Comprehensive Sewer Plan

City of
Edmonds
Washington

August 2013

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City of Edmonds

Comprehensive Sewer Plan

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City of Edmonds

COMPREHENSIVE SEWER PLAN

August 2013

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9-10-2013

City of Edmonds
Comprehensive Sewer Plan

LIST OF TABLES **Page**

LIST OF FIGURES **Page**

GLOSSARY

100-year flood: The magnitude of a flood likely to occur, on average, once every 100 years.

Average Wet Weather Flow: Wastewater flow during period when groundwater table is high and precipitation is at its peak, generally the four wet weather months, from November to February.

Class 1 Stream: A perennial or intermittent stream that is used by threatened or endangered fish or larger numbers of other fish, or that is used as a direct source of water for domestic use.

Force Main: Pressurized discharge pipe from a lift station.

Infiltration: Groundwater entering the sewage collection system through defective joints, pipes, and improperly sealed manholes.

Inflow: Sewage flows resulting from stormwater runoff entering the sewage collection system, typically through manhole covers, roof leaders, and area drains connected directly to sewer, cross connections from storm drains and catch basins, and direct flows into broken sewers.

Maximum Monthly Flow: Average daily flow during the highest flow month of the year.

Mini-Basin: Drainage catchment areas within the North Creek, Swamp Creek, Picnic Point, Everett or Little Bear Creek Drainage Basins. Mini-basins followed the King County delineation to the extent of the County's effort to define the mini-basins.

National Flood Insurance Program: Federally funded program providing flood insurance to property owners in flood plains provided the local government meets certain criteria for management of flood damage risk.

Orange Book: *Criteria for Sewage Works Design,* published by the Washington State Department of Ecology

Peak Hourly Flow: Wastewater flow during the highest flow hour.

Sensitive Area: Area in which development potential is limited by environmental factors such as steep slopes, wetlands, and valuable natural habitat.

Sewer Lateral: A sewer with no other common sewers discharging into it.

Sewer Submain: A sewer that receives flow from one or more lateral sewers.

Sewer Main or Trunk: A sewer that receives flow from one or more submains.

Sewer Interceptor: A sewer that receives flow from a number of main or trunk sewers, force mains, etc.

Urban Growth Area: Area in which urban development must be contained, as stipulated by the Growth Management Act.

ABBREVIATIONS

AAF	Average Annual Flow
ADWF	Average Dry Weather Flow
AWWD	Alderwood Water and Wastewater District
AWWF	Average Wet Weather Flow
BOD	Biological Oxygen Demand
CFR	Code of Federal Regulations
CIP	Capital Improvement Program
CWA	Clean Water Act
DOH	Washington State Department of Health
DOE	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
ERU	Equivalent Residential Unit
ESA	Endangered Species Act
FEMA	Federal Emergency Management Act
FOG	Fats, Oils and Greases
FPS	Feet per second
FWPCA	Federal Water Pollution Control Act (“The Clean Water Act”)
GMA	Growth Management Act
GPCD	Gallons per capita per day
GPAD	Gallons per acre per day
GPD	Gallons per day
HPA	Hydraulic Project Approval
I/I	Infiltration and Inflow
JARPA	Joint Aquatic Resources Permit Application
KCDNR	King County Department of Natural Resources
MMF	Maximum Month Flow
MBR	Membrane Bioreactor
MGD	Million Gallons per Day
mg/l	milligrams per liter
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
OCD	Washington State Office of Community Development
OFM	Washington State Office of Financial Management
ppd	Pounds per day
PVC	Polyvinyl Chloride
PWWF	Peak Wet Weather Flow
RCW	Revised Code of Washington
SEPA	State Environmental Policy Act
SRF	State Revolving Fund
TSS	Total Suspended Solids
UGA	Urban Growth Area
USFWS	United States Fish and Wildlife Service
WAC	Washington Administrative Code
WWTP	Wastewater Treatment Plant

CHAPTER I – EXECUTIVE SUMMARY

1.1 INTRODUCTION

The City of Edmonds' (City) Comprehensive Sewer Plan (the Plan) reviews the City's current sewage capacities and looks at the impact of projected growth on the City's sewage collection and conveyance system.

The analysis of the Edmonds Wastewater Treatment Plant (WWTP) was also done evaluating the existing plant under current and anticipated loadings and also evaluated the future of the plant when subjected to tightening effluent limits expected to be imposed on Puget Sound dischargers.

The Plan identifies future facilities required to accommodate both existing and future wastewater collection, conveyance and treatment needs as the City's population grows within the service area limits for the years 2019, 2033, and buildout conditions.

The plan was prepared in conformance with Washington Administrative Code (WAC) 173-240-050.

1.2 PLANNING DATA

Population, employment and student population forecasts were used to estimate the current and future loadings to the City's system.

Planning data from the Puget Sound Regional Council (PSRC) provides population forecasts based on U.S. Census data as broken down by Forecast Analysis Zones (FAZ). The PSRC data tends to be widely used throughout the region and is the data base that was used in developing and analyzing the flows.

After discussions with the City staff, the values were used for the baseline population and GIS delineation was used for the distribution of growth between the Sub-basins. Student populations were derived from the School District's forecast.

The service area is divided between eleven (11) Sub-basins. These 11 Sub-basins were used to encompass the entire service area boundary. The twelfth Sub-basin flows to the Lynnwood WWTP.

The definition of the population that has sewer service is complicated by the fact that some Edmonds customers are served to the City of Lynnwood. Conversely the Edmonds Wastewater Treatment Plant serves non-Edmonds customers. The population values and the methodology are presented in Chapter 6.

There are three segments that comprise the served population: residential, student and employment. These three sectors are generally thought to capture all the sources expected in the Edmonds Service Area. This approach works well in largely developed, non-industrial service areas. Similar approaches were used in the Alderwood Water and Wastewater District's Comprehensive Plan in 2010 and in the City of Lynnwood's Comprehensive Plan in 2012.

With these values of existing and projected users, a population equivalent was developed recognizing that a student or an employee contributes a fraction of a permanent resident. This ratio was established to be 5 to 1 for students, meaning that 5 students is equivalent to a resident and 3 to 1 for employees (i.e. 3 employees is equivalent to a resident). This ratio is consistent with textbook values.

1.3 PROJECTED WASTEWATER FLOWS AND LOADS

A capacity analysis of the existing City sewer network was undertaken using the XP-SWMM hydraulic modeling program.

Existing lift stations and their firm capacities also were included in the model. The flow data from the City's flow meters were largely used in calibrating the model. The location of the flow meters was instrumental in delineating the Sub-basin boundaries. These Sub-basin areas were consistent with the basin boundaries used in the previous I/I study.

The model was developed using information from the City's GIS electronic database, supplemented by selected as-built drawings, pump records, flow monitoring data, and with other available data such as ground elevation LIDAR information.

Models were constructed to represent the network in 2010, 2019, 2033, and build out. The year 2010 was used for calibration purposes utilizing flow metering data at a eight locations in the collection system and three flow meters at the plant.

Various flow conditions were evaluated for the flow data from each of the meters. Flow data from 2006 through 2012 was evaluated and summarized in Appendix B. Data for calibration purposes focused on flow from the years 2010 through 2012.

- Average Dry Weather Flow was defined as the average daily flow for the months of July through October when no measureable rain was recorded.
- Average Daily Flow was defined as the average flow over the entire year
- Average Wet Weather Flow was defined as the average of the daily flows from the months of November through March
- Maximum Month Flows are valuable particularly for the WWTP and are typically thought to be the design flow events for the plant. From the flow records, the maximum monthly average for the years 2010 through 2012 was selected.
- Peak Day Flows are the measured maximum daily flows over the period of 2010 through 2012.
- Peak Hour Flows used the measured peak day flows, applying a peak day to peak hour factor and by adding the diurnal flow variation to arrive at this estimated flow.

With the flows determined and the known population equivalence, a flow per population equivalence was determined. With the multiple flow meters and the extensive flow data that spanned several years, we saw consistent flow patterns in all the flow meter data. This historical flow data was used to project future and anticipated flows.

There was an anomaly in the data measured in Meters 3 and the MLT meter at the WWTP. These two meters are downstream of the flow diversion to King County and consequently reflect lower total flows coming into the Edmonds system. This explains the low per population equivalent values seen at these two meters.

The I/I component is captured in and part of the peak day and peak hour per population equivalent flow values. It is important to recognize that the I/I component is reflective of current conditions and that, as the pipes continue to age and degrade, the volume of I/I entering the system will continue to increase. An allowance for that continued degradation is incorporated into the per population equivalent values for 2019, 2033 and build out conditions. The Engineering and Planning Subcommittee of Metropolitan Water Pollution Abatement Advisory Committee (MWPAAC) has defined this degradation of sewers as a 7-percent per decade increase in I/I.

Though it might be acceptable to allow conditional surcharging of the conveyance lines, for the purposes of this analysis it has been conservatively estimated that no surcharging will be allowed. This effectively means that there is added and reserve capacity within the surcharging volumes.

Where pipe sections were identified as requiring an upgrade, the proposed upgrade was sized to provide capacity equal to or greater than the estimated build out flows and to prevent any conditional surcharging from occurring.

At lift stations where the estimated peak hour flows were shown to exceed the current firm capacity, a suitable build out upgrade flow capacity was estimated. This capacity was incorporated into the model for the planning horizon showing evidence of capacity limitation. This enabled the impact of the increased flow on the downstream sewer network to be investigated. The actual mechanical and electrical improvements to the lift stations would not likely be sized for the build out conditions.

The results of the capacity analysis were used to develop the capital improvement program detailed in Chapter 9.

1.4 CAPITAL IMPROVEMENTS PROJECTS

The capital improvement projects (CIP) developed in Chapter 9 are presented by time period. It should be noted that this plan has neither proposed a routing to extend sewers to every lot within the service boundary, nor was it the intention of this plan to finance those line extensions. The CIP does not include the line extensions and pump stations needed to serve presently unsewered areas. These line extensions are assumed to be initiated and financed by developers or through ULIDs. Consequently, no City financing mechanism is proposed for these lines.

The CIP is limited to the following categories:

- Existing lines that need to be upgraded/upsized to convey flows as population and flows increase
- Existing lift stations that need to be upgraded to accommodate increasing flows.
- Existing lift stations that need modifications or improvements. This might include equipment that has reached or are soon to reach their useful life, needed new features, and stations that are slated to be abandoned or rerouted.
- Chronic maintenance areas that can be resolved with a capital project.
- WWTP improvements to respond to increasing flows, loads or new regulations

Cost estimates for each CIP was prepared based on current year (2013) pricing. Detailed cost estimates can be found in Appendix E. These projects were assigned a target period for completion based on the anticipated added flows and the expectation that capacity would be exceeded by the end of that period. Those improvements shown as 2013 to 2019 projects are those projects that have current or soon anticipated capacity issues and should be pursued first. Those that are in subsequent periods of 2019 to 2033 and 2033 to Build Out are projects that should be completed on or before that target year. Capital Improvements Projects to be financed through the Sewer Fund for those periods are presented in Table 9.3 and are summarized below:

CIP financed from the Sewer Fund:

2013	2014	2015	2016	2017	2018	2019
$7,752,814	$4,319,349	$3,000,000	$3,005,000	$2,975,000	$2,930,000	$2,975,000

CHAPTER II – INTRODUCTION

2.1 PURPOSE AND NEED FOR PLAN

This 2012 Comprehensive Sewer Plan is prepared for the City to fulfill the requirements of Chapter 173-240-050 of the Washington Administrative Code (WAC) and Chapter 90.48 of the Revised Code of Washington (RCW). The WAC requirements are outlined in Table 2.1.

Table 2.1
Comprehensive Sewer Plan Requirements per WAC 173-240-050

Reference Paragraph	Description of Requirement	Location in Document
3a	Purpose and need for proposed plan	Section 2.1
3b	Who will own, operate, and maintain system	Section 2.2
3c	Existing and proposed service boundaries	Figure 3.1
3d	Layout map showing boundaries; existing sewer facilities; proposed sewers; topography and elevations; streams, lakes; and other water bodies; water systems	Figures 3.2
3e	Population trends	Chapter 6
3f	Existing domestic and/or industrial wastewater facilities within 20 miles	Figure 2.1
3g	Infiltration and inflow problems	Section5.6 and Chapter 7
3h	Treatment systems and adequacy of such treatment	Chapters 5 and 8
3i	Identify industrial wastewater sources	Section 6.1.2
3k	Discussion of collection alternatives	Chapter 9
3k	Discussion of treatment alternatives	Chapter 8
3k	Discussion of disposal alternatives	Chapter 8
3l	Define construction cost and O&M costs	Chapter 9 and Appendix E
3m	Compliance with management plan	Section 10.3.6
3n	SEPA compliance	Appendix D

In addition to the WAC requirements sited above, there are other recent state and local regulations that must be incorporated into the Comprehensive Sewer Plan Update. These additional requirements are outlined in Table 2.2.

Table 2.2
Additional Sewer Plan Requirements per State and Local Regulations

Description of Requirement	Location in Document
Evaluation of wastewater reuse per *Substitute Secondary Senate House Bill 1338*	Section 9.4
Capacity, Management, Operations and Maintenance (CMOM).	Section 10.3.5

The Plan provides a comprehensive guide to assist the City with managing and operating the sewer system and coordinating expansions and upgrades to the infrastructure for the next thirty years. The Plan serves as a guide for policy development and decision making for the City. It also provides other agencies and the public with information on the City's plans for sewer system extensions within the City's service area. This approach allows the City to provide high quality service to its customers and to continue protecting environmental quality.

The Plan evaluates existing and future capacity of the sewer system based on current and anticipated future wastewater flow rates. Future wastewater flow rates are estimated from existing flow data and population growth projected within the sewer service area.

An implementation plan is provided, including an estimated timeline for constructing selected projects. The financial analysis and the means by which the improvements were to be financed were addressed in Chapter 11. This chapter was prepared by FCS Group in close coordination with BHC and the City.

2.2 OWNERSHIP AND MANAGEMENT

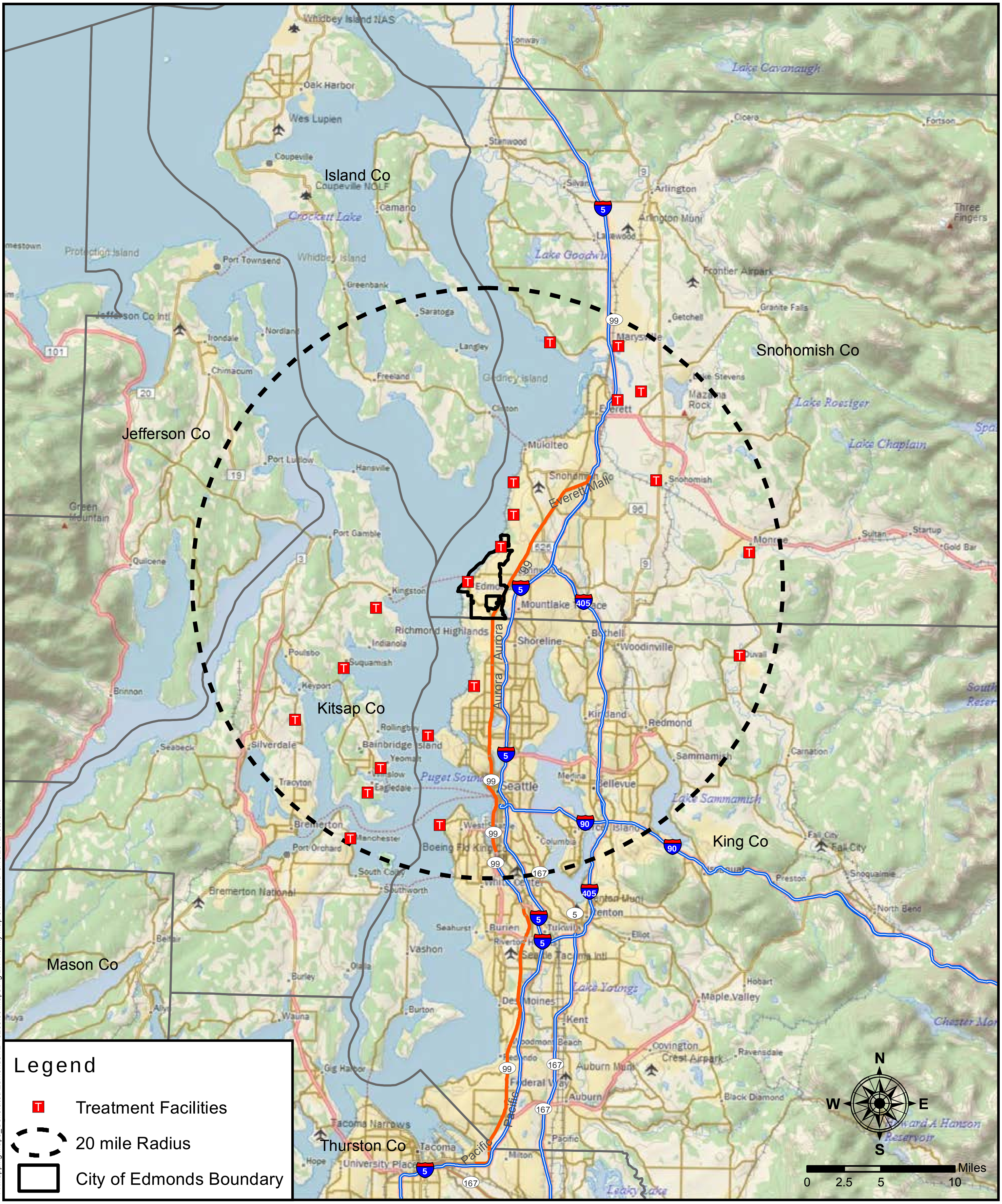
The City owns and maintains a public wastewater system and is governed by a City Council. The City has agreements for sewage collection and treatment with some of the surrounding municipalities and special purpose districts for reciprocal sewage treatment. These agreements are further explained in Chapter 3.

The City's wastewater system is under the general management of Mr. Jim Waite. The Sewer Division consists of 7.5 Full-time equivalent workers while the Treatment Plant employs 15 full time workers. The treatment plant is operated and managed under the general direction of Pamela Randolph. Additional Engineering and Administrative and Engineering employees are not accounted for in the above employment numbers.

2.3 SYSTEM HISTORY AND BACKGROUND

The City of Edmonds is located in southwest portion of Snohomish County, immediately north of the King County – Snohomish County boundary, as shown on Figure 2.1, Vicinity Map. The City's service area extends outside of the municipality boundaries into Mountlake Terrace and Shoreline, to the East and to the South. The City also sends a portion of the sewage north to Lynnwood and ultimately to the Lynnwood Wastewater Treatment Plant. The City encompasses approximately 8.9 square miles and but its service area is approximately 19.5 square miles. The area known as Esperance is an unincorporated area that is completely surrounded by the City of Edmonds.

Edmonds was incorporated in 1890 but a sanitary sewer system was not developed until 1920. A primary sewage treatment plant was constructed in 1957. The treatment plant was further expanded to accommodate agreements sewage treatment for portions of Mountlake Terrace and Ronald Wastewater District in 1959.



P:\Mapping\Maps_Generated\Edmonds\12-10265.00\maps\Fig 2.1 Vicinity Map 8.5x11.mxd 5/15/2012 ctolentino

This map is a geographic representation based on information available. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map.

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VICINITY MAP

COMPREHENSIVE SEWER PLAN

City of Edmonds

May 2012

Figure

2.1

In 1967, another treatment plant expansion took place as a result of increased service areas within the City and additional flows from Olympic View Sewer and Water District. Secondary treatment was designed subsequent to a 1986 report by CWC/HDR and was operational by 1991.

The City provides sanitary sewer service to customers within its sewer service area. Wastewater ultimately flows to one of three locations:

- Edmonds Wastewater Treatment Plant, which is owned and operated by the City.
- Brightwater Wastewater Treatment Plant, which is owned and operated by King County Metro. The City has an agreement with the County (see Appendix G) to send a portion of Edmonds sewage to the County for treatment via the Lake Ballinger Pump Station. In turn, the City receives and treats the sewage from the Richmond Beach Service Area. This agreement is describe further in Section 3.4.2.
- Lynnwood Wastewater Treatment Plant, which is owned and operated by the City of Lynnwood. The City has an agreement with Lynnwood to send a portion of the Edmonds sewage to Lynnwood for treatment.

Wastewater that affects the total flows through the City's collection and conveyance system can be categorized into three sources:

- Direct service. Flow from customers within the boundaries of the City that is also treated at the Edmonds Wastewater Treatment Plant.
- Lynnwood service. Flow that originates within City of Edmonds corporate boundaries and is sent to Lynnwood for treatment. The City maintains the sewer infrastructure (pump stations and sewer mains) and compensates Lynnwood for treatment.
- Tributary Service. Flow that originates from areas outside the City boundaries from other sewering agencies. These tributary areas include flow from City of Mountlake Terrace, Ronald Wastewater District, Olympic View Water and Wastewater District and small portions of the City of Lynnwood.

Inter-local agreements between the City and the neighboring sewering agencies define the terms by which sewer service is provided. It is possible that those agreements could be amended in the future but it is unlikely that flows would be routed differently than currently described. It is assumed for the purposes of this Plan that the flows will continue under the current routing mode and that there would be no change to the current inter-local agreements that govern these sewer services. Consideration should be given to investigate rerouting options. A recommendation for this study is included in Chapter 9.

Planning for future wastewater operations requires the City to address the land use decisions within the City sewer service boundary as determined by the City of Edmonds, the City of Shoreline and the City of Mountlake Terrace.

2.4 SERVICE AREA CHARACTERISTICS

The City boundaries lie entirely within Snohomish County. However, the service area has portions that extend into the City of Shoreline (King County).

The service area is generally built out and is characterized as a bedroom community largely comprising of single or multi-family residential units. The topography within the City ranges from flat and gently rolling to hilly with steep slopes along the stream corridors and those properties immediately adjacent to Puget Sound. Wetlands are found adjacent to the many creeks, small streams and lakes within the City service area (see Figure 3.2).

Sewer service extensions presented in this report are planned only within the City's service area boundary. These boundaries are shown on Figure 3.1. Since the City is bounded by other sewering agencies on all sides, it is not anticipated that the service area boundaries would be expanded. Though not likely, it is possible that the City could re-route sewer infrastructure from the northern portion from Lynnwood WWTP back to Edmonds WWTP. Similarly, some flows within the City boundaries could be rerouted differently to avoid lines or pump stations that are shown to have capacity issues.

The City could potentially also install a Lift Station upstream of Lake Ballinger Pump Station. While this would likely not increase flows to the WWTP it would eliminate the need for gravity main upsizing and would eliminate or reduce payments to King County for Lake Ballinger Operations and Maintenance.

2.5 CITY SEWER POLICIES

Development of the City's Comprehensive Sewer Plan is currently guided by the Comprehensive Plans from the adjacent agencies.

The City's policy for sewer service recognizes that its function is not to plan land uses for the service area but to respond to land uses planned by the land use planning agencies.

The public sewer system in the City may be extended by one of two methods. One being a developer extension agreement, where a developer, property owner or a group of property owners request and construct a sewer under the terms and conditions of a developer extension agreement. The second method is a Utility Local Improvement District (ULID) process following RCW 35.43.040 and 35.43.042, where a group of property owners petition the City to extend sanitary sewers to their area and then are assessed for the sewer improvements.

It is the City's policy that the property owners desiring sewer service initiate a request for sanitary sewer service. After entering a Developer's Extension Agreement with the City, the proposed sewer design will be reviewed by the City to ensure compliance with the standards and design criteria. Sewer extensions shall follow the current version of the City of Edmonds "Standard Specifications Manual" and the "Developer Extensions Manual" as provided in the Developer's Extension Agreement. Once the improvements have been constructed and confirmed through the City inspection to meet established standards, then it shall be deeded to the City.

The City Council has the authority to set policies, ordinances, and zoning. The City may find it necessary from time to time to reevaluate their policies based on Snohomish County and adjacent City land use, policies and ordinances.

CHAPTER III – LAND USE AND SERVICE AREA

3.1 SERVICE AREA DESCRIPTION

The existing sewer service area for the City can be described as comprising four different service areas as summarized below:

City of Edmonds. The City of Edmonds municipal boundaries comprise of 5,700 acres. Approximately 4,450 acres within the City of Edmonds is collected and treated at the Edmonds WWTP. The City both owns and maintains this portion of the system and is responsible for treatment. Approximately 1,250 acres on the northern boundary the City of Edmonds is collected and treated at the Lynnwood WWTP. The City owns and maintains this portion of the system and Lynnwood is paid on an ERU basis for the sewage treatment. Additionally, Olympic View Water and Sewer District maintains a sewer system within Edmonds City limits. All Olympic wastewater is collected and treated at the Edmonds WWTP.

King County and City of Woodway*.* The City of Woodway is collected and conveyed to the Edmonds WWTP, together with the Richmond Beach Pump Station flow, via the Richmond Beach/Woodway sewer trunk. The sewers within this area are owned and maintained by Olympic View Water and Sewer District. The County operates the Richmond Beach Pump Station. An agreement was signed in 2000 for “reciprocal sewage treatment” with King County which is further explained in 3.4.2.

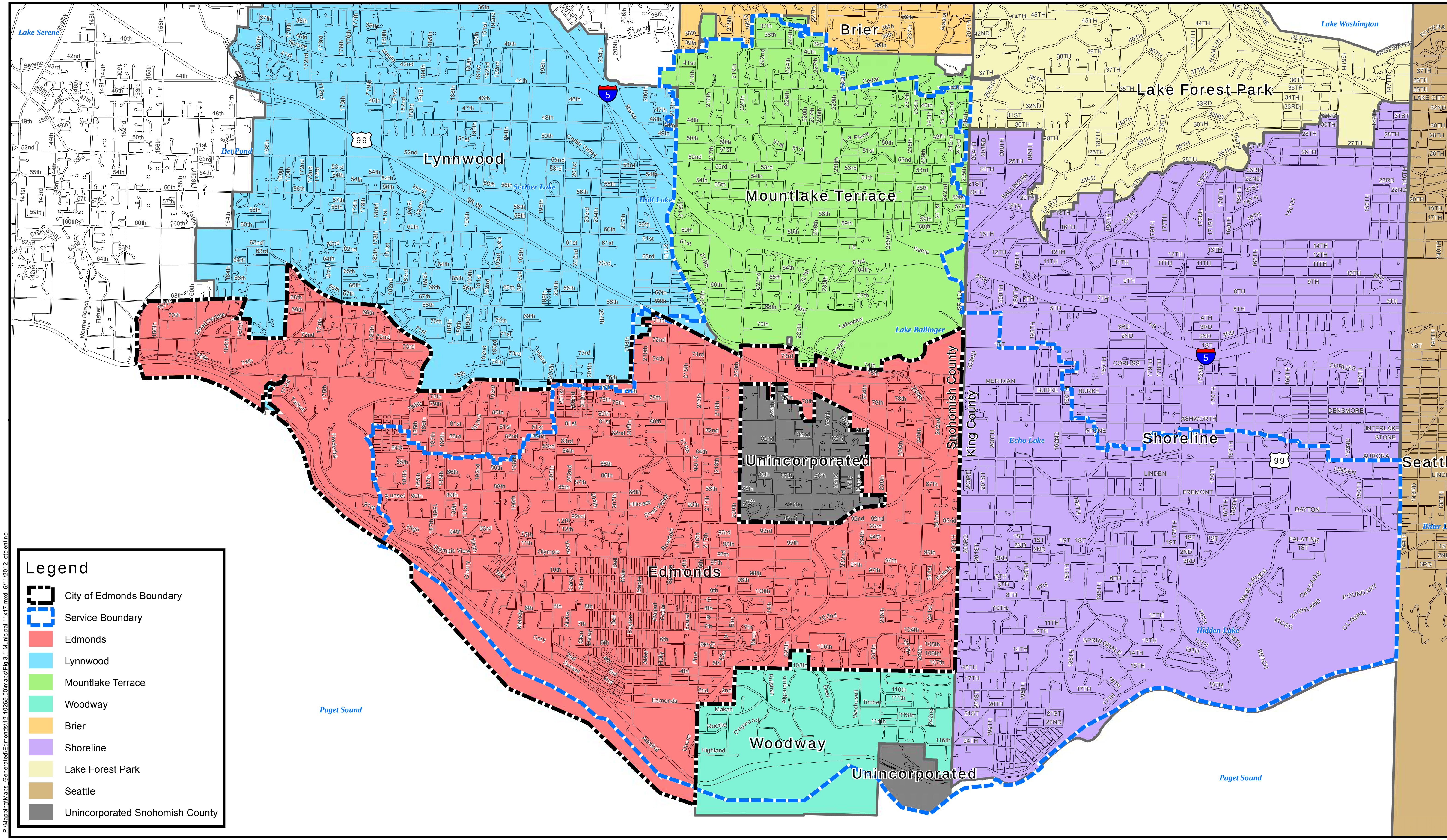
City of Mountlake Terrace**.** The City of Mountlake Terrace lies directly east of the City of Edmonds. The sewage from Mountlake Terrace is collected and conveyed by the Lake Ballinger Pump Station, near SR 104 or N 205th St. The sewer lines are owned and maintained by Mountlake Terrace and the Lake Ballinger Pump Station is owned and operated by King County. Operations of the Lake Ballinger Pump Station are described further in 3.4.2.

Ronald Wastewater District and City of Shoreline. The southern portion of the City’s service area is located in the City of Shoreline. Shoreline does not own or maintain any sanitary sewer system components; these portions are either owned by King County or Ronald Wastewater District.

3.2 SURROUNDING VICINITY CHARACTERISTICS

3.2.1 Topography

Figure 3.1 shows the City’s service area boundary and the corporate boundaries of the cities described in Section 3.1.



P:\Mapping\Maps Generated\Edmonds\12-10265.00\maps\Fig 3.1 Municipal 11x17.mxd 6/11/2012 ctolentino

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GIS Data: City of Edmonds, Snohomish & King County base data.

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NORTH

0 1,600 3,200 6,400 Feet

Scale in Feet

MUNICIPAL BOUNDARIES

COMPREHENSIVE SEWER PLAN

City of Edmonds
May 2012

Figure
3.1

The topography of the City ranges from flat and gently rolling to hilly, with a few steep slopes along the stream corridors and property immediately adjacent to Puget Sound. Wetlands, lakes and many creeks and small streams are found throughout the City (see Figure 3.2).

3.2.2 Geology

The retreat of glaciers at the end of the last ice age formed the rolling terrain characteristic of the City. Erosion and flooding of low lying areas during that period resulted in soil deposits of two primary classifications as identified by the United States Department of Agriculture, Soil Conservation Service. These soil types are the Alderwood Series and the Everett Series, which are described below and displayed on Figure 3.3.

The Alderwood Series is the most prevalent soil type in the City. The soil is moderately well drained and has a weakly consolidated to strongly consolidated substratum at a depth of 24 to 40 inches. Permeability is moderately rapid in the upper horizons but very slow in the consolidated substratum. These moderately well drained acidic forested soils formed in loamy glacial till and occur on rolling till plains and moraines.

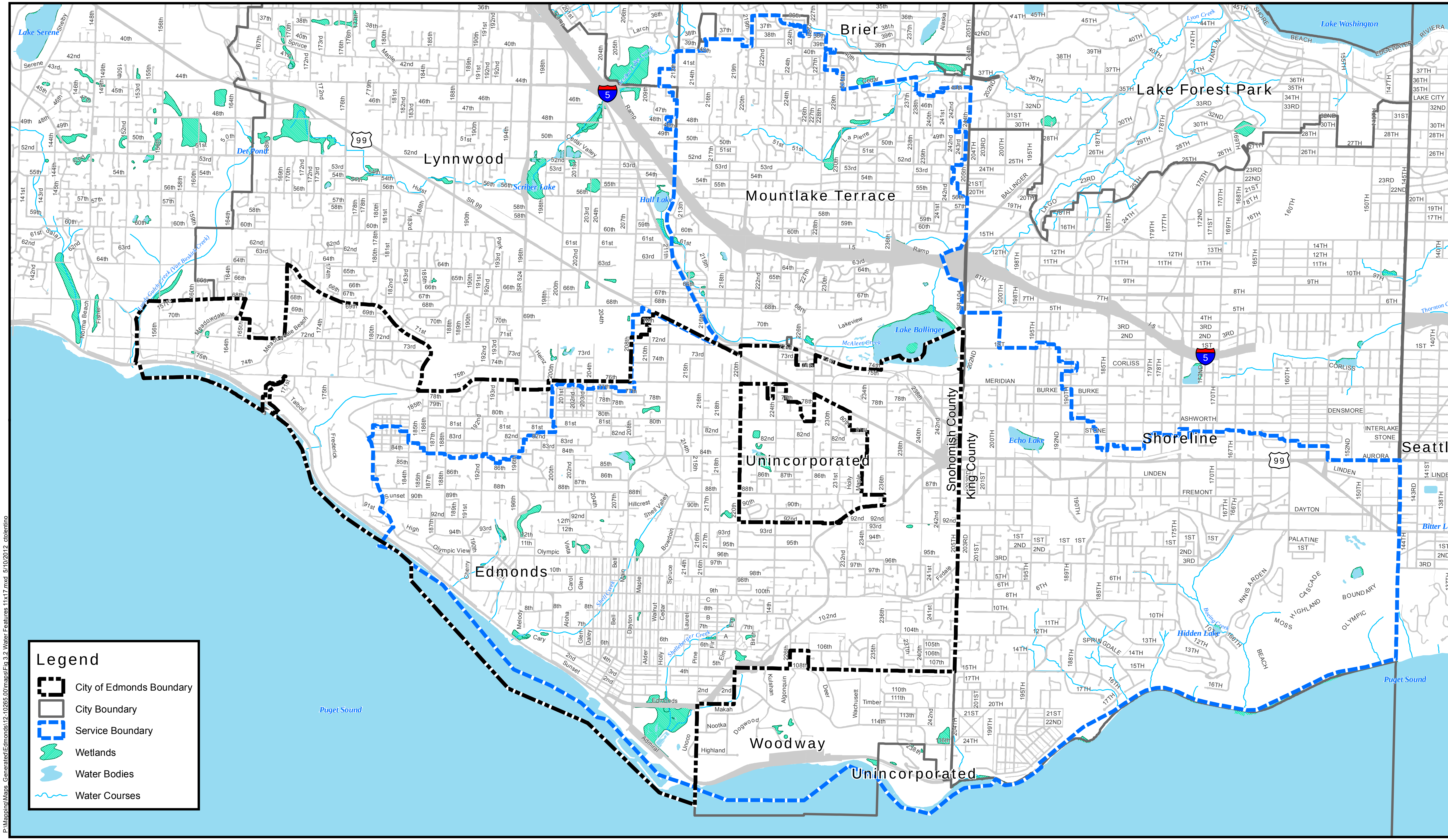
The Everett Series forms the soils located on outwash plains, terraces, and fans and occur on slopes ranging from 0 to 65 percent. These soils are glacial outwash, characterized as somewhat excessively drained, gravelly, gently undulating soil underlain by sand and gravel and found on terraces.

3.2.3 Water Resources

The City's municipal water system provides service to approximately 80 percent of the population within the City limits or more than 10,050 customer accounts. The other 20 percent of the City's population receive water service from the Olympic View Water & Sewer District, which is located within the southwest portion of the City limits.

All water supplied to the City customers is currently purchased from Alderwood Water and Wastewater District and is conveyed through a single metered connection near the northeast corner of the water system. The City also has the capacity to serve a portion of its system with water purchased from Seattle Public Utilities (SPU), but currently maintains this source of supply and the single metered connection on standby. Water purchased from Alderwood Water and Wastewater District originates from the City of Everett Sultan River source. Water supplied by SPU originates from SPU's Tolt River source.

Interties are also provided with the City of Lynnwood and Olympic View Water District (see Figure 3.4).



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Wetlands: Snohomish County, March 2004
King County, November 2004

Wetland locations in the dataset are approximate. This dataset contains polygons that represent the basic wetlands categories used in the King County Stream and Wetlands Survey. All wetland areas within this dataset should be surveyed before land use changes are made.

GIS Data: City of Edmonds, Snohomish & King County base data.

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NORTH

0 1,600 3,200 6,400 Feet

Scale in Feet

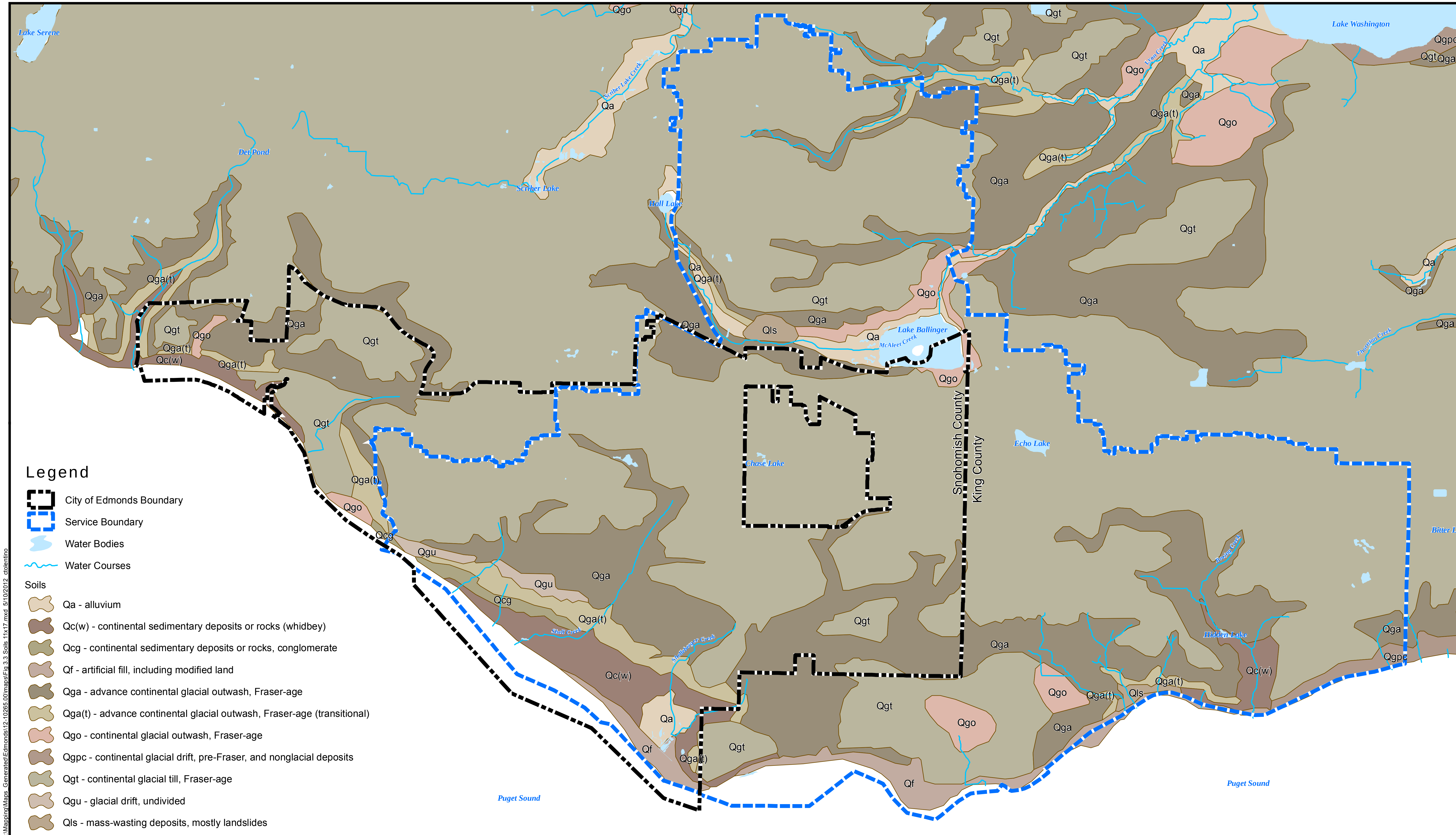
City of Edmonds Inc. 1890

WATER FEATURES

COMPREHENSIVE SEWER PLAN

City of Edmonds
May 2012

Figure
3.2



P:\Mapping\Maps Generated\Edmonds\12-10265.00\maps\Fig 3.3 Soils 11x17.mxd 5/10/2012 ctolentino

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Soils Data: Washington State Department of Natural Resources 2005

GIS Data: City of Edmonds, Snohomish & King County base data.

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NORTH

0 1,600 3,200 6,400 Feet

Scale in Feet

SOILS MAP

COMPREHENSIVE SEWER PLAN

City of Edmonds
May 2012

Figure 3.3

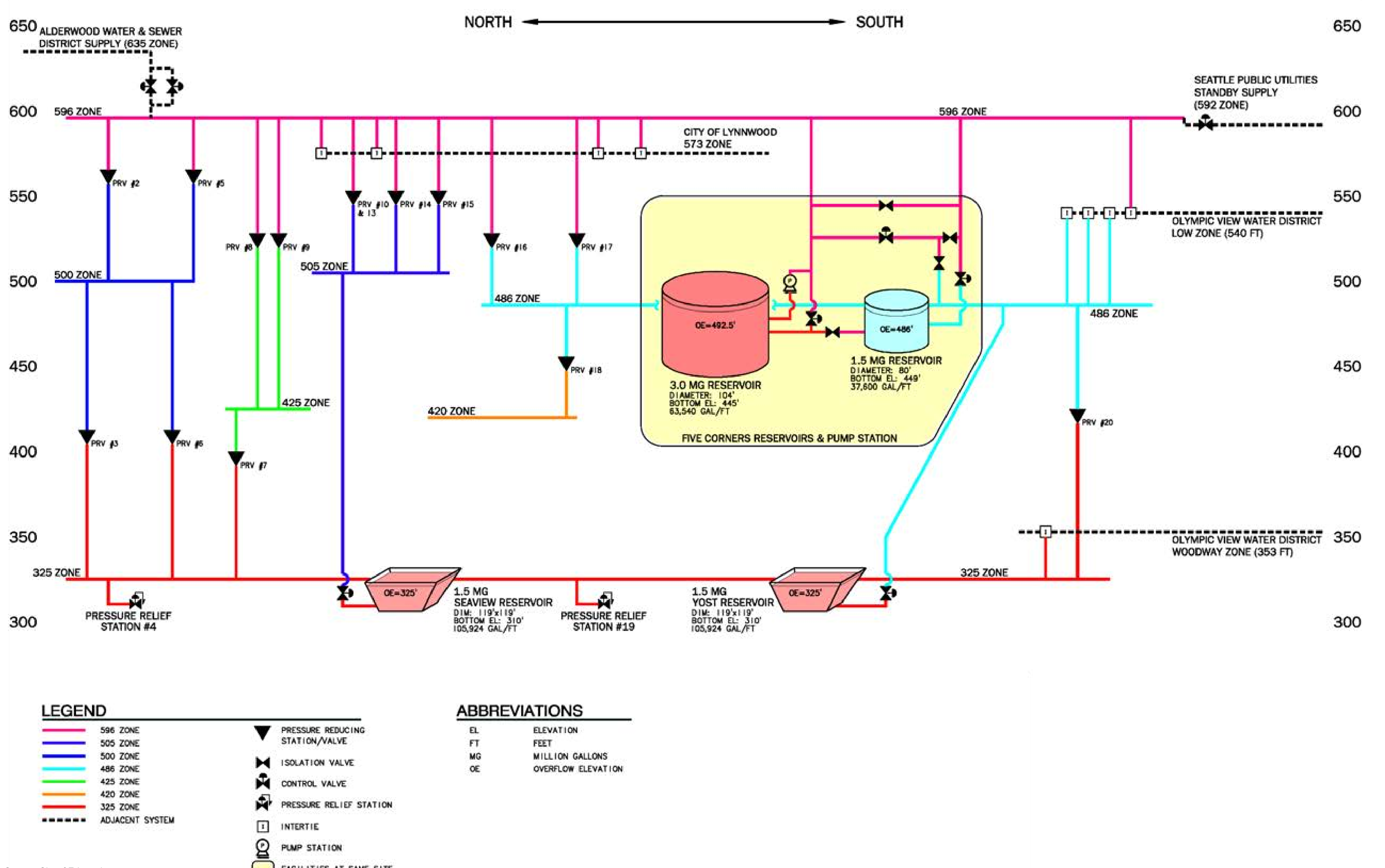

Image Source: City of Edmonds
Comprehensive Water System Plan, MSA August 2010

P:\Mapping\Maps_Generated\Edmonds\12-10265.00\maps\CompSewerPlan - March 2013\Fig 3.4 Water System Schematic 8.5x11.mxd 3/27/2013 ctolentino

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WATER SYSTEM SCHEMATIC

COMPREHENSIVE SEWER PLAN

City of Edmonds
March 2013

Figure
3.4

Surface Water – The two most dominant fresh water features in the sewer service area are Lake Ballinger and Echo Lake. Lake Ballinger is by far the larger of the two and is located in the central western portion of the City, near I-5 between the City of Edmonds and City of Mountlake Terrace. It has an intermittent inlet and drains through McAleer Creek to Lake Washington. The lake has a surface area of 100 acres, a mean depth of 15 feet, and a maximum depth of 25 feet.

Echo Lake is located in Shoreline, a few blocks east of Highway 99. Echo Lake has an area of 12 acres and a watershed area of 288 acres.

Puget Sound borders the City on the west.

Groundwater – A study done in 1997 by the US Geological Survey found that 94% of the groundwater in South Snohomish County was considered soft to moderately hard. No appreciable widespread groundwater contamination was found at the time of the study.

Concentrations of arsenic, iron and manganese were the most widespread groundwater problems in the area. The population growth in Snohomish County has increased dramatically in the last 10 years and has affected the quantity and the quality of groundwater. Most groundwater recharge in Snohomish County is from infiltration of precipitation, and impervious surfaces caused by increased development prevent infiltration. Consequently, less groundwater is becoming available as land development increases.

3.3 LAND USE

3.3.1 Growth Management Act

The State of Washington adopted the Growth Management Act with the intent of concentrating most new development and population gains within urban areas of the more populous and rapidly growing counties. These counties are required to define an urban growth boundary within which urban services like sewers are provided, and any new parcels created outside that boundary must be low density with sufficient acreage to support onsite sewage disposal systems conforming to State Health regulations.

The entire service area is within the GMA boundaries of the City or the adjacent cities for urban development. Consequently, the limitations on extending sewer service to unsewered areas is a non-issue.

Zoning within the service area can be classified as commercial/industrial, low density multi-family, high density multi-family, single family, and undeveloped lands such as public right of ways, parks, and open space. These zoning areas are depicted in Figure 3.5. Low density multi-family zoning allows a variety of low-density, multi-family housing including townhouses, multi-family structures and attached or detached homes on small lots.

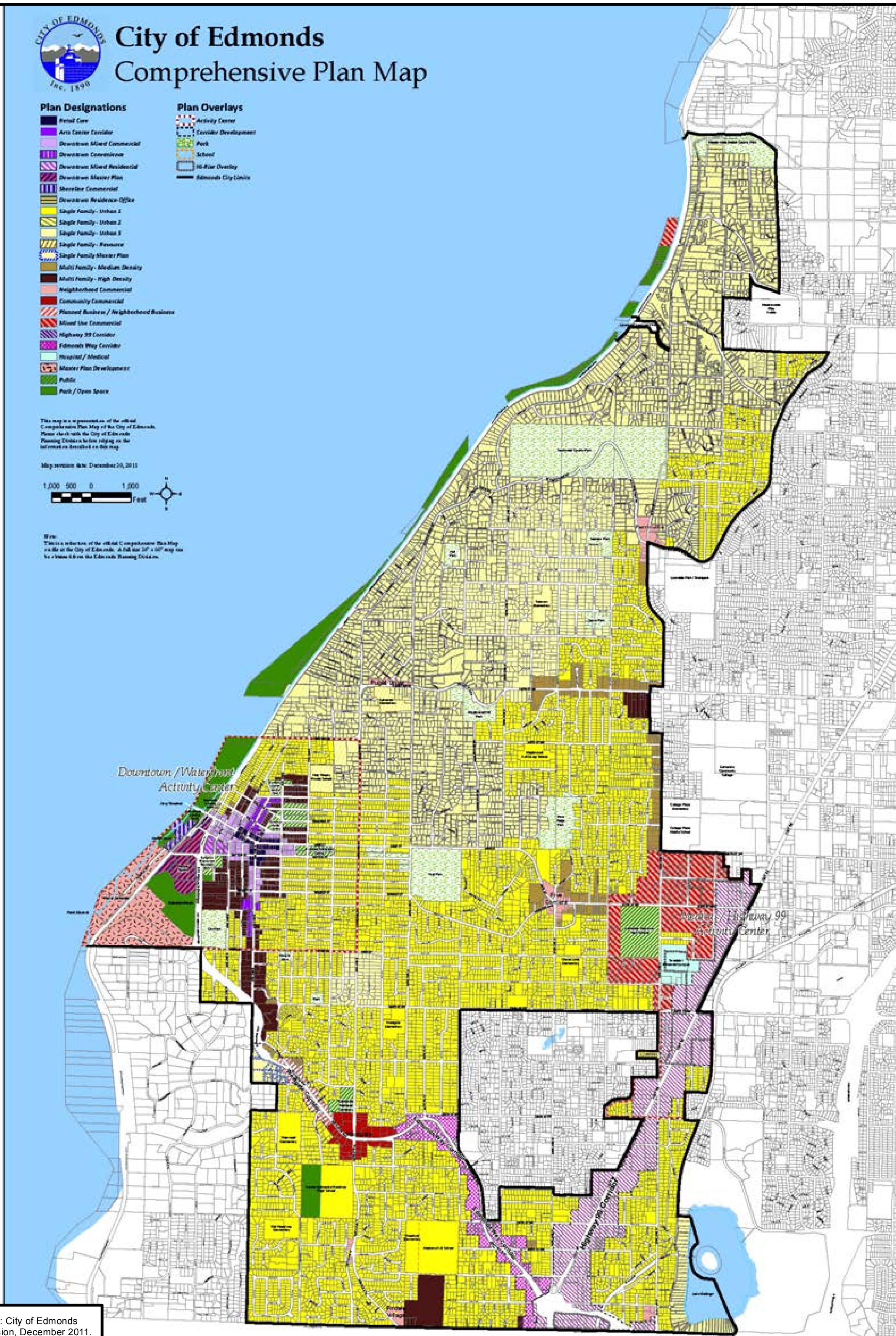

Image Source: City of Edmonds Planning Division, December 2011.

P:\Mapping\Maps_Generated\Edmonds\12-10265.00\maps\CompSewerPlan - March 2013\Fig 3.5 Comp Plan 8.5x11.mxd 4/4/2013 ctolentino

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COMPREHENSIVE PLAN MAP

COMPREHENSIVE SEWER PLAN

City of Edmonds

March 2013

Figure

3.5

3.4 RELATIONSHIPS WITH ADJACENT SEWERAGE AGENCIES

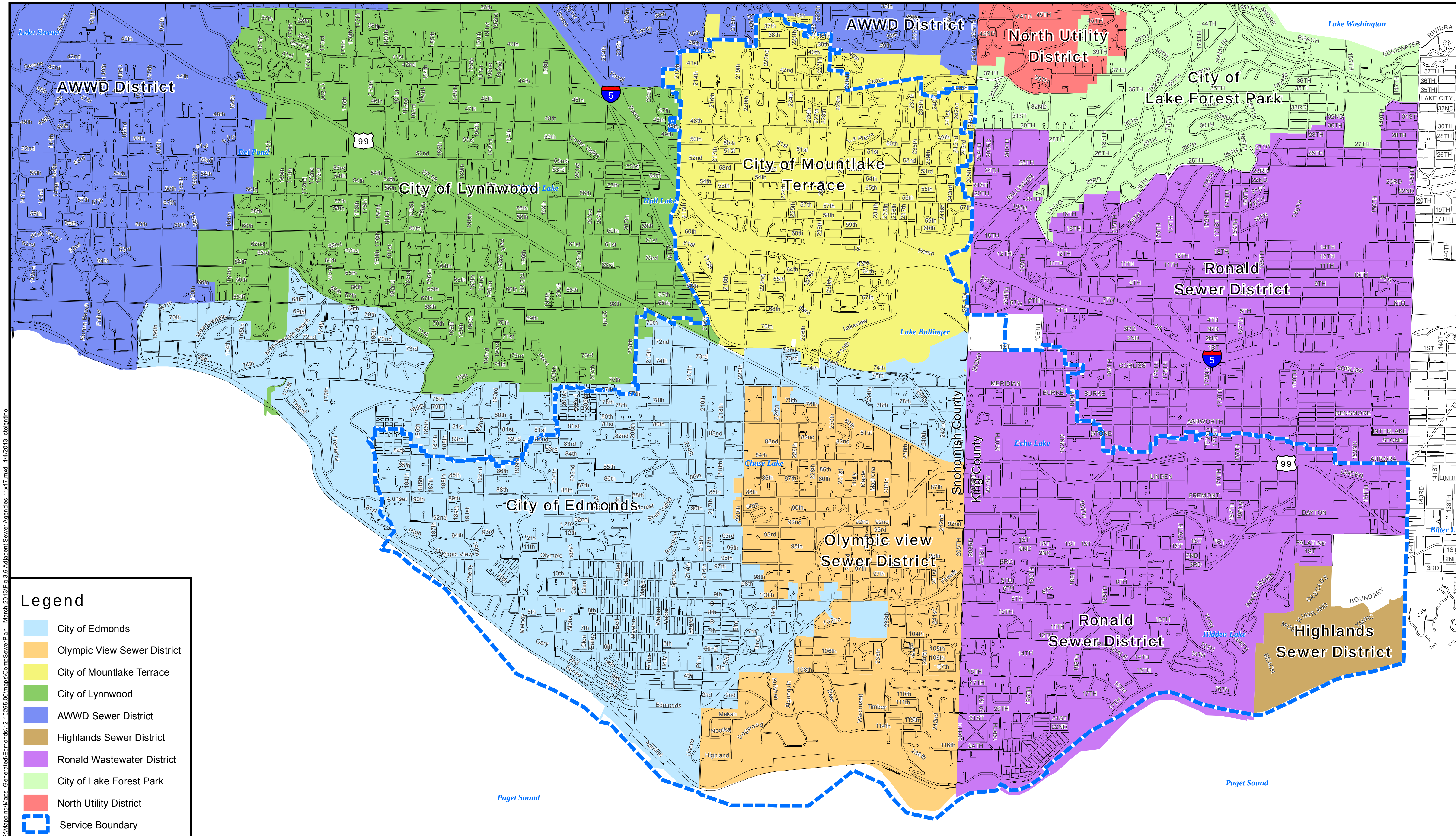
Neighboring agencies such as utility districts and municipalities provide sewer service adjacent to the City of Edmonds. Summaries of the agreements made between the City of Edmonds and the various agencies are described below, as well as background information on each of the adjacent service providers. Copies of the referenced interlocal agreements are included in Appendix G.

- City of Lynnwood
- King County Metro
- City of Mountlake Terrace
- Ronald Wastewater District
- Olympic View Water and Wastewater District

The geographical relationship between these agencies is represented on Figure 3.6. To better understand the current contractual agreements with the neighboring sewer utilities, refer to graphical presentations on Figures 3.7 to 3.10.

3.4.1 City of Lynnwood

City of Lynnwood borders the northeast portion of the City of Edmonds. A portion of the flows within Edmonds municipal boundaries are routed to the Lynnwood Sanitary System and treated at the Lynnwood WWTP. This accounts for approximately 15% of the influent flow into the Lynnwood WWTP or about 300,000 gallons per day (Annual Average Flow). The City of Edmonds owns and maintains the sewer infrastructure in this area but pays Lynnwood on a per customer basis for the treatment. As of 2010, there is an approximate sewered population of 6,200, and an employment population of 509. There are no schools in this zone. See Figures 3.7 and for a map of the area. City of Edmonds also receives a small portion of flow from Lynnwood boundaries that flows through the Meter 1 Sub-basin (see Figure 5.1). This is estimated at approximately 0.5% of the total flow tributary to Edmonds WWTP.



P:\Mapping\Maps Generated\Edmonds\12-10265.00\maps\CompSewerPlan - March 2013\Fig 3.6 Adjacent Sewer Agencies 11x17.mxd 4/4/2013 ctolentino

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Snohomish County/King County base data.

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NORTH

0 1,600 3,200 6,400 Feet

Scale in Feet

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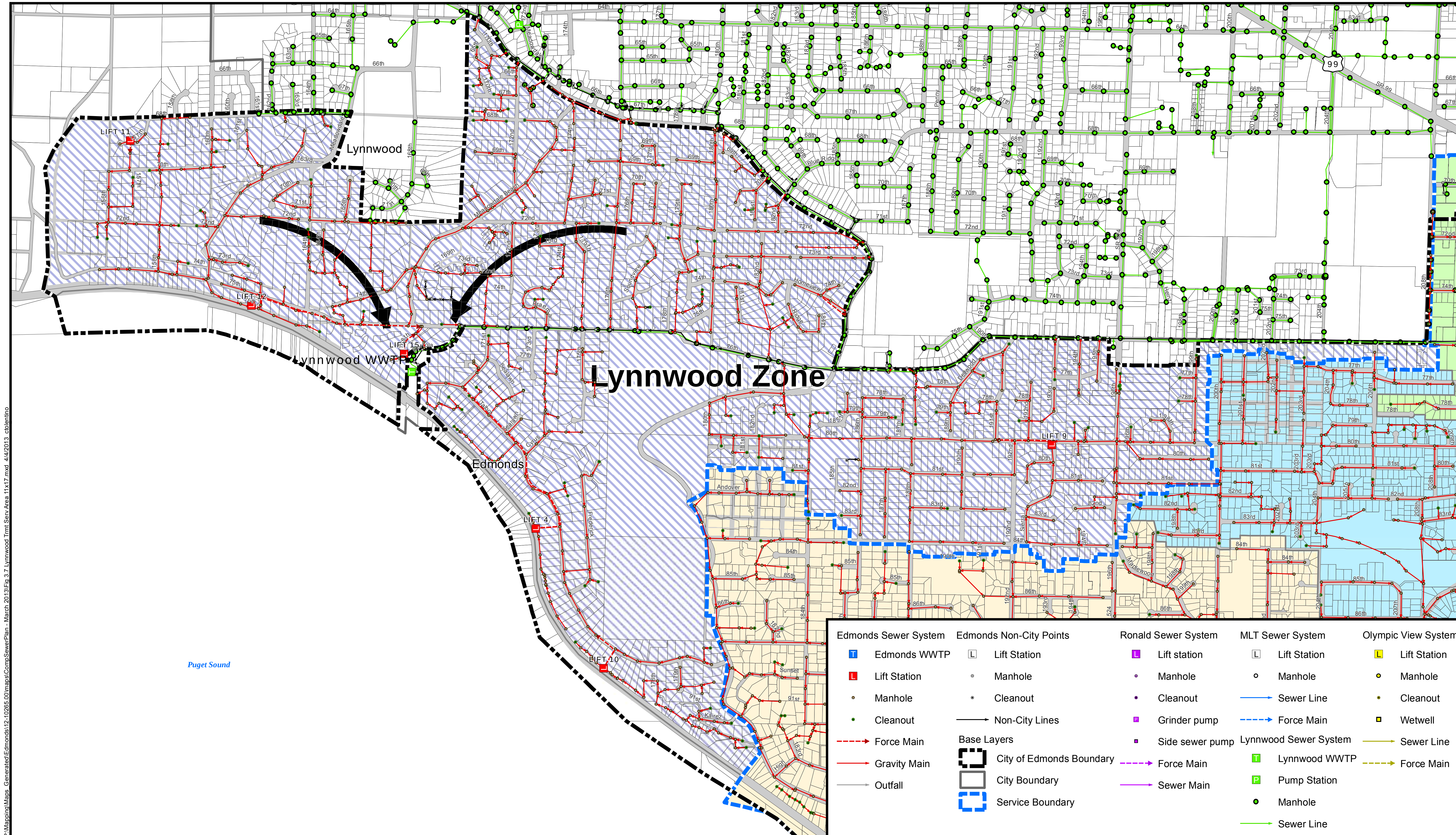
ADJACENT SEWER AGENCIES

COMPREHENSIVE SEWER PLAN
City of Edmonds
March 2013

Figure
3.6



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City of Lynnwood - March 2011, Olympic View Sewer District 2007
City of Mountlake Terrace (MLT) - 2012, Ronald Wastewater District 2010

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NORTH

0 750 1,500 3,000 Feet
Scale in Feet

CITY OF EDMONDS
Inc. 1890

LYNNWOOD TREATMENT SERVICE AREA

COMPREHENSIVE SEWER PLAN

City of Edmonds
March 2013

Figure
3.7

3.4.2 King County

The Richmond Beach Sub-basin area, as shown in Figures 3.8 and 5.1, is maintained and operated by Ronald Wastewater District and King County. Flow from the Richmond Beach Pump Station is ALWAYS sent to the City of Edmonds and treated at the City of Edmonds WWTP. King County also operates the Lake Ballinger Pump Station which serves a portion from Edmonds, Mountlake Terrace and Ronald Wastewater District (Meter B Sub-basin). This area is also referred to as “Edmonds East” in the 2000 Agreement with King County. The Edmonds East catchment has a considerably more populated area than Richmond Beach and thus, produces higher flows. The City of Edmonds and King County executed an agreement on October 6, 2000 that addresses responsibilities for the flow. The responsibilities are described in brief below and the full agreement can be seen in Appendix G.

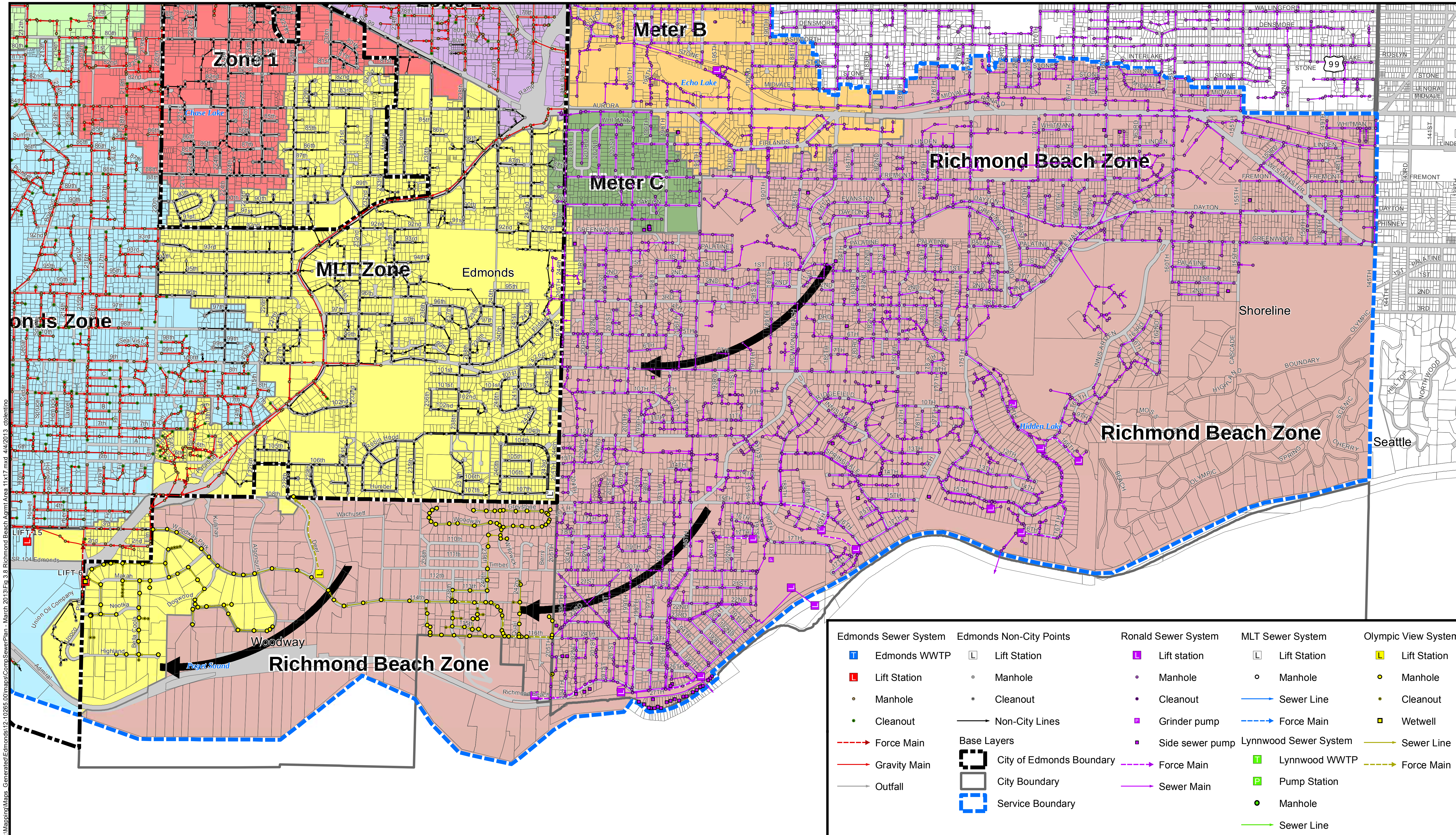
Sewage Treatment Responsibilities – January 1, 2000 to January 1, 2012

The agreement recognizes an initial period, defined in the agreement as 2000 to 2012, where Edmonds was responsible for seasonal treatment from BOTH Richmond Beach and Lake Ballinger Pump Station. This was presumably done while King County increased treatment capacity within their system (i.e. build the Brightwater Wastewater Facilities). During this period, sewage from Richmond Beach ALWAYS was conveyed to and treated at the Edmonds Wastewater Treatment Plant. All Lake Ballinger Flow was treated by Edmonds during the winter/spring months from November 1 until April 30. During the summer months, the flow swap was engaged and the County received a volumetric flow out of Lake Ballinger approximately equal to what the City is treating out of the Richmond Beach Sub-basin Area. There were limited periods that King County received all flows from Lake Ballinger, presumably when Edmonds needed to make repairs to their system. Edmonds was compensated $100,000 per year for this agreement.

Sewage Treatment Responsibilities – January 1, 2012 to July 1, 2036

In a subsequent agreement for the period January 1, 2012 to July 1, 2036, King County is responsible for treating a volumetric flow from the Lake Ballinger Pump Station that is equal to the flow pumped into Edmonds from the Richmond Beach Sub-basin area for the ENTIRE year. The flow in excess of this volume is directed to and treated by the Edmonds WWTP. Edmonds is responsible for Operations and Maintenance costs of the Lake Ballinger Pump Station based on the amount of flow pumped into Edmonds system (See Appendix G).

Theoretically, under the conditions of the flow swap, the flow from Richmond Beach Sub-basin should be within 5% of the flow sent to King County through the Ballinger Pump Station. Richmond Beach flow can be estimated by the influent parshall flume meter at the WWTP for Richmond Beach. The flow diverted out of Lake Ballinger can be estimated by subtracting the total flow into the Station (Meters A, B, D) from the downstream flow into the Edmonds system (Meter 3 minus Meter C). For the most part, in 2012, King County sent flow to Edmonds from the hours of 3 pm to 6 am. This



P:\Mapping\Maps Generated\Edmonds\12-10265.00\maps\CompSewerPlan - March 2013\Fig 3.8 Richmond Beach Agrmt Area 11x17.mxd 4/4/2013 ctolentino

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City of Mountlake Terrace (MLT) - 2012, Ronald Wastewater District 2010

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NORTH

0 1,000 2,000 4,000 Feet

Scale in Feet

CITY OF EDMONDS Inc. 1890

RICHMOND BEACH AGREEMENT AREA
COMPREHENSIVE SEWER PLAN
City of Edmonds
March 2013

Figure
3.8

indicates that they are matching the daily flow out of Richmond Beach in a 9 hour period, 6 am to 3 pm. In recent years and for the summer months it appears that the flow through Lake Ballinger Pump Station exceeds the flow through Richmond Beach Pump Station by approximately 1 MGD.

3.4.3 City of Mountlake Terrace

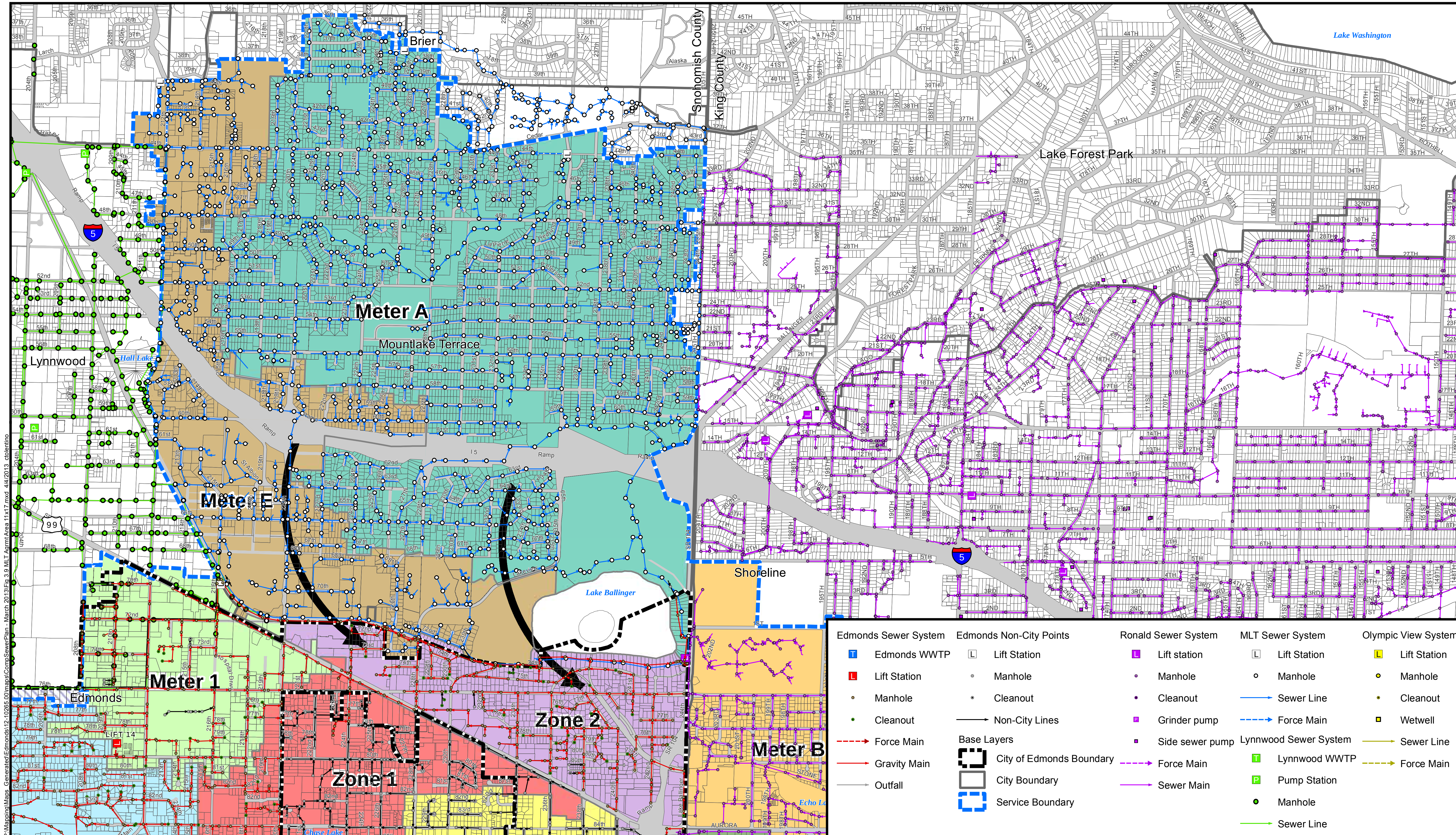
The City of Mountlake Terrace is adjacent to the southeast border of the City of Edmonds. Mountlake Terrace lies east of SR 99 and Edmonds to the west. A portion of the City of Mountlake Terrace's sewer system is routed to the Lake Ballinger Pump Station (approximately 2,265 acres). The sewage is then either routed south to King County Facilities or north to the Edmonds WWTP per the City of Edmonds/King County Agreement for Reciprocal Sewage Treatment. Regardless of where the sewage is routed, City of Mountlake Terrace is contractually bound to the City of Edmonds for treatment of the sewage flow. See Figure 3.9 for a map of the described area.

3.4.4 Ronald Wastewater District

Ronald Wastewater District is located within City of Shoreline municipal boundaries and is directly south of the City of Edmonds. A May 17th, 1988 agreement between City of Edmonds and Ronald Wastewater allows a portion of Ronald's flow to be conveyed to and treated at Edmonds WWTP. Ronald Wastewater District owns and maintains the sewer infrastructure in this area but pays Edmonds for treatment. Some of the flow from Ronald is directed through the Lake Ballinger Pump Station and may actually flow to King County per the Reciprocal Sewage Treatment Agreement. However, Ronald is still obligated to pay the City of Edmonds for all treatment costs. Figure 3.10 shows the portion of Ronald Wastewater District that flows north to Edmonds.

3.4.5 Olympic View Water and Wastewater District

Olympic View Water and Wastewater District maintains and operates a sewage system within the City of Edmonds municipal boundaries. Generally, the District is responsible for an area at the southern side of the City boundaries. Olympic pays Edmonds for treatment on a flow basis.



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NORTH

0 1,000 2,000 4,000 Feet

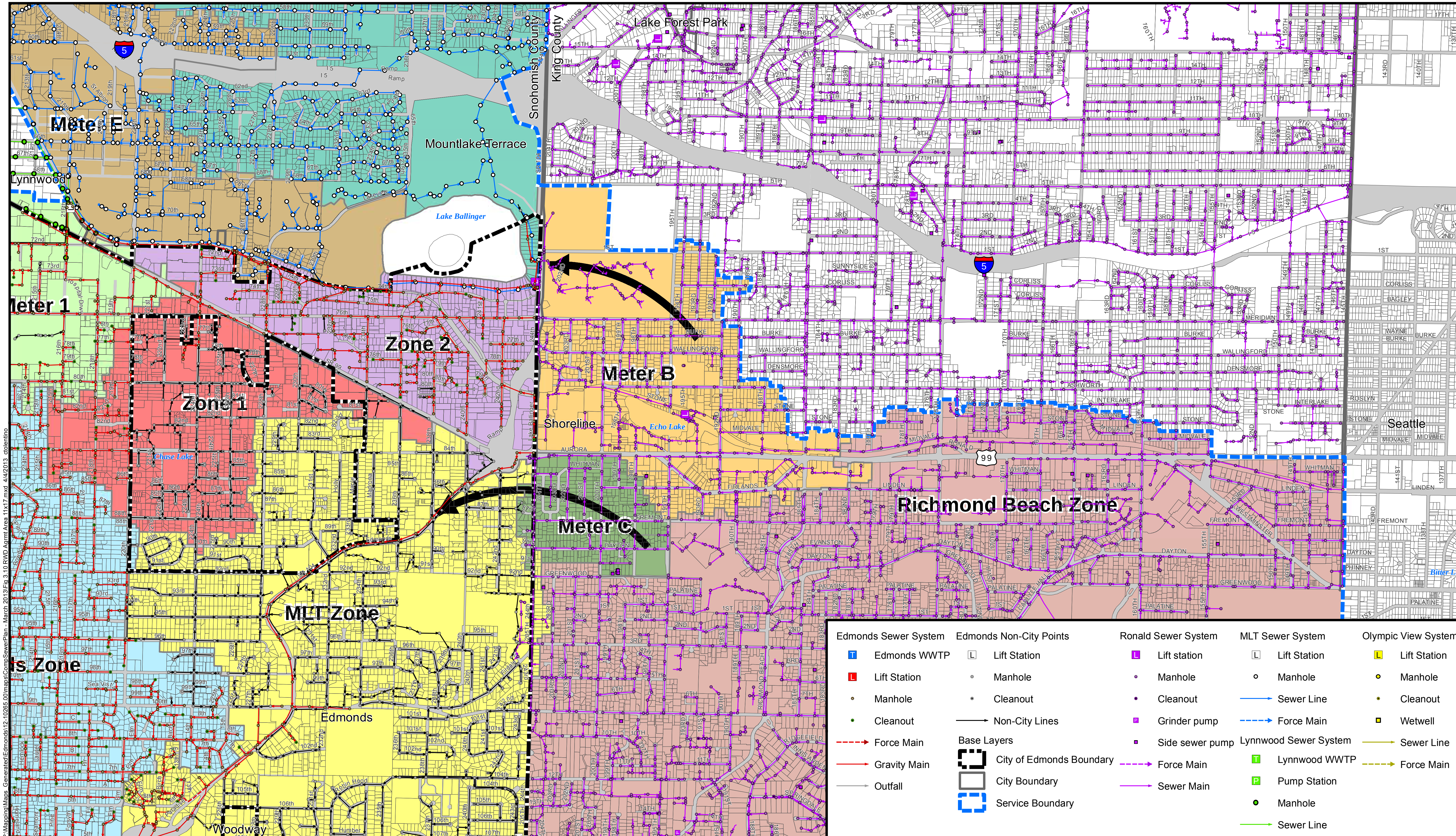
Scale in Feet

CITY OF EDMONDS Inc. 1890

MOUNTLAKE TERRACE AGREEMENT AREA

COMPREHENSIVE SEWER PLAN
City of Edmonds
March 2013

Figure
3.9



P:\Mapping\Maps Generated\Edmonds\12-10265.00\maps\CompSewerPlan - March 2013\Fig 3.10 RWD Agmt Area 11x17.mxd 4/4/2013 ctolentino

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NORTH

0 1,000 2,000 4,000 Feet

Scale in Feet

CITY OF EDMONDS Inc. 1890

RONALD WASTEWATER DISTRICT AGREEMENT AREA

COMPREHENSIVE SEWER PLAN

City of Edmonds
March 2013

Figure
3.10

CHAPTER IV – DESIGN CRITERIA

4.1 PERFORMANCE AND DESIGN CRITERIA

Sewer system design criteria and standards have been developed to maintain a consistent level of service throughout the City. These criteria and standards facilitate planning, design and construction of sewer system projects to achieve a predictable level of quality. These guidelines have been created to meet the increased need for sewer service in response to developments and population growth and the occasional updates to the land use regulations set forth by Cities or County.

The following is a partial list of criteria which affect sizing and siting of facilities. The City's design and construction standards are presented in the City's Standard Details and supplemental specifications modifications. Plans and design shall meet the "Criteria for Sewage Works Design," prepared by the Washington State Department of Ecology, as revised December 1998, except where more stringent City requirements are noted. These standards are to be followed unless otherwise approved by the City.

4.1.1 Sewer Mainline

- All sewer main extensions shall be designed and constructed to provide gravity service for all adjacent lots. In rare occasions where gravity service is not feasible the City may allow the use of individual grinder pumps for a limited number of connections. The design use and ownership of grinder pumps shall be per Section 4.1.5.

- Unless otherwise called for by the City, gravity sewers shall be constructed from PVC or concrete pipe. However, Ductile Iron or HDPE pipe materials may be required in certain applications. Pipe materials shall meet the following standards.

Material	Standard
Plastic – PVC	ASTM D3034-SDR 35 or F789
Concrete Class 2 (unreinforced)	ASTM C14 or AASHTO M 86
Concrete (reinforced)	ASTEM C76 or AASHTO M 170
Ductile Iron	AWWA C151
HDPE	ASTM D1248, Type III, Category 5, Class C, Grade P34 (See Section 2740)

- Ductile iron pipe (Class 52 DIP) and pipe anchors shall be required for all pipeline slopes of twenty percent (20%) and/or greater.

- Ductile iron pipe (Class 52 DIP) shall be required where the depth of cover is 15-feet or greater. Developers may request the use of PVC at depths greater than

15-feet. If so requested, the Developer shall certify the brand of pipe material to be used and he/she shall provide documentation that the pipe material is applicable to the soil conditions of the site and the proposed depth.

- Ductile iron pipe (Class 52 DIP) may be required where the depth of cover in traffic areas is less than 4 feet.
- All sewer pipes shall have 5- foot minimum cover in rights-of-ways and 3-foot minimum cover in all other areas.
- All pipes 8-inch and larger shall terminate at a manhole.
- Where a smaller diameter upstream pipe meets a larger diameter downstream pipe, the inverts at the manhole shall be determined by matching pipe crowns.
- Pressure sewer mains shall be ductile iron pipe or PVC meeting AWWA C-900.
- Minimum grade for 8-inch sewer mains shall be 0.5%, unless otherwise approved by the City's Engineer. Minimum grade for dead-end sewer mains that will not be extended shall be 0.75%, unless otherwise approved by the City's Engineer. Minimum grade and design criteria shall be in accordance with "Criteria for Sewage Works Design, State of Washington, DOE", unless City standards are more stringent.

4.1.2 Manholes

- Manhole numbers shall be obtained from the City.
- All sewer which are 8-inches and larger shall terminate in a manhole. All pipes entering/leaving a manhole shall be aligned with the center of the manhole unless otherwise authorized by the City.
- Manholes shall be 48" I.D. precast concrete, designed in accordance with the City's Standards and Details. All Manholes shall conform to ASTM C-478. Manhole frames and covers shall be locking type in accordance with City's Standards and Details and shall be supplied with stainless steel allen head cap screws. Manholes shall be a minimum of 5 feet deep unless otherwise approved by the City. See Standard Details 1 through 8.
- Inside drop manholes shall be 54" I.D (minimum) precast concrete and have a minimum drop structure of 5 feet.
- Where a drop manhole is required, the inside drop shall be per Detail No. E6.5 unless otherwise authorized or specified by the City.

- Manholes with incoming or outgoing sewer lines 15” or greater shall be 60” I.D. or greater, as directed by the City.

- Manholes shall have a minimum one-tenth of a foot (0.10 foot) drop at the center of the manhole.

- Manhole channels shall be shaped to allow placement and use of the City’s television inspection equipment. Channels shall be constructed at the full depth and diameter of mainline. Manhole shelves shall have slopes of ½ inch per foot. Channels and shelf shall be constructed plaster smooth.

- Manholes shall be placed at each grade and direction change. Distances between manholes shall not exceed 500 feet.

4.1.3 Side Sewers

- Side sewers laterals shall be constructed of SDR-35 PVC pipe, a minimum of 6-inches in diameter, and in accordance with ASTM D-3034. Installation shall follow Detail E6.4.

- The grade for 6-inch side sewer stubs shall be a minimum of two percent (2%).

- Approximate stub locations shall be shown on the plans.

- Cleanouts shall be used and placed over every side sewer at the property line.

- A side sewer stub shall be provided for each parcel on all new sewer extensions, regardless of whether the homeowner connects or not. The side sewer stub shall extend a minimum of 5-feet onto the property. The side sewer stub shall be located and terminate in accordance with Detail E6.4.

4.1.4 Pump Stations

Developers/Owners of developments that may require a pump station to provide sewer service shall contact the City regarding the design requirements of the station and the current City Pump Policies.

4.1.5 Individual Grinder Pumps

The use of individual grinder pumps to serve residential connections shall be limited to connections in which a gravity alternative is not feasibly possible. The City shall make the determination as to which connections qualify for service by grinder pump.

Grinder pumps shall meet the following standards.

1. Grinder pumps shall be owned and maintained by the property owner and shall only serve a single ERU.
2. Grinder pumps Systems shall be Zoeller 840 Series.
3. Minimum velocity for Grinder pump pipelines shall be 2.5 feet per second.
4. Pipelines shall be installed with cleanouts at the end of each line and at critical line size changes to facilitate cleaning.
5. Minimum storage volumes shall be 165 gallons. The Developer shall provided estimated flows to verify adequate storage capacity.

4.2 EASEMENTS

Easements dedicated to the City of Edmonds shall be provided for the construction, maintenance and operation of sewer mains or any other related City owned facilities which lie outside of public street right-of-ways. Easement documents shall be drawn up from the City's standard forms and shall include drawings and legal descriptions for each easement. Drawings and legal descriptions shall be signed and stamped by a Professional Land Surveyor, currently registered in the State of Washington.

Easements shall be a minimum of 15 feet in width, with the sewer located in the center of the easement. There shall be a separate easement provided for each lot that a sewer crosses.

Easements must be approved and received by the City prior to side sewer connection.

4.3 STANDARD DETAILS AND GENERAL NOTES

The City's Sample Plans, General Notes and Standard Details are provided in the Appendix I. The Sample Plans and Standard Details shall be considered during design and shall be followed during construction. At minimum a copy of the applicable manhole detail(s), the side sewer detail and the typical trench detail shall be included on all developer plans sets. Copies of additional individual details may also be required to be on the plans.

CHAPTER V - EXISTING FACILITIES

5.1 DRAINAGE BASINS

The City's service area is divided into different Sub-basins as identified on Figure 5.1. The sub-basins were originally delineated as part of the 2010 I&I Study by BHC Consultants, LLC. There are a total of 12 Sub-basins that either includes parts of the Edmonds corporate limits or areas that flow to and are treated by the Edmonds WWTP.

Sub-basins	In Edmonds City Limits	Flow to Edmonds WWTP	Flow to Lynnwood WWTP	Flows to King County
Meter 1	X	X		X
Zone 1	X	X		X
Zone 2	X	X	X	X
Meter A		X		X
Meter B		X		X
Meter C		X		
Meter E		X		X
MLT Zone	X	X		
Edmonds Zone	X	X		
LS #1	X	X		
Richmond Beach Zone		X		
Lynnwood Zone	X		X	

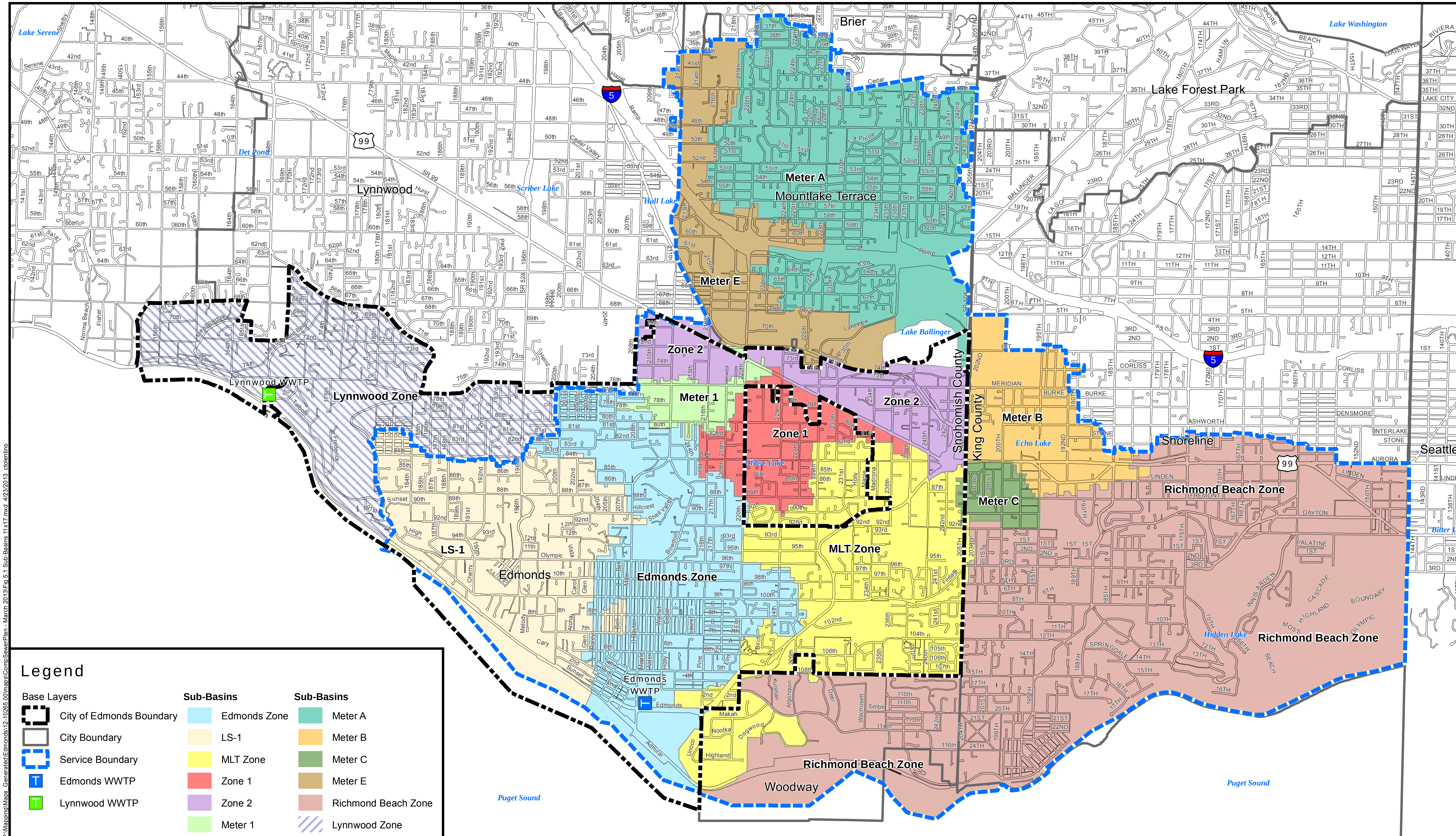
These Sub-basin boundaries are shown on Figures 5.1 and 5.2.

Sub-basins LS-1, Edmonds Zone, Meter C and the MLT Zone generally flow west towards Edmonds WWTP and Puget Sound. The Richmond Beach Zone Sub-basin is conveyed directly to the Edmonds WWTP where it is separately metered. Meter 1, Zone 1, Zone 2, Meter A, Meter B and Meter E generally flow to the south end of Lake Ballinger and are either pumped into the Edmonds System or to King County Metro. The Lynnwood Zone Sub-basin includes portions of the City, but is pumped to the Lynnwood WWTP. A more detailed description of each basin is included below.

The City operates ten different flow meters within the system. Sub-basin delineations are, for the most part, based on these meter locations. Relying on the flow data from these meters it is possible to identify flow in certain areas of the City. Similarly, per capita loadings and I&I contributions can be compared for each Sub-basin. This can be valuable information for identifying areas with high Inflow and Infiltration and for general information about the system.

5.1.1 Meter 1 Sub-basin

The Meter 1 Zone consists of approximately 160 acres and is located on the eastern edge of City of Edmonds municipal boundary.



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NORTH

0 1,600 3,200 6,400 Feet

Scale in Feet

CITY OF EDMONDS Inc. 1890

SUB-BASINS

COMPREHENSIVE SEWER PLAN

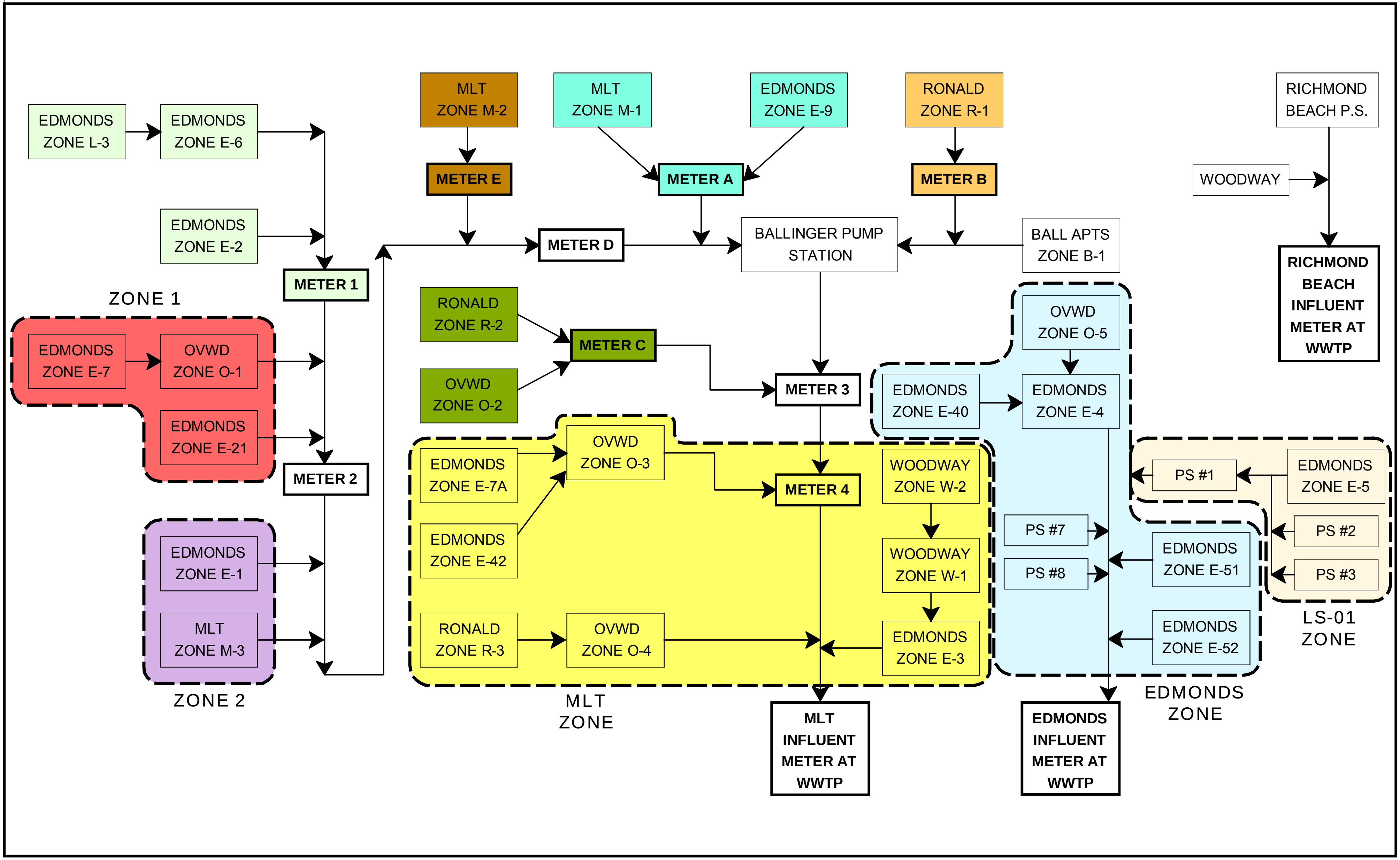
City of Edmonds

April 2013

Figure

5.1

FILE NAME (UPDATED BY) S:\CAD\EDMONDS\12-10265 COMP SWR PLAN\DWGS\F12-10265_FLOW DIA.DWG (PLS)
PLOT DATE & TIME APR 17 2012 11:32:43
XREFS: NONE



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Schematic Flow Diagram

Comprehensive Sewer Plan
Edmonds, Washington
April 2012

Figure

5.2

Generally, flow from this Sub-basin flows south towards Lake Ballinger and can be measured by the readings at meter 1.

5.1.2 Zone 1 Sub-basin

Zone 1 is comprised of approximately 324 acres and generally flows east to an outlet near SR 99. After it combines with flows from the Meter 1 Sub-basin, the flows are measured by meter 2. Therefore, Zone 1 Sub-basin flows can be measured by subtracting flow measured at meter 1 from meter 2.

5.1.3 Zone 2 Sub-basin

Zone 2 Sub-basin has approximately 525 acres and flows south towards the Lake Ballinger Pump Station. Flow from this area is combined with Zone 1 Sub-basin and Meter 1 Sub-basin. This combined flow joins with flow from Meter E Sub-basin before it flows through Meter D, immediately before the Lake Ballinger Pump Station. The flow in Zone 2 Sub-basin can be measured by subtracting both meter 2 and meter E readings from the meter D readings.

5.1.4 Meter A Sub-basin

Meter A Sub-basin is in Mountlake Terrace. Flow from this Sub-basin is directed toward the Lake Ballinger Pump Station. At that point the flow will either be pumped to the Edmonds system or to King County depending on the flow swap proportions. Meter A Sub-basin approximately 1,600 acres and all flow are measured at meter A.

5.1.5 Meter B Sub-basin

Meter B Sub-basin is comprised of approximately 555 acres and lies outside of the Edmonds corporate boundaries. For the most part, flows from Meter B Sub-basin flow through the Lake Ballinger Pump Station and are measured by meter B. The Ballinger Commons Apartments are part of this Sub-basin but are not routed through meter B.

5.1.6 Meter C Sub-basin

Meter C Sub-basin consists of approximately 143 acres and is largely located outside the corporate boundaries of Edmonds. Flows are combined with a small area in Olympic View Wastewater District and are measured through meter C.

5.1.7 Meter E Sub-basin

Meter E Sub-basin is comprised of approximately 663 acres and is located on west edge of the City of Mountlake Terrace, adjacent to the City of Edmonds municipal boundary. Flow from this Sub-basin is measured by flow meter E.

5.1.8 MLT Zone Sub-basin

The MLT Zone Sub-basin is comprised of approximately 1,575 acres. Sewage from this area generally flows northwest and to the City's WWTP. The MLT influent meter at the WWTP measures all flows exiting the MLT Zone Sub-basin plus upstream contributions. MLT Zone Sub-basin flows can be determined by subtracting meter 3 from the MLT influent meter.

5.1.9 Edmonds Zone Sub-basin

The Edmonds Zone is comprised of approximately 1,415 acres and lies directly east of the Edmonds WWTP. Flow from the Edmonds Zone is measured through the Edmonds Influent Meter at the WWTP. Since the LS #01 is tributary, it is necessary to subtract out LS #01 flows to estimate the flows originating in the Edmonds Zone Sub-basin.

5.1.10 LS-1 Zone Sub-basin

The LS-1 Zone Sub-basin lies at the north side of the Edmonds service area and is comprised of approximately 1,107 acres. There are three lift stations operating within this Sub-basin, stations 1, 2 and 3. All flows in this Sub-basin are pumped through Lift Station #1. This station, however, does not have a flow meter.

5.1.11 Richmond Beach Sub-basin

The Richmond Beach Sub-basin lies in the southwest corner of the City of Edmonds service area. It is comprised of 4,054 acres. All flow from the Richmond Beach Sub-basin is pumped through the Richmond Beach Pump Station and flows through the Richmond Beach Influent Meter at the WWTP. King County operates and maintains the Richmond Beach Pump Station as part of the 2000 agreement for reciprocal sewage treatment.

5.1.12 Lynnwood Zone Sub-basin

City of Edmonds has an agreement to send a portion of sewage within the Edmonds municipal boundary to Lynnwood WWTP for sewage treatment. This area is at the northeast corner of the Edmonds municipal boundary and is comprised of approximately 1,241 acres. Edmonds owns and operates six different lift stations within the Lynnwood Zone Sub-basin. Flow from this Sub-basin does not influence conveyance to and capacity at the Edmonds WWTP.

5.2 CITY COLLECTION AND CONVEYANCE FACILITIES

The City's inventory of gravity sewer lines totals approximately 680,000 linear feet of pipes ranging from 6-inches to 36-inches in diameter. This accounts for the City owned pipe only and not adjacent sewer adjacencies which own and operate the sewer infrastructure, and send flow to Edmonds for treatment. Table 5.1 below presents the summarized inventory of the City-owned piping systems.

Table 5.1
Summary of Pipe Inventory

Pipe Size	Total Length of City-owned Pipe (feet)
6-inch	19,678
8-inch	535,672
10-inch	34,145
12-inch	13,017
15-inch	9,612
18-inch	7,133
24-inch	21,937
30-inch	3,456
36-inch	3,237
Unknown	31,340
TOTAL	679,227 feet

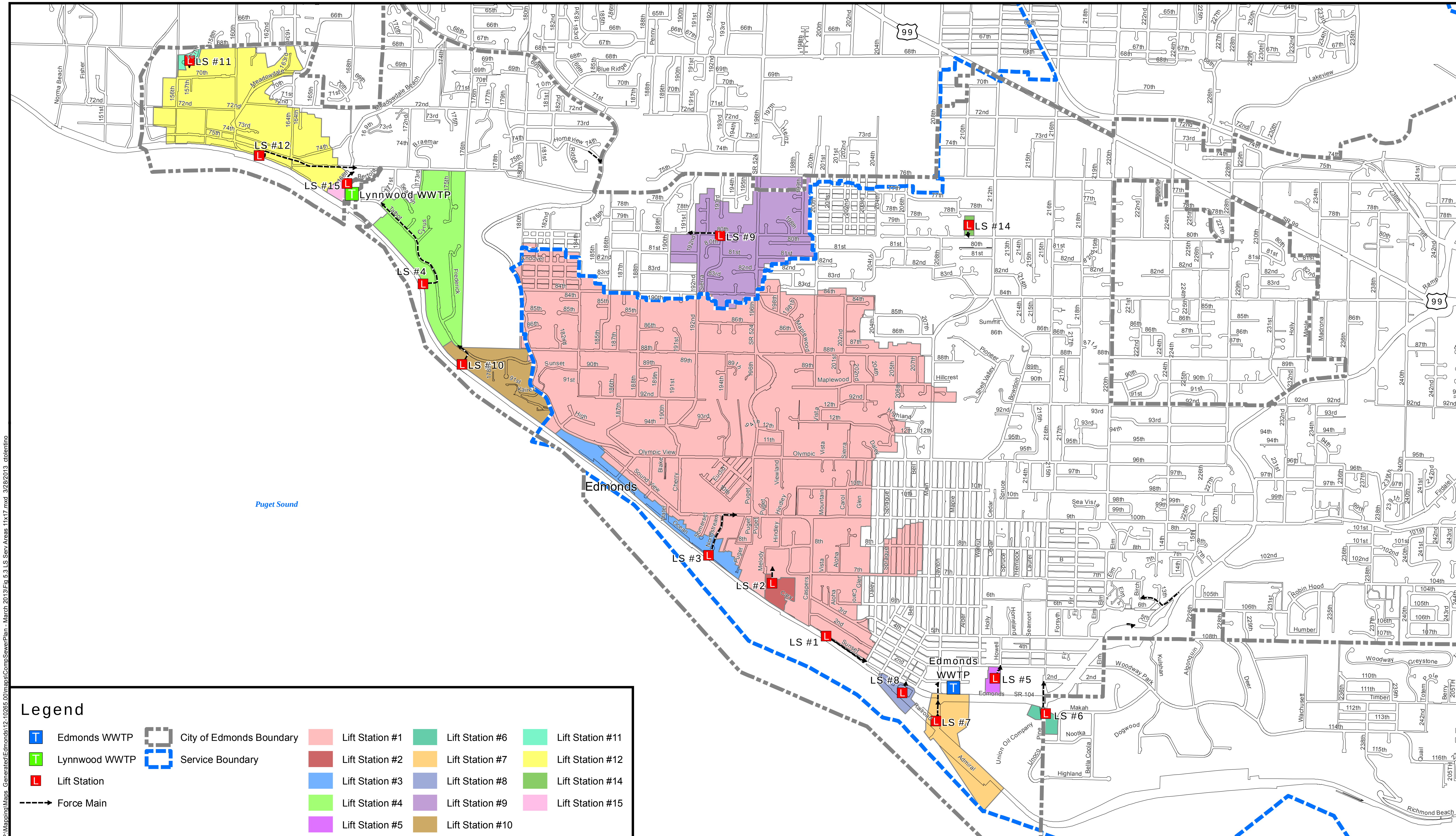
5.3 LIFT STATIONS

The City has a total of 14 active lift stations. Additionally, there are the Lake Ballinger Pump Station and the Richmond Beach Pump Station which are owned and maintained by King County. Several lift stations were upgraded in 2012. In addition, telemetry upgrades have been made at all of the lift stations. Most of the stations have alarm notifications which include: pump on/off; pump failure; power failure; high / low wet well level; generator run; operator in trouble; intrusion; and smoke detector.

Table 5.2 summarizes the Pump Station inventory as well as some of the operating conditions.

Figure 5.3 illustrates the relationship between each of the District's lift stations and give a representation of their location within the system.

Table 5.2 Pump Station Inventory						
Pump Station No.	Pump Type	Number of Pumps	Pump Manufacturer	Rated Capacity GPM @ TDH	Force Main Size and Type	PS Upgrades Year (if any)
1	Wet Well / Dry Well	2		1425 gpm @ 19 feet	10-inch AC & 12-inch DI	2002
2	Submersible	2	Hydromatic HPGFHX300	85 gpm @ 35 feet	3-inch DI	2011
3	Wet Well / Dry Well	2	4" Allis Chalmers	114 @ 94 feet	4-inch DI	2012
4	Wet Well / Dry Well	2	4" PACO	308 gpm @ 164 feet	6-inch DI	2012
5	Submersible	2	Hydromatic HPGX200CD	37 gpm @ 48 feet	2-inch HDPE	2012
6	Wet Well / Dry Well	2	4" Gormann Rupp	335 gpm @ 45 feet	6-inch DI	2005
7	Wet Well / Dry Well	2	6" Gormann Rupp	210 gpm @ 22 feet	4-inch PVC	2008
8	Wet Well / Dry Well	2	4" PACO	137 gpm @ 22 feet	4-inch DI	2008
9	Wet Well / Dry Well	2	2 - 4" WEMCO 2 - 5" WEMCO	332 gpm @ 38 feet	6-inch DI	2012
10	Wet Well / Dry Well	2	Hydromatic HPGFX	114 gpm @ 49 feet	4-inch DI	2012
11	Submersible	2	4" Gormann Rupp	95 gpm @ 73 feet	2-inch HDPE	2012
12	Wet Well / Dry Well	2	6" KSB	308 gpm @ 142 feet	6-inch DI	2012
14	Submersible	2	Hydromatic HPGX200CD	37 gpm @ 33 feet	2-inch HDPE	2012
15	Submersible	2	Hydromatic HPGHX500	42 gpm @ 60 feet	2-inch HDPE	2012



P:\Mapping\Maps Generated\Edmonds\12-10265.00\maps\CompSewerPlan - March 2013\Fig 5.3 LS Serv Areas 11x17.mxd 3/28/2013 ctolentino

BHC Consultants, LLC
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Seattle, Washington 98101
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206.505.3406 (fax)
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Sewer Zones: City of Edmonds, December 2011
GIS Data: City of Edmonds, Snohomish County & King County.

Data sources supplied may not reflect current or actual conditions. This map is a geographic representation based on information available. It does not represent survey data. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map.

NORTH

0 1,000 2,000 4,000 Feet
Scale in Feet

LIFT STATION SERVICE AREAS
COMPREHENSIVE SEWER PLAN
City of Edmonds
March 2013

Figure 5.3

5.4 EDMONDS WWTP

5.4.1 General

The Edmonds Wastewater Treatment Plant (WWTP) provides wastewater treatment service for residential, commercial, and industrial customers for the City of Edmonds sewer service boundary. The facility was initially built in 1957 and has undergone several modifications, updates and expansions. In 1991 the Edmonds WWTP was upgraded from a primary plant to secondary plant. Currently the plant is rated to treat 11.8 mgd maximum month flow.

The plant is located at 200 2nd Ave South, Edmonds, WA, 98020.

The Washington State Department of Ecology regulates discharges to waters of the state through the National Pollutant Discharge Elimination System (NPDES) permit system. NPDES permits are developed based on federal and state water quality standards and treatment requirements.

The existing system is permitted under the NPDES discharge permit number WA-002405-8 (modified May 9, 2012). Effluent limitations are summarized in Table 5.3. The plant has been continuously compliant with these standards.

Table 5.3 Current NPDES Effluent Limitations for Edmonds WWTP Discharge

Parameter	Average Monthly Limits[1]	Average Weekly Limits[1]	Maximum Daily Limits[1]
Carbonaceous Biochemical Oxygen Demand (5 day BOD)	25 mg/L, 2460 lbs/day 85% removal of influent $CBOD_5$	40 mg/L, 3936 lbs/day	N/A
Total Suspended Solids (TSS)	30 mg/L, 2952 lbs/day 85% removal of influent TSS	45 mg/L, 4430 lbs/day	N/A
Fecal Coliform Bacteria	200/100 mL	400/100 mL	N/A
pH	Daily minimum ≥ 6.0 and daily maximum of ≤ 9.0		N/A
Total Residual Chlorine	191 µg/L	N/A	442 µg/L
[1]Current load limits are based on the Maximum Month Design Flow (MMDF) of 11.80 mgd.			

Biosolids (sludge) treatment and use are regulated under federal (40 CFR Part 503) and State (Chapter 173-308 WAC) regulations through the Statewide General Permit for Biosolids Management. Sludge from the Edmonds plant is dewatered using a belt filter press and incinerated using an on-site fluidized bed incinerator.

The plant has been compliant with the regulations for sewage sludge incinerators based on air emission limits established in Title 40 Part 503 of the Clean Water Act (CWA). The air emissions standards have recently been expanded by the EPA. On February 21, 2011, the EPA published their newest final SSI emission regulations in the Federal Register at Title 40 Part 60, under the provisions of the Clean Air Act (CAA), Section 129 “Solid Waste Incineration Units”. The new regulations were declared to be effective on May 20, 2011.

The previous and new air quality emission limits, how the plant's current emissions compare with the new standards and how the new regulations will affect the current incinerator equipment, operations and costs are discussed in Section 8.7.1.

5.4.2 Existing Wastewater Treatment Facilities and Loadings

The plant was originally constructed in 1957 and has been modified or upgraded several times since then. Table 5.4 summarizes the history of the WWTP.

Though the historical perspective of the improvements and modifications to the plant is interesting, the current infrastructure is really the important issue. The following sections describe the current facilities.

General: The current plant has a design maximum month flow of 11.8 mgd. The maximum month flow the plant currently treats is about 9.5 mgd. Flow is measured by three Parshall flume meters on the influent side of the WWTP and by an effluent meter.

Table 5.4
Edmonds WWTP Historical Improvements and Capacity

Project description	Date	Design Capacity		
		Maximum Month (mgd)	Average Annual (mgd)	Peak Hour (mgd)
Original Construction				
Grit removal, sewage grinding, primary settling, digestion, chlorination and outfall.	1957		2	
Improvements and Modifications				
Capacity Expansion	1959		4	
Two additional clarifiers, effluent pumping, sludge dewatering and incineration system. Removed grit and digestion.	1967		7.6	
Secondary Treatment	1991	11.8	9.1	40

Headworks

The headworks consists of three channels designated for measuring Edmonds, Mountlake Terrace, and Richmond Beach basin flows. Before the flow is measured with parshall flumes, three 4-foot wide mechanical bar screens with ¼-inch openings screens the influent. The flow then enters a wet well where four 100 hp vertical non-clog raw sewage pumps, each with a capacity of 9,260 gpm, the process flow though two 24" pipes to a primary influent splitter box. The splitter box gravity feeds the flow to the primary clarifiers.

Primary Clarifiers

Edmonds has three primary clarifiers. Two of the clarifiers are center fed square tanks 60 feet by 60 feet with a surface area of 3,600 square feet each. The third clarifier is rectangular, 91 feet long by 45 feet wide for a surface area of 4,095 square feet. The total surface area of the three primary clarifiers is **11,295** square feet.

The primary clarifiers provide quiescent conditions that reduces the flows velocity to the point that solids can be settled and removed. The clarifier also allows floatable material like plastics, oil, grease and scum to be skimmed off the surface and removed. Typically primary clarifier removals of the plant influent are 50 to 70 percent of suspended solids and 25 to 40 percent of BOD_5.

The primary sizing design criteria for clarifiers is the surface overflow rate, or the flow rate divided by the clarifier surface area; this is known as the vertical flow velocity. Typical design values for peak hourly flows are in the range of 2,000 to 3,000 gallons per day per square foot (gpd/sf). At 3,000 gpd/sf, the existing primary clarifiers would have a maximum performance-based capacity of 11,295 sf x 3,000 gpd/sf = 33.885 mgd.

Aeration Basins

After leaving the primary clarifiers, the liquid stream enters a channel that can flow to one of the three aeration basins. The three aeration basins are each 75.3 feet wide by 58 feet long and 20.6 feet deep with a total volume of approximately 673,000 gallons each (2.0 million gallons total). The aeration basins provide biological treatment by increasing the dissolved oxygen in the basin with fine bubble diffusers that disperse forced air. The oxygenated water encourages the growth of bacteria and microorganisms which consumes the waste flow’s organic solids. When the process flow enters the aeration basins it first goes through a premix box where return activated sludge (RAS) from the secondary clarifiers mixes with the influent. The return sludge is the settled solids from the clarifiers and they are returned to increase the mixed liquor concentration and solids retention time (SRT) in the aeration basins.

Secondary Clarifiers

The secondary clarifiers are necessary for separating treated effluent from the mixed liquor solids leaving the aeration basins. The three circular clarifiers are 90 feet in diameter with a 17.5 foot side water depth which provide quiescent conditions for gravity sludge settling to occur. The mixed liquor from the aeration basin is fed into the center of the clarifier and flows outward to the effluent launders. The projected annual average surface overflow rate, in year 2033 is 306 gpd/sf and is far less than the average performance design of 550 gpd/sf.

The settled solids from the bottom of the clarifiers are the source for return sludge recycled back to the aeration basins. Secondary sludge pumps return the activated sludge from the clarifiers back to the to the individual premix boxes at each aeration basin. The waste activated sludge is wasted to a storage tank and then pumped to the belt presses for dewatering before incineration.

Chlorine Disinfection

The plant effluent is disinfected using liquid sodium hypochlorite (bleach). The sodium hypochlorite disinfection flash mix structure is provided to recombine effluent from the secondary clarifiers, however, current operation is to feed sodium hypochlorite at the secondary clarifier weir overflows which increases the contact time. The structure also provides 12.5% concentration sodium hypochlorite solution injection to the secondary effluent. Sodium hypochlorite is bought in bulk and stored at the facility in two 3,000 gallon tanks.

The purpose of the chlorine contact chamber is to provide a minimum of 20 minutes of detention time at peak hour flow rates, prior to discharge of the secondary effluent to the outfall, in order to allow the sodium hypochlorite solution time to react with the effluent. The current peak hour contact time using only the chlorine contact chamber is 14 minutes and is projected to be about the same in the year 2033. The practice of feeding sodium hypochlorite at the secondary weir overflow will continue.

The plant is meeting the current disinfection criteria by increasing the chlorination dose and then dechlorinating. The plant is able to control the chlorine residual through dechlorination by using bisulfate. The bisulfate is a 38% $NaHSO_3$ solution that when added to water releases sulfur dioxide which reacts with free chlorine and chloramines reducing effluent concentrations.

Sludge Dewatering

Primary and WAS is combined before dewatering and averages about 1.0% total solids. The dewatering equipment consists of two belt presses where one operates at a time from 12 to 24 hours a day depending on the Edmonds Plant sludge production. The dewatered sludge is fed to the onsite fluidized bed incinerator.

Incineration

From the belt presses, the dewatered sludge cake is deposited by a belt conveyor into a hopper that delivers the dewatered sludge to the fluid bed incinerator by a hydraulic pump. The fats, oils, and greases (FOG) are collected in the Primary Sludge Tank and are mixed with raw and WAS as feed to the belt presses. Large influxes of FOG are not desirable for incineration because their high fuel value makes temperature control more difficult.

Internally the incinerator has a reactor bed of sand that is fluidized by a controlled, pre-heated air supply that is blown through it. Here the dewatered sludge cake is fed into the fluidized sand bed where it is burned. In this bed the dewatered sludge is broken up by the sands fluidizing motion and is incinerated by the heat. Diesel fuel is pumped into the reactor to aid in combustion, as required. The amount of supplemental fuel required depends on the heat content of the combustion air (which is pre-heated by the primary flue gas heat exchanger), and the heat content of the sludge, which is dependent on the solids content of the dewatered sludge (% volatile solids). When the incinerator is operating at its design capacity with 27% dry solids (75% volatile), or greater, the incinerator should theoretically operate autogenously (thermally self-supporting), and supplemental fuel should only be required for start-up.

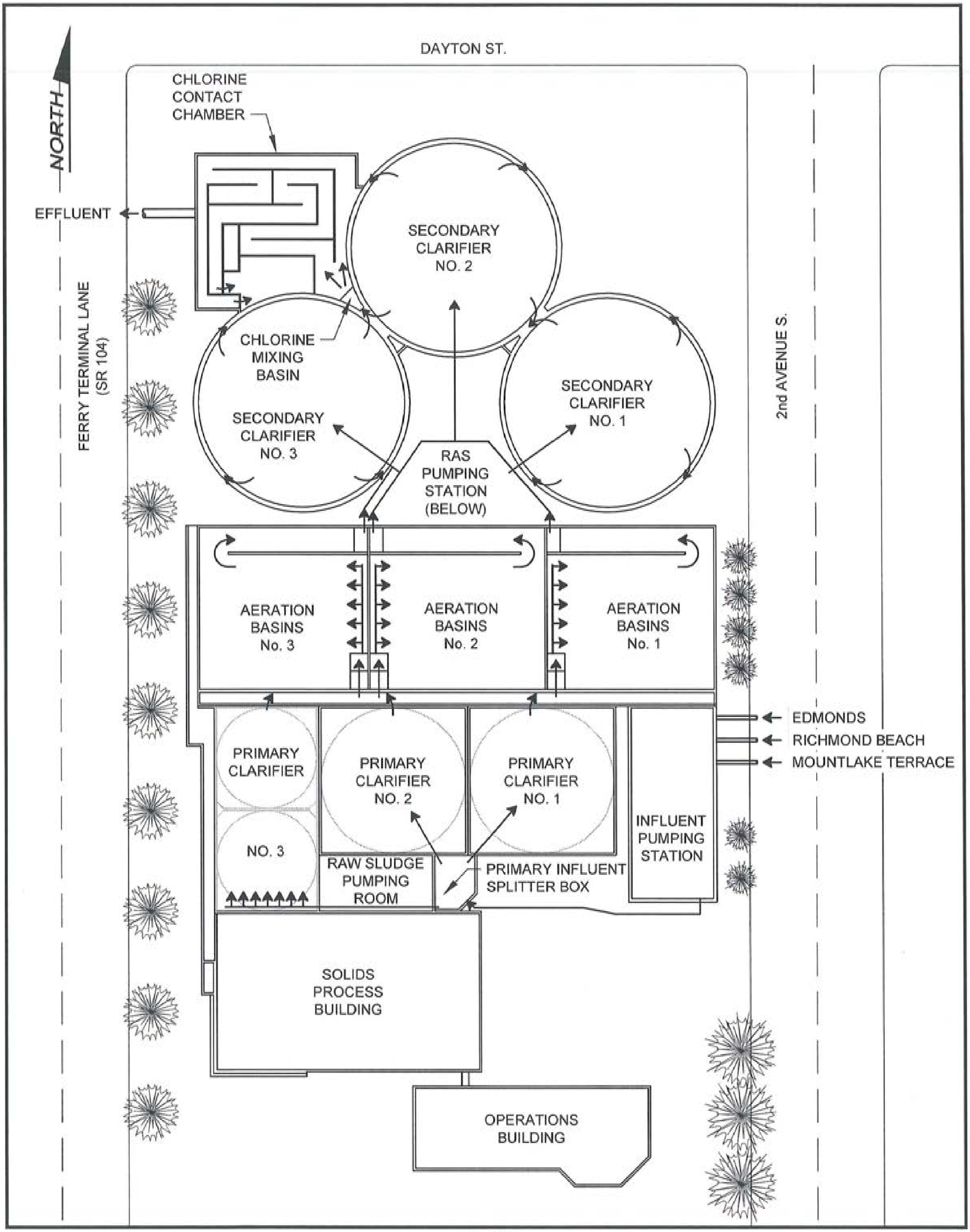
The incinerated sludge byproducts are gases and ash. The gases and ash exit the top of the incinerator and pass through a heat exchanger. The heat exchanger pre-heats the incinerator fluidizing air. The exhausted gas and ashes pass through a wet Venturi cyclone scrubber for particulate removal, followed by a wet tray scrubber where the finer particulate is removed and the gas is cooled by passing the scrubbed gas (which is re-heated with diesel fuel) counter-current to a large quantity of water. Combustion air is routed to the stack at about 10% of total combustion air to prevent a visible steam plume when it is released through a stack to the atmosphere.

The captured ash is thickened in a gravity thickener and dewatered in a vacuum filter. Current operations produce, on average, about 25 cubic yards of ash a week.

Plant Effluent

The treated and disinfected effluent is discharged approximately 1,250-feet off shore through a 36-inch outfall into Puget Sound. The outfall branches into two diffusers, each 160 feet long with diffuser ports at MLLW elevation that ranges from 56 to 73 feet deep.

A layout of the Edmonds WWTP is shown in Figure 5.4. Historical loadings and anticipated plant improvements are discussed in Chapter 8.



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PLOT DATE & TIME APR 04 2013 08:16:04
XREFS: NONE

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CITY OF EDMONDS Inc. 1890

WWTP Layout

Comprehensive Sewer Plan
Edmonds, Washington
May 2012

Figure
5-4

5.5 Additional Regulatory Requirements

Substitute Secondary House Bill 1338 – Wastewater Reuse
While reuse of reclaimed wastewater treatment plant effluent is becoming more and more common, the demand for year-round reclaimed effluent in the Pacific Northwest is very limited, particularly in a suburban setting. To be acceptable for reuse, effluent must meet the quality standards specified in the state's Water Reclamation and Reuse Standards.

5.6 Infiltration and Inflow

The District maintains a pro-active approach to I and I reduction. In 1979, the City embarked on an aggressive program to reduce inflow by eliminating roof drain connections and other stormwater connections and by sealing manholes. Monitoring the peaking factors during large storm events in the 1980's and 1990's showed that the effort to reduce I&I appeared to be working. However, a storm in late January, 2006 raised new concerns. Flow measurements indicated higher than normal peaking factors and thus increased I&I for this storm. A 2010 I&I study was performed by BHC Consultants in order to address these concerns (see Appendix A). The study identified key areas within the system that are predicted to have higher I&I than other areas of the system. The areas and the efforts are explained further below:

5.6.1 Zone 1 Problem Area

The Zone 1 basin was predicted to have the highest I&I problems and is tagged as an area of concern. The prediction is based off of higher than normal peaking factors in gallons per acre day. It was recommended to T.V. inspect and smoke test areas within this basin to further identify the exact pipe sections and manholes that can be fixed.

5.6.2 LS-01 Zone

LS-01 Zone was predicted to have the second worse I&I problem out of all the sub-basins. Out of the three storm events, analyzed in the study, the peaking factor from average dry weather flow was over 5. The study recommends further T.V. inspection and smoke testing in the LS-01 zone to identify the exact lengths of pipe and manholes that need to be fixed.

5.6.3 MLT Zone

The MLT Zone was also identified as a higher than normal I&I area.

The City will continue to take a pro-active approach to reducing I&I in the system and therefore avoiding larger than normal flows at the plant during high precipitation storm events.

Chapter VI – EXISTING AND FUTURE POPULATION AND FLOW PROJECTIONS

6.1 POPULATION

6.1.1 General

Baseline population (Population 2010) estimates per Sub-basin were calculated using 2010 Census data. A residential density was calculated for each census tract based on current residentially zoned acreage, and that density was applied to the total residential acreage within each Sub-basin.

A further breakdown of the methodology used as well as resources can be found in Appendix C.

6.1.2 Existing Residential, Commercial and Student Populations

Table 6.1 identifies the eleven Sub-basins that flow to the Edmonds WWTP and the twelfth Sub-basin presented on Figure 5.1 is the Lynnwood Zone Sub-basin. Flows from this area are within the Edmonds City limits but are treated at the Lynnwood WWTP. For the purposes of this Comprehensive Plan, the flows from the Lynnwood Zone Sub-basin were analyzed and included the CIP.

The sewer generating categories were classified into residential population, employees and students. Existing population for each of these categories was available through Snohomish County or the Edmonds School District. There are portions of the Richmond Beach Sub-basin that are not sewered and that percentage is reflected in the sewered population values on Table 6.1. Other than these large tracts, it has been assumed that virtually all parcels are sewered. It is recognized, however, that there might be an occasional and isolated parcel that is not served. These isolated parcels constitute a small percentage and are reflected in Table 6.1. All commercial (i.e. employees) and student populations were counted as sewered. There are no industrial dischargers to the Edmonds system.

Historical and textbook values of domestic wastewater (i.e. little or no I/I contribution) assigned to residential customers are typically found to be between 50 and 60 gals per capita per day (gpcd). Students and employees are generally found to be a fraction of the contribution of a full time resident. Historical values for students have been found to range from 10 to 15 gallons per student per day. Textbook values per employee can vary broadly depending on the nature of the commercial use. The typical per employee contribution ranges from 15 to 25 gallons per employee per day. This range is consistent with the values used by both the Alderwood Water and Wastewater District's Comprehensive plan dated 2009 and the City of Lynnwood's Comprehensive Plan dated 2012.

Based on these values, a ratio for students and employees was established so a population equivalence could be developed. Five students generate the same volume of wastewater as a full time resident, or a 5 to1 ratio for students. Similarly, a 3 to 1 ratio is expected for employees.

The development of the Population Equivalence (see Table 6.1) was based on these ratios. This means that a resident living in the Sub-basin would be counted as one and all students would be counted as 20% and all employees would be counted as 0.33 people. This formula was applied to the population, employees and students to determine the Population Equivalent.

Table 6.1
City of Edmonds - Existing Population 2010

Sub-Basins	Population		Employment	Student Population	Population
	Total Population	Total Sewered Population	Total Employment (1)	Total Population (2)	Equivalent (#)
Meter 1	1,788	1,788	1,535	1,722	2,644
Zone 1	2,686	2,686	592	378	2,959
Zone 2	4,835	4,815	4,585	0	6,342
Meter A	12,075	12,075	1,657	1,691	12,965
Meter B	4,473	4,249	2,664	450	5,226
Meter C	1,486	1,412	182	0	1,472
Meter E	5,828	5,537	5,367	1,372	7,598
MLT Zone	10,626	10,095	1,604	1,177	10,864
Edmonds Zone	10,790	10,790	3,558	503	12,075
LS #1	6,410	6,090	508	1,181	6,495
Richmond Beach Zone	19,755	17,037	7,528	17,617	23,067
Lynnwood Zone	6,528	6,202	509	0	6,371

Notes
1. The ratio of flow per employee to flow per resident is assumed to be 1:3 (DOE, Criteria for Sewage Works Design - Orange Book).
2. The ratio of flow per employee to flow per resident is assumed to be 1:5 (DOE, Criteria for Sewage Works Design - Orange Book).

These population numbers were assigned to the geographic Sub-basin. Furthermore, forecasted values of population, employment and students also followed these Sub-basin boundaries.

6.1.3 Future Residential, Commercial and School Populations

The task of this Plan is to evaluate the performance of the sewer collection, conveyance and treatment components for baseline (existing), 6-year, 20-year and build out scenarios. To evaluate the conditions on these target years, the Plan determined the residential, commercial and student populations for the years 2019, 2033 and build out.

Various sources of data were used to estimate these populations and employment figures. These sources include the following:

- 2010 Census Data, by Census Block
- 2010 Covered Employment Estimates, Washington State Employment Security Department, provided as custom estimates via PSRC
- 2008-2010 Three-Year American Community Survey, Self-Employment Estimates for Edmonds
- Office of Financial Management, Population Estimates for 2011 and 2012
- Snohomish County 2012 Buildable Lands Report
- Snohomish County Draft Initial Growth Targets for 2035
- King County 2007 Buildable Lands Report
- City of Shoreline Comprehensive Plan Land Use and Buildable Lands Capacity Update, 2012
- Shoreline Community College Unduplicated Annual Head Count
- Edmonds School District Update of Long Range Enrollment Projections 2012 to 2032
- Conversations regarding local long-range planning efforts with City Staff in Edmonds, Shoreline, and Mountlake Terrace; the Snohomish County Demographics Team; and staff and facility planners at school districts and at individual schools.

The population was then distributed to the 12 Sub-basins, described earlier, so the hydraulic model could be define that infrastructure that was at or approaching its maximum capacity.

The City of Edmonds service area spans two counties and serves several cities or Special Service Districts. Consequently, there were several document sources that were used to determine the future population/employees.

Residential population baselines have been established for each Sub-basin based on Census data. Employment baselines have been established for each Sub-basin from PSRC custom estimates for State-reported Covered Employment; self-employment estimates have been added to calculate baseline total employment for each Sub-basin.

The Richmond Beach Zone Sub-basin straddles the Snohomish-King County boundary. For the purpose of these forecast estimates, two separate evaluations, prepared for the portions of the Richmond Beach Zone Sub-basin in each County, have been added together to compute a final estimate for the entire Sub-basin for each target year.

King County Population and Employment Forecast. King County forecast estimates are based on the 2007 Buildable Lands Report, for Shoreline's primarily residential zoning, and on the 2012 Update to the Shoreline Comprehensive Plan, which included updated population and employment capacity estimates specifically along the Aurora/Highway 99 Corridor. The City of Shoreline is planning for significant increases in development along this corridor, impacting population and employment Richmond Beach Zone Sub-basin, Meter C Sub-basin, and Meter B Sub-basin. The 2031 horizon for this report has been used as an interpolation point from which to estimate forecasts for the target yeas; this interpolation has been extended to estimate a build out scenario as well.

Snohomish County Population and Employment Forecast. Snohomish County 6-year population forecast estimates are based on the 2012 Buildable Lands Report, which offers detailed capacity analysis based on both underlying city zoning and market trends.

The 20-year estimates are based on the County's 2035 Initial Growth Targets, aspirational estimates which are to be adopted into the countywide planning policies; these will assist with the next GMA-mandated round of comprehensive plan updates. However, Edmonds City Staff feels that these Initial Growth Targets are based on past market trends and do not account for a potential market shift favoring the significantly more dense, multi-story, mixed use development currently permitted in the zoning along Highway 99. The City of Edmonds has loosely approximated additional population and employment in selected sub-basins in order to approximate the scenario within which market conditions favor a shift towards this additional density along Highway 99 sometime within the next 20 years.

The 2035 horizon for the Initial Growth Targets has been used as an interpolation point from which to extend forecast estimates out to a build out scenario for residential population. The employment capacity expressed in the 2012 Buildable Lands Report, with market reductions removed, stands in as the data point for the estimated employment buildout scenario

Student Enrollment Baselines and Forecast Estimates
Individual Schools and School Districts have been surveyed to gather baseline enrollment statistics. The Edmonds School District provided a long-range forecast report recommending consideration of a medium-growth scenario throughout the school district. These growth rates have been applied to the District schools within the Service Area. Private schools are generally assumed to retain stable student enrollment populations through time, and none within the Service Area reported plans for major expansions. Shoreline Community College, with no major plans for facility expansion, also expects a relatively stable on-campus student population in the future; anticipated increases in enrollment are likely to be offset by concurrent increases in student participation in distance learning programs.

The summary of this analysis is presented in Table 6.2.

6.2 FLOWS

6.2.1 General

Edmonds is fortunate to have ten functioning and reliable flow meters. These flow meters are presented schematically on Figure 5.2. An eleventh flow meter (Meter 4) has not been maintained or calibrated. Consequently, this data is not available or is thought to be unreliable.

Table 6.2
City of Edmonds - Population and Growth Projections

Sub-Basins	2019					2033					Buildout				
	Total Population	Total Sewered Population	Sewered Employment	Sewered Students	Population (1) Equivalence	Total Population	Total Sewered Population	Sewered Employment	Sewered Students	Population (1) Equivalence	Total Population	Total Sewered Population	Sewered Employment	Sewered Students	Population (1) Equivalence
City of Edmonds															
Meter 1	1,867	1,867	1,567	1,745	2,738	2,361	2,361	1,616	1,943	3,288	4,017	4,017	1,677	2,410	5,057
Zone 1	2,908	2,908	751	383	3,235	3,413	3,413	999	427	3,831	4,754	4,754	981	529	5,186
Zone 2	5,280	5,280	5,088	0	6,974	6,691	6,691	5,870	0	8,646	10,874	10,874	6,507	0	13,041
Meter A	13,597	13,597	2,221	1,710	14,679	15,417	15,417	3,097	1,877	16,824	18,438	18,438	4,171	2,268	20,281
Meter B	6,471	6,471	3,714	440	7,796	11,056	11,056	5,347	443	12,925	20,880	20,880	8,847	450	23,916
Meter C	1,775	1,775	332	0	1,886	2,413	2,413	565	0	2,601	3,811	3,811	1,065	0	4,166
Meter E	6,170	6,170	5,674	1,390	8,337	6,579	6,579	6,152	1,548	8,937	7,258	7,258	6,738	1,920	9,886
MLT Zone	11,414	11,414	1,721	1,191	12,225	12,356	12,356	1,904	1,313	13,253	13,920	13,920	2,128	1,599	14,948
Edmonds Zone	11,752	11,752	3,842	509	13,133	12,901	12,901	4,284	561	14,440	14,810	14,810	4,826	685	16,554
LS #1	6,631	6,631	511	1,197	7,041	6,895	6,895	516	1,333	7,333	7,333	7,333	523	1,653	7,838
Richmond Beach Zone	24,933	22,440	9,232	15,540	28,622	34,430	32,709	11,883	16,347	39,935	54,141	54,141	17,486	17,817	63,527
Lynnwood Zone	6,754	6,754	514	0	6,925	7,024	7,024	521	0	7,197	7,473	7,473	531	0	7,650

1. The ratio of flow per employee to flow per resident is assumed to be 1:3 and ratio of 1:5 for students (DOE, Criteria for Sewage Works Design - Orange Book).

Flow data from these ten meters was collected from July 2006 through November 2012. A graphical representation of this flow data is presented in Appendix B. In order to capture different flow scenarios four flow conditions were graphed. These four flow conditions were the Average Dry Weather, Average Daily, Average Wet Weather and Maximum Month. Graphical presentation of the Peak Day and Peak Hour was not viewed as meaningful. Total daily flow data for this six and half year period was evaluated.

- **Average Dry Weather Flow** – This flow condition is defined as the average daily flow for the months of July through October when no rainfall was recorded. As expected, the flow was very stable during this period. Any day with measureable rainfall was excluded from the data set. The intent of presenting this data is to capture the base domestic flow conditions with neither infiltration nor inflow.

- **Average Daily Flow** – This flow condition captured all daily flows during the year. The average of all these flows would be considered the annual average flow.

- **Average Wet Weather Flow** – This flow condition is defined as the average daily flow from the months of November through March. All flows during this period were analyzed regardless of the amount of precipitation. The value of this data set was to understand the I&I contribution to the system.

- **Maximum Month Flow** – The Maximum Month Flows are of particular interest for the WWTP. Since the NPDES permit is written with monthly discharge limitations, treatment plants are typically designed with this flow condition as the design flow. The determination of this value was based on the highest monthly average flow.

- **Peak Day Flow** – The Peak Day Flow is the maximum total daily flow recorded at the meters during a 24-hour period. In December 2006 and December 2007, the area experienced an abnormally high rainfall event. This translated to record flows at the ten meters and at the WWTP. These rainfall events have not been replicated since that time.

- **Peak Hour Flow** - Peak Hour Flow is defined as the peak sustained flow rate occurring during a one-hour period. It is typically used to size the collection and interceptor sewers, pump stations, piping, flow meters, and certain physical WWTP processes. The Peak Hour flows were determined from two factors: 1) the addition of diurnal flow patterns which were developed from 5-minute flow data for the year 2009 (see Figure 6.1) and 2) the peaking factor between peak day and peak hour which was derived from 5-minute data.

6.2.2 Recorded Flows

The graphical presentation of the flow data starting in July 2006 through November 2012 is displayed in Appendix B and summarized on Table 6.3. It is meaningful to evaluate the entire period to understand the growth or trending during this six and half year period. However, averaging this entire time period was not representative of the current day flows. There are several factors that are effect the flow patterns at the meters. These include:

- City pipeline rehabilitation projects
- New sewer line extensions
- New customers and connections
- Degradation of the pipelines. King County has concluded from their studies that there is a 7% degradation of the pipe, and hence a 7% increase in I&I, every decade.

Viewing the flow graphs for this period, it appears that these factors are offsetting. There is not any trending patterns over the period. This is perhaps understandable since much of the service area is built out and largely sewered. Consequently, flow data for the years 2010 through 2012 were used to capture the current conditions.

The components of wastewater flow evaluated include: Average Dry Weather Flow (ADWF), Annual Average Daily Flow (AAF), Average Wet Weather Flow (AWWF), Maximum Month Flow (MMF), Peak Day Flow (PDF) and Peak Hour Flows. A summary of the flow events was derived by summing the flows from the three influent meters (MLT, Edmonds and Richmond Beach) at the WWTP for the period of 2010 through 2012. It should be noted that these values are not necessarily the peak recorded flows for the plant. Significant storm events in 2007 and 2009 resulted in flows in excess of that which is presented below:

	Current Influent Flows[1]
	Edmonds WWTP
Average dry weather flow (ADWF)[2], mgd	3.97
Annual average flow (AAF), mgd	5.82
Average wet weather flow (AWWF)[3], mgd	7.52
Maximum month flow (MMF)[4], mgd	9.66
Peak day flow[5] (PDF), mgd	21.65
Peak wet weather flow[6] (PWWF), mgd	27.5

Notes:

1. Values represent flow events from 2010 to 2012.
2. ADWF is defined as the average of the days with zero rainfall during four dry weather months (July through Oct) for years 2010 to 2012.
3. AWWF is defined as the average of five wet weather months (November through March) for years 2010 to 2012.
4. Maximum month flow (MMF) is the average flow for the maximum month, as defined in the current NPDES permit. The MMF is sometimes referred to as peak month flow and is considered the design flow for the WWTP.
5. Peak Day Flow is from wet weather event on 12/12/2010. It should be noted that the historical high daily flow of 23.84 mgd was recorded on 12/3/2007.
6. PWWF is an estimate value using the peak hour to peak day ratio seen from the December 3, 2007. This factor was approximately 1.27. It should be noted that the historical high peak flow of 30.26 mgd was recorded on 12/3/2007.

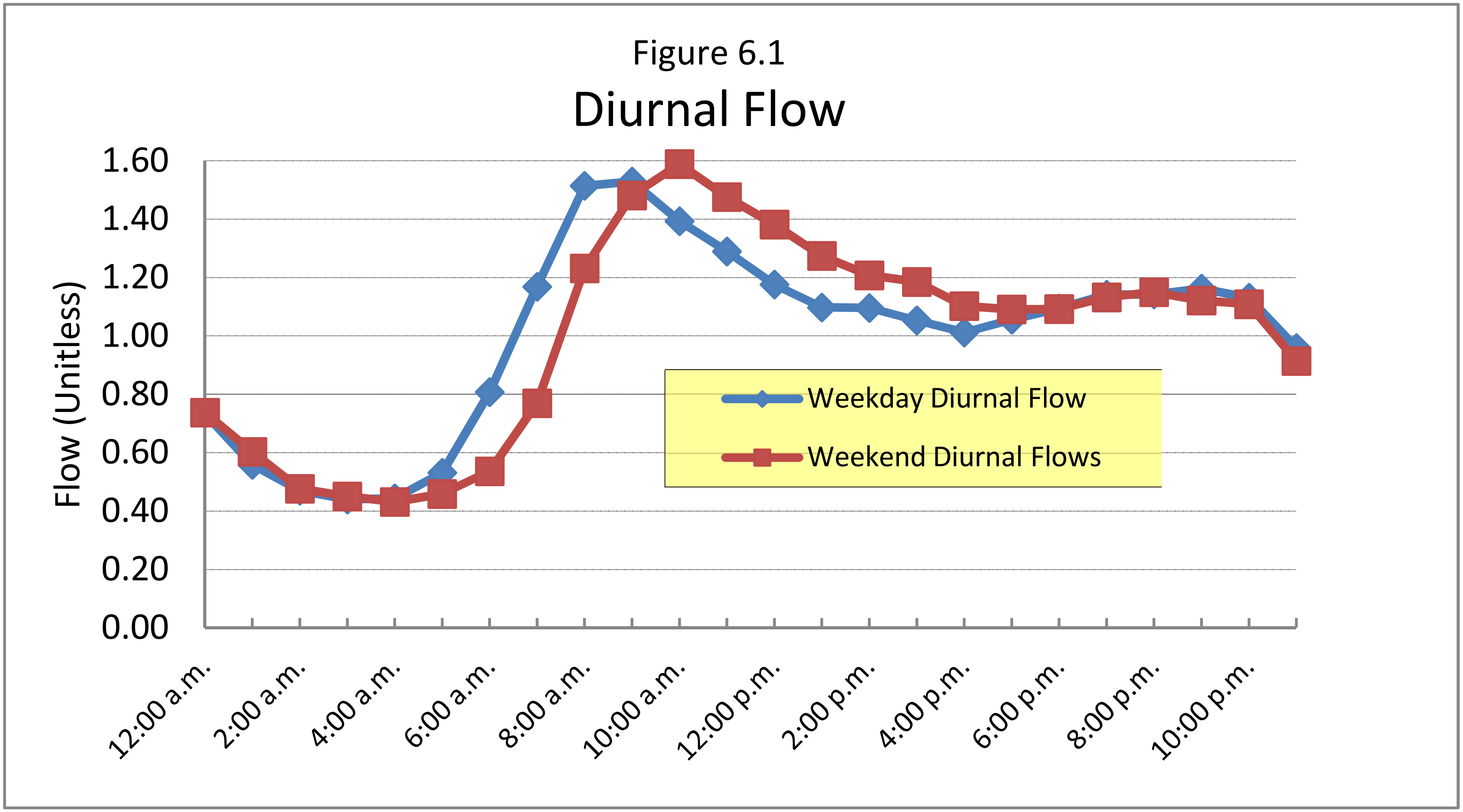


Figure 6.1
Diurnal Flow
Flow (Unitless)
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
12:00 a.m.
2:00 a.m.
4:00 a.m.
6:00 a.m.
8:00 a.m.
10:00 a.m.
12:00 p.m.
2:00 p.m.
4:00 p.m.
6:00 p.m.
8:00 p.m.
10:00 p.m.
Weekday Diurnal Flow
Weekend Diurnal Flows

Table 6.3
City of Edmonds - Measured Flows by Meter

Meters	Sub-basins	Size in Acres	Population Equivalent (5)	Average Dry Weather (1)		Average Daily Flow (2)		Average Wet Weather (3)		Maximum Month (2)		Peak Day (2)	
				Flow mgd	Flow per Equivalent	Flow mgd	Flow per Equivalent	Flow mgd	Flow per Equivalent	Flow mgd	Flow per Equivalent	Flow mgd	Flow per Equivalent
Meter 1	Meter 1	161.0	2,644										
	Total Meter 1	161.0	2,644	0.140	53	0.161	61	0.173	65	0.225	85	0.555	210
Meter 2	Zone 1	324.3	2,959										
	Meter 1	161.0	2,644										
	Total Meter 2	485.3	5,603	0.249	44	0.335	60	0.422	75	0.605	108	1.74	311
Meter A	Meter A	1602.4	12,965										
	Total Meter A	1602.4	12,965	0.703	54	0.974	75	1.214	94	1.602	124	3.723	287
Meter B	Meter B	555.0	5,226										
	Total Meter B	555.0	5,226	0.257	49	0.304	58	0.352	67	0.448	86	1.33	254
Meter C	Meter C	143.3	1,472										
	Total Meter C	143.3	1,472	0.076	52	0.115	78	0.147	100	0.215	146	0.646	439
Meter D	Meter E	663.0	7,598										
	Zone 2	525.5	6,342										
	Zone 1	324.3	2,959										
	Meter 1	161.0	2,644										
	Total Meter D	1673.8	19,543	1.250	64	1.449	74	1.628	83	1.949	100	4.293	220
Meter E	Meter E	663.0	7,598										
	Total Meter E	663.0	7,598	0.498	66	0.563	74	0.617	81	0.896	118	2.441	321
Meter 3	Meter C	143.3	1,472										
	Meter B	555.0	5,226										
	Meter A	1602.4	12,965										
	Meter E	663.0	7,598										
	Zone 2	525.5	6,342										
	Zone 1	324.3	2,959										
	Meter 1	161.0	2,644										
	Total Meter 3	3974.5	39,206	1.031	26	1.937	49	2.911	74	3.665	93	5.273	134
MLT at WWTP	MLT Zone	1573.9	10,864										
	Meter C	143.3	1,472										
	Meter B	555.0	5,226										
	Meter A	1602.4	12,965										
	Meter E	663.0	7,598										
	Zone 2	525.5	6,342										
	Zone 1	324.3	2,959										
	Meter 1	161.0	2,644										
	Total MLT at WWTP	5548.4	50,070	1.500	30	2.560	51	3.576	71	4.398	88	7.826	156
Edmonds at WWTP	Edmonds	1415.8	12,075										
	LS-01 Zone	1106.6	6,495										
	Total Edmonds at WWTP	2522.4	18,570	1.406	76	1.715	92	1.982	107	2.455	132	6.22	335
Richmond B at WWTP		4054.4											
	Total RB at WWTP	4054.4	23,067	1.060	46	1.542	67	1.967	85	2.803	122	7.601	330

(1) Average Dry Weather Flow is defined as the average daily for months of July through October with days of zero rainfall for years 2010 - 2012.

(2) Flow Data obtained from City provided information. Consolidated from monthly Discharge Monitoring Reports (DMR's), for years 2010 - 2012.

(3) Average Wet Weather Flow is defined as the average flow from the months of November through March for years 2010 - 2012.

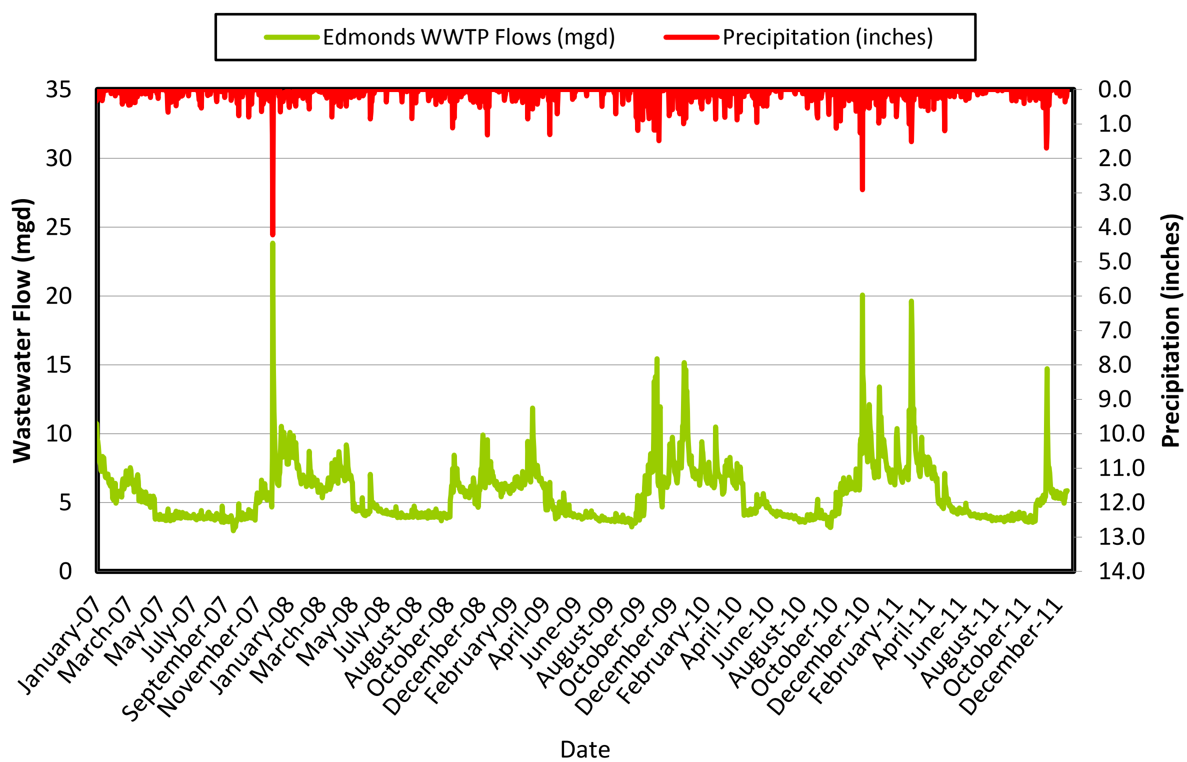
(4) Peak Hour data derived from Peak day x 1.27 peaking factor at the WWTP which accounts for the diurnal flow patterns plus the peak storm event

(5) Population Equivalent is 2010 values see Table 6.1

A graphical presentation of flow at the WWTP for the period of record (2007 through 2012) is presented in Figure 6.2. A visual comparison of the 2007 and 2010 storm events is evident.

The flow per population equivalent as presented on Table 6.3, shows some slight variability in the values. In particular, the data measured in Meters 3 and the MLT meter at the WWTP reflects per population equivalent values that are unusually low. However, these two meters are downstream of the flow diversion to King County and consequently reflect lower total flows coming into the Edmonds system. This explains the low per population equivalent values seen at these two meters.

Figure 6.2
Edmonds Wastewater Flows



6.2.3 Estimated Future Flows

The application of the appropriate per population equivalent value is the basis for the future flow projections. With differing demographics and residential/commercial composition, each Sub-basin will have different per equivalent contribution. Therefore, it is recommended that the derived values be applied for the future growth conditions as presented below:

- Sub-basin Meter 1 – use values from Meter 1

- Sub-basin Zone 1 – use values from Meter 2
- Sub-basin Zone 2 – use values from Meter 2
- Sub-basin Meter A – use values from Meter A
- Sub-basin Meter B – use values from Meter B
- Sub-basin Meter C – use values from Meter C
- Sub-basin Meter E – use values from Meter E
- Sub-basin MLT Zone – this sub-basin is influenced by the flow swap. The determination of the appropriate flows can be reach by either subtracting the Meter 3 data from the MLT meter data or by using data from a non-subtraction meter such Meters A, B, C or E. Subtracting Meter 3 data from MLT meter results in data that is very close to Meter B flow data. Therefore, the forecast has used values from Meter B.
- Sub-basin Edmonds Zone – use Edmonds meter at the WWTP
- Sub-basin LS#1 – use Edmonds meter at the WWTP
- Sub-basin Redmond Beach Zone – use Richmond Beach meter at WWTP
- Sub-basin Lynnwood Zone – this Sub-basin flows to the Lynnwood WWTP. The only flow records available for this Sub-basin are from the single effluent flow meter at the WWTP.

The per population equivalent values used on Tables 6.4, 6.5 and 6.6 originate from the corresponding values in Table 6.3, as noted above, and have a 7% per decade pipe degradation factor for the increased I/I.

The 7% factor is applied to the I/I component for all the flow scenarios except the Average Dry Weather Flows, which by definition, has little or no I/I contribution.

6.3 WWTP FLOWS

Comparing historical flows with forecasted flows requires an understanding of the King County Interlocal Agreement. Historically, as described in Section 3.4.2, a seasonal flow swap with King County was executed that sent all winter and spring flows from both Richmond Beach and the flows at the Lake Ballenger PS to Edmonds. The summer flows were swapped such that the volumetric flows from Richmond Beach were directed to King County. Effective in 2012, the agreement calls for all flow throughout the entire year to be swapped with King County. This means that the total volume of wastewater received by Edmonds will be reduced.

Consequently, the WWTP flow projections reflect this change in operation. Table 6.7 presents the forecasted flows at the WWTP. These flows are the basis for the WWTP loadings shown on Table 8.1

Table 6.4
2019 Flow Projections

Sub-Basins	Population Equivalence (1)	Average Dry Weather		Average Daily		Average Wet Weather		Maximum Month		Peak Day	
		Flow per Population Equivalent (2)	Sewer Flow (gpd)	Flow per Population Equivalent (2)	Sewer Flow (gpd)	Flow per Population Equivalent (2)	Sewer Flow (gpd)	Population Equivalent (2)	Sewer Flow (gpd)	Population Equivalent (2)	Sewer Flow (gpd)
Meter 1 (3)	2,738	53	144,977	61	167,637	66	180,586	86	236,696	217	592,781
Zone 1 (4)	3,235	44	143,520	60	195,495	77	247,830	111	357,916	322	1,040,686
Zone 2 (5)	6,974	44	309,444	60	421,506	77	534,347	111	771,703	322	2,243,825
Meter A	14,679	54	795,916	76	1,115,621	95	1,398,754	126	1,856,486	297	4,358,676
Meter B	7,796	49	383,374	59	456,429	68	531,040	87	680,260	263	2,051,222
Meter C	1,886	52	97,352	79	149,407	102	192,119	150	282,882	455	858,159
Meter E	8,337	66	546,466	74	620,787	82	682,531	120	1,001,542	332	2,768,108
MLT Zone (6)	12,225	49	601,206	59	715,771	68	832,775	87	1,066,782	263	3,216,721
Edmonds Zone	13,133	76	994,360	93	1,222,071	108	1,418,831	135	1,767,399	346	4,541,938
LS #1 (7)	7,041	76	533,066	93	655,139	108	760,620	135	947,484	346	2,434,885
Richmond Beach Zone	28,622	46	1,315,255	68	1,938,442	87	2,487,933	125	3,568,814	341	9,772,245
Lynnwood Zone (8)	6,925	76	524,316	93	644,386	108	748,136	135	931,932	346	2,394,919

Notes

1. Values from Table 6.2
2. Value derived from Table 6.3 as modified in Section 6.2.3. An additional allowance of 7% per decade is applied to account for the increased the I/I component
3. The values used for Sub-basin Meter 1 are from Meter 1 flow data
4. The values used for Sub-basin Zone 1 are from Meter 2 flow data
5. The values used for Sub-basin Zone 2 are from Meter 2 flow data
6. The values used for Sub-basin MLT Zone are from Meter B flow data
7. The values used for Sub-basin LS#1 are from the Edmonds Meter at the WWTP
8. No Flow data available for Lynnwood Zone, therefore use Edmonds Meter at WWTP

Table 6.5
2033 - Flow Projections

Sub-Basins	Total Population Equivalence (1)	Average Dry Weather		Average Daily		Average Wet Weather		Maximum Month		Peak Day	
		Flow per Population Equivalent (2)	Sewer Flow (gpd)	Flow per Population Equivalent (2)	Sewer Flow (gpd)	Flow per Population Equivalent (2)	Sewer Flow (gpd)	Flow per Population Equivalent (2)	Sewer Flow (gpd)	Flow per Population Equivalent (2)	Sewer Flow (gpd)
Meter 1 (3)	3,288	53	174,100	62	203,871	67	220,883	90	294,602	232	762,433
Zone 1 (4)	3,831	44	169,981	62	237,328	80	305,142	117	447,787	348	1,332,495
Zone 2 (5)	8,646	44	383,615	62	535,605	80	688,649	117	1,010,571	348	3,007,191
Meter A	16,824	54	912,230	78	1,313,118	99	1,668,148	133	2,242,113	320	5,379,691
Meter B	12,925	49	635,623	59	768,139	70	903,474	91	1,174,146	283	3,660,939
Meter C	2,601	52	134,298	82	212,863	107	277,326	159	414,310	493	1,282,548
Meter E	8,937	66	585,777	75	672,938	83	745,348	125	1,119,469	357	3,191,214
MLT Zone (6)	13,253	49	651,727	59	787,601	70	926,366	91	1,203,895	283	3,753,695
Edmonds Zone	14,440	76	1,093,286	95	1,367,198	111	1,603,880	140	2,023,170	371	5,360,647
LS #1 (7)	7,333	76	555,240	95	694,350	111	814,552	140	1,027,493	371	2,722,475
Richmond Beach Zone	39,935	46	1,835,116	70	2,786,399	91	3,625,185	132	5,275,128	369	14,744,535
Lynnwood Zone (8)	7,197	76	544,910	95	681,432	111	799,398	140	1,008,378	371	2,671,827

Notes
1. Values from Table 6.2
2. Value derived from Table 6.3 as modified in Section 6.2.3. An additional allowance of 7% per decade is applied to account for the increased the I/I component
3. The values used for Sub-basin Meter 1 are from Meter 1 flow data
4. The values used for Sub-basin Zone 1 are from Meter 2 flow data
5. The values used for Sub-basin Zone 2 are from Meter 2 flow data
6. The values used for Sub-basin MLT Zone are from Meter B flow data
7. The values used for Sub-basin LS#1 are from the Edmonds Meter at the WWTP
8. No Flow data available for Lynnwood Zone, therefore use Edmonds Meter at WWTP

Table 6.6
Build Out - Flow Projections

Sub-Basins	Population Equivalence (1)	Average Dry Weather: Flow per Population Equivalent (2)	Average Dry Weather: Sewer Flow (gpd)	Average Daily: Flow per Population Equivalent (2)	Average Daily: Sewer Flow (gpd)	Average Wet Weather: Flow per Population Equivalent (2)	Average Wet Weather: Sewer Flow (gpd)	Maximum Month: Population Equivalent (2)	Maximum Month: Sewer Flow (gpd)	Peak Day: Population Equivalent (2)	Peak Day: Sewer Flow (gpd)
Meter 1 (3)	5,057	53	267,792	63	316,396	68	344,170	92	464,523	243	1,228,304
Zone 1 (4)	5,186	44	230,119	63	326,891	82	424,336	121	629,304	366	1,900,560
Zone 2 (5)	13,041	44	578,610	63	821,933	82	1,066,946	121	1,582,319	366	4,778,754
Meter A	20,281	54	1,099,670	80	1,612,604	102	2,066,863	138	2,801,249	336	6,815,764
Meter B	23,916	49	1,176,124	60	1,436,382	71	1,702,177	93	2,233,766	298	7,117,748
Meter C	4,166	52	215,074	84	348,618	110	458,193	166	691,039	520	2,166,871
Meter E	9,886	66	647,948	76	750,279	84	835,293	129	1,274,531	375	3,706,872
MLT Zone (6)	14,948	49	735,122	60	897,792	71	1,063,924	93	1,396,187	298	4,448,858
Edmonds Zone	16,554	76	1,253,366	96	1,586,667	113	1,874,665	144	2,384,863	389	6,445,956
LS #1 (7)	7,838	76	593,424	96	751,230	113	887,587	144	1,129,148	389	3,051,931
Richmond Beach Zone	63,527	46	2,919,245	71	4,525,435	94	5,941,682	137	8,727,523	389	24,716,116
Lynnwood Zone (8)	7,650	76	579,208	96	733,234	113	866,324	144	1,102,098	389	2,978,820

Notes

1. Values from Table 6.2
2. Value derived from Table 6.3 as modified in Section 6.2.3. An additional allowance of 7% per decade is applied to account for the increased the I/I component
3. The values used for Sub-basin Meter 1 are from Meter 1 flow data
4. The values used for Sub-basin Zone 1 are from Meter 2 flow data
5. The values used for Sub-basin Zone 2 are from Meter 2 flow data
6. The values used for Sub-basin MLT Zone are from Meter B flow data
7. The values used for Sub-basin LS#1 are from the Edmonds Meter at the WWTP
8. No Flow data available for Lynnwood Zone, therefore use Edmonds Meter at WWTP

Table 6.7
City of Edmonds - WWTP Flow Projections 2019 and 2033

Sub-Basins	2019 Average Annual (gpd) (1)	2019 Maximum Month (gpd) (1)	2019 Maximum Day (gpd) (2)	2019 Peak Hour (gpd) (2)	2033 Average Annual (gpd) (1)	2033 Maximum Month (gpd) (1)	2033 Maximum Day (gpd) (2)	2033 Peak Hour (gpd) (2)
MLT Meter at WWTP								
Meter 1	168,000	237,000			204,000	295,000		
Zone 1	195,000	358,000			237,000	448,000		
Zone 2	422,000	772,000			536,000	1,011,000		
Meter A	1,116,000	1,856,000			1,313,000	2,242,000		
Meter B	456,000	680,000			768,000	1,174,000		
Meter C	149,000	283,000			213,000	414,000		
Meter E	621,000	1,002,000			673,000	1,119,000		
MLT Zone	716,000	1,067,000			788,000	1,204,000		
Total MLT Meter	3,843,000	6,254,000	17,040,000	25,170,000	4,731,000	7,907,000	22,030,000	32,930,000
Edmonds Meter at WWTP								
Edmonds Zone	1,222,000	1,767,000			1,367,000	2,023,000		
LS #1	655,000	947,000			694,000	1,027,000		
Total Edmond Meter	1,877,000	2,715,000	6,770,000	9,850,000	2,062,000	3,051,000	7,890,000	10,880,000
Richmond Beach Meter at WWTP								
Richmond Beach Zone	1,938,000	3,569,000	8,273,000	12,037,000	2,786,000	5,275,000	9,642,000	13,295,000
Total Richmond Beach Meter	1,938,000	3,569,000	8,273,000	12,037,000	2,786,000	5,275,000	9,642,000	13,295,000
Total Flow	7,658,000	12,538,000	32,083,000	47,057,000	9,579,000	16,233,000	39,562,000	57,105,000
Total Flow at WWTP **(i.e. accounts for King County flow swap)** (3) and (4)	5,720,000	8,969,000	32,083,000	47,057,000	6,793,000	10,958,000	39,562,000	57,105,000

1. Values from Tables 6.4 and 6.5
2. Values for Maximum Day and Peak Hour were derived from the hydraulic model that accounts for short duration storms and flow attenuation. This assumes that all flows (including King County) are sent to Edmonds. Also assumes no backup in the upstream conveyence system.
3. Average Annual and Maximum Month values have subtracted a volume equal to the Richmond Beach values.
4. Maximum Day and Peak Hour values do not subtract the Richmond Beach flows since all flows may be directed to Edmonds for these events.

CHAPTER VII – MODEL CONSTRUCTION AND CAPACITY ANALYSIS

7.1 MODEL SOFTWARE

A hydraulic capacity analysis of the City's existing sewer network was undertaken with the use of XPSWMM, version 14.10 by XPSolutions. This software was selected by the City, and have the following key features and advantages:

- It offers dynamic modeling capability.
- It uses a stable modeling platform.
- License upgrades are available if additional model nodes are required or if models are to be connected.
- XPSWMM software's is capable of reading and using GIS data files that facilitates data transfer and has shape file viewing capability.
- It is widely used by the modeling community in the region including the author.
- Licenses are owned by the author, facilitating multi-user development and review.

7.2 MODEL CONSTRUCTION

7.2.1 Data Sources

The following information was obtained for use in constructing hydraulic models of the existing sewer network:

- City provided GIS base access system including manhole/points, pipes/links, and lift station information
- Lift station as-built, record drawings and plan drawings information were provided to supplement GIS data.
- Lift Station data sheets were provided, as shown in Table 5.2.

Information on planned modifications to the existing sewer network was provided by the City.

7.2.2 Model Coverage

The City has 11 defined Sub-basins (Figure 5.1), 10 of which collect and convey flow into the Edmonds WWTP. The model only includes the City's physical system attributes (pipes, manholes and lift stations) that convey flow into the Edmonds WWTP, and does not include physical system attributes conveying flow to the City of Lynnwood WWTP.

The scope of work limited the extent of importing pipes 8-inches and larger, however with the data available in GIS, it was easier and quicker to incorporate all pipes regardless of size. This allows the model to illustrate physical attributes throughout the City's service area. The modeled area includes all City-owned sewer pipes 8-inches in diameter or greater (with the exception of force mains which have a smaller diameter) within the city limits as determined by GIS shapefiles. The model also contains eight City lift stations (LS) as well as the King County Lake Ballinger Pump Station.

7.2.3 Modeling of Physical System Features

The system data obtained from the City's GIS mapping was imported into the model. Existing City GIS information provided used NAD 1983 datum. Manhole rim elevations were augmented using mapping software ArcGIS ArcMap by utilizing the 2-foot contour elevation attribute information provided by the City. Information was spatially joined to each manhole based upon its geographic locations via 'closest' definition, and software output created a table matching the closest location elevation to the manhole location. Manhole inverts were calculated from the difference between spatially joined rim elevations, measure down depths and pipe diameters. Pipe/link information was imported from the existing City GIS. The upstream and downstream inverts were assigned via connecting manhole information.

The hydraulics were checked for obvious data errors such as incorrect inverts, missing pipe sizes, and negatively sloped pipes. The hydraulics associated with the Lift Stations were investigated based on the most recent available as-built data. Hydraulic revisions included incorporating storage volume for wet well nodes, adding offline storage facilities, adding overflow locations, and adding force mains between the Lift Stations and gravity sewer connections.

In XPSWMM, the ability to input base flow and a diurnal pattern is contained within the "Hydraulics" mode. This parameter combination was used in two different ways in subsequent modeling tasks. For model calibration, the average daily dry weather flow (see Table 6.3) was distributed evenly among the manholes in each respective meter basin. Then a diurnal pattern, as derived from meter data collected at the Edmonds treatment plant, was applied to the dry weather flow for the model to generate a 24-hour hydrograph. The RTK method was used in XPSWMM to generate the infiltration and inflow (I&I) component of the total flow.

For future flows, the peak daily flow (see Tables 6.4, 6.5 and 6.6) for different future scenarios was distributed among the manholes within each meter basin. In this case, a pattern developed from the calibrated model to represent the I&I response in the pipes was applied. This is further discussed in the Model Calibration and Future Flow Comparison sections.

Nine lift stations were modeled throughout the City service area. These stations were modeled as static head pumps based on capacity and the head data provided by the City. LS 2 was modeled as a dynamic head pump because a pump curve was available. It should be noted that three lift stations were rehabilitated late in 2012, which does not correspond to the available monitoring data. Therefore, the old capacity for these LS was used for the calibration exercise and the capacity was upgraded for the future flow analysis exercise. Table 7.1 below shows the pump capacity and provided head for each LS for the calibration period and for the future flow condition.

Table 7.1 - Lift Station Modeling Data

		Calibration Period		Future Flow	
Lift Station	**No. of Pumps**	**Max Head (ft)**	**Pumping Capacity[1] (gpm)**	**Max Head (ft)**	**Pumping Capacity[1] (gpm)**
1	2	40.0	1,425	40.0	1,425
2	2	46.7	128	46.7	128
3[2]	2	180.0	90	190.0	114
5[2]	2	60.0	35	100.0	37
6	2	90.0	335	90.0	335
7	2	45.0	210	45.0	210
8	2	45.0	137	45.0	137
14[2]	2	25.5	33	70.0	37

[1]Represents pumping rate per pump
[2]According to available data, these LS were rehabilitated in 2012 which included increasing LS pumping capacity
[3]Updated PS curve required due to system backups under future flow estimate

The Lake Ballinger PS is also included in the model which had several data unknowns. Most notably, the flow swapping between the City and King County presented a particular challenge because the circumstances of this are mostly unknown or unpredictable. For calibration purposes, the pump curve and a “dummy” overflow weir was used to depict the flow swap. In the future flow conditions, there are times when all the flow is directed to King County and times when all the flow is sent to the City. The flow swap between the City and King County is described in Section 3.4.2. Generally flows from the Lake Ballinger PS enter the City’s system for 15 hours per day. However, there are times when flow is directed simultaneously to both agencies. And lastly, there are times when flow is sent exclusively to only the County’s system. To capture the most severe flow scenario, the hydraulic analysis was configured with the assumption that all flow was being directed to and through the City’s conveyance system. This worst flow condition scenario also assumed a concurrent storm event. This condition is very conservative and captures the most extreme conditions.

For future scenarios, the pump curve had to be upsized to prevent backups in the upstream system due to insufficient pumping capacity and increase peak flows. This assumption that calls for upsizing pumps to prevent backups would also apply to the King County Pump Station, even though the City has no control on the County's schedule to implement these modifications.

7.3 LOADING

The model was loaded with peak day flow measured at each meter for the initial model calibration. Due to the location of meters throughout the system, some Sub-basin flow loading was calculated by subtraction of measured flow between two flow meters. Following Sub-basin flow calculations, the total Sub-basin flow was evenly distributed between manholes. The intent of the loadings into the sewer system is to determine the total flow along the conveyance system and at the WWTP.

The area that flows to Lynnwood WWTP (Sub-basin Lynnwood Zone) enters a large diameter interceptor that is owned and maintained by the City of Lynnwood. This interceptor is the backbone of flows entering that plant. The majority of the Edmonds flow enters this interceptor through 8-inch diameter pipes. The remaining Edmonds' flow is collected and pumped through one of six Edmonds-owned lift stations.

The hydraulic analysis of the Lynnwood Zone looks at the tributary area to each of these lift stations and applying the peak hour flow estimations to determine the suitability of the pumping capacity (refer to Table 7.2).

7.4 HYDROLOGIC MODELING

In order to perform model calibration to observed flows, the "Runoff" (Rnf) mode of XPSWMM was utilized to introduce hydrologic flow into the model. The Rainfall Dependent Inflow and Infiltration (RDII) module of XPSWMM was used to represent wet weather response in the system. This module relies upon the RTK method of hydrograph generation. Three parameters (R, T, and K) for three different I&I response times (short-, medium-, and long-term) are required. The R parameter is the percentage of rainfall that makes its way into the sewer system, T is the time to peak for that volume of water, and the K determines the duration of the recession limb. The three sets of parameters compute three triangular hydrographs which are added by the method of convolution to generate the total hydrograph. Accepted values based on past engineering experience were used as initial values. These values were adjusted during model calibration so that the peaking factor and daily averages matched within reasonable values.

Table 7.2
Lynnwood Zone Lift Station Analysis

Lift Stations	Current Rated Capacity (gpm @ TDH)	2010		2019		2033		Build Out	
		Population Equivalent	Peak Hour Flow (gpm) (1)	Population Equivalent	Peak Hour Flow (gpm) (1)	Population Equivalent	Peak Hour Flow (gpm) (1)	Population Equivalent	Peak Hour Flow (gpm) (1)
LS #4 (2)	308 gpm @ 164 ft	645	179	675	188	702	195	731	203
LS #9 (5)	332 gpm @ 38 ft	838	233	877	244	912	253	950	264
LS #10 (2)	114 gpm @ 49 ft	204	57	214	59	222	62	231	64
LS #11 (3)	95 gpm @ 73 ft	19	5	20	6	21	6	22	6
LS #12 (3)	308 gpm @ 142 ft	672	187	704	195	731	203	762	212
LS #15 (4)	42 gpm @ 60 ft	22	6	23	6	24	7	25	7

Notes
1) Peak Hour flow rate from DOE Orange Book
2) LS #10 pumps to LS #4 which lifts to the WWTP.
3) LS #11 pumps to LS #12 which lifts to the WWTP.
4) LS #15 pumps directly to the WWTP.
5) LS #9 lifts into the gravity system that enters the Lynnwood Interceptor.

7.5 MODEL CALIBRATION

Model calibration is an iterative process to match model predicted values to measured real world data. Average daily flow (ADF) data collected at 10 meter locations between 2006 and 2012 was used during calibration. The purpose of the this modeling exercise was to examine system capacity for the comprehensive plan, therefore the peak daily flow (PDF) from the monitoring period was collected for each meter basin. This value was used as the calibration metric.

Sewer system flow is made up of different components, most notably average dry weather flow (ADWF) and I&I. Following storm events, the I&I component is generally much larger than the ADWF component. For model calibration, the flow input into the model was separated into these two components. The ADWF per manhole was broken down for input into the model as follows:

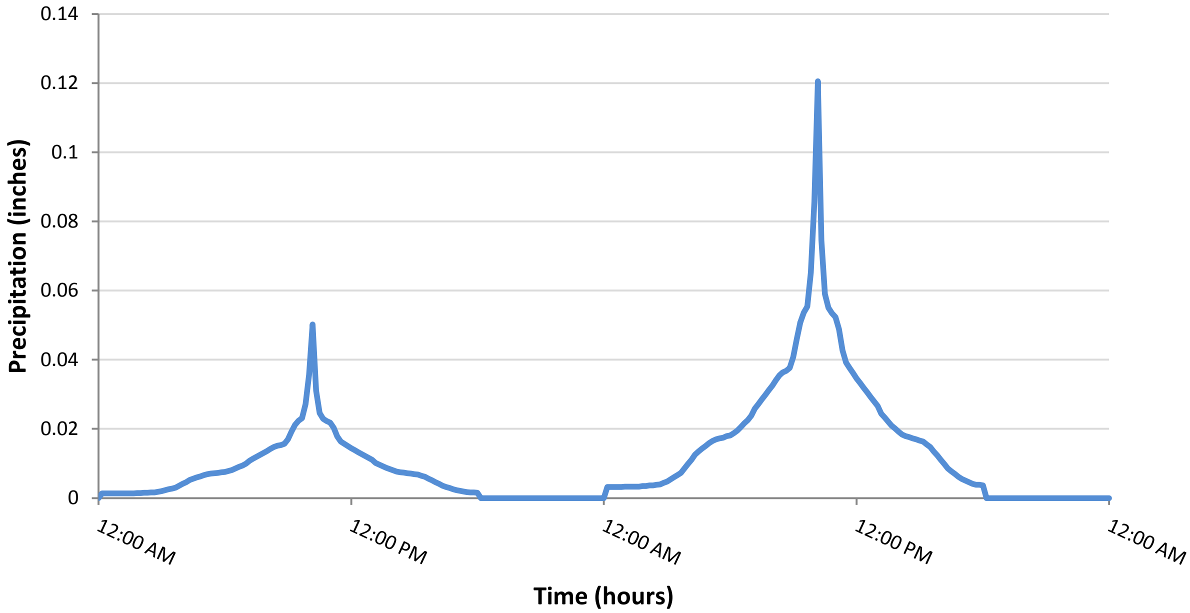
$$\text{ADWF} = \frac{\text{Meter ADWF}}{\text{No. Tributary MHs}}$$

In order to represent fluctuations in flow throughout the day, a diurnal pattern was applied to the ADWF component. This pattern was determined by processing 5 minute interval flow data at the Edmonds Treatment Plant for three contiguous dry months of a given year. Figure 6.1 shows this pattern. This same pattern was used for th entire service area.

As mentioned in Section 7.4, the RDII module of XPSWMM was used to generate the I&I flow component. Only PDF values were presented in Table 6.3, which means that some portion of the day will have a flow that is lower than average and some portion will have a flow that is above average. The actual shape of this hydrograph for typical storm conditions for the City system is variable. The peak value of the hydrograph is very important because that is the portion of the flow that often causes capacity restrictions. Monitoring data collected at the treatment plant indicated that the peaking factor at the plant was approximately 1.27, meaning the peak flow for the day was approximately 27% higher than the peak day. It was assumed that for meters located upstream in the system the peaking factor would be greater to account for attenuation as the flow moved downstream.

A rainfall time-series must be implemented in order to use the RDII module. A typical rainfall pattern for western Washington based on the total rainfall for the November 19, 2012 (2.4-inches of total rainfall and was the largest collected in the monitoring period) storm event was used.

Figure 7.1 - Rainfall Hyetograph used for Calibration



The model was run for two days to allow for some antecedent condition buildup. Figure 7.1 above shows the rainfall time series that was used for the calibration procedure. The first day had the same rainfall pattern applied with 1-inch of total rainfall, to build antecedent conditions, before the second day with 2.4-inches of total rainfall.

The flow "swapping" situation at the KC Lake Ballinger Pump Station presented a considerable challenge during model calibration. Mass balance analysis determined that for the peak flow periods being considered, an average of approximately 4.2 MGD (6.5 cfs) of flow is sent towards Edmonds from the KC pump station. Thus, the total pumping capacity at the pump station was set to 6.5 cfs and a weir was added to allow additional flow to leave the model (this represented the flow being sent towards King County). A significant portion of the flow seen at the total MLT meter at the plant is being sent from the KC Lake Ballinger PS (refer to Figure 5.2 for meter schematic).

The service area is divided up into Sub-basins. The flow from different "meter" areas had flow contributions that are measured directly at a meter location. The flows from the "zone" areas had to be determined from a mass balance exercise. These numbers can be somewhat unreliable. But in the absence of any other information, the modeled used this available data in the calibration exercise. Table 6.3 shows the mass balance results and the target PDF numbers used in calibration.

Table 7.3 shows the PDF at each meter location, the model predicted average, the assumed peak hourly flow at each meter, and the model predicted peak hourly flow.

Table 7.3 - Calibration Result Summary

Flow Meter	Model Peak Flow (cfs)	Assumed Peak Flow (cfs)[1]	Diff (%)	Model Peak Day Flow (cfs)	Observed Peak Day Flow (cfs)	Diff (%)	Model Peak:Peak Day
Total Meter D	10.95	8.44	29.7%	6.74	6.64	1.5%	1.62
Total Meter B	3.24	2.61	24.3%	1.89	2.06	-8.3%	1.72
Total Meter A	8.33	7.32	13.8%	5.07	5.76	-12.0%	1.64
Total Meter 2	3.80	3.42	11.0%	2.28	2.69	-15.3%	1.67
Total Meter 1	1.32	1.09	20.7%	0.79	0.86	-7.6%	1.66
Total Edmonds	14.01	12.22	14.6%	8.04	9.62	-16.5%	1.74
Total MLT Zone	15.47	15.38	0.6%	11.47	12.11	-5.3%	1.35

[1]Based on 1.27 peaking factor at the treatment plant

The focus of calibration was at the Edmonds Treatment Plant with the meters Total MLT Zone and Total Edmonds having the most emphasis as they are nearest the treatment plant. The Total Edmonds meter is heavily influenced by a nearby LS and this greatly impacted the average flow. Because limited data is available for calibration, a percent difference between model predicted PDF and the monitoring PDF of +/- 20% was determined to be satisfactory. The assumed peak flow shown in Table 3 was determined by multiplying the monitored PDF value by 1.27 (the peaking factor at the plant). This value was not explicitly used as a calibration metric, but was tracked to ensure peak values predicted by the model were within acceptable ranges compared to the PDF values.

7.6 MODELING ANALYSIS AND RESULTS

CAPACITY ANALYSIS

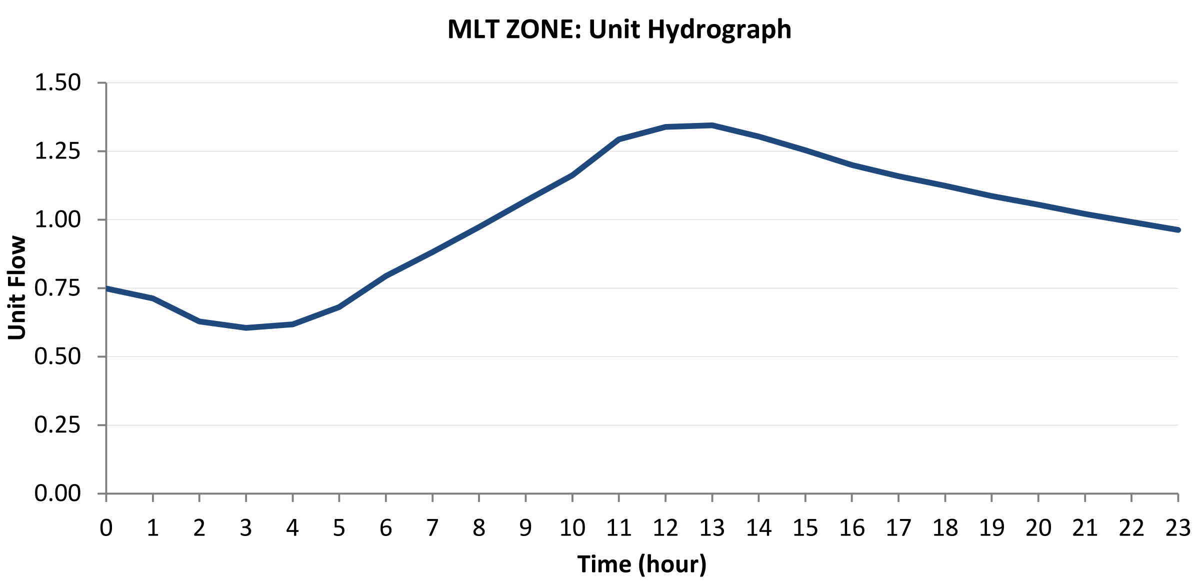
The capacity analysis was used to determine which pipes may require upsizing due to current lack of capacity or population growth and deterioration of existing infrastructure. Four conditions for capacity analysis were looked at; 2013 (existing), 2019, 2033, and Buildout. Table 6.3 presents the PDF for each meter basin. Considering the relative uncertainty involved in using the RDII module for predicting future flows, it was decided to directly input into the model future PDF values distributed among respective meter basins, replacing the ADWF was input during the calibration task. This allows for a methodology that controls exactly how much flow is being entered into the system. Therefore, the RNF mode of XPSWMM and rainfall time series utilized in the calibration exercise were no longer required for capacity analysis. However, hydrograph shape determined during calibration was used to develop a unit hydrograph representing wet weather system response for each meter basin. This diurnal pattern was applied to future flows in determining the peak flow predicted by the model.

The PDF for each year are shown below in Table 7.4 and the unit hydrograph for meter MLT Zone is shown in Figure 7.2 as an example.

Table 7.4 - Peak Average Daily Flow for Capacity Analysis

Zones	Size in Acres	No. Tributary MHs (AQ)	2010 PDF (mgd)	2010 PDF (cfs)	2019 PDF (mgd)	2019 PDF (cfs)	2033 PDF (mgd)	2033 PDF (cfs)	Buildout PDF (mgd)	Buildout PDF (cfs)
Total Meter 1	161	95	0.56	0.86	0.59	0.92	0.76	1.18	1.23	1.90
Zone 1	324	9	1.19	1.83	1.04	1.61	1.33	2.06	1.90	2.94
Total Meter A	1,602	5	3.72	5.76	4.36	6.74	5.38	8.32	6.82	10.55
Total Meter B	555	2	1.33	2.06	2.05	3.17	3.66	5.66	7.12	11.01
Total Meter C	143	1	0.65	1.00	0.86	1.33	1.28	1.98	2.17	3.35
Zone 2	526	342	0.11	0.17	2.24	3.47	3.01	4.65	4.78	7.39
Total Meter E	663	1	2.44	3.78	2.77	4.28	3.19	4.94	3.71	5.74
MLT Zone	1,574	142	2.55	3.95	3.22	4.98	3.75	5.81	4.45	6.88
Edmonds	1,416	961	4.04	6.26	4.54	7.03	5.36	8.29	6.45	9.97
LS-01 Zone	1,107	821	2.18	3.37	2.43	3.77	2.72	4.21	3.05	4.72

Figure 7.2 - Calibrated Model Diurnal Pattern

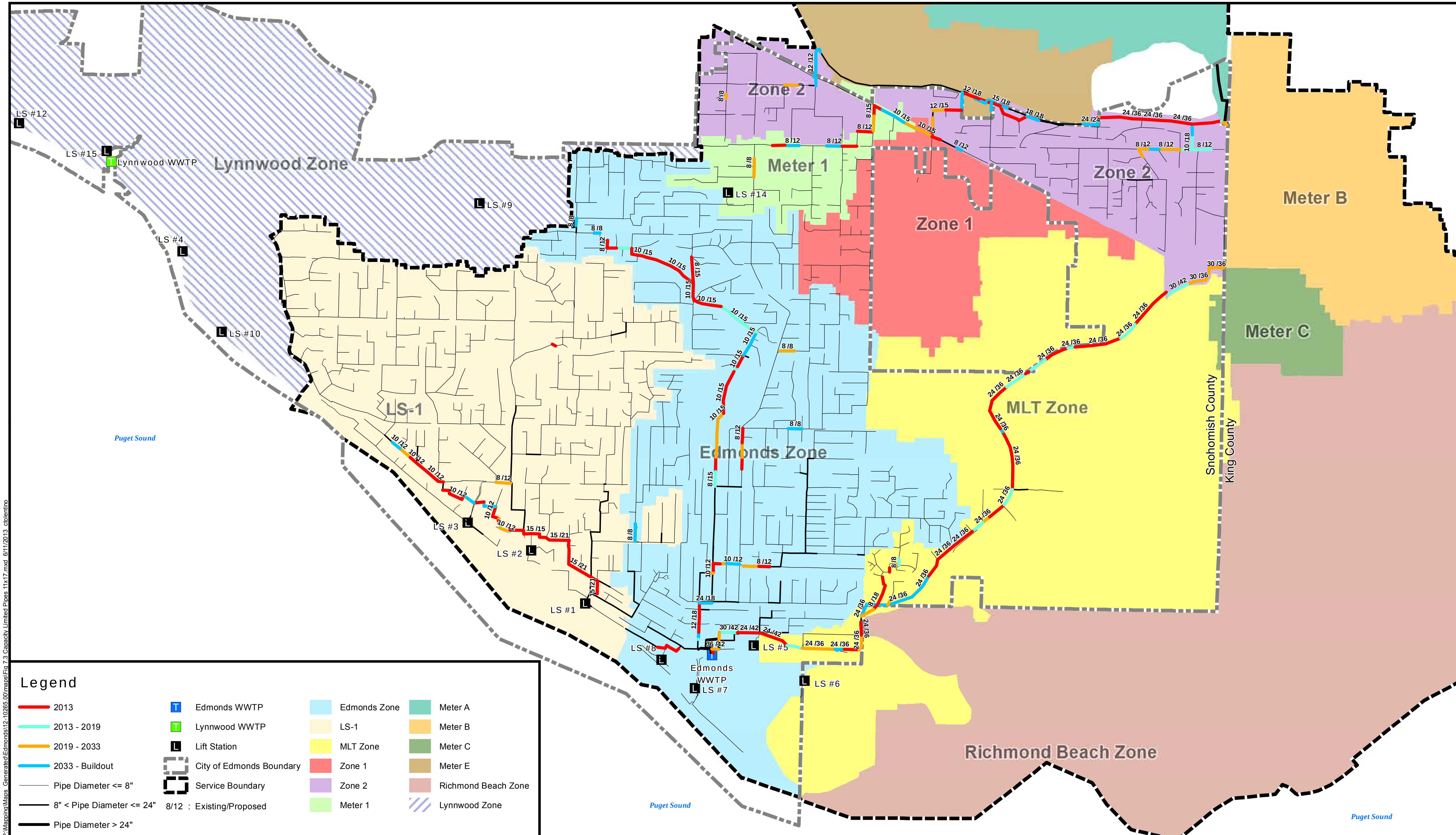


To determine which pipes needed to be upsized, the PDF for the Buildout condition was input into the model as outlined above. The simulated ratio of depth of flow to pipe diameter (d/D) was used as the original basis for upsizing. Several iterations were required to upsize pipes in order to create a free flow condition. The model with the upsized pipes that produced a free flow condition for the Buildout scenario was also run with the PDF for the 2013, 2019, and 2033 scenarios. This produced the peak flow that would be going through each pipe for each future flow scenario (Qyear). These values were then compared to each pipe's existing hydraulic capacity (Qcap). When the ratio of Qyear/Qcap exceeded 0.93, the pipe for that scenario was considered surcharged. The following criteria were used to determine which pipes would require upsizing:

- Upsize pipes whose capacity is limited (Qbuildout/Qcap > 0.93)
- Pipes < 10-inch in diameter whose capacity is limited were upsized to 12-inch
- Pipes > 10-inch whose capacity is limited were upsized in 6-inch increments
- Some exceptions were made if the pipe was only slightly surcharged and then an increase of 3-inch was applied based on engineering judgment
- If any pipes that were not identified as having a Qbuildout / Qcap > 0.93 but have pipes upstream and downstream that were upsized, then these pipes were also upsized for continuity
- No pipe offsets were adjusted
- No forcemains were upsized
- Qyear/Qcap ratio of intermediate scenarios was used to phase the upsizing.

Several iterations of this procedure were conducted. In some cases surcharging was allowed, based on engineering judgment, if the pipe was an isolated case. No Flooding was observed in this system.

In summary, the pipe diameters were upsized for the Buildout peak flows and phasing was determined using the intermediate scenarios. See Figure 7.3 that summarizes the pipe upsizing results on a map showing existing and proposed pipe diameters color-coded by year in which upsizing will be required. The corresponding table of pipe diameters is also included in Appendix B.1. The proposed pipe diameters are preliminary estimates and should be scrutinized further during design engineering.



P:\Mapping\Maps_Generated\Edmonds\12-10265.00\maps\Fig 7.3 Capacity Limited Pipes 11x17.mxd 6/11/2013 cbtolentino

BHC Consultants, LLC
1601 Fifth Avenue, Suite 500
Seattle, Washington 98101

206.505.3400
206.505.3406 (fax)
www.bhcconsultants.com

Capacity Limited Pipes: Aqualyze Inc., June 2013
Sewer Zones: City of Edmonds, December 2011
GIS Data: City of Edmonds, Snohomish County & King County.
Data sources supplied may not reflect current or actual conditions. This map is a geographic representation based on information available. It does not represent survey data. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map.

CAPACITY LIMITED PIPES

COMPREHENSIVE SEWER PLAN

City of Edmonds
June 2013

Figure
7.3

FUTURE FLOW COMPARISON

The predicted flow was compared to the calculated value at each flow meter for the Buildout scenario as shown in Table 7.5.

Table 7.5 - Model Results Comparison for Buildout Condition

Flow Meter	Model Peak Flow (cfs)	Assumed Peak Flow (cfs)[1]	Diff (%)	Model Peak Day Flow (cfs)	Model Peak:Peak Day
Total Meter D	26.93	22.82	18.0%	17.70	1.52
Total Meter B	17.07	13.99	22.0%	11.02	1.55
Total Meter A	15.82	13.39	18.1%	10.54	1.50
Total Meter 2	7.49	6.15	21.9%	4.81	1.56
Total Meter 1	2.94	2.41	22.0%	1.88	1.57
Total LS-01 Zone	6.36	6.00	6.0%	4.76	1.34
Total Edmonds	18.99[2]	18.66	1.8%	14.50[2]	1.31
Total MLT Zone	73.62	63.20	16.5%	49.09	1.50

[1]Based on 1.27 peaking factor at the treatment plant
[2]Model predicted portion of flow leaving system through diversion weir at LS-01. Accounted for by adding hydrograph through diversion weir to hydrograph at Total Edmonds Flow Meter in Model Peak and Average Flow in Table.

The methodology outlined above allowed for the phasing sequence of the pipe upsizing for each of the flow scenario. The list of the pipes to be updated along with the year of update is provided in Appendix B. Table 7.6 below summarizes the total pipes in the model in addition to those requiring upsizing phased over the four scenarios.

Table 7.6 - Modeled Pipe Summary

Upsized Pipe Summary	
Total Model Pipes	2,390
Total Pipes Upsized	227
Pipes Upsized 2013	115
Pipes Upsized 2019	34
Pipes Upsized 2033	46
Pipes Upsized Buildout	32
Minimum Existing Diameter (in)	8
Maximum Existing Diameter (in)	36
Maximum Future Diameter (in)	42

7.7 MODEL LIMITATIONS

The list below summarizes the model limitations encountered during this project and should be noted when reviewing or using the results generated by this model.

- LS information provided in the form of pumping capacity and corresponding head was assumed to be correct.
- The limited information available at KC Lake Ballinger PS including detailed configuration of adjacent pipe networks, the flow swapping with King County, and exact pump operation at this facility introduces uncertainties that could affect model results. Every effort was made to ensure information input into the model was sufficient to perform modeling tasks.

CHAPTER VIII – EDMONDS WASTEWATER TREATMENT PLANT

8.1 INTRODUCTION

The purpose of this section is to evaluate the Edmonds Wastewater Treatment Plant for its ability to meet treatment objectives over the planning period.

The Edmonds treatment plant liquid stream consists of a headworks with three mechanical screens, three rectangular primary clarifiers, three aeration basins, three circular secondary clarifiers, and a chlorine contact tank. The disinfected plant effluent is discharged through a single 36-inch diameter outfall into Puget Sound. The outfall branches into two lines 1250 feet out into the bay with two diffusers, each 160 feet long with diffuser ports at MLLW elevation that ranges from 56 to 73 feet deep. The solids stream includes belt press dewatering and incineration of the sludge cake using a fluidized bed incinerator.

A detailed description of the existing facilities is presented in Section 5.4.

The original Edmonds WWTP was completed in 1957 to treat 2.0 million gallons per day (mgd). Edmonds expanded the primary plant to a design flow of 4.0 MGD in 1959, and for a third time in 1967, to a design flow of 7.6 MGD, by adding two clarifiers and effluent pumping. The third expansion also included dewatering equipment and an incinerator for solids handling.

In 1991 the plant was expanded to secondary treatment with a capacity of 11.8 mgd for maximum month loading. A conventional secondary treatment process was implemented consisting of three aeration basins, three circular secondary clarifiers, and a chlorine contact basin. Additionally, new operations and solids handing buildings were constructed. The Edmonds Plant layout is shown in Figure 5.4.

8.2 TREATMENT REQUIREMENTS

The Edmonds wastewater treatment plant operates under the terms of NPDES Permit No. WA-002405-8 last modified May 9, 2012. A copy of the permit is included in Appendix K.

The treatment plant effluent requirements established by the permit are a maximum monthly concentration of 25 milligrams per liter (mg/L) for carbonaceous biochemical oxygen demand ($CBOD_5$), 30 mg/L for total suspended solids (TSS) and 200/ 100 mL for fecal coliform bacteria density. $CBOD_5$ and TSS effluent limits are also held to an 85% minimum removal. The facility is subject to whichever discharge limit is more stringent when reporting: concentration mg/L or 85% removal.

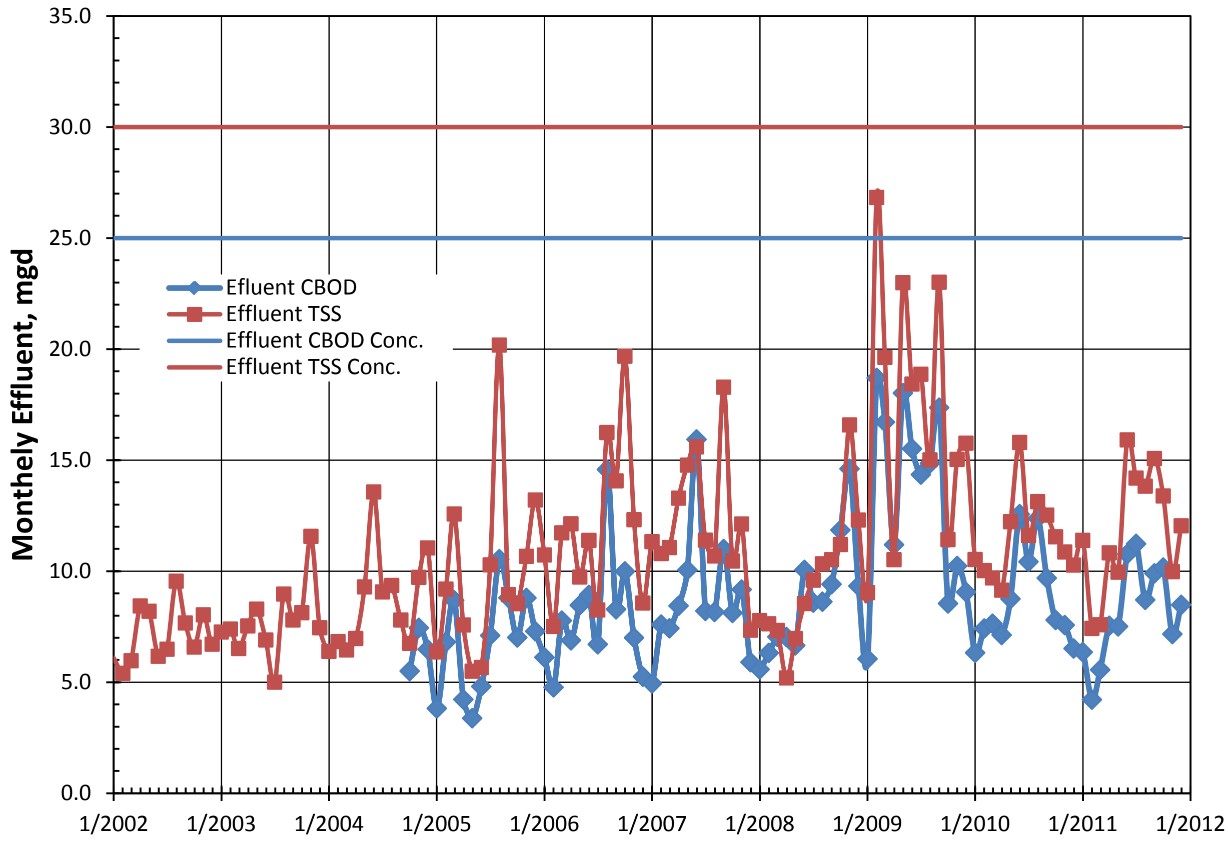
Based on a maximum month design flow of 11.8 million gallons per day (mgd), the average monthly mass discharge limit of 25 mg/L for BOD_5 and 30 mg/L for TSS is

2,460 and 2,952 pounds per day respectively. The permit also limits the chlorine residual concentration to 0.191 mg/L.

8.3 TREATMENT PERFORMANCE

Figure 8.1 is a plot of the effluent $CBOD_5$ and TSS concentration over the last 10 years. The Edmonds plant is consistently under the monthly average of 25 and 30 mg/L limit for $CBOD_5$ and TSS respectively as stipulated in the NPDES Permit.

Figure 8.1 Edmonds WWTP - Effluent $CBOD_5$/TSS Conc.

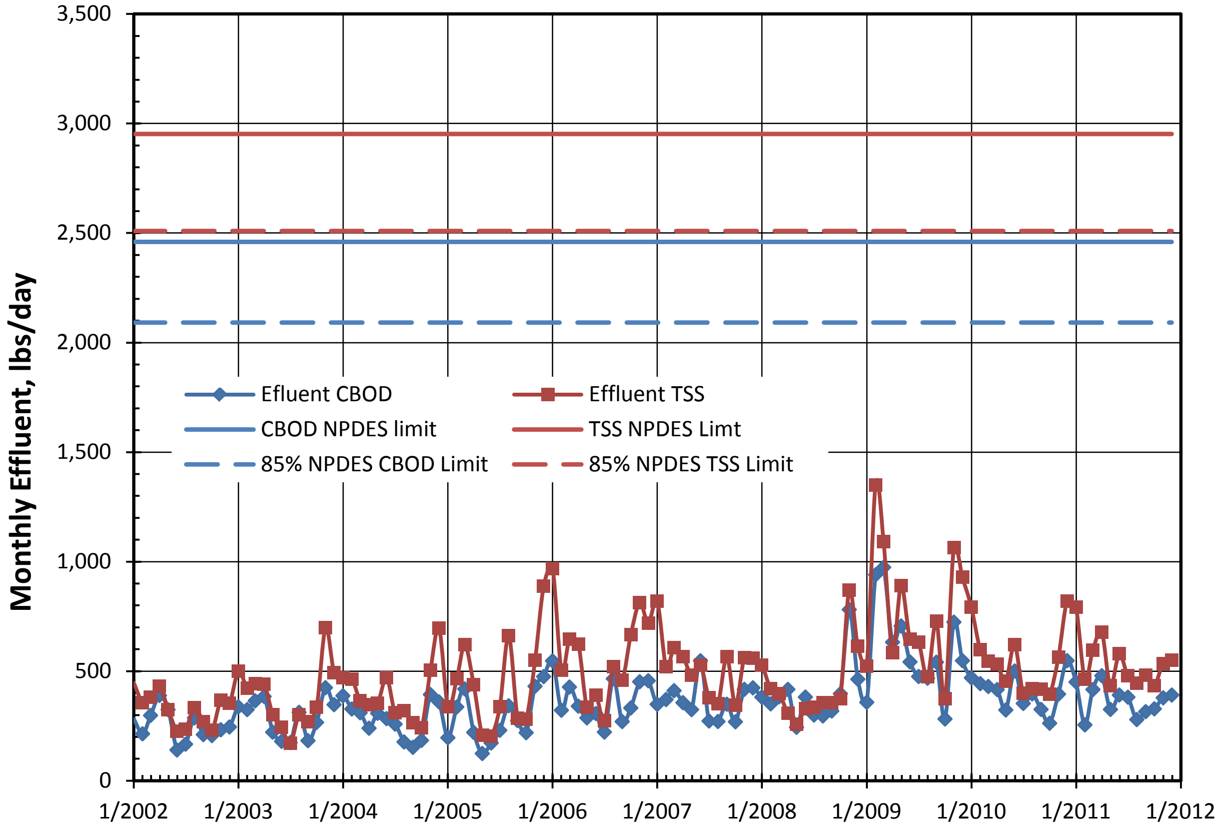


The determination of the effluent mass discharge is calculated by multiplying the concentration times the daily flow:

$$\left(\frac{mg}{L}\right) \cdot \left(\frac{million\ gallons}{day}\right) \cdot 8.34 \left(\frac{lb}{gal}\right) = \frac{lbs}{day}$$

This formula uses the measured effluent concentrations from limited composite samples and the continuously measured flow values. The results yield the total mass BOD and TSS being discharged from the plant. It should be noted, however, that such calculations tend to over-state the total mass. This is referred to as 'flow biasing'. During the wet weather months when extreme flow conditions occur, the extrapolation of those flow conditions throughout the entire month tends to overestimate the total mass discharge. Figure 8.2 is the effluent mass loading.

Figure 8.2 Edmonds WWTP - Effluent Mass $CBOD_5$/TSS



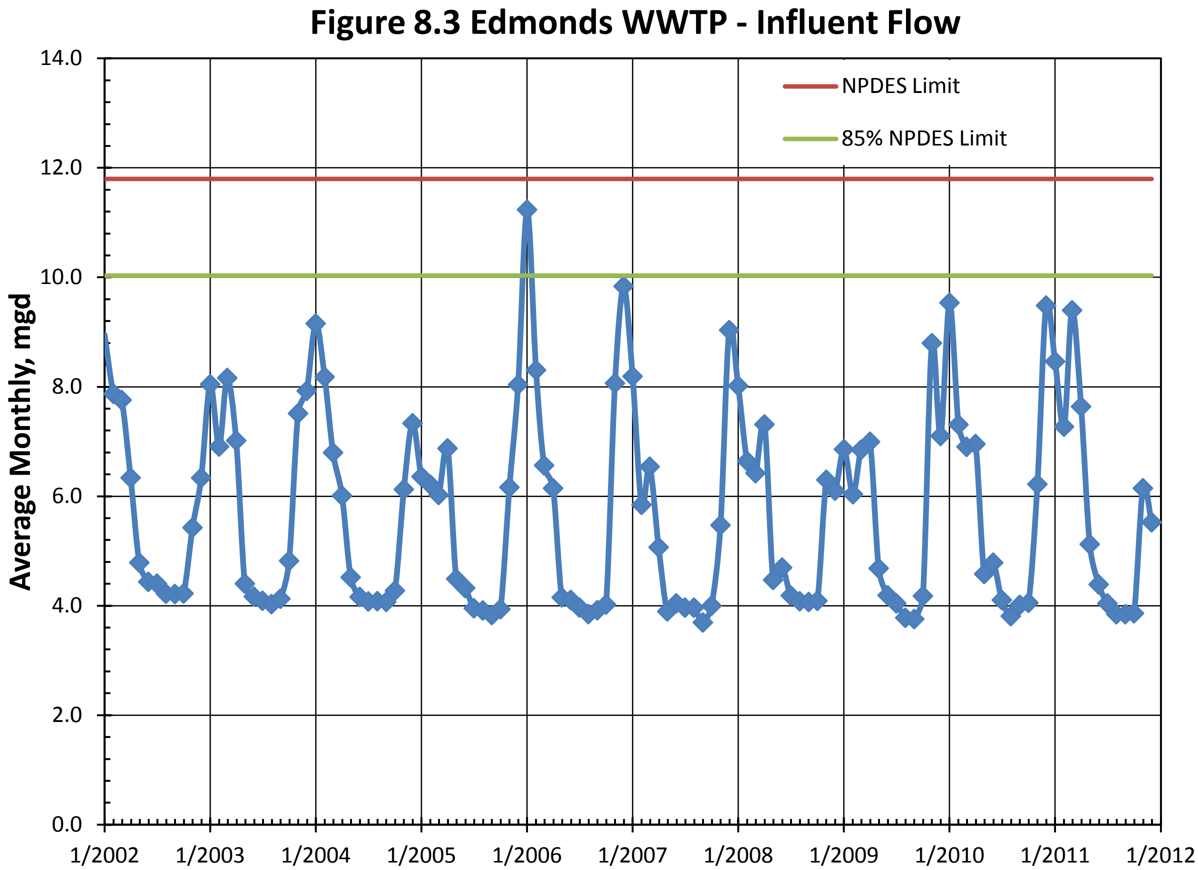
8.4 NPDES PERMITTED CAPACITY AND HISTORICAL LOADING

The NPDES permit specifies the permitted capacity of the plant. The Edmonds WWTP is permitted to treat a **maximum monthly flow of 11.8 mgd**. The "maximum month" criterion is the highest monthly average loading in one calendar year.

Section S4.B: *Plans for Maintaining Adequate Capacity*, states that the City of Edmonds needs to submit a plan and schedule to Ecology to maintain capacity if the influent flow reaches 85% of the design criteria for three consecutive months. When flows reach **10.03 mgd** for three months in a row the City will be subject to this condition.

There are three parshall flumes that measures flow at the Edmonds WWTP. As stated in Section 3.4.2, the loading to Edmonds has been largely influenced by the flow swapping agreement with King County through the Lake Ballinger pump station.

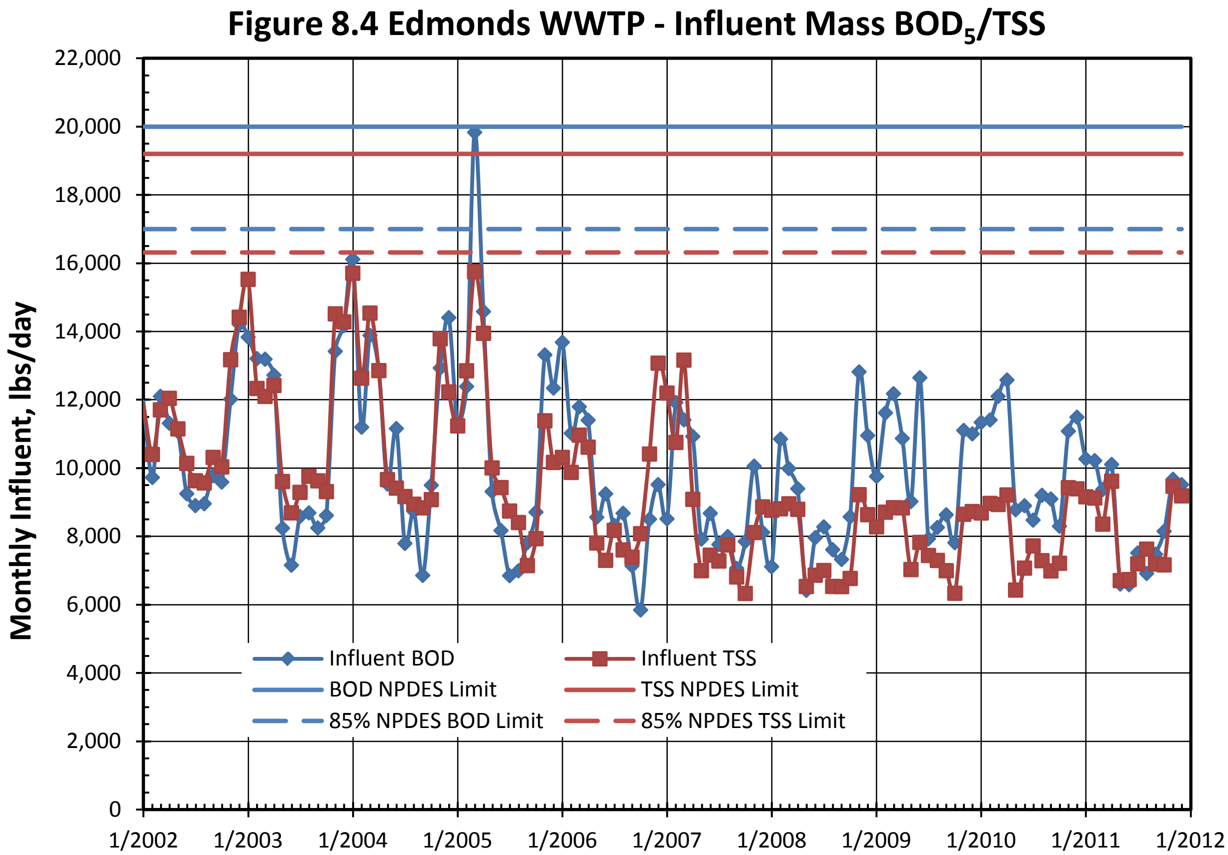
Figure 8.3 shows a plot of the influent flow over the last 10 years. As shown the flows are well below the plant design flow, or the level that would trigger a plant expansion study.



Average monthly flows through the 10 year period of record show consistent seasonal patterns. Other than one large event in 2006 the influent flow has been far below the NPDES permit. Past flows look to be approaching the 85% limit but this figure does not reflect the new reciprocating flow agreement with King County concerning the Lake Ballinger pump station.

The NPDES permitted average BOD and TSS loading design criteria for the plant in section S4.A is **20,000 and 19,200 lbs/day respectively for maximum month** loads. When BOD loads reach **17,000 pounds per day** or TSS loads reach **16,320 pounds per day** Edmonds will be subject to the 85% planning criteria.

Figure 8.4 shows a plot of the influent mass BOD and TSS over the last 10 years.



8.5 VIOLATIONS AND BYPASSES

In April 2009 the Edmonds plant received a warning letter from the Department of Ecology (DOE) for being out of compliance with their wastewater discharge permit. The violation was for February 2009 because the discharged TSS did not meet the minimum 85% removal because of some temporary process problems. No further action was taken. Aside from the warning letter, Edmonds has had no violations in the last decade concerning treatment or bypasses.

8.6 FUTURE CAPACITY EVALUATION

A capacity analysis has been conducted as part of this comprehensive plan to predict what equipment or processes, if any, are likely to exceed their ability to handle plant flows and loads during the planning period. The capacity analysis is presented as Table 8.1.

Taking into consideration the Lake Ballinger pump station flow swap, projections for future flows and loads were made based on predicted population growth for the Edmonds service area. **The flow projections calculated for the Edmonds plant gave a maximum monthly flow of 5.72 mgd in the year 2019 and 6.79 mgd in year 2033.**

Table 8.1
Current and Future Loadings to WWTP

Design / Plant	Design Data		Plant Data	NPDES	Projected		Metcalf and Eddy		DOE Orange Book
Component	Year 1991	Current Design	Year 2009-2011	Permit WA-002405-8	Year 2019	Year 2033	Typical Design	Range Design	Range Design
Population Equivalent									
Flow, mgd									
Average Annual	6.7	9.1	5.79		5.72	6.79			
Maximum Month	8.7	11.8	9.66	11.8	8.97	10.96			
Peak Hour	31.3	40.0	30.30		47.1	57.1			
Max Day	16.8	21.6	21.60	21.5	32.1	39.6			
Max flow to secondary	22.9	22.9	22.90		22.9	22.9			
BOD_5, lbs/day									
Annual AVG	11,200	15,300	9,611		9,490	11,265			
Max Month AVG	14,100	19,200	12,647	20,000	11,744	14,349			
Max day	22,400	30,500	16,276		24,188	29,839			
TSS, lbs/day									
Annual AVG	8,300	11,300	8,051		7,949	9,436			
Max month AVG	11,600	15,900	9,615	19,200	8,929	10,909			
Max day	21,600	29,400	11,321		16,824	20,755			
Per Capita, lbs/cap/day									
Annual AVG BOD									
Annual AVG TSS									
Effluent Limits									
$CBOD_5$, lbs/day									
AVG month, 25 mg/L (NPDES)				2,460					
or									
AVG week, 40 mg/L (NPDES)				3,936					
TSS, lbs/day									
AVG month, 30 mg/L (NPDES)				2,952					
or									
AVG week, 45 mg/L (NPDES)				4,429					
Fecal Coliform Bacteria									
Monthly geometric mean				200					
Weekly geometric mean				400					
Chlorine, lbs/day									
AVG month (0.191 mg/L, NPDES)				18.8					
Max Day (0.442 mg/L, NPDES)				43.5					
Headworks									
Mechanical Bar Screens									
Number	3								
Width, ft	4								

Table 8.1
Current and Future Loadings to WWTP

Design / Plant	Design Data		Plant Data	NPDES	Projected		Metcalf and Eddy		DOE Orange Book
Component	Year 1991	Current Design	Year 2009-2011	Permit WA-002405-8	Year 2019	Year 2033	Typical Design	Range Design	Range Design
bar spacing, in	0.5								
Parshall Flumes									
Number	3								
Throat, ft	2								
Raw Sewage Pumps									
Number	4								
Type	vertical, non-clog								
Capacity, each, gpm	9,260								
HP, each	100								
Drive type	2 variable, 2 consant								
Primary Clarifiers									
Primary Sedimentation Tanks									
Number	3	3	3		3	3			
Clarifiers 1&2									
Width, ft	60	60	60		60	60			
Length, ft	60	60	60		60	60			
Clarifiers 3									
Width, ft	45	45	45		45	45			
Length, ft	91	91	91		91	91			
Average Depth, ft	10	10	10		10	10			
Total Surface Area, square feet	11,295	11,295	11,295		11,295	11,295			
Surface Load Rate, gpd/sf									
Annual Average	593	806	513		506	601	1,000	800 to 1,200	
Max month	770	1,045	855		794	970			
Peak hour	2,771	3,541	2,683		4,170	5,055	2,500	2,000 to 3,000	
Detention time, hrs									
Annual Average	3.0	2.2	3.5		3.5	3.0			
Max month	2.3	1.7	2.1		2.3	1.9	2	1.5 to 2.0	
Peak hour	0.6	0.5	0.7		0.4	0.4			
Max Day	1.2	0.9	0.9		0.6	0.5			
BOD Removal, %									
Annual Average flow	39%	36%	37%		37%	35%		25 to 40	
Maximum month flow	36%	33%	31%		32%	30%			
Max Day	29%	26%	28%		21%	18%			
TSS Removal, %									
Annual Average flow	61%	58%	62%		62%	61%		50 to 70	
Maximum month flow	58%	54%	57%		58%	55%			
Max Day	49%	45%	40%		32%	28%			

Table 8.1
Current and Future Loadings to WWTP

Design / Plant	Design Data		Plant Data	NPDES	Projected		Metcalf and Eddy		DOE Orange Book
Component	Year 1991	Current Design	Year 2009-2011	Permit WA-002405-8	Year 2019	Year 2033	Typical Design	Range Design	Range Design
Aeration Basins									
Number	3	3	3		3	3			
Width, ft	58	58	58		58	58			
Length, ft	75.3	75.3	75.3		75.3	75.3			
Side water depth, feet	20.6	20.6	20.6		20.6	20.6			
Volume total, gal	2,018,892	2,018,892	2,018,892		2,018,892	2,018,892			
Contact zone volume, gal	348,000	348,000	348,000		348,000	348,000			
CMAS Mode									
Total Detention Time, hr									
Annual Average	7.2	5.3	8.4		8.5	7.1			
Max month	5.6	4.1	5.0		5.4	4.4		3 to 5	
Max Day	2.9	2.2	2.2		1.5	1.2			
MLSS Conc, mg/L	1,800	1,800	1,708		1,800	1,800		1,500-4,000	
Q_R/Q, mgd/mgd								0.25 to 0.5	
F:M Ratio									
Annual Average	0.23	0.33	0.42		0.20	0.24			
Max month	0.30	0.43	0.46		0.26	0.33		0.2 to 0.6	
Max Day	0.53	0.75	0.61		0.63	0.81			
SRT, days									
Annual Average	9.3	6.3	9.4		10.0	8.1			
Max month	6.2	4.2	6.9		8.0	6.2		3 to 15	
Max Day	2.8	1.9	4.2		2.6	2.0			
Oxygen Demand, lb/hr									
Annual Average	315	452	278		275	333			
Max month	413	591	400		367	463			
Max Day	733	1041	537		880	1120			
Contact Stabilization Mode									
Contact MLSS Conc, mg/L								1,000-3,000	
Contact time, min									
Annual Average	75	55	87		88	74			
Max month	58	42	52		56	46		30 to 60	
Peak Hour, w/out bypass	16	13	17		11	9			
Peak hour, w/ bypass	22	22	22		22	22			
Max Day	30	23	23		16	13			
Stabilization MLSS Conc, mg/L								6,000-10,000	
Stabilization time, hrs									
Annual Average	12.0	8.8	13.8		14.0	11.8			
Max month	9.2	6.8	8.3		8.9	7.3			
Max Day	4.8	3.7	3.7		2.5	2.0			
Peak hour, w/ bypass	3.5	3.5	3.5		3.5	3.5		2 to 4	
Peak Hour, w/out bypass	2.6	2.0	2.6		1.7	1.4			

Table 8.1
Current and Future Loadings to WWTP

Design / Plant	Design Data		Plant Data	NPDES	Projected		Metcalf and Eddy		DOE Orange Book
Component	**Year 1991**	**Current Design**	**Year 2009-2011**	**Permit WA-002405-8**	**Year 2019**	**Year 2033**	**Typical Design**	**Range Design**	**Range Design**
Q_R/Q, mgd/mgd	0.50	0.50	0.50		0.50	0.50		0.50 to 1.50	
Blowers									
Number	4								
Type	multi-stage, centrifugal								
Capacity, each,	3,300								
HP, each, cfm	250								
RAS Pumps									
Number	4								
Type	Horizontal, non-clog centrifugal								
Capacity, each,gpm	2,100								
HP, each	25								
Secondary Clarificaters									
Number	3	3	3		3	3			
Diameter, ft	90	90	90		90	90			
Side water Depth, ft	17.5	17.5	17.5		17.5	17.5			
Total surface area, sq ft	19,085	19,085	19,085		19,085	19,085			
Surface loading rate, gpd/sq ft/d									
Annual average flow	351	477	304		300	356		400 to 700	
Maximum month flow	456	618	506		470	574			
Peak to secondary (w/out bypass)	1,640	2,096	1,588		2,468	2,992		1,000 to 1,600	
Peak To secondary (w/ bypass)	1,200	1,200	1,200		1,200	1,200			
Total weir length, ft									
Solids loading, lb/hr/sf									
Annual average flow	0.3	0.4	0.3		0.3	0.3			
Maximum month flow	0.4	0.6	0.5		0.4	0.5		0.8 to 1.2	
Peak hour	1.2	1.57	1.4		1.9	2.2		1.6	
Chlorine Contact Chamber									
Number of Tanks	2	2	2		2	2			
Length, ft	251	251	251		251	251			
Width, ft	5.5	5.5	5.5		5.5	5.5			
Side water depth, ft	15.5	15.5	15.5		15.5	15.5			
Total volume, gal	320,110	320,110	320,110		320,110	320,110			
Dentention Time, min									
Annual Average	69	51	80		81	68		30 to 120 min	60-120
Maximum month	53	39	48		51	42			
Peak hour	15	12	15		10	8		15 to 90 min	> 20
Number of Chlorinators									

Table 8.1 Current and Future Loadings to WWTP									
Design / Plant	**Design Data**		**Plant Data**	**NPDES**	**Projected**		**Metcalf and Eddy**		**DOE Orange Book**
Component	**Year 1991**	**Current Design**	**Year 2009-2011**	**Permit WA-002405-8**	**Year 2019**	**Year 2033**	**Typical Design**	**Range Design**	**Range Design**
*including portion of outfall									
Chlorination Equipment									
Number of Chlorinators	2	2	2		2	2			
Capacity, lb/day	2,000	2,000	2,000		2,000	2,000			
Cylinder Size, lbs	2,000	2,000	2,000		2,000	2,000			
Cylinder Storage Number	8	8	8		8	8			
Average Daily Demand, lbs	380	380	380		380	380			
Effluent Pumps									
Number	5								
Type	Vertical, mixed flow								
Capacity, each,gpm	7,000								
HP, each	100								
Drive type	(2) VFD, (3) constant								
Primary Sludge Production									
Annual Average			4,627		4,932	5,715			
Max month			5,733		9,715	11,496			
Sludge avg TS, %			3.44%				2-6%		
Secondary Sludge Production									
Annual Average			5,484		5,413	6,631			
Max month			8,476		7,780	9,915			
Sludge avg TS, %			0.65%				0.5 to 1.5%		
Primary Sludge and Scum Pumps									
Number	6					21,411	83,898		
Type	Air operated, diaphram								
Capacity, gpm	150								
Primary Sludge Storage Tanks									
Number	1	1	1		1	1			
Volume, gal	29,000	29,000	29,000		29,000	29,000			
Detention Time, days									
Annual Average		1.2	1.8		1.7	1.5			
Maximum month		0.9	1.5		0.9	0.7			
Max day		0.8			0.8	0.8			
Mixer type and HP									

Table 8.1

Current and Future Loadings to WWTP

Design / Plant	Design Data		Plant Data	NPDES	Projected		Metcalf and Eddy		DOE Orange Book
Component	Year 1991	Current Design	Year 2009-2011	Permit WA-002405-8	Year 2019	Year 2033	Typical Design	Range Design	Range Design
Primary Sludge Transfer Pumps									
Number	2								
Type	Air operated diaphram								
Capacity, gpm	150								
WAS and Secondary Pumps									
Number	5								
Type	Progeressive Cavity								
Capacity, each,gpm	50								
HP, each	5								
Drive type	Constant								
WAS Storage Tank									
Number	1	1	1		1	1			
Volume, gal	102,000	102,000	102,000		102,000	102,000			
Detention Time, days									
Annual Average		1.7	1.0		1.0	0.9			
Maximum month		1.0	0.7		0.7	0.6			
Max day		0.6							
Mixer type and HP									
WAS Transfer Pumps									
Number	2								
Type	Progeressive Cavity								
Capacity, each,gpm	150								
HP, each	7.5								
Drive type	VFD								
Belt Filter Press									
Number	2	2			2	2			
Width, ft	6.6	6.6			6.6	6.6			
Capacity, each, gpm	150								
Hours operated/Day									
Annual Average		12	12		12	12			
Max month		17	17		17	17			
Max Day		23.7	23.7		23.7	23.7			
Loading, gpm, one BP for hours operated									
Annual Average		108	162		162	197			
Max month		116	172		173	218			
Max Day		130			187	235			
Loading, lb dry solids/hr		509			509	509			

Table 8.1
Current and Future Loadings to WWTP

Design / Plant	Design Data		Plant Data	NPDES	Projected		Metcalf and Eddy		DOE Orange Book
Component	Year 1991	Current Design	Year 2009-2011	Permit WA-002405-8	Year 2019	Year 2033	Typical Design	Range Design	Range Design
Incinerator									
Number	1	1			1	1			
Type	Fluidized bed								
Diameter, ft	10	10			10	10			
Capacity, mmbtu	9.7	9.7			9.7	9.7			
Hours Operated Daily									
Annual Average		12	12		12	12			
Max month		17	17		17	17			
Max Day		23.7	23.7		23.7	23.7			
Capacity, lb/hr	942								
Loading, lb dry solids/hrs operated									
Annual Average			843		862	1,029			
Max month			836		1,029	1,259			
Ash Thickening									
Number	1								
Type	gravity								
Diameter, ft	8								
Ash Dewatering									
Number	1								
Type	vacuum filter								
Capacity, lb/hr	200								
Ash Production, cy/d									
Annual Average		2.1			2.1	2.1			
Max month		3.2			3.2	3.2			
Max Day		4.0			4.0	4.0			

These projected flows are far less than the overall rated capacity of 11.8 mgd for the plant and do not exceed the 85% criteria (10.03 mgd) within the planning period. The projected maximum month BOD loadings for the plant are 11,744 pounds per day in 2019 and 14,349 pounds per day in year 2033. The BOD loading in 2033 is far less than the 85% design criteria let alone the NPDES permitted limit of 20,000 lbs/day.

The projected TSS lbs/day maximum month loading for the Edmonds plant is 8,949 and 10,909 lbs/day, in years 2019 and 2033, respectively. The projected TSS load in year 2033 is less than half of the NPDES permitted limit of 19,200 lbs/day.

In addition to the overall plant capacity analysis, the capacity of the plant's individual unit processes were evaluated against typical design values, as shown in literature that is widely consulted in the wastewater engineering field, including "*Wastewater Engineering: Treatment and Reuse",* by Metcalf & Eddy; "*Design of Municipal Wastewater Treatment Plants",* prepared jointly by the Water Environment Federation (WEF) and American Society of Civil Engineers (ASCE); and "*Criteria for Sewage Works Design*" (the Orange Book) by the Washington State Department of Ecology

Using these projections the capacities of the unit processes were compared with commonly accepted design values, as shown on Table 8.1. The capacity for the mechanical equipment used was based on the manufacturer's rating and the plant design data. **None of the unit processes are projected to be significantly overloaded during the planning period.**

The only unit process that is not meeting typical design criteria is the chlorine contact chamber detention time. The facility, already aware of this, maintains elevated disinfection levels as explained in the Section 5.4.2. Furthermore, the current operation feeds sodium hypochlorite at the secondary clarifier weir overflow which increases the contact time.

8.7 FUTURE REGULATORY ISSUES FOR WWTP

The existing liquid stream processing at the Edmonds facility regularly produces compliant effluent and the capacity of the plant can easily handle the projected flows and loads. However, there are three potential regulatory issues that could impact the plant requirements in the future. The potential regulatory issues are:

- Sewage Sludge Incineration (SSI) Air Emissions
- Secondary Treatment Bypass
- Total Nitrogen Discharge Limits

8.7.1 Sewage Sludge Incineration (SSI) - Air Emissions

The most pressing issue is the requirement of new sewage sludge incinerator (SSI) air quality standards. On February 21, 2011, the EPA published their newest final SSI emission regulations in the Federal Register Title 40 Part 60, under the provisions of the Clean Air Act (CAA), Section 129 "Solid Waste Incineration Units". These new standards supplement the older Clean Water Act (CWA 40 CFR, Part 503) regulations. The new regulations were declared to be effective on May 20, 2011. The regulations dictate different emission limits for new (or substantially modified) incinerators and for existing sewage sludge incinerators; as well as different limits for multiple hearth incinerators and fluidized bed incinerators. Existing SSI units will have 5 years to comply from the effective date of the regulations, or until May 19, 2016. The new CAA regulations will require a Title V air permit.

Previous regulations for sewage sludge incinerators (SSI) were based on emission limits established in Title 40 Part 503 of the Clean Water Act (CWA). The previous air quality emission limits were as follows, and the City has been in compliance with these limits:

- Particulate matter emission limit of 0.18 g/m^3 (0.08 grams/cu ft) dry gas at standard temperature and pressure corrected to 12% carbon dioxide.
- Beryllium emission of 10 g per 24-hour period.
- Mercury emission limit of 3,200 g per 24-hour period.
- Lead, arsenic, cadmium, chromium, and nickel feed cake limits based on ambient air quality and health risk specific concentrations.
- Total Hydrocarbons monthly average concentration of 100 ppm by volume, corrected to 0% moisture and 7% oxygen.
- Carbon monoxide monthly average concentration of 100 ppm by volume, corrected to 0% moisture and 7% oxygen.

The new emission limits that apply to the Edmonds Wastewater Treatment Plant are given in Table 8.2 below. The existing SSI regulation is for incinerators that were in operation before the new regulations. New SSI's built, or substantially modified, will be held to more stringent emission limits. Substantial modification includes any revisions to the feed system, reactor, ash system and energy recovery systems; but not the emission control equipment or routine maintenance.

In addition to new emission limits, the new regulations will require that compliance tests be conducted annually.

The "2007" column in Table 8.2 summarizes data received from the plant for their source emissions evaluation by Am Test-Air Quality, LLC, which was conducted in late May of 2007 and finalized into a report in July 31, 2007. The 2007 evaluation was based on the old regulations, so there are several pollutants (hydrogen chloride, dioxins and furans) that are currently regulated that were not sampled or tested.

Table 8.2 EPA Emission Limits for Fluidized Bed Incinerators

Pollutant	Units	Existing SSI	New SSI	2007
Cd	mg/dscm @ 7% O_2	0.0016	0.0011	0.00031
CO	ppmvd @ 7% O_2	64	27	1.6
HCl	ppmvd @ 7% O_2	0.51	0.24	-
Hg	mg/dscm @ 7% O_2	0.037	0.0010	**0.053**
NO_X	ppmvd @ 7% O_2	150	30	24
Pb	mg/dscm @ 7% O_2	0.0074	0.00062	**0.180**
PCDD/PCDF, TEQ	ng/dscm @ 7% O_2	0.10	0.0044	-
PCDD/PCDF, TMB	ng/dscm @ 7% O_2	1.2	0.013	-
PM	mg/dscm @ 7% O_2	18	9.6	**34.8**
SO_2	ppmvd @ 7% O_2	15	5.3	10.5

Where:

Cd - Cadmium
CO - Carbon Monoxide
HCl - Hydrogen Chloride
Hg - Mercury
NO_X - Nitrogen Oxides
Pb - Lead
PCDD/PCDF - Polychlorinated Dibenzo -P-Dioxins and Polychlorinated Dibenzofurans
PM - Particulate Matter
SO_2 - Sulfur Dioxide
TEQ - Toxic Equivalency
TMB - Total Mass Balance

Stack gas emission records are limited. Assuming that this one test is representative of Edmond's sludge, improvements to the existing emission control equipment will be required. However, it should be noted that sludge quality can vary significantly between samples and one sample is not necessarily representative. A significant sampling and testing program is recommended before any modifications are made to the emissions control system.

The 2007 report conducted three runs for each of the tests and the sludge was further analyzed during each run. In Table 8.2, the 2007 column has three pollutants that exceed the new regulations for existing SSI's; mercury, lead, and particulate matter. Particulate matter and most metals (except mercury) are removed as solids by the plant's existing Venturi scrubber. Because of its extremely high vapor pressure, mercury is 100% vaporized during the incineration process. so it is not removed by the existing wet scrubber. If mercury cannot be removed by source controls, a new packed-bed carbon scrubber will be required.

The **particulate matter** concentration is above the new regulated threshold. The EnviroCare International VenturiPak™ scrubber system at Edmonds has been widely tested at other locations and generally complies with the new particulate matter regulations for existing incinerators. The VenturiPak™, if operated optimally, is typically in compliance with the new regulations for existing SSI for Cd, HCl, Pb, PM, and SO_2.

The 2007 concentrations are likely the results of the scrubber system not operating optimally. An evaluation of the system was conducted in 2012 which resulted in a new venturi throat and additional sprays were added. A compliance test was conducted in 2013 and all new standards were met.

If further optimization of the existing scrubber is needed to meet the new regulations, then additional treatment to remove small (sub-micron) particulates will be required. EnviroCare makes a wet electrostatic precipitator (Star™ ESP) that can be retro-fit with the existing scrubber. The estimated cost of the retro-fit would be about $0.8 million. A pilot test of this equipment is scheduled in 2013.

Lead emissions appear to be very high but this is misleading. The first two emission test runs were in compliance but the third test run was 400 times the concentration of the first two. Considering that the lead concentration in the bio-solids varied by only 9% (at one standard deviation) suggests that the concentration found in the third emissions run was invalid. The skewed emissions test run was perhaps a recording, operations, or lab error but it is not likely representative of typical emission levels. A new stack test would confirm this.

Mercury emissions are not reduced by the existing scrubber system and other actions will likely be necessary for lowering this emissions concentration. Edmonds has two choices to control mercury emissions:

- Require amalgam separators at dental offices
- Implement mercury emission removal equipment

Amalgams are the mercury fillings used in dentistry. Requiring dentists in the service area to use amalgam separators would decrease the amount of mercury in the waste stream. Amalgam separators would be preferred for Edmonds because of the costs of mercury removal treatment processes. The City has already begun a campaign to reduce these discharges, but results are not yet known.

Mercury emission removal equipment, such as that provided by Kombisorbon® would remove 99% of mercury, dioxins, furans and more. The system works by directing the flume gas through a sulfur impregnated activated carbon filter. The adsorbent (activated carbon) can be divided into several layers and removes mercury in all forms through adsorption and chemical reactions. The removal system includes a dust protection layer to extend the life of the activated carbon. The service life of the dust protection and adsorbent layers is estimated to be 3 to 4 years. A budgetary proposal has been received for the Edmonds facility and the system would cost about $1.4 million. Dust protection and adsorbent material replacement cost is roughly $30,000.

Before any actions are further considered Edmonds needs to perform at least one more stack test. The incinerated solids may have changed dramatically due to plant influent changes. The estimated cost to conduct these annual tests is about $25,000.

8.7.2 Secondary Bypass

The Edmonds treatment plant has the ability to route peak flows around the secondary treatment units (aeration basins and secondary clarifiers). The plant has never used this bypass, and the flow projections shown in Table 8.1 predict that the future peak day flow will not exceed the plant peak day design capacity of 21.5 mgd. Therefore the current permit does not allow for bypassing and blending of secondary effluent. However, for long-range planning purposes this may be necessary in the future.

The practice of bypassing peak wet weather flows around secondary treatment processes, and blending the bypass with secondary effluent, has been commonly used in the past throughout the US. In recent years this practice has become more controversial, and the EPA was asked to formalize a bypass regulation that specifically authorizes these bypasses. In December, 2005 the EPA published the provisions that allow for bypasses in the Federal Register at 40 CFR 122.41(m). The key provisions include:

- Discharges must meet secondary effluent limitations, including the 85% removal requirement, or any other more stringent requirements that are necessary to meet water quality standards
- All flows diverted from secondary treatment units must receive a minimum of primary treatment and any supplemental treatment or technology shown to be feasible. The policy does not authorize diversions around any other treatment units, including primary treatment units
- The availability of feasible alternatives will be determined on a plant-by-plant basis, and the authority to bypass the secondary process will be incorporated into the plant's NPDES permit.
- The permittee is responsible for submitting a comprehensive analysis of the feasibility of eliminating the secondary bypass
- If the DOE determines that there is no feasible alternative to secondary bypass flow diversion, then they may approve secondary flow diversion

8.7.3 Total Nitrogen Discharge Limits

Nitrogen is a nutrient which is believed to be one of the main causes of oxygen depletion in South Puget Sound (south of Tacoma Narrows). As a result, the Department of Ecology is conducting a TMDL Study of all of the sources of nitrogen entering Puget Sound (including the effects from discharges north of the Narrows). Ecology is adding nitrogen monitoring requirements to all permits for plants discharging to Puget Sound, in order to gather data for the study.

Although not imminent, for long-range planning purposes, consideration should be given as to how Edmonds plants would meet a future total nitrogen limit.

Total nitrogen (TN) removal is normally accomplished by biological nitrification and de-nitrification, just as carbonaceous BOD removal is currently accomplished in the aeration basins. However, the slower growing nitrifying micro-organisms require about three times the minimum detention time that is recommended for carbonaceous BOD removal. In addition anoxic (without dissolved oxygen) basins are needed to provide biological de-nitrification. De-nitrification is the conversion of nitrates to nitrogen gas through bacteria stripping the nitrates of their oxygen; the nitrogen gas then releases to the atmosphere.

The total additional tankage required would be about 6 million gallons. The only space available for new aeration and anoxic basins would be to expand the plant to the parking lot across 2nd Avenue S. east of the facility; which is the facilities property. This site is not large enough to accommodate conventional activated sludge tanks

Edmonds other option would be converting the plant's activated sludge process to a membrane bioreactor (MBR) system. This choice is the most logical for plants with space restraints. Whereas conventional activated sludge plants operate at a mixed liquor suspended solids (MLSS) concentration of 2,000 to 4,000 mg/L, MBRs operate at a concentration of 8,000 to 12,000 mg/L. This higher concentration reduces the required aeration basin size proportionately, so the required basins would be reduced to about 2.0 million gallons, or about the volume of the existing aeration basins.

In addition, with the MBR process the liquid and solids are separated by a membrane, not by gravity settling, so the need for secondary clarifiers is eliminated. This, in turn, would allow space for the required membrane basins and membrane support building.
Additionally the MBR plant would have to improve the headworks screening for the MBR system. Screening requirement is 3 mm (1/8") sized openings, current bar screens have 6 mm (1/4") openings.

8.8 PLANT IMPROVEMENTS AND ADDITIONAL NEEDS

8.8.1 Improvements since 2006 Comprehensive Plan

Since the 2006 Comprehensive Plan, the City has completed or is in the process of completing the following improvements at the WWTP.

1. 2007-Electrical Improvement Project. #C-251
    i. Replace the three main switch gear breakers with draw-out style breakers to allow us to service the breakers without a total plant power outage.
    ii. Add a 600 amp breaker to the "B" side distribution panel for a feeder to the 100 building.
2. 2007-MCC Feeder Installation. #M-009
    i. Added a new MCC to the 100 building for the new screenings equipment and to move some of the load from the existing MCC

due to under size cables between the existing MCC breaker and the MCC bus bars.

3. 2007-Screenings System Improvement. #C-161
   i. Replaced the influent bar screens with Headworks bar screens (3).
   ii. Replaced the screenings pump with two Wemco pumps.
   iii. Modified the screenings hopper feed water to use raw sewage from the influent pumps
   iv. Added flow meters on the hopper make up water and the screenings transfer flow.
   v. Added a JWC Macho Monster grinder between the screenings conveyer and the screenings hopper.
   vi. Replaced the old screenings de-watering unit with a Headworks washer compactor.
4. 2009-Odor Control Improvement Project. #C-311
   i. Install duct work, a VFD controlled fan, and carbon scrubber on the three Aeration Basins.
   ii. Install duct work, a two speed fan and a carbon scrubber on the secondary clarifier #2.
   iii. Enclose secondary clarifier #2
   iv. Remove the ventilation louvers and the window between the incinerator room and the belt press room.
   v. Install two fans and duct work to bring outside air into the belt press room.
   vi. Install a fan and duct work to allow us to route the foul air from the Waste Activated Sludge (WAS) storage tank to the incinerator while the incinerator is running. Or route it to the chemical scrubber when the incinerator is down
   vii. Added duct work to route the air from the Raw Sludge storage tank through fan #FIC-654.
5. 2009-Secondary Clarifier #2 Refurbishment. #C-316
   i. Strip and repaint all the steel in secondary clarifier #2.
6. 2009-Clay Feeder Project. #C-317
   i. Install a platform over the Sludge Hopper in the incinerator room.
   ii. Install a kaolin clay feeder on the platform that will feed Kaolin clay into the sludge hopper.
   iii. Install a control panel for the feeder with a VFD and timers for the vibrator.
   iv. This system allows us to control the undesirable effects of high sodium content in the sludge. When we feed clay we can control the melting point of the ash.

7. 2009-Aration Basin Control Up-grade. #M-050
    i. Install new Dissolved Oxygen probes on all three Basins.
    ii. Install new Total Suspended Solids probes on all three basins.
    iii. Install three instrument transmitters and three radio transmitters on the basins.
    iv. Install a radio receiver in the CP-301 and hook it into the Programmable Logic Controller (PLC).
    v. Program the PLC to trend the TSS of the basins.
8. 2010-Energy Efficiency Up-grade. #C-322
    i. Replace the course air diffuser in the WAS storage tank with Sanitair membrane style fine bubble diffusers.
    ii. Replace the centrifugal aeration blower 304 with a high efficiency turbo style blower.
9. 2010-300 PLC Upgrade. #C-328
    i. Replace the old Input/Output (I/O) PLC cards with new model cards.
10. 2010-Sludge Pump Replacement. #M-054
    i. Replace air operated RAW Sludge Transfer pump #RST-608 with an electric driven duel diaphragm Penn Valley pump. This will save electricity usage by reducing the demand on the air compressors.
11. 2011-Lighting Up-grade. C-366
    i. Replace all the florescent lighting and some outside lighting with high efficiency lighting.
    ii. Install motion sensors in various locations around the plant.
12. 2011-Outfall Diffuser Project. #C-367
    i. Have the diffuser orifice plates removed to allow less head lose through the diffusers
    ii. Perform a new mixing zone analysis.
13. 2012-A Basin Up-grade. #C-365
    i. Remove all the diffusers and piping grids in Aeration Basin #1.
    ii. Install two baffle walls to convert the complete mix basin to a plug flow basin.
    iii. Install Sanitair's new panel style diffusers.
    iv. Replace the existing single air control valve to the basin with two control valves, one on each grid section.
14. 2012-VFD Replacement. C-384
    i. Replace three, obsolete Variable Frequency Drives (VFD) with new VFDs.
    ii. Install two new VFDs on pumps DSP-615 and BDW-401.
15. 2012-Switch Gear Access Platform.

   i. Install a platform over secondary clarifier #1 behind the plants main electrical switch gear to allow personnel access to the rear panels of the switch gear.

16. 2012-Fiber Optic Network. C-387
    i. Replace the existing plant PLC and SCADA network cables with Fiber Optic cable.
17. 2012-Non-Potable Water Pump Up-grade. C-322
    i. Replace one 50 HP non-potable water pump with a 30 HP pump and a VFD.
    ii. Install a booster pump, in the belt press room, for the high pressure applications,
18. 2012-Hypochlorite Pump Relocation. C-386
    i. Relocate the sodium hypochlorite pumps from the hypo room to the caustic storage area down stairs.
    ii. Install an uninterruptible power supply to the power circuit for the disinfection pumps
    iii. Add a fourth pump for disinfection.
19. 2012-Roof Replacement. C-383
    i. Replace aging roofs on buildings 100, 300, and 600.
20. 2012-Underground Storage Tank (UST) Monitoring Up-grade.
    i. Up-grade the level indicator on the UST to have the ability to perform statistical inventory control. This will bring us into compliance with the Department of Ecology.
    ii. Up-grade the leak monitoring system to a more reliable model.

8.8.2 Additional WWTP Improvements

Current or future modifications at the WWTP, due to obsolescence, operator preferences, or energy upgrades include the following (refer to Table 9.5):

WWTP-1 Switchgear Upgrade. The existing automatic transfer switch is corroded and failing. This improvement will insure reliable emergency power.

WWTP-2 Incinerator Testing and Compliance. Install new air emissions and monitoring equipment on the existing incinerator, modify pre-heat burner fuel source from diesel to natural gas and install a secondary heat exchanger to preheat air for plume suppression.

WWTP-3 Control System Upgrades. This work would begin in Building 600.

WWTP-4	Ameresco Energy Project. Replace the water feature pump and install a VFD. Install thermostat and controls on Shop heater. Evaluate replacement of Sludge Pump.
WWTP-5	Facility Improvements. This would include upgrades and expansion of the facilities, including the Men's Locker room.
WWTP-6	Variable Frequency Drive Upgrade. Replaces three old drives and installs two new drives
WWTP-7	Upgrade Flow Telemetry Equipment to improve data retrieval accuracy.
WWTP-8	Secondary Clarifier #3 Steel Coating, Weir washer and concrete coating and repair.
WWTP-9	Secondary Clarifier #1 Steel Coating, Weir washer and concrete coating and repair.
WWTP-10	Chlorine Contact Chamber Inspection and Coating.
WWTP-11	Diesel Day Tank. Obsolete day tank.
WWTP-12	Polymer Make up Equipment. Equipment has past its useful life.
WWTP-13	Unanticipated Plant and Operational Improvements and Repairs.
WWTP-14	Screenings Improvements. Evaluate options for better handling of screening materials.
WWTP-15	Belt Filter Press Energy Project. Evaluate the best solids handling options to maximize solids capture and cake.
WWTP-16	Convert 200 HP Blower to Turbo Blower. Energy saving measure.
WWTP-17	Upgrade Heat Pumps in Building 700. Energy saving measure
WWTP-18	Upgrade the Control Valve Actuators on the Effluent Pumps.
WWTP-19	Automatic Flow Shearing Process. Energy Saving measure.
WWTP-20	Recoat Primary Clarifier #1 Steel Equipment and Concrete Repair.
WWTP-21	Chemical Use Area. Improve access to eyewash and maneuverability.

CHAPTER IX – COMPREHENESIVE PLAN AND CAPITAL IMPROVEMENTS

9.1 CAPITAL IMPROVEMENT PROJECTS RANKING

Three major components make up the Capital Improvements Program (CIP), 1) those reoccurring maintenance issues, 2) that infrastructure that has known deficiencies or integrity issues and 3) that infrastructure that needs to be upsized resulting from population growth and the associated increase in flow values. Together these three components comprise the CIP. The City has an extensive and detailed categorization of the entire system.

Each fault/problem was assigned a point value which reflects the City staff's assessment and judgment. The City has three main categories of deficiencies:

a) the Red Area, which are chronic O&M issues that require the frequent and repeated attention of the City O&M Staff. The City has identified line segments that require regular flushing. This flushing schedule prioritizes the severity of the condition by the frequency of flushing. The location of these segments is presented in Appendix F.1 and also included in the I&I Study. Reportedly some problem segments have been removed from the trouble list due to actions implemented by the maintenance staff. The source of many of these problems stem from either low flow or grease accumulations. In the latter case, most of the property owners have been notified of pre-treatment requirements and the City's Fats, Oils and Grease policy.

b) the Granite system. Areas of know deficiencies have been identified through the City's Granite Software. This is a very comprehensive listing of known problems. These problems are categorized using approximately 28 descriptors. These descriptors have been aggregated into issues that are O&M in nature and which generally are individually minor, but collectively may warrant a CIP. The second Granite category are those CIP that could be rectified using trenchless technologies and the last category are those issues that likely would require major construction including digging up and replacement of the line segment.

c) Capacity Issues. With forecasted population and development, the anticipated future flows were applied to the existing piping infrastructure to determine which pipes are currently or, in the future, will be over capacity and surcharging the system.

A comprehensive listing of the Capital Improvement Projects considered all three of these factors. Isolated reports of minor faults or problems generally do not warrant a CIP. However, when several reoccurring maintenance issues are found in a single pipe reach, that segment might become a candidate for replacement or repair. Consequently, all faults/problems have been listed by pipe reach to aggregate the problem areas. The detailed presentation of the individual problems is listed in Appendix F (Tables F.1 – Red Areas; Table F.2 – Granite O&M segments; Table F.3 – Granite Known Deficiencies-Trenchless; Table F.4 – Granite Known Deficiencies-Dig up and Replace).

The assignment of points is summarized in Table 9.1

TABLE 9.1
Point Assignment for Capital Improvement Projects

Category	Red Areas	Granite - O&M	Granite - Trenchless	Granite - Dig up and Replace	Capacity
Grease	5				
Dirt, Grease, Grit	5				
Girt	5				
Black Water	5				
None	0				
Grit, Black Water	5				
Grit (a lot)	6				
N/A	0				
Clean Flume		1			
Brush Sensor		1			
Depressions in Pipe		4			
Problem Laterals - Abandoned		6			
Debris and Deposits		0			
Grease - Medium		0			
Problem Laterals - Connections		5			
Medium Root Problems		2			
Light Root Problems		1			
Roots		1			
Joint Gasket Exposed - Severe		2			
Problem Joint - Offset Medium		2			
Joint Separation - Medium		2			
Joint Separation - Small		1			
Joint Separation		1			
Crack			5		
Heavy Root Problem			3		
Hole in Pipe - Medium			9		
Hole in Pipe - Small			8		
Hole in Pipe			8		
Joint Separated - Large			3		
Infiltration in Joint			5		
Deformed				7	
Broken				4	
Broken Hole				4	
Pipe Repair				10	
Hole in Pipe - Large				10	
Joint Offset - Large				3	
Capacity - Model					10
Known Surcharging Pipe Segments					20

These point assignments were made to each fault/problem and then summed by pipe segment. Ranking of the most severe segments were done both including and excluding the 'Granite-O&M' problems. Both rankings are listed in Appendix F (Table F.6 – All categories and Table F.7 – without Granite O&M). The pipe segment ranking presented in Table 9.2 represents the ranking without the 'Granite-O&M' components. This table identifies only the top ranked projects that are expected to be funded in the 6-year funding window. The ranking of all projects is presented in Table F.7. It was felt that this ranking best reflects the problems that can be resolved by a CIP project. The exclusion of the 'Granite-O&M' problems were viewed to be reoccurring maintenance issues such as flushing and root cutting and were viewed as maintenance issues that are not easily solved with a CIP. Those areas will require continued vigilance and follow up to intercept fats, oils and grease before they enter the City's system. Those problems noted to have 'low flow' are typically associated with new developments that have not completely built out. With time, these problems may resolve themselves without a CIP.

In addition, there were other Granite descriptors that were entries which were unassociated with any deficiency. These codings included camera out of water, cleanout, continue against flow, continue with flow, continue TV after jetting, end of pipe, end of push camera, end of run, infiltration, inside drop, lateral, outside drop, pipe continue, pipe diameter change, pipe direction change, pipe type, start against flow, start with flow, status, stop, and TV from other end.

9.2 CAPACITY LIMITATIONS IN EXISTING LINES

Based on the future estimated population growth presented in Chapter 6 and the flow projections and modeling results found in Chapter 7, certain deficiencies were anticipated in the collection and conveyance system. The population projections and corresponding flow projections were based on four time periods: 2013 (current), 2019, 2033 and build out. The CIP is presented in three time periods: 2013 to 2019, 2019 to 2033 and lastly 2033 to build out. The identification of the capacity issues for each of these three periods is presented in Table F.5 (Appendix F).

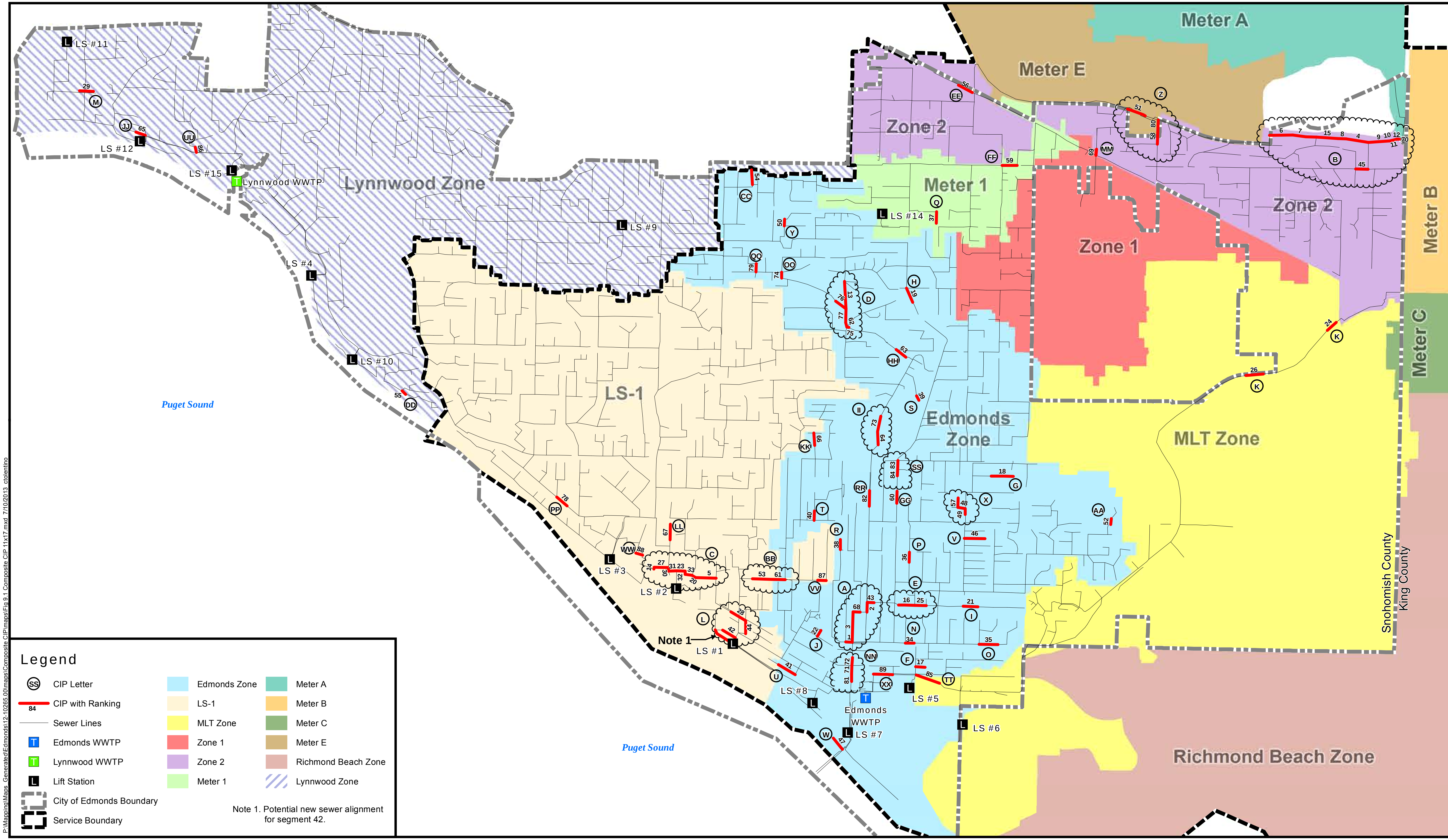
The line capacity issues together with the other known and scheduled projects and are ranked on Table 9.2 and presented on Figure 9.1. These ranked projects total $10,244,475 to be spread over the five years between 2015 and 2019 or about $2,000,000 per year. From this pool of projects the City can prioritize, select and coordinate with other City projects. In addition to these identified projects, Table F.7 (Appendix F) has a long list of other projects, with lower rankings, from which the City could choose.

The more distant CIPs, such as those shown for 2019 to 2033 and 2033 to build out, are based on extended population and flow forecasts and will tend to be less precise. None-the-less, they are presented for informational purposes and as an indicator of future potential capacity issues while providing the level of service in Chapter 4.

Table 9.2
Ranking and Composite Capital Improvement Projects - Without Granite O&M Only

CIP Letter	Segment and Ranking Number	Reason	Manhole #	Distance of Run (ft)	Comments	Table	Ranking and Point Assignment: Red Area	Granite - Trenchess	Granite - Dig up and Replace	Capacity - Model	Observed Surcharged Conditions	TOTAL	Granite O&M	Cost Estimate (see Appendix E)
	Coll -1	Multiple Defects	8-75-8-57	144			0	38	0	0		38	0	
	Coll -2	Multiple Defects	8-50-8-52	213	Increase 10" to 12"	F.5	0	15	8	10		33	34	
A	Coll -68	Multiple Defects	8-59-8-58	148			0	10	0	0		10	5	$ 309,842
	Coll -43	Multiple Defects	8-51-8-50	150	Increase 10" to 12"	F.5	0	5	0	10		15	4	
	Coll -3	Multiple Defects	8-58-8-57	657			0	30	0	0		30	176	
	Coll -4	Multiple Defects	17-61-17-84	484	Increase 24" to 36"	F.5	0	0	0	10	20	30	28	
	Coll -6	Multiple Defects	17-47-17-48	500	Increase 24" to 36"	F.1 and F.5	0	0	0	10	20	30	4	
	Coll -7	Multiple Defects	17-48-17-59	506	Increase 24" to 36"	F.1 and F.5	0	0	0	10	20	30	4	
	Coll -8	Multiple Defects	17-60-17-61	179	Increase 24" to 36"	F.1 and F.5	0	0	0	10	20	30	4	
B	Coll -9	Multiple Defects	17-84-17-85	457	Increase 24" to 36"	F.1 and F.5	0	0	0	10	20	30	4	
	Coll -10	Multiple Defects	17-85-17-86	111	Increase 24" to 36"	F.1 and F.5	0	0	0	10	20	30	4	$ 2,113,193
	Coll -11	Multiple Defects	17-86-17-87	43	Increase 24" to 36"	F.1 and F.5	0	0	0	10	20	30	4	
	Coll -12	Multiple Defects	17-87-17-88	35	Increase 24" to 36"	F.1 and F.5	0	0	0	10	20	30	4	
	Coll -15	Capacity - Model	17-59-17-60	463	Increase 24" to 36"	F.5	0	0	0	10	20	30		
	Coll -45	Multiple Defects	17-78-17-82	266	Longitudinal - Wider (8" - 12")	F.2 and F.5	0	5	0	10		15	0	
	Coll -70	Multiple Defects	17-88-17-89	19	Increase 24" to 36"	F.1 and F.5	0	0	0	10		10	4	
	Coll -5	Multiple Defects	8-265-8-266	438	Increase 15" to 21"	F.5	0	0	0	10	20	30	6	
	Coll -14	Multiple Defects	8-244-8-243	305	Increase 10" to 12"	F.5	0	0	0	10	20	30	3	
	Coll -20	Multiple Defects	8-249-8-265	98			0	3	0	0	20	23	1	
	Coll -23	Roots	8-246-8-247	180		F.1	0	0	0	0	20	20	1	
C	Coll -27	Multiple Defects	8-243-8-242	305	Increase 10" to 12"	F.5	0	10	0	10		20	0	$ 736,038
	Coll -30	Observed Surcharge	8-242-8-245	78							20	20		
	Coll -31	Observed Surcharge	8-245-8-246	173							20	20		
	Coll -32	Observed Surcharge	8-247-8-248	71							20	20		
	Coll -33	Observed Surcharge	8-248-8-249	147							20	20		
	Coll -13	Multiple Defects	9-224-9-202	591	Increase 8" to 15"	F.5	10	10	0	10		30	4	
	Coll -62	Multiple Defects	9-20-9-19	268	Increase 10" to 15"		0	0	0	10		10	8	
D	Coll -75	Multiple Defects	9-19-9-18	50	Increase 10" to 15"	F.1 and F.5	0	0	0	10		10	4	$ 547,117
	Coll -76	Multiple Defects	9-201-9-202	280	Increase 10" to 15"	F.1 and F.5	0	0	0	10		10	4	
	Coll -77	Multiple Defects	9-202-9-20	299	Increase 10" to 15"	F.1 and F.5	0	0	0	10		10	4	
E	Coll -16	Multiple Defects	12-75-8-14	349			0	0	28	0		28	0	$ 355,687
	Coll -25	Multiple Defects	12-73-12-75	247	Increase 8 to 12"	F.3 and F.5	0	0	10	10		20	0	
F	Coll -17	Multiple Defects	11-8-11-7	207			0	26	0	0		26	12	$ 44,693
G	Coll -18	Multiple Defects	12-143-12-142	475			0	25	0	0		25	5	$ 104,450
H	Coll -19	Multiple Defects	13-53-9-212	325			0	25	0	0		25	4	$ 43,802
I	Coll -21	Multiple Defects	12-109-12-110	319			0	20	0	0		20	5	$ 29,193
J	Coll -22	Multiple Defects	8-332-8-331	144			0	20	0	0		20	5	$ 23,531
K	Coll -24	Multiple Defects	16-128-16-129	252	Increase 24" to 36"	F.3	0	0	10	10		20	0	$ 620,525
	Coll -26	Multiple Defects	16-133-16-134	379	Increase 24" to 36"	F.3 and F.5	0	0	10	10		20	0	
	Coll -28	Multiple Defects	8-280-8-281	371	Increase 15" to 21"	F.5	0	10	0	10		20	0	
L	Coll -42	Multiple Defects	8-285-8-284	319			0	15	0	0		15	5	$ 506,839
	Coll -44	Multiple Defects	8-281-8-282	281	Increase 15" to 21"	F.5	0	5	0	10		15	1	
M	Coll -29	Multiple Defects	1-55-1-52	297			0	0	20	0		20	0	$ 149,270
N	Coll -34	Multiple Defects	12-84A-12-83	189			0	5	14	0		19	10	$ 92,363
O	Coll -35	Multiple Defects	12-101-12-95	406			0	5	14	0		19	2	$ 206,654
P	Coll -36	Multiple Defects	12-49-12-50	220			0	8	10	0		18	0	$ 122,160
Q	Coll -37	Multiple Defects	13-22-13-22A	247			0	18	0	0		18	0	$ 37,898
R	Coll -38	Multiple Defects	8-68B-8-68	217			0	17	0	0		17	2	$ 48,491
S	Coll -39	Multiple Defects	12N-79-13-65B	109			0	3	14	0		17	0	$ 63,942
T	Coll -40	Multiple Defects	8-107-8-106	201			0	10	6	0		16	6	$ 115,289

	Table 9.2 Ranking and Composite Capital Improvement Projects - Without Granite O&M Only						Ranking and Point Assignment							
CIP Letter	Segment and Ranking Number	Reason	Manhole #	Distance of Run (ft)	Comments	Table	Red Area	Granite - Trenches	Granite - Dig up and Replace	Capacity - Model	Observed Surcharged Conditions	TOTAL	Granite O&M	Cost Estimate (see Appendix E)
U	Coll -41	Multiple Defects	7-79-7-80	419			0	15	0	0		15	30	$ 158,717
V	Coll -46	Multiple Defects	12-126-12-125	443			0	15	0	0		15	0	$ 170,957
W	Coll -47	Multiple Defects	7-9-7-10	304			0	14	0	0		14	15	$ 115,879
	Coll -48	Multiple Defects	12-134-12-132	159			0	14	0	0		14	2	
X	Coll -49	Multiple Defects	12-132-12-131	129			0	14	0	0		14	0	$ 127,173
	Coll -57	Multiple Defects	12-133-12-134	197			0	0	10	0		10	16	
Y	Coll -50	Multiple Defects	9-299-9-298	145			0	3	10	0		13	6	$ 39,790
	Coll -51	Multiple Defects	14-56-14-62	406	Increase 12" to 18"	F.5	0	3	0	10		13	2	
Z	Coll -58	Multiple Defects	14-66-14-65	348			0	10	0	0		10	16	$ 189,931
	Coll -80	Multiple Defects	14-65-14-64	175			0	0	10	0		10	4	
AA	Coll -52	Multiple Defects	12-248-12-247	128			0	13	0	0		13	0	$ 23,239
BB	Coll -53	Multiple Defects	8-136-8-137	401			0	12	0	0		12	14	$ 48,578
	Coll -61	Multiple Defects	8-135-8-316	96			5	5	0	0		10	9	
CC	Coll -54	Multiple Defects	9-363A-9-363	318			0	12	0	0		12	8	$ 38,492
DD	Coll -55	Multiple Defects	14-3-14-3A	105			0	9	3	0		12	0	$ 27,890
EE	Coll -56	Multiple Defects	2-113A-2-113	336			0	11	0	0		11	1	$ 52,922
FF	Coll -59	Multiple Defects	14-34-14-33	328	Increase 10" to 12"	F.5	0	0	0	10		10	13	$ 108,920
GG	Coll -60	Multiple Defects	8-4-8-5	262	Increase 8" to 12"	F.5	0	0	0	10		10	12	$ 154,225
HH	Coll -63	Multiple Defects	9-11-9-10	268	Increase 10" to 15"	F.5	0	0	0	10		10	6	$ 160,101
II	Coll -64	Multiple Defects	8-35-8-36	287	Increase 10" to 15"	F.1 and F.5	0	0	0	10		10	5	$ 290,138
	Coll -73	Multiple Defects	8-34-8-35	334	Increase 10" to 15"	F.1 and F.5	0	0	0	10		10	4	
JJ	Coll -65	Multiple Defects	1-36A-1-36	214			0	0	10	0		10	5	$ 109,761
KK	Coll -66	Multiple Defects	8-114-8-113	269			0	0	10	0		10	5	$ 137,041
LL	Coll -67	Multiple Defects	8-240-8-239	336			0	10	0	0		10	5	$ 43,021
MM	Coll -69	Multiple Defects	14-48-14-50	130	Increase 10" to 15"	F.1 and F.5	0	0	0	10		10	4	$ 114,781
	Coll -71	Multiple Defects	7-47-7-50	187	Increase 12" to 18"	F.1 and F.5	0	0	0	10		10	4	
NN	Coll -72	Multiple Defects	7-48-7-47	166	Increase 12" to 18"	F.1 and F.5	0	0	0	10		10	4	$ 330,952
	Coll -81	Multiple Defects	7-50-7-52	159			0	10	0	0		10	4	
OO	Coll -74	Multiple Defects	9-193-9-196	128	Increase 10" to 15"	F.1 and F.5	0	0	0	10		10	4	$ 38,164
PP	Coll -78	Multiple Defects	4-163-4-162	295	Increase 10" to 12"	F.5	0	0	0	10		10	4	$ 109,250
QQ	Coll -79	Multiple Defects	9-188-9-189	174	Increase 8" to 12"	F.5	0	0	0	10		10	4	$ 53,872
RR	Coll -82	Multiple Defects	8-41-8-42	332	Increase 8" to 15"	F.5	0	0	0	10		10	3	$ 222,590
SS	Coll -83	Multiple Defects	8-2-8-2A	197	Increase 8" to 12"	F.5	0	0	0	10		10	2	$ 190,375
	Coll -84	Multiple Defects	8-2A-8-3	134	Increase 8" to 12"	F.5	0	0	0	10		10	2	
TT	Coll -85	Multiple Defects	11-19-11-18	526	Increase from 24 to 42	F.5	0	0	0	10		10	1	$ 362,003
UU	Coll -86	Multiple Defects	3-12F-3-12E	116			0	0	10	0		10	1	$ 56,142
VV	Coll -87	Multiple Defects	8-97-8-98	186			0	10	0	0		10	1	$ 20,920
WW	Coll -88	Multiple Defects	4-83-4-82	150	Increase 10" to 12"	F.1 and F.5	0	0	0	10		10	0	$ 49,610
XX	Coll -89	Multiple Defects	7-33-7-32	441	Increase 30" to 42"	F.1 and F.5	0	0	0	10		10	0	$ 428,064
TOTAL														$ 10,244,475



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Capacity Limited Pipes: Aqualyze Inc., June 2013
Sewer Zones: City of Edmonds, December 2011
GIS Data: City of Edmonds, Snohomish County & King County.
Data sources supplied may not reflect current or actual conditions. This map is a geographic representation based on information available. It does not represent survey data. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map.

NORTH

0 1,000 2,000 4,000 Feet

Scale in Feet

COMPOSITE CIP

COMPREHENSIVE SEWER PLAN

City of Edmonds
July 2013

Figure
9.1

9.3 BASIS FOR CIP COSTS ESTIMATES

Construction cost estimates were prepared for most of the CIP projects listed in Table 9.3. Documentation for these estimates can be found in Appendix E. Those projects that do not have supporting cost estimates are based on actual bid amounts or detailed cost estimating done during the design phases. Certain assumption needed to be made in terms of quantities and unit prices. Those assumptions are presented below.

Several unit price items were used to determine the cost estimates. Quantities were estimated for each item and unit prices were estimated from recent bid results. An estimated construction cost was developed for each project including contingencies and sales tax. Total project costs were then estimated for each improvement. All costs are 2013 dollars and summarized on Table 9.3.

CONSTRUCTION ESTIMATES-ASSUMPTIONS

- 10% of the construction costs are Mobilization.
- Traffic control at $5/LF of mainline sewer.
- Trench dewatering estimated at $5/LF.
- Sheeting, shoring and bracing estimated at $5/LF.
- Saw cutting along both sides of the trench estimated to be required for the entire length of the mainline sewer.
- Pavement removal is limited to a trench width of 60 inches, plus an allowance of 12 inches on both sides of the trench, for a total width of 84 inches.
- Temporary sewer bypass estimated to be $5/LF for all cut and cover installations.
- Import trench backfill is estimated based on the assumption that 50% of all excavation will require imported material. Maximum width is 60 inches and an average depth of 8 feet.
- Crushed surfacing, base course is assumed to be 8 inches deep and a maximum pay width of 84 inches.

TABLE 9.3 Capital Improvements Projects										
Sub-Basin	Description	CIP No.	2013 - 2019 (2013 Dollars)							
			2013	2014	2015	2016	2017	2018	2019	2012 - 2019 Total
Collection System (See Appendix E for Cost Estimates)										
	2012 Sewer Replacement / Rehab Improvements		$350,000	$849,029						$1,199,029
	2013 Sewer Replacement / Rehab Improvements		$120,000	$1,807,767						$1,927,767
	2014 Sewer Replacement / Rehab Improvements			$191,262						$191,262
	City-wide Sewer Improvements			$33,981						$33,981
	City-wide CIPP Sewer Rehabilitation		$302,600	$436,893						$739,493
	Meter Installation Basin LS-01		$72,600							$72,600
	Meter Installations Basin Edmonds Zone			$19,417						$19,417
	Smoke Test in Basin LS-01		$75,000							$75,000
	Comprehensive Sewer Plan		$99,100							$99,100
	2015 Sewer Replacement / Rehab Improvements				$2,000,000					$2,000,000
	2016 Sewer Replacement / Rehab Improvements					$2,000,000				$2,000,000
	2017 Sewer Replacement / Rehab Improvements						$2,000,000			$2,000,000
	2018 Sewer Replacement / Rehab Improvements							$2,000,000		$2,000,000
	2019 Sewer Replacement / Rehab Improvements								$2,000,000	$2,000,000
	Collection System Subtotal		**$1,019,300**	**$3,338,349**	**$2,000,000**	**$2,000,000**	**$2,000,000**	**$2,000,000**	**$2,000,000**	$14,357,649
PUMP STATIONS										
	Pump Station Rehabilitation (PS #3, 4, 5, 9, 10, 11, 12, 14, 15)		$4,822,810							$4,822,810
	Pump Station Subtotal		**$4,822,810**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$4,822,810**
Edmond WWTP										
	Switchgear Upgrade	WWTP-1	$1,297,724							$1,297,724
	Incinerator Testing and Compliance	WWTP-2	$100,000	$90,000	$850,000					$1,040,000
	Control System Upgrades	WWTP-3	$67,469	$250,000	$80,000	$80,000	$80,000	$80,000		$637,469
	Ameresco Energy Project	WWTP-4	$15,000							$15,000
	Facility Improvement	WWTP-5	$350,000							$350,000
	Variable Frequency Drive upgrade	WWTP-6	$25,000							$25,000
	Upgrade Flow Telemetry Equipment	WWTP-7	$15,000	$10,000						$25,000
	Secondary Clarifier #3 Steel Coating, weir washer, concrete	WWTP-8		$175,000						$175,000
	Secondary Clarifier #1 Steel Coating, weir washer, concrete	WWTP-9				$125,000				$125,000
	Chlorine Contact Chamber Inspection and Coating	WWTP-10		$250,000		$250,000				$500,000
	Diesel Day Tank	WWTP-11		$6,000						$6,000
	Polymer Make Up Equipment	WWTP-12		$80,000						$80,000
	Unanticipated Plant and Operational Improvements/Repairs	WWTP-13		$50,000	$50,000	$50,000	$425,000	$750,000	$750,000	$2,075,000
	Screenings Improvements	WWTP-14		$20,000					$100,000	$120,000
	Belt Filter Press Energy Project	WWTP-15		$50,000	$20,000	$500,000				$570,000

TABLE 9.3 Capital Improvements Projects											
Sub-Basin	Description	CIP No.	2013 - 2019 (2013 Dollars)								
			2013	2014	2015	2016	2017	2018	2019	2012 - 2019 Total
	Convert 200 HP blower to Turbo Blower	WWTP-16					$350,000			$350,000
	Upgrade Heat Pumps in Building 700	WWTP-17					$50,000			$50,000
	Ugrade Control Valve Actuators on Effluent Pumps	WWTP-18					$35,000			$35,000
	Automatic Flow Shearing Process	WWTP-19					$35,000			$35,000
	Recoat Primary Clarifier #1 Steel Equipment/Concrete Repair	WWTP-20						$100,000		$100,000
	Chemical Use Area	WWTP-21							$125,000	$125,000
	Unspent Funds from 2012		$40,511							$40,511
	Subtotal EDMONDS WWTP		**$1,910,704**	**$981,000**	**$1,000,000**	**$1,005,000**	**$975,000**	**$930,000**	**$975,000**	**$7,776,704**
TOTAL COST			**$7,752,814**	**$4,319,349**	**$3,000,000**	**$3,005,000**	**$2,975,000**	**$2,930,000**	**$2,975,000**	**$26,957,163**

- Crushed surfacing, top course is assumed to be 4 inches deep and a maximum pay width of 84 inches.
- HMA is based on a maximum thickness of 3 inches applied over a width of 20 feet (1/2 road) for the entire length of all mainline sewers.
- Restoration is based on 5% of the construction subtotal.
- Cleanup and testing is based on 5% of the construction subtotal.
- Manholes - It is assumed that the terminal manholes will be salvaged and only the intermediate manholes will be replaced or modified.
- Lift station rehabilitation assumes that no excavation will be necessary and that the needed increase in the capacity can be accomplished with pump and motor changes, and electrical revisions.

ALLIED AND OTHER COSTS – ASSUMPTIONS

- 40% contingency to address pre-design level of cost estimating.
- 9.0% State Sales Tax.
- 12% of the estimated construction cost is for engineering design, survey, geotechnical investigation and permits.
- 7% of the estimated construction cost is for construction services.
- 2% of the estimated construction cost is for District Administration.
- 1 % of the estimated construction cost is for legal.

9.4 WASTEWATER REUSE

RCW 90.48.112 requires consideration of reclaimed water in wastewater plans. Although the law does not specifically require implementation of a reclaimed water alternative, it strongly encourages it. RCW 90.46.005 states in part that to the extent that reclaimed water is appropriate for beneficial uses, it should be so used to preserve potable water for drinking purposes.

9.4.1 Regulatory Requirements

Beneficial use of reclaimed water for irrigation of crops, supplemental stream or wetland flow enhancement, groundwater recharge, toilet and urinal flushing, etc. requires treatment to reclamation and reuse standards, which are more stringent than the conventional secondary standards required for surface water disposal using an outfall. The added treatment facilities required include effluent coagulation, filtration, additional disinfection and more treatment facility redundancy and reliability requirements.

The use of reclaimed water is permitted in the State of Washington, and is jointly regulated by the State Departments of Health (Division of Drinking Water); and Department of Ecology. The "*State of Washington Reclamation and Reuse Standards*", September, 1997 (Publication #97-23) provides the guidance for acceptable reclaimed water treatment and use. Under all reuse options, the proposal must demonstrate the beneficial uses being made of the reclaimed water. Membrane Bio-reactors (MBRs) are not specifically mentioned in this publication, though it has generally and widely been adopted as an acceptable treatment process meeting reuse standards.

The State Reclamation Standards define four levels of treatment required depending on the final use of the reclaimed water. Class A reclaimed water is the highest quality and can be utilized for any of the permitted uses. In addition to conventional secondary activated sludge treatment (oxidation and sedimentation), Class A reclaimed water requires coagulation, filtration, and disinfection to less than 2.2 total coliform per 100 ml, which is a very stringent disinfection standard. The MBR treatment process (with disinfection) will also produce Class A reclaimed water (with added disinfection), because the coagulation occurs within the activated sludge process itself and filtration is provided through the fine pore membranes.

Classes B, C, and D reclaimed water do not require filtration, and Class C and D have less stringent disinfection requirements. Use of these classes is generally restricted to irrigation of non-food crops (such as forest land) with restricted public exposure.

Because the most logical uses of this reclaimed water involve irrigation of golf courses and public parks, which are subject to human exposure, treatment to Class A reclaimed water standards is recommended.

In addition, the reclaimed water must be reliably generated. Emergency storage or alternative discharge options must be provided for upset conditions. Excess flow will continue to be discharged to Puget Sound.

The standards also require automatic alarms, treatment unit redundancy, and qualified operations staffing.

9.4.2 Potential Uses and Demand

While reuse of reclaimed wastewater treatment plant effluent is becoming more and more common, the demand for year-round reclaimed effluent in the Pacific Northwest is very limited, particularly in a suburban setting. Nevertheless, the City has made accommodations for use of reclaimed water at the WWTP.

In assessing the potential use of Class A reclaimed water, sites were identified for irrigation and/or industrial, commercial and public use. Irrigation can include parks, commercial nurseries, golf courses, and cemeteries. Industrial uses of reclaimed water can include boiler feed, cooling, process water, sewer flushing, and processing plant wash down. There were no industrial sites identified in the City's service area. Thus, the main uses of reclaimed water from the WWTP would be irrigation of open access areas.

This analysis looked at the top 25 water consumers in the City. Their water usage for the winter months of November through February was compared to the annual average water usage. If these top water users had significant irrigational uses, the difference would be evident when comparing these values. Oddly, only a handful of users exhibited increased irrigational demands of the City's domestic water supply. The most significant users were Swedish Hospital, the City of Lynnwood and 99 Ranch Market. These users actually reported either no increase in irrigational needs or a reduction in summertime uses. Consequently the volume of irrigational demands within a three mile radius of the plant is relatively small as presented in Table 9.4.

TABLE 9.4
Wastewater Reuse Demand

User	Average Annual Water Consumption 2007 -2011 (CCF)	Average Winter (Nov thru Feb) Water Usage, 2007 - 2011 (CCF)	Average Non-Winter usage (Mar - Oct), 2007 - 2011 (CCF)	Average Monthly Winter Water Usage (CCF)	Average Monthly Non-Winter Water Usage (CCF)	Estimated Irrigational Monthly Demand (CCF)
Highland Park Condominiums	4,782	1,253	3,529	313	441	128
Tops Foods	7,459	1,945	5,514	486	689	203
Edmonds School (1)	5,491	1,450	4,041	363	505	143
Park Ballinger Apartments	4,557	1,495	3,062	374	383	9
TOTAL						483

Note 1. The Edmonds School values are likely skewed since the schools are largely unused during the summer months

9.4.3 Reclaimed Water Treatment Facilities at WWTP

Effluent Quality

The effluent produced by the City's WWTP would likely require an effluent filter added to the last stage of a secondary treatment process to meet the Class C reclaimed water standard. This system could potentially be designed within the space constraints at the WWTP.

It is assumed that the reclaimed water will be pumped to off-site irrigation users, and that no on-site storage will be provided.

9.4.4 Reclaimed Water Conveyance and Distribution

Conveyance Alternatives
Conveyance of reclaimed water by pumping is the only logical and practical conveyance method.

Truck hauling could be considered for other general uses, such as sewer flushing, street washing, dust control, roadside planter watering, etc. But this expected volume of usage is likely to be very small.

Conveyance and Distribution Facilities
The conveyance of reclaimed water from the WWTP would require a pump station and 27,200 feet of 4” diameter force main.

9.4.5 Economic Analysis of Reuse

A present worth factor of 12.46 based on 5% interest rate and 20-year project life is used for economic analysis.

Estimated Capital Cost of Treatment and Conveyance

Site work	$100,000
Reclaimed water booster station	400,000
Conveyance	900,000
Distribution	350,000
Subtotal	$1,750,000
Contingencies @ 40%	700,000
Subtotal	$2,450,000
State Sales Tax @ 9.0%	220,000
Total Construction	$2,670,000
Engineering @ 12%	$320,000
Construction Management @ 7%	190,000
City Administration @ 2%	53,000
Legal @ 1%	27,000
Total Capital	$3,260,000
Amortized Annual Capital Cost	$262,000

Estimated Annual O&M Cost of Treatment and Conveyance

Treatment & Conveyance	
Chemicals	$6,000
Electricity	1,000
Equipment maintenance and replacement	12,000
Labor	40,000
Total Annual O&M Cost	$59,000

Total Annual Cost	**$321,000**

Based on an average monthly usage of 483 CCF or a total of about 2,898 CCF during a six month period during the year. At $2.30/ccf, the annual of cost of water is only $6,700. The cost of conveying reclaimed water for irrigational uses does not financially make sense.

CHAPTER X – OPERATIONS AND MAINTENANCE PROGRAM

10.1 CITY MANAGEMENT AND PERSONNEL

The City's Public Works & Utilities Department is composed of approximately 75 full time positions that are organized into seven distinct divisions. The division heads report to the Public Works Director who is responsible for the overall management of the Department.

10.1.1 Organization

Two divisions of the Public Works & Utilities Department have specific functions that are vital to the inner workings and function of the wastewater utility. These divisions work independently, yet cooperatively, in a symbiotic relationship with one another.

The City's sewer collection system is under the general management of Jim Waite. The City's wastewater treatment plant is under the general management of Pamela Randolph. Additional employees of the Public Works & Utilities Department within the Engineering Division and Administration Division which provide tertiary support to the Sewer Section of the Water/Sewer Division and Wastewater Treatment Plant Division are not accounted for in the above employment numbers.

10.1.2 Certification and Training

The City encourages its employees to obtain certification and training for skills relevant to operating and maintaining the sewer system. All staff must, at a minimum, have the following:

- A high school diploma or GED.
- A driver's license.

In addition, the City provides employees with opportunities for training and certification relative to their position function. Each staff member annually receives some training. Depending on the employee's function, training may include safety, confined space entry, record keeping, pump station electrical and instrumentation, pump station operation, public relations, vactor truck operations and emergency response. Training is provided in varying mixes of the following categories:

- Manufacturer training by various equipment suppliers and representatives.
- On-the-job training in the field, the shop, or in the office.
- In-house class room training.

- Industry-wide training at conferences and seminars away from the City.

To promote the improvement of its employees, the City may elect to pay for annual certification fees, employee time and tuition during certification training courses and provides time off for certification testing. The City also provides staff opportunities to receive the continuing education necessary to maintain certification. Professional growth requirements for certification are met through continuing education units (CEU).

10.2 OPERATIONS AND MAINTENANCE ACTIVITIES AND PROGRAMS

This section presents the operations and maintenance activities, including preventive and corrective routines, procedures and wastewater related programs.

10.2.1 Collection System Maintenance

10.2.1.1 Lift Stations

The City has a two-person crew that is dedicated to lift station maintenance and incident response. This crew visits every lift station a minimum of once per week. Those stations that are older or that have a tendency to be a source of problems are visited more frequently.

The emergency generators are exercised a minimum of once per month. That frequency increases to twice per month during the winter months. Typically the generators are exercised for a 1 to 2 hour period.

Approximately half of the wet wells are washed down every month. These wet wells are those that have a high incident of grease accumulation. The remaining wet wells are washed down on a bi-monthly frequency.

10.2.1.2 Sanitary Sewers

The City's staff has established a plan to conduct regular internal inspection (closed circuit televising) of 680,000 linear feet of pipeline. The established schedule is to complete about 33% each year. The digital records of these inspections are reviewed by the technicians and any segment that is identified as needing repair, sliplining or replacement is noted. Similarly, those segments that are structurally sound, but in need of routine attention are also tracked and, if warranted, added to the 'frequent flushing' list. Those lines that have deficiencies are logged and tracked on Granite, the City's O&M tracking software.

The lines that have been previously identified as needing routine maintenance and flushing are identified in Appendix F.

The staff is also alert to the potential of odor concerns, though odor complaints in the collection system are extremely rare.

The crews will also hydraulically jet the lines at the time of internal inspections if needed. Additionally, there are designated areas that are chronic maintenance problems that are more frequently cleaned. In some cases, the cleaning is conducted as often as every three months.

10.2.2 WWTP Operations and Maintenance

The program maintenance protocol currently being used at the WWTPs consists of a system that tracks historical preventative maintenance measures for each piece of equipment. This system is the backbone of scheduling all preventative maintenance. All routine preventative maintenance like oil changes, lubrication and exercising of infrequently used equipment and corrective maintenance performed are chronicled on this record.

The plant staff does most of the repairs and rebuilds with in-house personnel. More complex tasks such as motor rewinding, electrical or instrumentation modifications are out sourced to a third party.

Critical equipment that could affect effluent quality has redundant and backup equipment ‘on-the-shelf’. This redundancy allows the City to respond to equipment failures without effluent violations. With the backup equipment available the City currently does not routinely replace old equipment until such time as the maintenance efforts become burdensome and replacement is the prudent decision.

10.3 PROGRAMS

10.3.1 Pretreatment Program

The City, through Ordinance No. 3401, established pretreatment requirements for all non-residential dischargers into the City’s system (see Appendix H). These standards include a general prohibition that disallows any discharge that would result in a pass through or interference with the Public Owned Treatment Works. The intent of this ordinance is to:

1. Prevent the introduction of pollutants into the POTW which will pass through the POTW inadequately treated, into the receiving waters or otherwise be incompatible with the POTW
2. Ensure that the quality of the POTW sludge is maintained at a level which allows its use and disposal in compliance with the applicable statues and regulations.
3. Protect the POTW personnel who may be affected by wastewater and sludge in the course of their employment and to protect the general public
4. Improve the opportunity to recycle and reclaim wastewater and biosolids from the POTW
5. Promote strategies that reduce the amounts of pollution generated by users, thereby reducing the associated hazards to the POTW and receiving waters.

This policy also contains a specific and detailed description of the prohibited substances. The following is a general summary of some, but not all, of those specific prohibitions:

- Any substance that is considered explosive and/or has a flashpoint of less than 140 degrees Fahrenheit.
- Any substance that may cause an obstruction to the flow in a sewer or at the plant. This includes garbage with particles greater than one-quarter inch (1/4"), waste from industrial processes including sludges, screenings, and pretreatment residues, animal guts or tissues, paunch manure, bones, hair, hides or fleshings, entrails, whole blood, feathers, ashes, cinders, sand, earth, gravel, coal, rubbish, spent lime stone or marble dust, metal, glass, straw, shavings, grass clippings, rags, spent grains, spent hops, waste paper, wood, plastics, gas, tar, asphalt residues, residues from refining, or processing of fuel or lubrication oil, mud, or glass grinding or polishing wastes.
- Any wastewater generally having a pH less than 5.0 or greater than 11.0
- Any wastewater containing petroleum oil, non-biodegradeable cutting oil or product or mineral oil origin
- Any noxious or malodorous substance
- Any substance that may result in toxic gases, vapors or fumes.
- Medical wastes
- Trucked or hauled pollutants (including Septage)
- Any sludges, screenings or other residues from pre-treatment wastes
- Substances that might result in biosolids to be unsuitable for reclamation
- Substances containing color such as stains, dyes, and paints
- Wastewater that is greater than 104 degrees Fahrenheit.
- Any amount of unpolluted water including non-contact cooling water, stormwater, and other indirect inflow sources.
- Wastewater causing effluent toxicity in an analytical test
- Wastewater containing radioactive wastes.
- Detergents and other substances that may cause foaming
- Any substance that may cause fire or explosion
- Any substance that would result in a violation of the City's NPDES permit.
- Any substance that may harm the sewer system or treatment equipment
- Any hazardous or dangerous waste as defined by WAC 173-303
- Persistent pesticides
- Slug loadings
- Fats, Oils and Greases interfering with the operation of the plant
- Metal concentrations must not exceed
  - Arsenic 0.36 mg/l
  - Cadmium 0.27 mg/l
  - Chromium 1.99 mg/l
  - Copper 2.98mg/l
  - Cyanide 0.29 mg/l
  - Lead 1.09 mg/l
  - Mercury 0.07 mg/l

  - o Nickel 2.14 mg/l
  - o Silver 1.44 mg/l
  - o Zinc 5.13 mg/l
  - o Non-polar FOGs 100 mg/l
- High strength dischargers of BOD, TSS and FOG are obligated to have special provisions that might restrict their rate of discharge or have specific pretreatment requirements.

The City's pretreatment resolution also defines the requirements for sizing and maintaining the grease traps and/or interceptors.

Failure to comply with the limitations and prohibitions presented above may result in the issuance of a Corrective Order and, if the directive of the corrective order is not followed, fines may be imposed on the violator.

10.3.2 Water Reclamation and Reuse

The current plant uses chlorinated effluent for wash down purposes within the plant. No offsite use is currently allowed. The plant does not meter wash down water, so the volume of reuse water is not known.

10.3.3 Biosolids Recycling

All biosolids generated at the plants are incinerated onsite. The ash is transported to the local transfer station which is then hauled to the landfill.

10.3.4 Sewage Spill Response Plan

Emergency response to reported sewage spills in the collection system are forwarded to the Water/Sewer Division. During non-business hours, the City has a rotating assignment among the staff to be on-call to respond to incidents 24 hours a day, 7 days per week.

Protection against accidental discharges of pollutants to the WWTP may prompt the director to require the violators to implement spill plans to prevent future discharges. When such plans are required by the director, they shall contain at least the following elements:

1. Description of discharge practices, including non-routine batch discharges;
2. Description of stored chemicals;
3. Procedures for immediately notifying the POTW of any accidental or slug discharge. Such notification must also be given for any discharge which would violate any of the standards in ECC 7.91.010 through 7.91.040; and
4. Procedures to prevent adverse impact from any accidental or slug discharge. Such procedures include, but are not limited to, inspection and maintenance of storage areas, handling and transfer of materials, loading and unloading

operations, control of plant site runoff, worker training, building of containment structures or equipment, measures for containing toxic organic pollutants (including solvents), and/or measures and equipment for emergency response.

Any discharger is obligated to notify the WWTP immediately upon the occurrence of a slug load or "accidental discharge" of substances regulated by Chapters 7.90 through 7.102 ECC. The notification shall include location of discharge, date and time thereof, type of waste, concentration and volume, and corrective actions.

Within seven days following an accidental discharge, the user is obligated to submit a detailed written report describing the cause of the discharge and the measures to be taken by the user to prevent similar future occurrences.

The City has a reporting protocol that includes informing the Department of Ecology within the next business day of the event.

10.3.5 CMOM

The EPA has issued draft regulations implementing the Capacity, Management, Operations, and Maintenance (CMOM) program. CMOM requires the development of facility maintenance plans, tracking of asset condition, establishing level of service and performance goals. Key requirements are outlined below:

1. Capacity Assurance Plan
   - evaluate existing system;
   - identify capacity deficiencies;
   - establish short and long-term remedies to capacity deficiencies.

2. Management Program
   - specify program goals;
   - establish organizational structure
   - legal authority (e.g. service agreements) to manage flow;
   - establish program measures and ranking of O&M activities based on current capacity and structural deficiencies.
   - audit documentation of changes in system condition and performance
   - establish standards and requirements for new construction as well as rehabilitation and repair.

3. Overflow Response Plan (ORP)
   - steps to respond to SSO's and to implement response plan

4. Audit Operations and Maintenance performance
   - initial assessment of O&M activities;
   - establish performance goals, measures and priorities
   - perform periodic audits to identify progress and required revisions to the program.

The City Staff has utilized an asset tracking system called Granite. This system is a data management system that chronicles the condition of all known problem segments in the City. This data is included in Appendix F. This data was integrated into the CIP listings in this chapter.

10.3.6 Puget Sound Water Quality Management Plan

The Federal Water Pollution Control Act established the requirement for a Water Quality Management Plan. Resultantly, RCW 90.71 established the need of a Puget Sound Water Quality Management Plan. The stated objectives of this governance are to recover of the Puget Sound waters by the year 2020. This Comprehensive Sewer Plan is consistent with the intended goals of the Water Quality Management Plan.

10.4 MANAGEMENT SYSTEM / RECORD KEEPING

10.4.1 Collection System

The City maintains an ongoing record of existing and as-built sewer extensions. Previously these records were retained as AutoCAD files, though more recently, the City has developed GIS based drawings in an effort to have a more comprehensive and consolidated record of pipe age, size and material, invert and rim elevations, slopes and manhole identifiers. As the GIS mapping expands, the O&M activities should be incorporated into this data base.

These activities should include the last time the pipe segments were internally televised, flushed and jetted. It could also include incident reports, backup events and surcharging manholes.

10.4.2 National Pollution Discharge Elimination System (NPDES) Permit

The City's NPDES permit requires that record keeping be maintained and that regular reporting be made to DOE. Any spills in the City's collection system are reported as part of the NPDES Permit requirements. A copy of the City's current NPDES Permit is included in Appendix K.

10.5 PERFORMANCE INDICATORS

10.5.1 Wastewater Treatment Plant

The treatment plant operates under the current NPDES Permit No. WA-0024058. This permit requires regular reporting of influent loading and effluent mass and concentrations discharged through the existing marine outfall.

Performance of the plant is presented in Figures 8-1 through 8-4. From the period 2002 through 2012, the plant had no violations of the limits defined in the permits.

The NPDES permits also define the maximum allowable influent loadings and concentrations. None of the loading limitations were exceeded for the period 2002 through 2012.

In addition, the WWTP has other permits and regulations that affect operations, e.g. PSCAA permit that regulates the air emissions.

10.6 CONDITION ASSESSMENT

10.6.1 Collection System

The City staff has an ongoing routine of performing internal inspection of the City's lines. As described in section 10.2.1.2 the staff TVs approximately 230,000 linear feet of pipe each year. These records are retained and reviewed to judge the progression of the deterioration of those pipe segments.

The staff also maintains a frequent flush list. The frequency and any particular observances are tracked to specifically address these chronic problem areas.

10.6.2 Lift Stations

The City is currently undertaking an aggressive program of lift station rehabilitation. It is anticipated that this program will be concluded in 2013 – 2014. This work is included in Table 9.3.

10.7 SEWER DIVISION STAFFING NEEDS

The City employs a total of 7.5 FTE in the Sewer Division.

To compare the pipeline and lift station staffing with other wastewater purveyors, the report has looked at the Woodinville Water District, Southwest Suburban Sewer District and Alderwood Water and Wastewater District.

The summary below also presents the estimates as used by EPA in the *Estimating Costs and Manpower Requirements for Conventional Wastewater Treatment Facilities* and *Innovative and Alternative Technology Assessment Manual*.

Agency	Service Area, Ac	Lift Stations	Current Staff	Length Pipe, LF	Person/ 100,000 LF	Person/ 10,000 Ac
Woodinville WD	1,261	2	3	181,000	1.66	23.8

SWSSD	7,848	11	7	1,419,700	0.50	9.0
AWWD	24,498	14	10	1,942,900	0.50	4.1
City of Edmonds	5,700	14	7.5	680,000	0.90	13.2
EPA Estimate for Edmonds			12.3			

As expected, the personnel per acre values decrease as the size of the service area increases. However, using a very conservative application of the EPA guidelines, it would suggest that the City might be under staffed.

Prior to adding staff, it is recommended that the City revisit their previous staffing studies to determine if adding staff is warranted.

10.8 WWTP STAFFING

The WWTP is staffed 18 hours/day, 7 days/week. The City has a total WWTP Staff of 15 FTE.

The EPA *Estimating Costs and Manpower Requirements for Conventional Wastewater Treatment Facilities* suggests that a WWTP the size and complexity of the Edmonds plants could support 25 FTE. This publication is several years old and tended to overestimate the manpower requirement.

Chapter 11 – FINANCIAL PLAN

11.1 INTRODUCTION

The objective of the sewer system financial plan is first to identify the total cost of providing sewer service, and then to present a financial program that allows the sewer utility to remain financially viable during the execution of its 7-year Capital Improvement Program (CIP), as defined in Chapter XI of this document. This viability analysis considers the historical financial condition of the utility, the sufficiency of utility revenues to meet current and future financial and policy obligations, and the financial impact of executing the CIP.

11.2 PAST FINANCIAL PERFORMANCE

The City of Edmonds legally owns and operates a combined utility fund that includes water, sewer, and stormwater utilities. Therefore, standard financial statements are not readily available for the sewer utility alone. Financial information regarding each individual utility is available in the form of utility accounting reports at a sub-account level of detail. Using these reports and detailed utility financial data provided by City staff, we tried to construct a simple financial report mimicking income and cash flow statements.

Table 11.1 summarizes the sewer utility's historical revenues, operating expenses, and transfer and debt service payments.

Table 11.1: Historical Financial Performance (2008 – 2012)

	2008	2009	2010	2011	2012
REVENUES					
Sewer Sales	$ 4,971,286	$ 5,177,227	$ 5,128,274	$ 5,159,508	$ 5,204,471
Intergovernmental Services	1,742,983	1,795,899	1,737,886	1,809,936	2,002,393
Miscellaneous Revenues	234,292	173,053	142,737	186,609	131,085
Total Revenues	**$ 6,948,561**	**$ 7,146,179**	**$ 7,008,896**	**$ 7,156,053**	**$ 7,337,950**
OPERATING EXPENDITURES					
Salaries and Wages	$ 1,507,104	$ 1,562,851	$ 1,595,992	$ 1,600,811	$ 1,681,040
Benefits	575,530	594,919	607,642	622,789	642,743
Supplies	479,094	504,700	475,169	503,698	564,549
Services	1,405,722	1,283,597	1,601,954	1,739,772	1,651,293
Intergovernmental Services	234,162	214,280	236,574	194,661	88,441
City Utility Tax	280,997	469,835	465,215	468,078	445,414
Building, Machinery, & Equipment	5,823	-	-	6,012	-
Interfund Services & Rentals	601,761	522,981	466,899	477,276	539,922
Total Operating Expenditures	**$ 5,090,193**	**$ 5,153,163**	**$ 5,449,446**	**$ 5,613,097**	**$ 5,613,402**
OPERATING SURPLUS / (DEFICIT)	**$ 1,858,369**	**$ 1,993,016**	**$ 1,559,450**	**$ 1,542,956**	**$ 1,724,548**
Debt Service Interest	$ 92,616	$ 73,085	$ 66,281	$ 56,819	$ 54,698
SURPLUS / (DEFICIT) AFTER DEBT INTEREST	**$ 1,765,753**	**$ 1,919,931**	**$ 1,493,169**	**$ 1,486,137**	**$ 1,669,850**
Debt Service Principal	$ 656,838	$ 283,307	$ 314,886	$ 318,928	$ 300,796
Interfund Transfers Out for Capital	601,000	1,428,815	3,524,169	661,545	556,874
TOTAL CASH OUTLAY	**$ 6,440,647**	**$ 6,938,370**	**$ 9,354,782**	**$ 6,650,390**	**$ 6,525,770**
CASH SURPLUS / DEFICIT	**$ 507,915**	**$ 207,809**	**$ (2,345,886)**	**$ 505,663**	**$ 812,179**

Overall, the sewer utility's total revenues have been stable around $7.0 million in each of the last five years. Of that total, rate revenues have been stable around $5.2 million in last five years. Historically, the City's growth rate has been low, and the City did not adjust its sewer rates in the last five years. The City utility tax rate was increased from 6% to 10% at the beginning of 2009. As a result the utility's rate revenues increased from approximately $5.0 million in 2008 to $5.2 million in 2009.

The City maintains and operates a wastewater treatment plant that also serves neighboring jurisdictions through interlocal agreements. The City's major partnering jurisdictions are the City of Mountlake Terrace, Olympic View Water and Sewer District, and Ronald Sewer District. These jurisdictions share the cost of maintaining and operating the treatment plant proportional to their wastewater flow. Revenues from these agencies slightly increased from $1.7 million in 2010 to $2.0 million in 2012. This increase is the result of overall O&M cost increases (as can be seen from the total operating expenditures).

Total operating expenditures increased from $5.1 million in 2008 to $5.6 million in 2012. The most noticeable contributors to this increase were the growth in City utility taxes, services, and salaries and wages. As mentioned earlier, the increase in the utility tax expenditure was the result of a utility tax rate adjustment in 2009. Increases in the other two expense categories were mainly a result of, and in line with, inflationary trends.

Over the last five years, the utility posted operating surpluses ($1.7 million on average). These surpluses have been used to make debt service payments (principal and interest), and transferred to the capital construction fund for funding the utility's capital projects.

Generally speaking, the utility has not been burdened by its debt service obligations. The utility generated operating surpluses sufficient to cover its debt service payments.

Over the last five years, the City transferred approximately $6.8 million from the sewer operating fund to the sewer capital construction fund to pay for the utility's capital needs. On average, this amount corresponds to approximately $1.4 million a year. Transfers out for capital peaked in 2010 with an approximately $3.5 million transfer. In that year, the utility posted a cash deficit of $2.3 million and used its available cash balances to meet the deficiency. In the remainder of the analysis period (i.e., 2008, 2009,2011, and 2012), the utility generated cash surpluses after paying for its operating expenditures, servicing debt, and transferring monies for its capital needs.

In short, the utility has been financially healthy and self-sufficient in recent years. On the other hand, the utility needs to fund substantial capital investment to rehabilitate its aging infrastructure, as identified in this comprehensive plan. To finance these capital projects and maintain the financial strength of the utility, the City will need a series of rate increases. The analysis of the utility's capital funding needs and other financial requirements, and hence projected rate adjustments, are provided later in this chapter.

11.3 CAPITAL FUNDING RESOURCES

The City may fund the sewer CIP from a variety of sources. In general, these sources can be summarized as: 1) governmental grant and loan programs; 2) publicly issued debt (tax exempt or taxable); and 3) cash resources and revenues. These sources are described below.

11.3.1 Government Programs

Historically, federal and state grant programs were available to local utilities for capital funding assistance. However due to budgetary constraints, these assistance programs have been mostly eliminated, substantially reduced in scope and amount, or replaced by loan programs. Remaining miscellaneous grant programs are generally lightly funded and heavily subscribed. Nonetheless, the benefit of even low-interest loans makes the effort of applying worthwhile. The major funding sources are as follows:

Department of Ecology Grants and Loans.

The Department of Ecology (Ecology) Water Quality Program administers three major funding programs that provide low interest loans, grants, or loan and grant combinations for projects that protect, preserve and enhance water quality in Washington State. These loan and grant programs are primarily for wastewater projects. Each funding cycle begins in the fall when Ecology accepts project applications. Ecology rates and ranks applications based on the highest-priority needs. The amount of available grant and loan funding varies from year to year based on the state's biennial budget appropriation process and the annual congressional federal budget. The three sources of funding for water quality projects are

- Centennial Clean Water Fund Grant Program,
- Federal Clean Water Act Section 319 Nonpoint-Source Grant Program, and
- Washington State Water Pollution Control Revolving Fund Loan Program.

Public Works Trust Fund (PWTF) Loans. Cities, towns, counties and special purpose districts are eligible to receive loans. Water, sewer, storm, roads, bridges and solid waste/recycling are eligible and funds may be used for repair, replacement, rehabilitation, reconstruction and improvements including reasonable growth (generally the 20-year growth projection in the comprehensive plan).

In 2011, the PWTF Board made some significant changes in its loan programs. Jurisdictions are no longer required to contribute a local match towards project costs. The standard loan offer is 1% interest repaid over a 20-year term. Applicants may request alternative loan terms. Shorter repayments terms qualify for a lower interest rate (0.5% for 10-year term, and 0.75% for 15-year term), while longer repayment terms require a higher interest rate (1.5% for 25-year term, and 2% for 30-yearterm). Applicants may qualify for additional interest rate reductions based on financial distress. All loan terms are subject to negotiation and Public Works Board approval.

The Public Works Assistance Account did not receive a 2013-15 biennial appropriation. As part of the biennial budget prioritization process, the funding in the Public Works Assistance Account was diverted to the General fund to help pay for competing state priorities.

11.3.2 Public Debt

General Obligation Bonds. General obligation (G.O.) bonds are bonds secured by the full faith and credit of the issuing agency, committing all available tax and revenue resources to debt repayment. With this high level of commitment, G.O. bonds have relatively low interest rates and few financial restrictions. However, the authority to issue councilmanic G.O. bonds is restricted in terms of the amount and use of the funds, as defined by the Washington State constitution and statute. Specifically, the amount of debt that can be issued without a public vote is linked to assessed valuation.

RCW 39.36.020 states:

> *"(ii) Counties, cities, and towns are limited to an indebtedness amount not exceeding one and one-half percent of the value of the taxable property in such counties, cities, or towns without the assent of three-fifths of the voters therein voting at an election held for that purpose.*
>
> *(b) In cases requiring such assent counties, cities, towns, and public hospital districts are limited to a total indebtedness of two and one-half percent of the value of the taxable property therein."*

While bonding capacity can limit the availability of councilmanic G.O. bonds for utility purposes, these can sometimes play a valuable role in project financing. A rate savings may be realized through two avenues: the lower interest rate and related bond costs; and the extension of the repayment obligation to all tax-paying properties (not just developed properties) through the authorization of an ad valorem property tax levy.

Revenue Bonds. Revenue bonds are commonly used to fund utility capital improvements. The debt is secured by the rate revenues of the issuing utility and the debt obligation does not extend to the City's other revenue sources. With this limited commitment, revenue bonds typically bear higher interest rates than G.O. bonds and also require security conditions related to the maintenance of dedicated reserves (a bond reserve) and financial performance (added bond debt service coverage). The City agrees to satisfy these requirements by ordinance as a condition of bond sale.

Revenue bonds can be issued in Washington without a public vote. There is no bonding limit, except perhaps the practical limit of the utility's ability to generate sufficient revenue to repay the debt and provide coverage. In some cases, poor credit might make issuing bonds problematic.

11.3.3 Cash Resources

Capital Facilities Charges. A capital facilities charge (CFC) as provided for by RCW 35.92.025, refers to a one-time charge imposed on new customers as a condition of connection to the utility system. The purpose of the CFC is two-fold: (1) to promote equity between new and existing customers; and (2) to provide a source of revenue to fund capital projects. Equity is served by providing a vehicle for new customers to share in the capital costs incurred to support their addition to the system. CFC revenues provide a source of cash flow used to support utility capital needs; revenue can only be used to fund utility capital projects or to pay debt service incurred to finance those projects.

In the absence of a CFC, growth-related capital costs must be borne in large part by existing customers. In addition, the net investment in the utility already collected from existing customers, whether through rates, charges and/or assessments, would be diluted by the addition of new customers, effectively subsidizing new customers with prior customers' payments. To establish equity, a CFC should recover a proportionate share of the existing and future infrastructure costs from a new customer. From a financial perspective, a new customer should become financially equivalent to an existing customer by paying the CFC.

The City updated its capital facilities charges at the end of 2011, and adopted a three-year phase-in strategy to implement its new capital facilities charges. The City is currently in the second year of its three-year phase-in period. The City currently imposes a charge of $3,495.25 per equivalent dwelling unit (EDU) for its sewer utility. The charge is expected to increase to $4,417 per ERU at the beginning of 2014.

Utility Funds and Cash Reserves. User charges (rates) paid by the utility's customers are the main funding source for all sewer utility activities. The rates cover total annual costs associated with operation and maintenance of the sewer system, and other ongoing costs of providing sewer service. Rates can pay for capital improvement projects in two ways: either paying for debt service or directly paying for capital projects. Although funding capital costs directly through rates does not result in additional interest expense associated with issuing debt, this approach can cause large and/or volatile rate increases.

11.3.4 Summary

An ideal funding strategy would include the use of grants and low-cost loans when debt issuance is required. However, these resources are very limited and competitive in nature and do not provide a reliable source of funding for planning purposes. It is recommended that the City pursue these funding avenues but assume for planning purposes that bond financing will be utilized to meet needs above the utility's available cash resources. G.O. bonds may be useful for special circumstances, but due to the bonding capacity limits, this vehicle is most often reserved for other City (non-utility) purposes. Revenue bonds are a more secure financing mechanism for utility needs. The Capital Financing Strategy developed to fund the updated CIP assumes the following funding priority:

1. Available grant funds,
2. Accumulated capital cash reserves,
3. Annual use of excess cash (above minimum balance targets) from operating reserves,
4. Capital reserves and other miscellaneous capital resources, including government program loans to the extent that they are accessible,
5. Revenue bond financing, and
6. Direct rate funding.

11.4 FINANCIAL PLAN

The City of Edmonds' sewer utility operates as an enterprise fund and as such it is responsible for funding all of its related costs. It is not dependent on general tax revenues or general fund resources. The primary sources of funding for the utility are retail and wholesale sewer service charges. The City controls the level of service charges by ordinance, and subject to statutory authority, can adjust user charges as needed to meet financial objectives.

The financial plan can only provide a qualified assurance of financial feasibility if it considers the total system costs of providing sewer service – both operating and capital. To meet these objectives, the following elements are completed:

- **Capital Funding Plan** – This plan identifies total CIP obligations for the planning period 2013 – 2019. The plan defines a strategy for funding the CIP, including an analysis of available resources from rate revenues, existing reserves, capital facilities charges, debt financing and any special resources that may be readily available (e.g. grants, developer contributions, etc). The capital funding plan impacts the financial plan through the use of debt financing (resulting in annual debt service) and the assumed rate revenue resources available for capital funding.

- **Financial Plan** – This forecast identifies annual non-capital costs associated with the operation, maintenance, and administration of the sewer system. Included in the financial plan is a reserve analysis that forecasts cash flow and fund balance activity along with testing for satisfaction of actual or recommended minimum fund balance policies. The financial plan ultimately evaluates the sufficiency of utility revenues in meeting all obligations, including cash uses such as operating expenses, debt service, and reserve contributions, as well as any coverage requirements associated with long-term debt.

11.4.1 Financial Policies

A brief summary of the key financial policy assumptions used in the financial analysis, as well as those recommended in the financial program are discussed below:

Reserve Policies. Utility reserves serve multiple functions. They can be used to address the variability and timing of expenditures and receipts; occasional disruptions in activities, costs or revenues; utility debt obligations; and many other functions. The collective use of individual reserves helps to limit the City's exposure to revenue shortfalls and meet long-term capital obligations. Common reserves among municipal utilities are operating reserves, capital contingency reserves, and bond reserves.

- **Operating Reserve** – An operating reserve, or working capital reserve, provides a minimum unrestricted fund balance needed to accommodate the short-term cycles of revenues and expenses. These reserves are intended to address both anticipated and unanticipated changes in revenues and expenses. Anticipated changes may include billing and receipt cycles, payroll cycles, and other payables. Operating reserves can be used to meet short-term cash deficiencies due to the timing of actual revenues and expenditures.

  Generally, utilities target a certain number of days of working capital as a beginning cash balance to provide the liquidity needed to allow regular management of payables and payment cycles. Consistent with industry practice, a working capital reserve of between 45 to 60 days of operating and maintenance (O&M) expenses are targeted in this analysis. Based upon the City's 2013 sewer budget, the target range is equivalent to between $700,000 and $935,000.

- **Capital Contingency Reserve** – A capital contingency reserve is an amount of cash set aside in case of an emergency should a piece of equipment or a portion of the utility's infrastructure fail unexpectedly. Additionally, the reserve could be used for other unanticipated capital needs including capital project cost overruns. There are various approaches to identifying an appropriate level for this reserve, such as (1) identifying a percentage of utility system fixed asset costs and, (2) determining the cost of replacing highly critical assets or facilities. As an industry standard, the target capital contingency reserve is typically set at 1-2% of original asset value or average annual CIP spending. For purposes of this analysis, no minimum target fund balance is set, per City staff's direction, to reduce the utility's rate adjustment needs.

- **Bond Reserve** – Bond covenants often establish reserve requirements as a means of protecting an agency against the risk of nonpayment. The bond reserve can be funded with cash on hand, but is more often funded at the time of borrowing as part of the bond principal. This reserve requirement can also be met by using a surety bond. The City maintains a restricted bond reserve in compliance with its bond covenants.

System Reinvestment Policies. The purpose of system reinvestment funding is to provide for the replacement of aging system facilities to ensure sustainability of the system for ongoing operation. Each year, the utility's assets lose value, and as they lose value they are moving toward eventual replacement. That accumulating loss in value and future liability is typically measured for reporting purposes through annual depreciation expense, which is based on the original cost of the asset over its anticipated useful life. While this expense reflects the consumption of the existing asset and its original investment, the replacement of that asset will likely cost much more, factoring in inflation and construction conditions. Therefore, the added annual replacement liability is even greater than the annual depreciation expense.

On the spectrum of policy options related to system reinvestment funding, basing a system reinvestment policy on the projected replacement cost of assets would result in the largest immediate rate impact and the lowest future debt obligation. A policy based on annual depreciation expense has the next greatest immediate rate impact. This policy does not target a replacement reserve level sufficient to cash fund 100% of future replacement costs and therefore assumes some replacement costs will be debt-financed.

One approach aimed at mitigating the accumulating asset replacement liability, as well as current rate impacts, is to fund an amount from rates equal to annual depreciation expense, net of annual debt principal repayment. Annual debt principal payments are one source of annual equity contribution to the system. Using annual depreciation expense as the measure of annual equity loss, and as a basis for a system reinvestment policy, it is appropriate then, to reduce the annual depreciation expense by the annual equity contribution, as measured by debt principal repayment. This approach tends to balance reducing near-term rate impacts with mitigating accumulating asset replacement liability.

The analysis provided herein does not incorporate any system reinvestment funding, per City staff's direction, to reduce immediate rate impacts.

Debt Policies. Bond covenants often establish a minimum debt coverage ratio as a means of protecting an agency against the risk of nonpayment. Typically, the revenue bond coverage requirement is expressed as a multiple of the annual debt service payment, and ranges between 1.25 and 2.00 (the higher the perceived creditworthiness of borrower, lower the bond coverage requirement). A 1.25 coverage requirement means that annual rate revenue must be set sufficient to support annual operating expenses, annual revenue bond debt repayment, and a cushion of 25% of the annual revenue bond debt repayment. For the purposes of this analysis, it is assumed that the sewer utility will meet a 1.25 revenue bond coverage ratio independently, without relying on the City's water and stormwater utilities' financial performance.

11.4.2 Capital Funding Plan

The City of Edmonds' share of the CIP developed for this plan totals $26.5 million ($28.4 million inflated) over the 2013-2019 planning horizon. Costs are escalated to the year of planned spending for financing projections at an annual inflation rate of 3%.

The CIP consists of three components; wastewater treatment plant projects, collection system projects, and projects driven by the operating needs and/or to improve operating efficiency. Partnering jurisdictions (i.e. City of Edmonds, City of Mountlake Terrace, Olympic View Water and Sewer District, and Ronald Sewer District) share the cost of wastewater treatment plant projects based on each jurisdiction's capacity share in the treatment plan in accordance with the interlocal agreement dated May 17, 1988. The City of Edmonds' share is 50.787%.

Table 11.2 summarizes annual CIP expenditures in 2013 and inflated costs.

Table 11.2: Capital Improvement Program (2013 – 2019)

	2013	2014	2015	2016	2017	2018	2019	TOTAL
In 2013 Dollars								
WWTP Projects - Total	$ 1,910,704	$ 981,000	$ 1,000,000	$ 1,005,000	$ 975,000	$ 930,000	$ 975,000	**$ 7,776,704**
WWTP Projects - City of Edmonds' Share	$ 970,389	$ 498,220	$ 507,870	$ 510,409	$ 495,173	$ 472,319	$ 495,173	**$ 3,949,555**
Collection System Projects	5,842,110	3,338,350	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	**19,180,460**
Maintenance Related Projects	743,000	597,000	754,000	440,000	425,000	425,000	-	**3,384,000**
TOTAL CIP for the CITY OF EDMONDS	**$ 7,555,499**	**$ 4,433,570**	**$ 3,261,870**	**$ 2,950,409**	**$ 2,920,173**	**$ 2,897,319**	**$ 2,495,173**	**$ 26,514,014**
Inflated Dollars								
WWTP Projects - Total	$ 1,910,704	$ 1,010,430	$ 1,060,900	$ 1,098,191	$ 1,097,371	$ 1,078,125	$ 1,164,201	**$ 8,419,922**
WWTP Projects - City of Edmonds' Share	$ 970,389	$ 513,167	$ 538,799	$ 557,738	$ 557,322	$ 547,547	$ 591,263	**$ 4,276,226**
Collection System Projects	5,842,110	3,438,500	2,121,800	2,185,454	2,251,018	2,318,548	2,388,105	**20,545,534**
Maintenance Related Projects	743,000	614,910	799,919	480,800	478,341	492,691	-	**3,609,661**
TOTAL CIP for the CITY OF EDMONDS	**$ 7,555,499**	**$ 4,566,577**	**$ 3,460,518**	**$ 3,223,992**	**$ 3,286,681**	**$ 3,358,787**	**$ 2,979,367**	**$ 28,431,421**

The capital funding plan determines the total resources available to meet CIP costs and further evaluates if new debt financing will be required. The City is assumed to entirely fund its share using sewer utility sources (either by cash financing or debt issues). The 2013 beginning balance of the sewer utility fund was $7,603,137. Of this amount, $1,250,000 is assumed to be reserved as working capital based on the set operating fund target balances, and the remainder ($6,353,137) is assumed to be available for capital. The capital funding plan is summarized in Table 11-3 below.

Table 11.3: Annual Capital Fund Cash Flow (2013 – 2019)

	2013	2014	2015	2016	2017	2018	2019
Beginning Balance	$ 6,353,137	$ 7,816,336	$ 3,512,765	$ 490,166	$ 3,358,237	$ 407,884	$ 3,064,195
plus: Grants / Donations / Outside Sources	47,000	-	-	-	-	-	-
plus: Capital Facilities Charges	10,000	10,000	10,000	10,000	10,000	10,000	10,000
plus: Net Debt Proceeds Available for Projects	8,300,000	-	-	6,000,000	-	6,000,000	-
plus: Interest Earnings	15,883	19,541	17,564	3,676	33,582	5,099	45,963
plus: Transfer of Surplus from Operating Fund	645,816	233,466	410,354	78,387	292,745	-	227,991
less: Capital Expenditures	(7,555,499)	(4,566,577)	(3,460,518)	(3,223,992)	(3,286,681)	(3,358,787)	(2,979,367)
Ending Balance	**$ 7,816,336**	**$ 3,512,765**	**$ 490,166**	**$ 3,358,237**	**$ 407,884**	**$ 3,064,195**	**$ 368,782**

The costs shown in the table are inflated to the year of spending. A majority (71.4%) of the 7-year CIP is projected to be financed with new debt issues. The remaining 28.6% of the 7-year CIP is financed from utility resources such as existing cash balances, rates, capital facility charge revenues, and capital fund interest earnings. The capital funding strategy anticipates three bond issues, one in 2013 in the amount of $8.3 million (the City is already in the process of issuing), and the other two in 2016 and 2018 both in the amount of $6.0 million.

11.4.3 Financial Forecast

The Financial Forecast, or revenue requirement analysis, projects the amount of annual rate revenue needed to meet the utility's financial obligations. The analysis incorporates operating revenues, operating and maintenance (O&M) expenses, debt service payments, rate funded capital needs, and any other identified revenues or expenses related to utility operations, and determines the sufficiency of the current level of rates. Revenue needs are also impacted by debt covenants (typically applicable to revenue bonds) and specific fiscal policies and financial goals of the utility (as described above).

For this analysis, two revenue sufficiency criteria have been developed to reflect the financial goals and constraints of the utility: (1) cash needs must be met and (2) debt coverage requirements must be realized. In order to operate successfully with respect to these goals, both tests of revenue sufficiency must be met.

Cash Test. The cash flow test identifies all known cash requirements for the utility in each year of the planning period. Capital needs are identified and a capital funding strategy is established. This may include the use of debt, cash reserves, outside assistance, and rate funding. Cash requirements to be funded from rates are determined. Typically, these include O&M expenses, debt service payments, system reinvestment funding or directly funded capital outlays, and any additions to specified reserve balances. The total annual cash needs of the utility are then compared to total operating revenues (under current rates) to forecast annual revenue surpluses or shortfalls.

Coverage Test. The coverage test is based on a commitment made by the City when issuing revenue bonds. For purposes of this analysis, revenue bond debt is assumed for any needed debt issuance. As a security condition of issuance, the City is required per covenant to agree that the revenue bond debt would have a higher priority for payment (a senior lien) than most other utility expenditures; the only outlays with a higher lien are O&M expenses. Debt service coverage is expressed as a multiplier of the annual revenue bond debt service payment. For example, a 1.0 coverage factor would imply no additional cushion is required. A 1.25 coverage factor means revenues must be sufficient to pay O&M expenses, annual revenue bond debt service payments, plus an additional 25% of annual revenue bond debt service payments. The excess cash flow derived from the added coverage, if any, can be used for any utility purpose, including funding capital projects. The existing coverage requirement on the City's outstanding revenue bonds is 1.25 times bond debt.

In determining the annual revenue requirement, both cash and coverage sufficiency tests must be met – the test with the greatest deficiency drives the level of needed rate increase in any given year. The analysis uses this rate revenue requirement to indicate annual rate adjustments.

11.4.4 Projected Financial Performance

The revenue requirement analysis is based on the following data, assumptions, and adjustments:

- The 2013 budget is used as the basis of the analysis.
- Rate revenues under existing rates are calculated to increase with customer growth. Customer growth assumptions are provided by City staff, and projected to be approximately 0.5% per year.
- Labor costs (i.e. salaries and wages) are escalated annually at 3%.
- Benefits costs are escalated annually at 10%.
- Other operating and maintenance expenses are escalated annually at 3%.
- The City's annual fund interest earnings rate is assumed to be 0.25 in 2013 and 2014. From this level, it is assumed to increase by 25 basis points (i.e. 0.25%) each year, reaching 1.5% in 2019.
- Inflated capital expenses reflect annual construction cost inflation of 3% starting in 2014.
- In addition to maintenance and operating costs, revenue requirements include capital costs for new debt service incurred to fund the CIP.
- The City is currently in the process of issuing a revenue bond in 2013 to fund the capital needs of its three utilities (i.e. sewer, water, and stormwater) through 2015. The analysis presented herein is based on the draft borrowing terms and repayment schedule for the anticipated 2013 issue as provided by City's bond advisor.
- The forecast assumes a revenue bond interest rate of 5%, a repayment term of 20 years, and required coverage of 1.25 times debt service for the proposed subsequent bond issues.
- The 2013 beginning balance of the sewer utility fund was $7,603,137. Of this amount, $1,250,000 is assumed to be reserved as working capital based on the set operating fund target balances, and the remainder is assumed to be transferred to the capital fund.

Table 11.4 summarizes the projected financial performance and rate revenue requirements of the sewer utility for 2013 through 2019 based upon the above assumptions.

Table 11.4: Summary of Revenue Requirements (2013 – 2019)

Revenue Requirements	2013	2014	2015	2016	2017	2018	2019
Revenues							
Rate Revenues Under Existing Rates **[a]**	$ 4,935,000	$ 4,959,675	$ 4,984,473	$ 5,009,396	$ 5,034,443	$ 5,059,615	$ 5,084,913
Non-Rate Revenues	69,030	69,670	73,953	78,432	88,356	94,579	108,748
Total Revenues	**$ 5,004,030**	**$ 5,029,345**	**$ 5,058,427**	**$ 5,087,828**	**$ 5,122,798**	**$ 5,154,194**	**$ 5,193,661**
Expenses							
411 Sewer Cash O&M Expenses **[b]**	$ 2,193,939	$ 2,279,110	$ 2,368,721	$ 2,462,948	$ 2,562,107	$ 2,666,539	$ 2,776,614
411 Treatment O&M - Edmonds Only	1,888,449	1,962,640	2,040,811	2,123,256	2,210,296	2,302,282	2,399,595
Transfer to Fund 414 (excl. Capital)	130,201	130,500	130,807	130,785	130,098	129,695	129,979
Existing Debt Service	352,792	193,771	193,561	192,803	192,476	192,138	191,252
New Debt Service	111,637	493,478	494,508	1,018,941	1,016,994	1,543,258	1,541,999
Total Expenses	**$ 4,677,018**	**$ 5,059,498**	**$ 5,228,408**	**$ 5,928,732**	**$ 6,111,972**	**$ 6,833,913**	**$ 7,039,439**
Annual Rate Adjustment	**0.00%**	**6.00%**	**6.00%**	**6.00%**	**6.00%**	**6.00%**	**6.00%**
Rate Revenues After Rate Increase **[a]**	$ 4,935,000	$ 5,257,256	$ 5,600,554	$ 5,966,270	$ 6,355,868	$ 6,770,906	$ 7,213,046
Net Cash Flow After Rate Increase	327,012	267,427	446,100	115,971	332,252	31,572	282,355
Coverage After Rate Increases	8.04	5.34	5.77	3.26	3.57	2.59	2.83

[a] Net of City utility taxes and intergovernmental payments from partners for wastewater treatment services.
[b] Net of City utility taxes; includes additional state taxes due to proposed rate increases.

As shown in the table, revenues under the existing rates are not sufficient to fund projected rate needs. The projected revenue deficiency is primarily due to new debt repayment obligations and funding of the proposed capital improvement program.

It is projected that the City will need to increase its sewer rates by 6% annually in 2014 through 2019. The analysis assumes that the rate adjustments would be implemented at the beginning of each year, and the new rates will be in effect for the entire year.

Table 11.5 below demonstrates the projected cash balances (operating, capital, and debt reserve funds) for the sewer utility, assuming that the rate increases proposed in Table 11.4 above are implemented.

Table 11.5: Projected Cash Balances (2013 – 2019)

Fund Balances	2013	2014	2015	2016	2017	2018	2019
Operating Fund	$ 931,197	$ 965,158	$ 1,000,904	$ 1,038,488	$ 1,077,995	$ 1,109,567	$ 1,163,931
Capital Fund	7,816,336	3,512,765	490,166	3,358,237	407,884	3,064,195	368,782
Debt Reserve Fund	629,455	629,455	629,455	1,152,914	1,152,914	1,676,374	1,676,374
Total	**$ 9,376,988**	**$ 5,107,378**	**$ 2,120,524**	**$ 5,549,639**	**$ 2,638,793**	**$ 5,850,136**	**$ 3,209,086**
Combined Minimum Target Balance	*$ 961,374*	*$ 1,315,763*	*$ 1,343,602*	*$ 1,896,223*	*$ 1,923,907*	*$ 2,481,474*	*$ 2,513,363*

The City is considering implementing higher rate adjustments to reduce its reliance on debt financing and start cash financing the utility's approximately $2.0 million a year repair and replacement needs by 2019. If the City were to implement this policy decision, the needed annual rate adjustments would be 9.5% in 2014 through 2019. The projected financial performance of the sewer utility under this scenario is summarized in Table 11.6.

Table 11.6: Summary of Revenue Requirements (2013 – 2019) – Alternative Scenario

Revenue Requirements	2013	2014	2015	2016	2017	2018	2019
Revenues							
Rate Revenues Under Existing Rates **[a]**	$ 4,935,000	$ 4,959,675	$ 4,984,473	$ 5,009,396	$ 5,034,443	$ 5,059,615	$ 5,084,913
Non-Rate Revenues	69,030	69,670	73,953	78,432	87,221	93,161	101,964
Total Revenues	**$ 5,004,030**	**$ 5,029,345**	**$ 5,058,427**	**$ 5,087,828**	**$ 5,121,664**	**$ 5,152,776**	**$ 5,186,877**
Expenses							
411 Sewer Cash O&M Expenses **[b]**	$ 2,193,939	$ 2,285,797	$ 2,383,203	$ 2,486,473	$ 2,596,080	$ 2,712,537	$ 2,836,408
411 Treatment O&M - Edmonds Only	1,888,449	1,962,640	2,040,811	2,123,256	2,210,296	2,302,282	2,399,595
Transfer to Fund 414 (excl. Capital)	130,201	130,500	130,807	130,785	130,098	129,695	129,979
Existing Debt Service	352,792	193,771	193,561	192,803	192,476	192,138	191,252
New Debt Service	111,637	493,478	494,508	905,524	903,578	1,080,869	1,079,610
Rate Funded CIP	-	-	-	-	-	57,506	1,411,664
Total Expenses	**$ 4,677,018**	**$ 5,066,185**	**$ 5,242,889**	**$ 5,838,841**	**$ 6,032,528**	**$ 6,475,028**	**$ 8,048,508**
Annual Rate Adjustment	**0.00%**	**9.50%**	**9.50%**	**9.50%**	**9.50%**	**9.50%**	**9.50%**
Rate Revenues After Rate Increase **[a]**	$ 4,935,000	$ 5,430,844	$ 5,976,508	$ 6,576,998	$ 7,237,822	$ 7,965,042	$ 8,765,329
Net Cash Flow After Rate Increase	327,012	434,329	807,572	816,589	1,292,515	1,583,175	818,786
Coverage After Rate Increases	8.04	5.63	6.40	4.23	4.83	4.61	5.22

[a] Net of City utility taxes and intergovernmental payments from partners for wastewater treatment services.
[b] Net of City utility taxes; includes additional state taxes due to proposed rate increases.

Table 11.7 below demonstrates the projected cash balances (operating, capital, and debt reserve funds) for the sewer utility under this scenario, again assuming that the rate increases shown in Table 11.6 above are implemented.

Table 11.7: Projected Cash Balances (2013 – 2019) – Alternative Scenario

Fund Balances	2013	2014	2015	2016	2017	2018	2019
Operating Fund	$ 931,197	$ 965,158	$ 1,000,904	$ 1,038,488	$ 1,077,995	$ 1,119,732	$ 1,163,931
Capital Fund	7,816,336	3,679,667	1,019,374	3,292,033	1,301,280	1,567,703	808,103
Debt Reserve Fund	629,455	629,455	629,455	1,039,498	1,039,498	1,213,985	1,213,985
Total	**$ 9,376,988**	**$ 5,274,280**	**$ 2,649,733**	**$ 5,370,019**	**$ 3,418,773**	**$ 3,901,420**	**$ 3,186,018**
Combined Minimum Target Balance	*$ 961,374*	*$ 1,315,763*	*$ 1,343,602*	*$ 1,782,807*	*$ 1,810,491*	*$ 2,019,085*	*$ 2,050,974*

If the City is able to obtain available low cost loan and/or grant alternatives to fund its capital needs, required rate increases would be less than the projected rate increases presented above.

It is important to note that these projections are based upon current assumptions and the capital program identified herein. Circumstances might change over time, causing actual rate adjustments to be higher or lower once actual costs are known. It is imperative that the City track its costs as they become available and compare them to assumptions used in the study. If significant changes occur, the City should revisit the analysis and make appropriate changes.

11.5 CURRENT AND PROJECTED RATES

The City charges its residential sewer customers a flat bi-monthly (in some cases, monthly) rate on a "per dwelling unit" basis. All other customers are charged a bi-monthly base charge and a uniform volume charge. The volume charge is applied on a per hundred cubic feet (ccf) of water consumption basis. The City's current (2013) sewer rates are as follows:

Table 11.8: Existing Sewer Rates

Customer class / Rate category		Bi-monthly Rates
Single-family residences		
Connected	$	50.64
Unconnected		8.16
Duplexes and multi-unit residences		
Connected (per unit)	$	40.69
Unconnected (per unit)		8.16
All other customers		
Fixed rate (per account)	$	5.76
Volume rate (per ccf)		3.26

Table 11.9 presents the City's projected sewer rates incorporating the rate adjustments shown in the financial forecasts under the baseline implementation scenario.

Table 11.9: Projected Sewer Rates (2014 – 2019)

Customer class / Rate category		2014		2015		2016		2017		2018		2019
Projected Rate Increases		**6.00%**		**6.00%**		**6.00%**		**6.00%**		**6.00%**		**6.00%**
Single-family residences												
Connected	$	53.68	$	56.90	$	60.31	$	63.93	$	67.77	$	71.83
Unconnected		8.65		9.17		9.72		10.30		10.92		11.58
Duplexes and multi-unit residences												
Connected (per unit)	$	43.13	$	45.72	$	48.46	$	51.37	$	54.45	$	57.72
Unconnected (per unit)		8.65		9.17		9.72		10.30		10.92		11.58
All other customers												
Fixed rate (per account)	$	6.11	$	6.47	$	6.86	$	7.27	$	7.71	$	8.17
Volume rate (per ccf)		3.46		3.66		3.88		4.12		4.36		4.62

Table 11.10 presents the City's projected sewer rates incorporating the rate adjustments shown in the financial forecasts under the alternative scenario.

Table 11.10: Projected Sewer Rates (2014 – 2019) – Alternative Scenario

Customer class / Rate category	2014	2015	2016	2017	2018	2019
Projected Rate Increases	**9.50%**	**9.50%**	**9.50%**	**9.50%**	**9.50%**	**9.50%**
Single-family residences						
Connected	$ 55.45	$ 60.72	$ 66.49	$ 72.80	$ 79.72	$ 87.29
Unconnected	8.94	9.78	10.71	11.73	12.85	14.07
Duplexes and multi-unit residences						
Connected (per unit)	$ 44.56	$ 48.79	$ 53.42	$ 58.50	$ 64.06	$ 70.14
Unconnected (per unit)	8.94	9.78	10.71	11.73	12.85	14.07
All other customers						
Fixed rate (per account)	$ 6.31	$ 6.91	$ 7.56	$ 8.28	$ 9.07	$ 9.93
Volume rate (per ccf)	3.57	3.91	4.28	4.69	5.13	5.62

11.6 CONCLUSION

Starting in 2014, the City’s current rates are projected to be insufficient to fully fund the forecasted financial obligations of the utility. New financial obligations for which the utility will require additional rate revenues are mostly driven by the capital financing impacts (i.e. debt service payments for the new bond issues) of the proposed $26.5 million total CIP (2013 dollars; $28.4 million inflated dollars).

To generate adequate working capital to fund utility obligations and meet annual cash flow and debt service coverage requirements, a series of rate increases will be needed in years 2014 through 2019.