CITY OF RENTON

LONG-RANGE WASTEWATER MANAGEMENT PLAN

FINAL | July 2022

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City of Renton
Long-Range Wastewater Management Plan

REPORT

FINAL | July 2022

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Abbreviations

AACE	American Associate of Cost Estimators
ADS	ADS Environmental Services, LLC
ADU	Accessory Dwelling Unit
ADWF	average dry weather flow
APA	Aquifer Protection Area
APWA	American Public Works Association
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing Methods
AWWA	American Water Works Association
BOD	biochemical oxygen demand
BWF	base wastewater flow
CCTV	closed-circuit television
CAD	computer-aided design
CALAMAR	Calcul de lames d'eau a l'aide du radar
Carollo	Carollo Engineers, Inc.
CAS	Corrugated aluminized steel
CD	Center Downtown
cfs	cubic feet per second
CIPP	Cured-in-place pipe
City	City of Renton
CI	cast iron
CIWEM	Chartered Institution of Water and Environmental Management
CIP	capital improvement program
CMMS	Computerized Maintenance Management System
CO	Commercial Office
CP	concrete pipe
CRWSD	Cedar River Water and Sewer District
CV	Center Village
d/D	diameter ratio
DHI	Danish Hydraulic Institute
DI	Ductile iron
DIP	ductile iron pipe
du/net acre	dwelling units per net acre
DUIP	Downtown Utility Improvement Project
DWF	dry weather flow
ECM	Enterprise Change Management
Ecology	Department of Ecology

E/G	engine generator
EIS	Environmental Impact Statement
ENR	Engineering News Report
EPA	Environmental Protection Agency
FM	force main(s)
FOG	fats, oil and grease
ft	foot/feet
GIS	Geographic Information System
GMA	Growth Management Act
GMPC	Growth Management Planning Council
GPAD	gallons per acre per day
GWI	groundwater infiltration
gpm	gallons per minute
HDPE	high-density polyethylene
HGL	hydraulic grade line
hp	Horsepower
IACC	Infrastructure Assistance Coordinating Council
I/I	Infiltration and Inflow
ID	Identification
KC	King County
KCBHRR	King County Board of Health Rules and Regulations
lf	linear feet
Lake Line	Kennydale Lake Line Sewer System
LEHD	Longitudinal Employer Household Dynamics
LID	Local Improvement District
LN	lined pipe
LRWWMP	Long-Range Wastewater Management Plan
M	Million
mgd	Million gallons per day
MH	manholes
mi^2	square miles
N/A	not applicable
NACWA	National Association of Clean Water Agencies
NASSCO	National Association of Sewer Service Companies
NE	Northeast
NEPA	National Environmental Policy Act
O&M	operations and maintenance
OERP	Overflow Emergency Response Plan
OMP	Operations Master Plan

OSS	on-site system
PAA	Potential Annexation Area
PACP	Pipe Assessment Certification Program
PE	Person Equivalent
PSC	pre-stressed concrete pipe
PSRC	Puget Sound Regional Council
Public Works	Public Works Department
PWTF	Public Works Trust Fund
PWWF	peak wet weather flows
PVC	polyvinyl chloride
R&R	repair and replacement
RMC	Renton Municipal Code
RMF	Residential Multi-Family
ROW	right-of-way
RPM	revolutions per minute
RSD	Road Services Division
RUL	remaining useful life
RWSP	Regional Wastewater Services Plan
SAD	Special Assessment District
SCADA	supervisory control and data acquisition
SDC	system development charges
SEPA	Washington State Environmental Policy Act
SE	Southeast
SSO	sanitary sewer overflows
SW	Southwest
SWD	Solid Waste Division
TAZ	Traffic Analysis Zone
TDH	total dynamic head
TM	Technical memoranda
UC	Urban Center
UGA	Urban Growth Area
UGB	Urban Growth Boundary
US	Urban Separator
VCP	vitrified clay pipe
VMAC	Virginia Mason Athletic Center
WA	Washington
WAC	Washington Administrative Code
WEF	Water Environment Federation
WRRM	Wastewater Revenue Requirement Model

WSPU	Water System Plan Update
WWF	wet weather flow
XXX	Unknown Material
yrs	years

EXECUTIVE SUMMARY

ES.1 Introduction

The City of Renton (City) is updating its Long-Range Wastewater Management Plan (LRWWMP) to provide a road map for redevelopment while maintaining a high level of service for existing customers. The existing system is aging and will continue to require investment to maintain a high level of service. The LRWWMP is intended to provide the City with a "living" plan that can be used and adapted to assist in decision making for the next 20 years.

This LRWWMP was prepared in accordance with requirements of Washington Administrative Code (WAC) 173-240-050, which is administered by the Washington State Department of Ecology (Ecology), and meets the requirements of the Washington Growth Management Act (GMA).

This chapter presents the objectives of this LRWWMP, and a brief overview of the City's wastewater collection system. A list of abbreviations is provided in the Table of Contents to assist the reader in understanding the information presented in this LRWWMP.

ES.2 Overview of Existing Sewer System

Chapter 2 – Overview of Existing Sewer System provides a description of the City's existing collection system and an inventory of the City's assets. The City's collection system consists of approximately 247 miles of gravity sewer, 6.8 miles of force mains, and 20 pump stations that collect and convey wastewater to King County's (KC) Interceptors. These interceptors convey the City's flow to the KC owned and operated South Treatment Plant.

Each pump station is described in this chapter to provide framework for the condition assessment and any related Capital Improvement Program project. Additionally, other components of the system are broken down such as materials and diameters of the total gravity sewer system. The City's collection system is shown in Figure ES.1.

ES.3 Operational Policies and Criteria

Polices and criteria regulate the manner that the City operates and plans for its future. The City's policies and criteria are detailed in the Renton Municipal Code, the Comprehensive Plan, City ordinance, and through adoption of this and other plans. The following policies and criteria are summarized in Chapter 3 – Operational Policies and Criteria:

- Customer Service Objective.
- Planning Objective.
- Service Area Extension Objectives.
- Financial Objective.
- Facility Objective.
- Operations Objective.

ES.4 Planning Considerations

Chapter 4 – Planning Considerations and Technical Memorandum (TM) 1 describe the City's land use policies and demographic projections that are used to develop future wastewater flow projections. The City's land use policies and sewer system are connected with adjacent sewer systems' policies and systems including the KC interceptors and serving small areas of Kent and Tukwila. Existing land use provides the basis for designing properly sized sewage facilities, including trunks, interceptors, and lift stations. In most cases the City's sewers are downstream, or at the receiving end of the effluent, from the systems adjacent to the City. Therefore, proper planning for the City's sewers requires that the plans of these adjacent utilities be evaluated.

In addition to adjacent utility plans, the land use plans and policies of KC and the Growth Management Planning Council (GMPC) were also considered. As discussed below, the entire planning area is within the Urban Growth Boundary (UGB) established by the GMPC. The City supports the countywide framework policies (F-255 and F-102) that call for the designated Urban Area to be served with sanitary sewers and prefers cities as the provider of sewer services. The entire study area has been designated Urban by the 2012 King County Comprehensive Plan with 2013 Amendments.

Two planning periods are evaluated in this LRWWMP:

- Existing system.
- Build-out.

The existing system is defined as the 2012 sanitary flows calibrated with 2018 flow data. Currently, build-out is projected at 2040. Evaluations are performed for both average dry weather flow (ADWF) and peak wet weather flows (PWWF). A summary of the modeled total ADWF and PWWF flows for metered basins, for each planning period is shown in Table ES.1.

Table ES.1 Existing and Projected Modeled Wastewater Flows

Flow Condition	Existing Conditions	Build-out Conditions
ADWF (mgd)	8.50	13.3
PWWF (mgd)	54.2	64.74
Peaking Factor	6.38	4.87

Note:
Abbreviation: mgd – million gallons per day.

ES.5 System Analysis and Results

As growth occurs, additional customer flows can exceed sewer capacity. Future growth is anticipated and is modeled through the existing hydraulic model of the collection system. The model was used as a basis to perform a capacity analysis. Based on the severity of the deficiencies identified, the most probable cause and the location, four types of recommendations were developed to mitigate or confirm these problem areas:

- Additional long-term depth monitoring.
- Infiltration and Inflow (I/I) Evaluation: Micro-monitoring for areas with elevated I/I.
- Piping reconfiguration.
- Programmatic upsizing.

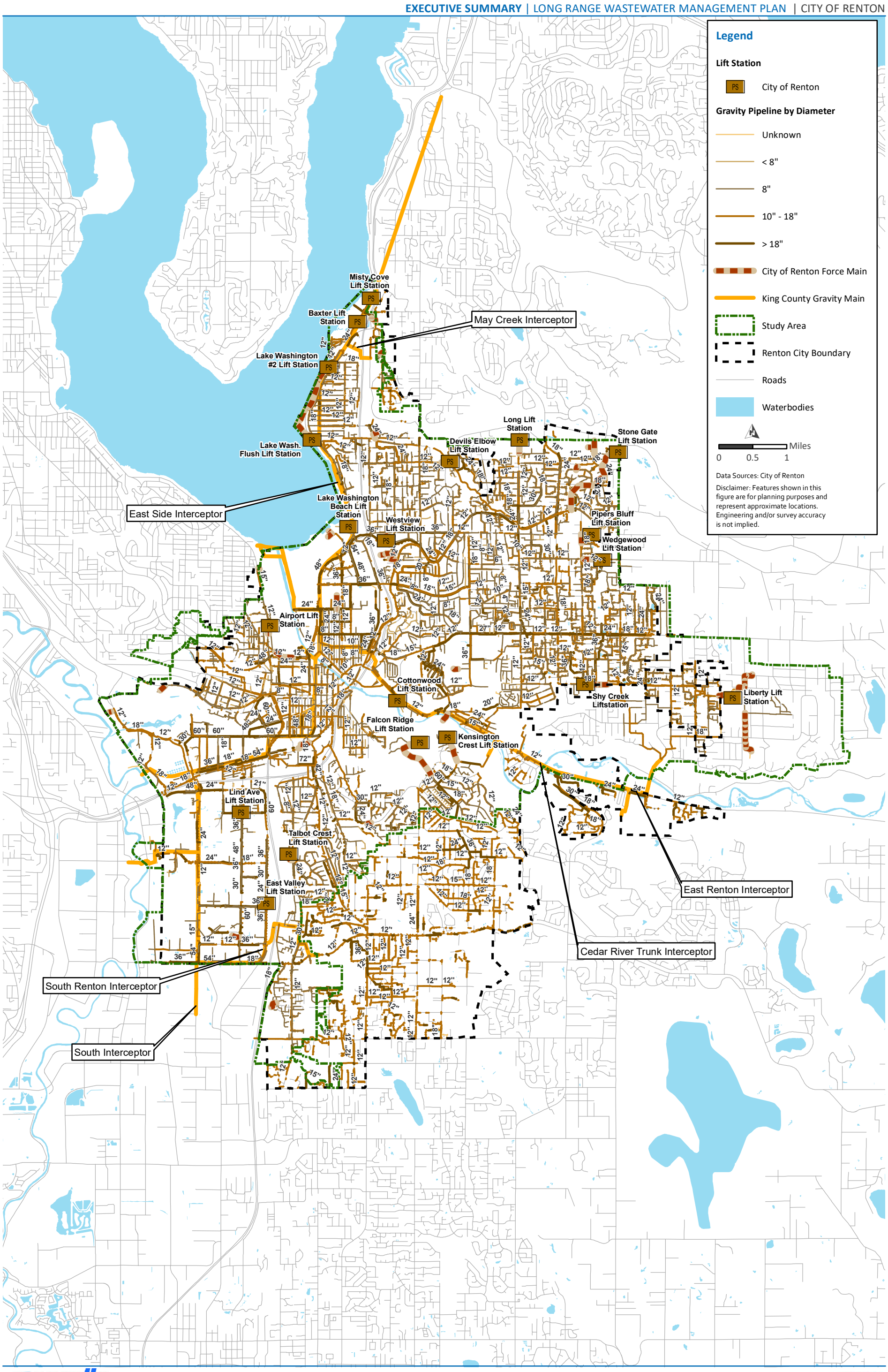

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Figure ES.1
Existing System

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Capacity deficiencies and proposed improvements to provide sufficient capacity for future development are detailed below in Table ES.2.

Table ES.2 Deficiency Recommendations

Deficiency ID[(1)]	Reason Deficient	Condition Risk	Recommend
05A	Capacity	High	Depth Monitoring
45A	Capacity	High	I/I Evaluation
7A	Capacity	Moderately High	I/I Evaluation
2A	Capacity	Moderately High	I/I Evaluation
3A	Capacity	Moderately High	I/I Evaluation
46A	Capacity, diameters change	High	Depth Monitoring
37A	Negative slopes	High	Piping Reconfiguration
48A	Capacity, grade change	High	Depth Monitoring
24A	Negative slopes	High	Piping Reconfiguration
20B	Capacity, shallow slope	Low	Programmatic Upsizing
20A	Capacity, shallow slope	Low	Programmatic Upsizing
22A	Capacity, diameters change	High	Depth Monitoring
21A	Capacity, shallow slope	Moderately High	Depth Monitoring
41A	Capacity, shallow slope	Moderately High	I/I Evaluation
23A	Capacity	Moderately High	Programmatic Upsizing
15A	Capacity	High	Depth Monitoring
14A	Capacity	High	Depth Monitoring
BA	Pump Station backwater	High	Programmatic Upsizing or Pump Station Improvements
05B	Capacity	High	Depth Monitoring or I/I Evaluation
05C	Capacity	Moderately High	Depth Monitoring or I/I Evaluation
11A	Negative slopes	Moderately Low	Piping Reconfiguration
25A	Capacity, shallow slope	Moderately High	Programmatic Upsizing

Note:
Abbreviation: ID – identification.
(1) Deficiency ID based on associated mini basin number.

ES.5.1 Hydraulic Modeling Overview

The City's collection system hydraulic model was constructed using a multi-step process utilizing data from a variety of sources. The latest version (2016) of Danish Hydraulic Institute's (DHI) Mike Urban was used to update the hydraulic model. The City conducted temporary flow monitoring to gain a better understanding of flows in the service area and calibrate hydraulic model predicted flows to actual collection system flows. Additional information on the modeling calibration is provided in Appendix H, TM 2.

ES.5.2 Capacity Criteria

The primary criterion used to identify capacity-deficient trunk sewers was the maximum flow depth to pipe diameter ratio (d/D) less than or equal to one. The d/D value is defined as the depth (d) of flow in a pipe during peak flow conditions divided by the pipe's diameter (D).

ES.5.3 Capacity Evaluation

The capacity evaluation was performed for the system, Existing and Build-out, under a 20 to 30 year design storm. Sewer improvements were sized to a d/D of 2, to prioritize improvements for the most serious surcharging. For such large design storms much of the system surcharges and improvements for all surcharging was infeasible.

ES.6 Replacement and Rehabilitation Program

Chapter 6 – Replacement & Rehabilitation Program documents the City's prioritized collection system repair and replacement (R&R) program. R&R prioritization is based on a risk, which identifies the criticality and vulnerability of an asset. Criticality represents the consequence of failure, and the vulnerability represents the likelihood of failure. A consistent approach is used to identify and prioritize force mains, lift stations, and gravity mains.

The risk associated with an asset (pipe, manhole, pump, etc.) is a measure of the impact of asset failure on the overall system. Risk is calculated as the product of criticality and vulnerability, or:

$$\text{Risk} = \text{Criticality} \times \text{Vulnerability}$$

Both force mains and lift stations were analyzed together. The criticality, vulnerability, and risk ratings for each force main and lift station were quantified on a relative risk scale, with one representing the lowest risk and four representing the highest risk. Each lift station and its corresponding force main's calculated risk are shown below in Table ES.3.

Table ES.3 Risk Matrix for Lift Stations

Normalized Risk Ranking					
Vulnerability Level	4 (severe)				Lake WA No. 2 Lake WA Flush
	3 (moderate)		Talbot Crest	Devil's Elbow Kensington Crest	
	2 (low)	East Valley Shy Creek		Long Wedgewood	
	1 (negligible)	Falcon Lind Avenue Westview Liberty	Lake WA Beach Cottonwood Pipers Bluff	Baxter Stonegate	Airport Misty Cove
		1 (negligible)	2 (low)	3 (moderate)	4 (severe)
		Criticality Level			

Note:
Abbreviation: WA – Washington.

Using TM 3 – Pipe Risk Approach and Procedures from the Closed-Circuit Television (CCTV) Phase 2 Project, gravity sewer risks were calculated similarly. Table ES.4 shows the final result of the normalized risk ranking for the City's pipe.

Table ES.4 Risk Matrix for Length of Gravity Mains (ft)

Normalized Risk Ranking					
Vulnerability Level	4 (severe)	1,805	7,061	10,061	2,935
	3 (moderate)	44,840	63,075	103,884	44,551
	2 (low)	76,510	100,541	148,925	58,546
	1 (negligible)	210,622	180,371	186,199	61,306
		1 (negligible)	2 (low)	3 (moderate)	4 (severe)
		Criticality Level			

ES.7 Operations and Maintenance

Regular Operation and Maintenance (O&M) is required to provide effective and efficient maintenance services for utility rate payers. Delayed O&M may contribute to adverse sewer events, including sewer backups, sanitary sewer overflows (SSOs), pipe breaks, etc. Chapter 7 – Operations & Maintenance considers the City's existing and planned O&M activities and programs and provides recommendations to improve existing or address future needs. These activities are greater than the current level of service; therefore, additional workforce may be required in the future to meet City goals.

ES.8 Capital Improvement Program

Chapter 8 – Capital Improvement Program of the LRWWMP assesses the City's ability to fund the recommended improvements from Chapter 5 – System Analysis and Results and Chapter 6 – Replacement and Rehabilitation Program detailed in Tables ES.2, ES.3, and ES.4. The projects include a financial status of the sewer utility, funding required to finance the scheduled improvements, updating the system development charges (SDC), potential funding sources, and the impacts of sanitary sewer improvements on sewer rates.

To aid in finding individual projects, projects have been separated in sections by facility type:

- "LS" = Lift Station.
- "P" = Pipeline.
- "G" = General.

Figure ES.2 displays the various facility types of capital improvement program (CIP) allocation.

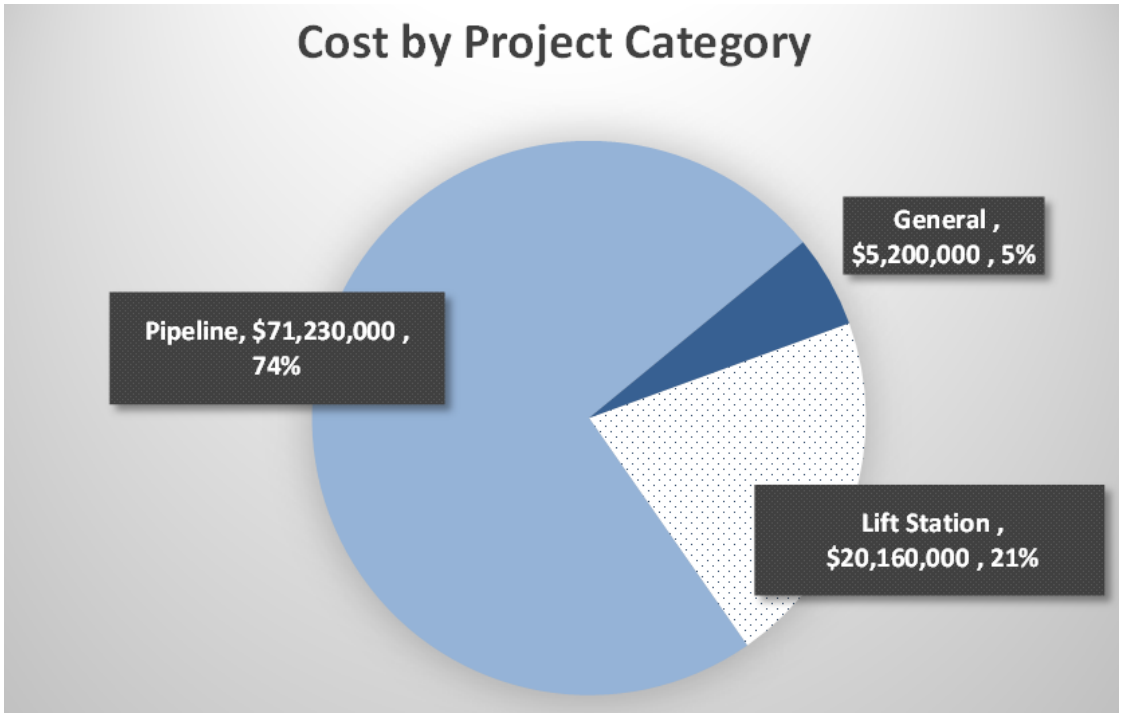

Figure ES.2 Cost by Facility Type

ES.9 Financial Analysis

A Wastewater Revenue Requirement Model (WRRM) was conducted in 2018 to analyze the future finances of the City. The LRWWMP's CIP differs from the WRRM CIP; therefore, the LRWWMP analyzed the City's financial capacity to implement the LRWWMP CIP. This analysis showed the City has the financial capacity to execute the LRWWMP CIP. Differences between the 2018 WRRM and LRWWMP CIP timing will create larger drawdowns of the reserve fund in the coming years, but still remain above the City's minimum requirements. By 2025 it is expected that the reserve fund will begin building up again.

The City is not committed to CIP spending summarized in the LRWWMP. Per the City budgeting policy, the Utility's spending is based on a biannual budget approved by the City Council. Due to COVID-19, short term revenue could not be predicted, but it is expected that this will likely not heavily impact any long-term analysis. If reductions in revenue persist due to COVID-19 or other economic factors, then CIP projects may be delayed.

Chapter 1
INTRODUCTION

1.1 Introduction

The purpose of the City of Renton's (City) Long-Range Wastewater Management Plan (LRWWMP) is to present policy and an assessment of the system to recommend facility improvements. The LRWWMP is intended to provide a road map for redevelopment and maintaining a high level of service for existing customers. The existing system is aging and will continue to require investment to maintain a high level of service. The LRWWMP is intended to provide the City with a "living" plan that can be used and adapted to assist in decision making for the next 20 years, both financially and for infrastructure capacity and condition.

The LRWWMP results from an evaluation of the existing sanitary sewer system which provides the groundwork for recommendations to resolve existing deficiencies and concerns, as well as accommodating growth. This chapter presents the objectives of this LRWWMP, and a brief overview of the City's wastewater collection system. A list of abbreviations is provided in the Table of Contents to assist the reader in understanding the information presented in this LRWWMP.

This LRWWMP and recommended improvements were prepared in accordance with requirements of Washington Administrative Code (WAC) 173-240-050, which is administered by the Washington State Department of Ecology (Ecology), and meets the requirements of the Washington Growth Management Act (GMA).

1.2 Background and Goals

The City is located in King County (KC), near Seattle, Washington. It is southeast of downtown Seattle and adjacent to Lake Washington and the Cedar River, as shown in Figure 1.1. The City owns and operates most of the sewer collection system within the City limits, as well as in nearby jurisdictions including Kent, Tukwila, and incorporated KC. The City discharges wastewater to the KC Interceptor where it is conveyed to KC's South Treatment Plant located in the City.

This LRWWMP is the fourth of plans developed previously in 1992, 1998, and 2010. The LRWWMP was prepared over six years from 2015 with plans for approval in 2020 but wasn't approved till 2022. The LRWWMP provides a recognized framework for making decisions about Renton's sanitary sewer service area which includes properties both inside and outside the City limits. It is intended to aid decision-makers as well as users, including the Wastewater Utility, City Council members, the Mayor, City staff, builders, developers, community groups, and other government agencies. The LRWWMP is a useful tool in the following ways:

- As a framework for improvements and operations that govern sanitary sewer system developments in the Renton Wastewater Utility service area. The LRWWMP provides a basis for the following:
  - Allocating improvements.
  - Allocating costs to new sanitary sewer system users.

- To provide guidelines for improving the existing system to maintain a high quality of service at a reasonable cost.
- To provide a basis of accommodating changes that occur which can't be forecasted. To this end, the LRWWMP lists policy issues and operational criteria that can be used to developed alternatives and directions for development, improvements, and operations.

1.3 Referenced Documents

This update to the LRWWMP is inspired by the need to provide constant evaluation of the sewer system and operating policies in order to meet the needs of the customers and to ensure compatibility with the City's comprehensive plans.

The following documents were referenced in the preparation of this LRWWMP:

- King County Comprehensive Plan 2016 (King County, Updated October 2018). Establishes an overall direction for land use planning in KC. Note, land use used in the hydraulic modeling was based on the 2012 Plan.
- Criteria for Sewage Works Design (Ecology, 2008). Provides guidance for the design of municipal sewer systems and establishes minimum requirements in the State of Washington.
- King County Countywide Planning Policies (King County, December 2012 Amended June 2016). Provides framework for comprehensive plans for KC and cities within KC.
- Washington Administrative Code, Title 173. Defines the structure of general sewer plans.
- Stantec 2015 Model Update Report.
- City of Renton 2010 Long-Range Wastewater Management Plan.
- City of Renton 2015 Comprehensive Plan Amended December 2018.
- King County Board of Health Code and Regulations.
- City of Tukwila 2015 Comprehensive Plan.
- City of Kent 2015 Comprehensive Plan.

1.4 Washington State Requirements

The primary purpose of this LRWWMP is to develop a "living" document that is flexible and can be readily modified to respond to ongoing redevelopment. The major objectives of the LRWWMP are to identify capacity deficiencies in the wastewater collection system, develop feasible alternatives to correct these deficiencies, and plan the infrastructure that will serve future development.

The goals of this LRWWMP, to meet the requirements from the Washington State Criteria for Sewage Works Design, include:

- Prepare the LRWWMP in compliance with WAC Chapter 173-240-050.
- Prepare the LRWWMP to be consistent with KC Code 28.84.050 (pages 28-50). The purpose and need for the proposed plan.
- Consideration of reclaimed water in compliance with RCW 90.48.112.
- Consideration of water conservation measures in compliance with RCW 90.48.495.

Each WAC requirement is detailed in Table 1.1 as well as the location within the plan.

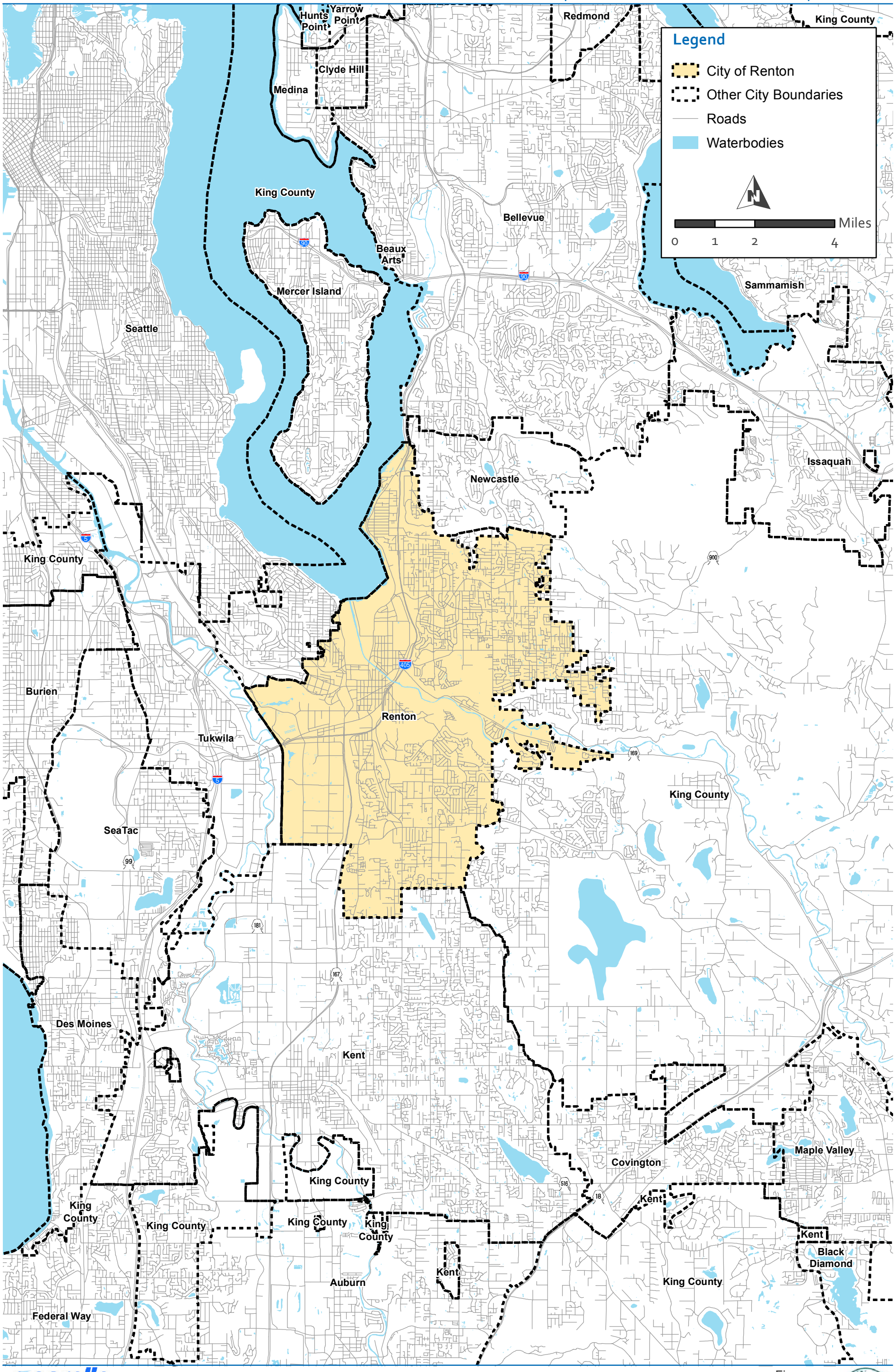

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Figure 1.1
Vicinity Map

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Table 1.1 WAC Plan Requirements

Requirement	Location in Plan
Purpose and need for the proposed plan.	Chapter 1
Discussion of who will own, operate, and maintain the system.	Chapter 2
Existing and Proposed Service Boundaries.	Chapter 2
Layout map including: • Proposed sewers and areas proposed to be served by each. • Boundary lines of municipality or district and vicinity. • Existing sewers and areas served by each. • Topography and elevations of existing and proposed ground. • Information on streams, lakes, other bodies of water, and discharges. • Information on water systems.	 Figures 2.1 and 2.2 Figure 1.1 Figure 2.2 Figure 2.3 Figure 2.4 Figure 2.4
Population trends and methods used to determine those trends.	Table 4.1
Information on existing wastewater facilities in the area.	Chapter 2
Discussion of infiltration and inflow problems.	Chapter 5
Discussion of the provisions for treatment, discharge, and reuse.	Not included, all service performed by KC
Information on facilities producing industrial wastewater.	Chapter 5
Information on existing wells or other water supply sources.	Chapter 2
Discussion of alternatives evaluated and alternatives chosen.	Chapter 6, Chapter 8
Information on existing and proposed cost per service.	Chapter 9
Statements regarding compliance with SEPA and, if applicable, NEPA.	Appendix A
Consideration of reclaimed water (RCW 901.48.112).	Chapter 2
Consideration of water conservation measures (RCW 90.48.495).	Chapter 2

Note:
Abbreviations: SEPA – Washington State Environmental Policy Act; NEPA – National Environmental Policy Act.

As noted in Table 1.1, provisions for treatment, discharge, and reuse are not included in the LRWWMP. The King County Service Agreement states that King County will provide all service to Renton and is the responsibility of King County to receive all flows.

1.5 Report Organization

This LRWWMP contains nine chapters, followed by appendices that provide supporting documentation for the information presented in the report. The chapters are briefly described below:

Chapter 1 – Introduction: This chapter presents the need for this LRWWMP and the objectives of the study. Lists of abbreviations and reference materials are also provided to assist the reader in understanding the information presented.

Chapter 2 – Overview of Existing Sewer System: This chapter describes the existing wastewater collection system.

Chapter 3 – Operational Policies and Criteria: This chapter presents the policies for ownership, operations, and maintenance of the collection system. It also reviews the criteria for evaluating the wastewater collection system.

Chapter 4 – Planning Considerations: This chapter presents a description of the study area, defines the planning horizon for this study, and summarizes the land use classifications. Lastly, this chapter summarizes the methodology and results for estimating existing and future sanitary sewer flows resulting from the flow monitoring program.

Chapter 5 – System Analysis and Results: This chapter discusses hydraulic evaluation of the wastewater collection system.

Chapter 6 – Replacement and Rehabilitation Program: This chapter describes the City's prioritized rehabilitation and replacement program.

Chapter 7 – Operations and Maintenance: This chapter presents the operational and maintenance programs from the 2012 Operations and Maintenance (O&M) Plan.

Chapter 8 – Capital Improvement Program: This chapter describes the improvements necessary to resolve existing and future deficiencies and accommodate growth. The proposed improvements are also listed by priority and project type.

Chapter 9 – Financial Analysis: This chapter evaluates the financial status of the City's water utility and the ability to finance CIP projects.

Additionally, Technical Memoranda (TMs) are included in the appendices as follows:

Appendix G – TM 1: Rain and Flow Monitoring and Projections

Appendix H – TM 2: Model Development and Calibration

Appendix I – TM 4: Risk Findings

Other appendices included are as follows:

Appendix A – SEPA Checklist

Appendix B – Agency Comment Letters and Responses

Appendix C – Approvals

Appendix D – Hydraulic Model and Deficiency Results

Appendix E – Service Agreements

Appendix F – Stantec Model Update and Capacity Analysis Report

Appendix J – Standard Plans and Specifications

Appendix K – CIP Detail Sheets

Appendix L-1 – Wellhead Protection Plan Update

Appendix L-2 – Wellhead Protection Areas and Septic Systems Map

Appendix M – Water Reclamation Evaluation Checklist

Appendix N – Approved Grinder Pump Stations for Single Family Residences

1.6 Key Issues

This LRWWMP addresses the following key issues:

- The need and timing of the replacement of older, deteriorating sanitary sewer facilities within large, neighborhood-size areas within the City.
- The evaluation of the City's system capacity to address both system deficiency and potential development.
- The evaluation of sanitary sewer lift stations and force mains for removal, rehabilitation, and replacement.
- The City's Infiltration and Inflow (I/I) program in coordination with the overall KC program to evaluate options and needs for I/I reduction.
- Review, monitoring, and coordination with the public to eliminate industrial waste and grease discharges to the sewer system.
- Implementation of recommended improvements by priority which maintains affordable rates for the system users.

Some of these issues were also addressed during preparations of the 1992, 1998, and 2010 LRWWMP.

1.7 SEPA and Approval Process

A SEPA Checklist has been prepared for this LRWWMP and is presented in Appendix A. It is anticipated that this proposed LRWWMP will not have a probable significant adverse impact on the environment and that an environmental impact statement (EIS) will not be required. However, many of the projects proposed herein will require SEPA checklists and an engineering determination will be made with each individual project.

This LRWWMP includes review by adjacent utility systems. It has also been reviewed and approved by the King County Utilities Technical Review Committee and the Department of Ecology. All comments are included in Appendix B, Agency Comment Letters and Responses.

1.8 Acknowledgements

Carollo Engineers, Inc. (Carollo) and their team members, including ADS Environmental Services, LLC, would like to acknowledge and thank the following individuals for their efforts and assistance in completing this LRWWMP. Their cooperation and courtesy in obtaining a variety of necessary information were valuable components in completing and producing this report:

- David Christensen, City of Renton, Wastewater Utility Engineering Manager.
- Don Ellis, City of Renton, Engineering Specialist – Geographic Information System (GIS).
- Joe Stowell, City of Renton, Wastewater Utility Manager.
- Ann Fowler, City of Renton, Senior Engineer.
- Richard Marshall, City of Renton, Wastewater Maintenance Manager.

Chapter 2

OVERVIEW OF EXISTING SEWER SYSTEM

2.1 Overview of Existing System

The City of Renton (City) currently provides sanitary sewer service to approximately 25.6 square miles both inside and outside the City limits. Overall, the City's collection system contains approximately 14,000 customer connections. The City's collection system is municipally owned, operated, and maintained; the system is managed by the City's Public Works Department (Public Works).

The City's collection system consists of approximately 247 miles of gravity mains (1,304,160 feet), over 6,700 manholes, 5.16 miles (27,433 linear feet [LF]) of force mains (FMs), and 20 lift stations that collect and convey wastewater to King County's (KC's) regional transmission interceptors. These interceptors convey the City's flow to the KC owned and operated South Treatment Plant for treatment.

Figure 2.1 presents the City's existing collection system. A more extensive description and analysis of the system can be found in Chapter 5 – System Analysis and Results.

2.2 System Components

The purpose of a sanitary sewer is to convey wastewater from its source to a point of treatment. Since the generation of wastewater can vary considerably, there is seldom any control over the volume of wastewater that must be conveyed at any particular time. For this reason the sanitary sewer system is designed to accommodate a wide range of wastewater flow rates.

The best method for conveying wastewater is a gravity sewer system. A gravity sewer system is made up of collector sewers, which as their name implies, collect the wastewater from the various sources. These collector sewers then convey the wastewater to interceptor sewers, which convey it to the point of treatment. The sanitary sewer system must be capable of transporting all of the constituents of the wastewater stream, which include the suspended solids, floatable solids and liquid constituents. In general, most of the floating materials are carried along with the flow stream; however, suspended solids have a tendency to settle out of the waste stream, unless minimum carrying velocities are achieved. This requires that the sanitary sewers be constructed with a minimum slope to create a gravity flow that will result in a velocity that will continuously carry the suspended solids portion of the waste stream.

Another major sewer system component, and typically the most vulnerable, is the sewage lift station. A lift station is needed when the sanitary sewer system must overcome topographic restrictions that make it impossible or financially unfeasible to construct a gravity sewer. However, some lift stations are temporary, used only until the gravity sewer system can be built.

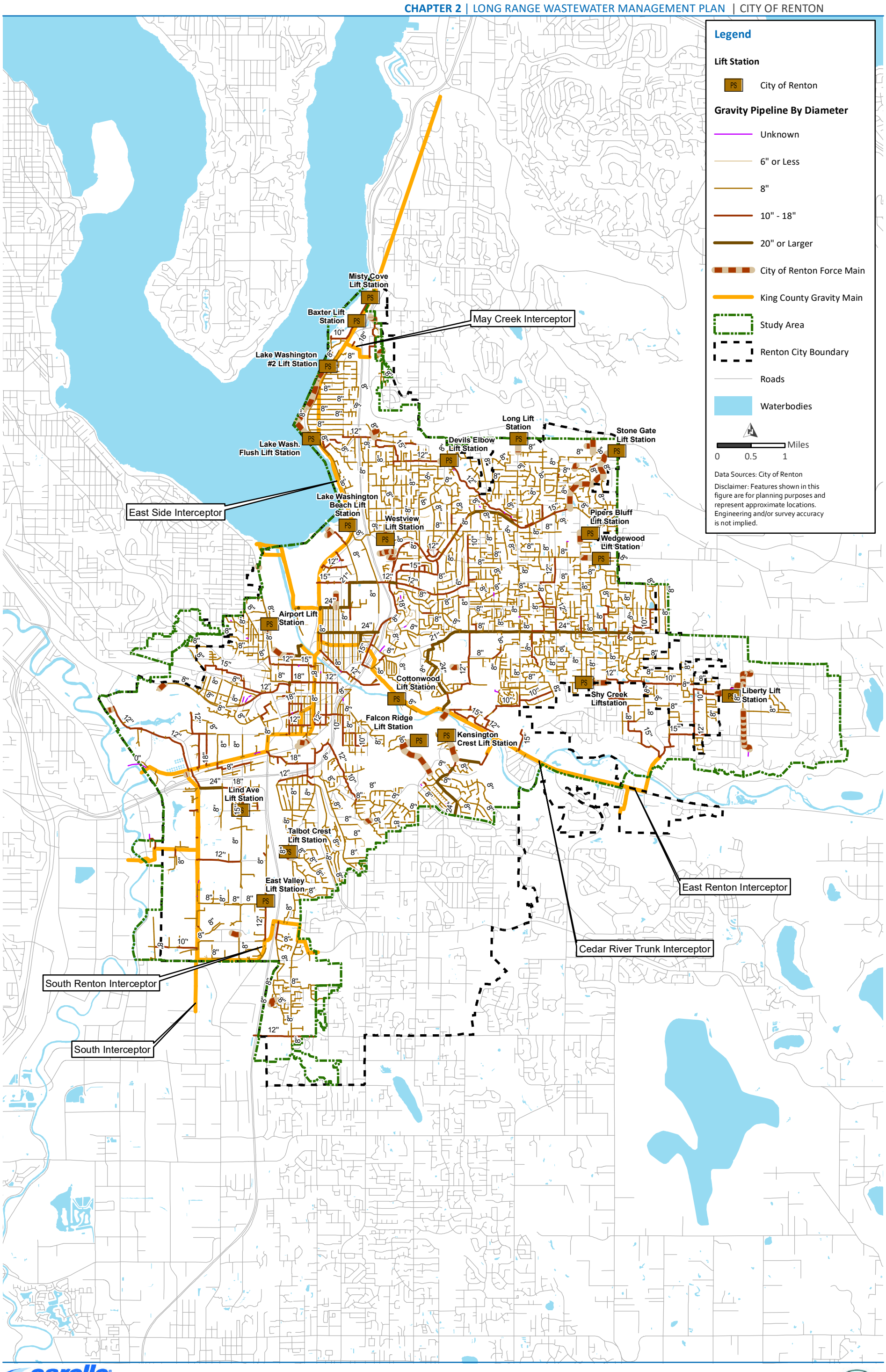

Figure 2.1
Existing System

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2.3 Wastewater Collection Basins

The City is divided into six major wastewater collection basins and 67 mini-basins illustrated in Figure 2.2 that consist of one or more model basins. Wastewater basins delineate large areas of the conveyance system network that ultimately flow to one location, specifically the regional interceptor running throughout the City's collection system. The basin boundaries almost always follow topographic features, such as ridge lines, streams, and rivers, and capture each property contributing flow to the sewer collectors in that basin.

The model basins were developed by KC's Infiltration and Inflow (I/I) Program for the Renton Sewer Service Area. These collection basins and model basins would ideally follow the natural drainage patterns of the City's service area. However, because of natural and service area boundaries, the wastewater collection basins do not always follow drainage basins. The six major basins are: West Cedar River, East Cedar River, East Lake Washington, Black River, Downtown, and May Valley.

2.3.1 West Cedar River Basin

The West Cedar River Basin includes the eastern portion of the City bordering the Cedar River. The basin consists of primarily single-family and multi-family developments with some commercial and light industrial land uses. West Cedar River Basin includes the Cottonwood, Falcon Ridge, and Kensington Crest Lifts Stations. The wastewater collected in the basin is transported to KC's Cedar River Trunk Interceptor at several connection points.

2.3.2 East Cedar River Basin

The East Cedar River Basin is located at the east side of the City's sanitary sewer service area. The basin extends from approximately Bremerton Avenue NE to the Urban Growth Boundary east of the City. The basin can be partially served by gravity through the East Renton Interceptor. The East Cedar River Basin includes the Shy Creek and Liberty lift stations. The wastewater collected in the basin is transported to KC's Cedar River Trunk Interceptor at several connection points.

2.3.3 East Lake Washington Basin

The East Lake Washington Basin is located in the northern part of the City. The City serves the entire basin, which consists of a variety of land uses including single-family and multi-family residential, and light commercial. The wastewater collected in the basin is transported to KC's East Side Interceptor at several connection points. The East Lake Washington Basin includes the Devil's Elbow, Lake Washington Beach, Lake Washington Flush, Lake Washington #2, Long, Stone Gate, Pipers Bluff, Wedgewood, and Westview Lift Stations.

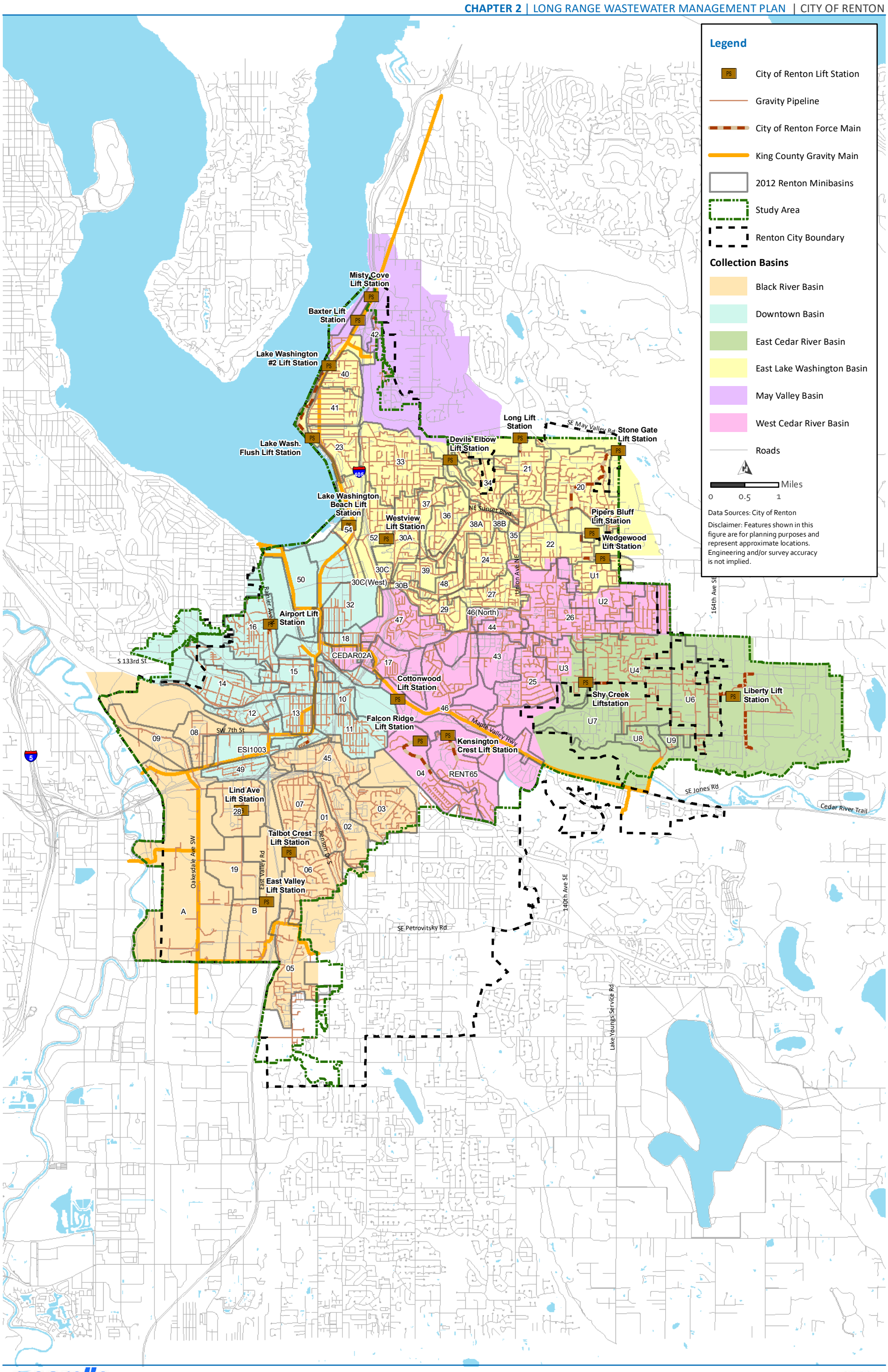

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Figure 2.2
Wastewater Basins

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2.3.4 Black River Basin

The Black River Basin is a large drainage basin in the southwest part of the City. The higher elevations in the Rolling Hills, Talbot Hill, and Panther Creek areas are generally single-family and multi-family residential developments along with commercial uses surrounding Valley Medical Center, while the valley floor is generally industrial and commercial land uses. A portion of the south and west portions of the valley floor are un-modeled. The upper elevations of the basin are served by Soos Creek Water and Sewer District. The Black River Basin includes the East Valley, Lind Avenue, and Talbot Crest Lift Stations. The wastewater collected in the basin is transported to KC's East Side, South Renton, and South Interceptors at several connection points.

2.3.5 Downtown Basin

The Downtown Basin is located in the northwest part of the City and includes the Central Business District, West Hill, and North Renton Industrial areas. Land use within the basin consists of single-family, multi-family, commercial, and heavy industrial land uses. The model basin includes the Airport Lift Station. Skyway Water and Sewer District also provides sewer service to parts of the West Hill that are within the Downtown Basin. The wastewater collected in the basin is transported to KC's East Side Interceptor at several connection points.

2.3.6 May Valley Basin

The May Valley Basin is located in the northeast part of the City on the periphery of the City's current service boundary. The portion of the basin within the City's service area is currently only about half serviced with a sewer collection system. The remainder of the basin is within Coal Creek Utility District's service area. Land use within the basin consists of primarily single-family and light commercial land uses. The May Valley Basin includes the Baxter and Misty Cove Lift Stations. The wastewater collected in the basin is transported to KC's May Creek Interceptor and East Side Interceptor at several connection points.

2.4 Interceptors and Collection Systems

Interceptors are sewers that receive flow from collector sewers and convey wastewater to a point for treatment or disposal. They are typically located in low lying or centralized areas in order to facilitate the gravity flow of the wastewater. The interceptors and all other sewers make up the collection system.

2.4.1 Existing Sewer System

Currently, the City's gravity mains consist of approximately 60 percent polyvinyl chloride (PVC), 25 percent concrete pipe (CP), 5 percent ductile iron pipe (DIP), 3 percent vitrified clay pipe (VCP), and 6 percent unknown pipes. The majority of pipe material within the existing system is comprised of CP and PVC. Older sewers typically used concrete pipe, while PVC is more common in newer sewer installations.

As shown in Table 2.1, a majority of the sanitary sewer system is constructed with 8-inch diameter pipe. This is consistent with the Department of Ecology's criteria for minimum sanitary sewer sizing.

Table 2.1 Gravity Sewer Inventory

Diameter (inch)	Length (lf)[2]	Percentage of System
6	42,426	3.2%
8	1,033,293	79.1%
10	52,746	4.0%
12	82,153	6.3%
14	1,001	0.1%
15	35,143	2.7%
16	358	0.0%
18	25,605	2.0%
20	745	0.1%
21	8,826	0.7%
22	3,751	0.3%
24	20,066	1.5%
Total (feet)	1,306,113	100%
Total (miles)	247.4	100%

Note:
(1) System only includes gravity mains and excludes private sewers and KC pipes.
(2) lf = linear feet.

The City's sanitary sewer system also contains 6,735 manholes which join the various links of sanitary sewer pipe. These manholes vary in construction type from brick manholes to precast concrete manholes.

2.4.2 Interceptors

KC connections receive wastewater from the City's collection system at more than 79 locations. This sewage is then either conveyed to another drainage basin or directly to the South Treatment Plant for treatment.

2.5 Lift Stations and Force Mains

Sewage lift stations are used to convey wastewater from a low point to a higher point through the use of a pump and pressurized FM. The City owns and maintains 20 lift stations, which are described in Table 2.2. The topography of the City's service area is such that most of the system is operated under gravity flow conditions with the exception of some areas that require pumping to higher elevations. The topography of the system is shown in Figure 2.3. Details on FM and lift station condition are in Chapter 6 – Replacement and Rehabilitation Program.

The most common type of lift station is comprised of a wet well which contains a submersible pump located directly in the wet well. The second most common type of lift station is a configuration with the mechanical and electrical equipment located above the ground surface and over a large manhole wet well from which the wastewater is pumped. A wet well/dry well configuration is the third most common type; this is comprised of electrical and mechanical equipment located underground in a sealed enclosure adjacent to a large manhole which the wastewater is pumped. Additionally, the West View Lift Station contains a grinder submersible combination.

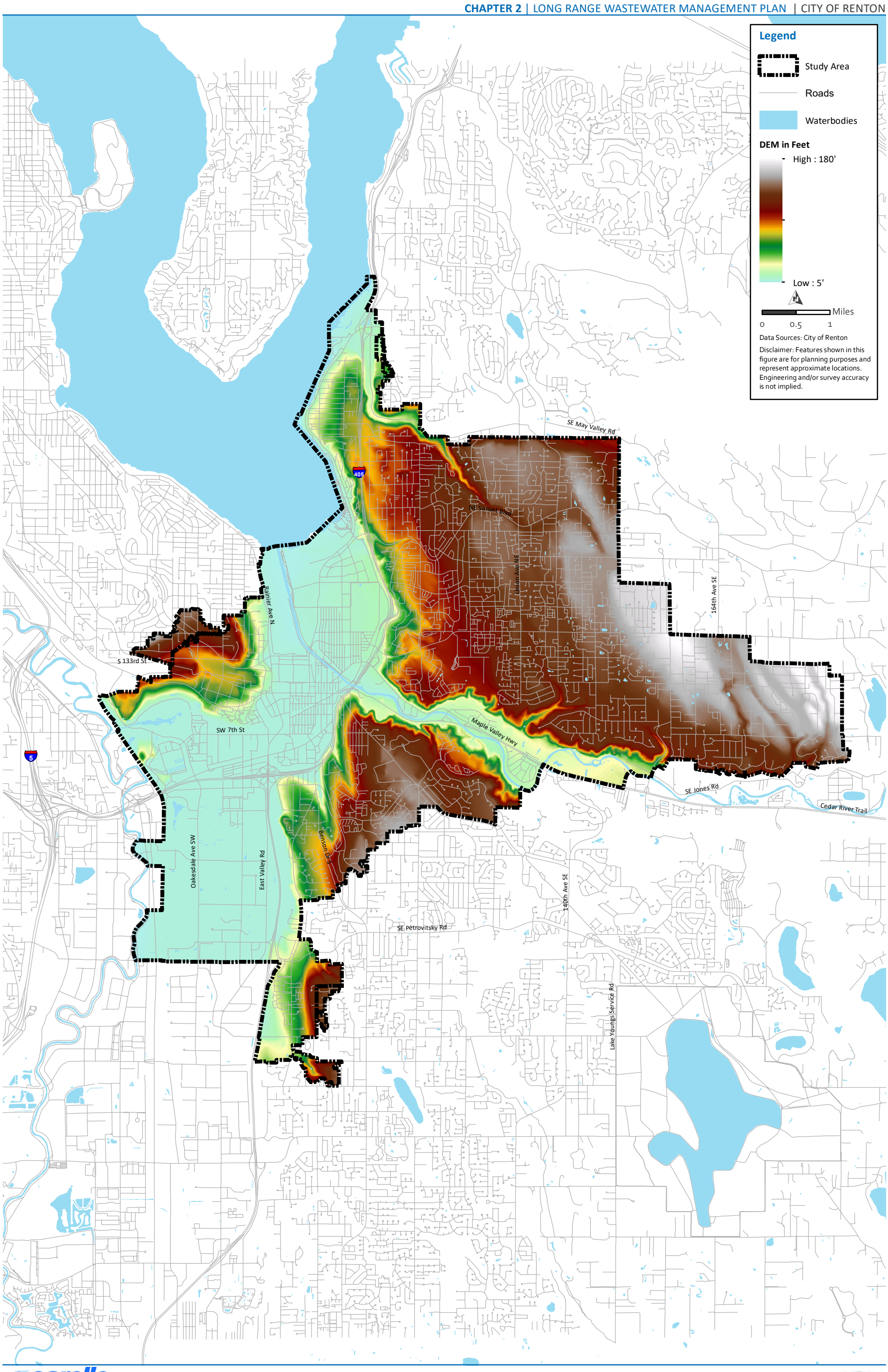

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Figure 2.3
Topography

Last Revised: August 20, 2019
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2.5.1 Airport Lift Station

The Airport Lift Station is located on the west side of West Perimeter Road adjacent to the Renton Municipal airport. This facility is a duplex submersible pump system in a wet well with an adjacent valve vault and an on-site back-up emergency generator. This facility serves the southern portion of the west side of the airport as well as approximately 37 acres of residential and commercial properties west of Rainier Avenue South. The current lift station was constructed in 2014.

2.5.2 Baxter Lift Station

The Baxter Lift Station is located in the former J.H. Baxter and Company pole yard near the southeast corner of the southern-most football practice field of the Virginia Mason Athletic Center (VMAC) Seattle Seahawks training facility and adjacent to the King County Trail. This facility operates as a duplex submersible pump system. The station is constructed in a large structure that contains a primary wet well and two pumps for standard operation and a secondary wet well for emergency storage. There is a third pump to transfer the emergency storage back into the primary wet well. This station has an adjacent valve vault and an on-site back-up emergency generator. This facility serves the VMAC Seattle Seahawks Training facility as well as the Barbee Mill neighborhood to the south. The current lift station was constructed in 2008.

2.5.3 Cottonwood Lift Station

The Cottonwood Lift Station is located west of the Riviera Apartments, south of the Maple Valley Highway. This station is a submersible pump duplex station in a wet well with an adjacent valve vault. This facility serves the area between the Maple Valley Highway and the Cedar River, east of the former Stoneway concrete facilities. The current station was constructed in 1994. The FM was also replaced at that time. Upgrades to this lift station are currently in design phase.

2.5.4 Devil's Elbow Lift Station

The Devil's Elbow Lift Station is located in NE 27th Street just northwest of where the road crosses Honey Creek. This facility is a submersible pump duplex station in a wet well with an adjacent valve vault that also contains the control system. There is a trailer-mounted emergency back-up generator located in the cul-de-sac of NE 24th Street. This generator is setup to automatically power this station but can also be transported to other sites is needed. The current station was constructed in 2000. Upgrades to this lift station are currently in design phase.

2.5.5 East Valley Lift Station

The East Valley Lift Station is located on the northwest corner of the intersection of SW 34th Street and the East Valley Road. This facility operates as a submersible pump duplex station. The station was constructed in a large structure that contains a primary wet well and two pumps for standard operation and a secondary wet well for emergency storage. There is a third pump in the secondary wet well that discharges the emergency storage to the force main. The station also has an adjacent valve vault and an on-site backup generator. This facility serves the commercial areas north and west of the lift station. The current station was built in 2003. Pumps were replaced in 2019 due to damage sustained from a private construction project. Additional upgrades to this lift station are currently in design phase.

2.5.6 Falcon Ridge Lift Station

The Falcon Ridge Lift Station is located at the east end of SE 8th Place in the plat of Falcon Ridge. This station is a submersible pump duplex station in a wet well with an adjacent valve vault and an on-site emergency generator. This station serves the Falcon Ridge neighborhood exclusively. The current station was constructed in 2019. The FM associated with this station is long and has an excessively high head.

2.5.7 Kensington Crest Lift Station

The Kensington Crest Lift Station is located at the northeast corner of the Kensington Crest (A.K.A. Shadowhawk) multi-family complex and provides service to the complex. This facility is a submersible pump duplex station. The station was built in 2002.

2.5.8 Lake Washington Beach Lift Station

The Lake Washington Beach Lift Station is located in the south parking lot at Coulon Beach Park. This facility is a duplex wet well with adjacent valve vault. The station serves the restroom facilities at the park. The current station was constructed in 2011.

2.5.9 Lake Washington Flush Lift Station

The Lake Washington Flush Lift Station is located at the south end of Mountain View Avenue North. The facility is a submersible, single, non-clogging pump for pumping lake water into the gravity sewer along the Kennydale lakefront for flushing purposes. The low-pressure sewer Lake Line then discharges into Lake Washington No. 2 Lift Station. A new pump, along with a new valve vault was installed in 2004.

2.5.10 Lake Washington No. 2 Lift Station

The Lake Washington No. 2 Lift Station is located at the north end of the Kennydale Beach Park Road. This facility serves lakefront properties west of Lake Washington Boulevard North in the Kennydale area. The station is a submersible pump duplex station in a rehabilitated wet well. The current station was constructed in 1994.

2.5.11 Liberty Lift Station

The Liberty Lift Station is located at 16655 SE 136th Street at Liberty High School. This facility is a duplex submersible lift station in a wet well with adjacent valve vault. The current station was constructed in 2012.

2.5.12 Lind Avenue Lift Station

The Lind Avenue Lift Station is located on the west side of Lind Avenue SW near the intersection with SW 19th Street. This station is a submersible pump duplex station in a wet well with an adjacent valve vault and an on-site emergency generator. This station serves the commercial and industrial areas in the vicinity of the lift station. The current station was constructed in 2014 (City Project No. S-3626).

2.5.13 Long Lift Station

The Long Lift Station is located on the east side of Union Avenue NE, just north of NE 27th Street. This facility is a submersible pump duplex station, which serves the Caledon Plat. The lift station was constructed in 2001.

2.5.14 Misty Cove Lift Station

The Misty Cove Lift Station is located in the northeast corner of the Misty Cove Condominium complex. This station is a submersible pump duplex station in a wet well with an adjacent valve vault. This facility serves the lakefront properties that are north of the VMAC Seattle Seahawks Training facility. The current station, along with a new force main was constructed in 2014 (City Project No. S-3627).

2.5.15 Pipers Bluff Lift Station

The Pipers Bluff Lift Station is located at 1160 Ilwaco Place NE. This station is a submersible pump duplex station in a wet well with an adjacent valve vault. This station serves the Piper's Bluff plat exclusively. The current station was constructed in 2015.

2.5.16 Shy Creek Lift Station

This station is located at the northeast corner of the intersection of SE 136th Street & 142nd Avenue SE. This station is a submersible pump duplex station in a wet well with an adjacent valve vault. The station was constructed in a large structure that contains a primary wet well and two pumps for standard operation and a secondary wet well for emergency storage. There is a third pump to transfer the emergency storage back into the primary wet well. The current station was constructed in 2008.

2.5.17 Stone Gate Lift Station

The Stonegate Lift Station is located at 2615 Nile Avenue NE. The station is within an easement on an open space tract in the Stonegate neighborhood. This station is a submersible pump duplex station in a wet well with an adjacent valve vault. The station also includes an underground vault for emergency storage. The emergency storage vault gravity flows back to the primary wet well. There is an on-site emergency back-up generator. The facility serves the entire plat of Stone Gate as well as several plats to the east and south. The current station along with a new force main was constructed in 2012.

2.5.18 Talbot Crest Lift Station

The Talbot Crest Lift Station is located under the roadway at 2511 Talbot Crest Drive. This facility is a submersible pump duplex station in a wet well with an adjacent valve vault. The station serves the plat of Talbot Crest exclusively. The current station was constructed in 2000.

2.5.19 Wedgewood Lift Station

The Wedgewood Lift Station is located at 5401 NE 10th Street. This facility is a submersible pump duplex station in a wet well with an adjacent valve vault. The station is constructed in a large structure that contains a primary wet well and two pumps for standard operation and a secondary wet well for emergency storage. There is a third pump to transfer the emergency storage back into the primary wet well. The station serves the plat of Wedgewood, as well as the surrounding basin area. The station was constructed in 2006.

2.5.20 Westview Lift Station

The Westview Lift Station is located on the west side of Monterey Avenue NE. This facility is a duplex submersible lift station designed to serve the twelve-lot Westview Plat. This station was originally constructed in 1995. Upgrades including a new adjacent valve vault, wet well lining, new pumps and hardware and electrical were performed in 2010.

Table 2.2 Existing Lift Station Inventory Summary

Name	Location	Station Type	No. of Pumps	Manufacturer	Normal Operating Capacity (gpm)	Normal Operating TDH (ft)	Hp	Pump Speed (RPM)	Voltage	Emergency Power Connect	Telemetry	FM Size (inches)
Airport	451 West Perimeter Road / Airport	Submersible	1-Duty 1-Standby	Flygt Flygt	100 100	54 54	10 10	1735 1735	460	Yes	Allen Bradley Compact Logix	4
Baxter	4505 Ripley Lane	Submersible	1-Duty 1-Standby 1-Flow Transfer	Flygt Flygt Flygt	450 450 250	21 21 15	5 5 3	1745 1745 1700	460	Yes	Rugid 9	8
Cottonwood	2101 Maple Valley Highway	Submersible	1-Duty 1-Standby 1-Flow Transfer	Hydromatic Hydromatic Paco	230 230 -	32.5 32.5 -	3 3 -	1750 1750 -	230 / 460 115	Yes	Rugid 6	4
Devil's Elbow	3001 NE 27th Street	Submersible	1-Duty 1-Standby	Flygt Flygt	500 500	155 155	35 35	3520 3520	460	Yes	Rugid 6	6
East Valley	3371 East Valley Road	Submersible	1-Duty 1-Standby 1-Flow Transfer	Flygt Flygt Flygt	362 362 362	30.5 30.5 30.5	5 5 5	1735 1735 1735	230/460	Yes	Rugid 9	8
Falcon Ridge	2471 SE 8th Place	Submersible	1-Duty 1-Standby	Flygt Flygt	230 230	82.7 82.7	11 11	3495 3495	460	Yes	Allen Bradley Compact Logix	4
Kensington Crest	3000 SE 8th Street	Submersible	1-Duty 1-Standby	Flygt Flygt	160 160	80 80	10 10	1745 1745	460	Yes	Rugid 9	4
Lake Washington Beach	1201 Lake Washington Boulevard N	Submersible Grinder	1-Duty 1-Standby	Vaughn Vaughn	125 125	24 24	5 5	1725 1725	230	Yes	Rugid 9	4
Lake Washington Flush	2725 Mountain View Avenue North	Submersible	1-Duty	Paco	400	6.5	2	1150	120/240	Yes	Rugid 6	4
Lake Washington No. 2	3903 Lake Washington Boulevard N	Submersible	1-Duty 1-Standby	Hydromatic Hydromatic	385 385	35 35	7.5 7.5	1750 1750	480	Yes	Rugid 6	6
Liberty	16655 SE 136th Street	Submersible	1-Duty 1-Standby	Flygt Flygt	617 617	69 69	20 20	1755 1755	460	Yes	Allen Bradley Compact Logix	8
Lind Avenue	1891 Lind Avenue SW	Submersible Grinder	1-Duty 1-Standby	Vaughan Vaughan	500 500	12 12	7.5 7.5	1170 1170	480	Yes	Allen Bradley Compact Logix	8
Long	5702 Union Avenue NE	Submersible	1-Duty 1-Standby	Flygt Flygt	100 100	90 90	10 10	1735 1735	230/460	Yes	Rugid 6	4
Misty Cove	5023 Ripley Lane N	Submersible	1-Duty 1-Standby	Flygt Flygt	190 207	32 32	4 4	3430 3430	460	Yes	Allen Bradley Compact Logix	4
Pipers Bluff	1160 Ilwaco Place NE	Submersible	1-Duty 1-Standby	Flygt Flygt	106 105	66.7 66.7	4 4	3430 3430	460	Yes	Allen Bradley Compact Logix	4
Shy Creek	5110 SE 2nd Place	Submersible	1-Duty 1-Standby 1-Flow Transfer	Flygt Flygt Flygt	550 550 275	40 40 15	10 10 3	1735 1735 1700	460	Yes	Rugid 9	8
Stonegate	2615 Nile Avenue NE	Submersible	1-Duty 1-Standby	Flygt Flygt	425 425	172 172	85 85	1775 1775	460	Yes	Rugid 9	8
Talbot Crest	2511 Talbot Crest Drive South	Submersible	1-Duty 1-Standby	Flygt Flygt	110 110	33 33	3 3	1700 1700	460	Yes	Rugid 6	4
Wedgewood	5401 NE 10th Place	Submersible	1-Duty 1-Standby 1-Flow Transfer	Flygt Flygt Flygt	505 511 400	67.2 67.2 11	15 15 3	1755 1755 1680	460	Yes	Rugid 9	8
Westview	1149 Monterey Avenue NE	Submersible	1-Duty 1-Standby	Flygt Flygt	70 70	34 34	3.8 3.8	3395 3395	240	Yes	Rugid 6 Bastard	3

Note:
Abbreviations: gpm – gallons per minute; TDH – total dynamic head; ft – foot/feet; hp – horsepower; RPM – revolutions per minute.

2.5.21 Force Mains

A summary of the FMs is provided in Table 2.3. Additional information regarding lift stations and FMs is provided in Chapter 6 – Replacement and Rehabilitation Program.

Table 2.3 Collection System Force Main Inventory

Diameter (inch)	Length (LF)	Percentage of System
2	6,970	19.3%
3	1,863	5.2%
4	10,996	30.4%
6	2,979	8.2%
8	12,282	34.0%
10	1,026	2.8%
Total (feet)	36,116	100%
Total (miles)	6.8	100%

2.6 Water System

The City provides water service to City customers from a series of groundwater wells. As shown in Figure 2.4, there are ten reservoirs and one operational storage/equalizing detention clearwell at the Maplewood Treatment and Booster Pump Station (BPS) Facility. These storage facilities within the City total 22,877,053 gross volume gallons of water. The City operates 12 BPS to convey treated water from low pressure zones to high pressure zones. Altogether, the City's water system is 1,629,560 feet (308.6 miles) with a majority 8-inch DIPs.

The City has a Water System Plan Update (WSPU) that was approved by DOH in February 2021 that includes a conservation plan identified in Chapter 6. Part of the conservation plan discusses the potential for the use of reclaimed water. Further discussion on reclaimed water can be found in Chapter 4 of this Plan. This WSPU was developed by the City in coordination with this planning effort.

A wellhead protection program (WHPP) was prepared by the City and approved by DOH in 1999. The City's Water System Plan Update completed updates to the WHPP. Changes to the program are included in Appendix L-1. Compliance with WHPP requirements is part of a broader City effort identified in the WSPU as the Aquifer Protection Program. In 1998, the City adopted an Aquifer Protection Ordinance to protect its water supply from being contaminated.

The ordinance regulates land use within the aquifer recharge area in order to protect the aquifer from contamination and are defined as Critical Areas. As part of aquifer protection the City has designated an aquifer protection area (APA), which is that area within the zone of capture for the City's aquifers and spring. The APA is divided into three zones:

- **Zone 1** encompasses the 1-year groundwater capture zone for the downtown wells. Regulations adopted for this zone provide the strongest protection for the area that is very close to the most important and vulnerable wells.
- **Zone 1 Modified** encompasses the 1-year capture zones for the Maplewood, Wellfield, and Springbrook Springs, which are partially outside of the City limits. Regulations are somewhat less strict than those in Zone 1 and are intended to provide appropriate

protection for important wells/springs that are deep and/or partially protected by intervening layers of relatively impermeable earth materials.

- **Zone 2** provides a level of protection adequate for areas that are further away from the most important sources but still within the capture zone or for deep backup wells. Zone 2 encompasses:
  - The portion of the capture zone for downtown wells that lies between the 1-year capture zone boundary and the City limits.
  - The portion of the capture zone for Well 5A that lies within City limits.
  - The portion of the capture zone for Springbrook Springs that lies between the 1-year capture zone boundary and the 10-year boundary.

Land use in Zone 1 is more strictly regulated than in Zone 1-Modified or Zone 2. All new development within Zone 1 must connect to the sewer system. Existing development must connect if it is within 330 feet of a sewer line. In Zone 2, all new platted single-family, multi-family, and commercial development must connect to the sewer system. However, a single-family residence is required to connect only if it is within 330 feet of a sewer line.

The water facilities and aquifer protection areas are shown on Figure 2.4. Currently the wellhead protection zones and the aquifer protection areas refer to the same zones. The City is in the process of updating the program: 1) update APA zones to reflect capture zone delineations, 2) will be performing site surveys at facilities within the APA zones that store/use hazardous materials, 3) provide outreach and training for aquifer protection. A more detailed description of the proposed aquifer protection policies can be found in Chapter 3 – Operational Policies and Criteria.

Additionally, Appendix L-2 shows the relationship between the wellhead protection zones and where existing septic systems are located in the City.

2.7 Operation and Maintenance

The current operation and maintenance program for the sewer utility consists of four elements: normal operations, emergency operations, preventive maintenance and staffing. Normal operation of the sewer system is shared by the Maintenance Services and Utility Systems divisions. The program is described and evaluated in more detail in Chapter 7 – Operations and Maintenance.

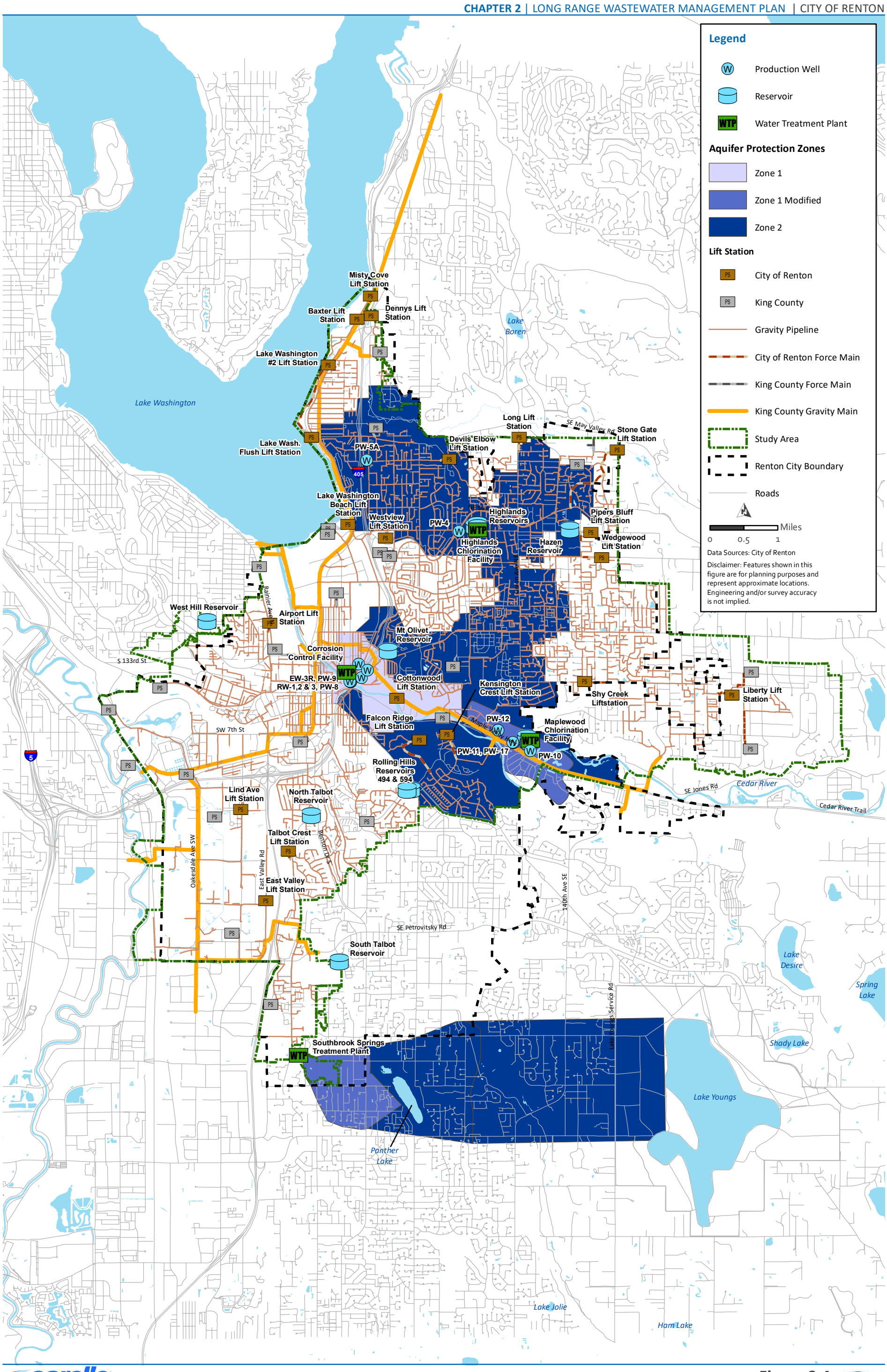

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Figure 2.4
Water Facilities and Aquifer Protection Areas

Chapter 3

OPERATIONAL POLICIES AND CRITERIA

3.1 Introduction

The existing sewer system is designed and operated according to specific ordinances, regulations, and engineering standards (hereafter collectively referred to as policies and criteria). All of the policies originate from eight sources, listed in descending order, from those with the broadest authority to those with the narrowest:

- Federal Regulation – Environmental Protection Agency (EPA).
- State Regulations – Department of Ecology (Ecology).
- King County (KC) Policies – Department of Natural Resources – Wastewater Treatment Division.
- City of Renton Comprehensive Plan.
- City of Renton Ordinances – City Council.
- Administrative Policies – Mayor.
- Department Policies – Public Works Department.
- Long-Range Wastewater Utility Policies – Wastewater Utility Staff.

Federal regulation, state regulations, county policies, and city ordinances dictate requirements that are set by law. Policies that originate in the Office of the Mayor, Public Works, or Wastewater Utility cannot be less stringent or in conflict with other, broader laws. Those policies and criteria referencing the Long-Range Wastewater Management Plan (LRWWMP) have or will become official policies with the adoption of the LRWWMP by City of Renton (City) City Council.

3.2 Operational Goal

The goal of the City's Wastewater Utility is to provide adequate, reliable sanitary sewer services at a minimum cost to the customer.

Guiding the Wastewater Utility's daily operations as well as its planning activities, the policies in this LRWWMP stem from this goal. Objectives and policies that fall into six areas of emphasis support this broad service goal:

1. Customer Service.
2. Planning Objective.
3. Service Area Extension.
4. Financial.
5. Facility.
6. Operations.

The policies and criteria supporting each objective are provided below. Note, given the nature of the content, this chapter is presented in traditional policy format, rather than outline format that is used in other chapters. For actual wording of a given policy and criteria, refer to the indicated source for complete text.

3.3 Customer Service Objective

Ensure the availability of an adequate level of sanitary sewer service that is consistent with land use, environmental protection, and annexation goals and policies.

3.3.1 Policies

- Sewer facilities and services should be consistent with the growth and development concepts directed by the Comprehensive Plan (Policy U-1, 2018 City of Renton Comprehensive Plan).
- Ensure and encourage the use of the sanitary sewer system within the urban areas in a manner consistent with land use and environmental protection goals and policies (LRWWMP).
- All new developments should be required to connect to the sanitary sewer system, except properties that have adequate soils to support on-site septic systems, are zoned for low density single family residential development, located away from environmentally sensitive areas, and outside Aquifer Protection Areas (Policy U-21, 2018 City of Renton Comprehensive Plan).
- Actively promote connection to the public sewers by all residents within the City's service area (LRWWMP).
- Public sewer expansions shall not occur in the Rural Area and on Natural Resource Lands except where needed to address specific health and safety problems threatening the existing structures and the use of septic or other onsite wastewater systems has been determined by KC to be not feasible; or to serve a new school authorized to be located in the Rural Area by R-327 (Policy F-264.A, 2018 King County Comprehensive Plan).

3.3.2 Implementation

- The owner of each house, building or property used for human occupancy, employment, recreation or other purpose, situated within the City and abutting on a public sanitary sewer of the City which said public is hereby required at the owner's expense to install suitable toilet facilities therein and to connect such facilities directly with the proper public sewer in accordance with the provisions of this Chapter, within ninety days after the date of official notice to do so (Renton Municipal Code [RMC] 4-6-040.A).
- Where a public sanitary or combined sewer is not available under the provisions of Title IV Chapter 6 of the RMC, the building sewer shall be connected to a private sewage disposal system complying with the provisions of this section (RMC 4-6-040.A.1).
- The owners of private sewerage disposal systems shall operate and maintain the facilities in a sanitary manner at all times at no expense to the City (RMC 4-6-040.I.4).
- The owner or occupant of lands or premises located within the urban growth area (UGA) (as defined in the King County Comprehensive Plan) undertaking new residential or nonresidential construction, short subdivision or subdivision from which sewage will originate shall connect to a public sewer, provided the sewer utility permits such connection (King County Board of Health Rules and Regulations [KCBHRR] No. 3, 13.04.050).
- Sanitary sewers, together with all appurtenances, shall be constructed or deferred before a final short plat is submitted or a short subdivision is recorded. Sanitary sewers shall be constructed to specifications and standards of the Wastewater Utility, approved by the Department and in accordance with other standards of the City. A

separate construction permit will be required for any such improvements, along with associated engineered plans prepared per the City's drafting standards and associated fees (RMC 4-7-100).

- Unless septic tanks are specifically approved by the Planning/Building/Public Works Department and the KC Health Department, sanitary sewers shall be provided by the developer at no cost to the City and designed in accordance with City standards. Side sewer lines shall be installed eight feet into each lot if sanitary sewer mains are available, or provided with the subdivision development (RMC 4-6-040F).
- Development that is within two hundred feet of a public sewer, where an on-site system (OSS) is operating, connection to the public sewer is required when the sewering authority permits such connection and when:
  - Repair, modification, or replacement of the system is necessary, or the existing OSS has failed and an OSS fully conforming to this title cannot be designed and installed (KCBHRR 13.04.050).
  - At such time that additional construction which in any way affects the on-site sewage system is proposed (KCBHRR No. 3, 13.04.050).
  - They are part of a sewer Local Improvement District (LID) (RMC 4-6-040.A).
- New development (residential and non-residential) in Zone 1 of the Aquifer Protection Area (APA) shall be required to connect to the City sewer system (RMC 4-6-040J.1.a.i).
- All existing development (residential and non-residential) in Zone 1 of the APA that is within the specified proximity of existing or future gravity sanitary sewer shall be required to connect to the City sewer system within two years of the availability of the new sewer line (RMC 4-6-040J.1.a.iii).
- Any new development (residential and non-residential) in Zone 2 of the APA shall be required to connect to the City sewer system (new single-family residential development on existing lots may be allowed to use on-site disposal systems until public sewer service becomes available, as determined by the Wastewater Utility) (RMC 4-6-040J.2.a.i).
- The City, at the discretion of the Wastewater Utility, may defer compliance with non-health related standards dealing with extension, design, or capacity for temporary sanitary sewer service. Temporary sanitary sewer service may include pump tests, temporary discharge permits, connections for temporary construction sites, or other similar usage. The property owner will retain the responsibility and will execute an agreement to either directly or financially meet said standards at the direction of the City (LRWWMP).
- After connection to the sewer system, all private sewage disposal facilities shall be abandoned and filled with suitable material; provided, however, the owner of the subject premises may suitably clean the septic tank to utilize the same and any adjoining drain field systems for the disposal of stormwater (RMC 4-6-040.I.6).

3.4 Planning Objective

Ensure that the City's sewage collection system is consistent with the public health and water quality goals of Washington State (Policy U-F, 2018 City of Renton Comprehensive Plan).

3.4.1 Policies

- Sewer facilities and services should be consistent with the growth and development concepts expressed in the Land Use Element. Extension of sewer service should be coordinated with expected growth and development. (Policy U-20, 2018 City of Renton Comprehensive Plan).
- Apply level of sanitary sewer service standards consistently throughout the service area (LRWWMP).
- Sewer system improvements supporting areas of the City projected to experience high levels of growth should be prioritized to ensure that sewer service is concurrent with anticipated growth. (Policy U-25, 2018 City of Renton Comprehensive Plan).
- Timely and orderly extension of the sewer system should be provided within the City's existing and future service areas to meet public health requirements (Policy U-24, 2018 City of Renton Comprehensive Plan).
- Implementation and coordination of programs for the improvement, phasing and financing of sewer infrastructure should be developed consistent with the Land Use Element of the Comprehensive Plan (LRWWMP).
- Approval of development should be conditioned on the availability of adequate utility service and should not result in decreases in local levels of service for existing development. All new development should be required to pay their fair share of construction costs for necessary utility system improvements (Policy U-5, 2018 City of Renton Comprehensive Plan).
- Sewer facilities and services should be in place prior to occupancy of development projects (LRWWMP).
- Sewer service should be expanded so that the current levels of service are maintained through build-out of the adopted land use (LRWWMP):
  - Note: While land use plans typically deal with twenty-year projections, the sewer facilities installed today have a life expectancy of 75 to 100 years. A Sanitary Sewer Utility has to consider the current Land Use Plan, historical trends, and predictions for further growth when designing sewers. The Wastewater Utility may install a facility larger than needed for the land use projected in the 20-year plan if additional capacity needs are projected for the long-term future. It is in the best interests of the ratepayers to obtain the longest use possible from a facility and not have to replace newer facilities.
- Continue coordination with KC Wastewater Treatment Division regarding Inflow/Infiltration reduction initiatives, system improvements, and interconnections between City and KC sewer infrastructure (Policy U-27, 2018 City of Renton Comprehensive Plan).
- Protect surface and groundwater quality through coordination with KC to reduce surcharging conditions that may cause wastewater overflows (Policy U-26, 2018 City of Renton Comprehensive Plan).
- Coordinate with non-City sewer providers operating within the City and neighboring jurisdictions to accommodate road construction and other public works projects (Policy U-23, 2018 City of Renton Comprehensive Plan).
- For planning purposes, the Wastewater Utility should use sanitary sewer service boundaries established by agreement with adjacent municipalities. Where boundaries

do not exist, the Wastewater Utility shall use natural basins, KC's Urban Growth Boundary (UGB), and negotiations with adjacent sewer service providers to determine the ultimate service area (LRWWMP).

- Facilities should be planned and sized to serve natural basins to minimize the need for pumping and inter-basin transfers (LRWWMP).
- Projected sewage flows from development should be calculated based on adopted land use plans and policies. These projections should be used as a guide in developing the wastewater Capital Improvement Program (CIP). The CIP should be updated as land use plans and policies are revised (Policy U-22, 2018 City of Renton Comprehensive Plan).

3.5 Service Area and Extension Objectives

Ensure the availability of an adequate level of sanitary sewer service to areas annexing to the City or areas within the City's Potential Annexation Area (PAA).

3.5.1 Policies

- Support annexation where infrastructure and services allow for urban densities, service providers would be consolidated, and/or it would facilitate the efficient delivery of service. (Policy L-8, 2018 City of Renton Comprehensive Plan).
- Ensure the availability of an adequate level of sanitary sewer service through system planning that is consistent with land use, environmental protection, and annexation goals and policies (Goal U-E, 2018 City of Renton Comprehensive Plan).
- The City will follow state guidelines that define a City's ability to assume facilities in annexation areas (LRWWMP).
- The City may assume existing portions of adjacent sanitary sewer systems, at the discretion of the City Council, when such assumptions promote the logical and efficient development of the City's sanitary sewer system (LRWWMP).
- Allow the extension of sanitary sewer services within the City's PAA according to such criteria as the City may require. Sanitary sewer service shall not be established within the boundaries of another sewer service provider's district, except by agreement with that provider.
- As the service provider, the City is the point of contact or focal point. Not all regulations or criteria originate with the City. Some regulations or criteria originate at the federal, state, or county level. All applicable regulations will be followed in the provision of service in unincorporated areas (LRWWMP).
- Areas annexed without existing municipal sanitary sewer service shall be served by the City unless a service agreement exists or is negotiated with a neighboring utility (LRWWMP).
- The City Council shall consider annexations without assumptions of existing sanitary sewer facilities under the following conditions:
  - The sanitary sewer facilities are or will be operated and maintained by an adjacent municipal utility.
  - The adjacent utility has executed a service boundary agreement with the City.
  - The annexation area is better served by the adjacent utility either because of location within a drainage basin or because it is the most logical extension of facilities (LRWWMP).

- When areas outside of the city limits annex to the City, they must be provided with an adequate level of sewer service. The City will serve annexed areas that do not have sewer service unless a service agreement exists or is negotiated with a neighboring utility. (LRWWMP).
- Areas annexed with existing sanitary sewer service must meet the City's sanitary sewer service objectives. Upgrading of sanitary sewer facilities to City standards, within all or portions of newly annexed areas will be required if there is a threat to public health and safety. If improvements are necessary, they may be accomplished by developer installation or LID as a condition of the annexation (LRWWMP).
- In the UGA all new development shall be served by public sewers, unless application of this policy to a proposal for a single-family residence on an individual lot would deny all reasonable use of the property; or sewer service is not available for a proposed short subdivision of urban property in a timely or reasonable manner as determined by the King County Utility Technical Review Committee. These onsite systems shall be managed by the property owner that can consider an Onsite Sewage System Maintainer certified by the Public Health – Seattle & KC. (2018 King County Comprehensive Plan, Policy F-255).
- KC shall work with cities, special purpose districts, other local service providers and residents to identify and distinguish local, countywide and regional services. Over time, cities will assume primary responsibility for coordinating the provision of local services delivery in urban areas. In general, the county will continue to provide local services delivery within the Rural Area and Natural Resource Lands. Special purpose districts may still provide services, where appropriate. The county will also assume primary responsibility for coordinating the provision of countywide services, including countywide services that must be delivered within City boundaries. The county will also work with cities, special purpose districts, and other counties to identify regional service and facility needs and develop strategies to provide them. (2018 King County Comprehensive Plan, Policy F-102).

3.5.2 Implementation

It is recommended the City update the City Code to ensure the availability of an adequate level of sanitary sewer service to areas within the City's Potential Annexation Area (PAA) that includes all developments. As currently written, sanitary sewer service to properties outside the City's corporate limits will not be permitted except under the following conditions:

- Public Entity: The applicant is a municipal or quasi-municipal corporation including a school, hospital or fire district, KC, or similar public entity.
- Necessary Service: Service is necessary to convert from a failed or failing septic system or in the area that has been defined by the Seattle-King County Health Department as a health concern area.
- Vested Service: Those properties for which the City has granted a valid sewer availability certificate prior to July 21, 2008, and the project has a current vested right to build.
- In the City's Sewer Service Area, Existing Legal Lot(s) Desiring to Construct One Single-Family Residence or Connect One Existing Single-Family Residence: The Administration may approve the connection of one single-family residence on an existing legal lot.

- In any case, as a condition of sewer service by the City, the property owner(s) shall execute a covenant to annex for each parcel when the property being provided sewer service is within the City's PAA (RMC 4-6-040.C).

3.6 Financial Objective

Provide sound financial policies on which to base operations of the Wastewater Utility that will allow the utility to meet its overall goal.

3.6.1 Policies

- Criteria should be established for developing the fees and rates necessary to maintain the Wastewater Utility's established level of service (LRWWMP).
- The Wastewater Utility shall be operated as an enterprise utility (financially self-supporting) (LRWWMP).
- The Wastewater Utility should use a rate setting process that complies with standards established by the American Public Works Association (LRWWMP).
- The Wastewater Utility should use cost-based rates and additional charges that:
  - Recover current, historical, or future costs associated with the City's sanitary sewer system and services.
- Equitably charge utility customers to recover costs commensurate with the benefits they receive.
- Provide adequate and stable sources of funds to cover the current and projected annual cash needs of the Wastewater Utility (LRWWMP).
- Portions of the revenue generated from sewer user rates will be used for wastewater utility related capital improvement projects, including debt service for the projects (RMC 8-5-15F).
- New customers seeking to connect to the sanitary sewer system shall be required to pay charges for an equitable share of the cost of the system. Revenue from these charges is used to finance part of the CIP (RMC 4-1-180.C).
- Customers should be charged for supplemental, special purpose services through separate ancillary charges based on the cost to provide the service. Ancillary charges create more equitable fees and increase operating efficiency for services to customers. Revenue from ancillary charges should be used to offset operations and maintenance (O&M) costs (LRWWMP).
- The utility should maintain information systems that provide sufficient financial and statistical information to ensure conformance with rate-setting policies and objectives (LRWWMP).
- Rates shall be developed using the cash basis to determine the total revenue requirements of the Wastewater Utility (LRWWMP).
- User charges shall be sufficient to provide cash for the expenses of operating and maintaining the Wastewater Utility. To ensure the fiscal and physical integrity of the Wastewater Utility, an amount shall be set aside each year for capital expenditures from retained earnings, that is, an amount shall be set aside to cover some portion of the depreciation of the physical plant. The amount may be transferred from the Sanitary Sewer Fund to the Construction Fund for general purposes, or for specific purposes, such as creating a reserve for main replacement (LRWWMP).

- A Working Capital Reserve will be maintained to cover emergencies, bad debts, and fluctuations in cash flow (LRWWMP).
- The customer classes for the utility shall be single-family (including attached single-family), commercial (including multi-family), and industrial (RMC 4-6-040.E.2).
- The inflation rate should be based on information provided by the Finance Department (LRWWMP).
- Large industrial users should be charged for services on the same basis as all other users (LRWWMP).
- The utility should use generally accepted cost allocation principles for all cost allocation purposes (LRWWMP).
- The utility fees and charges should be calculated for the service area as a whole. Rates should be the same regardless of location (except for the inside/outside City distinction discussed below) (LRWWMP).
- When the City takes over existing service of properties outside the City limits by agreement with an adjacent district, the City shall charge the normal in-city rates (LRWWMP).

3.6.2 Implementation

- For customers residing outside the City limits, sanitary sewer rates are 1.5 times the residential City rates (RMC 8-5-15C).
- Renton provides for a senior and/or disabled citizen discount on City sewer rates (RMC 8-5-15D4).
- Owners of properties that have not been assessed or charged an equitable share of the cost of the sanitary sewer system shall pay, prior to connection to the system, one or more of four charges:
  - System development charge.
  - Special assessment charge.
  - Latecomer's fees.
- Inspection/approval fees.

3.7 Facility Objective

Provide a wastewater collection system that ensures adequate capacity and system reliability, is consistent with land use and environmental protection goals and policies, and is well maintained.

3.7.1 Policies

- Protect the health and safety of City citizens from environmental hazards associated with utility systems through the proper design and siting of utility facilities (LRWWMP).
- Promote the co-location of new utility infrastructure within rights-of-way and utility corridors, and coordinate construction and replacement of utility systems with other public infrastructure projects to minimize construction related costs and disruptions (LRWWMP).
- Design criteria should be established to provide an optimum performance level and a standard of quality for the sanitary sewer system (LRWWMP).

- All lift stations that will be converted to public maintenance shall have control and telemetry systems that are consistent and compatible with the current City system (LRWWMP).
- Joint use facilities will be pursued only in those areas where they would improve reliability or reduce operating costs. All joint use facilities must comply with City policy and design standards (LRWWMP).

3.7.2 Implementation

- Public sewers shall conform to the latest City standards, as adopted by City Code, as well as Ecology Criteria for sewage works design and the Recommended Standards for Sewage Works of the Great Lakes-Upper Mississippi River Board of State Sanitary Engineers. The standards are subject to review by Ecology. All public sewer extensions shall conform to City standards and be consistent with the City LRWWMP (RMC 4-6-040.F.2).
- The public sewer shall be polyvinyl chloride (PVC) plastic pipe American Society for Testing Methods (ASTM) D 3034. Rubber gaskets for PVC pipe shall meet ASTM 1869 standards. However, ductile iron (DI) American Water Works Association (AWWA) C151, that is Type II push-on or Type III mechanical joints, together with cement mortar lining that is 3/32 of an inch in accordance with AWWA C 104 and PVS C900 pipes can be used for force mains or areas with external loading concerns. Also public sewers installed in filled or unstable ground, in areas with high ground water levels, or in areas where the potential for infiltration occurs, may be required to be either DI, or PVC plastic pipe. Exact pipe material shall be as determined by the Wastewater Utility. Alternative pipe materials may be considered by the Wastewater Utility on a case-by-case basis. Minimum size shall be 8 inches in diameter (RMC 4-6-040.F.3).
- Manholes shall be installed at the end of each line, at all changes of grade, size or alignment, and at distances no greater than 400 feet for 15-inch diameter sewers or smaller. Greater spacing may be permitted in larger sewers. Manholes shall be a minimum of 48 inches in diameter, shall be precast concrete or cast in place concrete, with steel reinforcement. Steps shall be placed at 1-foot intervals, conforming to current safety regulations.
- The manhole covers shall be 24-inch diameter cast iron (CI) frame and lid. All connections to the manhole shall match the existing inverts or have a drop connection in accordance with current City standards (RMC 4-6-040.F.5).
- All private lift stations for commercial or multi-family use shall have alarm and standby emergency operation systems, and meet or exceed Ecology specifications as detailed in Recommended Standards for Sewage Works. All private single-family lift stations shall meet or exceed City standards for that type of facility (RMC 4-6-040.F.6). City provides development guidelines for lift stations and review during building permit approval. The development handout is included in Appendix N.
- All person(s) or local improvement districts desiring to extend sanitary sewer mains as part of the City's system must extend said mains under the supervision of the Wastewater Utility (RMC 4-6-040.F.7).
- No property shall be served by City sewer unless the sewer main is extended to the extreme boundary limit of said property as required by this section. All extensions shall extend and cross the full width of the property to be served by sewer except when

shown by engineering methods, to the satisfaction of the Wastewater Utility, that future extension is not possible or necessary. If an exemption is granted, the property owner is not relieved of the responsibility to extend the main and shall execute a covenant agreeing to participate in an extension if, in the future, the Wastewater Utility determines that it is necessary (RMC 4-6-010.B).

- Any facility improvements, identified by the current adopted LRWWMP, that are not installed or are being installed must be constructed by the property owner(s) or developer(s) desiring service (RMC 4-6-040.B).
- Any party extending utilities that may serve other than that party's property may request a latecomers' agreement from the City (RMC 9-5-1).
- Any party required to oversize utilities may request that the utility participate in the cost of the project (RMC 4-6-010.C).
- Grease and oil interceptors or other approved methodology, shall be required on all restaurant, garage, and gas station premises and shall be so situated as to intercept the sources of grease and oil wastes but exclude domestic or human wastes. Grease, oil, and sand interceptors shall be provided in any other case if, in the opinion of the Wastewater Utility, they are necessary for the proper handling of liquid wastes. All interceptors shall be of a type and capacity approved by the Wastewater Utility (RMC 8-5-11).
- Old building sewers may be used in connection with new buildings only when the Wastewater Utility finds they meet all standards and specifications of the City. The applicant / owner is required to provide testing / examination material (i.e., closed-circuit television [CCTV]) prior to the City determination (RMC 4-6-040.G.13).
- The size and slope of the building sewer shall be subject to the approval of the Wastewater Utility. The standard minimum sizes and slopes are (RMC 4-6-040.G.3):
  - 4 inches at a 2 percent slope (1/4 inch per foot) for single-family residential.
  - 6 inches at a 2 percent slope (1/4 inch per foot) for multi-family, commercial, or industrial.
- In no event shall the diameter of the side sewer stub be less than 6 inches. The Wastewater Utility may allow, under certain circumstances, a 6-inch side sewer to be laid at no less than 1 percent (1/8 inch per foot). A grade release holding the City harmless for the flatter slope will be required.
- If a building cannot be served by a gravity system an approved, private lift station may be utilized to provide service (RMC 4-6-040.G.5).

3.7.3 Analysis and Design Criteria

Wastewater Flow Rates: Wastewater flow rates will be established based on adopted land use plans and policies as reflected in the Puget Sound Regional Council (PSRC) Land Use Baseline projections. Per capita and employee flow rates will be calibrated to flow measurement data (LRWWMP).

3.7.3.1 Sanitary Sewer Design Criteria

All sewer lines within the City shall be designed in accordance with good engineering practice by a professional engineer with minimum design criteria presented in Chapter C1 of the "Criteria for Sewerage Works Design," prepared by Ecology, November 2007, or as superseded by

subsequent updates. The sewer lines shall also conform to the latest City Standards and Specifications. Detailed standards are included in Title 4, Chapter 6 of the City Code:

- **Design Loading for Sanitary Sewer Facilities:** Sanitary sewer system flows are composed of residential, institutional, commercial, and industrial sewage, along with infiltration and stormwater inflow. Sanitary sewer systems must be capable of conveying the ultimate peak flows of these wastewater sources. No overflows shall be permitted (LRWWMP):
  - **Design Period:** The design period is the length of time that a given facility will provide safe, adequate and reliable service. The period selected for a given facility is based on its economic life, which is determined by the following factors: the structural integrity of the facility, rate of degradation, cost of replacing the facility, cost of increasing the capacity of the facility, and the projected population growth rate serviced by the facility. Collection and interceptor sewers are designed for the ultimate development of the contributing area. The life expectancy for new sanitary sewers, using current design practices, is in excess of eighty years (LRWWMP).
- **Design of Sanitary Sewer Facilities:** Allowable sewer pipe shall be high-density polyethylene (HDPE) or PVC. For normal depth, PVC is generally preferable, because it has longer laying lengths, which results in fewer joints, reducing the potential for infiltration. Table 3.1 summarizes sanitary sewer design criteria (LRWWMP):
  - **Gravity Sewer Sizing:** Gravity sewers are sized to provide capacity for peak, wet-weather flows. The smallest diameter sewer allowed is 8-inches, except for limited conditions. All sewers will be laid on a grade to produce a mean velocity when flowing half-full of at least two feet per second.
  - **Manhole Sizing:** Manholes will be at least 48-inches in diameter and will be spaced at intervals not to exceed 400 feet on sewer lines 15-inches in diameter or less, and 500 feet on sewer lines 18-inches in diameter or larger. These distances are consistent with most standards, but approval can be granted for longer distances.
  - **Roughness Coefficient:** The Manning equation shall be used to design and analyze wastewater flow characteristics of the sanitary sewers. The Manning roughness constant [n] shall vary depending on the pipe material. For sewer modeling, a Manning's equivalent of 0.013 will be used. Typical values are summarized in Table 3.1.
  - **Reference Datum**: The North American Vertical Datum (NAVD) 1988 is the standard datum used within the City for design and construction of sanitary sewer facilities.
  - **Separation between Sanitary and Other Facilities:** Ecology requires a ten-foot horizontal separation of water and sewer facilities for health reasons. Sanitary and storm sewer facilities require seven feet separation per the Surface Water Design Manual and shall have basic separation requirements for construction purposes. In unusual conditions the separation distance can be shortened, but a minimum horizontal separation of five feet between sanitary and other facilities shall be maintained per Ecology. Wherever possible, a horizontal separation of seven feet is desirable. These distances are measured edge to edge.
  - **Hydraulic Analysis:** The hydraulics of the City's sewer service area is modeled with the MikeUrban software program by the Danish Hydraulic Institute (DHI). The

model was calibrated and updated to reflect the system wet weather flows in 2018. The City currently maintains and updates the model as needed.

- All new developments, with the exception of developments involving less than five single-family residences, may require a hydraulic analysis. The sanitary sewer system hydraulic analyses will be performed using the City's hydraulic computer model. The developer may be responsible for paying the cost of the analysis of the sanitary sewer system. If the analysis concludes improvements need to be made, the developer and the City may need to negotiate cost allocation.

Table 3.1 Sanitary Sewer Design Criteria

Criteria	Details
Sanitary Sewer Sizing:	Peak Wet-Weather Flow
Minimum Sewer Size:	8 inches in Diameter (6 inches for limited conditions)
Pipe Materials:	PVC HDPE
Manholes:	
Maximum Spacing	400 feet for pipe < 15 inches 500 feet for pipe > 18 inches
Minimum Manhole Size	48 inches in diameter
Minimum Clear Opening	23 inches in diameter
Maximum Depth	20 feet (where possible)
Separation From Water Mains:	
Horizontal Separation (Parallel)	10 feet
Minimum Horizontal Separation (Parallel)	5 feet
Minimum Vertical Separation (Perpendicular)	18 inches
Hydraulic Criteria:	
Depth to Diameter Ratio	0.85
Minimum Scouring Velocity	2 feet per second
Manning Roughness Coefficient	
Design	0.013
PVC	0.011
Concrete	0.012
Lined DI / CI	0.012
Vitrified Clay	0.013
Sewer Modeling	0.013

3.7.3.2 Lift Station Design Criteria

Sewage lift stations within the City shall be designed in accordance with good engineering practice by a professional engineer using the minimum design criteria presented in Chapter C2 of the "Criteria For Sewerage Works Design," prepared by Ecology, August 2008, or any subsequent updates, and shall conform to the latest City standards and specifications. Detailed standards are included in Title 4, Chapter 6 of the City Code. Table 3.2 summarizes Lift Station design criteria (LRWWMP):

- **Design Loading for Lift Stations:** Lift stations shall be designed to handle the peak, wet-weather flow from the contributing area. All lift stations, except for private stations for a single-family home, shall have a minimum of two pump units, each with the capacity to handle the expected maximum flow:
  - **Design Period:** The design period for lift stations shall take into consideration long-term needs, replacement or expansion difficulties, service area growth rate and useful life. A lift station should have a minimum design period of twenty years for the facility and ten years for mechanical and electrical equipment. Consideration should be given to longer design periods for lift stations that are expected to serve an indefinite life. Consideration must also be given to the ability of the consumers to pay for the facilities.
- **Design of Lift Station Facilities:** If wide variations in wastewater flow rates are expected for the lift station, then consideration should be given to the use of three or more pumping units. If three pumps are used, two of them must have the capacity to convey peak wastewater flow rates. Each pump shall be capable of passing spheres of at least three inches in diameter:
  - **Backup Power:** Each lift station will be provided with an on-site power backup. The City may allow the use of portable power backup for smaller stations. A lift station designed for portable power backup shall be provided with sufficient wet-well storage to allow adequate time for maintenance personnel to transport, setup, and provide the necessary backup, during a power outage. Wet-well storage will be designed on the basis of the peak, wet-weather flow.
  - **Force Mains:** Force mains shall be sized to maintain a minimum velocity of 2 feet per second. The force main shall have a maximum velocity of 10 feet per second when all pumps are operating together. Regardless of these velocity criteria, minimum size shall be three inches in diameter. A minimum of four inches in diameter is preferable.
  - **Ownership:** Each lift station to be owned by the City shall have control and telemetry systems that are consistent and compatible with the current City system.
- **Elimination of Lift Station Facilities:** Lift station facilities are typically eliminated through the development of the gravity sewer system. Highest priority should be given to elimination of lift station facilities because of their high degree of vulnerability and high O&M costs. Considerations for the elimination of a lift station include environmental risks, life-cycle costs, lift station impacts on downstream sanitary sewer facilities, vulnerability to vandalism, and lift station accessibility (LRWWMP).

Table 3.2 Lift Station and Force Mains Design Criteria

Criteria	Details
General Design Criteria	Criteria for Sewerage Works Design.
Lift Station Sizing:	Peak Wet Weather Flow.
Number of Pumps:	Minimum of two pumps.
Two Pumps:	Each pump to handle the peak flow rates.
Three Pumps:	Two pumps to handle peak flow rates.
Design Periods:	
Facility:	20 years.
Mechanical and Electrical:	10 years.
Wet-well Storage:	Sufficient wet-well storage to allow adequate time for maintenance personnel to transport, setup, and provide the necessary backup, during a power outage.
Reliability:	On-site power backup.
Elimination of Lift Stations:	High Priority.
Force Mains:	
Minimum Diameter:	3 inches.
Velocity:	
Minimum:	2 feet per second.
Maximum:	10 feet per second.

3.8 Operations Objective

Maintain the sanitary sewer system in a safe, reliable, and efficient operating condition. Provide the organizational structure and staff necessary to operate the City's Wastewater Utility system efficiently.

3.8.1 Policies

- The City will use its Wastewater Operations Master Plan (OMP) to document current activities and programs into an O&M procedures manual, review programs for effectiveness and future regulatory requirements, analyze and recommend programs in accordance with the City's long-range goals and objectives, and assist with the development of an implementation strategy (LRWWMP).
- System Repair and Replacement shall be performed in a manner that includes risk assessment, condition, and coordination with other Capital Projects as part of determining when projects will be performed (LRWWMP).
- The City will maintain its wastewater collection system according to the following guidelines:
  - Maintenance shall be performed by the sanitary sewer maintenance staff and supervised by the Field Superintendent.
  - All maintenance personnel shall be trained in the procedures and techniques necessary to efficiently perform their job descriptions.
  - Dry, heated shop space shall be available to all maintenance personnel.

  - Tools shall be obtained and maintained to repair all items whose failure will impact the ability to meet other policy standards.
  - Spare parts shall be stocked for all equipment items whose failure will impact either the ability to meet other policy standards or the inability to continue providing service to customers.
  - Equipment and software to conduct condition assessments, including CCTV Inspections (LRWWMP).
- The City should provide a preventive maintenance schedule for all facilities and equipment. This schedule should be based on the functional and economically useful life of the equipment and facilities as determined by the manufacturer or industry experience:
  - Worn parts should be repaired, replaced, or rebuilt before they have a high probability for failure.
  - Pipelines should be replaced through a condition assessment that includes a risk based prioritization.
  - Where feasible and practical, equipment should be replaced before it becomes obsolete (LRWWMP).
- The City will maintain the wastewater collection system in a timely manner that provides service continuity to the customer:
  - Equipment breakdown repairs will be made even if overtime labor is involved.
  - Equipment that is taken out of service for maintenance will be returned to service as soon as possible (LRWWMP).
- Written records and reports should be maintained on each facility and item of equipment showing its O&M history (LRWWMP).
- The property owner shall own and maintain the side sewer from the house connection to the wastewater main, including the building side sewer and the side sewer stub (that portion of the side sewer within the right-of-way or easement). If a side sewer becomes plugged, it is the property owner's responsibility to correct the problem. The City will assist in locating the side sewer based on any as-built records it has. If it is determined that the problem exists within the City sewer main, the City will provide professional clean up and repair service (LRWWMP).
- A vulnerability analysis will be performed to determine a reasonable "worst case" failure for each basin. The analysis will consider the failure of the interceptor and trunk sewers, failure of the largest mechanical component, and power failure to a single power grid (LRWWMP).
- The Wastewater Utility is responsible for operating the sanitary sewer system, including its planning, design, O&M, records management, customer service, and construction management (LRWWMP).
- The Wastewater Utility shall consist of two sections: Wastewater Utility Systems Section and Surface Water / Wastewater Maintenance Services Section. The Wastewater Utility Systems Section is responsible for project management of CIP projects, planning and design, and customer service. Surface Water / Wastewater Maintenance Services Section is responsible for inspection, testing and repair of facilities, routine preventative maintenance, and responding to emergencies (LRWWMP).

- Wastewater Utility customer service is performed by the Development Services Division (general) and by the Wastewater Utility staff (technical) (LRWWMP).
- Ensure wastewater utility staffing is sufficient to maintain the sewer system and provide adequate service to City residents. Staffing levels should be commensurate with the physical extent of the sewer system and the number of residents served (Policy U-24, 2018 City of Renton Comprehensive Plan).
- Provide the levels of staffing and diversity of skills necessary to operate the City's wastewater utility system (LRWWMP).
- The Wastewater Utility should utilize the expertise in other City departments, according to inter-departmental agreements, to augment the Wastewater Utility's expertise (LRWWMP).

3.8.2 Implementation

Restaurants and other food processing establishments, garages, and gas stations shall install and maintain grease traps, grease and oil interceptors, or other approved methodology on their premises as determined by the Wastewater Utility (RMC 8-5-11).

3.9 Recommendations

The City has robust policies and criteria to aid in providing adequate, reliable sanitary sewer service at a minimum cost to the customer. These policies and criteria are found in the Comprehensive Plan, RMC, reference manuals, and as LRWWMP policies. Through review of these documents, a discrepancy in Section 3.3.2 was found in regard to the distance from an OSS. We recommend the RMC is revised to be consistent with the KC Health Department. The recommended policy would state:

> "Existing development that is within three hundred and thirty feet of a public sewer, where an on-site system (OSS) is operating, connection to the public sewer is required when the sewering authority permits such connection and when:
>
> - Repair, modification, or replacement of the system is necessary, or the existing OSS has failed and an OSS fully conforming to this title cannot be designed and installed; or
> - At such time that additional construction which in any way affects the on-site sewage system is proposed (KCBHRR No. 3, 13.04.050).
> - They are part of a sewer Local Improvement District (LID) (RMC 4-6-040.A)."

The City also identified a discrepancy in Section 3.5.2 in regard to the implementation of areas annexing the City or in the City's PAA. Currently the code states the City will only provide sewer services outside the City limits under certain conditions. However, the City would like to modify the policy to allow all development the opportunity to connect to public sewers. This will be reflected in a future iterations of the code.

We recommend the City continue its regular review of policies and criteria to keep pace with changing system and development conditions.

Chapter 4
PLANNING CONSIDERATIONS

4.1 Introduction

This chapter describes the City of Renton's (City) land use policies and demographic projections that are used to develop future wastewater flow projections.

The City's land use policies and sewer system are connected with adjacent sewer systems' policies and systems in several ways. Existing land use provides the basis for designing properly sized sewerage facilities, including trunks, interceptors, and lift stations. Many of the basins at the edges of the City's service area are also served in part by other cities or districts. In most cases, the City's sewers are downstream, or at the receiving end of the effluent, from the systems adjacent to the City. Therefore, proper planning for the City's sewers requires that the plans of these adjacent utilities be evaluated.

In addition to adjacent utility plans, the land use plans and policies of King County (KC) and the Growth Management Planning Council (GMPC) were also considered. As discussed below the entire planning area is within the Urban Growth Boundary (UGB) established by the GMPC. The City refers to a portion of this area as the Potential Annexation Area (PAA). The City supports the countywide framework policies (F-255 and F-102) that call for the designated Urban Area to be served with sanitary sewers and prefers cities as the provider of sewer services. The entire study area has been designated Urban by the 2018 King County Comprehensive Plan.

4.2 Basis of Planning

The Study Area, shown as a dashed green line in Figure 4.1, is the currently agreed-upon service boundary considered for the Long-Range Wastewater Management Plan (LRWWMP). The Study Area encompasses areas that coincide with the City limits and UGB.

Two planning periods are evaluated in this LRWWMP:

- Existing system.
- Build-out.

Evaluations are performed for both average dry weather flow (ADWF) and peak wet weather flows (PWWF). The existing system is defined as 2012 sanitary flows calibrated with 2018 flow data. Build-out conditions are projected to occur in 2040.

4.3 Planning Area

The planning area for this LRWWMP corresponds, for the most part, with the current City limits and PAA, as shown in Figure 4.1. Service is provided consistent with regional planning and agreements with adjacent utilities.

4.3.1 Existing Service Area

The City currently serves customers in the Existing Service Area. As described in Chapter 2 – Overview of Existing Sewer System, the City serves six drainage basins: Black River, Downtown, East Cedar River, East Lake Washington, May Valley, and West Cedar River. Several basins are served by utilities other than the City: City of Renton, City of Tukwila, City of Kent, and Soos Creek Water and Sewer District provide service within the Black River Basin; Soos Creek Water and Sewer District also provides service within the West Cedar River Basin; Skyway Water and Sewer District serves parts of the Downtown Basin; and May Valley Basin is partially served by Coal Creek Water and Sewer District. Figure 4.2 shows the City of Renton's service area and the adjacent sewer systems that border the City.

The City has negotiated service area boundaries along the common borders in these Basins with Coal Creek Water and Sewer District, Soos Creek Water and Sewer District, Skyway Water and Sewer District, and Cedar River Water and Sewer District. Additionally, natural boundaries in certain areas make the City the logical sanitary sewer provider to them, especially the area to the east of the Green River within the City of Tukwila. Figure 4.2 reflects these agreed upon service area boundaries.

4.3.2 Potential Annexation Areas

The PAA, the gold line in Figure 4.1, is the area between this line and the existing City boundary, the dashed black line in Figure 4.1. Consistent with City policies outlined in Chapter 3 – Operational Policies and Criteria, property owner(s) in the PAA will be required to execute a covenant to annex for each parcel when the property is being provided sewer service if they meet the City's sanitary sewer service objectives. The City aims to provide sewer services to areas in the PAA without existing sewer service in a timely and reasonable manner. The total area of PAA for the City is 7,603 acres.

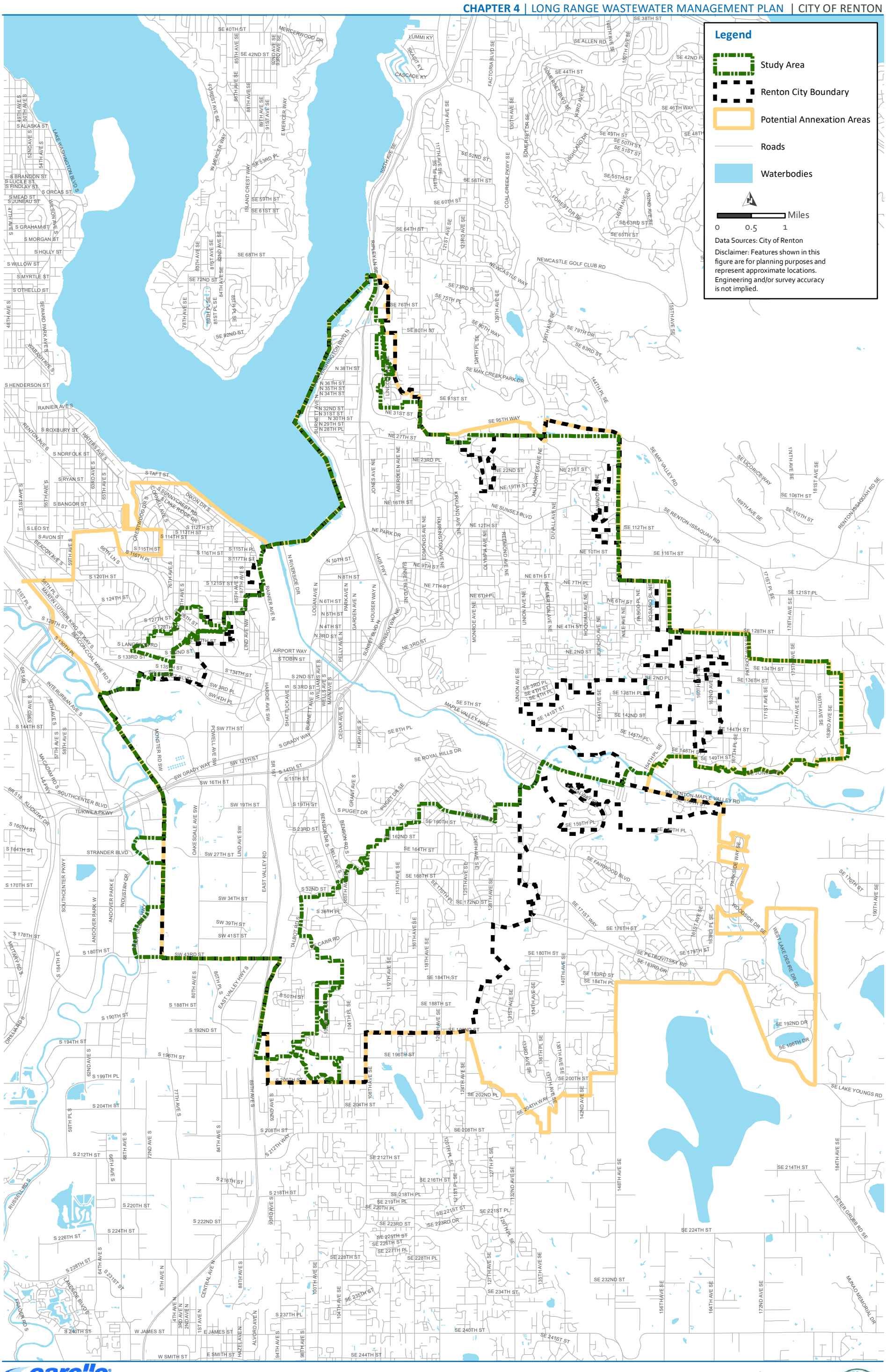

Figure 4.1
Study Area

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WaterSystemPlan2017\Study_Area.mxd

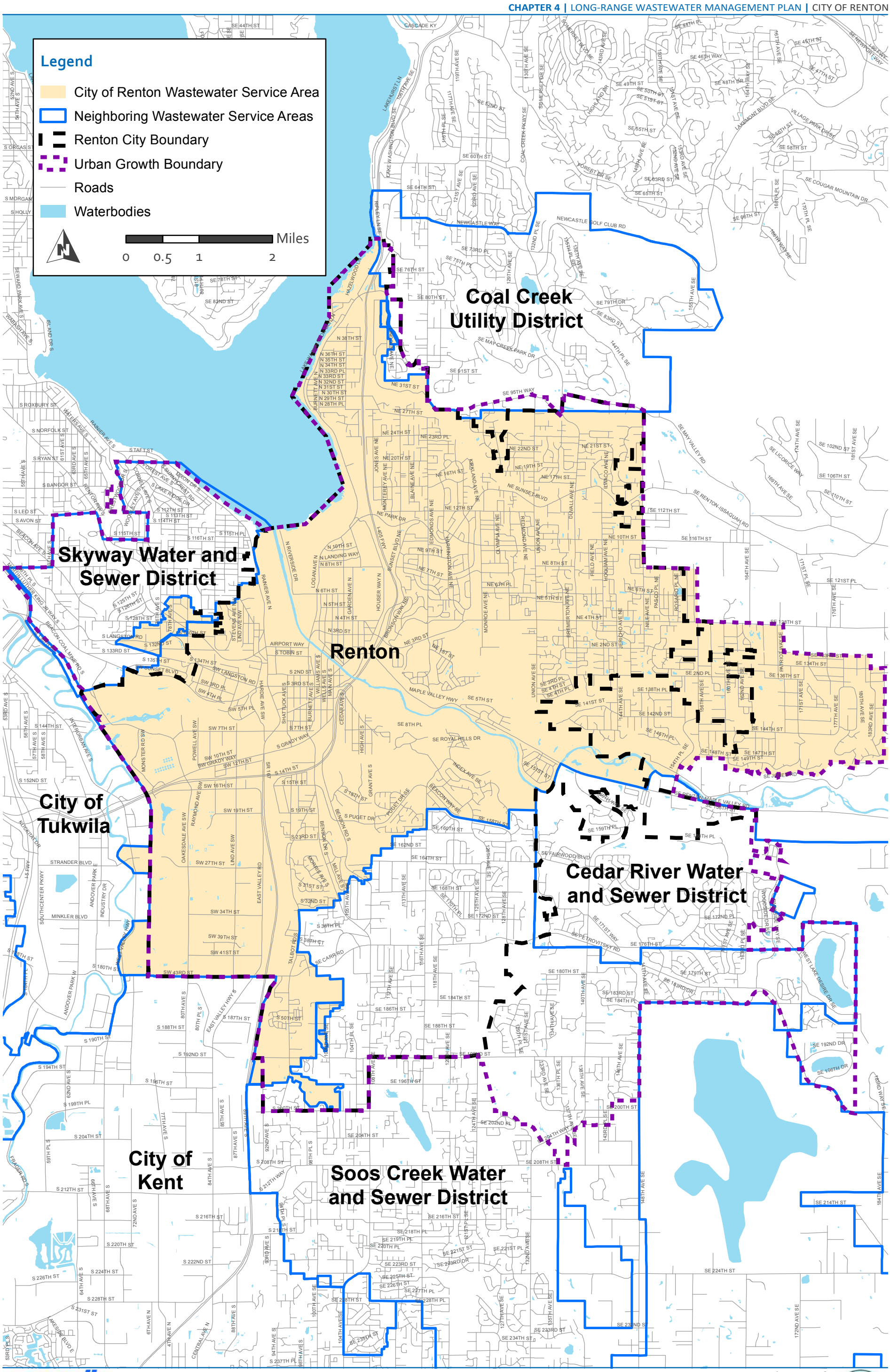

Figure 4.2
Sewer Service Area and Adjacent Utility Systems

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4.4 Land Use

Land Use designations and regulations provide important information in evaluating sewer system capacity. Existing and future land use information is an integral component in projecting wastewater generation for the City and jurisdictions within the service area boundary, including KC, City of Tukwila, and City of Kent.

The City designates parcels into twelve land use categories, as shown in Figure 4.3, these categories include:

- Residential Single Family.
- Residential Low Density.
- Residential Medium Density.
- Residential Multi-Family.
- Center Village.
- Urban Center Downtown.
- Urban Center North.
- Employment Area – Industrial.
- Employment Area – Valley.
- Commercial Neighborhood.
- Commercial/Office/Residential.
- Commercial Corridor.

4.4.1 City of Renton Land Use

The existing land use pattern of the City reflects 100 years of settlement and expansion. The original City was settled in the broad floodplain at the confluence of the Cedar and Black Rivers along the shore of Lake Washington. Downtown Renton, the Renton Municipal Airport, and the Boeing/PACCAR industrial area now occupy these lands. Since the 1950s, the hills and highlands above the valley have been developed primarily for residential housing and accompanying retail businesses.

4.4.1.1 Downtown Renton

The Landing Development sits on approximately 60 acres of former Boeing Industrial Land and currently consists of various retail uses and a significant multi-family component. This development will continue to expand within its existing 60-acres over time as current surface parking is replaced by structured parking, thus permitting future infill of additional retail, residential, and commercial office applications. Future phases of The Landing include an additional approximate 30 acres of land for similar uses as the existing. The initial development of The Landing was a partnership between the City and the developer Harvest Partners.

Areas immediately north and south of downtown are characterized by older, single-family development interspersed with small-scale multi-family developments.

Outside of the central business district, commercial areas are concentrated along the major arterials and freeway exchanges, including Rainier Avenue, Grady Way, Sunset Boulevard, NE 4th Street, the NE 44th Street exit from Interstate 405, and SW 43rd Street. These areas are generally characterized by low intensity, auto-oriented strip commercial, but also include the City's automall along Grady Way and several large-scale retailers.

4.4.1.2 The Green River Valley

South of downtown to the city limits, the Green River Valley has developed with manufacturing, office and warehouse uses. The south and eastern portions of the valley include some commercial uses. New commercial and industrial development activity, as well as changes in business type is expected to increase sewer flows in the Valley within the future.

4.4.1.3 Residential Growth

Significant residential development has occurred on the uplands above the Green River Valley, downtown, and East Kennydale areas. These areas are primarily comprised of single-family neighborhoods, although some concentrations of multi-family and commercial uses exist. West of downtown, residential development extends seamlessly from the City up onto the West Hill of unincorporated KC. On the east side of the service area, residential development extends from downtown to the UGB, with the denser development closer to downtown and becoming less dense as you travel east.

The City's PAA and sanitary sewer service area on the East Renton Plateau is generally characterized by large-lot single-family, moderate density single-family developments, and vacant, un-platted parcels. This area, known as the East Renton highlands, has seen significant single-family growth occur over the past decade and anticipates continued expansion of the sewer system.

4.4.1.4 Passive Land Use

The geography and hydrology of the City vicinity, as well as a proactive parks acquisition program by the City, combine to provide significant open spaces that constitute a passive land use. Some larger examples include lands adjacent to the Cedar River and May Creek, Gene Coulon Park on Lake Washington, the Black River Riparian Wildlife Habitat area, and habitat areas of the Green River Valley.

4.4.1.5 2015 Comprehensive Plan

The City has had a Comprehensive Plan since 1965. The current plan, adopted in 2015 and annually amended, was developed and approved under the regulatory requirements of the Washington Growth Management Act (GMA) and the policy framework of the KC Countywide Planning Policies. While the plan includes Transportation, Housing, Capital Facilities, Utilities, Downtown, Economic Development, and Environmental Elements, it is the policy decisions expressed in the Land Use Element that gives the plan its primary direction and cohesiveness. This LRWWMP proceeds from and supports the policies and Land Use Map of the Comprehensive Plan. Utility Element policies have been addressed in Chapter 3 – Operational Policies and Criteria.

To the extent that the City has jurisdiction or can require compliance, development within the service area must be consistent with the City's Comprehensive Plan. Consistency with certain elements of the Comprehensive Plan is required as a condition of sanitary sewer service outside the city limits. The Comprehensive Plan is intended to provide the basis for all development regulations, functional plans and other City plans and programs that may in some way support, implement or derive from the City's land use plans. The Comprehensive Plan is a broad statement of community goals and policies that direct the orderly and coordinated physical development of the City. The Comprehensive Plan anticipates change and provides specific guidance for future legislative and administrative actions. The Comprehensive Plan also serves

as a guide for designating land uses and infrastructure development as well as developing community services.

4.4.1.6 Service Outside the City

Sewer service outside the City is outlined in the current code.

4.4.2 City of Renton Land Use Designations

For the purposes of the LRWWMP, the Land Use Map adopted on September 22, 2014 within the Land Use Element of the Comprehensive Plan was assumed to represent the intended future pattern of land uses in the planning area as shown in Figure 4.3 with areas tabulated in Table 4.1. The City's Land Use schema identifies six types of land uses: Residential Low Density, Residential Medium Density, Residential High Density, Commercial & Mixed Use, Employment Area, and Commercial Office Residential. The service area addressed in the LRWWMP includes most of the area within the existing city limits, the UGB, and one area outside the UGB. The area outside of the City (dashed black line in Figure 4.1), and within the study area (solid green line in Figure 4.1) includes 117 acres (0.18 square miles [mi^2]) within the city limits of Tukwila, approximately 15 acres (0.02 mi^2) within the city limits of Kent, and 12 acres of unincorporated areas in the City's PAA (0.02 mi^2).

Table 4.1 Land Use of Renton's Sewer Service Area

Land Use Designation	Within Existing City Boundaries (Acres)	PAA (Acres)
Residential Single Family	5,000	1,504
Employment Area	1,779	0
Residential Medium Density	925	73
Commercial Neighborhood	32	2
Commercial Corridor	1,046	144
Commercial/ Office / Residential	137	6
Residential Multi-Family	688	286
Employment Area - Industrial	528	47
Residential Low Density	3,782	5,538
Urban Center North	348	3
Urban Center Downtown	233	0
Center Village	216	0
Total	**14,714 (23.0 mi^2)**	**7,603 (11.9 mi^2)**

The district designations on the land use map correspond to policies in the Land Use Element of the Comprehensive Plan and are implemented by the City's adopted Zoning Map and Zoning Code. The land use designations are described below based on Renton Municipal Code (RMC) 4-2-020.

4.4.2.1 Residential Designations

Residential Low Density Land Use Designation

The designation is intended to guide development on land appropriate for a range of low intensity residential and employment where land is either constrained by sensitive areas or

where the City has the opportunity to add larger-lot housing stock, at urban densities of up to four dwelling units per net acre (du/net acre), to its inventory.

Residential Medium Density Land Use Designation

The Residential Medium Density designation is for "neighborhoods based on a mix of single-family and small to mid-sized multi-family developments built around amenities such as shopping centers, recreation areas, and other community gathering places." Residential medium density land use designations include between three and eight dwellings per acre (R-6 and R-8 Zoning).

Residential High Density Land Use Designation

The Residential High Density Land Use designation provides a mix of residential styles including small lot detached dwellings or attached dwellings. Residential High Density is "intended to increase opportunities for detached dwellings as a percent of the housing stock, as well as allow some small-scale attached housing choices and to create high-quality infill development that increases density while maintaining the single-family character of the existing neighborhood." Higher density neighborhoods may "provide a mix of detached and attached dwelling structures organized and designed to combine characteristics of both typical single-family and small-scale multi-family developments." High density land use designations include between five and fourteen dwellings per acre (R-10 and R-14 Zoning).

Residential Multi-Family Designation

The multi-family residential land use designation is intended to encourage a range of multi-family living environments that provide shelter for a wide variety of people in differing living situations, from all income levels, and in all stages of life. Densities range from 10 to 20 dwellings per acre (Residential Multi-Family [RMF] Zoning).

Legend

- Renton City Boundary
- Roads
- Renton Wastewater Service Boundary
- Waterbodies

Comprehensive Land Use Designations

Residential

- Residential Low Density
- Residential Single Family
- Residential Medium Density
- Residential Multi-Family

Center Designations

- Center Village
- Urban Center Downtown
- Urban Center North

Employment Area Designations

- Employment Area - Industrial
- Employment Area - Valley

Commercial Designations

- Commercial Neighborhood
- Commercial/Office/Residential
- Commercial Corridor

Miles

0 0.5 1 2

Figure 4.3
Comprehensive Plan Land Use

Last Revised: October 28, 2021
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4.4.2.2 Commercial and Mixed Use Designations

Commercial Neighborhood Land Use Designation

The purpose of Commercial Neighborhood designation is for "small-scale convenience retail/commercial areas offering incidental retail and service needs for the surrounding area. Uses serving a larger area may be appropriate if they also serve the residents of the immediate area and are compatible with the scale and character of the neighborhood."

Commercial/Office/Residential Land Use Designation

The Commercial Office (CO) designation is "established to provide areas appropriate for professional, administrative, and business offices and related uses, offering high-quality and amenity work environments. In addition, a mix of limited retail and service uses may be allowed to primarily support other uses within the zone, subject to special conditions."

Center Village Land Use Designation

Center Village (CV) designations are characterized by an existing commercial and multi-family core served by transit and set in the midst of suburban patterns of residential development or in the City's downtown. CV zoned lands are suitable for redevelopment into compact urban development with a pedestrian-oriented, mixed-use center, and community focal point. The zone is intended to revitalize an area, creating a vibrant, urban center where surface parking is discouraged. CV zoning implements the Commercial and Mixed Use designation.

4.4.2.3 Center Downtown Land Use Designation

Center Downtown (CD) designation within downtown Renton is appropriate for the widest mix of uses, is served by transit, and is suitable for intensive urban use within a pedestrian environment. The CD zone is intended to revitalize the area by creating a vibrant, urban center in the City's historic downtown core. Surface parking is discouraged in this zone, except as a land bank. CD zoning implements the Commercial and Mixed Use Land Use Designation.

4.4.2.4 Urban Center Land Use Designation

The Urban Center (UC) North land use designation include lands that are located within the City's Designated Regional Growth Center, if there is a potential for the creation of dense employment, destination retail, recreation, or public gathering space with the UC zone. The UC zoned areas have large parcels of land with the potential for large scale redevelopment opportunities that will create a mixed-use retail, employment, and residential center. UC zoning implements the Commercial Mixed Use land use designation.

4.4.3 School Designations

The City serves public elementary, middle, and high schools from the Issaquah and Renton School districts, in addition to Renton Technical College. These schools are spread throughout the City and can be found within each service basin, except for the May Valley Basin, as shown in Table 4.2. There are two schools in the City's service area, Maywood Middle School and Briarwood Elementary School, which are not currently connected to the public sewers. Both of these schools are in the East Cedar River Basin.

Table 4.2 Schools Served by Renton

Name	Mini-basin	Employment (PE's)(1)	Staff (PE's)(1)
Highlands Elementary	48	545	63
Honey Dew Elementary	26	525	62
Kennydale Elementary	33	559	66
Maplewood Elementary	44	612	56
Sierra Heights Elementary	21	618	63
Talbot Hill Elementary	7	526	50
Tiffany Park Elementary	4	466	52
McKnight Middle School	37	1159	105
Nelson Middle School	2	1041	70
Hazen High School	22	1380	124
Renton High School	15	1218	90
Renton Secondary Learning Center	14	298	34
Apollo Elementary School	22	576	69
Briarwood Elementary School	U6	440	70
Liberty High School	U6	1224	107
Maywood Middle School	U9	905	80
Renton Technical College	27/29	3400	230

Note:
(1) PE(s) – Person Equivalent.

4.4.4 Land Use Outside Renton's PAA

A remaining 137 acres of jurisdiction is part of the service area beyond the city limits and PAA. Table 4.3 displays the land use designations for those areas within the City's service area.

Table 4.3 Land Use Designations for Areas Outside Renton

Jurisdiction (Designation)	Land Use (Density)	Area (Acres)
Kent US(1)	US(1) (1 unit / acre maximum)	15
Tukwila (Commercial/ Light Industrial)	Commercial/Office/Light Industrial	82
Tukwila (Tukwila Urban Center)	Commercial/Office/Light Industrial/ Multi-Family (22 du/net acre maximum)	40

Note:
(1) US – Urban Separator.

4.4.4.1 King County Land Use

For the purposes of the LRWWMP, the 2018 King County Comprehensive Plan was used to direct Land use within the unincorporated portions of the study area. All of the service area in unincorporated KC is designated "urban", with the exception of the service to Apollo Elementary School just east of the Urban Growth Area (UGA). Land within the UGA is intended to develop at urban densities and with urban service levels. The UGB is the division line between the

designated urban and rural areas that defines the eastern boundary of the City's PAA. According to the KC Countywide Planning Policies that provide a policy framework for all comprehensive plans in KC, cities may not annex areas outside the UGB nor may they provide sewer service, except "where needed to address specific health and safety problems or the needs of public facilities such as schools (Policy F-264)".

Unincorporated areas of KC are divided into community planning areas, each with a community plan. For the purposes of the LRWWMP, community plans were based on those adopted as part of the 2012 King County Comprehensive Plan. Where conflicts or inconsistencies between the policies of the community plans and KC's Comprehensive Plan occur, the Comprehensive Plan takes precedence. The community plans, West King County, SE King County, Greater Maple Valley/Cedar River, West Hill, and Four Creeks/Tiger Mountain, cover most of the unincorporated areas within the study area of this LRWWMP.

4.4.4.2 City of Kent Land Use

City of Kent Planning Division assures quality in the land development process by effective administration of land use codes and compliance with the GMA. The Comprehensive Plan Land Use Map provides the general vision for the City's growth over the next twenty years, and provides a framework for amendments to the City's official Zoning Districts Map. Approximately 15 acres of the City's sewer service area are within the City of Kent. This area is designated as single-family residential.

4.4.4.3 City of Tukwila Land Use

Approximately 122 acres of the City's sewer service area are within the City of Tukwila. Based on the 2015 Comprehensive Plan, 40 acres are within the Tukwila Urban Center that contains an intense diverse mix of use that will continue to evolve over time. The center is a regional commercial/industrial area with limited mixed-use residential. The remaining area is designated as Commercial/Light Industrial.

4.4.5 Adjacent Utility Systems/Joint Use, Service Agreements, and Related Plans

The City has entered into several joint use and service agreements with neighboring districts and private customers when it has been economically beneficial. A list and a summary of these joint use and service agreements are presented below. The full text for each of these agreements is presented in Appendix F, Service Agreements:

- Coal Creek Utility District (formerly Water District No. 107):
  - CAG-035-075, 1975 - Construction of an interceptor line from the City sewer service area through Water District No. 107 to a collection trunk operated by the Municipality of Metropolitan Seattle.
  - Sewer Utility Franchise, 1987 - The City granted Water District No. 107 the right to install sewer lines within the service area of Water District No. 107.
  - CAG-01-031, 2001 - Sewer service boundary clarification.
- City of Kent:
  - CAG-012-83, 1983 - Provides for the installation of a sanitary sewer main that is owned and operated by the City and allowing the City to provide sewer service to the adjacent properties that are in the Kent service area.
- King County:

  - Franchise No. 14056, 2001 - Grants the City the right to construct sewer lines along KC roads.
- Soos Creek Water and Sewer District, formerly called Cascade Sewer District:
  - Resolution 1234 AG-764-64, 1964 - Interceptor sewer line from the Cascade sewer system through portions of the City to the sewer system of the municipality of Metropolitan Seattle. Addendum 1 and 2 were made in 2011 and 2014, respectively.
  - Agreement CAG-039-074, 1974 - Extension of the City's sewer service to certain areas within the Cascade sewer service area.
  - CAG-91-083, 1991 - Soos Creek Water and Sewer District to provide sewer service to certain properties within City limits.
  - CAG 91-083 Adden#2-08, 2008 – Soos Creek and Sewer District revise service boundary and transfer of service to City.
  - CAG - 097-164, 1997 - Revision of the water and sewer service boundary.
  - CAG -083-91 Addendum 1-04, 2004 - The Soos Creek Water and Sewer District may connect certain properties (described in the 1991 agreement) to the City's Sewer System.
- Skyway Water and Sewer District:
  - CAG-03-197, 2003 - Sewer and water service boundary clarification.
  - CAG-06-170, 2006 - Skyway Water and Sewer District may connect a portion of their service area into the City's sewer facilities.
- Cedar River Water and Sewer District:
  - CAG-99-014, 1999 - Water and sewer service boundary clarification.

The City is surrounded by seven neighboring sewer utility entities, as previously shown in Figure 4.2. These neighboring utility entities are listed below.

4.4.5.1 Coal Creek Water and Sewer District

Coal Creek Water and Sewer District (formerly King County Water District No. 107) provides sewer service in part of the May Valley Basin. The City and Coal Creek have made boundary adjustments to remove previous service overlaps. This interlocal agreement provides for joint use of a sewer main in Lincoln Avenue for the provision of service to that area and to allow for another portion of the City's service area to flow into Coal Creek's system.

4.4.5.2 Cedar River Water and Sewer District

Cedar River Water and Sewer District (CRWSD) provides service to parts of the Lower Cedar River Basin. However, only a small fraction of the wastewater from CRWSD ultimately flows through the City's system by flowing through the Soos Creek Water and Sewer District. The majority of sewage from CRWSD flows directly into KC's Cedar River Interceptor located along the Maple Valley Highway. CRWSD's last Comprehensive Sewer Plan was adopted in 2016. The City and CRWSD have entered into a 1999 interlocal agreement identifying the common service boundary between the two service providers.

4.4.5.3 Soos Creek Water and Sewer District

Soos Creek Water and Sewer District adopted the Soos Creek Water and Sewer District Sewer Comprehensive Plan in July of 2014. In 1997, the District and City entered into an interlocal agreement revising the boundary between Soos Creek and the City that had been set by a 1991 agreement. Based upon these agreements, the City is the service provider to some areas currently outside the City and Soos Creek provides service to some areas inside the city limits.

A 1964 agreement provides for joint use of a sewer interceptor in the Tiffany Park Subbasin, and the 1991 agreement provides for joint use of the Springbrook Interceptor, located on South 192nd Street. The Springbrook Interceptor will provide service to the southernmost portions of the City.

4.4.5.4 City of Kent

SW 43rd Street is the principal dividing line between the Cities of Renton and Kent. The City has an agreement with Kent to serve a small area south of SW 43rd Street east of 72nd Avenue Street and west of the Puget Sound Electric Railway right-of-way. The City of Kent Comprehensive Sewer Plan was adopted in 2002 (dated 2000). The Renton and Kent City limits adjoin each other. There is a small portion of the City of Kent, south of South 55th Street and east of the Valley Freeway that is in the City's service area. There are no service area overlaps or gaps between the two entities, except for that one small area.

4.4.5.5 City of Tukwila

The City serves a portion of the City of Tukwila east of the Burlington Northern Railroad and south of Longacres. Tukwila also discharges from a lift station into the KC Sewer System within the City along Monster Road SW. Tukwila prepared a Comprehensive Sewer Plan in 2014. Approximately 122 acres of the City's sewer service area is within the City of Tukwila.

4.4.5.6 Skyway Water and Sewer District

Skyway Water and Sewer District adopted a Comprehensive Plan in 2004 The Skyway sewer service area is shown in Figure 4.2. The boundary between Skyway and the City has been set by an interlocal agreement adopted in 1994. An area in the southern portion of the District, as well as in the service area to the south of the District, could be served by gravity to the City's sanitary sewer system. An agreement to allow the district to route portions of this southern service area through the City's facilities was entered into in 2006. Skyway Water and Sewer District provides sanitary sewer service to a small area of the City along Rainier Avenue near South 117th Place and the northwest portion of the airport. Skyway sewage discharges into the KC System within the City at the north end of the Renton Airport. (Coordinate with Skyway about how much flows they will have so we can plan for the future).

4.4.5.7 King County Regional Wastewater Services Plan

For more than 40 years, KC has protected water quality in the Puget Sound region by providing wastewater treatment services to King, Pierce, and Snohomish counties, including the City. To ensure the continuation of high quality wastewater treatment services in the future, KC carried out an intensive planning effort, involving numerous elected officials, representatives from local sewer agencies, organizations, and individuals from around the region.

The Regional Wastewater Services Plan (RWSP) resulted from these efforts, which was adopted by the KC Council in November 1999, via Ordinance 13680. The RWSP outlines a number of important projects, programs, and policies for KC to implement through 2030, and work is well underway. A summary of the major components of the RWSP includes Brightwater Treatment System, Conveyance System Improvements, Regional Infiltration and Inflow Control, Combined Sewer Overflow Control, Odor Control Program, Biosolids Recycling, and Reclaimed Water. In 2013, KC completed a comprehensive review of RWSP. The Compressive Review found that full expansion of the South Treatment Plant, located in the City, will likely occur in the 2030s based on updated treatment capacity needs, not 2029 as previous planned.

In December 1999, as part of the RWSP, the KC Council approved the development of a Regional Infiltration and Inflow (I/I) Control Program. The purpose of the program is to reduce the risk of sanitary sewer overflows and the cost of adding capacity to facilities that convey wastewater to KC treatment plants.

In 2000, KC's Wastewater Treatment Division, in cooperation with the local component agencies that it serves, of which the City is one of, launched an I/I Program. The recommendations of the I/I Program represent the consensus reached by the KC and local agencies throughout the 6-year program development process. Knowledge gained from flow monitoring, modeling, pilot projects, and a benefit-cost analysis conducted during the I/I control study served as the basis for consensus.

Recommendations are presented for both I/I reduction and long-term I/I control and for program administration and policy. In addition to cost-effectively removing enough I/I from the collection system to delay, reduce, or eliminate some otherwise needed conveyance system improvement (CSI) projects, measures must be in place to maintain I/I reductions long-term and to prevent future increases in I/I throughout the regional system. Long-term I/I control includes policy, administrative, financial, and technical measures that promote an ongoing program of review, maintenance, and repair of the collection and conveyance system.

4.4.5.8 King County Conveyance System Improvement Program

Since 1999, the CSI Program focuses on guiding major upgrades and improvements to KC-owned facilities. A 2017 CSI program update was completed with conceptual projects approved in 2017. As part of this effort, a Regional Needs Assessment report was completed in 2015, where the City discharges are included in the South Lake Washington Planning Area. As discussed in Chapter 5 – System Analysis and Results, surcharging in these interceptors impacts capacity in the City's system.

4.4.5.9 King County Reclaimed Water Comprehensive Plan

The City is participating in the regional forum, consisting of King County, Cascade Water Alliance, Seattle Public Utilities, and individual surrounding purveyors, in combined effort to develop a master agreement for reclaimed water as well as reclaimed water planning and policies. The forum represents a regional approach to strategic planning and system expansions needed to accommodate the distribution, sale, supply, and reuse of reclaimed water that could include the City's current and future service area.

In 2011, the King County Wastewater Treatment Division began another engineering, environmental, and economic analysis of conceptual reclaimed water strategies. The City is now working with King County to provide them appropriate information for this analysis. A completed King County Water Reclamation Evaluation Checklist for this use is included in Appendix M.

The City will support the regional supplier's study of reclaimed water use opportunities and will work with King County Department of Natural Resources to identify potential reclaimed water users and demand. Any reclaimed water to be used as a source of supply should only be provided through retail water suppliers. The City has identified several potential users of reclaimed water for landscape irrigation uses, including the Boeing Longacres Facilities. The full list of potential reclaimed water users from the City's largest consumers is in the checklist.

4.5 Demographic Analysis

Future sewer system requirements are based, in part, upon future demographic growth projections within the sewer service area. Demographic growth projections were created for areas within the City, unincorporated KC, and several small service areas that the City has agreed to serve in adjacent jurisdictions. Most of the projected sewer area growth will occur in the areas east of the current City limits, including a large non-sewered area within unincorporated KC in the East Plateau service area, also known as the East Renton Highlands. This section summarizes the demographic projections made as part of latest hydraulic model update documented in the 2012 Hydraulic Model Update (Stantec, 2015).

Demographic projections were sought for existing condition and build-out. The existing condition was set as the year 2012 to correspond with the most recent flow monitoring effort. Puget Sound Regional Council (PSRC) Land Use Baseline projections, which were developed using the UrbanSims, provide demographic data through 2040. The City will likely reach build-out by 2040 with future growth from redevelopment. Therefore, the City defined the Ultimate projection as the PSRC 2040 projection plus a 25 percent factor as a margin of safety to account for future redevelopment and changes to building practices.

Population, household, and employment data was derived from the PSRC Traffic Analysis Zone (TAZ) projections for the years 2012 and 2040. The data obtained was provided in geographic subdivisions based on the sewer mini-basin boundaries provided to PSRC by Stantec. Consistent with other LRWWMP, demographic data and results in this chapter are summarized based on sewer mini-basins, rather than TAZ.

4.5.1 Residential Population Projections

In total, existing populations were determined to be 43,869 single-family and 24,417 multi-family using both PSRC residential and Baseline Land Use. The total future population was projected to be 76,731 and 37,386 which is an increase of 32,862 and 12,452 single- and multi-family households, respectively, over a period of 28 years. This is an approximately 1,174 single-family and 445 multi-family increase in population annually.

Mini basins which see the greatest growth include basins 30B, 30C, and U9 at rates of 2,000 percent, 4,650 percent, and 2,582 percent, respectively, over the 28 year period.

4.5.1.1 Existing - 2012

The PSRC data provided 2012 residential projections for single-family and multi-family populations. Stantec performed a review of the data to resolve any obvious inaccuracies identified through the review of City geographic information system (GIS) data within each mini-basin, including land-use, parcel count, and aerial photos. Additionally, larger multi-family developments were reviewed using KC Assessor's information.

Based on this review, populations for the following basins were modified as documented in the 2012 Hydraulic Modeling Update:

- Basin 5 – The Land Use Baseline projections list 126 parcels and a single-family residential population of 169. City GIS data shows 170 parcels within the basin, with an estimated 100 single-family lots. A multiplier of 2.5 persons per single-family lot was used to estimate a single-family residential population of 250 for this basin. The

multi-family population supplied by PSRC is negligible, and is consistent with the City GIS data.

- Basin 20 – The estimate from PSRC for this mini-basin encompassed the Ultimate mini-basin boundary. To estimate the population for the current boundary, the total of 3,007 people was scaled on an area ratio of the current/ultimate basins for an adjusted population of 2,390. The multi-family development and zoning is all within the current mini-basin boundary, so this population was not modified.
- Basin 25/Basin 43 – Both of these mini-basins include large mobile home parks, which are not accounted for in the PSRC projections for either single-family or multi-family populations. Basin 25 includes approximately 240 mobile homes, and Basin 43 includes approximately 200 mobile homes. To account for these populations, a multiplier of 1.8 (multi-family) was applied to each mobile home, and the populations were added to the projections supplied by PSRC. For Basin 25, the total residential population was adjusted from 983 to 1,415. For Basin 43, the population was adjusted from 49 to 410.
- Basin U1 - The Land Use Baseline projections list 58 parcels and a single-family residential population of 255. City GIS data shows approximately 205 parcels within the basin, with an estimated 197 single-family lots. A multiplier of 2.5 persons per single-family lot was used to estimate a single-family residential population of 490 for this basin. The multi-family population supplied by PSRC is negligible, and is consistent with the GIS data.
- Basin U6 – The estimate from PSRC for this mini-basin encompassed the ultimate mini-basin boundary. To estimate the population for the current boundary, the total of 2,050 people was scaled on an area ratio of the current/ultimate basins for an adjusted population of 1,345. The multi-family population supplied by PSRC is negligible, and is consistent with the GIS data. It was not modified.
- Basin U9 – The estimate from PSRC for this mini-basin encompassed the ultimate mini-basin boundary. To estimate the population for the current boundary, the total of 1,268 people was scaled on an area ratio of the current/ultimate basins for an adjusted population of 68. No multi-family population was projected. This is consistent with the GIS data.

All modifications were reviewed and accepted by City Planning Department staff.

4.5.1.2 Future

The PSRC 2040 residential projections estimated single-family and multi-family populations that are aligned with the Vision 2040 Regional Growth Strategy. Ultimate projections were calculated as the PSRC 2040 projection plus 25 percent to be conservative.

Unlike the 2012 projections, no changes were made to the PSRC output with one exception. Recent detailed projections for mini-basin 45, which were made as part of the Thunder Hills Sanitary Sewer Interceptor Design Project, were incorporated into the 2040 demographic projection. Mini-basin 45 multi-family populations were increased using a higher growth rate similar to the adjacent mini-basin 3 PSRC estimates.

4.5.2 Employment

The total existing employment is 44,506 using 2012 basin population estimates. The total future employment was projected to be 104,414 which is an increase of 59,908 employees over a period of 28 years. This is approximately a 2,140 increase in employment annually. Major regions of

growth for future employment are mini-basins 27, 32, 43, 48, 50, and U9 with growth rates of 10,891 percent, 5,017 percent, 2,400 percent, 4,700 percent, 3,447 percent, and 31,300 percent, respectively.

Where employment projections were not released for several TAZ due to confidentiality requirements by the Employment Securities Department, alternate methods were used in these areas, which are discussed further in this section. In addition, the school enrollments were estimated to account for sewer use by students, as they are not captured in the PSRC employment projections. Note, the TAZ projections meet or exceed the City's adopted GMPC population and employment targets for the City and PAA. Demographic projections are summarized in Table 4.4 and discussed further in the following sections.

4.5.2.1 Existing - 2012

PSRC employment projections, also based on the Baseline Land Use model, were throughout the Sewer Service Area. As previously mentioned, projections were not available for six mini basins due to confidentiality requirements by the Employment Securities Department: Basins 30C, 32, 50, 52, U3, and U8. Therefore, demographic projections for those mini-basins were developed using 2011 Longitudinal Employer-Household Dynamics (LEHD) data, developed by the U.S. Census Bureau. Through a review of available GIS data, no obvious discrepancies were found in either the PSRC or LEHD data.

4.5.2.2 Future

PSRC 2040 employment are based on local growth targets that are aligned with the Vision 2040 Regional Growth Strategy. Mini-basin employment allocations were made using the PSRC, except where no data was available. For these six basins, Stantec produced custom allocations, which were reviewed and accepted by City Planning Department staff. Ultimate projections were calculated as the PSRC 2040 projection plus 25 percent.

4.5.3 Schools

The City serves public elementary, middle, and high schools from the Issaquah and Renton School Districts in addition to private schools, Renton Technical College, and the University of Phoenix campus. These schools are spread throughout Renton and can be found within each service basin except for the May Valley Basin. There are two schools in Renton's service area, Maywood Middle School and the Briarwood Elementary School, that are not currently connected to the public sewers. These are located in the East Cedar River Basin.

4.5.3.1 Existing - 2012

School enrollment projections were determined for schools within the existing sewer service area using published data from the local school districts, including the Renton School District and Issaquah Schools. Student populations were generally developed using enrollment statistics for the 2011-2012 school year. School staffing were not included in enrollment, as staff are considered in the PSRC employment projection.

4.5.3.2 Future

School enrollment projections for 2040 are not available from the PSRC or school districts. Therefore, school population estimates were projected to grow at the same rate as the residential population. As with other categories, the resulting projection was increased by 25 percent to create the Ultimate projection.

Table 4.4 Demographic Projections (From Stantec 2015 Hydraulic Model Update Report)

Sewer Mini basin	2012 Basin Population Estimates				Ultimate Population Estimates (2040 Population+25%)				Area (acres)		
	Single-Family	Multi-Family	Employment	Schools	Single-Family	Multi-Family	Employment	Schools	2012	Ult	% Diff
1	180	82	22	0	554	420	29	0	71.79	71.79	0.00%
2	81	1,303	342	1,041	209	1,608	713	1,367	127.50	134.72	5.67%
3	1,012	1,307	95	0	1,660	1,836	248	0	194.52	194.52	0.00%
4	1,094	49	22	466	2,109	121	160	909	205.17	205.17	0.00%
5	250	1,823	4,126	0	701	2,238	5,633	0	213.91	233.53	9.18%
6	1,513	10	25	0	2,173	14	165	0	224.34	224.34	0.00%
7	1,232	27	67	526	1,936	31	88	822	162.60	162.60	0.00%
8	0	0	2,248	0	0	0	5,310	0	82.14	82.14	0.00%
9	0	0	272	0	0	0	645	0	111.02	111.02	0.00%
10	173	121	537	0	201	65	1,011	0	54.44	54.44	0.00%
11	803	461	1,140	0	1,148	559	2,201	0	163.83	163.83	0.00%
12	23	1,492	458	0	34	1,803	883	0	73.57	73.57	0.00%
13	402	438	698	0	398	498	1,301	0	81.08	81.08	0.00%
14	1,041	401	504	298	1,795	483	1,088	471	205.98	205.98	0.00%
15	110	456	736	1,218	139	576	1,504	1,539	92.33	92.33	0.00%
16	1,077	380	241	0	1,534	481	583	0	177.15	177.15	0.00%
17	545	149	202	0	765	355	379	0	122.66	122.66	0.00%
18	350	209	148	0	408	280	279	0	38.85	38.85	0.00%
19	0	0	1,480	0	0	0	3,496	0	144.37	144.37	0.00%
20	2,390	490	261	0	5,943	549	973	0	309.45	620.56	100.53%
21	1,425	17	59	618	1,998	35	335	871	143.52	176.54	23.00%
22	1,065	1,433	599	1,956	1,690	1,905	2,049	2,815	208.76	208.76	0.00%
23	858	393	52	0	1,228	500	98	0	111.83	111.83	0.00%
24	1,258	136	63	0	1,839	179	109	0	130.46	130.46	0.00%
25	1,583	35	111	0	1,321	90	200	0	179.79	179.79	0.00%
26	2,189	1,440	818	525	3,270	2,228	1,800	795	382.54	382.54	0.00%
27	1,097	62	11	1,135	1,434	86	1,209	1,489	102.98	102.98	0.00%
28	0	0	5,365	0	0	0	12,673	0	180.04	180.04	0.00%
29	574	120	16	2,265	770	188	44	3,127	85.78	85.78	0.00%
30A	787	835	60	0	941	1,688	139	0	133.61	133.61	0.00%
30B	38	3	0	0	55	63	0	0	4.68	4.68	0.00%
30C	2	324	12	0	95	499	106	0	21.21	21.21	0.00%
32	321	281	105	0	368	328	5,373	0	141.77	141.77	0.00%
33	3,184	11	218	559	4,903	18	398	861	320.61	375.94	17.26%
34	721	227	43	0	1,223	279	75	0	127.92	127.92	0.00%
35	328	224	113	0	438	314	313	0	60.08	60.08	0.00%
36	40	1,376	397	0	41	1,634	854	0	117.20	117.20	0.00%
37	256	352	257	1,159	341	494	451	1,592	69.08	69.08	0.00%
38A	642	253	469	0	808	370	1,091	0	91.24	91.24	0.00%
38B	47	17	2	0	55	63	0	0	16.72	16.72	0.00%
39	508	515	127	0	640	690	329	0	86.04	86.04	0.00%
40	593	87	33	0	776	113	63	0	74.87	74.87	0.00%
41	1,063	94	61	0	1,319	133	116	0	117.31	117.31	0.00%
42	0	0	147	0	0	0	329	0	20.06	20.06	0.00%
43	549	624	7	0	611	1,085	175	0	116.45	116.45	0.00%
44	282	578	487	0	361	835	909	0	127.88	127.88	0.00%
45	20	1,157	2,733	0	133	2,390	5,165	0	158.81	158.81	0.00%
46	1,994	615	679	0	2,431	741	1,469	0	389.97	389.97	0.00%
46 (North)	67	665	21	0	106	1,055	36	0	23.84	23.84	0.00%
47	777	1,496	606	0	1,089	2,628	1,269	0	196.30	196.30	0.00%
48	462	168	6	545	609	243	288	737	60.26	60.26	0.00%
49	12	0	544	0	15	0	1,284	0	71.85	71.85	0.00%

Sewer Mini basin	2012 Basin Population Estimates				Ultimate Population Estimates (2040 Population+25%)				Area (acres)		
	Single-Family	Multi-Family	Employment	Schools	Single-Family	Multi-Family	Employment	Schools	2012	Ult	% Diff
50	4	174	30	0	5	210	1,064	0	162.61	162.61	0.00%
52	597	6	187	0	1,054	5	1,028	0	148.12	148.12	0.00%
54	139	1,066	883	0	446	1,680	1,668	0	252.50	252.50	0.00%
A	4	0	4,975	0	5	571	11,753	0	857.19	857.19	0.00%
B	0	0	2,580	0	85	0	6,046	0	323.32	323.32	0.00%
CEDAR02A	302	146	318	0	370	211	599	0	48.59	48.59	0.00%
ESI1003	237	620	7,126	0	255	1,108	14,185	0	403.86	403.86	0.00%
RENT65	561	526	189	0	1,115	811	569	0	178.09	178.09	0.00%
U1	255	8	7	0	1,004	8	16	0	75.48	75.48	0.00%
U2	1,054	56	23	0	2,014	61	51	0	139.04	139.04	0.00%
U3	1,064	63	59	0	1,743	88	303	0	141.67	141.67	0.00%
U4	2,927	10	251	612	4,649	30	614	975	471.97	471.97	0.00%
U5	NA	NA	NA	NA	976	75	36	0	NA	112.94	
U6	1,345	6	32	1,664	4,055	33	544	3,309	219.90	615.17	179.75%
U7	NA	NA	NA	NA	1,685	9	96	0	NA	173.66	
U8	294	0	3	0	496	0	26	0	43.01	43.01	0.00%
U9	68	0	1	905	1,824	0	314	1,305	12.21	212.66	1641.94%
U10	NA	NA	NA	NA	2,335	178	64	0	NA	354.03	
Total	**43,869**	**25,417**	**44,506**	**15,492**	**76,731**	**37,869**	**104,414**	**22,984**	**10,407.68**	**12,070.34**	

Note:
Abbreviation: NA – not applicable.

4.6 Sewer Collection System Flow Components

The City has separate sewer and stormwater collection systems, where only wastewater is conveyed in the sanitary sewer system. However, some groundwater and stormwater inevitably enter the sanitary sewer through defects in pipes and manholes (MHs) and illicit storm drain connections. Therefore, sewer flows may vary substantially between dry and wet weather.

The different flow components are described in the section below.

4.6.1 Dry Weather Flow Components

There are two components of dry weather flow:

- Base wastewater flow (BWF).
- Dry weather groundwater infiltration (GWI).

4.6.1.1 Base Wastewater Flow

The BWF is the sanitary flow generated by routine water usage of the City's residential, commercial, and mixed-use customers. Conveying this flow is the primary function of the collection system. The flow has a diurnal pattern that varies by customer. Typically, a residential diurnal pattern has two peaks with the more pronounced peak following the wake-up hours of the day, and a less pronounced peak occurring in the evening. Commercial and mixed-use patterns, though they vary depending on the type of use, typically have more consistent higher flow patterns during business hours, and lower flows at night. Furthermore, the diurnal flow pattern of a weekend may vary from the diurnal flow experienced during a weekday.

4.6.1.2 Groundwater Infiltration

Dry weather GWI enters the sewer system through defects such as cracks, misaligned joints, MH defects, and broken pipelines. Dry weather GWI only occurs when the relative depth of the groundwater table is higher than the depth of the pipeline and where there is a defect; therefore it varies throughout the system. Dry weather GWI (or base infiltration) cannot easily be separated from BWF by flow measurement techniques. Therefore, dry weather GWI is typically grouped with BWF.

4.6.1.3 Average Dry Weather Flow

ADWF is the average flow that occurs on a daily basis during the dry weather season and is representative of routine wastewater discharges into the collection system from customers as well as baseline groundwater infiltration.

4.6.2 Wet Weather Flow Components

Wet Weather Flow (WWF) includes two components:

- Infiltration and Inflow (I/I).
- Wet weather GWI.

4.6.2.1 Inflow and Infiltration

The stormwater I/I response in the sewer system to rainfall is seen immediately (inflow) or within hours after the storm (infiltration).

Inflow is stormwater that enters the sewer system via a direct connection to the system, such as roof drain and downspout connections, leaky MH covers, and illicit storm drain

cross-connections. Infiltration is stormwater that enters the sewer system by percolating through the soil and then through defects in pipelines, MHs, and joints. The adverse effects of I/I entering the sewer system is that it increases both the flow volume and peak flows such that the sewer system could be operating at or above its capacity. If too much I/I enters the sewer system, sanitary sewer overflows (SSOs) could occur.

4.6.2.2 Wet Weather Groundwater Infiltration

Wet weather GWI is not specific to a single rainfall event, but rather to the effects on the sewer system over the entire wet weather season. The depth of the groundwater table rising above the pipe invert elevation causes GWI. Sewer pipes within close proximity to a body of water can be greatly influenced by groundwater effects.

Wet weather GWI is associated with extraneous water entering the sewer system through defects in pipes and MHs while the ground is saturated during the wet weather season. Wet weather GWI may occur throughout the year, although rates are typically higher in the late winter and early spring in the Pacific Northwest.

4.6.2.3 Peak Wet Weather Flow

PWWF is the highest observed hourly flow that occurs following the selected design storm event. PWWF in a sewer system can be more than ten times the base flow, causing utilities to construct high-capacity infrastructure to convey and treat these flows.

4.7 Flow Monitoring

As part of the Scope of Services for this LRWWMP, Carollo Engineers, Inc. (Carollo) contracted with ADS Environmental Services, LLC (ADS) to conduct a Temporary Flow Monitoring Program within the City's sanitary sewer collection system. The purposes of the flow monitoring program were to correlate actual collection system flows to the hydraulic model predicted flows, evaluate the system's capacity, and estimate basin I/I. The temporary flow monitoring data was collected for a period of approximately four months from December 22, 2017 to April 22, 2018. The "ADS Flow Monitoring Report" prepared by ADS summarizes the flow monitoring program and was submitted to the City as a stand-alone report. The report can be found as an attachment to Appendix G, TM 1.

4.8 Average Dry Weather Flow

Developing an accurate estimate of the future quantity of wastewater generated at build-out of the collection system is an important step in maintaining and sizing sewer system facilities, for both existing conditions and future scenarios.

Base flow can be estimated for a wastewater system by comparing dry weather flow and wet weather flow at the various flow monitoring locations. To estimate ADWF for more specific areas, such as individual wastewater basins, dry weather flows are typically estimated based on the area contributing to flows and flow coefficients developed for each land use type. This method is developed based on the assumption that areas with similar land uses, such as low density residential parcels, produce equivalent quantities of wastewater flow. System-wide flows can be compared to known flows at flow monitors, or at the treatment plant to verify accuracy. This method of estimating base flows is an industry standard for planning and provides sufficiently accurate data for planning purposes.

4.8.1 Average Dry Weather Flow Development

Existing ADWFs for each basin were estimated using data from the Flow Monitoring Program for each of the flow monitoring basins. ADWF was developed using the driest days from the flow monitoring period based on the following set of minimum criteria:

- Less than 0.1 in of rain in the previous day.
- Less than 0.4 in of rain in the previous 3 days.
- Less than 1.0 in of rain in the previous 5 days.
- Selected days must exhibit average-day flows within 85 percent to 115 percent of the average-day flows of remaining dry days.
- In addition, those dry days that exhibited unusual flow patterns were not used to generate net dry day flow values for a basin.

Characteristic dry weather 24-hour diurnal flow patterns for each site were developed based on the hourly data. The hourly flow data were also used to calibrate the hydraulic model for the observed dry weather flows during the flow monitoring period. Hourly patterns for weekday and weekend flows vary and were separated to better understand dry weather flow. An example of the dry weather flow diurnal patterns is shown in Flow Monitoring Basin MH0537, in Figure 4.4.

Carollo estimated the average weekday and weekend dry weather levels and velocities at each site from the data provided by ADS for use in the model calibration process.

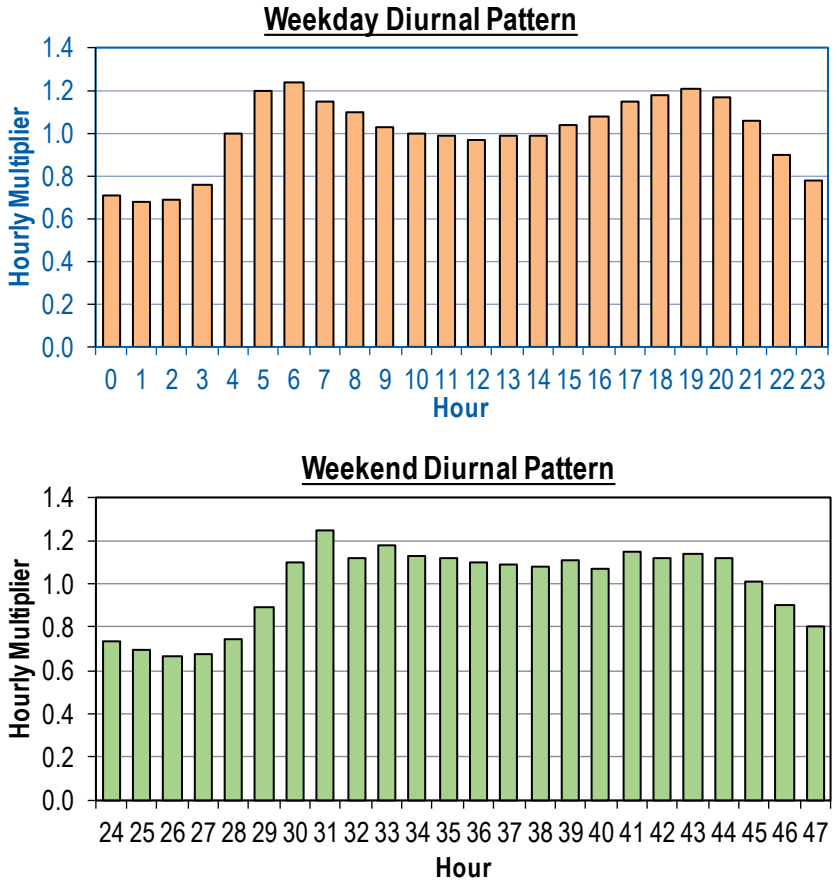

Figure 4.4 Typical Weekday vs Weekend Dry Weather Flow Variation (MH0537)

4.9 Wet Weather Flows

PWWF in a wastewater collection system are caused by rainfall dependent I/I. Peak hour flows can result in flows more than ten times the base flow, causing utilities to construct high-capacity infrastructure to convey and treat these extraneous flows.

Existing and projected PWWFs are predicted using the hydraulic model and design storm used for this LRWWMP. This analysis uses four separate multi-day, 20-30 year recurrence design storms, illustrated in Chapter 5 – System Analysis and Results. These storms were identified in the 2012 KC I/I Study and correspond to the recurrence interval within historical KC rainfall. To represent typical Pacific Northwest winter rainfall conditions, antecedent rainfall was added from historical data. Further detail on the development of the design storm can be found in Chapter 5 – System Analysis and Results.

4.9.1 Rainfall Data

An important part of the flow monitoring program is the collection and analysis of rainfall data. Three significant rainfall events occurred during the course of the flow monitoring period, as well as a few other relatively minor events. The storms recorded during the Temporary Flow Monitoring Program did present data in terms of the collection system's I/I response to wet weather flow events, and is appropriate for I/I analysis and model calibration purposes.

4.9.2 Wet Weather Flow Data

The flow monitoring data was evaluated to determine how the collection system responds to wet weather events. A summary of the peak wet weather flow mini basin during current and buildout conditions is shown in Table 4.5.

4.10 Projected Flows

A summary of the modeled PWWF flows for each planning period is shown in Table 4.5. As previously described, these flows were calculated using land use data for the study area and an average wastewater conveyance required per capita. These flows were calculated by simulating the February 1996 design storm, described in Chapter 5 – System Analysis and Results. Flows consider both I/I change and system expansion.

Table 4.5 Design Event Projected Wet Weather Flow

Sewer Mini basin	Current PWWF (mgd)[1]	Buildout PWWF (mgd)[1]
1	0.57	0.77
2	2.25	2.97
3	0.67	0.87
4	10.15	12.14
5	3.51	4.53
6	1.20	1.44
7	4.16	5.57
8	0.69	1.53
9	2.96	3.51
10	0.38	0.47
11	2.49	3.53

Sewer Mini basin	Current PWWF (mgd)[1]	Buildout PWWF (mgd)[1]
12	0.70	0.88
13	2.26	2.79
14	2.87	3.03
15	5.80	6.68
16	1.20	1.67
17	0.20	0.37
18	0.52	2.70
19	0.32	0.52
20	0.97	2.20
21	1.35	1.51
22	3.00	4.66
23	1.29	2.04
24	1.95	2.45
25	1.25	1.61
26	2.32	2.90
27	0.36	0.52
28	2.00	2.89
29	0.80	0.86
30A	4.35	6.40
30B	3.14	4.90
30C	1.76	2.33
32	2.45	3.33
33	0.96	1.60
34	0.21	0.29
35	3.14	4.88
36	0.65	0.80
37	0.77	0.97
38A	0.21	0.27
38B	3.14	4.90
39	1.54	1.97
40	0.54	0.69
41	1.34	1.48
42	0.09	0.14
43	0.22	0.36
44	2.37	3.15
45	6.26	8.23
46	17.04	27.21
46 (North)	0.33	0.46

Sewer Mini basin	Current PWWF (mgd)[1]	Buildout PWWF (mgd)[1]
47	8.89	11.89
48	2.41	3.23
49	0.42	0.60
50	3.14	4.06
52	0.41	0.55
54	5.92	7.71
A	15.27	20.07
B	6.75	8.51
CEDAR02A	25.41	36.72
ESI1003	59.19	83.48
RENT65	11.13	13.70
U1	0.01	0.02
U2	0.13	0.25
U3	0.30	0.61
U4	0.28	0.91
U5	0.00	0.00
U6	0.28	0.91
U7	0.00	0.00
U8	1.01	2.65
U9	0.00	0.00
U10	0.00	0.00

Notes:
Abbreviation: mgd – million gallons per day.
(1) PWWF Modeling Results are from the respective design storm.

Chapter 5
SYSTEM ANALYSIS AND RESULTS

5.1 Introduction

This chapter summarizes the conveyance analysis of all aspects of the existing system and their recommended improvements. It includes a summary of system-wide concerns and the hydraulic analysis performed using the updated Danish Hydraulic Institute (DHI) MikeUrban hydraulic model. The results are summarized at the end of the chapter for each sewer mini-basin and within the entire system (system-wide) in Table 5.10.

This chapter builds on Chapter 4 – Planning Considerations and summarizes the detailed technical information provided in Technical Memorandum (TM) No. 2 - Model Development and Calibration that can be found in Appendix I.

5.2 System-Wide Concerns

The sewer system has system-wide concerns that are common throughout its mini-basins. These concerns, summarized below, impact both the City of Renton's (City's) operations and capital planning.

5.2.1 King County-Interceptor Surcharging

During peak flows, King County (KC) will use its interceptors for storage of wastewater and for controlling flows in the South Treatment Plant. This may result in surcharging of the KC interceptors. KC reserves the right to surcharge its interceptors to an elevation of 25 feet (ft). KC has never reached this extreme, to the City's knowledge; however, the City has experienced sewer surcharge problems in the low-lying areas. As a result of KC's surcharging, it is possible that additional wastewater could overflow in low-lying areas through manhole covers and side sewer connections.

KC, as part of their regional conveyance system needs report (Report), dated December 2017, identified long-term capacity concerns within this Long-Range Wastewater Management Plan's (LRWWMP's) planning period within portions of the east-side interceptor in the City. The Report identifies capacity projects to alleviate the capacity concerns; however, these projects are not in KC's 6 year capital improvement plan.

The City has not designed facilities to accommodate a sewer surcharge to an elevation of 25 ft. The City's current position is that KC is responsible for providing adequate capacity within its interceptors and wastewater treatment facilities. In addition, the City considers KC to be responsible for proper effluent disposal. During the preparation of the LRWWMP, no specific analysis was made of the effect of KC's surcharging on the City's sewer system. KC should continue to study and identify areas of potential risk and alternatives to mitigate this problem. In the past, KC has increased the influent and effluent capacity at South Plant and has installed parallel interceptor facilities. This has significantly reduced the chance of surcharging but does not eliminate the problem.

5.2.2 Adjacent Utility Systems

For purposes of this LRWWMP, all of the comprehensive plans for the adjacent utility systems described in Chapter 4 – Planning Considerations were examined. The hydraulic analysis utilized the projected Ultimate Peak 20-year design flows, as computed by KC. These flows were obtained from KC and assigned as constant inflow conditions. This conservative assumption contributed to surcharging and capacity issues in portions of the system.

The City has several agreements with adjacent utilities that allow joint use of facilities within the City, as summarized in Chapter 4 – Planning Considerations. If capacity limitations become evident, through visual inspection or flow measurements, then the City and the adjacent utility should work together to correct the limitation as specified in the joint use agreement.

5.2.3 Hazard Mitigation Plan

The City partnered with KC Emergency Management to update the Regional Hazard Mitigation Plan. The City developed a city-specific plan – Hazard Mitigation Plan (Renton Annex) – as part of the regional effort. The Regional and city-specific Hazard Mitigation Plan seek to mitigate long-term risk to people and property from the effect of both natural and man-made hazards. The City is subject to a number of natural and man-made hazards that could affect the city, such as earthquakes, flooding, landslides, winter/wind storms, coal mine hazards, hazardous materials release, and terrorism/civil disturbance. The sanitary sewer system may be vulnerable to a variety of the identified hazards.

5.2.4 Septic Systems

There are still a small percentage of developed properties within City Limits that are served by private septic systems. In addition, the developed properties within the sewer service area but outside of the city limits are primarily served by private septic systems. The Seattle-King County Department of Public Health has an approved Septic Management Plan (King County On-Site Septic System Management Plan – July 2007) and has started revising the document, however, the latest draft has not yet been approved (King County On-Site Sewage System Management Plan – September 2016). The latest Septic Management Plan identifies East Hill in unincorporated KC and Renton, potentially served by Cedar River Water and Sewer District and to a much lesser extent the City. This area was identified as challenging for the proper functioning of OSS due to high density development with smaller lots, poor soils, older septic systems, and high or perched water tables. The latest OSS Plan states "work is needed to document the environmental and current status of systems to develop competitive grant applications to seek funding for sewer extension projects."

5.2.5 Wastewater Quality

The quality of wastewater transported in the City sanitary sewer system varies considerably depending on the wastewater source, detention time within the sanitary sewer system and the volume of infiltration and inflow (I/I).

The quality of domestic wastewater varies and is a direct result of the type of water used within the home. Some domestic sewage can be considered stronger than others can. One household appliance, the garbage disposal, can greatly impact the quality of wastewater. Most new home construction incorporates garbage disposal in its design. Use of these garbage disposals increases both suspended solids and the biochemical oxygen demand (BOD), two common results tested for when measuring contaminant concentrations.

The total volume of industrial waste produced within the City is small compared with the volume of domestic wastewater. However, an industrial or commercial development can have a considerable impact on the sanitary sewer collection system immediately downstream of the facility. Industrial waste can contain high concentrations of chemicals that can make the waste highly corrosive or toxic. If discharge of an industrial waste to the sanitary sewer system creates problems, then pretreatment of the industrial waste should be considered. Several federal, state, and local regulations govern the pretreatment of industrial waste.

The KC Industrial Waste Program is a state delegated authority to implement the Federal Pretreatment Program and handles the industrial waste for the City. The most recent list of industrial discharges is provided in Table 5.1. This program administers the waste discharge permits, inspections, enforcements, compliance and collection of surcharge monitoring fees. The program also works with businesses to help them implement pollution prevention practices. The industrial dischargers submit monthly self-monitoring reports to the KC Industrial Waste Program to confirm compliance with their NPDES permits. The City regularly coordinates with King County on program compliance including collaboration on conducting twice yearly monitoring of the discharges.

Table 5.1 Renton Summary of Industrial Discharges

Industrial Discharger	Industry Type	Authorization Type	Approval Number	Effective Date	Expiration Date	Max Volume (gpd)
Aero Plastics Inc.	General Type	No Control Document Required	400391-01	15-Nov-17		
Alliance Packaging LLC	Corrugated Container	Major Discharge Authorization	689-08	9-Dec-20	8-Dec-25	4,500
Allpak Container Corporation	Corrugated Container	Major Discharge Authorization	585-06	21-Jun-18	20-Jun-23	4,000
Amazon Services LLC – SWA2-4	General Type	No Control Document Required	400502-01	28-Jul-21		
Barbee Mill Company, Inc.	Groundwater Remediation - Metals	Major Discharge Authorization	4133-03	29-Oct-17	28-Oct-22	25,000
Boeing Commercial Airplane - Renton	Metal Finishing - CFR 433	Permit	7630-06	2-Jan-18	1-Jan-23	75,000
Boeing Electronics Center	Metal Finishing - CFR 433	Permit	7508-05	9-Mar-17	8-Mar-22	15,000
Buchan Bros.	Vehicle Washing	No Control Document Required	400319-01	30-Jun-16		
Buchan Bros.	Vehicle Washing	Letter of Authorization	10356-01	28-Feb-03		
Cintas Corporation	Laundry-Industrial	Permit	7857-03	16-Aug-20	15-Aug-25	120,000
Distribution International	General Type	No Control Document Required	400451-01	22-Apr-19		
E&E Foods	Food Processing-Fish	Permit	7961-01	10-Feb-21	9-Feb-26	85,000
Hartung Glass Industries - Flat Glass Products	Glass Manufacturing	Minor Discharge Authorization	400465-01	20-Nov-19		
Hilite Seafood	Food Processing – Seafood	No Control Document Required	1034-01	21-Dec-16	20-Dec-21	21,000
Kenworth Truck Co.	Manufacturing-Misc	Major Discharge Authorization	400221-01	4-Jun-15		
King County RSD(1) - Renton Decant Facility	Decant Station	Major Discharge Authorization	4451-01	9-May-18	8-May-23	73,000
King County SWD(2) - Renton Transfer Station	Solid Waste - Transfer Fac	Major Discharge Authorization	4367-03	5-Jun-21	4-Jun-26	52,000
Northwest Gourmet Food Products Inc. - Renton Facility	Food Processing-Other	Permit	4419-01	15-Jun-17	14-Jun-22	2,037
Ocean Beauty Seafoods LLC - Renton	Food Processing-Seafood	Major Discharge Authorization	7949-01	1-Feb-20	31-Jan-25	3,000
Phillips 66 Company - Renton Terminal	Groundwater Remediation - Organics	Major Discharge Authorization	4444-02	1-Dec-18	21-Dec-22	43,305
Phillips 66 Company - Renton Terminal	Groundwater Remediation - Organics	Permit	261-06	14-Jan-21	13-Jan-26	5,000
Renton Coil Spring Co. Inc.	Manufacturing-Misc	No Control Document Required	7910-02	5-Mar-20	4-Mar-25	50,400
Republic Services - Monster Road SW	General Type	Major Discharge Authorization	400396-01	15-Nov-17		
Rosemount Specialty Products LLC	Manufacturing-Misc	No Control Document Required	4484-01	11-Feb-19	10-Feb-24	48,000
Schwartz Brothers Bakery - Renton	Food Processing-Bakery	Minor Discharge Authorization	400192-02	16-Dec-19		
Service Linen Supply	Laundry - Linen	Major Discharge Authorization	830-03	1-Jul-21	30-Jun-26	6,000
Sheets Unlimited LLC	Corrugated Container	Minor Discharge Authorization	388-06	1-Mar-19	3-Sep-22	120,000
SKIS Painting	General Type	No Control Document Required	816-05	7-May-21	30-Sep-25	2,500
Stoneway Concrete - Black River	Cement/Readymix	Major Discharge Authorization	400458-01	10-Jul-19		
Stoneway Concrete - Houser Way	Cement/Readymix	Major Discharge Authorization	4080-04	28-Sep-20	27-Sep-25	25,000
Trojan Lithograph	Printing	Letter of Authorization	10193-03	15-Jul-18	14-Jul-23	1000
United Rentals – Tukwila		No Control Document Required	400202-01	22-Apr-15		
Valley Medical Center	Hospital	Minor Discharge Authorization	709-04	2-Aug-17	1-Aug-22	

Note:
(1) RSD - Road Services Division.
(2) SWD - Solid Waste Division.

5.2.6 Wastewater Quality Analysis and Recommendations

A major problem associated with wastewater quality is the generation of hydrogen sulfide that occurs during wastewater transport from its source to the point of treatment. The hydrogen sulfide found in wastewater results from the anaerobic bacterial reduction of the sulfate ions that are present. Hydrogen sulfide poses three serious problems: it is highly corrosive, has an obnoxious odor, and, as a gas, is toxic to humans and has been known to cause death to sewer maintenance workers. The production of hydrogen sulfide is directly related to the BOD of the wastewater. Wastewater exhibiting a high BOD will tend to generate more hydrogen sulfide than wastewater exhibiting a lower BOD.

Hydrogen sulfide is very corrosive to both sewers and pumping facilities. Hydrogen sulfide released from the wastewater will tend to dissolve on condensation within the crown of a sanitary sewer. The hydrogen sulfide retained in the condensation is converted to sulfuric acid through oxidation by aerobic bacteria. This sulfuric acid will react with the cement bonding material within concrete pipes, or iron within steel pipes, and can corrode a pipe to the point of structural failure. Sanitary sewer pipes are most susceptible to this type of corrosion in their crowns because that is where most condensation occurs.

Aeration, periodic cleaning, and use of non-corrosive pipe materials can control effects of hydrogen sulfide. If excessive hydrogen sulfide production is evident at a lift station, aeration of the wet well should be considered to reduce the hydrogen sulfide in the wastewater and reduce the effects of anaerobic bacteria that produce the hydrogen sulfide. Periodic cleaning of the sanitary sewers will also remove the biological slime that forms on the pipe walls and produces the hydrogen sulfide. The most effective method of mitigating corrosion by hydrogen sulfide is through the use of non-corrosive pipe materials, such as polyvinyl chloride (PVC), or high-density polyethylene (HDPE). Existing pipes experiencing severe corrosion can be rehabilitated through the use of various slip form liners or fiberglass resin liners.

In order to control the generation of hydrogen sulfide, the City conducts preventative maintenance with routine cleaning sewer pipes with inadequate slopes. In addition, all pipes are cleaned before video inspection is performed. Both of these tasks reduce biological growth on the walls of the sewer pipes and reduce the hydrogen sulfide generation potential.

Excessive I/I will tend to reduce the production of hydrogen sulfide and the concentration of contaminants in the wastewater. As the City works to reduce structural defects causing I/I, there may be more impact by contaminants and hydrogen sulfide. The City may have to increase efforts to reduce hydrogen sulfide and be more aware of potential contaminants.

The planning area for this LRWWMP corresponds, for the most part, with the current City limits and urban growth boundary (UGB), as shown in Figure 4.1. Service is provided consistent with regional planning and agreements with adjacent utilities. System-wide concerns present in the wastewater infrastructure include some segments approaching the end of the Remaining Useful Life and infiltration and inflow.

5.2.7 Aging Sanitary Sewers

Sanitary sewer system installation began in earnest during the 1940's and 1950's as a federal program to provide housing for workers at the Renton Boeing Plant and has continued through today. Prior to this boom, the City also had significant sewer installations in the 1920s and 1930s for the Central Business District. Some of these sewers have reached the end of their useful life. This LRWWMP recommends a program to address condition issues of these aging sanitary sewers through rehabilitation and replacement.

5.2.8 Infiltration and Inflow

I/I occur in all sanitary sewer systems. Infiltration is defined as water entering the sanitary sewer system through pipes, joint connections, manhole (MH) covers, and walls. Inflow is defined as water discharged to the sanitary sewer system through connections to roof drains, yard drains, foundation drains, and cross connections with storm sewers and combined sewers. The combination of I/I may be a major portion of the total wastewater flow which must be carried by the sanitary sewer system. I/I problems in an existing sanitary sewer system can be studied to determine their effect. Finding and correcting I/I sources can be challenging, as determining the source can be evasive.

Elimination of storm inflow from the system is difficult due to conflicting concerns. Sealing MH lids and maintaining the water tightness of the lids decreases inflow, but gas, particularly hydrogen sulfide and methane, can collect in the sealed MHs. The City attempts to minimize vent holes for the system, but inflow cannot be prevented completely. During the design and construction of new main extensions, the City utilizes MH liners and coatings as well as sealed MH covers in wet areas. The City also performs video inspections during the wet season on all new gravity sewers to check for leaks.

5.2.8.1 Historical Infiltration and Inflow

In December 1999, as part of the Regional Wastewater Services Plan (RWSP), the KC Council approved the development of a Regional I/I Control Program. The purpose of the program is to reduce the risk of sanitary sewer overflows (SSOs) and the cost of adding capacity to facilities that convey wastewater to KC treatment plants. KC installed over 800 flow meters to measure flows throughout KC. The flow meters monitor depth of flow and velocity. Early flow monitoring data between late 2000 and early 2001 were considered unrepresentative because of drought conditions that lowered the groundwater table and therefore reduced I/I to the system. Consequently, KC performed additional flow monitoring from late 2001 to early 2002. This effort proved more productive as data from several storms was captured. Rainfall in the region was also monitored by KC. The Calcul de lames d'eau a l'aide du radar system (CALAMAR) used a combination of 73 rain gauges throughout the region, as well as the National Weather Service radar, to generate rainfall quantities to an accuracy of plus or minus 10 percent.

In 2000, KC's Wastewater Treatment Division, in cooperation with the local component agencies that it serves, launched an I/I Program. Ten pilot projects were selected to evaluate the effectiveness of various sewer rehabilitation technologies in reducing I/I in local agency collection systems. The completion of the ten pilot projects in January 2004 marked a major milestone in the KC study. The projects demonstrated that I/I could be effectively reduced, depending on the location and method of rehabilitation. The results of the pilot projects, along with other information, were used to prepare a long-term regional plan for reducing I/I in local agency systems.

5.2.8.2 Current Infiltration and Inflow

Old and aging sewers contribute to excessive I/I into the sanitary sewer system. In conjunction with KC's program for reducing I/I, the City identified, through model analysis, areas of concern for investigation, additional metering, and replacement or rehabilitation of the sewers. There are certain portions of the sanitary sewer system that are known as having I/I in excess of the 1,500 gallons per acre per day (GPAD) identified as the acceptable amount as determined through the joint planning effort between KC and the component agencies. The City works to reduce the I/I in these portions of the system through its mainline and lateral replacement program. If these systems are replaced, I/I will be reduced and KC's requirements will be met. If a system is not scheduled for replacement or a replacement is delayed, the City may have to perform interim rehabilitation to reduce I/I if required for capacity needs.

The City is participating with KC on its program to gain knowledge and experience to determine methods for I/I abatement. The additional data produced through the current effort occurring will be used by the City in determining feasibility of using I/I improvements in lieu of upsizing sewer systems where capacity restraints have been identified.

The modeled values of I/I are shown for every mini-basin in Figure 5.5. The sewer model has also identified portions of the sewer system that have I/I or capacity problems during large storms that may not be evident with physical signs during smaller storms. To better understand these areas, the City will initiate I/I Metering, Investigation, and Rehabilitation and Replacement, as needed.

5.2.9 Other Concerns

The Downtown Utility Improvement Project (DUIP) is a pipeline replacement project intended to support the anticipated future redevelopment of the City's Downtown area. This program will be incorporated into the City's hydraulic model and evaluated during the capacity evaluation.

Additionally, combined sewers are designed to carry both stormwater and wastewater within a single system. Current codes in the City do not allow combined sewers because it causes stormwater, which is relatively clean, to be treated along with wastewater. Combined sewer systems within the City have been replaced with separate sanitary and storm sewer systems.

5.3 Hydraulic Model

Wastewater collection system models are valuable tools used to assess the performance of collection systems during dry and wet weather conditions and to plan for future improvements. These models provide a means to simulate the impact of different storm sizes on the collection system, and determine where future system deficiencies are likely to occur. In addition, a well-calibrated model provides a method for testing alternative improvement scenarios. The flow monitoring wastewater basins used in the model for calibration is shown in Figure 5.1.

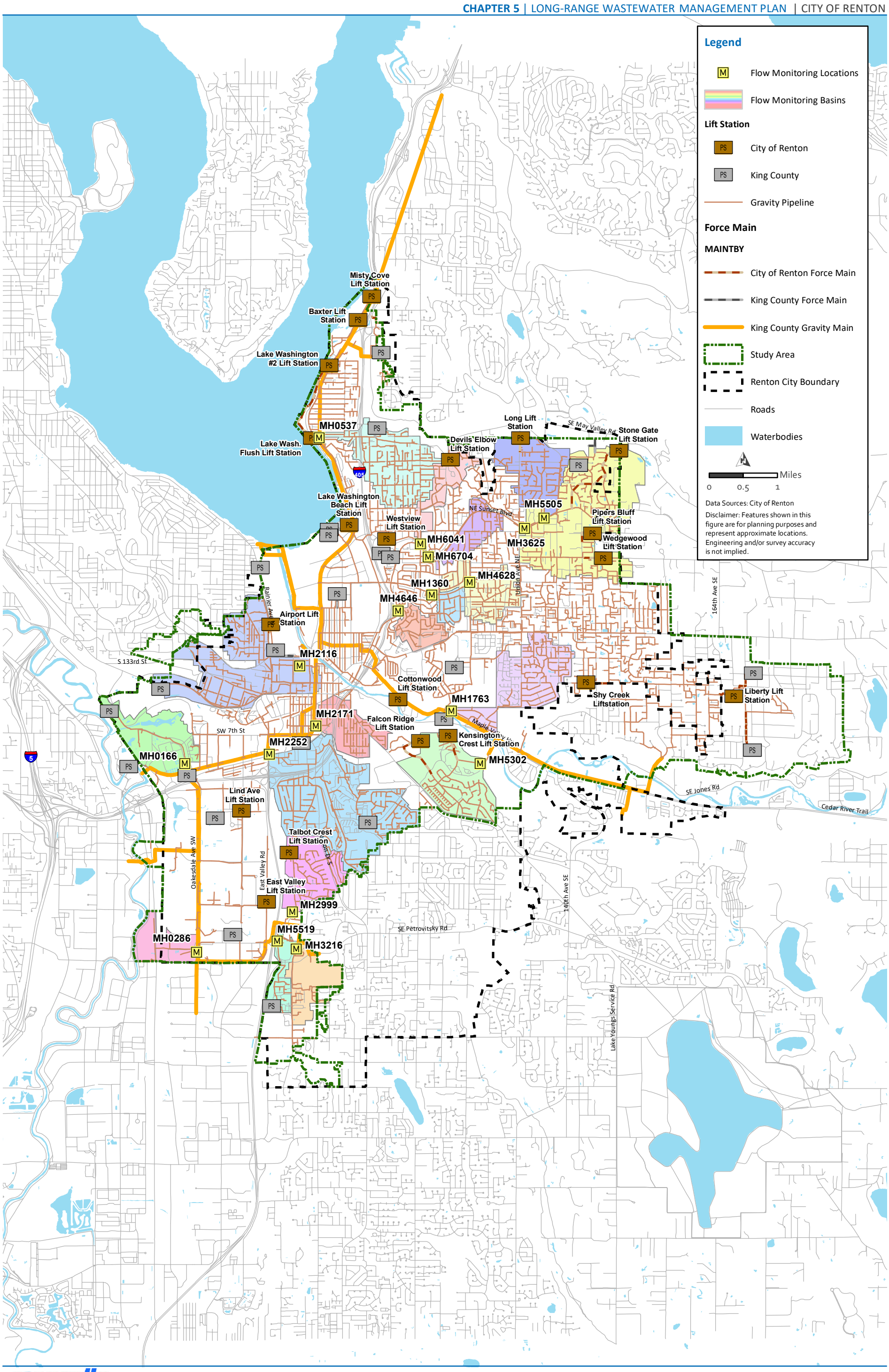

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Figure 5.1
Flow Monitoring Locations

5.3.1 Model Development and Calibration

A sewer collection system model is a simplified representation of the real sewer system. Sewer system models can assess the conveyance capacity for a collection system. In addition, sewer system models can perform "what if" scenarios to assess the impacts of future developments and land use changes. The model was developed using the MikeUrban hydraulic modeling software package, developed by DHI. The hydraulic model is a full pipe model and includes 100 percent of the total system pipelines.

For this project, flow monitoring was conducted at 18 meter sites for a period of approximately five months from December 2017 to April 2018. Flow monitoring data was used to calibrate the updated hydraulic model for both dry and wet weather conditions. Dry weather flow (DWF) calibration ensures an accurate depiction of base wastewater flow generated within the study area. The WWF calibration process consists of calibrating the hydraulic model to specific storm events to accurately simulate the peak and volume of I/I into the sewer system. The hydraulic model was calibrated following the Chartered Institution of Water and Environmental Management (CIWEM) code of practice. The updated hydraulic model is shown in Figure 5.2.

5.3.2 Model Evaluation Results

The hydraulic model is well calibrated; simulating WWF storms accurately. A summary of dry and wet weather flow model calibration is provided in Table 5.2. The percent difference in volume is shown for each of the three storms that were used for calibration. The CIWEM standards require the model to meet the calibration standards for two out of the three WWF storms. The model is within calibration criteria for every site for DWF and for 16 of the 18 sites for WWF. Calibration standards were not met for Site MH3216 and MH6041. Site MH3216 showed greater response in the model than in the meter; therefore the model is conservative. Site MH6041 flow monitoring showed very little flow response to Storms 2 and 3, which made it difficult to match across the season and be within typical parameters for the sewer system. For this reason, the calibration focused on matching Storm 1. These sites are discussed in further detail in TM 2: Model Update and Calibration, located in Appendix I of this LRWWMP. Appendix I also discusses the level calibration and shows example calibration figures.

Table 5.2 Model Calibration

Flow Meter ID	DWF Percent Difference (%)	WWF Storm 1 Volume Flow Percent Difference (%)	WWF Storm 1 Peak Flow Percent Difference (%)	WWF Storm 2 Volume Flow Percent Difference (%)	WWF Storm 2 Peak Flow Percent Difference (%)	WWF Storm 3 Volume Flow Percent Difference (%)	WWF Storm 3 Peak Flow Percent Difference (%)
MH0166	-0.2%	**31.1%**	-1.5%	-3.0%	11.9%	15.4%	-0.9%
MH0286	1.0%	7.2%	-1.8%	0.1%	-11.9%	-7.8%	**-25.8%**
MH0537	-0.7%	10.1%	2.0%	5.2%	-6.6%	17.2%	13.3%
MH1360	5.0%	18.1%	9.7%	**-12.8%**	7.2%	15.1%	2.5%
MH1763	-1.1%	13.0%	13.7%	**-38.9%**	**-15.0%**	-0.3%	-5.0%
MH2116	-8.1%	-	-	-9.5%	-12.6%	3.7%	7.3%
MH2171	-0.4%	6.8%	10.9%	-6.7%	7.7%	17.3%	19.5%
MH2252	-0.8%	-2.5%	-5.8%	-9.4%	12.2%	8.1%	**58.3%**
MH2999	-7.2%	11.0%	-10.9%	11.3%	1.8%	16.8%	7.0%
MH3216	-0.4%	18.8%	-4.4%	**-11.3%**	**25.2%**	13.5%	**47.8%**
MH3625	-2.5%	4.7%	5.0%	**-14.7%**	-6.1%	-1.7%	-8.5%
MH4628	0.0%	10.4%	3.5%	**-21.2%**	15.0%	10.9%	-1.6%
MH4646	0.0%	-1.9%	-6.6%	**-18.3%**	**-19.7%**	-2.2%	1.9%
MH5302	-8.6%	-4.3%	-8.7%	-7.9%	6.7%	-1.6%	0.8%
MH5505	0.4%	6.6%	-1.9%	-9.5%	6.3%	-2.2%	-14.7%
MH5519	3.7%	12.2%	**33.1%**	10.9%	24.0%	9.8%	1.3%
MH6041	-0.1%	**-14.5%**	-8.9%	16.5%	19.7%	**39.3%**	**140.3%**
MH6704	-0.2%	-8.4%	**-19.1%**	16.7%	21.8%	15.2%	3.0%

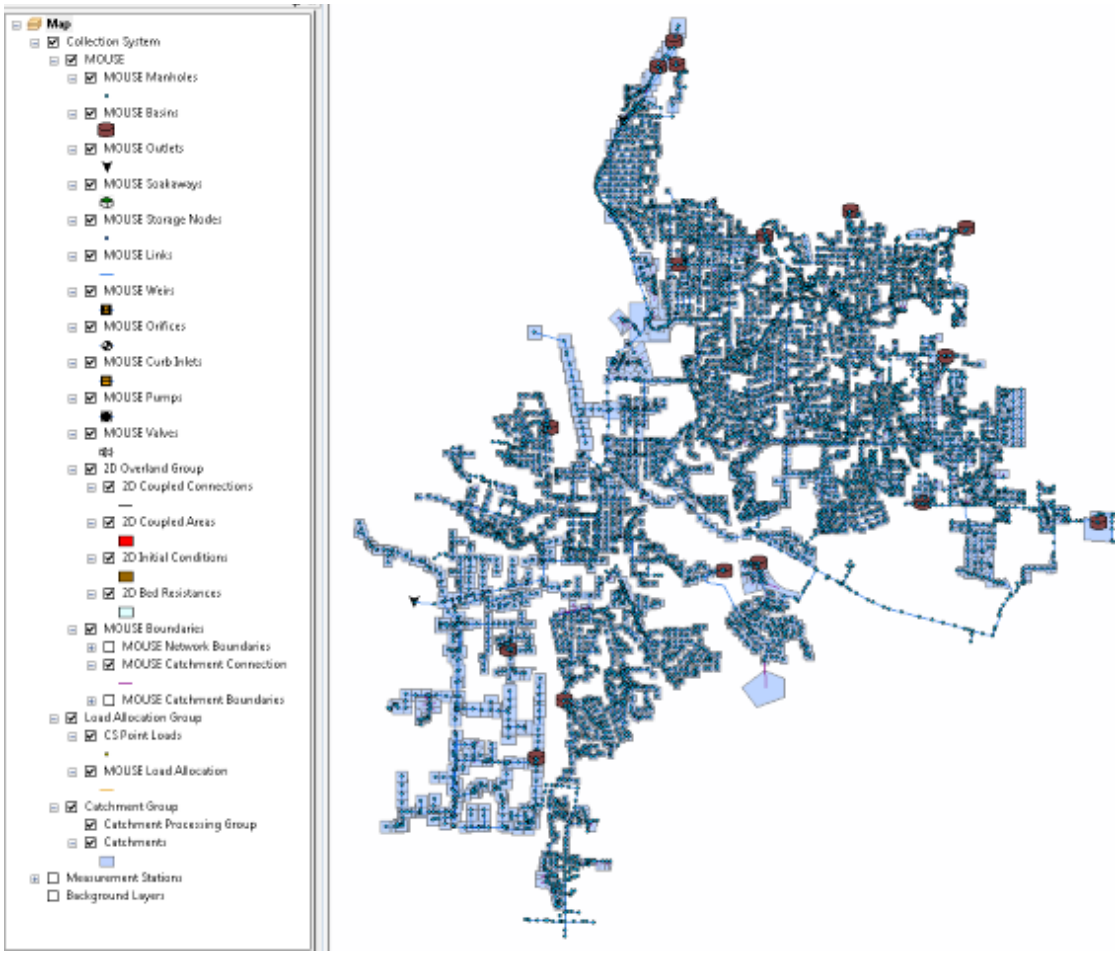


Figure 5.2 Updated Hydraulic Model

5.4 Capacity Evaluation

Capacity problems are the result of inadequate pipe sizes or slopes, or backwater conditions. These problems may concern lack of capacity in the sewer system or available capacity for future development. A hydraulic analysis has been performed on the City's sewer system. This analysis did not show capacity problems in the current system. Capacity problems do occur throughout the system in various degrees at build-out.

As the City implements more water conservation programs, there may be a negative impact on the operation of a sewer system. Reduction of the liquid component of wastewater could cause problems in moving solids through the lines. Problems moving solids could impact the operation of the system, increase the potential of SSOs and will increase the need for flushing. This section describes the capacity evaluation performed as part of this LRWWMP. Deficiencies were identified per the analysis criteria and presented in the following sections.

5.4.1 Analysis Criteria

Capacity evaluation of the wastewater collection system was performed in accordance with the following criteria, using the hydraulic model developed for this LRWWMP:

- 20-year and 30-year, multi-day design storms are used for evaluating the City's sewer infrastructure. Essentially, these design storm have a three to five percent chance (1/30 - 1/20) that a peak of 3.7 inches of rain will fall in any 24-hour period in a given year.
- It was assumed that system degradation is considered for this analysis. I/I degradation is estimated at seven percent per decade, and 28 percent for buildout. This assumption is based on KC's Updated Planning Assumptions for Wastewater Flow Forecasting (2014).
- During Peak Wet Weather Flow (PWWF), water levels were allowed to rise no more than three feet from the MH rim. Sewers were allowed to surcharge under these maximum flow conditions during the design storms presented above. Additionally, pipes that surcharged to a ratio of depth/diameter > 2 were flagged as well in the hydraulic model results.
- No surcharging was allowed for shallow MHs (shallow MHs consist of locations where the difference between the MH rim and top of pipe was less than 3.5 ft).
- Areas that were identified as a deficiency based on the analysis criteria but were caused by KC backwatering conditions are not included in the results presented in this section. The City is unable to fix issues pertaining to KC's interceptor backwater condition. Additional information and figures showing the heightened hydraulic grade line (HGL) due to KC Interceptors are shown in Appendix I, in this LRWWMP.
- Modeled Lift Station influent is larger than firm capacity of lift station for the design storm.

5.4.2 Design Storm

This analysis uses four separate multi-day, 20-30 year recurrence design storms for the capacity evaluation. These storms were identified in the 2012 KC I/I Study and correspond to the recurrence interval within historical KC rainfall. There are five of these historical rain gauges which are used in different areas of the system. Figure 5.3 shows each of the four design storms. Table 5.3 outlines which design storm was used for the capacity analysis in each mini-basin.

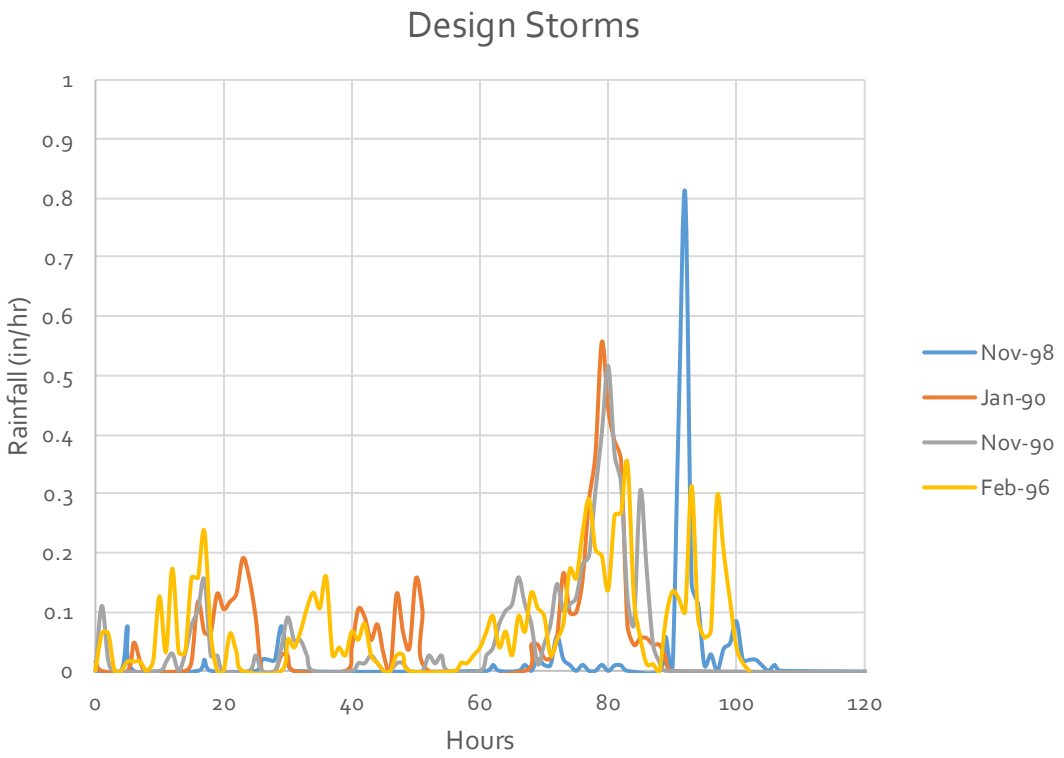


Figure 5.3 Design Storm Hydrographs

Table 5.3 Modeled Design Storms by Mini-Basins

Sewer Mini Basin	Design Storm
1	Nov-98
2	Nov-98
3	Nov-98
4	Jan-90
5	Nov-90
6	Nov-90
7	Nov-98
8	Feb-96
9	Feb-96
10	Feb-96
11	Feb-96
12	Feb-96
13	Feb-96
14	Feb-96
15	Feb-96
16	Feb-96
17	Nov-90
18	Feb-96
19	Feb-96

Sewer Mini Basin	Design Storm
20	Nov-90
21	Nov-90
22	Nov-90
23	Jan-90
24	Feb-96
25	Nov-90
26	Nov-90
27	Feb-96
28	Feb-96
29	Feb-96
30A	Feb-96
30B	Feb-96
30C	Feb-96
32	Feb-96
33	Feb-96
34	Jan-90
35	Jan-90
36	Feb-96
37	Feb-96

Sewer Mini Basin	Design Storm
38A	Feb-96
38B	Feb-96
39	Feb-96
40	Feb-96
41	Feb-96
42	Feb-96
43	Jan-90
44	Nov-90
45	Nov-90
46	Nov-98
46 (North)	Nov-90
47	Nov-90
48	Nov-90
49	Feb-96
50	Feb-96
52	Feb-96

Sewer Mini Basin	Design Storm
54	Feb-96
A	Feb-96
B	Feb-96
CEDAR02A	Nov-90
ESI1003	Feb-96
RENT65	Jan-90
U1	Feb-96
U2	Feb-96
U3	Feb-96
U4	Feb-96
U5	Feb-96
U6	Feb-96
U7	Feb-96
U8	Feb-96
U9	Feb-96
U10	Feb-96

5.4.3 Capacity Evaluation Results

A capacity analysis of the modeled collection system was performed with the City's calibrated hydraulic model using the system performance criteria outlined above. The I/I degradation assumption created a conservative scenario for projecting future system conditions. Capacity analysis was performed for existing conditions (2012) and build-out conditions (2040) for Lift Stations and the collection system.

5.4.4 Lift Station Capacity

The hydraulic model includes representations of all of the City's major lift stations. The model simulates the existing lift station pumps and, when required, allowing and tracking flow beyond the existing capacity. The peak hourly flow during the design storm upstream of modeled lift station was used to determine whether stations met the firm capacity of the station. Firm capacity is defined as the capacity of the pump station with one pump offline. It is recommended the City investigate lift station capacity as a separate project in the future.

The lift stations were evaluated for sufficient capacity under peak wet weather flow under current and buildout conditions. Table 5.4 shows the lift station capacity, modeled flows, and deficiencies. The City has two lift stations that are deficient:

- Airport.
- Lind Avenue.

At buildout, it is anticipated that the firm capacity of three additional stations will be deficient:

- Kingston.
- Stonegate.
- Baxter.

These additional buildout deficiencies are due large, anticipated increase in flow from new development. The deficiencies at Lift Stations with current deficiencies are also anticipated to grow worse with additional development. However, every lift station has sufficient total capacity to convey both current and buildout total pump capacities, except buildout flows to the Airport Lift Station. The City is currently working on upgrading the Airport lift station, which will address the capacity issue.

Falcon Ridge accepts flows from Soos Creek Water and Sewer District, which may be a source of model inaccuracy. It is recommended the City work with Soos Creek Water and Sewer District to better understand both Utilities contributions to the Falcon Ridge Lift Station.

The City should further investigate flows at the Lind Avenue Lift Station to confirm station performance in wet weather flows. The City has not historically observed capacity issues at this station; therefore, it is anticipated the deficiency may only be in very large storms similar to the 25- to 30-year design storm.

The City should continue to evaluate potential developments contributing to Kingston, Stonegate, and Baxter lift stations. The City should make necessary lift station improvements prior to granting a utility permit that exceeds its capacity.

5.4.5 Collection System Capacity

The capacity analysis identified areas in the sewer system where flow restrictions may occur or where the pipe does not have sufficient capacity to convey design flows. Sewers that lack sufficient capacity to convey design flows could produce backwater effects in the collection system that increase the risk of SSOs. Potential system deficiencies were identified for PWWF under both existing and build-out conditions and are highlighted in Figures 5.4 and 5.5, respectively.

The Downtown Utility Improvement Project (DUIP) adjusted the DWF in the area from 0.22 cfs to 8.96 cfs. Wet weather flow assumptions were taken from Flow Monitoring Basin 6041, which was deemed similar in age and I/I rate to the new construction of the DUIP. All pipelines within the DUIP were adequately sized. However, some of the connection points between the existing system and DUIP project caused elevated HGL's. Further analysis is needed to finalize any improvements.

Under buildout condition, twenty-two areas were considered potentially deficient based on design storms and evaluation criteria. These locations and associated information are presented in Table 5.5. Additional information on the deficiencies and proposed improvements can be found in Chapter 8 – Capital Improvement Program.

Table 5.4 Lift Station Evaluation

Pump Station Number	Pump Station Name	Storm Used	Pump Firm Capacity (gpm)[1]	Total Pump Capacity (gpm)	Current Modeled PWWF (gpm)	Buildout Modeled PWWF (gpm)	Current Modeled Deficiency (gpm)	Buildout Modeled Deficiency (gpm)
L01	Shy Creek	Feb 96	825	1375	18	180	807	7645
L02	Devil's Elbow	Jan-90	500	1000	119	237	381	263
L03	Airport	Feb-96	100	200	174	216	-74	-116
L04	East Valley	Feb-96	724	1086	492	548	232	176
L05	Talbot Crest	Nov-90	110	220	35	35	75	75
L07	Long	Nov-90	100	200	69	69	31	31
L08	Kensington	Jan-90	160	320	56	182	104	-22
L09	Wedgewood	Feb 96	905	1416	150	237	755	668
L25	Lind Avenue	Feb-96	500	1000	542	630	-42	-130
L29	Stone Gate	Nov-90	425	850	244	593	181	-168
L30	Falcon Ridge	Jan-90	100	200	142	154	-42	-54
L32	Misty Cove	Feb-96	190	397	125	160	65	30
L34	Liberty	Feb 96	617	1234	1	184	616	433
L39	Baxter	Feb-96	700	1150	548	817	152	-117

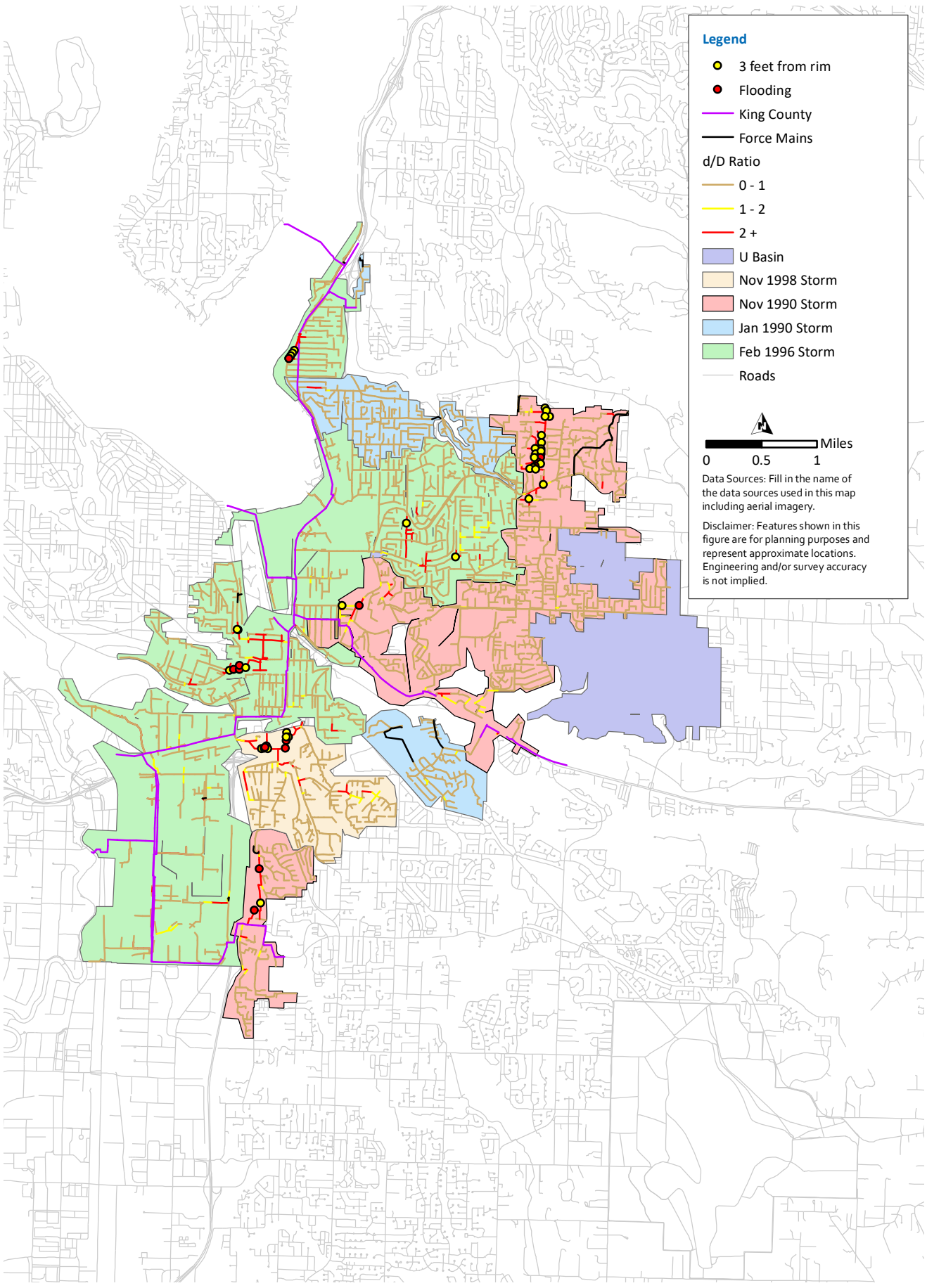
Note:
(1) gpm – gallons per minute.

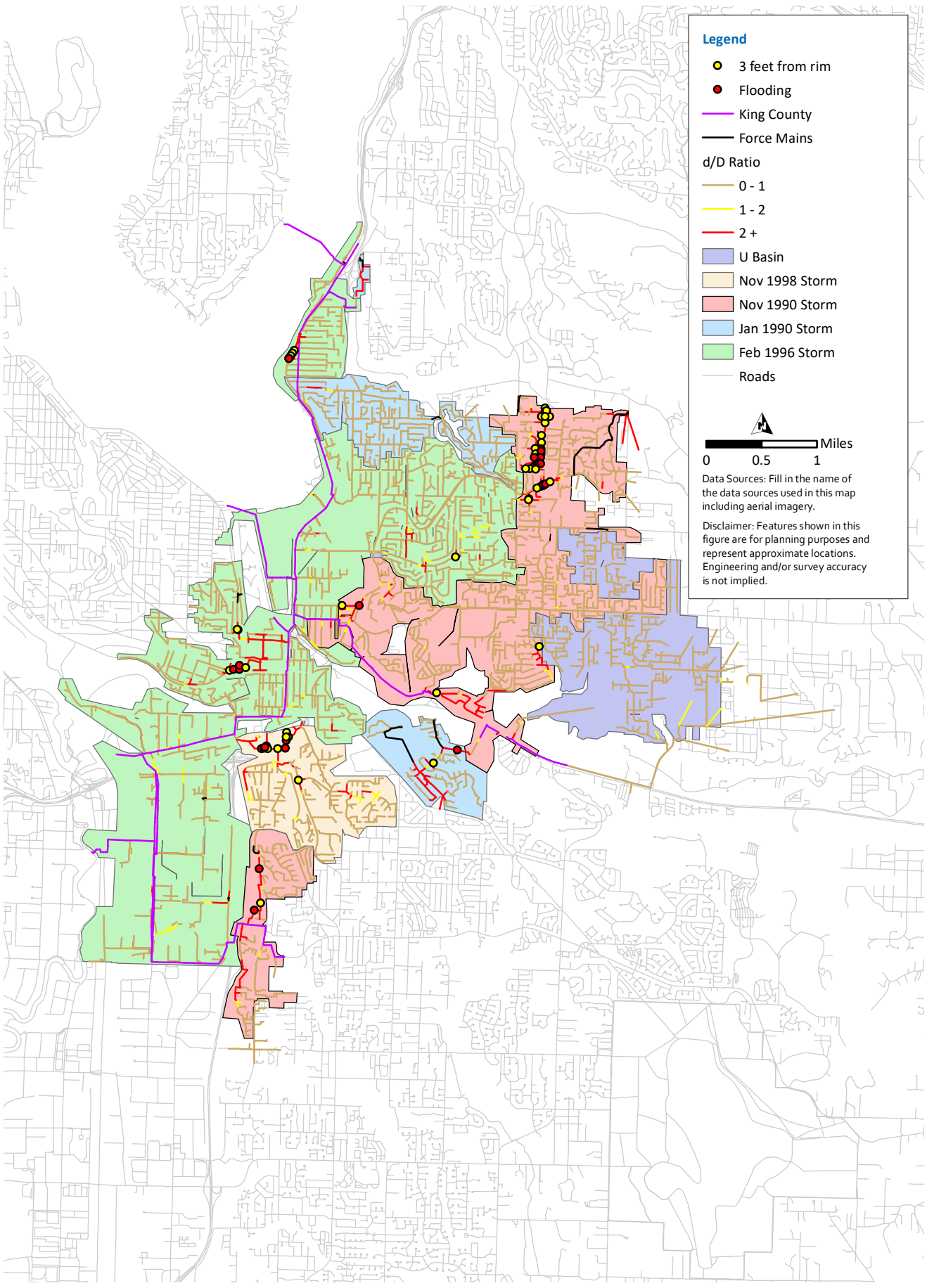
Table 5.5 Buildout Deficiency Locations

Deficiency ID[1]	Upstream MH	Downstream MH	Mini Basin	Storm Event	Pipe Sections	Length and Diameter	Highest Surcharged MH	Description of Surcharge	Reason Deficient
05A	MH3043	RE*SRENT.R18-19	5	Nov-90	22	5,005' - 8"	MH2998	Flooding	Capacity
45A	MH2252	MH4031 & MH 2672	45	Nov-98	30	2,242' - 8" & 246' - 10" & 526 - 12" & 636' - 15" & 4,670' - 18"	MH2257	Flooding	Capacity
7A	MH2276	SSMH009	7	Nov-98	8	2,082 - 8"	MH2272	10.7 ft from rim	Capacity
2A	MH2681 & MH2678	MH2676	2	Nov-98	4	987' - 8"	MH2677	1.6 ft from rim	Capacity
3A	MH2369	MH2336	3	Nov-98	16	3,930 - 8"	MH2337	8.5 ft from rim	Capacity
46A	MH4640 & MH1854	RE*CEDAR1.R10-05A	46	Nov-90	20	584' - 8" & 358' - 10" & 1,191' - 12" & 549' - 15" & 660' - 21" & 760' - 24"	MH4692	Flooding	Capacity, diameters change
37A	MH6042 & MH0840	MH0825	37	Feb-96	15	2,989' & 8"	MH0839	5.1 ft from rim	Negative slopes
48A	MH0887	MH0845	48	Feb-96	8	1,262 - 8" & 441 - 12"	MH0847	17.2 ft from rim	Capacity, grade change
24A	MH0927	MH0761	24	Feb-96	3	409' - 8" & 233' - 10"	MH0924	0.8 ft from rim	Negative slopes
20B	MH6612	MH6613	20	Nov-90	1	282' - 8"	MH6612	12.1 ft from rim	Capacity, shallow slope
20A	MH5238	MH3726	20	Nov-90	11	1,253' - 8"	MH5240	5.4 ft from rim	Capacity, shallow slope
22A	MH3064	MH5504	22	Nov-90	26	2,732' - 8" & 463' - 10" & 1276' -12" & 1,067' - 15"	MH3615	0.5 ft from rim	Capacity, diameters change

Deficiency ID[1]	Upstream MH	Downstream MH	Mini Basin	Storm Event	Pipe Sections	Length and Diameter	Highest Surcharged MH	Description of Surcharge	Reason Deficient
21A	MH4301	MH3625	21	Nov-90	47	9,778' - 8"	MH3581	Flooding	Capacity, shallow slope
41A	MH0925	MH0761	41	Feb-96	15	2,230 - 8"& 358' - 10"	MH3329	Flooding	Capacity, shallow slope
23A	MH3499	MH3497	23	Jan-90	2	700' - 8"	MH3498	13.2 ft from rim	Capacity
15A	MH2469	2790	15	Feb-96	55	153' - 6" & 4,461' - 8" & 764' - 10" & 3,204' - 12" & 2,284' - 15" & 272' - 18" & 144' - 24"	MH2183	Flooding	Capacity
14A	MH5443	MH6332	14	Feb-96	6	1050' - 8"	MH6337	8.7 ft from rim	Capacity
BA	MH2981	MH5188	B	Feb-96	6	1,353' - 8" & 387' - 10"	L04-East Valley	9.5 ft from rim	Capacity
05B	MH3306	RE*SRENTON.R1 8-17	5	Nov-90	25	366' - 8" & 901' - 10"	MH5531	4.8 ft from rim	Capacity
05C	MH3304	MH5523	5	Nov-90	21	3,462' - 8"	MH3205	10.2 ft from rim	Capacity
11A	MH6825	MH5049	11	Feb-96	2	607' - 10"	MH5050	10.1 ft from rim	Negative slopes
25A	MH1708	MH1660	25	Nov-90	25	3,326 - 8"	MH1694	6.9 ft from rim	Capacity, shallow slope

Note:
(1) Deficiency ID based on associated mini basin number.


Legend
3 feet from rim
Flooding
King County
Force Mains
d/D Ratio
0 - 1
1 - 2
2 +
U Basin
Nov 1998 Storm
Nov 1990 Storm
Jan 1990 Storm
Feb 1996 Storm
Roads
N
Miles
0
0.5
1
Data Sources: Fill in the name of the data sources used in this map including aerial imagery.
Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.


Legend
3 feet from rim
Flooding
King County
Force Mains
d/D Ratio
0 - 1
1 - 2
2 +
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Nov 1998 Storm
Nov 1990 Storm
Jan 1990 Storm
Feb 1996 Storm
Roads
N
Miles
0
0.5
1
Data Sources: Fill in the name of the data sources used in this map including aerial imagery.
Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

5.5 Recommendations

This section describes recommendations for each of the deficiency areas identified in Table 5.5. Deficiencies can be caused by a combination of local physical flow constraints and excessive upstream flow from I/I. The design storms identified for system planning have return intervals of 20-30 years, therefore, the City may not observe surcharging during normal WWF. Appendix J shows the hydraulic grade lines at each deficiency. These are used to help identify possible physical flow constraints in the vicinity of the deficiency, which includes negative slopes, undersized pipes, and downstream backwater conditions. Therefore, a systematic approach was taken to confirm and address capacity issues, as shown in in the flow chart shown in Figure 5.6 and outlined below:

- Piping reconfiguration: Identified the deficient pipe segment has a negative (reverse) slope. It is recommended to replace these sections of pipe to create a positive slope, if possible, to address both capacity and potential maintenance concerns.
- I/I Evaluation: Considered if excess upstream flow from I/I was a major factor in the deficiency. A criteria of 7,500 GPAD of I/I was used to delineate excess I/I areas. 7,500 GPAD represents the cutoff for the highest 10 percent of basins, ensuring the worst I/I basins are prioritized. For these areas, an I/I evaluation, followed by rehabilitation and replacement of structural deficiencies, is recommended to address the deficiency.
- Programmatic upsizing: If there is a clear undersized pipe segment without excess I/I in the upstream mini-basin, then it is recommended the City upsize the pipe segments causing the deficiency. These segments were relatively short.
- Long-term flow monitoring: Long-term flow monitoring is recommended for the remaining deficiencies to better understand the issues in order to identify the most cost-effective improvements.

All identified deficiencies and recommendations are detailed below in Table 5.6. Figure 5.8 shows the system wide improvement recommendations by deficiency.

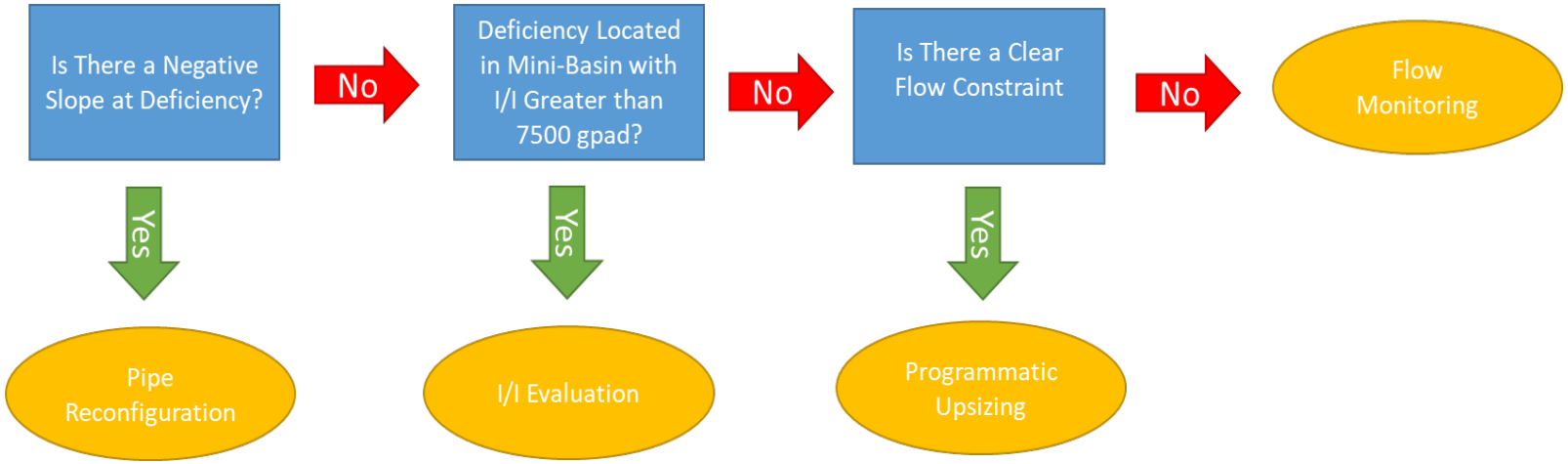


Figure 5.6 Recommendation Decision Flow Chart

Table 5.6 Deficiency Recommendations

Deficiency ID	Pipe Configuration Constraint	I/I (GPAD)	Downstream Undersized Flow Constraint	Recommendation
05A	None	1,320	Unclear	Long-term Flow Monitoring
45A	None	11,000	None	I/I Evaluation
7A	None	11,000	None	I/I Evaluation
2A	None	11,000	None	I/I Evaluation
3A	None	11,000	None	I/I Evaluation
46A	None	2,750	Unclear	Long-term Flow Monitoring
37A	Negative slopes	1,910	None	Piping Reconfiguration
48A	None	1,030	Unclear	Long-term Flow Monitoring
24A	Negative slopes	1,035	None	Piping Reconfiguration
20B	Negative slopes	1,230	Clear Constraint	Programmatic Upsizing
20A	Negative slopes	1,230	Clear Constraint	Programmatic Upsizing
22A	None	1,230	Unclear	Long-term Flow Monitoring
21A	None	2,290	Unclear	Long-term Flow Monitoring
41A	None	4,708	None	Long-term Flow Monitoring
23A	None	480	Clear Constraint	Programmatic Upsizing
15A	None	5,625	Unclear	Long-term Flow Monitoring
14A	None	5,625	Unclear	Long-term Flow Monitoring
BA	None	175	Clear Constraint	Programmatic Upsizing
05B	None	9,570	None	I/I Evaluation
05C	None	2,450	None	I/I Evaluation
11A	Negative slopes	4,545	None	Piping Reconfiguration
25A	None	1,310	None	I/I Evaluation

5.5.1 Piping Reconfiguration

Pipeline reconfiguration was recommended for areas in the system that presented negative slopes causing a capacity deficiency in the collection system. The negative slope also increases the risk of solids accumulation in the pipe and other maintenance issues. The first action would be to confirm the geographic information system (GIS) information and confirm that the modeled negative slopes and inverts are accurate. In the event where these are accurate, and where physically possible, potential pipe replacement may be recommended to create a positively sloped pipe.

Of the 22 deficiencies, five are at negative pipe slope segments. The location and inverts to reconfigure are outlined in Table 5.7. Preliminary design evaluation of each location is recommended to identify site specific constraints that may limit changes to slope. This may require replacing pipe lengths upstream and/or downstream of the deficiency to achieve a positive slope.

Table 5.7 Piping Reconfiguration Locations

Deficiency ID	Location	Invert ID	Invert Elevation
37A	Edmonds Avenue and NE 9th Street	MH0738	273.66
24A	Monroe Avenue and NE 7th Street	MH0761	360.25
11A	Grant Avenue and SE 9th Street	MH5049, MH5050, MH5052, MH5053	Unknown
20A	SE 99th Court	MH3726	321.86
20B	Jericho Place and NE 16th Street	MH6616	453.85

5.5.2 I/I Evaluation

An I/I evaluation, followed by rehabilitation and replacement of structural deficiencies, is recommended for deficiency in mini-basins with excessive I/I (defined as 7,500 GPAD). The evaluation should incorporate micro-monitoring to focus rehabilitation and replacement activities on areas with the greatest I/I. Micro-monitoring consists of installing multiple flow monitors for a relatively short period of time in mini-basins to identify areas with relatively high I/I. Flow meters are often moved to identify smaller and smaller areas with higher I/I. This allows rehabilitation and repair activities to be focused on specific areas, rather than an entire mini-basin.

Mini-basin I/I rates in GPAD is shown in Figure 5.7. Of the 22 deficiencies, seven occur in mini-basins with high I/I (greater than 7500 GPAD). A total of seven upstream mini-basins contribute to the deficiencies, as shown in Table 5.8, where mini-basins 2, 3, and 7 contribute to multiple current system deficiencies. Deficiencies 05C and 25A became deficient during buildout conditions. The upstream demographics of these areas were unchanged in buildout conditions, so the deficiency is attributed to I/I despite I/I rates lower than 7500 GPAD.

Table 5.8 Micro-Monitoring Recommendations for I/I

Deficiency ID	Manhole Location	Upstream Mini-Basins with High I/I
45A	MH2258	45, 7, 3, 2, 1
7A	MH2480	7
2A	MH2489	2
3A	SSMH004	3
05B	MH5516	5
05C	MH5516	5
25A	MH1696	25 & U3

5.5.3 Programmatic Upsizing

For sites where modeling indicated that capacity issues were caused by short and undersized stretches, upsizing was recommended. Programmatic upsizing was typically recommended for areas without significant surcharging and where modeling allowed identification of a defined segment responsible for the deficiency. These locations are described in additional detail in Table 5.9, which shows the location, pipe, and pipe diameter.

Deficiencies 23A, BA, and 46A also all correspond to areas with high condition risk; therefore, upsizing could be completed in conjunction with pipe rehabilitation and replacement program activities.

Table 5.9 Programmatic Upsizing Location and Additional Information

Deficiency ID	Location	Pipe ID's	Current Pipe Diameter	Proposed Pipe Diameter	Upsizing Length (ft)	Comments
23A	N 28th Place and Park Avenue North	GM03987, GM03986, GM03985	8″ 12″	12″ 16″		Reconfiguration at MH3498 if possible.
BA	SE 24th Street and E Valley Road	GM05178, GM05179	8″	12″		Backwater from Pump Station influences hydraulics.
46A	Sunset Boulevard North and NE 3rd Street	GM04391	8″ 12″	12″ 16″		Significant stretch of pipe that is deficient, but change in diameter appears to be hydraulic restriction.

5.5.4 Additional Long-Term Flow Monitoring

Additional long-term flow monitoring was recommended for the remaining deficiencies. Of the twenty-two deficient locations, five are recommended to undergo additional long-term flow monitoring. The City reviewed these deficiencies and confirmed that they have not observed capacity issues at these location in the field. Therefore, long-term flow monitoring is

recommended to determine the extent and possible causes of the deficiency. The recommended quantity, type, duration, location, and priority of the monitoring is provided in Table 5.10.

The recommended duration is chosen based on the recurrence of the deficiency given the surcharging seen in the model calibration events (6 months to 1 year storms) and design storms (20 to 30 year storms). Based on the HGL under different storms, 2-5 years of monitoring is recommended for Deficiency 05A; 1-2 years for deficiency 22A; 3-7 years for deficiency 14A, 15A, and 21A, 48A, and 41A.

Table 5.10 Long-Term Flow Monitoring Recommendations

Deficiency ID	Location	Quantity	Duration	Manhole ID
05A	Talbot Road South and 36th Street to 27th Place	1	2- 5 years	MH2998
22A	Whitman Court NE and NE 12th Street	2	1-2 years	MH3616, MH3622
21A	Anacortes Avenue NE and NE 17th Street to NE 26th Street	2	3-7 years	MH3542, MH3581
15A	Renton High School	1	3-7 years	MH2118
14A	West Sunset Blvd and SW 4th Place	1	3-7 years	MH6332
41A	Lake Washington Boulevard and Burnett Avenue North	1	3-7 years	MH3381
48A	NE 7th Street and Harington Avenue NE	1	3-7 years	MH0847

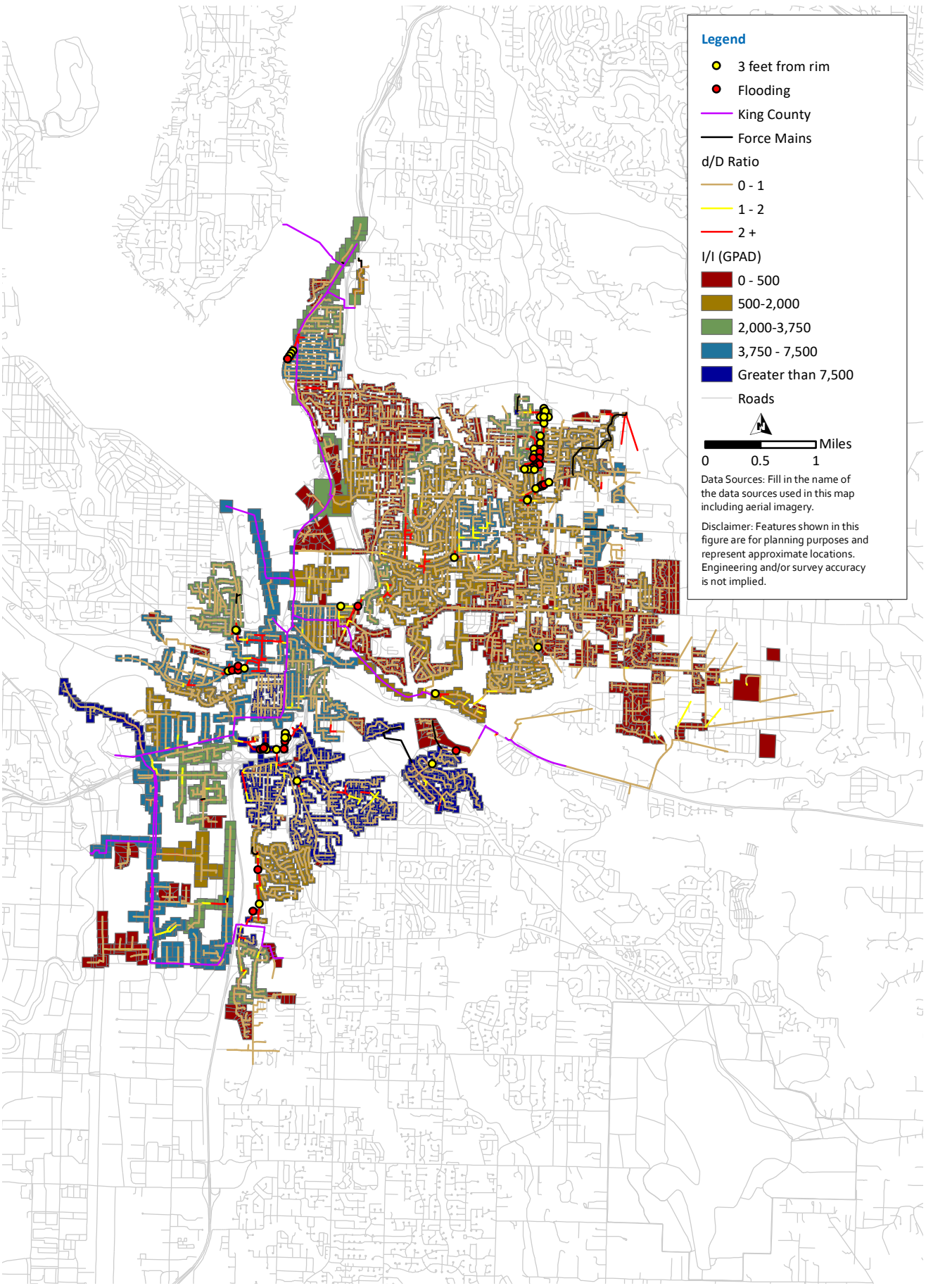
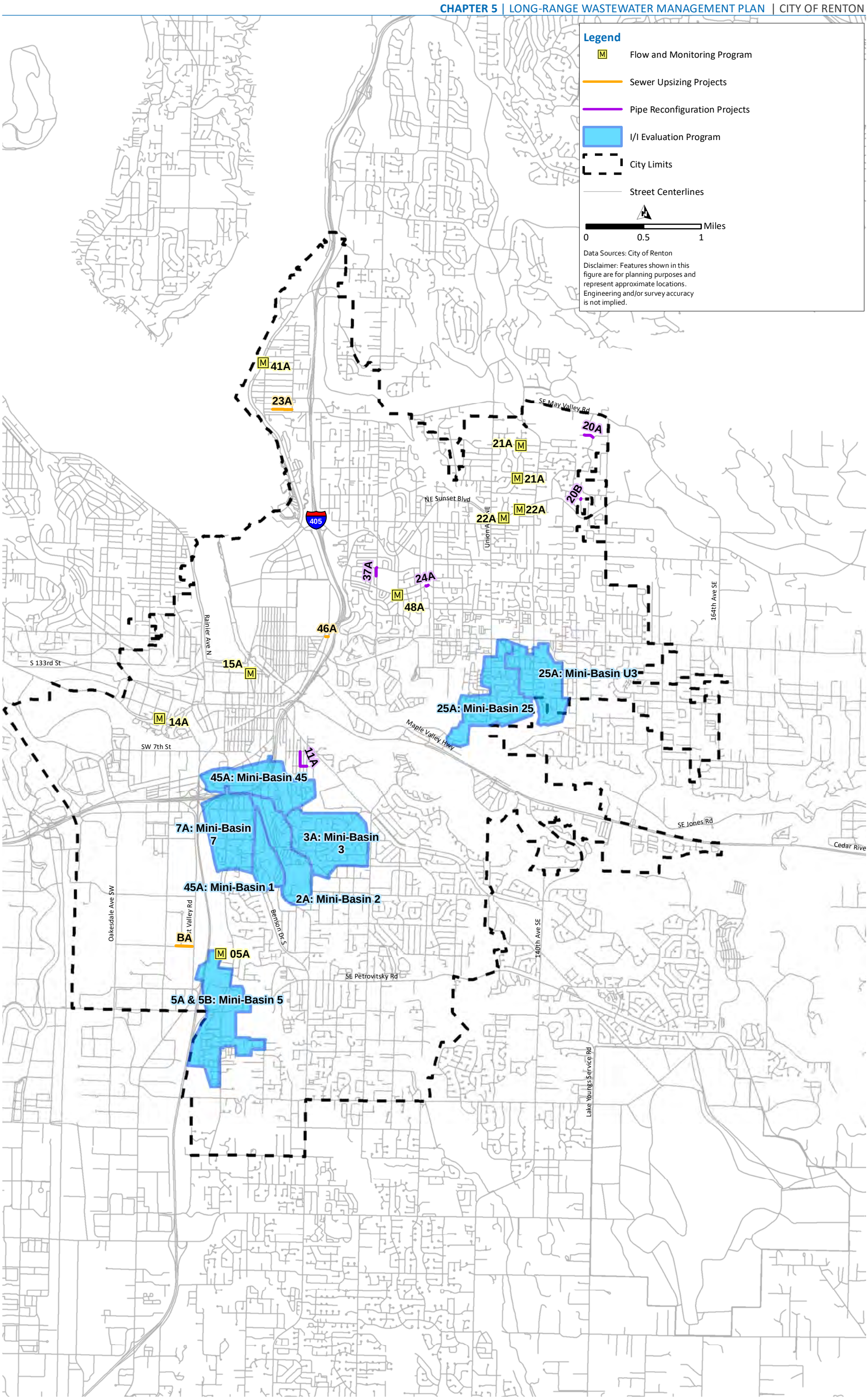


Figure 5.7
Modeled I/I Overlaid with Deficiencies


Legend
Flow and Monitoring Program
Sewer Upsizing Projects
Pipe Reconfiguration Projects
I/I Evaluation Program
City Limits
Street Centerlines
Miles
0
0.5
1
Data Sources: City of Renton
Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.
M 41A
23A
SE May Valley Rd
20A
21A M
M 21A
20B
NE Sunset Blvd
M 22A
22A M
405
37A
24A
M 48A
46A
Rainier Ave N
164th Ave SE
S 133rd St
15A M
25A: Mini-Basin U3
25A: Mini-Basin 25
M 14A
Maple Valley Hwy
SW 7th St
11A
45A: Mini-Basin 45
7A: Mini-Basin 7
3A: Mini-Basin 3
SE Jones Rd
45A: Mini-Basin 1
2A: Mini-Basin 2
BA
M 05A
Benson Dr S
140th Ave SE
SE Petrovitsky Rd
5A & 5B: Mini-Basin 5
Lake Youngs Service Rd

Chapter 6

REPLACEMENT AND REHABILITATION PROGRAM

6.1 Introduction

This chapter documents the City of Renton's (City's) prioritized collection system replacement and rehabilitation (R&R) program. R&R prioritization is based on a risk, which is based on the criticality and vulnerability of an asset. Criticality represents the consequence of failure, and the vulnerability represents the likelihood of failure. A consistent approach is used to identify and prioritize force mains (FMs), lift stations, and gravity mains as documented in the following sections.

6.2 Replacement and Rehabilitation Plan Goals

The City is implementing a risk-based R&R program that takes into account the criticality and vulnerability of their system. Using this approach, the City can proactively replace or rehabilitate infrastructure to reduce the System's risk.

6.2.1 Prioritizing Using Risk

The risk associated with an asset (pipe, manhole [MH], pump, etc.) is a measure of the impact of asset failure on the overall system. Risk is calculated as the product of criticality and vulnerability, or:

Risk = Criticality x Vulnerability

Risk criteria were developed from the Halcrow Risk and Remaining Life Planning Tools (Weber Davis Aqueduct, March 2011) and refined to meet the City's objectives and available data sources. Data sources and levels were chosen that represented the selected criteria, were readily available, and that could be applied consistently across the entire system. Table 6.1 shows the matrix of the normalized risk rankings that were used for this study.

Table 6.1 Normalized Risk Ratings

Normalized Risk Ranking					
Vulnerability Level	4 (severe)	Moderately Low	Moderately High	High	High
	3 (moderate)	Moderately Low	Moderately High	Moderately High	High
	2 (low)	Low	Moderately Low	Moderately High	Moderately High
	1 (negligible)	Low	Low	Moderately Low	Moderately Low
		1 (negligible)	2 (low)	3 (moderate)	4 (severe)
		Criticality Level			

6.3 Lift Station and Force Main Current R&R Program

The Wastewater Utility operates 20 sewage lift stations in which each has its own FM that delivers the flow to the gravity system (Fig.6.1). Since the 2010 Long-Range Wastewater Management Plan (LRWWMP), six lift stations have been decommissioned and two lift stations added. Over the past 25-years, the City has replaced, rehabilitated, or eliminated all previous 25 lift stations. However, their FMs often times were not. In 2016 the City conducted a risk assessment of the Lift Stations and FMs. Based on this study, the City had developed and is near completion on the lift station and FM R&R project that has systematically addressed or mitigated potential risks to its existing infrastructure. Over the 20 year planning period, it is anticipated that continued R&R will be needed and prioritized by the highest risk.

6.4 Force Main R&R

The City completed a preliminary condition assessment of its FMs in the 2016 Existing Force Main Condition Assessment and Lift Station Evaluation Report (Carollo Engineers, Inc. [Carollo], 2016). The 2016 project included developing an updated inventory of the lift stations and FMs, performing a preliminary risk assessment of the FMs to identify those having the highest risk of failure, field verifying the preliminary risk rankings, and preparing routine evaluation and maintenance guidelines. This section summarizes the preliminary condition and risk assessment. FM R&R recommendations are presented based on the 2016 project and improvements being made as part of the Rehabilitation Program.

6.4.1 Force Main Criteria

A preliminary "desktop" risk assessment was performed for the City's sewer FMs. Criticality and vulnerability criteria used to establish risk are summarized below in Sections 6.4.1.1 and 6.4.1.2. The criticality, vulnerability, and risk ratings for each FM were quantified on a relative risk scale, with one representing the lowest risk and four representing the highest risk.

6.4.1.1 Force Main Criticality

Criticality describes the consequence of failure of a particular asset. Criticality factors used in the desktop risk assessment for the FMs are:

- Cost to repair, which includes FM material, diameter, length, and excavation and backfill costs.
- Potential for life-threatening injuries or fatalities from FM break. Injuries or fatalities can be of a pedestrian, a household, or a vehicle.
- Ability to maintain flow using bypass pumps or a Vactor Truck.
- Loss of critical infrastructure and transportation links. For example, a FM located underneath a major highway is given a higher impact rating compared to one located in a low-use road.
- Emergency construction access constraints, such as FMs located in backyards, in a wetland, or on a steep slope.
- Damage to nearby property, based on the number of properties damaged from FM leakage.
- Environmental impact to waterways, wetlands, or other sensitive areas. A FM located near an environmentally sensitive area is given a higher rating than one located further away.

6.4.1.2 Force Main Vulnerability

The vulnerability metric reflects the likelihood of asset failure. Physical or performance failure and technological obsolescence qualify as asset failure; however, the desktop risk assessment considered physical failure only asset mortality. Factors used to assess the physical vulnerability of the FMs are:

- Material type. Cast iron (CI) and ductile iron (DI) pipes generally have a shorter useful life compared to polyvinyl chloride (PVC) and high-density polyethylene (HDPE) FMs, and thus have a higher vulnerability rating.
- Age. As the FM ages, its remaining useful life (RUL) decreases and becomes more likely to fail.
- History of failure. FMs having a history of frequent failures are more likely to fail again.
- Maintenance history. If routine maintenance is required to prevent FM failure, the FM is considered to be in poor condition and is more likely to fail.
- Pipe conditions based on closed-circuit television (CCTV) records.
- Soil corrosivity based on soil classification from the United States Soil Conservation Map. Electronic conductive soils such as peat, clay, and silt are more corrosive than non-conductive soils such as sand and gravel for CI and DI FMs.
- Cathodic protection for CI and DI FMs.
- Potential of third-party damage from nearby construction or utility failures.

No CCTV or cathodic protection data was available for the analysis. Accordingly, these factors were excluded from the analysis, but should be included in the future if available.

6.4.2 Force Main Risk Assessment

A criticality and vulnerability level were assigned for each FM based on the available data and input from City staff. Once levels were assigned for all criteria, a weighted average was used to determine the overall rating. Normalized ratings were determined by allocating the weighted average of criticality and vulnerability into quartiles. The results of the desktop risk assessment are shown in Table 6.2.

6.4.3 Force Main Recommendations

The recommendations of the system inventory and risk assessment of the City's sewer FMs were incorporated into the Lift Station and FM Rehabilitation Program, summarized in Table 6.2, including:

- It is recommended that the City conduct CCTV inspection of FMs after FM cleanouts are installed as part of the Lift Station and FM Rehabilitation.
- It is recommended that the City monitor the condition of the stream banks adjacent to the Devil's Elbow lift station and evaluate alternatives to armor the banks to protect the lift station and FM.
- It is recommended the City continue regular maintenance and its active rehabilitation program for FMs.

Table 6.2 Force Main Risk Assessment Summary

Lift Station Name	Force Main Diameter (inches)	Force Main Length	Normalized Risk Ranking
Baxter	8"	155 lf[1]	High
Devil's Elbow	6"	506 lf	High
Lake WA No. 2	6"	192 lf	High
Falcon Ridge	4"	3,217 lf	Moderately-High
Kensington Crest	4"	1,350 lf	Moderately-High
Lake WA[2] Beach	4"	337 lf	Moderately-High
Lake WA Flush	4"	18 lf	Moderately-High
Long	4"	783 lf	Moderately-High
Misty Cove	4"	175 lf	Moderately-High
Wedgewood	8"	1,019 lf	Moderately-High
Airport	4"	530 lf	Moderately-Low
Cottonwood	4"	52 lf	Moderately-Low
East Valley	8"	120 lf	Moderately-Low
Stonegate	8"	4,944 lf	Moderately-Low
Talbot Crest	4"	520 lf	Moderately-Low
Westview	3"	340 lf	Moderately-Low
Liberty	8"	900 lf	Low
Lind Avenue	8"	180 lf	Low
Pipers Bluff	4"	1,017 lf	Low
Shy Creek	1''	226 lf	Low

Note:
(1) lf – linear feet.
(2) WA - Washington.

6.5 Lift Station R&R

Lift stations criticality and vulnerability are commonly assessed by individual components, such as pump, wet well, electrical system, etc. Each component may be rehabilitated as it reaches its usable life, rather than replacing the entire pump station. Regular maintenance conducted by the City helps extend the useful life; however, the infrastructure will eventually reach the end of its useful life and require rehabilitation or replacement.

6.5.1 Lift Station Criteria

Similar to the FM criteria, a risk assessment was performed for the City's 20 lift stations. Vulnerability was established based on the RUL of the lift stations. Initial RUL was determined based on the age of the facility. The initial RUL was then adjusted based on the past condition assessments and the ongoing FM and Lift Station Rehabilitation Program. Lift station criticality was based on the FM criticality.

6.5.1.1 Lift Station Criticality

The same criticality factors that influence FM impacts the lift station associated with it. Therefore, the FM criticality factors were applied to the lift stations, as presented in Table 6.2.

6.5.1.2 Lift Station Vulnerability

The City's lift stations were assessed a vulnerability, or likelihood of failure, score based on RUL. Since several lift stations have been rehabilitated in the past, RUL was calculated for both structural integrity of the lift station and the components within the lift station, which include mechanical and electrical coatings, roofing, etc. The structural usable life for a lift station was selected as 75 years. The usable life for the components of a lift station was selected as 25 years, which is consistent with the City's capital improvement program (CIP) planning.

6.5.2 Lift Station Criticality Assessment

Lift Station criticality scores mirrored their FMs, as presented previously and detailed in Table 6.3.

6.5.3 Lift Station Vulnerability Assessment

Vulnerability scores were calculated based on RUL. RUL was calculated using the construction or renovation date of each lift station for structural and components within the lift station, which are presented in Table 6.3. RUL was adjusted based on prior condition assessments and the FM and Lift Station Rehabilitation Program:

- Lake WA No. 2 and Lake WA Flush Stations were assigned a Components RUL of 0 to 5 years based on the findings of the Lake Line Project condition assessment.
- Devil's Elbow and Talbot Components RUL was adjusted upwards to 6 to 10 years based on the FM and Lift Station Rehabilitation Program.
- Cottonwood Lift Station was considered to be fully renovated as part of the Rehabilitation Program.

The RUL of each lift station was based on component RUL, as it was less than the structural RUL in all cases.

The vulnerability levels for Lift Stations were determined from the RUL as follows:

- Level 1 (Negligible): RUL greater than 15 years.
- Level 2 (Low): RUL between 11 and 15 years.
- Level 3 (Moderate): RUL between 6 and 10 years.
- Level 4 (Severe): RUL of 5 years and less.

The results of the vulnerability scores for each lift station are found in Table 6.3.

Table 6.3 Lift Station Risk Assessment Summary

Lift Station Name	Criticality Score	Construction Date	Renovation Date	Structural RUL (yrs)[4]	Components RUL (yrs)	Vulnerability Score	Vulnerability Designation	Risk Score
Baxter	3p	2008		66	16	1	negligible	(1,3)
Devil's Elbow	3	2000		58	6 to 10[1]	3	moderate	(3,3)
Lake WA No. 2	4	1972	1994	30	0 to 5[2]	4	severe	(4,4)
Falcon Ridge	1	1981	2019	37	24	1	negligible	(1,1)
Kensington Crest	3	2002		60	10	3	moderate	(3,3)
Lake WA Beach	2	2011		69	19	1	negligible	(1,2)
Lake WA Flush	4	1972	2005	30	0 to 5[2]	4	low	(4,4)
Long	3	2006		64	14	2	low	(2,3)
Misty Cove	4	2014		72	22	1	negligible	(1,4)
Wedgewood	3	2006		64	14	2	low	(2,3)
Airport	4	2014		72	22	1	negligible	(1,4)
Cottonwood	2	1994	2018[3]	53	26	1	negligible	(1,2)
East Valley	1	2004		62	12	2	low	(2,1)
Stonegate	3	2012		70	20	1	negligible	(1,3)
Talbot Crest	2	2000		58	6 to 10[1]	3	moderate	(3,2)
Westview	1	1996	2010	54	18	1	negligible	(1,1)
Liberty	2	2012		70	20	1	negligible	(1,2)
Lind Avenue	1	1978	2014	36	22	1	negligible	(1,1)
Pipers Bluff	2	?				3	moderate	(3,2)
Shy Creek	1	2007		65	15	2	low	(2,1)

Notes:
(1) Devil's Elbow and Talbot RUL as adjusted upwards to 6 to 10 years based on the FM and Lift Station Rehabilitation Program.
(2) Lake WA No. 2 and Lake WA Flush Stations were assigned a RUL of 0 to 5 years based on the findings of the Lake Line Project condition assessment.
(3) Cottonwood Lift Station was considered to be fully renovated as part of the Rehabilitation Program.
(4) yrs – years.

6.5.4 Lift Station Risk Assessment

The risk score was calculated applying the same method as the FM risk assessment. A matrix of the normalized risk rankings for the lift stations is shown in Table 6.4. Two lift stations which are part of the Lake Line were categorized at the highest risk level. Five lift stations were categorized in the moderately-high risk level including Devil's Elbow, Kensington Crest, Talbot Crest, Long, and Wedgewood. The remaining thirteen lift stations are categorized as low to moderately-low risk level.

Table 6.4 Risk Matrix for Lift Stations

		Normalized Risk Ranking			
Vulnerability Level	4 (severe)				Lake WA No. 2 Lake WA Flush
	3 (moderate)		Talbot Crest	Devil's Elbow Kensington Crest	
	2 (low)	East Valley Shy Creek		Long Wedgewood	
	1 (negligible)	Falcon Lind Avenue Westview Liberty	Lake WA Beach Cottonwood Pipers Bluff	Baxter Stonegate	Airport Misty Cove
		1 (negligible)	2 (low)	3 (moderate)	4 (severe)
		Criticality Level			

6.5.5 Risk Based Lift Station Recommendations

The City's lift stations are well maintained and it is recommended the City continue regular maintenance and rehabilitation to address aging equipment. The operation of lift stations with moderate and severe criticality should be monitored closely, as the potential impacts from failures at these stations are relatively higher than other stations. In addition to regular maintenance, the City plans for a full rehabilitation of lift stations every 15 to 20 years to limit vulnerability.

6.5.6 Rehabilitation Improvements

The Lift Station and FM Rehabilitation Project paired the 2016 risk findings with a detailed condition assessment to generate comprehensive rehabilitation improvements to address condition issues and enhance operations and maintenance (O&M). The improvements, shown in Table 6.5, provide enhancements to aid in future O&M of the lift stations and FMs:

- FM cleanouts to allow access for inspection and rehabilitation.
- Backup power (engine generator [E/G] install), where needed.
- Telemetry Improvements, where needed.
- Added Flow Meters, where needed.

Common rehabilitation items include wet well repair or recoating and structural improvements. The Cottonwood and Baxter lift stations also will receive new pumps. The rehabilitation is anticipated to provide approximately 15 years of useful life in all lift stations. Falcon Ridge was not included in the Rehabilitation Project, so improvements are not included in Table 6.5.

The Lake WA No. 2 Lift Station and the Lake WA Flush Station, which serve the Kennydale Lake Line Sewer System (Lake Line), are not included in the Rehabilitation Program. The Lake Line evaluation provided a comprehensive analysis that addressed the City's short- and long-term issues concerning the system. Kennydale Lake Line Sewer System Evaluation Technical Memorandum (TM) 1: Phase 1 Existing Conditions (Carollo, 2017) documents the condition assessment of the stations and identified rehabilitation improvements for the lift and flush stations. The City is waiting to implement these improvements until the long-term approach for O&M of the Lake Line is determined in 2020-2021 through the completion of the Kennydale Lake Line Sewer System Improvements Project, which may change the sizing and extent of improvements needed.

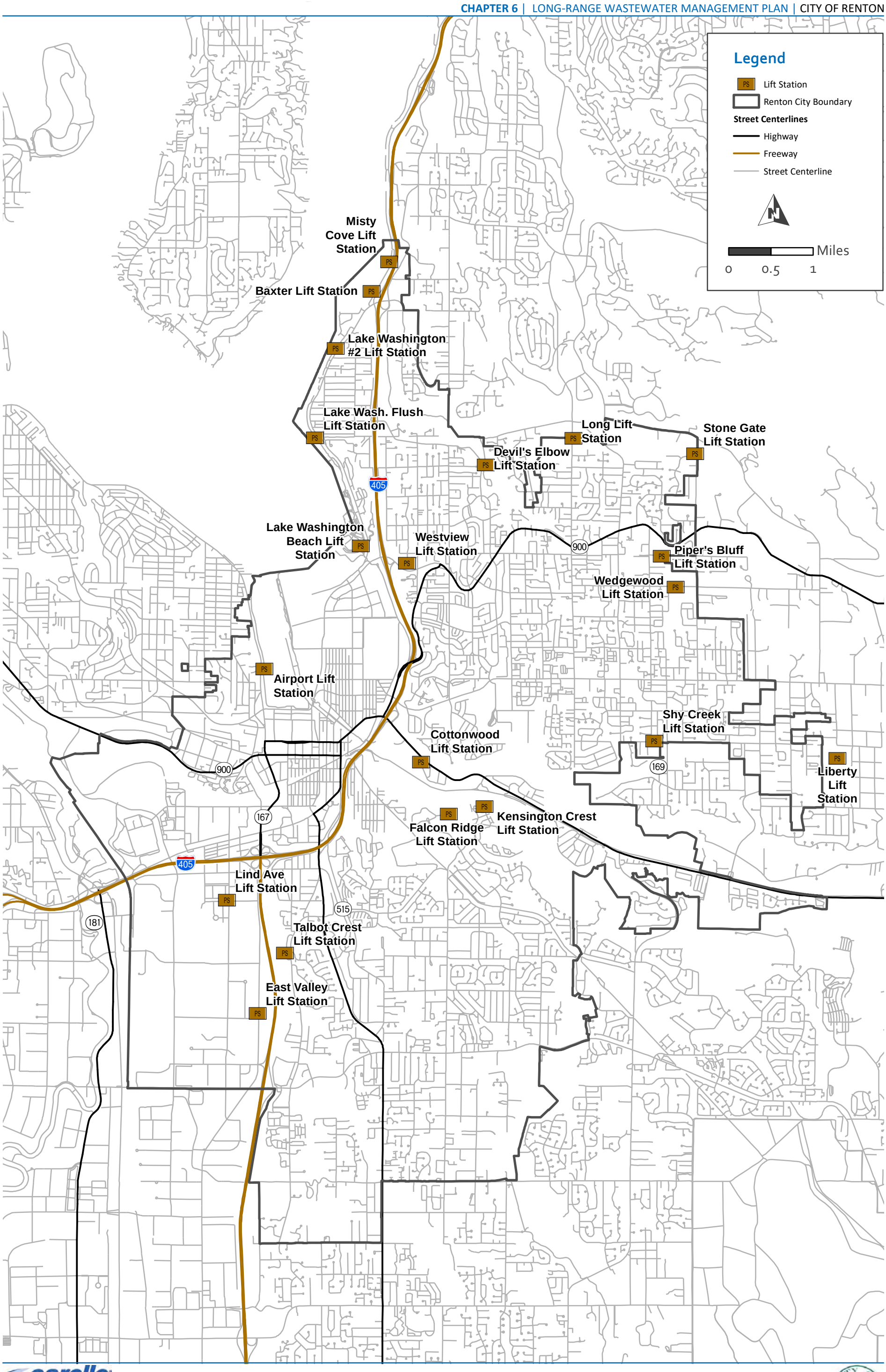


Figure 6.1
City of Renton Lift Stations

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Table 6.5 Lift Station and Force Main Rehabilitation Program

Group 1																					
No.	Lift Station Name	Pump Replacement	Motor Control Replacement	Telemetry Improvements	Add Flow Meter	E/G Install	Noise Abatement	Slope Stabilization	Wet Well Structural	Assess Coatings	Wet Well Recoat	Temp Wet Well System/Pump	FM Cleanouts	FM Maintenance Equip. Evaluation	FM Reconfiguration	FM Replacement	MH or Vault Improvements	Structural E/G Pad or Vault	Control Room Structural	Misc. Structural (Telem.)	Environmental/Agency Elements
1	Cottonwood	X	X	X	X	X	X						X					X			
2	Devil's Elbow			X				X		X	X	X	X								
3	East Valley			X		X			X				X					X		X	
4	Misty Cove												X				X				
5	Piper's Bluff					X							X					X	X		
6	Shy Creek					X			X	X	X	X	X					X			
7	Baxter	X							X							X					X
8	Stonegate									X	X		X								
9	Airport and Lind												X								
Group 2																					
10	Liberty				X	X							X	X							
11	Wedgewood					X							X								
12	Lake WA Beach			X		X										X		X		X	X
13	Talbot Crest			X	X	X				X	X	X	X				X	X			
14	Long			X	X	X							X					X			X
16	Westview			X	X	X							X					X			
17	Kensington Crest				X	X					X	X	X					X			

6.6 Gravity Sewer System R&R

A risk-based prioritization of gravity sewer mains was developed in 2016 and documented in CCTV Program Phase 2 project's TM No. 4: Risk Findings, which is provided in Appendix I. This section summarizes the findings that include criticality and vulnerability analysis, the RUL analysis, a risk-based evaluation, and a recommended R&R program for the system's gravity mains.

6.6.1 Gravity Sewer Main Criteria

Similar to the City's FM analysis, a risk assessment was performed for the City's gravity mains. Criticality and vulnerability criteria were used to establish the assets risk of failure and are summarized below.

6.6.1.1 Criticality

Once the criteria and data sources were found, each pipe segment was assigned a score-based criteria rating found in Tables 6.6 and 6.7. The levels varied from negligible criticality or vulnerability (Level 1) to severe (Level 4). The levels are represented numerically as 1 to 4. Weighted factors, as discussed above, were applied to reflect the City's priorities.

As discussed above, criticality represents the consequence of failure of a particular asset. Table 6.6 shows the criteria, weighting, and description of each level for criticality of gravity sewer mains. These criteria and data sources reflect an iterative refinement process that reflected the City's typical key decision factors and the perceived accuracy of the data. Criteria were scored on four levels based on analysis of available geographic information system (GIS) information that best represented each criterion. Where the decision factors or available data did not support four levels of scoring, two levels of scoring were typically used. For example, the criticality criterion for environmental impacts receives a level of 3 when within 50 feet (ft) from a critical area and a level of 1 at greater distances. Given the high level of the critical area data, the City was not comfortable in differentiating the criteria further without a site-specific investigation (wetland delineation, geotechnical analysis, etc.). These site-specific analyses are generally conducted as part of the design of the R&R program and could not be reasonably completed City wide.

The weighting factor for each criterion in Table 6.6 was discussed with City staff and used to identify certain criteria that would impact the system more than other criteria. For criticality, it was agreed that the loss of critical infrastructure and transportation links should have a weighting factor of 2, while the other criteria were kept at a factor of 1. The scoring of these criteria was adjusted with respect to the weighting factor.

A total score was calculated for each criteria for all gravity collection pipes in the system. For example, if a pipe segment was located in an arterial street, its Loss of Critical Infrastructure and Transportation Links criteria was scored as Level 3, or moderate, rating. Multiplying the level of three by a weight of two on Table 6.6, the final weighed level for that criteria would be 3 x 2 = 6. The same calculation would be made for the remaining criteria and summed for an overall criticality score. The same process was repeated for the vulnerability criteria.

6.6.1.2 Vulnerability

The likelihood of failure is known as the asset's vulnerability. Table 6.7 shows the criteria that were used to determine the vulnerability of each asset. Similar to the criticality criteria in Table 6.6, the criteria, weighting, and description of each level were used as a decision factor to find the vulnerability of the asset.

Table 6.6 Criticality Criteria

Criteria	Weighting	Level 1	Level 2	Level 3	Level 4
Cost to Repair Failure	1	Small Repair Effort by City Crew Pipe Diameter: ≤ 12" AND Pipe Depth: < 12 ft	Large Repair Effort by City Crew Pipe Diameter: > 12" AND Pipe Depth: < 12 ft	Small Repair Effort by Contractor Pipe Diameter: ≤ 12" AND Pipe Depth: ≥ 12 ft	Large Repair Effort by Contractor Pipe Diameter: > 12" AND Pipe Depth: ≥ 12 ft
Loss of Critical Infrastructure and Transportation Links	2	Negligible No Site of Interest OR Non-arterials	Low No Site of Interest OR Collector Street	Moderate Site of Interest OR Arterial Street	Severe Critical Infrastructure OR Freeways
Damage to Property	1	Negligible Distance to Building Footprint: > 10 ft		Moderate Distance to Building Footprint: ≤ 10 ft	
Environmental Impacts to waterway, wetland, or other Sensitive Area	1	Negligible Distance from Critical Area: > 50 ft		Moderate Distance to Critical Area: < 50 ft	
Loss of Service to Customers	1	Negligible Collection Line		Moderate Trunk Line	
Reputational Damage	1	Negligible Outside Wellfield Capture Zone OR Distance to Critical Water Body > 200 ft	Low Within 5 year Wellfield Capture Zone OR 2. Distance to Critical Water Body > 100 ft and ≤ 200 ft	Moderate Within 1 year Wellfield Capture Zone OR 2. Distance to Critical Water Body > 50 ft and ≤ 100 ft	Severe Distance to Critical Water Body < 50 ft OR 2. Distance from well ≤ 500 ft
Damage to Local Business and Economy	1	Negligible Pipeline outside of Overlay District		Moderate Pipeline within Overlay District	

Table 6.7 Vulnerability Criteria

Criteria	Weighting	Level 1[1]	Level 2	Level 3	Level 4
Structural Condition, CCTV Inspection Results	1	Negligible Pipe not yet inspected: material is PVC or DIP[1] Structural NASSCO[2] Score: ≤ 2	Low Pipe not yet inspected: all other materials Structural NASSCO Score: > 2 and ≤ 3	Moderate Structural NASSCO Score: > 3 and ≤ 4	Severe Structural NASSCO Score: > 4
O&M Condition, CCTV Inspection Results	1	Negligible Pipe not yet inspected: material is PVC or DIP O&M NASSCO Score: ≤ 2	Low Pipe not yet inspected: all other materials O&M NASSCO Score: > 2 and ≤ 3	Moderate O&M NASSCO Score > 3 and ≤ 4	Severe O&M NASSCO Score: > 4
RUL Estimate	1	Negligible RUL > 20 years	Low RUL between 10 and 20 years	Moderate RUL between 5 and 10 years	Severe Less than 5 years RUL
Frequency of Preventative Maintenance	1	Negligible No Cleaning	Low Annual OR Biannual Cleaning	Moderate Monthly or Quarterly Cleaning	Severe Biweekly or Weekly Cleaning
Slope of Pipe Segment	1	Negligible Slope > 0.5%	Low Slope ≤ 0.5%	Moderate	Severe

Note:
(1) DIP – ductile iron pipe.
(2) NASSCO – National Association of Sewer Service Companies.

6.6.2 Gravity Sewer Criticality Assessment

Once the criteria and data sources were found, each pipe segment was assigned a score-based criteria rating found in Tables 6.8 and 6.9.

The amount of pipe found in each criticality level was calculated and is shown in Table 6.8. Figure 6.2 shows the map of the City's total criticality score results using the guidelines from Table 6.1. To aid in review, a consistent color scheme is applied to the levels and scores in all mapping, with light green showing the Level 1, or negligible pipes, dark green showing the Level 2, or low criticality piping, orange representing the Level 3, or moderately critical piping, and red showing the Level 4, or severe criticality piping.

Severe criticality mains make up 12.9 percent of the gravity collection system and are largely located along major roadways or in the Valley. The majority (61.5 percent) of piping in the Valley is either moderate or low criticality. Negligible criticality piping is distributed throughout the system and accounts for the remaining 25.7 percent.

Table 6.8 Criticality Score Range

Criticality Level	Length (ft)	Percent of Total
1 (negligible)	333,777	25.7%
2 (low)	352,977	27.1%
3 (moderate)	447,195	34.4%
4 (severe)	167,286	12.9%

6.6.3 Gravity Sewer Vulnerability Assessment

Using the criteria in Section 6.4.1.2, the length of pipe allocated to each vulnerability level was calculated and is shown in Table 6.9. Figure 6.3 shows a map of the four vulnerability criteria results. About three quarters of the City's gravity mains have negligible or low vulnerability, indicating they have substantial RUL and are without O&M issues. RUL is discussed in detail in the following section. Moderate vulnerability pipes are largely in older portions of the system. There are very few, approximately 2 percent, severe vulnerability pipes, which are spread throughout the system.

Table 6.9 Vulnerability Score Range

Vulnerability Level	Length (ft)	Percent of Total
1 (negligible)	638,499	49.1%
2 (low)	384,523	29.6%
3 (moderate)	256,350	19.7%
4 (severe)	21,863	1.7%

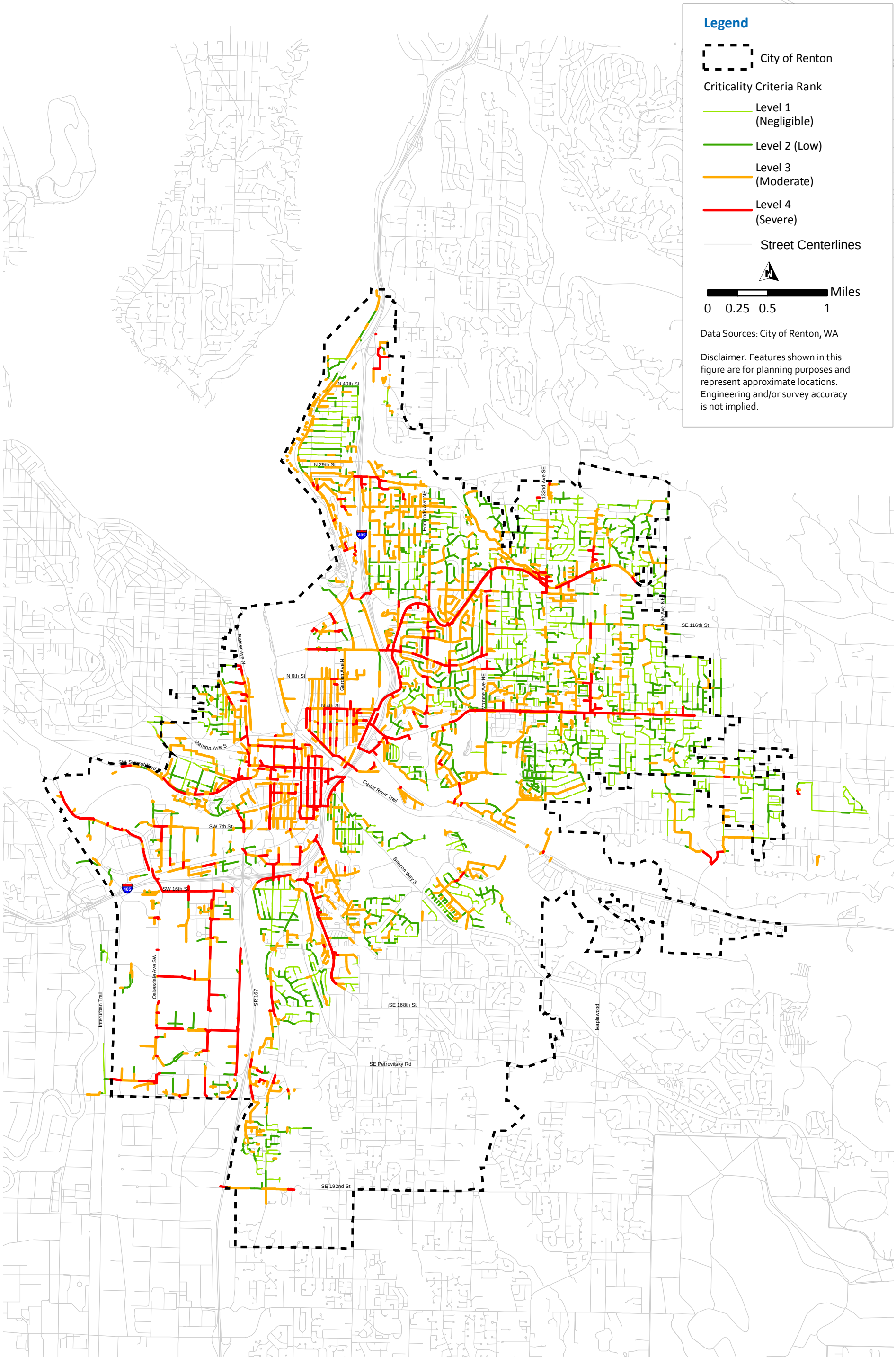

Figure 6.2
Criticality Criteria Results

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6.6.3.1 Remaining Useful Life Analysis

Because the City has a limited amount of CCTV for their gravity mains, the main criteria used for the vulnerability was a RUL estimate, or how many years a pipe with a certain material has before it will most likely fail. Due to the importance of this criteria, detailed information is presented below.

Pipe age and material type were used to determine the RUL of the collection system pipelines. GIS data and field research were used to determine the type of material and year or decade that pipe segments were installed.

Pipe manufacturers establish a theoretical useful life based on pipe material; however, the actual useful life is commonly lower due to soil conditions, aggressive wastewater materials, roots, installation errors, etc. The original useful life varies from 60 years for concrete pipe (CP) to 100 years for vitrified clay pipe (VCP). Since the age and material data for some of the pipelines were unavailable, it is assumed that the original useful life for all unknown pipelines is 50 years. Table 6.10 presents the estimated useful life of pipes of various materials.

Table 6.10 Useful Life of Pipes

Pipe Material	Original Useful Life (Years)
Corrugated Aluminized Steel (CAS)	60
Concrete Pipe (CP)	75
Ductile Iron Pipe (DIP)	75
Polyethylene	90
Pre-stressed Concrete Pipe (PSC)	85
Polyvinyl Chloride Pipe (PVC)	100
Vitrified Clay Pipe (VCP)	100
Lined Pipe (LN)	75
Unknown Material (XXX)	50

Table 6.11 summarizes the City's gravity sewer system by material type into short, medium, and long-term replacement. The cells are color-coded to show the three categories of RUL; red indicates pipe that is expected to reach the end of their useful life in the next 10 years or has reached its useful life, light orange represents pipe with a RUL of between 10 and 20 years, and green represents pipe that has a RUL of over 20 years. In total, approximately nine percent of the existing collection pipes with known installation year are expected to reach the end of their useful lives by the year 2026.

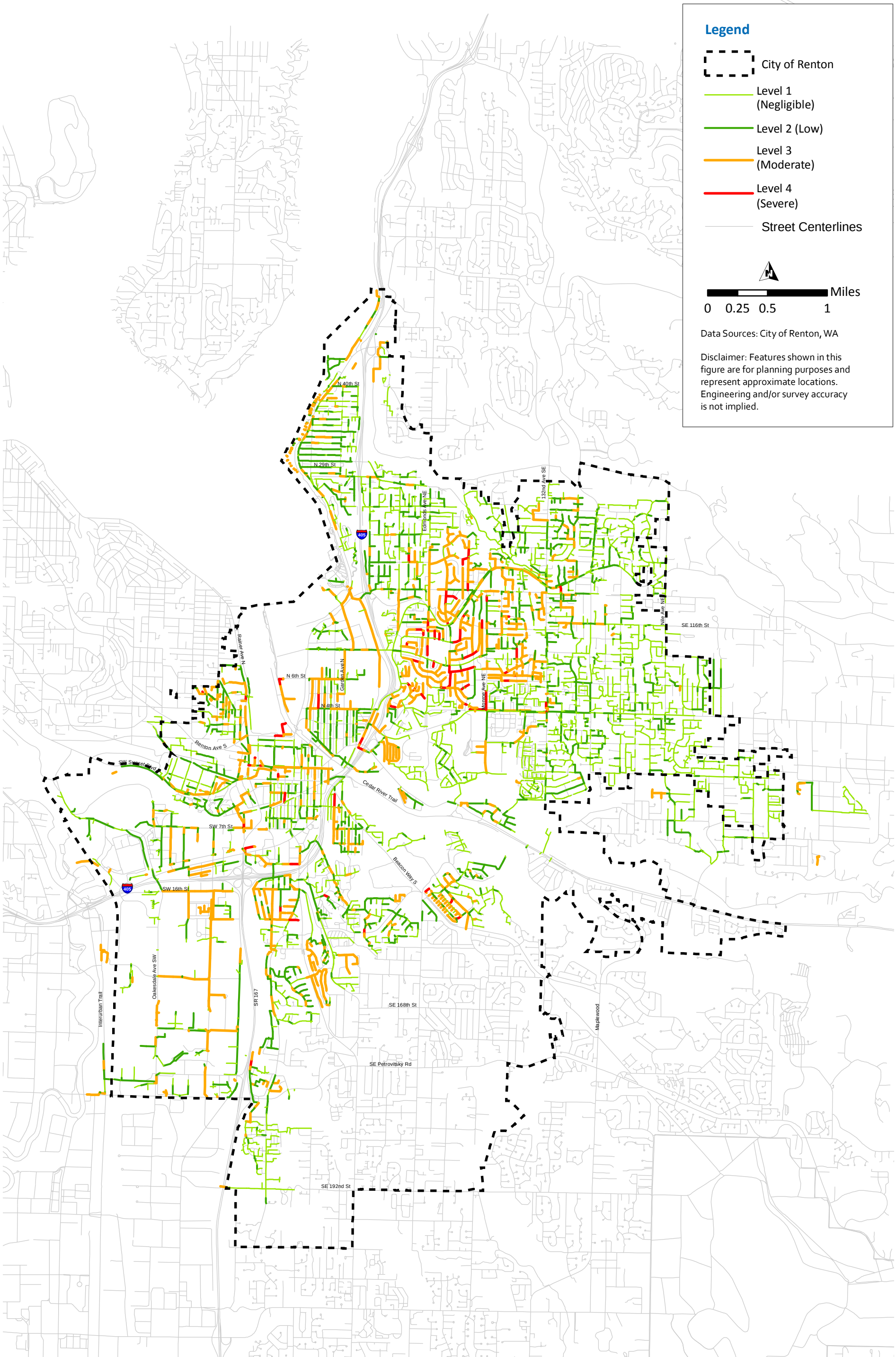

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Figure 6.3
Vulnerability Criteria Results

Table 6.11 Remaining Useful Life

Feet of Pipeline [1]				
Material	**>20 Years**	**<=20 Years and >10 Years**	**<=10 Years**	**Grand Total**
CAS	604	830	1,395	2,829
CP	265,992	49,683	55,824	371,499
DIP	58,591	0	186	58,777
Polyethylene	6,573	0	0	6,573
PSC	147	0	0	147
PVC	707,458	0	3,958	711,415
VCP	32,731	0	5,865	38,596
LN	16,653	265	0	16,918
XXX	7,716	36,485	50,236	94,438
Grand Total	**1,096,464**	**87,263**	**117,465**	**1,301,192**

Note:
(1) Feet of pipeline is specific to year installed per the City and not by decade.

Pipelines were assigned to one of four levels shown in Table 6.8 and Table 6.9. After discussing the breakdown of the three replacement ranges with the City, it was agreed that the assets with a RUL of less than, or equal to, 10 years could be split into two categories: between 5 and 10 years would be considered a "moderate" level, and assets that have less than 5 years of RUL would be labeled as "severe." The resulting RUL levels were:

- Level 1 (Negligible) greater than 20 years.
- Level 2 (Low) RUL between 11 years and 20 years.
- Level 3 (Moderate) RUL between 6 years and 10 years.
- Level 4 (Severe) RUL less than 5 years.

Table 6.12 shows the linear footage breakdown of these levels. Further detail on the RUL source data can be found in CCTV Phase 2 Project's TM 3 - Pipe Risk Approach and Procedures and RUL scores can be found in TM 4 - Risk Findings (Carollo 2017).

Figure 6.4 shows the map results of the RUL analysis, with the four levels color-coded similar to the previous figures. Please note that the Sunset Lane project was completed in 2019 and replaced and revised the layout of the pipe system around the new park, which is not reflected in the figure.

Table 6.12 Remaining Useful Life by Length

RUL Level	Length (ft)	Percent
1 (negligible)	1,102,619	84.7%
2 (low)	86,030	6.6%
3 (moderate)	3,707	0.3%
4 (severe)	108,877	8.4%

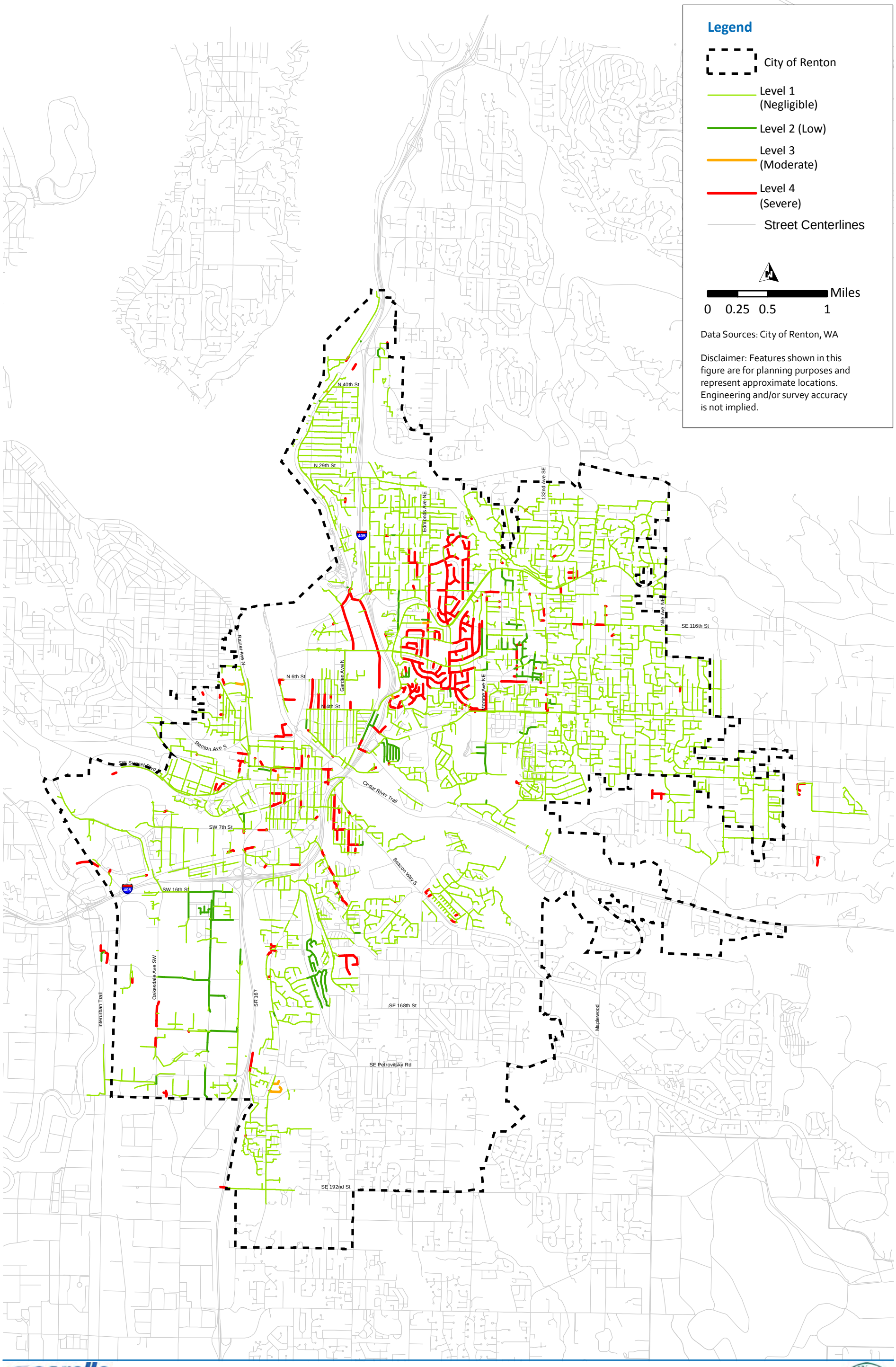

Figure 6.4
Remaining Useful Life of System

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6.6.4 Gravity Sewer Mains Risk Assessment

A risk-based prioritization was developed for their R&R projects. As discussed above, risk is calculated as the product of criticality and vulnerability. A risk ranking was developed for all gravity collection pipelines in the system during the study. This assessment is at a conceptual planning level and does not include survey, site inspections, or other detailed investigations.

Pipeline risk was determined by combining the vulnerability and criticality scores for each pipe segment. Those two scores were then combined into 16 different "criticality, vulnerability" combinations (for example: 1, 2; 2,3; or 4,4). Each combination was categorized with a risk ranking of low, moderately-low, moderately-high, and high, as shown in Table 6.1. Table 6.13 shows how the linear feet of pipe was categorized into the 16 combinations using the normalized risk rankings. Figure 6.5 shows the final result of the normalized risk ranking for the City's piping system.

Table 6.13 Risk Matrix for Length of Gravity Mains (feet)

Normalized Risk Ranking					
Vulnerability Level	4 (severe)	1,805	7,061	10,061	2,935
	3 (moderate)	44,840	63,075	103,884	44,551
	2 (low)	76,510	100,541	148,925	58,546
	1 (negligible)	210,622	180,371	186,199	61,306
		1 (negligible)	2 (low)	3 (moderate)	4 (severe)
		Criticality Level			

Table 6.14 uses the results from Table 6.13 and shows the total lengths for the four colored risk ratings.

Table 6.14 Pipe Length Totals Based on Risk Rating

Color	Total Length (ft)	% of Total Length
Low	467,504	36%
Moderately-Low	394,691	30%
Moderately-High	381,491	29%
High	57,548	4%

The following gravity main R&R is recommended based on the risk assessment:

- To confirm the condition of individual pipe's RUL, the City should continue to conduct ongoing monitoring through CCTV inspections and tracking of point repairs and other maintenance issues. For the most critical or vulnerable pipelines, more advanced condition assessment may be warranted.
- Approximately 57,500 lf of gravity mains are considered high risk and should be rehabilitated in the short- and medium-term planning horizon (10 year period). Individual capital projects will likely be warranted for long segments and large diameter

mains, while rehabilitation of smaller mains may be accomplished through annual R&R program funding.

- Approximately 381,500 LF of gravity sewers are considered moderately-high risk and should be monitored in the short-term and medium-term planning horizon (10 year period). Pipe segments in poor condition should be repaired, rehabilitated, or replaced through an annual R&R program.
- Remaining pipelines should be monitored in the medium-term planning horizon. Pipe segments in poor condition should be repaired, rehabilitated, or replaced through an annual R&R program.

6.7 Recommended R&R Program

The recommended improvements for the replacement and rehabilitation program are summarized below:

6.7.1 Force Mains

- It is recommended that the City conduct a CCTV inspection of FMs after FM cleanouts are installed as part of the Lift Station and FM Rehabilitation.
- It is recommended that the City monitor the condition of the stream banks adjacent to the Devil's Elbow lift station and evaluate alternatives to armor the banks to protect the lift station and FM.
- It is recommended the City continue regular maintenance and its active rehabilitation program for FMs.

6.7.2 Lift Stations

- The operation of lift stations with moderate and serve criticality should be monitored closely and maintenance activities conducted promptly.
- The Lake WA No. 2 Lift Station and Lake WA Flush Station, which both serve the Lake Line Sewer System, have a severe risk and should be addressed in the short-term.
- It is recommended that comprehensive R&R of Lift Stations and FMs be performed during the long-term planning horizon.

6.7.3 Gravity Sewer System

- To confirm the condition of individual pipe's RUL, the City should continue to conduct ongoing monitoring through CCTV inspections and tracking of point repairs and other maintenance issues. For the most critical or vulnerable pipelines, more advanced condition assessment may be warranted.
- Approximately 57,500 lf of gravity mains are considered high risk and should be rehabilitated in the short- and medium-term planning horizon (10 year period).
- Approximately 381,500 lf of gravity mains are considered moderately-high risk and should be monitored in the short-term and medium-term planning horizon (10 year period). Pipe segments in poor condition should be repaired, rehabilitated, or replaced through an annual R&R program.
- Remaining pipelines should be monitored in the medium-term planning horizon. Pipe segments in poor condition should be repaired, rehabilitated, replaced through an annual R&R program.

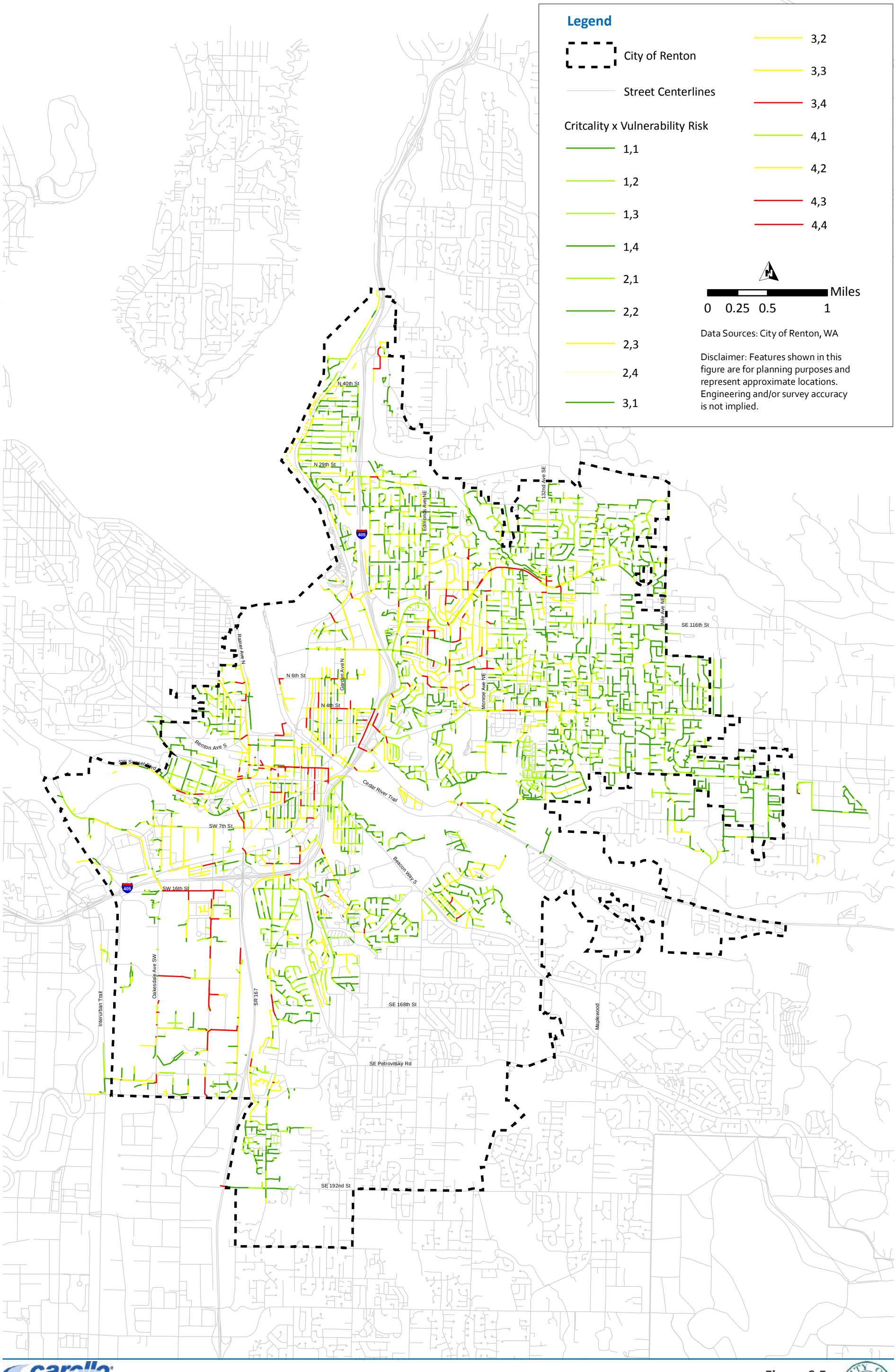

Figure 6.5
Map of Criticality x Vulnerability

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Chapter 7

OPERATIONS AND MAINTENANCE

7.1 Introduction

This operation and maintenance (O&M) chapter summarizes the City of Renton's (City) Wastewater Operations Master Plan (OMP), which was developed in 2012 as a living document. The OMP provides specific guidance on how to manage, maintain, and operate the system assets with greater stewardship and effectiveness. This O&M chapter has been supplemented and reorganized from the 2010 Long-Range Wastewater Management Plan (LRWWMP) for consistency with the OMP.

7.2 Operations and Maintenance Programs

The O&M programs presented in this chapter are consistent with the "Wastewater Collection Systems Management, Sixth Edition" by Water Environment Federation (WEF) Manual of Practice No. 7 and "Core Attributes of Effectively Managed Wastewater Collection Systems," June 2010 (Appendix A), developed by the American Public Works Association (APWA), American Society of Civil Engineers (ASCE), National Association of Clean Water Agencies (NACWA), and WEF. These sources provided a foundation of good engineering practices for O&M of sanitary sewer collection systems; providing guidance and direction.

Through development and implementation of a management program encompassing these practices, the City can provide efficient and effective collection system O&M while protecting public health and the environment. Where current City programs and practices are lacking, enhancements have been recommended. In most cases, these program deficiencies were identified in the OMP and are actively being developed by the City.

Based on the City's system and needs, O&M activities are divided into the following programs and practices:

1. System Inventory and Information Management.
2. Collection System Maintenance.
3. Lift Station Operations and maintenance.
4. Predictive Repair and Replacement (R&R) Program.
5. Overflow Emergency Response.
6. Fats, oil, and grease (FOG) Source Control.
7. System Infrastructure Capacity.
8. Design and Construction.
9. Legal Authority.
10. Safety, Training, and Certification.
11. Interagency Coordination.
12. Administration and Facility Maintenance.
13. Financial Program.

The categories were formulated to be integrated within the organizational structure of the City Public Works, which is presented in this chapter. Using this framework, a workforce estimate has been developed to evaluate the staffing levels needed to perform the City's O&M functions at a high level.

7.3 Organization

The City's O&M tasks are supported by the City's organization. The sewer utility operates under the direction of the Public Works Administrator, as shown in Figure 7.1. Wastewater services are provided under two divisions: Utility Systems and Maintenance Services. The Utility Systems Director and the Maintenance Services Director both report to the Public Works Administrator. The Surface/Waste Water Special Operations Services Manager reports to the Wastewater Manager who in turn reports to the Maintenance Services Director. The Wastewater Utility Engineering Manager reports to the Utility Systems Director.

The Surface/Waste Water Special Operations Services Manager and Wastewater Manager evenly divide their duties, overseeing the O&M of the sanitary sewer and storm water systems.

7.3.1 Wastewater Maintenance Services

The Wastewater Maintenance staff focuses on preventative maintenance and troubleshooting of the collection system. Maintenance staff works to prioritize and monitor issues to keep the system operating in optimal conditions. Maintenance work may involve electronic, mechanical, and other types of improvements to existing systems.

Currently, there are two Lift Station technicians and eight Maintenance Services workers responsible for the continued operation of the sanitary sewer system.

7.3.2 Wastewater Utility Services

The Wastewater Utility staff is responsible for the design and management of capital improvement program (CIP) projects, coordination of developer extensions of the sewer system, and long-range planning for the Utility. The Wastewater Utility Engineering Manager oversees the Wastewater Utility staff.

Currently, the Wastewater Utility staff consists of three engineering project managers, one grease/industrial waste specialist, and a geographic information system (GIS) specialist.

7.3.3 Communication

Efficient and economical functioning of a team requires adequate provision for regular, effective communication among its members. The normal channels of communication available to maintain effective coordination are:

1. Vehicular two-way radios.
2. Cellular Telephones.
3. Daily work assignment meetings..
4. Electronic records and GIS system inventory
5. Documentation in the Computerized Maintenance Management System (CMMS), supplemented through more detailed work logs and inspection reports.
6. Emergency phone numbers for "on-call" employees.
7. Direct, City-owned telephone connection to City Hall.
8. Weekly staff meetings.

As the complexity of the system increases and the service area expands, the need for trained, efficient staff to keep pace with public demand and advances in technology will become imperative. New employees need orientation and basic training; while more experienced employees can improve by continued training.

7.3.4 Divisional Coordination

The Wastewater Utility utilizes the services of other City departments, according to inter-departmental agreements, to augment the Wastewater Utility's expertise. The Finance and Information Services Department is responsible for customer billing, payment collection, project cost reporting, fund activity reporting, and basic computer needs. The Human Resource and Risk Management Departments are responsible for employee records, union labor negotiations, salary schedules, and risk management evaluation.

Within the Public Works Department, the Wastewater Utility utilizes the services of the Technical Services Section. Technical Services provides support to Wastewater through Mapping and Property Services. This includes computer-aided design (CAD) mapping, development of the City's GIS, surveys, and property management.

Within the Department of Community and Economic Development, the Wastewater Utility utilizes the services of the Development Services Division. Development Services provides plan review, permit issuance, and inspection for developer extensions. They also provide inspection service for the Utility's Capital Improvement Projects.

7.4 Wastewater Operations Master Plan

The OMP is summarized in this LRWWMP. There are two primary purposes of the OMP; 1) to document current procedures and programs into an O&M manual, review existing programs for effectiveness and compliance with potential future regulatory requirements; and 2) analyze and recommend program improvements in accordance with the City's long-term goals and objectives, and assist with the development of an improvement implementation strategy.

The master copy of this document is maintained by the Wastewater Utility Engineering Manager to be a living document. The Wastewater Utility Manager solicits updates, comments, and recommendations from wastewater operations team members, which after review by the wastewater operations management team are subsequently incorporated into the master document.

7.5 Systems Inventory and Information Management

In recent years the City has made substantial investment in improving its system inventory and information management.

7.5.1 Information Management System

Providing time for keeping and maintaining accurate records should be an integral consideration in determining the time to be allotted to any departmental task. Adequate records are an essential tool in utility management and operation, providing the supporting data for operations assessment and long-term planning, while saving time and reducing difficulty when trouble arises. The sewer utility has need for several types of records: facility operation, personnel, customer contact, inventory, and facility maintenance and repair. These and other appropriate

documents should be legible, concise, permanent, accurate and accessible. Their importance to the efficient functioning of the utility is critical.

There are many different information systems that are currently used in the management, and O&M of the City's wastewater system. These information systems and recommended improvements, as stated in the OMP, are shown in Table 7.1. Most of these information systems are managed outside of the City's Utility Systems Department and contain data for other non-wastewater related functions and groups.

Information management is a key component of operating an effective and efficient wastewater system. The City continues to work toward the vision of a seamless, integrated, information management system. The benefits of developing this seamless, integrated, information management vision are as follows:

- Improved budgeting, planning, and decision making for capital planning.
- More efficient use of O&M staff.
- Extended useful service life of assets.
- Reduced risk of asset failures including overflows, breaks, and permit violations.
- Better projections of asset lives and rehabilitation or replacement costs.
- Enhanced customer service through reduced emergencies and improved response times.

Since the 2010 LRWWMP, the City has integrated many information systems that have increased the efficiency of wastewater business processes. These changes to information systems are introduced gradually to allow City staff to learn and implement the benefits of the upgrades. Further upgrades, especially in terms of automated scheduling, are anticipated in the future as need arises.

GIS serves as a key user interface across multiple information systems and is used on a daily basis. Since the 2010 LRWWMP, the wastewater utility has hired a full time GIS specialist to assist with use of the information systems.

Table 7.1 Existing and Recommended Information System Improvements

Information System	Existing Software Vendor	Description	Recommended Improvement
CMMS	Cityworks	GIS based Computerized maintenance management system of sewer pipeline assets, sewer manhole assets, sewer lift station assets. Allows tracking of service requests, work orders, preventive maintenance, and work order costs. Operators use Cityworks to track their time.	
GIS	ESRI ArcGIS	Contains spatial data on sewer pipeline assets, sewer manhole assets, sewer lift station assets, lateral stubs, parcels, addresses, FOG locations, zoning, and ROW(7) easements.	

Information System	Existing Software Vendor	Description	Recommended Improvement
CCTV[1]	CUES Granite Net	Contains tabular and graphical data on sewer assets, inspections, condition, defects, and inspection photos and videos. The City is currently planning to upgrade to the latest version of CUES Granite Net with additional modules for GIS integration and NASSCO[5] PACP[6] standards.	
Hydraulic Model	DHI[2] MikeUrban	Contains tabular and spatial data on sewer pipeline assets, sewer manhole assets, sewer lift stations, modeled flows, pipeline capacities, contributing areas, and Infiltration and Inflow parameters.	
SCADA[9]	Wonderware	Contains real-time and historical tabular data on influent/effluent flows, pump run times, pump start times, and rain gauges.	Integrate with Water Utility.
FOG	XC2	Contains tabular data on cross connection and FOG locations, permits, and inspections.	Integrate with GIS.
Utility Billing / Customer Information System	SpringBrook	Contains tabular data on customers, wastewater billing history, and consumption records.	
Permits Management	EnerGov	Contains tabular data on permits, planning, business licenses, code compliance, side sewer connections, and permit inspections.	
Financial Information System	Tyler Technologies Eden	The City's financial and accounting system of record that contains all financial data including budgets, revenues, capital and operating expenses, and fixed assets.	
SDC[10]/SAD[8] Database		Contains tabular data on system development charges and special assessment district charges.	
KC[4] Assessors Database	Microsoft SQL Database	Database that contains tabular data on parcels, tax history, and property legal descriptions.	
Outside Data Sources	Data	Various outside data sources that including the KC flow monitoring and rainfall data, KC IMAP system, SeaTac Airport rainfall data, and Renton Airport rain gauge data.	
LaserFiche	None	This system is currently being implemented by the City and will contain scanned, electronic documents including record drawings, as-built drawings, and other relevant documents.	

Information System	Existing Software Vendor	Description	Recommended Improvement
ECM	None	This system is proposed to provide a centralized web site for capturing and linking to various data on projects, policies and procedures, drawings, and other electronic content. The existing hardcopy O&M policies and procedures could be scanned and populated into the ECM(3) for improved accessibility, ease of use, and linking to other information systems.	Implement with Microsoft SharePoint.
Renton Results	None	This system is the City's reporting tool for outcome management and financial performance measures. This system could be expanded to include many of the same functions as ECM above.	Implement with Microsoft SharePoint.

Note:
(1) CCTV - closed-circuit television.
(2) DHI - Danish Hydraulic Institute.
(3) ECM - Enterprise Change Management.
(4) KC – King County.
(5) NASSCO - National Association of Sewer Service Companies.
(6) PACP - Pipe Assessment Certification Program.
(7) ROW - right-of-way.
(8) SAD - Special Assessment District.
(9) SCADA – supervisory control and data acquisition.
(10) SDC - Standard Development Charge.

7.5.2 Business Process

In addition to recommended information systems, the OMP documents business processes and recommended improvements. Business processes reflect the ability to conduct O&M tasks by streamlining and enhancing how the tasks are currently completed. A review of business processes is recommended as part of the upcoming OMP update to incorporate the changes to information systems discussed in the previous section.

7.6 Collection System Maintenance

The City maintains more than 191 miles of gravity sewer throughout the system. The Wastewater Maintenance Services Crew's primary goal is to maintain sewer pipelines to minimize damage to property due to wastewater overflows. The collection system maintenance program includes both preventive and corrective maintenance. The preventative maintenance program includes: lift station inspection and maintenance, manhole inspection and maintenance, CCTV inspection, root cutting, grease removal, and hydraulic line cleaning. Corrective maintenance is that which improves the performance of existing equipment, facilities and infrastructure. The corrective maintenance program is mainly composed of repairing sewers and clearing plugs. Additionally, easement maintenance and minor road work is periodically required to access the collection system. The following section briefly describes each O&M program.

CCTV has undergone substantial changes since the last LRWWMP; therefore, it is presented in more detail below in Section 7.6.3. Additionally, side sewer maintenance is a major problem

within a sanitary sewer system. It is the City's policy that individual property owners are responsible for maintaining their side sewers. If a problem occurs, it is the property owner's responsibility to contact a private plumber to investigate and correct the problem. Therefore, no discussion of side sewers is provided below.

7.6.1 Maintenance Priorities

Wastewater Maintenance Services has developed a program to maintain the existing system. First level of priority is the inspection and maintenance of the portions of the system that are known to have problems if not handled on a weekly, monthly, quarterly, or annual basis. This includes the inspection and maintenance of lift stations, areas of known root problems, and areas of known grease problems.

The second level of priority is the routine inspection and maintenance that is required to identify any additional high priority maintenance issues and to identify potentially unexpected conditions that may cause problems for the customers. The second level of priority includes CCTV inspection of the system and hydraulic line cleaning. It is typically recommended by insurers involved with utility system management that, in order to minimize claims against the utility, the entire system should be inspected approximately every five years. Since line cleaning is performed prior to CCTV inspection, this means the system is cleaned on the same cycle as CCTV inspection.

7.6.2 Manhole Inspection and Maintenance

The City has identified problem areas in the collection system. The City's personnel inspect the sanitary sewer manholes in those areas on a weekly, monthly, or quarterly basis - determined by historical maintenance needs in the area - for the following situations:

1. A visual guarantee of proper sewage conveyance.
2. Assessment of the state of solids buildup in manhole wet wells.
3. Verification of the condition of the manhole lid/cover and support rings for wear and stability.
4. Visual affirmation of condition of sewer channels and ladder rings.

Corrective actions are taken to address any issues that are found during the inspections. The City inspects the remaining manholes/pipes in conjunction with the video inspection program. O&M staff perform the same inspections and any required maintenance on those manholes at that time. The City uses a line service truck for inspection and repair of manholes and lines. It carries parts used in sewer line repair and repairs to manholes are made as needed.

7.6.3 CCTV Inspection

Routine video inspection of the sanitary sewer system is an essential part of the maintenance responsibilities. The City uses the NASSCO PACP methodology to assess pipes during CCTV Inspection. Structural correction and obstructions are the primary cause of line failure in sanitary sewer pipes. Operational deficiencies, such as FOG build up, are also noted. Routine inspections of the lines are crucial to be aware of potential trouble spots. Sewage spill claims have proven to be a very costly type of litigation for municipalities to deal with and routing video inspection of the sewer system is the first line of defense.

The City has recently implemented a new CCTV inspection program that includes purchase and installation of the latest version of CUES Granite Net CCTV software, purchase of new CCTV trucks and cameras, and the development of a risk-based condition assessment program.

7.6.3.1 CCTV Inspection Equipment

Since the 2012 OMP, the City has invested in a CCTV truck, camera equipment, updates to the CUES Granite Net, and information technology (IT) to support the new equipment and software.

The City purchased a customized CCTV inspection truck that includes the following major equipment: hybrid freightliner step van with inverter, safe entry/exit bumper, transporter/camera lockable storage compartment, TV step van exterior lighting & viewing room, roof top air conditioner with heat strip, file cabinet under viewing room desktop, wall mounted storage cabinet mounted above desktop, and bench seat in viewing room. The inspection truck included a new solid state color sewer TV camera with pan, rotate, and zoom head. Additionally, the truck is equipped with a self-propelled lateral inspection / evaluation system.

7.6.3.2 CCTV Software

The CUES Granite Net program contains tabular and graphical data on sewer assets, inspections, conditions, defects and inspection photos and videos. The City's IT and software allow the sewer condition data, with associated photos and videos, to be collected via the Granite Net CCTV process and automatically transferred and/or linked to ArcGIS for spatial analysis and reporting. New and updated sewer pipeline and manhole asset data from ArcGIS is also automatically transferred to Granite Net, along with the latest GIS spatial data, in order to provide the latest information to the CCTV operations staff. The updated software also interfaces with modules for a variety of different users and specialized functions.

7.6.3.3 NASSCO Rating and Scoring

The City uses the NASSCO system of rating the collection system to maintain consistent and reliable data on condition. This includes standards of the PACP standard compatible mainline information (Main Assets, Main Inspections and Main Observations). CCTV operators are trained and well versed in NASSCO system coding. The City uses its own inspection methodology for manholes and laterals that is focused on identifying assets for rehabilitation.

7.6.3.4 CCTV Driven Improvements

City operators make point repairs to critical pipe defects identified through the CCTV Inspection. Repairs are made following the CCTV Inspection; depending on availability of necessary operators, equipment, and customer notifications.

The City pursues preventative maintenance through its annual Pipe Replacement and Rehabilitation program. The Program bids out a large replace or rehabilitate aging pipes project each year to address aging infrastructure, typically in the same general area (rather than spread out over the entire system). To assist with identifying areas, the City has developed a decision support tool to help determine areas of pipes and structures to rehabilitate or replace based on historical CCTV Inspection scoring.

7.6.4 Root Cutting

Routine sewer facility inspection commonly identifies root intrusion within both private and public sewer mains. If the problem is within the City ROW, the City will correct the problem and remove the root.

A hydraulic root cutter is used to routinely remove roots that accumulate within sewer lines creating flow restrictions and blockages. Numerous lines throughout the City have been examined and discovered to have had a history of problems created by roots. These particular lines require root removal more frequently to ensure there is no interruption of flow.

7.6.5 Grease Removal

Grease problems are typically associated with major food processing operations, the majority of which involves restaurants where grease is released into the conveyance system. Many of the older restaurants within the City do not have grease removal systems while newer restaurants have been and will continue to be required to install grease removal systems. Despite the implementation of grease removal systems, many are not properly maintained. Grease buildup problems occur most often in the side sewers; however, some grease buildup problems also occur in the sanitary sewer collection system. When problems do occur, the City maintenance crews are usually called out to investigate. A proper monitoring program reduces maintenance time involved in removing grease buildup.

The City has achieved moderate success in noting problems and identifying the sources. The Wastewater Utility has also worked with new construction and implemented tenant improvements to ensure that these users are installing proper grease removal systems and/or bio-agent facilities. The City has a grease removal program for standard food-services establishments and multi-family housing to improve grease collection at these locations.

7.6.6 Hydraulic Line Cleaning

Jetting a sanitary sewer pipe is the principal means of cleaning the line portion of the sewer of sludge, debris, or obstruction. Hydraulic Line Cleaning is a common means of addressing acute and preventative maintenance concerns, as well as performed prior to CCTV Inspection. The sewer lines are cleaned with a vacuum-high velocity cleaning/jetting truck which performs two primary functions: vacuuming and jetting. A hose with a special end fitting is inserted into a pipe and high-pressure water (up to 2,500 pounds per square inch) is sent through the hose. The high-pressure water exits the small hole at the tip of the cone fitting, breaking down the sludge and obstructions. The hose is propelled down the length of the pipe via the numerous other holes found in the end fitting. The hose is inserted through a manhole into the pipe and the line is jetted to the next manhole. The hose is then retracted via a motor driven reel system back to the entry manhole. All of the sludge/debris is scoured toward the entry manhole because the spraying water forces it in that direction and is vacuumed out as required.

There are a number of lines in the City that have inconsistent grades, creating septic conditions within the lines. A part of the maintenance program is to use the Vac-Con to flush water through these particular lines periodically to prevent those conditions from occurring until the inverted slope can be reconfigured. The Vac-Con is the primary equipment used for emergency blockages in the lines and is used to assist TV inspection.

7.6.7 Repair Sewers and Clear Plugs

When problems with the sewers are identified through the preventative maintenance program described above, repairs are made to the infrastructure or clogs are removed. The preventative maintenance program is efficient and typically represents only one percent of the maintenance manhour allotment.

7.6.8 Easements and Access Road Maintenance

In addition to public roads, the City operates, maintains, repairs and constructs sewer mains, and lines in, over, along, and under roads and easements located within the sewer service area. As the utility performs work within the easements, minor roadwork and improvements are necessary. All work done within the easements is done in accordance to any permits and City and KC standards. Note, the Street and Surface Water Maintenance crews conduct maintenance for the Wastewater Utility along road right of ways and other areas where work efforts overlap.

7.7 Lift Station Operations and Maintenance

The City maintains 20 lift stations throughout the system. The pump crew's primary goal is to maintain stations to minimize damage to property due to wastewater overflows. The Wastewater has two operators dedicated to lift station maintenance that includes daily inspections and regular preventative maintenance. The City maintains an O&M Manual for each lift station. It is recommended the City review and update, as necessary, these manuals and associated Standard Operating Procedures (SOPs) during the next OMP update.

7.7.1 Lift Station Inspection and Maintenance

Lift station inspection and maintenance involves weekly, monthly, and annual tasks which align with preventative and corrective maintenance procedures. The following describes the inspection and maintenance program for the sewage lift stations and wet well facilities:

7.7.1.1 Sewage Lift Stations

The City has on-call staff 24-hours per day. They also perform a daily inspection of the telemetry at each station.

Every week the City performs an inspection of each lift station. This weekly inspection includes a security check, recording pump motor hours, checking motor noise, temperature, and vibration.

The City changes all filters, cleans electrodes, exercises all valves, and runs each emergency generator on a monthly basis.

On an annual basis, the City checks the pump bearings and seals, tests the entire electrical system at each station, and performs an infrared test of the system.

7.7.1.2 Wet Well Facilities

On a weekly basis, the City checks the security, float settings, and operation of each wet well.

The City washes down, checks the interior condition, ladders, hatches, etc. in each wet well.

The City performs a pump down of each wet well once a year. They take this time to clean the wet well.

The lift station crew uses a vehicle equipped with a crane to lift pumps, equipment, utility compartments for parts, tools, etc. for the lift station maintenance program.

7.7.2 Telemetry (SCADA)

Successful operation of any municipal sewer system requires that the municipality maintains a comprehensive maintenance program and that they obtain accurate sewage flow rate information. A telemetry and control system is the means by which flow rates are measured and maintenance needs are updated.

The SCADA system collects data from the City's lift stations which is then continually stored on servers at the shops. The SCADA information is only used when someone makes a query which is usually related to lift station evaluation. Data compiled by SCADA includes inflow, outflow, pump run times, and pump starts. The civil engineers have access to the SCADA and control subconsultant (RH2 Engineering), which helps the City maintain the system. The current system occasionally experiences communication failures and other issues that cause data errors. The City has planned SCADA systems, in collaboration with the Water Utility, which is anticipated resolve communication failures and provide additional monitoring and analysis features.

The master telemetry unit, located at the City Shop, includes an intelligent telephone dialer alarm system, so that critical alarms can be relayed to on-duty maintenance personnel even during a telemetry system failure.

7.8 Predictive Repair and Replacement Program

The City is currently expanding its Asset Management Program, which is described in more detail in Chapter 6 – Replacement & Rehabilitation Program. The City's asset management program prioritized asset renewal schedule and costs and is closely tied to O&M activities.

7.9 Emergency Response

The City's Overflow Emergency Response Plan (OERP) provides measures to protect public health and the environment in the event of a sanitary sewer overflow (SSO). Historically, overflows have not been related to lack of capacity of the system. There has been one overflow in the past 10 years. This occurred on August 9, 2021 at 505 Rainier Ave N between MH0619 and MH0615 and was related to FOG. FOG O&M is described in Section 7.10 below. The City may also develop project specific emergency response plans, as required.

In addition to OERP, the Wastewater Utility participates in the City's Comprehensive Emergency Response Plan and the broader Regional Hazard Mitigation Plan. In the case of these wider emergencies, the Wastewater Utility follows the direction of the Emergency Operation Center or other responsible official.

7.10 FOG Source Control

Maintenance issues such as blockages and overflows can be caused or increased by FOG that is discharged into the system. Controlling discharge into the collection system can assist in enhancing and improving the collection system performance.

FOG buildup problems occur most often in the side sewers. However, some FOG buildup problems also occur in the sanitary sewer collection system. When problems do occur, the City maintenance crews are usually called out to investigate. A proper monitoring program reduces maintenance time involved in removing grease buildup. Additionally, the City has worked with new construction and tenant improvements to ensure that these users are installing proper grease removal systems and/or bio-agent facilities.

Property owners may need to inspect or maintain their grease traps on a weekly basis depending on how much FOG enters the drains. The City recommends property owners inspect to clean grease interceptors at least twice a year. Establishments suspected of causing problems to the collection system may be inspected by the City. Depending on how full the grease trap is the City will rate the condition to be good, fair, or poor. Traps in fair condition are advised to monitor the buildup and maintenance schedule and increase frequency as necessary. If the trap is in poor condition, the establishment is issued a compliance order and will need to clean the trap immediately. After cleaning, the establishment is required to contact the City within 30 days to verify the grease has been properly cleaned.

The OMP identified multiple items for future effort with regard to the FOG program, including identifying regulatory requirements, summarizing the FOG Control Plan and training, identifying performance measures, and conducting a program evaluation.

7.11 System Infrastructure Capacity

The City has developed several tools and activities for determining system capacity such as hydraulic models, flow monitoring, and field investigation. The key elements of the program are to identify existing areas of the system with capacity deficiencies and to confirm the available hydraulic capacity for development. The City's hydraulic computer model is the main tool used for this identification. The purpose of this model is 1) to evaluate the existing sanitary sewer system and determine areas of capacity constraint, and 2) to provide a tool for planning future improvements.

The analysis of the hydraulic capacity of the system is presented in Chapter 5 – System Analysis and Results. The analysis includes evaluation of the City's facilities for system capacity to address both system deficiencies and potential development within the City's sewer service area. The CIP for capacity projects is developed from the LRWWMP and is maintained and updated annually by Wastewater Utility Director.

7.12 Design and Construction

Utility Systems lead the City's program to ensure proper design, construction, and inspection as necessary to enable the collection system projects. Design involves converting the projects identified in the planning process to paper to provide a set of documents (plans and specifications) that will be used to construct the facilities. Construction involves building the actual facilities that are planned and designed. Inspection helps resolve issues that arise during construction and confirms that the facilities are constructed as planned and designed.

7.12.1 Design

Most designs are completed in house by the Utility Systems Project Managers. Projects may be contracted out if the Utility Systems department is too overloaded, the project involves a lift station, or it involves significant environmental issues. Design projects are selected based on this Plan and follow the Washington State Department of Ecology (Ecology) Standards, the Orange Book, Washington State Department of Transportation (WSDOT) Standards, and the City's adopted supplements and amendments. The pump station design standards are not documented, but institutional design standards exist. The City has recently updated its standard details and specifications, which are provided in Appendix J, Standard Details and Specifications. This update, in part, coordinated the standard details between the City's Development Services and its Utilities.

All designs involve appropriate City staff, including Construction Inspectors, lift station technicians, Maintenance Services, and Development Services.

7.12.2 Construction

The construction contractor is typically determined by competitive bidding; however, other forms of selection such as emergency direct award or sole source are sometimes applied. The project must be constructed as designed using the materials and procedures specified. The City must approve any significant changes, and these changes should be documented.

7.12.3 Inspection

Utility Systems does not select the inspectors for construction observation. All inspections are coordinated by the Development Services Department. Utility Systems allows the inspector assigned to the project to dictate the level of involvement that the Utility Systems has during construction.

The inspector's main goal is to ensure that the project is constructed as designed and specified. The inspection for a collection system project verifies that the pipe and appurtenances have been installed correctly for line and grade and with the proper materials. The inspector witnesses tests of installed pipe. Construction administration, including Requests for Information (RFIs) and submittals, is typically lead by Wastewater Utility Engineers.

The City requires CCTV of new sewer lines to be completed after construction. Currently this CCTV information is not used to establish a baseline for subsequent inspections.

7.13 Legal Authority

The City's collection system is municipally owned, operated and maintained. It is managed by the City's Public Works Department. The customer is responsible for the maintenance and condition of the laterals from the point of connection back to the property. The City has the authority to operate, maintain, and administer a wastewater system through ordinances, service agreements, or other legally binding procedures. Additional information on the City's legal authority, policies, and standards can be found in Chapter 3 – Operational Policies and Criteria.

7.14 Safety, Training, and Certification

Training opportunities are of such high priority to effective operation of the system that the City has linked them to its overall personnel evaluation program. Employees are evaluated and promoted through a set of job categories with pay commensurate to the category. It is essential that the promotional program continue to be closely linked with the training program, not only because it promotes efficient operation, but also because mandatory certification of wastewater utility workers is required by the state. The State Department of Health stipulates qualifications and training requirements for obtaining and maintaining certification.

7.15 Interagency Coordination

Communication and outreach with customers, constituents, and other stakeholders is critical to effectively manage a wastewater collection system. To be effective, communications must be ongoing, open, timely, and two-way with reciprocal information sharing. Key stakeholders for collection system operators include policymakers, customers, local residents and businesses, regulatory agencies, local health officials, environmental organizations, community and business groups, neighboring agencies and systems, and employees. Effective communications with each

of these groups will require different techniques that are tailored to specific interests, perspectives, and each situation. Additional information on interagency communication can be found in Chapter 1 – Introduction and Chapter 3 – Operational Policies and Criteria.

7.16 Financial Program

The City's primary objective is to maintain an adequate revenue stream and implement effective accounting practices to support the effective management of the system. This is accomplished through financial programs such as the biennial budget process with mid-bi correction as needed, the development of the CIP and Rehabilitation and Replacement Program. Additional information on the financial program can be found in Chapter 8 – Capital Improvement Program.

The financial program is conducted in cooperation with the Administrative Services Division based on input from Wastewater Utility staff.

7.17 Administrative Duties and Facility/Equipment Maintenance

Administrative duties as well as facility and equipment maintenance are crucial components to the success of the Wastewater Utility. Administrative tasks are broad-sweeping and require multiple skillsets of staff to complete. Additionally, the OMP maintains all new equipment and facilities maintenances procedures.

7.17.1 Administrative Duties

The key administrative duty of the City's O&M staff is to establish routine operation duties and schedules. Routine operations involve the analysis, formulation, and implementation of procedures to ensure that the sanitary sewer facilities are functioning efficiently. The utility's maintenance procedures work well. Repairs are made promptly so customers do not experience unnecessary inconvenience.

7.17.2 Tools and Equipment

Sewer O&M staff is equipped primarily with City-owned equipment. The equipment available for daily use includes rolling stock, shop tools and incidental equipment, as well as other portable equipment for field use. City Operators are responsible for cleaning, maintenance, and repair on all non-rolling stock tools equipment. The rolling stock - specialized vehicles, such as Vacuum Trucks and the CCTV Inspection Truck, and trucks/vehicles - repaired and maintained by the Fleet Maintenance Section.

For Fleet Maintenance, the Wastewater Utility works with Fleet Services for procurement of parts and to maintain a standard of service for each vehicle. IT has become an important tool for O&M, including GIS based CMMS and asset inventory. As previously described, the IT department maintains all information technology with assistance from Wastewater Utility Staff (as necessary), including specialized software, database servers, etc.

7.18 Work Force Estimates

The wastewater utility is staffed by both Maintenance Services and Utility Systems teams. The primary roles of each team, summary of programs, and estimated staffing levels have been summarized in preceding sections.

7.18.1 Future Resource Recommendations

The LRWWMP evaluations have identified recommended projects and programs that will require additional future resources. Resources that are responsible for the City's wastewater operations are currently divided across multiple department and divisions. These resources include the following positions and area of responsibilities:

- Information and IT Support - Wastewater operations-related support functions that are currently provided include approximately 0.1 full-time equivalent (FTE).
- Electronic Document Management System (EDMS)/ECM Support - It is recommended the City provide 0.25 FTE of resources to support increased use of LaserFiche EDMS and future ECM efforts (SharePoint).
- Hydraulic Model Support - It is recommended the City provide 0.25 FTE of resources to support improved integration of the MikeUrban hydraulic model with GIS and SCADA.
- Outside Support- Outside consultants and contractors currently provide support for the MikeUrban hydraulic model and Wonderware SCADA system. These resources are required on an interim basis when there are major upgrades to infrastructure, such as lift stations, that require changes to SCADA, and when master plan updates are completed that include changes to the hydraulic model.

7.18.2 Emergency Operations

Emergency operations are the unplanned and unscheduled tasks needed to keep the system in operation. The primary objectives of these procedures are to ensure public safety, restore essential services as quickly as possible, and to provide assistance to other areas as required. This would include responding to sewer blockages, pipes broken by construction, and damage to the system by acts of nature. All of the O&M staff are also available to aid any of the other sections with additional manpower or equipment.

The Wastewater O&M staff has the responsibility to keep the system operating when there are power or mechanical failures at lift stations. The City's telemetry system allows for 24-hour remote monitoring and access to the system by the crew. With this access, they can be alerted to a problem and correct it remotely, determine that it can wait until the next shift, or mobilize the necessary manpower and equipment. The City follows all Ecology guidelines for emergency notification procedures. The City's emergency response plan is focused on SSO notifications and is summarized in Section 7.9 above.

7.18.3 Maintenance Services Staffing

Currently, there are eight FTE, including supervisory personnel and maintenance workers, who operate and maintain the wastewater system. The tasks that are performed by wastewater utility staff include inspection, testing, installation and repair of system facilities and preventive maintenance, corrective maintenance, record keeping, administrative tasks, training, and response to emergencies.

The estimated FTE hours of work required to adequately maintain the sanitary sewer system are shown in Table 7.2. For maintenance activities, the annual FTE hours total seven. The FTE hours of work required for operational tasks for the sanitary sewer system are shown in Table 7.3. For operational tasks, the annual FTE hours total two. For adequate maintenance of the sanitary sewer system, the City would need a total of approximately 17,081 hours (the sum of O&M tasks)

worked per year. The City spends approximately 14,350 hours per year on O&M. This is approximately 2,731 hours short of the hours estimated for O&M of the sanitary sewer system.

The size of the maintenance crew should be increased to carry the full workload of the Utility without neglecting preventive maintenance, emergency preparedness, record keeping, or safety precautions. Further staff increases should be tied to the actual growth of the sewer system. An expansion of the system requiring new service connections and/or additional facilities, without enlargement of the staff, will result in diminished levels of service for all maintenance programs. In view of predicted population growth in the service area over the next several years and the growing demand for sanitary sewer service, an increase in the size of the sewer system could be projected to continue at a similar rate of growth. With that increase in demand, there may be a need for additional staff.

As shown in Table 7.2, the City would like to add an additional two operators to increase their maintenance activity FTE from 7 to 9. These operators would assist in doubling the amount of CCTV inspection, which then increases the need for root cutting, grease removal, and hydraulic line cleaning. Manhole inspections, sewer repairs, and unscheduled maintenance would not increase and would only be performed as needed. The City plans to use the CIP to repair non-point source sewer in a cost effective matter.

The City also plans to increase staff time from 2 FTE to 2.5 FTE as shown in Table 7.3. By doubling administrative duties, the City may have a separate full-time wastewater manager and surface water manager.

Maintenance and technical staff additions may be accompanied by additions to the clerical, secretarial, and other support staff needed to ensure that record keeping, billing, public relations, communications, and other general functions of support staff are performed with the accuracy and timeliness required.

Table 7.2 Staffing Time for Maintenance Activities

Preventative Maintenance	Frequency of Maintenance	Desired Time per Year (FTE)	Existing Time per Year (FTE)
Collection System Maintenance			
Manhole inspection, repair and maintenance	As needed	0.5	0.5
CCTV inspection	Continuous	2	1
Root cutting/grease removal	Continuous	1.5	1
Hydraulic line cleaning	Continuous	1.5	1
Repair sewers	As needed	0.5	0.5
Unscheduled maintenance	As needed	1	1
Lift Station O&M			
Lift station inspection	Twice per weekly	1	1
Lift station cleaning and maintenance	Monthly (cleaning), Annually (maintenance)	1	1
Total for Maintenance Activities		**9**	**7**

Table 7.3 Staffing Time for Operations Tasks

Operations Tasks	Task Frequency	Desired Time per Year (FTE)	Existing Time per Year (FTE)
Administrative duties	Daily	1	0.5
Asset Management	Annually	0.5	0.5
Tool and equipment cleaning	Once per week	0.25	0.25
Staff meetings and Cleanup	Daily	0.25	0.25
Training and conferences	Annually	0.25	0.25
	Total for Operations	**2.5**	**2**

7.18.4 Wastewater Utility Engineering Staff

The City is not looking to increase their staff as number of capital projects are not anticipated to increase in the next six years. They don't work on their own, but in coordination with "development" which is found on the organization chart.

The current engineering staff organization is described in Section 7.3 of this Chapter. The engineering staff is responsible for two major tasks, administrative and capital improvement projects.

The various tasks and the hours of work are described in relevant sections within the Chapter, as summarized in Table 7.4. The number of hours required for each task is not easily defined.

Additional administrative tasks that are recommended in this LRWWMP are 1) prepare new ordinances and revise existing ordinances, 2) setup and administer grease trap management and certification ordinance, 3) inventory and update hydraulic computer model, and 4) perform computer analyses using the sewer system hydraulic model. These tasks will require additional City staff or other resource staffing alternatives.

Table 7.4 Wastewater Utility Engineering Staff Activities

Tasks/Projects
Administrative Tasks
Latecomer's Agreement Administration
LRWWMP Review Support
Comprehensive Sewer Plan Update
Customer Service Support
Support to Other Divisions/Departments/Agencies
FOG / Industrial Waste Program
Engineering Tasks
Asset Management
System Infrastructure Capacity
Design and Construction
Major Capital Improvement Projects

7.19 Recommendations

The O&M staff requested purchasing equipment and tools for the department's crews, which are currently shared with other City agencies. Additionally, acquisition of equipment for collection system maintenance including a 10-yard dump truck, excavator/backhoe and trailer, shoring, trench box, and a service truck was requested.

Chapter 8

CAPITAL IMPROVEMENT PROGRAM

8.1 Introduction

This chapter summarizes the Capital Improvement Program (CIP) for the City of Renton's (City) Long-Range Wastewater Management Plan (LRWWMP). The purpose of this chapter is to describe the CIP projects and programs including pipeline, lift station, and general facility types. The CIP consists of the cost estimates and schedules for the recommended improvements. This CIP was developed in 2019. Therefore, there are projects planned for 2020 outlined in this CIP that will have passed before the adoption of this Plan in 2022.

The following sections present cost estimating assumptions, the recommended projects, estimated costs of each individual project, and a summary of the CIP.

8.2 Cost Estimating Assumptions

The cost estimates presented in this CIP are opinions developed from bid tabulations, cost curves, information obtained from previous studies, and Carollo Engineers, Inc.'s experience on other projects. The cost estimates have been prepared for the general master planning purposes. Capital costs, or "total project costs," are presented in the CIP.

All costs are in 2019 dollars and were developed using a Class 5 budget estimate, as established by the American Associate of Cost Estimators (AACE). The Engineering News Report (ENR) Construction Cost Index for a 20-city average for July 2019 is 11293. This level of estimate is used for master planning and assumes a 0 percent to 2 percent level or project definition. The expected accuracy range is minus 30 percent to plus 50 percent.

8.2.1 Baseline Cost Assumptions

This is the total estimated construction cost, in dollars, of the proposed improvement for pipelines and lift stations. All cost estimates provided in this CIP represent total project cost including materials, construction, engineering, legal, and administrative costs. Costs were represented as unit costs, as described in subsequent sections.

8.2.1.1 Gravity Sewer Unit Costs

For pipes, Baseline Construction Costs are calculated by multiplying the estimated new pipe length by a proposed unit cost. These improvements involve a series of assumptions to develop a cost per linear foot (lf). All of the known pipelines involved in this CIP are between 6 inches and 24 inches.

The gravity sewer unit costs provided are for typical open-cut installation with stable soil at an average depth of 15 feet. Costs include manhole installation at every 300 foot interval, excavation, hauling, soldier piles, wood lagging shoring, pipe materials and installation, backfill material and installation, and pavement replacement for a two lane width roadway. Costs do not include erosion and sediment control, individual side sewers, traffic control, or other general conditions. Open-cut costs listed by pipeline diameter are available in Table 8.1.

Table 8.1 Open-Cut Costs by Pipeline Diameter

Pipeline Diameter	Construction Cost per LF
6″	$330
8″	$341
10″	$352
12″	$363
14″	$374
16″	$385
18″	$396
24″	$407

Gravity sewer rehabilitation for typical right-of-way pipelines can be completed through cost-effective cured-in-place pipe (CIPP) which varies in construction cost per linear foot. CIPP estimates are shown in Table 8.2. CIPP costs include pre-inspection, installation, lateral reinstatement, post-inspection closed-circuit television (CCTV), traffic control, and bypass pumping. Traffic control is assumed for a collector street.

Table 8.2 CIPP Costs by Pipeline Diameter

Pipeline Diameter	Construction Cost per LF
6″	$52.80
8″	$70.40
10″	$88.00
12″	$105.60
14″	$123.20
16″	$140.80
18″	$158.40
21″	$184.80
24″	$211.20

8.2.1.2 Force Main Rehabilitation/Replacement Costs

Recent force main (FM) rehabilitation and replacement costs were obtained from the City's current Wastewater Utility Capital Improvement Program. An average cost per FM rehabilitation was used for future cost estimating by using the total amount spent to-date by the City of $2.28 million (M) for all 19 FMs. This determined the rehabilitation/replacement cost of $120,000 per FM.

FM assessment includes the same criteria as lift station assessment which may include one or more of the following: addition of flow meters, engine generator installation, noise abatement, slope stabilization, FM cleanouts, FM maintenance evaluation, FM replacement, manhole or vault improvements, and environmental/agency elements.

8.2.1.3 Lift Station Unit Costs

Recent lift station rehabilitation projects completed by the City were compiled to create the lift station rehabilitation cost. This cost was used to estimate lift station repair and upgrade projects in the City's CIP. As detailed in the 2019 Wastewater Utility Capital Investment Program, all

previous 20 lift stations were replaced, rehabilitated, or eliminated within the 25-year span. The total amount spent on rehabilitation of all lift stations to-date by the City is $2.8 M. This determined the rehabilitation cost of $140,000 per low to moderately-low lift station. A similar cost will be derived by the City for high to moderately-high lift station rehabilitation.

The assessment for rehabilitation of lift stations may include one or more of the following: pump replacement, motor control replacement, telemetry improvements, addition of flow meters, engine generator installation, noise abatement, slope stabilization, structural adjustments to the wet well, assessment of coatings, wet well recoating, temp wet well system, FM cleanouts, FM maintenance evaluation, FM replacement, manhole or vault improvements, structural engine generator pad changes, structural control room changes, miscellaneous structural improvements such as telemetry, and environmental/agency elements.

8.2.2 Total Capital Improvement Cost

The costs presented in this LRWWMP are high-level planning costs to help the City in making financial decisions. A planning contingency cost will be added to the Total Allied Project Cost to account for unforeseen events and unexpected conditions through the design process of these projects.

As shown in the following sample calculation of the capital improvement cost, the total cost of all project contingencies (construction and planning) and allied costs (engineering services, construction management, and project administration) is 82 percent of the baseline construction cost.

Example:

Baseline Construction Cost	**$1,000,000**
City Administrative (10%)	$100,000
Design (20%)	$200,000
Construction (10%)	$100,000
Admin, Design, & Construction	**$1,400,000**
Scope Contingency (30%)	$420,000
Total Capital Improvement Cost	**$1,820,000**

8.3 Capital Improvement Program

As discussed in Chapter 5 – System Analysis and Results and Chapter 6 – Replacement and Rehabilitation Program, the CIPs are prioritized based on their urgency and risk to mitigate deficient systems. The timing for implementing these improvement projects is based on the affordability and urgency of the project. It is recommended that the City monitor growth and adjust project implementation accordingly.

8.3.1 Planning Periods

The following terms are used to define timing and prioritization into three planning periods:

- **Short-term (2020 - 2025).** Proposed facilities determined to be a high priority.
- **Medium-term (2026 - 2029).** Proposed facilities determined to be a medium priority or proposed facilities to service major growth areas to be developed in the medium-term.
- **Long-term (2030 - 2039).** Proposed facilities determined to be a low priority or proposed facilities to service major growth areas to be developed in the long-term.

8.3.2 Project and Program Naming

The CIP projects were named based on the facility type.

8.3.3 Project Types

In the current Wastewater Utility Capital Investment Program, projects are categorized by type. These types include the following:

- "M"= Maintenance.
- "P" = Planning.
- "C" = Cross Category.
- "D" = Development.
- "R" = Regulatory.
- "A" = Acquisition.

Maintenance projects are focused on renewing infrastructure in poor condition, as recommended and prioritized in Chapter 6 – Replacement and Rehabilitation Program. Planning projects focus on allocating miscellaneous/emergency funds or including funds for long-term or operational planning. Development projects are designated based upon projected growth and flow volume; no development projects were identified in this CIP. Similarly, no CIP projects are listed under the acquisition or regulatory categories.

8.3.4 Capital Improvement Program by Year

An individual Project Sheet was generated for each CIP project and includes project identifiers, description, costs, project type, and comments to aid in future implementation. A location map is included for projects that are located in a specific area. To aid in finding individual projects, Project Sheets have been separated in sections by facility type:

- "LS" = Lift Station.
- "P" = Pipeline.
- "G" = General.

Lift Station projects addresses the City's 20 traditional lift station / FM and the unique Kennydale Lake Line System. Pipeline Projects address capacity and rehabilitation and replacement of the gravity sewer system. General Sewer project support the capital projects through long-term and operational planning, as well as various smaller miscellaneous projects.

A summary of all CIP projects by facility type and project type is shown in Table 8.4. A summary of costs by project category and type is presented at the end of the chapter.

Table 8.3 Capital Improvement Program Summary

Capital Improvement Program Summary (Current Dollars)															
Project		Total CIP Cost Estimate	CIP Phasing (Current Dollars)										Short-term	Medium-term	Long-term
Enter Cost Type Here: Current Dollars			2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	(2020-2025)	(2026-2029)	(2030-2039)
Pump Stations		$20,160,000	$3,000,000	$180,000	$0	$300,000	$0	$0	$650,000	$640,000	$640,000	$640,000	$3,480,000	$2,570,000	$14,110,000
LS-01	Lift Station Rehabilitation	$900,000	$900,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$900,000	$0	$0
LS-02	Forcemain Rehabilitation/Replacement	$400,000	$400,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$400,000	$0	$0
LS-03	Telemetry Upgrade	$300,000	$0	$0	$0	$300,000	$0	$0	$0	$0	$0	$0	$300,000	$0	$0
LS-04	Devil's Elbow Stream Bank Study	$180,000	$0	$180,000	$0	$0	$0	$0	$0	$0	$0	$0	$180,000	$0	$0
LS-05	Kennydale Lakeline Sewer Upgrade	$1,700,000	$1,700,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,700,000	$0	$0
LS-06	Kennydale Lakeline Renewal	$8,000,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$8,000,000
LS-07	Low and Moderately-Low Risk Lift Station and FM Rehabilitation	$6,110,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$6,110,000
LS-08	Moderately-High and High Risk Lift Station and FM Rehabilitation	$2,570,000	$0	$0	$0	$0	$0	$0	$650,000	$640,000	$640,000	$640,000	$0	$2,570,000	$0
Pipelines		$71,510,000	$1,500,000	$3,450,000	$4,830,000	$3,780,000	$3,720,000	$3,810,000	$3,810,000	$3,540,000	$3,540,000	$3,540,000	$21,090,000	$14,430,000	$35,990,000
P-01	2020 Sanitary Sewer Main Replacement/Rehabilitation	$1,500,000	$1,500,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,500,000	$0	$0
P-02	2021 Sanitary Sewer Main Replacement/Rehabilitation	$2,000,000	$0	$2,000,000	$0	$0	$0	$0	$0	$0	$0	$0	$2,000,000	$0	$0
P-03	2022 Sanitary Sewer Main Replacement/Rehabilitation	$2,000,000	$0	$0	$2,000,000	$0	$0	$0	$0	$0	$0	$0	$2,000,000	$0	$0
P-04	2023 Sanitary Sewer Main Replacement/Rehabilitation	$2,000,000	$0	$0	$0	$2,000,000	$0	$0	$0	$0	$0	$0	$2,000,000	$0	$0
P-05	2024 Sanitary Sewer Main Replacement/Rehabilitation	$2,000,000	$0	$0	$0	$0	$2,000,000	$0	$0	$0	$0	$0	$2,000,000	$0	$0
P-06	2025 Sanitary Sewer Main Replacement/Rehabilitation	$3,540,000	$0	$0	$0	$0	$0	$3,540,000	$0	$0	$0	$0	$3,540,000	$0	$0
P-07	2026-2029 Sanitary Sewer Main Replacement/Rehabilitation	$14,160,000	$0	$0	$0	$0	$0	$0	$3,540,000	$3,540,000	$3,540,000	$3,540,000	$0	$14,160,000	$0
P-08	2030-2039 Sanitary Sewer Main Replacement/Rehabilitation	$35,360,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$35,360,000
P-09	Sewer Capacity Improvements	$5,800,000	$0	$1,450,000	$1,450,000	$1,450,000	$1,450,000	$0	$0	$0	$0	$0	$5,800,000	$0	$0
P-10	Flow Monitoring Program	$1,470,000	$0	$0	$330,000	$330,000	$270,000	$270,000	$270,000	$0	$0	$0	$1,200,000	$270,000	$0
P-11	I/I Evaluation Program	$1,680,000	$0	$0	$1,050,000	$0	$0	$0	$0	$0	$0	$0	$1,050,000	$0	$630,000
General		$5,200,000	$500,000	$500,000	$500,000	$200,000	$500,000	$200,000	$200,000	$200,000	$200,000	$200,000	$2,400,000	$800,000	$2,000,000
G-01	Wastewater Operations Master Plan	$300,000	$300,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$300,000	$0	$0
G-02	Long-Range Wastewater Management Plan	$300,000	$0	$0	$0	$0	$300,000	$0	$0	$0	$0	$0	$300,000	$0	$0
G-03	Sanitary Sewer Hydraulic Model	$600,000	$0	$300,000	$300,000	$0	$0	$0	$0	$0	$0	$0	$600,000	$0	$0
G-04	Miscellaneous/Emergency Projects	$4,000,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$1,200,000	$800,000	$2,000,000
CIP Total (Current Dollars)		$96,870,000	$5,000,000	$4,130,000	$5,330,000	$4,280,000	$4,220,000	$4,010,000	$4,660,000	$4,380,000	$4,380,000	$4,380,000	$26,970,000	$17,800,000	$52,100,000
Annual Cost (Current Dollars)		$4,844,000	$5,000,000	$4,130,000	$5,330,000	$4,280,000	$4,220,000	$4,010,000	$4,660,000	$4,380,000	$4,380,000	$4,380,000	$4,495,000	$4,450,000	$5,210,000

8.4 Lift Station Projects

The City is completing the current series of lift station rehabilitation in 2020. It is anticipated the City's lift stations will require additional rehabilitation by the end of the planning period, given the useful life of non-structural components and continued preventative maintenance of structural elements Other major projects include the Kennydale Lake Line Upgrade and Renewal projects will allow long-term operation of the system and renewal in the long-term. Prioritization of long-term rehabilitation of the lift station and FM projects are based on risk.

8.4.1 LS-01: Lift Station Rehabilitation

The Wastewater Utility operates 20 lift stations throughout the City. At this point, the City is going into the maintenance/rehabilitation phase for each of the stations. In 2016, the City completed the process of evaluating the needs for each station. The second phase of full rehabilitation of lift stations began in 2017 and will be completed in 2020. The cost for this has been reported by the City at $900,000 in 2020.

8.4.2 LS-02: Force Main Rehabilitation/Replacement

The Wastewater Utility operates lift stations that each have their own FM that delivers the flow to the gravity system. While many of the lift stations have been either rehabilitated or replaced, their FMs often times were not. In 2016, a FM evaluation was completed that prioritized FMs. The replacement and rehabilitation of FMs identified began in 2016 and will be complete in 2020. The estimated cost is $400,000 in 2020.

8.4.3 LS-03: Telemetry Upgrade

The telemetry and control system records and stores flow rates and alarms for each lift station, which is then monitored in a supervisory control and data acquisition (SCADA) system. SCADA can then be accessed by the operations and maintenance (O&M) team, as well as engineers, to help the City monitor infrastructure. This system occasionally experiences communication and other issues that result in data errors which can be critical at times. Automatically generated reports are a benefit of the updated SCADA. It is currently anticipated that the system will be updated every five years. The cost for this has been reported by the City to be $300,000 and is planned for 2023.

8.4.4 LS-04: Devil's Elbow Stream Bank Study

It is recommended that the City monitor the condition of stream banks adjacent to the Devil's Elbow lift station and evaluate alternatives to armor the bank to protect the lift station and FM. The timing for this project is recommended to be completed in the short-term. The FM length is 506 LF with 6 inch diameter. The Level 5 AACE estimated cost for this project is $180,000 in the short-term.

8.4.5 LS-05: Kennydale Lake Line Sewer Upgrade

The Kennydale Lake Line Sewer System Improvement Project will allow long-term operation of the system. This program includes design and construction of a preferred alternative: 1) Lake Line System rehabilitation and repair or 2) Replacement with Individual Lift Stations. The City has budgeted a total of $1.7 M for 2019 and $1.7 M for 2020 for a total of $3.4 M for this effort.

8.4.6 LS-06: Kennydale Lake Line Renewal

The Kennydale Lake Line Sewer System Evaluation identified multiple options for the replacing the system at the end of its usable life. For budgetary purposes, the least expensive option, Individual Lift Stations, for $8 M will be budgeted in the long-term. For additional details, see the 2019 Kennydale Lake Line Sewer System Evaluation Phase 2B and 3 Summary Report.

8.4.7 LS-07 Low and Moderately-Low Risk Lift Station and Force Main Rehabilitation

This project addresses long-term renewal needs for existing facilities. Lift stations and FMs in the moderately-low to low risk categories are recommended to be evaluated for rehabilitation in the long-term, which are listed in Table 8.4. The recommended rehabilitation is consistent with the City's historical Lift Station rehabilitation schedule.

Table 8.4 Moderately-Low and Low Risk Lift Stations

Moderately-Low Risk	Low Risk
Baxter	East Valley
Stonegate	Shy Creek
Airport	Lind Avenue
Misty Cove	Westview
	Liberty
	Lake WA Beach
	Cottonwood
	Pipers Bluff

Note:
Abbreviation: WA – Washington.

- The cost for rehabilitation of thirteen low and moderately-low risk lift stations is $3.27 M in the long-term.
- The cost for FM rehabilitation and replacement is $2.84 M in the long-term.

Altogether, FM rehabilitation and replacement and lift station rehabilitation are estimated to cost $6.11 M in the long-term planning horizon.

8.4.8 LS-08: Moderately-High and High Risk Lift Station and Force Main Rehabilitation

Lift stations and FMs that are moderately-high to high risk are recommended for rehabilitation in the medium-term, which are listed in Table 8.5. The recommended rehabilitation is consistent with the City's historical Lift Station rehabilitation schedule.

Table 8.5 Moderately-High Risk Lift Stations

Moderately-High Risk
Talbot Crest
Long
Wedgewood
Devil's Elbow
Kensington Crest

Altogether, the planned cost is $2.57 M current value for the medium-term. This does not include the rehabilitation of Lake WA No. 2 and Lake WA Flush stations.

8.5 Pipeline Projects

Pipeline projects address aging gravity sewer and the City's relatively few pipe capacity deficiencies. The rehabilitation and replacement is the largest City expense during the planning period. These pipeline projects may involve full replacement with open-cut installation or rehabilitation through CIPP. To identify and plan for replacement and rehabilitation activities, the CIP includes condition assessments to identify deficiency and timing, infiltration and inflow (I/I) micro-monitoring, and verification of capacity deficiencies through long-term monitoring. All pipeline projects are shown in Figure 8.1.

8.5.1 Sanitary Sewer Main Replacement/Rehabilitation

The City's annual Sanitary Sewer Main Replacement/Rehabilitation Program identifies and repairs, rehabilitates, or replaces sewer pipe. Activities are mainly prioritized based on risk. Pipe risk will be updated throughout the planning period through routine CCTV inspections and required maintenance and any changes in criticality. More advanced condition assessment may be conducted for high risk pipes.

The program currently prioritizes high and moderately-high risk pipes, as defined in this LRWWMP and shown in Figure 8.2. However, lower risk pipes may be addressed when cost-effective.

Program costs for the planning period are based on:

- Full open-cut replacement of all high-risk sewer pipes (54,000 LF) with a cost of $35.16 M.
- Rehabilitation (CIPP) of approximately half of the moderately-high sanitary sewers (177,000 LF) with an annual cost of $27.32 M.
- Gravity Sewer condition assessment budgetary placeholder of $50,000.

The total cost of this program is $62.54 M in the short-, medium-, and long-term.

The actual method of sanitary sewer main replacement or rehabilitation will be determined through site-specific design. The program is administered through separate annual budget line items.

8.5.2 P-01: 2020 Sanitary Sewer Main Replacement/Rehabilitation

This is an annual program that is performed to identify and either repair, rehabilitate, or replace portions of sewer pipe that do not meet current standards. The program will be city-wide and may consist of individual projects. The annual cost of this project is $1.5 M in 2020.

8.5.3 P-02: 2021 Sanitary Sewer Main Replacement/Rehabilitation

This is an annual program that is performed to identify and either repair, rehabilitate, or replace portions of sewer pipe that do not meet current standards. The program will be city-wide and may consist of individual projects. The annual cost of this project is $2.0 M in 2021.

8.5.4 P-03: 2022 Sanitary Sewer Main Replacement/Rehabilitation

This is an annual program that is performed to identify and either repair, rehabilitate, or replace portions of sewer pipe that do not meet current standards. The program will be city-wide and may consist of individual projects. The annual cost of this project is $2.0 M in 2022.

8.5.5 P-04: 2023 Sanitary Sewer Main Replacement/Rehabilitation

This is an annual program that is performed to identify and either repair, rehabilitate, or replace portions of sewer pipe that do not meet current standards. The program will be city-wide and may consist of individual projects. The annual cost of this project is $2.0 M in 2023.

8.5.6 P-05: 2024 Sanitary Sewer Main Replacement/Rehabilitation

This is an annual program that is performed to identify and either repair, rehabilitate, or replace portions of sewer pipe that do not meet current standards. The program will be city-wide and may consist of individual projects. The annual cost of this project is $2.0 M in 2024.

8.5.7 P-06: 2025 Sanitary Sewer Main Replacement/Rehabilitation

This is an annual program that is performed to identify and either repair, rehabilitate, or replace portions of sewer pipe that do not meet current standards. The program will be city-wide and may consist of individual projects. The annual cost of this project is $3.54 M in 2025.

8.5.8 P-07: 2026-2029 Sanitary Sewer Main Replacement/Rehabilitation

This is an annual program that is performed to identify and either repair, rehabilitate, or replace portions of sewer pipe that do not meet current standards. The program will be city-wide and may consist of individual projects. The annual cost of this project is $3.54 M in the medium term. The total cost is $14.14 M.

8.5.9 P-08: 2030-2039 Sanitary Sewer Main Replacement/Rehabilitation

This is an annual program that is performed to identify and either repair, rehabilitate, or replace portions of sewer pipe that do not meet current standards. The program will be city-wide and may consist of individual projects. The annual cost of this project is $3.54 M in the long-term. The total cost is $35.36 M.

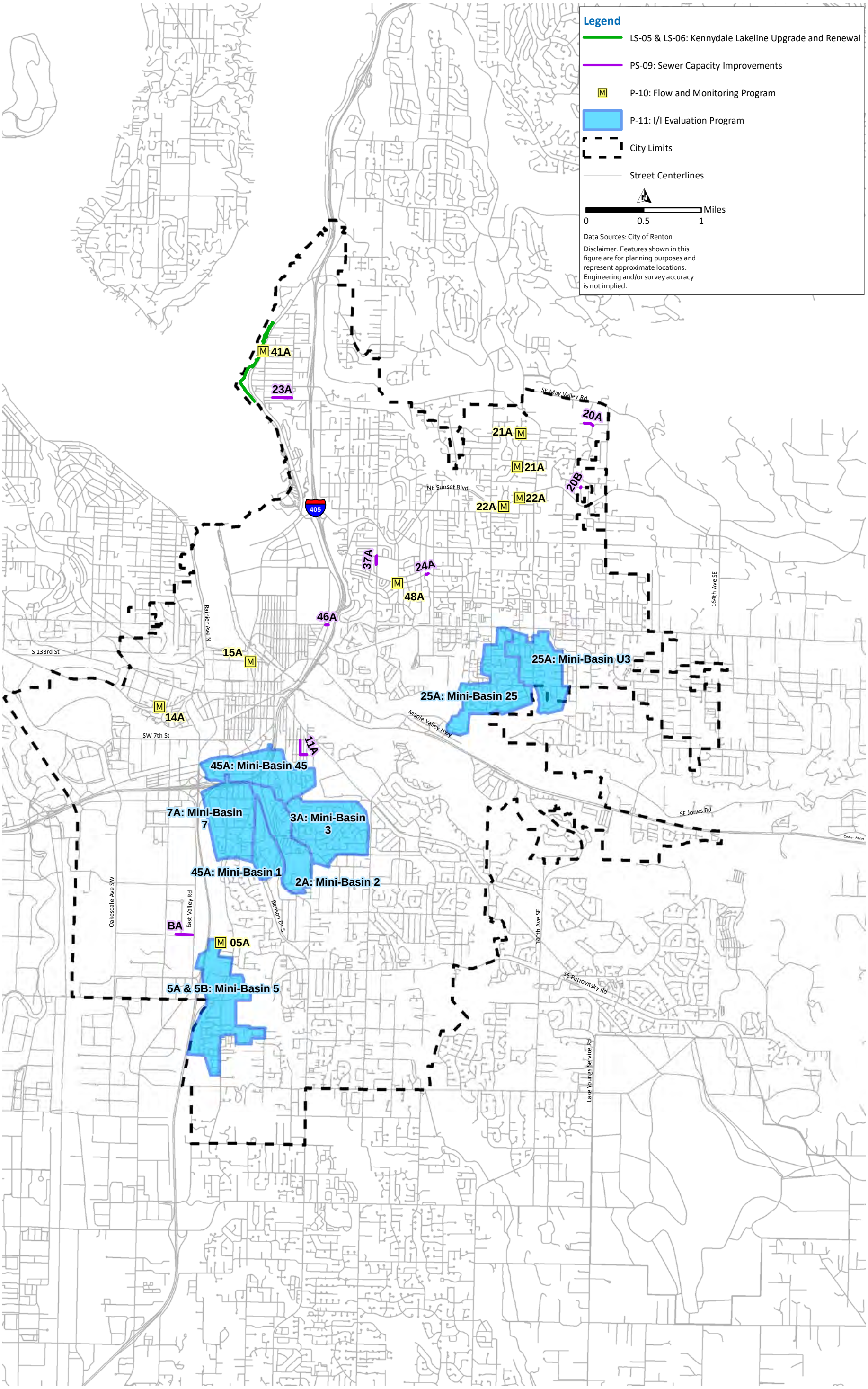

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Figure 8.1
Overview of CIP Projects

8.5.10 P-09: Sewer Capacity Improvements 2021-2024

Pipe capacity improvements have been categorized together due to the need for infrastructure replacement, rather than rehabilitation, due to lack of pipe hydraulic capacity. Pipe capacity improvements were based on the City's calibrated sewer hydraulic model to address either pipe size or adverse slope segments. Details on the deficiencies, locations, and other parameters are shown in Table 8.6 and Figure 8.2:

- The total length of pipe upsizing is 5,497 LF and will cost $3.64 M.
- The cost for reconfiguration of 3,440 LF of adverse slope pipe is $2.17 M.

The total $5.81 M in expenses are estimated for the short-, medium-, and long-term.

Table 8.6 Upsizing and Reconfiguration Locations and Cost

Deficiency ID	Location
23 A	North 28th Place and Park Avenue North
BA	SE 24th Street and East Valley Road
46A	Sunset Blvd North and NE 3rd Street
37A	Edmonds Avenue and NE 9th Street
24A	Monroe Avenue and NE 7th Street
11A	Grant Avenue and SE 9th Street
20A	SE 99th Court
20B	Jericho Place and NE 16th Street

Note:
Abbreviation: ID – identification.

8.5.11 P-10: Flow Monitoring Program

The flow monitoring project is to verify deficiencies identified in the hydraulic model for the specified pipe. These locations have typically not been observed deficient, so additional monitoring over a specified period of time is recommended. All deficiency locations are shown with details in Table 8.7. Altogether, the flow monitoring program is estimated to cost $1.47 M and timing will be short-, and medium-term.

Table 8.7 Flow Monitoring Locations and Duration

Deficiency ID	Location	Meter Quantity	Duration	Manhole ID
05A	Talbot Road South and 36th Street to 27th Place	1	2- 5 years	MH2998
22A	Whitman Court NE and NE 12th Street	2	1-2 years	MH3616, MH3622
21A	Anacortes Avenue NE and NE 17th Street to NE 26th Street	2	3-7 years	MH3542, MH3581
15A	Renton High School	2	3-7 years	MH2182, MH2118
14A	West Sunset Blvd and SW 4th Place	1	3-7 years	MH6332
41A	Lake Washington Boulevard and Burnett Avenue North	1	3-7 years	MH3324
48A	NE 7th Street and Harrington Avenue NE	1	3-7 years	MH0847

Note:
Abbreviation: MH – manhole.

8.5.12 P-11: I/I Evaluation Program

Micro-monitoring is recommended for areas in wastewater basins that prior flow monitoring indicated significant I/I in the collection system. This involves installing multiple flow monitors where high I/I is observed and breaking larger areas into smaller basins to refine the location of I/I. By micro-monitoring deficiencies identified in the hydraulic model, an isolated location within the area will be identified for replacement. The downstream start location for micro-monitoring is shown in Table 8.8. Repair or Replacement of identified I/I issues will be allocated to Sanitary Sewer Main Replacement/Rehabilitation.

Table 8.8 I/I Evaluation, Quantity, and Duration

Deficiency ID	Study Quantity	Locations	Basins to Monitor
45A	5	SSMH004, MH2489, MH2480, MH2258	45, 7, 3, 2, 1
7A			
2A			
3A			
05B	1	MH5516	5

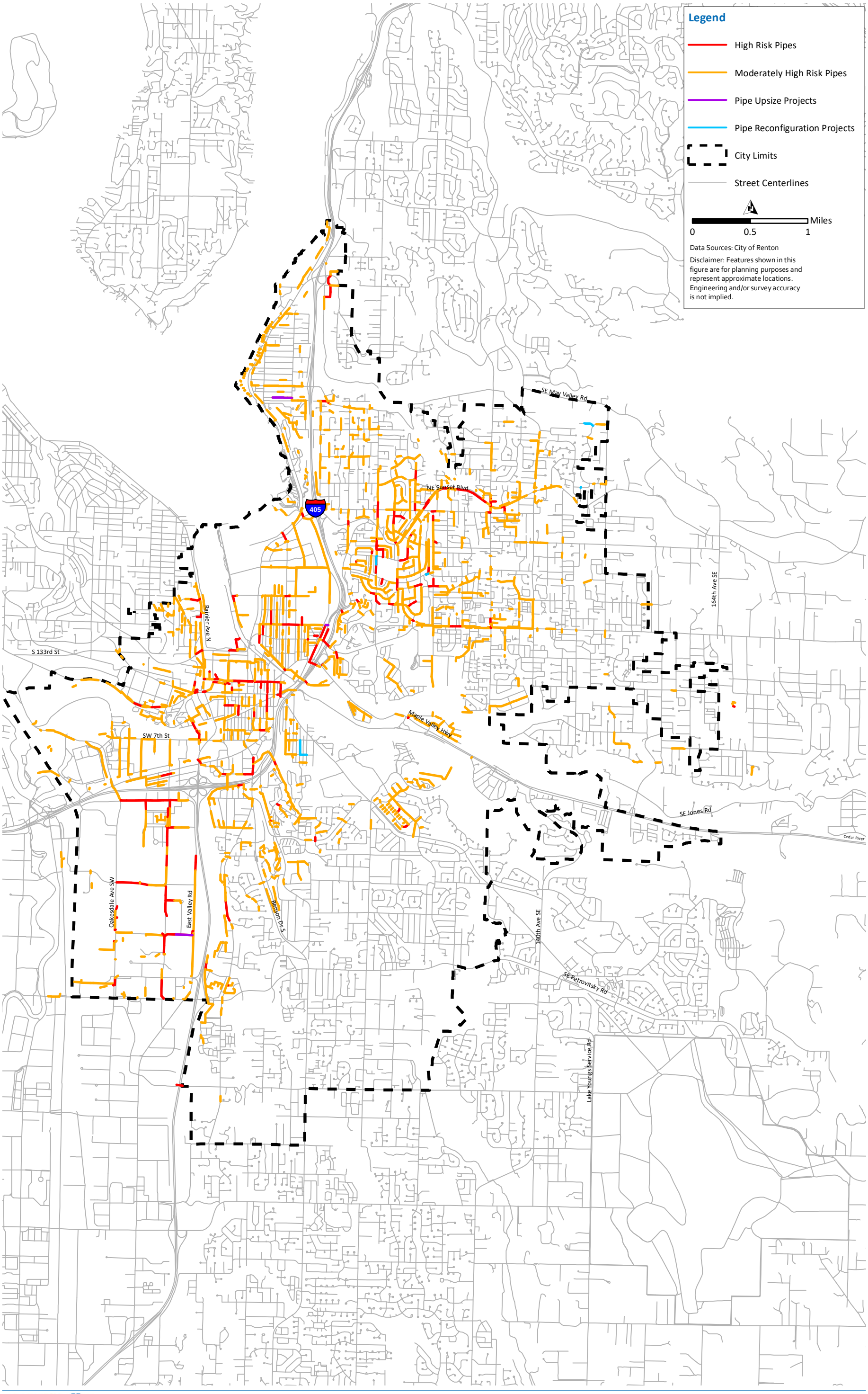

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Figure 8.2

High and Moderately-High Gravity Sewer Risk with Upsizing and Reconfiguration

8.6 General Projects

General programmatic projects involve necessary funding which cannot be allocated to a specific facility type. These projects involve implementation and compliance with regulatory requirements such as the Wastewater Operations Master Plan (OMP). Additionally, future miscellaneous and emergency projects for all infrastructure types have been allocated as general projects.

8.6.1 G-01: Wastewater Operations Master Plan

This project will be an update to the Wastewater OMP created by the City. The purpose of the OMP is to document current procedures and programs into an O&M manual and review existing programs for effectiveness and compliance of potential future regulatory requirements. Additionally, the OMP analyzes and recommends program improvements in accordance with the City's long-term goals and objectives. Based on the City's existing resources and implementation budget, it is recommended to implement this OMP over 5 years. The cost for this OMP is estimated by the City as $600,000 in 2020.

8.6.2 G-02: Long-Range Wastewater Master Plan

The LRWWMP considers a 20-year planning period for the analysis of existing and projected conditions. The sewage collection system's operational and capital requirements are detailed to achieve the City's operational goals and fulfill regulatory requirements. The cost is estimated at $300,000 in 2024.

8.6.3 G-03: Sanitary Sewer Hydraulic Model

As discussed in Chapter 7 – Operations and Maintenance in the System Infrastructure Capacity, the City has a hydraulic model that allows them to evaluate the existing sanitary sewer system and determine areas of capacity constraint, and provide a tool for planning future improvements. The model needs to be updated as the system expands, and flow monitoring and physical system data is collected by survey or field inspection. The cost is estimated by the City as $600,000 over two years in the short-term for the model to be updated in 2021 and 2022.

8.6.4 G-04: Miscellaneous / Emergency Projects

This project is to perform small repairs, replacements, or installations of sewers that are not scheduled in the CIP, but become a priority due to unexpected problems, failures, or coordination with other projects. This could also include service to planned annexation areas and any future new pipeline extensions. Based on historical spending, the cost is estimated by the City as $200,000 annually, or $4.0 M, in the short-, medium-, and long-term planning horizon.

8.7 Summary of CIP

Altogether, recommend improvements include eight lift station projects, eleven pipelines, and four general projects. The majority of projects are allocated as maintenance projects at $80.94 M of the total $96.87 M. Cross category projects follow at $10.25 M, as well as planning projects at $5.68 M. Seventy-seven percent of short-term project funding is allocated to pipelines with general at nine percent. In the short-term, lift stations require the remaining fourteen percent of funding.

The CIP recommends investing $26.97 M into the wastewater system during short-term. The annual short-term cost for all recommended programs is approximately $4.5 M per year from 2020 to 2025. For medium-term, the CIP recommends an additional $17.8 M be invested to continue these programs. The annual medium-term cost is approximately $4.45 M per year from 2026 to 2039. For long-term, the CIP recommends $52.1 M be invested to continue to maintain the sewer system. The annual long-term cost is approximately $5.21 M.

Detailed sheets for each CIP project presented in this chapter can be found in Appendix K. Table 8.9 summarizes the total cost and annual cost for each planning period.

Table 8.9 CIP Planning Period Summary

Planning Period	Total Cost	Annual Cost
Short-term (2020-2025)	$26.97 M	$4.5 M
Medium-term (2026-2029)	$17.8 M	$4.45 M
Long-term (2030-2039)	$52.10 M	$5.21 M

Pipelines account for a majority of the capital cost of planned projects (74 percent) at $71.51 M of the $96.87 M. Lift stations account for $20.16 M (21 percent) of the total CIP. The remaining $5.2 M (6 percent) is associated with general projects. Table 8.10 summarizes the total estimated capital costs by facility type. Figure 8.3 shows the various facility types of CIP allocation.

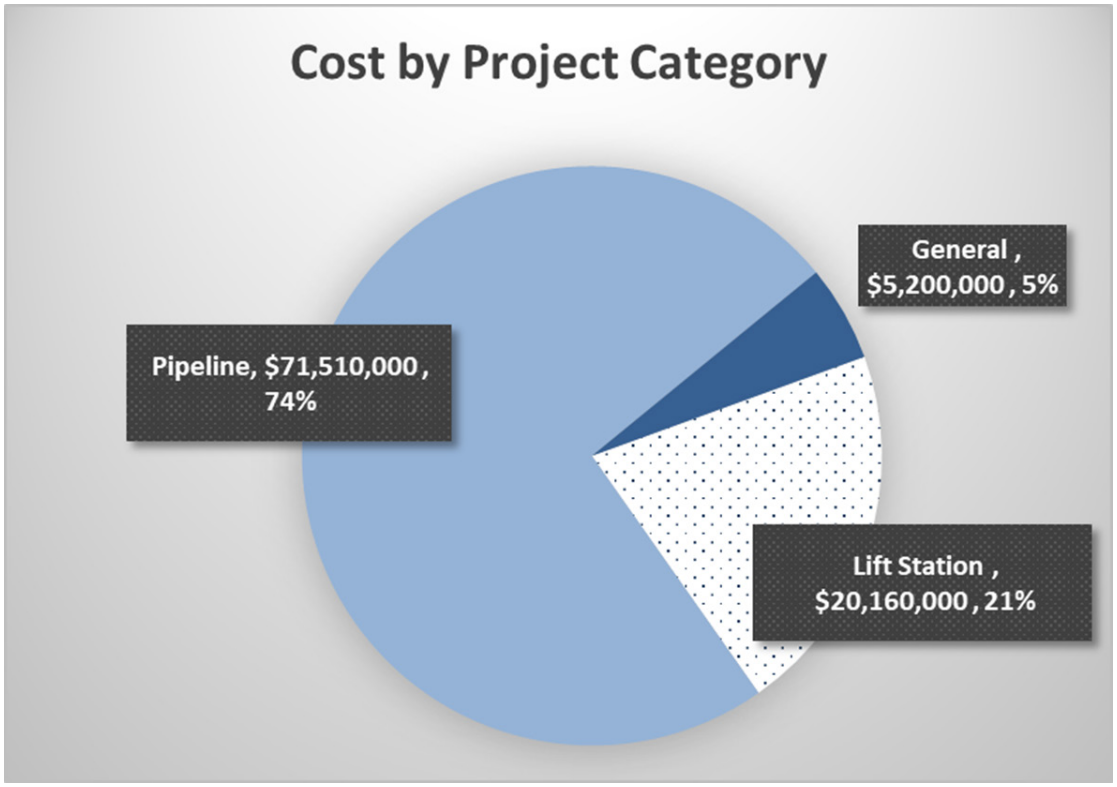

Figure 8.3 Cost by Facility Type

Table 8.10 CIP Summary by Facility Type

Project ID	Title	Total Capital Cost ($)	Planning Period		
			Short-term (2020-2025)	Medium-term (2026-2029)	Long-term (2030-2039)
Lift Station					
LS-01	Lift Station Rehabilitation	$900,000	$900,000		
LS-02	FM Rehabilitation/Replacement	$400,000	$400,000		
LS-03	Telemetry Upgrade	$300,000	$300,000		
LS-04	Devil's Elbow Stream Bank Study	$180,000	$180,000		
LS-05	Kennydale Lake Line Sewer Upgrade	$1,700,000	$1,700,000		
LS-06	Kennydale Lake Line Renewal	$8,000,000			$8,000,000
LS-07	Low and Moderately-Low Risk Lift Station and FM Rehabilitation	$6,110,000			$6,110,000
LS-08	Moderately-High and High Risk Lift Station and FM Rehabilitation	$2,570,000		$2,570,000	
Pipeline					
P-01	2020 Sanitary Sewer Main Repl/Rehab	$1,500,000	$1,500,000	$0	$0
P-02	2021 Sanitary Sewer Main Repl/Rehab	$2,000,000	$2,000,000	$0	$0
P-03	2022 Sanitary Sewer Main Repl/Rehab	$2,000,000	$2,000,000	$0	$0
P-04	2023 Sanitary Sewer Main Repl/Rehab	$2,000,000	$2,000,000	$0	$0
P-05	2024 Sanitary Sewer Main Repl/Rehab	$2,000,000	$2,000,000	$0	$0
P-06	2025 Sanitary Sewer Main Repl/Rehab	$3,540,000	$3,540,000	$0	$0
P-07	2026-2029 Sanitary Sewer Main Repl/Rehab	$14,160,000	$0	$14,160,000	$0
P-08	2030-2039 Sanitary Sewer Main Repl/Rehab	$35,360,000	$0	$0	$35,360,000
P-09	Sewer Capacity Improvements	$5,800,000	$5,800,000	$0	$0
P-10	Flow Monitoring Program	$1,470,000	$1,200,000	$270,000	$0
P-11	I/I Evaluation Program	$1,680,000	$1,050,000	$0	$630,000
General					
G-01	Wastewater OMP	$300,000	$300,000		
G-02	Long-Range Wastewater Management Plan	$300,000	$300,000		
G-03	Sanitary Sewer Hydraulic Model	$600,000	$600,000		
G-04	Miscellaneous/Emergency Projects	$4,000,000	$1,200,000	$800,000	$2,000,000

Chapter 9

FINANCIAL ANALYSIS

9.1 Introduction

This chapter analyzes the financial status of the City of Renton's (City's) water utility for the Long-Range Wastewater Management Plan (LRWWMP). The purpose of this chapter is to provide a cursory evaluation to show the City's ability to finance necessary Capital Improvement Program (CIP) projects in Chapter 8 – Capital Improvement Program.

The following sections present the City's financial status, funding required to finance the scheduled improvements, potential funding sources, and the impact of water system improvements on water rates.

9.2 Historical Financial Performance

The City and King County have updated their fees and rates. In November 2021, the City released their fee schedule for 2021-2022, which can be found on the City's website at rentonwa.gov. Key rates and fees related to this Plan are summarized below.

9.2.1 Current Wastewater Rates, Fees, and Charges

The City and King County (KC) wastewater rates are summarized in Table 9.1.

Table 9.1 2022 Wastewater Utility Monthly Rates[1]

Category	City	KC
Single-Family	$31.74	$49.27
Other Users		
Minimum Charge[3]	$31.74	$49.27
Per 100 cf[2]	$3.58	$6.57

Notes:
(1) Outside City Limits: Rates are 1.5 times the above for the Renton rates.
(2) cf – cubic feet.
(3) Includes 750 cf.

Construction permit fees are summarized in Table 9.2.

Table 9.2 Construction Permit Fees[1]

Type of Service	2021	2022
Residential	$375	$375
Commercial	$375	$375
Industrial	$375	$375
Repair of any of the above	$375	$375
Cut and Cap/Demolition Permit	$375	$375
Ground Water Discharge (temporary connection to wastewater system for one-time discharge of contaminated ground water to 50,000 gallons)	$375 + KC sewer rate discharged amount	$375 + KC sewer rate discharged amount

Note:
(1) Per Res. 4422, fees for an Accessory Dwelling Unit (ADU) will be waived as of the adoption date of Res. 4422, through December 31, 2022.

The City pays for expansion of the sewer system through system development charges (SDCs). The SDC allocation is based on a property's associated water meter size as shown in Table 9.3.

KC also has a charge for first time connection to sanitary sewers in KC, including the City's Sewer Service Area, called the sewage treatment capacity charge. This charge pays for building sewage treatment capacity to serve newly connected customers. Single-family customers pay $66.35 per month for 15 years. It may also be paid as a lump sum of $9,927.44 to KC. This charge is established annually and changes to the capacity charge apply only to new connections.

Table 9.3 2021-2022 System Development Charge[1] Wastewater Fee

Meter Size, inch	2021	2022
5/8 x 3/4	$3,450	$3,500
1 1/2	$17,250	$17,500
2	$27,600	$28,000
3	$55,200	$56,000
4	$86,250	$87,500
6	$172,500	$175,000
8	$276,000	$280,000

Note:
(1) Outside City Limits: Rates are 1.5 times the above for the Renton rates.
(2) Per Res. 4422, utility system development charges (hookup fees) for an ADU will be reduced by 50% as of the adoption date of Res. 4422, through December 31, 2022.

9.2.2 Historical Financial Operations

The City's operating revenues and expenses for the years 2015 to 2019 are summarized in Table 9.4 and Table 9.5, respectively. The tables present City and KC wholesale water services (King County Metro Fund) revenue and expense. The Plan was developed using 2019 historical operating revenue and expenses and was not updated for the future years during Plan development.

Table 9.4 Historical Operating Revenue[1]

Operating Revenue	2015	2016	2017	2018	2019 Budget
City Revenue	$ 10,880,141	$ 13,286,986	$ 15,143,808	$ 12,124,358	$ 11,582,615
King County Metro Fund	$ 16,638,722	$ 16,142,469	$ 16,922,259	$ 16,886,297	$ 16,922,613
Total	$ 27,518,863	$ 29,429,455	$ 32,066,067	$ 29,010,655	$ 28,505,228

Note:
(1) Source: City's Financial Statements.

Table 9.5 Historical Operating Expenses[1]

Operating Expenses	2015	2016	2017	2018	2019 Budget
City Expense	$ 6,832,715	$ 13,785,490	$ 11,593,468	$ 10,655,159	$ 13,858,678
King County Metro Fund	$16,638,722	$ 15,140,189	$ 16,827,147	$ 16,463,648	$ 16,922,613
Total	$ 23,471,437	$ 28,925,679	$ 28,420,615	$ 27,118,807	$ 30,781,291

Note:
(1) Source: City's financial statements.

9.2.3 Wastewater Utility Fund

The City maintains substantial fund balances to ensure continued operation of the Utility. These include operation, bond, and undesignated as shown in Table 9.6.

Table 9.6 Historical Utility Fund

Utility Fund	2015	2016	2017	2018	2019 Budget
Operation	$ 838,706	$ 838,706	$ 838,706	$ 661,227	$ 661,227
Bond	$ 307,857	$ 806,900	$ 373,343	$ 949,646	$ 954,259
Undesignated	$ 6,442,525	$ 9,990,909	$ 12,647,613	$ 15,799,129	$ 17,263,715
Total	$ 7,589,088	$ 11,636,515	$ 13,859,662	$ 17,410,002	$ 18,879,201

9.2.4 Outstanding Debt

The City has outstanding debt through the Waterworks Revenue Bond debt and Public Works Trust Fund Loans. As of 2019, the Waterworks Revenue Bond has $22.3 million (M) in outstanding principal debt and the Public Works Trust Fund Loans have $1.9 M in outstanding principal debt.

9.3 Financial Analysis

The City's ability to fund its CIP was evaluated by comparing the historical and future funding requirements. The financial analysis was developed in 2020 using 2019 data and was not updated to reflect future years during Plan development.

9.3.1 Projected Capital Improvement Program Levels

Projected CIP is described in Chapter 8 – Capital Improvement Program and summarized in Table 9.7 and Figure 9.1 below. The following terms are used to define timing and prioritization into three planning periods:

- **Short-term (2020 - 2025).** Proposed facilities determined to be a high priority.
- **Medium-term (2026 - 2029).** Proposed facilities determined to be a medium priority or proposed facilities to service major growth areas to be developed in the medium-term.
- **Long-term (2030 - 2039).** Proposed facilities determined to be a low priority or proposed facilities to service major growth areas to be developed in the long-term.

Table 9.7 shows the expected cost per planning period. Comparison of annual CIP cost.

Table 9.7 CIP Planning Period Summary

Planning Period	Total Cost	Annual Cost
Short-term (2020-2025)	$ 26.27 M	$ 4.38 M
Medium-term (2026-2029)	$ 17.79 M	$ 4.45 M
Long-term (2030-2039)	$ 51.47 M	$ 5.15 M

9.3.2 Financial Analysis

A Wastewater Revenue Requirement Model (WRRM) was conducted in 2018 to analyze the future finances of the City. The LRWWMP's CIP differs from the WRRM CIP; therefore, this Section seeks to show the financial capacity of the LRWWMP CIP by comparing of the two CIP

costs. For the purpose of this analysis, all assumptions in the WRRM were considered applicable, including expected rate increase of 2 percent from 2020 to 2024.

The differences between the proposed LRWWMP and WRRM CIP, as shown in Figure 9.1 and Table 9.8. The proposed LRWWMP and WRRM CIP are both in current dollars. The annual WRRM CIP spending is $4 M from 2021 through 2024 and then $4.5 M from 2025 through 2029, as shown in Table 9.8. With the WRRM the fund balance does not get drawn down. The LRWWMP CIP shows annual spending from 2021 through 2024 will be higher than the WRRM, and from 2025 to 2029 the proposed CIP is lower than the WRRM. This results in a net drawdown of approximately $1.5 M dollars of the 2018 $15.8 M undesignated wastewater funds. This spending is additional planned to address existing repair and replacement (R&R) and capacity needs in the system.

This analysis to show the City's financial capacity in respect to the LRWWMP CIP. The City is not committed to CIP spending summarized in the LRWWMP. Per the City budgeting policy, the Utility's spending is based on a biannual budget approved by the City Council.

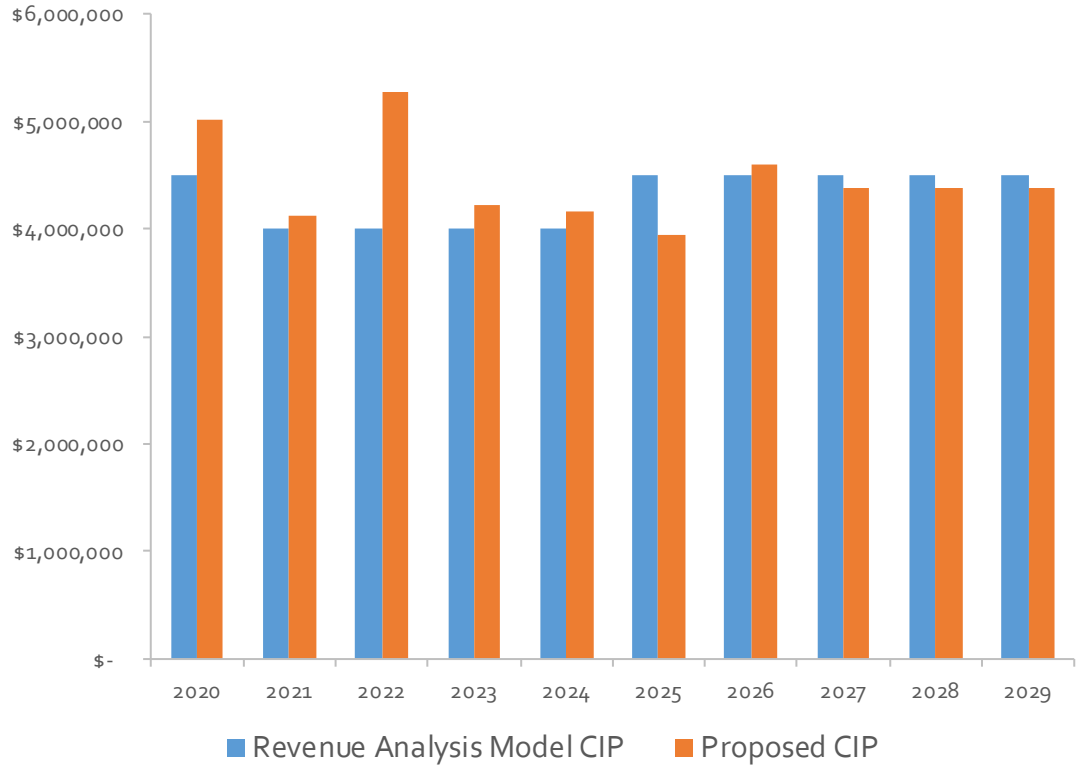

Figure 9.1 CIP Proposed and Rate Analysis Model

Table 9.8 Projected Future Operating Expenses

CIP Analysis	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
WRRM CIP	$ 4,500,000	$ 4,000,000	$ 4,000,000	$ 4,000,000	$ 4,000,000	$ 4,500,000	$ 4,500,000	$ 4,500,000	$ 4,500,000	$ 4,500,000
Proposed CIP	$ 5,010,200	$ 4,130,000	$ 5,280,000	$ 4,230,000	$ 4,160,000	$ 3,950,000	$ 4,600,000	$ 4,380,000	$ 4,380,000	$ 4,380,000
Fund Balance Change	($510,200)	($ 130,000)	($ 1,280,000)	($ 230,000)	($ 160,000)	$ 550,000	($ 100,000)	$120,000	$120,000	$120,000

9.4 Available Funding Assistance and Financing

The ten-year planning period shows the City will have adequate funding for the anticipated short-term projects shown in the CIP, so more bonds and funding isn't necessary. However, there are bond assistance and grant options available if needed.

9.4.1 Grants and Low Cost Loans

The Infrastructure Assistance Coordinating Council (IACC) is a non-profit organization that helps improve the delivery of infrastructure assistance, both financial and technical, to local governments and tribes in Washington State. The IACC has put together a list of funding opportunities that are currently available for drinking water and wastewater projects.

The Public Works Trust Fund (PWTF) is a potential loan for eligible projects including repair, replacement, and construction of infrastructure for domestic water projects that improve public health and safety, respond to environmental issues, promote economic development, or upgrade system performance.

9.4.2 Bond Financing

Bond financing is obtained by issuing general obligation or revenue bonds. Revenue bonds do not require voter approval and may be repaid with revenues from rates, miscellaneous fees or connection charges.

9.5 Summary

Due to unusual circumstances from COVID-19, short term revenue cannot be predicted, but in the long term, it is not expected to heavily impact the budget and long-term analysis. Over the next five years, the City is anticipating spending approximately $22,810,000 in capital projects. CIP spending as proposed for the short term can still be completed although it will draw down the reserve fund. However, by 2025 it is expected that even with CIP spending, the reserve fund will begin to build up again. Based on the City's 2020 rate study, rates are expected to increase at 2 percent from 2020 till 2024.

Appendix A

SEPA CHECKLIST

Appendix B

AGENCY COMMENT LETTERS AND RESPONSES

Appendix C

APPROVALS

Appendix D

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Appendix F

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Appendix G

TM 1 - RAIN AND FLOW MONITORING AND PROJECTIONS

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TM 2 - MODEL DEVELOPMENT AND CALIBRATION

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Appendix J

STANDARD PLANS AND SPECIFICATIONS

Appendix K

CIP DETAIL SHEETS

Appendix L-1

WELLHEAD PROTECTION PLAN UPDATE

Appendix L-2

WELLHEAD PROTECTION AREAS AND SEPTIC SYSTEMS MAP

Appendix M

WATER RECLAMATION EVALUATION CHECKLIST

Appendix N

APPROVED GRINDER PUMP STATIONS FOR SINGLE FAMILY RESIDENCES