

Wastewater Comprehensive Plan Update November 2012



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CITY OF LYNNWOOD
PUBLIC WORKS DEPT.

April 30, 2013

Mr. Lester O. Rubstello
City of Lynnwood Public Works Department
P.O. Box 5008
Lynnwood, WA 98046

Re: *Wastewater Comprehensive Plan Update*

Dear Mr. Rubstello:

I have reviewed the draft *City of Lynnwood Wastewater Comprehensive Plan Update*, dated November 2012, and have the following comments.

Page 3-1 is missing.

WAC 173-240-050(3)(i) requires a "List of all establishments producing industrial wastewater, the quantity of wastewater and periods of production, and the character of the industrial wastewater insofar as it may affect the sewer system or treatment plant. Consideration must be given to future industrial expansion." I realize from the annual pretreatment report that Lynnwood has no significant industrial wastewater dischargers, although fats, oils and grease is an ongoing concern. A brief discussion of the character of current and future industrial wastewater discharges should be included in the plan.

WAC 173-240-050(3)(n) requires "A statement regarding compliance with the State Environmental Policy Act (SEPA) and the National Environmental Policy Act (NEPA), if applicable." Please include SEPA documentation in the final plan.

Please submit the final sewer comprehensive plan to Ecology for approval under WAC 173-240. Sewage facilities within the planning area must be constructed according to an approved comprehensive plan and design standards. Except for sewer line extensions covered under WAC 173-240-030(5), the City of Lynnwood must submit engineering reports and plans and specifications for construction of all wastewater facilities for review and approval.

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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 from October to May in the Lynnwood area.

Biochemical Oxygen Demand (BOD): Measure of the biodegradable material in a wastewater sample by the amount of oxygen used by waste-consuming organisms over 5-days.

Bioselector: Process component in beginning of wastewater treatment train wherein air and nutrients are kept at a level to select for the most desirable organisms to biodegrade the organic materials in the wastewater.

Class 'A' Reclaimed Water: An oxidized, coagulated, filtered, disinfected wastewater with the median number of total coliform organisms not exceeding 2.2 per 100 milliliters and the

maximum number of total coliform organisms in any one sample not exceeding 23 per 100 milliliters.

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.

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.

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.

Polymer: Chemical mixed with sludge to enhance coagulation in the dewatering process.

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

Secondary Clarifier: Large quiescent tank in which activated sludge is directed into a center hopper and clear effluent is discharged over a weir.

Sewer Lateral: A sewer from a sewer main to serve one or more customers with no other common sewers discharging into it.

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

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.

Total Suspended Solids: Measure of the total of biodegradable and non-biodegradable solids in wastewater.

UV Disinfection: Disinfection of clarified treated sewage effluent by exposure to ultraviolet radiation using banks of lamps suspended in a narrow effluent channel.

Abbreviations

AWWF	Average Wet Weather Flow
BOD	Biochemical Oxygen Demand
CFR	Code of Federal Regulations
CIP	Capital Improvement Program
CWA	Clean Water Act
DOE	Washington State Department of Ecology
DOH	Washington State Department of Health
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
FEMA	Federal Emergency Management Act
FPS	Feet per second
FWPCA	Federal Water Pollution Control Act ("The Clean Water 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
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
POTW	Publicly Owned Treatment Works
PVC	Polyvinyl Chloride
RCW	Revised Code of Washington
SRF	State Revolving Fund
TSS	Total Suspended Solids
USFWS	United States Fish and Wildlife Service
UV	Ultraviolet
WDFW	Washington Department of Fish and Wildlife

Documents Incorporated by Reference

Lynnwood Infiltration and Inflow Study by Gray & Osborne, Inc. March 2011
City of Lynnwood Wastewater Comprehensive Plan, Gray & Osborne, Inc 2006
City of Lynnwood Comprehensive Plan

Executive Summary

Background

The Wastewater Comprehensive Plan Update, August 2012 Draft, was prepared in coordination with preparation of the 2012 Water System Plan Update. This coordination allowed joint development of land use plans, population and employment projections, basic mapping and similar documentation useful to both planning efforts.

The Sewer Service Area as shown in the 2012 Update remains as shown in the 2006 Wastewater Comprehensive Plan. Selected areas within the existing Lynnwood city limits continue to be served by the Alderwood Water District and the Cities of Mountlake Terrace and Edmonds. In addition, part of the City of Edmonds continues to be served into the Lynnwood wastewater treatment plant.

The Urban Growth Area (UGA) likewise remains as established in years past. Portions of this UGA currently receive sewer service from others and there are no plans for Lynnwood to provide or replace such service.

Several goals and policies and policies related to sewer service are stated in the Update to provide a basis for identifying necessary capacity improvements, including:

- The sewer system will be designed to contain all wastewater resulting for a 20-year storm event, which is in agreement with the standards of King County Metro and other local sewer agencies.
- Wastewater flows would be allowed to surcharge under peak hour conditions of a 20-year event to within five (5) feet of the ground surface, which will be less costly than requiring the flow to be retained within a full pipe.

These goals and policies do mean that storm conditions exceeding a 20-year event may result in wastewater backing up into some structures, or overflowing from one or more manholes. However, economics impose some limits on the ability of any sewer system to cope with events of unusual magnitude. The above policies generally comply with applicable law and local practice.

Projections for 2018 and 2032

Future development with associated population and employment growth has been focused into selected nodes along SR-99, the City Center, the former Lynnwood High School site and similar locations in accordance with the 2035 City Center forecast and related City documents.

Population and employment were projected for milestone dates of 2018 and 2032 in accordance with the *Vision 2040 Preliminary Growth Distribution Working Paper* prepared in May 2011 by the Snohomish County Tomorrow Planning Advisory Committee. These projections were adjusted in several ways:

- Employment data is based on Covered Employment Estimates provided by the State and was adjusted upwards to account for those in uncovered employment.
- Projected City population and employment was prorated among those areas within the city limits that receive sewer service from other agencies.
- Additions were made for that part of Edmonds that sends wastewater to Lynnwood for treatment.

The resulting projections were interpolated to provide data for evaluating system needs in six years, as well as the 20-year planning horizon.

Hydraulic Model

A truncated model of principal sewer pipes plus lift stations and force mains was prepared using MIKE URBAN software to simulate the system hydraulics. This software combines Geographic Information System (GIS) data with the sewer collection system attributes plus the Pipeflow module to provide a dynamic simulation over time of unsteady flow through the system, including the lift stations. A truncated model allows a cost-effective focus of the work effort on the collection system components of greatest significance, and avoids spending effort on the 8-inch collector sewers serving small areas that are unlikely to have capacity concerns.

To populate the MIKE URBAN model, the City sewer system was divided into 18 Sub-Basins. Projected population and employment for 2032 and 2018 was distributed among these sub-basins by on City zoning and land use planning. Diurnal curves were developed defining how wastewater flow varied throughout the day.

Flow monitoring data reported in the *Lynnwood Infiltration and Inflow Study*, March 2011, was not calibrated or correlated among the 12 flow monitoring stations as part of that previous effort. However, the data was used for this Update to estimate flow variation among the 18 Sub-Basins from City averages.

The resulting model was calibrated in relation to the 2010 flows recorded at the Lynnwood wastewater treatment plant (WWTP) for annual average day, average day of the maximum month, peak day and peak hour conditions. Variations of modeled results varied by less than 5 percent from the flows actually recorded. The modeled 2010 results also generally agreed with observations reported by the City staff. Future projections are summarized below:

Projected Flows for the Existing Sewer System Model				
Flows Shown as MGD				
Model Factor	1.0	1.28	3.03	4.28
Milestone Date	Average Day	Av Day Max Month	Peak Day	Peak Hour
2010	3.569	4.570	10.816	15.577
2018	4.104	5.252	12.434	17.563
2032	4.867	6.227	14.742	20.824

Input of the projected 2032 flow to the hydraulic model allows conditions expected for 2032 to be simulated in the existing sewer system. The model identifies which pipes flow full and the Pipeflow module allows the modeled results to be shown in profile.

Collection Deficiencies

Lift Stations No. 4, No. 8 and No. 16 have been identified by the City as improvements in process. These improvements were assumed to be completed by 2018 and incorporated accordingly into the sewer system model. The loads to calibrated model were then increased to reflect first, the 2032 projected conditions, and then the 2018 flow conditions.

Under projected 2032 peak hour flow conditions, much of the trunk sewer system is projected to have insufficient capacity to contain the wastewater flow projected to result from a 20-year storm event at 5 feet below ground surface. If growth and development occur as projected, significant improvements will be needed for the pipe and pumping systems.

Modeled results for 2018 conditions are similar to the 2032 projections, though less severe.

In general, these results are foreshadowed by the calibration results for 2010 as well as Staff observations of existing and past conditions, meaning the pipe deficiencies recognized in 2010 simply will become worse as flows increase.

The relationship among the deficiencies noted for 2010, 2018 and 2032 conditions allow improvements to be prioritized. The resulting improvements would be designed and budgeted to provide the capacity needed for 2032 conditions even when constructed under the Six-Year Capital Improvement Program (CIP).

Treatment Deficiencies

The WWTP is operated in accordance with conditions defined by the National Pollution Discharge Elimination System (NPDES) permit issued to the facility by the Department of Ecology. The plant capacity is rated adequate for flow up to 7.7 million gallons per day (MGD) under the average day of the maximum month conditions.

Projected wastewater flows shown in the table above indicate capacity is adequate through at least 2032. NPDES permit conditions require that when flows reach 85 percent of the permitted capacity (about 6.55 MGD) for three consecutive months the city must prepare a plan showing how adequate treatment capacity will be maintained. This situation may be reached by 2040.

Disinfection is currently provided using chlorine gas from one-ton cylinders. Chlorine gas is a hazardous material that is toxic. The current City installation does not meet Fire Code requirements. Several disinfection alternatives are available that meet modern standards including ultraviolet disinfection, various gas containment systems, liquid sodium hypochlorite (bleach) which can either be delivered or generated onsite.

The existing incinerator has provided sludge disposal for over 20 years. It appears to have adequate capacity to meet the needs projected through at least 2032. However, it is not able to meet air quality standards that will be in effect by 2016. Trucks to haul the incinerated ash must be backed down the steep, twisting access road to the WWTP, loaded and then driven up the road for ultimate disposal. This becomes difficult to impossible during winter weather. The existing WWTP does not have a truck turn-around, or sludge/incinerated ash storage onsite.

As the incinerator ages, the lack of a backup system may become more of a concern. Installation of a dryer would reduce sludge to dry pellets with only 10 percent moisture, which would provide several advantages:

- Dried sludge has a higher heat value and means the incinerator would need less diesel fuel
- Sludge pellets are organic and meet Class A standards so could be used as fertilizer
- Dried sludge could be trucked for disposal at Edmonds or elsewhere, though the volume would be larger than sludge ash.

The steel structure for both Building No. 1 and No. 2 exhibit substantial rust and deterioration, as usually happens for such structures near marine environments and especially for wastewater facilities. Building No. 1 rehabilitation has higher priority over Building No. 2.

Estimated Project Costs

The table below summarizes the improvements identified to date needed for the wastewater facilities.

Estimated Project Costs		
Description	Projects	Estimated Project Cost
Lift Stations	3	\$10,638,000
Conveyance Improvements by 2018	10	\$10,418,000
Treatment Improvements	12	\$5,730,000
Subtotal by 2018	25	\$26,928,000
Conveyance Improvements by 2032	12	\$8,656,000
Total Identifies	37	\$35,584,000

Updated flow monitoring included with 2018 Conveyance Improvements may justify additional hydraulic modeling. Updated modeling results may result in changes to the conveyance improvements needed. These could reduce the total costs or delay projects to a later time frame. Changes in the expected development rates, population growth and employment may also affect the conveyance needs.

Four engineering reports are identified among the treatment improvements included among the projects to be completed by 2018. These will undoubtedly identify additional improvements needed for Buildings No. 1 and 2 at the treatment facility. Other needs may also arise from these engineering reports.

Recommendations

The projects shown above as needed by 2018 are included in the Six-Year Capital Improvements Program and recommended for implementation. In particular, additional flow monitoring plus the engineering reports are essential to making the best use of capital funds.

Chapter 1 Purpose

1.1 Introduction

The City of Lynnwood is located on Figure 1-1 in relation to Puget Sound and western Washington. Figure 1-2 shows the immediate vicinity of the City and adjacent jurisdictions including wastewater treatment facilities within 20 miles of the Lynnwood facility.

1.2 Need for Plan Update

A number of changes have occurred within the City vicinity since the previous 'Wastewater Comprehensive Plan' was prepared in 2006. In addition, several land use changes have been adopted or are proposed to facilitate future development, both commercial and multifamily residential. Particular focus is placed on City Center, High School Site and Highway 99 Nodes.

These changes require analysis of the adequacy of existing sewer facilities, identification of alternatives, evaluation to select future improvements, and review of the utility finances to assure that adequate funding will be available when needed.

1.3 Growth Management Compliance

Snohomish County has defined the urban growth area (UGA) for the County as a whole in accordance with state law together with employment and population projections provided by the State Office of Financial Management.

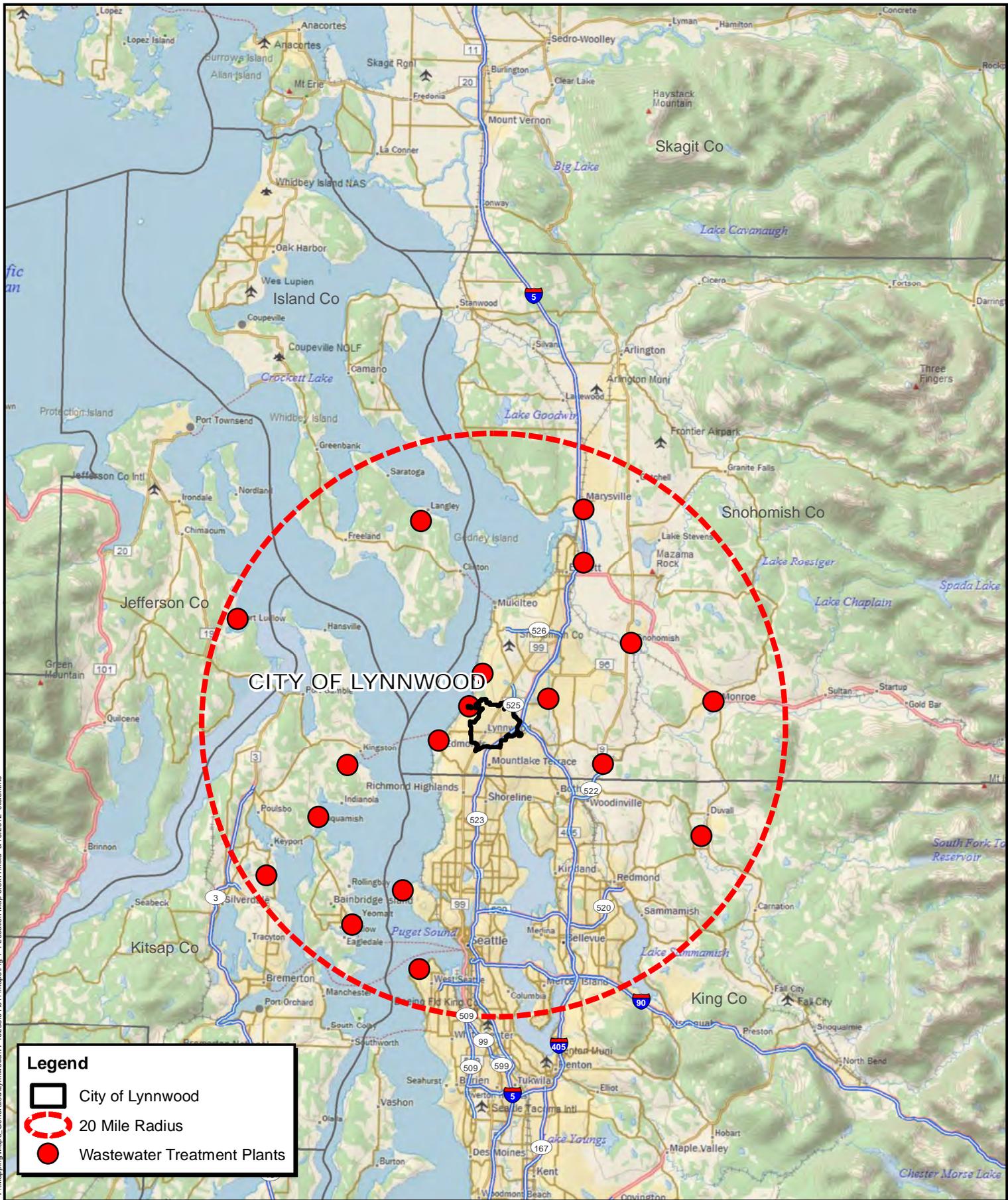
The UGA assigned to the City of Lynnwood is shown on Figure 1-3. The City has no immediate plans to annex any parcels outside of the current city limits.

1.4 System Responsibilities

The City of Lynnwood operates a sewer collection and interception system serving part of the area within the city limits. Part of the area within the city limits and the UGA is served by other sewerage agencies. The City also serves part of the City of Edmonds. These service areas are delineated on Figure 1-4.

Some parcels within the city limits are not yet served by any sewer system. Some of these are undeveloped, or even undevelopable. Those that are developed use onsite sewage system administered by the Snohomish County Department of Public Health.

All of the wastewater collected by the City sewer system is treated at a wastewater treatment plant (WWTP) owned and operated by the City just south of Haine's Point. This facility meets standards for secondary treatment and discharges into Puget Sound in compliance with a National Pollution Discharge Elimination System (NPDES) permit issued by the State Department of Ecology (DOE), which is included as Appendix D.



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Legend

- City of Lynnwood
- 20 Mile Radius
- Wastewater Treatment Plants

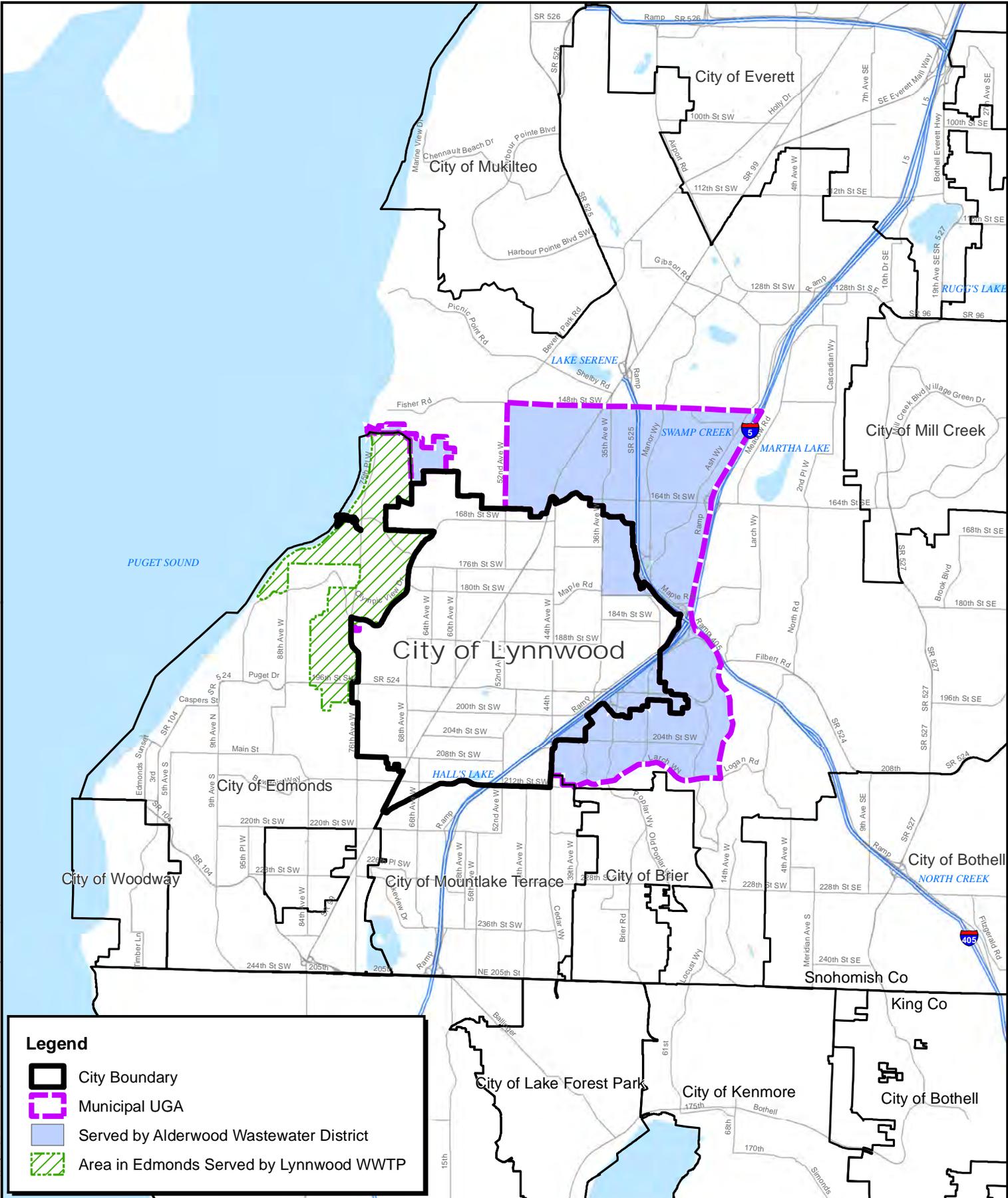


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LOCATION MAP

City of Lynnwood
 2012 Wastewater
 Comprehensive Plan Update
 August 2012



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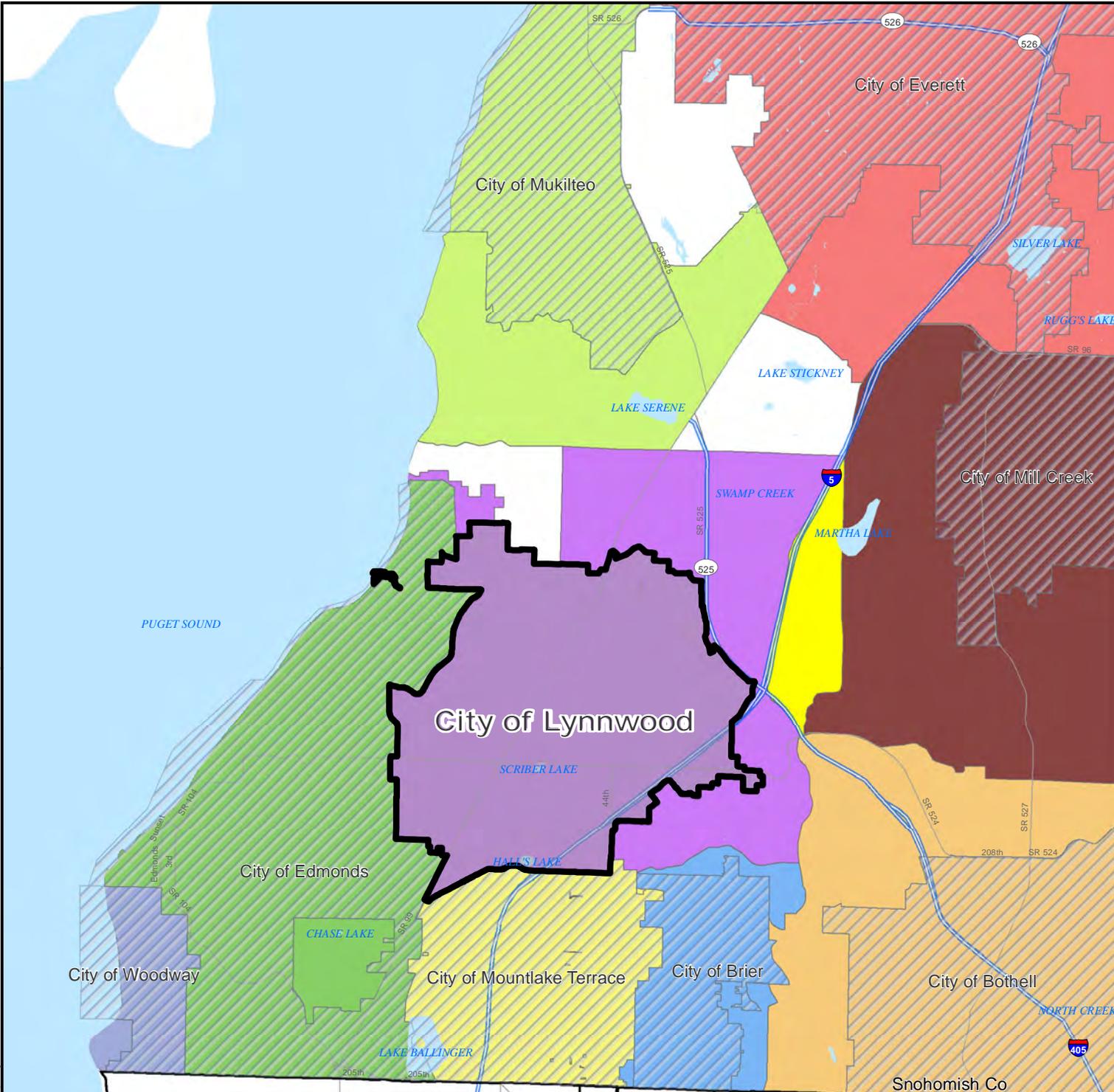
LYNNWOOD WASHINGTON

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NORTH

VICINITY MAP
 City of Lynnwood
 2012 Wastewater
 Comprehensive Plan Update
 August 2012

Figure
 1-2



Legend

-  City of Lynnwood
-  Lynnwood Municipal UGA
-  City Boundaries
-  (Various colors) Municipal UGA
-  MUGA Area Claimed by Multiple Municipalities

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NORTH

URBAN GROWTH AREAS
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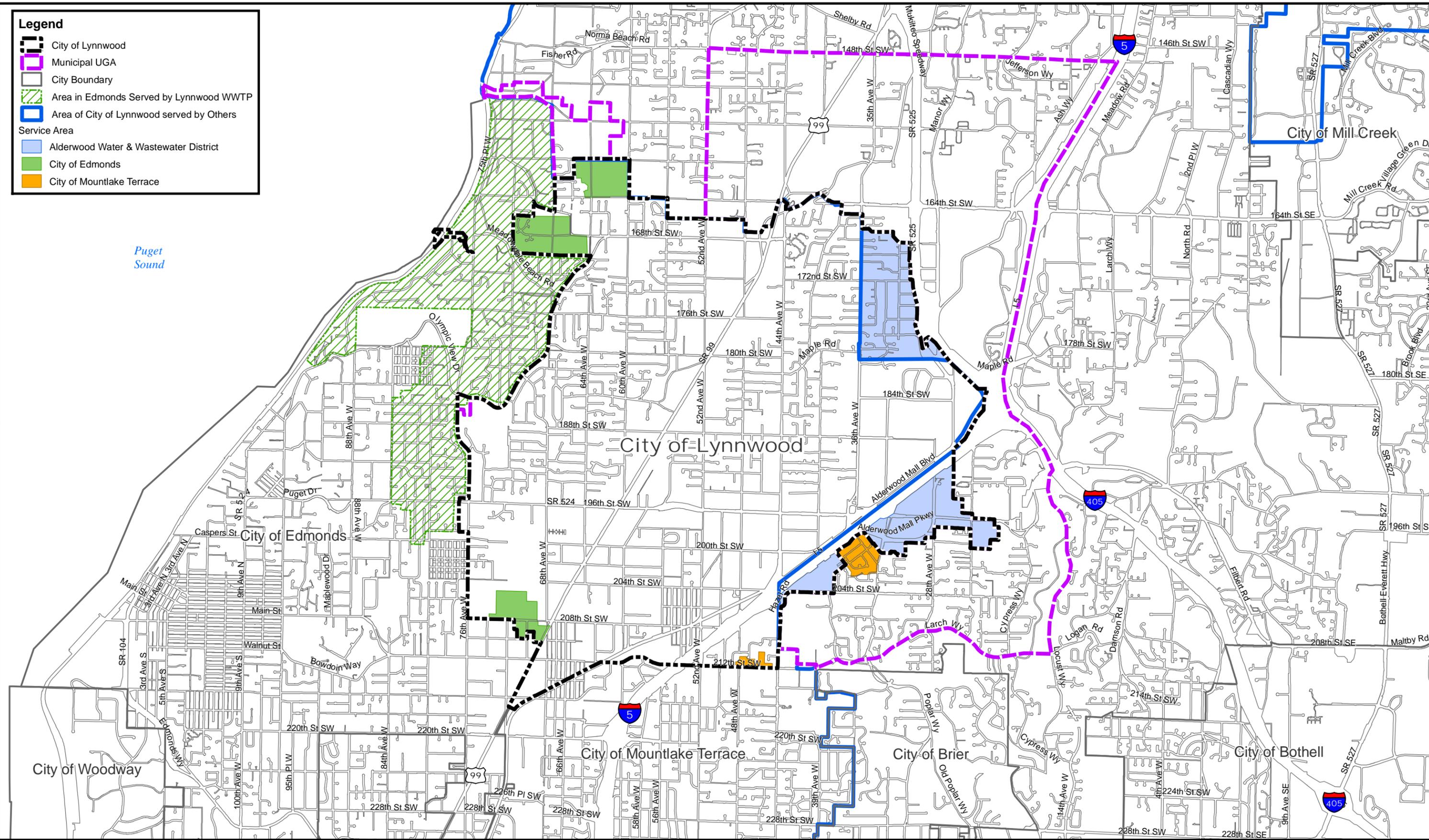
Figure
 1-3

Legend

-  City of Lynnwood
-  Municipal UGA
-  City Boundary
-  Area in Edmonds Served by Lynnwood WWTP
-  Area of City of Lynnwood served by Others

Service Area

-  Alderwood Water & Wastewater District
-  City of Edmonds
-  City of Mountlake Terrace



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NORTH

0 1,500 3,000
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 Scale in Feet



SEWER SERVICE AREAS
 City of Lynnwood
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 August 2012

Chapter 2 Goals and Policies

2.1 Approach

Section 14.04.005 of the Lynnwood Municipal Code states as its purpose the protection of public health and safety by controlling the quality of wastewater discharged to the wastewater collection and wastewater treatment system. Pollution control shall be implemented through regulation and control of the quantity and quality of industrial or commercial wastes admitted or discharged which shall enable the city to comply with all applicable state and federal laws required by the Federal Clean Water Act of 1977, the General Pretreatment Regulations (40 CFR 403) and any subsequent amendments thereto. The objectives of this title are to:

- A. Protect the health, safety and welfare of the publicly owned treatment works (POTW) and its personnel and the general public;
- B. Avoid or abate public nuisances;
- C. Make provisions for the collection and treatment of all wastewater generated by domestic and nondomestic sources under the jurisdiction of the city;
- D. Protect the city's wastewater collection and treatment system from pollutants which may interfere with the operation of the system or contaminate the sludges or other waste products generated as a result of operating the system;
- E. Prevent pollutants from entering the wastewater treatment and collection system which could pass through the system, inadequately treated, into the receiving waters;
- F. Generate sufficient revenues to operate, maintain, repair, improve and construct the wastewater collection and treatment system.

2.2 Management

The City wastewater facilities are managed within the Department of Public Works:

Public Works Director – Bill Franz PE
Deputy Public Works Director – Jeff Elekes, PE
Operations and Maintenance Director – Les Rubstello, PE
Treatment Plant Supervisor – John Ewell, PE
Utility Supervisor – Paul McIntyre

2.3 Cooperation and Coordination

City of Edmonds: An inter-local agreement sends wastewater from about 1,041 acres within the Edmonds city limits to the Lynnwood wastewater plant for treatment and disposal. About 5,000 people are estimated to live within this transfer area and contribute about 15 percent of the average day flow treated by Lynnwood.

Edmonds has capacity in their treatment facilities for this volume and would like to redirect the flow or to receive flow from Lynnwood for treatment. The concept is attractive to both cities. However, additional interceptor facilities would be needed and several alternatives may be feasible. The cost-effectiveness of these alternatives has not been evaluated. No capital funding source has been identified to implement such a change.

Alderwood Water District: About 428 acres within the Lynnwood city limits have wastewater service by Alderwood with the flow transmitted to King County Metro for treatment and disposal. Changes to this service agreement are not contemplated.

City of Mountlake Terrace: A small 8 acre portion within the Lynnwood city limits is served through Mountlake Terrace to King County Metro for treatment and disposal. Changes to this service agreement are not contemplated.

Snohomish County: Administers a large urban growth area (UGA) north and east of the existing Lynnwood city limits. The City has no intention for annexations within this UGA for the foreseeable future.

King County – Metro: Wastewater from parts of the City flow through adjacent jurisdictions for treatment and disposal by King County Metro. The City has no direct involvements with Metro however.

2.4 Sewer System Design

Criteria for Sewage Works Design by the Department of Ecology, current edition, (otherwise known as the ‘Orange Book’) provides the basis for engineering design and facilities construction.

The City supplements the ‘Orange Book’ with the Washington State Department of Transportation *Standard Specifications* current edition.

In addition, the City has a series of Standard Plans and General Notes (revised June 2011). One section is titled Sewer Standard Notes with eight specific notes included. Ten Standard Plans specifically addressing sewer construction are identified as Std6-1 through Std6-17 with some numbers not used.

Sewage pretreatment is separately addressed by the ‘Fats, Oil, & Grease (FOG) Control Manual, updated July 2011. Standard Plan Std2-1 provides requirements for a Grease Interceptor.

2.5 City of Lynnwood Municipal Code

Several titles within the Lynnwood Municipal Code (LMC) establish policies relevant to the sewer system as summarized in Table 2-1.

Table 2-1 Sewer Service Area Policies

Policy	Description	Reference
Sewer Fund	All revenue shall be paid into the 'sewer fund'. Payments from the fund are paid by the Treasurer on vouchers approved by City Council	Chapter 3.20
Local Improvements Guaranty Fund	City shall maintain 'guaranty fund' per Chapter 35.54 RCW in anticipation of local improvement district (LID) bonds equaling at least 5 percent of the outstanding principal.	Chapter 3.24
Local Improvements Financing	LID's may be initiated by petition or resolution as described in Chapter 35 RCW. Area assessed, assessment method, costs assessed, bond issuance, paying installments, and delegation to a hearing examiner shall be per City ordinance.	Chapter 3.28
Reimbursement Agreements	City may establish for a developer of infrastructure a reimbursement agreement for prorated share of costs to be recovered within 15 years.	Chapter 3.30
Utility Taxes	City may establish license for revenue from utilities including 'sewerage operation'.	Chapter 3.41
General Sewer Provisions	Protect public health by controlling the quality of wastewater collected for treatment.	Chapter 14.04
Sewer Use	Connection to the sewer is required by Snohomish County Board of Health when sewer is within 200 feet of any part of the building.	Chapter 14.12
Building Sewers and Connections	Permit required for connection and charges are due. Lateral are owned by the City and side sewers by the property owner. Joint side sewers can be approved, except new buildings generally require separate connection. Private pump stations may be approved. Backwater valve may be required.	Chapter 14.16
Sewer Charges	Sewer rates comprise two parts: basic charge determined from five wastewater strength classifications (low, average, medium, high and very high) and volume charge with initial 1,000 cubic feet per month included and each 100 CF additional is extra.	Chapter 14.40
Private Sewers	Permitted when sewer is not available within 200 feet.	Chapter 14.44
Areas Outside City	Served only by Council approved special contract.	Chapter 14.48
Connections to Extended Lines	Charge for connection is distinguished between sewers built under a LID (Class A) or a developer (Class B) and among three areas (I, II, and III) depending on when the sewer was installed.	Chapter 14.50
Wastewater Pretreatment	Requirements are organized into three Articles (1- Regulations, II – Administration and III – Enforcement) with specific discharge limits defined for selected pollutants, protocol for accidental discharges, added requirements for fats, oils and grease.	Chapter 14.6

2.6 Environmental Stewardship

Sustainability: The City Council has adopted policies to move the City facilities towards an improved sustainability posture. It is recognized of City facilities that the sludge incinerator is the largest contributor to greenhouse gases. The City is interested in identifying alternatives that will reduce the City impact to the local environment.

Receiving Water Quality: Puget Sound is the receiving water for treated effluent discharged from the City wastewater treatment facilities. These discharges are in compliance with the effluent standards define in the National Pollution Discharge Elimination System (NPDES) permit issued by the Department of Ecology for the facility.

Air Quality: The sludge incinerator is the major contributor to greenhouse gases and related emissions directly owned and operated by the City.

Reclaimed Water and Reuse: Lynnwood desires to reclaim at least some of the wastewater flow for reuse in some manner within the City. A suitable use has not been identified to date, though possible uses are identified and addressed in this Plan.

Local Eco System: Several streams, wetlands and lakes within the city limits exist and provide habitat for a variety of local wildlife. City parks, the golf course and the beach west of the wastewater treatment facilities supplement these resources. City code encourages sustainable building practices to retain and enhance these habitats as well as other properties under private ownership.

2.7 Operations and Maintenance

Collection System: City Lift Stations will be maintained in accordance with the requirements of Chapter C2 'Sewage Pump Stations' of *Criteria for Sewage Works Design* by the Department of Ecology (also known as the *Orange Book*). Among other factors, this reference requires that stations be designed for a 20-year useful life and be able to provide peak design flow with the largest pump out of service. The City defines 'peak design flow' as the peak hour flow projected for the 20-year planning horizon.

Interceptor and collector sewers will be maintained in accordance with Chapter C1 of the *Orange Book*. Pipe capacities will be at least peak hour flow as projected for the 20-year planning horizon. The Orange Book does not address whether pipe capacity should be determined flowing full, or a specific fraction of full, or whether surcharging is acceptable.

Design of the sewer collection facilities will be based on containing all wastewater resulting from the projected effects on the sewer system resulting from a 20-year storm event. This criterion is compatible with King County Metro standards and many other local sewerage agencies. Surcharging of manholes to within 5 feet of the ground surface is acceptable in meeting this criterion provided no overflow onto ground occurs and no wastewater backup into homes or businesses occur.

Treatment Facilities: The City will plan, design, operate and maintain City treatment facilities in general accordance with the requirements of the *Orange Book*, Chapters T1 through T5 plus such additional federal regulations as may be applicable.

The City will comply with more specific requirement as stated in the National Pollution Discharge Elimination System (NPDES) permit issued for the City treatment facilities and renewed from time to time.

2.8 Financial Policies

Rates: The City will maintain and update a sewer rate structure adequate to fund routine sewer operations, maintenance, administration plus service debt obligations and accumulate an appropriate reserve fund.

Connection Charges: The City will periodically update the sewer connection charge to reflect the equitable value of facilities of general benefit to the sewer system.

Special Charges: The City may develop one or more 'Special Charges' applicable to the cost of sewerage facilities for new development within a defined benefit area.

Onsite Septic Sewer Systems: Individual property owners are responsible for operation and maintenance of existing onsite sewer system in accordance with applicable regulations. The Snohomish Health District is the arm of Snohomish County responsible for administration and enforcement of onsite sewerage regulations.

Chapter 3 Sewer Service Area

3.1 Urban Growth Area

The City of Lynnwood is located in southwest Snohomish County. The City began as a small community of farms, forestlands, and businesses, and was incorporated in 1959. The modern city grew from the Alderwood Manor area, which was founded in 1917 near the spot where 196th Street and Interstate 5 converge today.

The City limits are at approximately 164th Street SW to the north, 217th Street SW to the south, Interstate 5 and State Route 525 to the east, and Olympic View Drive and 76th Avenue West to the west. The current City limits encompass 4,900 acres.

The urban growth area assigned to the City by Snohomish County is shown as Figure 1-3. The City does not anticipate significant annexations in the foreseeable future. Part of the area within the existing city limits and much of the UGA already receives sewer service from other adjacent sewerage agencies.

Figure 3-1 shows planned land use within the City. Three general areas have received significant land use planning attention with the goal of focusing efficient future development:

- City Center
- Former High School site
- SR-99 Corridor

A number of parcels remain undeveloped. Open space comprise a substantial percentage of these parcels, with the balance comprising developable properties as shown on Figure 3-1.

Selected area and parcels within the City sewer area are not yet connected to the sewer system. Some of these are developed and continue to use onsite sewage systems as shown in Figure 3-2.

3.2 Topography and Natural Features

Lynnwood is located on terrain characterized by gently rolling hills and valleys. Figure 3-3 shows the topography of the Lynnwood area. The topography within the City is gently sloping with a maximum elevation of 610 feet at 164th Street SW and 36th Avenue West, and a minimum elevation within the City of 240 feet at 180th Street SW and 76th Avenue West, though the small separate parcel for the WWTP is at sea level.

Lynnwood is located in the Puget Lowlands, which generally are characterized by glacial soils. Basic soils information for the Lynnwood area is summarized in the NRCS Soil Survey of Snohomish County, Washington.

Local weather data is collected by Snohomish County at the Alderwood Water District Office at 15204 - 35th Avenue West in Lynnwood. Lynnwood, like much of the Puget Sound area, has moderate temperature and precipitation. Precipitation in Lynnwood can range from 25 to 50 inches annually. Average annual precipitation is about 39 inches with December usually being the wettest month with about 5.9 inches of precipitation.

Lynnwood has above average precipitation for the Puget Sound area because it is located near the Puget Sound convergence zone. Northwest winds in the upper atmosphere become split by

the Olympic Mountains, then re-converge over Puget Sound, causing updrafts. These updrafts can lead to convection and produce rain showers or more active weather.

Sensitive areas are presented and described in the *City of Lynnwood Comprehensive Plan* as amended November 2002. These include areas classified as flood hazards, landslide hazards, seismic hazards, wetlands, water bodies, fish and wildlife habitat. The sensitive areas within the sewer service area are identified in mapping provided by Snohomish County and are shown in Figure 3-4.

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

Specific buffers and building setbacks apply to any development that abuts or contains hillsides, ravine sidewalls, or bluffs. These buffers may be reduced when justified by special geotechnical studies. These development regulations can affect the amount of buildable area as well as reducing the potential risk of damage from landslides. Lynnwood is located in the Puget Lowlands, which generally are characterized by glacial soils. Glacial soils are prone to debris flows and shallow landslides. Lynnwood, however, contains few landslide hazard areas. Most such areas of concern are located adjacent to the area just south of Haine's Point in the Lynnwood UGA.

Wetlands are defined by the City's municipal code (Ord. 2257 § 2, 1999; Ord. 1877, 1992) as follows:

“Areas that are inundated or saturated by surface water or ground water at a frequency or duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soils conditions. Wetlands generally include swamps, marshes, bogs and similar areas. Wetlands do not include those artificial wetlands intentionally created from non-wetland sites, including, but not limited to, irrigation and drainage ditches, grass-lined swales, canals, detention ponds and landscape amenities. Wetlands include those artificial wetlands intentionally created from non-wetland areas to mitigate conversion of wetlands, if permitted or required by the city.”

Wetlands support valuable and complex ecosystems and consequently development is severely restricted if not prohibited in most wetlands and the surrounding buffer areas. The major wetlands within the City of Lynnwood include the North Scriber Creek Wetland, Scriber Creek Wetland, Scriber Lake Park Wetland, Hall Lake Wetland, and the 44th and I-5 Wetland.

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

The Snohomish County Sensitive Areas Ordinance includes Swamp Creek as an area that is especially prone to liquefaction. Swamp Creek lies outside of the Lynnwood City limits and sewer service area but is within the Urban Growth Area.

3.3 Water Features and Natural Habitat

Lakes and streams are classified as sensitive areas due to the variety of plants and animals that they support. Lynnwood is located within, or partially within, at least five watersheds: Swamp Creek, Scriber Creek, just south of Haine's Point, Hall Creek, and Puget Sound. The area just south of Haine's Point is a prominent natural feature at the northwestern corner of the city and drains into the marine shoreline of Puget Sound.

Much of the environmentally sensitive land in Lynnwood is located along Scriber Creek and its tributaries. In the City's stream rating system, Scriber Creek, Swamp Creek, Hall Creek, and Lund's Creek are all Category I streams. The Sensitive Areas Ordinance requires 50-foot buffers from the nearest development.

Category II streams are defined by the Lynnwood municipal code as streams "other than Category I streams and that flow year-round during years of normal rainfall or those streams that are used by salmonids in any portion of the stream system." Category II streams including Gold Creek and Poplar Creek are required per the City code "to have a minimum buffer of 25 feet; provided, that the buffer shall be increased to a minimum of 50 feet in Category II streams used by salmonids."

Category III streams are those streams "that are naturally intermittent or ephemeral during years of normal rainfall and are not used by salmonids in any portion of the stream system." Category III streams are required to have a minimum buffer of 10 feet.

Sensitive fish and wildlife habitat is defined as areas which meet the definition of a "Fish and Wildlife Habitat Critical Area" pursuant to WAC 365-190-080(5) and is essential for maintaining specifically listed species in suitable habitats. Any proposed activity within 300 feet of these areas, including construction related to wastewater collection systems, requires that a habitat assessment be prepared. The Lynnwood Parks and Recreation Department has been working to acquire lands surrounding the area just south of Haine's Point to create a habitat corridor.

The City also has a Sensitive Areas Ordinance which requires sensitive areas to be protected and preserved when adjacent development occurs. Per the *City of Lynnwood Comprehensive Plan* (amended November 2002), Lynnwood provides (or is likely to provide) habitat for the following species listed as priority habitat species (PHS) and species of concern (SOC) by the WDFW: great blue heron, wood duck, pileated woodpecker, Columbian black-tailed deer, and bald eagle. Other species that may occur in the Lynnwood area that are listed as Candidate or Threatened species include the following: little willow flycatcher, northern red-legged frog, and spotted frog.

3.4 Natural Drainage Basins

Most of the City of Lynnwood occupies a ridge between Puget Sound to the west and Swamp Creek to the east. Drainage from within the city limits flows by gravity as creeks generally into one of these directions. Figure 3-5 outlines the major drainage basins as described below:

- Scriber Creek drains the largest area within the City and is a tributary of Swamp Creek.
- Swamp Creek is the direct receiving water for several drainage conveyances at the northeast corner of the City.
- Tunnel Creek is another tributary of Swamp Creek.
- Golde Creek is tributary to Scriber Creek some distance south of the city limits.
- Poplar Creek is also tributary to Scriber Creek some distance south of the city limits.
- Hall Creek drains southwest from the City into Lake Washington.
- Perrinville Creek drains west into Puget Sound
- Meadowdale Pond
- Just south of Haine's Point drains northwest from the city into Puget Sound with the City wastewater treatment facility located just inland across the railroad tracks.

That these drainage basins are not tributary to each other within the City sewer service area complicates wastewater collection by requiring several lift stations.

3.5 Water Systems

The City of Lynnwood provides water service to most of the residents of the City as shown in Figure 3-6. The water service area is smaller than the sewer service area since the water service area does not include the portion of Edmonds that is provided sewer service by Lynnwood.

The City of Lynnwood does not own their water source and consequently does not hold any water rights. The City of Lynnwood purchases its water supply from the Alderwood Water and Wastewater District (AWWD) under a 1978 Water Supply Agreement, which states that the AWWD will supply the necessary peak day water supply to the City of Lynnwood. In turn, the AWWD purchases its water supply from the City of Everett. The City of Everett's water source is the Sultan River waterworks complex, located approximately 20 miles east of the City of Everett. The City of Everett waterworks complex includes the Lake Spada Reservoir, the Chaplain Reservoir, and the Everett Filtration Plant.

The Chaplain Reservoir was formed in 1929 by the construction of an earth-fill dam. In 1942, the elevation of the dam was raised and the current storage capacity of the Chaplain Reservoir is approximately 4.5 billion gallons. The Lake Spada Reservoir is located upstream of the Chaplain Reservoir. The Lake Spada Reservoir was formed by construction of the George Culmback Dam. The Culmback Dam was a joint project between the City of Everett and Snohomish County Public Utility District (PUD) No. 1. The dam was designed to supply both a source of drinking water and hydroelectric power. The current storage capacity of the Lake Spada Reservoir is 50 billion gallons.

The City of Everett’s 20 MG Reservoir No. 3 feeds the AWWD Pump Stations No. 1 and No. 2. The combined capacity of the AWWD Pump Stations No. 1 and No. 2 is 50 million gallons per day (MGD). These pump stations supply the AWWD’s 20-MG reservoir and two 28-MG reservoirs located just west of 35th Avenue West and north and south of 156th Street SW. All three reservoirs are owned by the AWWD and have an overflow elevation of 635 feet. These three reservoirs serve the City of Lynnwood 635 Zone through the master meter located south of 164th Street SW and Spruce Way.

Water is then conveyed through a 24-inch-diameter water main to approximately 173rd Place SW at Spruce Way. A pressure-reducing valve supplies the two Lynnwood reservoirs, which have a combined capacity of 5.77 MG, and serve the 573 Zone. The AWWD 724 Booster Pump Station fills the AWWD 2.0 MG standpipe and is supplied from the AWWD’s 28 MG Reservoir No. 1. The AWWD 724 Booster Pump Station has three booster pumps, each with capacities of 1,500 gpm. The AWWD’s High Tank No. 1 (2.0 MG) and High Tank No. 2 (3.07 MG) directly serve 724 Zone in the City of Lynnwood.

A water system schematic, showing reservoirs, booster stations and transmission piping, is included as Figure 3-7. The possibility of supplementing the City’s water supply distribution system through the use of reclaimed water from the WWTP is evaluated in Chapter 9.

3.6 Sewer Service

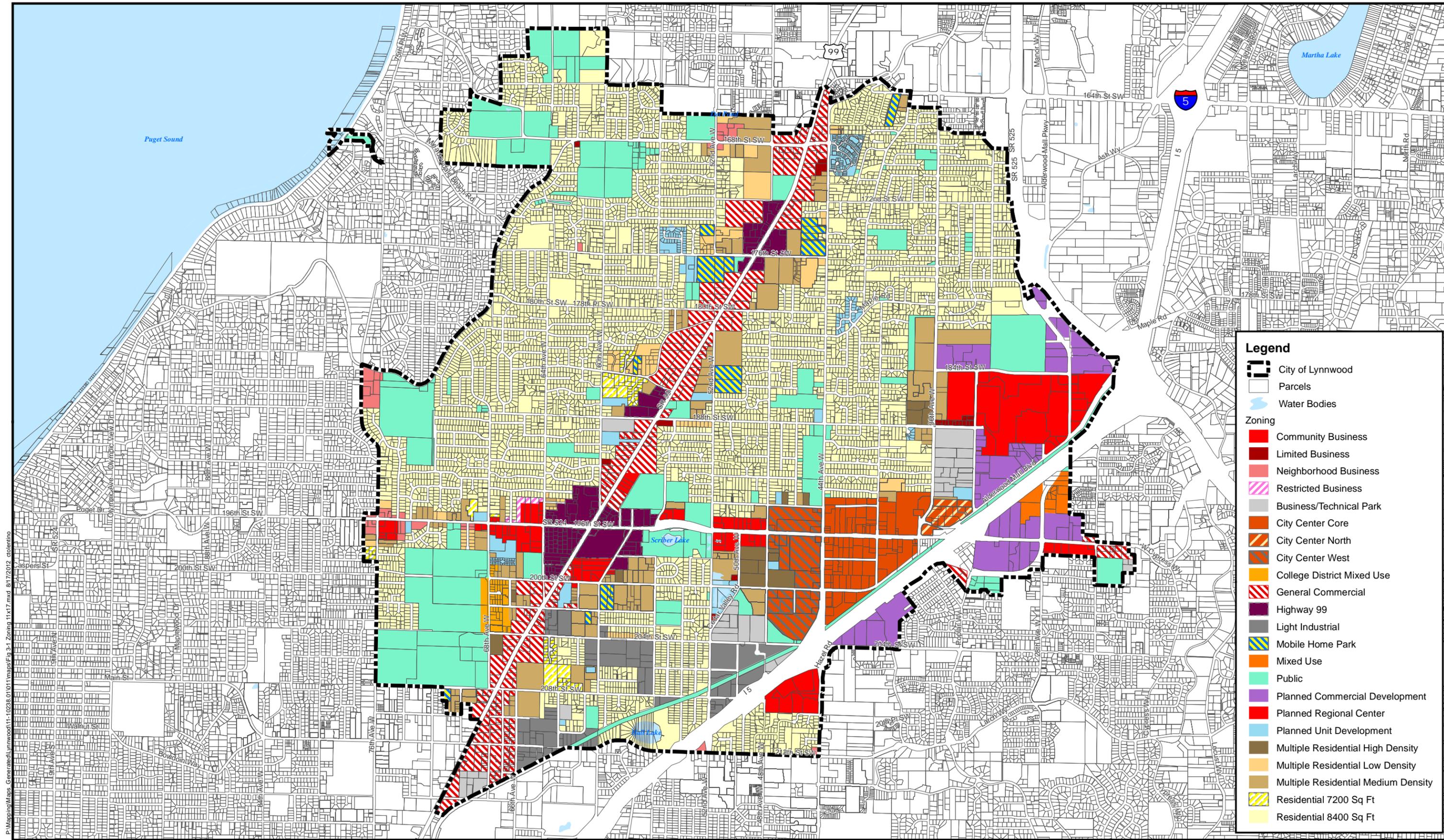
Most sewer service within the city limits is provided by the City; however significant areas within the city limits are served by others as summarized in Table 3-1.

Table 3-1 Sewer Service Areas		
Sewer Service Provider	Service Area in Acres	Percent of Total
Alderwood Water District	361	7.3
City of Edmond	163	3.3
City of Mountlake Terrace	43	0.9
City of Lynnwood	4,377	88.5
Total City Limits	4,944	100.0

The existing City sewer system is shown in Figure 3-8.

About 234 parcels within the Lynnwood sewer service area remain served by onsite septic systems as shown on Figure 3-2. An additional 60 parcels within the sewer service area served by the Alderwood Water District plus 2 parcels within the Mountlake Terrace sewer service area also still have onsite septic sewer facilities.

In addition to the areas within the city limits, Lynnwood also provides sewer service to an area of about 1,041 acres within the Edmonds city limits.



Legend

- City of Lynnwood
- Parcels
- Water Bodies

Zoning

- Community Business
- Limited Business
- Neighborhood Business
- Restricted Business
- Business/Technical Park
- City Center Core
- City Center North
- City Center West
- College District Mixed Use
- General Commercial
- Highway 99
- Light Industrial
- Mobile Home Park
- Mixed Use
- Public
- Planned Commercial Development
- Planned Regional Center
- Planned Unit Development
- Multiple Residential High Density
- Multiple Residential Low Density
- Multiple Residential Medium Density
- Residential 7200 Sq Ft
- Residential 8400 Sq Ft

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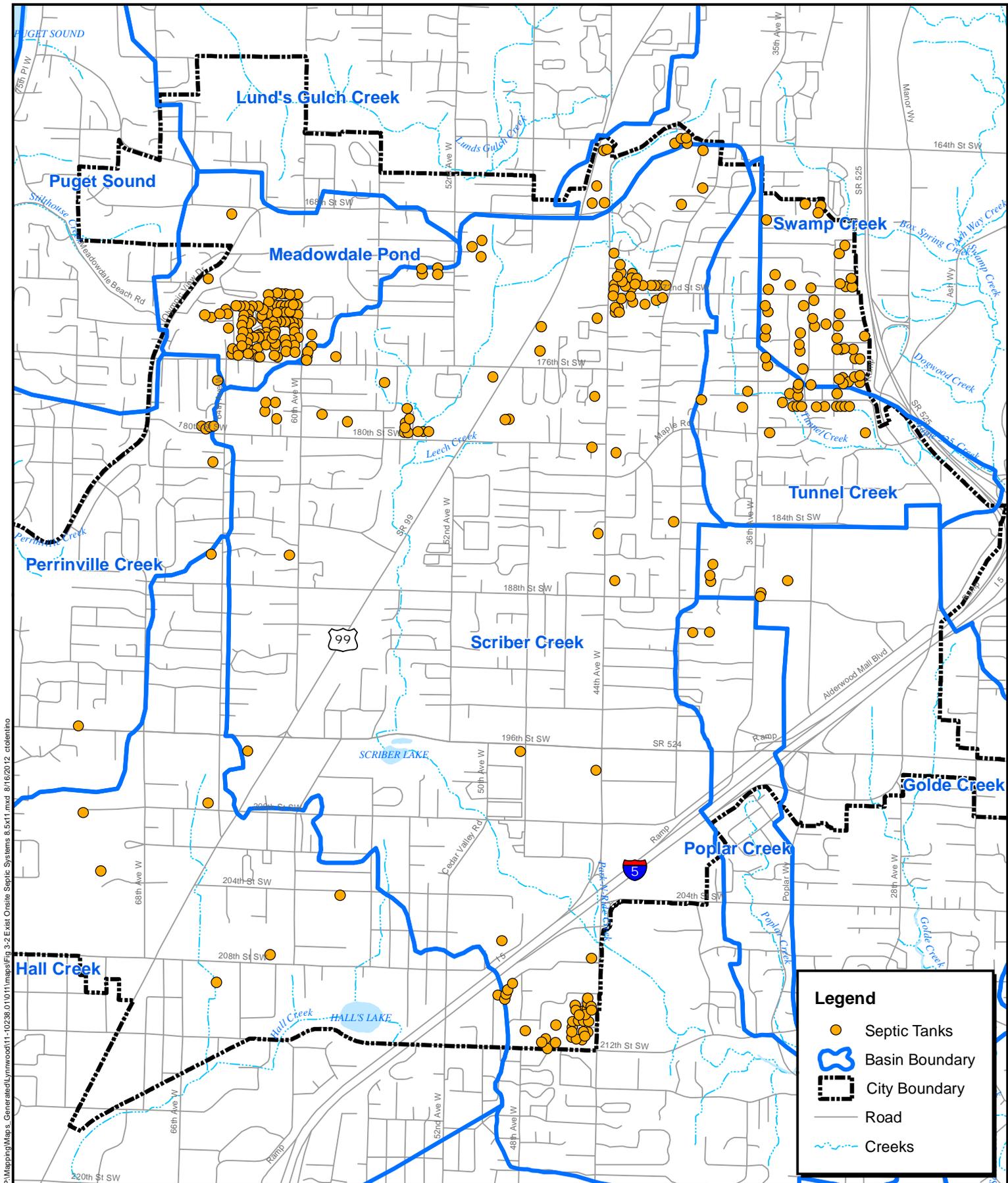
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ZONING MAP
 City of Lynnwood
 2012 Wastewater Comprehensive
 Plan Update
 August 2012

Figure
 3-1



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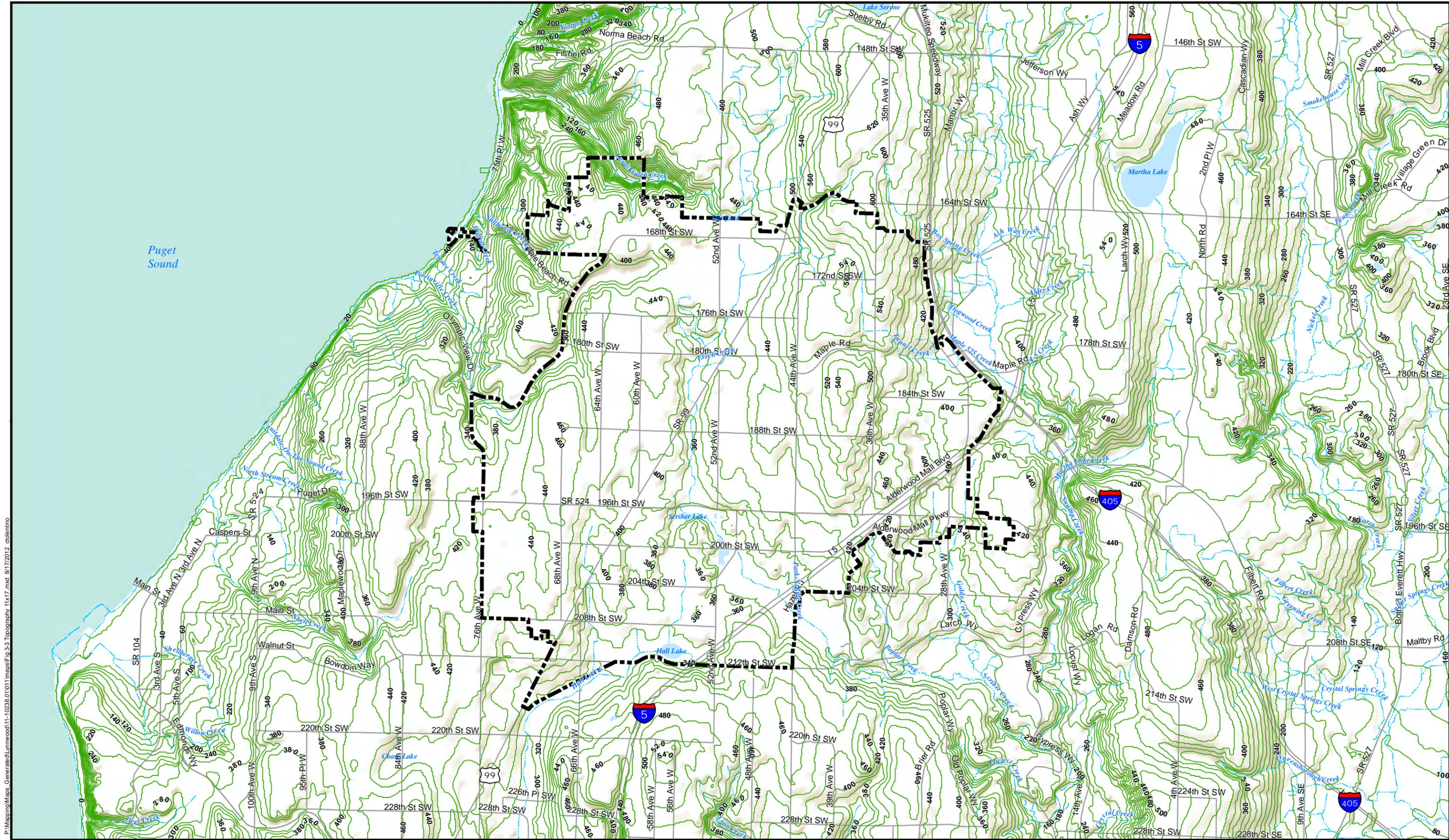
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EXISTING ONSITE SEPTIC SYSTEMS
 City of Lynnwood
 2012 Wastewater
 Comprehensive Plan Update
 August 2012

Figure
 3-2



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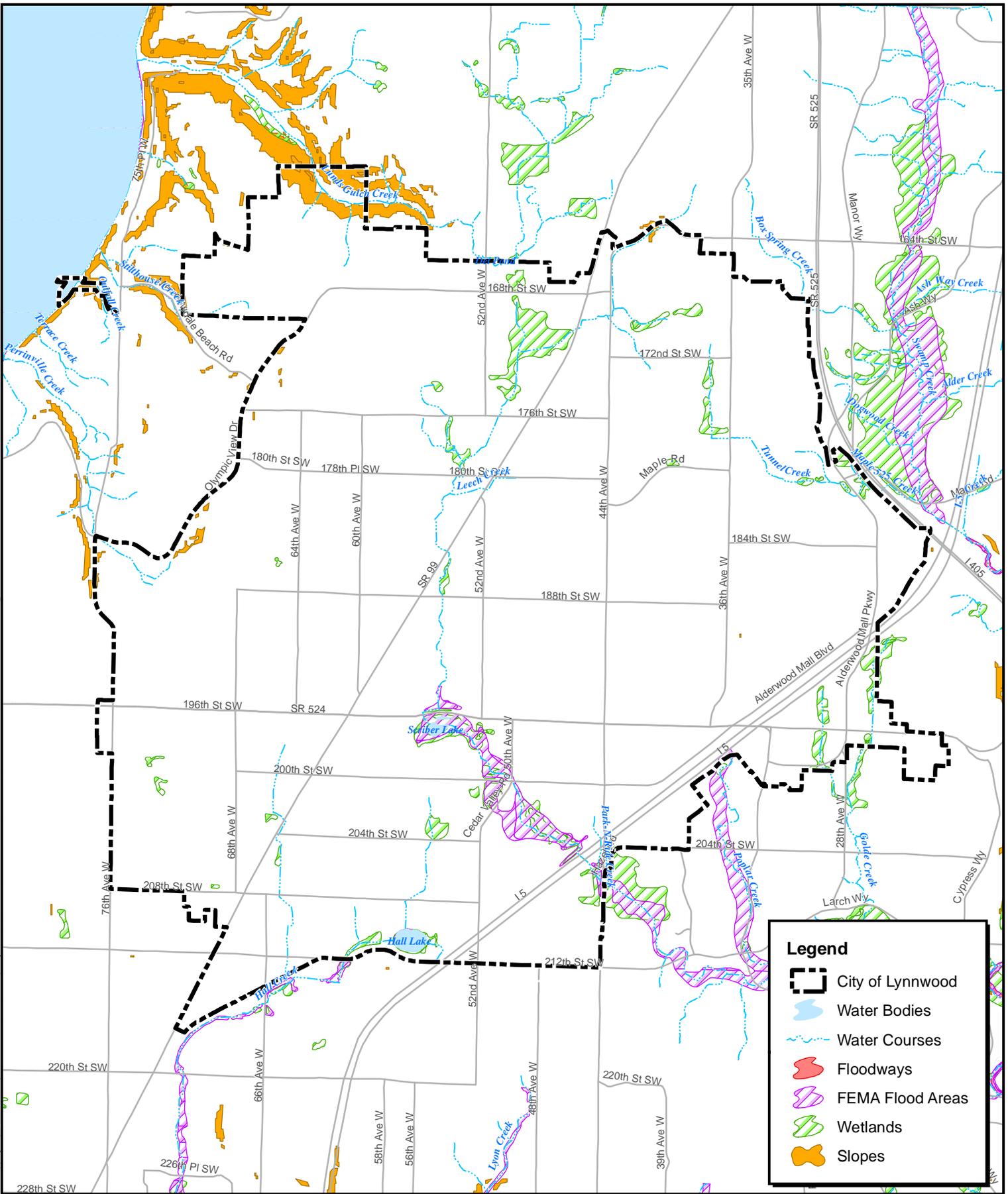
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- City of Lynnwood
- Water Bodies
- Water Courses
- 20ft Contours



TOPOGRAPHIC MAP
 City of Lynnwood
 2012 Wastewater
 Comprehensive Plan Update
 August 2012

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Legend

- City of Lynnwood
- Water Bodies
- Water Courses
- Floodways
- FEMA Flood Areas
- Wetlands
- Slopes

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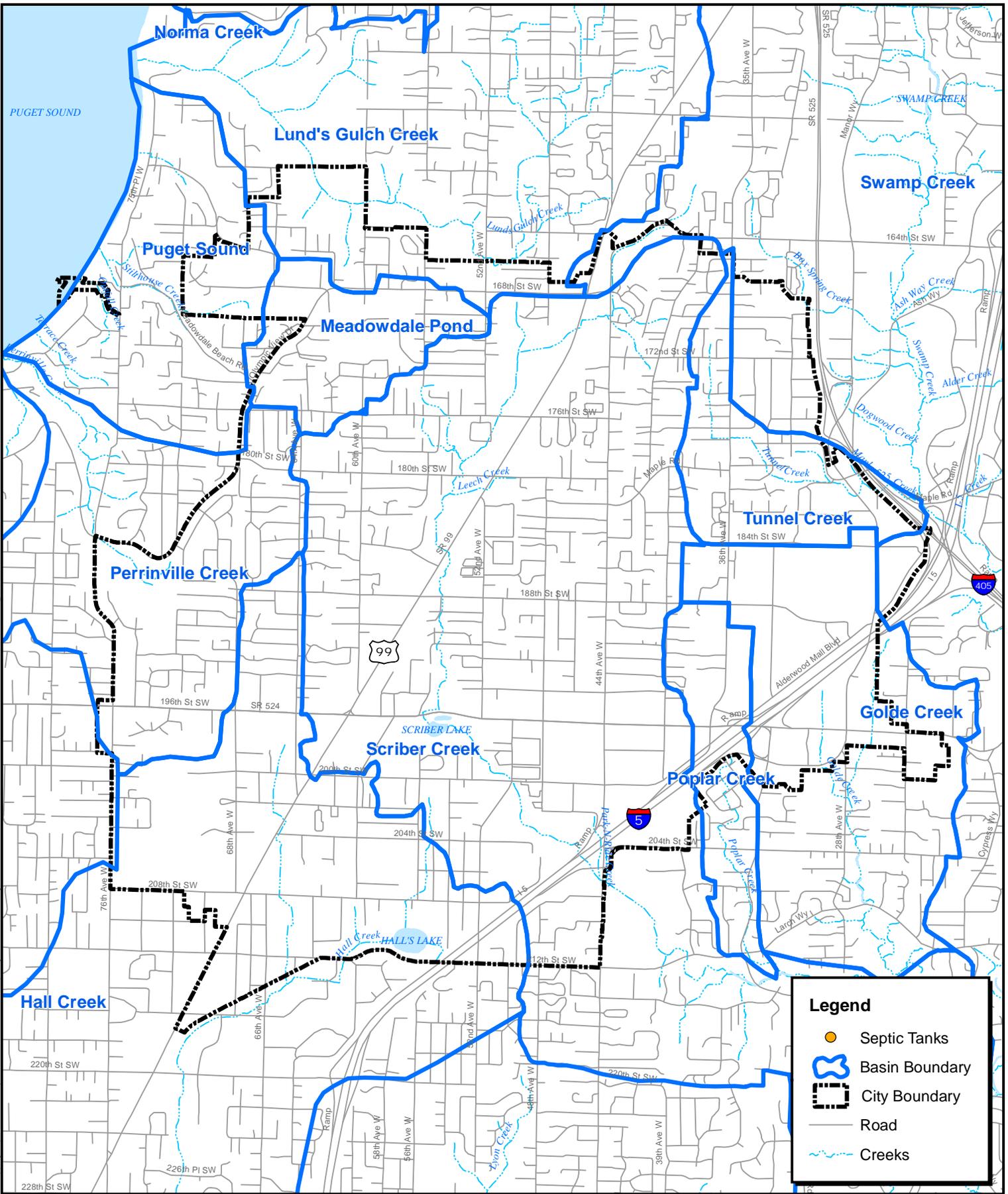


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SENSITIVE AREAS
 City of Lynnwood
 2012 Wastewater
 Comprehensive Plan Update
 August 2012

Figure
 3-4



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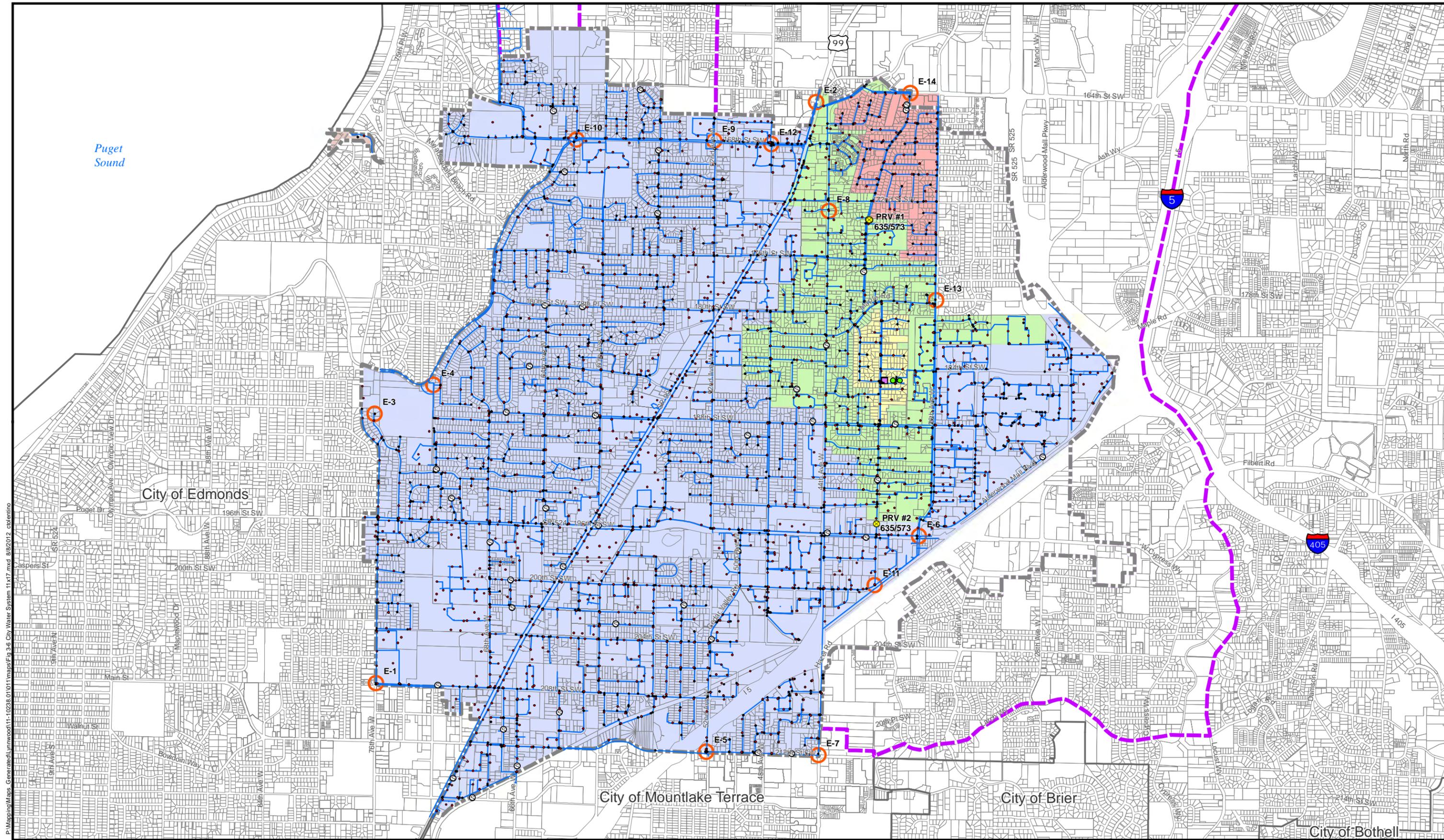
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NATURAL DRAINAGE BASINS

City of Lynnwood
 2012 Wastewater
 Comprehensive Plan Update
 August 2012

Figure
 3-5



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Water System: Lynnwood March 2011
 Intertie Locations: G&O Comp Plan November 2005
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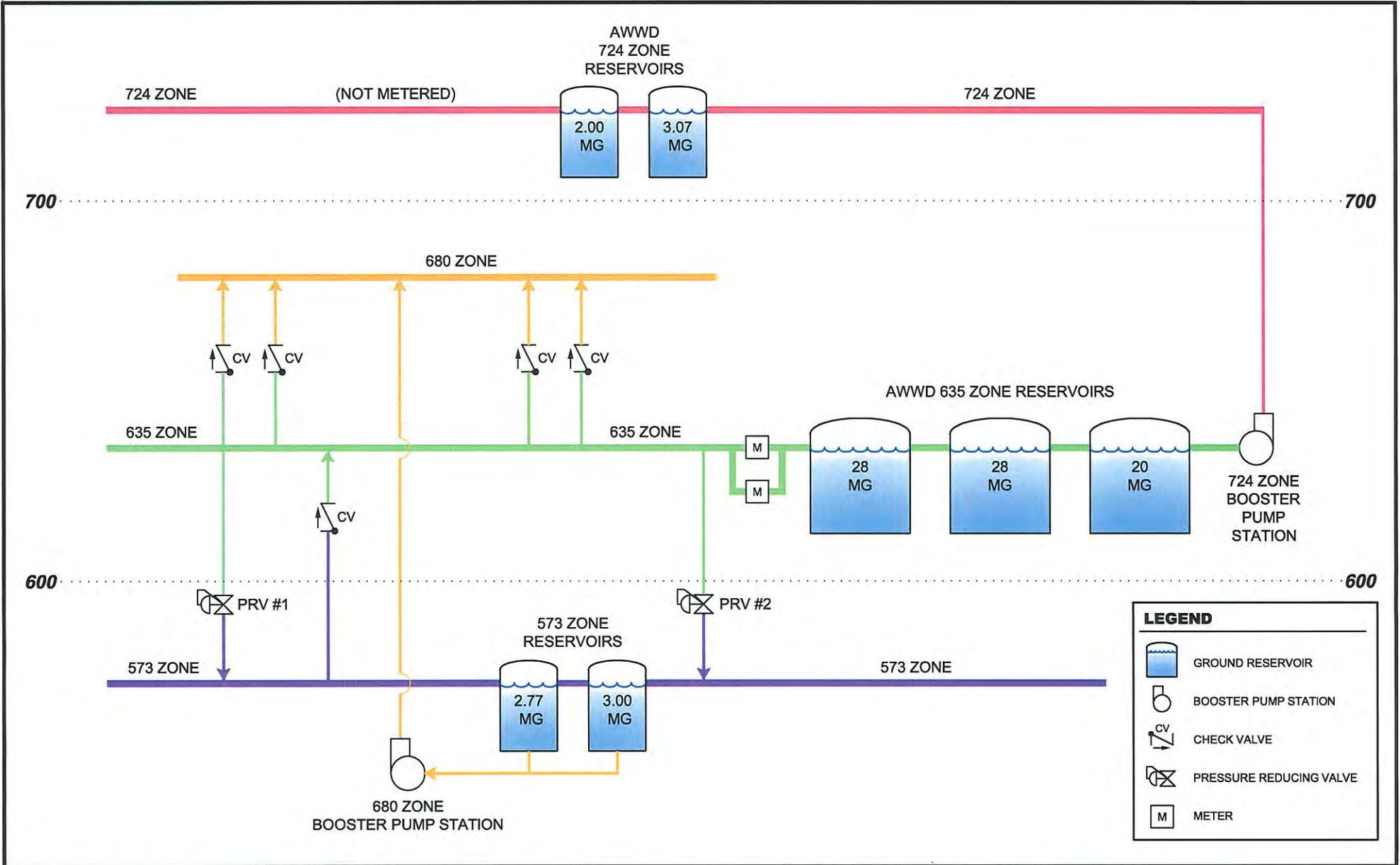
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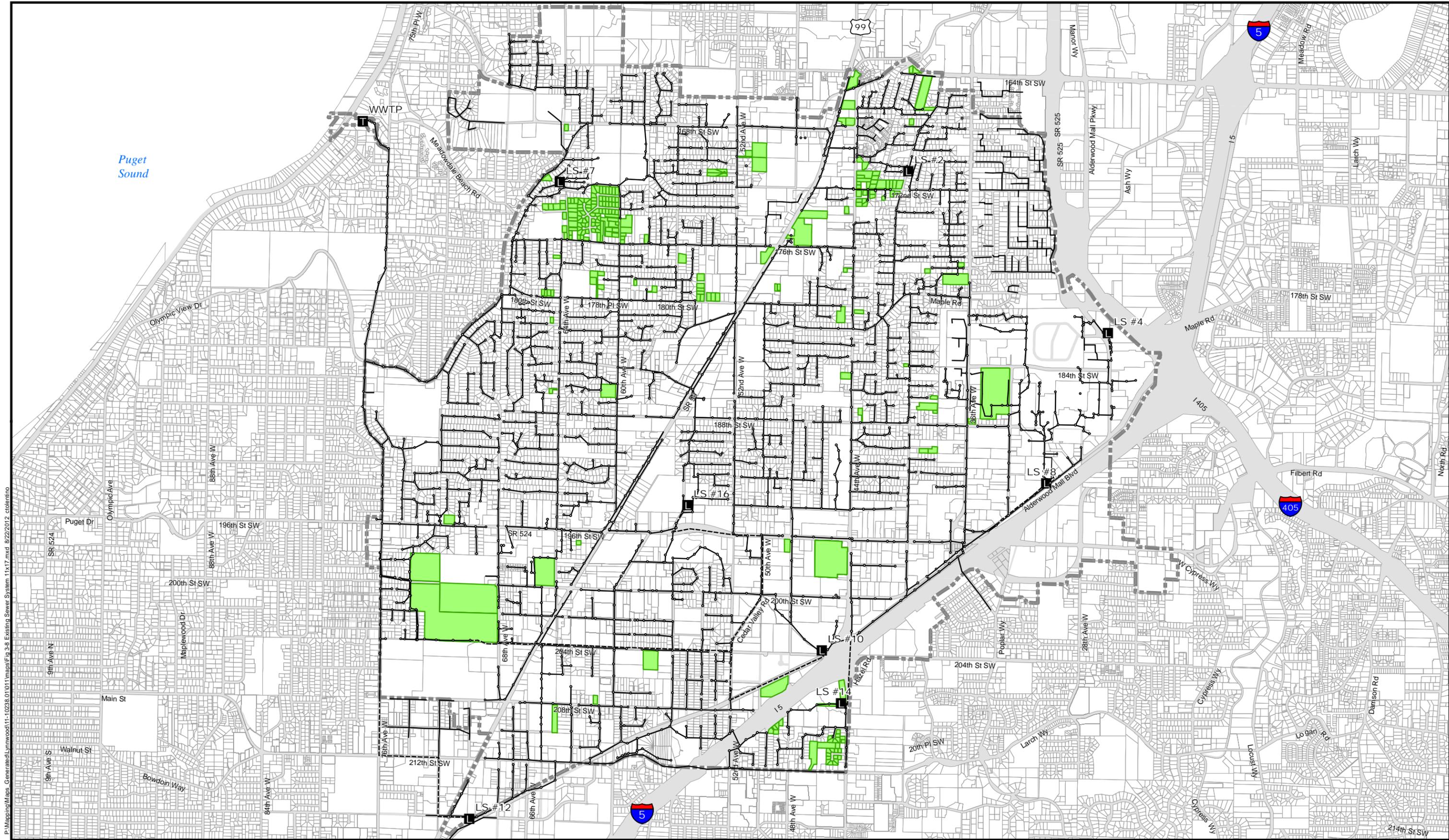


- | | | | |
|---------------------|----------------------|-----------------------|--------------------|
| Water System | Water System | Pressure Zones | Base Layers |
| ○ Sample Stations | ■ Pumps | 573 | City of Lynnwood |
| ● PRV | ● Reservoirs | 635 | Municipal UGA |
| • Hydrants | — Water Lines | 680 | City Boundary |
| • Valves | ○ Intertie Locations | 724 | |
| | | WWTP | |



CITY WATER SYSTEM
 City of Lynnwood
 2012 Wastewater
 Comprehensive Plan Update
 August 2012





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Sewer System: City of Lynnwood March 2011
 GIS Base Data: Snohomish County
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- Lift Stations
- Manholes
- Force Main (FM)
- Sewer Lines
- Parcels with Septic Tanks
- City of Lynnwood
- Parcels



EXISTING SEWER SYSTEM
 City of Lynnwood
 2012 Wastewater Comprehensive
 Plan Update
 August 2012

Figure
 3-8

Chapter 4 Projected Population

4.1 Existing Population

Population and employment growth rates for the City over the last 10 years are shown in Table 4-1 based Washington State Office of Financial Management data plus the 2000 and 2010 censuses.

Table 4-1 City Historic Population and Employment Years 2000 to 2010				
Year	Population	Annual Population Growth Rate	Covered Employment*	Annual Employment Growth Rate
2000	33,847	--	22,341	--
2001	34,010	0.5%	21,527	(3.6%)
2002	33,990	(0.1%)	20,739	(3.7%)
2003	34,500	1.5%	21,986	6.0%
2004	34,540	0.1%	22,493	2.3%
2005	34,830	0.8%	22,962	2.1%
2006	35,230	1.1%	24,321	5.9%
2007	35,490	0.7%	25,751	5.9%
2008	35,680	0.5%	25,859	0.4%
2009	35,740	0.2%	23,757	(8.1%)
2010	35,836	0.3%	22,889	(3.7%)

Data Sources - Covered Employment: provided by custom estimate from Puget Sound Regional Council.

Note: Covered employment, according to PSRC, “refers to positions covered by the Washington Unemployment Insurance Act...[and] exempts the self-employed, proprietor and corporate officers, military personnel, and railroad workers.” These data are provided in this table to illustrate annual growth rates only and may not accurately reflect *total* employment numbers for each year.

As shown in Table 4-1, the City’s year 2010 population was 35,836. This represents a nearly 6% percent increase since 2000. The average annual growth rate over the last ten years is approximately 0.6 percent. The average annual growth rate for employment over the last ten years is approximately 0.4%, with larger fluctuations year-to-year due to economic factors.

The April 2011 population estimate by the State Office of Financial Management (OFM) estimated the City population as 35,860. These numbers show the recent growth rate has been about 0.067 percent.

Covered Employment Estimates as listed in Table 4-1 captures only 85 to 90 percent of the total employment. Total employment was estimated by adding self-employment data as is provided by the American Community Survey (ACS). Since single-year ACS estimates for 2010 were not tallied for the City of Lynnwood, the reported 10.2 percentage of self-employed households in the City of Everett has been used as a proxy and has been added to 2010 covered employment to estimate Lynnwood’s total employment in Table 4-1.

4.2 Population and Employment Projections

In 2006, the City and Snohomish County cooperated in an extensive allocation process which tied together Countywide Planning Policies, the Snohomish County Buildable Lands Report, Puget Sound Regional allocations, public input, current city zoning and planning efforts. This resulted in agreed-upon population and employment allocations for the year 2025:

- total projected City population of 43,782
- total City employment of 38,550

Additional information was researched to project population and employment beyond the year 2025. In 2008, the Puget Sound Regional Council released VISION 2040 which outlined a new regional growth strategy and provided broad population and employment allocations on a regional basis. In May, 2011, the Snohomish County Tomorrow Planning Advisory Committee released the *Vision 2040 Preliminary Growth Distribution Working Paper*, providing “early indication of what post-2025 population and employment growth based on Vision 2040 might look like.” These data, or draft allocations for 2035 as they are referred to in Table 4-2, should be qualified as preliminary and unofficial because Snohomish County Tomorrow has yet to engage in an official growth targeting exercise and adopt an official growth scenario which is scheduled for 2012-2013. Moreover, Lynnwood’s current zoning has not yet been adjusted to support these draft allocation densities¹.

Table 4-2 summarizes forecasted population and employment data for 2025 and 2035 along with the 2010 population and employment data from Table 2-1. Data for target years 2012 and 2018 were calculated using straight-line interpolation between 2010 and 2025 data points. Data for target year 2032 were calculated using straight-line interpolation between 2025 and 2035 data points.

Table 4-2 Projected City Population & Employment		
Year	Population	Source
2010	35,836	2010 Federal Census, American Fact Finder 2
2012	36,895	<i>Interpolation</i>
2018	40,074	<i>Interpolation</i>
2025	43,782	Allocation Process completed in 2006
2032	50,127	<i>Interpolation</i>
2035	52,846	Draft Allocation, Snohomish County Tomorrow, May 2011
Year	Employment	Source
2010	25,224	2010 Covered Employment Estimate + ACS Self-Employment Est.
2012	27,001	<i>Interpolation</i>
2018	32,331	<i>Interpolation</i>
2025	38,550	Allocation Process completed in 2006
2032	43,031	<i>Interpolation</i>
2035	44,951	Draft Allocation, Snohomish County Tomorrow, May 2011

¹Methodology Conversation with Steve Toy, Snohomish County and Kevin Garrett, City of Lynnwood. August 25, 2011.

4.3 Allocation of Projected City Population and Employment

Population and employment are not expected to grow uniformly throughout the City. Several substantive planning efforts currently exist to concentrate development to specific allocation areas. Specific areas for which quantifiable population and employment projections can be estimated are the following:

- City Center
- The former Lynnwood High School site

Projections for these areas are summarized in Tables 4-3, 4-4 and 4-5.

Table 4-3 Projected Population and Employment in City Center

Year	Population	Source
2010	236	2010 Federal Census, American Fact Finder 2, Census Block level data
2012	874	<i>Interpolation</i>
2018	2,789	<i>Interpolation</i>
2025	5,022	City Center Subarea EIS, adjusted to remove “transition area”
2032*	8,829	<i>Interpolation</i>
2035*	10,460	60% of Total City Population Growth from 2025 to 2035
Year	Employment	Source
2010	4,192	2010 Covered Employment Estimate + ACS Self-Employment Est.
2012	5,277	<i>Interpolation</i>
2018	8,534	<i>Interpolation</i>
2025	12,333	City Center Subarea EIS, adjusted to remove “transition area”
2032*	15,066	<i>Interpolation</i>
2035*	16,238	61% of Total City Population Growth from 2025 to 2035

*Data for these years are based only on extrapolation of current trends. The City Center is not currently zoned to support these population and employment densities.

The Environmental Impact Statement for the City Center Plan forecast a total of 5,400 residents and 15,000 employees within the City Center by the year 2020². However, that forecast date has been adjusted to 2025 in Table 4-3 because of the delays in development due to the recent economic recession³. Additional adjustments were made to the 2025 forecast to remove population and employment growth attributed to the “transition area”, which was removed from the City Center in 2007 without a subsequent adjustment to the forecasted growth.

A comparison of forecasted City growth between 2010 and 2025 and City Center Growth for the same period shows the percentage of the City’s growth allocated to the City Center between 2010 and 2025, as shown in Table 4-4.

² Lynnwood City Center Plan Final SEIS, Summary, Page S-4.

³ Methodology: Conversation with Steve Toy, Snohomish County and Kevin Garrett, City of Lynnwood. August 25, 2011.

Table 4-4 Growth Comparison of Total City and City Center		
Parameter	Population	Employment
City growth from 2010 to 2025	7,946	13,326
City Center growth from 2010 to 2025	4,786	8,141
City Center percentage of total City growth	60%	61%

The 2035 forecast data for the City Center were estimated by assuming that the City Center will continue to capture 60 percent of the population growth and 61 percent of the employment growth. Data for target years 2012 and 2018 were calculated using straight-line interpolation between 2010 and 2025 data points. Data for target year 2032 were calculated using straight-line interpolation between 2025 and 2035 data points.

The City is currently in the process of evaluating a proposal to develop the former Lynnwood High School site. Five development alternatives incorporating various combinations of retail and commercial uses were presented in pre-draft EIS memoranda in April 2011. The City of Lynnwood has not indicated a preferred alternative and is not likely to do so before 2012. Table 4-5 illustrates the development of Alternative 1, the project sponsor's preferred alternative.

Table 4-5 Former Lynnwood High School Site Projected Population and Employment		
Year	Population	Source
2010	0	Site currently vacant
2012	0	Alternative 1 – Costco Developed
2018	594	Alternative 1 – Anticipated Build-Out
2032	473	<i>25.1% continued growth (same as City of growth, 2018-2032)</i>
Year	Employment	Source
2010	0	Site currently vacant
2012	320	Alt 1 – Costco Developed
2018	1,210	Alt 1 – Anticipated Build-Out
2032	1,611	<i>33.1% continued growth (same as City growth, 2018-2032)</i>

Table 4-6 shows the City is estimated to experience 25.1% growth in population and a 33.1% growth in employment between 2018 and 2032. These growth rates were applied to the 2018 assumed build-out data to estimate 2032 population and employment for the former Lynnwood High School site.

Several other areas within the City are anticipated to grow at rates higher than the city-wide rates:

- Highway SR 99 Corridor – 3 nodes at 176th, 188th, and 196th Streets
- Alderwood Mall
- Transition Area – between City Center and Alderwood Mall

The Highway SR 99 Corridor is shown on Figure 4-1 with the three nodes of focused development. Data for estimating forecasts for these areas are not currently available. Scenarios are still in development for a SR 99 Corridor plan to adopt higher rates of growth at several nodes along the highway. And the most recent Snohomish Buildable Lands Report in 2007 assigned no additional population and employment capacity to the Alderwood Mall, effectively representing static employment capacity for the Mall at least to the year 2025⁴. This may not be a realistic scenario, however.

More than 50 percent of the 2010 employment within the City is in other areas than the allocation areas identified herein. City planning allocates most of the employment growth to the above allocation areas. As Lynnwood grows some additional employment can be expected in the other, unallocated areas. For purposes of analyzing the sewer system and potential hydraulic capacity needs the difference between employment projected For Lynnwood as a whole and the five allocation areas was distributed as summarized below:

Alderwood Mall	20 %
Transition Area	5 %
Remainder of City	75 %

With these assumptions, employment allocations for these areas were assumed as summarized in Table 4-6.

Table 4-6 Employment Allocation						
Focus Area	2010	2010 Percent	2012	2018	2025	2032
Total City Employ	25,933	---	27,651	32,661	38,550	43,031
City Center	3,748	14%	4,893	8,327	12,333	15,394
High School	-0-	-0-	-0-	980	980	980
SR 99 – 176 th	608	2%	648	766	904	980
SR 99 – 188 th	734	3%	782	925	1,091	1,218
SR 99 – 196 th	1,357	5%	1,445	1,710	2,018	2,252
Alderwood Mall	4,295	17%	4,367	4,388	4,576	4,761
Transition Area	894	3%	926	931	994	1,040
Unallocated Area	14,297	55%	14,571	14,651	15,602	16,298

Table 4-6 provides the basis for estimated wastewater flows into various part of the City sewer collection system.

4.4 Tributary Sewer Service Areas

Sewer service in the Lynnwood vicinity is divided among several sewerage agencies, primarily due to the topography and drainage basins described in Chapter 3. Table 4-7 summarizes these dispositions, which include responsibility for collection system maintenance.

⁴ Methodology Conversation with Steve Toy, Snohomish County and Kevin Garrett, City of Lynnwood August 25, 2011

Table 4-7 Relationships of Sewer Service Areas and Lynnwood		
Territory	Area in Acres	Approximate 2010 Population
Incorporated Lynnwood	4,944	35,800
Served by Alderwood	-361	-3,000
Served by Edmonds	-163	-1,000
Served by Mountlake Terrace	-10	-100
City served inside city limits	4,410	31,700
Edmonds Contribution	+1,041	5,000
Total served by Lynnwood	5,451	36,700

As noted in Table 4-7, part of the City of Edmond receives wastewater treatment service from the City of Lynnwood, though Edmonds continues to maintain the collection system

4.5 City of Edmonds Tributary Area

Wastewater from part of the City of Edmonds is collected by Edmonds and transmitted to Lynnwood for treatment at the City of Lynnwood facility. The City of Lynnwood agreement for wastewater with the City of Edmonds is based on a tabulation titled 'Edmonds Participation in Lynnwood WWTP Operations'. The tabulation summarizes operations from 2004 through 2008. The tabulated wastewater flow attributed to Edmonds is summarized in Table 4-8 and remains the current financial basis.

Table 4-8 Edmonds Contribution to Lynnwood WWTP					
Parameter	2004	2005	2006	2007	2008
Lynnwood Water Consumption, MGD	1.948	1,925	2.034	1.921	1.785
Lynnwood WWTP Flow, MGD	2.039	1.870	2.312	2.024	1.981
Sewage Flow ratio	1.047	0.971	1.137	1.054	1.110
Edmonds Flow to Lynnwood, MGD	0.306	0.252	0.359	0.278	0.273
Edmonds Percent of Lynnwood	15.02	13.50	15.54	13.73	13.78

Table 4-8 shows flows vary for both Lynnwood and Edmonds. However, Edmonds appears to show a slight decline as a percentage of the total Lynnwood WWTP flow. This is consistent with the respective land uses. The portion of Edmonds contribution to the Lynnwood WWTP is residential and largely built-out. Lynnwood is growing, both in population and in commercial activity. The resultant percentage decline is consistent with the relative development trends. The 5-year average is about 14.3 percent.

4.6 Areas Diverted to Alderwood, Mountlake Terrace & Edmonds

As shown in Table 4-7, a significant part of the City of Lynnwood receives sewer service from the Alderwood Water District and a small portion is served by the City of Mountlake Terrace. Both deliver the City of Lynnwood wastewater to King County Metro for treatment and disposal. Another part is directed to the City of Edmonds for treatment. Population estimates for these sewer service areas related to the City are not separately enumerated by any agency.

The most recent household data available was developed by the 2000 Census. In that Census the City of Lynnwood population was 33,847 people. A total of 13,808 housing units existed and 13,328 were occupied. The vacancy rate was therefore about 3.6 percent. Average 2000 household size was about 2.5 persons, which includes a mix of single and multifamily households. The household size may not have changed significantly since then.

Table 4-7 summarized the approximate service area relationships for the Lynnwood sewer system distributing estimates of the relative populations based on land areas and land uses.

Chapter 5 Wastewater Flows

5.1 Historic Wastewater Flows

Wastewater flows for the entire sewer service area are recorded with an effluent meter at the treatment facility. Influent metering has not been reliable because piping constraints have not been able to produce uniform flow over a range of influent conditions due to site limitations. Principal hydraulic results for the years 2008 through 2010 are summarized in Table 5-1.

Table 5-1 DMR Effluent Flow Monitoring Summary Flow in Millions of Gallons per Day				
Year	Maximum Day	Minimum Day	Average Day	Max Month Average Day
2008	7.56	3.04	4.03	4.43
2009	8.58	2.90	4.09	4.42
2010	12.75	2.78	4.21	5.37

The calendar year 2010 documents the largest one-day flow, the smallest minimum day, and the largest annual average day flow. Accordingly, 2010 was used as the planning basis for existing flow conditions.

The Table 5-1 daily flow values were determined from diurnal recording of effluent flow variation through the 24 hours of each day. The lowest average day flows for 2010 were recorded during August as 3.44 MGD, which is normally the driest period of the year with the least extraneous water entering the sewer pipes as infiltration or rain-induced inflow with a minimum day Of 2.78 MGD.

The diurnal recording charts as shown in Figure 5-1, show the minimum flow occurred over August 17, 18 and 19 (Tuesday, Wednesday and Thursday) during the early morning hours of 1 to 3 AM was about 1.5 MGD. This minimal flow probably includes a small unknown infiltration component.

The 2010 annual average day flow of 4.21 MGD less the 2010 minimum day of 2.78 MGD leaves a 1.23 MGD difference that is largely a mix of infiltration plus some rain-induced inflow.

For planning purposes within the City of Lynnwood, Tables 4-7 and 4-8 were used to allocate population and employment, which indicate wastewater flow allocation. Accordingly 14 percent of the Lynnwood WWTP flow record was attributed to Edmonds and 86 percent to Lynnwood. The Lynnwood flow component is estimated from the 2010 minimum day flow as follows:

$$\text{City Domestic Sewage} = 2.78 \text{ MGD} \times 0.86 = 2.39 \text{ MGD}$$

Wastewater generation was compared with metered City water consumption in recent years. Table 2-5 from the Lynnwood Water System Plan was summarized as shown in Table 5-2.

Table 5-2 Residential and Non-Residential Water Consumption						
Customer Class	Annual Average Day Water Consumption					
	2009		2010		2011	
	MGD	Percent	MGD	Percent	MGD	Percent
Residential	2.254	67%	1.981	67%	1.940	66%
Non-Residential	1.114	33%	0.992	33%	0.984	34%
Total	3.368		2.973		2.293	

The average of the annual average day water consumption shown in Table 5-2 is about 2.88 MGD. The City domestic sewage quantity computed above as 2.39 MGD, which is 83 percent of the annual average daily water consumption. Although some irrigation demand is present in the annual average day water demand, that ratio is typical for many western Washington sewer systems.

5.2 Existing Unit Flows

Residential Sewage is estimated from the average household size which was shown in Section 4.4 as about 2.5 persons. Single family residential water consumption is shown in Table 2-8 of the Water System Plan as averaging 1.191 MGD during 2011. The residential difference of 0.749 MGD from Table 5-2 above is the multi-family component. There were 6,770 single family water customers so the water equivalent residential (ERU) flow for 2011 was computed as shown below:

$$\begin{aligned} \text{Single Family Water Demand} &= 1.191 \text{ MGD} / 6,770 \text{ homes} = 176 \text{ GPD per ERU} \\ \text{Per Capita Demand} &= 176 \text{ GPD} / 2.5 \text{ persons} = 70 \text{ GPD} \end{aligned}$$

Table 5-2 indicated that the residential component of potable water in the City is about 67 percent of the total average day flow. Domestic sewage flow for the City is presumed to comprise a similar ratio with the 2010 average annual volume computed below:

$$\text{Residential Sewage} = 2.39 \text{ MGD} \times 0.67 = 1.60 \text{ MGD}$$

The population within the Lynnwood sewer service area is shown in Table 4-7 as about 31,700 people. Section 3.6 identifies about 234 homes within the City sewer service area as still using onsite septic systems, which represent about 600 people. The population actually connected to the City sewers is estimated at about 31,100 people. The domestic sewage is derived above as 1.60 MGD equals about 50 GPD per person.

Per capita sewage estimated above as 50 GPD per capita is about 71 percent of the per capita water demand. Sewage generation usually ranges from 80 to 90 percent of the average winter water consumption. The ratio at 71 percent may seem low but is based on annual average water demand which includes some irrigation use not present in the winter water demand.

Non-Residential Flow is estimated from Table 5-2 as 33 percent of the 2010 minimum day flow of 2.39 MGD, or about 0.79 MGD. Table 4-6 showed employment within the City was 25,224 employees in 2010 including an allowance for employees not covered by the State of Washington, such as the self-employed. Each employee is therefore estimated to generate sewage as calculated below:

$$\text{Non-Residential Sewage} = 0.79 \text{ MGD} / 25,224 \text{ employees} = 31 \text{ GPD per employee}$$

This is within the 20 to 35 GPD per employee range used by the 'Water System Design Manual' and the 'Criteria for Sewage Works Design'.

Infiltration and Rain-Induced Inflow is additional to the residential and non-residential components estimated above. The maximum day during the years summarized in Table 5-1 occurred on December 12, 2010 was recorded as 12.75 MGD, which coincided with a storm event recorded as 2.94 inches of precipitation. Figure 5-2 reproduces the diurnal chart for that period and shows effluent flows exceeded the 20 MGD capacity of the recording chart for about two hours.

The December average daily flow was recorded as 5.37 MGD. The difference between the December and the August average day flow of 3.38 MGD indicated the system response to wet weather conditions during December 2010, was about 1.99 MGD including only modest rain-induced flows.

The December 12, 2010, storm event indicates that peak instantaneous flow was about 21 MGD and the total flow for the day was 12.75 MGD. Subtraction of the December average day flow of 5.37 MGD indicates the rain-induced contribution was about 7 MGD from the 2.94 inches of precipitation. A straight-line calculation indicates that 1-inch of precipitation produced about 2.4 MGD of extraneous flow. Precipitation during the peak hour period produced a rain-induced flow component at a rate of about 15 MGD.

The direct effect a storm event has on the Lynnwood sewer system cannot be precisely defined on a straight-line or any other mathematical formula. Storm intensities vary. The direction a storm moves may affect the sewer capacity since moving in the pipe flow direction may minimize peak conditions while moving against pipe flow may cause an increase. Antecedent moisture conditions will have an effect. Whether extraneous flow reaches the sewer directly through an inlet or roof drains, or enters indirectly as groundwater through pipe joints or breaks produces time delays for the hydraulic capacity.

Two notable storm events in recent years appear useful in defining these relationships as summarized in Table 5-3.

Table 5-3 Rain-Induce Inflow				
Storm Date	Precipitation Inches	MGD @WWTP	Induced MGD	MGD per Inch
12 Dec 2010	2.94 per day	12.75	7	2.3
7 Jan 2009	0.95 per day	7.56	2	2.1

The most representative rain gauge for Lynnwood is located near the Ballinger Way NE interception with 25th Ave NE and King County. Recorded rainfall isopluvials indicate the following approximate storm frequencies:

10-year event	2.3 inches of precipitation	(10% chance exceeded annually)
25-year event	2.6 inches of precipitation	(4% chance exceeded annually)
100-year event	3.2 inches of precipitation	(1% chance exceeded annually)

The December 12th storm approximated a fifty-year event, meaning a 2 percent chance of occurring during any single year. Sewer systems in King County are normally designed to contain and convey wastewater under about a 20-year event before at least one location overflows. The 20-year event for Lynnwood would be about 2.5 inches and induce about 5.5 MGD of extraneous flow for a response rate of about 2.2 MGD per inch.

The data presented in this Section allows some generalizations to be made for the City sewer system as a whole, which are summarized in Table 5-4.

Table 5-4 Average Wastewater Flow per Acre			
2010 Daily Monitoring Reports Data About 4,000 Acres Served by Sewers within City			
Parameter	MGD @ WWTP	MGD in City	Approx GPD per Acre
Annual Average Day	4.21	3.62	900
Average Day of Max Month	5.37	4.62	1,100
Minimum Day	2.78	2.39	600
Rain-Induced Response	5.5	4.7	1,200

5.3 Existing Peaking Factors

Table 5-1 summarizes the three years of flow from 2008 through 2010. Economics during this period were challenging. Never-the-less, average day wastewater flow increased about 4 percent. This increase does not agree with population changes, though it may reflect commercial activity. The values recorded in Table 5-1 indicate that the 2010 values are most reflective of existing conditions and provide the best basis for predicting future wastewater trends.

Peak hour flows for purposes of planning and design are not readily derived from recorded flow data. Some interpolation is required. Section 5.1 notes that the December 12, 2010, storm event of 2.94 inches produced instantaneous flows recorded at the WWTP exceeding 20 MGD. NOAA rainfall isopluvial charts indicate this was at least a 50-year event. Sewerage facilities cannot be designed economically to contain ALL flow under ANY storm event. A larger than designed storm event will cause overflows at one or more locations, usually for brief periods ranging from a few minutes to several hours.

Sewer systems in King County are normally designed to contain and convey wastewater under about a 20-year event before at least one location overflows. This criterion was used to define the peak hour flow for analysis of the Lynnwood sewer system. The calculated 4.28 peaking factor representing a 20-yr, 24-hr storm event, where 2.5 in of precipitation in a 24-hr period

would be observed. Peak hour flow at the WWTP during a storm of this magnitude would be 18.00 MGD.

To calculate this peaking factor the daily rainfall accumulation data from the King County iMap for the Brugger’s Bog rain gage located near Ballinger Way NE and 25th Ave NE in Shoreline , WA was selected as the most representative gage available for the Lynnwood sewer system. Data from this rain gage was analyzed and compared to NOAA isopluvial data for the approximate locations of the WWTP and the Brugger’s Bog rain gage. The values for each location were averaged and converted to a unit-less average for the rainfall data. The December 8, 2010 Brugger’s Bog rain gage recorded 1.26 inch, which is about the same as the isopluvial information for a 2-year, 24-hour storm (1.25 in) at the approximate location of the WWTP. Thus the peak daily flow at treatment plant of 10.67 MGD corresponded to a 2- year, 24-hour storm. Using this value and the unit-less average rainfall data, the WWTP peak flows for 5-, 10-, 25-, 50- and 100-year, 24-hour frequency storms were generated.

From the collected and generated data, Peak Flow at WWTP versus Storm Magnitude and Precipitation (in/24-hr) versus Storm Magnitude graphs were plotted. From these plots a 20-year, 24-hour storm was estimated to produce about 2.5 inches of precipitation in a 24-hour period, and the WWTP would see about 18.00 MGD as the peak hour flow. The peaking factor for this storm of 4.28 was computed by dividing the WWTP’s peak hour flow by the 2010 annual average daily flow, or $18.00 \text{ MGD} \div 4.21 \text{ MGD} = 4.28$. This factor was then applied to the 2010 and 2032 hydraulic model simulation.

The effects of precipitation on a sewer system are highly variable. Some these variable factors can be summarized as follows:

- storm direction in relation to wastewater flow in the pipe system
- time of day as late night storms would coincide with minimal sewage generation
- antecedent precipitation effect of surface water conditions
- storm intensity or rate of precipitation

Sewer agencies with sewer systems that are separate from storm drainage systems are required to record overflows that occur more than once in five years. Given the variability inherent in precipitation patterns, sewer systems are usually planned and designed for storms exceeding at least a 5-year event as a safety factor. A 20-year event is used by King County Metro as a reasonable balance between the cost of additional, rarely used wastewater capacity, and containment of most storm events.

Accordingly, the peaking factors were derived from the 2010 annual average day flow of 4.21 MGD as shown in Table 5-5.

Table 5-5 Wastewater Flow Peaking Factors 2010 Daily Monitoring Reports Data	
Maximum Day of 12.75 MGD (50-year event)	= Average Day (4.21 MGD) x 3.03
Minimum Day of 2.78 MGD	= Average Day (4.21 MGD) x 0.66
Average Day Max Month of 5.37 MGD	= Average Day (4.21 MGD) x 1.28
Peak Hour of 18 MGD	= Average Day (4.21 MGD) x 4.28

These peaking factors were used to calibrate the hydraulic model and to project future hydraulic conditions with the resulting flows reaching the wastewater treatment facilities.

5.4 Infiltration and Inflow Study

The *Lynnwood Infiltration and Inflow Study* was completed in March 2011 by Gray & Osborne. The conclusions therein were based on monitoring using 12 flow meters covering most of the City sewer system from late December 2008 into March 2009. Figure 5-3 shows the schematic of the flow monitoring program.

As often happens during flow monitoring studies, some data gaps exist due to various issues. And flows recorded by one meter may not agree with data from other meters. However, the resulting data is sufficient to define some differences between the flow monitored areas.

The average day flow recorded at the WWTP from late December 2008 through early March 2009 was about 4.1 MGD. Subtraction of 14 percent as the contribution received from Edmonds leaves about 3.65 MGD as originating from the City of Lynnwood sewers.

Flow Meters 2, 4, 8, 10 and 11 contribute directly to the 76th Avenue trunk sewer. The numerical sum of the average day flow recorded for these meters was about 3.94 MGD. A significant area contributed directly to the 76th Avenue trunk, which was monitored by Flow Meter 12. However, recorded flow for Meter 12 does not agree with the upstream tributary meters or with the WWTP flow record. Accordingly, the metered flows have been adjusted proportionally so the total average flow for the metered period agrees with the DMR record.

The *Study* does not reference any calibration effort for any meters so the absolute flow rate as measured for any meter may or may not be reliable, and the relationships between various meters may not be precise either. Never-the-less, a number of general relationships can be discerned from the *Study* as summarized in Table 5-6.

Table 5- 6 Average Day Flow Monitoring Relationships				
Flow Meter	Acres	Average MGD	GPD/Acre	Ratio to Average Day
1	338	0.221	655	0.9
2	356	0.268	752	1.0
3	320	0.425	1,296	1.7
4	511	0.275	539	0.7
5	250	0.113	454	0.6
6	722	0.536	742	1.0
7	285	0.188	659	0.9
8	463	0.562	1,213	1.6
9	464	0.408	880	1.2
10	285	0.081	274	0.4
11	110	0.087	795	1.1
12	786	0.505	642	0.9
Totals	4,900	3.66	745	1.0

Under the 'Average Day' heading, the value shown as 'GPD/Ac' indicates the relative development density. Flow Meters 3 and 8 monitored the most densely developed areas. Flow Meter 5 monitored the least dense.

The charts presented in the Study show diurnal variations, which allow the minimum flow for each meter to be identified. The difference between the average day recorded for each meter and the minimum is essentially the sewage flow originating in that metered area. The minimum flow therefore approximates infiltration as summarized in Table 5-7.

Table 5-7 Infiltration Relationships among Monitoring Basins				
Flow Meter	Acres	Min MGD	GPD/Acre	Ratio to Average Day
1	338	0.091	271	0.9
2	356	0.109	308	1.0
3	320	0.171	536	1.7
4	511	0.147	288	0.9
5	250	0.041	166	0.5
6	722	0.201	278	0.9
7	285	0.077	269	0.9
8	463	0.219	472	1.5
9	464	0.165	356	1.2
10	285	0.036	121	0.4
11	110	0.027	242	0.8
12	786	0.205	261	0.9
Totals	4,900	3.66	306	1.0

Flow Meter 10 shows the smallest infiltration rate per acre. This is corroborated by the 'Ratio' value of 0.4 which is the 'GPD' for 'Minimum Day' divided by the 'GPD' for 'Average Day'. In contrast, Flow Meters 3 and 8 recorded the highest 'GPD/Ac' value and the most deviation from average day MGD with a 'Ratio' of 1.7 and 1.5. These monitored basins may warrant closer evaluation for pipe system defects.

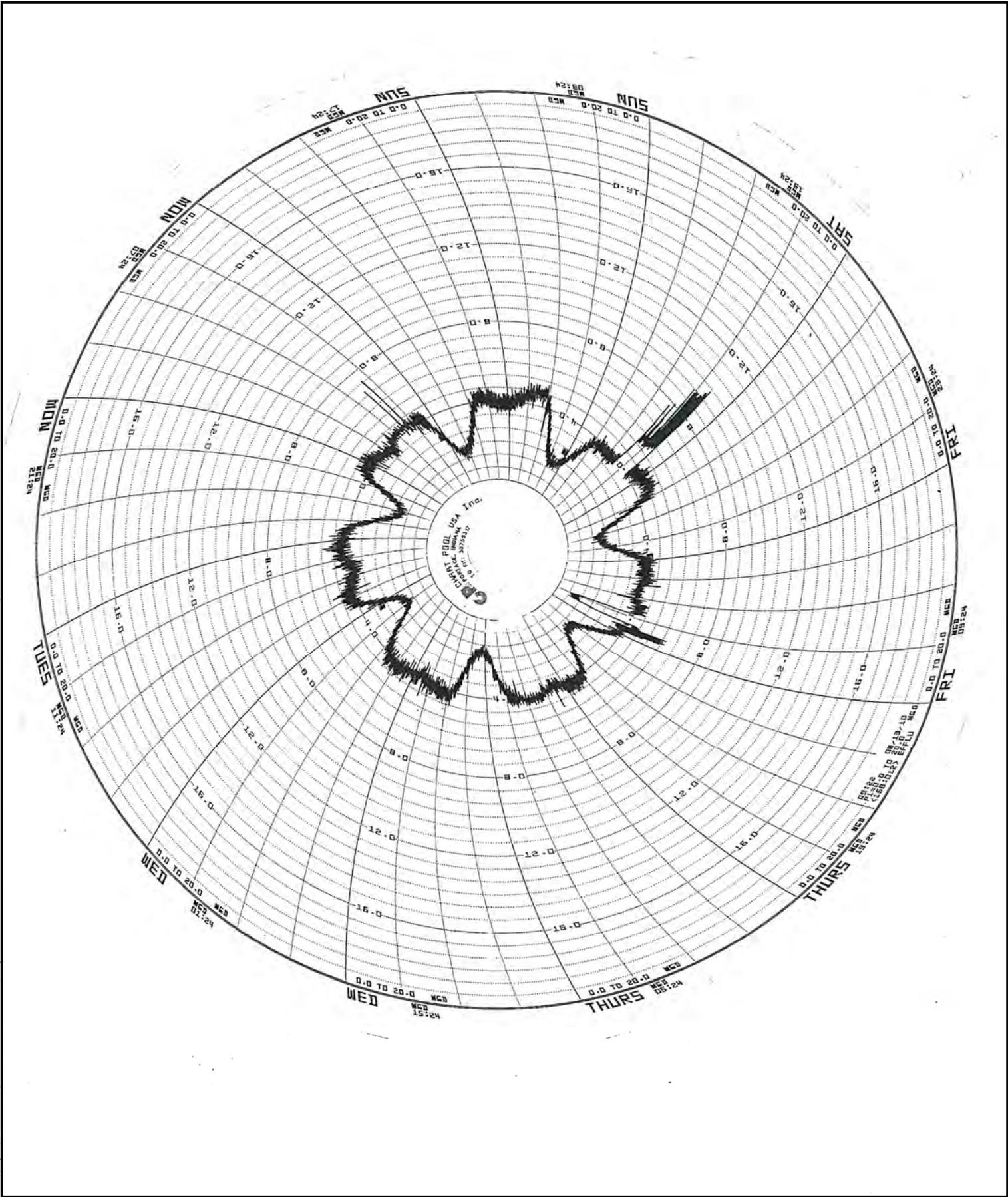
The meter record also identifies peak flows. The largest storm recorded during the metered period occurred on 12 January 2009 as 0.9 inches over 24 hours. The WWTP record the flow as 7.56 MGD. Subtraction of the sewage and infiltration flow components from each meter record approximates the rain-induced flow as summarized in Table 5-8.

Table 5-8 Rain-Induced Relationships among Monitoring Basins				
Flow Meter	Acres	Maximum MGD	GPD/Acre	Ratio to Average Day
1	338	0.324	254	0.4
2	356	0.634	303	0.5
3	320	1.008	1,756	2.9

Table 5-8 Rain-Induced Relationships among Monitoring Basins				
4	511	1.656	423	0.7
5	250	0.310	752	1.2
6	722	----	----	---
7	285	0.302	351	0.6
8	463	1.512	1,525	2.5
9	464	0.590	325	0.5
10	285	0.936	1,390	2.3
11	110	0.140	418	0.7
12	786	----	----	----
	4,900	3.000	612	1.0

Flow Meter 6 failed during the monitoring period and did not record the January 12th event. Since flows recorded by Meter 12 do not correlate with other records, flows shown in Tables 5-7 and 5-8 were derived by interpolating available records. Storm effects are judged too tenuous for such derivations to be useful in Table 5-8.

Flow Meters 3, 8 and 10 recorded large 'GPD/Ac' values. These three monitoring basins also showed large 'Ratio' values indicating wastewater flow during storm events was much higher than on average days. These results indicate high rain-induced inflow reaching the sewers. These basins warrant further study to identify direct connections to the sewer such as roof drains, storm inlets, flooding manholes or sewer pipe defects



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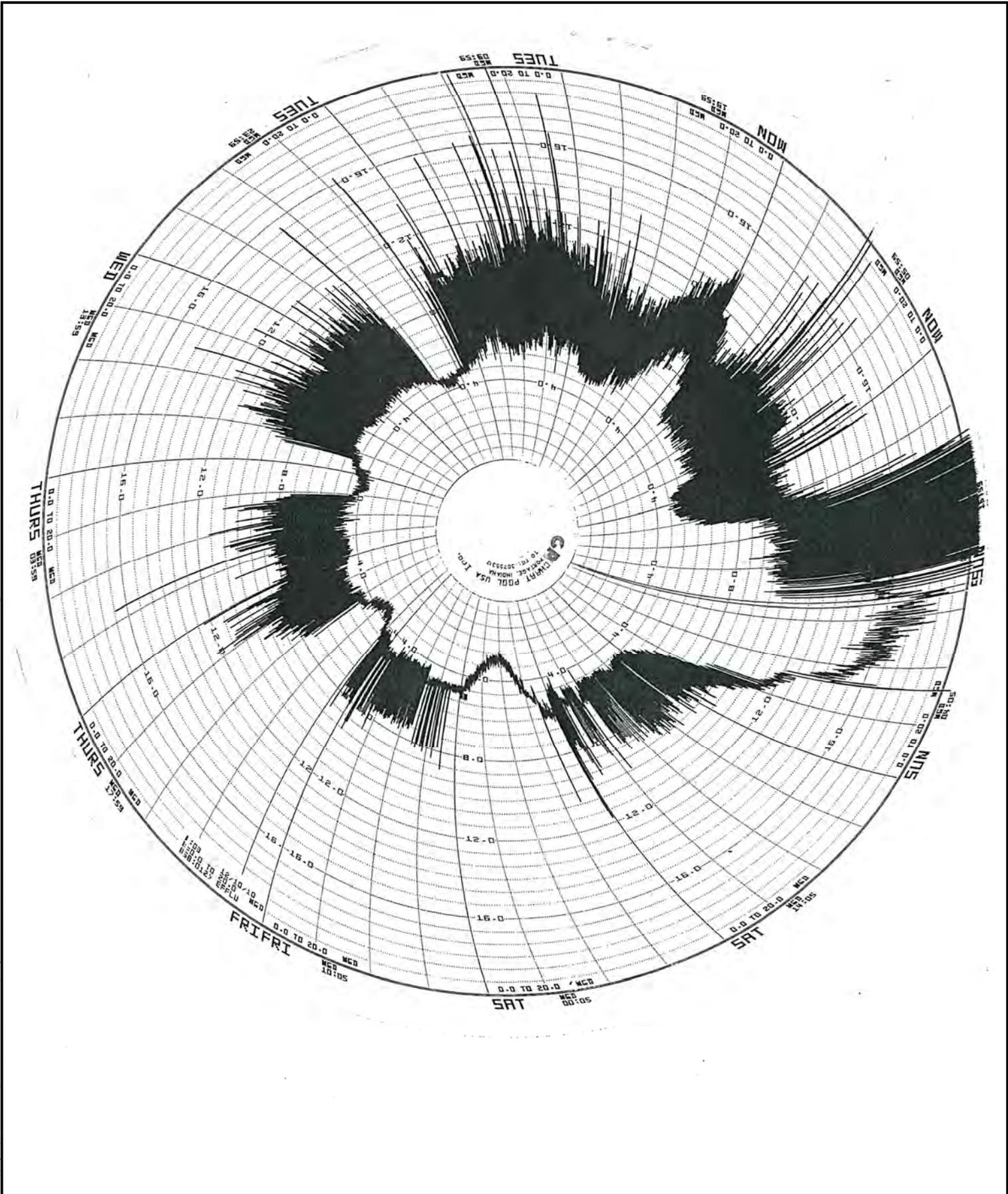


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MINIMUM DAY
RECORDED FLOW
City of Lynnwood
2012 Wastewater
Comprehensive Plan Update
August 2012

Figure
5-1



P:\Mapping\Maps - Generated\Lynnwood\11-10238-01\011\maps\Fig 5-2 Maximum Recorded Flow 8.5x11.mxd 9/9/2012 ctolemino

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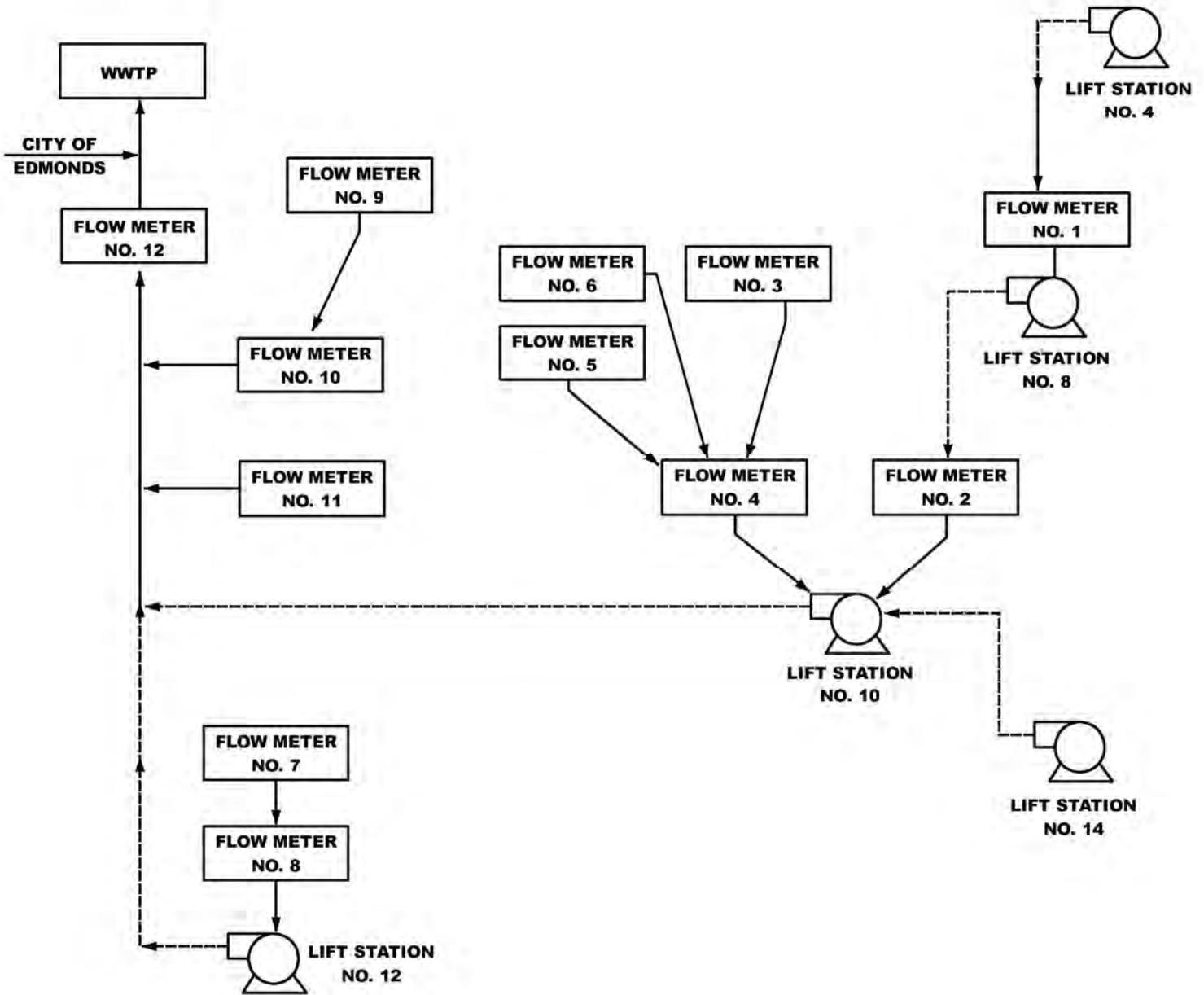
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**MAXIMUM DAY
 RECORDED FLOW**
 City of Lynnwood
 2012 Wastewater
 Comprehensive Plan Update
 August 2012

Figure
 5-2

PMMapping\Map3_Generated\Lynnwood\11-10238_01\01\1\maps\Fig 5-3 Flow Monitor Schematic 8.5x.11.mxd 8/16/2012 ctolemino



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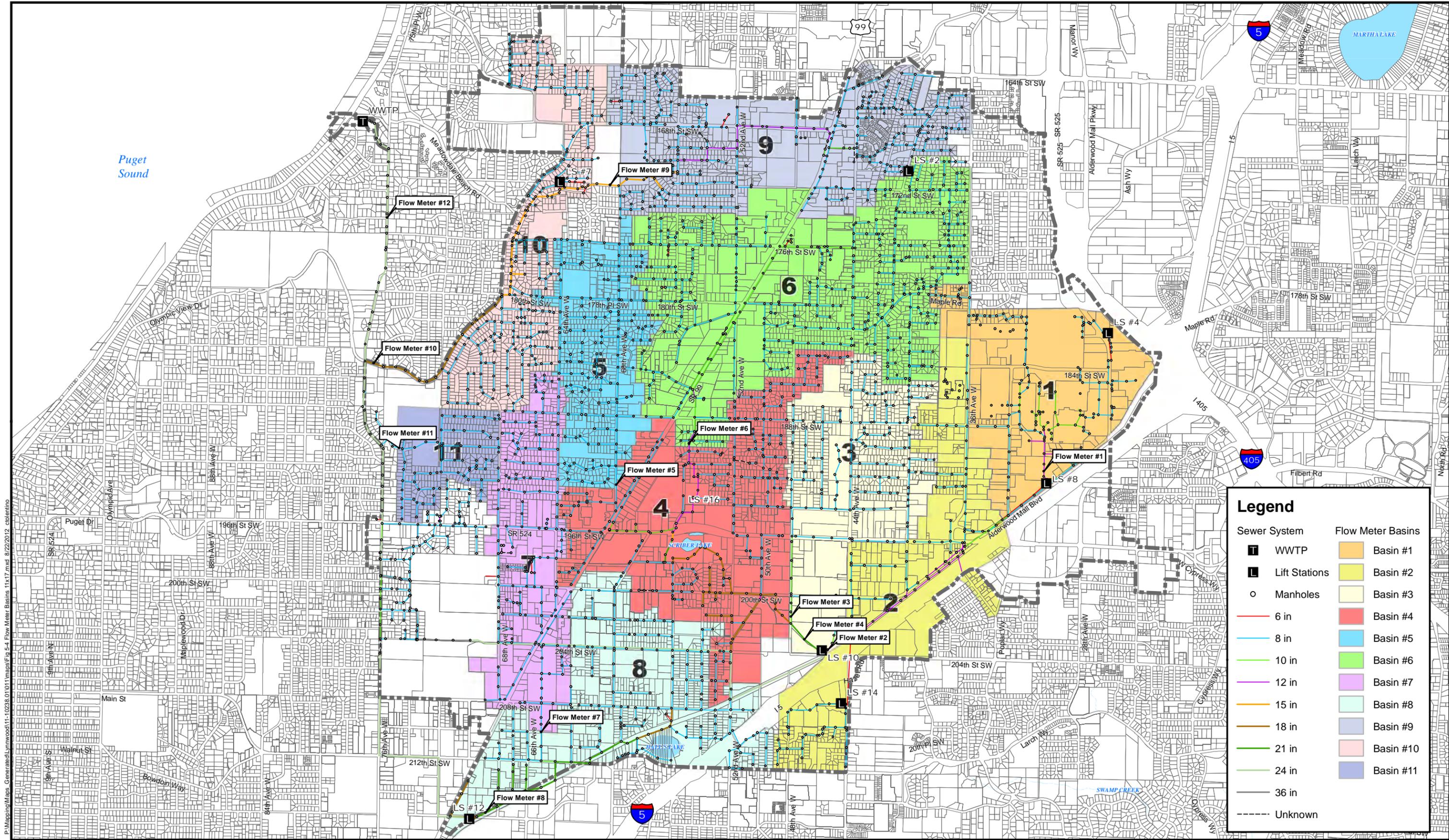
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SCHEMATIC**
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2012 Wastewater
Comprehensive Plan Update
August 2012

Figure
5-3



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Sewer System: City of Lynnwood March 2011
Flow Meter Basins: G&O March 2011 I&I Study
GIS Base Data: Snohomish County
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