City of Sherwood Oregon

Home of the Tualatin River National Wildlife Refuge

SANITARY SYSTEM MASTER PLAN

JULY 2007

MSA
Murray, Smith & Associates, Inc.
Engineers/Planners
Portland, Oregon

In Association with:

FCS GROUP
Solutions-Oriented Consulting

City of Sherwood Oregon

Home of the Tualatin River National Wildlife Refuge

RESOLUTION 2007-071

A RESOLUTION ACCEPTING THE SANITARY MASTER PLAN

WHEREAS, the City of Sherwood owns, operates and maintains the public wastewater collection system within the City limits. Wastewater is collected from residential, commercial, and industrial services and is discharged into interceptor sewers owned and operated by CWS for treatment at the Durham treatment facility; and

WHEREAS, consultant Murray, Smith and Associates (MSA) was authorized by the City of Sherwood to develop the Sanitary Master Plan under Resolution 2006-060. This plan evaluates the sanitary sewer system in light of current and future anticipated population growth within the City. The City expects to continue to grow through development of the expanded UGB, by continued infill, and by increased density with the current City limits; and

WHEREAS, MSA has completed a comprehensive analysis of the City of Sherwood's sanitary system to identify system deficiencies, future extension and expansion and to recommend facility improvements that correct existing deficiencies and provide future system expansion; and

WHEREAS, after due consideration and multiple public involvement opportunities, staff recommends acceptance of the Sanitary Master Plan, marked as Exhibit A.

NOW, THEREFORE, THE CITY RESOLVES AS FOLLOWS:

Section 1: The City Council accepts the Sanitary Master Plan as the comprehensive, public facility planning direction for the City.

Section 2: The City Council authorizes an initiation of a plan amendment application consistent with the City of Sherwood Municipal Code Title 16 - Zoning and Community Development Code to adopt the new master plan as a technical appendix to the code and hereby directs the Planning Supervisor and the City Engineer to coordinate the review process in a timely manner.

Section 3: Upon adoption of this resolution, the Sanitary Master Plan dated July 2007 supersedes all previous Sanitary Master Plans for the City of Sherwood.

Section 4: This Resolution is and shall be effective upon its approval and adoption by Council.

Duly passed by the City Council this 7th day of August 2007.

Keith S. Mays, Mayor

ATTEST:

Sylvia Murphy, City Recorder

SANITARY SYSTEM MASTER PLAN

FOR

CITY OF SHERWOOD

JULY 2007

Prepared by:

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DEFINITION OF TERMS

The table below contains a list of abbreviations and acronyms used throughout this master plan.

Abbreviation/Acronym	Definition
ASTM	American Society for Testing and Materials
AWWTF	Advanced Wastewater Treatment Facility
CCI	Construction Cost Index
cfs	Cubic feet per second
CIP	Capital Improvement Plan
City	City of Sherwood
CMOM	Capacity, Management, Operation and Maintenance
CPRC	Center for Population Research and Census
CSP	Concrete Sewer Pipe
CWS	Clean Water Services
DEQ	Oregon Department of Environmental Quality
Dia.	Diameter
DIP	Ductile iron pipe
ENR	Engineering News Record
EPA	U.S. Environmental Protection Agency
FB	Freeboard
FEMA	Federal Emergency Management Agency
FOG	Fats, oils and grease
FY	Fiscal year
GIS	Geographical Information System
gpad	Gallons per acre per day
gpcd	Gallons per capita per day
gpd	Gallons per day
HDPE	High density polyethylene
HGL	Hydraulic grade line
I&I	Infiltration and Inflow
IE	Invert elevation
IGA	Intergovernmental Agreement
LF	Linear feet
mgd	Million gallons per day
MOP	Manual of Practice
MSL	Mean Sea Level
NPDES	National Pollution Discharge Elimination System
NRCS	Natural Resources Conservation Service
OAR	Oregon Administrative Rules
PUD	Planned Unit Development
PVC	Polyvinyl Chloride
RCSP	Reinforced concrete sewer pipe
RLIS	Metro Regional Land Information System
SDC	System Development Charge
SRI	Storm-induced infiltration and inflow

Abbreviation/Acronym	Definition
SSO	Sanitary Sewer Overflow
UGB	Urban Growth Boundary
WEF	Water Environment Federation
WWI	Wet weather inflow

EXECUTIVE SUMMARY

Authorization

On November 21, 2006 the City of Sherwood (City) authorized Murray, Smith & Associates, Inc. (MSA) to prepare this Sanitary System Master Plan for the City.

Introduction

The City of Sherwood retained the services of Murray, Smith & Associates, Inc. (MSA) to prepare this comprehensive Sanitary System Master Plan. The purpose of this plan is to evaluate the wastewater collection system and make recommendations for improvements and upgrades throughout the City's facilities. Recommendations will be based on ultimate build out in the City and will include near-term and long-term projects that can be incorporated into the City's Capital Improvement Program to provide adequate system capacity.

Background

The City of Sherwood is located south of the Tualatin River, approximately 15 miles southwest of Portland along State Highway 99W. The City of Tualatin is adjacent to the City to the east. Sherwood shares wastewater management responsibilities with Clean Water Services (CWS) through a "Large City" Intergovernmental Agreement (IGA). Under the IGA, Sherwood is referred to as a "self-service provider" and is responsible for specific sanitary sewer system functions within the City limits. These functions include system maintenance and other associated functions of the wastewater collection system to be provided in accordance with CWS standards. CWS assumes responsibility for wastewater treatment. The City of Sherwood service area was included under the recent EPA/DEQ Watershed Based NPDES Permit issued to CWS.

Under the IGA, the City owns, operates and maintains the wastewater collection system within City limits. Wastewater is collected from residential, commercial, and industrial services and is discharged into interceptor sewers owned and operated by CWS. Wastewater is then pumped by CWS for treatment at their Durham Advanced Wastewater Treatment Facility located in the City of Tigard. The City is responsible for all wastewater collection piping smaller than 24 inches in diameter located within the City limits, and CWS owns and maintains interceptor sewers 24 inches and larger, as well as all pump stations and force mains.

The City of Sherwood has undertaken this Sanitary System Master Plan to evaluate its sanitary sewer system in light of current and future anticipated population growth within the City. The most recent sanitary sewer plan update was prepared for the City in 1991, when the City's population was approximate 3,000. Since that time, the City has experienced rapid population growth, reaching 16,115 by 2006. In recent years, several former Metro Urban Reserve Areas, referred to as Areas 48, 54, 55, and 59, were brought into the City's urban

growth boundary (UGB). The City expects to continue to grow through development of the expanded UGB, as well as by continued infill and increased density within the current City limits. It is also anticipated that additional land will be brought in over the planning period.

Scope

The scope of work for this study includes the following work tasks:

- Project Management
- Data Collection / Basin Characteristics
- Existing Sanitary Sewer System Review
- Sanitary Sewer System Analysis and Master Plan Development
- Project Coordination and Master Plan Presentation
- Rate and System Development Charge (SDC) Study Update
- System Operation, Maintenance and Rehabilitation Review

Study Area

The boundary for the study area is the City's Urban Growth Boundary (UGB), as defined by the City's Zoning & Comprehensive Plan Map. The City currently provides sanitary sewer service only to the area within the City limits. The future sanitary sewer service area identified for this plan includes only the area enclosed within the established UGB. The study area contains a total of approximately 3,300 acres.

Table ES-1 presents a population forecast summary in 5 year increments through 2025. The saturation development population is also presented. Based on the estimated population growth rates, it is estimated that the City's sanitary system service area, as defined by the current UGB, will approach saturation development, or build-out conditions in approximately 2040.

Table ES-1
Population Forecast Summary

Year	Population
2005	14,940
2010	18,970
2015	22,130
2020	25,290
2025	28,450
Build-out (approx. 2040)	37,940

Wastewater System

Developed areas within the City of Sherwood are presently served by publicly owned sewage disposal facilities operated through an Intergovernmental Agreement (IGA) between the City of Sherwood and Clean Water Services (CWS). The City owns, operates and maintains the wastewater collection system within City limits, and CWS provides wastewater treatment. Under the IGA, the City owns, operates and maintains conveyance facilities smaller than 24-inches in diameter, while CWS owns and maintains the piping 24-inches in diameter and larger and all pump stations and forcemains. Wastewater is collected from residential, commercial, and industrial services and is discharged into interceptor sewers primarily owned and operated by CWS. Wastewater is then pumped by CWS for treatment at their Durham Advanced Wastewater Treatment Facility (Durham AWWTP). This study examines the City owned facilities, and includes a review of CWS conveyance facilities leading up to the Sherwood Pump Station. A copy of the IGA between the City and CWS is included in Appendix B.

City owned conveyance facilities do not currently include any pump stations. A small group of privately owned residential lots currently have individual booster pumps to connect to the municipal collection system. Also, a privately owned lift station serves several lots along SW Tualatin-Sherwood Road, and there are also several lots with privately owned on-site septic systems within the City.

The existing municipal sanitary sewage collection system serving the study area includes approximately 55.7 miles of gravity sewer divided into two major drainage basins. Roughly 70 percent of the collection system is constructed of polyvinylchloride (PVC) pipe. The remainder (30 percent) is mostly a mix of concrete sewer pipe (CSP) and reinforced concrete sewer pipe (RCSP) with nominal lengths of other materials. Much of the system piping has been installed since the population growth starting in the 1990's.

The City has two major drainage basins, each served by a trunk sewers conveying waste north to the Sherwood Pump Station operated by CWS. The pump station passes flow through the Upper Tualatin Interceptor and ultimately reaches the Durham AWWTP.

Existing Deficiencies

The collection system is known to have isolated problem areas. Problems include root intrusion, grease build-up, recurring manhole flow restrictions, 6-inch diameter pipes difficult to inspect and maintain, and service laterals with flow restrictions. Unsewered areas to the north and south of roughly Pine Street and Sunset Boulevard require connection to the system. These deficiencies are addressed by the recommended systems improvements.

Design Flow Development

The evaluation of the existing sanitary sewer facilities and the planning of new systems to serve the fully developed study area require that forecasts of future wastewater flow rates be determined. The normal components of total wastewater flow rates in a City sewer system may include domestic, commercial, industrial, and institutional as well as extraneous storm water such as infiltration and inflow (I&I). This analysis estimated wastewater contributions from areas with land uses designated as Industrial, Commercial, Residential and Institutional/Public.

The CWS unit design flows from the 2000 Clean Water Comprehensive Plan were referenced as part of the plan update. The unit flows, which represent dry weather flows, were determined from an analysis of land use and service area flows documented in the CWS 1995 Collection System Needs Analysis. The CWS unit design wastewater flows for residential, commercial, and industrial flows are presented in Table ES-2. No large point sources, and no areas zoned Heavy Industrial, are identified in the Sherwood Service Area.

Table ES-2
CWS Unit Design Wastewater Flows

Description	Design Flows
Single Family Residential	67 gpcd
Multi-Family Residential	87 gpcd
Mixed Use	87 gpcd
Mixed Use Employment Area	3,660 gpad
Commercial	3,660 gpad
Institutional/Public	3,660 gpad
Industrial	3,660 gpad
Heavy Industrial	7,320 gpad
Noncontributing	--

Notes: gpcd: gallons per capita per day
gpad: gallons per acre per day

Design flow criteria and analysis methodology were reviewed to be consistent with CWS practices where applicable. The review found that the design flow criteria established by the CWS Sewer Master Plan Update (2000) for the entire Durham Treatment Facility service area overestimated the historical dry weather flows passing through the Sherwood Pump Station. Design flow criteria specific to Sherwood were then developed to represent the existing sanitary flows. Infiltration and inflow values were calibrated using continuous flow monitoring data for 2006 and 2007. The more conservative CWS flow criteria were used for developing industrial and commercial areas. A summary of the design flows used is presented in Table ES-3.

Table ES-3
Model Design Flows

Contributing Flow	Design Flow
Sanitary flows: All Existing Land Uses	71 gallons per capita per day
Infiltration and Inflow: Peak rate	1970 gpad apportioned to pipes by inch-diameter times length weighting factor
Sanitary flows: Future Residential Land Use	71 gallons per capita per day
Sanitary flows: Future Commercial Land Use	3,660 gallons per acre per day
Sanitary flows: Future Industrial Land Use	3,660 gallons per acre per day

Analysis

Methodology

Analysis of the sanitary sewer system capacity used a hydraulic grade line (HGL) approach. For consistency with CWS analysis and planning, the Hydra software (version 6.4) was used to conduct the HGL analysis. The Hydra approach to the HGL analysis differs from some traditional HGL approaches in that it does not use the traditional peaking factor method for sanitary flows. Sanitary flows are instead routed through the system over a 24-hour period scaling the average dry weather flow by a diurnal time-series curve that simulates actual system flows over a design day. The Hydra approach looks at the combined loading from sanitary flows, steady wet-weather infiltration, and storm induced inflows and infiltration.

Surcharging Severity Ranking

Evaluation of the existing wastewater collection system was performed using a ranking system developed by CWS to determine the severity of sanitary sewer surcharging problems. The ranking system was first developed as part of the CWS 1995 *Collection System Needs Analysis*. As part of the development of the recommended Capital Improvement Plan (CIP), the ranking severity of surcharging potential was used to prioritize capital improvements related to increasing system capacity.

Modeling Results

The system was found to be adequate to handle the existing design flows. A single pipe (City ID # 20Ssan) was found to surcharge--but not overflow--and did not rank high enough to recommend improvements due to the height of the freeboard (11 feet). The buildout or saturation development condition showed surcharging over the CWS sewer trunks, the City owned portion of the Rock Creek Trunk, the facilities where the Area 54/55 development was connected to the system, and at some places where the collectors feed into the surcharging trunks. The CWS trunk line capacity deficiencies under build-out conditions were also identified in the 2000 CWS Sewer Master Plan Update. A subsequent analysis was conducted wherein the trunk surcharging was eliminated by upsizing the trunks. This analysis showed that most of the collector pipe surcharging was due to the surcharging in the trunks. The remaining problem areas were associated with the connections to the new development in Areas 48 and 54/55.

Recommended System Improvements

Basis of Cost Estimates

The recommended CIP identifies projects and presents estimated project costs. Project costs are based on unit costs developed from recent experience with construction costs for similar work in the area, and assume the work will be completed by private contractors using

prevailing wages. These unit costs include an aggregate 45-percent allowance over the estimated construction cost to provide for contingencies, engineering, legal and administrative costs. Table ES-4 presents these unit costs for piping installed in both improved and unimproved areas.

Table ES-4
Collection Piping Unit Cost Summary

Pipe Diameter, inches	Project Cost, $/linear foot (Unimproved Areas)	Project Cost, $/linear foot (Improved Areas)
8	$186	$211
12	$201	$227
15	$212	$238
18	$248	$279
24	$272	$303

Project costs are presented in 2007 dollars. Since construction costs change periodically, an indexing method to adjust present estimates in the future is useful. The Engineering News Record (ENR) Construction Cost Index (CCI) is an index commonly used for this purpose. For future reference, the April 2007 ENR CCI of 8,629 for the Seattle area construction market (the nearest market ENR monitors) was used for construction cost estimates in this report.

Capital Improvement Plan

Recommended system improvements are divided into System Capacity Improvements, which are necessary to increase collection system capacity, and System Rehabilitation Improvements, which are intended to rehabilitate or replace deteriorating facilities. Recommended system improvements are presented in Table ES-5 and are illustrated on Plate 1 in Appendix C.

Table ES-5
Recommended Capital Improvements

Project No.	Project Category	Project Location	Size (inch)	Length (feet)	Unit Cost ($/linear foot)	Estimated Project Cost ($)
1	Collection System Extension	Area 59	15	3,730	$238	$887,740
2	Capacity Upgrade	Area 54/55	18	537	$248	$133,176
3	Capacity Upgrade	Area 54/55	15	533	$212	$112,996
4	Collection System Extension	Area 54/55	15	3,875	$238	$922,250
5	Collection System Extension	Area 54/55	12	2,555	$201	$513,555
6	Capacity Upgrade	Rock Creek Trunk	18	1,436	$248	$356,128
7	Capacity Upgrade	Rock Creek Trunk	24	1,349	$272	$366,928
8	Capacity Upgrade	Area 48 North	12	3,011	$227	$683,497
9	Collection System Extension	Area 48 North	12	3,280	$227	$744,560
10	Collection System Extension	Area 48 South	15	2,650	$238	$630,700
11	Rehabilitation	SW Willamette St. at Orcutt Place	8	362	$211	$76,382
12	Rehabilitation	SW Willamette St. at Highland Drive	8	592	$211	$124,912
13	Rehabilitation	SW Gleneagle Drive	8	145	$211	$30,595
14	Rehabilitation	SW Washington St.	8	250	$211	$52,750
15	Rehabilitation	SW Schamburg Dr. at Division	8	1,162	$211	$245,182
16	Rehabilitation	SW Sunset Blvd.	8	800	$211	$168,800
17	Rehabilitation	SW Pine/SW Park.	8	362	$211	$76,382
18	Rehabilitation	Old Town Laterals	-	-	-	$40,000
19	Rehabilitation	Ash Street Manhole	-	-	-	$10,000
					Total	**$6,176,533**

Project Scheduling

Based on conversations with City staff and private consultants developing the concepts plans for Areas 54, 55, and 59, the following planning level project prioritization was developed.

- Project 1 - Area 59: 2007 to 2008.
- Projects 2 to 5 - Area 54/55: 2009 to 2012.
- Projects 6 to 10 - Rock Creek Trunk and Area 48: 2013 to 2022.
- Projects 11 to 19 – Rehabilitation projects: 2007 to 2011.

CWS Trunk Upsizing

Hydraulic modeling indicated that under future build-out conditions, two of the primary Clean Water Services (CWS) trunk sewers that convey wastewater to the Sherwood Pump Station are undersized and will need to be upsized to accommodate projected future flows. These improvements are consistent with capacity improvements identified by the CWS 2000 Sewer Master Plan Update. Since CWS owns and maintains these facilities, costs for these projects are not included in the City's capital improvement plan, but will be included in the CWS capital improvement plan.

System Operation, Maintenance, and Rehabilitation

The City has a tremendous investment in the infrastructure and equipment which comprise the sanitary sewer collection system. To protect this investment and obtain full useful life of these facilities, a program for operation, maintenance and rehabilitation of the system is necessary. A sanitary sewage collection system functions to transport wastewater from the points of their origin to a treatment facility. To ensure the public safety, it is critical that no release of wastewater from the collection system be allowed to occur. A plan and recommendations are presented for

- Management and operation of the system;
- Preventative and ongoing maintenance;
- Rehabilitation of aging elements;
- Record keeping and incidence reporting.

Financial Evaluation Overview

The purpose of the financial evaluation is to provide reasonable assurance that the City's Sanitary Fund has and will have the financial ability to maintain and operate the wastewater system on an ongoing basis, plus have the capacity to obtain sufficient funds to construct the wastewater system improvements as identified in the Master Plan.

In completing the financial evaluation, the historical financial performance of the Sanitary Fund was documented; capital funding options available for wastewater system projects identified; a capital funding strategy for the Capital Improvement Program (CIP) was developed; and revenue requirements and customer impacts considering the "total system" costs of providing wastewater service, operating and capital, were determined.

A number of forecast assumptions were used in the analysis:

- Rate revenue (under existing rate levels) was calculated to increase with growth in future years, which is projected to average 3.72 percent per year (consistent with those used in this Plan for facility planning purposes). The analysis incorporates Clean Water Services proposed 3.5 percent rate increase for FY 2007/08.
- Operations and maintenance expenses (O&M) were escalated assuming general inflation of 3.0 percent per year and labor inflation of 5.0 percent per year. Clean Water Services treatment costs are planned to increase in proportion to growth plus 3.5 percent escalation.
- In addition to O&M expenses, the revenue requirement included debt service costs and rate-funded system reinvestment (depreciation) funding.
- Revenue bond debt financing terms included a 20-year repayment term, 5.0 percent interest cost and 2.0 percent issuance cost.

Table ES-6 summarizes the financial performance and rate requirements for FY 2006/07 through FY 2012/13. Based on the analyses presented herein, the Sanitary Fund can meet its forecasted operating and capital funding needs with annual inflationary-level revenue increases. Thus, the Capital Improvement Program is considered affordable. The FY 2008/09 increase of 6 percent incorporates a recommended policy of funding depreciation expense through rates, in addition to the inflationary adjustment. The City is currently undergoing a rate and SDC study to update rates and charges consistent with current costs and City policies. Results of that study could alter the rate strategy presented herein, although it is not anticipated to be materially different.

The average residential wastewater bill is currently $29.62 per month. It is forecast to increase to $36.03 / month by FY 2012/13 and to $55.56 by FY 2026/27. These rates remain well within the 1.5 percent median household income affordability index for utility bills. Table ES-7 summarizes the 6-year rate forecast.

This analysis does not include evaluation of the financial impacts of shared Clean Water Services capital projects.

Table ES-6
Revenue Requirements

	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13
Revenue							
Rate revenue under existing rates	$ 2,123,000	$ 2,279,147	$ 2,364,038	$ 2,452,090	$ 2,528,828	$ 2,607,967	$ 2,689,583
Use of SDCs for debt service	-	-	-	-	-	-	-
Non-rate revenue	38,646	40,162	17,040	17,012	18,416	21,971	24,811
Total annual revenue	$ 2,161,646	$ 2,319,309	$ 2,381,078	$ 2,469,102	$ 2,547,244	$ 2,629,938	$ 2,714,394
Materials and Services							
Professional & technical	$ 1,380,398	$ 1,707,600	$ 1,833,194	$ 1,968,027	$ 2,100,652	$ 2,242,215	$ 2,393,318
Facility & equipment	10,000	11,208	11,544	11,891	12,247	12,615	12,993
Other purchased services	84,895	118,000	121,540	125,186	128,942	132,810	136,794
Supplies	9,500	10,304	10,613	10,932	11,259	11,597	11,945
Minor Equipment	16,000	46,000	47,380	48,801	50,265	51,773	53,327
Non-Capitalized Vehicles	-	40,000	41,200	42,436	43,709	45,020	46,371
Reimbursements	150,298	225,451	236,724	248,560	260,988	274,037	287,739
	$ 1,651,091	$ 2,158,563	$ 2,302,195	$ 2,455,832	$ 2,608,063	$ 2,770,068	$ 2,942,487
Other Expenditures							
Debt Service	$ 38,098	$ 38,098	$ 38,302	$ 39,573	$ 77,606	$ 122,432	$ 151,500
Rate-Funded System Reinvestment	-	-	76,058	87,169	84,853	89,202	104,750
Transfers Out (shared capital)	93,000	106,725	109,927	113,225	116,621	120,120	123,724
Additions to meet minimum fund balance	-	-	-	-	-	-	-
	$ 131,098	$ 144,823	$ 224,287	$ 239,966	$ 279,080	$ 331,755	$ 379,974
Total annual rate-funded expenditures	$ 1,782,189	$ 2,303,386	$ 2,526,482	$ 2,695,798	$ 2,887,143	$ 3,101,823	$ 3,322,461
Annual Surplus (Deficiency)	$ 379,458	$ 15,923	$ (145,404)	$ (226,696)	$ (339,899)	$ (471,884)	$ (608,067)
Annual Rate Increase	**0.00%**	**0.00%**	**6.00%**	**4.00%**	**4.00%**	**3.00%**	**4.00%**
Cumulative Rate Increase	**0.00%**	**0.00%**	**6.00%**	**10.24%**	**14.65%**	**18.09%**	**22.81%**

Table ES-7
Current Rates Projected with Across-the-Board Increases

	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13
Rate Increase		**6.00%**	**4.00%**	**4.00%**	**3.00%**	**4.00%**
Fixed Charge - per Month						
	$19.11	$20.25	$21.06	$21.91	$22.56	$23.46
Volume Charge - $ / CCF Winter Average Water Use						
	$1.314	$1.393	$1.449	$1.507	$1.552	$1.614

** includes 3.5% 2007/08 rate increase per Clean Water Services.*

SECTION 1
INTRODUCTION

Authorization

On November 21, 2006 the City of Sherwood (City) authorized Murray, Smith & Associates, Inc. (MSA) to prepare this Sanitary System Master Plan for the City.

Background

The City of Sherwood is located south of the Tualatin River, approximately 15 miles southwest of Portland along State Highway 99W. The City of Tualatin is adjacent to the City to the east. Sherwood shares wastewater management responsibilities with Clean Water Services (CWS) through a "Large City" Intergovernmental Agreement (IGA). Under the IGA, Sherwood is referred to as a "self-service provider" and is responsible for specific sanitary sewer system functions within the City limits. These functions include system maintenance and other associated functions of the wastewater collection system to be provided in accordance with CWS standards. CWS assumes responsibility for wastewater treatment. The City of Sherwood service area was included under the recent EPA/DEQ Watershed Based NPDES Permit issued to CWS.

Under the IGA, the City owns, operates and maintains the wastewater collection system within City limits. Wastewater is collected from residential, commercial, and industrial services and is discharged into interceptor sewers owned and operated by CWS. Wastewater is then pumped by CWS for treatment at their Durham Advanced Wastewater Treatment Facility located in the City of Tigard. The City is responsible for all wastewater collection piping smaller than 24 inches in diameter located within the City limits, and CWS owns and maintains interceptor sewers 24 inches and larger, as well as all pump stations and force mains.

The City of Sherwood has undertaken this Sanitary System Master Plan to evaluate its sanitary sewer system in light of current and future anticipated population growth within the City. The most recent sanitary sewer plan update was prepared for the City in 1991, when the City's population was approximate 3,000. Since that time, the City has experienced rapid population growth, reaching 16,115 by 2006. In recent years, several former Metro Urban Reserve Areas, referred to as Areas 48, 54, 55, and 59, were brought into the City's urban growth boundary (UGB). The City expects to continue to grow through development of the expanded UGB, as well as by continued infill and increased density within the current City limits. It is also anticipated that additional land will be brought in over the planning period.

Purpose

This plan will evaluate the wastewater collection system and make recommendations for improvements and upgrades throughout the City's facilities. Recommendations will be based on ultimate build out in the City and will include near-term and long-term projects that can

be incorporated into the City's Capital Improvement Program to provide adequate system capacity.

Study Area and Study Period

The study area for this plan includes all area within the City's current Urban Growth Boundary (UGB). The study period for this plan is to the year 2027.

Compliance

The City's Sanitary System Master Plan has been completed in accordance with Oregon Administrative Rules (OAR 660-011) and in coordination with the Clean Water Services 2000 Sewer Master Plan Update and 2007-2011 capital improvements program.

Scope of Work

The scope of work for this plan includes the following:

- ***Gather and Review Information*** -- Compile and review existing maps, as-builts, aerial maps, system base maps, City standards, studies, reports and other information pertaining to the physical wastewater collection system and study area. Review available information related to service area, land use, population distribution and historical wastewater flows.
- ***Develop Planning Criteria*** -- Develop criteria for analysis of existing sanitary sewer system and the design of future improvements. Criteria will be in conformance with current CWS requirements where applicable.
- ***Review Regulatory Requirements*** -- Review all applicable regulatory requirements that must be met by recommended improvements for wastewater collection and conveyance systems.
- ***Basin Delineation and Flow Projection*** -- Delineate sewer service basins and sub-basins. Confirm previous basin configurations developed as part of previous planning and expand the delineations to include new existing areas, including the recent expansions to the UGB (Areas 48, 54, 55, and 59). Develop sewage contributions for each basin and sub-basin.
- ***Develop Sanitary System Map*** -- Develop a comprehensive map of the City's wastewater collection system, including CWS interceptor sewers, pumping station and force main, showing both existing and proposed wastewater facilities. The map will be used to present plan recommendations for system improvements.
- ***Develop Wastewater Collection System Hydraulic Model*** -- Develop a hydraulic model of the collection system to determine relative capacities and identify potential restrictions that may pose problems with future UGB development. Computerized modeling will be conducted using the HYDRA flow analysis software program.

- ***Conduct Infiltration and Inflow (I&I) Assessment*** -- Evaluate historic flow records in comparison to recent records, to assess potential I&I impacts. Review existing CWS flow monitoring information. Collect data from City staff regarding known deficient areas contributing to I & I. Recommend an I&I correction plan based upon the evaluation of flow information and the nature of the I&I.
- ***Develop System Improvements Alternatives*** -- Analyze and identify potential wastewater facility collection and conveyance alternatives and select the most viable alternatives for further analysis.
- ***Conduct Environmental Review*** -- Conduct an appropriately scaled environmental review throughout the development of alternatives to identify significant environmental issues and/or fatal flaws with the various project alternatives under consideration. The review will consider a number of relevant factors including but not limited to: land use, noise, air quality, wetland and vegetation, water quality, biological resources and cultural resources.
- ***Develop Recommended System Improvements*** -- Develop recommended wastewater collection system facilities improvements which correct existing deficiencies and provide the required ultimate capacity. Improvements will include gravity sewers, pumping stations, and force mains as necessary to collect sewage to a common point in the system.
- ***Prepare Capital Improvement Plan*** -- Develop a proposed Capital Improvement Plan (CIP) for the recommended improvements. The plan will consist of a list of recommended improvements, budget level project cost estimates for each proposed improvement, and the recommended schedule for implementing the improvements.
- ***Review Funding Structure*** -- Review current sanitary sewer system fees and charges relative to identified system improvement needs. Work with City staff to identify, analyze, and agree on key policy issues such as system development charge (SDC) objectives and rate structure options. Review capital improvement financing strategies and identify an overview of potential funding opportunities and sources identified. Also review Sherwood's existing funding mechanisms encompassing operations and maintenance (O&M) and CIP recommendations.
- ***Complete a Sanitary System Rate and System Development Charge Study*** -- Provide updated rate and SDC studies for the sanitary system CIP recommendations. Conduct a study that will include revenue requirement analysis, cost of service analysis, rate design and SDC analysis. This Rate and SDC study will be published as a separate, stand alone document after completion of the Sanitary System Master Plan.
- ***Prepare Sanitary System Master Plan Document and System Plan Map*** -- Prepare a sanitary system master plan report that documents and describes the planning and analysis work efforts, including a color map identifying all existing and proposed sanitary system facilities.

SECTION 2
STUDY AREA CHARACTERISTICS

General

This section presents a discussion of the City of Sherwood (City) study area and its physical features, land uses and development characteristics relative to the preparation of this Sanitary System Master Plan. The City of Sherwood (City) service area population is also reviewed, with population forecasts developed for the identified planning period. The vicinity map shown on Figure 2-1 illustrates the City's location within the Portland Metropolitan area.

Study Area

The boundary for the study area is the City's Urban Growth Boundary (UGB), as defined by the City's Zoning & Comprehensive Plan Map. The City currently provides sanitary sewer service only to the area within the City limits. The future sanitary sewer service area identified for this plan includes only the area enclosed within the established UGB. The City does not currently provide sanitary sewer service to several former Metro Urban Reserve Areas, referred to as Areas 48, 54, 55, and 59, that were recently brought into the City's UGB. Where sanitary sewer service is not currently provided within the UGB, wastewater system improvements will be constructed as the City develops, to provide for full planned development.

The study area contains a total of approximately 3,300 acres. This total includes approximately 390 acres of existing dedicated railways and roadways. Surface transportation to the City is provided by Interstate 5, Tualatin-Sherwood Road, and Highway 99. The Southern Pacific Railroad also passes through the City limits. A detailed discussion of land use is presented later in this chapter. Within the study area, two sanitary sewer system basins have been identified as shown on Plate 1 in Appendix C.

Physical Environment

Topography

Ground elevations in the study area range from approximately 140 feet above mean sea level (MSL) near the northern boundary, and rise to the south, to approximately 430 feet above MSL along the hills to the southeast. Most of the City is near an elevation of 180 to 260 feet with gentle slope (0 to 6 % slopes). Slopes are greater near the hills and creek banks, ranging up to 15 to 25%. The study area topography is shown on Plate 1 in Appendix C.

Climate

The climate of the study area is greatly tempered by Pacific Ocean winds and is characterized by mild, wet winters and warm, dry summers. The Oregon Climate Service reports mean

monthly temperatures for the Willamette Valley from the years 1971 to 2000 ranging from 57 to 80 degrees Fahrenheit (ºF), with daily extremes of 8º and 107ºF.

Average annual rainfall for the study area is 37 inches, with roughly 75 percent of the precipitation accumulating as rain during the six months of October through March. Extreme 24-hour winter storm precipitation ranges from 2.0 to 2.6 inches. Snowfall is light, averaging 4 inches or less annually. Precipitation data for the study was obtained from the United States Geologic Services (USGS) rain gage at the Durham Treatment Facility, which is the closest monitored location.

Geology, Soils and Groundwater

Soils in the study area are generally comprised of alluvium overlying Columbia River basalt. The Natural Resources Conservation Service (NRCS) identifies the soils within the City limits as clay loams, silt loams, and loams. Within Areas 54 and 55, the soils are primarily Aloha and Huberly silt loams in the flatter sections, and Quatama loam in steeper sections. Within Area 59, the soils are various silt loams. The portion of Area 48 located within the study area is roughly composed of half silt loam, and half Xerochrepts-Rock outcrop complex, an exposed basalt formation. There are some areas in Sherwood that are underlain by sandy deposits with varying depths. These areas are typically close to wetland areas and are largely undiscoverable without adequate soil testing.

Surface water hydrology is relatively consistent within the study area, and is influenced by seasonal rainfall. Generally groundwater is well below the surface and does not normally impact construction. However, there are some areas in Sherwood where seasonal groundwater can be very near the surface and may impact construction during the wet weather season. The Old Town area of central Sherwood is an example where the depth of seasonal groundwater may vary from 2 to 20 feet below the surface, depending on the location. It is recommended that groundwater investigations be undertaken prior to construction in these areas to identify and address groundwater issues. Two perennial streams, Cedar Creek and Rock Creek, flow through the City. Areas along Cedar Creek and Rock Creek are located within the 100-year flood plain boundary, as defined by the Federal Emergency Management Agency (FEMA). Several tributaries to these creeks are also within the 100-year flood plain. North of the City limits, much of the Tualatin River National Wildlife Refuge (Refuge) is within the 100-year flood plain. This area typically has saturated soils year round. The existing Clean Water Services (CWS) 24-inch diameter interceptor sewer carrying wastewater from Sherwood passes through this Refuge area.

Land Use

General

All land within the study area has been assigned City of Sherwood land use designations. Present and future development is guided by these designations which are established under

the City's Comprehensive Plan. The City's land use designations provide for various categories of industrial, employment, commercial, and residential development. Land use information was used as the basis for analyzing and projecting sanitary sewer flows for the collection system. Table 2-1 summarizes land uses and zoning classifications for the study area. Zoning classifications identified in Table 2-1 are in accordance with the Comprehensive Plan designations, and the Sherwood Plan and Zone Map. Figure 2-2 illustrates the current land uses within the study area. After the study analyses were completed, Area 59 was annexed.

Table 2-1
Land Use Summary

Zone	Zoning Description	Area within City UGB (acres)
VLDR	Very Low Density Residential	105
LDR	Low Density Residential	762
MDRL	Medium Density Residential – Low	186
MDRH	Medium Density Residential – High	192
HDR	High Density Residential	161
NC	Neighborhood Commercial	1
OC	Office Commercial	17
OR	Office Retail	0
RC	Retail Commercial	97
GC	General Commercial	80
LI	Light Industrial	231
GI	General Industrial	260
IP	Institutional/Public	142
	UGB Expansion Area 48	306
	UGB Expansion Area 54 & 55	247
	UGB Expansion Area 59 (annexed 5/07)	89
	Other Non-Annexed Areas in UGB	34
	Existing Rights-of-Way	390
	Total	**3,300**

Note: Land use is based on the City Comprehensive Plan including recent UGB expansion areas.

Residential Land Use

Existing residential development within the City limits is currently intermixed with some undeveloped tracts of land. Approximately 100 acres of the 1406 acres zoned as residential are undeveloped. This undeveloped land is made up of approximately 31 acres zoned as Very Low Density Residential (VLDR), and 69 acres zoned as Medium Density Residential, Low (MDRL). The current number of residential units is approximately 5,465. It is also anticipated that UGB expansion areas 54, 55 and 59 will be zoned primarily for residential development.

The total number of residential dwelling units at projected build-out was calculated based on saturation development, which includes development of vacant land to the maximum density per acre allowed for the applicable zoning designation as defined by the City of Sherwood's Zoning and Development Code plus future redevelopment of existing developed areas to the maximum density per acre allowed. The projected number of residential units at build-out or saturation development is 13,550.

Commercial Land Use

Commercially zoned land exists primarily along Highway 99 and within the Old Town District. While most of the commercial zoning classification is general and retail, some office commercial zoning is located on the south side of Highway 99, north of Sunset Blvd.

Industrial Land Use

The primary industrial zoned area is located along SW Tualatin-Sherwood Road east of Highway 99W, and along Highway 99W northeasterly of its intersection with SW Roy Rogers Road and SW Tualatin-Sherwood Road. Of the four former Metro Urban Reserve Areas recently brought into the UGB, Area 48 located adjacent to existing industrial zoned land, offers the most likely expansion of industrial development. Based on Oregon Department of Revenue data, existing uses within Area 48 include primarily residential uses, with some commercial, industrial, rural, public and undeveloped. Area 48 planning will likely follow the direction identified in the prior City of Tualatin/City of Sherwood Quarry Area Concept Planning project, which proposes primarily industrial uses for Area 48. The total acreage of Area 48 that will be included in the study area is approximately 306 acres, using the UGB boundary and the City's proposed 124th Street divider boundary line as the assumed delineation. As there is a potential for industrial development in these areas, industrial level water usage is factored into the flow generation analysis presented in this study.

Socio-Economic Environment

Population Estimates

Estimates of the existing and proposed population within the study area were developed through a review of existing City of Sherwood planning data, previous water system supply planning efforts, population forecast data developed by Metro for the region's water suppliers and Portland State University population forecasts. Estimates of the existing population and total number of dwelling units were developed through an analysis of City of Sherwood planning data.

Current Population

Historical population estimates were obtained through the analysis of data provided by the City of Sherwood and the Center for Population Research and Census (CPRC) at Portland State University. The CPRC data represents estimates of Sherwood's population inside the existing City limits on July 1 of each year. Population estimates for the beginning of each decade are based on census counts published by the U.S. Census Bureau, while annual estimates between the census counts are derived by analyzing supplemental data, including economic changes, building permits issued, and annexations. Table 2-2 presents a summary of these historical population estimates from 1996 through 2006. The average annual growth rate over this period was approximately 8.9 percent. The most current population figures for 2006 placed the City's population at 16,115 residents.

Table 2-2
Historical and Current Population Summary

Year	Population	Percent Change
1996	6,900	
1997	8,125	17.8%
1998	9,100	12.0%
1999	9,855	8.3%
2000	12,230	24.1%
2001	12,840	5.0%
2002	13,680	6.5%
2003	14,050	2.7%
2004	14,190	1.00%
2005	14,940	5.29%
2006	16,115	7.86%

Economic Conditions and Trends

Economic conditions within the City and general area indicate steady future growth in the City should be anticipated. The City's downtown district has recently undergone renewal

and significant new residential and commercial areas have been developed in the last decade. Further commercial and industrial growth should be anticipated as the prospective industrial development of Area 48 proceeds.

Land Use and Build-out

The City of Sherwood's Zoning and Development Code was the source of land use projections that were used for development of this study. The plan projects zoning within the UGB until full build-out. Most of the vacant buildable land is located in former Metro Urban Reserve Areas that were recently brought into the City's UGB. Of these areas, Area 59 and Areas 54 and 55 (the Brookman Addition) will likely include new residential zones, while Area 48 is anticipated to be zoned predominantly industrial. Build out may also include localized redevelopment, development of unimproved Planned Unit Development (PUD) zones, and infill city wide where possible.

Population Forecasts

Population forecasts at saturation development for the study area have been developed and are summarized in Table 2-3. The anticipated saturation development population data were developed based on a detailed review of data available from the Metro Regional Land Information System (RLIS). A detailed discussion of the methodology used to develop an ultimate population projection for the service area is discussed below.

Population forecasts at saturation development for the study area were developed by analyzing present zoning classifications for all developed and undeveloped residential areas within the UGB. Residential land use designations include VLDR, LDR, MDRL, MDRH and HDR as identified previously in Table 2-1.

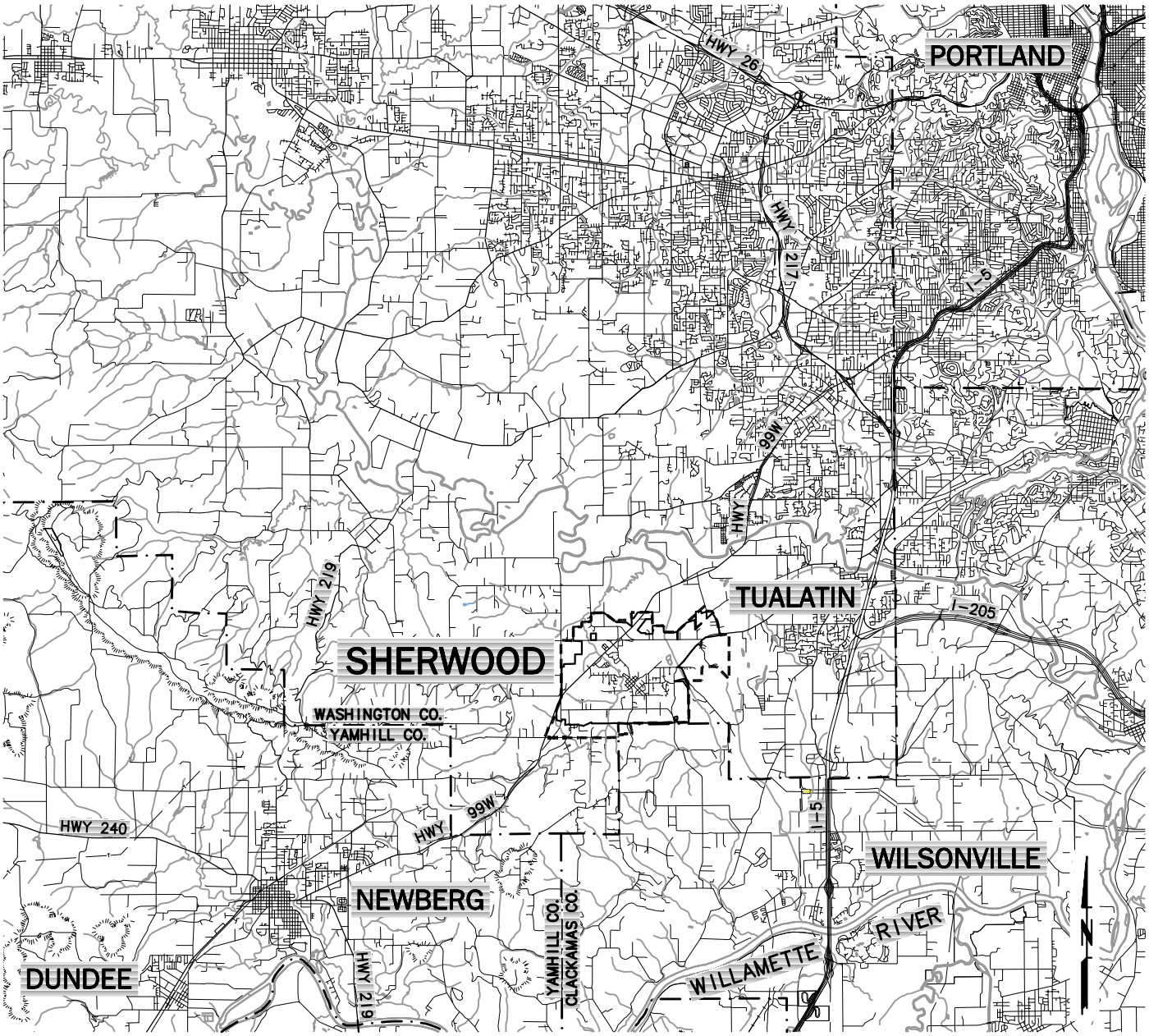
The total number of residential dwelling units anticipated at saturation development was determined by multiplying the total area available for each zoning designation by the maximum density per acre for that zoning designation as defined by the City of Sherwood's Zoning and Development Code. For the Urban Growth Boundary expansion areas 54, 55 and 59, the City's previous estimates provided during the water master planning were followed, resulting in the assumption that approximately 270 acres, or 73% of the total 370 acres, will be available for residential development. A reduction factor of 20 percent was then applied to this available land area to account for right-of-ways, stream corridors and open spaces. Pursuant to Metro Code 3.07.1120(C), planning for residential densities in UGB expansion areas assumed a minimum of 10 dwelling units per net developable residential acre. The approach to address Area 48 planning follows the direction identified in the prior City of Tualatin/City of Sherwood Quarry Area Concept Planning project, which proposes primarily industrial uses for Area 48, therefore no future residential development was anticipated. The estimated total population at saturation development was then determined by multiplying the anticipated average number of persons per household, from City, Metro and Census 2000 data, by the total number of dwelling units calculated.

Table 2-3 presents a population forecast summary in 5 year increments through 2025. The saturation development population previously developed is also presented. Based on the estimated population growth rates, it is estimated that the City's sanitary system service area, as defined by the current UGB, will approach saturation development, or build-out conditions in approximately 2040.

Table 2-3
Population Forecast Summary

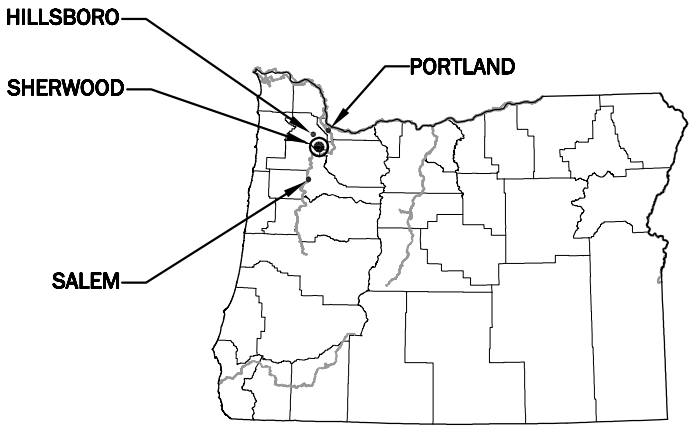
Year	Population
2005	14,940
2010	18,970
2015	22,130
2020	25,290
2025	28,450
Build-out (approx. 2040)	37,940

For sanitary system planning purposes, it is prudent to use the build-out population forecasting methodology. This methodology provides for the most economical development of sanitary system infrastructure improvements by assuming full occupancy at build-out conditions allowing for actual development to progress without incurring additional costs for facility duplication.



VICINITY MAP

SCALE: 1"=15,000'



OREGON

Figure 2-1

City of Sherwood Oregon

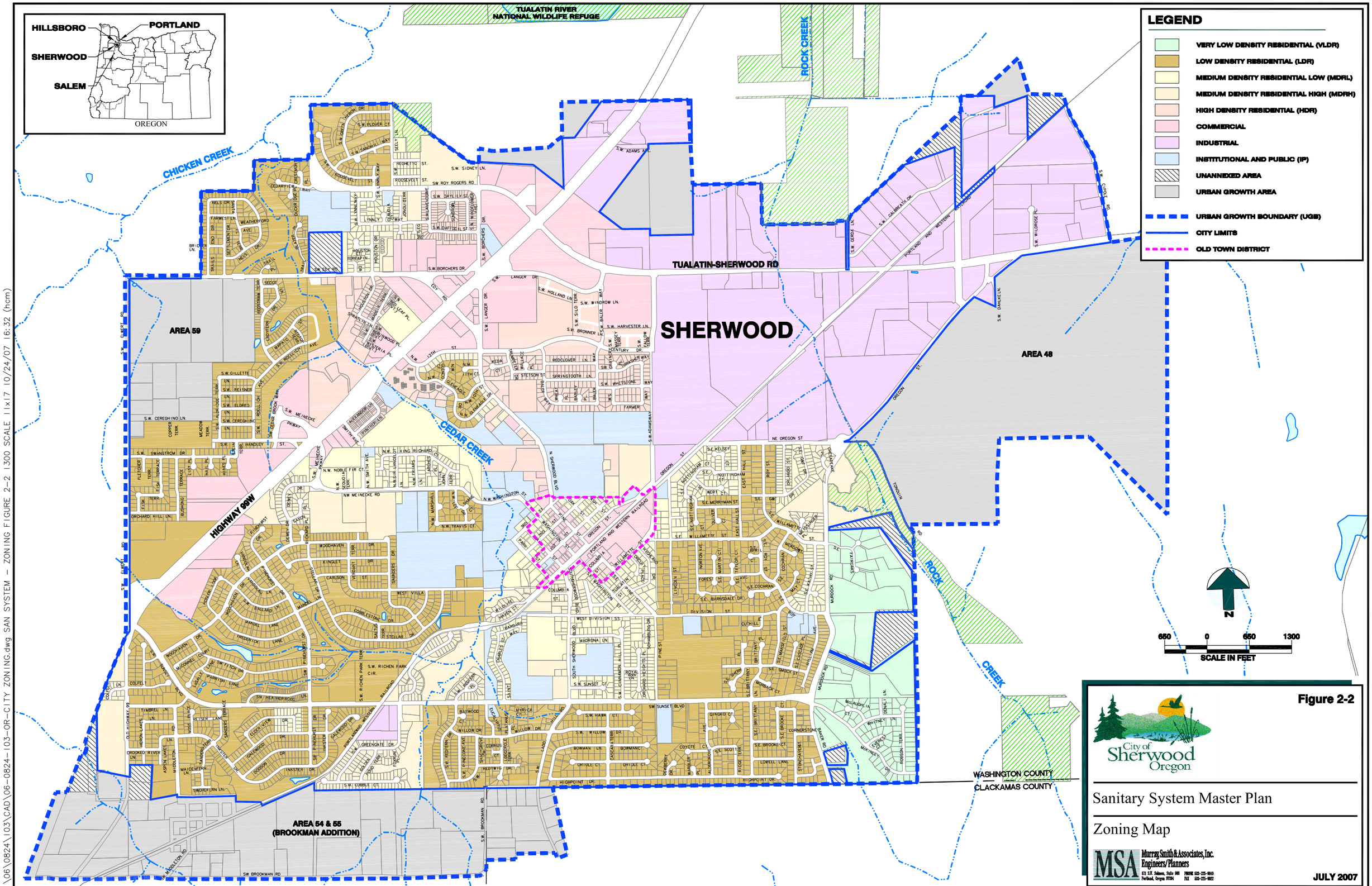
Sanitary System Master Plan

Vicinity Map

MSA Murray, Smith & Associates, Inc. Engineers/Planners
121 S.W. Salmon, Suite 900 Portland, Oregon 97204 PHONE 503-225-9010 FAX 503-225-9022

JULY 2007

G:\06\0824\105\CAD\06-0824-105-OR-VICINITY MAP.dwg FIGURE 2-1 10/24/07 16:29 (hcm)


HILLSBORO
PORTLAND
SHERWOOD
SALEM
OREGON
TUALATIN RIVER NATIONAL WILDLIFE REFUGE
ROCK CREEK
CHICKEN CREEK
CEDAR CREEK
ROCK CREEK
SHERWOOD
TUALATIN-SHERWOOD RD
HIGHWAY 99W
AREA 59
AREA 48
AREA 54 & 55 (BROOKMAN ADDITION)
WASHINGTON COUNTY
CLACKAMAS COUNTY
LEGEND
VERY LOW DENSITY RESIDENTIAL (VLDR)
LOW DENSITY RESIDENTIAL (LDR)
MEDIUM DENSITY RESIDENTIAL LOW (MDRL)
MEDIUM DENSITY RESIDENTIAL HIGH (MDRH)
HIGH DENSITY RESIDENTIAL (HDR)
COMMERCIAL
INDUSTRIAL
INSTITUTIONAL AND PUBLIC (IP)
UNANNEXED AREA
URBAN GROWTH AREA
URBAN GROWTH BOUNDARY (UGB)
CITY LIMITS
OLD TOWN DISTRICT
N
650 0 650 1300
SCALE IN FEET
City of Sherwood Oregon
Figure 2-2
Sanitary System Master Plan
Zoning Map
MSA Murray, Smith & Associates, Inc. Engineers/Planners
121 S.W. Salmon, Suite 900 Portland, Oregon 97204
PHONE 503-225-9010 FAX 503-225-9022
JULY 2007
G:\06\0824\103\CAD\06-0824-103-OR-CITY ZONING.dwg SAN SYSTEM - ZONING FIGURE 2-2 1:300 SCALE 11x17 10/24/07 16:32 (hcm)

SECTION 3
EXISTING SANITARY SEWER SYSTEM

Wastewater Conveyance System Overview

Developed areas within the City of Sherwood are presently served by publicly owned sewage disposal facilities operated through an Intergovernmental Agreement (IGA) between the City of Sherwood and Clean Water Services (CWS). The City owns, operates and maintains the wastewater collection system within City limits, and CWS provides wastewater treatment. Under the IGA, the City owns, operates and maintains conveyance facilities smaller than 24-inches in diameter, while CWS owns and maintains the piping 24-inches in diameter and larger and all pump stations and forcemains. Wastewater is collected from residential, commercial, and industrial services and is discharged into interceptor sewers primarily owned and operated by CWS. Wastewater is then pumped by CWS for treatment at their Durham Advanced Wastewater Treatment Facility (Durham AWWTP). This study examines the City owned facilities, and includes a review of CWS conveyance facilities leading up to the Sherwood Pump Station. A copy of the IGA between the City and CWS is included in Appendix B.

City owned conveyance facilities do not currently include any pump stations. A small group of privately owned residential lots currently have individual booster pumps to connect to the municipal collection system. Also, a privately owned lift station serves several lots along SW Tualatin-Sherwood Road, and there are also several lots with privately owned on-site septic systems within the City.

Wastewater Collection System

The existing municipal sanitary sewage collection system serving the study area includes approximately 55.7 miles of gravity sewer divided into two major drainage basins. Table 3-1 summarizes the system pipe lengths and sizes, including CWS piping to the Sherwood Pump Station. Roughly 70 percent of the collection system is constructed of polyvinylchloride (PVC) pipe. The remainder (30 percent) is mostly a mix of concrete sewer pipe (CSP) and reinforced concrete sewer pipe (RCSP) with nominal lengths of ductile iron (DIP) pipe, cast iron (CIP) pipe, high density polyethylene (HDPE), and clay. Approximately one percent of the system has unreported or unknown material. Table 3-2 summarizes the system pipe materials by total length. Small portions of the City's collection system were constructed in the early 1900's. However, most of the system piping has been installed since the population growth starting in the 1990's.

Table 3-1
Existing Sewer Piping Size Inventory

Pipe Diameter (inches)	Pipe Length (feet)		
	Clean Water Services	City of Sherwood	Total
4	-	544	544
6	-	9440	9440
8	-	262159	262159
10	-	6840	6840
11	-	113	113
12	181	8531	8712
15	-	1701	1701
16	-	255	255
18	4626	4673	9299
20	-	12	12
24	18210	-	18210
Total, feet	23017	294268	317285
Total, miles	4.4	55.7	60.1

Table 3-2
Existing Sewer Piping Material Inventory

Pipe Material	Length, Feet	Length, miles	Percent of system
PVC	218062	41.3	68.7
Concrete	91299	17.3	28.8
Unreported	4247	0.8	1.3
Ductile Iron	1781	0.3	0.6
Cast Iron	888	0.2	0.3
HDPE	574	0.1	0.2
Clay	435	0.1	0.1
Total	*317285*	*60.1*	*100.0*

Unsewered Areas

Most of the developed land within the study area is currently served by City wastewater collection facilities. Exceptions include an area along Cottle Lane, a private road located south of SW Sunset Boulevard, and an area on SW Pine Street where several lots are served by private septic systems. It is anticipated that system upgrades will be needed to serve these areas and unsewered sections of the Urban Growth Boundary (UGB) expansion areas, which are currently undeveloped.

Undeveloped, unsewered areas were assumed to develop with reasonable system connection points based on available 20-foot topographic contours, existing line stubs, system capacity,

likely road alignment, and tax lot considerations. The proposed connection paths for undeveloped lots within sanitary subbasins are indicated on Plate 1 in Appendix C. CWS Design and Construction Standards (2007) Section 5.02 covers design standards for the extension of public conveyance systems.

Trunk Sewers and Facilities Outside of the City

Sherwood Trunk Sewer

The Sherwood Trunk Sewer conveys sewage from the Cedar Creek sewage collection basin to the Sherwood Pump Station. The 24-inch diameter trunk sewer is constructed of reinforced concrete sewer pipe and has a capacity flowing full of approximately 5.9 million gallons per day (mgd). The facility is owned, operated and maintained by CWS, in accordance with the IGA as describe previously in this section. The trunk sewer has operated without any known sanitary sewer overflows (SSO's).

For this study, the Sherwood Trunk Sewer is defined as the trunk sewer that originates at Sunset Boulevard, then travels north along the Cedar Creek Basin and extends to the Sherwood Pump Station. Calculations were made to estimate the capacity of the Sherwood Trunk under surcharged conditions without overflows at manholes/access ports.

Rock Creek Trunk Sewer

The Rock Creek Trunk Sewer conveys sewage from the Rock Creek sewage collection basin to the Sherwood Trunk Sewer prior to reaching the Sherwood Pump Station. The 18-inch diameter trunk is constructed of reinforced concrete sewer pipe and has a capacity flowing full of approximately 3.2 mgd. The City of Sherwood is responsible for maintaining the segment located within the City limits, and the outlying facilities are owned, operated and maintained by CWS.

The Rock Creek Trunk Sewer is defined as the trunk sewer that begins at Oregon Street and proceeds northerly along Rock Creek, intersecting the Sherwood Trunk Sewer just upstream of the Sherwood Pump Station.

Upper Tualatin Interceptor

The Upper Tualatin Interceptor delivers the City's sewage to the Durham AWWTP directly from the Sherwood Pump Station. It is owned, maintained and operated by CWS. The interceptor is approximately 6,800 feet in length and varies from 18 to 42 inches in diameter. The interceptor also collects and delivers sewage flows from King City, Tualatin, and Tigard to the Durham WWTP. An analysis of this interceptor is outside the scope of this study.

Sherwood Pump Station

The pump station referred to in this study is the Sherwood Pump Station, owned and operated by CWS. The Sherwood Pump Station is located along the north side of Highway 99 roughly 1,000 feet southwest of Kummrow Avenue. As described above, sewage flows are directed to the pump station through the Sherwood and the Rock Creek Trunk Sewers. Sewage is then pumped from Sherwood's collection system to the Durham AWWTP. Table 3-3 contains a summary of the Sherwood Pump Station features.

Table 3-3
Existing Pump Stations and Force Main Characteristics

Pump Station Feature	Sherwood Pump Station
Type	Wetwell/Drywell
Number of Pumps	2
Horsepower	150
Type of Pump	Vertical Non-clog
Force Main Size and Length	18-inch diameter, 2,800 feet
Pump Manufacturer	Cornell
Pumping Capacity per Pump	3,700 gallons per minute (5.3 mgd)
Total Dynamic Head	93 feet

Status of Conveyance System

As part of this plan, the operational condition of the existing sanitary sewer collection system was reviewed to identify potential known existing operations and maintenance (O&M) problems. This review included interviews with City of Sherwood and CWS maintenance staff responsible for operation and maintenance of wastewater conveyance facilities.

Gravity Collection System Operation

A summary of existing system deficiencies and O&M problem areas are as follows:

Cleaning

Observation of grease sediment buildup has been reported in several sewer mains that provide service to local restaurants. These include the 8-inch diameter sewer main located west of the intersection of SW Tualatin-Sherwood Road and SW Baler Way between Manhole 1770NSan and Manhole 1765NSan, and the 8-inch diameter sewer main extending from the 24-inch diameter Sherwood Trunk Sewer at Manhole 241NSan to the vicinity of SW Langer Drive at Manhole 1879NSan and Manhole 1884NSan. Cleaning is typically required twice annually to remove grease and sediment buildup from these gravity sewer mains.

Recurring Manhole Flow Restriction Maintenance Areas

Several areas were identified as having upstream manhole flow restriction problems that require regular maintenance flushing, in some cases on a weekly basis, to remove debris build-up and lateral back-up flows. These problems were reported at the following manhole locations:

- End of S.W. Keda Court cul-de-sac, Manhole 1575NSan.
- End of S.W. Wheat Place cul-de-sac, Manhole 1553NSan.
- End of S.W. Barley cul-de-sac, Manhole 1554NSan.
- Southwest corner of S.W. Farmer Way, Manhole 1544NSan.
- East end of S.W. Cobble Court, at cul-de-sac, Manhole 294NSan.
- S.W. Reghetto Street, just west of S.W. Lavender Terrace, Manhole 1188NSan
- North side of Tualatin-Sherwood Road, near the intersection with S.W. Adams Way, Manhole 1179NSan.

Manhole/Access Ports Sealing/Maintenance

Most of the manholes/access ports on the CWS interceptor trunk sewers located in the vicinity of the Refuge have been sealed. Manholes on the smaller 21-inch and 18-inch diameter trunk sewer, located south of the railroad and falling under the City's jurisdiction, are not accessible due to their location in an area that is flooded year round. The City does not provide maintenance to these inaccessible manholes that are bolted and sealed.

System Upgrades

While the City has no formal sewer replacement program, upgrades to existing sewers are coordinated with pending street improvements. Recent system upgrades were made at the following locations:

- Replacement of the 12-inch diameter main under the railroad tracks at Park Street.
- Replacement of the existing 8-inch diameter back-lot main, from Pine Street to east of Ash Street, completed as part of the Downtown Streetscape Project.

Existing system improvements under design are:

- Removal of the existing 12-inch diameter pipe northwest of 3rd Street and Washington Street. The flow is redirected through a new 12-inch diameter pipe from 3rd and Park Street to 3rd and Washington and replacement of the 8-inch diameter pipe from 3rd and Washington to existing manhole on Washington Street.
- New services running from approximately Farmer Way and Adams Avenue south under the railroad tracks and connecting with the facilities on Oregon Street.

Areas of Infiltration and Inflow (I&I)

Currently there are no significant areas of I&I within the City's wastewater collection system. The CWS trunk sewers located in the floodplain areas, are known to have some I&I issues.

Root Intrusion

There is a documented root intrusion problem along the City's 12-inch diameter sewer main that extends northerly from the intersection of SW Main Street and SW Columbia Street, to the junction with the 24-inch diameter trunk sewer located near NW Washington Street.

Other Maintenance Problem Areas

Several areas were identified as having various maintenance problems as noted below:

1. *SW Orcutt Place – 6-inch diameter sewer*
   - At Manhole 42NSan on SW Willamette Street, at intersection with SW Orcutt Way, TV inspection camera cannot pass upstream beyond a 25-foot pipe stub-out from this manhole to Orcutt Place, due to a grade change in the pipeline.
   - Manhole flows at this location are also impeded due to upstream flows from SW Willamette Street entering at a 90-degree angle.
   - City staff suggested that the 6-inch diameter sewer on SW Orcutt Place be upgraded to an 8-inch diameter sewer

2. *SW Highland Drive – 6-inch diameter sewer*
   - At Manhole 1340NSan on S.W. Willamette Street, at intersection with SW Highland Drive, TV inspection camera cannot pass upstream beyond a 25-foot pipe stub-out from this manhole to SW Highland Drive, due to a grade change in the pipeline.
   - Manhole flows at this location are also impeded due to upstream flows from SW Willamette Street entering at a 90-degree angle.
   - TV inspection camera access is not adequate for the 6-inch diameter sewer on Highland Place.
   - City staff suggested that the 6-inch diameter sewer on SW Highland Drive be upgraded to an 8-inch diameter sewer.

3. *SW Gleneagle Drive – 6-inch diameter sewer*
   - TV inspection camera access is not adequate for the 6-inch diameter sewer on SW Gleneagle Drive, upstream of Manhole 1201NSan. TV inspection camera cannot pass upstream beyond this manhole.
   - City staff suggested that the 6-inch diameter sewer be upgraded to an 8-inch diameter sewer or corrections be made to the manhole. The existing pipe is 145 linear feet with 2 service connections.

4. *6-inch diameter sewer between SW 2nd Street and SW 3rd Street, Southwest of SW Washington Street*
   - TV inspection camera access is not adequate for the 6-inch diameter sewer located southwest of SW Washington Street, upstream of Manhole 341NSan. TV inspection camera cannot pass upstream beyond this manhole due to interference from an existing plastic pipe connection piece.
   - City staff suggested that the 6-inch diameter sewer be upgraded to an 8-inch diameter sewer or corrections be made to the manhole.

5. *12-inch diameter sewer crossing City Park*
   - Access is not adequate for the 12-inch diameter sewer located north of SW 3rd Street and SW Main Street, downstream of Manhole 331NSan. There is no access easement along this pipe section, so access is difficult.
   - City staff suggested that the 12-inch diameter sewer be re-routed along SW 3rd and SW Washington Street.

6. *Intersection of SW Schamburg Drive and SW Division Street - 6-inch diameter sewer*
   - The 6-inch diameter sewer located on SW Schamburg Drive, upstream of Manhole 918NSan is very shallow.
   - The 6-inch diameter sewer located on SW Division Street, downstream of Manhole 918NSan is very shallow, only 2-feet deep. Existing fir trees at the intersection of Division Street and Washington Street are pushing down on sewer main. Obstruction noted in TV report.
   - The 6-inch diameter sewer located north of the intersection of SW Division Street and SW Washington Street, downstream of Manhole 1916NSan has inadequate access, due to lack of easement. This section of sewer main also has old clay drain tile pipe segments.
   - City staff suggested that the shallow 6-inch diameter sewers be deepened and upsized to 8-inch diameter in this area.

7. *Upper Pine Street – Existing individual service booster pumps for 6-inch diameter sewer*
   - Currently, individual service booster pumps are needed for the last several houses connected to the 6-inch diameter S.W. Pine Street sewer located north of SW Sunset Boulevard.
   - City staff suggested that a new replacement sewer could be installed for these services, to reverse flow toward SW Sunset Boulevard instead of SW Division Street. This improvement could be coordinated with pending street improvements on SW Pine Street.

8. *Vicinity of City Hall, Between SW Pine Street and SW Park Street*

- The 6-inch and 8-inch diameter sewer located between Manhole 346NSan and Manhole 345NSan has segments in very bad condition, south of SW Pine Street. Segments of old clay drain tile pipe should be replaced.
- A new manhole should be installed on the existing 12-inch diameter pipe at Junction 343NSan, located 36 feet downstream of Manhole 344NSan. Currently there is inadequate TV inspection access at this junction point, and the camera will not pass through.
- Several lateral connections in Old Town have multiple 90-degree bends that should be upgraded.
- Existing Manhole 346NSan located at Ash Street was replaced without a base. City staff would prefer a new manhole be installed along the alley.

SECTION 4
PLANNING AND DESIGN CRITERIA

General

The basis for planning and designing wastewater facilities includes current and future regulatory requirements, and process or component design criteria. These subjects are discussed in detail in the following section.

A sanitary sewage collection system functions to transport wastewater from the points of their origin to a treatment facility. Sewers, once installed, have a fixed capacity and must be designed with adequate capacity to provide continuous and reliable service throughout their design life to both the existing and future service area. This section presents design criteria used for the analysis of the sanitary sewer system.

The City of Sherwood operates under Clean Water Services (CWS) sanitary sewer design and construction standards. The design criteria and capacity evaluation approach used by (CWS) are utilized in this study. Use of CWS standards and methods facilitates meeting discharge permitting requirements and accommodates the CWS goal of regionally consistent design and construction standards.

Regulatory Requirements

Sanitary Sewer Overflows

Requirements are established in Oregon Administrative Rules (OAR) 340-041-0009, Sections 6 and 7. Sanitary Sewer Overflows (SSOs) are prohibited and if an SSO does occur in the City's sewer system it must be reported to Oregon Department of Environmental Quality (DEQ) along with a plan to reduce the number of future events. To date the City does not have any reported SSOs or manhole upsets. CWS provides wastewater treatment for the City through an Intergovernmental Agreement (IGA). Wastewater is collected in the City's sewage collection system and is discharged into interceptor sewers owned and operated by CWS. Wastewater is then pumped by CWS, for treatment at their Durham Advanced Wastewater Treatment Facility located in the City of Tigard. The National Pollutant Discharge Elimination System (NPDES) permit for the metropolitan area of Washington County is held by CWS, which is further detailed in the IGA between the City and CWS as discussed in Section 4.

CMOM (Capacity, Management, Operation and Maintenance) Requirements

The EPA is developing new rules for municipalities with NPDES permits regarding operation of their sanitary sewer collection systems. Although the City does not have an NPDES permit, rules may be extended to satellite systems when the program is finalized. CWS will be required to meet CMOM requirements as the holder of the NPDES permit, and

they will likely require their satellite systems to meet the rules. Rules state that there are to be no SSOs except under extreme environmental conditions. These rules also require a stringent maintenance and monitoring program for sewers to prevent such overflows.

Endangered and Threatened Species

Endangered and threatened species can be found in this study area. These include:

- Bald eagle (threatened; proposed delisted)
- Chinook salmon (threatened; Upper Willamette River Evolutionary Significant Unit)
- Steelhead (threatened; Upper Willamette River Evolutionary Significant Unit)

Construction in listed species habitat may require a Biological Assessment, and appropriate construction windows will need to be determined to minimize potential impacts to salmon spawning and to eagle nesting periods. The primary consideration for construction around Chicken Creek, Cedar Creek, Rock Creek and the Tualatin River will be allowing adequate lead time to coordinate with regulatory agencies and establish appropriate construction periods.

Surface Water Quality Assessment

Chicken Creek, Cedar Creek, and Rock Creek have a limited water quality status assigned by DEQ. Temperature, dissolved oxygen, chlorophyll-a, and fecal coliform were identified as problems in Cedar and Rock Creeks, and ammonia and pH were also identified in Rock Creek. Chicken Creek has had problems with coliforms, phosphorous, pH, and chlorophenoxy herbicides. Maintaining good water quality of the creeks feeding into the Tualatin River National Wildlife Refuge is a priority.

Section 404 Wetland Removal/Fill Permit

The Clean Water Act Section 404 Permit requires studies into wetland delineation, impact assessment, and mitigation plans for projects including filling or dredging existing wetlands. Through Section 404, the U.S. Army Corps of Engineers also has jurisdiction over the construction of utility crossings such as sewers and force mains through navigable waters and wetlands. Final construction of projects through wetlands and waterways will need to be coordinated closely with the U.S. Army Corps of Engineers.

Design Concepts and Constraints

Design Period

A wastewater collection system is designed to meet the immediate needs of the community, plus a reserve capacity for growth. Sanitary System Master Plans typically utilize a minimum twenty year period for planning purposes. Both the design criteria and planning periods should be consistent with the type of facility being designed and constructed. The selected design life of a structure governs the planning criteria used to size it. Pipelines have a design life of approximately 50 years and planning criteria of ultimate build-out population. Pump stations have a design life of 50 years for below ground structures corresponding to a time period when an ultimate population is served, and pumps and appurtenances have a design life of 15 to 20 years and are sized for the anticipated population increase during that period.

Sewer Design Standards

In order for a sewage collection system to operate efficiently it must be designed to meet certain standards. The principal sanitary sewer design criteria that influence the preparation of this report are presented below.

- All sanitary sewer gravity lines shall have sufficient grade to maintain a minimum velocity of two (2) feet per second when flowing full or half-full. Main sewers should be at least eight (8) inches inside diameter. The upstream section of a lateral sewer which will not be extended in the future may be of six (6) inch inside diameter if no more than 250 feet long.

- Sanitary sewer force mains shall have a velocity of 3.5 to 8. 0 feet per second and a minimum pipe diameter of four (4) inches.

- Manholes should be located at each change of grade and alignment and at each pipe intersection and at intervals generally not to exceed 500 feet.

- Sanitary sewers should be designed and constructed to exclude the transport of storm runoff.

- All sanitary sewer joints should be as watertight as possible to prevent infiltration or inflow of ground and surface waters.

- All sewers should be installed at a depth sufficient to be protected from frost and traffic damage and to drain basements of served properties. Minimum depth of cover requirements for pipelines are presented in Table 4-1.

Table 4-1
CWS Minimum Pipeline Depth of Cover

Type of Pipe	Cover-Paved Areas (inch)	Cover-Unpaved Areas (inch)
Non-reinforced Pipe	48	36
RCP Class III	30	18
RCP Class IV	24	12
RCP Class V	18	6
AWWA C900	24	12
AWWA C905	24	12
Ductile Iron	18	6

- Sanitary sewer capacities should be calculated using a Manning's equation pipe friction factor "n" of 0.013.

- Wastewater facilities concepts are based on 1” = 600’ topographic mapping obtained from the Metro Regional Land Information System (RLIS).

- Surcharging shall not be designed into the sanitary piping system. Existing surcharging should be eliminated where feasible.

- The minimum separation distance between sanitary sewer and utilities other than waterlines should be 5 feet (clear). Additional separation distance should be provided with waterlines as required by the Oregon Department of Health Services.

The recommended sewer system improvements presented in Section 6 follow these design guidelines.

Design Flow Criteria

The evaluation of the existing sanitary sewer facilities and the planning of new systems to serve the fully developed study area require that forecasts of future wastewater flow rates be determined. The normal components of total wastewater flow rates in a City sewer system may include domestic, commercial, industrial, institutional and other sources as well as extraneous storm water (infiltration and inflow). The analysis of this study is based on calculated wastewater contributions from areas with land uses designated as Industrial, Commercial, Residential and Institutional/Public. This study utilizes design flow criteria as established by CWS’s design standards, presented below.

Design Sanitary Flows

The CWS unit design flows from the 2000 Clean Water Comprehensive Plan were referenced as part of the plan update. The unit flows, which represent dry weather flows, were determined from an analysis of land use and service area flows documented in the CWS 1995 Collection System Needs Analysis. The CWS unit design wastewater flows for residential, commercial, and industrial flows are presented in Table 4-2. No large point sources, and no areas zoned Heavy Industrial, are identified in the Sherwood Service Area.

Table 4-2
CWS Unit Design Wastewater Flows

Description	Design Flows
Single Family Residential	67 gpcd
Multi-Family Residential	87 gpcd
Mixed Use	87 gpcd
Mixed Use Employment Area	3,660 gpad
Commercial	3,660 gpad
Institutional/Public	3,660 gpad
Industrial	3,660 gpad
Heavy Industrial	7,320 gpad
Noncontributing	--

Notes: gpcd: gallons per capita per day
gpad: gallons per acre per day

Table 4-3 presents the distribution of CWS unit design wastewater flows applied to the City of Sherwood land use zoning classifications.

Table 4-3
Land Use and Unit Flow Summary

City Zone	City Zoning Description	CWS Land Use Category	Unit Flow
VLDR	Very Low Density Residential	Single Family Residential	67 gpcd
LDR	Low Density Residential	Single Family Residential	67 gpcd
MDRL	Medium Density Residential – Low	Single Family Residential	67 gpcd
MDRH	Medium Density Residential – High	Single Family Residential	67 gpcd
HDR	High Density Residential	Multi-Family Residential	87 gpcd
NC	Neighborhood Commercial	Commercial	3,660 gpad
OC	Office Commercial	Commercial	3,660 gpad
OR	Office Retail	Commercial	3,660 gpad
RC	Retail Commercial	Commercial	3,660 gpad
GC	General Commercial	Commercial	3,660 gpad
LI	Light Industrial	Industrial	3,660 gpad
GI	General Industrial	Industrial	3,660 gpad
IP	Institutional/Public	Institutional/Public	3,660 gpad

Notes: gpcd: gallons per capita per day
gpad: gallons per acre per day

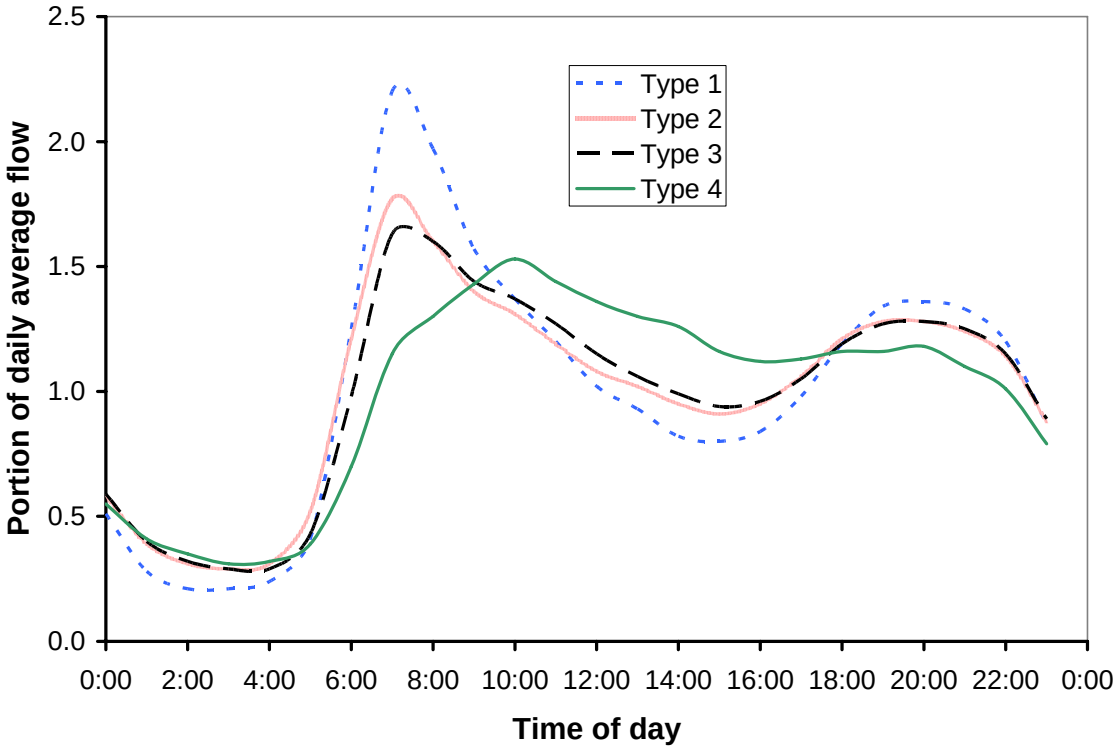
Diurnal Curves (Daily Peaking Factors)

Four land use diurnal curves were also developed by CWS in the 2000 Clean Water Comprehensive Plan to be applied to the unit flows. The diurnal curve approach is similar to the peaking factor approach. The CWS diurnal curves are summarized in Table 4-4 and illustrated in Figure 4-1.

Table 4-4
Predominant Land Use Diurnal Flow Curves Description

Type	Predominant land use	Characteristic peaks
1	Residential	High morning and early evening peaks
2	Mixed Residential and Commercial	Medium morning and early evening peaks
3	Commercial	Medium morning and early evening peaks
4	Industrial	Small morning peak, almost no evening peak

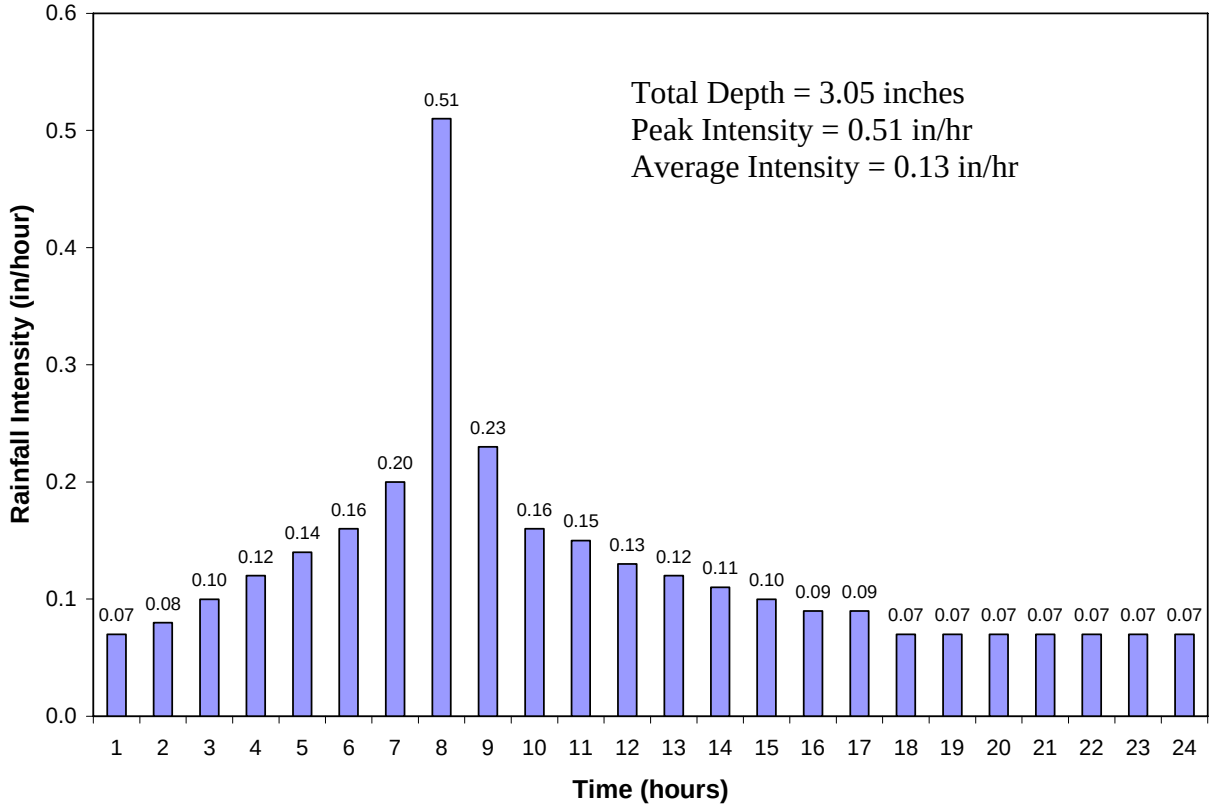
Figure 4-1
Predominant Land Use Diurnal Flow Curves



Design Storm

The NPDES permit held by CWS requires sanitary sewer overflows to be controlled in response to 5-year storm events. CWS has adopted the NRCS Type 1A rainfall distribution for modeling the sewer system using hydrologic unit hydrograph methods. The depth of rainfall for the 5-year 24-hour storm event is 3.05 inches. Figure 4-2 illustrates the hyetograph for this storm event.

Figure 4-2
5-yr 24-hr NRCS Type 1A Design Storm



Sewer System Surcharging

Surcharging of the sewer occurs when the pipe is flowing under some pressure. This condition is evidenced by observation of the water surface at manholes/access ports which are above the pipe crown. Under severe surcharge conditions, sewage overflows at manholes/access ports or backflow and flooding of facilities connected to the system may occur. Sewer surcharging requires flow reduction measures and/or system improvements as the system does not have capacity to carry the sewage flow. Occasionally, minor surcharging may occur in portions of the gravity sewer system. This condition can be tolerated to the extent that no overflow or damage occurs. In general, the standard practice for this plan is to assume that surcharging shall not be designed into the sanitary piping system in accordance with CWS requirements. System surcharging will be analyzed and assessed for use in prioritizing recommended Capital Improvement Plan (CIP) projects.

Surcharging Severity Ranking

Evaluation of the existing wastewater collection system was performed using a ranking system developed by CWS to determine the severity of sanitary sewer surcharging problems. The ranking system was first developed as part of the CWS 1995 *Collection System Needs Analysis*, and is presented in Table 4-5. As part of the development of the recommended

Capital Improvement Plan (CIP), the ranking severity of surcharging potential will be used to prioritize capital improvements related to increasing system capacity.

Table 4-5
CWS Sanitary Surcharge Severity Ranking

Rank	Description	Improve	HGL Freeboard
LS	HGL daylights with significant HGL increase (HGL > ground elevation)	Yes	< 0 feet
LH	HGL daylights (HGL > ground elevation)	Yes	< 0 feet
HS	High HGL with significant HGL increase	Yes	Between 0 and 3 feet
HH	High HGL	Yes	Between 0 and 3 feet
IS	Intermediate HGL with significant HGL increase	Yes	Between 3 and 10 feet
IH	Intermediate HGL	No	Between 3 and 10 feet
DS	Deep HGL with significant HGL increase	No	Greater than 10 feet
DH	Deep HGL	No	Greater than 10 feet
OK	No surcharging	No	HGL within pipe crown

Notes: Table reproduced from CWS (2000). HGL = Hydraulic grade line.

Infiltration and Inflow

Infiltration and inflow (I&I) is extraneous water flow that enters the sanitary sewer collection system. By definition, infiltration is water entering the collection system from the ground through service connections, defective pipes, pipe joints, connections or manhole/access port walls. Inflow is defined as water entering the collection system from roof drains, foundation drains, cooling water discharges, catch basins, cross connections from storm sewers and combined sewers, surface runoff and natural drainage. Since identifying the contribution of flow separately for infiltration and inflow is difficult, they are typically combined as a single contributing component.

For the existing developed areas, I&I values are assigned based on a comparison of recorded dry weather flow to flows during storm events. Currently unsewered areas will be served with pipelines installed using updated City and CWS design and construction standards. The I&I values to be used for these areas will be as cited in the CWS Master Planning documents to maintain consistency throughout the service area.

SECTION 5
SYSTEM ANALYSIS

General

This section covers the hydraulic analysis of the sanitary sewer collection system. The analysis develops the average dry weather flows and calibrates the flow contribution from infiltration and inflow. An overview of the modeling software Hydra (version 6.4) used to conduct the hydraulic grade line analysis is presented. The Hydra program evaluates the capacity of the system with regard to physical constraints, wastewater design flows, and infiltration and inflow. Existing and future capacity deficiencies are identified using the surcharge severity ranking system used by Clean Water Services (CWS). Recommended improvements associated with collection system capacity issues are presented in Section 6.

Design Flow Development

The evaluation of the existing sanitary sewer facilities and the planning of new systems to serve the fully developed study area require that forecasts of future wastewater flow rates be determined. The normal components of total wastewater flow rates in a City sewer system may include domestic, commercial, industrial, and institutional as well as extraneous storm water such as infiltration and inflow (I&I). This analysis estimated wastewater contributions from areas with land uses designated as Industrial, Commercial, Residential and Institutional/Public.

Design flow criteria and analysis methodology were reviewed to be consistent with CWS practices where applicable. The review found that the design flow criteria established by the CWS Sewer Master Plan Update (2000) for the entire Durham Treatment Facility service area overestimated the historical dry weather flows passing through the Sherwood Pump Station. Design flow criteria specific to Sherwood were then developed to represent the existing sanitary flows. Infiltration and inflow values were calibrated using continuous flow monitoring data for 2006 and 2007. The more conservative CWS flow criteria were used for developing industrial and commercial areas. A summary of the design flows used is presented in Table 5-1

Table 5-1
Model Design Flows

Contributing Flow	Design Flow
Sanitary flows: All Existing Land Uses	71 gallons per capita per day
Infiltration and Inflow: Peak rate	1970 gpad apportioned to pipes by inch-diameter times length weighting factor
Sanitary flows: Future Residential Land Use	71 gallons per capita per day
Sanitary flows: Future Commercial Land Use	3,660 gallons per acre per day
Sanitary flows: Future Industrial Land Use	3,660 gallons per acre per day

Average Wet and Dry Weather Flows

Average dry weather flows represent the typical sanitary flows from the service area. The CWS 2000 Sewer Master Plan Update presented design dry weather unit flow rates by land use that were averages for the entire CWS service area; however, these unit rates were much larger than the flows seen at the Sherwood Pump Station as well as the CWS flow monitoring stations upstream (D050) and downstream (D040) of the pump station. This analysis generated ADWF unit rates using the available flow data.

The monthly flows through the Sherwood Pump Station are illustrated in Figure 5-1. The summer months of July, August, and September were used to determine the dry weather flows. Table 5-2 shows the annual flows, dry weather flows, population, and annual rainfall from 2000 through 2006. The large rainfall in 2003 accounts for the elevated dry weather flows in 2004.

A unit design flow rate of 71 gallons per capita per day (gpcd) was adopted as the dry weather flow. CWS flow monitoring upstream of the pump station (Monitor D050) provided the basis for determining the wet weather infiltration (WWI), or slow infiltration. The flow monitoring data are illustrated in Figures 5-2 and 5-3. WWI is determined as the difference between the dry weather flows and the wet weather flows during periods without flow directly induced by storm events. A value of 0.29 mgd for WWI was adopted for the Sherwood service area. Figure 5-4 illustrates the WWI.

Figure 5-1
Monthly Sherwood Pump Station Flows

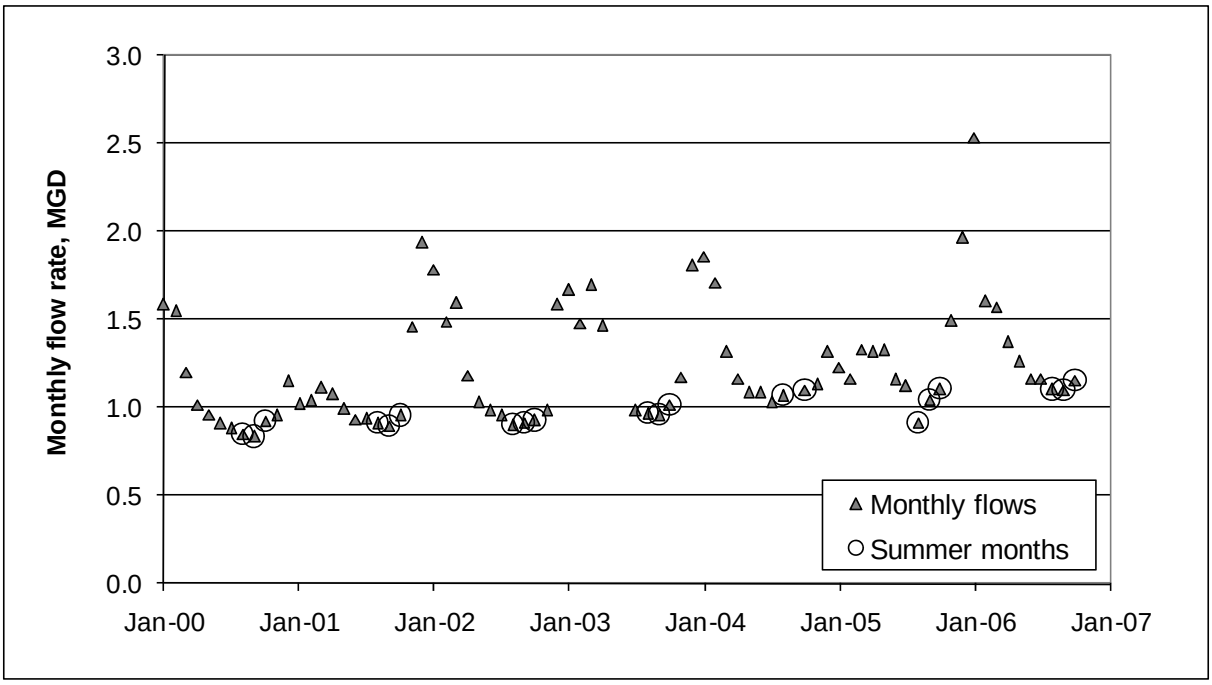


Figure 5-2
Monthly Sherwood Pump Station Flows, 2005 to 2006

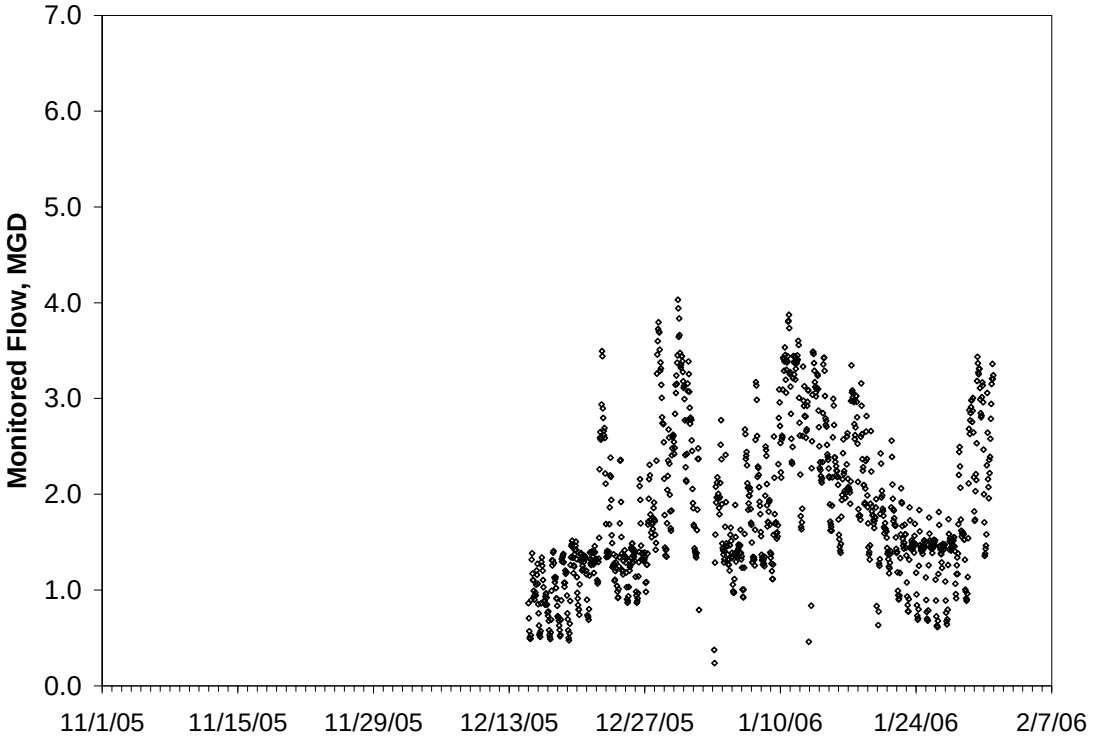


Figure 5-3
Monthly Sherwood Pump Station Flows, 2006 to 2007

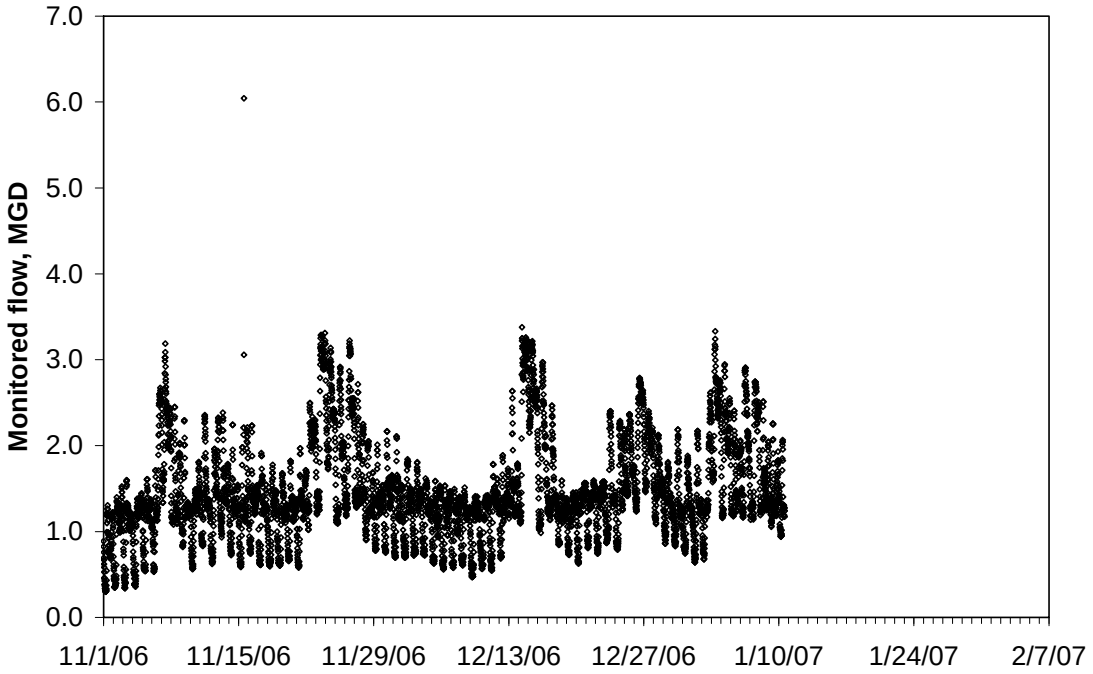
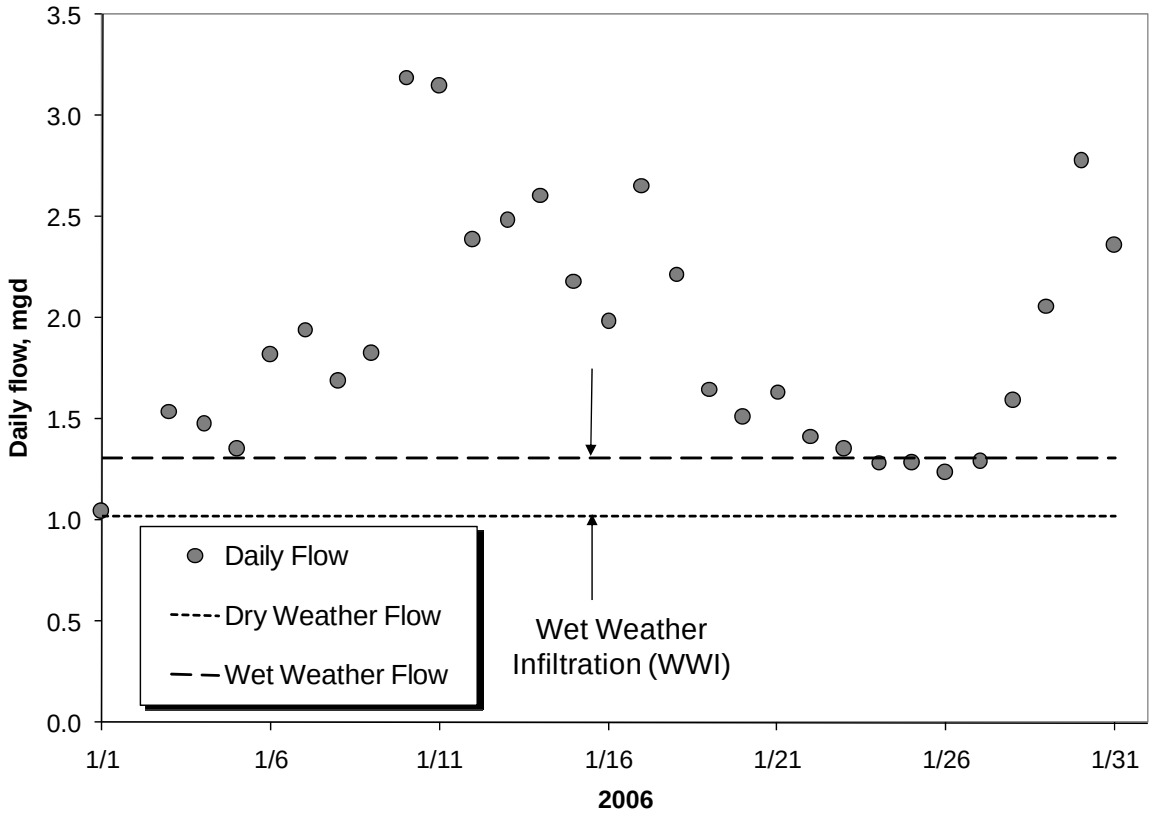


Table 5-2
Sherwood Pump Station Flows

Year	Population	Annual Average Flow (MGD)	Annual Average Unit Flow (gpcd)	Dry Weather Flow (MGD)	Dry Weather Unit Flow (gpcd)	Annual Rainfall at Durham AWWTP (inch)
2000	12,230	1.07	87.4	0.87	71.1	--
2001	12,840	1.11	86.2	0.92	71.7	--
2002	13,680	1.20	87.4	0.92	66.9	33.17
2003	14,050	1.32	94.2	0.98	69.8	40.44
2004	14,190	1.26	89.0	1.08	76.4	27.58
2005	14,940	1.27	85.8	1.02	68.4	35.20
2006	16,115	1.40	87.1	1.12	69.5	43.16

Notes: MGD = million gallons per day. gpcd = gallons per capita per day

Figure 5-4
Illustration of Wet Weather Infiltration



Design Storm-induced Infiltration and Inflow

Infiltration and inflow (I&I) is extraneous water flow that enters the sanitary sewer collection system. By definition, infiltration is water entering the collection system from the ground through service connections, defective pipes, pipe joints, connections or manhole/access port walls. Inflow is defined as water entering the collection system from roof drains, foundation drains, cooling water discharges, catch basins, cross connections from storm sewers and combined sewers, surface runoff and natural drainage. Since identifying the contribution of flow separately for infiltration and inflow is difficult, they are typically combined as a single contributing component.

For this analysis, I&I values are assigned to existing developed areas based on a comparison of recorded dry weather flow to flows during storm events. Existing unsewered areas will be served with pipelines installed using updated City and CWS design and construction standards.

Two storms were selected for infiltration and inflow calibration from the CWS monitoring data upstream of the pump station. Hydrologic parameters to be calibrated included RAP_AREA, RAP_BEG, RAP_MAX, and RAP_END. These are the area associated with infiltration, and the time of the start, peak, and end of the triangular inflow hydrograph, respectively. Preference was given to calibrating the peak flows over the minimum flows or timing of the peaks. Graphical comparisons of the model calibration are shown in Figure 5-5 and Figure 5-6.

Figure 5-5
Model-Data Comparison, January 6, 2006, Storm

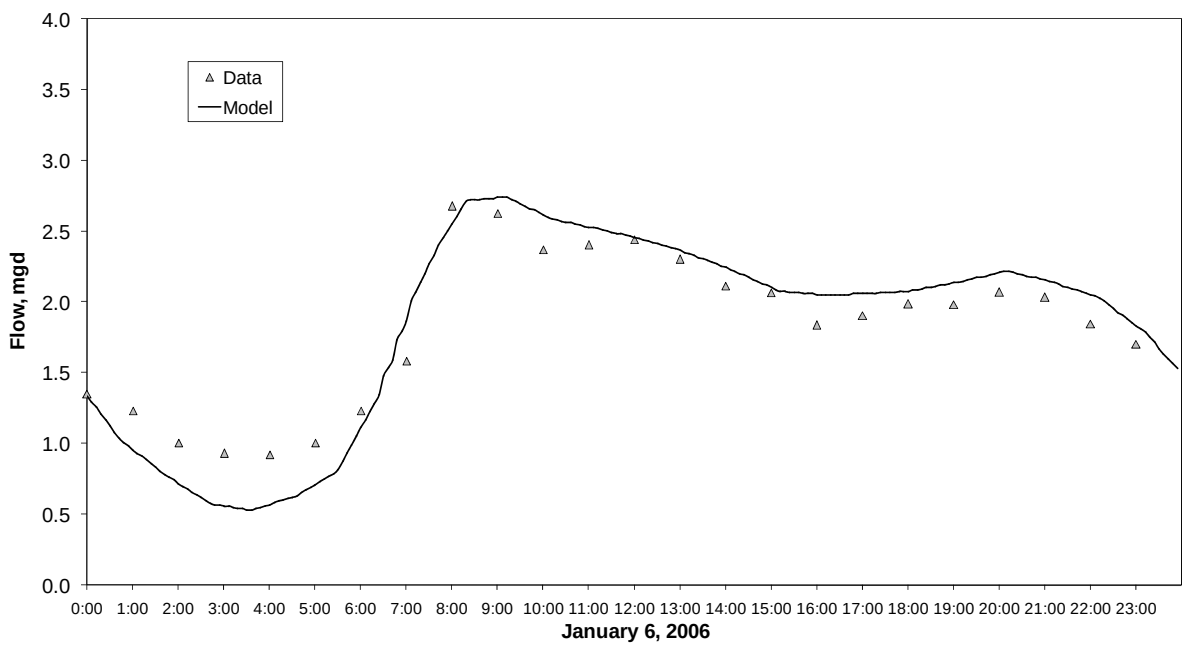
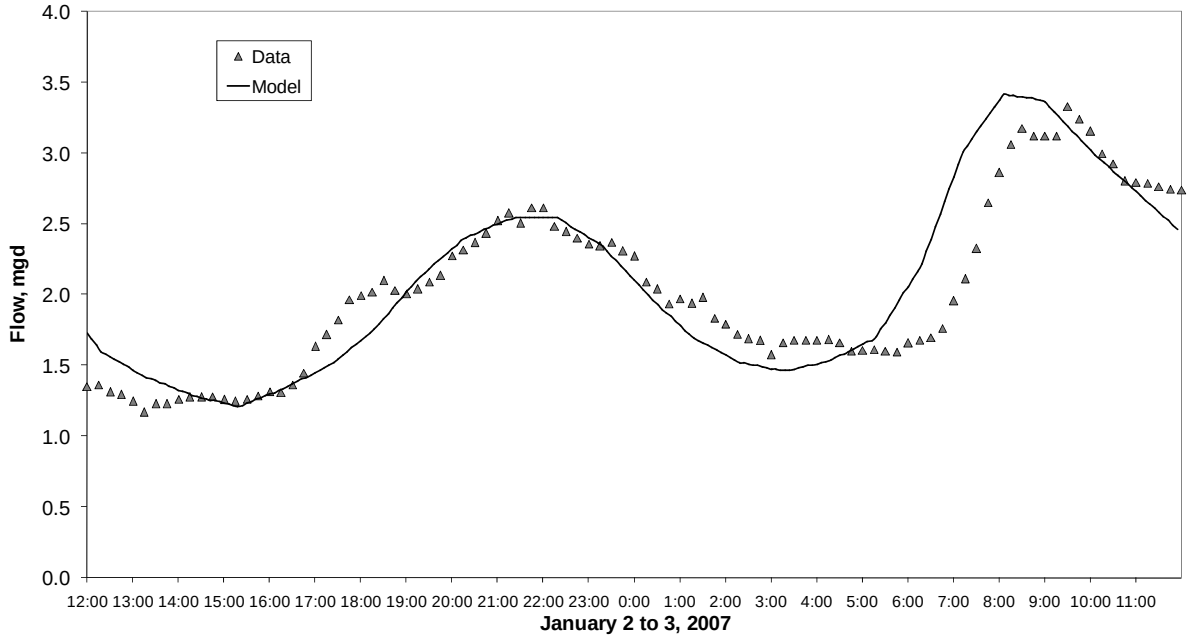


Figure 5-6
Model-Data Comparison, January 2-3, 2007, Storm



Saturation Development Flows

The saturation development condition represents the ultimate development condition when all land is fully developed to the maximum densities allowed in the City Comprehensive Plan. Analysis of this condition assumed all land was developed and that the total service area population was the build-out population discussed in Section 2. The existing condition unit design flows were used for the saturation development condition. New commercial, industrial, and institutional flows were added using the CWS unit flow rate of 3,660 gallons per acre per day (gpad).

Analysis Methodology

Hydra Model

Analysis of the sanitary sewer system capacity used a hydraulic grade line (HGL) approach. For consistency with CWS analysis and planning, the Hydra software (version 6.4) was used to conduct the HGL analysis. The Hydra approach to the HGL analysis differs from some traditional HGL approaches in that it does not use the traditional peaking factor method for sanitary flows. Sanitary flows are instead routed through the system over a 24-hour period scaling the average dry weather flow by a diurnal time-series curve that simulates actual system flows over a design day. The Hydra approach looks at the combined loading from sanitary flows, steady wet-weather infiltration, and storm induced inflows and infiltration.

Inflows are input into the Sherwood Hydra model using two methods. Sanitary loadings are input through the Parcel Layer method. In this method, loads are input directly for each tax lot proportional to the land use area, or by the lot's residential population. Infiltration, both steady infiltration and rapid storm-induced infiltration, and direct storm inflows are input using the *defects database*. Practically any number of additional loadings can be applied to each pipe or manhole using the defects database. These approaches are further discussed in this section.

Sanitary System Layer

The Hydra sanitary system layer (SY layer) represents the model system geometry model as links and nodes. Links represent gravity conveyance pipes. Nodes represent manholes and pumps. All links terminate at both ends at a node. The data needed to build the SY layer include, at a minimum, pipe invert elevations, pipe diameters, node (manhole and pump) locations, and manhole ground (rim) elevations. Locations and other geometric data were brought into the SY layer from a GIS format using the Hydra *GISTransfer Wizard*. Additional data are input in the project design file ("PROJECT.DES") such as pipe roughness and pump curve data.

The system consists of all conveyance pipes other than the individual connections to tax lots with all flows leaving the system through the Sherwood Pump Station. Section 3 discussed the existing conveyance system.

Parcel Layer

Hydra offers multiple scales and approaches to inserting sanitary flows. The Parcel Layer (PA layer) represents the smallest spatial scale available, and is well-suited to incorporating data for individual tax lots. Hydra also offers a larger scale layer, the Service Area Layer; however, because of the interest in evaluating collection pipes, this layer does not offer the appropriate scale and was not used.

Each spatially delineated region in the PA layer can have two types of associated sanitary flow loadings, "residential" and "commercial." Residential flows are generated from the associated population in the individual parcel region, i.e., a taxlot, and the per capita flow value. Commercial flows represent any sanitary flow source which represented by a flow per unit area. Within the PA layer, "commercial" flow represents actual flows from commercial, industrial, and institutional/public land use zones.

For tax lots representing a single housing unit, the population for one dwelling unit was assigned. For larger parcels which represent multiple dwelling units, the zoning density outlined in the City Comprehensive Plan was used to assign a number of dwelling units. This is appropriate for condominium and other high density lots.

Defects Database Component (Infiltration and Inflow)

The defects database component allows for all sources of infiltration and inflow. Infiltration sources include groundwater inflow through leaks in pipes and joints caused by age, cracking, tree roots, and material defects. Inflow is generally from direct flow though manhole covers. Additionally, undocumented and illegal connections from roof-top and other drains can be appreciable.

Any of these sources can be input through the defects database. If considered separately, difference scenarios can be quickly evaluated. Each component of the SY layer can incorporate an individual defects component. Thus, each manhole and pipe can have its individual contribution considered. This allows for the evaluation of the impact of I/I remediation efforts.

Hydraulic Evaluation Criteria

Analysis of the existing wastewater collection system was performed using the ranking system developed by CWS to determine the severity of sanitary sewer surcharging problems. These criteria are discussed in Section 4 and summarized in Table 4-5.

Modeling Assumptions

The following assumptions were made in conducting the system analysis:

Missing conveyance system information: The key conveyance system data—pipe size, invert elevations (IE), and manhole rim elevations—were provided by the City. Missing invert elevations were assigned based on adjacent pipe IE values at common manholes, or by linear interpolation between known IE values. For the most upstream IE values, where linear interpolation was not possible, the pipe segment was assigned the minimum slope as outlined in the CWS design standards to establish the upstream IE. Missing manhole rim elevations were assigned values through a combination of linear interpolation and checking with topographic mapping.

Infiltration and inflow apportioning: Wet weather infiltration (WWI) and storm-induced infiltration and inflow (SRI) were apportioned to the conveyance system using a weighting factor of pipe diameter (inch) times pipe length (feet). The larger diameter pipes are generally concrete, and the smaller diameter pipes are typically PVC. This approach was used to reflect that concrete pipes are expected to have a greater infiltration and inflow contribution.

Saturation development population: The saturation development population assumed all land had been developed according to the City Comprehensive Plan. The additional population associated with the full development does not account for the increased redevelopment population density. To reflect this, the ratio of people per dwelling unit was increased uniformly to match the projected saturation development population. Commercial and

industrial areas were assumed to have been redeveloped and the more conservative CWS unit design flows were applied.

Modeling Results

The system was found to be adequate to handle the existing design flows. A single pipe (City ID # 20Ssan) was found to surcharge--but not overflow--and did not rank high enough to recommend improvements due to the height of the freeboard (11 feet). The buildout or saturation development condition showed surcharging over the CWS sewer trunks, the City owned portion of the Rock Creek Trunk, the facilities where the Area 54/55 development was connected to the system, and at some places where the collectors feed into the surcharging trunks. The CWS trunk line capacity deficiencies under build-out conditions were also identified in the 2000 CWS Sewer Master Plan Update. A subsequent analysis was conducted wherein the trunk surcharging was eliminated by upsizing the trunks. This analysis showed that most of the collector pipe surcharging was due to the surcharging in the trunks. The remaining problem areas were associated with the connections to the new development in Areas 48 and 54/55. Peak flows in the trunks near the Sherwood pump station are reported in Table 5-3. A short summary table of all City owned pipes with identified surcharging and their ranking in presented in Table 5-4. Improvements are discussed in Section 6.

Table 5-3
Existing and Build-out Condition Sewer Trunk Peak Flows

Location	Existing Condition Peak Flow (cfs)	Build-out Condition Peak Flow (cfs)
Sherwood Sewer Trunk	6.4	11.5
Rock Creek Sewer Trunk	1.4	5.8
Sherwood Pump Station	7.5	17.2

Table 5-4
Model Identified Surcharging with Severity Ranking of City Owned Pipes

Pipe Characteristics				Existing Condition				Build-out Condition				Build-out with trunk improvements			Improvement Needed		
City ID	Dia. (inch)	Slope (feet/ 100feet)	Cap. (cfs)	Peak Flow (cfs)	Surch. (feet)	FB (feet)	Rank	Peak Flow (cfs)	Surch. (feet)	FB (feet)	Rank	Surch. (feet)	FB (feet)	Rank	Exist	BO	BO with trunk
20	12	0.00	1.76	0.91	0.01	11.69	DH	1.19	0.04	11.66	DH	0.04	11.66	DH	no	no	no
620	8	0.02	1.81	0.01	0.00	9.88	OK	0.14	0.00	9.54	OK	0.38	8.97	IH	no	no	no
647	8	0.00	0.20	0.01	0.00	10.69	OK	0.14	0.00	10.35	OK	0.00	9.81	IS	no	no	**yes**
374	15	0.00	2.53	0.80	0.00	8.62	OK	5.92	10.49	0.00	LS	0.00	8.18	OK	no	**yes**	no
1788	18	0.00	5.68	1.28	0.00	2.04	OK	7.18	1.11	0.00	LS	0.00	1.36	OK	no	**yes**	no
1789	8	0.00	0.77	0.04	0.00	2.04	OK	0.61	1.93	0.00	LH	0.41	1.52	HH	no	**yes**	**yes**
379	15	0.00	3.02	0.79	0.00	8.94	OK	1.17	8.25	0.00	LH	0.00	8.50	OK	no	**yes**	no
381	12	0.00	1.96	0.78	0.00	1.50	OK	1.16	1.00	0.00	LH	0.00	1.10	OK	no	**yes**	no
216	12	0.00	2.08	0.39	0.00	12.84	OK	2.49	2.95	9.79	IS	0.00	12.50	OK	no	**yes**	no
217	12	0.00	1.79	0.39	0.00	11.33	OK	2.48	3.67	7.74	IS	0.00	10.77	OK	no	**yes**	no
365	18	0.00	5.95	1.26	0.00	6.01	OK	7.18	1.93	3.82	IS	0.00	5.55	OK	no	**yes**	no
370	18	0.00	4.13	0.87	0.00	13.34	OK	6.33	3.78	9.09	IS	0.00	12.76	OK	no	**yes**	no
372	15	0.00	2.80	0.81	0.00	9.56	OK	5.96	6.16	5.21	IS	0.00	9.14	OK	no	**yes**	no
415	24	0.00	6.16	5.01	0.00	9.91	OK	8.97	5.10	4.44	IS	0.00	9.75	OK	no	**yes**	no
416	24	0.00	6.10	4.70	0.00	10.29	OK	8.31	5.19	4.73	IS	0.00	10.15	OK	no	**yes**	no
429	18	0.00	6.04	1.25	0.00	8.49	OK	7.17	2.28	5.60	IS	0.00	8.03	OK	no	**yes**	no
237	12	0.02	4.54	0.00	0.00	9.58	OK	0.01	1.93	7.10	IH	0.65	9.38	IH	no	no	no
238	12	0.05	7.58	0.00	0.00	8.44	OK	0.01	1.57	5.89	IH	0.11	8.35	IH	no	no	no
239	12	0.01	2.92	0.00	0.00	9.51	OK	0.00	1.43	7.10	IH	0.15	9.38	IH	no	no	no
300	10	0.00	1.19	0.92	0.00	6.73	OK	1.30	0.00	6.52	IH	0.00	6.52	IH	no	no	no
461	8	0.00	0.64	0.32	0.00	5.74	OK	0.51	0.16	5.42	IH	0.16	5.42	IH	no	no	no
164	8	0.54	8.93	0.02	0.00	9.62	OK	0.03	4.75	4.25	IH	0.00	9.62	OK	no	no	no
183	8	0.08	3.47	0.14	0.00	8.98	OK	0.18	4.77	3.66	IH	0.00	8.98	OK	no	no	no
184	8	0.09	3.56	0.01	0.00	8.93	OK	0.01	3.85	4.45	IH	0.00	8.93	OK	no	no	no
210	12	0.05	7.77	0.00	0.00	11.26	OK	0.01	0.42	9.94	IH	0.00	11.10	OK	no	no	no
214	15	0.00	4.43	1.52	0.00	9.88	OK	4.07	2.57	6.84	IH	0.00	9.58	OK	no	no	no

Table 5-4
Model Identified Surcharging with Severity Ranking of City Owned Pipes (Cont.)

Pipe Characteristics				Existing Condition				Build-out Condition				Build-out with trunk improvements			Improvement Needed		
City ID	Dia. (inch)	Slope (feet/ 100feet)	Cap. (cfs)	Peak Flow (cfs)	Surch. (feet)	FB (feet)	Rank	Peak Flow (cfs)	Surch. (feet)	FB (feet)	Rank	Surch. (feet)	FB (feet)	Rank	Exist	BO	BO with trunk
215	12	0.01	2.95	1.13	0.00	12.84	OK	1.58	2.63	9.79	IH	0.00	12.50	OK	no	no	no
253	12	0.02	4.84	0.06	0.00	10.60	OK	0.08	1.56	8.51	IH	0.00	10.46	OK	no	no	no
371	18	0.01	8.28	0.87	0.00	11.48	OK	6.32	3.78	6.75	IH	0.00	10.90	OK	no	no	no
397	10	0.01	2.38	0.09	0.00	9.16	OK	0.39	3.26	5.21	IH	0.00	8.80	OK	no	no	no
398	10	0.08	6.31	0.09	0.00	6.07	OK	0.38	0.43	4.95	IH	0.00	5.71	OK	no	no	no
417	8	0.03	2.10	0.33	0.00	10.27	OK	0.70	5.09	4.73	IH	0.00	10.15	OK	no	no	no
480	8	0.06	2.94	0.14	0.00	7.04	OK	0.20	2.64	3.89	IH	0.00	7.00	OK	no	no	no
480	8	0.04	2.28	0.22	0.00	9.92	OK	0.32	4.91	4.51	IH	0.00	9.88	OK	no	no	no
1047	8	0.15	4.70	0.33	0.00	10.36	OK	0.71	1.55	8.38	IH	0.00	10.24	OK	no	no	no
1077	8	0.08	3.36	0.08	0.00	7.04	OK	0.12	2.64	3.89	IH	0.00	7.00	OK	no	no	no
1157	8	0.12	4.25	0.11	0.00	10.10	OK	0.14	5.12	4.41	IH	0.00	10.10	OK	no	no	no
1670	8	0.06	3.01	0.02	0.00	11.88	OK	0.03	4.30	6.98	IH	0.00	11.88	OK	no	no	no
1790	8	0.00	0.77	0.03	0.00	8.96	OK	0.61	1.39	7.03	IH	0.00	8.57	OK	no	no	no
1826	8	0.01	0.98	0.01	0.00	11.70	OK	0.01	4.97	6.13	IH	0.00	11.70	OK	no	no	no
460	8	0.00	0.42	0.32	0.00	1.40	OK	0.51	0.02	1.23	HS	0.02	1.23	HS	no	**yes**	**yes**
373	15	0.00	2.81	0.80	0.00	9.15	OK	5.95	8.63	2.28	HS	0.00	8.73	OK	no	**yes**	no
382	12	0.08	10.19	0.78	0.00	1.51	OK	1.16	0.65	0.36	HH	0.00	1.37	OK	no	**yes**	no
1053	8	0.02	1.67	0.33	0.00	7.94	OK	0.71	4.77	2.74	HH	0.00	7.82	OK	no	**yes**	no
195	18	0.00	4.77	2.45	0.00	11.52	OK	5.28	0.06	10.90	DS	0.02	10.90	DH	no	no	no
25	12	0.00	0.77	0.91	0.00	11.43	OK	1.20	0.00	11.43	DS	0.00	11.43	DS	no	no	no
193	18	0.00	4.94	2.44	0.00	11.54	OK	5.27	0.28	10.69	DS	0.20	10.75	DS	no	no	no
213	12	0.00	1.86	1.53	0.00	13.62	OK	4.08	0.12	13.40	DS	0.00	13.32	OK	no	no	no
367	18	0.00	5.41	0.89	0.00	16.73	OK	6.40	2.94	13.16	DS	0.00	16.27	OK	no	no	no
368	18	0.00	5.51	0.89	0.00	16.91	OK	6.40	3.19	12.95	DS	0.00	16.41	OK	no	no	no
369	18	0.00	6.15	0.88	0.00	15.91	OK	6.39	3.29	11.71	DS	0.00	15.43	OK	no	no	no
430	18	0.00	6.14	1.23	0.00	18.94	OK	7.12	2.59	15.70	DS	0.00	18.48	OK	no	no	no

Table 5-4
Model Identified Surcharging with Severity Ranking of City Owned Pipes (Cont.)

Pipe Characteristics				Existing Condition				Build-out Condition				Build-out with trunk improvements			Improvement Needed		
City ID	Dia. (inch)	Slope (feet/ 100feet)	Cap. (cfs)	Peak Flow (cfs)	Surch. (feet)	FB (feet)	Rank	Peak Flow (cfs)	Surch. (feet)	FB (feet)	Rank	Surch. (feet)	FB (feet)	Rank	Exist	BO	BO with trunk
191	18	0.00	5.00	2.09	0.00	12.15	OK	4.82	0.22	11.21	DH	0.11	11.32	DH	no	no	no
192	18	0.00	5.05	2.12	0.00	12.88	OK	4.86	0.28	11.94	DH	0.20	12.03	DH	no	no	no
194	18	0.00	5.27	2.44	0.00	12.34	OK	5.28	0.19	11.53	DH	0.16	11.56	DH	no	no	no
199	12	0.06	8.94	1.21	0.00	15.54	OK	1.63	0.94	14.60	DH	0.16	15.38	DH	no	no	no
202	8	0.07	3.10	0.13	0.00	17.92	OK	0.19	0.01	17.82	DH	0.01	17.82	DH	no	no	no
212	18	0.00	5.00	2.02	0.00	15.23	OK	4.73	0.14	14.37	DH	0.02	14.49	DH	no	no	no
565	8	0.14	4.58	0.06	0.00	15.14	OK	0.09	0.16	14.37	DH	0.05	14.49	DH	no	no	no
1185	8	0.05	2.60	0.30	0.00	12.74	OK	0.38	0.31	11.94	DH	0.23	12.03	DH	no	no	no
1226	8	0.06	2.94	0.02	0.00	12.04	OK	0.03	0.22	11.21	DH	0.12	11.32	DH	no	no	no
1230	8	0.00	0.48	0.03	0.00	12.80	OK	0.03	0.31	11.94	DH	0.23	12.03	DH	no	no	no
1537	8	0.28	6.43	0.07	0.00	11.94	OK	0.10	0.70	10.64	DH	0.77	11.10	DH	no	no	no
145	8	0.09	3.71	0.06	0.00	11.37	OK	0.08	0.71	10.07	DH	0.00	11.37	OK	no	no	no
149	24	0.00	10.89	4.60	0.00	12.41	OK	8.21	1.63	10.07	DH	0.00	12.31	OK	no	no	no
151	24	0.01	20.33	4.66	0.00	19.99	OK	8.27	1.55	17.20	DH	0.00	19.89	OK	no	no	no
197	18	0.01	8.94	2.56	0.00	11.36	OK	5.44	0.01	10.49	DH	0.00	11.04	OK	no	no	no
198	18	0.01	8.78	2.56	0.00	15.54	OK	5.44	0.44	14.60	DH	0.00	15.38	OK	no	no	no
222	12	0.02	5.27	0.43	0.00	12.20	OK	0.62	1.10	10.32	DH	0.00	12.12	OK	no	no	no
418	8	0.04	2.35	0.33	0.00	11.78	OK	0.70	0.19	11.14	DH	0.00	11.68	OK	no	no	no
1611	12	0.06	8.38	1.13	0.00	14.81	OK	1.56	1.12	13.19	DH	0.00	14.71	OK	no	no	no
1613	8	0.25	6.10	0.02	0.00	26.16	OK	0.03	0.02	25.65	DH	0.00	26.12	OK	no	no	no
1791	8	0.01	0.93	0.03	0.00	17.76	OK	0.60	0.94	16.27	DH	0.00	17.38	OK	no	no	no
1792	8	0.01	0.94	0.03	0.00	17.59	OK	0.60	0.83	16.19	DH	0.00	17.25	OK	no	no	no
1827	8	0.00	0.77	0.01	0.00	17.14	OK	0.01	4.60	11.94	DH	0.00	17.14	OK	no	no	no
1828	8	0.00	0.77	0.01	0.00	26.64	OK	0.01	4.10	21.94	DH	0.00	26.64	OK	no	no	no
1829	8	0.00	0.74	0.01	0.00	26.44	OK	0.01	3.90	21.94	DH	0.00	26.44	OK	no	no	no

Notes: BO = build-out condition FB = freeboard cfs = cubic feet per second

SECTION 6
RECOMMENDATIONS AND CAPITAL IMPROVEMENT PLAN

General

This section presents a recommended Capital Improvement Plan (CIP) for the City of Sherwood's wastewater collection system. This plan recommends proposed system improvements for the correction of existing deficiencies and to accommodate future system needs as identified in previous sections of this master plan.

Basis of Cost Estimates

The recommended CIP identifies projects and presents estimated project costs. Project costs are based on unit costs developed from recent experience with construction costs for similar work in the area, and assume the work will be completed by private contractors using prevailing wages. These unit costs include an aggregate 45-percent allowance over the estimated construction cost to provide for contingencies, engineering, legal and administrative costs. Table 6-1 presents these unit costs for piping installed in both improved and unimproved areas.

Table 6-1
Collection Piping Unit Cost Summary

Pipe Diameter, inches	Project Cost, $/linear foot (Unimproved Areas)	Project Cost, $/linear foot (Improved Areas)
8	$186	$211
12	$201	$227
15	$212	$238
18	$248	$279
24	$272	$303

These planning level unit cost estimates include the following assumptions:

- Gravity sewer depths average 12-foot;
- No rock excavation;
- Sheeting, shoring and dewatering will be required;
- No property or easement acquisition costs;
- No service connections;
- No specialty construction costs;
- Construction by private contractors;
- A 20% allowance for mobilization, dewatering, traffic control, and erosion control;
- A 45% engineering, administration and contingency allowance.

The project cost estimates presented in this plan represent opinions of cost only, acknowledging that final costs of individual projects will vary depending on actual labor and material costs, site conditions and requirements, market conditions for construction, regulatory factors, final project scope, project schedule and other factors. The estimates are preliminary and are based on the conceptual planning work that has been presented in this master plan. The estimates should be reviewed and updated as the projects proceed through the implementation process.

Project costs are presented in 2007 dollars. Since construction costs change periodically, an indexing method to adjust present estimates in the future is useful. The Engineering News Record (ENR) Construction Cost Index (CCI) is an index commonly used for this purpose. For future reference, the April 2007 ENR CCI of 8,629 for the Seattle area construction market (the nearest market ENR monitors) was used for construction cost estimates in this report.

Recommended System Improvements

General

Recommended system improvements are divided into System Capacity Improvements, which are necessary to increase collection system capacity, and System Rehabilitation Improvements, which are intended to rehabilitate or replace deteriorating facilities. Recommended system improvements are presented in Table 6-2 and are illustrated on Plate 1 in Appendix C. A brief description of each project is presented later in this section.

Table 6-2
Recommended Capital Improvements

Project No.	Project Category	Project Location	Size (inch)	Length (feet)	Unit Cost ($/linear foot)	Estimated Project Cost ($)
1	Collection System Extension	Area 59	15	3,730	$238	$887,740
2	Capacity Upgrade	Area 54/55	18	537	$248	$133,176
3	Capacity Upgrade	Area 54/55	15	533	$212	$112,996
4	Collection System Extension	Area 54/55	15	3,875	$238	$922,250
5	Collection System Extension	Area 54/55	12	2,555	$201	$513,555
6	Capacity Upgrade	Rock Creek Trunk	18	1,436	$248	$356,128
7	Capacity Upgrade	Rock Creek Trunk	24	1,349	$272	$366,928
8	Capacity Upgrade	Area 48 North	12	3,011	$227	$683,497
9	Collection System Extension	Area 48 North	12	3,280	$227	$744,560
10	Collection System Extension	Area 48 South	15	2,650	$238	$630,700
11	Rehabilitation	SW Willamette St. at Orcutt Place	8	362	$211	$76,382
12	Rehabilitation	SW Willamette St. at Highland Drive	8	592	$211	$124,912
13	Rehabilitation	SW Gleneagle Drive	8	145	$211	$30,595
14	Rehabilitation	SW Washington St.	8	250	$211	$52,750
15	Rehabilitation	SW Schamburg Dr. at Division	8	1,162	$211	$245,182
16	Rehabilitation	SW Sunset Blvd.	8	800	$211	$168,800
17	Rehabilitation	SW Pine/SW Park.	8	362	$211	$76,382
18	Rehabilitation	Old Town Laterals	-	-	-	$40,000
19	Rehabilitation	Ash Street Manhole	-	-	-	$10,000
					Total	**$6,176,533**

System Capacity Improvements

Recommendations for collection system capacity improvements were developed based on projected wastewater flows, hydraulic modeling, I&I assumptions and review of previous work. These improvements are further categorized as projects that either provide an extension of the collection system or an upgrade of system capacity to an existing facility.

Hydraulic modeling of the collection system indicates there are no areas of surcharging under current conditions. Modeling results indicate capacity improvements to the wastewater

collection system, in general, are only necessary to accommodate growth. The timing and sequencing of these projects will be determined as growth occurs. The projects are presented below based on an assumption of the sequencing of future growth.

1. Collection System Extension - Area 59

It is recommended that the collection system be extended from the Sherwood Trunk Sewer at Manhole 182NSan, with approximately 3,730 linear feet of 15-inch diameter pipe to serve Area 59. It is anticipated that the alignment of this pipe will be finalized with the completion of development plans for the area.

2. Capacity Upgrade - Area 54/55

It is recommended that approximately 537 linear feet of 12-inch diameter collection pipe be replaced with new 18-inch diameter pipe from Manhole 233NSan to Manhole 231NSan.

3. Capacity Upgrade - Area 54/55

It is recommended that approximately 533 linear feet of 12-inch diameter collection pipe be replaced with new 15-inch diameter pipe from Manhole 236NSan to Manhole 233NSan.

4. Collection System Extension - Area 54/55

It is recommended that the collection system be extended from Manhole 236NSan, with approximately 3,875 linear feet of new 15-inch diameter pipe to serve Area 54/55. It is anticipated that the alignment of this pipe will be finalized with the completion of development plans for the area.

5. Collection System Extension - Area 54/55

It is recommended that the previous 15-inch diameter pipe extension be further extended with approximately 2,555 linear feet of new 12-inch diameter pipe to serve Area 54/55. It is anticipated that the alignment of this pipe will be finalized with the completion of development plans for the area.

6. Capacity Upgrade - Rock Creek Trunk

It is recommended that approximately 1,436 linear feet of 15-inch diameter Rock Creek Trunk be replaced with new 18-inch diameter pipe from Manhole 414NSan to Manhole 402NSan. It is anticipated that the alignment of this pipe will be finalized with the completion of development plans for the area.

7. Capacity Upgrade - Rock Creek Trunk

It is recommended that approximately 1,349 linear feet of 18-inch diameter Rock Creek Trunk be replaced with new 24-inch diameter pipe from Manhole 402NSan to Manhole 396NSan. It is anticipated that the alignment of this pipe will be finalized with the completion of development plans for the area.

8. Capacity Upgrade - Area 48 North

It is recommended that approximately 3,011 linear feet of 8-inch and 10-inch diameter collection pipe be replaced with new 12-inch diameter pipe from Manhole 402NSan to Manhole 440NSan.

9. Collection System Extension - Area 48 North

It is recommended that the collection system be extended from Manhole 402NSan, with approximately 3,280 linear feet of new 12-inch diameter pipe to serve Area 48. It is anticipated that the alignment of this pipe will be finalized with the completion of development plans for the area.

10. Collection System Extension - Area 48 South

It is recommended that the collection system be extended from Manhole 414NSan, with approximately 2,650 linear feet of new 15-inch diameter pipe to serve the south side of Area 48. It is anticipated that the alignment of this pipe will be finalized with the completion of development plans for the area.

System Rehabilitation Improvements

Based on information provided by City staff, a number of other system improvements are recommended. These improvements, intended to replace or upgrade deteriorating pipes and manholes, can be completed as part of ongoing maintenance.

11. Rehabilitation - SW Willamette St. at Orcutt Place

It is recommended that approximately 362 linear feet of 6-inch diameter pipe be replaced with new 8-inch diameter pipe on SW Orcutt Place from Manhole 42NSan to Manhole 1929NSan to alleviate flow restrictions in the existing sewer, and improve maintenance capability.

12. Rehabilitation - SW Willamette St. at Highland Drive

It is recommended that approximately 592 linear feet of 6-inch diameter pipe be replaced with new 8-inch diameter pipe on SW Highland Drive from Manhole 1340NSan to Manhole 1911NSan, to alleviate flow restrictions in the existing sewer, and improve maintenance capability.

13. Rehabilitation - SW Gleneagle Drive

It is recommended that approximately 145 linear feet of 6-inch diameter pipe be replaced with new 8-inch diameter pipe on SW Gleneagle Drive from Manhole 1201NSan to Manhole 1207NSan, to alleviate flow restrictions in the existing sewer, and improve maintenance capability.

14. Rehabilitation - SW Washington Street

It is recommended that approximately 250 linear feet of 6-inch diameter pipe be replaced with new 8-inch diameter pipe on SW Washington Street from Manhole 341NSan to Manhole 342NSan, to alleviate flow restrictions in the existing sewer, improve maintenance capability and accommodate development in the area.

15. Rehabilitation - SW Schamburg Drive at Division Street

It is recommended that approximately 1,162 linear feet of 6-inch diameter pipe be replaced with new 8-inch diameter pipe on SW Schamburg Drive from Manhole 43NSan to manhole 919NSan, to alleviate flow restrictions in the existing sewer, improve maintenance capability and to improve the existing shallow sewer condition.

16. Rehabilitation - SW Sunset Blvd.

It is recommended that the collection system be extended from the existing facilities east of Manhole 659NSan, with approximately 800 linear feet of new 8-inch diameter pipe to serve the currently unsewered area.

17. Rehabilitation - Vicinity of City Hall, Between S.W. Pine Street and S.W. Park Street

It is recommended that approximately 362 linear feet of 8-inch diameter aging clay sewer pipe be replaced with new 8-inch diameter pipe in the vicinity of City Hall, Between S.W. Pine Street and S.W. Park Street from Manhole 346NSan to Manhole 345NSan, to alleviate flow restrictions in the existing sewer. Also, a new manhole should be installed on the existing 12-inch diameter pipe at Junction 343NSan, located 36 feet downstream of Manhole 344NSan to alleviate flow restrictions and improve maintenance capability.

18. Rehabilitation - Old Town Lateral Connections

It is recommended that problematic lateral connections in Old Town be replaced to alleviate flow restrictions in the existing sewer.

19. Rehabilitation - Ash Street Manhole Replacement

It is recommended that Manhole 347NSan located at Ash Street, which was previously installed without a base, be replaced with a new manhole and base.

Additional System Deficiencies

City staff identified several additional manhole flow restrictions, typically located at the end of cul-de-sacs, which require frequent flushing to remove debris. The locations of these manholes with flow restrictions are listed below:

- SW Keda Court at Manhole 1575NSan
- SW Wheat Place at Manhole 1553NSan
- SW Barley at Manhole 1554NSan
- SW Farmer Way at Manhole 1544NSan
- SW Cobble Court at Manhole 294NSan
- SW Reghetto St. at Manhole 1188NSan
- Tualatin Sherwood Road at Manhole 1719NSan.

It is recommended that these manholes be further investigated to determine the causes of the flow restrictions.

Project Scheduling

Based on conversations with City staff and private consultants developing the concepts plans for Areas 54, 55, and 59, the following planning level project prioritization was developed.

- Project 1 - Area 59: 2007 to 2008.
- Projects 2 to 5 - Area 54/55: 2009 to 2012.
- Projects 6 to 10 - Rock Creek Trunk and Area 48: 2013 to 2022.
- Projects 11 to 19 – Rehabilitation Projects: 2007 to 2011.

CWS Trunk Upsizing

Hydraulic modeling indicated that under future build-out conditions, two of the primary Clean Water Services (CWS) trunk sewers that convey wastewater to the Sherwood Pump Station are undersized and will need to be upsized to accommodate projected future flows. These improvements are consistent with capacity improvements identified by the CWS 2000

Sewer Master Plan Update. Since CWS owns and maintains these facilities, costs for these projects are not included in the City's capital improvement plan, but will be included in the CWS capital improvement plan.

Capacity Upgrades – Rock Creek Trunk

The 18-inch diameter sewer trunk extending from the City limits to the existing 24-inch diameter Sherwood Trunk will need increased capacity as the industrial zones in NE Sherwood develop and Area 48 is developed. Approximately 5,200 linear feet of 18-inch diameter trunk will need to be upsized to 24-inch diameter pipe.

Capacity Upgrades – Cedar Creek Trunk

Approximately 15,260 linear feet of the 24-inch diameter Sherwood Trunk will need to have increased capacity, by upgrading to 36-inch diameter pipe. This capacity will serve the development in Area 54, 55, and 59, as well as provide for future redevelopment under higher densities over the western Sherwood service area.

SECTION 7
SYSTEM OPERATION, MAINTENANCE AND REHABILITATION

General

The City has a tremendous investment in the infrastructure and equipment which comprise the sanitary sewer collection system. To protect this investment and obtain full useful life of these facilities, a program for operation, maintenance and rehabilitation of the system is necessary. A sanitary sewage collection system functions to transport wastewater from the points of their origin to a treatment facility. To ensure the public safety, it is critical that no release of wastewater from the collection system be allowed to occur. This section provides a plan and recommendations for

- Management and operation of the system;
- Preventative and ongoing maintenance;
- Rehabilitation of aging elements;
- Record keeping and incidence reporting.

Sanitary Sewer Overflows

A sanitary sewer overflow (SSO) is an unintentional discharge of raw sewage from a municipal sanitary sewer. A SSO can spill raw sewage into basements or out of manholes and onto city streets, playgrounds and into streams. The untreated sewage from these overflows contaminates our waters, causing serious health and water quality problems.

Requirements for SSOs are established in Oregon Administrative rules (OAR) 340-041-120, Sections 13 and 14. Sanitary sewer overflows are prohibited and if a SSO does occur it must be reported to DEQ.

SSOs have a variety of causes, including but not limited to inadequate capacity, blocked, broken or cracked pipes, severe weather, power failure or vandalism. To address SSOs, the EPA has developed guidelines for municipalities regarding operation of their sanitary sewer collection systems.

Capacity, Management, Operation and Maintenance Guidelines

With the goal of reducing or eliminating the incidence of a SSO, the U.S. Environmental Protection Agency (EPA) has developed a guidance document intended to clarify the requirements of the NPDES permit language in regard to operation and maintenance of collection systems. These guidelines extend to any municipality contributing to the treatment and/or conveyance system of a permit holder. EPA's Guide for Evaluating Capacity, Management, Operation and Maintenance (CMOM) Programs at Sanitary Sewer Collection Systems, January 2005, provides specific suggestions in terms of CMOM programs.

CMOM builds on the standard operation and maintenance activities routinely implemented by the operator with additional information management requirements.

Collection System Capacity Evaluation

The City should periodically evaluate the capacity of the collection system in both wet and dry weather conditions to confirm pipe capacity is maintained as it was designed. The capacity evaluation program supports the effectiveness of the maintenance program. Capacity evaluation begins with the information presented in this master plan including system size, inventory of pipe lengths, size, material and age, condition, pipe slopes and inverts, etc. This system information is updated and maintained through general inspection of the system.

Areas where system capacity deficiencies exist, such as wet weather related SSOs, surcharged lines, or basement backups, should be identified. Inspection and/or maintenance of these problem areas should be scheduled.

Flow Monitoring

Flow monitoring can provide important information about the collection system. Flow monitoring provides information on dry weather flows as well as areas that are affected by infiltration and inflow (I&I). In lieu of flow meters, visually monitoring manholes during low-flow periods to determine areas with excessive I&I is useful. For a small system this may be an effective means of determining areas that need further investigation.

Determination of Infiltration and Inflow

Infiltration and inflow is best evaluated through flow monitoring followed by video inspection. Monitoring is performed to quantify the excess flow attributable to I&I and better direct the video investigations. Once general areas are identified, video investigation is used to pinpoint cracked pipe, leaky joints, or inappropriate service connections.

Mapping

Information derived from monitoring and inspection is used to update system maps, which can be used as a blueprint for scheduling and planning maintenance activities.

Collection System Management

Efficient operation and effective maintenance efforts are a result of adequate collection system management. A formal CMOM program would include a collection system management plan created to establish procedures for achieving department goals. Some of the goals of the management plan, according to the Guide for Evaluating CMOM Programs at Sanitary Sewer Collection Systems include:

- protection of public health and prevention of unnecessary property damage,
- minimization of infiltration, inflow and exfiltration, and maximum conveyance of wastewater to the treatment plant,
- provision of prompt response to service interruptions,
- efficient use of allocated funds,
- identification of and remedy solutions to design, construction, and operational deficiencies, and
- performance of all activities in a safe manner to avoid injuries.

Collection System Operation

Collection systems have little of what is traditionally referred to as "operability" as compared to a wastewater treatment plant. However, as presented in the Guide for Evaluating CMOM Programs at Sanitary Sewer Collection Systems, efficient operation of the collection system would include knowing what comprises the system (inventory and physical attributes), knowing where the system is (maps and location), knowing the condition of the system (assessment), planning and scheduling work based on condition and performance, performing maintenance based on condition and performance of the system, and training personnel to do the work safely and efficiently. Additionally, the method of operation of each system component or program must be clearly communicated to the operator.

Current Maintenance Practices

The following sections describe equipment, personnel, procedures and programs currently in place within the Sanitary and Storm Sewer Section of the Public Works Department at the City of Sherwood.

Division of Responsibilities

Clean Water Services (CWS), a county service district, holds the NPDES permit allowing discharge of treated wastewater to the Tualatin River. CWS owns and operates several waste treatment facilities in the region. The City of Sherwood does not own or maintain treatment facilities but has an Intergovernmental Agreement with Clean Water Services to send untreated waste to CWS's Durham Advanced Wastewater Treatment Plant. The Agreement, a copy of which is included in Appendix C clarifies the individual responsibilities of the City and the District. In general, the City owns and maintains all components of the collection system smaller than 24-inch in diameter. The District operates and maintains wastewater treatment facilities, the surface water collection system, sanitary sewer trunks 24-inch diameter and larger.

Equipment

The City owns and operates several large pieces of equipment. The "System Truck" is a combination vacuum and jet rodder known as the "jetter". Using the system truck, both functions including power washing and vacuuming can be accomplished. The jetter holds 1000 gallons of water or a nearby fire hydrant can be accessed.

An attachment for the system truck uses the high pressure water to operate a circular saw which cuts roots as it travels along the line. A second attachment is used to cut protruding service taps.

The City also owns and operates a television inspection truck. The camera sits on a transporter which rides on tracks. The speed and direction is controlled from the van. The operator monitors a video display of the camera travel which is also recorded onto the hard drive. There is a footage counter which records the distance the camera has traveled.

The City does not currently own or have plans to acquire lining or pressure grouting equipment. In the event these activities are required, the City would likely contract with Clean Water Services or hire a private contractor using normal city procurement practices.

Personnel

The Maintenance and Operations department is comprised of five employees. Two people, who perform many of the maintenance activities, are classified as Utility Worker II and a third employee is a Lead Utility worker. There is also an administrative person and the Operations Supervisor. The operators have wastewater collection certification through DEQ and are required to earn 2 CEUs every two years to maintain that certification.

The System

City staff reports there are no single "problem areas" in the system but rather specific sewer trunks and laterals which are problematic. The system experiences few incidences of surcharge conditions which was confirmed by the hydraulic modeling analysis presented in Section 2. There is about 3000-foot of main in an area of restaurants referred to as the "grease line". This line must be cleaned frequently cleaned due to grease build up. A second area near Columbia Street tends to attract root growth.

Information Management

The department is in the process of installing Hansen's Information Management System Software. This computer program will be used to track all data and assets, to generate work orders and reports and to schedule preventative maintenance. Currently hard copy lists are being used.

Recommended Maintenance Activities

Maintenance operations can be divided into routine, preventative, and emergency response activities.

- Routine - Clean Water Services requires the City to clean and inspect a portion of the collection system piping every year.
- Preventative – The City is aware of certain "problem areas". Work is performed in these areas on a regular basis to prevent blockages. Preventative maintenance also includes periodic servicing of mechanical and electrical equipment.
- Emergency – the staff responds to breakages and back ups as they occur.

In the future, the operation's supervisor has plans to implement a more aggressive I&I rehabilitation program. Also, a program for regular inspection of restaurant grease traps is in the preliminary planning stage.

Sewer System Inspection

Sewer inspection is an important component of any maintenance program. Visual inspections provide valuable information regarding the accuracy of system mapping, the presence of I&I and the physical condition of the system. Visual inspection should take place on an ongoing basis. Visual inspection allows the operator to determine the structural condition of the system, the presence of grease, roots, or debris and condition of structures including joints. Careful record keeping is the key to prevention of future emergencies. Information to be recorded following an inspection includes:

- Location and identification of line being inspected;
- Pipe size and type;
- Name of personnel performing inspection;
- Distance inspected;
- Cleanliness of the line;
- Structural condition of manholes or pipe, offsets or misalignments;
- Accumulations of grease, debris or grit;
- Presence of corrosion;
- Evidence of surcharge and presence of I&I.

There are sections of CWS's large collection main, located within the refuge area and along Rock Creek, which are below water most of the year. Manholes in this area have been sealed to prevent infiltration of water into the system. Therefore, inspection at these locations is difficult.

Sewer Cleaning

The purpose of sewer cleaning is to remove accumulated material from the sewer. Cleaning helps to prevent blockages and is also used to prepare the sewer for inspection. Stoppages in gravity sewers are usually caused by a structural defect, poor design, poor construction, an accumulation of material in the pipe, or root intrusion. Protruding taps may catch debris which then causes further buildup of solids.

There are essentially three methods of sewer cleaning. These include hydraulic, mechanical, and chemical cleaning. The Water Environment Federation's (WEF) Manual of Practice (MOP) No. 7 Wastewater Collection System Management, 5th Edition, offers additional information on sewer cleaning methods.

The City of Sherwood owns a system truck as previously discussed. The system truck is used to jet clean the sewer line with high-pressure water. The debris is then vacuumed from the manhole with the high-powered vacuum hose.

Fats, oils and grease (FOG) in the system can cause an increase in maintenance costs and backups in the system. FOG typically comes from food or petroleum products. Often restaurants, hotels and some industries dispose of significant amounts of FOG into the system. As the wastewater cools, the grease coagulates and is deposited on the pipe walls and can build up in sewer lines. Properly designed and maintained grease traps can effectively trap grease. The City has identified the need for a program of monitoring and inspecting area grease traps. This program, anticipated by the end of 2007, will include an educational component to inform the public about the impact of oil and grease on the collection system.

According to EPA Region 4 Guide to Collection and Transmission System Management, Operation and Maintenance Programs a program to address FOG would include a grease control ordinance, grease trap and interceptor design standards, permitting and inspecting commercial grease traps and interceptors, a credible enforcement component, a public education component for residential sources, performance measures, and a mechanism for including program information into the IMS.

Accurate record keeping regarding areas of the collection system susceptible to stoppages is essential to an effective sewer cleaning program. Cleaning of gravity sewer mains is typically performed quarterly to remove grease and sediment in the sewer mains.

Root Intrusion

Roots of trees enter sewers typically in older parts of town where the trees are more mature and their root system is more established. When pipes lie outside of the paved street or close to the curb, roots have an opportunity to enter. Roots typically enter the pipe at joints or

cracks in the pipe. As the root grows, the crack enlarges impacting the structural integrity of the pipe. Additionally, the enlarged cracks allow more I&I to infiltrate.

As mentioned, the City has an adaptor on the service truck used to cut the roots at the inside edge of the pipe. Typically a chemical treatment is applied that kills the root for several feet back from the pipe.

Vandalism

Sometimes a blockage is created when something is thrown into a manhole. If blockages or overflows become a problem due to vandalism access to manholes can be prevented by installing bolt-down or lockable manhole covers.

Emergency Preparedness and Response

The City should have a plan in place for dealing with routine and catastrophic emergencies. Routine emergencies include overflowing manholes, line breaks, or localized electrical failure. Catastrophic emergencies include floods, tornadoes, earthquakes, serious chemical spills or widespread electrical failure. The plan should be in writing and available to all staff.

The plan must clearly identify the steps to be taken in the event of an emergency or a sewer system overflow. The plan should include an overflow response plan detailing response procedures, equipment, and methods of public and regulatory notification.

SECTION 8
FINANCIAL EVALUATION

Introduction

The purpose of the financial evaluation is to provide reasonable assurance that the City's Sanitary Fund has and will have the financial ability to maintain and operate the wastewater system on an ongoing basis, plus have the capacity to obtain sufficient funds to construct the wastewater system improvements as identified in Section 6.

In completing the financial evaluation, the historical financial performance of the Sanitary Fund was documented; capital funding options available for wastewater system projects were identified; a capital funding strategy for the Capital Improvement Program (CIP) was developed; and revenue requirements and customer impacts considering the "total system" costs of providing wastewater service, operating and capital, were determined. The evaluation includes the following elements:

- ***Historical Financial Performance***
  - Comparative statements of revenue and expenses FY 2000/01 to 2005/06
  - Comparative balance sheets FY 2000/01 to 2005/06
  - Debt service schedules
- ***Funding Sources***
- ***Fiscal Policies***
- ***Capital Financing Plan***
  - Six-year CIP with revenue sources FY 2007/08 to 2012/13
  - Total wastewater system projects with revenue sources FY 2007/08 to 2026/27
- ***Projected Financial Performance***
  - Revenue requirement forecast FY 2006/07 to 2012/13 (one actual year and the 6-year CIP forecast)
- ***Current Rate Structure, Rate Forecast, and Affordability Test***

Historical Financial Performance

The City of Sherwood provides wastewater collection and conveyance services. Clean Water Services provides regional transmission/treatment services.

The financial statements presented below show the historical financial performance of the Sanitary Fund. Net income has declined over the last few years, with the Fund experiencing a net operating loss in FY 2005/06 (including depreciation expense). The financial evaluation addresses rate levels necessary to fund depreciation expense in addition to meeting ongoing operating and capital costs, as well as maintaining appropriate levels of cash reserves.

Comparative Statements of Revenues, Expenses and Fund Equity

Table 8-1 summarizes the Statements of Revenues, Expenses and Fund Equity for the Sanitary Fund from FY 2000/01 to 2005/06.

Table 8-1
Statements of Revenues, Expenses and Fund Equity

	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06
Operating revenues						
Charges for services:						
Utility charges for services	$ 1,300,085	$ 1,540,810	$ 1,618,786	$ 1,752,499	$ 1,909,243	$ 2,051,027
Other charges for services				1,229	200	
Infrastructure development fees:						
System development charges			506,969	905,112	1,078,769	677,068
System development credits			9,907	13,344	-	
Utility connection fees					14,550	11,985
Utility Meters and Connections	16,824	10,977				
Other revenue					-	
Total operating revenues	1,316,909	1,551,787	2,135,662	2,672,184	3,002,762	2,740,080
Operating Expenses						
Materials and Services:						
Professional and technical services			1,643,016	2,275,973	2,099,882	2,501,350
Facility and equipment			5,219	3,343	4,734	7,360
Other purchased services			445	713	96,400	125,697
Supplies			3,539	7,321	9,591	6,955
Minor equipment purchases			-	1,717	1,203	7,797
Other materials and services			-	-	-	-
Reimbursements				131,058	153,347	151,397
Contracted Services	1,072,277	1,191,615	149,590			
Other	25,577	6,439	-			
Depreciation	15,232	16,784	85,460	83,166	84,546	77,598
Total operating expenses	1,113,086	1,214,838	1,887,269	2,503,291	2,449,703	2,878,154
Operating income (loss)	203,823	336,949	248,393	168,893	553,059	(138,074)
Nonoperating revenue (expenses):						
Interest revenue	10,788	3,468	57,053	46,101	90,555	93,047
Interest expense			(13,923)	(10,640)	(12,866)	(8,926)
Payment for debt service			(18,217)	(25,390)	(26,578)	(27,827)
Total nonoperating revenue	10,788	3,468	24,913	10,071	51,111	56,294
Income before contributions	214,611	340,417	273,306	178,964	604,170	(81,780)
Capital contribution-private developers	20,697	50,834		778,510	780,007	
Reclass capital assets between funds				(16,694)		
Transfers from other funds					-	-
Transfers to other funds	(415,963)	(360,948)			-	(40,470)
Prior period adjustment			6,257,585			
Net Assets - beginning	422,052	241,397	3,428,428	9,959,319	10,900,099	12,284,276
Net Assets- ending	$ 241,397	$ 271,700	$ 9,959,319	$ 10,900,099	$ 12,284,276	$ 12,162,026

Comparative Balance Sheets

Figure 8-2 presents the Balance Sheets for the Sanitary Fund from FY 2000/01 to 2005/06.

Table 8-2
Balance Sheet

	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06
ASSETS						
Current Assets:						
Cash and cash equivalents	$ 70,623	$ 109,243	$ 3,474,555	$ 4,000,029	$ 2,821,558	$ 2,938,099
Receivables	102,132	87,312	123,512	89,520	141,234	122,720
Advances to other funds						1,595,075
Total current assets	172,755	196,555	3,598,067	4,089,549	2,962,792	4,655,894
Noncurrent assets:						
Advances from other funds					1,595,075	
Capital assets:						
Land			13,718	14,968	14,968	14,968
Infrastructure			6,867,563	7,906,941	8,685,451	8,685,451
Buildings and improvements						-
Machinery and equipment			654			-
Licensed vehicles	167,842	167,842	167,842			-
Construction work in progress	-	50,834	124,651			-
Less accumulated depreciation	(97,388)	(114,172)	(809,610)	(888,120)	(972,666)	(1,050,264)
Total noncurrent assets	70,454	104,504	6,364,818	7,033,789	9,322,828	7,650,155
Total assets	$ 243,209	$ 301,059	$ 9,962,885	$ 11,123,338	$ 12,285,620	$ 12,306,049
LIABILITIES AND FUND EQUITY						
Current liabilities:						
Accounts payable	$ 1,812	$ 29,359		$ 221,742		$ 144,023
Other current liabilities			3,566	1,497	1,344	-
Total current liabilities	1,812	29,359	3,566	223,239	1,344	144,023
Noncurrent liabilities:						
Other noncurrent liabilities						
Total liabilities	1,812	29,359	3,566	223,239	1,344	144,023
Fund equity:						
Invested in capital assets	70,454	104,504	6,364,818	7,033,789	9,322,828	7,650,155
Restricted for Capital Projects					2,317,974	
Unrestricted	170,943	167,196	3,594,501	3,866,310	643,474	4,511,871
Total fund equity	241,397	271,700	9,959,319	10,900,099	12,284,276	12,162,026
Total liabilities and fund equity	$ 243,209	$ 301,059	$ 9,962,885	$ 11,123,338	$ 12,285,620	$ 12,306,049

Existing Debt

The City has one outstanding debt obligation for the Sanitary Fund – a Public Works & Fieldhouse loan obtained in 2002 with Bank of America. The Sanitary Fund's share of this debt obligation is 16 percent. Table 8-3 shows the Sanitary Fund's share of the outstanding debt service schedule for this loan.

Table 8-3
Debt Repayment

Type	Loan
Purpose	2002 Public Works faciltiy & fieldhouse
Original principal	$1,900,000
Payee	Bank of America
	Sanitary Fund Share 16%

Payment date		Beginning balance	Principal	Interest	Ending balance
Nov	2002	304,000	6,028	3,496	297,972
Feb	2007	191,524	7,322	2,203	184,202
May	2007	184,202	7,406	2,118	176,796
Aug	2007	176,796	7,491	2,033	169,305
Nov	2007	169,305	7,577	1,947	161,728
Feb	2008	161,728	7,665	1,860	154,063
May	2008	154,063	7,753	1,772	146,310
Aug	2008	146,310	7,842	1,683	138,468
Nov	2008	138,468	7,932	1,592	130,536
Feb	2009	130,536	8,023	1,501	122,513
May	2009	122,513	8,116	1,409	114,398
Aug	2009	114,398	8,209	1,316	106,189
Nov	2009	106,189	8,303	1,221	97,886
Feb	2010	97,886	8,399	1,126	89,487
May	2010	89,487	8,495	1,029	80,992
Aug	2010	80,992	8,593	931	72,399
Nov	2010	72,399	8,692	833	63,707
Feb	2011	63,707	8,792	733	54,915
May	2011	54,915	8,893	632	46,022
Aug	2011	46,022	8,995	529	37,027
Nov	2011	37,027	9,099	426	27,928
Feb	2012	27,928	9,203	321	18,725
May	2012	18,725	9,309	215	9,416
Aug	2012	9,416	9,416	108	(0)

Funding Sources

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

Government Programs

Special Public Works Fund

The Special Public Works Fund program provides funding for the infrastructure that supports job creation in Oregon. Loans and grants are made to eligible public entities for the purpose of studying, designing and building public infrastructure that leads to job creation or retention.

In 2003 the rules for the Special Public Works Fund (Division 42) underwent a dramatic revision. The rules are now broken out into five (5) major divisions:

- Infrastructure (e.g., public infrastructure needed to support job creation)
- Community Facilities (e.g., publicly owned facilities that support the local economy)
- Essential Community Facilities Emergency Projects (e.g., city halls, community centers)
- Railroads

Wastewater systems are listed among the eligible infrastructure projects to receive funding. The Special Public Works Fund is comprehensive in terms of the types of project costs that can be financed. Besides actual construction, eligible project costs can include costs incurred in conducting feasibility and other preliminary studies and for design and construction engineering. The Fund is primarily a loan program. Grants can be awarded, up to the program limits, based on job creation or on a financial analysis of the applicant's capacity for carrying debt financing. The total loan amount per project cannot exceed $15 million. The department is able to offer very attractive interest rates that typically reflect low market rates for very good quality creditors. In addition, the department absorbs the associated costs of debt issuance thereby saving applicants even more on the overall cost of borrowing. Loans are generally made for 20 year terms, but can be stretched to 25 years under special circumstances.

Water/Wastewater Fund

The Water/Wastewater Fund was created by the Oregon State Legislature in 1993. It was initially capitalized with lottery funds appropriated each biennium and with the sale of state revenue bonds since 1999. The purpose of the program is to provide financing for the design and construction of public infrastructure needed to ensure compliance with the Safe Drinking Water Act or the Clean Water Act.

Eligible activities include reasonable costs for construction improvement or expansion of drinking water, wastewater or storm water systems. To be eligible a system must have received, or is likely to soon receive, a Notice of Non-Compliance by the appropriate regulatory agency, associated with the Safe Drinking Water Act or the Clean Water Act.

Projects also must meet other state or federal water quality statutes and standards. Criteria include projects that are necessary to ensure that municipal water and wastewater systems comply with the Safe Drinking Water Act or the Clean Water Act.

In addition, other limitations apply:

- The project must be consistent with the acknowledged local comprehensive plan.
- For water system projects, the municipality will require the installation of meters on all new service connections to any distribution lines that may be included in the project.
- Recipient shall certify that a registered professional engineer will be responsible for the design and construction of the project.

The Fund provides both loans and grants, but it is primarily a loan program. The loan/grant amounts are determined by a financial analysis of the applicant's ability to afford a loan (debt capacity, repayment sources and other factors). The Program's guidelines, project administration, loan terms and interest rates are similar to the Special Public Works Fund program. The maximum loan term is 25 years or the useful life of the infrastructure financed, whichever is less. The maximum loan amount is $15,000,000 per project through a combination of direct and/or bond funded loans. Loans are generally repaid with utility revenues or voter approved bond issues. A limited tax general obligation pledge may also be required. "Credit worthy" borrowers may be funded through sale of state revenue bonds.

Community Development Block Grant (CDBG)

Since the late 1980's the state of Oregon has administered the U.S. Department of Housing and Urban Development's Community Development Block Grant (CDBG) funds for the non-entitlement cities and counties of the state. The primary objective of the program is the development of viable (livable) urban communities by expanding economic opportunities and providing decent housing and a suitable living environment principally for persons of low- and moderate-income. Each year the state develops an annual "Method of Distribution" which establishes how the funds will be used for that calendar year. The Method of Distribution can be found on the department's web site.

Only non-entitlement (non-metropolitan) cities and counties in rural Oregon can apply for and receive grants. Urban (entitlement) cities: Ashland; Bend; Corvallis; Eugene; Medford; Portland; Salem; and Springfield and counties: Clackamas; Multnomah; and Washington are not included in the state's 2006 Community Development Block Grant program because they receive Community Development Block Grant funds directly from the U.S. Department of Housing and Urban Development. Under the 2006 CDBG Method of Distribution, improvements to water and wastewater systems projects are eligible for funding.

The City should pursue all available grants and low cost loans. When the City has exhausted all grant and loan options, issuing public debt may be the next best option.

Public Debt

Revenue Bonds

Revenue bonds are commonly used to fund utility capital improvements. The debt is secured by the revenues of the issuing utility and the debt obligation does not extend to other City resources. With this limited commitment, revenue bonds typically require security conditions related to the maintenance of dedicated reserves (a bond reserve) and financial performance measures (added bond debt service coverage). In order to qualify to sell revenue bonds, the City must show that the net revenue (less operating and maintenance expense) for the Sanitary Fund (or on a combined basis with other enterprise funds, if applicable) is equal to or greater than a factor, typically 1.2 to 1.4, times the annual revenue bond debt service. This factor is commonly referred to as the coverage factor, and is applicable to revenue bonds sold on the commercial market. There is no bonding limit, except perhaps the practical limit of the utility's ability to generate sufficient revenue to repay the debt and meet other security conditions. In some cases, poor credit might make issuing bonds problematic.

Revenue bonds incur relatively higher interest rates than government programs, but due to the highly competitive nature of the low-interest government loans, revenue bonds are assumed to be a more reliable source of funding. To be conservative, the analyses presented herein assume that capital projects above the amount available from cash reserves will be funded with revenue bonds. However, the City should pursue the low-interest loans for eligible capital projects.

Sanitary Fund Cash Resources and Revenues

Sanitary Fund financial resources available for capital funding include rate funding, cash reserves, and system development charges.

- *Rate Funding* -- As part of the rate study in progress, a policy to fund depreciation expense through rates will be established. Funding of this policy has been incorporated into this financial evaluation. The annual funding level will be available to help fund future system replacement projects.

- *Capital Cash Reserves* -- Cash reserves are comprised of previously collected system development charge revenues, transfers of operating revenues in excess of requirements, and interest earnings on operating cash reserves. The Sanitary Fund is projected to begin FY 2007/08 with $836,744 in capital cash reserves.

- *System Development Charges* -- The City imposes a system development charge (SDC) on all new connections to the wastewater system. The charge is intended to

recover a fair share of collection and conveyance system infrastructure from new connections. The improvement fee portion of the charge is $0.083 per gallon per day (gpd) of sewage and the reimbursement portion is $0.230 per gpd. A single residence is assumed to generate 535 gpd, equating to a total City SDC of $167.46. Clean Water Services imposes an additional SDC of $2,700, which is expected to increase to $2,800 in FY 2007/08. The capital projects included in this Plan include only the City's collection/conveyance projects; thus, only the City's SDC is assumed to be available to help fund these projects. The regional charge is assumed to fund the City's share of eligible Clean Water Services projects (not included in this Plan).

The City's SDC will be updated as part of the rate study process to reflect current and planned eligible system infrastructure.

Fiscal Policies

Critical to the long-term financial health and performance of the Sanitary Fund is the development of sound fiscal policies to guide financial performance. The key policies incorporated into this financial evaluation include:

- Minimum operating fund balance equal to 30 to 45 days of annual operating & maintenance expense. Year-end cash balances in excess of 45 days to be transferred to the capital fund to help pay for capital projects.
- Capital contingency reserve equal to at least 1 percent of total system assets.
- System reinvestment funding through rates, using depreciation expense as the benchmark for the appropriate level of funding. The annual contribution is based on "net depreciation funding" from rates, which equals the annual depreciation expense less annual principal payments. This benchmark is roughly equivalent to "break-even" performance from a balance sheet perspective. This policy is assumed to begin in FY 2008/09.

Capital Financing Plan

The capital financing plan evaluates planned capital costs and available resources to determine whether additional funding will be required from rates, either to pay for new debt service or to directly fund the capital projects.

Table 8-4 summarizes the 6-year capital funding strategy. Total capital costs from FY 2007/08 through FY 2012/13 equal $3.5 million in current dollars. Costs have been escalated annually at 4.0 percent for a total cost of $4 million.

Table 8-4
6-year Capital Funding Strategy

Capital Financing 2007/08-2012/13	2007/08	2008/09	2009/10	20010/11	2011/12	2012/13	Total
Capital Projects Current Dollars	$ 735,011	$ 735,011	$ 583,246	$ 583,246	$ 583,246	$ 292,106	$ 3,511,865
Capital Projects Escalated	$ 764,411	$ 794,987	$ 656,073	$ 682,315	$ 709,608	$ 369,607	$ 3,977,001
Funding Sources							
Capital Fund Balance	$ 762,123	$ 780,737	$ 229,610	$ 125,732	$ 119,333	$ 97,995	$ 2,115,531
Revenue Bond Proceeds	2,288	14,250	426,462	556,584	590,275	271,611	1,861,471
Total Funding Sources	$ 764,411	$ 794,987	$ 656,073	$ 682,315	$ 709,608	$ 369,607	$ 3,977,001
Revenue Bond Issued	$ 2,543	$ 15,838	$ 473,975	$ 623,403	$ 661,138	$ 304,219	2,081,116

Table 8-5 shows the total capital projects from FY 2007/08 through FY 2026/27 and the anticipated funding sources. Capital projects over this planning horizon total $6.2 million in current dollars and $8.2 million escalated.

Table 8-5
20-year Capital Funding Strategy

Capital Financing 2007/08 through 2026/27	Total
Capital Projects	$ 8,186,968
Funding Sources	
Capital Fund Balance	$ 3,198,891
Revenue Bond Proceeds	4,988,077
Total Funding Sources	$ 8,186,968

Roughly 53 percent of the 6-year CIP and 40 percent of the 20-year CIP is forecasted to be funded with cash reserves. The remaining needs are assumed to be funded with revenue bonds. Debt service on revenue bonds is assumed to begin the year following debt issuance.

Projected Financial Performance

The FY 2007/08 Sanitary Fund operating budget forms the baseline for forecasting future operating costs and estimating the impacts of recommended wastewater system capital improvements.

Revenue Requirement Analysis

The revenue requirement analysis determines the amount of rate revenue needed in a given year to meet that year's expected financial obligations. Two separate conditions must be satisfied for each year of the analysis period in order for rates to be sufficient: annual cash needs must be met, and the minimum revenue bond debt service coverage requirement (if any) must be realized.

The cash flow test identifies cash requirements for the Sanitary Fund in the year addressed.

Those requirements can include cash operating and maintenance expenses, debt service, directly funded capital outlays, capital transfers, and any forecasted additions to reserves. The total cash needs are then compared to forecasted utility revenues. Any projected shortfalls are identified and the level of rate increase necessary to make up the shortfall is estimated.

The coverage test is based on bond covenants applicable to outstanding revenue bonds, which require that a specific test of revenue sufficiency be met. This requirement typically stipulates that annual revenues must be sufficient to meet operating expenses plus a factor multiplied times annual debt service on all revenue bond debt issued. The City does not currently have any revenue bonds outstanding. This analysis assumes a coverage factor of 1.25 on all future revenue bond issues, excluding SDC revenues.

A number of forecast assumptions are used in the analysis:

- Rate revenue (under existing rate levels) is calculated to increase with growth in future years, which is projected to average 3.72 percent per year (consistent with those used in this Plan for facility planning purposes). The analysis incorporates Clean Water Services proposed 3.5 percent rate increase for FY 2007/08.
- Operations and maintenance expenses (O&M) are escalated assuming general inflation of 3.0 percent per year and labor inflation of 5.0 percent per year. Clean Water Services treatment costs are planned to increase in proportion to growth plus 3.5 percent escalation.
- In addition to O&M expenses, the revenue requirement includes debt service costs and rate-funded system reinvestment (depreciation) funding.
- Revenue bond debt financing terms include a 20-year repayment term, 5.0 percent interest cost and 2.0 percent issuance cost.

Table 8-6 summarizes the financial performance and rate requirements for FY 2006/07 through FY 2012/13. The City's existing rates are not adequate to support the projected needs of the Sanitary Fund over the study period. A 6 percent increase is needed to meet FY 2008/09 expenditures (primarily to fund depreciation expenses through rates), followed by inflationary-level increases thereafter. In addition to annual inflation, the major driver of the FY 2008/09 increase is incorporating a policy of funding system reinvestment (depreciation expense) through rates.

Table 8-6
Revenue Requirements

	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13
Revenue							
Rate revenue under existing rates	$ 2,123,000	$ 2,279,147	$ 2,364,038	$ 2,452,090	$ 2,528,828	$ 2,607,967	$ 2,689,583
Use of SDCs for debt service	-	-	-	-	-	-	-
Non-rate revenue	38,646	40,162	17,040	17,012	18,416	21,971	24,811
Total annual revenue	$ 2,161,646	$ 2,319,309	$ 2,381,078	$ 2,469,102	$ 2,547,244	$ 2,629,938	$ 2,714,394
Materials and Services							
Professional & technical	$ 1,380,398	$ 1,707,600	$ 1,833,194	$ 1,968,027	$ 2,100,652	$ 2,242,215	$ 2,393,318
Facility & equipment	10,000	11,208	11,544	11,891	12,247	12,615	12,993
Other purchased services	84,895	118,000	121,540	125,186	128,942	132,810	136,794
Supplies	9,500	10,304	10,613	10,932	11,259	11,597	11,945
Minor Equipment	16,000	46,000	47,380	48,801	50,265	51,773	53,327
Non-Capitalized Vehicles	-	40,000	41,200	42,436	43,709	45,020	46,371
Reimbursements	150,298	225,451	236,724	248,560	260,988	274,037	287,739
	$ 1,651,091	$ 2,158,563	$ 2,302,195	$ 2,455,832	$ 2,608,063	$ 2,770,068	$ 2,942,487
Other Expenditures							
Debt Service	$ 38,098	$ 38,098	$ 38,302	$ 39,573	$ 77,606	$ 122,432	$ 151,500
Rate-Funded System Reinvestment	-	-	76,058	87,169	84,853	89,202	104,750
Transfers Out (shared capital)	93,000	106,725	109,927	113,225	116,621	120,120	123,724
Additions to meet minimum fund balance	-	-	-	-	-	-	-
	$ 131,098	$ 144,823	$ 224,287	$ 239,966	$ 279,080	$ 331,755	$ 379,974
Total annual rate-funded expenditures	$ 1,782,189	$ 2,303,386	$ 2,526,482	$ 2,695,798	$ 2,887,143	$ 3,101,823	$ 3,322,461
Annual Surplus (Deficiency)	$ 379,458	$ 15,923	$ (145,404)	$ (226,696)	$ (339,899)	$ (471,884)	$ (608,067)
Annual Rate Increase	**0.00%**	**0.00%**	**6.00%**	**4.00%**	**4.00%**	**3.00%**	**4.00%**
Cumulative Rate Increase	**0.00%**	**0.00%**	**6.00%**	**10.24%**	**14.65%**	**18.09%**	**22.81%**

Table 8-7 summarizes the 6-year rate forecast.

Table 8-7
Current Rates Projected with Across-the-Board Increases

	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13
Rate Increase		**6.00%**	**4.00%**	**4.00%**	**3.00%**	**4.00%**
Fixed Charge - per Month						
	$19.11	$20.25	$21.06	$21.91	$22.56	$23.46
Volume Charge - $ / CCF Winter Average Water Use						
	$1.314	$1.393	$1.449	$1.507	$1.552	$1.614

** includes 3.5% 2007/08 rate increase per Clean Water Services.*

Affordability Test

A median household income index analysis is one way to gauge rate level affordability. To complete the test, residential wastewater bills are compared to 1.5 percent of median household income for the period of analysis. This analysis provides an indication of a residential customer's ability to pay the existing and forecasted rates. If rates exceed 1.5 percent of the median household income in any of the years, it suggests the system's rates might not be affordable.

The 2000 Census data show that the median household income for the City of Sherwood in 1999 was $62,518. Inflating this amount at historical and projected inflation rates (Portland-Salem CPI Urban Wage Earners and Clerical Workers) is equivalent to about $74,000 in 2007 and $83,000 in 2012. Applying 1.5 percent of these amounts results in a maximum monthly wastewater utility bill of $92 in 2007 and $104 in 2013.

The average residential wastewater bill is currently $29.62 per month. It is forecasted to increase to $36.03 / month by FY 2012/13 and to $55.56 by FY 2026/27. These rates remain well within the 1.5 percent median household income affordability index for utility bills.

Summary

This section presented a financial evaluation of the capital funding needs of the recommendations presented in Section 6. This analysis does not include evaluation of the financial impacts of shared Clean Water Services capital projects.

Based on the analyses presented herein, the Sanitary Fund can meet its forecasted operating and capital funding needs with annual inflationary-level revenue increases. Thus, the Capital Improvement Program is considered affordable. The FY 2008/09 increase of 6 percent incorporates a recommended policy of funding depreciation expense through rates, in addition to the inflationary adjustment. The City is currently undergoing a rate and SDC study to update rates and charges consistent with current costs and City policies. Results of that study could alter the rate strategy presented herein, although it is not anticipated to be materially different.

APPENDIX A
List of References

APPENDIX A
LIST OF REFERENCES

1. Area 59 Project, Revised Concept Plan, updated September 2006

2. City of Sherwood Comprehensive Plan Part II, August 2003.

3. City of Sherwood Sanitary Sewer Plan Update, June 1991, David Evans and Associates.

4. City of Sherwood Zoning and Development Code, Rev. January 2007.

5. *Design and Construction Standards for Sanitary Sewer and Surface Water Management*, Clean Water Services. June 2007.

6. Intergovernmental Agreement with CWS, dated January 4, 2005.

7. *Soil Survey of Clackamas County, Oregon,* U.S. Department of Agriculture, Soil Conservation Service, November, 1985.

8. *Soil Survey of Washington County, Oregon,* U.S. Department of Agriculture, Soil Conservation Service, July 1982.

9. *Soil Survey of Yamhill Area, Oregon,* U.S. Department of Agriculture, Soil Conservation Service, January 1974.

10. 2000 CWS Sanitary Sewer Master Plan Update, August 2001, PMA Engineering.

APPENDIX B
Intergovernmental Agreement

INTERGOVERNMENTAL AGREEMENT
BETWEEN CITY OF SHERWOOD AND
CLEAN WATER SERVICES

THIS AGREEMENT is made and entered into as of the 4th day of January, 2005, between the **City of Sherwood** a municipal corporation of the State of Oregon, hereinafter referred to as "City," and **Clean Water Services**, formerly Unified Sewerage Agency, a municipal corporation and county service district, hereinafter referred to as the "District."

WHEREAS the City has authority to operate and maintain sewerage and surface water management systems as provided for under its charter, relevant laws, rules and the Agreement. The City performs a variety of functions critical to the operation, maintenance and management of sewerage and surface water management facilities as outlined in the Agreement. It is anticipated that this Agreement may periodically require updating or modification by agreement of the parties; and

WHEREAS as a county service district organized under ORS 451, the District has the legal authority for the sanitary sewerage and storm water (surface water) management programs within its boundaries consistent with relevant laws, rules and agreements. The District performs watershed, sub-basin and facility planning, develops standards and work programs, is the permit holder, and operates and maintains wastewater treatment facilities, surface water collection system and sanitary sewer systems within unincorporated areas and within certain cities within its boundaries. The District also performs various ancillary functions throughout the basin and within various cities; and

WHEREAS in 1970, City, by action of its Council pursuant to an election duly conducted within the boundaries of the District, agreed to be within such sanitary sewer district; and

WHEREAS in 1989, City consented by action of its Council to have District manage storm and surface water drainage within the District's boundary, including those portions of the system within the City, and consented to the petition to the Portland Metropolitan Area Boundary Commission (Boundary Commission) to expand District's authority to include storm and surface water drainage management, which was granted by the Boundary Commission; and

WHEREAS District and Washington County Cities have enjoyed a strong and effective partnership over more than three decades since District's formation. This partnership has greatly enhanced protection of public health and the environment and has been the foundation of enormous economic growth. Collaboration built through communication must remain as its cornerstone. Accordingly, the District and the City commit to cooperatively and openly engage each other in the timely discussion of topics of interest to the other party. A variety of forums and means will be employed to

promote the above such as the Washington County Managers meetings, the City/District Technical Committee as well as ongoing individual communications.; and

WHEREAS, City and District have the authority to enter into contracts for the cooperative operation of service facilities under ORS 451.560 and ORS Chapter 190; and

WHEREAS, City and District previously entered into an Agreement for the cooperative operation of sanitary sewer and surface water facilities, and said Agreement is in need of amendment.

NOW, THEREFORE, in consideration of the covenants and agreements to be kept and performed by the parties hereto, it is agreed as follows:

Section 1. Definition of Terms

Wherever the following terms are used in this agreement they shall have the following meaning unless otherwise specifically indicated by the context in which they appear:

A. Area of Geographic Responsibility means the area set forth in the map attached as Exhibit A as may be amended.

B. Board means the Board of Directors of the District, its governing body.

C. Chief Executive Officer means the City official responsible for managing the day-to-day business affairs of City.

D. Council means the City Council, governing body of City.

E. Industrial Waste means any liquid, gaseous, radioactive or solid waste substance or a combination thereof resulting from any process of industrial or manufacturing business, or from the development or recovery of natural resources. For the purposes of this agreement, Industrial Waste shall also include any substance regulated under 33 USC Sec 1317, together with regulations adopted thereunder.

F. Operation and Maintenance means the regular performance of work required to assure continued functioning of the storm and surface water system and the sanitary sewerage system and corrective measures taken to repair facilities to keep them in operating condition, and in compliance with the requirements of applicable laws, regulations, and permits.

G. Order means Resolutions, Orders and Directives of the District prescribing general standards and conditions for construction or use of the storm and surface water facilities and the sanitary sewerage facilities, and Rates and Charges.

H Person means the state of Oregon, any individual, public or private corporation, political subdivision, governmental agency, municipality, industry, co-partnership, association, firm, trust, estate or any other legal entity whatsoever.

I. Program Funding means the revenues made available to City through Section 4. of this agreement to follow the adopted work programs and performance standards.

J. Rates and Charges are defined in the District's "Rates and Charges" Resolution and Order (R&O) No. 01-34, or as may be amended. The following terms when used in this agreement shall be as defined in that R&O:

1. Dwelling Unit Equivalent (DUE)
2. Equivalent Service Unit (ESU)
3. Impervious Surface Area
4. Permit Application and Inspection
5. Sanitary Sewer Service Charge
6. Sanitary System Development Charge (SDC; Connection Charge)
7. Storm and Surface Water Service Charge
8. Storm and Surface Water System Development Charge

K. Sanitary Sewerage System means any combination of sewer treatment plant, pumping or lift facilities, sewer pipe, force mains, laterals, manholes, side sewers, laboratory facilities and equipment, and any other facilities for the collection, conveyance, treatment and disposal of sanitary sewage comprising the total publicly-owned Sanitary Sewerage System within District jurisdiction, to which storm, surface and ground waters are not intentionally admitted.

L. Standards means the standards and conditions of use of the storm and surface water system and the sanitary sewer system as specified and adopted by the District. Standards also shall mean applicable statutes and rules of the United States and the State of Oregon.

M. Storm and Surface Water System means any combination of publicly owned storm and surface water quality treatment facilities, pumping or lift facilities, storm drain pipes and culverts, open channels, creeks and rivers, force mains, laterals, manholes, catch basins and inlets, grates and covers, detention and retention facilities, laboratory facilities and equipment, and any other publicly owned facilities for the collection, conveyance, treatment and disposal of storm and surface water comprising the total publicly owned Storm and Surface Water System within District's jurisdiction, to which sanitary sewage flows are not intentionally admitted.

N. Work Program and Performance Standards are adopted by the District after considering input from the cities to define the activities required to operate and maintain the sanitary sewer and storm and surface water systems.

Section 2. Determination of Programs, Rules, Policies and Standards

The District is responsible for the management and operation of the sanitary sewer and storm and surface water systems within its boundary, and is the designated permittee who shall obtain and enforce timely compliance with relevant federal and delegated state Clean Water Act permits for treatment plants, collection systems, and stormwater. The District, after considering input from the cities, shall adopt orders, standards, specifications, work programs, and performance criteria for the proper and effective operation of the sanitary sewer and storm and surface water systems and to comply with state and federal permits, laws and regulations. In addition, the District, after considering input from the cities, shall have the authority to make changes to its orders, work programs and performance Standards. Any such changes to work programs and performance standards that the Board determines are required by state and/or federal permits or regulations will become effective 90 days from the date of notice to City by District or as mutually agreed to. Any changes to work programs and performance standards, not required by state and/or federal permits and regulations, shall be mutually agreed to by the District and City before they become effective. Proposed changes not required by state and/or federal permits and regulations should be communicated between the District and the City in or before September of the year before they are to be implemented to allow District and City to budget appropriately for the following fiscal year.

A. City agrees to follow and enforce the Orders, Standards, specifications, work programs, and performance criteria promulgated by the District, subject, however, to program funding and to the extent that City may be lawfully authorized to act. The City shall not be responsible for any failure to act or defect in performance caused by lack of adequate program funding, inadequacies in the Work Program and Performance Standards as adopted by the District, or lack of lawful authority to act. Lack of adequate funding from the District and compliance with the Work Program and Performance Standards as adopted by the District shall be absolute defenses to any claim against the City under this Agreement. City further agrees to notify District of apparent violations of the subject Orders, Standards, specifications, work programs, and performance criteria, of which it has knowledge, which may require District legal action or enforcement.

Section 3. Division of Responsibilities

A. Division of Responsibilities

1. The purpose of this agreement is to delegate to and contract with the City to perform specific functions. The responsibilities of the District and City are defined in this Section and Appendix A. Exhibit A is a map

showing boundaries of responsibility between the District and City and is hereby made a part of Appendix A and incorporated into this agreement.

2. All functions relating to the subject matter of this Agreement not specifically listed in this Section or Appendix A as being the responsibility of City shall remain the responsibility of the District.

B. Procedure for Modifying the Division of Responsibilities

1. Responsibilities defined in this Section and Appendix A may be modified from time to time with approval in writing by the City Manager or designee and the District General Manager or designee.

2. Responsibilities defined in this Section and Appendix A may be modified by the District Board after receiving input from the City and determining the change is necessary to comply with state or federal permits, laws or regulations. The District Board shall not reduce the total scope of City responsibilities without consent of the City unless there is a change in the program or funding requiring the reduction, or unless the Board determines the City has failed to correct identified instances of nonperformance related to the adopted standards that are necessary to comply with state or federal permits, laws or regulations.

3. Upon reasonable notice from City to District, District shall assume responsibility for any portion of the program defined in this Section and Appendix A. Reasonable notice shall be at least six (6) months, unless agreed to in writing by the District and City. Corresponding adjustments to the revenue allocation shall be made to reflect the change in responsibility upon implementation of such changes. City shall be responsible for correcting or paying to have corrected any deficiencies in the system resulting from non-performance of the programs under its responsibility, subject, however, to funding availability.

4. The responsibilities defined in Appendix A and responsibility boundaries defined in Exhibit A are not changed due to City annexations of area currently inside the District's boundary. Provided that after formal adoption and subsequent consultation between the City and District, service area boundaries may be altered based on Senate Bill 122 boundary revisions. For annexations of territory not currently within the District's boundary, the District will amend Appendix A and Exhibit A to define the responsibilities for the new area in cooperation with the City and in cooperation with adjacent cities.

C. Additional City Responsibilities

1. Prior to issuing any non-residential sanitary sewer permit, City shall require the applicant to prepare and submit to City a District Sewer Use Information form. City shall submit the completed form to the District. The District will determine if an Industrial Waste Discharge Permit is required. The District will respond within 15 days.

2. Require persons who are proposing 'development', as defined in the District's Design and Construction Standards Resolution and Order, to obtain a Service Provider Letter from the District.

3. Following City review and initial approval, forward proposed construction drawings to the District for the following:

   a) Any addition, modification, construction, or reconstruction (other than repairs) of the publicly-owned sanitary sewerage system and storm and surface water system. District will review these drawings to assure conformance to adopted District standards, orders, and master plans.

   b) Any "development" as defined in the District's Design and Construction Standards Resolution and Order. District will review these drawings to assure conformance with the conditions of the Service Provider Letter issued following the provisions in Section 3.C.2.

   The District shall not charge a fee for these types of reviews. The City shall not approve or issue permits for such work until it receives notification of District approval. The District shall complete its reviews within 15 working days from its receipt of complete construction drawings from the City, otherwise the City may consider the drawings as being approved by the District.

4. The City may notify the District in writing that it wishes the District to issue Connection Permits for either or both of the sanitary or storm water systems. In such cases, the District shall not issue Connection Permits until the City indicates in writing that the development complies with the City's standards. City will collect all connection, permit, and development fees for developments within the City unless City and District agree that the District will collect the fees.

5. Other than for issuance of connection permits, obtain District review and approval prior to entering into any agreement for the use of the Storm and Surface Water System or the Sanitary Sewerage System.

6. Inform the District in writing not less than 30 days prior to initiating or entering into any agreement for the financing or incurring of

indebtedness relating to the storm and surface water system or the sanitary sewerage system. Revenues allocated by the District to the City for the performance of functions identified in Appendix A are considered restricted, and may only be used to perform those functions (including reasonable administration and security for bonds) delegated to the City for such things as operation and maintenance of the sanitary or storm and surface water system. City shall not obligate any assets or facilities of the District's sanitary or storm and surface water system for any debt. For purposes of debt funding, the District's asset schedule for storm and surface water and sanitary sewer facilities shall be the basis for determining ownership within City boundaries. In general, sanitary sewer lines 24" and over are the property of the District regardless of location, as are sanitary treatment plants and pump stations, and storm and surface water quality and quantity facilities that are one acre or greater in surface area.

7. Allow the District access at any reasonable time upon reasonable notice to inspect and test storm and surface water facilities and sewerage facilities within City and City Area of Geographic Responsibility.

8. Grant the District permits from time to time as may be necessary for the installation of storm and surface water facilities and sewerage facilities in the public streets and ways of City without imposing permit issuance fees, but only to the same extent as the City waives such fees for itself, and provided that the District shall adhere to any conditions required pursuant to ORS 451.550(6).

9. To issue no new permit for the construction within, or modification to, a wetland, floodway, or floodplain without first receiving the written approval by the District, pursuant to Section 5.D. This paragraph shall not apply to permits issued by City pursuant to a current permit under 33 USC Section 1344(e) (a section 404 general permit), and within the scope of such permit. This section does not apply to actions related to City flood insurance program. The City retains the responsibility to issue land use approvals and building permits.

10. To pursue, when City deems feasible and appropriate, the conversion of storm and surface water facilities from private to public ownership, through the acquisition of easements and other property rights as necessary, for those privately owned storm and surface water facilities which are identified as being necessary or appropriately a part of the public system.

11. To the extent that it is so required by law or regulation, City shall comply with Oregon Administrative Rules (OAR) Chapter 340, Division 49, "Regulations Pertaining to Certification of Wastewater System

Operator Personnel," including the obligation that City shall have its wastewater collection system supervised by one or more operators certified at a grade level equal to or higher than the system classification shown on page 1 of District's NPDES permit, issued by the State. The District shall notify City of any modification to the NPDES permits affecting their operations.

D. City Responsibilities Outside of its City Limits

1. Not withstanding the procedures in Section 3.B, City is not obligated by this agreement to accept responsibility for any programs or work activities outside of its City limits unless the City agrees to accept responsibilities outside of the City limits as set forth in Appendix A.

2. To the extent City has agreed to responsibilities both inside and outside of its City limits, for activities which are the responsibility of City, City shall perform the work to meet the minimum requirements specified in the District's adopted Work Programs and Performance Standards. When the same type of service is being performed by City both inside and outside City, the service shall be prioritized and performed in a like manner in each area, including the response to storms and other emergencies. The exception shall be if City provides a higher degree of service inside City due to its own supplemental funding.

Section 4. Determination and Division of Revenue; Operating Procedures and Rules Relating to Revenue

A. After consultation between City and District staff, the District Board shall determine and certify annually for both the sanitary sewerage system and for the storm and surface water system the monthly service charge and system development charge. The City agrees to impose these charges as a minimum. The City may impose additional charges as allowed in Section 4.E.4.

B. After consultation between City and District staff, the District Board shall determine and certify annually for both the sanitary sewerage system and for the storm and surface water system the portion of the monthly service charge and system development charge to be retained by the City for performance of the functions defined in this Agreement and for the City's share of annual debt service payment. Except as provided in Section 4.D, District shall notify City by the September preceding the start of the next Fiscal Year of any proposed decrease in the monthly service charge and system development charge to be retained by the City and any other proposed changes that could affect the City's 5-Year Sanitary Sewer or Stormwater Financial Forecast Plans..

C. The District Board shall not implement any significant change in the division of monthly service charge revenue from that shown in the Rates and Charges

Resolution and Order No. 01-34 effective Fiscal Year 2001/2002 until July 1, 2004 with the following exceptions:

1. The Board may make routine principal and interest adjustments for debt service repayment.

2. The Board may make adjustments in response to significant increases or decreases in program responsibilities

D. Changes in the division of revenue will typically be made as a part of the annual Fiscal Year budget process. However, the division of revenue may be adjusted by the District to recognize changes in responsibilities that occur outside the normal budget cycle after coordination and communication with the Cities. Any such mid-year changes in the division of revenue initiated by the District Board shall only be implemented when the Board determines such a change is necessary to comply with state or federal permits, laws or regulations. If there is a mid-year change in responsibilities, which the District determines to be significant, the District Board may, upon 60 days notice to City, adjust the division of revenue outside of the annual budget process

E. Operating Procedures Relating to Revenue

1. City shall remit to the District the portion of sanitary sewer service charges and systems development charges collected, and storm and surface water service charges and systems development charges collected, less the City Portion, as identified in Section 4.B.

2. Payments shall be remitted on a monthly basis, with a report on District designated forms.

3. Payments to the District of revenue collected by the billing party shall be due within 20 days following the end of each month, unless the payment has been appealed by the billing party.

4. City may charge and collect a service charge or system development charge at a higher rate per DUE and ESU than that set by the District when the City determines it is needed for the local City system. The City shall retain 100% of these additional revenues collected. Such additional charge shall be consistent with the services provided by City and with applicable federal rules in order to preserve eligibility for grants and other funding programs.

5. City may request District to perform permit and inspection services for private development construction of public storm and surface water facilities and sanitary sewer facilities, and for erosion control. City

shall remit to the District the fee set forth in District's Rates and Charges to compensate District for its costs for such services performed relative to these fees, as prescribed by District Order or separate agreement with City.

6. For Industrial Waste fees, District shall remit to City a percentage of system development charges, volume, and monthly service charges collected equal to the percentages of service charges retained by the City as defined in Section 4.B. District shall retain one hundred percent (100%) of the annual Industrial Waste permit fee, and any penalty fees, COD, SS (as those terms are defined in the Rates and Charges) and other fees related to Industrial Waste that may be assessed.

7. City will institute administrative procedures to diligently maintain regular billings and collection of fees, adjust complaints thereto, and pursue delinquency follow-ups and take reasonable steps for collection thereof.

8. City and District shall each establish separate accounts for the storm and surface water program and sanitary sewerage program for the purpose of accounting for service charges and systems development charges collected and received pursuant to this agreement.

9. District or City may at any reasonable time upon reasonable notice inspect and audit the books and records of the other with respect to matters within the purview of this Agreement.

10. City and District shall each prepare and submit to each other a performance report of the storm and surface water functions, and the sanitary sewer functions for which each is responsible. After consultation with the City, District will specify the requirements, frequency, and content of the performance report.

11. The City and District may, each at its own cost, install permanent and temporary volume and quality monitoring stations, and other monitoring equipment, to determine the effectiveness of City and District programs.

12. Interest may accrue on late monthly payments as specified in Section 4.E.1 at a rate of 1.25 times the monthly Local Government Investment Pool (LGIP) earnings rate as posted for the previous month, and will be applied each month to the unpaid balance.

Section 5. Administrative and Operating Provisions

A. The District will not extend sewer service to areas outside the City except with prior approval of the City where such areas are included in the Urban Planning Area Agreement between the City and the appropriate county or counties and any of the following exists:

   1. A new or existing single family property desires sewer service and needs to directly connect to a sewer line within the city.

   2. A new development desires sewer service and needs to directly connect a lateral or mainline public sewer directly to a sewer line within the city.

B. Each party shall obtain and maintain in full force and effect for the term of this agreement, at its own expense, comprehensive general liability and automobile insurance policies for bodily injury, including death, and property damage, including coverage for owned, hired or non-owned vehicles, as applicable, for the protection of the party, and the other party, its elected and appointed officials, officers, agents, employees and volunteers as additional insureds. The policies shall be primary policies, issued by a company authorized to do business in the State of Oregon and providing single limit general liability coverage of $2,000,000 and separate automobile coverage of $1,000,000 or the limit of liability contained in ORS 30.260 to 30.300, whichever is greater. If either party is unable to obtain insurance as required by this sentence, the parties shall cooperate on amending this Section to require types and levels of insurance that are available. The certificates shall provide that the other party will receive thirty (30) days' written notice of cancellation or material modification of the insurance contract at the address listed below. Each party shall provide certificates of insurance to the other party prior to the performance of any obligation under this agreement. If requested, complete copies of insurance policies shall be provided to the other party. Each party shall be financially responsible for their own deductibles, self-insurance retentions, self-insurance, or uninsured risks.

C. District will not establish local assessment districts within City, without first obtaining City approval.

D. District will process applications from City pursuant to Section 3.C.9 for Wetland, Floodplain, and Floodway modifications. Timely review of the application shall be provided by the District. Upon review and approval by District, and upon request by City, the District shall act as a facilitator and liaison for State and Federal review and permit processes.

E. The City shall report all sanitary sewer overflows that it becomes aware of to the District within 24 hours of learning of the overflow. The City shall require all permittees of the City to report sanitary sewer overflows to the City. City agrees to reimburse District for any expense, costs, damages,

claims, fines, or penalties incurred by District that result from or are related to City's failure to so timely and adequately report.

F. This agreement is for the benefit of the parties only. Each party agrees to indemnify and hold harmless the other party and its officers, employees, and agents, from and against all claims, demands and causes of actions and suits of any kind or nature for personal injury, death or damage to property or the environment on account of or rising out of the operation of this Agreement, including the performance or non-performance of duties under this Agreement, or in any way resulting from the negligent or wrongful acts or omissions of the indemnifying party and its officers, employees, and agents. In addition, each party shall be solely responsible for any contract claims, delay damages or similar items arising from or caused by the action or inaction of the party under this agreement. Inability to perform an activity or to properly perform because of insufficient funding from the District is not a negligent act or omission or willful misconduct of the party charged with the activity but shall be the responsibility of the District. Performance of any activity in compliance with the Work Program and Performance Standards as adopted by the District is not a negligent act or omission or willful misconduct.

G. District and City acknowledge that District may receive notices of violation or fines from state or federal agencies for violations of state or federal rules. As the permittee and the entity that establishes standards and controls payment, District shall be responsible for responding to notices of violations and for payment of all fines. District shall invite the City to participate in any discussions with state and federal agencies regarding notices of violation involving City actions or responsibility. City will cooperate with District in the investigation and response to any notice of violation involving actions relating to actions or responsibilities of the City. If a fine is imposed, City shall reimburse District to the extent that the fine results from non-performance of adopted programs or non-compliance with District, state, or federal rules or policies by the City and those acting on behalf of the City. If possible, the City shall reimburse the District prior to the date due for payment of the fine. The City shall not be responsible for reimbursement if the City's non-performance or non-compliance was caused by lack of adequate funding by District. If more than one party is responsible, the City's responsibility for reimbursement payment will be allocated based on the degree of responsibility and degree of fault of the City. Disputes over the amount of reimbursement shall be resolved by the dispute resolution process set out in Section 6 of this Agreement. To the extent that the City is required to perform any work to correct a violation, District shall provide adequate funding for the work to be performed, unless the violation was caused by the City's omission or misconduct.

H. Nothing in this Agreement shall be construed as a limitation upon or delegation of the statutory and home rule powers of City, nor as a delegation or limitation of the statutory powers of District. This Agreement shall not limit any right or remedy available to City or District against third parties arising from illegal acts of such third parties.

I. Where this Agreement calls for review or approval of a fee or charge, District shall perform such review in a timely manner, shall not unreasonably withhold approval, and shall provide its decision to City in writing. If, within 30 days of written request by City for approval by District, the District has failed to provide a written response, the request shall be deemed approved.

Section 6. Dispute Resolution; Remedies

A. In the event of a dispute between the parties regarding their respective rights and obligations pursuant to this Agreement, the parties shall first attempt to resolve the dispute by negotiation. If a dispute is not resolved by negotiation, the exclusive dispute resolution process to be utilized by the parties shall be as follows:

1. Step 1. Upon failure of those individuals designated by each party to negotiate on its behalf to reach an agreement or resolve a dispute, the nature of the dispute shall be put in writing and submitted to City's Chief Executive Officer and District's General Manager, who shall meet and attempt to resolve the issue. If the issue in dispute is resolved at this step, there shall be a written determination of such resolution, signed by City's Chief Executive Officer and District's General Manager, which determination shall be binding on the parties. Resolution of an issue at this step requires concurrence of both parties' representatives.

2. Step 2. In the event a dispute cannot be resolved at Step 1, the matters remaining in dispute after Step 1 shall be reduced to writing and forwarded to the Mayor and the Chairman of the Board of Directors. Upon receipt of the written issue statement, the Mayor and Chairman shall meet and attempt to resolve the issue. If the issue is resolved at this step, a written determination of such resolution shall be signed by the Mayor and Chairman. Resolution of an issue at this step requires concurrence of both the Mayor and the Chairman.

3. Step 3. In the event a dispute cannot be resolved at Step 2, the parties shall submit the matter to mediation. The parties shall attempt to agree on a mediator. In the event they cannot agree, the parties shall request a list of five (5) mediators from the American Arbitration Association, or such other entity or firm providing mediation services to which the parties may further agree. Unless the parties can

mutually agree to a mediator from the list provided, each party shall strike a name in turn, until only one name remains. The order of striking names shall be determined by lot. Any common costs of mediation shall be borne equally by the parties, who shall each bear their own costs and fees therefor. If the issue is resolved at this step, a written determination of such resolution shall be signed by both parties. Resolution of an issue at this step requires concurrence by both parties. In the event a dispute is not resolved by mediation, the aggrieved party may pursue any remedy available to it under applicable law.

B. Neither party may bring a legal action against the other party to interpret or enforce any term of this Agreement in any court unless the party has first attempted to resolve the matter by means of the dispute resolution of subsection A above. This shall not apply to disputes arising from a cause other than interpretation or enforcement of this Agreement.

C. Parties may mutually agree in writing to waive any of the above steps, or to enter into alternate processes or additional processes such as binding arbitration prior to filing legal action.

Section 7. Effect of this Agreement

This Agreement shall supersede all prior agreements of similar scope and subject matter, including amendments and the "City Committee Agreement" between the parties with respect to sanitary sewerage and service, storm and surface water management; provided that, except as expressly modified herein, all rights, liabilities, and obligations of such prior agreements shall continue. This Agreement shall be effective upon its execution by both parties hereto, and shall continue in effect for four renewable terms of five years each. This Agreement shall be deemed automatically renewed for a single succeeding five year term up to a limit of 25 years, unless either party gives the other written notice not less than one year prior to the nominal expiration of term of its intent not to renew this agreement. If District enters into an intergovernmental agreement with any other city in its territory covering the same subject as this Agreement and if any of the provisions of the other agreement differ from this Agreement, the City may elect to replace any provision of this Agreement with the parallel provision from the other agreement, with the exception of Appendix A and Exhibit A. The replacement shall be effective on receipt by District of written notice from the City. This Agreement may not otherwise be modified except by written amendment or as otherwise specified in this Agreement.

Section 8. Amendments

At any time, either party may request in writing to open this Agreement for specific amendment. If such request is made, the other party must respond within 90 days. If the parties do not agree and the party requesting such amendment desires to proceed with the

amendment, then remedies pursuant to Section 6 shall apply. All amendments shall be in writing and approved by the governing body of the respective parties.

Section 9. Severability

In the event a court of competent jurisdiction shall deem any portion or part of this Agreement to be unlawful or invalid, only that portion or part of the Agreement shall be considered unenforceable. The remainder of this Agreement shall continue to be valid.

IN WITNESS WHEREOF, this instrument has been executed in duplicate by authority of lawful actions by the Council and District Board of Directors.

CLEAN WATER SERVICE
OF WASHINGTON COUNTY, OREGON

By _____
FOR ~~Chairman, Board of Directors~~ -
GENERAL MANAGER

Approved as to Form:

_____
Attorney for District

CITY OF SHERWOOD, OREGON

By _____
City Manager

Attest: _____
City Recorder

_____
City Attorney

APPENDIX A			
DIVISION OF RESPONSIBILITIES	**EFFECTIVE THROUGH JUNE 30, 2004**		
SHERWOOD			
Basic Workplan	Inside City Limits	Outside City Limits	
Sanitary Maintenance			
Lines under 24"			
Line Cleaning	City	District	
Root Cutting	City	District	
Emergency response	City	District	
Overflow and Complaint response and investigation	City	District	
Cross connection investigation and response	City	District	
Manhole adjustment	City	District	
Non-structure line sealing and point repair	City	District	
Manhole rehabilitation (sealing)	City	District	
TV inspection	City	District	
Compilation of TV reports and system evaluation	City	District	
I&I abatement and system rehabilitation projects	District and City	District	
Root Foaming	City	District	
Structural line repairs	City	District	
Line replacements	City	District	
Pump station maintenance	District	District	
Lines 24" and Larger			
All maintenance, inspection, repair, and replacement	District	District	
SWM Maintenance			
Line Cleaning	City	District	
Root Cutting	City	District	
Catch Basin cleaning	City	District	
Water quality manhole maintenance	City	District	
Storm and emergency response	City	District	
Complaint response and investigation	City	District	
Street Sweeping	City	District	
Water Quality facility maintenance	City for local District for Regional	District	
Water Quantity facility maintenance	City for local District for Regional	District	
Maintenance of public Streams/creeks/open channels	City	District	
Processing and disposal of sweeper, catch basin and storm line material	City	District	
Structural line repairs	City	District	
Line replacements	City	District	
Pump station maintenance and operation	District	District	

Roadside ditches and piping system in County Roads	District	District	
TV inspection	City	District	
Compilation of TV reports and system evaluation	City	District	
Proactive Leaf management program	City	District	
ENGINEERING, INSPECTION, AND SUPPORT ELEMENTS			
Development Process (development review, plan review)	City	District	
Sanitary Sewer connection permit issuance	City	District	
SWM connection permit issuance	City	District	
Billing and collection of monthly service charges	City	District	
Inspection of developer projects	City	District	
Installation of Sanitary Sewer Masterplan Projects	City 21" and less, District 24" & up	District	
Installation of Masterplan Pump Station Projects	District	District	
Installation of SWM Masterplan Projects	City	District	
Erosion control permit issuance	City	District	
Erosion control inspection	City	District	
Accounting	City	District	
Industrial Waste Program	District	District	
Maintaining GIS information	City and District	District	
Maintaining system mapping	City and District	District	
Maintaining Engineering records of systems	City and District	District	
Preparing and revising sanitary sewer masterplans	District	District	
Preparing and revising SWM masterplans	District	District	
Response to customer billing inquiries	City	District	
Public information, newsletters, etc., for SWM and Sanitary programs	City and District	District	

APPENDIX A

4-Jan

DIVISION OF RESPONSIBILITIES **EFFECTIVE JULY 1, 2004 to JUNE 30, 2005**

Sherwood	Inside City, and Inside Responsibility Boundary	Outside City, and Inside Responsibility Boundary	Inside City, and Outside Responsibility Boundary
Sanitary Maintenance			
Lines under 24"			
Line Cleaning	City	City	
Root Cutting	City	City	
Emergency response	City	City	
Overflow and Complaint response investigation and reporting	City	City	
Cross connection investigation and response	City	City	
Manhole adjustment	City	City	
Non-structure line sealing and point repair	**City and District**	District	
Manhole rehabilitation (sealing)	**City and District**	District	
TV inspection	City	City	
Compilation of TV reports and system evaluation	District	District	
I&I abatement and system rehabilitation projects	**City and District**	District	
Root Foaming	**City and District**	District	
Structural line repairs	**City**	District	
Lateral Repairs in Public Right of Way	**City**	District	
Line replacements	**City**	District	
Pump station maintenance	District	District	
Vector Control	City	City	
Offroad inspection and locator post maintenance	City	City	
Easement and Access Road Maintenance	City	City	
Lines 24" and Larger			
All maintenance, inspection, repair, and replacement	District	District	
SWM Maintenance			
Line Cleaning	City	City	
Root Cutting	City	City	
Catch Basin cleaning	City	City	
Water quality manhole maintenance	City	City	
Storm and emergency response	City	City	
Complaint response investigation and reporting	City	City	
Street Sweeping	City	City	
Water Quality facility maintenance	City for local, District for Regional	City for local, District for Regional	

Water Quantity facility maintenance	City for local, District for Regional	City for local, District for Regional	
Maintenance of public Streams/creeks/open channels	City	City	
Processing and disposal of sweeper material	**City and District**	City	
Processing and disposal of catch basin and storm line material (excluding leaves)	**City and District**	District	
Structural line repairs	**City**	District	
Line replacements	**City**	District	
Pump station maintenance and operation	District	District	
Roadside ditches and piping system in County Roads	District	District	
Roadside ditches and piping system in City Roads	City, Funded by Street Fund	None	
TV inspection	City	City	
Compilation of TV reports and system evaluation	District	District	
Proactive Leaf management program	City	City	
Utility Locates	City	City	
ENGINEERING, INSPECTION, AND SUPPORT ELEMENTS			
Development Process (development review, plan review)	City	District	
Sanitary Sewer connection permit issuance	City	District	
SWM connection permit issuance	City	District	
Billing and collection of monthly service charges	City	District	
Inspection of developer projects	City	District	
Installation of Sanitary Sewer Masterplan Projects	City 21" and under, District 24" & up	District	
Installation of Masterplan Pump Station Projects	District	District	
Installation of SWM Masterplan Projects	City	District	
Erosion control permit issuance	City	District	
Erosion control inspection	City	District	
Accounting	City	District	
Industrial Waste Program	District	District	
Fat, Oil and Grease Program	**City and District**	District	
Maintaining GIS information	City and District	City and District	
Maintaining system mapping	City and District	City and District	
Maintaining Engineering records of systems	City and District	City and District	
Preparing and revising sanitary sewer masterplans	District	District	
Preparing and revising SWM masterplans	**City and District**	District	
Response to customer billing inquiries	City	District	
Public information, newsletters, etc., for SWM and Sanitary programs	City and District	City and District	

Flow Monitoring	District	District	
Formation and Administration of LID's	City and District	District	
Inspection of Private Facilities	City	District	
Marking Utilities	City	City	
Fixture Counting	City	District	
Field Yard General Maintenance	City	City	

APPENDIX A	4-Jan		
DIVISION OF RESPONSIBILITIES	**EFFECTIVE JULY 1, 2005**		
Sherwood	Inside City, and Inside Responsibility Boundary	Outside City, and Inside Responsibility Boundary	Inside City, and Outside Responsibility Boundary
Sanitary Maintenance			
Lines under 24"			
Line Cleaning	City	City	
Root Cutting	City	City	
Emergency response	City	City	
Overflow and Complaint response investigation and reporting	City	City	
Cross connection investigation and response	City	City	
Manhole adjustment	City	City	
Non-structure line sealing and point repair	District	District	
Manhole rehabilitation (sealing)	District	District	
TV inspection	City	City	
Compilation of TV reports and system evaluation	District	District	
I&I abatement and system rehabilitation projects	District	District	
Root Foaming	District	District	
Structural line repairs	District	District	
Lateral Repairs in Public Right of Way	District	District	
Line replacements	District	District	
Pump station maintenance	District	District	
Vector Control	City	City	
Offroad inspection and locator post maintenance	City	City	
Easement and Access Road Maintenance	City	City	
Lines 24" and Larger			
All maintenance, inspection, repair, and replacement	District	District	
SWM Maintenance			
Line Cleaning	City	City	
Root Cutting	City	City	
Catch Basin cleaning	City	City	
Water quality manhole maintenance	City	City	
Storm and emergency response	City	City	
Complaint response investigation and reporting	City	City	
Street Sweeping	City	City	
Water Quality facility maintenance	City for local, District for Regional	City for local, District for Regional	

Water Quantity facility maintenance	City for local, District for Regional	City for local, District for Regional	
Maintenance of public Streams/creeks/open channels	City	City	
Processing and disposal of sweeper material	City	City	
Processing and disposal of catch basin and storm line material (excluding leaves)	District	District	
Structural line repairs	District	District	
Line replacements	District	District	
Pump station maintenance and operation	District	District	
Roadside ditches and piping system in County Roads	District	District	
Roadside ditches and piping system in City Roads	City, Funded by Street Fund	None	
TV inspection	City	City	
Compilation of TV reports and system evaluation	District	District	
Proactive Leaf management program	City	City	
Utility Locates	City	City	
ENGINEERING, INSPECTION, AND SUPPORT ELEMENTS			
Development Process (development review, plan review)	City	District	
Sanitary Sewer connection permit issuance	City	District	
SWM connection permit issuance	City	District	
Billing and collection of monthly service charges	City	District	
Inspection of developer projects	City	District	
Installation of Sanitary Sewer Masterplan Projects	City 21" and under, District 24" & up	District	
Installation of Masterplan Pump Station Projects	District	District	
Installation of SWM Masterplan Projects	City	District	
Erosion control permit issuance	City	District	
Erosion control inspection	City	District	
Accounting	City	District	
Industrial Waste Program	District	District	
Fat, Oil and Grease Program	District	District	
Maintaining GIS information	City and District	City and District	
Maintaining system mapping	City and District	City and District	
Maintaining Engineering records of systems	City and District	City and District	
Preparing and revising sanitary sewer masterplans	District	District	
Preparing and revising SWM masterplans	District	District	
Response to customer billing inquiries	City	District	
Public information, newsletters, etc., for SWM and Sanitary programs	City and District	City and District	

Flow Monitoring	District	District	
Formation and Administration of LID's	City and District	District	
Inspection of Private Facilities	City	District	
Marking Utilities	City	City	
Fixture Counting	City	District	
Field Yard General Maintenance	City	City	

City of Sherwood Oregon

COPY

City of Sherwood, Oregon

Resolution No. 2000-903

A RESOLUTION AUTHORIZING THE CITY MANAGER TO SIGN THE INTERGOVERNMENTAL AGREEMENT WITH THE UNIFIED SEWERAGE AGENCY OF WASHINGTON COUNTY (USA)

WHEREAS, the current intergovernmental agreement between the City of Sherwood and USA was originally written in 1970 and is out of date; and

WHEREAS, USA and the cities are under increasing regulatory control and financial risk for water pollution; and

WHEREAS, during the past two years USA and the cities of Washington County have extensively studied more efficient methods to provide storm and sanitary sewer services; and

WHEREAS, USA recently developed a revised intergovernmental agreement with cities that better addresses current realities.

NOW, THEREFORE, THE CITY RESOLVES AS FOLLOWS:

The City Manager is authorized to finalize and sign the Intergovernmental Agreement with USA.

Duly passed by the City Council this 26th day of September 2000.

Walt H Hitchcock

Walt Hitchcock, Mayor

ATTEST:

C L Wiley

C.L. Wiley, Recorder

APPENDIX C
Plate 1: System Improvements Map

Plate 1

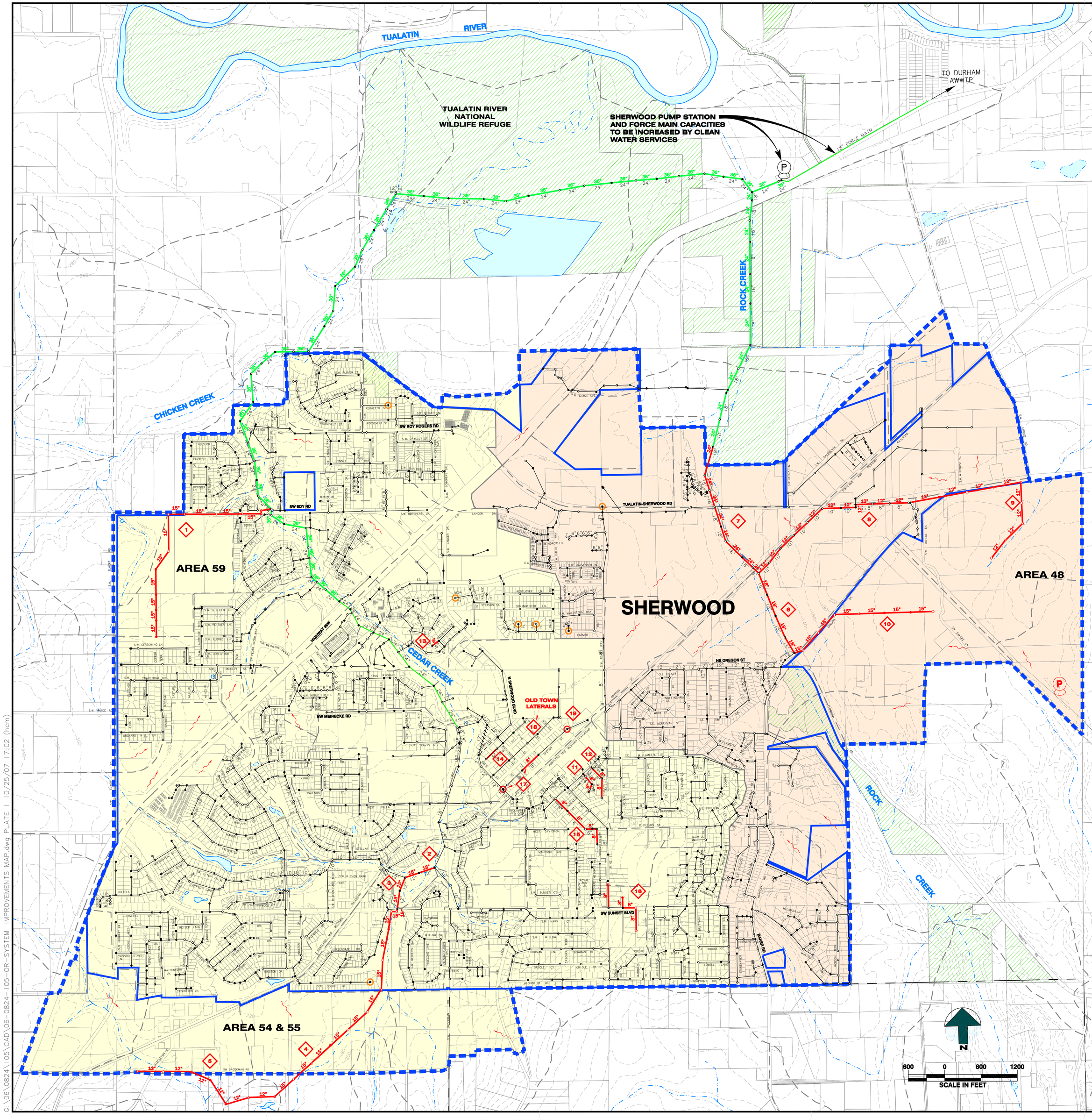
City of Sherwood Oregon

Sanitary Master Plan

System Improvements Map

MSA Murray, Smith & Associates, Inc. Engineers/Planners
121 S.W. Salmon, Suite 900 Portland, Oregon 97204
PHONE 503-225-9010 FAX 503-225-9022

JULY 2007



LEGEND

- PUMP STATION
- CITY SANITARY SEWER LINE AND NODE
- PIPE DIAMETER
- EXISTING PROJECT
- CLEAN WATER SERVICES TRUNK LINE
- ROCK CREEK BASIN
- CEDAR CREEK BASIN
- TUALATIN RIVER NATIONAL WILDLIFE REFUGE
- URBAN GROWTH BOUNDARY (UGB)
- CITY LIMITS
- SUBBASIN BOUNDARY

PROPOSED FACILITIES

- PUMP STATION
- PROPOSED PIPE - NEW (DIAMETER IN INCHES INDICATED)
- PROPOSED PIPE - REPLACING EXISTING PIPE (DIAMETER IN INCHES INDICATED)
- PROPOSED PIPE - REPLACING EXISTING PIPE (BY CLEAN WATER SERVICES) (DIAMETER IN INCHES INDICATED)
- PROJECT IDENTIFICATION
- PROPOSED MANHOLE IMPROVEMENT
- PROPOSED MANHOLE INVESTIGATION
- PROPOSED UNSEWERED AREA ROUTING

NOTES: PIPE DIAMETER 8 INCHES UNLESS OTHERWISE INDICATED. ABANDONED LINES NOT SHOWN.

G:\06\0824\105\CAD\06-0824-105-OR-SYSTEM IMPROVEMENTS MAP.dwg PLATE 1 10/25/07 17:02 (hcm)

121 S.W. Salmon, Suite 900 ▪ Portland, Oregon 97204-2919 ▪ www.msa-ep.com