. Funds are available only to reduce assessments.

The major disadvantage to the ULID process is that it may be politically difficult to approve formation. The ULID process may be stopped if 40 percent of the property owners protest its formation. Also, there are significant legal and administrative costs associated with the ULID process, which increases total project costs by approximately 30 percent over other financing options.

APPENDIX A

NPDES PERMIT

APPENDIX B

ENVIRONMENTAL IMPACT STATEMENT (EIS)
ADOPTION SHEET

APPENDIX C

SAMISH WATER DISTRICT CUSTOMERS AND MAP

APPENDIX D

DISCHARGE MONTHLY REPORTS

APPENDIX E

HYDRAULIC MODEL FLOW INPUTS

APPENDIX F

SEWER MODEL RESULTS MAP

APPENDIX G

CITY OF BURLINGTON PARK IRRIGATION ANALYSIS

APPENDIX H

BURLINGTON MUNICIPAL CODE: SEWER RATES