City of Mt. Angel Oregon

WASTEWATER SYSTEM FACILITIES PLAN

Final Draft April 2014

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May 1, 2014

Dan Bernt
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Dear Mr. Bernt:
We received the revised Wastewater System Facilities Plan for the City of Mt. Angel, prepared by Westech Engineering, Inc. in our Eugene office on April 30, 2014. The Facilities Plan revisions adequately address our comments in our letter dated April 22, 2014. We approve the revised Plan.

The Facilities Plan does not address environmental issues, as required if State or Federal funds are sought to fund this project. If funding is pursued through the State Revolving Fund program, the City will need to provide documentation to the Department stating when and where the Facilities Plan and environmental review were made available for public comment. This summary of public participation should include documentation of advertising, public meetings, and responses to public comments, if any were made.

The next step is to begin pre-design work. To avoid extra work and needless expense, the City should not authorize final design until a pre-design report is reviewed and agreed upon by City staff and DEQ.

Should implementation of this Facilities Plan lapse over five years, please consult DEQ staff to ensure the proposed Plan and issues are still timely. Preparation of a new Facilities Plan may be required after five years.

Please feel free to call me at (541)687-7359 if you have any questions or comments.

Sincerely,

Robert Haberman
Project Officer

WASTEWATER SYSTEM FACILITIES PLAN

CITY OF MT. ANGEL, OREGON

Final Draft April 2014

Prepared for
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FOREWORD

Using this Report

This report will be used by many people whose needs for information will differ widely. Accordingly, an Executive Summary appears at the beginning of this report. The summary provides an overview of the report and presents the main conclusions. Readers may gain a good general understanding of the report and its contents by reading the summary. Additional detailed information is presented in the body of the report.

LIST OF ABBREVIATIONS

AAF	average annual flow
AC	asbestos cement
ADWF	average dry weather flow
ATS	automatic transfer switch
AWWA	American Water Works Association
AWWF	average wet weather flow
BGS	below ground surface
BOD	5-day carbonaceous biological oxygen demand
BSF	base sewage flow
CFS	cubic feet per second
CIP	capital improvement plan
CMU	concrete masonry units
DAF	dissolved air flotation
DEQ	Oregon Department of Environmental Quality
DHS	Oregon Department of Human Services
DO	dissolved oxygen
EPA	US Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FM	force main
FPS	feet per second
FRP	fiber reinforced plastic
GPD	gallons per day
HDPE	high density polyethylene
HP	horsepower
IGA	intergovernmental agreement
KW	kilowatt
MAO	mutual agreement and order
MBR	membrane bioreactor
MH	manhole
MMDWF	maximum month dry weather flow
MMWWF	maximum month wet weather flow
MG	million gallons
MGD	million gallons per day
NPDES	National Pollutant Discharge Elimination System
OAR	Oregon Administrative Rule
ODOT	Oregon Department of Transportation
OPSC	Oregon Plumbing Specialty Code

ORS	Oregon Revised Statutes
PDF	peak day flow
PHF	peak hour flow
PIF	peak instantaneous flow
PSI	pounds per square inch
PVC	Polyvinyl chloride
RPM	revolutions per minute
SBR	sequencing batch reactor
SCADA	Refers to a Supervisory Control and Data Acquisition (telemetry) system
SDC	system development charge
SF	square feet
SRT	solids retention time
TDH	total dynamic head
TSS	total suspended solids
TV	television
UGB	urban growth boundary
USGS	United States Geological Survey
UV	ultraviolet light
VFD	variable frequency drive
WEF	Water Environment Federation
WWTP	wastewater treatment plant

CITY OF MT. ANGEL
Wastewater System Facilities Plan
Mt. Angel, Oregon

EXECUTIVE SUMMARY

Summary Outline

Introduction

Project Objectives

Background Information and Need for Plan

Study Area and Planning Considerations

Basis for Facilities Planning

Overview of Existing Facilities

Wastewater Flows and Loads

Collection System Deficiencies and Recommended Improvements

Treatment System Deficiencies and Recommended Improvements

Recommended Capital Improvement Plan

EXECUTIVE SUMMARY

INTRODUCTION

The purpose of this study is to provide a comprehensive evaluation of the City's wastewater system with respect to its existing and future needs, identify improvements and associated costs necessary to meet those needs, and provide the City with a framework for the provision of sanitary sewer service through the year 2035.

This executive summary has been prepared to provide a concise overview of the evaluations and analyses performed in each chapter of the study. A summary of the capital improvement program costs appears at the end of this summary.

PROJECT OBJECTIVES

This Wastewater Facilities Plan was completed to achieve the following objectives;

- *Evaluate Current and Future Needs*

Evaluate the City's sanitary sewerage facilities with respect to existing and future needs, identify improvements and associated costs necessary to meet those needs, and provide the City with a guide for future development of the City's sanitary sewerage system.

- *Satisfy Funding Agency Requirements*

As with most small cities, Mt. Angel may have some difficulty accumulating sufficient resources to construct the required improvements. Therefore, outside funding may need to be acquired. The federal and state funding agencies that distribute funds for public wastewater projects have published guidelines for the preparation of Facilities Plans. This plan is intended to conform to those guidelines.

BACKGROUND INFORMATION AND NEED FOR PLAN

The City of Mt. Angel is located in the agricultural area of north central Marion County in the heart of the Willamette Valley. The urban growth boundary encompasses approximately 870 acres. Of this area, approximately 683 acres are located within the City Limits. The current population of Mt. Angel is approximately 3,790. The City was incorporated in 1893. Mt. Angel has developed a stable economy with strong agricultural, health care, and diversified small industrial sectors.

The City currently operates the wastewater utility under a NPDES permit issued by the Oregon Department of Environmental Quality (ODEQ). The wastewater utility consists of a conventional gravity collection system and a facultative lagoon treatment plant with a polishing wetland. Treated effluent from the plant is currently disposed of on a seasonal basis by surface water discharge to the Pudding River. The treatment plant is located west of the City.

The existing Sewerage System Facilities Plan was prepared by Westech Engineering and was adopted by the City in 1989. This document included a list of recommended improvements for the wastewater utility and enabled the City to obtain an EPA construction grant for construction

of the existing treatment plant. The plant was constructed in 1992 and has been in service ever since. Due to the age of the 1989 Facilities Plan and the treatment plant, a new Facilities Planning document is needed to guide the development of the wastewater utility for the next planning period.

The City received a grant from the Oregon Community Development Block Grant program administered by the Oregon Economic and Community Development Department to fund the preparation of this plan.

Additional background and introductory information is presented in Chapter 1 of the plan.

STUDY AREA AND PLANNING CONSIDERATIONS

The City's Comprehensive Plan was developed in the 1980's and established a large urban growth boundary (UGB) encompassing 870 acres, approximately 187 acres of which are outside the present City limits. Eventually all areas inside the UGB will be part of the City and will be served by the City's utility systems. The Oregon Department of Land Conservation and Development (DLCD) mandates that the planning area for facilities planning be limited to the land within the present UGB of the City. Therefore, the improvements recommended in this plan are based on development of land within the UGB in its present location, as well as the existing land use zoning for these areas. It is assumed that no significant development will occur within the study area that will require major changes to the existing zoning, and that there will be no significant expansions of the UGB within the study period. Changes in any of these assumptions could change the recommendations contained in this facilities plan. Should significant changes in any of the above occur, the facilities plan should be updated accordingly. Additional information regarding the study area and planning considerations is presented in Chapter 2.

The DEQ recommends a minimum 20-year planning period for facilities planning. In order to assess the City's needs over this time, population growth projections must be made to determine future wastewater flows and loads. The DEQ mandates the use of County coordinated growth rates and population projections. Therefore, the growth rates and population projections used in the Facilities Plan are based on figures developed by Marion County. Using the growth rate projected by the County, the projected municipal population of Mt. Angel in the year 2035 is expected to be approximately 5,544 (see Section 5). Wastewater flow and load projections are detailed in Chapter 5.

BASIS FOR FACILITIES PLANNING

During the coming years, improvements to the City's existing wastewater collection and treatment facilities will be required to ensure reliable operation and compliance with regulatory standards. Haphazard improvements that do not adequately consider all of the issues that impact the system may end up costing the City more in the long run than well thought-out, carefully applied solutions. For example, if a particular sewer pipe cannot convey the volume of wastewater that flows into it, a logical solution is to replace the pipe with a larger pipe. However, if the larger pipe is sized only to accommodate the existing flow volumes and future growth upstream of the pipe occurs, the pipe size may need to be increased a second time to accommodate the flow increases. Instead of replacing the pipe twice, a more cost-effective solution is to replace the pipe once with a pipe sized to accommodate the existing flows plus the

anticipated future growth. As this simple example illustrates, most wastewater facilities are not well suited for incremental expansion to accommodate growth. More often than not, the most cost effective solution is to initially size the facilities to accommodate anticipated growth within the planning period. Therefore, this Facilities Plan not only considers the existing deficiencies, but also considers what improvements are likely to be required during the planning period as the City grows and develops. The intent of the recommendations proposed in the plan is to provide the City with reliable wastewater facilities that not only meet current demands, but will also adequately serve the City well into the future.

The City currently operates the wastewater facility under a NPDES permit issued by DEQ. All future facilities must be developed and maintained to ensure that the City can remain in compliance with the NPDES permit. Detailed descriptions of the regulatory requirements relevant to the City's wastewater utility are presented in Chapter 3.

OVERVIEW OF EXISTING FACILITIES

Chapter 4 provides a detailed description of Mt. Angel's existing wastewater collection and treatment facilities. The City currently serves approximately 962 user accounts. The existing wastewater facilities consist of a conventional gravity collection system that conveys wastewater to the treatment plant. The gravity collection piping includes approximately 65,000 feet of mainline piping, 250 manholes, and 1,000 service laterals. The flow of wastewater from the users to the treatment plant is entirely by gravity. There are no pump stations in the system. The collection system collects large amounts of groundwater infiltration and stormwater inflow (I/I) during the winter months and additional I/I corrective measures are recommended. The City's existing NPDES permit requires that the City prepare and implement an inflow reduction plan. The City should prepare this plan as soon as possible using funds set aside for I/I corrective measures.

The treatment facility is located west of Mt. Angel Gervais Road west of the urban growth boundary. The treatment plant consists of a headworks, three facultative lagoons and a polishing wetland. The treated effluent is disinfected using a chlorine gas feed system. During the summer months, all wastewater is stored in the lagoons and no discharge occurs from the plant. During the winter months, plant effluent is pumped to the Pudding River for discharge. Prior to being discharged, a sulfur dioxide solution is added to the effluent to remove the toxic form of chlorine. The plant also includes an operations building that houses the chemical feed equipment as well as a control room, office space, and a laboratory. An overall schematic representation of the existing wastewater collection and treatment system is presented in Figure 4-1. Detailed maps of the collection system are included in Appendix C. The following recommendations are listed at the end of Chapter 4. The background information behind these recommendations is also included in Chapter 4.

- Collection System – A long-term I/I reduction program is recommended. The City currently allocates approximately $50,000 per year for I/I reduction efforts. This commitment should be formalized indefinitely. The City should also consider funding the program at a higher rate to increase the rate at which repairs can be made and to offset the impacts of inflation over time. Additional recommendations for a long-term I/I reduction plan are discussed in

Chapter 6. The City should immediately prepare and begin to implement the inflow reduction plan required in Schedule C of the City's NPDES permit.

- Treatment Plant Access Road – Widen and improve the access road to enable delivery trucks to deliver chemicals and other products to the plant operations building. Also raise the road surface as needed to ensure adequate access during high-water events.
- Lagoon Sludge Removal – The City should plan to remove sludge from the lagoons toward the end of the planning period.
- Treatment Plant Telemetry System – The treatment plant does not have an alarm telemetry system. A modern alarm telemetry system should be installed early in the planning period.
- Treatment Plant Lagoon Dikes – Remove shrubs, trees, and blackberries from the lagoon dike slopes. This should be an annual maintenance item.
- Treatment Wetland Influent Header Pipe – Rehabilitate or replace the existing distribution valves.
- Treatment Wetland Effluent Control Boxes – Modify the vegetation screens to simplify the cleaning process.
- Treatment Wetland Vegetation Maintenance – The City should begin systematically draining each wetland cell and transplanting the vegetation from dense areas to spare areas to fill in the existing gaps in the wetland vegetation.
- Treatment Plant Effluent Pump Station – Install a sluice gate on the influent pipe to make it easier to enter the wetwell for maintenance.
- Treatment Plant Effluent Flow Meter Vault – Modify the valves to enable them to be operated from the surface in order to eliminate confined space entry requirements.
- Treatment Plant Effluent Pump Station Electrical and Control System – The pump station electrical power distribution and control system will reach the end of its useful life during the planning period. Therefore, the City should plan to update these facilities.

WASTEWATER FLOWS AND LOADS

Chapter 5 of the plan includes an analysis of the existing wastewater flow rates, organic loading rates, and solids loading rates to the treatment plant. Population projections are used to estimate future flows and loads. The design flows and loads are used to analyze the existing systems. The design flows and loads consist of the existing flows and loads, plus the flows and loads due to population growth. The reader is referred to Chapter 5 for a description of the flow projection methodology and the results. Chapter 5 also includes an analysis flow and loading data from of the City's only industrial user (Pepsi Northwest Beverages). This user currently operates under a permit issued by the City. The analysis presented in Chapter 5 shows that this user has not been able to comply with the conditions of the permit issued by the City. The following recommendations are listed at the end of Chapter 5.

- The City should evaluate the influent flow measurement system and correct any problems to ensure that no future erroneous readings are collected.

- The City should re-evaluate the policies and approach used to administer the permit for the Pepsi Northwest Beverages facility. This should include an evaluation of the billing calculations used to determine the monthly bills for the Pepsi plant as well as the procedures used to review the flow and loading data from the plant and enforce the provisions of the permit on a monthly basis. The City should also establish a record keeping procedure to establish a long-term data base of flows and loads from the Pepsi plant. It is critical that the City is able to adequately manage the discharges from the Pepsi plant. Should discharges from the Pepsi plant overload or cause upsets of the City's facility, the DEQ may require the City to implement a formal industrial pretreatment program in accordance with 40 CFR 403. Such industrial pretreatment programs are typically implemented by larger municipalities and are costly to administer. Such a program would likely require the full time efforts of at least one public works staff member. For the City of Mt. Angel, this would represent a significant increase in labor costs for the wastewater utility. As such, it is critical that the City demonstrates to DEQ the ability to manage and control discharges from the Pepsi plant without the need for a formal industrial pretreatment program.

COLLECTION SYSTEM DEFICIENCIES AND RECOMMENDED IMPROVEMENTS

Chapter 6 presents an analysis of the wastewater collection system. Current operation and maintenance practices are first reviewed and two changes are recommended. The first recommendation is to establish a regular cleaning and television inspection program (Program-1). The second operational recommendation is to increase funding for the sewer rehabilitation program from approximately $50,000 per year to approximately $100,000 per year (Program-2). Background information for this recommendation is presented in Section 6.2.5. Chapter 6 also identifies the areas in the City that contribute the highest amounts of I/I and includes recommendations for where the City should concentration rehabilitation efforts. As noted above, the City's existing NPDES permit requires the preparation of an inflow reduction plan. This plan has not been prepared and should be prepared as soon as possible using funds set aside for sewer rehabilitation work.

In addition to operation and maintenance practices, the ability of the existing collection system to convey the anticipated wastewater flows is analyzed in Chapter 6. This analysis shows that the existing system lacks the capacity to adequately convey existing and projected wastewater flows. A hydraulic model was used to simulate flow through the collection system. At design flows, the model predicts widespread surcharging and raw sewage overflows. In order to correct these problems improvements to the collection system are identified. These improvements largely consist of replacing undersized sewer pipes with larger diameter pipes. A listing of the recommended collection system projects is included in Chapter 6. These improvements are later prioritized in Chapter 8 to develop the recommended Capital Improvement Plan (see below).

TREATMENT SYSTEM DEFICIENCIES AND RECOMMENDED IMPROVEMENTS

Chapter 7 includes an analysis of the treatment system. The treatment plant is evaluated with respect to its ability to adequately treat and dispose of the projected wastewater flows and loads during the planning period. In general, this analysis shows that the treatment plant should be able to adequately treat the anticipated flows and loads during the planning period as long as two conditions are met. The first is that actual population growth does not exceed projected growth

rates. The second condition is that discharge from the Pepsi NW Beverages plant does not exceed the flow and loading limits listed in the current permit for the facility. Based on the assumption that these two conditions are met, no major wastewater treatment expansion project (e.g., adding new lagoons or other unit processes) is recommended. A notable exception to this statement is the existing headworks that lacks the ability to convey peak wastewater flowrates. As such, a new headworks is recommended. A number of other smaller scale improvements are recommended to address existing shortcomings and to update equipment that will likely become obsolete during the planning period. The recommended improvements also include the removal of the sludge from the first lagoon cell. Each of the recommended projects are described in Chapter 7.

RECOMMENDED CAPITAL IMPROVEMENT PLAN

The Facilities Plan identifies a number of deficiencies and includes several recommended improvement projects. Some of these projects are more critical than others. Some projects should be constructed early in the planning period. While other projects are not needed immediately, but will be needed as the City expands and the existing system continues to age.

A prioritizing process was developed to rank the improvement projects. Factors utilized in the prioritizing process included several measures of criticality, as well as the cost/benefit ratio of each project. This process identified essential, high benefit to cost projects for early implementation, and the deferral of less critical, lower value projects. Each of the projects identified in the plan were examined and assigned a priority for implementation and appear in Table ES-1 below.

Priority 1 projects are considered to be needed immediately. They have been developed to resolve existing or near term system deficiencies. It is recommended that Priority 1 improvements are undertaken as soon as practical. Priority 2 projects will be needed beyond the near term of the Priority 1 projects to improve the quality of service throughout town. Although not critical at this time, they will likely be required at the some point during the planning period. Priority 3 projects are long term improvements designed to provide sanitary sewer service to areas that develop in response to population growth. While important, they are not considered to be critical at the present time and should not be included in the City's list of proposed improvements for the next 20 year planning period.

At a minimum, all of the Priority 1 and Priority 2 improvements should be included in the CIP. The Priority 3 improvements are largely growth driven. It is envisioned that these improvements will be constructed as part of future development and that individual developers will construct and pay for the Priority 3 improvements on an incremental basis.

It is recommended that the City implement the Priority 1 improvements as soon as possible. Work on the Priority 1 improvements should begin immediately after agency approval and City adoption of this Facilities Plan. It is anticipated that Priority 2 projects will be required later in the planning periods and may be constructed as finances become available and as the need arises.

Several potential funding programs are available to assist Cities with the funding of major infrastructure improvements. Several of these programs are identified and discussed in Chapter 8. Even with funding assistance increases in user rates and SDC fees are likely to be needed. As a parallel work effort to this facilities plan, the City also performed a sewer rate and SDC fee study (Appendix G). The financial analysis includes recommendations for rate increases that are needed to fund the recommended capital improvements.

Table ES-1 | Recommended Capital Improvement Priorities

Project Code [1]	Project	Priority	Total Estimated Project Cost [2]
G-1	Main Trunk Sewer – Manhole #5 to New Manhole #100	1	$ 612,000
G-2	North Trunk Sewer – Marquam St. MH #100 to Pershing St. MH #20	1	$ 340,000
G-3	North Trunk Sewer - Marquam Street MH #20 to Railroad MH #25	1	$142,000
G-4	North Trunk Sewer - Marquam Street MH #25 to Main St MH #60	1	$375,000
G-5	South Trunk Sewer - Segment 1 New MH #100 to May Street MH #130	1	$596,000
G-8	South Trunk Sewer - MH #136 to MH #146	1	$357,000
G-14	Construct New Line from MH 115 to MH 109	1	$50,000
T-1	Treatment Plant Access Road Improvements	1	$85,000
T-4	Wetland Improvements, effluent boxes, influent valves	1	$69,000
T-5	Effluent Pump Station Confined Space Entry Improvements	1	$39,000
		Subtotal Priority 1….	**$ 2,665,000**
G-6	South Trunk Sewer - May Street MH #130 to MH #135	2	$ 171,000
G-7	South Trunk Sewer – South. Pershing Street MH #135 to MH #136	2	$128,000
T-2	Headworks Improvements	2	$528,000
T-3	Lagoon Cell 1 Sludge Removal	2	$888,000
T-6	Effluent Pump Station Electrical and Control System Modernization	2	$460,000
T-7	Facilities Plan Update	2	$75,000
		Subtotal Priority 2….	**$ 2,250,000**
G-9	Sewer Basin 1 Trunk Sewer	3	$ 493,000
G-10	Sewer Basin 2 West Trunk Sewer	3	$300,000
G-11	Sewer Basin 2 East Trunk Sewer	3	$252,000
G-12	Sewer Basin 3 Trunk Sewer	3	$336,000
G-13	Sewer Basin 7 Southwest Trunk Sewer	3	$ 552,000
		Subtotal Priority 3….	**$ 1,933,000**
		TOTAL….	**$ 6,848,000**
Recurring Annual Programs			
Pgm-1	Sewer Cleaning and Inspection Program (Program – 1)		$13,000
Pgm-2	Annual I/I Correction Program (Program – 2)		$100,000
		Subtotal Recurring Annual Programs….	**$ 113,000**

[1] Project Code Legend:
G = Gravity Sewer T = Treatment Pgm = Improvement Program

[2] See Section 8.3 for basis of project cost estimates

CHAPTER 1

INTRODUCTION

Chapter Outline

1.1 Introduction
1.2 Authorization
1.3 Purpose
1.4 Scope of Study
1.5 Previous Studies and Reports
1.6 Wastewater Terms and Definitions

INTRODUCTION

CHAPTER 1

1.1 INTRODUCTION

The City of Mt. Angel is located in the agricultural area of north central Marion County in the heart of the Willamette Valley. The urban growth boundary encompasses approximately 870 acres. Of this area, approximately 683 acres are located within the City Limits. The current population of Mt. Angel is approximately 3,790. The City was incorporated in 1893. Mt. Angel has developed a stable economy with strong agricultural, health care, and diversified small industrial sectors.

The City currently operates the wastewater utility under a NPDES permit issued by the Oregon Department of Environmental Quality (ODEQ). The wastewater utility consists of a conventional gravity collection system and a facultative lagoon treatment plant with a polishing wetland. Treated effluent from the plant is currently disposed of by surface water discharge to the Pudding River. The treatment plant is located west of the City.

The existing Sewerage System Facilities Plan was prepared by Westech Engineering and was adopted by the City in 1989. This document included a list of recommended improvements for the wastewater utility and enabled the City to obtain an EPA construction grant for construction of the existing treatment plant. The plant was constructed in 1992 and has been in service ever since. Due to the age of the 1989 Facilities Plan and the treatment plant, a new Facilities Planning document is needed to guide the development of the wastewater utility for the next planning period. The analysis presented in this facilities plan shows that despite its age, the existing treatment plant has a significant amount of reserve capacity. This is largely due to the fact that the original design of the plant was based on fairly aggressive population growth projections that have not materialized. For example, the growth model used as the basis for the plant design estimated a population of 4,100 people in the year 2000. The current population of Mt. Angel is approximately 3,700. As such, the plant has a fair amount of reserve capacity and the treatment plant improvement projects recommended in this plan are generally needed to modernize the facilities rather than to increase treatment capacity.

1.2 AUTHORIZATION

The City authorized Westech Engineering to proceed with the preparation of this Wastewater Facilities Plan in the summer of 2012. The plan has been prepared to meet the current requirements of the regulatory and funding agencies.

1.3 PURPOSE

The purpose of this plan is to provide a comprehensive evaluation of the City's wastewater system with respect to its existing and future needs, identify improvements and associated costs necessary to meet those needs, and provide the City with a framework for the provision of wastewater service through the year 2035.

This plan will assist the City in the planning and implementation of capital improvements and will assist the development community as the wastewater system is expanded for future growth. The plan will benefit the current and future residents of the City by enhancing the quality of life through improved water quality, planned growth, scheduled improvements, and an equitable distribution of improvement costs.

1.4 SCOPE OF STUDY

The scope of the Wastewater Facilities Plan is intended to comply with the applicable requirements of DEQ and the City. Study area characteristics were identified and included both physical and socioeconomic conditions. Existing population and land use were examined and projected into the future.

The existing wastewater system was investigated. Data was collected on the existing wastewater collection and treatment systems from operating records, conversations with City staff, on-site investigations, maps, as-built records, and other pertinent documentation. Existing facilities were evaluated in terms of location, sizing, capacity, condition, limitations, and performance. Consideration was given to the manner in which existing and proposed facilities could be used in the future as the study area develops to City zone densities.

Typical wastewater characteristics were identified in terms of loads, flows, strength and I/I allowances throughout the year. Future characteristics were projected to establish capacity requirements. Flows were addressed for both dry period and wet period conditions, and unit design values were established. Future wastewater characteristics were projected.

The basis for planning was established. Applicable regulatory requirements were identified and addressed, including current and future treatment criteria and discharge standards. The design capacity of the City's collection piping and treatment facilities was examined to determine impacts to present and future operation of wastewater facilities. Alternatives were identified for collection, treatment, and effluent disposal/reuse. Alternatives for system administration were identified and evaluated.

Nonviable options were screened out, and a limited number of selected alternatives were established and evaluated in detail. Finally, a recommended plan was identified that will enable the City to provide wastewater collection and treatment within the study area. This plan includes preliminary design data, capital improvement and operational costs, and a potential financing plan.

1.5 PREVIOUS STUDIES AND REPORTS

The following reports and studies were referenced in the preparation of this study:

- *Construction Drawings, Sewerage System Improvements,* Mt. Angel, Oregon, Westech Engineering, Inc., December, 1991.
- *Construction Drawings, Mt. Angel WWTP Dechlorination Improvements,* Mt. Angel, Oregon, Westech Engineering, Inc., June, 2006.
- *Facilities Plan Update*, Mt. Angel, Oregon, Westech Engineering, Inc., September 1983.

- *Mt. Angel Sanitary Sewer Mainline TV Inspection Reports,* Mt. Angel, Oregon, Westech Engineering, Inc., May 1995.
- *Precipitation-Frequency Atlas of the Western United States (NOAA Atlas 2), Volume X-Oregon*, by US Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service.
- *Sewerage System Facilities Plan Update,* Mt. Angel, Oregon, Westech Engineering, Inc., October 1989.
- *Sewer System Facilities Planning Report and Sewer System Evaluation Study,* Mt. Angel, Oregon, Westech Engineering, Inc, May 1978.
- *Soil Survey of Marion County Area, Oregon*, USDA Soil Conservation Service, September 1972.

1.6 WASTEWATER TERMS AND DEFINITIONS

An understanding of key wastewater terms and definitions is necessary for an understanding of the discussions in this and subsequent sections. The following does not include all terms used in this report, but will provide a useful glossary for those readers not familiar with wastewater terminology. The different sewage flow classifications are defined in Chapter 5.

- Aerobic - Microorganisms living in the presence of free oxygen, or biological treatment processes that occur in the presence of oxygen.
- Anaerobic - Microorganisms capable of living without the presence of free oxygen, or biological treatment processes that occur in the absence of oxygen.
- Anoxic Denitrification - The process by which nitrate nitrogen is converted biologically to nitrogen gas in the absence of oxygen. This process is also known as anaerobic denitrification.
- Attached Growth Process - A biological treatment process in which the microorganisms responsible for the conversion of the organic matter or other constituents in the wastewater to gases and cell tissue are attached to some inert medium such as rocks, slag, ceramic or plastic materials. Attached growth treatment processes are also known as fixed film processes.
- Biological Treatment Processes - Treatment processes by which the stabilization and decomposition of organic material in sewage is accomplished by living microorganisms. The organic matter is used as a food source for microorganisms, and converted to forms which can either be removed from the waste stream (soluble organics) or are sufficiently stabilized to allow disposal without negatively affecting the environment (insoluble organics).
- Biological Nutrient Removal - The removal of nitrogen and/or phosphorus with biological treatment processes.
- BOD (Biochemical Oxygen Demand) - The amount of oxygen required to biologically stabilize the organic material in sewage by aerobic treatment processes. All references to BOD in this report are to 5-day BOD at 20°C (BOD5).
- Chlorine Residual - The measured residual of chlorine used in disinfecting wastewater. Chlorine residual can exist in two forms; combined or free. The specific form is dependent on the rate of formation, which is controlled by the pH and temperature. A free chlorine residual is the most effective in achieving disinfection.

- Facultative Processes - Biological treatment processes in which the organisms can function in the presence or absence of molecular oxygen.
- Fecal Coliform - Bacteria which are used as an indicator of fecal pollution.
- Industrial Wastes - Wastes produced as a result of manufacturing or processing operations.
- Infiltration/Inflow (I/I) - Groundwater and stormwater which enters the sanitary sewer system.
- Excessive I/I - Portion of infiltration or inflow which can be removed from the sewerage system through rehabilitation at less cost than continuing to transport or treat that portion of I/I.
- Infiltration - Water that enters the sewage system from the surrounding soil. Common points of entry include broken pipe and defective joints in pipe and manhole walls. Although generally limited to sewers laid below the normal groundwater level, infiltration also occurs as a result of rain or irrigation water soaking into the ground and entering mains, manholes, or shallow house sewer laterals with defective joints or other faults.
- Base Infiltration - Water that enters the sanitary sewer system from the surrounding soil during periods of low groundwater levels.
- Rainfall Induced Infiltration - Additional infiltration which enters the sewerage system during and for several days after a period of rainfall. Rainfall often percolates into sewer ditches, especially ditches with granular backfill, and establishes a perched water table. This water then infiltrates into faulty sewers and manholes.
- Sludge - Solid and semisolid residuals resulting from wastewater treatment operations. Sludge, a biosolid, must periodically be removed from treatment systems.
- Inflow - Stormwater runoff which enters the sewerage system only during or immediately after rainfall. Points of entry may include connections with roof and area drains, storm drain connections, holes in manhole covers in flooded streets, and manhole cones located in ditch lines and that do not have watertight joints.
- Lagoon (Stabilization Pond) - A shallow basin constructed by excavating the ground and diking, for the purpose of treating raw sewage by storage under conditions that favor natural biological treatment and accompanying bacterial reduction.
- Nitrification - The biological process by which ammonia nitrogen is converted first to nitrite, then to nitrate.
- Denitrification - The biological process by which nitrate is converted to nitrogen and other gaseous end products.
- NPDES - National Pollutant Discharge Elimination System.
- pH - The degree of acidity or alkalinity of waste water, 7.0 being neutral, a lower number being acidic, and a higher number being basic.
- Sanitary Sewage - Waterborne wastes principally derived from the sanitary conveniences of residences, business establishments, and institutions.
- Suspended Growth Process - A biological treatment process in which the microorganisms responsible for the conversion of the organic matter or other constituents in the wastewater to gases and cell tissue are maintained in suspension within the liquid.

- TSS (Total Suspended Solids) - All of the solids in sewage that can be removed by settling or filtration. The quantity of TSS removed during treatment impacts the sizing of sludge handling and disposal processes, as well as the effectiveness of disinfection.
- Wastewater - The total fluid flow in a sewerage system. Wastewater may include sanitary sewage, industrial wastes, and infiltration and inflow (I&I).

CHAPTER 2

STUDY AREA AND PLANNING CONSIDERATIONS

Chapter Outline

2.1 Introduction
2.2 Study Area
2.3 Study Period
2.4 Physical Environment
- 2.4.1 Climate and Rainfall Patterns
- 2.4.2 Topography
- 2.4.3 Soils
- 2.4.4 Geologic Hazards
- 2.4.5 Public Health Hazards
- 2.4.6 Energy Production and Consumption
- 2.4.7 Water Resources
- 2.4.8 Flora and Fauna
- 2.4.9 Environmentally Sensitive Areas

2.5 Socioeconomic Environment
- 2.5.1 Economic Conditions and Trends
- 2.5.2 Population and Growth Projections
- 2.5.3 Land Use

STUDY AREA AND PLANNING CONSIDERATIONS CHAPTER 2

2.1 INTRODUCTION

Mt. Angel is located northeast of Salem in the agricultural area of north central Marion County. State Highway 214 bisects the City north to south. The City's Comprehensive Plan was most recently updated in 2009 and establishes a large urban growth boundary (UGB) encompassing roughly 870 acres. Approximately 683 acres of land within the UGB is located within the current City limits. Eventually all areas inside the UGB will be part of the City and will be served by the City's utility systems. Figure 2-2, presented at the end of this chapter for formatting reasons, is a vicinity map depicting these features.

2.2 STUDY AREA

The City of Mt. Angel currently provides wastewater service to all areas within the City limits. The study area of this report is the entire area within the UGB.

The improvements recommended in this plan are based on the development of land within the UGB in its present location, as well as the existing land use zoning for these areas. It is assumed that no significant development will occur within the study area that will require major changes to the existing zoning, and that there will be no significant expansions of the UGB within the study period. Changes in any of these assumptions could change the recommendations contained in this plan. Should significant changes in any of the above occur, this plan should be updated accordingly.

The location of the UGB, City limits and land use zoning designations for Mt. Angel are shown in Figure 2-3 presented at the end of this chapter.

2.3 STUDY PERIOD

Choosing a "reasonable" design period for which a utility system should be designed is a somewhat arbitrary decision. If the design period is too short the public faces the prospect of continual upgrades and replacements as demands exceed capacity. On the other hand, choosing a design period that is too long can lead to facilities with excess capacity that may never be needed if population growth does not occur at the projected rates. Such facilities can place an economic burden on the present population and may become obsolete before being fully utilized.

The Oregon Department of Environmental Quality (ODEQ) has established 20 years as a proper planning period for sanitary sewer system improvements. This report will evaluate the anticipated sewage collection, pumping, treatment, and disposal needs for the 20 year planning period. The collection system piping will be planned for the ultimate development of land within the UGB based on current land use designations. Although this may result in capacities greater than those needed during the 20-year planning period, sewage collection lines are, by their very nature, unsuited for incremental expansion without extensive capital outlays. The planning period for proposed wastewater treatment systems will be 20 years from the projected completion of the improvements.

It should be recognized that projections into the future are subject to many variables and assumptions, some of which may prove inaccurate. Accordingly, it is recommended that the City review its wastewater system at five-year intervals and update this report as appropriate.

2.4 PHYSICAL ENVIRONMENT

2.4.1 Climate and Rainfall Patterns

The study area is located on the Willamette Valley floor immediately west of the cascade foothills. The climate in Mt. Angel is relatively mild throughout the year, characterized by cool, wet winters and warm, dry summers. Irrigation in the summer months is common due to low precipitation.

Extreme temperatures in the study area are rare. Days with maximum temperature above 90°F occur only 5-15 times per year on average, and temperatures below 0°F occur only about once every 25 years. Mean high temperatures range from the low 80s in the summer to about 40°F in the coldest months, while average lows are generally in the low 50s in summer and low 30s in winter.

Although snow falls nearly every year, amounts are generally quite low. Willamette Valley floor locations average less than 10 inches per year, mostly during December through February. High winds occur several times per year in association with major weather systems.

Relative humidity is highest during early morning hours, and is generally 80-100 percent throughout the year. During the afternoon, relative humidity is generally lowest, ranging from 70-80 percent during January to 30-50 percent during summer. Annual evaporation is about 35 inches, mostly occurring during the period April through October.

Winters are likely to be cloudy. Average cloud cover during the coldest months exceeds 80 percent, with an average of about 26 cloudy days in January. During summer, however, sunshine is much more abundant, with average cloud cover less than 40 percent. More than half of the days in July are clear.

There are extensive weather records for the North Willamette Valley Experiment Station located north of Mt. Angel. While the data from this weather station is not specifically for Mt. Angel, these values are generally believed to be representative for the immediate area around the City. Despite daily and weekly variations, the annual average climate is representative. The City also measures daily precipitation at the wastewater treatment plant.

The study area receives an average of approximately 42.6 inches of precipitation annually, with the majority of the rainfall occurring during the winter months. The wettest year (since 1963) was 1996 when approximately 74.1 inches of rainfall was measured. Approximately 79% percent of the annual precipitation occurs between November 1 and April 30.

2.4.2 Topography

The area within Mt. Angel's UGB is relatively flat and generally slopes from the southeast to the northwest. Elevations range from approximately 300 feet in the Southeast to 150 feet in the Northwest. The UGB is situated on a bench with Walker Ditch to the South, Zollner Creek to the

North, and Pudding River to the west. Mount Abbey is located to the southeast of the City outside the UGB. The Mt. Angel Abbey is located on this hill. Within the UGB, the gently sloping terrain is well suited for the construction of a gravity collection system. Mt. Angel is one of few Cities in the area that does not have a single pumping station in sanitary sewer collection system. All wastewater generated in the City flows by gravity into the treatment plant.

2.4.3 Soils

Soil surveys for the areas within the Mt. Angel UGB are available from the U.S. Department of Agriculture Soil Conservation Service. Eleven different soil types have been identified and mapped within the study area and appear on Figure 2-4, presented at the end of this chapter.

Each soil type has unique qualities and while some may be excellent for agriculture they may pose substantial problems with regard to foundation suitability. There do not appear to be any soil types that are unsuitable for the construction wastewater system infrastructure from a foundation stability point of view. The construction of significant structures—buildings and tanks—recommended by this report will require detailed geotechnical reports that will be performed during the design development phase.

2.4.4 Geologic Hazards

Known geologic hazards within the study area include seismic concerns and flooding.

2.4.4.1 Seismic

The 2008 U.S. Geological Survey (USGS) National Seismic Hazard Maps display earthquake ground motions for various probability levels across the United States. These factors are applied in the seismic provisions of building codes, insurance rate structures, risk assessments, and other public policy. A review of these maps identifies Oregon as having a relatively high seismic risk. The Oregon Structural Specialty Code shares this assessment and has adopted similar ground motion data as the USGS. Seismic risk factors for structures are typically influenced by a combination of factors including the geographical location, specific building and structural configurations, and local soil types. The construction and rehabilitation of significant structures recommended by this report (buildings and hydraulic structures) will require detailed geotechnical reports and seismic evaluations.

2.4.4.2 Flooding

The Pudding River located west of the City is the primary stream near the study area. The Federal Emergency Management Agency (FEMA) has established a 100-year floodplain designation and insurance ratings for the study area. While sometimes referred to as the “100 year flood”, it is more accurate to consider the event to have a one percent chance of occurrence in any year, or a 10 percent chance of occurrence during any 10 year period. During a 100 year flood the Pudding River as well as other intra-basin drainage channels rise out of their normal channels creating a large flood plain. The limits of this floodplain are defined by FEMA and are presented on Figure 2-5, which appears at the end of this chapter. Flood profiles and maps for the streams in and around the study area are included in the Flood Insurance Study prepared for Marion County and appear on Flood Insurance Rate Maps (FIRMs). It should be noted that the FEMA flood boundaries are based on flood elevations. Therefore the actual inundation

boundaries may vary due to localized topographical variations. Final determinations of whether a specific property is affected must be determined based on a topographic survey of the property in question. As shown in Figure 2-5, the Pudding River floodplain does not appear to extend into the study area. However, the small tributaries that flow through the study area into the Pudding River were not included in the FEMA study and some flooding near these streams should be anticipated as was observed during recent major flood events (e.g., February 1996).

2.4.5 Public Health Hazards

There are no known public health hazards with the City of Mt. Angel.

2.4.6 Energy Production and Consumption

Electricity is provided to the community by Portland General Electric. Natural gas service is provided by Northwest Natural Gas. There are no known power generation facilities with the City.

2.4.7 Water Resources

The City's present water supply is from groundwater. The City does not utilize any surface water. The City currently supplies water to the community from one of three wells. The wells range in depth from 600 to 800 feet.

2.4.8 Flora and Fauna

The study area encompasses upland areas as well as riparian areas associated with the Pudding River and its tributaries. Therefore, there is a wide variety of plant and animal life within the study area. Common plants include Douglas Fir, hardwood trees such as Oregon White Oak, Ash, Alder, Maple, Oregon Grape, Dogwood, Wild Rose, Sycamore, and Poplar. Common wildlife species include Muskrat, Beaver, Opossum, Raccoon, Skunk, Coyote, and Deer. The Pudding River provides habitat for rainbow trout, coastal cutthroat trout, dace, sculpin, salmon, and steelhead.

2.4.9 Environmentally Sensitive Areas

The Pudding River, Zollner Creek, and the riparian areas and wetlands adjacent to these natural waterways are considered to be environmentally sensitive areas. Figure 2-6 included at the end of this chapter shows the locations of designated wetlands within the study area.

2.5 SOCIOECONOMIC ENVIRONMENT

Growth within the study area will depend on socioeconomic conditions within the City of Mt. Angel. The following section contains a general discussion of economic conditions, trends, population, land use, and public facilities relating to the both the study area and the City.

2.5.1 Economic Conditions and Trends

Mt. Angel's economy is based primarily on agriculture and health care. Mt. Angel serves as a business center for nearby agricultural operations. The City also includes several assisted care

living facilities and some light industrial activity. The economic activity in Mt. Angel is relatively stable and large boom or bust cycles do not seem likely in the foreseeable future.

2.5.2 Population and Growth Projections

Mt. Angel's population in 2009 was 3,790[1]. In 2009 Marion County updated the coordinated population projections for all Cities in the County (Marion County Ordinance No. 1291, October 7, 2009). The County coordinated average annual growth rate for the City is estimated to be 1.08% from 2010 through 2030. With this growth rate the population is expected to grow to 5,544 by the year 2040.

An in depth discussion of future population growth is presented in Chapter 5 -Wastewater Flows and Loads.

2.5.3 Land Use

The City's Comprehensive Plan was originally developed in 1977 and most recently updated in 2009. The Comprehensive Plan includes a large urban growth boundary (UGB) that encompasses approximately 870 acres with approximately 683 acres within the current City Limits.

Eventually the entire area within the UGB will be part of Mt. Angel and will be served by the City's utility systems. The planning area is made up of land in two general categories, namely land inside of City limits and land outside of the City limits, all of which is inside the Urban Growth Boundary. Land use zoning in Mt. Angel is comprised primarily of residential uses, although the Comprehensive Plan sets aside large areas for industrial and commercial development. Total areas under each zoning designation are listed in Table 2-1and ranked in Figure 2-1. A map showing the UGB, City limits and land use zoning areas appears on Figure 2-3 at the end of this chapter.

The majority of the land within the City limits is currently developed or partially developed. The majority of the land inside the UGB, but outside the City limits, is undeveloped or underdeveloped. Of the undeveloped land inside the planning area and outside the City limits, the vast majority (approximately 90%) is zoned for low-density residential use and the remainder for a mix of industrial and public.

[1] Census data, Population Research Center

Table 2-1 | Approximate Areas by Land Use Zone

Land Use	Area inside City Limits	Area in UGB & Outside City Limits	Total	
			(Acres)	(%)
Commercial	35.3	0	35.3	4%
High-Density Residential	70.0	0	70	8%
Low-Density Residential	232.6	166.7	399.3	46%
Industrial	87.6	6.5	94.1	11%
Public	158.0	4.3	162.3	19%
Right of Ways	99.5	9.5	108	12%
Total (Acres)	683	187	870	100%

Figure 2-1 | Ranked Land Uses

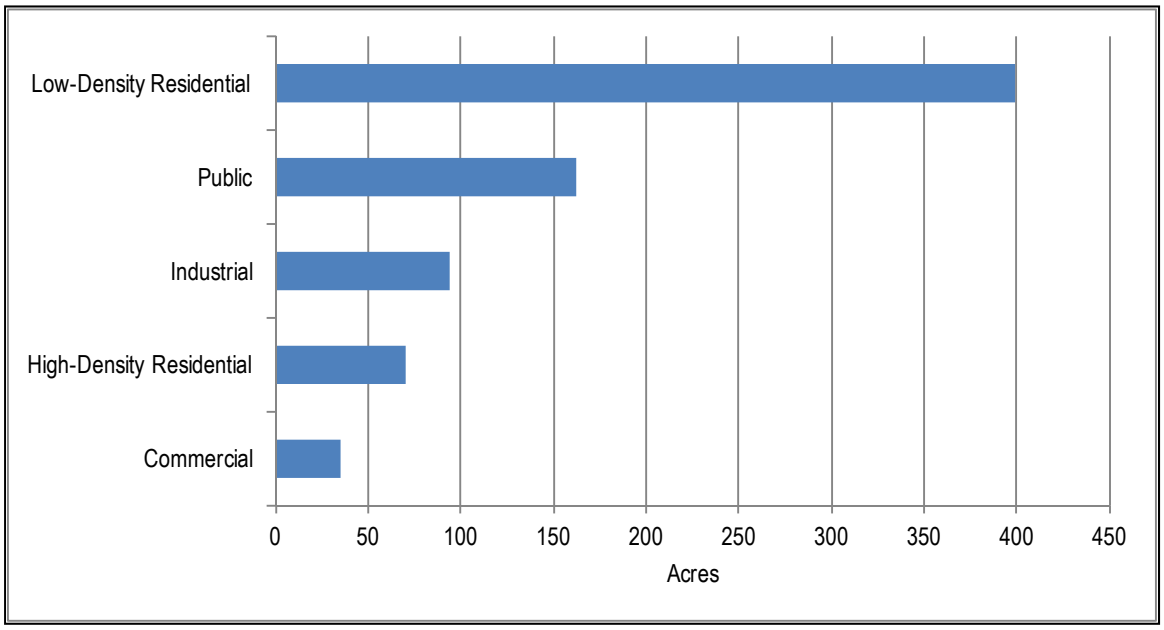


Figure 2-2 | Study Area and Vicinity Map

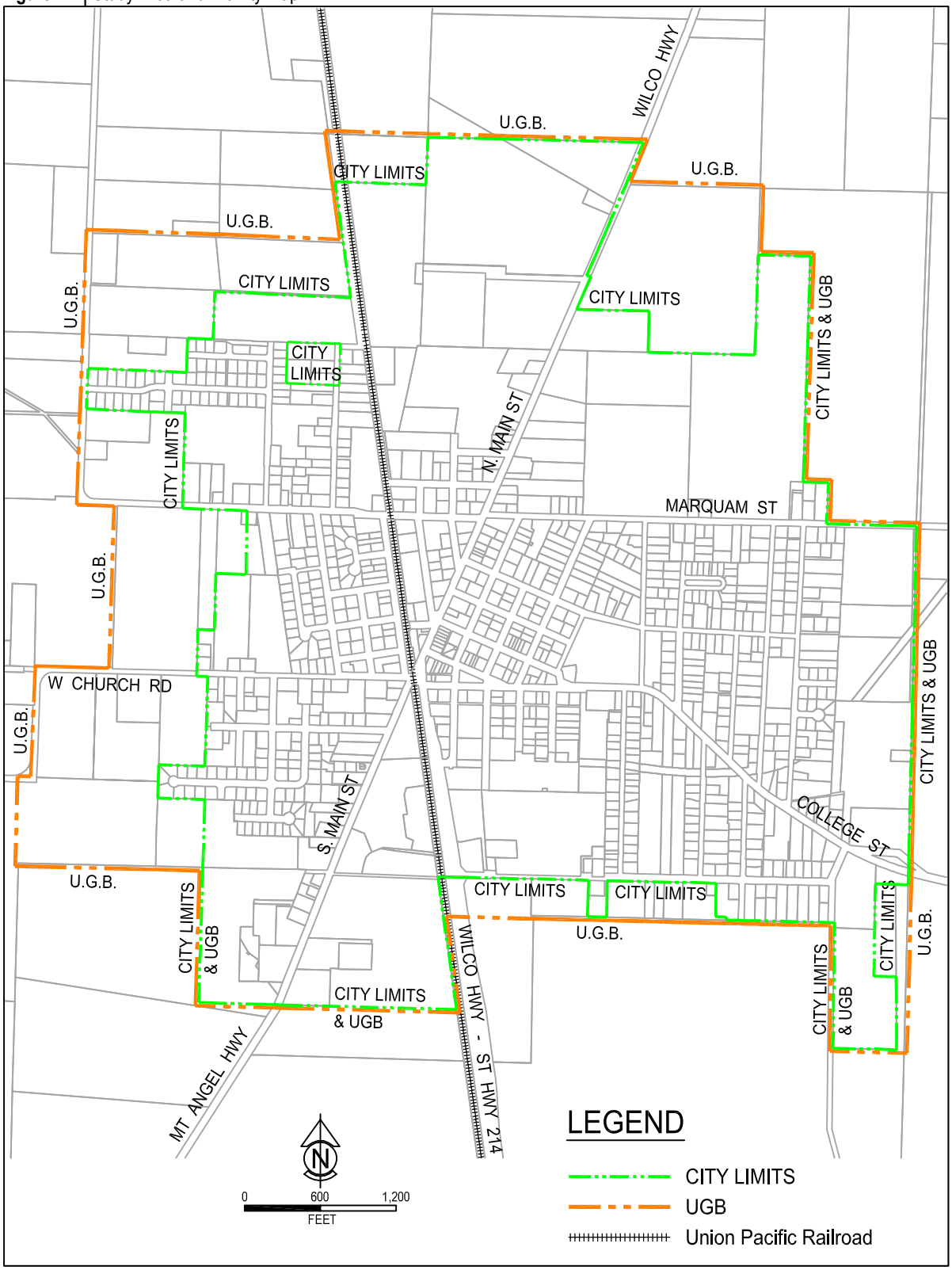


Figure 2-3 | Comprehensive Plan Designations

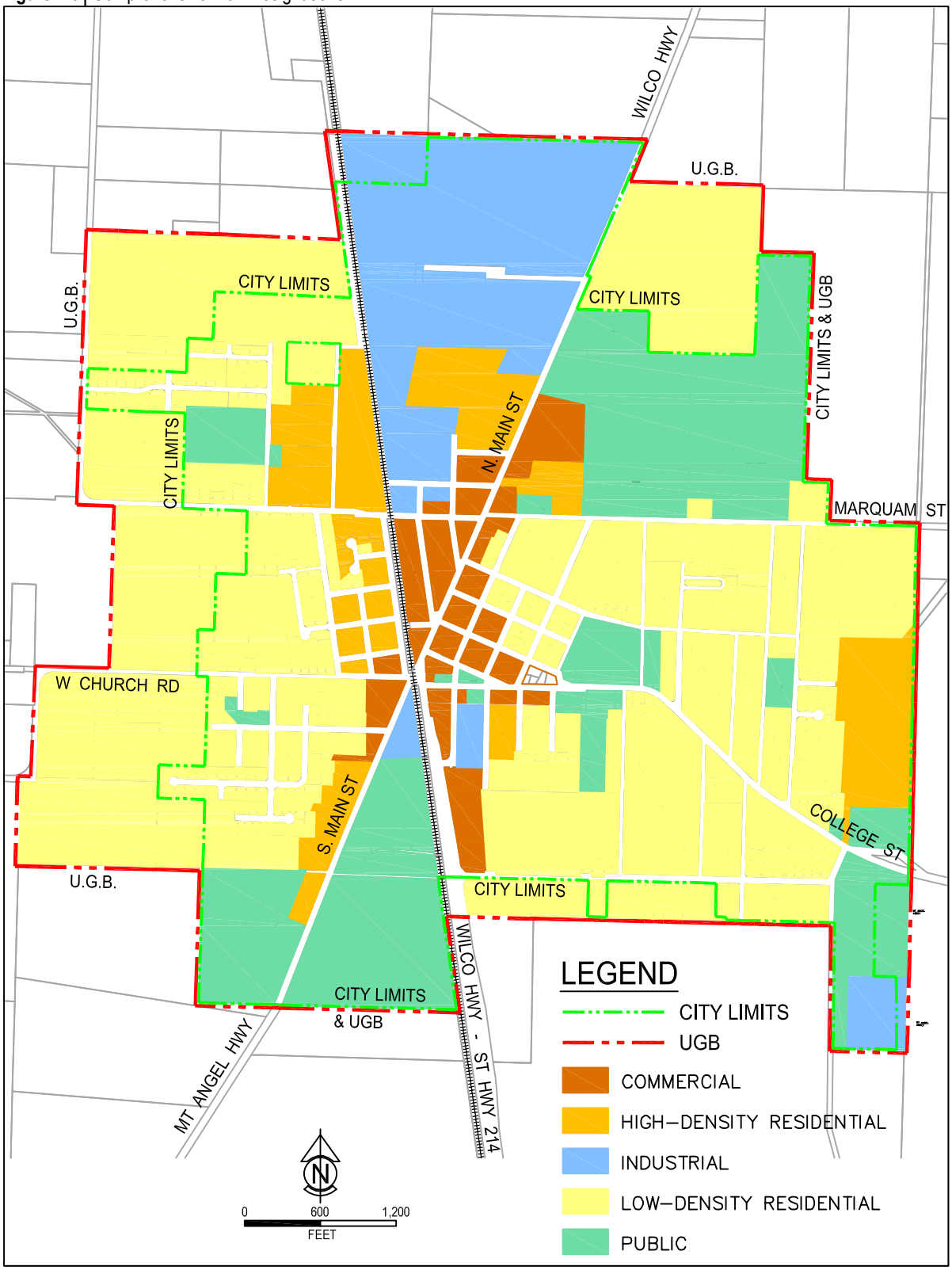


Figure 2-4 | Soils Map

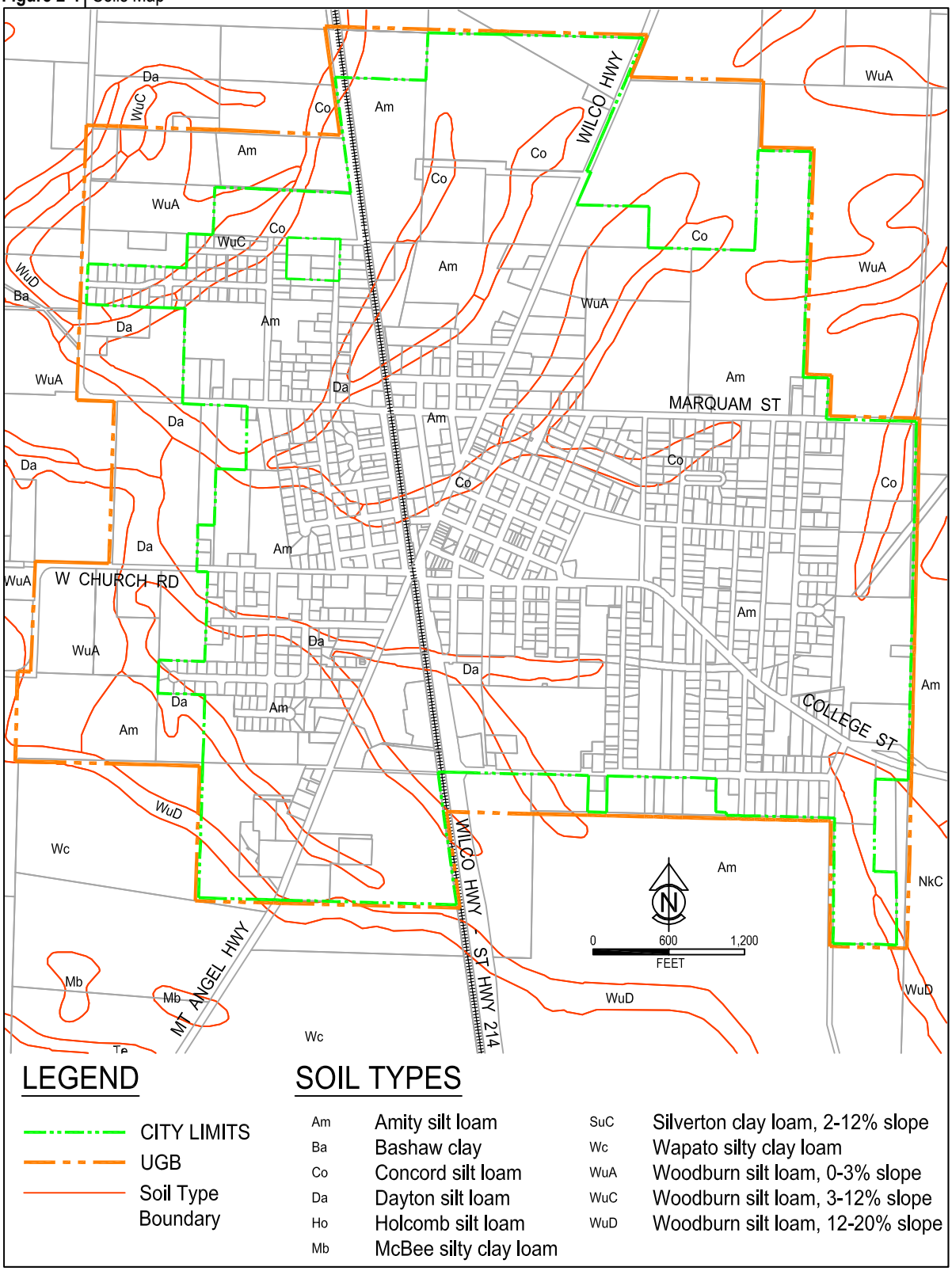


Figure 2-5 | 100 Year Flood Plain Map

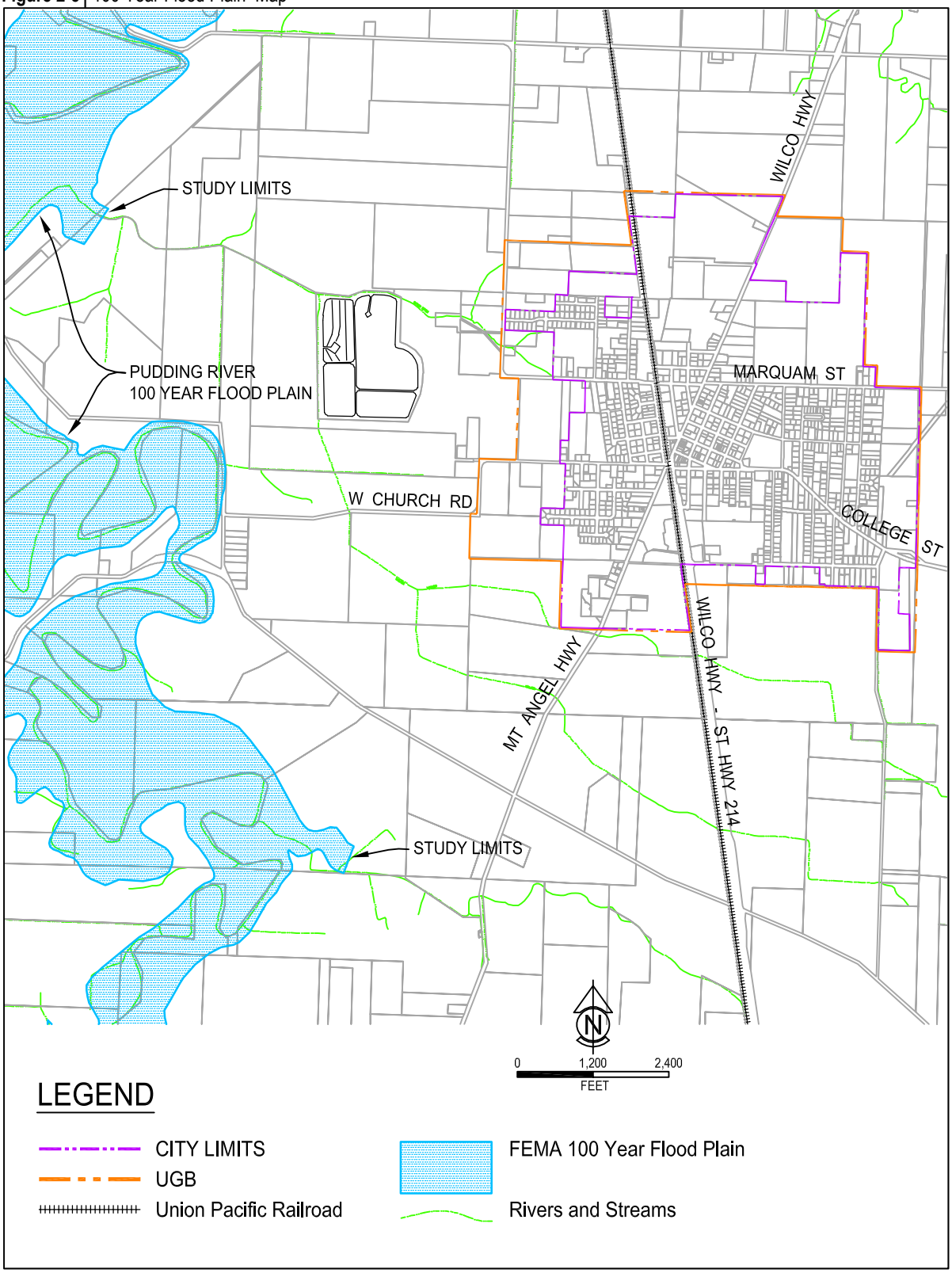
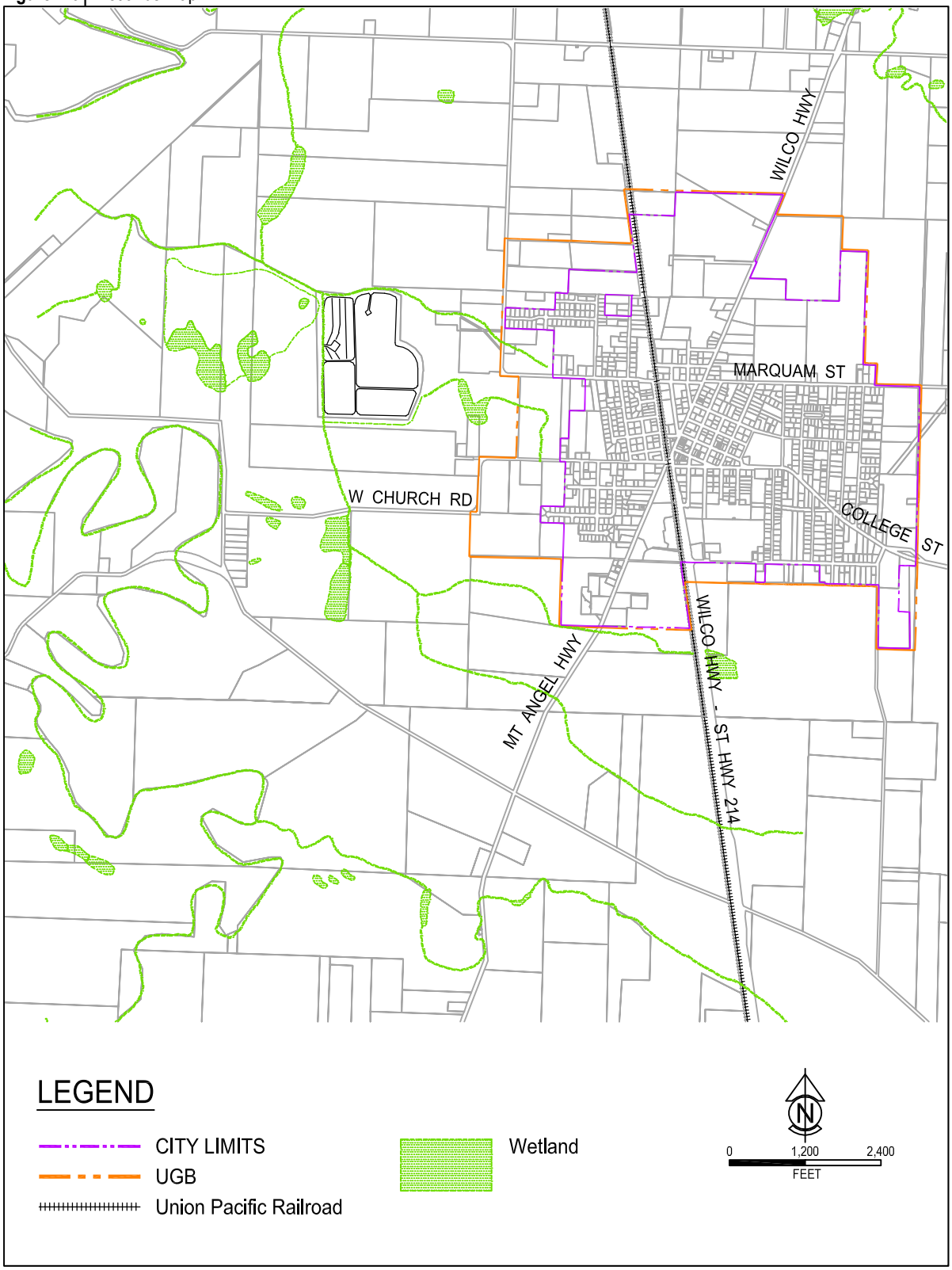


Figure 2-6 | Wetlands Map



CHAPTER 3

BASIS OF PLANNING

Chapter Outline

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BASIS OF PLANNING

CHAPTER 3

3.1 INTRODUCTION

The purpose of this chapter is to present an overview of the regulatory requirements as well as the basic design criteria used to develop and evaluate the various alternatives. This chapter presents the common baseline used to evaluate each of the recommended improvements. All of the recommended improvements must meet all applicable regulatory requirements and provide reliable service for a reasonable cost.

3.2 REGULATING AGENCIES

The U.S. Environmental Protection Agency (EPA) regulates disposal and/or reuse of sewage sludge and septage, as well as the discharge of wastewater effluent, whether to surface waters or subsurface disposal. The basis of the regulations imposed or overseen by the EPA is the Federal Water Pollution Control Act of 1972 (Public Law 92-500) often referred to as the Clean Water Act (CWA). The scope of the Clean Water Act has been revised and expanded over the subsequent years. The EPA promulgates regulations to implement the requirements of the CWA and subsequent legislation, and is required to coordinate its requirements with other federal agencies such as the National Oceanic and Atmospheric Administration, the U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, and with state agencies such as the Department of Environmental Quality (DEQ), the Department of Fisheries, and the Department of Health.

In Oregon, the Oregon Department of Environmental Quality (DEQ) is the EPA's delegated agency to implement the Clean Water Act.

3.3 EXISTING PERMIT REQUIREMENTS

The City's existing treatment plant is regulated under a National Pollutant Discharge Elimination System (NPDES) permit issued by DEQ (Appendix A). The existing permit has expired and the City has submitted a timely renewal application to the DEQ. Under these circumstances, the DEQ allows permit holders to continue to operate under the old permit until a new permit is issued.

The City is currently permitted to discharge treated effluent to the Pudding River from November 1 through April 30 of each year. No discharge is allowed from May 1 through October 31. The permit does allow discharge during the month of May with special approval from the DEQ. However, discharge during the month of May is not likely to be approved unless unusually wet weather conditions occur during the month of April and are expected to continue into May. In addition to seasonal limitations, the NPDES permit includes several other limitations with respect to effluent quality and quantity (Table 3-1). The rate at which water can be discharged is also limited by the flowrate in the Pudding River (Table 3-2). Operators must check the stream flow in the Pudding River on a daily basis and adjust the discharge rate to ensure compliance with Table 3-2. To facilitate this, the City established a stream gauging station on the Pudding River when the treatment plant was originally constructed.

Finally the NPDES permit establishes a mixing zone in the Pudding River. The mixing zone is defined as that portion of the Pudding River extending from a point ten feet upstream of the outfall to one hundred feet downstream from the outfall.

Table 3-1 | Current NPDES Permit Discharge Limitations

NPDES Permit Schedule A, Treated Effluent, Outfall 001(Pudding River)
Discharge Permitted November 1 – April 30

Constituent	Max. Concentration (mg/L)		Max. Mass Load (lb/day)		
	Avg. Monthly	Avg. Weekly	Avg. Monthly	Avg. Weekly	Daily
BOD5	20	30	300	450	600
TSS	20	30	300	450	600
pH		Range		6.0 – 9.0	
E. coli Bacteria		Monthly Geometric Mean		126 cts/100 ml	
		Maximum Single Sample		406 cts/100 ml	
BOD5 Removal Efficiency		Min. Monthly Average Removal		85%	
TSS Removal Efficiency		Min. Monthly Average Removal		85%	
Total Chlorine Residual		Maximum Monthly Average		0.13 mg/L	

Table 3-2 | Receiving Stream Flow Discharge Rate Limitations

Pudding River Flow (cfs)	Maximum Effluent Flow (mgd)
100-199	0.30
200-299	0.68
300-399	1.10
400-499	1.50
500-599	1.90
600-699	2.28
700-799	2.76
800-899	3.24
900-999	3.72
Greater than or equal to 1000	4.20

3.3.1 Mixing Zone

The City's outfall diffuser in the Pudding River utilizes four ports fitted with duck bill check valves to distribute effluent in the receiving water. The NPDES permit defines the mixing zone for this outfall as that portion of Pudding River extending from a point ten feet upstream of the outfall to a point one hundred feet downstream from the outfall. The Zone of Immediate Dilution (ZID) is defined as that portion of the mixing zone that is within ten feet of the point of discharge.

In May of 2010, the DEQ completed an outfall mixing zone study for the City (Appendix D). The study was conducted in accordance with the DEQ's 2007 Internal Management Directive regarding regulatory mixing zones. A Level 1 mixing zone study was completed. The DEQ concluded that a Level 1 study was appropriate because of the following observations.

- Mt. Angel is a "minor" NPDES permit holder.
- The discharge has no reasonable potential to exceed acute criteria other than potentially chlorine or ammonia.

- The available dilution is greater than 20 times 25% of the critical flow.

To address chlorine toxicity, the permit includes relatively low chlorine limits. In order to comply with these limits, the effluent is dechlorinated prior to discharge. Therefore, there is no reasonable potential for the discharge to violate chlorine toxicity criteria. As part of the 2005 permit renewal process the DEQ conducted a reasonable potential analysis for ammonia toxicity and concluded that there was also no reasonable potential for acute or chronic ammonia toxicity from the discharge into the receiving stream.

The environmental mapping summary of the mixing zone report indicated that there are no nearby public recreation areas, no drinking water intakes within 0.5 miles, and no other nearby dischargers with NPDES permits.

3.3.2 Future Permit Modifications

As part of the permit renewal application completed in 2009, the City requested that DEQ revaluate the parameters of the stage discharge curve (Table 3-2). The stage discharge parameters listed in Table 3-2 were determined by chlorine toxicity at the edge of the mixing zone. The City recently installed a dechlorination system to remove free chlorine from the treated effluent prior to discharge. Therefore, the stage discharge parameters are obsolete and should be revised based on the current nature of the City's discharge. For the purposes of this plan, it has been assumed that the stage discharge limitations will be relaxed or eliminated when the permit is renewed.

3.4 RECEIVING STREAM BACKGROUND INFORMATION

The Pudding River is a tributary of the Molalla River which is a tributary of the Willamette River. In addition to the general water quality standards included in OAR 340-041, the Pudding River has also been listed on the 303d list for several parameters. This listing means the Pudding River does not meet the water quality standards for certain parameters. In these cases, the DEQ is required to establish Total Maximum Daily Loads (TMDLs) of pollutants that are believed to affect the particular water quality impairment. The TMDL may assign waste load allocations (WLA) to pollution sources such as Mt. Angel's effluent discharge.

In 1993, the DEQ completed a TMDL to address dissolved oxygen impairment in the Pudding River. This TMDL contained WLAs for the summer months. Since Mt. Angel only discharges during the winter months, the 1993 TMDL had no affect on the NPDES permit for the City's treatment plant.

In 2008, the DEQ completed a TMDL to address 30 water quality impairments in the Molalla-Pudding River Subbasin. Of this number, approximately seven of the listings are on the main stem of the Pudding River and, therefore, have the potential to impact the City. The City's existing permit expired in 2009 and a renewal is pending. Once the renewal is completed, the DEQ will likely update the permit to include additional limitations that may be required to address the 2008 TMDL and the Molalla-Pudding Subbasin Water Quality Management Plan. Therefore, a review of the 2008 TMDL was completed as part of this facilities planning effort.

The 2008 TMDL includes waste load allocations (WLAs) for several parameters in the Pudding River including temperature, bacteria, pesticides, nitrate, and metals. WLAs are the amount of a particular pollutant that may be discharged from a source such as Mt. Angel's wastewater treatment plant.

- *Temperature TMDL*

Mt. Angel discharges treated wastewater effluent to the Pudding River during the winter months only. During this time, the temperature of the City's effluent stream is lower than the maximum temperature allowed in the Pudding River. Therefore, Mt. Angel's wastewater discharge does not cause a thermal impairment of the Pudding River during the winter months. The 2008 TMDL included several waste load allocations for sources that discharge during the summer months. However, a thermal WLA for Mt. Angel is not needed because the City does not discharge during the summer months. Therefore, the temperature TMDL will only impact the City's wastewater treatment plant if the City were to attempt to gain regulatory approval for a year-around discharge to the Pudding River. This plan does not recommend a year-around discharge. Therefore, the temperature TMDL should have no impact on the City's wastewater utility during the planning period.

- *Bacteria TMDL*

The 2008 TMDL included waste load allocations for several sources of human pathogens including the Mt. Angel Wastewater Treatment Plant. DEQ uses *E.coli* as an indicator species of contamination by human pathogens. The in-stream water quality standard for *E.coli* is 126 organisms per 100 mL based on a 30-day log mean and a maximum sample reading of 406 organisms per 100 mL. This is the same disinfection criteria included in the City's NPDES permit. Therefore, the DEQ has determined that City's effluent permit limits for *E.coli* are generally protective of water quality in the Pudding River. This means that as long as the City is able to meet the NPDES permit limits for effluent *E.coli* concentrations then the City will be in compliance with the waste load allocation for bacteria. As such, no changes to the City's NPDES permit limits for *E.coli* are anticipated for this planning effort.

- *Pesticides TMDL*

The 2008 TMDL for pesticides addressed two chemicals (DDT, and dieldrin) in the Pudding River. These chemicals were used in the past for insect control. These chemicals have since been banned, but still persist in the environment. As noted in the TMDL, the primary source for these chemicals is from sediment transported by erosion and runoff from agricultural lands. Nonetheless, the DEQ established a waste load allocation for DDT and dieldrin for the Mt. Angel Wastewater Treatment Plant. DEQ concluded that the City's wastewater collection system likely includes connections to surface water such as infiltration and inflow and these connections may be a source of sediment that includes the pesticides in question. Based on this, DEQ assigned a waste load allocation for DDT and dieldrin equal to Mt. Angel's current conditions. This means that as long as the concentrations of DDT and dieldrin in Mt. Angel's effluent stream do not increase above current values and do not cause a measurable increase in the Pudding River, then DEQ will consider the City to be in compliance with the waste load allocation. During the 2005-2010 permit cycle, the City collected and analyzed multiple effluent samples for DDT and dieldrin. Based on discussions with the City, no DDT or dieldrin was detected in theses samples.

It should be noted that test reports for these samples could not be located as part of this facilities planning process. Therefore, these results are based on verbal communication with the City. Nonetheless, the absence DDT and dieldrin from the City's effluent stream is a reasonable observation. Therefore, the risk of the concentrations of these contaminates increasing during the planning period is considered minimal and no changes to the City's NPDES permit with respect to DDT and dieldrin are anticipated.

- *Metals TMDL*

The 2008 TMDL for metals addressed three listings in the Pudding River. These included iron, manganese, and arsenic. Iron, manganese, and arsenic are naturally occurring substances and are particularly prevalent in soils deriving from eroded volcanic rocks. The DEQ concluded in the 2008 TMDL that the observed concentrations of manganese and arsenic reflect natural conditions and these substances are not being concentrated by anthropogenic activities. Based on this conclusion the 2008 TMDL recommends delisting the manganese and arsenic impairments on the Pudding River. As such, the listing for these two metals is not expected to affect the City of Mt. Angel.

As part of the 2008 TMDL, the DEQ did conclude that iron is being concentrated above natural concentrations by human activities. In the 2008 TMDL, the DEQ stated that the most likely source of iron was from human caused activities that lead to eroding stream banks and runoff. Based on this conclusion, the 2008 TMDL includes an iron waste load allocation for Mt. Angel's wastewater treatment plant discharge. DEQ assigned a waste load allocation for iron equal to Mt. Angel's current conditions. This means that as long as the concentration of iron in Mt. Angel's effluent stream does not increase above current values and does not cause a measurable increase in the Pudding River, then DEQ will consider the City to be in compliance with the waste load allocation. Based on verbal discussions with DEQ, the City will be required to determine the concentrations of iron in the City's effluent as a condition of the renewed NPDES permit. Until this data is collected, it is not possible to know if the iron listing will affect the City. However, if the source of the excess iron is truly human caused stream bank erosion as suggested by DEQ, it seems unlikely that the City's wastewater utility will concentrate iron to any measurable degree. Therefore, it has been assumed that the iron listing will not impact that City's wastewater treatment plant for this planning effort. If this assumption turns out to be wrong, the City may need to amend this plan accordingly.

3.5 GROUNDWATER PROTECTION

Groundwater is a critical natural resource providing domestic, industrial, and agricultural water supply as well as other beneficial uses. Groundwater also provides base flow for rivers, lakes, streams, and wetlands. All groundwater in the state is protected from pollution. Oregon's groundwater protection rules are described in OAR 340-040. With respect to the City's wastewater utility, the facultative lagoons have the highest potential to impact groundwater quality. The lagoons were constructed with a combination of synthetic and clay liners to minimize seepage loss. The City also maintains a network of monitoring wells around the lagoons and collects samples for water quality analysis on a regular basis. A description of these sampling results is included in Section 4.4.4.

3.6 WASTEWATER RECYCLING

An alternative to direct discharge to surface water is to recycle the treated effluent for other uses such as irrigation or industrial process water. Of these uses, irrigation is the most feasible due to the lack of any known appropriate industrial user(s) in Mt. Angel.

Reuse of effluent by land application is governed by OAR 340-055, Recycled Water Use, and groundwater quality is governed by OAR 340-040, Groundwater Quality Protection. Requirements for less than total effluent reuse can be included in an NPDES permit. Therefore, a separate permit is not always required. Per OAR 340-055 recycled wastewater is characterized in five classes including Class A through D and Non-disinfected water. These classes range in quality from Class A being the most treated to Non-disinfected water being the least treated. Each wastewater class has different treatment and testing requirements and beneficial purposes. The treatment requirements and possible beneficial uses described in the rules are summarized in Table 3-3 and **Error! Reference source not found.**.

The DEQ does not require a contract between the City and the end user of the recycled water. However, DEQ does recommend that such a contract be put in place. The City has the responsibility to assure that recycled water is appropriately applied. For example, recycled water cannot be applied at greater than agronomic rates and the irrigation site(s) must conform to the setback requirements.

3.7 SLUDGE STABILIZATION REQUIREMENTS

As discussed in Chapter 7, the sludge that accumulates in the lagoons will need to be removed during the planning period. As such, the regulations regarding sludge stabilization and disposal are summarized in this subsection.

The term “sludge” refers to the solids that settle and are removed when a liquid with suspended solids passes through a settling basin or tank. Sludge may originate from several sources in a wastewater treatment plant, but can typically be classified as either raw or primary sludge (primary settling of untreated sewage) or secondary sludge (excess biological sludge from secondary treatment processes). All sludge must be stabilized prior to reuse or disposal. Stabilized sludge is a mixture of solids and liquids that is one of the end products of the wastewater treatment process. Adequately processed sludge is classified in regulations as “biosolids.” It is commonly disposed of by applying it to agricultural or forest land after adequate processing.

3.7.1 Biosolids Quality

Wastewater biosolids are subject to differing regulations and restrictions based on quality. The Code of Federal Regulations (40 CFR 503) defines standards for three measures of biosolids quality:

- Pathogens
- Vector attraction (the tendency of the sludge to attract rodents, insects and other organisms that can spread disease)
- Trace elements

Biosolids that meet the higher of two standards for all three of these measures are designated exceptional quality (EQ) biosolids. EQ biosolids have fewer reporting and monitoring requirements and virtually no restrictions on use. Use is restricted for biosolids that do not meet the higher standard by any of these three measures. The following is a short discussion of each of these measurements of biosolids quality.

Table 3-3 | Treatment & Monitoring Requirements for use of Recycled Water

Reuse Class	**A**	**B**	**C**	**D**	**Non-Disinfected**
Minimum Treatment Required	Oxidation, filtration & disinfection	Oxidation & disinfection	Oxidation & disinfection	Oxidation and disinfection	Oxidized
Parameter - Total Coliform (number/100 mL)					
7 day median	2.2	2.2	23	No Limit	No limit
Maximum single sample	23	23	240	No limit	No limit
Parameter – E. coli (number /100 mL)					
30 day LOG mean	Not Required	Not Required	Not Required	126/100ML	No limit
Maximum Single Sample	Not Required	Not Required	Not Required	406/100ML	No limit
Parameter – Turbidity Prior to Disinfection (NTU)					
24 hour mean	2	No limit	No limit	No limit	No limit
5% of the time during any 24 hour period	5	No limit	No limit	No limit	No limit
Maximum any sample	10	No limit	No limit	No limit	No limit
Minimum Monitoring Requirements					
Total Coliform	Daily	3/week	1/week	Not Required	As in NPDES or WPCF Permit
Turbidity	Hourly	Not Required	Not Required	Not Required	Not Required
E. Coli	Not Required	Not Required	Not Required	1/week	Not Required
Public Access					
	Controlled: Same as Class D for some uses and unrestricted for others	Controlled: Same as Class D	Controlled: Same as Class D plus direct contact restrictions for some uses	Controlled: Notification of staff and signs posted around the perimeter of use area	Prevented: fences, gates, locks
Set-Back Requirements					
From property line where irrigation is applied directly to the soil	None	10 feet	10 feet	10 feet	Site specific
From property line where sprinkler irrigation is used	None	50 feet	70 feet	100 feet	Site specific
From food preparation or serving area or drinking fountain to edge of sprinkler irrigation	Cannot be sprayed directly on to use area	10 feet	70 feet	70 feet	Site specific
From edge of irrigation to water supply source for human consumption	None	None	100 feet	100 feet	150 feet

Table 3-4 | Allowable Uses for Recycled Water

Beneficial Purpose	Class A	Class B	Class C	Class D	Non-disinfected
Irrigation					
Fodder, fiber, seed crops not intended for human ingestion, commercial timber	Yes	Yes	Yes	Yes	Yes
Firewood	Yes	Yes	Yes	Yes	No
Sod	Yes	Yes	Yes	Yes	No
Pasture for animals	Yes	Yes	Yes	Yes	No
Processed food crops	Yes	Yes	Yes	No	No
Orchards or vineyards if an irrigation method is used to apply recycled water directly to the soil	Yes	Yes	Yes	No	No
Golf Courses, cemeteries, highway medians, industrial or business campuses	Yes	Yes	Yes	No	No
Any agricultural or horticultural use	Yes	No	No	No	No
Parks, playgrounds, school yards, residential landscapes, other landscapes accessible to the public	Yes	No	No	No	No
Industrial, Commercial, or Construction					
Industrial cooling	Yes	Yes	Yes	No	No
Rock crushing, aggregate washing, mixing concrete	Yes	Yes	Yes	No	No
Dust control	Yes	Yes	Yes	No	No
Nonstructural fire fighting using aircraft	Yes	Yes	Yes	No	No
Street sweeping or sanitary sewer flushing	Yes	Yes	Yes	No	No
Stand alone fire suppression systems in commercial and residential buildings	Yes	Yes	No	No	No
Non-residential toilet or urinal flushing, floor drain trap priming	Yes	Yes	No	No	No
Commercial car washing	Yes	No	No	No	No
Fountains when the water is not intended for human consumption	Yes	No	No	No	No
Impoundments or Artificial Groundwater Recharge					
Water supply for landscape impoundments including, but not limited to, golf course water ponds and non-residential landscape ponds	Yes	Yes	Yes	No	No
Restricted recreational impoundment	Yes	Yes	No	No	No
Nonrestricted recreational impoundments including, but not limited to, recreational lakes, water features accessible to the public, and public fishing ponds	Yes	No	No	No	No
Artificial groundwater recharge	Yes	No	No	No	No

3.7.2 Pathogen Requirements

Pathogen requirements define two classes of biosolids - Class A and Class B. Class A is the higher standard and requires complete destruction of pathogens before disposal. Class B requirements call for reducing pathogens before disposal and applying the biosolids to land in such a way that pathogens are further reduced.

To be classified as Class A, biosolids must be treated using one of the EPA's Processes to Further Reduce Pathogens (PFRP), or an equivalent process. These processes include composting, heat drying, heat treatment, thermophilic aerobic digestion, beta ray irradiation, gamma ray irradiation, and pasteurization. Regardless of the process used, Class A biosolids must not exceed maximum allowable fecal coliform density or Salmonella bacteria density.

Class B biosolids must be treated using one of the EPA's Processes to Significantly Reduce Pathogens (PSRP), or an equivalent process. These processes include aerobic digestion, air drying, anaerobic digestion, composting, and lime stabilization.

3.7.3 Vector Attraction Requirements

Biosolids must meet one of the following requirements for reducing vector attraction if they are to be applied to land without restrictions:

- Volatile solids in the sludge shall be reduced by a minimum of 38 percent.
- The specific oxygen uptake rate for sludge treated by aerobic digestion shall be less than or equal to 1.5 mg oxygen per hour per gram of total solids at a temperature of 20°C.
- Aerobic processes shall treat the sludge for a minimum of 14 days with an average temperature of at least 45°C and a minimum temperature of 40°C.
- Alkali addition shall raise the pH of the sludge to a minimum of 12 for two hours and maintain the pH at a minimum of 11.5 for an additional 22 hours without additional alkali.

The use of the land where the biosolids is applied is restricted if vector attraction reduction is achieved by measures, such as injecting the biosolids below the surface of the land or disposing of them on the surface and incorporating them into the soil within six hours.

3.7.4 Trace Elements

Ten elements typically found in biosolids have been identified as critical. Two limits have been set for each of these trace elements: Exceptional Quality (EQ) and a ceiling limit. If all the trace elements are below the EQ limit, then no restrictions are placed on loading rates. If any of the trace elements are over the ceiling limit, then the biosolids are not suitable for land application. If the trace elements fall between these two limits, restrictions are placed on loading rates.

3.7.5 Biosolids Use

Table 3-5 outlines some of the general restrictions on the use of biosolids depending on the quality of the biosolids.

Table 3-5 | Biosolids Use Restrictions Based on Quality Rating

Biosolids Quality Rating by Category			
Pathogens	Vector Attraction	Trace Elements	Use Restrictions
EQ	EQ	EQ	No restrictions are imposed on application or use with regard to pathogens, vector attraction, or trace elements.
Class B	EQ	EQ	Application is subject to EPA defined waiting periods for crops, grazing, and public access. Biosolids cannot be distributed for home use, in bags, or in containers.
EQ	-	EQ	Biosolids must be injected or tilled into the soil. Biosolids cannot be distributed for home use, in bags, or in containers.
EQ	EQ	-	Bulk application must not exceed EPA defined cumulative loading rates. Biosolids distributed in bags or containers are subject to annual loading rate restrictions.
All Other Biosolids Qualities			Application is subject to trace loading requirements and pathogen waiting periods. Biosolids must be injected or tilled into the soil and cannot be distributed for home use, in bags, or in containers.

EQ – Exceptional Quality Biosolids

3.7.6 Biosolids Land Application Site Criteria

Site criteria for land applying biosolids includes geological formation, flood plain proximity, groundwater and surface water proximity, topography, and soils, as well as method of application. Table 3-6 contains an overview of some of the general criteria contained in OAR 340-050.

Land application of biosolids at sites used for agricultural purposes requires special management considerations. These relate to access to the site, types of crops grown, plant nutrient-uptake rates, timing and duration of biosolids application (i.e., site life and seasonal constraints), and grazing restrictions. A brief discussion of each of these issues follows.

- Access. Controlled access must be provided for municipal biosolids application sites for 12 months following surface application of biosolids. Controlled access is defined as public entry or traffic being unlikely. Privately owned rural land is typically assumed to have controlled access, while public lands such as parks may require fencing to ensure access control.
- Crops. Biosolids or biosolids derived products are not to be used directly on fruits or vegetables which may be eaten raw. As a general rule, crops grown for human consumption should not be planted within 18 months of application of municipal biosolids. If the edible parts will not be in contact with the biosolid amended soil, or if the crop will be processed or treated prior to marketing in such a manner to ensure that pathogen contamination is not a

concern, this requirement may be waived by DEQ. There are no restrictions on planting times for crops not grown for direct human consumption.

- Nutrient Loading. Biosolids application to agricultural land should not exceed the annual nitrogen loading required for maximum crop yield. Biosolids are, therefore, typically managed according to their fertilizer value. Biosolids may be applied above agronomic rates on a onetime basis or less than once per year so long as runoff, nuisance conditions, and groundwater concerns are adequately addressed. In cases of higher than agronomic application rates, the acceptable loading rate and application frequency is typically based on nitrogen accumulation and annual nitrogen use.
- Site Life. Sites generally have a limited application life, which may be determined by the chemistry of the soil and the metals loading from the biosolids. Site life is determined by dividing lifetime biosolids loading limits (based on the most limiting constituent) by the annual application rate.
- Seasonal Constraints. The main consideration in land applying on sloping ground is to avoid surface runoff and soil erosion. Additionally, biosolids application should be restricted to the dry season to prevent soil damage that may occur from equipment traffic during the wet season.
- Grazing Restrictions. Grazing animals should not be allowed on pasture or forage for 30 days after application of stabilized biosolids, 180 days after application of non-stabilized biosolids, and 7 days after application of air-dried biosolids.

Site Monitoring and Reporting. As previously noted, site monitoring is typically not required where "EQ" biosolids are applied at or below agronomic rates based on crop nitrogen requirements. However, if the biosolids contain high concentrations of heavy metals or other toxic elements, or if crop nitrogen requirements are exceeded on a regular basis, soil monitoring and special management practices may be required. At the discretion of DEQ, monitoring wells and groundwater background characterization and/or monitoring may be required on any site on a case by case basis.

Table 3-6 | Site Criteria for Biosolids Application

Parameter	Criteria
Geology	Must have a stable formation
Within Flood Plain	Restricted period of application and incorporation of biosolids
Groundwater	At time of application; 4-foot minimum depth to permanent groundwater; 1-foot minimum depth to temporary groundwater
Topography	Must have appropriate management to eliminate surface runoff
Slope less than or equal to 12%	• Surface application of liquid dewatered or dried biosolids
Slope greater than 12% but less than 20%	• Direct incorporation of liquid biosolids into the soil, surface application of dewatered or dried biosolids
Soils	• Minimum rooting depth of 24 inches
	• No rapid leaching
	• Avoid saline or alkali soil
	• pH of 6.5 to 8.2 for heavy metal accumulator crops, or pH can be raised by adding lime to the soil.
Method of Application & Proximity to Water Bodies	Buffer strips may be required to protect water bodies. Size depends on method of application and proximity to sensitive area (determined at discretion of DEQ), generally as follows:
	• Direct injection: no limit required
	• Truck spreading: less than 50 foot buffer strip
	• Spray irrigation: 300 to 500 foot buffer strip
	• Near ditch, pond, channel, or waterway: greater than 50 foot buffer strip
	• Near domestic water source or well; greater than 200 foot buffer strip

3.8 RELIABILITY AND REDUNDANCY REQUIREMENTS

The EPA has established minimum standards for mechanical, electrical, fluid systems, and component reliability for all new or expanding sewerage facilities, including treatment plants. These reliability standards establish minimum levels of reliability for three classes of sewerage facilities. Pump stations associated with, but physically removed from the actual treatment works may have a different classification than the treatment works itself.

The purpose of these reliability standards is to ensure that the treatment facilities will operate effectively on a day-to-day basis and that provisions are made for operation during power failures, flooding, peak loads, equipment failures, and maintenance shutdowns. These reliability and redundancy standards are designed to ensure that unacceptable degradation of the receiving

water will not occur due to the interrupted operation of specific treatment process or unit operation.

The reliability classification will be based on the water quality and public health consequences of a component or system failure. Specific requirements pertaining to treatment plant unit processes for each reliability class are described in EPA's technical bulletin, Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability, EPA 430-99-74-001. EPA and DEQ guidelines for classifying sewerage works are summarized as follows:

- Reliability Class I. These are works whose discharge, or potential discharge, (1) is into public water supply, shellfish, or primary contact recreation waters, or (2) as a result of its volume and/or character, could permanently or unacceptably damage or affect the receiving waters or public health if normal operations were interrupted. Examples of Reliability Class I works are those with a discharge or potential discharge near drinking water intakes, into shellfish waters, near areas used for water contact sports, or in dense residential areas.
- Reliability Class II. These are works whose discharge, or potential discharge, as a result of its volume and/or character, would not permanently or unacceptably damage or affect the receiving waters or public health during periods of short-term operations interruptions, but could be damaging if continued interruption of normal operations were to occur (on the order of several days). Examples of a Reliability Class II works are works with a discharge or potential discharge moderately distant from shellfish areas, drinking water intakes, areas used for water contact sports, and residential areas.
- Reliability Class III. These are works not otherwise classified as Reliability Class I or Class II.

For this Facilities Plan, it is assumed that all treatment plant and pump station improvements will be designed to EPA Reliability Class I standards. Table 3-7 contains the typical redundancy requirements for treatment plant and pump station components that are designed in accordance with the EPA Reliability Class I standards. In addition to the standards listed in the table, unit operations must be designed to pass the peak hydraulic flow with one unit out of service. Mechanical components in the facility must also be designed to enable repair or replacement without violating the effluent limitations or causing diversion of untreated sewage. The information in this table is not specific to the proposed alternative, and some of the plant components shown are not necessarily included in the existing or future facilities. Some of the items listed below apply regardless of the Reliability classification of the treatment facility.

Table 3-7 | EPA Reliability Class I Requirements

System Component	Capacity/Redundancy Requirements
Raw Sewage Pumps	Handle peak flow with largest unit out of service. As a minimum, the Peak flow is defined as the flow associated with a 5-year, 24-hour storm.
Mechanical Bar Screens	Provide one backup with either manual or mechanical cleaning (manual cleaning acceptable if only two screens)
Grit Removal	Provide a minimum of two units.
Primary Sedimentation	Handle 50% of design flow capacity with largest unit out of service. Design flow is defined as the flow used as the design basis of the component.
Activated Sludge Process	A minimum of two equal size basins. No backup basin required.
Aeration Blowers	Supply the design air capacity with the largest unit out of service. Provide a minimum of two units.
Air Diffusers	Allow for the isolation of largest section of diffusers (within a basin) without measurably impairing oxygen transfer.
Secondary Sedimentation	Handle 75% of design flow capacity with largest unit out of service. Design flow is defined as the flow used as the design basis of the component.
Disinfection Contact Basin	Handle 50% of the design flow with largest unit out of service. Design flow is defined as the flow used as the design basis of the component.
Effluent Pumps	Handle peak flow with largest unit out of service. Peak flow is defined as the maximum wastewater flow expected during the design period of the treatment works.
Electrical Power	Two separate and independent sources of electrical power shall be provided, either from two separate utility substations or from a single substation and a plant based generator. Designated backup source shall have sufficient capacity to operate all vital components, critical lighting, and ventilation during peak flow conditions, except that components used to support the secondary processes need not be included as long as treatment equivalent to sedimentation and disinfection is provided.

3.9 COLLECTION SYSTEM DESIGN CRITERIA

The requirements and regulations covering the design and sizing of the collection piping portion of the wastewater conveyance system include both City design standards and DEQ guidelines. The City has Public Works Design Standards that apply to all public sewer improvements within existing and proposed public right-of-way and public utility easements, as well as to all improvements to be maintained by the City. This includes both gravity collection piping and pump stations. As discussed in Chapter 6, no pump stations appear to be required for the complete development of the UGB. Therefore, design criteria for pumping stations are not included in this document.

The City design criteria dictates that the collection system piping must be designed to convey all flows projected at the ultimate development of land within the tributary area based on current land use designations. Although this may result in capacities greater than those needed during the 20-year planning period, sewage collection lines are, by their very nature, unsuited for incremental expansion without extensive capital outlays. Under DEQ guidelines, there is one allowable exception to this requirement as it relates to large diameter trunk sewers serving tributary areas that are not expected to develop for 30 or more years. However, none of the proposed new gravity sewers within the study area fall under this category.

The City Public Works Design Standards and associated details implement and clarify current DEQ standards as contained in OAR 340-052, Appendix A and DEQ design guidelines. Table 3-8 includes a list of the minimum allowable slope based on mainline pipe sizes.

Table 3-8 | Minimum Mainline Pipe Slopes

Inside Pipe Diameter (inches)	% Slope (ft/100 ft)
8	0.40
10	0.28
12	0.22
15	0.15
18	0.12
21	0.10
24	0.09
27	0.08

CHAPTER 4

EXISTING WASTEWATER FACILITIES

Chapter Outline

4.1 Introduction
4.2 General Overview of Existing Wastewater Facilities
4.3 Wastewater Collection System
- 4.3.1 Service Area and User Connections
- 4.3.2 Drainage Basins
- 4.3.3 Gravity Collection System
- 4.3.4 Inflow and Infiltration
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- 4.3.2 Collection System Deficiencies

4.4 Existing Wastewater Treatment and Disposal System
- 4.4.1 Plant Performance
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4.5 Wastewater System Operator Licensing
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4.7 Recommendations

EXISTING WASTEWATER FACILITIES

CHAPTER 4

4.1 INTRODUCTION

The City of Mt. Angel operates and maintains the wastewater system that provides sanitary sewer service to customers within the city limits. The City's system currently serves approximately 960 user accounts. The City's municipal wastewater system consists of a conventional gravity collection system, a facultative lagoon treatment plant with an effluent polishing wetland, and a surface water discharge to the Pudding River.

This chapter provides an inventory of the existing wastewater system components including a description of funding mechanisms and operation and maintenance budgets. The evaluation of these specific systems and the development of improvement alternatives are performed in other chapters of this study.

4.2 GENERAL OVERVIEW OF EXISTING WASTEWATER FACILITIES

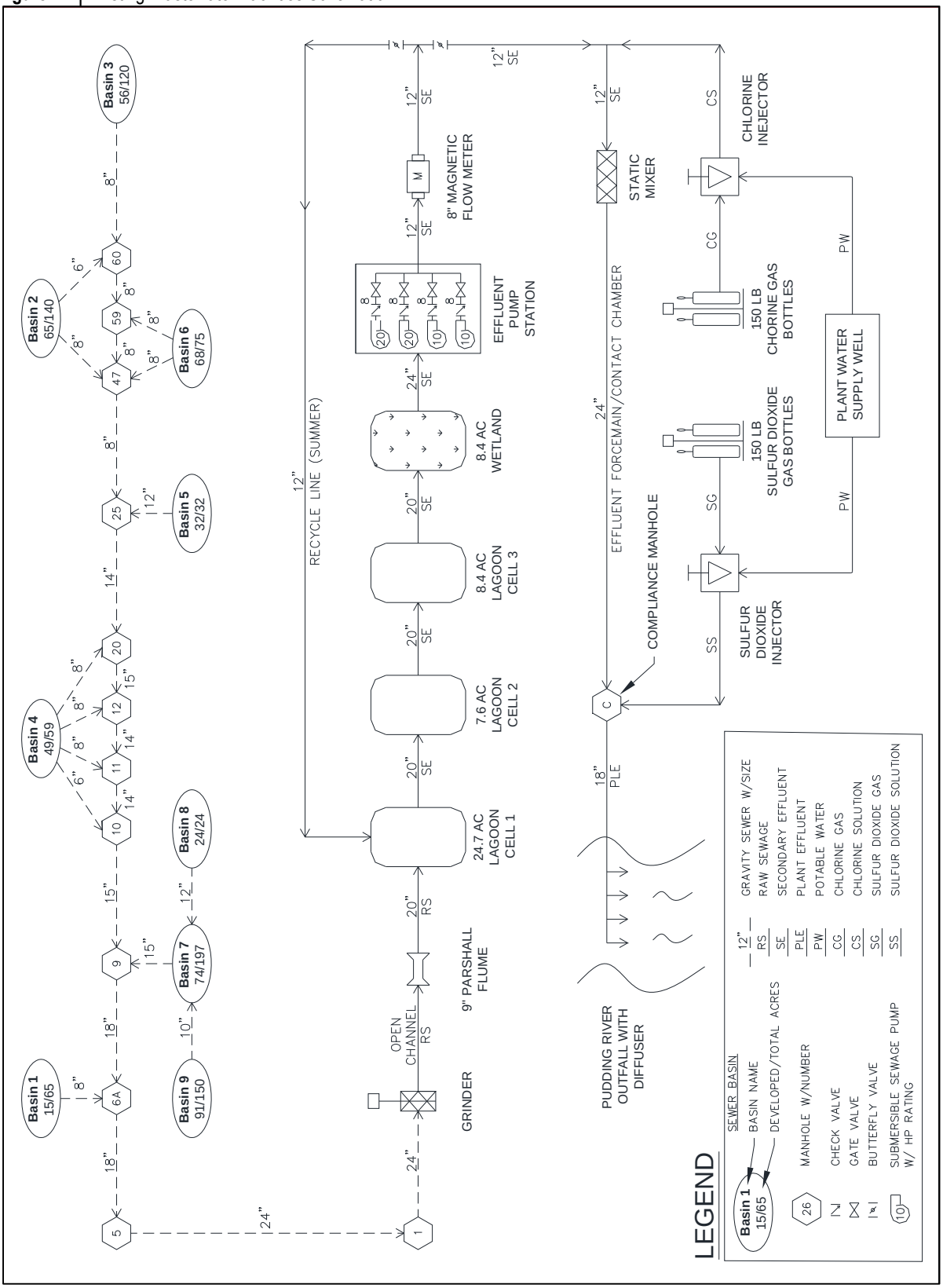
Mt. Angel's wastewater facilities consist of a conventional gravity collection system that conveys wastewater to the treatment plant. The flow of wastewater from the users to the treatment plant is entirely by gravity. There are no pump stations in the system. The treatment facility is located west of Mt. Angel Gervais Road west of the urban growth boundary. The treatment plant consists of a headworks, three facultative lagoons and a polishing wetland. The treated effluent is disinfected using a chlorine gas feed system. During the summer months, all wastewater is stored in the lagoons and no discharge occurs from the plant. During the winter months, plant effluent is pumped to the Pudding River for discharge. Prior to being discharged, a sulfur dioxide solution is added to the effluent to remove the chlorine. The plant also includes an operations building that houses the chemical feed equipment as well as a control room, office space, and a laboratory. An overall schematic representation of the existing wastewater collection and treatment system is presented in Figure 4-1. Detailed maps of the collection system are included in Appendix C.

4.3 WASTEWATER COLLECTION SYSTEM

The City's existing sanitary sewage collection system collects wastewater from residences, businesses, industries, and public facilities and conveys the water to the treatment plant by gravity. There are no pump stations in the system. This chapter provides an overview of the existing wastewater collection system within the study area with an emphasis on flow routing and known and reported problems.

Although all public sewers within the study area are owned by the City, three entities have jurisdiction over the right-of-ways within which the sewer mainlines are located. In addition to the City, the Oregon Department of Transportation (ODOT) has jurisdictional oversight for facilities constructed within the Highway 214 right-of-way. Marion County has jurisdictional oversight for sewer facilities constructed within County right-of-ways such as Main Street, College Street, Church Street, and Marquam Street.

Figure 4-1 | Existing Wastewater Facilities Schematic



4.3.1 Service Area and User Connections

The City's system currently serves 962 user accounts. These accounts are classified as residential, commercial, and industrial as shown in Table 4-1.

Pepsi Northwest Beverages is an industrial user that discharges wastewater to the City's system under an individual waste discharge permit issued by the City. The waste discharge permit sets limits on the quantity and strength that may be discharged to the City's system and identifies the method of billing. Wastewater flows and loads from the Pepsi plant are measured at a monitoring station on a monthly basis. The data from this monitoring station are presented and evaluated in Chapter 5.

Table 4-1 | Sewer Connection Summary

User Classification	Number of Accounts
Residential	893
Commercial	66
Industrial	3
Total	962

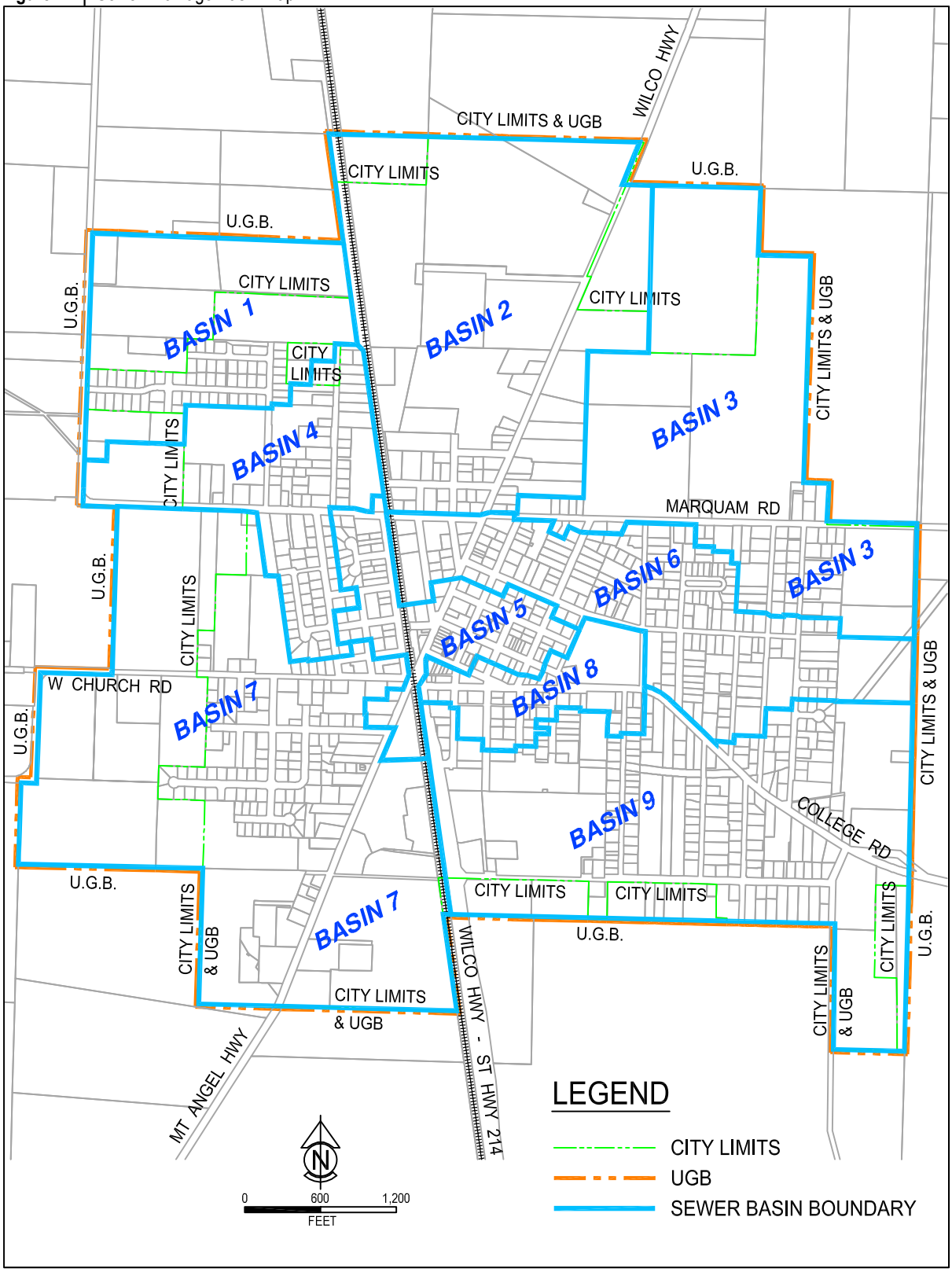
4.3.2 Drainage Basins

To aid in the analysis of the collection system, it is convenient to divide the collection system into separate drainage basins. The basin boundaries are based on a combination of factors including topography, urban growth boundaries, as well as the existing drainage patterns and trunk sewer locations. The collection system is divided into nine distinct basins as shown in Figure 4-2. The approximate area within each of the major sewer drainage basins is listed in Table 4-2. The routing of the existing system is shown schematically in Figure 4-1.

Table 4-2 | Sewer Drainage Basin Areas

Basin	Total Area (Acres)	Sewered Area (Acres)	Non-Sewered Area (Acres)
Basin 1	65	15	50
Basin 2	140	66	74
Basin 3	120	67	53
Basin 4	57	48	9
Basin 5	34	34	0
Basin 6	75	68	7
Basin 7	197	97	100
Basin 8	24	24	0
Basin 9	150	91	59
Totals	862	510	352

Figure 4-2 | Sewer Drainage Basin Map



4.3.3 Gravity Collection System

Mt. Angel's collection system includes approximately 65,000 feet of mainline pipe, 250 manholes, and approximately 1,000 service laterals. Pipe sizes range from 3-inch to 24-inch diameter (Figure 4-3). Most of the piping is 8-inch diameter. The entire collection system operates by gravity. There are no pump stations in the City. The original collection system was built in 1910. Most of the pipe installed at that time was terra cotta. Approximately 1800 feet of this pipe remains in service. The original collection system has been extended over the years. Early extensions used vitrified clay pipe and concrete pipe with mortar joints. In the 1950s, concrete pipe with rubber joints was used. In the 1970s some sewer segments were constructed using asbestos cement pipe. Since the 1970s most extensions have been made using PVC pipe. Over the last several years, the City has rehabilitated several segments of the system using cured in place pipe. Approximately 9,000 feet of mainline pipes have been lined using cured in place pipe since 2001. As a result of this history, the City has a variety of pipe materials (Figure 4-4).

Most pipelines installed after 1960 use some type of rubber gasket to seal the joint. Pipes with rubber gaskets generally leak much less than mortar jointed pipe. Most new construction has utilized PVC pipe with rubber gaskets. Public Works design standards were adopted in 1996. The public works design standards allow only rubber gasketed PVC and ductile iron pipe for the construction of gravity sewers.

Figure 4-3 | Pipe Inventory by Diameter

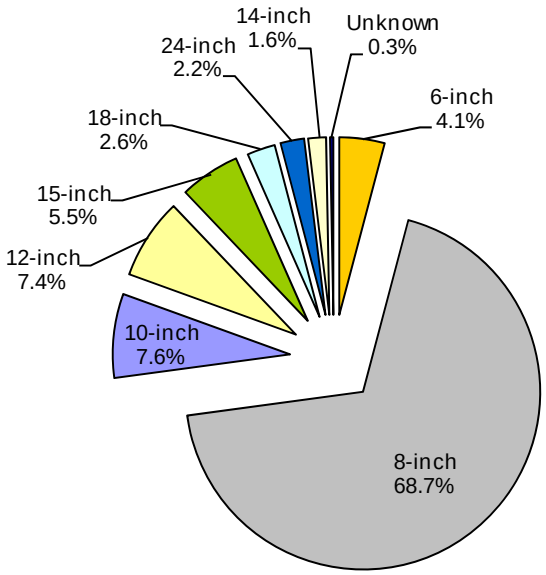
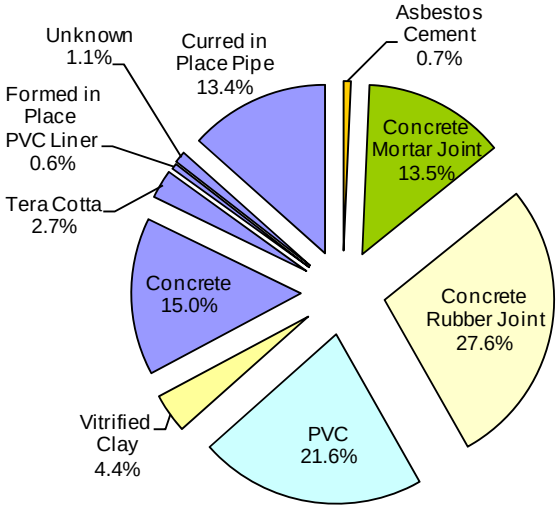


Figure 4-4 | Pipe Inventory by Material



4.3.4 Inflow and Infiltration

The collection system is typical of many western Oregon sewer systems in that it experiences higher flows during the winter months because of infiltration and inflow (I/I). The average dry weather flow measured at the WWTP during the months of May through and October is approximately 0.385 MGD. The highest daily flows measured most years approach 3.0 MGD. The average flow during the wet weather months (November through April 30) is approximately 0.834 MGD. The ratio between average dry weather flow and the peak day flow is approximately 8. Despite the fact that no known raw sewage overflows from the collection system have ever been documented, significant portions of the collection system surcharge during large winter storms. This surcharging indicates that high I/I flows cause capacity issues in the system. High I/I flows are problematic for a number of reasons. I/I utilizes reserve capacity and ultimately decreases the useful life of the gravity collection system. I/I is also a burden to the treatment facilities since it must be treated and discharged as though it was wastewater. This increases operations and maintenance costs.

Schedule C of the City's NPDES permit requires that the City prepare in inflow reduction plan. The City has not yet prepared this plan and should do so as soon as possible. Chapter 6 includes a recommendation to increase funding for I/I reduction work. This funding can be used to prepare and implement the inflow reduction plan.

In an effort to determine which portions of the collection system collect the most I/I, Westech personnel conducted field investigations during the early winter months in 2013. Field investigations included manhole inspections, spot checking instantaneous flows in the sewers, noting surcharging limits and flow mapping.

During larger winter storms, significant portions of the collection system surcharge. In order to estimate the I/I quantities from various portions of the collection system, Westech personnel collected measurements of I/I during a moderate winter storm in March of 2013. A moderate storm was chosen to avoid surcharged conditions. Instantaneous flow measurements were collected at strategic manholes in the collection system. Calibrated flow measurement weirs were inserted into the pipes entering the manholes. Where the physical condition of the pipe penetration in the manhole did not allow for the use of weirs, the flow depth in the pipe was measured along with the velocity of the water. These two measurements were used to estimate the flow in the pipe by multiplying the cross sectional area by the velocity. The measurements were performed between midnight and 6 A.M. when sanitary flows are lowest. This allows for the assumption that all flow in the collection system is from I/I. The flow measurements together with estimates of pipe leakage per foot of mainline are presented in Figure 4-5.

Based upon the field investigations and a review of the Discharge Monitoring Reports (DMRs), the following statements can be made regarding I/I and the City's efforts to reduce I/I. The reader is encouraged to refer to Figure 4-5 during the following discussion.

- While the City has some base I/I throughout the winter months. The vast majority of the I/I is either direct inflow or rainfall induced infiltration (RII). Once the soil is wet during the winter and early spring a major rainstorm will result in increased flows observed at the WWTP within a few hours after the precipitation starts.

- Though I/I flows decrease after a major storm, prolonged dry periods (i.e., a few weeks) are required before flows to the WWTP return to near summer levels. This suggests that a significant volume of groundwater must be drained before I/I levels return to low flow values. Conceptually, one can envision that the I/I flows slowly drain a relatively large storage reservoir.
- The newer portions of the collection system that are constructed of PVC pipe materials contribute very little I/I.
- Inadequate trunk sewer capacity results in surcharging in the lower portions of the collection system.
- Surcharged conditions in the lower end of the collection system during major storm events may act to reduce I/I into that portion of the collection system.
- I/I originates from all major components within the collection system – manholes, service laterals and sewer mains.
- The sanitary sewers lines on Taylor Street between manholes #82 and #94 collect a very large amount of I/I. It is interesting to note that almost all of these lines have been lined with cured in place pipe. This demonstrates the significance of manhole and service lateral leakage and the need to also rehabilitate these elements of the system in addition to the mainlines.
- The most significant I/I contributions are from sewer basins five, six, and seven.

4.3.5 Known Collection System Non-Compliance Issues

The City has not received any warning letters from DEQ over the past few years regarding problems in the collection system.

There are a number of areas in the collection system that will likely experience compliance problems unless significant upgrades are completed within the planning period. These include the replacement or reconstruction of over capacity and faulty sewers that contribute significant I/I. Continued I/I control efforts are needed in the collection system regardless if growth within the collection system occurs. The specific projects are discussed in more detail in Chapter 6.

Figure 4-5 | Collection System I/I Measurements

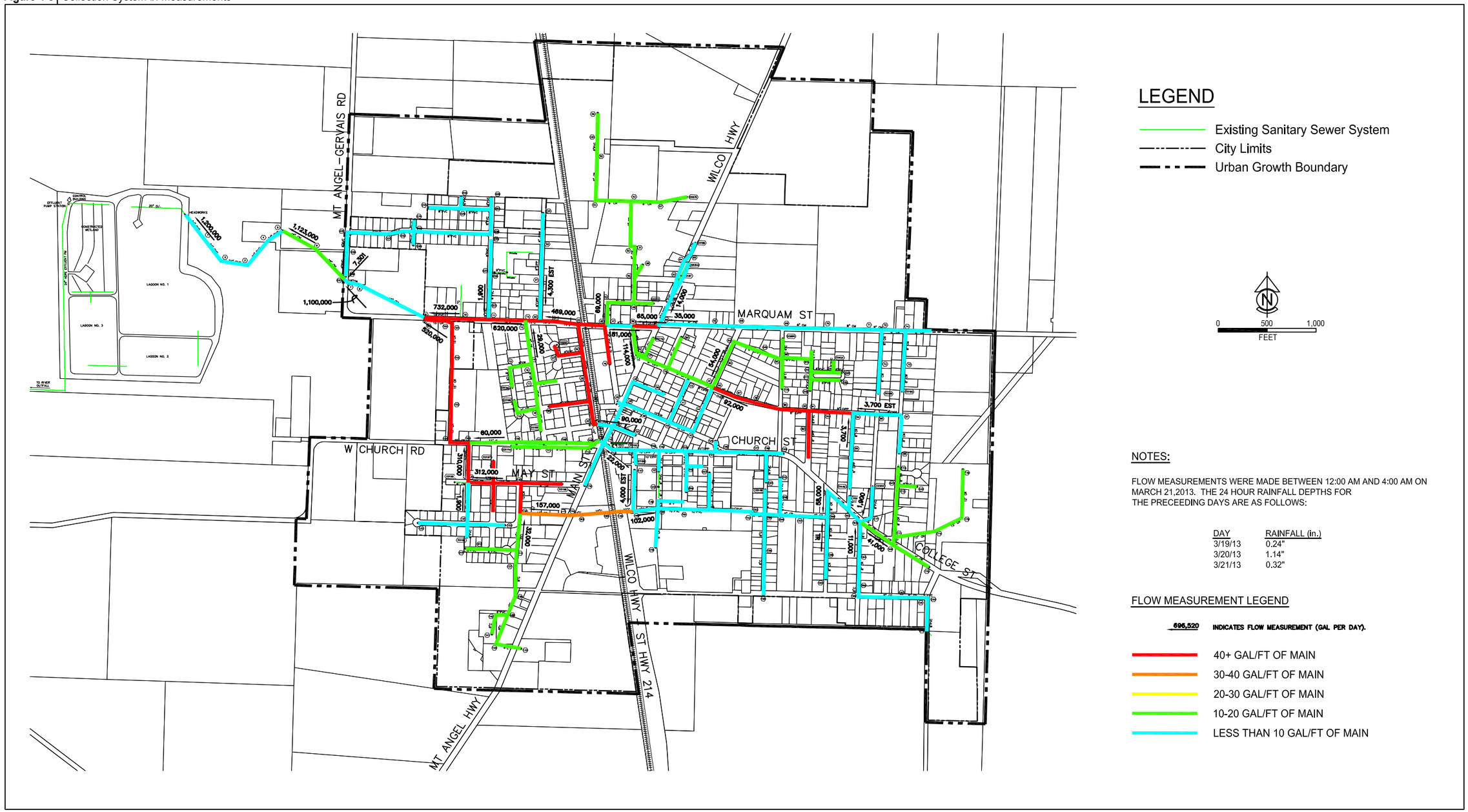


FIGURE 4-5

4.3.6 Collection System Deficiencies

Problems with the Collection System were identified from meetings and discussions with City staff and from field investigations. During major winter storms, portions of the collection system surcharge due to inadequate trunk sewer capacity and large amounts of infiltration and inflow. The shortcomings in the existing system can generally be divided into the following categories; lack of capacity, end of useful life, and infiltration and inflow problems. A short discussion of each of these categories follows. The deficiencies listed in this chapter are largely based on field observations and operational problems. Since components of the collection system (i.e., gravity collection piping) are not monitored on a full-time basis, this list of deficiencies should not be considered all-inclusive. As described in Chapter 6, several additional collection system deficiencies exist that are revealed through quantitative analysis.

- Lack of Capacity. This type of problem results from pipes that are too small to handle the peak sewage flows. This problem is a result of peak sewage flows increasing either due to development upstream or deterioration of the upstream system (i.e., increased I/I). Portions of the gravity collection piping appear to lack the capacity to convey peak flows.
- End of Useful Life. This type of problem is the result of old, damaged, or worn out facilities that no longer function as designed. The most common example of this type of problem includes broken or collapsed pipes. The correction of these types of problems requires replacement or reconstruction of the existing system.
- High Infiltration/Inflow. I/I flows in the collection system utilize capacity in the sewer mains which was intended for sanitary sewage. Large amounts of I/I result in surcharged sewers which can lead to overflows.

Large amounts of infiltration and inflow is far and away the most significant problem in the City's collection system. It is the underlying cause of the capacity problems in the trunk sewers. The recommended I/I correction measures are presented in Chapter 6. There is one known line that has collapsed and is in need of repair. This is the 10-inch AC line that extends from Manhole 115 to manhole 114 in Main Street. This line appears to be collapsed under the railroad and repairs are recommended early in the planning period. Table 4-3 outlines the major known problem areas, as well as the category that the problem falls under.

Table 4-3 | Known Collection System Deficiencies

Location (note 1)	**Problem Category**
Trunk Sewer from Manhole 5 to Manhole 60	Lack of Capacity, Surcharging, High I/I
Trunk Sewer from Manhole 9 to Manhole 136	Lack of Capacity, Surcharging, High I/I
Sewer Line from Manhole 115 to Manhole 114	End of Useful Life, line collapsed under railroad.
Sewer Line from Manhole 136 to Manhole 144	End of Useful Life, Obstruction
Basin 5	High I/I
Basin 6	High I/I
Basin 7	High I/I

Note 1: See collection system maps in Appendix C for manhole numbering. See Figure 4-2 for collection system basin map.

4.4 EXISTING WASTEWATER TREATMENT AND DISPOSAL SYSTEM

The City of Mt. Angel owns, operates and maintains the wastewater treatment plant (WWTP) serving the City. The WWTP is located west of the City. The WWTP has three facultative lagoons and a polishing wetland that normally operate in series on a summer-hold, winter-discharge operational scheme. This means that treated wastewater is discharged through an outfall pipeline to the Pudding River during the winter discharge season (November 1-April 30). During the summer months, all wastewater that flows to the plant is stored in the lagoons. Therefore at the start of the summer season, the lagoon levels are low and rise as the summer storage season progresses. The plant was originally constructed in 1992, and has undergone one significant modification since it was originally constructed. In 2006, a new sulfur dioxide gas feed system was added to remove the chlorine from the effluent prior to discharge to the Pudding River. In addition to the lagoons and wetland, the plant also includes a headworks, an effluent/recycle pump station, chlorine feed equipment, an outfall pipeline and diffuser in the Pudding River, and an operations building. The wastewater facilities are schematically presented in Figure 4-1. Plan views of the existing treatment facilities are included below (Figure 4-6 and Figure 4-7). A summary of the design data for the facilities is presented in Table 4-4. The following subsections provide an evaluation of the performance of the existing plant as well as a brief description of each to the individual unit processes that comprise the treatment facility.

Table 4-4 | Existing Treatment Plant Design Data

Design Flows			Design Loadings	
• ADWF	• 0.56 MGD		• BOD	• 1115 PPD
• AWWF	• 0.98 MGD		• TSS	• 1086 PPD
• PDF	• 3.18 MGD			
• PHF	• 4.30 MGD			
Influent Grinders				
• Type	• Chanel Mounted			
• Location	• Headworks			
• Number	• 2 in parallel (mounted side by side)			
• Capacity	• 1.83 MGD Each (3.66 MGD total)			
• Manufacturer/Model	• JWC Environmental / Channel Monster			
Influent Flow Measurement				
• Primary Device	• 9" Parshall Flume			
• Location	• Headworks			
• Measurement Range	• 0 – 4.3 MGD			
• Manufacturer/Model	• Stevens Model 61R Float Operated Mechanical Meter			
• Data Recording	• Continuous Chart Recorder			
Lagoon/Wetland Features	Cell1	Cell 2	Cell 3	Wetland
• Type	• Facultative	• Facultative	• Facultative	• Free Surface
• Area @ Average Depth	• 24.74 Ac	• 7.62 Ac	• 8.40 Ac	• 8.41 Ac
• Storage Volume	• 150.3 Ac -ft	• 46.1 Ac -ft	• 50.9 Ac -ft	• 17.6 Ac -ft
• Minimum Depth	• 2 Feet	• 2 Feet	• 2 Feet	• 1.5 Feet
• Maximum Depth	• 8 Feet	• 8 Feet	• 8 Feet	• 3.5 Feet
Effluent/Recycle Pump Station				
• Purpose	• Winter Discharge to Pudding River & Summer Recycling Through the Plant			
• Pump Type & Number	• 4 Submersible Pumps			
• Pump Size	• 2 @ 10 hp: 2 @ 20 hp			
• Firm Capacity (3 pumps)	• 3.27 MGD			
• Ultimate Capacity (4 pumps)	• 4.68 MGD			
Effluent Flow Measurement				
• Type	• Magnetic			
• Location	• Flow Meter/Mixer Vault			
• Size	• 8 – Inch diameter			
• Measurement Range	• 0 – 4.3 MGD			
• Manufacturer/Model	• Turbo Instruments Model MG711/E with Model ndf/USP converter			
• Data Recording	• Continuous Chart Recorder			
Disinfection Facilities				
• Type	• Gas Chlorination System (150 lb bottles)			
• Chlorinator	• Wallace & Tiernan V75 (500 pdd max capacity)			
• Gas Rotameter Capacity	• 50 lbs per day (installed) 100 lbs per day (spare)			
• Control System	• Flow paced from effluent meter reading			
• Injection Point	• Flow Meter/Mixer Vault			
• Chemical Mixing	• 12-inch diameter, 3-element static mixer			
• Contact Chamber	• 24-inch outfall pipe to Pudding River			
• Contact Volume	• 80,400 gallons			
• Minimum Contact Time	• 30 minutes at 3.86 MGD			

Table 4-4 | Existing Treatment Plant Design Data

Dechlorination Facilities	
• Type	• Sulfur Dioxide Gas (150 lb bottles)
• Chlorinator	• Wallace & Tiernan V10 K (200 pdd max capacity)
• Gas Rotameter Capacity	• 30 lbs per day (installed) 50 lbs per day (spare)
• Control System	• Flow paced from effluent meter reading
• Injection Point	• Compliance manhole near pudding river
• Chemical Mixing	• Natural turbulence in compliance manhole
Ancillary Facilities	
• Outfall Diffuser	• 4 port diffuser in Pudding River, 8-inch diameter ports with duckbill valves
• Plant Potable Water Supply	• Onsite water supply well

Figure 4-6 | Existing Wastewater Treatment Facilities

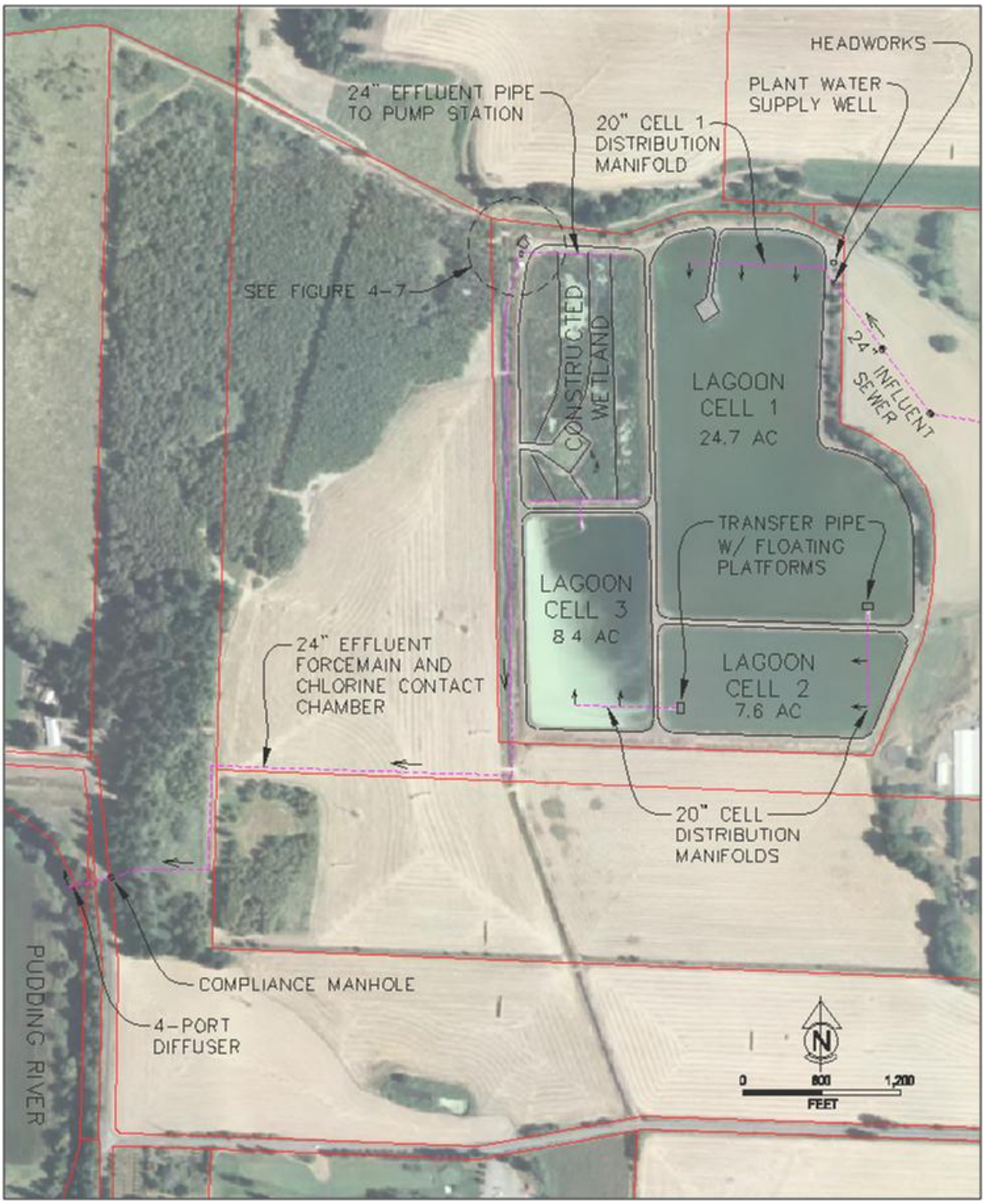
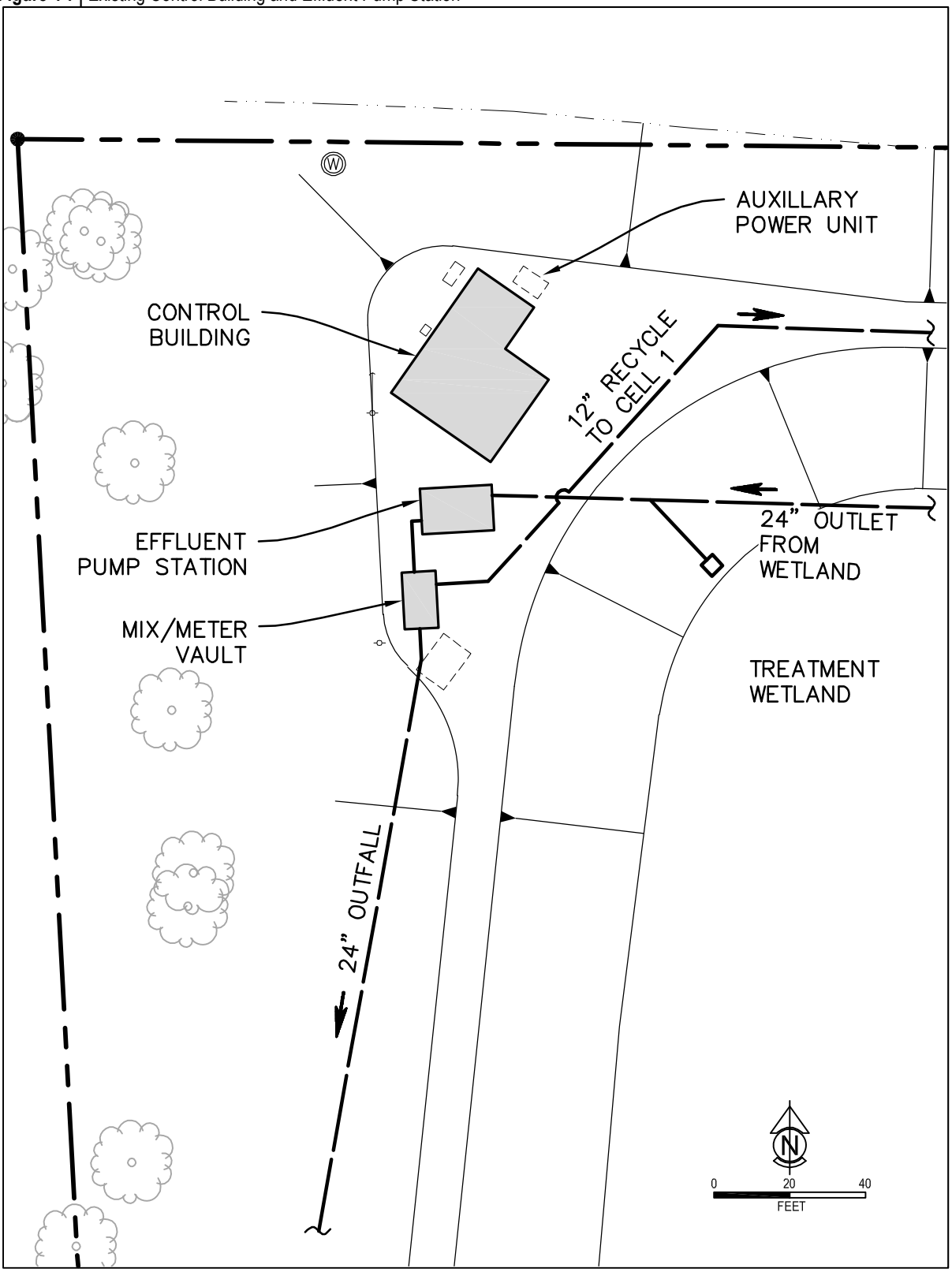


Figure 4-7 | Existing Control Building and Effluent Pump Station



4.4.1 Plant Performance

The City's existing effluent permit requires the production of an effluent with BOD and TSS concentrations below 20 mg/L during the winter discharge season. Average monthly effluent BOD and TSS concentrations are listed in Table 4-5 for the last four discharge seasons. As demonstrated in Table 4-5, the existing plant is capable of reliably meeting effluent permit limits under existing loading conditions.

Table 4-5 | Existing Treatment Plant Average Monthly Effluent BOD and TSS (mg/L)

Discharge Season	2008-2009		2009-2010		2010-2011		2011-2012		Average	
Month	BOD	TSS	BOD	TSS	BOD	TSS	BOD	TSS	BOD	TSS
November	-	-	-	-	8.7	9.3	10.0	6.0	9.4	7.7
December	11.0	7.0	5.7	7.3	10.0	7.2	10.0	5.8	9.2	6.8
January	5.8	7.0	9.8	9.5	6.8	6.8	8.3	8.0	7.7	7.8
February	13.5	17.0	10.0	7.3	6.8	2.8	9.0	4.6	9.8	7.9
March	14.0	15.8	6.0	3.6	7.0	3.8	10.5	9.8	9.4	8.3
April	15.3	16.0	12.8	13.3	8.0	3.5	7.3	6.8	10.9	9.9
Average	12.0	12.6	8.9	8.2	7.9	5.6	9.2	6.8	9.4	8.1

Note: Existing effluent BOD permit limit is 20 mg/L. Existing TSS permit limit is 20 mg/L.

In addition to the effluent concentration limits, the City's discharge permit also limits the total amount of pollutant that may be discharged by setting mass load limits. Mass load limits are determined by multiplying the effluent concentration of a pollutant by the effluent flow rate. Mass load limits are usually expressed in pounds of pollutant per day. Since flow and concentration are multiplied, increases in the flow rate must be offset by decreases in the pollutant concentration in order to maintain a constant effluent mass load. The existing permit allows for the discharge of 300 pounds per day of BOD and TSS on a monthly average basis during the winter discharge season. The existing permit does not allow for any discharge to surface waters during the summer months. Average monthly effluent BOD and TSS mass loads are listed in Table 4-6 for the last four discharge seasons.

It is clear from an examination of Table 4-6, that the existing plant is consistently able to produce an effluent quality that allows the City to meet the permitted effluent mass loads for BOD and TSS. Therefore, the plant performance has generally been good and will likely remain good until flows and loads increase in response to growth in the system.

Table 4-6 | Existing Treatment Plant Average Monthly Effluent BOD and TSS (pounds per day)

Discharge Season	2008-2009		2009-2010		2010-2011		2011-2012		Average	
Month	BOD	TSS	BOD	TSS	BOD	TSS	BOD	TSS	BOD	TSS
November	-	-	-	-	124	150	138	82	131	116
December	91	58	94	123	227	166	73	41	121	97
January	90	114	167	167	76	80	125	117	115	120
February	136	175	140	101	47	19	130	63	113	90
March	131	150	50	30	103	56	102	103	97	85
April	147	155	97	106	89	39	97	108	108	102
Average	119	130	110	105	111	85	111	86	114	102

Note: Existing effluent BOD and TSS mass load limits are 300 pounds per day.

4.4.2 Plant Access Roadway

The primary access to the treatment plant is along a gravel roadway off the Mt. Angel-Gervais Road west of the City. The gravel access road is approximately 1800 feet long from the Mt. Angel-Gervais Road to the treatment plant site. The access road is relatively narrow and has a relatively steep section near the Mt. Angel-Gervais Road. Many of the delivery trucks drivers that deliver products to the plant are not comfortable driving large delivery trucks down the access road. This includes the drivers that deliver chlorine and sulfur dioxide gas. The City currently accepts these deliveries at the City shops building or near the treatment plant entrance and hauls the gas cylinders to the treatment plant site in City vehicles. This is less than ideal, and improvements to the road are recommended. During high water events, the entrance road also floods near the treatment plant headworks preventing access to the site. This shortcoming should also be addressed during the planning period. The recommended roadway improvements are discussed in Chapter 7.

4.4.3 Headworks

The raw wastewater enters the plant through a 24-inch diameter trunk sewer that discharges by gravity into the treatment plant headworks. The headworks includes two grinders mounted side by side in the main concrete channel. The grinders reduce the size of coarse debris entering the plant. In 2008, the City overhauled the grinders by replacing the cutting wheels and the drive shaft assemblies in both units. The headworks also includes a Parshall flume for flow measurement and an automatic wastewater sampler for collecting influent samples. The sampler was installed in 2009 and is in very good condition. Flow measurement is accomplished in a 9-inch Parshall flume outfitted with a float actuated flow meter. Influent flow data is recorded continuously on a chart recorder. The headworks includes a primary flow channel and a manual bypass channel. The channel style grinders are located in the primary channel. The bypass channel is equipped with a manually cleaned bar screen.

Flow from the headworks is routed to lagoon cell 1 through 20-inch diameter ductile iron piping. The existing headworks does not include any screening or grit removal equipment. All solids that pass through the grinder remain in the waste stream and pass into the lagoons. This configuration is acceptable for a facultative lagoon system. In general, the headworks is in good condition and should serve the City for several more years. Routine maintenance will be required to ensure that the grinders and other equipment remain reliable. The mechanical flow meter is now more than 20 years old and likely will reach the end of its useful life during the planning period. The existing meter is also not capable of generating a digital flow signal for use at other locations in the plant. Based on these two shortcomings we recommend the City plan to replace the flow meter during the planning period.

4.4.4 Facultative Lagoons

The three facultative lagoons provide biological treatment and sludge digestion for the wastewater. The eastern one-third of cell 1 is lined with a buried PVC liner. The remainder of cell 1 is lined with a native clay liner. Cells 2 and 3 are entirely lined with a buried PVC liner. The three lagoon cells operate in series and are intended to provide both storage of wastewater during the non-discharge season and treatment to secondary standards. The lagoons are designed to operate between a minimum depth of two feet and a maximum depth of eight feet. The top of the dikes provide three feet of freeboard at high water levels. The City's existing NPDES permit allows discharge from the lagoons from November 1 through April 30 of each year. The permit has provisions that allow the City to discharge during the month of May with prior approval from the DEQ. To the best of the City's knowledge, there has never been a need to discharge outside the permitted discharge season.

From the headworks, flow enters cell 1 through a 20-inch diameter ductile iron diffuser pipe. The pipe distributes the flow across the north edge of the lagoon through three diffuser ports. The flow of water between to the subsequent cells is controlled by a pipe suspended from floats. The depth of the pipe below the floats is adjustable. A buried valve is located in the pipeline near the edge of the dike to isolate flow from the next lagoon in sequence. Flow from cell 1 is distributed along the eastern edge of cell 2 through a 20-inch diameter ductile iron transfer pipe with two, evenly-spaced, discharge ports. Flow from cell 2 is distributed along the southern edge of cell 3 through a 20-inch diameter ductile iron transfer pipe that also has two, evenly-spaced, discharge ports. A floating transfer pipe in cell 2 that is identical to the floating pipes in cells 2 and 3 is used to convey water from cell 3 into the constructed wetland.

The lagoons have been in service since 1992. Sludge tends to accumulate in the lagoons over time. The largest sludge accumulations typically occur in the first cell near the influent pipe discharge point. Sludge has not been removed from the lagoons to date. In order to ascertain the quantity of sludge present in the lagoons, the City completed a sludge survey of cell 1 in June of 2008 (Appendix B). Since all raw wastewater flows into cell 1, the vast majority of the sludge is located in cell 1 and there was no need to survey cells 2 and 3. The sludge survey showed modest accumulations near the ports on the cell 1 influent piping. The maximum depth of sludge that was measured was 1.7 feet. The sludge depth rapidly decreased moving south away from the discharge point. Within a distance of approximately 100 feet south of the influent header pipe, the sludge depth decreased to approximately 0.5 feet. The sludge depth in the majority of the lagoon

was generally less than 0.6 feet. At the time, these measurements were collected, the plant had been in service for 16 years. At the present time, the plant has now been in service for 20 years. In the coming years the sludge depth will continue to increase and sludge removal will likely be needed during the current planning period (i.e., prior to 2035). Prior to removing the sludge, the City will need to prepare and obtain DEQ approval of a Biosolids Management Plan in accordance with DEQ requirements. It is important for the City to realize that the DEQ cannot approve a Biosolids Management Plan if the City's existing NPDES permit is expired. The DEQ is not always able to renew NPDES permits in a timely fashion. The DEQ's current policy is to allow permit holders to operate under the conditions of the expired permit as long as a timely renewal application was submitted. At the present time, the City's NPDES permit is expired. Since the City submitted a timely renewal application; the City is allowed to operate under the conditions of the expired permit. The City needs to be aware that a Biosolids Management Plan must be prepared and approved before biosolids can be removed and that the Biosolids Management Plan can only be approved if the City's NPDES permit is not expired. The City may request an expedited permit renewal however, the biosolids disposal project may be delayed until the DEQ renews the City's expired NPDES permit.

In August of 2005, a lagoon leakage test was performed to determine the seepage rate from lagoon cell 2. This test was conducted to satisfy a requirement in the City's NPDES permit. This test showed an average seepage rate of 0.14 inches per day. This value is less than DEQ's maximum allowable seepage rate of 0.25 inches per day for an existing lagoon.

The City maintains a network of six groundwater monitoring wells around the lagoons. These wells were installed when the lagoons were originally constructed and groundwater samples have been collected and analyzed on a regular basis. Groundwater monitoring is required by the City's NPDES permit. The City is currently required to test the wells and submit a report to DEQ every other year. The most recent report was completed in January 2013 and should be on file with DEQ. The City is currently required to test each monitoring well on an annual basis for temperature, pH, specific conductance, nitrate-nitrogen, ammonia-nitrogen, Fecal Coliform, Ortho-phosphate, and total Kjeldahl nitrogen. Results from 2003 and 2004 showed contamination of monitoring well #3 with elevated levels of fecal coliform. In response to this data, the DEQ required the City to perform the seepage test described in the previous paragraph. As noted, the seepage rate was less than the maximum allowable rate. From 2005 to the present time, elevated fecal coliform levels have not been observed. This suggests that the contamination was an isolated incident, and may have resulted from the application of mink farm waste on the adjacent lands. If the lagoons were the source of the contamination, one would expect the elevated readings to continue. The data collected in 2012 showed elevated levels of Ortho-phosphate in wells 1, 2, 4, 5, and 6. There are currently no regulatory standards for Ortho-phosphate and the observed concentration ranges (0.31 to 0.70 mg/L) are only slightly above the laboratory minimum reporting limit of 0.1 mg/L. None of the samples collected in 2012 showed elevated levels of nitrate-nitrogen, ammonia-nitrogen, Fecal Coliform, or total Kjeldahl nitrogen.

In 2010, the Oregon Department of Water Resources (WRD) performed a routine safety inspection of the lagoon dikes. The WRD concluded that the dike structures were in excellent condition, but recommended some additional vegetation removal around the outside of the dikes.

Based on the above information, is has been assumed for this planning effort that the lagoon dikes and liners are in good condition and will serve the City for the remainder of the planning period. Therefore, no improvements to the dikes and liners are included in the capital improvement plan. That said, it is recommended that the City increase efforts to remove shrubs and trees including blackberries from the exterior slopes of the dikes. However, this work is generally considered to be maintenance work rather than a capital improvement project.

4.4.5 Constructed Wetland

Discharge from lagoon cell 3 is routed to the constructed wetland for additional treatment. The purpose of the constructed wetland is to further decrease effluent BOD and TSS concentrations prior to final discharge. The effluent permit limits for BOD and TSS are 20 mg/L. For systems that discharge directly from facultative lagoons, BOD and TSS permit limits of 30 mg/L and 50 mg/L respectively are common. The constructed wetland is used to meet the more stringent effluent BOD and TSS permit limits included in Mt. Angel's permit. The constructed wetland is divided into two main cells that operate in parallel. Each of these cells is further divided in half. Therefore, there are a total of four wetland cells with a high length to width ratio to promote plug flow conditions through the wetland. The wetland is planted with hard-stem bulrushes.

The water depth in the wetland can vary between 1.5 feet and 3.5 feet to provide additional storage if needed. The flow of water to the two wetland cells is controlled by a valve cluster on the pipe the leaves cell 3. Downstream of this valve cluster, a perforated pipe distributes the flow along the southern edge of the wetland cells. Water flows from south to north. At the north end of the wetland, two weir boxes in each of the four cells are used to control the water level in the wetland. Discharge from the wetland flows over the adjustable weirs and into a 24-inch ductile iron pipe that conveys wetland effluent to the effluent pump station.

Based on discussions with the City, the valves located on the wetland inlet piping are in poor condition and in need of maintenance or replacement. The other operational problem with the lagoons is related to the outlet boxes. The outlet boxes are screened to prevent wetland vegetation from entering the wetland discharge piping. The current configuration requires a significant amount of the operator's time to ensure that screens are properly cleaned and raked. A more operator friendly design is desired. There are also several areas of sparse wetland vegetation that were not present when the plant was originally constructed. The gaps are likely the result of normal aging and mortality of the wetland vegetation. In the coming years, we recommend the City systematically drain each wetland cell and transplant the wetland vegetation from areas where it is relatively dense to areas where it is sparse. We believe this is a normal routine maintenance item rather than a capital improvement project. Therefore, the City should update the O&M manual during the next round of treatment plant upgrades to include this operation. Other than these issues, the constructed wetland is in good condition and should continue to serve the City well for several years.

4.4.6 Effluent/Recycle Pump Station

Discharge from the constructed wetland is routed to the effluent/recycle pump station. This pump station provides two functions. It is used to pump treated effluent to the Pudding River for discharge during the winter months. During the summer months, the station is used to circulate

water through the plant in an effort to maintain a healthy biological system in the constructed wetland and to treat the wastewater during the summer months. The recycle piping is configured to all for pumped water to be routed to either cell 1 or cell 3.

The station consists of a wetwell, a valve vault, and a meter/mixer vault. Four submersible pumps are located in the wetwell. Each pump discharge pipe is fitted with an isolation valve and a check valve. These valves are located in a valve vault that shares a common wall with the wetwell. After passing through the valves, the pump discharge pipes connect to a common forcemain pipe that is routed through the meter/mixer vault. Once in the meter/mixer vault, the water passes through the effluent flow meter. The effluent flow meter is a magnetic flow meter and is used to measure the quantity of water discharged during the summer months and the quantity of water recycled through the wetland. On the downstream side of the flow meter a valved tee allows the operator to route pump station discharge to either the Pudding River or for recycle through the plant. In the winter months, the valves are set to direct water to the Pudding River. Before leaving the meter/mixer vault, the chlorine is added to the water in the vault and a static mixer provides chemical mixing.

The station operates as originally designed and has not been significantly modified. Based on discussions with operations personnel, all four pumps have been replaced in within the last four years. All other equipment is the original equipment installed in 1992.

Overall, the pump station is in good condition. However, there is currently no easy way to isolate the pump station wetwell from the wetland. This is problematic for maintenance and repair activities inside the wetwell. As such, it is recommended that a sluice gate be installed on the inlet to the pump station to provide the City with a means of isolating the wetwell from the wetland.

Since the plant was originally constructed, confined space entry requirements have changed significantly. As currently designed, the City must enter the meter/mixer vault periodically to adjust the positions of the valves. This requires confined space entry practices and is, therefore, time consuming. To correct this problem, we recommended modifying the valves and perhaps the vault hatches to allow operation of the valves from the surface without the need to enter the vault.

Finally, the electrical control system for the station is antiquated and will likely reach the end of its useful life during the planning period. As such, an upgrade of the electrical system is recommended.

4.4.7 Disinfection System

Chlorine gas is used to disinfect the treated effluent. The gas feed equipment is located in the operations building. The equipment consists of 150 pound gas cylinders, cylinder valves, chlorinator, gas injector, and solution feed lines. The chlorine injector is used to mix the chlorine gas with water to create a chlorine solution that is added to the effluent stream in the meter/mixer vault. A static mixer in the meter/mixer vault mixes the chlorine solution with the effluent. Chlorine contact time is provided in the 24-inch pipeline to the Pudding River Outfall. This pipeline is approximately 3,900 feet long. The pipe material is High Density Polyethylene. The pipeline provides 80,400 gallons of contact volume.

The effluent pipeline discharges into a compliance manhole located west of the treatment plant near the bank of the Pudding River. The compliance manhole is adjacent to 114th Avenue approximately 1,000 feet north of the intersection of 114th Avenue and West Church Street. From the compliance manhole, effluent flows by gravity to the effluent diffuser in the Pudding River.

To remove the remaining chlorine residual from the effluent, a sulfur dioxide solution is added to the effluent stream in the compliance manhole. The dechlorination system is a sulfur dioxide gas feed system that consists of 150 pound gas cylinders, cylinder valves, sulfonator, and gas injector. The system is very similar to the gas chlorine feed system. Sulfur Dioxide gas is mixed with water to create a sulfur dioxide solution. This solution is conveyed to the compliance manhole through a 2-inch diameter HDPE pipe that runs parallel to the 24-inch outfall pipeline. The natural turbulence in the compliance manhole provides the mixing energy needed to mix the sulfur dioxide solution with the plant effluent.

The disinfection equipment is in good condition. The chlorination equipment is a little dated, and may need to be replaced during the planning period. The sulfur dioxide feed equipment was installed in 2006 and is relatively new and should serve the City for many years.

4.4.8 Operations Building

An operations building is located at the treatment plant site. This building houses a lab, office space, a restroom, the main control room for the plant, and the chemical feed equipment. The building also houses tools and other maintenance equipment. The main power feed for the plant enters the operations building. The building is equipped with an auxiliary power generator, but the generator only powers the building power, the headworks equipment, and the water supply well. The generator does not power the effluent pump station.

The Operations Building has been well maintained since constructed in 1992 and should continue to serve the City well for years to come provided that needed routine maintenance activities (i.e., painting, roof maintenance, etc.) occur.

4.4.9 Pudding River Outfall

Treated effluent flows by gravity from the compliance manhole to the outfall diffuser in the Pudding River. The outfall diffuser has four ports with duck-bill style check valves. The four ports are connected to a distribution manifold that is encased in concrete below the bottom of the river.

4.4.10 Water Supply System

Potable water for the lab building and the water used to mix the chlorine and sulfur dioxide solutions is provided by a well located at the treatment plant site. The well is located in a small block building near the headworks. The well pump is a submersible pump that pumps into a pressure tank. The system is relatively simple and similar to a typical rural residential well water supply system. It appears that there is no alarm telemetry for a well pump fail condition. This is a shortcoming since the well pump provides the water needed to operate the chlorine and sulfur dioxide feed equipment. In the event of a well pump failure, improperly disinfected effluent or effluent with chorine concentrations exceeding permit limits may be discharged without the operator's knowledge. This is a shortcoming that should be addressed during the planning period.

4.4.11 Telemetry

The plant does not currently include any alarm telemetry to alert operators of problems during periods when the plant is unattended. This is a shortcoming that should be addressed during the planning period. At a minimum, alarms to notify operators of gas leaks, pump failures, power failure, and intrusion alarms should be included since these conditions may potentially result in public health hazards.

4.4.12 Summary of Treatment and Disposal System Deficiencies

- The wastewater treatment plant access road is not suitable for modern delivery trucks and is subject to flooding during high water events.
- The treatment plant lacks an alarm telemetry system.
- The valves on wetland header pipe are in poor condition and do not operate properly.
- The screens on the wetland outlet boxes require an excessive amount of operator time to maintain. A more operator friendly design is desired.
- There are large gaps in the wetland vegetation that should be addressed as soon as possible.
- There is no easy way to isolate effluent pump station wetwell from the wetland.
- Adjustment of the valves in the meter/mixer vault requires time consuming confined space entry practices.
- The effluent pump station electrical controls are antiquated and likely to reach the end of their useful life during the planning period.

4.5 WASTEWATER SYSTEM OPERATOR LICENSING

The City's wastewater collection system currently requires a level 2 certification for operation. The City's existing treatment system also requires a level 2 certification. Given the anticipated improvements to the treatment plant, it is unlikely that these classifications will change during the planning period.

4.6 WASTEWATER SYSTEM FUNDING MECHANISMS

Funding for the City's existing wastewater system comes from two major sources, user fees and system development charges (SDCs).

4.6.1 User Fees

User fees are monthly charges to all residences, businesses, and other users that are connected to the wastewater system. User fees are established by the City Council and are typically the sole source of revenue to finance wastewater system operation and maintenance. The City's user fee system is established in Chapter 52 of the City's Municipal Code. The user fees and charges were most recently revised by Resolution Number 1358. Together these two documents provide the basis for assessing sewer user fees.

Residential users are charge a monthly flat fee of $37.50. Commercial users including multifamily residential users are charged a monthly base charge of $37.50 per Equivalent Residential Unit (ERU). The City determines the number of ERUs for each commercial user on a case by case basis. User fees for industrial users are set on a case by case basis and are established by a permit issued by the City.

The City's sewer fund must provide sufficient revenues to properly operate and maintain the wastewater system and provide reserves for normally anticipated replacement of key system components such as pumps, motors, pump station control equipment, chemical feed equipment, manholes and sewer collection piping. Although the City relies exclusively on sewer fees for operation and maintenance costs, the sewer fund cannot typically finance major capital improvements without outside funding sources.

4.6.2 System Development Charges

A system development charge (SDC) is a fee collected by the City as each piece of property is developed. SDCs are used to finance necessary capital improvements and municipal services required by the development. SDCs can be used to recover the capital costs of infrastructure required as a result of the development, but cannot be used to finance either operation and maintenance, or replacement costs.

The SDC fee system is established in Chapter 50 of the City's Municipal Code. The SDC fees were most recently revised in 1999 by Resolution Number 783. Together these two documents provide the basis for the collection of SDC fees. The current SDC fee is $1,250 per ERU.

4.6.3 Annual Operation and Maintenance Costs

Annual operations and maintenance costs are recurring costs typically funded through user rates. The estimated revenue from sewer billings for the fiscal year 2013/14 budget is $715,000. Adding capital carryover from the previous fiscal year with the grant used to pay for the development of this facilities plan results in total revenue of $896,842. The budgeted expenditures for the 2013/14 fiscal year are listed below (Table 4-7).

The budget listed in Table 4-7 includes an expenditure of $49,000 under the capital outlay line item for I/I reduction. The capital outlay line item also includes approximately $75,000 used to fund this plan. The transfers line item includes a debt service payment of $188,022 for the bond that was used to finance the construction of the existing treatment plant. During the 2013/2014 fiscal year, the City chose to pay off the remainder of this loan. Therefore, the City will no longer have any debt associated with the construction of the wastewater treatment plant.

Table 4-7 | Sewer Utility Fund Expenditures

Item	Budget
Personnel Services	$ 266,700
Materials and Services	$ 96,850
Capital Outlay	$ 170,000

Transfers	$ 278,292
Contingency	$ 85,000
TOTAL EXPENDITURES	$ 896,842

4.6.4 Sewer SDC and Improvement Funds

The City currently has three funds that are used to save money for capital improvements. These include a sewer SDC fund with a current balance of approximately $0, a sewer sludge fund with a balance of approximately $1,000,000, and a sewer utility reserve fund with a current balance of approximately $340,000. During the 2013/2014 fiscal year, the City used all of the money in the SDC fund and approximately $200,000 from the sewer utility reserve fund to pay off the existing debt service associated with the original construction of the wastewater treatment plant. The sewer sludge fund is earmarked for the removal of sludge from the existing lagoons.

4.7 RECOMMENDATIONS

The intent of this chapter is to provide an inventory and summary of the existing wastewater facilities. Subsequent chapters of this report, as detailed in the table of contents, evaluate the various components of the wastewater system and present detailed improvement plans for the system as a whole. That said, there are a number of recommendations that can be made based on known problems with the existing facilities. These recommendations are summarized as follows.

- Collection System – A long-term I/I reduction program is recommended. The City currently allocates approximately $50,000 per year for I/I reduction efforts. This commitment should be formalized indefinitely. The City should also consider funding the program at a higher rate to increase the rate at which repairs can be made and to offset the impacts of inflation over time. Additional recommendations for a long-term I/I reduction plan are discussed in Chapter 6. The City should immediately prepare and begin to implement the inflow reduction plan required in Schedule C of the City's NPDES permit.
- Treatment Plant Access Road – Widen and improve the access road to enable delivery trucks to deliver chemicals and other products to the plant operations building. Also raise the road surface as needed to ensure adequate access during high-water events.
- Lagoon Sludge Removal – The City should plan to remove sludge from the lagoons toward the end of the planning period.
- Treatment Plant Telemetry System – The treatment plant does not have an alarm telemetry system. A modern alarm telemetry system should be installed early in the planning period.
- Treatment Plant Lagoon Dikes – Remove shrubs, trees, and blackberries from the lagoon dike slopes. This should be an annual maintenance item.
- Treatment Wetland Influent Header Pipe – Rehabilitate or replace the existing distribution valves.
- Treatment Wetland Effluent Control Boxes – Modify the vegetation screens to simplify the cleaning process.

- Treatment Wetland Vegetation Maintenance – The City should begin systematically draining each wetland cell and transplanting the vegetation from dense areas to spare areas to fill in the existing gaps in the wetland vegetation.
- Treatment Plant Effluent Pump Station – Install a sluice gate on the influent pipe to make it easier to enter the wetwell for maintenance.
- Treatment Plant Effluent Flow Meter Vault – Modify the valves to enable them to be operated from the surface in order to eliminate confined space entry requirements.
- Treatment Plant Effluent Pump Station Electrical and Control System – The pump station electrical power distribution and control system will reach the end of its useful life during the planning period. Therefore, the City should plan to update these facilities.

CHAPTER 5

WASTEWATER FLOWS AND LOADS

Chapter Outline

5.1 Introduction
5.2 Population
  5.2.1 Historic and Future Population
5.3 Wastewater Flows
  5.3.1 Plant Flow Records
  5.3.2 Existing Flow Estimates
  5.3.3 Pepsi Northwest Beverages Wastewater Flows
  5.3.4 Summary of Existing Wastewater Flows
  5.3.5 Wastewater Flow Projections
  5.3.6 Drainage Basin Service Area Flows
5.4 Wastewater Loads
  5.4.1 Plant Load Records
  5.4.2 Pepsi Northwest Beverages Wastewater Loads
  5.4.3 Load Projections
5.5 Recommendations

WASTEWATER FLOWS AND LOADS

CHAPTER 5

5.1 INTRODUCTION

In order to select and size both collection and treatment facilities for the planning period, projected wastewater flows and organic loadings must be determined. The projected flows and organic loadings were determined based on a number of variables including the following:

- Rate of projected population increase
- Land use zoning within the UGB
- Projected per capita and per acre flowrates and organic loadings.

This chapter develops wastewater flow and loading projections which are used for sizing the collection system components as well as the treatment plant components. The projected design flowrates were determined based on a number of variables including zoning of land within the service area, anticipated development density at buildout and within a 20-year planning period, and projected per capita and per acre flowrates.

5.2 POPULATION

Population projections serve as the basis for future wastewater flow and load projections. Much of the challenge in projecting system growth relates to the difficulty in accurately tracking or projecting actual populations.

At the time this facilities plan was prepared, there were no known large residential, commercial, or industrial developments planned in the City. Therefore the future flows and loads are based solely on municipal population growth within the City.

5.2.1 Historic and Future Population

Population histories provide a tool for determining the future growth rate of the municipal watewater system. The population in Mt Angel has steadily increased from approximately 936 people in 1920 to 3,790 in 2009. The current population of Mt Angel remains at approximately 3,700. Figure 5-1 shows the population trends in Mt. Angel from 1900 to the present time.

Growth forecasting was performed using the exponential growth formula shown below:

$$P = P_o e^{rt}$$

Where P = Population at time (t) in years

P_o = Initial population

r = Average annual growth rate

t = Time elapsed from basis year

In the review of Facilities Plans, the DEQ relies on the County population allocations as the 'coordinated number' for evaluating population projections. This number has been agreed to by

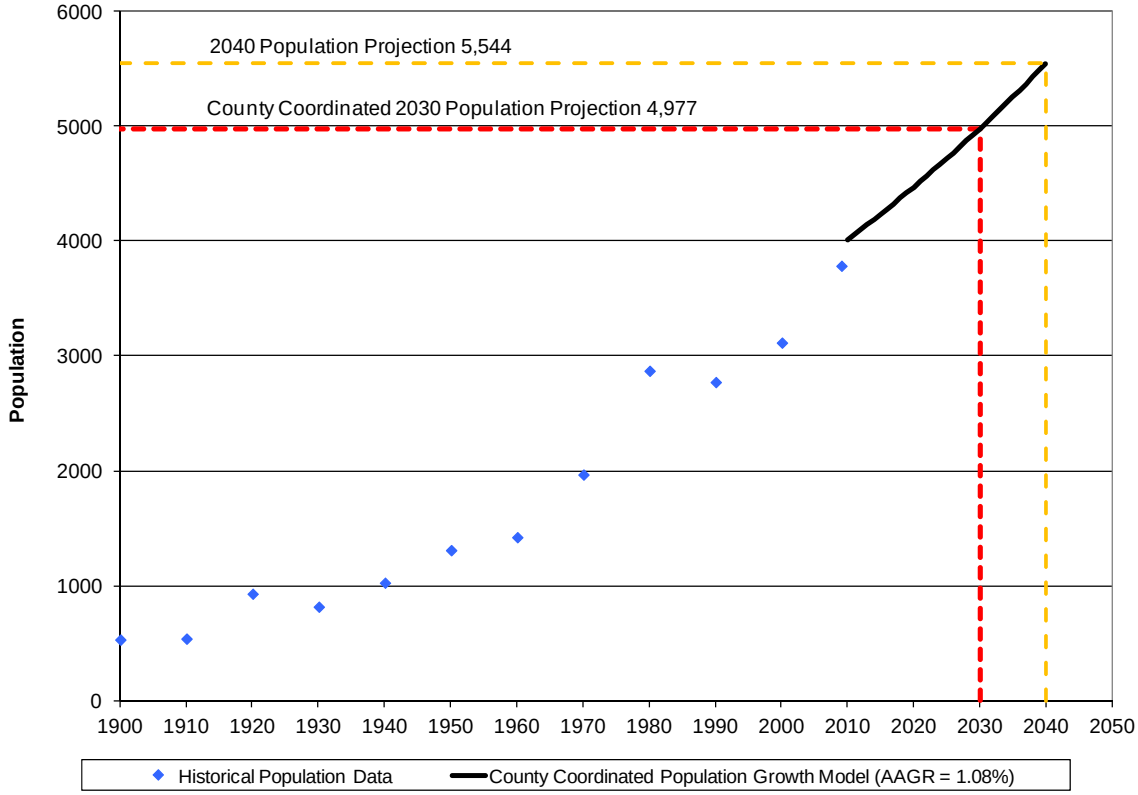
the Department of Land Conservation and Development (DLCD), the Office of the State Economist, and Marion County and is based on documented population trends. DEQ has indicated that the City is obligated under ORS 195.036 to conform to the County population allocation in order for the Department to approve the Facilities Plan. Therefore, the Marion County population projections for Mt. Angel will be used for facilities planning purposes.

In 2009 Marion County made population projections through 2030. The 2030 population allocation for Mt. Angel was projected at 4,977 with an average annual growth rate of 1.08% from 2010 to 2030. For the purposes of this document, the population was projected through the year 2040 using an average annual growth rate of 1.08% and the population model listed above. The population growth model is plotted together with historical population trends in Figure 5-1. The projected population is expected to reach 5,544 by 2040. The projected population estimates are listed by year in Table 5-1.

Table 5-1 | Mt Angel Population Projections

Year	Population
2020	4,467
2025	4,715
2030	4,977
2035	5,253
2040	5,544

Figure 5-1 | Population Growth Trend



5.3 WASTEWATER FLOWS

Wastewater facility evaluation and design typically account for the following standard flow rates:

- Average dry-weather flow (ADWF) - Average daily wastewater flow during the dry-weather months of May through October
- Average wet-weather flow (AWWF) - Average daily wastewater flow during the wet weather months of November through April
- Average annual flow (AAF) - Daily wastewater flow averaged over the entire year
- Maximum-month dry-weather flow (MMDWF) - Maximum monthly flow during the dry weather months
- Maximum-month wet-weather flow (MMWWF) - Maximum monthly flow during the wet weather months
- Peak-day flow (PDF) - Maximum one-day flow during wet the weather months
- Peak-hour flow (PHF) - Maximum flow over a short duration (peak hour).

5.3.1 Plant Flow Records

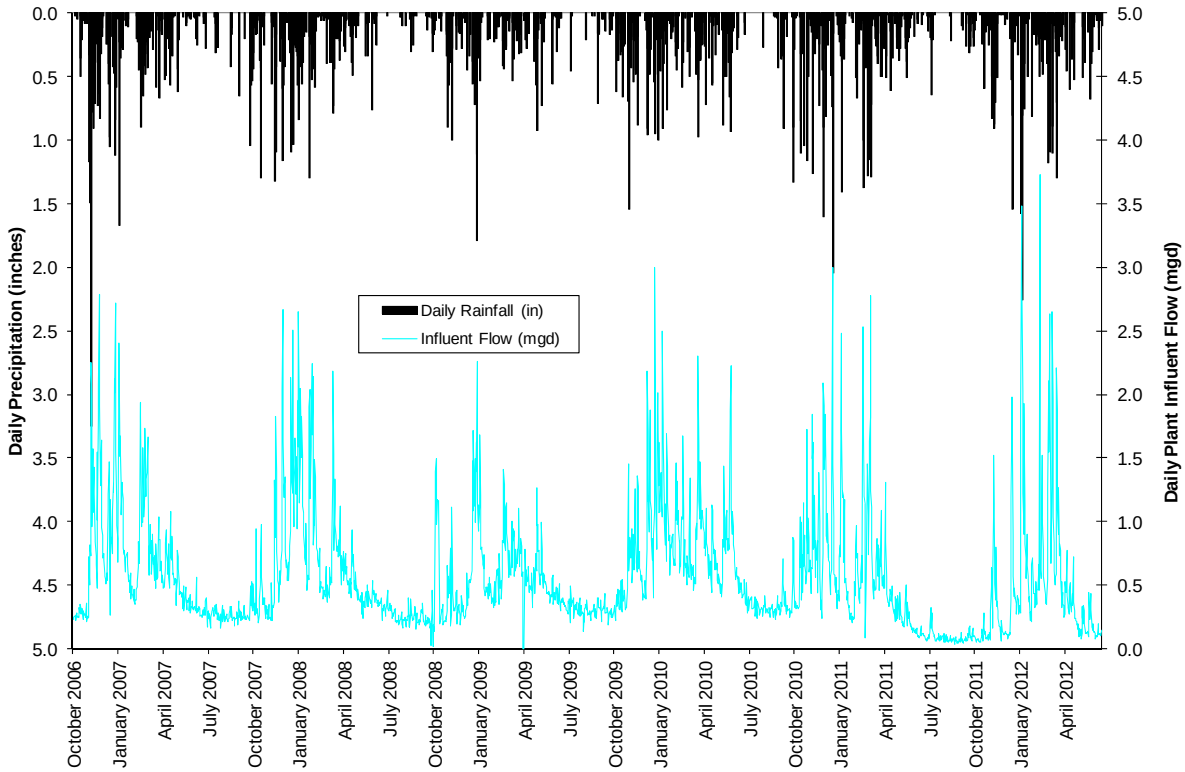
The City's treatment plant Discharge Monitoring Reports (DMRs) filed with the DEQ for the period from October 2006 through June 2012 were evaluated to identify flow patterns and evaluate current flows to the plant.

Plant inflows in Mt. Angel are strongly influenced by precipitation (Figure 5-2). This is common for wastewater collection systems in the Willamette Valley. Winter rains cause groundwater levels to rise. The groundwater enters the collection system through faults and cracks in the collection piping and manholes (infiltration) and through direct connections to storm drainage collection facilities (inflow). Infiltration and inflow (I/I) results in increased flows measured at the treatment plant. As shown in Figure 5-2, plant inflows during the winter months are significantly higher than flows during the dry summer months. This can also be seen in Table 5-2 where the various flow components are tabulated for the last five years in millions of gallons per day (mgd).

Table 5-2 | Summary of Plant Flow Data 2007 through 2011.

Year	Population	ADWF (mgd)	AAF (mgd)	AWWF (mgd)	MMDWF (mgd)	MMWWF (mgd)	PDF (mgd)
2007	3755	0.324	0.618	0.913	0.423	1.223	2.790
2008	3785	0.336	0.608	0.886	0.517	1.285	2.670
2009	3790	0.384	0.500	0.619	0.619	0.769	2.262
2010	3790	0.496	0.705	0.917	0.718	1.249	2.999
2011	3790	0.131	0.453	0.781	0.286	1.034	3.000
Average	3783	0.334	0.577	0.790	0.513	1.110	2.909

Figure 5-2 | Precipitation Effects on Plant Influent Flow



5.3.2 Existing Flow Estimates

An examination of Table 5-2 reveals that the 2011 dry weather flows were unusually low. Flowrates in the range of 80-110 gallons per person per day are typical in the United States during dry weather conditions. The 2011 data show a per-capita flowrate of approximately 35 gallons per person per day. The DMRs were further analyzed and it appears that there is some error in the City's flow measurement equipment that began sometime in the 2011 calendar year. For this reason, the 2011 data was discarded and not used further in this analysis. The data for 2007 through 2010 is listed in Table 5-3.

Table 5-3 | Summary of Plant Flow Data 2007 through 2010.

Year	Population	ADWF (mgd)	AAF (mgd)	AWWF (mgd)	MMDWF (mgd)	MMWWF (mgd)	PDF (mgd)
2007	3755	0.324	0.618	0.913	0.423	1.223	2.790
2008	3785	0.336	0.608	0.886	0.517	1.285	2.670
2009	3790	0.384	0.500	0.619	0.619	0.769	2.262
2010	3790	0.496	0.705	0.917	0.718	1.249	2.999
Average	3780	0.385	0.608	0.834	0.569	1.134	2.680

The DEQ has published guidelines for the estimation of wet weather flows in Western Oregon. The purpose of these guidelines it to identify a methodology that can be used to estimate

wastewater flows if all bottlenecks in the system were removed. In most systems such as Mt. Angel's where large amounts of I/I enter the collection piping and manholes, the flows can increase to the point that surcharging occurs in the system. Surcharging tends to decrease the amount of I/I that could occur if the surcharging were not present. In theory, the wet weather flow components listed in Table 5-3 are influenced by this phenomenon and the wet weather flows to the wastewater treatment plant would actually be higher if all the bottlenecks could be removed. It is important to consider the flowrates in the absence of throttling because as the improvements described in this plan are implemented, the capacity of the bottlenecks will be removed and the wet weather flows to the treatment plant will increase beyond the flows listed in Table 5-3.

In order to estimate the wet weather flow components that would occur in the absence of bottlenecks, the DEQ has published guidelines that describe a methodology to correlate wastewater flows to rainfall during moderate rainfall events when surcharging is believed to be absent. This mathematical correction is then used to extrapolate flows at higher rainfall events associated with peak wet weather flow conditions.

To establish a relationship between monthly rainfall and average monthly flow, the average monthly wastewater flowrates for the wet weather months are plotted against their corresponding monthly rainfall values. The monthly average flow and corresponding rainfall totals for the 2007 through 2010 winter months are plotted in Figure 5-3. A linear regression is performed to establish the relationship between monthly rainfall and average monthly flow. This relationship can be used to predict plant inflows as a function of monthly rainfall depth.

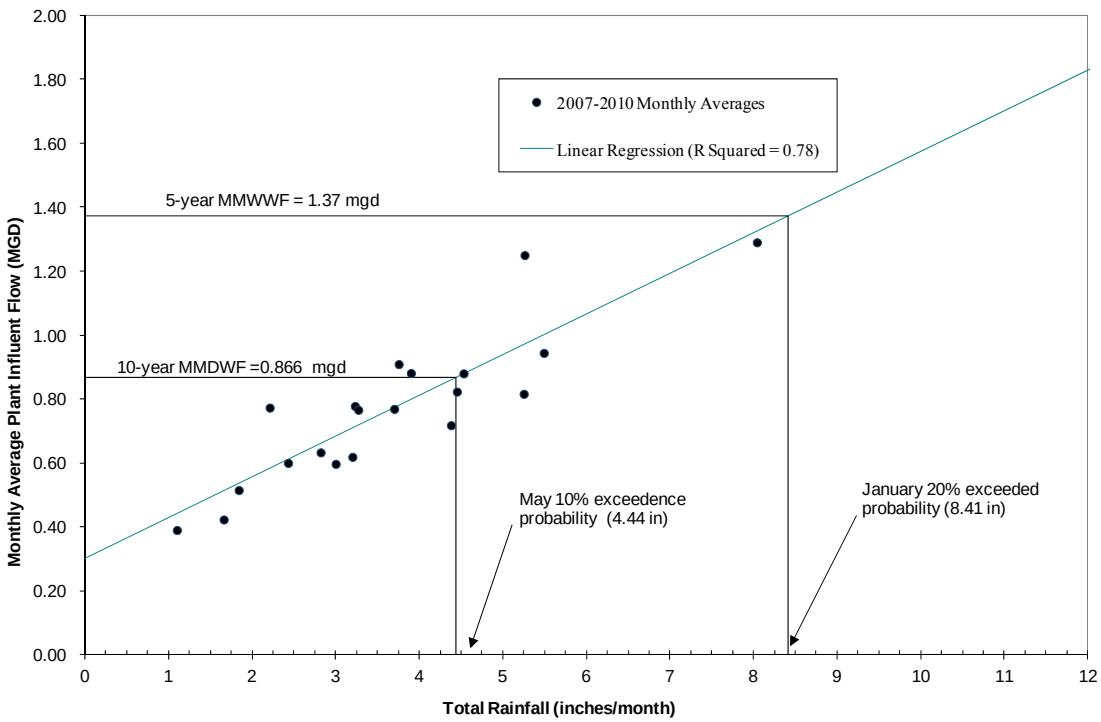
The Maximum Month Dry Weather Flow (MMDWF) is the monthly average flow for the rainiest summer month of high ground water. In the Willamette Valley the MMDWF invariably occurs in May. For the purposes of this report, the MMDWF is defined by the 10-year recurrence interval. Therefore, the MMDWF may be estimated by the monthly flowrate for the month of May with a 10-year recurrence interval. The linear regression established in Figure 5-3 may be used if the rainfall depth for the month of May that is associated with a 10-year recurrence interval is known. Rainfall depths corresponding to various exceedence probabilities have been calculated for the North Willamette Experiment Station near Canby[2]. This data set is assumed to be generally representative of rainfall patterns in Mt. Angel. For the month of May, rainfall depth associated with the 10% exceedence probability (i.e., 10-year recurrence interval) is 4.44 inches. Using this rainfall depth and the relationship established in Figure 5-3 the MMDWF can be estimated. As shown in Figure 5-3, the MMDWF is approximately 0.866 MGD.

The Maximum Month Wet Weather Flow (MMWWF) represents the highest monthly average attained during the winter period of high groundwater. The DEQ methodology is based on the assumption that high groundwater levels are not consistently maintained until the month of January. Therefore, heavy storms do not begin to cause a reliable or consistent infiltration and inflow response until January. This leads to the assumption that the MMWWF occurs in January. In the same manner used to determine the MMDWF, the rainfall depth associated with a 20% probability of exceedence (i.e., 5-year recurrence interval) for the month of January is used in the correlation between plant flows and rainfall to determine the MMWWF. Again, using the

[2] U.S. Dept. of Commerce, NOAA, Climatography of the United States No. 20, N. Willamette Exp. Stn

rainfall data from the North Willamette Experiment Station near Canby, the January rainfall total associated with the 20% exceedence probability is 8.41 inches. Using this rainfall depth and the relationship established in Figure 5-3 the MMWWF can be estimated. As shown in Figure 5-3, the MMWWF is approximately 1.37 MGD.

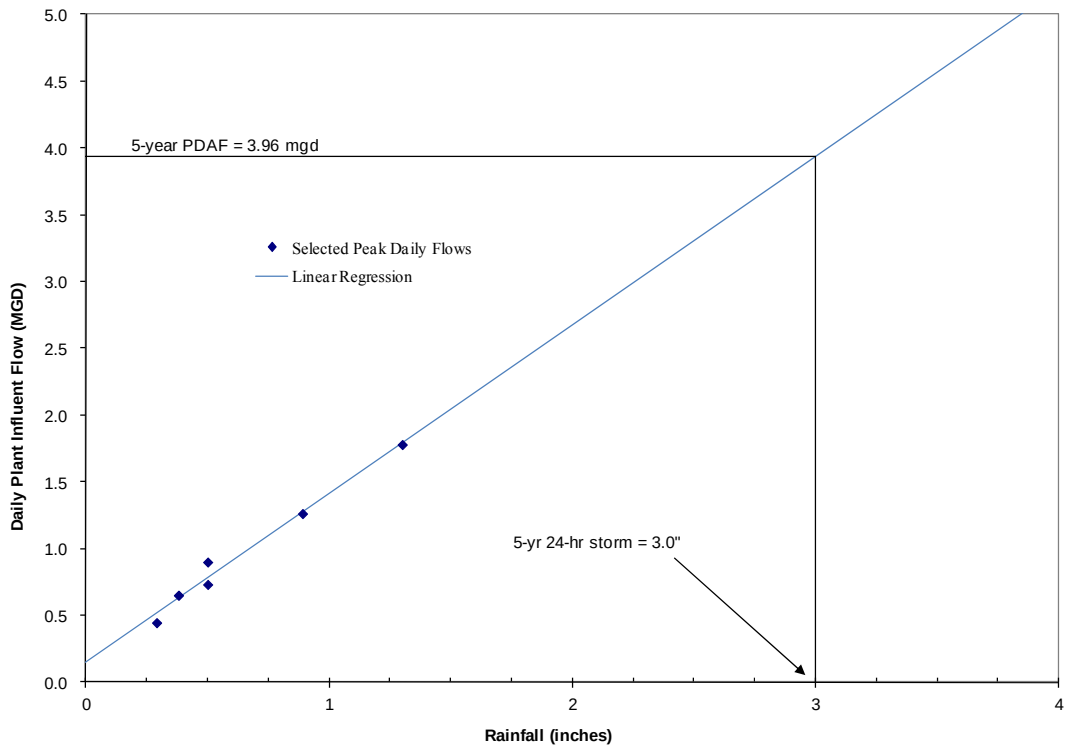
Figure 5-3 | MMWWF and MMDWF Determination



The Peak Day Flow (PDF) that would occur in the absence of bottlenecks may be estimated by determining the peak daily average flow associated with a 5-year storm. This PDF will occur under saturated subsurface conditions when the influence of rainfall on infiltration and inflow is the strongest. The PDF is determined by plotting observed peak average daily flow against the corresponding daily rainfall depths. The 5-year 24-hour rainfall depth is used in a linear regression of the data to determine the PDF. The data used to determine the PDF is plotted in Figure 5-4. These data points were carefully selected to ensure that groundwater levels were saturated for the period over which flow data was collected. The data were also screened to ensure that the flow measurements were not collected under significantly surcharged conditions as this would tend to decrease the flow measurements and result in erroneously low estimates. The 5-year 24-hour rainfall depth for Mt. Angel is approximately 3 inches[3]. Using this rainfall depth and the relationship established in Figure 5-4 the PDF associated with a 5-year 24-hour storm can be estimated. As shown in Figure 5-4, the PDF is approximately 3.96 MGD.

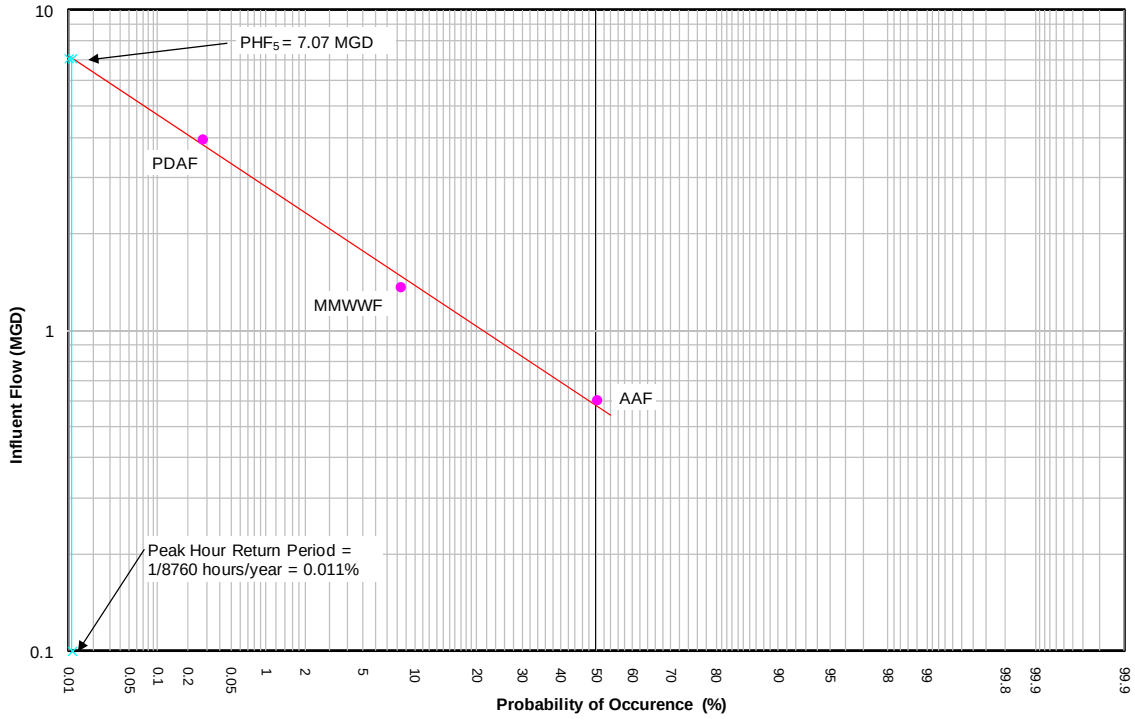
[3] U.S Dept. of Commerce, NOAA, Atlas 2, Volume X (Oregon), figure 26

Figure 5-4 | PDF Determination



A statistical approach is used to determine the Peak Hour Flow (PHF) that would occur in the absence of bottlenecks. This approach involves assuming that a particular year includes a 5-year storm with high groundwater conditions producing the MMWWF and the PDF. During this 5-year storm the PHF occurs within the peak day. These assumptions enable one to determine the portion of the year over which each flow component occurred. For example, the MMWWF occurs 1/12 of the time or with an 8.33% probability, the AAF occurs half of the time or with a 50% probability, and so on. The rainfall depth is assumed to be a random variable with a log-normal probability distribution. If this assumption is accurate, the AAF, MMWWF, and PDAF should plot as a straight line on log-probability paper. These flow components are plotted on Figure 5-5. Since the PHF occurs 1 hour out of this hypothetical year (i.e., 1/8760 or 0.011% probability), by extrapolating a linear regression to a probability of 0.011%, the PHF may be determined. Using this approach the PHF is approximately 7.07 mgd as shown in Figure 5-5.

Figure 5-5 | PHF Determination



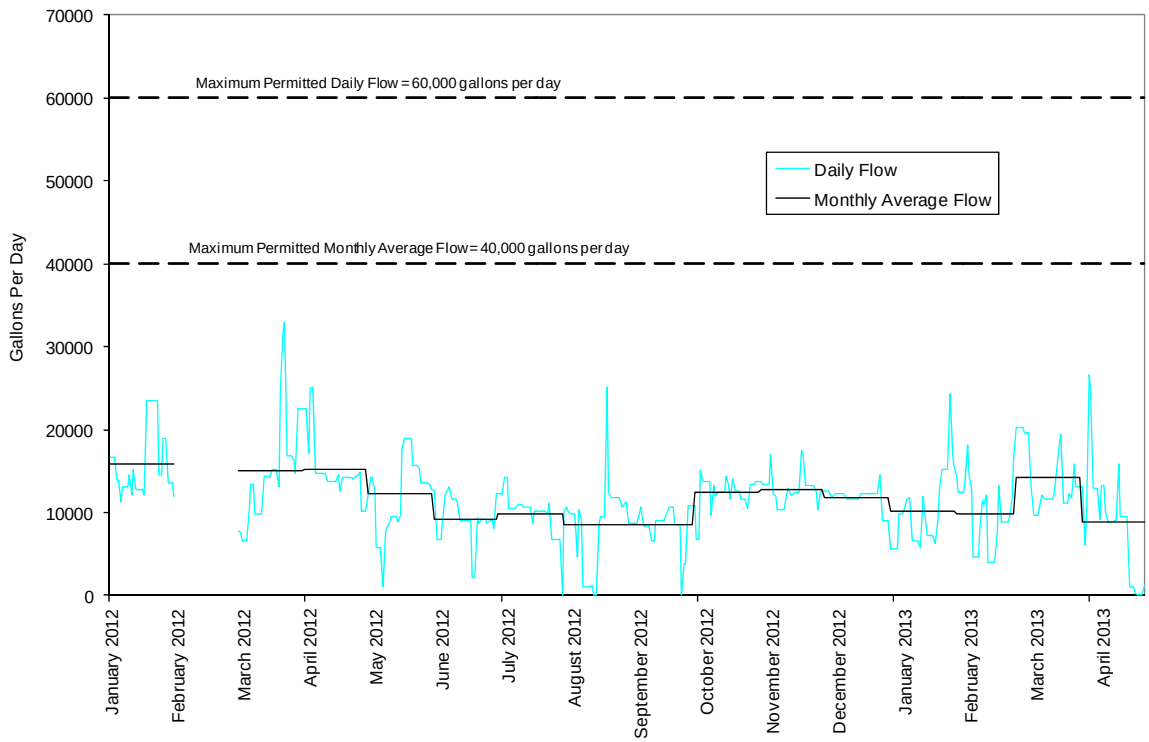
5.3.3 Pepsi Northwest Beverages Wastewater Flows

Pepsi Northwest Beverages is an industrial user that discharges process wastewater to the City's system under an individual waste discharge permit issued by the City. The relative size of this discharge is significant and is discussed separately from the rest of the City in this section.

The industrial use permit for the Pepsi plant sets forth a maximum average monthly flowrate limit of 40,000 gallons per day. The permit also sets a maximum daily limit of 60,000 gallons per day. Wastewater flows and loads from the Pepsi plant are measured continuously at a monitoring station and submitted to the City on a monthly basis. Data from January 2012 through April 2013 were analyzed for this report. Data for February 2012 could not be located and are not included in the analysis. The daily and monthly average flow rates are shown in Figure 5-6 together with the permitted limits. As shown in the figure, the flowrates from the Pepsi plant are well under the permitted limits. For the entire data set, the average monthly flowrate is 11,700 gallons per day, the maximum month flowrate is 16,000 gallons per day, and the maximum daily flowrate measured was 33,000 gallons per day. In theory, these flows should be included in the flow measurements collected at the City's wastewater treatment plant. Therefore, these values are reflected in the existing flow estimates presented above. For planning purposes, however, it is appropriate to include the additional flows from the Pepsi plant that are currently permitted by the City. These additional flows will be added to the flow estimates presented above, as follows, to account for the permitted flows that are not currently being captured in measurements collected at the wastewater treatment plant.

- The average dry weather flow, the average wet weather flow, and the average annual flow will be increased by 28,300 gallons per day (i.e., 40,000 gallons per day – 11,700 gallons per day).
- The maximum month dry weather flow and the maximum month wet weather flow will be increased by 24,000 gallons per day (i.e., 40,000 gallons per day – 16,000 gallons per day).
- The peak day and peak hour flows will be increased by 27,000 gallons per day (i.e., 60,000 gallons per day – 33,000 gallons per day).

Figure 5-6 | Pepsi Northwest Beverages Flowrate History



5.3.4 Summary of Existing Wastewater Flows

Accounting for the flows that are currently permitted from the Pepsi plant, the existing flow estimates presented in Table 5-4 were developed. These flow estimates will be used throughout the remainder of this plan. The wet weather flow components (i.e., MMDWF, MMWWF, PDF, PHF) are intended to be the theoretical maximum values that would occur if all bottlenecks in the system were to be removed.

Table 5-4 | Summary of Existing Flow Estimates

	ADWF	AAF	AWWF	MMDWF	MMWWF	PDF	PHF
Existing Flow (mgd)	0.413	0.636	0.862	0.890	1.39	3.99	7.10

5.3.5 Wastewater Flow Projections

This section builds on the discussions of population projections in Section 5.2 and the existing flow estimates listed in Table 5-4. Projections of future wastewater flows through the planning period were based on the existing flows combined with flow from the anticipated population growth. Peaking factors were used to estimate the increases in wet weather flow components.

The projected wastewater flowrates were based on the following assumptions.

- Population growth will occur in accordance with the projections in Section 5.2.
- Flow rates will increase in proportion to population increase.
- The per capita average dry weather flow rate associated with the population increase will remain constant during the planning period at a value of 100 gallons per capita per day.
- To account for potential growth at the Pepsi Northwest Beverages Plant, it is assumed that the average flow from the Pepsi plant will increase in proportion to population growth in the City. This assumption is conservative since Pepsi has indicated to the City that they do not intent to increase flows during the planning period.
- There will be no contribution from "wet" industries during the planning period. Commercial and industrial development will be "dry" with flows comparable to residential developments.
- The ratio of industrial and commercial development to municipal population will remain constant over the planning period.
- The City's infiltration and inflow reduction program will prevent any increase in infiltration and inflow into the existing collection system. In other words, existing I/I contributions will remain constant.
- All growth will occur in conformance with current land use policies as outlined in the City's Comprehensive Plan.
- The increase in the AWWF over the planning period is equal to twice the increase in the ADWF.
- The increase in the MMDWF over the planning period is equal to twice the increase in the ADWF.
- The increase in the MMWWF over the planning period is equal to three times the increase in the ADWF.
- The increase in the PDF over the planning period is equal to four times the increase in the ADWF.
- The increase in the PHF over the planning period is equal to five times the increase in the ADWF.

Based on these assumptions, the future estimates of wastewater flow listed in Table 5-5 were prepared.

Table 5-5 | Future Wastewater Flow Projections

		Projected Wastewater Flows (mgd)						
Year	Population	ADWF	AAF	AWWF	MMDWF	MMWWF	PDF	PHF
2020	4467	0.488	0.748	1.012	1.040	1.61	4.29	7.47
2025	4715	0.515	0.789	1.067	1.095	1.70	4.40	7.61
2030	4977	0.544	0.832	1.124	1.152	1.78	4.51	7.76
2035	5253	0.575	0.878	1.185	1.213	1.88	4.64	7.91
2040	5544	0.607	0.926	1.250	1.278	1.97	4.77	8.07

5.3.6 Drainage Basin Service Area Flows

The peak discharge from each basin was estimated to evaluate the capacity of the trunk sewers. Estimates of existing peak flows as well as projected peak flows associated with buildout were developed. In Chapter 6, the existing peak flows are used to determine existing deficiencies and the projected peak flows associated with buildout are used for sizing the recommended improvements. Flows associated with buildout conditions are used for sizing purposes because trunk sewers are not suited for incremental expansion. In small Cities like Mt. Angel it is generally more cost effect to install a sewer line sized for complete development of the upstream service area. This is due to the fact that the pipe sizes are relatively small (i.e., less than 24 inches in diameter). Over the life of a particular pipeline it is generally not cost effective to install a smaller diameter pipe (e.g., a 12-inch diameter pipe), then later replace this pipe with a larger pipe (e.g., 18-inch diameter pipe) before the smaller diameter pipe has reached the end of its useful life. Due to the relatively long life cycle of modern pipeline materials (i.e., 70+ years), it is usually more cost effective to install a larger pipe sized for buildout of the upstream basin. For this reason, peak flows associated with complete buildout of the UGB are used in this plan to size the trunk sewers in the City.

The peak flow from each basin at buildout conditions was determined by summing the following quantities.

- Existing average dry weather flow multiplied by a peaking factor of 3
- Existing I/I contribution
- Additional base sewage flow from growth multiplied by a peaking factor of 3
- Additional I/I from future development

In order to allocate existing the ADWF as measured at the treatment plant to each basin, an inventory of the City's users was completed. Water use records were used to generate a list of "unusual" users. Unusual users in this context are defined as users that use significantly more or less water than an equivalently sized residential development. Using this criteria a list of unusual users were identified. The water use for each of these users was allocated to the basin in which the user was located. The remaining ADWF for the "typical" users was determined by

subtracting the total use from the unusual users from the total ADWF for the City. The "typical" user ADWF was allocated to each basin by multiplying the "typical" user ADWF (i.e., Total ADWF minus unusual user ADWF) by the ratio of the remaining sewered area (i.e, total sewered area minus the area of the unusual users) of each basin to total remaining sewered area of the City.

As described in Chapter 6, measurements for infiltration and inflow were collected during a moderate winter storm in March of 2013. This data was used to allocate the existing I/I contributions to each basin. The percentage of the total I/I that was measured for each basin in March of 2013 was multiplied by the percentage of the total peak hour I/I for the entire City.

The additional ADWF associated with growth in the basin was determined by multiplying estimates of sewage flow per acre (Table 5-6) by the area of undeveloped land for each land use within each basin. A peaking factor of three was applied to these values to estimate PHF from new development. The additional I/I from future development was determined by multiplying 1,600 gallons per acre per day by the total undeveloped area within each basin.

Table 5-6 | Flow Rates Per Acre Used for Estimates of Flow from Undeveloped Areas

Land use	Flow (gallons/acre/day)
Commercial	1,500
High Density Residential	4,000
Low Density Residential	1,500
Industrial	1,500
Public	500

The existing peak flows and the projected peak flows at buildout are listed for each collection system basin in Table 5-7.

Table 5-7 | Projected Drainage Basin Service Area Flows at Buildout of the System

Basin	Total Area (Acres)	Sewered Area (Acres)	Unusual User Area (Acres)	Unusual User ADWF[1] (mgd)	Typical User ADWF[1] (mgd)	Existing I/I (mgd)	**Existing PHF (mgd)**	Future ADWF[1,2] (mgd)	Future I/I (mgd)	**Buildout PHF (mgd)**
Basin 1	65	15	0	0.000	0.011	0.045	**0.077**	0.075	0.080	**0.382**
Basin 2	140	66	41	0.030	0.018	0.508	**0.650**	0.104	0.107	**1.228**
Basin 3	120	67	43	0.005	0.017	0.214	**0.278**	0.065	0.085	**0.558**
Basin 4	57	48	0	0.000	0.035	0.265	**0.369**	0.013	0.014	**0.422**
Basin 5	34	34	1	0.010	0.024	0.870	**0.970**	0.000	0.000	**0.970**
Basin 6	75	68	0	0.000	0.049	1.170	**1.319**	0.028	0.011	**1.414**
Basin 7	197	97	37	0.039	0.043	2.058	**2.306**	0.135	0.161	**2.871**
Basin 8	24	24	6	0.002	0.013	0.135	**0.181**	0.000	0.000	**0.181**
Basin 9	150	91	24	0.041	0.049	0.649	**0.919**	0.082	0.094	**1.259**
Totals	862	510	152	0.126	0.259	5.915	**7.070**	0.501	0.553	**9.285**

Notes
1) ADWF multiplied by a peaking factor of 3 to estimate peak hour flow
2) For future ADWF, existing public right-of-ways are not included in the projections

5.4 WASTEWATER LOADS

In addition to the expected wastewater flow, evaluation and design of wastewater facilities requires estimates of the expected loads of various pollutants in the wastewater. Treatment facilities must be designed with operating capacity to treat the highest expected loads of pollutants over the planning period. Pollutants used as design parameters for this study were biochemical oxygen demand (BOD; sometimes referred to as a five-day oxygen demand expressed as BOD_5) and total suspended solids (TSS). The following classifications of wastewater pollutant loads were used.

- Average Load – Average daily wastewater load.
- Maximum Month Load – Daily wastewater load during the maximum month.

5.4.1 Plant Load Records

The City's treatment plant Discharge Monitoring Reports (DMRs) filed with the DEQ for the period from January 2007 through December 2010 were evaluated to identify loading patterns and evaluate current loads to the plant. This data set includes weekly BOD and TSS measurements from 24 hour composite samples taken from the wastewater treatment plant influent flow stream. Since the influent flow data for the 2011 calendar year does not seem to be accurate, the loading data from 2011 is not accurate and was not considered in this analysis.

Pollutant loads in pounds per day were calculated for BOD and TSS using the data sets described above. Pollutant load calculations were based on the concentration for each pollutant multiplied by the influent flow on the day the sample was collected.

The average monthly influent BOD and TSS loads measured at the treatment plant from October 2006 through December 2010 are plotted in Figure 5-7. The annual average influent loading and the maximum month loading are listed in Table 5-8 for BOD and TSS.

Figure 5-7 | Plant BOD and TSS Loading History

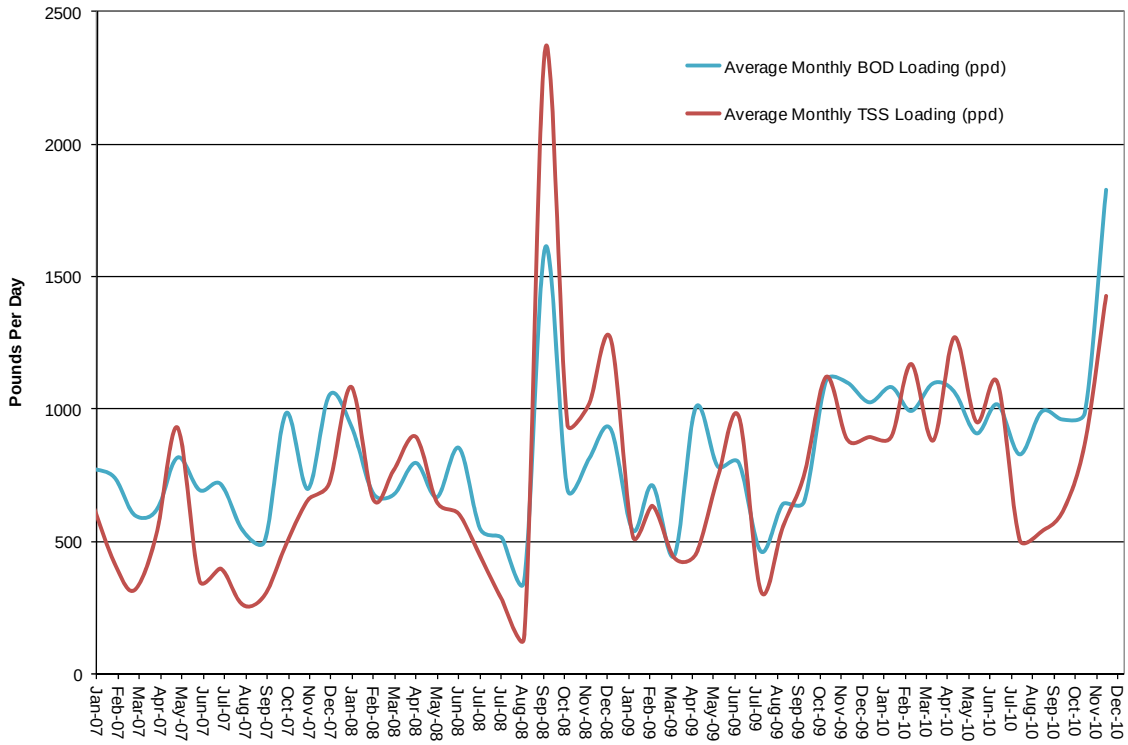


Table 5-8 | Summary of Plant BOD and TSS Loading Data 2007 through 2010.

		BOD Load (pounds per day)		TSS Load (pounds per day)	
Year	Population	Average Annual	Maximum Month	Average Annual	Maximum Month
2007	3755	718	1050	480	721
2008	3785	771	1609	763	2365
2009	3790	707	1104	723	1267
2010	3790	1008	1825	900	1428
Average	3780	801	1397	717	1445

Based on the engineering literature[4], typical BOD values in domestic wastewater fall in the range of 0.11 – 0.26 pounds per capita per day. TSS values are typically in the range of 0.13-0.33 pounds per capita per day. The BOD and TSS loading rates in Mt. Angel are within these ranges. Therefore, this loading data seems realistic and the 2007 through 2010 average loading rates

[4] Metcalf & Eddy. 2003

(Table 5-8) will be used for the existing population. Future influent loading rates that include the existing population and future growth are developed in the following subsection.

5.4.2 Pepsi Northwest Beverages Wastewater Loads

The BOD and TSS loads from the Pepsi plant are significant and are, therefore, considered separately in this analysis. The existing permit issued by the City allows maximum average monthly BOD and TSS loading rates of 35 pounds per day. The permit also sets the maximum daily BOD and TSS loading rate at no more than 55 pounds per day. The following figures show the BOD (Figure 5-8) and TSS (Figure 5-9) loading history from the Pepsi plant. As shown in these figures, the daily and average monthly BOD and TSS loading rates exceed the permit limits for relatively long periods of time. This data indicates that the loading is highest during the winter months. During the summer months, the Pepsi plant is able to comply with the permit limits. However, since the data set covers slightly more than one year, this seasonal variation may not be a regular occurrence and may have more to do with operational choices rather than weather changes.

The BOD and TSS loading rates from the Pepsi plant observed during the early part of 2013 are substantially higher than allowed by the permit. The BOD loading rates exceed 100 pounds per day on a regular basis. This loading rate consumes approximately 10% of the total organic treatment capacity of the City's wastewater treatment plant. TSS loading rates of more than 200 pounds per day are not uncommon. This rate of solids loading is approximately 20% of the total solids treatment capacity of the City's wastewater treatment plant. Solids loading at this rate will ultimately lead to the need to remove sludge from the plant sooner than originally anticipated by the City.

The loading data from the Pepsi plant indicates that it is appropriate for the City to reconsider the approach used to regulate the Pepsi plant. As part of this planning effort, Westech and City personnel met with representatives from the Pepsi plant. The Pepsi representatives indicated that they would make the changes needed to reduce BOD and TSS loading rates below the limits set forth in the permit. Based on this, the City provided direction to Westech to assume that the BOD and TSS loading rates from the Pepsi plant would not exceed 35 pounds per day on a monthly basis. This assumption is carried forward in this plan. However, it is critical that the City re-evaluate their internal policies with respect to enforcing the provisions of the permit for the Pepsi facility. Failure to do so will result in overloading of the wastewater treatment plant. This overloading may lead to plant upsets or violations of the City's NPDES permit. Problems at the wastewater plant caused by the Pepsi facility, may lead DEQ to require the City to implement a formal industrial pretreatment program in accordance with 40 CFR 403. Such industrial pretreatment programs are typically implemented by larger municipalities and are costly to administer. Such a program would likely require the full time efforts of at least one public works staff member. For the City of Mt. Angel, this would represent a significant increase in labor costs for the wastewater utility. As such, it is critical that the City demonstrates to DEQ the ability to manage and control discharges from the Pepsi plant without the need for a formal industrial pretreatment program. Therefore, a recommendation is included at the end of this chapter to re-evaluate the City's approach to regulating the Pepsi plant. This should include an evaluation of

the City's sewer use ordinance to ensure that adequate enforcement authority exists to regulate the Pepsi Plant.

For the purposes of estimating current wastewater loads to the City's plant it has been assumed that the existing BOD and TSS loads listed in Table 5-8 include a loading rate from the Pepsi plant approximately equal to the limits set forth in the permit issued by the City (i.e., 35 pounds per day monthly average). Based on the loading history presented in Figure 5-8 and Figure 5-9 the actual average loading rates from the Pepsi plant were likely higher than 35 pounds per day when the data presented in Table 5-8 was collected. Therefore, the assumption that the loading rates from the Pepsi plant were approximately 35 pounds per day on average during this time is somewhat conservative with respect to estimating existing plant loads.

Figure 5-8 | Pepsi Northwest Beverages BOD Loading History

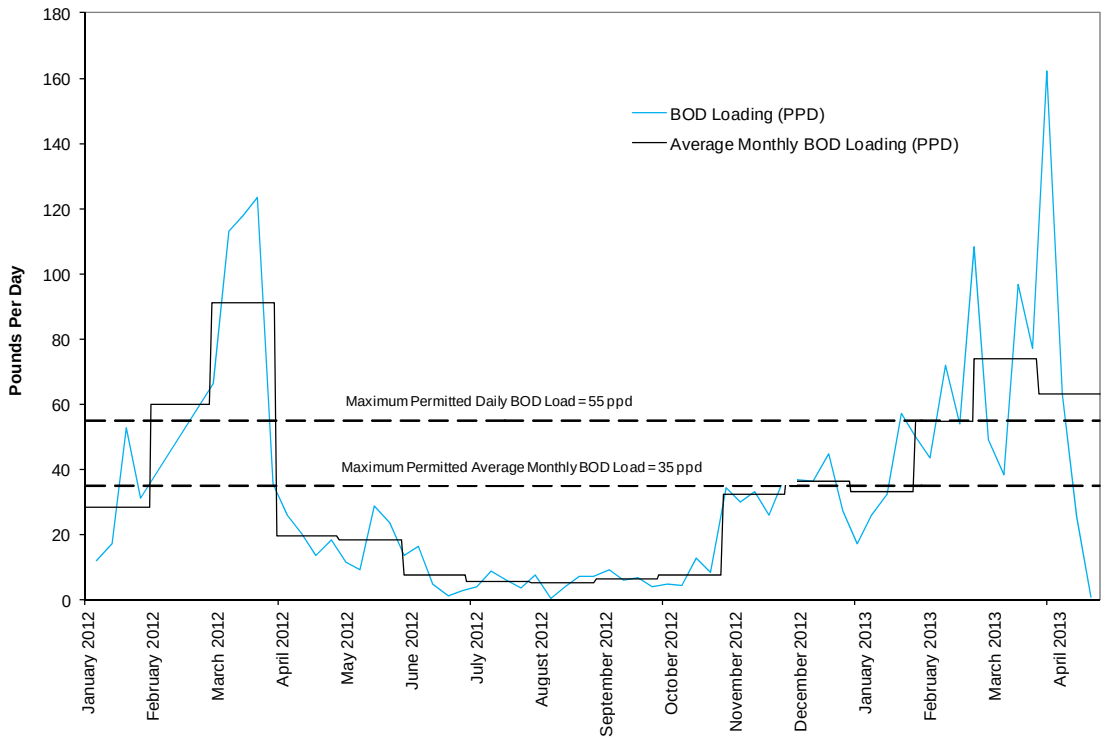
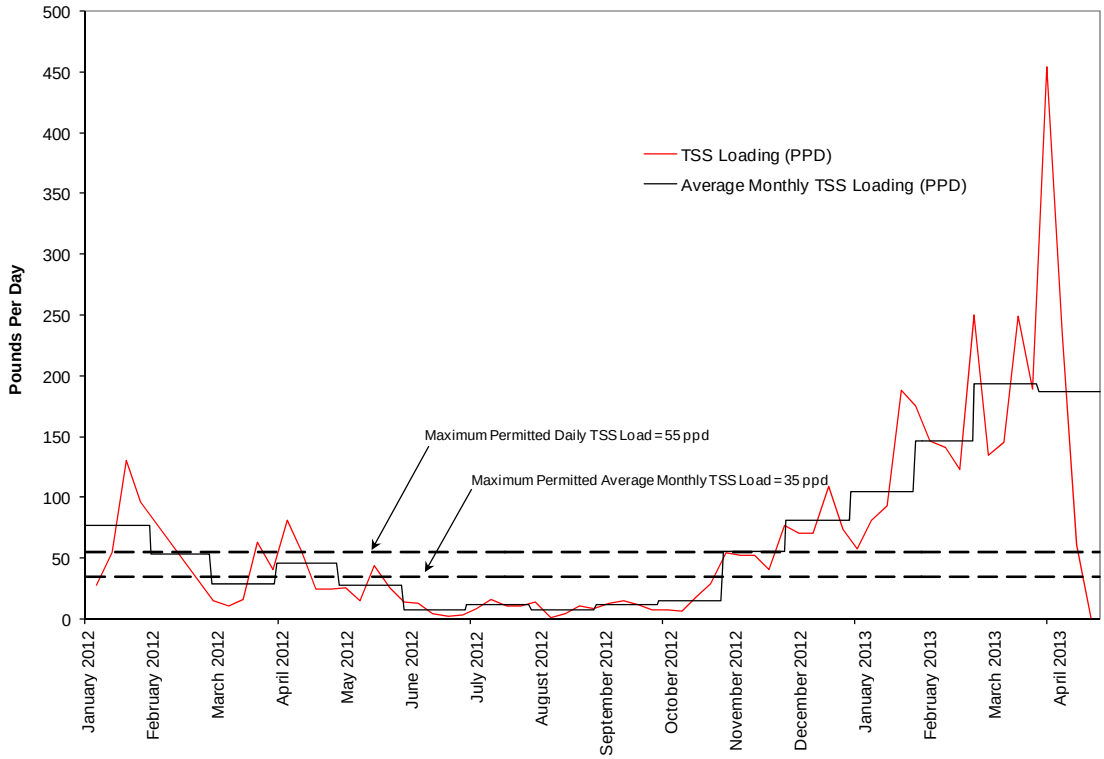


Figure 5-9 | Pepsi Northwest Beverages Suspended Solids Loading History



5.4.3 Load Projections

This section builds on the discussions of population projections in Section 5.2 and the existing load data listed in Table 5-8. Projections of future wastewater loads through the planning period were based on the existing loads combined with loads from the anticipated population growth. Peaking factors were used to estimate the increases in loading rates for the peak month.

The projected wastewater loading rates were based on the following assumptions.

- Population growth will occur in accordance with the projections in Section 5.2.
- BOD and TSS loading rates will increase in proportion to population increase.
- To account for potential growth at the Pepsi Northwest Beverages Plant, is assumed that the average loading rates from the plant will increase in proportion to population growth in the City.
- All growth will occur in conformance with current land use policies as outlined in the City's Comprehensive Plan.
- The per capita BOD loading rate for new population growth will be 0.22 pounds per person per day.
- The per capita TSS loading rate for new population growth will be 0.22 pounds per person per day.

- The ratio of peak monthly BOD and TSS loads to average loads from the municipal population is 1.8.

Based on these assumptions, the future estimates of influent wastewater loads listed in Table 5-9 were prepared.

Table 5-9 | Future Wastewater Load Projections

Year	Population	BOD (ppd)		TSS (ppd)	
		Average Annual	Peak Month	Average Annual	Peak Month
2020	4467	955	1719	871	1568
2025	4715	1011	1820	927	1669
2030	4977	1070	1927	986	1776
2035	5253	1133	2039	1049	1887
2040	5544	1198	2156	1114	2005

5.5 RECOMMENDATIONS

The intent of this chapter is to identify existing flows and loads that must be conveyed and treated by the wastewater pumping and treatment system. Subsequent chapters of this report include more detailed evaluations of each component of the wastewater system. However, this chapter does include the following recommendations.

- The City should evaluate the influent flow measurement system and correct any problems to ensure that no future erroneous readings are collected.
- The City should re-evaluate the policies and approach used the administer the permit for the Pepsi Northwest Beverages facility. This should include an evaluation of the billing calculations used to determine the monthly bills for the Pepsi plant as well as the procedures used to review the flow and loading data from the plant and enforce the provisions of the permit on a monthly basis. The City should also establish a record keeping procedure to establish a long-term data base of flows and loads from the Pepsi plant.

CHAPTER 6

COLLECTION SYSTEM EVALUATION

Chapter Outline

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6.2 Collection System Operation, Maintenance, & Rehabilitation
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- 6.2.2 Present Maintenance Practices
- 6.2.3 Preventative Maintenance Program Recommendations
- 6.2.4 Sewer Cleaning and Inspection Program (Program – 1)
- 6.2.5 Sewer Rehabilitation & Replacement Program (Program – 2)

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- 6.3.1 Gravity Main Capacity Analysis
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- 6.3.3 Summary of Collection System Deficiencies

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- 6.4.2 Reroute Sewage
- 6.4.3 Upgrade Existing Facilities
- 6.4.4 Infiltration/Inflow Reduction
- 6.4.5 Construct New Facilities

6.5 Recommended Gravity Collection System Improvements
- 6.5.1 Recommended Improvements to the Existing Collection System
- 6.5.2 Recommended Improvements to Serve Undeveloped Areas

6.6 Summary of Recommendations

COLLECTION SYSTEM EVALUATION

CHAPTER 6

6.1 INTRODUCTION

This chapter includes an analysis of the collection system. The first subsection focuses on operation, maintenance, and rehabilitation of the collection system. This is followed by the development of alternatives for potential improvements to the wastewater collection system.

This chapter addresses the following key questions:

- What are the current collection system operation and maintenance practices and how can they be improved?
- What are the existing collection system deficiencies?
- What collection system components are likely to become deficient during the planning period or prior to complete buildout of the system?
- What are the alternatives for correcting existing and projected deficiencies?

The existing and projected collection system deficiencies are presented. Where appropriate different alternatives for addressing each of the deficiencies are presented and discusssed. The alternatives are evaluated against each of the collection system deficiencies to generate complete collection system recommendation. In Chapter 7, the treatment system is evaluated and alternatives for correcting treatment system deficiencies are identified and evaluated.

6.2 COLLECTION SYSTEM OPERATION, MAINTENANCE, & REHABILITATION

This section discusses the need for maintenance of the gravity sewer collection piping and provides recommendations for the basic elements necessary for a maintenance program. The need for system-wide preventive maintenance is addressed first, and then the general recommended approaches to collection system maintenance are outlined.

6.2.1 Need for System-Wide Preventative Maintenance

Maintenance of sewerage systems is necessary to insure the proper operation of the facilities and to obtain the full useful life of those facilities. Sanitary sewer systems represent significant investment of public capital. If a sewer system is allowed to fall into disrepair because of the lack of maintenance, it will not operate efficiently or as designed. Health problems and property damage may result from sanitary sewer backups, surcharging and/or overflows. Without proper maintenance, a system's capacity can be reduced by debris clogging, root intrusion growth, structural damage, infiltration and inflow (I/I), and other factors that eventually lead to failures throughout the system. Repair of failed sections of a sanitary sewer system are costly, quite often exceeding the original cost of construction. In spite of this, many jurisdictions do not adequately fund the level of maintenance necessary to protect their investment in the sewerage system. Collection system maintenance can be separated into two types: preventive and corrective.

Preventive maintenance involves scheduled inspection of the system and data gathering to identify problem areas and analysis of this data so that scheduled maintenance can be targeted at specific problems. As a general rule, as preventative maintenance increases, the amount of corrective maintenance required decreases.

Corrective maintenance, often referred to as emergency maintenance, is typically performed when the sewer system fails to convey sewage. Causes for initiating corrective maintenance may include blockages, solids buildup, excessive I/I, flooding and sewer breaks. Corrective maintenance requires immediate action, and the jurisdiction will typically pay a premium to have this work performed.

6.2.2 Present Maintenance Practices

At the present time, the City does not clean and inspect the collection system pipes on a regular basis. The last time the lines were systematically inspected and cleaned was in 1995. On the other hand the City does have a relatively good I/I reduction program. The City currently allocates an average of approximately $50,000 per year for collection system rehabilitation work. Since the late 1990's, the City has rehabilitated a significant amount of the mainline piping by lining with cured in place pipe (CIPP). To date, the City has rehabilitated approximately 8,700 feet of mainline. This amount is equal to 13% of the total mainline pipe in the City. This rehabilitation work has been focused on the mainline piping and no work has been done on the associated service laterals or manholes.

6.2.3 Preventative Maintenance Program Recommendations

The following paragraphs outline some recommendations for implementing preventive and corrective maintenance throughout the City's sanitary sewer collection system. These include the following:

- Establish a systematic sewer cleaning and inspection program.
- Continue with the sewer rehabilitation and replacement program.

6.2.4 Sewer Cleaning and Inspection Program (Program – 1)

It is important that a systematic program for the cleaning and inspection of manholes and gravity sewers be established. Regular cleaning is necessary to prevent blockages, grease accumulation and sediment buildup in sewer lines. Normally, sanitary sewers laid at steep grades require less frequent cleaning than those laid at flat grades. Sewers at flat grades can experience sedimentation and grease buildup problems and will require more frequent cleaning and maintenance. Since nearly all of the sewers in Mt. Angel are laid at flat grades, routine cleaning is especially important.

As part of the cleaning program, it is important that the City continue to keep records, including conditions encountered such as pipe failures, grease and solids buildup, and other problems. These records are useful in scheduling corrective work and to establish a long term cleaning frequency schedule for different sewers. As the database is established, a schedule for subsequent cleaning can be tailored to the physical character of each line, the area served, and its

performance history. Specific problem areas requiring more frequent cleaning can be incorporated into this program.

The inspection component of the program should include both above ground and internal inspection of the sewer system. Above ground inspection is performed by inspecting right-of-ways and easements and noting evidence of structural failure, flooding, manholes covers above or below the present level of streets, or other problems.

The two common methods of internal inspection are TV inspection performed in conjunction with the cleaning activities, and smoke testing. TV inspection of a sewer system utilizes a specially designed television camera and equipment to view the interior of the piping system. A videotape and written record of the inspection is generated and retained by the City. Leaking sewer service connections, debris or root buildup, structural failures, leaking joints and other problems can be easily identified and documented. TV inspection of sewers requires that the sewers be cleaned immediately prior to the inspection. TV inspection of sewers is typically performed during the winter months so that sources of I/I can more easily be noted and identified.

Smoke testing is conducted by blowing harmless nontoxic smoke into the sewer system and observing the points at which it escapes. Smoke testing is typically performed during the summer months so that groundwater does not interfere with the smoke. Smoke testing can be used to identify potential leaks into the system caused by broken pipes, bad joints, manhole failures, and similar deficiencies. Smoke testing is also very effective for locating storm sewer cross connections and illegal connections such as roof and foundation drains. The equipment necessary to perform smoke testing is relatively inexpensive and can be purchased by the City. As the City continues to implement I/I corrective work, smoke testing will be a useful tool for prioritizing problem areas.

The total length of the City's collection system piping is approximately 65,000 feet. The City does not own the equipment needed to clean and inspect the sewer system. Therefore, this work will need to be performed by a contractor. From a practical standpoint, a contractor will clean and TV inspect a particular line segment at the same time. The costs for this work are currently about $1.50 per foot of mainline pipe. It is recommended that the program be funded with the goal of cleaning and inspecting every line in the City at 10 year intervals. This requires cleaning and inspecting approximately 6,500 feet of mainline per year at an annual cost of approximately $10,000. In addition to this work, it is also recommended that the City smoke test the entire collection system over the same 10-year period. Most contractors that perform TV inspection work will also perform smoke testing for the City. The costs for smoke testing are about $0.40 per foot of mainline pipe. Therefore, the recommended annual budget for smoke testing is $2,600 (e.g., 6,500 feet/year * $0.40 per foot). Adding this amount to the cost for the cleaning and inspection, the recommended annual budget for the cleaning and inspection program is $13,000 per year.

6.2.5 Sewer Rehabilitation & Replacement Program (Program – 2)

A sewer rehabilitation and replacement program should include mainline, manhole, and service lateral rehabilitation or replacement. This type of sewer rehabilitation program may also be

referred to as an I/I reduction program. The City's past rehabilitation efforts have not addressed the service laterals. Moving forward, we recommend the City begin to address service laterals as they are a significant portion of the collection system piping and contribute significant amounts of I/I.

The City's existing collection system is similar to other systems in Oregon in that it collects large amounts of I/I. The system is showing signs of aging and will continue to age and deteriorate. As such, it is important for the City to continue to rehabilitate the system during the planning period. Failure to continue with rehabilitation efforts will lead to major system failures that may need to be repaired under emergency circumstances. Periodic emergency repairs are likely to be more costly to the City in the long-run when compared to a more systematic rehabilitation program implemented on an annual basis. As noted above, the City currently allocates approximately $50,000 per year from sewer rehabilitation projects. Based on our analysis this amount is insufficient and should be increased to approximately $100,000 per year. The basis for this recommendation is presented in the following paragraphs.

To determine the appropriate funding rate for an I/I reduction program, one simply needs to sum all the mainlines, manholes, and service laterals that are to be included in the rehabilitation scheme (i.e., determine the scope of the work effort), estimate the total cost of rehabilitating these facilities, and determine the number of years over which the rehabilitation should occur.

To determine the scope of the rehabilitation effort, the areas of the collection system that collect the most I/I were first identified. Flow projections by sewer basin are presented in Chapter 5 (Table 5-7). These projections include an estimate of the existing peak I/I contribution from each basin. Dividing this number by the total sewered area in each basin provides a means to compare the various sewer basins to determine which generate the most I/I. The basins that contribute the greatest amount of I/I per sewered area are considered the areas where I/I reduction efforts will be most effective. This analysis is included in Table 6-1. As shown basins, 5, 6, and 7 contribute significantly more I/I than the other sewer basins. Therefore, initial I/I corrective work should be focused in these three basins.

Table 6-1 | Sewer Basin I/I Evaluation

Basin	Total Area (Acres)	Sewered Area (Acres)	Existing Peak I/I (mgd)	**I/I Per Sewered Area (gal/ac-day)**
Basin 1	65	15	0.045	2,981
Basin 2	140	66	0.508	7,751
Basin 3	120	67	0.214	3,215
Basin 4	57	48	0.265	5,491
Basin 5	34	34	0.870	**25,662**
Basin 6	75	68	1.170	**17,132**
Basin 7	197	97	2.058	**21,287**
Basin 8	24	24	0.135	5,616
Basin 9	150	91	0.649	7,136

Inspection of the sewer maps shows that the basins 5, 6, and 7 include several different pipe types and ages. For this plan, it has been assumed that all PVC lines are in good condition and do not need to be included in the rehabilitation plan. The lines that have recently been rehabilitated using cured in place pipe are also not included in the plan. This leaves only the lines that are concrete, vitrified clay, and AC. The total mainline length of concrete, vitrified clay, and AC lines in basins 5, 6, and 7 is approximately 12,620 feet. Of this amount, approximately 4,080 feet of mainlines are targeted for replacement as part of the recommended improvements listed below. As such, these lines are already scheduled to be replaced and are not included in the scope of the sewer rehabilitation plan. Therefore, Basins 5, 6, and 7 include approximately 8,540 feet of mainline rehabilitation work. Basins 5, 6, and 7 also include approximately 74 manholes and an estimated 23,000 feet of service lateral pipe. We have assumed that approximately 65% of the manholes and service laterals will need to be rehabilitated. The total cost for this recommended rehabilitation work is listed in Table 6-2.

Table 6-2 | Sewer Rehabilitation Program Total Costs

Item	Quantity	Unit Cost	Total Cost
Sewer Mainline	8,540 ft (1)	$100 / ft (2)	$854,000
Sewer Manholes	48 (3)	$5,000 / each	$240,000
Service Laterals	14,950 ft	$60 / ft	$897,200
Total Rehabilitation Construction Cost			**$1,991,000**

Notes:
(1) Total length of concrete, vitrified clay, and AC pipe in basins 5, 6, and 7 less the amount of mainline already scheduled for replacement.
(2) Average unit cost based on a typical mix of CIPP, pipe bursting, and open cut reconstruction.
(3) 65% of the total number in basins 5, 6, and 7.

As shown (Table 6-2), the total costs for the recommended rehabilitation project is $1,991,000 in 2013 dollars. To account for soft costs, engineering is assumed to be 15% of the construction cost. Legal, permitting, and administration costs are assumed to be 5% of the construction cost. A construction contingency of 5% is also added. Therefore, the total soft costs are assumed to be 25% of the construction costs. Including soft costs, the total project costs for the recommended I/I reduction plan is approximately $2,490,000. We recommend this work be completed over a 25 year period. At the end of this period other portions of the collection system will be an additional 25 years older and will have deteriorated further. Therefore, once the rehabilitation efforts are completed in basins 5, 6, and 7, future rehabilitation efforts should focus on other areas in the City. As such, the City should consider funding the recommended rehabilitation effort indefinitely.

Assuming that the recommended rehabilitation work is completed over 25 years, the annual funding rate should be approximately $100,000 per year. As with all the cost estimates presented in this plan, this budget amount is in 2013 dollars and will need to be adjusted over the years to account for increases in construction costs. As noted in Chapter 4, the City's existing NPDES permit requires the preparation of an inflow reduction plan. The City should use funds from the

sewer rehabilitation and replacement program to complete the required inflow reduction plan as soon as possible.

6.3 COLLECTION SYSTEM DEFICIENCIES

The purpose of this section is to determine the components of the existing collection system that are or will become deficient. This includes components that lack capacity to convey existing peak flows or will lack capacity as flows increase due to growth. Some collection system deficiencies were identified in Chapter 4. This section is intended to supplement those discussions. Together with the deficiencies listed in Chapter 4, the intent of this section is to present an overall list of deficiencies that must be addressed by the City.

6.3.1 Gravity Main Capacity Analysis

The peak design flows developed in Chapter 5 were used as the basis for an evaluation of the existing sanitary sewer trunk lines. Pipe sizes, lengths, slopes, and locations were determined from City records and field surveys. The evaluation was limited to the main trunk lines conveying sewage through the basins. This approach was taken since most of the pipes within a basin will actually encounter only a fraction of the capacity of the pipe. Typical practice is to construct sewer lines with pipe no smaller than 8-inches in diameter. This facilitates solids conveyance, cleaning, and maintenance. In the upper ends of the drainage basins, flows do not approach the capacity of the 8-inch diameter pipes. Therefore, it is not necessary to model all of the smaller diameter pipes in the collection system.

A model of the main trunk lines was developed using the SWMM5 hydraulic model. The hydraulic model simulates the routing of flow through the collection system. SWMM5 is a fully dynamic model that can simulate backwater, surcharging, split flows, and looped connections that occur in sewer systems. The peak drainage basin service area flows (Table 5-7) were used as inputs to the model. Both the existing peak flows and the projected peak flows associated with buildout were used in the modeling effort. The existing peak flows were used to determine existing deficiencies, and the projected peak flows associated with buildout were used for sizing the recommended improvements. The choice to use flow projections associated with buildout of the collection system for trunk sewer sizing is based on the fact that buried sewer collection pipes are not well suited for incremental expansion. Cases rarely exist where it is appropriate to size trunk sewers for 20 year flow projections. The design life of buried sewer collection pipes is 50-70 years. Therefore, it is not cost effective to upsize these sewer pipelines at 20-year intervals. It is more cost effective to size these facilities to convey projected peak flows associated with buildout of the entire basin.

The existing and projected flow estimates were added to the main trunk lines where their respective basins discharge into the main trunk lines. The model was run until steady-state flow conditions were achieved. These steady state conditions were used to locate the collection system deficiencies. This approach is somewhat conservative since, in reality, the peak drainage basin service area flows only persist for a short period of time (e.g., a few hours). After these peaks, the flows will begin to decrease and steady state conditions are not likely to actually occur.

Though somewhat conservative, this steady-state approach is reasonable for smaller systems like Mt. Angel.

The model was used to identify capacity deficiencies. Capacity deficiencies are defined as locations where overflows occur and flow does not reach the treatment plant, or where a pipe is surcharged and the hydraulic grade line (HGL) is within a specified distance from the ground surface. For the purposes of this analysis, pipe surcharge is allowed. When the modeled water surface reached a level less than 6 feet from the ground surface (freeboard less than 6 feet) a deficiency was identified. The 6-foot freeboard deficiency criterion was determined to be appropriate for short-term peak flows and adequate to protect from overflows. Basement flooding was not considered to be a significant concern given the relatively limited number of basements in the City and the lack of historical basement flooding complaints. For shallow pipes (pipes with less than 8 feet of available freeboard measured from ground to top of pipe) a capacity deficiency criterion that allows no more than 2 feet of surcharge was used instead of 6 feet minimum freeboard allowed for deeper pipes. The capacity deficiencies identified by the hydraulic analysis indicate where improvements may be needed to ensure that overflows do not occur and that adequate capacity is provided.

The hydraulic model was used to identify capacity deficiencies in the existing trunk sewer system as shown in Figure 6-1. As noted above, the flows used for this analysis are the existing peak drainage basin service area flows (Table 5-7). The hydraulic model predicts widespread surcharging throughout the City. The surcharging extends well beyond the limits indicated in Figure 6-1. However, this widespread surcharging is generally the result of the undersized trunk sewers shown in Figure 6-1. Therefore, not all surcharged manholes are shown in Figure 6-1 for the sake of clarity. The model predicts surface flooding at the following locations.

- Manhole #8 near Mt. Angel-Gervais Road
- Manhole #47 near the intersection of Marquam and Monroe Streets
- Manhole #130 near the intersection of May and Spruce Streets
- Manhole #78 near the intersection of John and May Streets
- Manhole #79 near the intersection of Garfield and Taylor Streets

Based on further analysis, the overflows at manholes #78 and #79 are the result of downstream capacity problems that can be corrected with downstream capacity improvements. As shown in Figure 6-1, the following trunk sewer segments do not have the capacity to convey the existing peak hour flows from the collection system.

- *"Main Trunk Sewer From Manhole #5 to Manhole #9"*

The "Main Trunk Sewer" starts at the wastewater treatment plant and extends across farmed fields to manhole #9 on Marquam Street. The lower portion of this trunk sewer includes 24-inch PVC pipes that were constructed in the mid 1990s as part of the treatment plant improvement project. This lower portion has adequate capacity to convey existing peak flows. The upper portion of this trunk sewer between manholes #5 and #9 includes 18-inch concrete pipe. This 18-inch segment lacks the capacity to convey existing peak flows.

- *"North Trunk Sewer"*

The "North Trunk Sewer" discharges into the Main Trunk Sewer at manhole #9. From manhole #9, the "North Trunk Sewer" continues east upstream on Marquam Street and ends at manhole #60 on Main Street. This entire trunk sewer segment lacks the capacity to convey existing peak flows.

- "*South Trunk Sewer"*

The "South Trunk Sewer" discharges into the Main Trunk Sewer at manhole #9 on Marquam Street. From manhole #9, the "South Trunk Sewer" continues south across farmed fields to Church Street. At Church Street the "South Trunk Sewer" jogs east, then south to May Street. At May Street, the "South Trunk Sewer" jogs east then south along South Pershing Street to manhole #136. From Manhole #136, the south trunk sewer extends east between homes and crosses Main Street and Highway 214. This entire trunk sewer segment lacks the capacity to convey existing peak flows.

6.3.1 Collection System Improvements to Serve Currently Undeveloped Areas

There are a number of areas within the City that are currently undeveloped and lack gravity sewer service. New gravity mainlines will need to be installed to serve these areas as they develop. Current City ordinances require that mainlines required to serve these areas be installed at the expense of the developer. These lines should be sized as required to serve all upstream areas.

6.3.2 Summary of Collection System Deficiencies

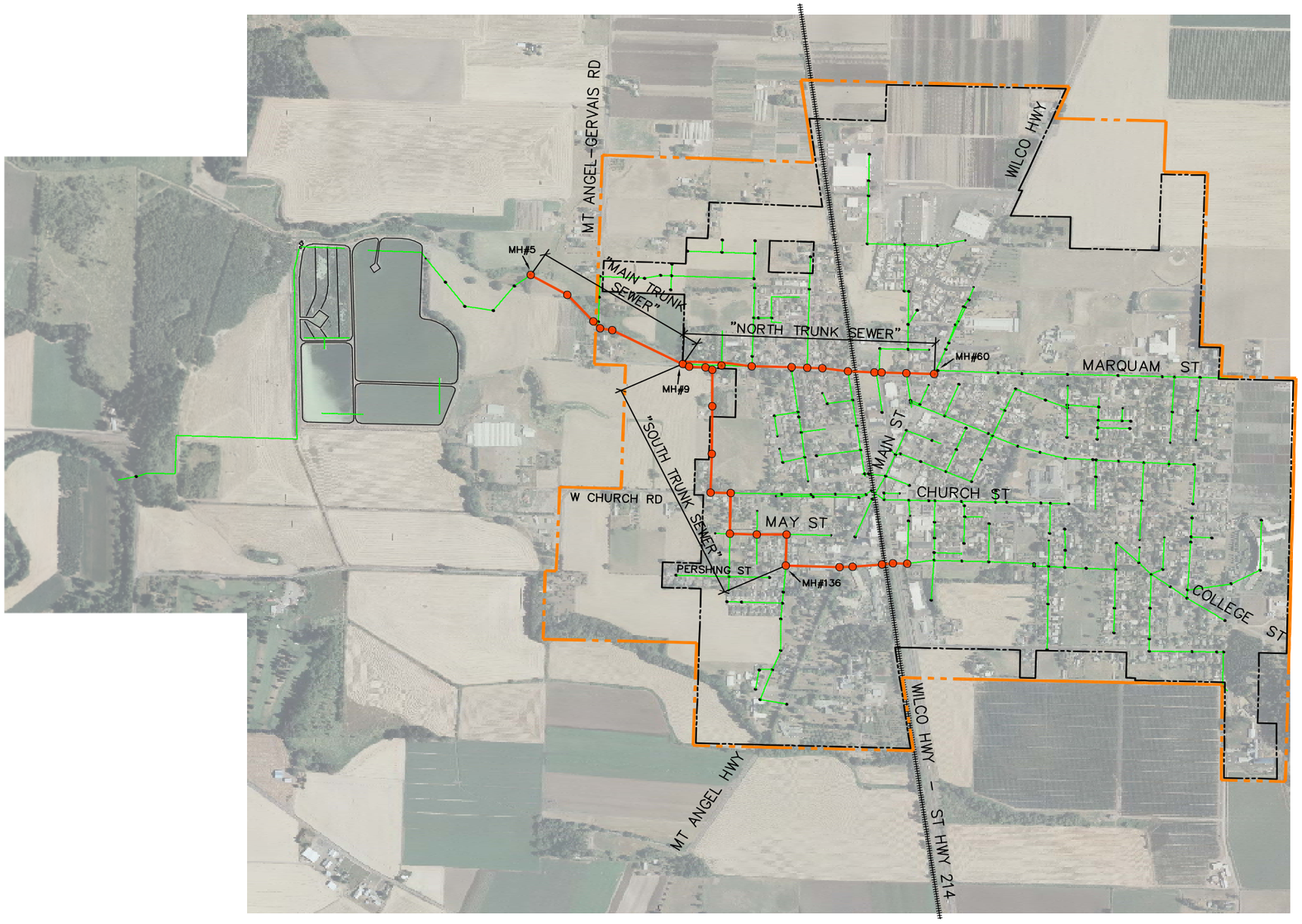
The known deficiencies described in Chapter 4 have been combined with the deficiencies described above to develop a complete list of collection system deficiencies. These deficiencies are listed in Table 6-3.

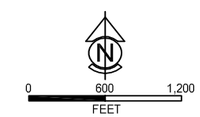
Table 6-3 | Summary of Collection System Deficiencies

Location (note 1)	**Problem Category**
Main Trunk Sewer from Manhole 5 to Manhole 9	Lack of Capacity
North Trunk Sewer Marquam Street from Manhole 9 to Manhole 60	Lack of Capacity, High I/I
South Trunk Sewer from Manhole 9 to Manhole 146	Lack of Capacity, High I/I
Sewer Line from Manhole 136 to Manhole 144	End of Useful Life, Obstruction
Basin 5	High I/I
Basin 6	High I/I
Basin 7	High I/I
Undeveloped Areas	No Sewer Service

Note 1: See collection system maps in Appendix C for manhole numbering. See Figure 4-2 for collection system basin map.

Figure 6-1 | Existing System Capacity Analysis





LEGEND

- Manhole Freeboard 0-2 feet
- Line Lacking Capacity
- Existing Sanitary Sewer System
- City Limits
- Urban Growth Boundary

FIGURE 6-1

6.4 COLLECTION SYSTEM ALTERNATIVES

The shortcomings identified in Table 6-3, will need to be addressed by implementing a comprehensive I/I correction program, increasing the size of many of the trunk sewers, and extending gravity sewer service to currently undeveloped areas.

Facilities planning requires the examination of a broad range of alternatives for each portion of the wastewater system. This section examines the alternatives for collecting wastewater within the study area and conveying it to the point of treatment. This section develops and screens wastewater collection alternatives using criteria such as land requirements, topographic constraints, reliability, operational flexibility, construction and long-term O&M costs, and regulatory restrictions. The alternatives listed in this section represent the tools used in the facilities planning effort to address the previously listed deficiencies in order to provide a comprehensive long-term solution for the City's collection system.

6.4.1 No Action

The no action approach implies that no improvements will be made to the existing collection system (excluding maintenance or repairs). Obviously, this approach is recommended for those areas of the system which have sufficient capacity to convey the design flows and are in acceptable condition. Although this approach may be justified in isolated areas within the system on a case-by-case basis where there is insufficient capacity to convey peak design flows (i.e., minor surcharging for short periods of time), this approach is effectively eliminated by DEQ guidelines and regulations.

Although it is always an option to not improve the system, the result will be health risks, damages, and inconveniences where sewage collection and facilities are inadequate. Furthermore, delaying required improvements almost inevitably leads to a greater future problem. However, to ensure that system improvements are justified, it is necessary to consider the costs and advantages of proposed improvements against the risks entailed by the no action alternative. It should be noted that since resources are limited and the sewer system cannot be upgraded all at one time, the phasing plan adopted by the City for the improvements will in effect require that the no action alternative be adopted on a temporary basis for all but the first phase improvements.

6.4.2 Reroute Sewage

Under this scenario, sewage would be diverted or rerouted from one sewer basin or system to another. This approach is practical in cases where an existing sewer has capacity in excess of that needed to convey design flows from that basin, and where flow diversion is practical from a construction and topographic standpoint.

6.4.3 Upgrade Existing Facilities

This approach involves constructing replacement pipes to provide adequate capacity for the design flows. This is the most obvious alternative since it provides assurance that the sewage

collection system can convey the design flows through town and that overflows will be kept to a minimum, which in turn limits the City's liability.

6.4.4 Infiltration/Inflow Reduction

As stated previously, the collection system collects large amounts of I/I during the winter months. While reduction of the existing I/I flows and minimization of future I/I flows is important, experience in western Oregon has shown that the goal of complete elimination of I/I is unreasonable and largely unattainable. For the purposes of this study, it was assumed that I/I reduction efforts would keep I/I amounts at their current level. In other words, no reduction in flows is assumed as a result of the recommended sewer rehabilitation and replacement program (i.e, Program-2). This assumption is based on the idea that I/I reduction should be an ongoing work effort included in the City's maintenance budget indefinitely. This approach is recommended because as the I/I corrective work is performed, other areas in the collection system will continue to age and deteriorate and new I/I sources will appear over time. These new I/I sources will replace the I/I sources that were removed as a result of the corrective work. This assumption may turn out to be somewhat conservative. If so, future flow projections during the next planning cycle can be adjusted accordingly.

6.4.5 Construct New Facilities

The construction of new collection system components including trunk sewers, lift stations, and force mains is the only method considered herein for providing service to undeveloped areas. This method basically involves extending the conventional gravity collection system into the undeveloped areas and installing new pump station where topographical limitations require. Septic tank effluent pumping (STEP) or Septic tank effluent gravity (STEG) collection systems were not considered practical given the City's reliance on a conventional gravity system and the potential deterioration of concrete components in the existing system from hydrogen sulfide present in STEP and STEG effluents.

6.5 RECOMMENDED GRAVITY COLLECTION SYSTEM IMPROVEMENTS

To address the I/I problems in basins five, six, and seven, implementation of the I/I reduction plan (i.e., Program-1) is recommended. This program is discussed in greater detail above.

To address the capacity problems listed in Table 6-3, it is recommended that these sewer segments be replaced with larger diameter lines. There are essentially no opportunities to reroute sewage through other nearby lines and the only practical alternative is to replace these lines. When these lines are replaced, it is also recommended that the manholes and service laterals either be replaced or rehabilitated to help control I/I. As shown in Figure 4-5, the recommended trunk sewer replacement projects will result in the replacement of several line segments with the worst I/I problems. Therefore, it is important, and will be most cost effective, to replace or rehabilitate the manholes and service laterals at the same time the mainlines are being replaced.

To provide service to areas that are currently undeveloped, recommended trunk sewer sizes and conceptual alignments are also recommended. It is important to note that the actual alignment of

these sewers will likely change when the undeveloped areas are platted and the public right of ways are established.

As noted previously, the recommended pipe sizes are based on complete buildout of the UGB in its current configuration. The decision to size the trunk sewers to convey peak flows associated with buildout conditions is based on the fact that buried trunk sewer pipelines are not well suited for incremental expansion. In other words, it is more cost effective in the long-run to install trunk sewers sized for complete buildout of the upstream basin rather than for 20-year flow projections.

The recommended sewer pipeline improvements are described in the following subsections. The recommended improvements to the existing system are shown graphically in Figure 6-2. The recommended improvements needed to serve currently undeveloped areas are shown in Figure 6-3.

The recommended project budgets for each project are listed in Table 6-4. A detailed breakdown of the construction costs, contingency, design, and administration costs are included in Appendix E. The cost estimates for the improvements to the existing collection system are generally based on open cut construction techniques. The cost estimates also include manhole replacement and replacement of the public and private portions of the service laterals. The cost estimates for the sewer line extensions needed to serve undeveloped areas only include the pipeline and manhole costs.

6.5.1 Recommended Improvements to the Existing Collection System

- *Main Trunk Sewer – Manhole #5 to New Manhole #100 (Project G-1)*

The existing 18-inch diameter pipeline lacks the capacity to convey existing peak flows and needs to be upsized. The recommended pipe size and material are 24-inch PVC. The total length of the project is approximately 2,040 feet. East of manhole #9, the north trunk sewer and south trunk sewer run parallel in Maquam Street. The recommend improvements include removing this parallel configuration by placing a new manhole #100 along the alignment of the trunk sewer in Marquam at the location where a northern projection of the south trunk sewer would intersect. This will result in the elimination of the existing manhole #99, and #100 and will simplify the collection system. It is logical that this project (i.e., Project G-1) will be constructed before the adjacent projects (i.e., G-2 and G-5). Therefore a short segment of line that crosses to the south side of Marquam Street must be extended from the proposed new manhole #100 to the existing manhole #101 to pick up flow from the south trunk sewer.

- *North Trunk Sewer – Marquam St. MH #100 to Pershing Street Manhole #20 (Project G-2)*

The existing 14 and 15-inch diameter pipes lack the capacity to convey existing peak flows. These pipes also collect large amounts of infiltration and inflow as show in Chapter 4. The recommended improvements include replacing the existing pipes with approximately 900 feet of new 18-inch diameter PVC pipe.

- *North Trunk Sewer - Marquam Street MH #20 to Railroad MH #25(Project G-3)*

The existing 14-inch diameter pipes lack the capacity to convey existing peak flows. These pipes also collect large amounts of infiltration and inflow as shown in Chapter 4. The recommended improvements include replacing the existing pipes with approximately 400 feet of 15-inch diameter PVC pipe.

- *North Trunk Sewer - Marquam Street MH #25 to Main St MH #60 (Project G-4)*

The existing 8-inch diameter pipes lack the capacity to convey existing peak flows. These pipes also collect large amounts of infiltration and inflow as shown in Chapter 4. The recommended improvements include replacing the existing pipes with approximately 830 feet of 12-inch diameter PVC pipe. This section includes a railroad crossing. The recommended project budget includes funds needed to install this pipe in an auger bored casing under the railroad. This segment also includes a crossing of Main Street which is an ODOT right of way. The cost estimate is based on an open cut crossing of Main Street.

- *South Trunk Sewer - Segment 1 New MH #100 to May Street MH #130 (Project G-5)*

This project is needed to increase the capacity of the south trunk sewer. This portion of the south trunk sewer also collects large amount of I/I as shown on Chapter 4. The project will start at the new Manhole #100 installed a part of project G-5 and continue south across the farmed fields to Church Street. The pipeline will make run east in Church street for a short distance to Manhole #105. From Manhole #105, the proposed pipeline will head south along the Spruce Street right of way across the City Park to Manhole #130. The existing pipeline along this entire alignment is 15-inches in diameter. The recommended improvements include replacing this pipeline with a approximately 1,950 feet of 18-inch diameter PVC pipe.

- *South Trunk Sewer - May Street MH #130 to MH #135 (Project G-6)*

This pipeline segment was constructed with concrete pipe and collects large amounts of I/I as shown in Chapter 4. The existing pipe is 15-inch diameter pipe that does have the capacity to convey the projected peak flows. However, this pipeline is known to have a significant I/I problem and both the upstream and downstream portions of the South Trunk Sewer are recommended to be replaced with PVC pipe. Therefore, in an effort to reduce I/I and to ensure continuity of pipeline materials in the South Trunk Sewer, replacement of this segment is also recommended. This segment is approximately 500 feet long. The recommended project budget is based on open cut construction techniques in an effort to be conservative. However, the final design may utilize a cured in pipe liner (CIPP) if the structural integrity of the existing concrete pipe is adequate. This approach could result in final costs being somewhat lower than the recommended budget. That said, the proposed project budget shown in Table 6-4 is recommended for planning purposes since it is unknown at this time if the line can be rehabilitated with CIPP.

- *South Trunk Sewer – South. Pershing Street MH #135 to MH #136 (Project G-7)*

This project is needed to increase the capacity of the existing 12-inch concrete pipe. In addition to lacking capacity, this segment also collects large amounts of I/I as shown in Chapter 4. This segment of the collection system is approximately 325 feet long. The recommended improvements include the installation of a 15-inch PVC pipeline.

- *South Trunk Sewer - MH #136 to MH #146 (Project G-8)*

This project is needed to increase the capacity of the existing 10-inch lines. The recommended improvements include the installation of approximately 1,200 feet of 12-inch diameter PVC pipe. The recommended project budget is based on open-cut construction techniques. However, portions of this pipeline pass through the backyards of existing houses. This section also includes an ODOT highway crossing and a railroad crossing. Based on these complications, the

it may be advantageous to use pipe bursting techniques for the installation of this segment. The recommended project budget is based on open cut construction techniques. Should the final design utilize pipe bursting, the final costs could be somewhat lower than the recommended budget. That said, the proposed project budget shown in Table 6-4 is recommended for planning purposes since it is unknown at this time if pipe bursting is feasible.

- *Construct New Line to Route Wastewater from Manhole 115 to Manhole 109 (Project G-14)*

This project is needed to repair a collapsed section of mainline immediately downstream of Manhole 115 in Main Street (Section 4.3.6). This section of line is collapsed under the railroad tracks and repairs in place will be difficult due to the inability to excavate under the railroad tracks. For this reason, we recommend constructing a new sewer line from manhole 115 to manhole 109. This will reroute wastewater such that a crossing of the railroad tracks is no longer required. The existing line can then be abandoned by constructing a cleanout on the northeast side of the railroad tracks and filling the line under the railroad tracks with grout. The total recommended budget for this project is $50,000.

6.5.2 Recommended Improvements to Serve Undeveloped Areas

Several large areas of undeveloped land exist inside the UGB. Some of these parcels will be served by relatively short extensions of the existing system. These relatively short extensions are not discussed in this section since the needed line extensions are relatively obvious. This section does identify five sewer extension projects that are needed to serve the larger parcels of undeveloped land within the UGB. It should be noted that the alignments shown in Figure 6-3 are conceptual in nature and the final alignments, overall project lengths, and costs will depend upon the locations of future right of ways and similar development patterns. It is envisioned that these improvements will largely be built by developers as these larger portions of undeveloped land are annexed and developed.

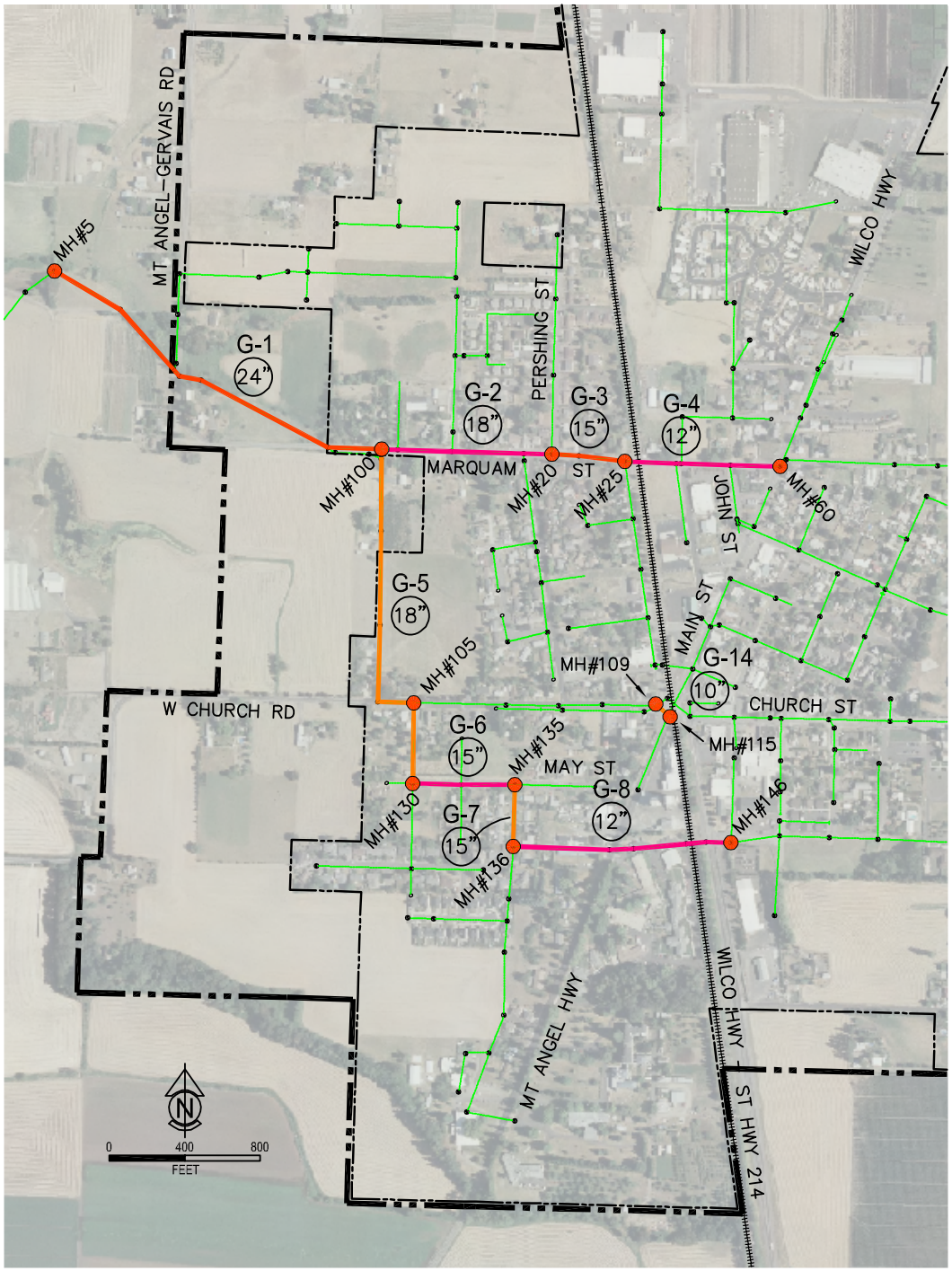
- *Sewer Basin 1 Trunk Sewer (Project G-9)*

This project is needed to serve the undeveloped area within the UGB in the northwest corner of the City. This area is located in sewer basin 1. The recommended improvement includes the extension of an 8-inch diameter line north from manhole #230 at the intersection of Hayes Street and the Mt. Angel – Gervais Road. The estimated trunk sewer length is 2,400 feet.

- *Sewer Basin 2 West Trunk Sewer (Project G-10)*

This project is needed to serve the undeveloped area within the north-central portions of the UGB. This area is bounded on the west by the railroad and on the east by Main Street (Hwy 214). This area includes the western portion of sewer basin 2. The recommended improvement includes the extension of an 8-inch diameter line east from manhole #55 near the Mt. Angel Beverage Company Building. The estimated trunk sewer length is 1,400 feet.

Figure 6-2 | Recommended Improvements to the Existing Collection System



- *Sewer Basin 2 East Trunk Sewer (Project G-11)*

This project is needed to serve the undeveloped area within the north-east portions of the UGB. This area includes the eastern portion of sewer basin #2 east of Main Street (Hwy 214). At this time, the basin boundary between sewer basin #2 and basin #3 corresponds to a ridge in the topography east of Main Street. As these areas develop, the final basin boundary may change and may not strictly follow the topographic divides. The City must carefully review any changes to the basin boundaries to ensure that the collection system downstream of the recommended extensions is adequately sized to handle any flow increases that might result from shifting the basin boundaries. The recommended improvement includes the extension of an 8-inch diameter line east North from cleanout #188 for approximately 1,200 feet.

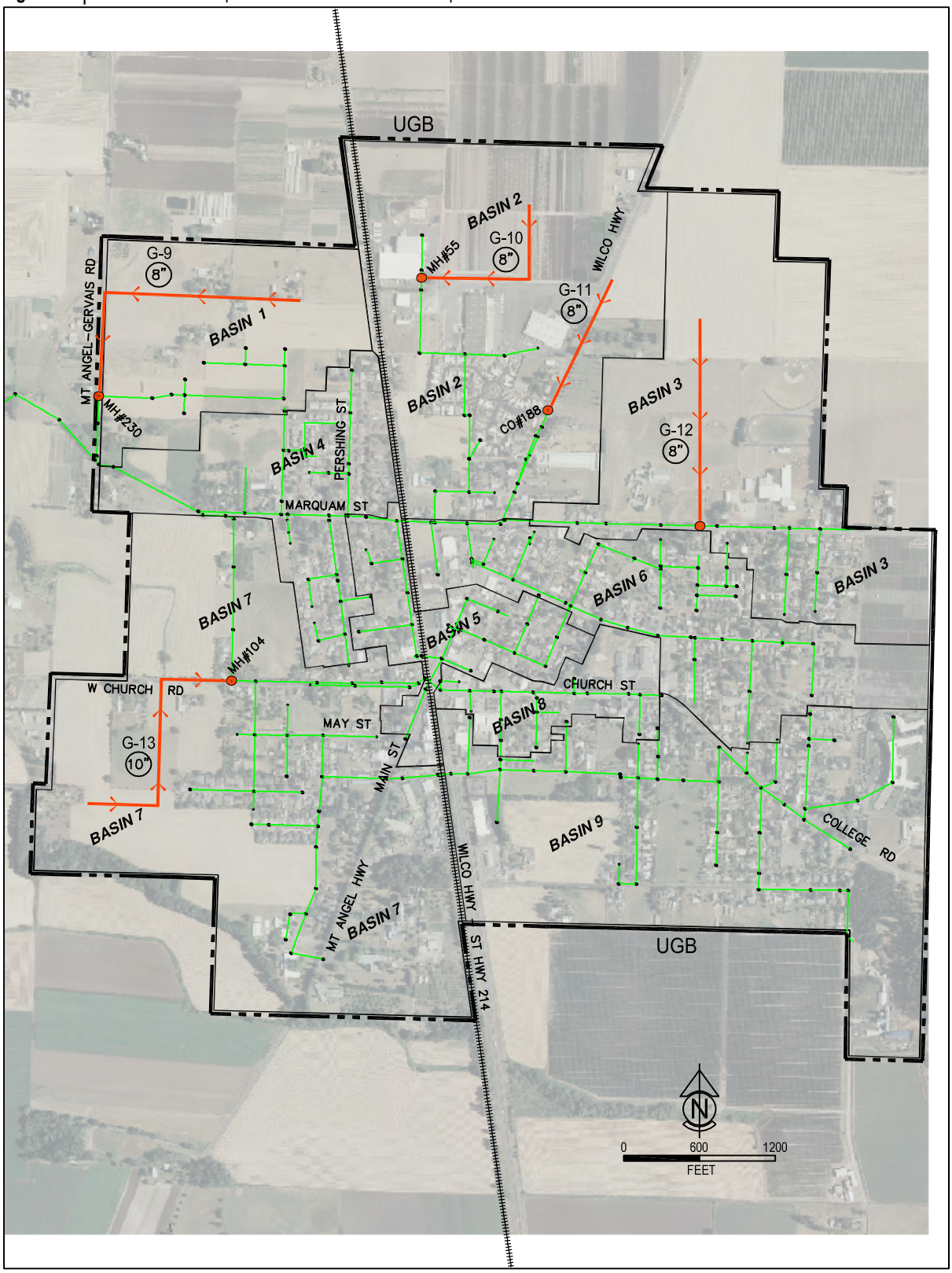
- *Sewer Basin 3 Trunk Sewer (Project G-12)*

This project is needed to serve the undeveloped area within the north-east portions of the UGB north of the High School. This area is entirely located within basin #3. As with project G-11, the basin boundary between sewer basin #2 and #3 may shift in the future due to development patterns. As such, the City must carefully review any development proposals in this area to ensure that the collection system downstream of the extensions has adequate capacity. The recommended improvement includes the extension of an 8-inch diameter line north from the 8-inch line in Marquam Street. The final alignment of this segment will need to be determined. This project will require the acquisition of a public utility easement from the School District. The estimated trunk sewer length is 1,600 feet.

- *Sewer Basin 7 Southwest Trunk Sewer (Project G-13)*

This project is needed to serve the undeveloped area within the southwest portion of the UGB. This area is located south of Church Street on the west side of the UGB. This area includes the southwestern portion of sewer basin 7. The recommended improvement includes the extension of a 10-inch diameter line west from manhole #104 in Church Street. A 10-inch diameter line is recommended instead of an 8-inch line not for capacity reasons, but because a 10-inch diameter line can be installed at a shallower grade. Based on the topographic data available for this facilities planning effort, the shallower grade permitted by a 10-inch line will be needed to serve the areas farthest upstream areas along this trunk sewer.

Figure 6-3 | Recommended Improvements to Serve Undeveloped Areas



6.6 SUMMARY OF RECOMMENDATIONS

The recommended improvements described above are listed in Table 6-4 and shown in Figure 6-2 and Figure 6-3. These improvements will result in a sewage collection system with the capacity needed to convey flows from within the planning area assuming development to zoning densities shown. The proposed improvements are intended to minimize the amount of new piping which must be installed, as well as to minimize the unnecessary replacement of existing sewer mainlines.

The improvements are based on the complete development of the land within the UGB. Therefore, many will not be required during the planning period. The improvements address existing deficiencies, as well as potential deficiencies at the end of the planning period and at buildout. Only the improvements that address the existing deficiencies are required at this time. The remaining deficiencies are growth dependent. Of these, some may be required before the end of the planning period and some may not. The improvements are prioritized in Chapter 8.

The alignment of future lines through the undeveloped portions of town has not yet been determined. The final alignment of sewer lines in these areas should be determined as property develops. Sewer lines should be placed within right-of-ways whenever possible. If the City Limits or UGB are to be expanded in the future, the sewer system should be re-examined to determine where additions are needed and if alternate alignments are justified. The capacity problems in the collection system are well documented. Any additional development upstream of the identified bottlenecks prior to the implementation of the recommended improvements will exacerbate the capacity problem and will result in additional surcharging of sewers and possible overflow or flooding of homes or businesses.

Table 6-4 | Recommended Collection System Improvements

Project Code	Project Description	Recommended Diameter	Length	Project Cost
Gravity Collection System Improvements				
G-1	Main Trunk Sewer – Manhole #5 to New Manhole #100	24	2,040	$612,000
G-2	North Trunk Sewer – Marquam St. MH #100 to Pershing St. MH #20	18	900	$340,000
G-3	North Trunk Sewer - Marquam Street MH #20 to Railroad MH #25	15	400	$142,000
G-4	North Trunk Sewer - Marquam Street MH #25 to Main St MH #60	12	830	$375,000
G-5	South Trunk Sewer - Segment 1 New MH #100 to May Street MH #130	18	1,950	$596,000
G-6	South Trunk Sewer - May Street MH #130 to MH #135	15	500	$171,000
G-7	South Trunk Sewer – South Pershing Street MH #135 to MH #136	15	325	$128,000
G-8	South Trunk Sewer - MH #136 to MH #146	12	1,200	$357,000
G-9	Sewer Basin 1 Trunk Sewer	8	2,400	$493,000
G-10	Sewer Basin 2 West Trunk Sewer	8	1,400	$300,000
G-11	Sewer Basin 2 East Trunk Sewer	8	1,200	$252,000
G-12	Sewer Basin 3 Trunk Sewer	8	1,600	$336,000
G-13	Sewer Basin 7 Southwest Trunk Sewer	10	2,100	$552,000
G14	Construct New Line From Manhole 115 to Manhole 109	10	80	$50,000
General Collection System				
Pgm-1	Sewer Cleaning and Inspection Program (Program – 1)	-	-	$ 13,000 per year
Pgm-2	Annual I/I Correction Program (Program – 2)	-	-	$ 100,000 per year

CHAPTER 7

TREATMENT SYSTEM EVALUATION

Chapter Outline

7.1 Introduction
7.2 Existing Treatment System Deficiencies
7.3 Treatment System Evaluation
    7.3.1 Headworks Hydraulic Evaluation
    7.3.2 Hydraulic Storage Capacity
    7.3.3 Organic Treatment Capacity
    7.3.4 Discharge Facilities Hydraulic Evaluation
    7.3.5 Receiving Stream Capacity
7.4 Projected Treatment System Deficiencies
7.5 Summary of Treatment System Deficiencies
7.6 Recommended Improvements
7.7 Long Term Treatment Plant Upgrades
7.8 Summary of Recommendations

TREATMENT SYSTEM EVALUATION

CHAPTER 7

7.1 INTRODUCTION

Chapter 4 includes a listing of existing treatment system deficiencies (Section 4.4.12) as well as some general recommendations to address these shortcomings (Section 4.7). This chapter builds on the information from Chapter 4 by evaluating the existing treatment system with respect to future flows and loads. The deficiencies identified in Chapter 4 are first summarized. This is followed by a detailed analysis of the existing treatment and disposal system with respect to future flows and loads. The purpose of this analysis is to identify treatment system components that are likely to become deficient during the planning period as a result of increased flows and loads due to growth. A comprehensive list of existing and projected shortcomings is then presented.

The second portion of this chapter includes a listing of the recommended improvements to address each deficiency. In some cases, the recommended improvement is relatively straightforward and a detailed alternatives analysis is not included. In cases where the recommended improvement is not obvious, a more detailed alternatives analysis is presented. This section concludes with a listing of all the recommended improvements for the treatment system.

7.2 EXISTING TREATMENT SYSTEM DEFICIENCIES

For completeness, the recommended treatment system shortcomings identified in Chapter 4 are listed in this subsection. These shortcomings include the following items.

- The wastewater treatment plant access road is not suitable for modern delivery trucks and is subject to flooding during high water events.
- The treatment plant lacks an alarm telemetry system.
- The valves on wetland header pipe are in poor condition and do not operate properly.
- The wetland outlet boxes require an excessive amount of operator time to maintain. A more operator friendly design is desired.
- There are large gaps in the wetland vegetation.
- There is no easy way to isolate the effluent pump station wetwell from the wetland.
- Adjustment of the valves in the meter/mixer vault requires time consuming confined space entry practices.
- The effluent pump station electrical controls are antiquated and likely to reach the end of their useful life during the planning period.

7.3 TREATMENT SYSTEM EVALUATION

This section includes a quantitative evaluation of the treatment plant with respect to the projected wastewater flows and loadings. The purpose of this analysis is to identify treatment system components that are likely to become deficient during the planning period as a result of increased flows and loads due to population growth.

7.3.1 Headworks Hydraulic Evaluation

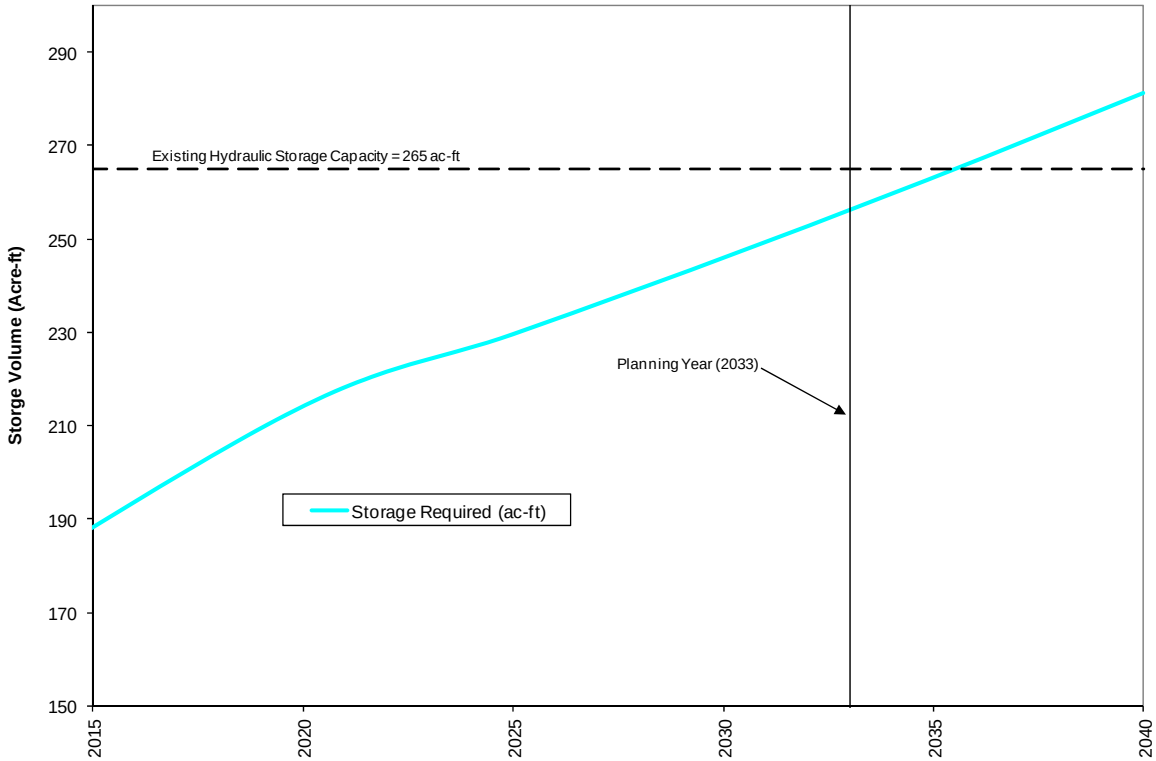
All wastewater from the collection system flows by gravity through the existing headworks before entering the first lagoon cell. The existing headworks was originally designed to convey a peak flowrate of approximately 4.3 MGD (Table 4-4). The headworks is fitted with a 9-inch Parshall flume which has a maximum capacity of approximately 5.7 MGD. As noted in Chapter 5, the existing peak hour flow to the plant is approximately 7.1 MGD (Table 5-4). This exceeds the hydraulic capacity of the existing headwork. As such, the hydraulic capacity of the existing headworks is deficient and improvements will be needed during the planning period.

7.3.2 Hydraulic Storage Capacity

The City does not currently discharge any treated effluent during the dry weather months of May through October. During this time all wastewater is stored in the existing lagoons. The existing storage capacity provided by the lagoons is approximately 265 acre-feet (Table 4-4). To evaluate the adequacy of this volume a water balance can be performed. The water balance includes summing all the water inputs and outputs from the lagoons to estimate the total summer storage requirements. Water balances were performed for various years during the planning period to estimate the total storage requirements for each year. The resulting storage requirements are plotted with the storage capacity of the treatment system in Figure 7-1. The water balance calculations are based on the following assumptions.

- ADWF * 184 days equals wastewater inflow
- Zero wastewater outflow
- 15 inches net summer evaporation (Evaporation – Rainfall)
- Zero lagoon leakage
- The lagoon and wetland are at minimum levels at the beginning of the dry weather storage season.

Figure 7-1 | Hydraulic Storage Requirements

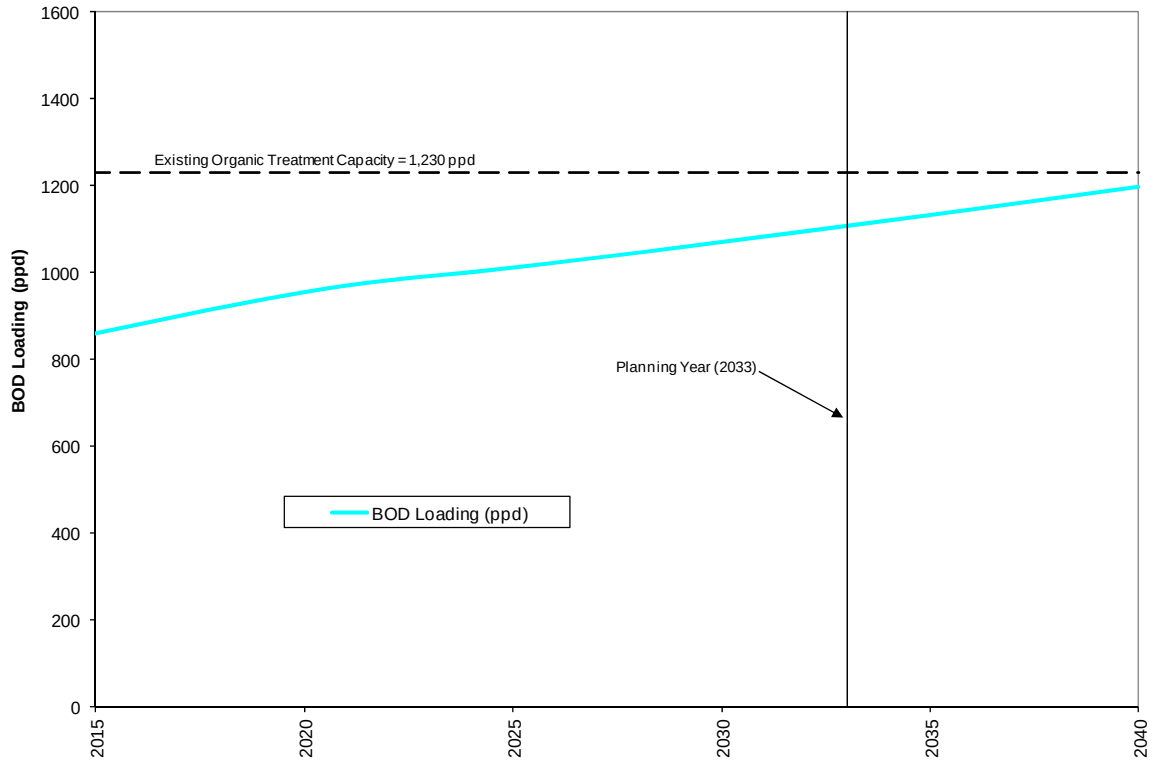


As shown (Figure 7-1) the existing plant provides adequate hydraulic storage through the end of the planning period. As such, the hydraulic storage capacity of the plant is adequate and no additional storage should be required during the planning period.

7.3.3 Organic Treatment Capacity

The facultative lagoons provide primary and secondary treatment of the waste stream. The organic treatment capacity of the lagoons is finite. If this capacity is exceeded compliance problems will result. The lagoons were designed for an overall organic loading rate of 30 pounds of BOD per acre per day with a maximum of 50 pounds of BOD per acre per day to the first cell on an average annual basis. These load rates correspond to an overall organic treatment capacity of approximately 1230 pounds per day. The projected BOD loads to the plant are plotted in Figure 7-2.

Figure 7-2 | Organic Treatment Evaluation



As shown (Figure 7-2), the existing plant has sufficient organic treatment capacity to serve the City well beyond the planning period. As such, improvements to increase the organic treatment capacity of the plant are not needed during the planning period.

7.3.4 Discharge Facilities Hydraulic Evaluation

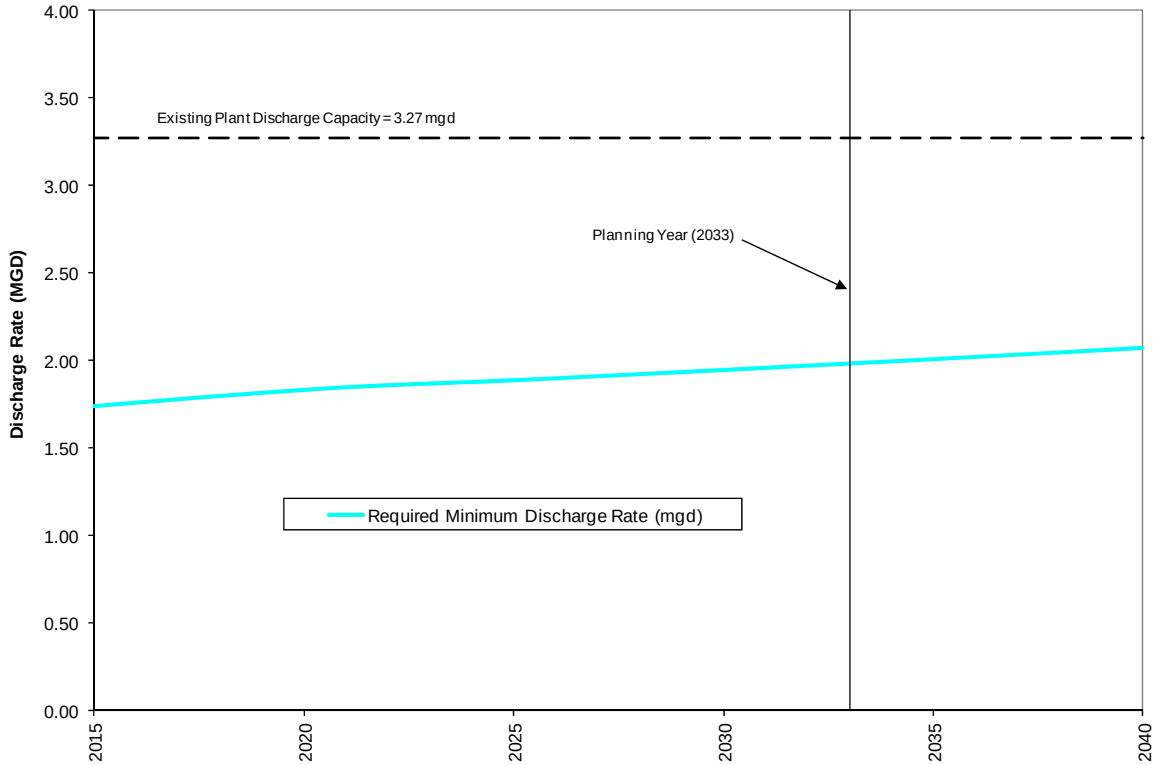
Once water enters the first lagoon cell, the flowrate through the plant is controlled by the discharge rate selected by the operator. The discharge rate is currently selected by starting the desired number of pumps in the effluent pump station. An analysis of the various hydraulic facilities used to convey water through the various treatment units to the point of discharge was performed to identify bottleneck in the system. This analysis showed that the capacities of the effluent pump station pumps limit the overall discharge capacity from the plant. The firm capacity (i.e., capacity with the largest pump out of service) of the station is 3.27 MGD (Figure 4-6). All of the various transfer pipes and hydraulic structures used to convey water from the first lagoon cell to the effluent pump station are adequately sized to convey this flow rate. Chlorine contact time is provided in the pipeline downstream of the effluent pump station. At a maximum discharge rate of 3.27 MGD, the pipeline provides approximately 35 minutes of contact time. This contact time should be sufficient to allow the City to meet the disinfection requirements included in the City's discharge permit.

In short, the maximum sustained rate of plant discharge may be considered to be equal to the firm capacity of the effluent pump station (i.e., 3.27 MGD). To determine if this capacity is adequate, a water balance was performed during the discharge season (November – April). The water balance includes summing all the inputs and outputs from the lagoons to determine the minimum

discharge rate that is needed to convey the treated water through the plant and dispose of water that accumulated during the summer months. Water balances were performed for various years during the planning period to estimate the required minimum discharge rate for each year. As the City grows, flows to the plant will steadily increase and the amount of water that must be discharged will also increase. The resulting minimum discharge rates are plotted with the firm discharge capacity of the treatment plant in Figure 7-3. The water balance calculations are based on the following assumptions.

- The discharge occurs over 181 days.
- The average November – April rainfall depth is 40 inches. This is also a conservative assumption since the average November-April rainfall depths for North Willamette Valley Experiment Station, Salem Airport, and Silverton, are 31.7 inches, 30.7 inches, and 35.1 inches respectively[5].
- Zero lagoon seepage. This is conservative since some seepage from the lagoons will occur.
- The lagoon and wetland are at maximum levels at the beginning of the wet weather discharge season.

Figure 7-3 | Required Plant Discharge Rate



As shown (Figure 7-3), the discharge rates required to dispose of the increased wastewater flows that are anticipated to occur during the planning period are significantly less than the current discharge capacity of the plant. As such, improvements to increase the plant discharge rate are not likely to be needed during the planning period.

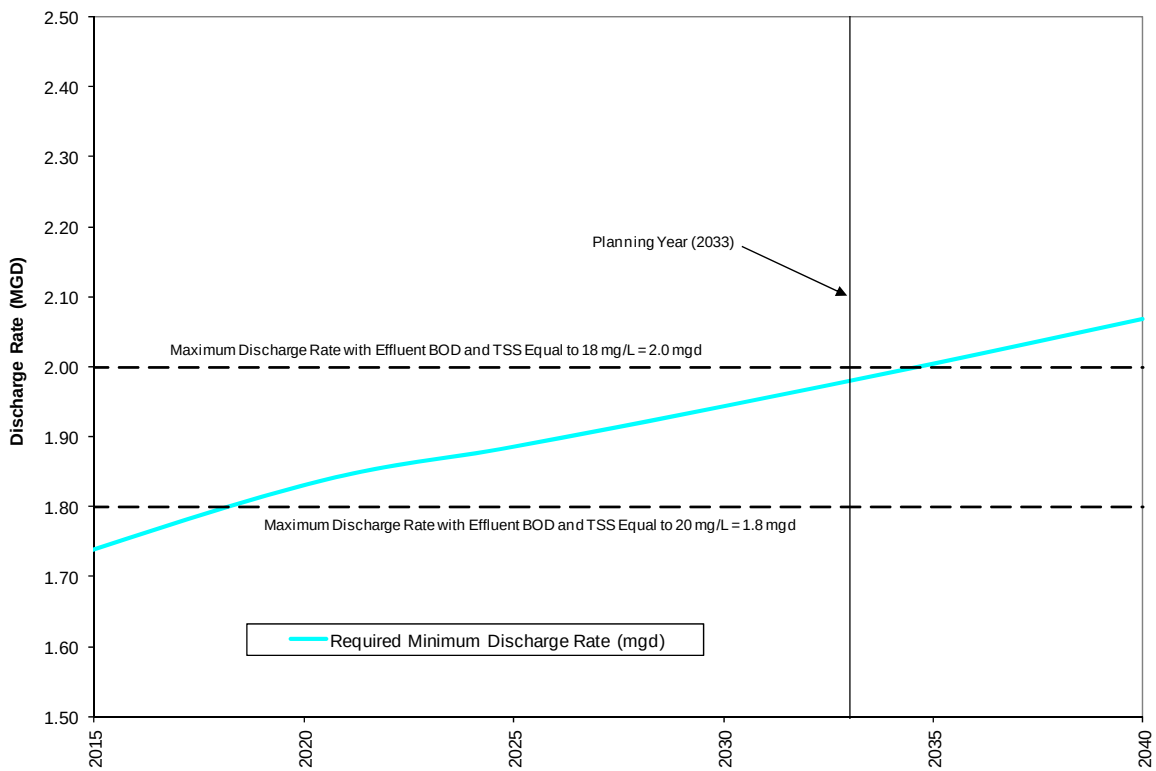
[5] NOAA Clim 20s

7.3.5 Receiving Stream Capacity

Treated effluent is discharged to the Pudding River during the wet weather discharge season (November – April). Discharge to the Pudding River is regulated by the City's existing NPDES permit (Section 3.3). The NPDES permits requires effluent BOD and TSS concentrations below 20 mg/L and total BOD and TSS effluent mass loads below 300 pounds per day on an average monthly basis. The mass load limits of 300 pounds per day limit the total amount of BOD and TSS that can be discharged. At effluent BOD and TSS concentrations of 20 mg/L, the discharge rate cannot exceed 1.8 mgd (300 ppd ÷ 20 mg/L ÷ 8.34 = 1.8 mgd).

A review of historic plant performance (Table 4-5) shows that effluent BOD and TSS concentrations are typically much lower than 20 mg/L. Therefore, the City can discharge effluent at a rate higher than 1.8 mgd without exceeding the mass load limits. As shown in Figure 7-3, water balance calculations demonstrate that the City will need to discharge at average rate of approximately 2 mgd at the end of the planning period to ensure that adequate storage reserves are provided for the following dry weather storage season. The required minimum discharge rate curve is again plotted in Figure 7-4. Also plotted in Figure 7-4 are lines that show the maximum rate of discharge that may occur without exceeding the existing mass load limits. One line is the maximum discharge rate allowed with effluent BOD and TSS concentrations equal to 20 mg/L. The second line is the maximum discharge rate allowed with effluent BOD and TSS concentrations equal to 18 mg/L. As shown in Figure 7-4, as long as the effluent quality is better than 18 mg/L BOD and TSS, the City should be able to discharge the required amount of effluent without exceeding the mass load limits.

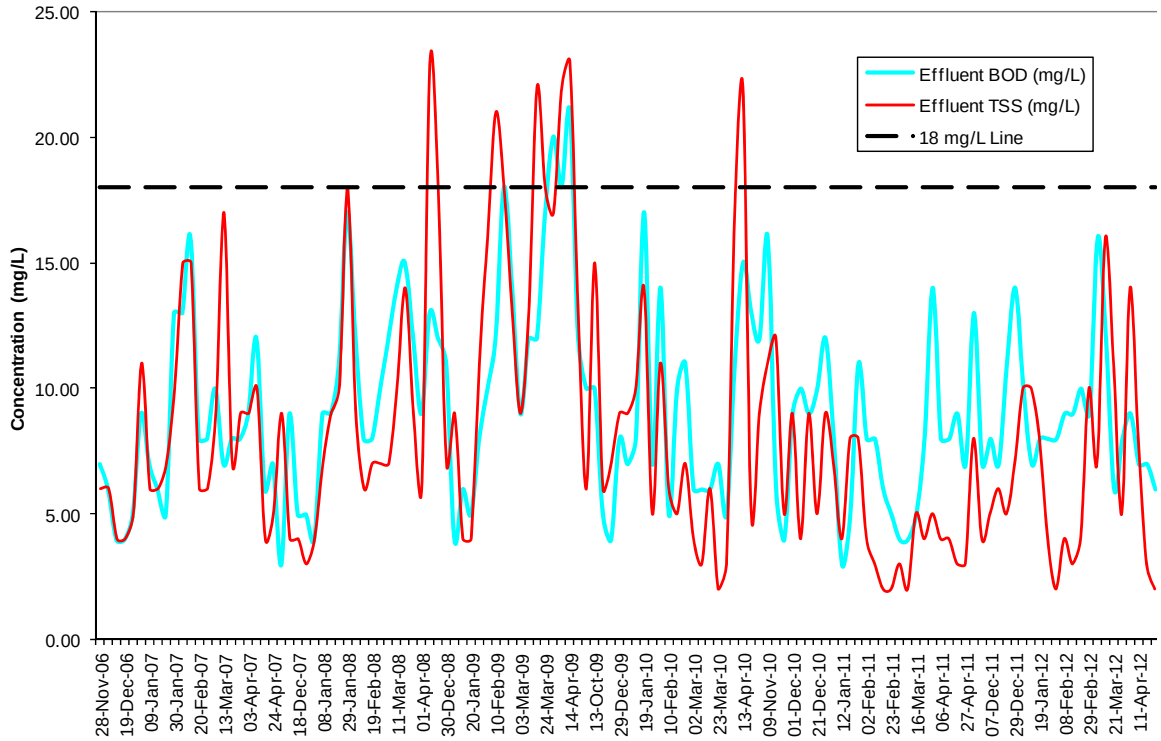
Figure 7-4 | Minimum Plant Discharge Rate Compared to Mass Load Limits



During the discharge season, the City measures effluent BOD and TSS data on a weekly basis. This data is plotting in Figure 7-5 for the last several discharge seasons. As shown, the effluent BOD and TSS rarely rise above 18 mg/L. On a monthly average basis, the effluent BOD and TSS has never risen above 18 mg/L (Table 4-5). Therefore, with good operational practices moving forward, the City should be able to keep effluent BOD and TSS values below 18 mg/L. This will enable the City to discharge effluent at rates above 2 mgd as needed to adequately dispose of wastewater for the remainder of the planning period. Based on this data, the existing plant and receiving stream are believed to be adequate to serve the City for the remainder of the planning period without major improvements to the treatment process.

This conclusion is based on the assumption that the next NPDES permit will include relaxed hydrograph controlled release requirements. As discussed above (Section 3.3.2) the existing NPDES permit includes additional limitations on the amount of effluent that can be discharged. The maximum allowed discharge rate is currently limited by the flow in the Pudding River. This limitation is known as a "hydrograph controlled" release. The relationship between river flow and allowable discharge rate was based on chlorine toxicity at the edge of the mixing zone. Since the City now dechlorinates effluent prior to discharge, chlorine toxicity is no longer an issue and the hydrograph controlled release parameters currently included in the NPDES permit (Table 3-2) are obsolete and should be revised. Should the DEQ choose not to relax the parameters of the hydrograph controlled release with the next permit renewal this facilities plan should be reviewed and updated as needed. If the DEQ does not relax the parameters of the hydrograph controlled release, it is likely that the City will need to make additional improvements to the treatment system during the planning period that are not currently included in this plan.

Figure 7-5 | Historic Effluent BOD and TSS Concentrations



7.4 PROJECTED TREATMENT SYSTEM DEFICIENCIES

The only projected treatment system deficiency identified in the previous analysis is the fact that the existing headworks is not sufficient to convey the existing and project peak flows. The remainder of the treatment plant should be able to serve the City for the remainder of the planning period with good operation and maintenance practices. As discussed above, this conclusion is based on the assumption that the DEQ will relax the parameters associated with the hydrograph controlled release with the next permit renewal. If this does not occur, it is likely that the City will need to make additional improvements to the treatment system during the planning period that are not currently included in this plan.

The existing treatment plant is able to serve the City for the remainder of the planning period without major process improvements because the projected growth rates are relatively modest. If growth occurs more rapidly than projected in this document, additional improvements to the treatment facilities may be needed during the planning period. For this reason, this plan includes a recommendation to update the flow and loading projections at 10-year intervals moving forward. This will enable the City to plan for upgrades that may be needed in response to growth rates that turn out to be faster than projected in this plan.

7.5 SUMMARY OF TREATMENT SYSTEM DEFICIENCIES

The following table includes a listing of all treatment system deficiencies identified in Chapter 4 and the previous sections of this Chapter.

Table 7-1 | Summary of Treatment System Deficiencies

Deficiency Number	Description
D-1	The wastewater treatment plant access road is not suitable for modern delivery trucks and is subject to flooding during high water events.
D-2	The valves on wetland header pipe are in poor condition and do not operate properly.
D-3	The wetland outlet boxes require an excessive amount of operator time to maintain. A more operator friendly design is desired.
D-4	There is no easy way to isolate the wetland from the effluent pump station.
D-5	Adjustment of the valves in the meter/mixer vault requires time consuming confined space entry practices.
D-6	The effluent pump station electrical controls are antiquated and likely to reach the end of their useful life during the planning period.
D-7	The treatment plant lacks an alarm telemetry system.
D-8	The existing headworks lacks the capacity to convey peak flows from the collection system.
D-9	Sludge accumulation in Lagoon Cell 1 is likely to impact the treatment process during the planning period.

7.6 RECOMMENDED IMPROVEMENTS

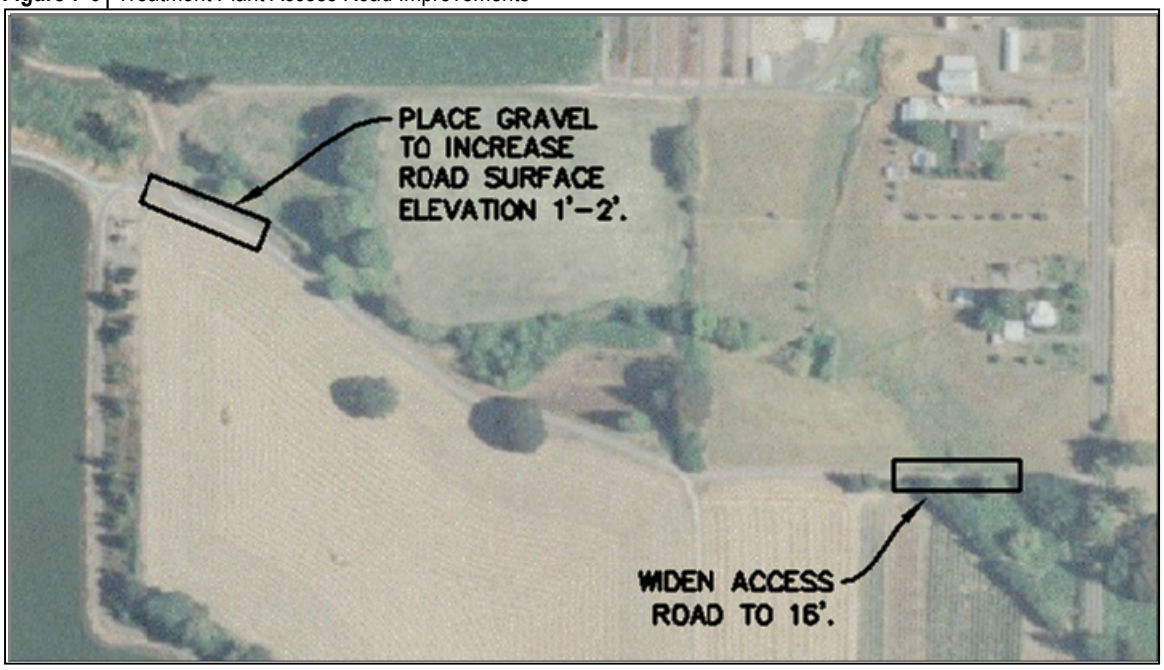
The following sections include the recommended improvements to address the deficiencies identified in Table 7-1.

- *Treatment Plant Access Road Improvements (Project T-1)*

Improvements to the treatment plant access road are recommended to improve access to the site for chemical delivery vehicles and other larger vehicles that must enter the site from time to time. These improvements will address deficiency D-1 in Table 7-1. This improvement project (project T-1) addresses two specific locations along the treatment plant access road. The first location is where the road crosses the drainage swale immediately west of the Mt. Angel-Gervais Road. The road in this location is relatively narrow and the embankments have eroded somewhat. The recommended improvements include widening the road in this location. This will require the acquisition of an additional 25 feet of easement north of the existing easement. The easement will need to be obtained from the owner of taxlot 2300 (map 61W04D). The culverts under the road will need to be extended to the north and additional fill will need to be placed over the culverts in order to widen the roadway surface. The recommended roadway width is a minimum of 16 feet. The total length of the roadway widening is expected to be approximately 220 feet.

The second location along the roadway that requires attention is immediately east of the treatment plant site access gate near the headworks. This area is subject to flooding and it is recommended that crush rock be placed to raise the road in this area by approximately 1-2 feet. The locations of these two improvements are shown in Figure 7-6. The total recommended budget for this project is $81,000. A detailed cost estimate is included in Appendix E.

Figure 7-6 | Treatment Plant Access Road Improvements



- *Headworks Improvements (Project T-2)*

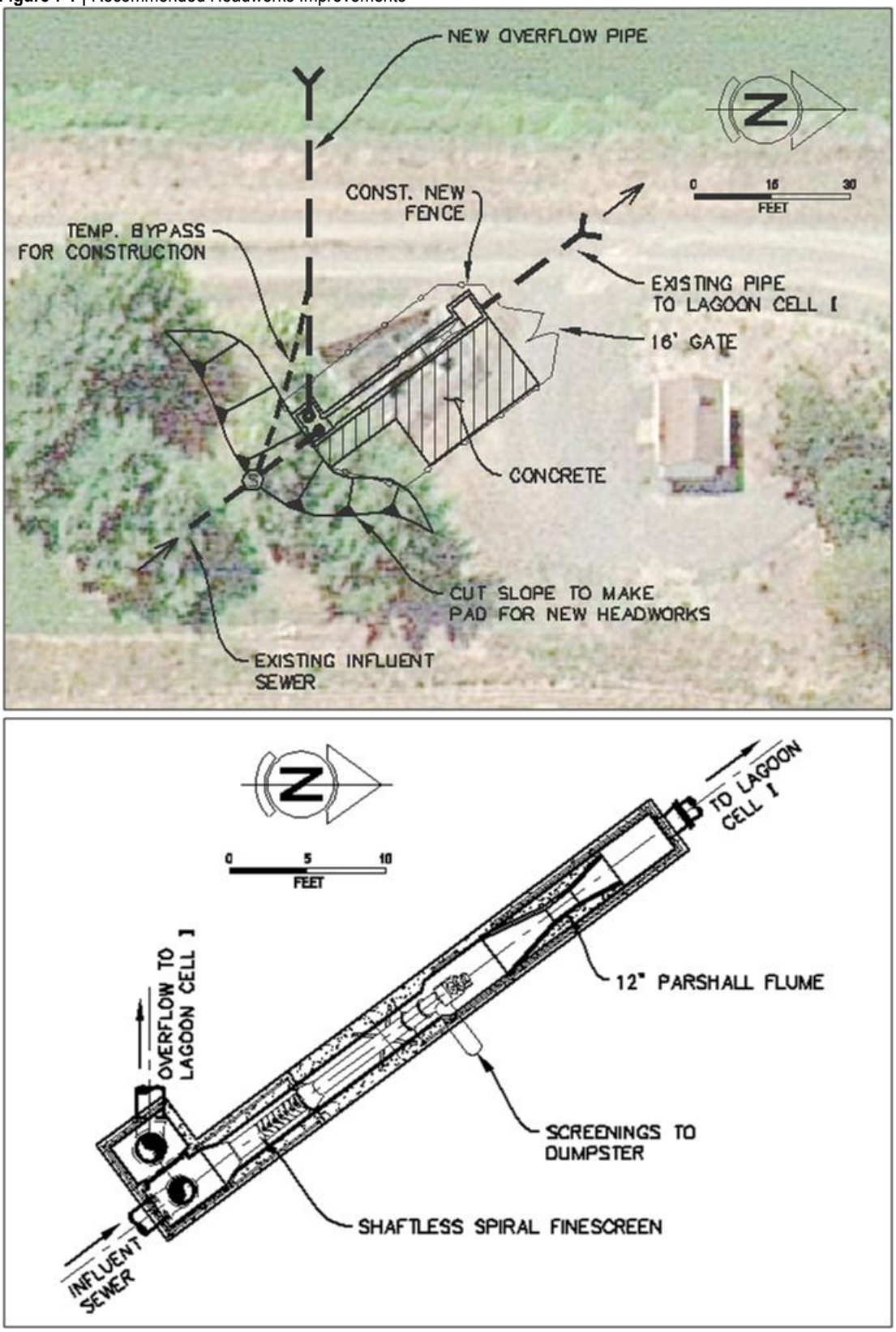
The existing headworks lacks the hydraulic capacity to convey existing and projected peak flows. As such a new headworks structure is recommended. This project will address deficiency D-8 listed in Table 7-1. The existing headworks structure includes a grinder but lacks a screening facility to remove plastics and other non-degradable solid materials. This material currently passes through the grinder and is deposited in the lagoons. This material will ultimately be removed from the lagoons when the sludge is removed. The most cost effective strategy for sludge disposal is likely to be applying it on farmed fields near the treatment plant. The farmers that own these fields will likely object to large quantities of plastics and other non-degradable materials being placed on their fields. Therefore, the sludge will need to be screened before land application. Experience has shown that it is easier to screen these objectionable materials from the raw wastewater rather than from the sludge. Therefore, we recommend that the new headworks be equipped with a fine screen with 6 millimeter openings to remove plastics and other debris from the waste stream. These screens typically include a conveyor to automatically remove the screened material and deposit it in a dumpster. The contents of the dumpster are typically removed by the local garbage disposal company.

In addition to screening facilities, the new headworks should also be equipped with a Parshall flume for flow measurement, an ultrasonic level transducer for flow measurement, and an automatic wastewater sampler. We recommend that the new headworks structure be placed in the same location as the existing headworks structure. This will require demolition of the existing structure to make the space needed for the new headworks. In order to construct the new headworks in this location, the raw wastewater must be diverted to the first lagoon cell on a temporary basis. It will be difficult to measure influent flows while the diversion is in place. As such, we recommend the City work with DEQ early in the design process to gain a short-term waiver of the influent flow measurement requirement to facilitate construction. A preliminary layout of the recommended headworks improvements is show in Figure 7-7. The total recommended budget for this project is $487,000. A detailed cost estimate is included in Appendix E and design criteria are listed in Table 7-2.

Table 7-2 | Recommended Headworks Design Criteria

Screen Type	Fine screen with shaft-less spiral auger
Screen Opening Size	6 mm
Screenings Disposal	Dumpster collected by local solid waste company on weekly basis
Standby Manual Bar Screen	None, bypass to lagoons on temporary basis
Flow measurement primary device	12-inch Parshall flume
Flow meter	Ultrasonic
Rain gauge	Tipping bucket with digital output
Online Monitoring	pH and temperature
Sampler	Automatic refrigerated composite sampler flow or time based sampling

Figure 7-7 | Recommended Headworks Improvements



- *Lagoon Cell 1Sludge Removal (Project T-3)*

At the Mt. Angel Wastewater Treatment Plant, sludge accumulates in the lagoon cells over time. The vast majority of the sludge is located in lagoon cell 1 since the raw sewage is first routed through this cell. Since the plant was originally constructed in the early 1990s, sludge has never been removed. Eventually the sludge will consume enough volume in the lagoon that it will begin to affect the treatment process. As such, sludge must be periodically removed. It is recommended that the sludge be removed from cell 1during the planning period. The sludge removal project will address deficiency D-9 listed in Table 7-1. The City currently has approximately $1,000,000 earmarked for this purpose in a sewer sludge reserve fund. These funds should be sufficient. If a suitable land disposal site can be located relatively close to the treatment plant (i.e., within 5 miles), we estimate the total required budget for sludge removal will be approximately $888,000. A detailed cost estimate is included in Appendix E.

The first step in the project will be measure the depth of the sludge in the lagoon to estimate the total quantity that must be disposed of. Using typical application rates, the total land area required for disposal can then be estimated. With this approximate land area suitable application sites can then be identified. Representatives from the City will need to meet with land owners to explain the potential project and ultimately get approval to dispose of the biosolids on their property. The biosolids do provide nutrients to the fields. Thus, many farmers tend to be cooperative.

Once a suitable site is located, the City will then need to prepare a biosolids management plan in accordance with DEQ requirements. The plan will include site authorizations signed by the land owners. Once the plan has been reviewed and approved by DEQ, the City can then advertise for bids to perform that work. It is anticipated that the sludge will be removed from the lagoons using a floating dredge. From the dredge, the solids will need to pass through a screening facility before being loaded into tanker trucks. The trucks will spread the liquid material on the fields and either the farmer or the contractor will need to incorporate the material into the soils by tilling.

Disposal options other than land application exist such as drying and hauling to a landfill, but in the case of Mt. Angel, these options are likely to be more costly than land applying the solids in a liquid form.

- *Wetland Improvements, effluent boxes, influent valves (Project T-4)*

To address deficiencies D-2 and D-3 listed in Table 7-1, minor improvements to the wetland water control devices are recommended. The existing isolation gate valves on the influent header pipe no longer open and close. Therefore, these valves should be replaced or rebuilt. The costs for this work are relatively minor and not considered to be a capital improvement project that needs to be included in this plan. On the other hand, the recommended improvements to the wetland outlet boxes are more substantial and may be listed as a capital improvement project.

The existing wetland outlet control boxes require a fair amount of operator time to clean and maintain. A more operator friendly design is desired by the City. To address this issue, we recommend construction of a sloped bar grate (e.g., 45 degree sloped grate with 1” spacing between bars) on the front of each box. This will allow the operator to rake the accumulated

vegetation to the top of the outlet box for removal and disposal. The recommended budget for this project is $46,000. A detailed cost estimate is included in Appendix E.

- *Effluent Pump Station Confined Space Entry Improvements (Project T-5)*

To address deficiencies D-4 and D-5 listed in Table 7-1, a confined space entry improvement project is recommended. This project includes the installation of a sluice gate over the influent pipe in the pump station wetwell. This will allow the operators to easily isolate the pump station from the wetwell as needed for maintenance activities. A stainless steel sluice gate is recommended. To eliminate the need to enter the mixer/meter vault to open and close valves, the existing valves should be replaced with new valves that have valve extensions that can be operated from the surface of the vault. The recommended project budget for this work is $31,000. A detailed cost estimate is included in Appendix E.

- *Effluent Pump Station Electrical and Control System Modernization (Project T-6)*

To address deficiencies D-6 and D-7 listed in Table 7-1, an electrical control system upgrade for the pump station is recommended. The recommended upgrades consist of the following elements.

  - Replace the existing effluent pump station motor control center with variable frequency drives.
  - Replace the existing control panel with a new PLC based control panel.
  - Install new SCADA system for remote treatment plant monitoring.
  - Install a new alarm autodialer for alarm callout.

These improvements will result in a modernized control system for the effluent pump station. The control system should be designed to allow the operator to select a desired discharge rate. The PLC should then automatically increase or decrease the speed of the effluent pumps to match the desired effluent flow rate. The SCADA system will allow operators to monitor the treatment plant at a central location. If desired, the system can also allow for remote monitoring by internet access. This does present security issues, so the City may want to consider the utility of remote monitoring carefully during the final design of the system. Whether remote monitoring is included or not, a new alarm autodialer should be installed so that critical alarms such as gas leaks, power failures, pump failures, and intrusion alarms can be communicated to the appropriate authority.

The total recommended project budget for these improvements is $460,000. A detailed cost estimate is included in Appendix E.

- *Facilities Plan Update(Project T-7)*

As described in section 7.4 the existing treatment plant is able to serve the City for the remainder of the planning period without major process improvements because the projected growth rates are relatively modest. If growth occurs more rapidly than projected in this document, additional improvements to the treatment facilities may be needed during the planning period. For this reason, this plan includes a recommendation to update the flow and loading projections and the lagoon water balance approximately 10-years after this plan is adopted. If the flow and loading projections show that the assumptions used in this plan are no longer valid, the plan should be updated as needed. This will enable the City to plan for upgrades that may be needed in response

to growth rates that turn out to be faster than projected in this plan. A total budget of $75,000 is recommended for the facilities plan update.

7.7 LONG TERM TREATMENT PLANT UPGRADES

The recommended treatment plant improvements listed above do not include any major expansion of the treatment facility or any additional unit processes. This is because the treatment plant is generally adequate to treat the projected flows and loads at the end of the planning period. However, as the City continues to grow beyond the planning period, major upgrades to the plant will eventually be required. Major upgrades to the plant may also be required if some of the fundamental planning criteria listed in this plan change during the planning period. For example if the Pepsi Northwest Beverages (see section 5.3.3 and section 5.4.2) approaches the City about increasing the permitted flow and loading from the beverage facility, major upgrades to the plant may be required to treat the increased waste stream.

For the sake of completeness, this section includes a discussion of the long range treatment plant improvements that will be required beyond the current planning period or if some of the planning assumptions used in this plan change during the current planning period. The following discussion is speculative and if improvements of this scale are needed for whatever reason, the first step will be to prepare a new facilities plan that analyzes alternatives at a greater level of detail.

As the flows and loads to the treatment plant increase, the plant will eventually encounter limitations with respect to organic treatment capacity, hydraulic storage capacity, and the ability to stay within the mass load limits included in the City's existing NPDES permit. It is highly unlikely that the City will be able to gain regulatory approval for increased mass load limits or wastewater discharge during the summer months to the Pudding River. Therefore, additional treatment will be needed to produce a higher quality effluent and additional disposal alternatives may also be needed to adequately dispose of the increased flows.

Several general alternatives are currently available to the City to provide the additional treatment and disposal capabilities. These include membrane bioreactors, activated sludge processes, and adding additional processes to the existing lagoon system to further polish the plant effluent. Based on current technologies, the authors of this document believe that constructing additional unit processes to further treat the lagoon effluent will likely be the most cost effective long-term solution. This is generally because the other options are not well suited for incorporation into a plant that discharges seasonally during the winter months. For a seasonal operational scheme, some type of storage facility must be provided to store wastewater during periods when no discharge is permitted. The size of the storage facilities required generally allows them to be used to provide the wastewater treatment. Such is the case in the City's existing lagoon system. The lagoon size is determined by the hydraulic storage requirements during the summer months. A lagoon sized to provide the needed dry weather storage volume is generally large enough to provide organic treatment as well without the need for additional mechanical treatment facilities. Therefore, the fact that the City's NPDES permit only allows for discharge during the winter months drives the treatment plant selection process toward a lagoon based system.

The organic treatment capacity of the existing plant is controlled by the size of the first lagoon cell. The first facultative lagoon in a series of lagoons is typically loaded at no more than 50 pounds of BOD per acre per day in Western Oregon. Exceeding this rate will likely result in insufficient treatment. As Mt. Angel continues to grow, the organic loading to the first lagoon cell will eventually exceed 50 pounds of BOD per acre per day and enhancements will be needed to increase the organic treatment capacity of the plant. Based on current technologies, the most likely solution will be to add air to the first lagoon cell using blowers with some sort of diffused aeration system. Therefore, it will be necessary to mechanically add air to the first lagoon cell at some point in the future.

The hydraulic storage capacity of the existing treatment plant is controlled by the volume of the existing lagoons. The only way to increase the volume of the lagoons is to construct more lagoons or to convert the existing treatment wetland to a storage lagoon. Due to wetland fill and floodplain issues in the area surrounding the existing treatment plant, constructing more lagoons will be difficult. Converting the existing wetland into a storage lagoon is a feasible option if additional unit processes are constructed to perform the polishing function currently performed by the treatment wetland. Another option for reducing the amount of water that must be stored is to dispose of treated effluent during the summer months by using it for irrigation on nearby farmed fields or the nearby golf course. This option equates to providing a dry weather disposal alternative which will reduce the amount of water that must be stored. At this time, we believe the most cost effective solution to meet future hydraulic storage will be a combination of converting the wetland into a storage lagoon and land application of recycled wastewater.

As the City grows beyond the planning period, it will no longer be possible to discharge water to the Pudding River during the winter months with effluent BOD and TSS mass loads below the permitted limit of 300 pounds per day. As such, additional treatment facilities will be needed to further polish the effluent prior to discharge. By providing additional treatment the effluent BOD and TSS concentrations can be reduced below values that can be produced by the current plant. With this cleaner effluent, a greater quantity can be discharged without exceeding the permitted mass load limits. Based on current technologies, we believe the best alternative for polishing the lagoon effluent is to install a dissolved air floatation system followed by sand filters. Facilities similar to these are currently in operation at the City of Molalla's Wastewater Treatment Plant. In fact, we believe the City of Molalla's wastewater treatment is a good representation of what Mt. Angel's wastewater plant might look like at some point in the future.

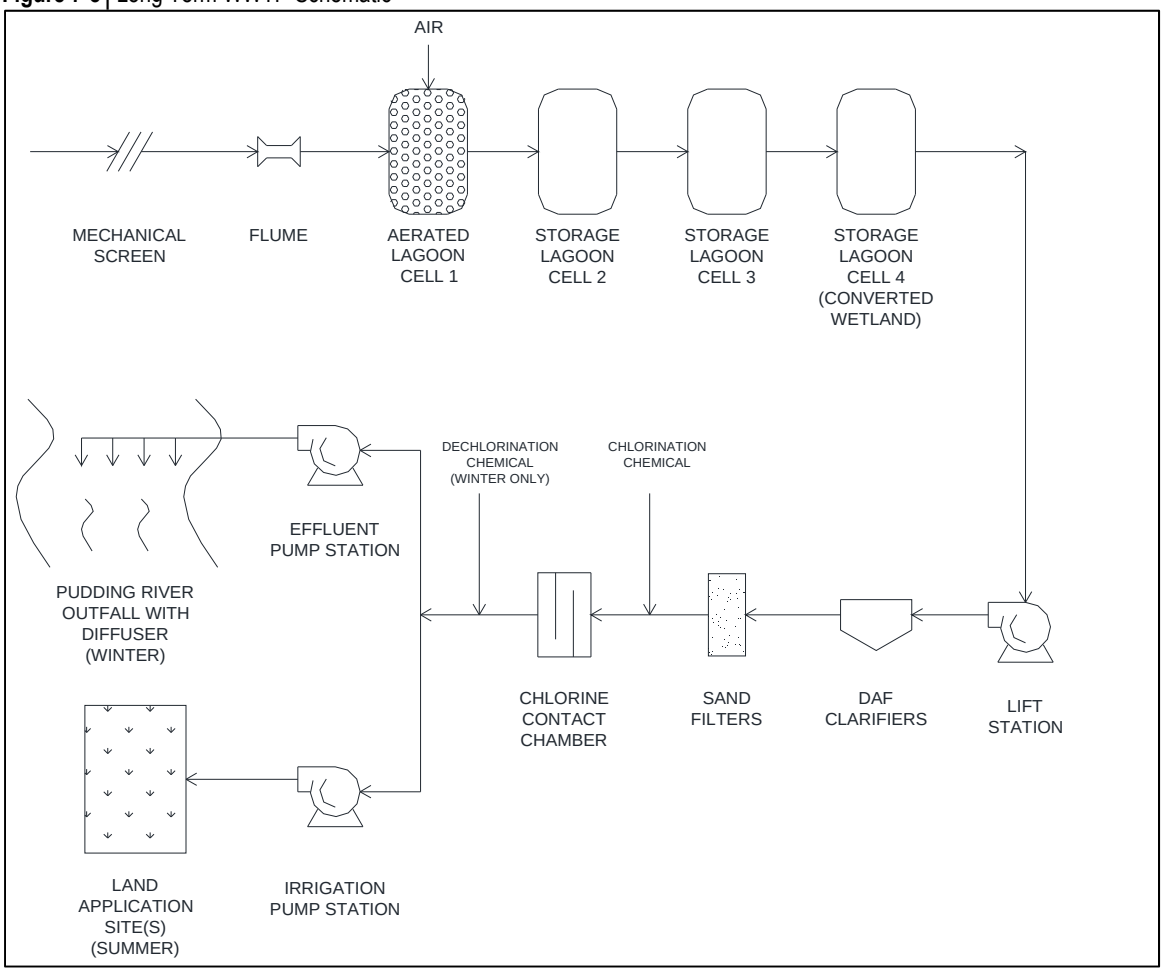
To summarize the above discussion, Figure 7-8 provides a schematic representation of what the authors of this document believe represents the best long-term solution for Mt. Angel's wastewater treatment plant. This solution is based on current technologies and will likely change as future technologies are brought to market. The major improvements to the existing plant will consist of the following.

- A new blower building with blowers and a diffused aeration system in lagoon cell #1.
- Converting the existing wetland to an additional storage lagoon.
- Installing a lift station to lift water from the final storage lagoon into a dissolved air floatation clarifier.
- Installing a one or more dissolved air floatation clarifiers.

- Installing one or more sand filters.
- Constructing a new chlorine contact chamber at the wastewater treatment plant site.
- Constructing a new irrigation pump station to convey treated effluent to a land application site during the summer months.
- Entering into a long –term agreement with a one or more private land owners to apply treated effluent on their property.

The costs for all of these improvements are likely to be in the $6 Million to $12 Million range. It is also likely that a long range plan will be developed to add these improvements in separate phases over a period of time rather than as a single large project. Again, none of these improvements are anticipated to be needed during the planning period. As such, none are included in the recommended capital improvement plan.

Figure 7-8 | Long Term WWTP Schematic



7.8 SUMMARY OF RECOMMENDATIONS

The recommended treatment system improvements described above are summarized below (Table 7-3). These improvements should result in a treatment system that will serve the City for the remainder of the planning period if population growth does not exceed the projections presented in this plan.

The City will also need to be diligent in working with DEQ on the renewal of the NPDES permit. As described above (section 7.3.5 and section 7.4), the ability of the existing treatment plant to continue to serve the City through the next planning period is based on the assumption that the DEQ will relax the parameters associated with the hydrograph controlled release with the next permit renewal. The City recently submitted a letter to DEQ requesting this be done when the new permit is issued. If this does not occur, it is likely that the City will need to make additional improvements to the treatment system during the planning period that are not currently included in this plan.

Table 7-3 | Recommended Treatment System Improvements

Project Code	Project Description	Recommended Budget
Treatment System Improvements		
T-1	Treatment Plant Access Road Improvements	$85,000
T-2	Headworks Improvements	$528,000
T-3	Lagoon Cell 1 Sludge Removal	$888,000
T-4	Wetland Improvements, effluent boxes, influent valves	$69,000
T-5	Effluent Pump Station Confined Space Entry Improvements	$31,000
T-6	Effluent Pump Station Electrical and Control System Modernization	$460,000
General Treatment System		
T-7	Facilities Plan Update	$75,000

CHAPTER 8

CAPITAL IMPROVEMENT PLAN

Chapter Outline

8.1 Introduction
8.2 Prioritized Improvements
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- 8.2.2 Prioritized Groups
- 8.2.3 Prioritized Capital Improvement Projects
- 8.2.4 Environmental Impact

8.3 Basis of Costs
- 8.3.1 Accuracy of Cost Estimates
- 8.3.2 Adjustment of Cost Estimates over Time
- 8.3.3 Engineering and Administrative Costs and Contingencies

8.4 Construction Cost Estimates
- 8.4.1 Gravity Collection System Improvement Costs
- 8.4.2 Wastewater Treatment Improvement Costs

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- 8.5.2 State and Federal Grant and Loan Programs
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CAPITAL IMPROVEMENT PLAN

CHAPTER 8

8.1 INTRODUCTION

As documented in the previous sections, there is a need for wastewater system improvements within the study area to correct existing and projected deficiencies. Some of these deficiencies are more critical than others. Some deficiencies present an immediate reduction to service level, while other deficiencies will manifest as the City expands and the existing systems continue to age.

Recommended improvements for specific components of the City's wastewater system have been described in previous chapters. This chapter builds on that work by assigning a priority to each of the improvement recommendations. The cost estimates have been developed to a conceptual level, for planning and budgeting purposes. More detailed cost estimates will be necessary as the projects are implemented.

8.2 PRIORITIZED IMPROVEMENTS

A prioritizing process is required since the scope of the proposed improvements is large. Projects that resolve immediate deficiencies should naturally have a higher priority than long term growth related improvements. The following approach is designed to provide a basis for evaluating and ranking the improvement projects.

8.2.1 Prioritization Criteria

The assignment of a particular project or capital improvement program to a priority level was made after an evaluation using the following criteria:

- Public Health Concerns—Projects targeted to resolve existing or near term regulatory compliance issues were assigned the highest priority.
- Capacity or Size Deficiencies—The severity of the deficiency was considered and compared with the service improvements provided by the replacement components. The projected 'yield' or cost-benefit ratio of a project was used to assign a priority of high, medium or low.
- Consumed Infrastructure—Projects to replace damaged or deteriorated infrastructure, particularly those facilities that have reached the end of their useful life and no longer function as designed were assigned a higher priority.
- City Priority—Projects identified by City operations and maintenance personnel to be high priority due to operational or maintenance problems.
- Demand Development—The anticipated timeframe for the development of land within the service area of proposed improvements was considered. Projects to serve approved or near term developments were given higher priority while improvements targeted to long term developments were deferred.

8.2.2 Prioritized Groups

In order to assist the City with their planning, scheduling and construction efforts each improvement project was assigned to one of three priority levels. The priority levels are:

- Priority 1—Near Term Improvements

  These projects are targeted to problem areas needing immediate attention. They have been developed to resolve existing or near term system deficiencies, resolve regulatory compliance issues or to serve known near term developments. It is recommended that Priority 1 improvements are undertaken as soon as practical.

- Priority 2—Intermediate Improvements

  These projects will be needed beyond the near term of the Priority 1 projects to provide service to anticipated future developments or to address problems with existing infrastructure that is likely to become deficient during the planning period. Although not critical at this time, Priority 2 improvements should be considered as improvement projects that will be upgraded to Priority 1 at some point during the planning period.

- Priority 3—Long Term Improvements/Possible Future Need

  These projects are needed to improve system reliability or to supply future demands if land develops to the zoned intensities. While important, they are not considered to be critical at the present time. If possible, improvements in this category should be incorporated into ongoing citywide development and improvement projects to capture the savings associated with concurrent construction. Projects that will need to be constructed by developers in conjunction with future developments were assigned to this group.

8.2.3 Prioritized Capital Improvement Projects

To aid in the development of a wastewater system capital improvement program (CIP), each improvement project was examined and assigned to one of the priority classes described above. Table 8-1 is a comprehensive listing of these projects. The reader is referred to previous chapters of this report for more detailed descriptions of the individual projects.

At a minimum, all of the Priority 1 and Priority 2 improvements should be included in the CIP. The Priority 3 improvements are largely growth driven. In general, it is envisioned that the Priority 3 improvements will be constructed as part of future development and that the developer will pay for the improvements. Should the City desire to promote development in certain areas, selected Priority 3 improvements may also be included in the CIP. Work on the Priority 1 improvements should begin immediately after agency approval and City adoption of this plan. As part of this facilities planning effort, the City also prepared a financial analysis of the wastewater utility. This analysis is included in Appendix G. This analysis includes recommendations for utility rate and SDC fee increases and is based on completing the Priority 1 and Priority 2 projects during the planning period.

Table 8-1 | Recommended Capital Improvement Priorities

Project Code [1]	Project	Priority	Total Estimated Project Cost [2]
G-1	Main Trunk Sewer – Manhole #5 to New Manhole #100	1	$ 612,000
G-2	North Trunk Sewer – Marquam St. MH #100 to Pershing St. MH #20	1	$ 340,000
G-3	North Trunk Sewer - Marquam Street MH #20 to Railroad MH #25	1	$142,000
G-4	North Trunk Sewer - Marquam Street MH #25 to Main St MH #60	1	$375,000
G-5	South Trunk Sewer - Segment 1 New MH #100 to May Street MH #130	1	$596,000
G-8	South Trunk Sewer - MH #136 to MH #146	1	$357,000
G-14	Construct New Line from MH 115 to MH 109	1	$50,000
T-1	Treatment Plant Access Road Improvements	1	$85,000
T-4	Wetland Improvements, effluent boxes, influent valves	1	$69,000
T-5	Effluent Pump Station Confined Space Entry Improvements	1	$39,000
		Subtotal Priority 1….	**$ 2,665,000**
G-6	South Trunk Sewer - May Street MH #130 to MH #135	2	$ 171,000
G-7	South Trunk Sewer – South. Pershing Street MH #135 to MH #136	2	$128,000
T-2	Headworks Improvements	2	$528,000
T-3	Lagoon Cell 1 Sludge Removal	2	$888,000
T-6	Effluent Pump Station Electrical and Control System Modernization	2	$460,000
T-7	Facilities Plan Update	2	$75,000
		Subtotal Priority 2….	**$ 2,250,000**
G-9	Sewer Basin 1 Trunk Sewer	3	$ 493,000
G-10	Sewer Basin 2 West Trunk Sewer	3	$300,000
G-11	Sewer Basin 2 East Trunk Sewer	3	$252,000
G-12	Sewer Basin 3 Trunk Sewer	3	$336,000
G-13	Sewer Basin 7 Southwest Trunk Sewer	3	$ 552,000
		Subtotal Priority 3….	**$ 1,933,000**
		TOTAL….	**$ 6,848,000**
Recurring Annual Programs			
Pgm-1	Sewer Cleaning and Inspection Program (Program – 1)		$13,000
Pgm-2	Annual I/I Correction Program (Program – 2)		$100,000
		Subtotal Recurring Annual Programs….	**$ 113,000**

[1] Project Code Legend:
G = Gravity Sewer T = Treatment Pgm = Improvement Program

[2] See Section 8.3 for basis of project cost estimates

8.2.4 Environmental Impact

It should be noted that while the improvements recommended in this report are not anticipated to have significant adverse impacts on the environment, each CIP project will need to undergo project-specific environmental review as part of the preliminary and final design process.

8.3 BASIS OF COSTS

In order to forecast municipal capital expenditures cost estimates have been prepared for each improvement alternative. The preparation methodology and intended use of these cost estimates are summarized below.

8.3.1 Accuracy of Cost Estimates

The accuracy and precision of cost estimates is a function of the level to which improvement alternatives are developed (i.e., detail and design) and the techniques used in preparing the actual estimate. Estimates are typically divided into three basic categories as follows:

- Planning Level Estimate. These are order-of-magnitude estimates made without detailed engineering design data. They are often performed at the zero to 2 percent stage of project completion and typically range from 35 percent over, to 25 percent below the final project cost. A relatively large contingency is typically included to reduce the risk of underestimating. This is particularly important since many times the project financing must be secured before the detailed design can proceed.
- Budgetary Estimates. This level of estimate is prepared during the preliminary design phase using process flow sheets, preliminary layouts and equipment details. This type of estimate is typically accurate to +30 and –15 percent of the final project cost.
- Engineer's Estimate. This estimate is prepared on the basis of well-defined engineering data, typically when the construction plans and specifications are completed. The estimating process at this level relies on piping and instrument diagrams, electrical diagrams, equipment data sheets, structural drawings, geotechnical data and a complete set of specifications. This estimate is sometimes called a definite estimate. The engineer's estimate is expected to be accurate within +15 percent to –5 percent of the pricing secured during the bidding process.

The project costs prepared as part of this study are planning level estimates. Actual project costs will depend on the final project scope, labor and material costs, market conditions, construction schedule, and other variables at the time the project is built. These variables are typically uncertain at the time planning level estimates are performed.

8.3.2 Adjustment of Cost Estimates over Time

A commonly used indicator to evaluate the change of construction costs over time is the Engineering News-Record (ENR) construction cost index. The index is computed from the prices for structural steel, Portland cement, lumber, and common labor, and is based on a value of 100 in the year 1913. The construction costs developed in this analysis are based on the September, 2013 ENR 20 City Construction Cost Index of 9551. As the planning period elapses, the costs

presented in this study can be updated to the present, by applying the ratio of the current cost index to the index used during the preparation of the estimate.

8.3.3 Engineering and Administrative Costs and Contingencies

The cost of engineering services for major projects typically covers special investigations, pre-design reports, topographic surveying, geotechnical investigations, contract drawings and specifications, construction administration, inspection, project start-up, the preparation of O&M manuals, and performance certifications. Depending on the size and type of the project, engineering costs may range from 16 to 25 percent of the contract cost when all of the above services are provided. The lower percentage applies to large projects without complex mechanical systems. The higher percentage applies to smaller, more complex projects that require the integration of a complex design into an existing facility and where full time inspection is required by the funding agencies or desired by the Owner.

The City will have administrative costs associated with any construction project. These include internal planning and budgeting costs, administration of engineering and construction contracts, legal services, and coordination with regulatory and funding agencies.

8.4 CONSTRUCTION COST ESTIMATES

The planning level estimates for the improvements recommended in this study are based on a number of assumptions as follows. The cost estimates reflect projects bid in late winter or early spring for summer construction. The estimates are based on construction costs of similar historical projects and on current estimates solicited from material and equipment vendors. The estimates are expected to have accuracies of +35 percent and –25 percent of the actual project cost. The following sections describe the cost estimating process for the various categories of projects.

8.4.1 Gravity Collection System Improvement Costs

The cost estimates for the proposed gravity pipeline improvements were based on the following assumptions.

- 8 inch gravity pipeline in urban areas construction cost (materials, installation & surface restoration, etc.) - $130 per foot
- 10 inch gravity pipeline in urban areas construction cost (materials, installation & surface restoration, etc.) - $140 per foot
- 12 inch gravity pipeline in urban areas construction cost (materials, installation & surface restoration, etc.) - $150 per foot
- 15 inch gravity pipeline in urban areas construction cost (materials, installation & surface restoration, etc.) - $170 per foot
- 18 inch gravity pipeline in urban areas construction cost (materials, installation & surface restoration, etc.) - $180 per foot

- 24 inch gravity pipeline in rural areas construction cost (materials, installation & surface restoration, etc.) - $180 per foot
- New Manholes (materials, installation, and surface restoration) - $8,000 each
- Service Laterals (materials, installation, and surface restoration) - $3,500 each
- Railroad & Highway Bores - $1000 per foot
- Construction Contingencies - 10% of estimated construction cost
- Engineering Costs (surveying, engineering design, and construction administration) - 20% of estimated construction cost
- Legal, Permits & Administrative Costs (permitting, administration, legal, easement acquisition and financing) - 10% of estimated construction cost

8.4.2 Wastewater Treatment Improvement Costs

Construction costs for the wastewater treatment plant improvements include site preparation and foundations, buildings, tankage, treatment equipment for each unit process, associated mechanical piping and pumping, chemical feed equipment, yard piping, outfall piping, and electrical and instrumentation.

A construction contingency of 10% of the estimated construction cost was used for the treatment plant estimates. Engineering, Legal, and administration costs were assumed to be 18% of the estimated construction cost. Permitting and Right of Way acquisition costs were assumed to be 2% and 1.5% of the estimated construction cost respectively.

8.5 FUNDING SOURCES

As a general rule, small communities are not able to finance major wastewater system improvements without some form of government funding such as low interest loans or grants. It is anticipated that the funding for the recommended capital improvement plan outlined in this report will be secured from multiple sources, including system development charges (SDCs), monthly user fees, as well as state and federal grant and loan programs. The following section outlines the major local and State/Federal funding programs that may be available for these projects.

8.5.1 Local Funding Sources

To a large degree, the type and amount of local funding used for the improvements will depend on the amount of grant funding obtained and the requirements of any loan funding. Local revenue sources for capital improvements include ad valorem taxes (property taxes), various types of bonds, user fees, connection fees and SDCs. Local revenue sources for operating costs include ad valorem taxes and user fees. The following sections discuss local funding sources and financing mechanisms that are most commonly used for the type of capital improvements presented in this study.

8.5.1.1 Existing Debt Service

At the close of fiscal year 2013/2014, the City will have no outstanding debt service associated with the wastewater utility.

8.5.1.2 User Fees

User fees are monthly charges to all residences, businesses, and other users that are connected to the system. User fees are established by the City Council and are typically the sole source of revenue to finance operation and maintenance. These fees are periodically modified to account for changes in operation and maintenance costs, and the need for new improvements. Although user fees are not sufficient to finance major capital construction projects, they can be used to repay long term financing. The reader is referred to Section 4.6.1 for a description of the City's current user fee structure. As part of this facilities planning effort, a financial analysis of the City's user rates and SDC fees was prepared. This analysis includes recommendations with respect to rate increases that are required to fund the improvements recommended herein. The reader is referred to the financial analysis included in Appendix G for additional information.

8.5.1.3 System Development Charge Revenues

A system development charge (SDC) is a fee collected by the City as each piece of property is developed. SDCs are used to finance necessary capital improvements and municipal services required by the development. SDCs can be used to recover the capital costs of infrastructure required as a result of the development, but cannot be used to finance either operation and maintenance, or replacement costs. The reader is referred to Section 4.6.2 for information on the City's current SDC charges.

As established in ORS 223, a SDC can have two principal elements, the reimbursement fee and the improvement fee. Fees are collected at issuance of building permits. The reimbursement portion of the SDC is the fee for buying into either existing capital facilities or those that are under construction. The reimbursement fee represents a charge for utilizing excess capacity in an existing facility that was paid for by previous developers. The revenue from this fee is typically used to repay existing improvement loans. The improvement portion of the SDC is the fee designed to cover the costs of capital improvements that must be constructed to provide an increase in capacity. Based on the infrastructure improvements and cost projections presented in this facilities plan, the existing SDC fee structure is not likely to be sufficient to meet the planning period goals. As part of the financial analysis for the wastewater utility (Appendix G), the existing SDC fee structure was reviewed. The financial analysis includes recommendations for SDC fee increases needed to fund the improvements recommended herein.

8.5.1.4 Connection Fees

Many cities charge connection fees to cover the cost of connecting a new development to the municipal sewer system. There are two types of connection fees. The first is for newly constructed connections and is designed to cover the cost of City inspections at the time of connection to the collection system. The second type of fee is designed to defray the City's administrative cost of setting up a new account and is charged against newly constructed connections as well as transfers of an existing service to a new owner.

8.5.1.5 Capital Construction Fund

Capital construction funds or sinking funds, are often established as a budget line item to set aside money for a particular construction purpose. A set amount from each annual budget is deposited in a sinking fund until sufficient reserves are available to complete the project. Such funds can also be developed from user fee revenues of from SDCs. The City currently maintains a sewer utility reserve fund for the completion of capital improvement projects. The current balance in this fund is approximately $340,000. The City also maintains a sewer sludge reserve fund that is earmarked to remove sludge from the City's existing lagoons. The current balance in this fund is approximately $1,000,000.

8.5.1.6 General Obligation Bonds

The sale of municipal general obligation bonds is a traditional method of funding municipal improvement projects. General obligation bonds utilize the City's basic taxing authority and are retired with property taxes based on an equitable distribution of the bonded obligation across the City's assessed valuation. General obligation bonds are normally associated with the financing of facilities that benefit an entire community and must be approved by a majority vote of the City's voters.

General obligation bonds are backed by the City's full faith and credit, as the City must pledge to assess property taxes sufficient to pay the annual debt service. This portion of the property tax is outside the State constitutional limits that restrict property taxes to a fixed percentage of the assessed value. The City may use other sources of revenue, including user fee revenues, to repay the bonds. If it uses other funding sources to repay the bonds, the amount collected as taxes is reduced commensurately.

The general procedure followed when financing improvements with general obligation bonds is typically as follows:

- Determination of the capital costs required for the improvement
- An election by the voters to authorize the sale of bonds
- The bonds are offered for sale
- The revenue from the bond sale is used to pay the capital cost of the project(s)

General obligation bonds can be "revenue supported", wherein a portion of the user fee is pledged toward repayment of the bond debt. The advantage of this method is that the need to collect additional property taxes to retire the bonds is reduced or eliminated. Such revenue supported general obligation bonds have most of the advantages of revenue bonds in addition to a lower interest rate and ready marketabilty.

The primary disadvantage with the use of general obligation bonds is that the debt incurred by this method is often added to the debt ratios of the City. This has the potential to limit restricting flexibility of the municipality to issue debt for other purposes.

8.5.1.7 Revenue Bonds

Revenue bonds are similar to general obligation bonds, except they rely on revenue from the sales of the utility (i.e., user fees) to retire the bonded indebtedness. The primary security for the bonds is the City's pledge to charge user fees sufficient to pay all operating costs and debts service.

Because the reliability of the source of revenue is relatively more speculative than for general obligation bonds, revenue bonds typically have slightly higher interest rates.

The general shift away from ad valorem property taxes makes revenue bonds a frequently used option for payment of long term debt. Many communities prefer revenue bonding, because it ensures that no additional taxes are levied. In addition, repayment of the debt obligation is limited to system users since repayment is based on user fees.

One advantage with revenue bonds is that they do not count against a City's direct debt. This feature can be a crucial advantage for a municipality near its debt limit. Rating agencies closely evaluate the amount of direct debt when assigning credit ratings. There are normally no legal limitations on the amount of revenue bonds that can be issued; however, excessive issue amounts are generally unattractive to bond buyers because they represent high investment risks.

Under ORS 288.805-288.945, Cities may elect to issue revenue bonds for revenue producing facilities without a vote of the electorate. Certain notice and posting requirements must be met and a sixty (60) day waiting period is mandatory.

The bond lender typically requires the City to provide two additional securities for revenue bonds that are not required for general obligation bonds. First, the City must set user fees such that the net projected cash flow from user fees plus interest will be at least 125% of the annual debt service (a 1.25 debt coverage ratio). Secondly, the City must establish a bond reserve fund equal to maximum annual debt service or 10% of the bond amount, whichever is less.

8.5.1.8 Improvement Bonds

Improvement (Bancroft) bonds are an intermediate form of financing that are less than full-fledged general obligation or revenue bonds. This form of bonding is typically used for Local Improvement Districts.

Improvement bonds are payable from the proceeds of special benefit assessments, not from general tax revenues or user fees. Such bonds are issued only where certain properties are recipients of special benefits not occurring to other properties. For a specific improvement, all property within the designated improvement district is assessed on the same basis, regardless of whether the property is developed or undeveloped. The assessment is designed to divide the cost of the improvements among the benefited property owners. The manner in which it is divided is in proportion to the direct or indirect benefits to each property. The assessment becomes a direct lien against the property, and owners have the option of either paying the assessment in cash, or applying for improvement bonds. If the improvement bond option is taken, the City sells Bancroft Improvement Bonds to finance the construction, and the assessment is paid over 20 years in 40 semiannual installments plus interest.

The assessments against the properties are usually not levied until the actual cost of the project is determined. Since the determination of actual costs cannot normally be determined until the project is completed, funds are not available from assessments for the purpose of paying costs at the time of construction. Therefore, some method of interim financing must be arranged.

The primary disadvantage to this source of revenue is that the development of an assessment district is very cumbersome and expensive when facilities for an entire City are contemplated.

Therefore, this method of financing should only be considered for discrete improvements to the collection system where the benefits are localized and easily quantified.

8.5.1.9 Certificates of Participation

Certificates of Participation are a form of bond financing that is distinct from revenue bonds. While it is more complex, and typically has a higher interest rate than revenue bonds, it is a process controlled by the City Council, and it does not have to be referred to the voters. This can result in significant time savings.

8.5.1.10 Ad Valorem Taxes

Ad valorem property taxes were often used in the past as a revenue source for public utility improvements. These taxes were the traditional means of obtaining revenue to support all local governmental functions. Ad valorem taxation is a financing method that applies to all property owners that benefit, or could potentially benefit from an improvement, whether the property is developed or not. The construction costs for the improvement project are shared proportionally among all property owners based on the assessed value of each property. Ad valorem taxation, however, is less likely to result in individual users paying their proportionate share of the costs as compared to their benefits.

8.5.2 State and Federal Grant and Loan Programs

Several state and federal grant and loan programs are available to provide financial assistance for municipal water system improvements. The primary sources of funding available for water system financing are Rural Utilities Service (RUS), Special Public Works Fund (SPWF), the Water/Wastewater (W/W) Financing Program, the Community Development Block Grant (CDBG) program, and the Clean Water State Revolving Fund (CWSRF).

8.5.2.1 USDA Rural Development

USDA Rural Development (RD) provides federal loans and grants to rural municipalities, counties, special districts, Indian tribes, and not-for-profit organizations to construct, enlarge, or modify water treatment and distribution systems and wastewater collection and treatment systems. Preference is given to projects in low-income communities with populations below 10,000.

Borrowers of RD loans must be able to demonstrate the following:

- Monthly user rates must be at or above the local are-wide average.
- They have the legal authority to borrow and repay loans, to pledge security for loans, and to operate and maintain the facilities and services.
- They are financially sound and able to manage the facility effectively.
- They have a financially sound facility based on taxes, assessments, revenues, fees, or other satisfactory sources of income to pay for all facility costs including O&M and to retire indebtedness and maintain a reserve.

The maximum RD loan term is 40 years, but the finance term may not exceed statutory limitations on the agency borrowing the money or the expected useful life of the improvements. The reserve can typically be funded at 10 percent per year over a ten-year period. Interest rates

for RD loans vary based on median household income, but tend to be lower than those obtained in the open market.

8.5.2.2 Oregon Infrastructure Finance Authority

The Oregon Infrastructure Finance Authority (IFA) manages a number of grant and low interest loan programs as described in the following sections.

Special Public Works Fund

The IFA administers the Special Public Works Fund (SPWF) program. The SPWF is a lottery-funded loan and grant program that provides funding to municipalities, counties, special districts, and public ports for infrastructure improvements to support industrial/manufacturing and eligible commercial economic development. Eligible commercial economic development is defined as commercial activity that is marketed nationally, or internationally, and attracts business from outside Oregon. Funded projects are usually linked to a specific private sector development and the resulting direct job creation (i.e., firm business commitment), of which 30% of the created jobs must be "family wage" jobs. The program also funds projects that build infrastructure capacity to support industrial/manufacturing development where recent interest by eligible business(s) can be documented.

The SPWF is primarily a loan program, although grant funds are available based on economic need of the community. Although the maximum loan term is 25 years, loans are generally made for 20-year terms. The maximum loan amount for projects funded with direct SPWF money is $1 million, while the maximum for projects financed with bond funds is $10 million.

Water/Wastewater Financing Program

The IFA also administers the W/W Financing Program, which gives priority to projects that provide system-wide benefits and helps communities meet the Clean Water Act or the Safe Drinking Water Act standards. It is intended to assist local governments that have been hard hit with state and federal mandates for public drinking water systems and wastewater systems. In order to be eligible for this program, the system must be out of compliance with federal or state rules, regulations or permits, as evidenced by issuance of Notice of Non-Compliance by the appropriate regulatory agency. The funded project must be needed to meet state or federal regulations. Priority is given to communities under economic distress.

Similar to the SPWF, the W/W Financing Program is primarily a loan program, although grant funds are available in certain cases, based on economic need of the community. Although the maximum loan term is 25 years, loans are generally made for 20-year terms. The maximum loan amount for projects funded with direct W/W money is $500,000, while the maximum for projects financed with bond funds is $10 million.

Economic and Community Development Block Grant

The IFA administers the CDBG, but the funds are from the U.S. Department of Housing and Urban Development (HUD), so all federal grant management rules apply to the program. The federal eligibility standards are strict. There are two subcategories of Public Works projects eligible for funding, "Public Water and Wastewater," and "Public Works for New Housing." Only the former is considered in this discussion.

Grants are available for critically needed construction, improvement, or expansion of publicly owned water and wastewater systems for the benefit of current residents. Generally, projects must be necessary to resolve regulatory compliance problems identified by state and/or federal agencies and the project must serve a community that is comprised of more than 51% of low and moderate income persons.

The program separates projects into three parts. Grants are available for:

- Preliminary Engineering and Planning Projects

  Generally, these grants fund preparation or update of Water System Master Plans and Wastewater Facility Plans, as required by the Oregon Department of Environmental Quality or Oregon Health Division. In addition, funds for grant administration and preparation of a final design funding application can be included in the project budget. All plans produced with grant funds must be approved by the appropriate regulatory agency. Grants of up to $10,000 can also be made for problem identification studies to delineate problems and corrective measures, as required by a regulatory agency.
- Final Design and Engineering Projects

  Final design and engineering, bid specifications, environmental review, financial feasibility, rate analysis, grant administration, and preparing a construction funding application are all eligible project activities. The final design, plans and specifications must be approved by the appropriate regulatory agency before a grant will be awarded.
- Construction Projects

  These grants fund construction and related activities, grant administration, and land/permanent easement acquisition.

  IFA has established an evaluation system that gives priority to projects that provide system-wide benefits. The overall maximum grant amount per water or wastewater project is $2,000,000 (including all planning, final engineering, and construction). The project cannot be divided locally into phases with the expectation of receiving more than one $2,000,000 grant. In order to qualify for grant funding under this program, the water user rates must be at or above statewide averages.

8.5.2.3 Clean Water State Revolving Fund

The Clean Water State Revolving Fund (CWSRF) is administered by Oregon DEQ and provides loans to cities, counties, special districts, and Indian tribes to construct, expand, or rehabilitate water pollution control, estuary management projects, and non-point source control plants.

Interest rates on loans are about 80% of the general obligation bond rate; however, there are additional financing costs and annual service fees that increase the effective rate. The maximum loan amount per project is 15% of the total available money in a particular year. The maximum loan term is 20 years, but there is an option for longer-term financing for treatment works for terms up to 30 years. This is accomplished by the community selling DEQ a revenue bond with repayment terms up to 30 years or the operational life of the treatment works, whichever is less.

8.5.3 Funding Recommendations

As available grant funding on public works projects has decreased in the last several years, it will be incumbent upon the City to aggressively pursue funding to finance the cost of the recommended improvements.

Based on the infrastructure improvements and cost projections presented in this plan, the existing SDC fee structure is not likely to be sufficient to meet the planning period goals. This plan accordingly recommends that the City complete a full review of its SDC rate structure and update these fees accordingly. All funding options will likely include an increase of the user rate and SDCs.

Another important element of the funding process is to schedule a "one stop meeting" with Oregon Infrastructure Finance Authority (IFA). The preparation of applicable grant applications should begin as soon as possible. Based on the 2013 guidelines for the Community Development Block Grant Program, approximately 66% of the families in Mt. Angel are classified as having low or moderate incomes. Therefore, the City may qualify for a number of grant programs. That said, in the coming months, the IFA will likely update this statistic based on the 2010 census data. Therefore, it is unclear if the City will remain above 51% low and moderate income once the 2010 census data is adopted. Should the percentage of low and moderate income families remain above 51%, the City may qualify for a $2,000,000 grant from the Community Development Block Grant Program administered by IFA.

CHAPTER 9

ENVIRONMENTAL REVIEW

Chapter Outline

9.1 Introduction
9.2 Alternatives to Proposed Action
  9.2.1 No-Action Alternative
  9.2.2 Facilities Plan Recommended Alternative (Preferred Alternative)
9.3 Improvements with No Environmental Impacts
9.4 Affected Environment/Environmental Consequences
  9.4.1 Land Use
  9.4.2 Floodplains
  9.4.3 Wetlands
  9.4.4 Wild and Scenic Rivers
  9.4.5 Cultural Resources
  9.4.6 Biological Resources
  9.4.7 Water Quality

ENVIRONMENTAL REVIEW

9.1 INTRODUCTION

Table 8-1 includes a listing of the projects that are recommended for inclusion in a capital improvement plan. It is envisioned that the Priority 1 and Priority 2 projects will be included in the capital improvement plan and will be constructed over the next 20 years. The Priority 3 projects are largely expected to be development driven and are not anticipated to be completed using City resources. A total of 16 Priority 1 and Priority 2 projects are recommended to be constructed during the next 20 years.

Most state and federal funding assistance programs require some level of environmental review as part of the application process. At the present time, the state and federal funding programs (if any) the City may use to fund the 16 capital improvement projects are not known. Therefore, it is not appropriate at the present time to expend resources to generate a detailed environmental report in support of a funding application that may not ever be made. Furthermore, many of the projects will not be completed for many years. In the interim, the environmental information may change significantly rendering a detailed report prepared at this time obsolete. It is also likely that many of the projects will be funded entirely with City funds.

None of the projects include the construction of a large infrastructure project (i.e., a new treatment plant) on an undisturbed site. Most of the projects include sanitary sewer pipeline reconstruction within existing road right of ways. Since the work associated with these projects is in areas that are currently developed, the environmental issues are expected to be limited. A few of the projects are expected to have some environmental issues that must be addressed. Should the City choose to pursue financial assistance from federal sources for these projects, a NEPA-ER may be required as part of the application process. It is anticipated that the information presented in this document will serve as the basis for the future preparation of a NEPA-ER if required as part of a future funding procurement effort.

9.2 ALTERNATIVES TO PROPOSED ACTION

The evaluation of environmental effects under NEPA requires that at least two alternatives be evaluated. The proposed improvements were the result of an exhaustive planning analysis and reflect the recommendation of the Wastewater System Facilities Plan. As part of the facilities planning process several alternatives to the proposed action were evaluated. As such, no alternatives to the proposed action, other than the no-action alternative, are presented in this Chapter.

9.2.1 No-Action Alternative

Under the No Action Alternative, the wastewater facilities improvements would not be constructed. The City's wastewater collection system would continue to age and deteriorate. Increased flows resulting from population growth would eventually lead to surcharging and bypasses of raw sewage. This would result in period violations of the City's NPDES permit. The City's treatment plant would also continue to age and deteriorate. Eventually, the mechanical

systems would reach the end of their useful life leading to inadequate wastewater treatment and NPDES permit violations.

9.2.2 Facilities Plan Recommended Alternative (Preferred Alternative)

By implementing the recommendations presented in this Wastewater Facilities Plan, the Preferred Alternative, the City would replace large sections of undersized trunk sewer pipes in the collection system. At the treatment plant, the entrance road would be improved, a new headworks would be constructed, the sludge would be removed from lagoon cell 1, and miscellaneous upgrades to improve the operation of the plant would also be made. The various elements of the recommended improvements are discussed in detail in Chapter 6 and Chapter 7.

9.3 IMPROVEMENTS WITH NO ENVIRONMENTAL IMPACTS

For several of the projects listed in the recommended capital improvement plan (Table 8-1) it is relatively obvious that there are no environmental issues that must be considered. These are listed as follows.

- *Project T-4 - Wetland Improvements, effluent boxes, influent valves*

This project includes installing screening equipment on the existing concrete structures used to control the flow of water from the treatment wetland. This project also includes replacing the existing valves that are used to control the flow of water into the treatment wetland. These improvements are completely internal to the wetland treatment process and will result in no ground disturbing activities.

- *Project T-5 – Effluent Pump Station Confined Space Entry Improvements*

This project includes installing a new sluice gate in the existing effluent pump station wetwell and modifying the valves in the pump station wetwell flow meter vault. All work in internal to existing concrete structures at the wastewater treatment plant.

- *Project T-3 – Lagoon Cell 1 Sludge Removal*

This project consists of removing and disposing of the accumulated sludge in lagoon cell 1. This project includes no land-disturbing activities.

- *Project T-6 – Effluent Pump Station Electrical and Control System Modernization*

This project includes replacing electrical and control equipment at the wastewater treatment plant. All work will be inside of existing structures.

- *Project T-7 – Facilities Plan Update*

This project is a planning project and not a construction project.

9.4 AFFECTED ENVIRONMENT/ENVIRONMENTAL CONSEQUENCES

9.4.1 Land Use

Affected Environment

With the exception of the access road improvements (Project T-1), the proposed improvements at the treatment plant are within the existing treatment plant property and no expansion of the treatment plant area is required. All of the collection system improvements are located in existing

easements or in road right of ways. Further, it is anticipated that all of the sewer collection piping improvements will be constructed in the same alignment as the existing pipelines. Therefore, the only project that potentially has land use issues is the access road improvement project (Project T-1).

The treatment plant access road improvements (Project T-1) require the acquisition of an additional 25 feet of right of access easement on the north side of the City's existing access easement. The easement will be obtained from Taxlot 2300 (map 61W04D). This property is located outside the City Limits and is under the jurisdiction of Marion County. The property is zoned for "Exclusive Farm Use" under Marion County Rural Zone Code. Based on discussions with Marion County Planning Officials, no land use actions are required since the project involves easement acquisition rather than a property transfer.

Environmental Consequences

None of the proposed improvements will affect land use.

Mitigation

The proposed improvements have no adverse impact on land use. Therefore, no mitigation is required.

9.4.2 Floodplains

Affected Environment

Figure 2-5 shows that the existing floodplain for the Pudding River is located entirely west and outside of the study area. As such, none of the work proposed in this plan is located in a flood hazard zone.

Environmental Consequences

None of the projects listed in this plan are located in flood hazard zone.

Mitigation

No mitigation will be necessary to protect floodplains or the National Flood Insurance Programs that is in place for the City of Mt. Angel.

9.4.3 Wetlands

Affected Environment

Figure 2-6 shows the national wetland inventory for the study area. The treatment plant access road improvements (Project T-1) will cross and impact a wetland area near the east edge of the access road. The proposed project includes constructing additional fill to widen the existing access road. Some of this fill will be located in the wetland. Other wetland areas are likely to exist that are not shown on Figure 2-6. Projects G-1 and G-5 (Figure 6-2) include reconstructing existing gravity sewer pipelines. These two projects cross undeveloped areas that may contain local wetland areas that are not show on Figure 2-6. The remainder of the projects listed in this plan are located in existing paved roadways and should not have any wetland impacts. Therefore, the three projects of concern are projects T-1, G-1, and G-5. Project T-1 will certainly require filling in existing wetlands. Projects G-1 and G-5 may or may not require work in wetland areas.

If wetland areas are found in projects G-1 and G-5, any impacts will be temporary since these projects include the installation of subsurface pipes. The ground surface will not be altered by projects G-1 and G-5.

Environmental Consequences

Wetlands are valuable for flood storage, stormwater retention, water quality improvement, and aquifer recharge, as well as providing food and habitat for wildlife. To the maximum extent possible the final designs for the facilities should avoid short-term and long-term adverse impacts associated with destruction of wetlands. As noted above Project T-1 will very likely result in filling a small portion of a local undocumented wetland area. Projects G-1 and G-5 may also have result in temporary wetland impacts.

Mitigation

It is recommended that wetland delineations be performed for project T-1, G-1, and G-5 prior to final design work. The final design for these facilities should seek to minimize any wetland impacts. Project T-1 will likely result in filling a small wetland area. As such, the City should anticipate that wetland mitigation is required for project T-1. The recommended project budgets presented in this plan for Project T-1 include wetland mitigation costs. It is anticipated that mitigation will consist of purchasing credits from an appropriate wetland mitigation bank.

9.4.4 Wild and Scenic Rivers

Affected Environment

The Pudding River is the only river potentially affected by the proposed improvements. However, the Pudding River is not classified as wild or scenic

Environmental Consequences

The proposed project does not affect any wild or scenic river.

Mitigation

No mitigation of impacts to wild or scenic rivers are required.

9.4.5 Cultural Resources

Affected Environment

A review of the Oregon Statewide Inventory of Historic Sites and Buildings revealed the following known (Table 9-1) historical resources in the vicinity of the study area. None of these structures are within the vicinity of the proposed improvements. With the exception of projects G-1 and G-5 (Figure 6-2), the proposed collection system improvements are all located within paved streets that have previously been disturbed. It is recommended that the pipelines be replaced in the same alignment. This will result in trench excavation through the backfill that was placed when the existing pipelines were originally installed. This is the case for all of the collection system improvements including project G-1 and G-5. As such, no new ground disturbing activities are anticipated as part of the gravity collection system improvements.

The proposee treatment plant improvement projects are all located within the City-owned treatment plant property. As part of the original construction of the existing treatment plant

project in the early 1990's, the City performed cultural resource investigations of the treatment plant site. These investigations included a pedestrian survey and a more detailed subsurface investigation. The results of this work were published in reports dated December 21, 1990 and February 12, 1991 respectively. These investigations showed that there were no cultural resources present at the site that were eligible for listing on the National Register. The Oregon State Historic Preservation Office concurred with these findings in a letter dated February 20, 1991. These documents are included in Appendix F. Based on this past cultural resource investigation work and the fact that all of the proposed treatment plant improvements are located entirely within the City's property, no cultural resource issues are anticipated for the treatment system improvement projects.

Environmental Consequences

The proposed project will not impact any known historic or cultural resources. However, unknown prehistoric, historic, or cultural resources may exist below the ground surface that are not detectable without subsurface probing or excavation.

Mitigation

No mitigation of known historic or cultural resources is necessary at this time. If any historical or archaeological artifacts are discovered during the course of construction, work must be temporarily halted and the Engineer must be contacted. Work may proceed at the discretion of the Engineer after consulting with the State Historical Preservation Officer.

Table 9-1 | Historical Resources within the Project Area

Name	Address
Saalfeld House	195 E College St.
Unnamed	460 E College St.
St. Marys Roman Catholic Church	575 E College
Unnamed	190 S Main St.
Wilco Farmers Store Ensemble	190 S Main St.
Queen of Angels Priory	840 S Main St.
Pudding River Bridge	Monitor-McKee Rd. NE
Vacant Land	12254 Mt. Angel-Gervais Rd.
House	12263 Mt. Angel-Gervais Rd.
Farm	12314 Mt. Angel-Gervais Rd.
House	12335 Mt. Angel-Gervais Rd.
House	12354 Mt. Angel-Gervais Rd.
House	12373 Mt. Angel-Gervais Rd.
Unnamed	830 Pershing St.
Unnamed	1005 Pershing St. N
Farm	12300 Pershing Rd
Windischar's General Blacksmith Shop	110 Sheridan St.

9.4.6 Biological Resources

Affected Environment

Biological resources include threatened, endangered, and candidate species, all of which are protected. The proposed project must not adversely affect threatened or endangered species or their habitats.

With the exception of projects T-1, T-5, G-1, and G-5, all proposed projects are located in paved roadways or within the previously disturbed areas of the treatment plant site. As such, no impacts to biological resources are anticipated for these projects.

Projects T-1, T-5, G-1 and G-5 include ground disturbing activities and have the potential to impact biological resources. As such, prior to the final design of these projects, it is recommended that the City perform the necessary field studies to ensure that no biological resources are impacted.

Environmental Consequences

The proposed project will not likely impact known threatened or endangered species or their habitat due to the relatively small amount of previously undisturbed ground that must be disturbed as part of the proposed improvements. However, to ensure that this is the case, appropriate research and fieldwork should be conducted prior to the final design for projects T-1, T-5, G-1, and G-5.

Mitigation

In the unlikely event that threatened or endangered species or their habitat are discovered as part of the research recommended above, the best approach would be to modify the design of the improvements to avoid the habitat. For the headworks improvements (project T-5), the headworks structure can be relocated to avoid the need to excavate the undisturbed areas. Retaining walls can also be constructed to minimize excavation. For the gravity collection system projects (i.e., G-1 & G-5), the final alignments can be altered to avoid sensitive areas. Trenchless pipe installation techniques such as auger boring and pipe bursting can also be used to avoid impacts to sensitive areas.

9.4.7 Water Quality

Affected Environment

The affected environment for water quality consists of surface water (Pudding River) and groundwater.

Environmental Consequences

Construction activities associated with the project may impact water quality in the short term. Construction activities, including clearing and grading, can lead to increased potential for erosion and sedimentation in downstream drainages. Accidental spills of oils, fuels, or solvents during construction could impact groundwater. Release of any potentially toxic materials such as hydraulic fluid, gasoline, chlorine, raw sewage or oil could harm fish habitat.

Mitigation

Mitigation measures for water quality issues include the following.

- A 1200C general NPDES permit will be needed for any construction activities that result in the disturbance of more than one acre.
- Existing components of the treatment plant will need to be kept on-line until new components can be brought on-line to ensure that the treatment plant is able to comply with the NPDES permit for the facility during construction.
- Water used to mitigate for dust created during construction activities shall be prevented from entering drainages and must be collected and disposed of in accordance with DEQ water quality standards and NPDES permit requirements.
- To reduce the possibility of chemical spills or releases of contaminant, including any non-stormwater discharge to drainage channels, the contractor shall implement appropriate hazardous material management practices.
- Why bypass pumping of sewage is required the contractor shall have multiple pumps on hand to ensure sewage spills are overflows do not occur.

REFERENCES

REFERENCES

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APPENDIX A

NPDES PERMIT

ISSUED

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
WASTE DISCHARGE PERMIT

Department of Environmental Quality
Western Region – Salem Office
750 Front Street NE, Suite 120, Salem, OR 97301-1039
Telephone: (503) 378-8240

Issued pursuant to ORS 468B.050 and The Federal Clean Water Act

ISSUED TO:
City of Mt. Angel
PO Box 960
Mt. Angel, OR 97362

SOURCES COVERED BY THIS PERMIT:

Type of Waste	Outfall Number	Outfall Location
Treated Wastewater	001	R.M. 37.5

FACILITY TYPE AND LOCATION:

Stabilization Lagoon without Aeration
West of Mt. Angel-Gervais Hwy.
Mt. Angel, Oregon
Treatment System Class: Level II
Collection System Class: Level II

RECEIVING STREAM INFORMATION:

Basin: Willamette
Sub-Basin: Molalla-Pudding
Receiving Stream: Pudding River
LLID: 1227161452842-37.5-D
County: Marion

EPA REFERENCE NO: OR-002876-2
Issued in response to Application No. 982793 received September 30, 2004.
This permit is issued based on the land use findings in the permit record.

Tim M. Feltz
for: Michael H. Kortenhof, Western Region Water Quality Manager

July 28, 2005
Date

PERMITTED ACTIVITIES

Until this permit expires or is modified or revoked, the permittee is authorized to construct, install, modify, or operate a wastewater collection, treatment, control and disposal system and discharge to public waters adequately treated wastewaters only from the authorized discharge point or points established in Schedule A and only in conformance with all the requirements, limitations, and conditions set forth in the attached schedules as follows:

Page
Schedule A - Waste Discharge Limitations not to be Exceeded 2
Schedule B - Minimum Monitoring and Reporting Requirements 4
Schedule C - Compliance Conditions and Schedules 8
Schedule D - Special Conditions 9
Schedule F - General Conditions 11

Unless specifically authorized by this permit, by another NPDES or WPCF permit, or by Oregon Administrative Rule, any other direct or indirect discharge of waste is prohibited, including discharge to waters of the state or an underground injection control system.

SCHEDULE A

1. Waste Discharge Limitations not to be exceeded after permit issuance.

a. Treated Effluent Outfall 001

(1) May 1 - October 31: No discharge to waters of the State (unless approved in writing by the Department)**

(2) November 1 - April 30: Effluent shall be discharged in accordance with the following tables:

Stream Flow (cfs)	Maximum Effluent Flow (mgd)
100-199	0.30
200-299	0.68
300-399	1.10
400-499	1.50
500-599	1.90
600-699	2.28
700-799	2.76
800-899	3.24
900-999	3.72
Greater than or equal to 1000	4.20

Parameter	Average Effluent Concentrations Monthly	Weekly	Monthly* Average lb/day	Weekly* Average lb/day	Daily* Maximum lbs
BOD_5	20 mg/L	30 mg/L	300	450	600
TSS	20 mg/L	30 mg/L	300	450	600

* Average dry weather design flow to the facility equals 0.0.56 MGD. Mass load limits are based upon the winter discharge rate of 1.8 MGD to allow for disposal of summer accumulations of treated wastewater as well as winter Stormwater impacting the lagoon surface.

** The discharge period at the permitted mass load and concentration limits may be extended into May if:

(i) It is projected that the lagoon water level would be higher than the minimum operating level on April 30, assuming average April river flows, and effluent is discharged in accordance with the above table;

(ii) Documentation is submitted in writing to the Department by April 1; and,

(iii) Written authorization is obtained from the Department.

(3)

Other parameters (year-round)	Limitations
E. coli Bacteria	Shall not exceed 126 organisms per 100 mL monthly geometric mean. No single sample shall exceed 406 organisms per 100 mL. (See Note 1)
pH	Shall be within the range of 6.0 - 9.0
BOD_5 and TSS Removal Efficiency	Shall not be less than 85% monthly average for BOD_5 and TSS.
Total Residual Chlorine	Shall not exceed a monthly average concentration of 0.13 mg/l and a daily maximum concentration of

(4) Except as provided for in OAR 340-045-0080, no wastes shall be discharged and no activities shall be conducted which violate Water Quality Standards as adopted in OAR 340-041 except in the following defined mixing zone:

The allowable mixing zone is that portion of the Pudding River extending from a point ten (10) feet upstream of the outfall to a point one hundred (100) feet downstream from the outfall. The Zone of Immediate Dilution (ZID) shall be defined as that portion of the allowable mixing zone that is within ten (10) feet of the point of discharge.

(5) Raw sewage discharges are prohibited to waters of the State from May 22 through October 31, except during a storm event greater than the one-in-ten-year, 24-hour duration storm. If an overflow occurs between May 22 and June 1, and if the permittee demonstrates to the Department's satisfaction that no increase in risk to beneficial uses occurred because of the overflow, no violation shall be triggered if the storm associated with the overflow was greater than the one-in-five-year, 24-hour duration storm.

b. No activities shall be conducted that could cause an adverse impact on existing or potential beneficial uses of groundwater. All wastewater and process related residuals shall be managed and disposed in a manner that will prevent a violation of the Groundwater Quality Protection Rules (OAR 340-040).

NOTES:

1. If a single sample exceeds 406 organisms per 100 mL, then five consecutive re-samples may be taken at four-hour intervals beginning within 48 hours after the original sample was taken. If the log mean of the five re-samples is less than or equal to 126 organisms per 100 mL, a violation shall not be triggered.

SCHEDULE B

1. **Minimum Monitoring and Reporting Requirements** (unless otherwise approved in writing by the Department).

The permittee shall monitor the parameters as specified below at the locations indicated. The laboratory used by the permittee to analyze samples shall have a quality assurance/quality control (QA/QC) program to verify the accuracy of sample analysis. If QA/QC requirements are not met for any analysis, the results shall be included in the report, but not used in calculations required by this permit. When possible, the permittee shall re-sample in a timely manner for parameters failing the QA/QC requirements, analyze the samples, and report the results.

a. Influent

The facility influent sampling location is taken at the headworks just after the Parshall Flume before flowing into the first lagoon cell.

Item or Parameter	Minimum Frequency	Type of Sample
Total Flow (MGD)	Daily	Measurement
Flow Meter Calibration	Annually	Verification
BOD_5	Weekly	Composite
TSS	Weekly	Composite
pH	3/Week	Grab

b. Treated Effluent Outfall 001

The facility effluent flow measurements and samples for BOD, TSS, and pH are taken just after the flow from the wetlands prior to entering the holding wet well. The facility effluent samples for bacteria and chlorine residual are taken from a ¾ inch PVC pipe with a hose spigot receives effluent from the chlorine contact pipe prior to entering the river.

Item or Parameter	Minimum Frequency	Type of Sample
Total Flow (MGD)	Daily	Measurement
Flow Meter Calibration	Annually	Verification
BOD_5	Weekly	Composite
TSS	Weekly	Composite
pH	3/Week	Grab
E. coli	Weekly	Grab (See Note 1)
Quantity Chlorine Used	Daily	Measurement
Chlorine Residual	Daily	Grab
Pounds Discharged (BOD_5 and TSS)	Weekly	Calculation
Average Percent Removed (BOD_5 and TSS)	Monthly	Calculation
DDT	Semi-Annually, November and April (See Note 2)	24-hour Composite

c. Groundwater Monitoring

(1) Groundwater Monitoring and Reporting Requirements

(a) Groundwater monitoring samples shall be conducted in the following monitoring wells, and sampling procedures shall be in accordance with the approved Monitoring Plan:

Monitoring Well	Well Designation
Monitoring Well 1	MW-1
Monitoring Well 2 ***	MW-2
Monitoring Well 3	MW-3
Monitoring Well 4	MW-4
Monitoring Well 5	MW-5
Monitoring Well 6	MW-6

(b) Sampling procedures shall be in accordance with the approved Monitoring Plan. At a minimum, the permittee shall monitor groundwater for the parameters at the frequencies as specified below. If the Department approved Monitoring Plan requires additional sampling and analysis of other parameters, the permittee shall conduct the additional monitoring as required in the Monitoring Plan. ***Monitoring Well Number 2 shall be monitored and sampled on a Semi-Annual basis during September and January until approved otherwise in writing by the Department.

Parameter	Minimum Frequency	Type of Sample
Temperature	Annually-September	Field Measurement
pH	Annually-September	Field Measurement
Specific Conductance	Annually-September	Field Measurement
Nitrate-Nitrogen	Annually-September	Grab
Ammonia-Nitrogen	Annually-September	Grab
TKN	Annually-September	Grab
Fecal Coliform	Annually-September	Grab
Orthophosphate-P	Annually-September	Grab
Water Level	Annually-September	Field Measurement

(c) Groundwater Reporting

i. Analytical results of groundwater monitoring for the parameters listed above and for any other parameters identified in the approved Monitoring Plan, shall be reported in a Department approved format. At a minimum, the report shall contain the reporting information identified in the approved Monitoring Plan. Reports are due to the Department by the 30th day of the month following the sampling event.

ii. Analytical Data Analysis and Reporting: An annual groundwater data analysis report shall be submitted to the Department by February 1 each year. The annual report shall contain the annual data analysis and reporting information identified in the approved Monitoring Plan.

(d) Groundwater Monitoring Resampling Requirements

i. If monitoring indicates that a concentration limit has been exceeded at a compliance point, the permittee shall notify the Department within 10 days and shall immediately resample the monitoring well. The results of both sampling events shall be reported to the Department within 10 days of receipt of the laboratory data.

ii. If monitoring indicates a significant increase (increase or decrease for pH) in the value of a parameter monitored, the permittee shall immediately resample unless otherwise approved in writing by the

Department. If the Resampling confirms a change in water quality, the permittee shall:

A. Report the results to the Department within 10 days of receipt of the laboratory data; and,

B. Prepare and submit to the Department within 30 days a plan for developing a preliminary assessment unless another time schedule is approved by the Department.

(2) If monitoring data indicate that the permittee's discharge poses a significant threat to groundwater quality, the Department may reopen this permit, if necessary, to include corrective action and/or additional monitoring requirements. Based on monitoring data or other system operational factors, the Department may also reopen this permit, if necessary, to reduce monitoring requirements.

2. **Reporting Procedures**

a. Monitoring results shall be reported on approved forms. The reporting period is the calendar month. Reports must be submitted to the Department's Western Region - Salem office by the 15th day of the following month.

b. State monitoring reports shall identify the name, certificate classification and grade level of each principal operator designated by the permittee as responsible for supervising the wastewater collection and treatment systems during the reporting period. Monitoring reports shall also identify each system classification as found on page one of this permit.

c. Monitoring reports shall also include a record of the quantity and method of use of all sludge removed from the treatment facility and a record of all applicable equipment breakdowns and bypassing.

3. **Report Submittals**

a. The permittee shall have in place a program to identify and reduce inflow and infiltration into the sewage collection system. An annual report shall be submitted to the Department by February 1 each year which details sewer collection maintenance activities that reduce inflow and infiltration. The report shall state those activities that have been done in the previous year and those activities planned for the following year.

NOTES:

1. *E. coli* monitoring must be conducted according to any of the following test procedures as specified in **Standard Methods for the Examination of Water and Wastewater, 19th Edition,** or according to any test procedure that has been authorized and approved in writing by the Director or an authorized representative:

Method	Reference	Page	Method Number
mTEC agar, MF	Standard Methods, 18th Edition	9-29	9213 D
NA-MUG, MF	Standard Methods, 19th Edition	9-63	9222 G
Chromogenic Substrate, MPN	Standard Methods, 19th Edition	9-65	9223 B
Colilert QT	Idexx Laboratories, Inc.		

2. The Department has little information concerning the discharge of DDT under this permit. Therefore, monitoring for DDT will be required semi-annually during the first year of this permit. After the first year, monitoring of the effluent for DDT may be eliminated unless otherwise notified in writing by the Department If it is determined that DDT is a significant pollutant in the discharge, this permit may be re-opened to establish a new limit and/or requirements for this pollutant. Upon approval of a Total Maximum Daily Load for DDT for this sub-basin, this permit may be re-opened to include new or revised limits or other conditions or requirements regarding DDT.

SCHEDULE C

Compliance Schedules and Conditions

1. By no later than September 30, 2005, the permittee shall submit to the Department for review and approval a proposed program and time schedule for identifying and reducing inflow. Within 60 days of receiving written Department comments, the permittee shall submit a final approvable program and time schedule. The program shall consist of the following:

   a. Identification of all overflow points and verification that sewer system overflows are not occurring up to a 24-hour, 5-year storm event or equivalent;

   b. Monitoring of all pump station overflow points;

   c. A program for identifying and removing all inflow sources into the permittee's sewer system over which the permittee has legal control; and

   d. If the permittee does not have the necessary legal authority for all portions of the sewer system or treatment facility, a program and schedule for gaining legal authority to require inflow reduction and a program and schedule for removing inflow sources.

2. Six (6) months prior to the removal of accumulated solids from the lagoon, the permittee shall submit to the Department a revised biosolids management plan developed in accordance with Oregon Administrative Rule 340, Division 50, "Land Application of Domestic Wastewater Treatment Facility Biosolids, Biosolids Derived Products, and Domestic Septage". Upon approval of the plan by the Department, the plan shall be implemented by the permittee.

3. By October 28, 2005, the permittee shall submit to the Department a report which either identifies known sewage overflow locations and a plan for estimating the frequency, duration and quantity of sewage overflowing, or confirms that there are no overflow points. The report shall also provide a schedule to eliminate the overflow(s), if any.

4. By no later than September 30, 2005, the permittee shall conduct a leak test on Lagoon Cell #2. By no later than three (3) months after conducting the leak test, the permittee shall submit the leak test results to the Department for review and approval

5. Should the results of the leak test (as required by Compliance Condition 4., above) show a significant leakage rate greater than or equal to 0.25 inches per day, then the permittee shall submit a Corrective Action Plan to the Department for review and approval within six (6) months after a determination that the lagoon cell is leaking at an unacceptable rate. Upon Department approval of the plan, the permittee shall implement the plan.

6. The permittee is expected to meet the compliance dates which have been established in this schedule. Either prior to or no later than 14 days following any lapsed compliance date, the permittee shall submit to the Department a notice of compliance or noncompliance with the established schedule. The Director may revise a schedule of compliance if he/she determines good and valid cause resulting from events over which the permittee has little or no control.

SCHEDULE D

Special Conditions

1. All Biosolids shall be managed in accordance with the DEQ approved Biosolids management plan, and the site authorization letters issued by the DEQ. Any changes in solids management activities that significantly differ from operations specified under the approved plan require the prior written approval of the DEQ.

   All new Biosolids application sites shall meet the site selection criteria set forth in OAR 340-50-0070. The permittee currently has one approved site. Property owners adjacent to any newly approved application sites shall be notified, in writing or by any method approved by DEQ, of the proposed activity prior to the start of application. For proposed new application sites that are deemed by the DEQ to be sensitive with respect to residential housing, runoff potential or threat to groundwater, an opportunity for Public comment shall be provided in accordance with OAR 340-50-0030.

2. The permittee shall comply with Oregon Administrative Rules (OAR), Chapter 340, Division 49, "Regulations Pertaining To Certification of Wastewater System Operator Personnel" and accordingly:

   a. The permittee shall have its wastewater system supervised by one or more operators who are certified in a classification <u>and</u> grade level (equal to or greater) that corresponds with the classification (collection and/or treatment) of the system to be supervised as specified on page one of this permit.

Note: **A "supervisor" is defined as the person exercising authority for establishing and executing the specific practice and procedures of operating the system in accordance with the policies of the permittee and requirements of the waste discharge permit. "Supervise" means responsible for the technical operation of a system, which may affect its performance or the quality of the effluent produced. Supervisors are not required to be on-site at all times.**

   b. The permittee's wastewater system may not be without supervision (as required by Special Condition 2.a. above) for more than thirty (30) days. During this period, and at any time that the supervisor is not available to respond on-site (i.e. vacation, sick leave or off-call), the permittee must make available another person who is certified in the proper classification <u>and</u> at grade level I or higher.

   c. The permittee is responsible for ensuring the wastewater system has a properly certified supervisor available at all times to respond on-site at the request of the permittee and to any other operator.

   d. The permittee shall notify the Department of Environmental Quality in writing within thirty (30) days of replacement or re-designation of certified operators responsible for supervising wastewater system operation. The notice shall be filed with the Water Quality Division, Operator Certification Program, 811 SW 6th Ave, Portland, OR 97204. This requirement is in addition to the reporting requirements contained under Schedule B of this permit.

   e. Upon written request, the Department may grant the permittee reasonable time, not to exceed 120 days, to obtain the services of a qualified person to supervise the wastewater system. The written request must include justification for the time needed, a schedule for recruiting and hiring, the date the system supervisor availability ceased and the name of the alternate system supervisor(s) as required by 2.b. above.

3. The permittee shall notify the DEQ Western Region - Salem Office (phone: (503) 378-8240) in accordance with the response times noted in the General Conditions of this permit, of any malfunction so that corrective action can be coordinated between the permittee and the Department.

SCHEDULE F
NPDES GENERAL CONDITIONS – DOMESTIC FACILITIES

SECTION A. STANDARD CONDITIONS

1. Duty to Comply with Permit
The permittee must comply with all conditions of this permit. Failure to comply with any permit condition is a violation of Oregon Revised Statutes (ORS) 468B.025, and 40 Code of Federal Regulations (CFR) Section 122.41(a), and grounds for an enforcement action. Failure to comply is also grounds for the Department to modify, revoke, or deny renewal of a permit.

2. Penalties for Water Pollution and Permit Condition Violations
ORS 468.140 allows the Department to impose civil penalties up to $10,000 per day for violation of a term, condition, or requirement of a permit. Additionally 40 CFR 122.41 (A) provides that any person who violates any permit condition, term, or requirement may be subject to a federal civil penalty not to exceed $25,000 per day for each violation.

Under ORS 468.943 and 40 CFR 122.41(a), unlawful water pollution, if committed by a person with criminal negligence, is punishable by a fine of up to $25,000 imprisonment for not more than one year, or both. Each day on which a violation occurs or continues is a separately punishable offense.

Under ORS 468.946, a person who knowingly discharges, places, or causes to be placed any waste into the waters of the state or in a location where the waste is likely to escape into the waters of the state is subject to a Class B felony punishable by a fine not to exceed $200,000 and up to 10 years in prison. Additionally, under 40 CFR 122.41(a) any person who knowingly discharges, places, or causes to be placed any waste into the waters of the state or in a location where the waste is likely to escape into the waters of the state is subject to a federal civil penalty not to exceed $100,000, and up to 6 years in prison.

3. Duty to Mitigate
The permittee must take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this permit that has a reasonable likelihood of adversely affecting human health or the environment. In addition, upon request of the Department, the permittee must correct any adverse impact on the environment or human health resulting from noncompliance with this permit, including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge.

4. Duty to Reapply

If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and have the permit renewed. The application must be submitted at least 180 days before the expiration date of this permit.

The Department may grant permission to submit an application less than 180 days in advance but no later than the permit expiration date.

5. Permit Actions
This permit may be modified, revoked and reissued, or terminated for cause including, but not limited to, the following:

a. Violation of any term, condition, or requirement of this permit, a rule, or a statute
b. Obtaining this permit by misrepresentation or failure to disclose fully all material facts
c. A change in any condition that requires either a temporary or permanent reduction or elimination of the authorized discharge
d. The permittee is identified as a Designated Management Agency or allocated a wasteload under a Total Maximum Daily Load (TMDL)
e. New information or regulations
f. Modification of compliance schedules
g. Requirements of permit reopener conditions
h. Correction of technical mistakes made in determining permit conditions
i. Determination that the permitted activity endangers human health or the environment

j. Other causes as specified in 40 CFR 122.62, 122.64, and 124.5

The filing of a request by the permittee for a permit modification, revocation or reissuance, termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

6. Toxic Pollutants
The permittee must comply with any applicable effluent standards or prohibitions established under Oregon Administrative Rules (OAR) 340-041-0033 for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

7. Property Rights and Other Legal Requirements
The issuance of this permit does not convey any property rights of any sort, or any exclusive privilege, or authorize any injury to persons or property or invasion of any other private rights, or any infringement of federal, tribal, state, or local laws or regulations.

8. Permit References
Except for effluent standards or prohibitions established under OAR 340-041-0033 for toxic pollutants and standards for sewage sludge use or disposal established under Section 405(d) of the Clean Water Act, all rules and statutes referred to in this permit are those in effect on the date this permit is issued.

9. Permit Fees
The permittee must pay the fees required by Oregon Administrative Rules.

SECTION B. OPERATION AND MAINTENANCE OF POLLUTION CONTROLS

1. Proper Operation and Maintenance
The permittee must at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) that are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems that are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

2. Duty to Halt or Reduce Activity
For industrial or commercial facilities, upon reduction, loss, or failure of the treatment facility, the permittee must, to the extent necessary to maintain compliance with its permit, control production or all discharges or both until the facility is restored or an alternative method of treatment is provided. This requirement applies, for example, when the primary source of power of the treatment facility fails or is reduced or lost. It is not a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

3. Bypass of Treatment Facilities

a. Definitions
(1) "Bypass" means intentional diversion of waste streams from any portion of the treatment facility. The term "bypass" does not apply if the diversion does not cause effluent limitations to be exceeded, provided the diversion is to allow essential maintenance to assure efficient operation or the diversion is due to nonuse of nonessential treatment units or processes at the treatment facility.
(2) "Severe property damage" means substantial physical damage to property, damage to the treatment facilities or treatment processes that causes them to become inoperable, or substantial and permanent loss of natural resources that can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

b. Prohibition of bypass.
(1) Bypass is prohibited unless:
(a) Bypass was necessary to prevent loss of life, personal injury, or severe property damage;

(b) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate backup equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass that occurred during normal periods of equipment downtime or preventative maintenance; and

(c) The permittee submitted notices and requests as required under General Condition B.3.c.

(2) The Department may approve an anticipated bypass, after considering its adverse effects and any alternatives to bypassing, when the Department determines that it will meet the three conditions listed above in General Condition B.3.b.(1).

c. Notice and request for bypass.

(1) Anticipated bypass. If the permittee knows in advance of the need for a bypass, a written notice must be submitted to the Department at least ten days before the date of the bypass.

(2) Unanticipated bypass. The permittee must submit notice of an unanticipated bypass as required in General Condition D.5.

4. Upset

a. Definition. "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operation error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventative maintenance, or careless or improper operation.

b. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the requirements of General Condition B.4.c are met. A determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance is not final administrative action subject to judicial review.

c. Conditions necessary for a demonstration of upset. A permittee who wishes to establish the affirmative defense of upset must demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

(1) An upset occurred and that the permittee can identify the causes(s) of the upset;

(2) The permitted facility was at the time being properly operated;

(3) The permittee submitted notice of the upset as required in General Condition D.5, hereof (24-hour notice); and

(4) The permittee complied with any remedial measures required under General Condition A.3 hereof.

d. Burden of proof. In any enforcement proceeding the permittee seeking to establish the occurrence of an upset has the burden of proof.

5. Treatment of Single Operational Upset

For purposes of this permit, A Single Operational Upset that leads to simultaneous violations of more than one pollutant parameter will be treated as a single violation. A single operational upset is an exceptional incident that causes simultaneous, unintentional, unknowing (not the result of a knowing act or omission), temporary noncompliance with more than one Clean Water Act effluent discharge pollutant parameter. A single operational upset does not include Clean Water Act violations involving discharge without a NPDES permit or noncompliance to the extent caused by improperly designed or inadequate treatment facilities. Each day of a single operational upset is a violation.

6. Overflows from Wastewater Conveyance Systems and Associated Pump Stations

a. Definitions

(1) "Overflow" means the diversion and discharge of waste streams from any portion of the wastewater conveyance system including pump stations, through a designed overflow device or structure, other than discharges to the wastewater treatment facility.

(2) "Severe property damage" means substantial physical damage to property, damage to the conveyance system or pump station which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of an overflow.

(3) "Uncontrolled overflow" means the diversion of waste streams other than through a designed overflow device or structure, for example to overflowing manholes or overflowing into residences, commercial establishments, or industries that may be connected to a conveyance system.

b. Prohibition of storm related overflows. Storm related overflows of raw sewage are prohibited to waters of the State. However, the Environmental Quality Commission (EQC) recognizes that it is impossible to design and construct a conveyance system that will prevent overflows under all storm conditions. The State of Oregon has determined that all wastewater conveyance systems should be designed to transport storm events up to a specific size to the treatment facility. Therefore, such storm related overflows will not be considered a violation of this permit if:

(1) The permittee has conveyance and treatment facilities adequate to prevent overflows except during a storm event greater than the one-in-five-year, 24-hour duration storm from November 1 through May 21 and except during a storm event greater than the one-in-ten-year, 24-hour duration storm from May 22 through October 31;

(2) The permittee has provided the highest and best practicable treatment and/or control of wastes, activities, and flows and has properly operated the conveyance and treatment facilities in compliance with General Condition B.1.;

(3) The permittee has properly implemented a Department approved Overflow Response Plan; and

(4) The permittee has implemented a program to evaluate and maintain the capacity of the conveyance system

c. Prohibition of other overflows. All overflows other than stormwater-related overflows (discussed in Schedule F, Section B, Condition 6.b.) are prohibited unless:

(1) Overflows were unavoidable to prevent an uncontrolled overflow, loss of life, personal injury, or severe property damage;

(2) There were no feasible alternatives to the overflows, such as the use of auxiliary pumping or conveyance systems, or maximization of conveyance system storage; and

(3) The overflows are the result of an upset as defined in General Condition B.4. and meeting all requirements of this condition.

d. Uncontrolled overflows are prohibited where wastewater is likely to escape or be carried into the waters of the State by any means.

e. Reporting required. Unless otherwise specified in writing by the Department, all overflows and uncontrolled overflows must be reported orally to the Department within 24 hours from the time the permittee becomes aware of the overflow. Reporting procedures are described in more detail in General Condition D.5. Reports concerning storm related overflows must include information about the amount and intensity of the rainfall event causing the overflow.

7. Public Notification of Effluent Violation or Overflow
If effluent limitations specified in this permit are exceeded or an overflow occurs, upon request by the Department, the permittee must take such steps as are necessary to alert the public about the extent and nature of the discharge. Such steps may include, but are not limited to, posting of the river at access points and other places, news releases, and paid announcements on radio and television.

8. Removed Substances
Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters must be disposed of in such a manner as to prevent any pollutant from such materials from entering waters of the state, causing nuisance conditions, or creating a public health hazard.

SECTION C. MONITORING AND RECORDS

1. Representative Sampling
Sampling and measurements taken as required herein must be representative of the volume and nature of the monitored discharge. All samples must be taken at the monitoring points specified in this permit, and shall be taken, unless otherwise specified, before the effluent joins or is diluted by any

other waste stream, body of water, or substance. Monitoring points may not be changed without notification to and the approval of the Department.

2. Flow Measurements
Appropriate flow measurement devices and methods consistent with accepted scientific practices must be selected and used to ensure the accuracy and reliability of measurements of the volume of monitored discharges. The devices must be installed, calibrated and maintained to insure that the accuracy of the measurements is consistent with the accepted capability of that type of device. Devices selected must be capable of measuring flows with a maximum deviation of less than ± 10 percent from true discharge rates throughout the range of expected discharge volumes.

3. Monitoring Procedures
Monitoring must be conducted according to test procedures approved under 40 CFR part 136, unless other test procedures have been specified in this permit.

4. Penalties of Tampering
The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit may, upon conviction, be punished by a fine of not more than $10,000 per violation, imprisonment for not more than two years, or both. If a conviction of a person is for a violation committed after a first conviction of such person, punishment is a fine not more than $20,000 per day of violation, or by imprisonment of not more than four years, or both.

5. Reporting of Monitoring Results
Monitoring results must be summarized each month on a Discharge Monitoring Report form approved by the Department. The reports must be submitted monthly and are to be mailed, delivered or otherwise transmitted by the 15th day of the following month unless specifically approved otherwise in Schedule B of this permit.

6. Additional Monitoring by the Permittee
If the permittee monitors any pollutant more frequently than required by this permit, using test procedures approved under 40 CFR part 136 or as specified in this permit, the results of this monitoring must be included in the calculation and reporting of the data submitted in the Discharge Monitoring Report. Such increased frequency must also be indicated. For a pollutant parameter that may be sampled more than once per day (e.g., Total Chlorine Residual), only the average daily value must be recorded unless otherwise specified in this permit.

7. Averaging of Measurements
Calculations for all limitations that require averaging of measurements must utilize an arithmetic mean, except for bacteria which shall be averaged as specified in this permit.

8. Retention of Records
Except for records of monitoring information required by this permit related to the permittee's sewage sludge use and disposal activities, which shall be retained for a period of at least five years (or longer as required by 40 CFR part 503). The permittee must retain records of all monitoring information, including: all calibration, maintenance records, all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit for a period of at least 3 years from the date of the sample, measurement, report, or application. This period may be extended by request of the Department at any time.

9. Records Contents

Records of monitoring information must include:
a. The date, exact place, time, and methods of sampling or measurements;
b. The individual(s) who performed the sampling or measurements;
c. The date(s) analyses were performed;
d. The individual(s) who performed the analyses;
e. The analytical techniques or methods used; and
f. The results of such analyses.

10. Inspection and Entry

The permittee must allow the Department representative upon the presentation of credentials to:

a. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;
b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;
c. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit, and
d. Sample or monitor at reasonable times, for the purpose of assuring permit compliance or as otherwise authorized by state law, any substances or parameters at any location.

SECTION D. REPORTING REQUIREMENTS

1. Planned Changes
The permittee must comply with OAR chapter 340, division 52, "Review of Plans and Specifications" and 40 CFR Section 122.41(l) (1). Except where exempted under OAR chapter 340, division 52, no construction, installation, or modification involving disposal systems, treatment works, sewerage systems, or common sewers may be commenced until the plans and specifications are submitted to and approved by the Department. The permittee must give notice to the Department as soon as possible of any planned physical alternations or additions to the permitted facility.

2. Anticipated Noncompliance
The permittee must give advance notice to the Department of any planned changes in the permitted facility or activity that may result in noncompliance with permit requirements.

3. Transfers
This permit may be transferred to a new permittee provided the transferee acquires a property interest in the permitted activity and agrees in writing to fully comply with all the terms and conditions of the permit and the rules of the Commission. No permit may be transferred to a third party without prior written approval from the Department. The Department may require modification, revocation, and reissuance of the permit to change the name of the permittee and incorporate such other requirements as may be necessary. The permittee must notify the Department when a transfer of property interest takes place.

4. Compliance Schedule
Reports of compliance or noncompliance with, or any progress reports on interim and final requirements contained in any compliance schedule of this permit must be submitted no later than 14 days following each schedule date. Any reports of noncompliance must include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirements.

5. Twenty-Four Hour Reporting
The permittee must report any noncompliance that may endanger health or the environment. Any information must be provided orally (by telephone) within 24 hours, unless otherwise specified in this permit, from the time the permittee becomes aware of the circumstances. During normal business hours, the Department's Regional office must be called. Outside of normal business hours, the Department must be contacted at 1-800-452-0311 (Oregon Emergency Response System).

A written submission must also be provided within 5 days of the time the permittee becomes aware of the circumstances. Pursuant to ORS 468.959 (3) (a), if the permittee is establishing an affirmative defense of upset or bypass to any offense under ORS 468.922 to 468.946, delivered written notice must be made to the Department or other agency with regulatory jurisdiction within 4 (four) calendar days of the time the permittee becomes aware of the circumstances. The written submission must contain:

a. A description of the noncompliance and its cause;
b. The period of noncompliance, including exact dates and times;
c. The estimated time noncompliance is expected to continue if it has not been corrected;
d. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance; and
e. Public notification steps taken, pursuant to General Condition B.7

The following must be included as information that must be reported within 24 hours under this paragraph:

f. Any unanticipated bypass that exceeds any effluent limitation in this permit;
   g. Any upset that exceeds any effluent limitation in this permit;
   h. Violation of maximum daily discharge limitation for any of the pollutants listed by the Department in this permit; and
   i. Any noncompliance that may endanger human health or the environment.

The Department may waive the written report on a case-by-case basis if the oral report has been received within 24 hours.

6. Other Noncompliance
The permittee must report all instances of noncompliance not reported under General Condition D.4 or D.5, at the time monitoring reports are submitted. The reports must contain:
   a. A description of the noncompliance and its cause;
   b. The period of noncompliance, including exact dates and times;
   c. The estimated time noncompliance is expected to continue if it has not been corrected; and
   d. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

7. Duty to Provide Information
The permittee must furnish to the Department within a reasonable time any information that the Department may request to determine compliance with this permit. The permittee must also furnish to the Department, upon request, copies of records required to be kept by this permit.

Other Information: When the permittee becomes aware that it has failed to submit any relevant facts or has submitted incorrect information in a permit application or any report to the Department, it must promptly submit such facts or information.

8. Signatory Requirements
All applications, reports or information submitted to the Department must be signed and certified in accordance with 40 CFR Section 122.22.

9. Falsification of Information
Under ORS 468.953, any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance, is subject to a Class C felony punishable by a fine not to exceed $100,000 per violation and up to 5 years in prison. Additionally, according to 40 CFR 122.41(k)(2), any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit including monitoring reports or reports of compliance or non-compliance shall, upon conviction, be punished by a federal civil penalty not to exceed $10,000 per violation, or by imprisonment for not more than 6 months per violation, or by both.

10. Changes to Indirect Dischargers
The permittee must provide adequate notice to the Department of the following:
   a. Any new introduction of pollutants into the POTW from an indirect discharger which would be subject to section 301 or 306 of the Clean Water Act if it were directly discharging those pollutants and;
   b. Any substantial change in the volume or character of pollutants being introduced into the POTW by a source introducing pollutants into the POTW at the time of issuance of the permit.
   c. For the purposes of this paragraph, adequate notice shall include information on (i) the quality and quantity of effluent introduced into the POTW, and (ii) any anticipated impact of the change on the quantity or quality of effluent to be discharged from the POTW.

SECTION E. DEFINITIONS

1. BOD means five-day biochemical oxygen demand.

2. CBOD means five day carbonaceous biochemical oxygen demand

3. TSS means total suspended solids.

4. "Bacteria" includes but is not limited to fecal coliform bacteria, total coliform bacteria, and E. coli bacteria.
5. FC means fecal coliform bacteria.
6. Total residual chlorine means combined chlorine forms plus free residual chlorine
7. Technology based permit effluent limitations means technology-based treatment requirements as defined in 40 CFR Section 125.3, and concentration and mass load effluent limitations that are based on minimum design criteria specified in OAR Chapter 340, Division 41.
8. mg/l means milligrams per liter.
9. kg means kilograms.
10. m^3/d means cubic meters per day.
11. MGD means million gallons per day.
12. 24-hour Composite sample means a sample formed by collecting and mixing discrete samples taken periodically and based on time or flow. The sample must be collected and stored in accordance with 40 CFR part 136.
13. Grab sample means an individual discrete sample collected over a period of time not to exceed 15 minutes.
14. Quarter means January through March, April through June, July through September, or October through December.
15. Month means calendar month.
16. Week means a calendar week of Sunday through Saturday.
17. POTW means a publicly owned treatment works.

CITY OF MT. ANGEL
Wastewater System Facilities Plan
Mt. Angel, Oregon

APPENDIX B

LAGOON CELL 1 BIOSOLIDS SURVEY (JUNE 2008)

WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS & PLANNERS

July 7, 2008

Mr. Dan Bernt
City of Mt Angel
P.O. Box 960
Mt Angel, OR 97362

RE: WWTP-Lagoon #1 Biosolids Inventory
J.O. 447.3310.0

Dear Dan:

This letter report summarizes Westech Engineering's recent biosolids inventory work performed in Lagoon #1 at the City's wastewater treatment plant (WWTP). The remainder of this letter is divided into the following sections:

- Fieldwork Description
- Discussion/Recommendations.

Short discussions on these items follow.

Fieldwork Description.

The fieldwork was performed on June 28, 2008. As per our agreement with the City, the biosolids depth was measured in Lagoon #1 only. This approach is appropriate as there are very likely few biosolids accumulated in lagoons #2 & #3. Lagoon #1 is approximately 22 acres in size. The biosolids depth was measured in 90 locations using a Sludge Judge. The majority of the measurements were taken in the northern portion of the lagoon where the sewer from the headworks discharges into the lagoon. This area has the highest concentration of biosolids as was expected. The attached figure shows the lagoon, the lagoon inlet piping, the locations where the biosolids depth was measured and the depth at each specific location.

Discussion/Recommendations.

Review of the attached figure and the field measurements shows that the depth of the measured biosolids ranged from a low of 0.1 feet to a high of 1.7 feet. Of note is that while 13 of the 90 readings taken had sludge depths of 1.0 feet or greater, this area of the lagoon is actually very small and represents an overweighting of the sampling to determine the extent of the "thicker" deposits. The vast majority of the lagoon has a biosolids depth of 0.7 feet or less.

No samples of the biosolids were collected for laboratory analysis. However, based upon a qualitative inspection of the biosolids, they are in general "light and fluffy" as opposed to "dense".

3841 Fairview Industrial Dr. S.E., Suite 100, Salem, Oregon 97302
Phone: (503) 585-2474 Fax: (503) 585-3986

In several other municipal wastewater lagoons where we've performed biosolids inventories and where the lagoons have been in service for a longer time period, the sludge is more consolidated and "dense".

The WWTP will be 16 years old this December. It is our opinion that the accumulated biosolids in Lagoon #1 at this time do not warrant removal. If biosolids were to be removed at this time, our recommendation would be to use a floating dredge and only remove biosolids from the northerly 400 feet of the lagoon. This area has the highest accumulation of biosolids. We believe that the removed biosolids could most cost effectively be dealt with by land application onto adjacent farm fields via a pipeline. Please note that removal of the biosolids from the lagoons is an involved process requiring planning and DEQ approval in addition to working with the adjacent landowners where the biosolids would most cost effectively by applied.

Assuming similar flow and organic loading conditions to the WWTP in the near future, it is our belief that removal of the biosolids will not be needed for at least several more and perhaps as many as ten more years unless effluent quality from the WWTP degrades. We do not recommend removal of biosolids at this time.

We hope this information is useful. It has been a pleasure working with you and the public works staff. Should you have any questions or require additional copies of the attached figure, please do not hesitate to contact us at (503) 585-2474.

Sincerely,

WESTECH ENGINEERING, INC.

_____
John L. Yarnall, P.E.

jly
enc.

LEGEND

+0.4 SLUDGE DEPTH MEASUREMENT IN FEET

BIOSOLIDS SURVEY PERFORMED ON JUNE 28, 2008

0 30 60 120
(feet)

24" PVC INFLUENT SEWER

HEADWORKS

OUTLET PORT (TYP 3)

20" INFLUENT PIPE

WATER SURFACE ELEV=132.16

LAGOON NO. 1

LAGOON NO. 2

CONSTRUCTED WETLAND

LAGOON NO. 3

NO.	DATE	DESCRIPTION	BY
1			

REVISIONS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

DSN. JLY
DRN. TMT
CKD. JLY
DATE: JULY 08

WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS
3841 Fairview Industrial Dr. S.E., Suite 100, Salem, OR 97302
Phone: (503) 585-2474 Fax: (503) 585-3986
E-mail: westech@westech-eng.com

CITY OF MT. ANGEL, OREGON

BIOSOLIDS SURVEY

WASTEWATER TREATMENT LAGOON BIOSOLIDS SURVEY

SHEET 1 OF 1

JOB NUMBER 447.3310.0

Sep 27, 2013 - 2:16pm
R:\Dwg\Mt-angel City of\WWTP Biosolids 447.3310.0\LAGOON_TOPO.dwg (Layout1 tab)

APPENDIX C

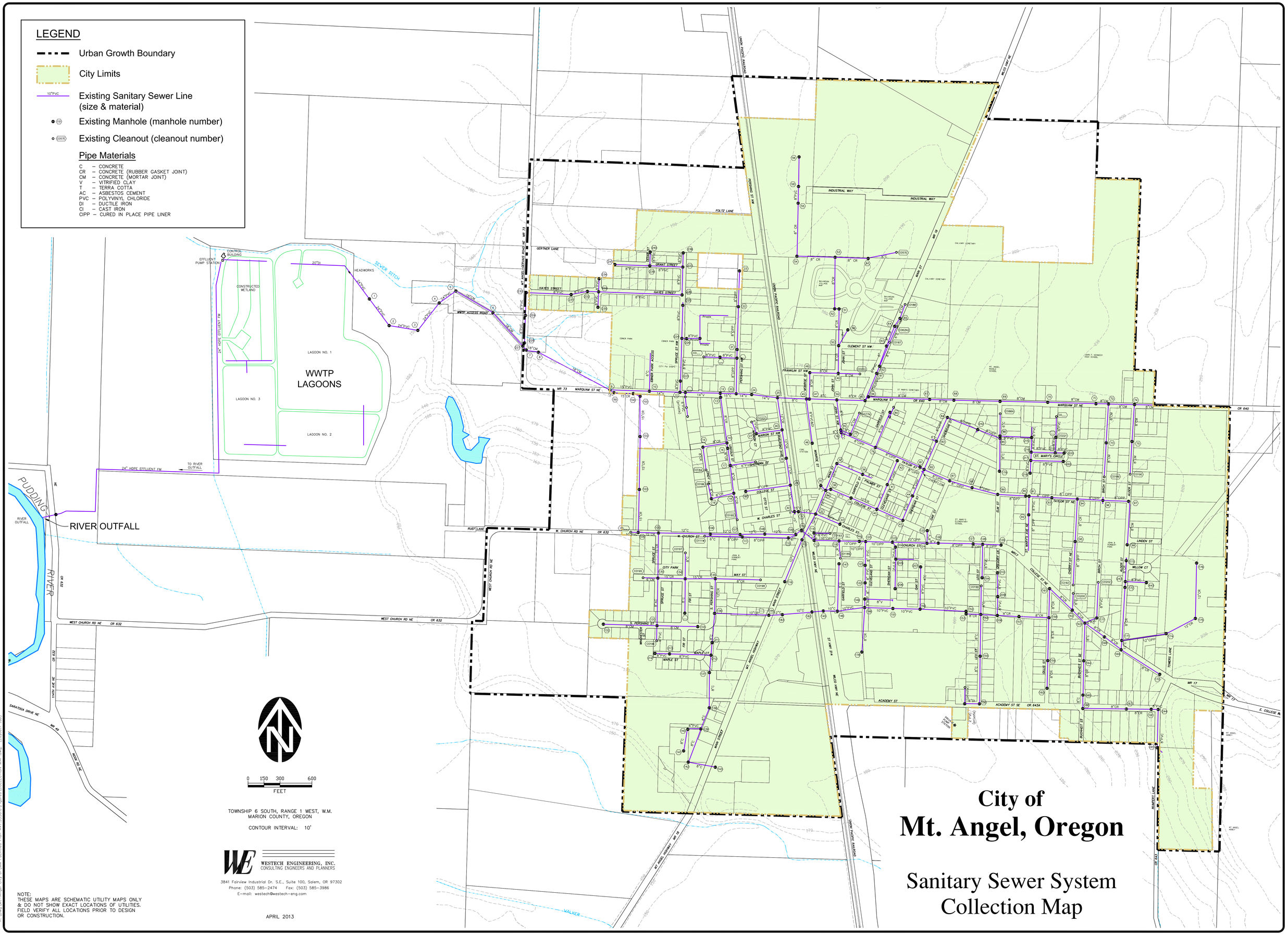
COLLECTION SYSTEM MAP

LEGEND

- Urban Growth Boundary
- City Limits
- 10"PVC — Existing Sanitary Sewer Line (size & material)
- 13 — Existing Manhole (manhole number)
- C0576 — Existing Cleanout (cleanout number)

Pipe Materials

C – CONCRETE
CR – CONCRETE (RUBBER GASKET JOINT)
CM – CONCRETE (MORTAR JOINT)
V – VITRIFIED CLAY
T – TERRA COTTA
AC – ASBESTOS CEMENT
PVC – POLYVINYL CHLORIDE
DI – DUCTILE IRON
CI – CAST IRON
CIPP – CURED IN PLACE PIPE LINER



TOWNSHIP 6 SOUTH, RANGE 1 WEST, W.M.
MARION COUNTY, OREGON

CONTOUR INTERVAL: 10'

WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS

3841 Fairview Industrial Dr. S.E., Suite 100, Salem, OR 97302
Phone: (503) 585-2474 Fax: (503) 585-3986
E-mail: westech@westech-eng.com

APRIL 2013

NOTE:
THESE MAPS ARE SCHEMATIC UTILITY MAPS ONLY & DO NOT SHOW EXACT LOCATIONS OF UTILITIES. FIELD VERIFY ALL LOCATIONS PRIOR TO DESIGN OR CONSTRUCTION.

City of Mt. Angel, Oregon

Sanitary Sewer System Collection Map

12/20/2013 7:42:12 AM
R:\Eng\Mt-Angel City of\WW Facilities Plan 447.3330.01\Figures\COLLECTION MAP.dwg, (Legend1 tab)

CITY OF MT. ANGEL
Wastewater System Facilities Plan
Mt. Angel, Oregon

APPENDIX D

PUDDING RIVER OUTFALL MIXING ZONE STUDY

Report

Mt. Angel WWTP
Mixing Zone Study
Final Report
May 2010

State of Oregon
Department of
Environmental
Quality

DEQ09-LAB-0012-TR
Last Updated: 6/8/2010
By: Wade Peerman

This report prepared by:

Oregon Department of Environmental Quality
Laboratory & Environmental Assessment Division
3150 NW 229th Ave., Suite 150
Hillsboro, OR 97124
503-693-5700

Contact:
Wade Peerman
(503) 693-5743

DEQ Staff Participating in Study
April Graybill, Western Region
Wade Peerman and Lori Pillsbury, Laboratory and Environmental Assessment Division

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State of Oregon
Department of
Environmental
Quality

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Background

The City of Mt. Angel operates a domestic wastewater treatment plant with an average dry weather design flow of 0.56 million gallons per day. National Pollutant Discharge Elimination System permit #101802, specifies that the facility is permitted to discharge wastewater to Pudding River continuously from November 1 to April 30. The facility has a permitted mixing zone defined as *that portion of the Pudding River extending from a point ten (10) feet upstream of the outfall to a point one hundred (100) feet downstream from the outfall. The Zone of Immediate Dilution (ZID) shall be defined as that portion of the allowable mixing zone that is within ten (10) feet of the point of discharge.*

In order to evaluate effects of waste water on Pudding River water quality at low flow conditions, this study was conducted during the known low stream flow season but outside of the period of permitted discharge. The facility was granted permission to discharge outside its normal discharge window for the purpose of this study. In an attempt to sample a representative discharge, the facility was encouraged to begin discharging a few days prior to the sampling date.

Project Summary

Laboratory staff conducted a field mixing zone survey of this site on October 12, 2009. The facility was discharging during the study at a flow rate of 0.352 MGD.

Based on the Regulatory Mixing Zone Internal Management Directive (ODEQ, 2007) and permit staff best professional judgment, this facility meets the two criteria for a Level 1 study:

1. The discharge has no reasonable potential to exceed acute criteria other than potentially chlorine or ammonia and available dilution of greater than 20 times 25% of critical flow
2. The discharge not classified as a "Major".

This report contains data required for this level.

Quality Assurance / Quality Control

DEQ LEAD field staff collected samples at the compliance location for outfall 001 (at the facility) and three in-stream locations on Pudding River. All sampling followed the QA/QC procedures outlined in the Quality Assurance Project Plan, Mixing Zone Studies, DEQ06-LAB-0041-QAPP. A complete sampling plan for this project is contained in the Sample and Analysis Plan (SAP), DEQ09-LAB-0012-SAP.

All sampling activities outlined in the SAP were conducted during this study. The outfall ports were visible under water and specific conductance measurements were used to delineate wastewater mixing in Pudding River. Since DEQ staff performed conductivity mapping at the outfall, a dye study was not necessary during this survey

A field duplicate sample collected at the upstream sampling location met all applicable QA/QC criteria. A transfer blank was collected for this study. The control limits for Total Kjedahl Nitrogen were exceeded in the transfer blank. No other analytes were detected in the transfer blank during this study.

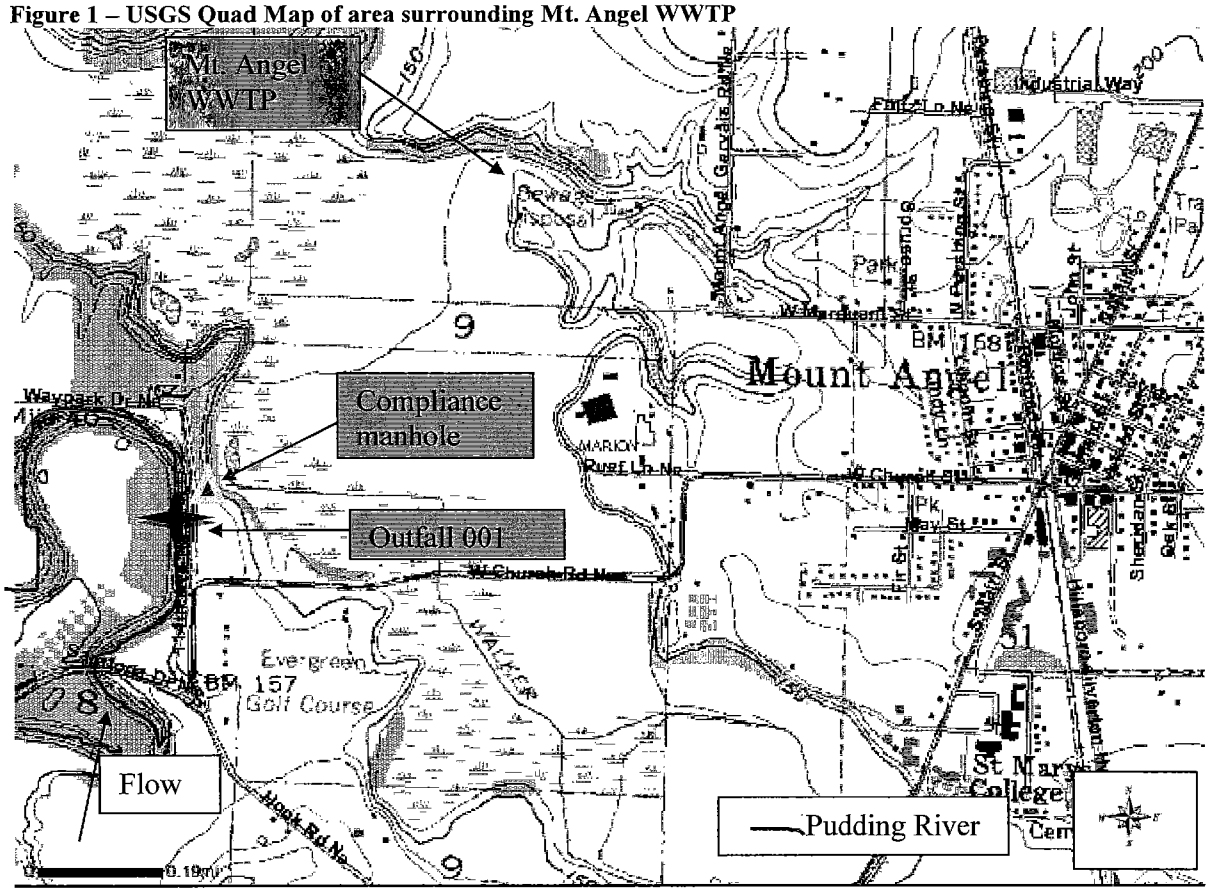
Environmental Mapping

This section of the report is intended to characterize and represent critical habitats, critical resources, and other beneficial uses of the receiving waterbody in the area surrounding the outfall. This portion was completed both in the field and through office research. A schematic of the field sampling area (drawn at the time of sampling) can be found in Appendix C.

The City of Mt. Angel WWTP discharges into Pudding River at River Mile 37.5 through Outfall 001. The outfall is contained within the Molalla-Pudding Sub-Basin of the Willamette Basin. It is located in the Willamette River and Tributaries Gallery Forest ecoregion. Figure 1 shows the location of this outfall on the USGS Quad Map of the area. There is an approved TMDL for the Molalla/Pudding River Subbasin of the Willamette Basin, at the Mt. Angel outfall location; Pudding River is listed on the 303(d) list for temperature year-around. Pudding River is designated as salmon and trout rearing and migration corridors, based on the ODFW fish habitat maps and Division 41, Water Quality Standards, Figure 340A (ODEQ, 2010b).

There are no public access sites to this portion of the river. The outfall is located downstream of a bridge over the river. No drinking water intakes are located within ½ mile downstream of the outfall. No other NPDES-permitted discharges are located within ½ mile upstream or downstream of the outfall (DEQ Facility Profiler database and DEQ OLD database, accessed May 13, 2010).

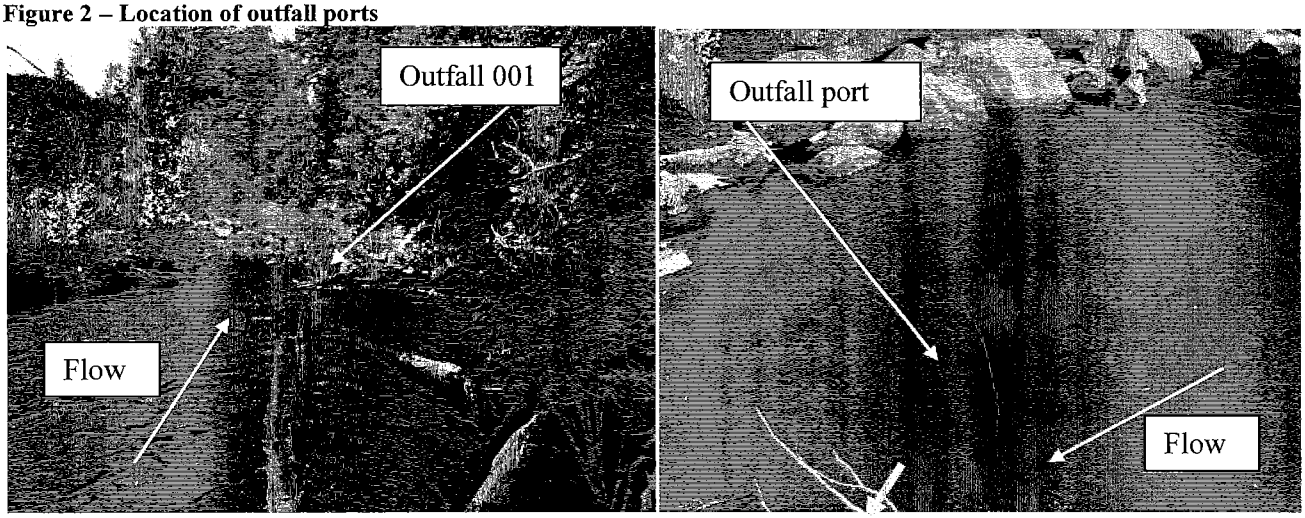
Figure 1 – USGS Quad Map of area surrounding Mt. Angel WWTP



Outfall Description

The Mt. Angel WWTP is currently permitted to discharge treated domestic wastewater through outfall 001 to Pudding River. Outfall 001 is a multiport diffuser where four ports enter the stream from the subsurface at roughly equal distances apart. Each port points downstream at a slight upward angle. The outfall ports were under water and all but one of the four diffuser ports were visible during the study. Conductivity mapping showed that only three of four ports were discharging during the survey. The distribution of sand around the ports suggested that the ports were buried until the effluent flow began.

Figure 2 – Location of outfall ports



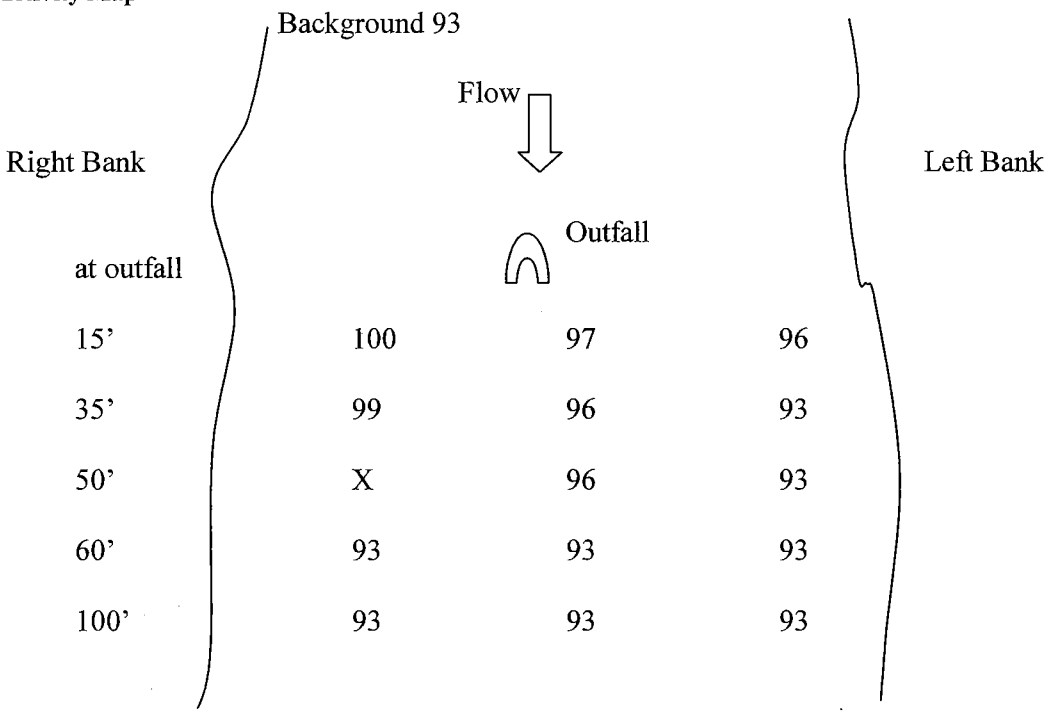
Mixing Zone / Receiving Water Conditions

The mixing zone for this facility is defined as *that portion of the Pudding River extending from a point ten feet upstream of the outfall to a point 25 feet from the east bank of the river and to a point 108 feet downstream from the outfall. The Zone of Immediate Dilution (ZID) shall be defined as that portion of the allowable mixing zone that is within ten feet of the outfall discharge port(s).*

Pudding River Stream Flow
DEQ staff collected stream flow and depth measurements during the field survey (see Appendix D). Based on these measurements, the discharge for Pudding River at this location during the study was 38.15 cubic feet per second. The United States Geological Survey gage at Woodburn recorded 28 cubic feet per second as provisional data for October 12, 2009. The USGS gage is downstream of the Mt. Angel outfall and Zolner Creek, a minor tributary. Figure 4 provides a schematic and summary of the flow measurements.

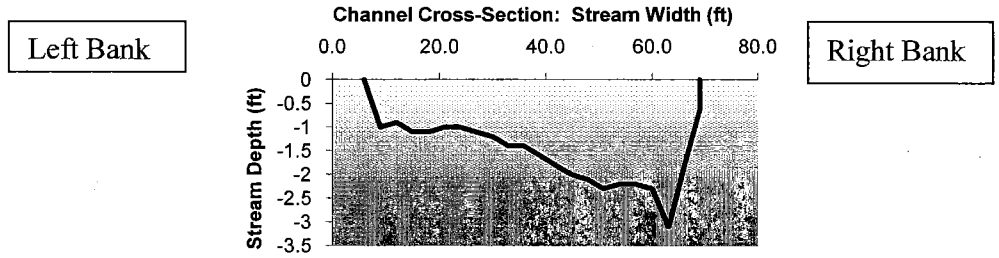
Conductivity Mapping
Conductivity mapping was completed during this field study. No stratification was observed in the waterbody; therefore, conductivity measurements were recorded at mid-depth. The wetted width of the river was approximately 32 feet. Measurements were taken at the right bank, left bank, and mid-channel *(All conductivity measurements are in µmohs/cm and are temperature compensated to 25°C).* Figure 3 shows these measurements.

Figure 3 – Conductivity Map



Stream bottom / bank conditions at outfall (Figure 4)
Manning's roughness coefficient (*n*) is a measure of the friction at the stream bottom and can be estimated from the stream bottom type and channel morphology. The sediment type of the Pudding River at the discharge location was predominantly sand with large woody debris and cobbles. The wetted width was 32 feet at the outfall. Water depth near the outfall pipe was approximately 1.5 feet.

Figure 4 – Flow measurements

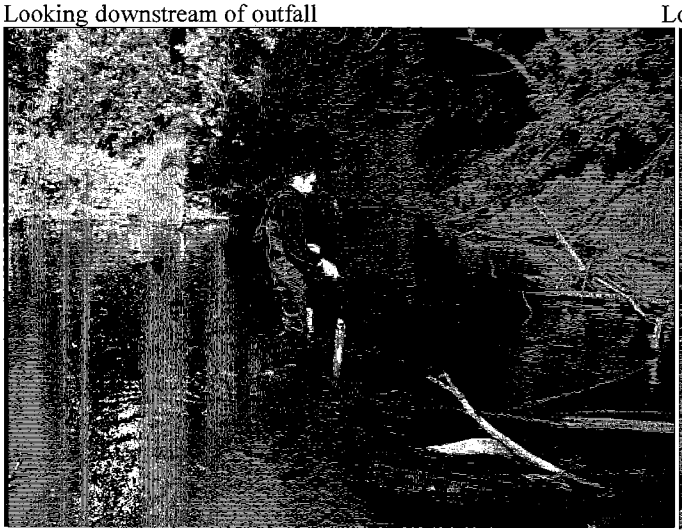


Site: upstream, Pudding R.

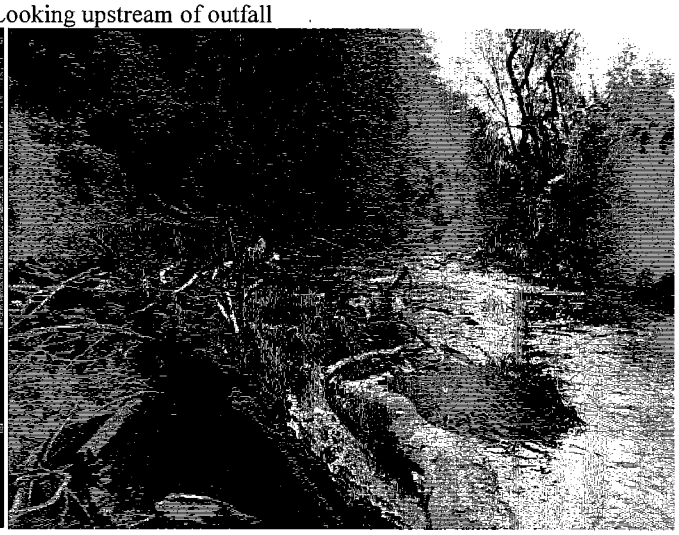
Stream Width		Cross Sectional Area			
63.0	ft	97.8	Sq.ft.	**LASAR #:**	
Stream Depth		**Velocity (ft/sec)**		**Date:**	10/12/09
3.10	Max	0.580	Max		
1.51	Avg	0.355	Avg	**Time:**	0:00
Total Discharge		**Max Cell Flow (%)**		**Personnel:**	WRP / LAP
38.15	cfs	9.9	Max		
		4.8	Avg		

Figure 5 – Stream conditions at outfall

Looking downstream of outfall



Looking upstream of outfall



Dye Study

DEQ staff did not conduct a dye study for this event. The outfall pipe was located visually, and conductivity mapping was completed to determine mixing conditions.

Analytical Results

Water quality samples were collected at the outfall 001 compliance point and at three in-stream locations, Table 1, Figure 5. Samples collected for biochemical oxygen demand, nutrients (total nitrogen and phosphorus), metals and *E. coli* were transported to the ODEQ laboratory for analysis. Specific conductance, pH, dissolved oxygen, temperature, and turbidity were measured on site by the field

sampling crew. Data are summarized in Table 1 and Appendix A. A complete report for this sampling event can be found on the LASAR website (http://deq12.deq.state.or.us/lasar2/) under Case # 20090929 (ODEQ, 2010a).

Table 1 – Field Sampling Locations

LASAR #	Station Name	Description
36055	Mt. Angel STP, final effluent	effluent from plant, sampled after dechlorination at a manhole cover on 114th Ave NE
36056	Pudding River, 50 feet upstream of Mt. Angel outfall	background / upstream location
NA	Mt. Angel outfall 001, in-stream location	no samples at this location, outfall samples collected at plant compliance point
36057	Pudding River, 10 feet downstream of Mt. Angel outfall	downstream edge of Zone of Immediate Dilution (ZID)
36058	Pudding River, 100 feet downstream of Mt. Angel outfall	downstream edge of regulatory mixing zone (RMZ)

Figure 5 – Overview of site locations

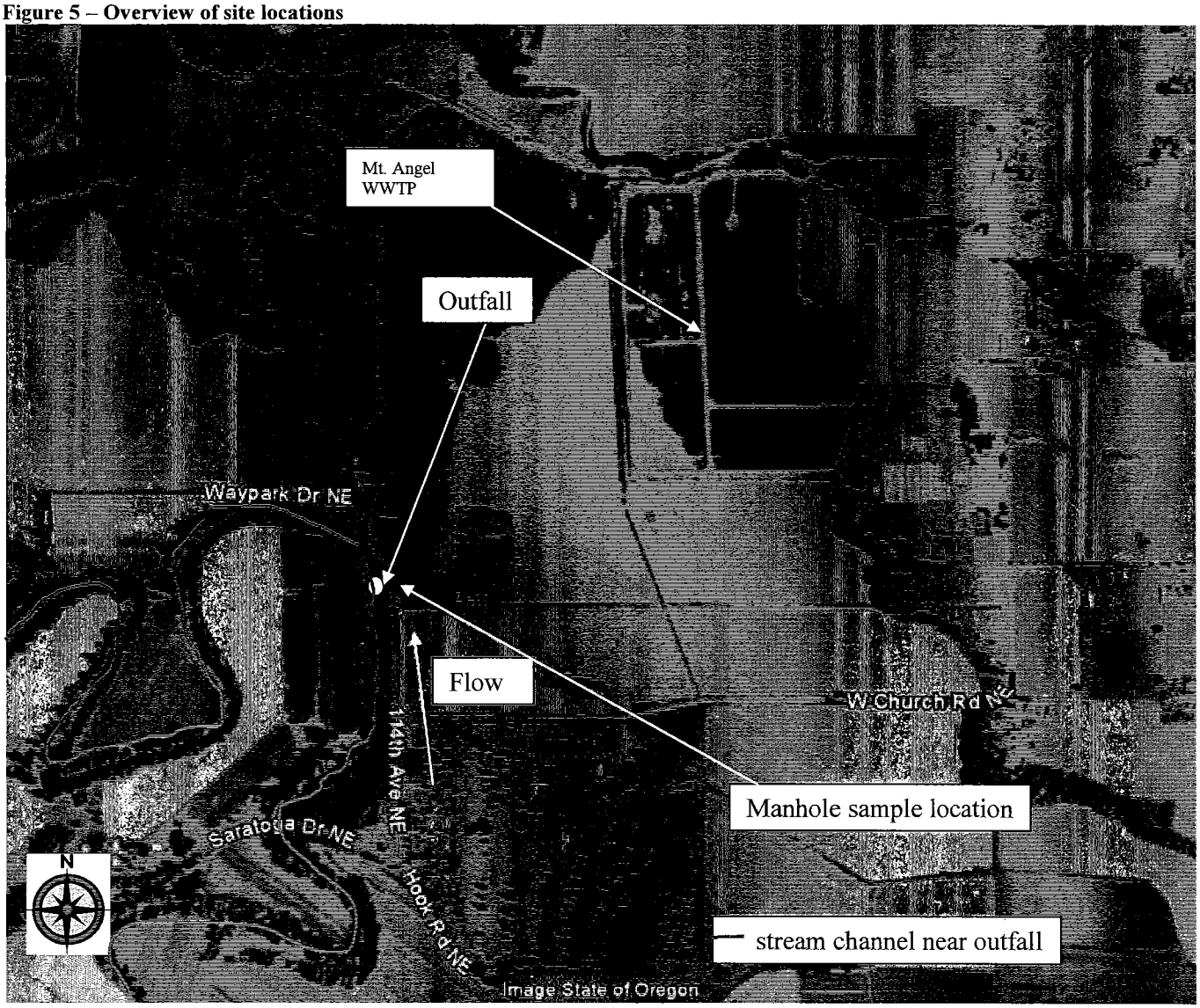


Table 2 – Summary of analytical results for sampling event dated October 12, 2009 (ODEQ, 2010a)

Parameter	Units	Acute Water Quality Criteria	Chronic Water Quality Criteria	Permit Limit [a]	Outfall 001 (plant discharge)	Pudding River, 50 feet upstream of Mt. Angel outfall	Pudding River, 10 feet downstream of Mt. Angel outfall	Pudding River, 100 feet downstream of Mt. Angel outfall
Conductivity	µmhos/cm				1094	93	93	94
Dissolved Oxygen	mg/L	Cold water – Not less than 8.0 mg/L or 90% saturation			6.3	10.8	10.6	10.6
DO % saturation	%				58	96	94	94
pH	s.u.	6.5 ≤ pH ≤ 8.5		6.0 ≤ pH ≤ 9.0	6.9	7.5	7.4	7.4
Temperature	° C	20 °C (max) [d]			11.6	9.8	9.9	9.8
Turbidity	NTU	no more than 10% increase above background			20	3	3	4
E. coli	MPN/ 100mL	406		406 (single sample)	>2420	73	77	93
Alkalinity	mg/L		20		176	34	34	34
Ammonia as N	mg/L	13.3 [c]	5.84 [c]		3.88	<0.020	<0.02	<0.02
BOD_5	mg/L			45 (W) 30 (M)	17	2.5	2.2	2.3
Nitrate/Nitrite as N	mg/L				0.0581	0.240	0.240	0.237
Total Kjeldahl Nitrogen (TKN)	mg/L				7.4	0.3	0.4	0.3
Total Organic Carbon (TOC)	mg/L				25	2	2	2
Total Phosphorus	mg/L				3.44	0.05	0.05	0.05
Total Suspended Solids (TSS)	mg/L			45 (W) 30 (M)	25	3	3	8

[a] Permit Limits are expressed as single sample limits unless otherwise specified, i.e. W = weekly average effluent concentrations; M = monthly average effluent concentrations. If no limit exists in permit, none is specified in this column. These permit limits are for the discharge period between November 1 and April 30.

[b] Duplicate samples collected at this location. All analytical parameters measured were within QA/QC range for a duplicate sample.

[c] Ammonia criteria based on upstream temperature and pH (EPA, 1999), salmonids present, early life stages absent.

[d] Temperature standard based on the designated use of salmon and trout rearing and migration use.

Table 3 – Results of samples for total metals (only includes those parameters detected in one or more samples) (ODEQ, 2009a)

Parameter	Units	Acute Water Quality Criteria [a]	Chronic Water Quality Criteria [a]	Outfall 001 (plant discharge)	Pudding River, 50 feet upstream of Mt. Angel outfall	Pudding River, 10 feet downstream of outfall	Pudding River, 100 feet downstream of Mt. Angel outfall
Metal Cations (Total)							
Aluminum	mg/L			0.561	0.106	0.120	0.266
Boron	mg/L			0.118	<0.020	<0.020	<0.020
Calcium	mg/L			88.9	7.73	7.89	7.92
Iron	mg/L		1.000	1.43	0.488	0.508	0.708
Lithium	mg/L			0.019	<0.015	<0.015	<0.015
Magnesium	mg/L			16.3	3.20	3.23	3.26
Manganese	mg/L			0.429	0.0307	0.0325	0.0466
Potassium	mg/L			15.6	1.37	1.41	1.40
Silicon	mg/L			42.0	14.6	14.8	15.4
Sodium	mg/L			95.6	5.65	5.79	5.81
Hardness	mg/L			289	32.5	33.0	33.2
Total Priority Pollutant Metals							
Arsenic	µg/L			<4.0	<2.0	<2.0	<2.0
Barium	µg/L			57.9	15.3	16.0	16.7
Cobalt	µg/L			0.39	<0.30	<0.20	0.24
Copper	µg/L	6.1	4.5	<1.5	<1.5	<1.5	<1.5
Lead	µg/L	19.1	0.75	0.26	<0.20	<0.20	<0.20
Nickel	µg/L	541	60.1	<3.0	<1.0	<1.0	<1.0
Zinc	µg/L	44.6	40.4	3.8	<3.0	<3.0	<3.0

[a] For hardness based criteria, the hardness from the upstream receiving water sample was used for calculations.
[b] Duplicate samples collected at this location. All analytical parameters measured were within QA/QC range for a duplicate sample.

Conclusions

Based on the data collected during the field study, the following items may warrant additional consideration.

Metals – The effluent sample exceeded the chronic criteria for iron, the chronic criteria for iron was not exceeded at the downstream edge of the zone of initial dilution or the downstream edge of the defined mixing zone.

E. coli – The effluent sample was greater than the permit limit for a single sample, the downstream samples did not show a significant increase above background E. coli levels measured in the upstream sample.

Lithium – Although Oregon has no water quality criteria for lithium, the presence of lithium in the plant effluent may be from various sources. One potential source of lithium is from the algaecide, disinfectant and fungicide lithium hypochlorite which can be used to sanitize equipment or could be the product the treatment plant is using to disinfect the wastewater they process.

Dissolved oxygen – The dissolved oxygen measured in the effluent did not meet the water quality criteria for cold water species. A decrease in dissolved oxygen was not measured at the downstream locations.

Conductivity mapping – Based on conductivity data collected, complete mixing occurred at the downstream edge of the defined mixing zone.

References

Environmental Protection Agency (EPA), 1999. 1999 Update of Ambient Water Quality Criteria for Ammonia (Freshwater), http://www.epa.gov/waterscience/criteria/ammonia/99update.pdf.

Oregon Department of Environmental Quality (ODEQ), 2010a. Laboratory Analytical Storage and Retrieval Database (LASAR), http://www.deq.state.or.us/news/databases.htm, Case # 20090929.

Oregon Department of Environmental Quality (ODEQ), 2010b. Oregon Administrative Rules, Division 41, http://www.deq.state.or.us/regulations/rules.htm.

Oregon Department of Environmental Quality (ODEQ), 2005. Reasonable Potential Analysis, Internal Management Directive, September 2005. http://www.deq.state.or.us/wq/pubs/imds/rpatoxics.pdf.

Oregon Department of Environmental Quality (ODEQ), 2007. Regulatory Mixing Zone, Internal Management Directive, December 2007. http://deq05/wq/wqpermits/PCGuidance.htm.

Oregon Department of Fish and Wildlife (ODFW), 2010. Fish Distribution Maps. http://nrimp.dfw.state.or.us/nrimp/default.aspx?pn=fishdistmaps, accessed January, 2010.

Appendix A – Field Data Sheet & Chain of Custody

Oregon Department of Environmental Quality

Laboratory and Environmental Assessment Division Chain of Custody Record [1]

Office Use Only: Sampling Event #: 20090929 Page 1 of 2

Sampling Event Name [2]: Mt. Angel STP Mixing Zone Evaluation

Fund Code [3]: 37443 QAPP/SAP #[4]: DEQ09-LAB-0012-SAP Report Recipients [5]: Lori Pillsbury, April Graybill (WR)

Sampling Event Collector (s) [6]: Lori Pillsbury, Wade Peerman Sampling Agency [7]: DEQ

Project Manager and Contact # [8]: Lori Pillsbury, 503-693-5735 Expected Turnaround Time (Default 45 days) [9]: Default

Sample Information						Bottle Numbers [10]						
Seq	LASAR ID # [10]	Station Name [11]	Sp. Sample	Date [12] / Time	QC Type [14] / Matrix [15]	P / R	C / DP	BOD / DQ	STP / S	TM		
1	36055	Mt. Angel STP, final effluent		10/12/09 1005	S / WWTP EFF	— / R517	— / —	— / —	STP 2367 / S965!	TM 1625		SPR 492 gm LRP 10/13/09
2	36056	Pudding R., 50 feet US of Mt. Angel outfall		10/12/09 1210	FP / SW	P402 / R1792	C1442 / —	390 / —	— / —	TM 1635		
3	36057	Pudding R., 10 feet DS of Mt. Angel outfall		10/12/09 1157	S / SW	P450 / R1066	C1458 / —	4050 / —	— / —	TM 1634		
4	36058	Pudding R., 100 feet DS of Mt. Angel outfall		10/12/09 1148	S / SW	P376 / R1661	C1456 / —	K132 / —	— / —	TM 1638		
5	36056	Field Duplicate – Pudding R. 50' US of Mt Angel		10/12/09 1210	FD / SW	P1272 / R2462	C1500 / —	427 / —	— / —	TM 1640		
6	10000	Transfer Blank		10/12/09 1230	TSFB / SW	P755 / R2110	— / —	— / —	— / —	TM 1613		

Event Comments:

Chain of Custody [17]

Relinquished By:	Agency/Company	Date/Time	Received by:	Agency/Company	Date/Time	Location
[illegible]	DEQ	10/12/09 1515	[illegible]	DEQ	10/13/09 0806	

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Oregon Department of Environmental Quality

Laboratory and Environmental Assessment Division Water Quality Field Data Record [1]

Sampling Event Name [2]: Mt. Angel STP Mixing Zone Evaluation

Sampling Event #: 20090929 (Office Use Only) Page 2 of 2

Fund Code [3]: 37M3 QAPP/SAP #[4]: DEQ09-LAB-0012-SAP

Report Recipients [5]: Lori Pillsbury, April Graybill (WR)

Sampling Event Collector (s) [6]: Lori Pillsbury, Wade Peerman

Sampling Agency [6]: DEQ

Project Manager and Contact # [7]: Lori Pillsbury, 503-693-5735

Expected Turnaround Time (Default 45 days) [8]: Default

Sample Information					Field Data									
Sample # [9]	LASAR ID # [10]	Station Name [11]	Date [12] / Time	QC Type [13] / Elevation [14]	Temp [20] (C)	Cond. [21] (umhos)	pH [22] (SU)	Alk. [23] (mg/L)	DO [24] (mg/L)	DO Sat [25] (%)	Turb. [26] (NTU)	TRC (mg/L)		
1	36055	Mt. Angel STP, final effluent	10/12/09	S	11.6	1094	6.9	—	6.3	58	20	—		
			1005	250	Item Comment: N 45.06777 W 122.82708									
2	36056	Pudding R. 50 feet US of Mt. Angel outfall	10/12/09	FP	9.8	93	7.5	—	10.8	96	3	—		
			1210	250	Item Comment: N 45.06729 W 122.82771									
3	36057	Pudding R., 10 feet DS of Mt. Angel outfall	10/12/09	S	9.9	93	7.4	—	10.6	94	3	—		
			1157	250	Item Comment: N 45.06758 W 122.82777									
4	36058	Pudding R., 100 feet DS of Mt. Angel outfall	10/12/09	S	9.8	94	7.4	—	10.6	94	4	—		
			1148	250	Item Comment: N 45.06777 W 122.82801									
5	36056	Pudding R. Field Duplicate 50 feet US of Mt Angel	10/12/09	FD	9.8	93	7.5	—	10.8	96	3	—		
			1211	250	Item Comment:									
6	10000	Transfer Blank	10/12/09	TSFB	12.5	<2	5.9	—	—	—	<1	—		
			1230		Item Comment:									

pH Meter #: Scotmaster [29]		Initials	Time	Temp.	Meter Reading	Diff.	<0.1 SU (y/n)	QC Check	Meter #	Initials	Date	Time	Meter Reading	True Value	Diff. or % Rec.	Control Limit
Pre	7	LAP	0730	21.0	7.02	—	Y	Cond. Low:	Scotmaster	LAP	10/12/09	0745	150	147.7	2	≤7%
	4	—						Cond. High:	↓			↓	1912	1918	<1	≤7%
	10	LAP	0730	20.9	10.12	+0.07	Y	pH (LIS):								
Post	7	LAP	1500	21.3	6.98	-0.04	Y	Turb. Low:	62596			0740	11.66	11.58	2	≤5%
	4	↓	↓	21.4	3.91	-0.08	Y	Turb. Mid.:	50868				50.4	51.5	2	≤5%
	10	↓	↓	21.3	10.07	+0.02	Y	Turb. High:		↓	↓	↓	485	480	1	≤5%

Rev. 1.0 11-Mar-09 DEQ06-LAB-0053-FORM 1 Field Data - WQ.SW

Appendix B – Field Summary Sheet

Mixing Zone
Field Summary Sheet

General Facility Information

Facility Name: *Mt. Angel STP*	**Address:** *PO Box 960 Mt. Angel, OR*	**Date of Survey:** 10/12/09 **County:** *Marion*
Facility Contact: *Dennis Clary*	**Phone #:** *503-845-2720*	**IMD Study Level:** *1*
Receiving Waterbody: *Pudding River*	**NPDES Permit #:** *101802* **Expiration Date:** *12/31/2009*	**Facility Type:** IW / DW Major / Minor
Function of Facility (brief description): *Domestic wastewater treatment facility*		
Discharge Timing & Type: (i.e. seasonality of discharge, batch, continuous) *winter season discharge, Nov. 1 – April 30*		

Outfall Information

Outfall Designation: 001	**Flow at time of sampling:** 1 MGD	**Water Depth @ outfall:** 1.5 feet	**River mile:**
Type of Outfall: (i.e. single, multi-port) multi-port	**Orientation of outfall (σ):** ~~varies~~ 0° (In degrees related to bottom of stream, 0° (H), 90° (V))	**Diameter of pipe:** ~6 inches	**Latitude / Longitude:** N 45.06746 W 122.82788
Nearest bank to outfall (looking downstream): ~~left~~ right		**Outfall distance from nearest bank (looking downstream):** 2 foot to 1st diffuser port	
Discharge direction in relation to flow (i.e. perpendicular / horizontal): multi directional		**CORMIX Form completed:** Yes / No	

Sampling Locations – Data Collection

Parameter	Outfall @ manhole	Site 1	Site 2	Site 3	Site 4
		Pudding R.			
Description of Sample Site	@ facility	50' US of outfall	10' DS of 001	100' DS of 001	
Latitude / Longitude	N 45.06777 W 122.82708	N 45.06729 W 122.82771	N 45.06758 W 122.82777	N 45.06777 W 122.82801	
River Mile					
Field Parameters collected	(Y) / N	(Y) / N	(Y) / N	(Y) / N	Y / N
Water Quality Samples collected	(Y) / N	(Y) / N	(Y) / N	(Y) / N	Y / N
Substrate Type	—				
Stream slope	—				
Stream Bottom Description (Manning's Roughness description)	—	large woody debris / sand	woody debris / rocks / sand	sand / small debris	

Mixing Zone
Field Summary Sheet

Other Data Collection

Conductivity Mapping Completed (Yes) / No
If Yes, attach field form with complete information
If No, provide explanation:

Velocity Transects Completed (Yes) / No
If Yes, attach form measurement form (Stream Discharge Field Sheet).
If No, provide explanation:

Macroinvertebrate Sampling Yes / (No)
If Yes, complete macroinvertebrate field forms & attach.

Photos Taken (Yes) / No
Take photos of all sampling locations including the outfall and outfall pipe if possible.

Ambient Weather Conditions
cool/cloudy

Additional Notes:

diffuser looked like 4 separate ports - mostly parallel to DS flow - slight angle - only 3 of 4 ports appeared to be discharging - Evidence that ports were buried until flow began - pools in front of discharging ports

*** Manning's Roughness Coefficient – *n***

Description	*n*
Bare earth, straight	0.020 – 0.030
Bare earth, winding	0.040 – 0.05
Mountain streams, gravel, cobbles	0.040 – 0.050
Mountain streams, gravel, cobbles, boulders	0.050 – 0.70
Grass lined, weeds	0.050 – 0.06
Heavy brush, timber	0.10 – 0.12
Major rivers	0.030 – 0.035
Sluggish with pools	0.040 – 0.050

Appendix C – Stream Description & Conductivity Mapping

Mixing Zone
Stream Description & Conductivity Mapping Summary

Sampling Event:	Receiving Waterbody:	Date of Survey:
mt Angel mz	Pudding River	Oct 12 2009
		County: Marion
Bank Full Width:	Wetted Width: 32 feet	

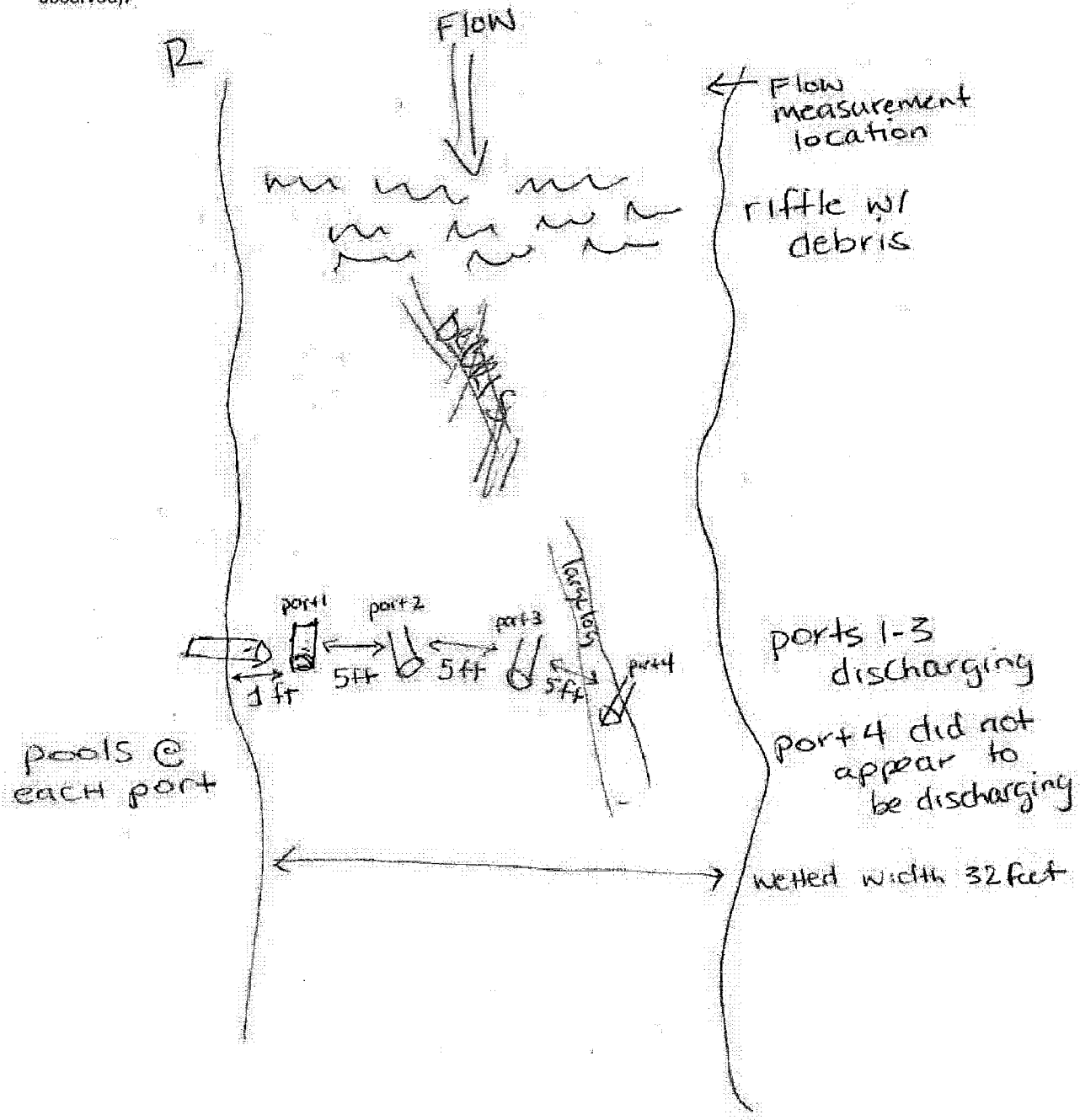
effluent SpC = 1094 umhos/cm

Conductivity Mapping
(include approximate location on stream sketch)

Location	Latitude/Longitude	Field Conductivity (µmhos/cm)		
		~~Surface~~ L	Mid Mid	~~Bottom~~ R
upstream			93	
15' DS		96	97	100
35' DS		93	96	99
50' DS		93	96	
60' DS		93	93	93
100' DS		93	93	93

Mixing Zone
Stream Description & Conductivity Mapping Summary

Notes / Sketch (include other outfalls or inputs in the stream reach evaluated, note obstructions to flow observed):



Appendix D – Flow

Stream Discharge Field Sheet

Site: Mt Angel - Pudding R. US of 001

LASAR #: ~~123456~~

Date: 10/12/09

Time: 1500

Meter Type: M McB

Meter S/N:

Time Avg.(sec): 40

Personnel: WRP, LAP

Tracking Information:

Report To:

Sampling Event:

Sampling Project:

Sub Project

Expedition:

Date Received:

Received By:

Date Released:

L

Observ.	TAPE (ft)	DEPTH (ft)	Velocity (ft/sec) Top (0.2)	Middle (0.6)	Bottom (0.8)	Velocity Coef.
1	6	0		0		1.00
2	9	1.0		0.15		1.00
3	12	0.9		0.26		1.00
4	15	1.1		0.29		1.00
5	18	1.1		0.47		1.00
6	21	1.0		0.42		1.00
7	24	1.0		0.58		1.00
8	27	1.1		0.45		1.00
9	30	1.2		0.42		1.00
10	33	1.4		0.25		1.00
11	36	1.4		0.23		1.00
12	39	1.6		0.25		1.00
13	42	1.8		0.40		1.00
14	45	2.0		0.44		1.00
15	48	2.1		0.52		1.00
16	51	2.3		0.55		1.00
17	54	2.2		0.48		1.00
18	57	2.2		0.44		1.00
19	60	2.3		0.53		1.00
20	63	3.1		0.34		1.00
21	66	1.8		0.10		1.00
22	69	0.6		0.26		1.00
23						1.00
24						1.00
25						1.00
26						1.00
27						1.00
28						1.00
29						1.00
30						1.00
31						1.00
32						1.00
33						1.00
34						1.00
35						1.00
36						1.00
37						1.00
38						1.00
39						1.00
40						1.00

CITY OF MT. ANGEL
Wastewater System Facilities Plan
Mt. Angel, Oregon

APPENDIX E

COST ESTIMATES

Recommened Collection System Improvements Cost Estimates

Mt. Angel Wastewater Facilities Plan
4/26/2013

Priority Ranking
1= priority 1
2= priority 2
3= priority 3

Project Code	Priority	Project & Location(s)	Size/capacity	Length (ft)	Pipe Cost ($/ft)	Manholes #	Manhole Cost[1] ($)	Service Laterals #	Service Lateral Cost [3] ($)	Other Costs	Construction Cost	10% Construction Contingency	20% Engineering	10% Legal, Permits, Easement, Admin	Total Project	Rounded Total	*Total project costs rounded to nearest $1000* Prior 1	Prior 2	Prior 3
Gravity Collection System Improvements																			
G-1	1	Main Trunk Sewer - MH #5 to New MH #100	24 inch	2040	$ 180.00	7	$ 56,000.00	4	$ 14,000.00		$ 437,200.00	$ 43,720.00	$ 87,440.00	$ 43,720.00	$ 612,080.00	$ 612,000	$612,000	$0	$0
G-2	1	North Trunk Sewer - Marquam Street New MH #100 to Pershing Street MH # 20	18 inch	900	$ 180.00	4	$ 32,000.00	14	$ 49,000.00		$ 243,000.00	$ 24,300.00	$ 48,600.00	$ 24,300.00	$ 340,200.00	$ 340,000	$340,000	$0	$0
G-3	1	North Trunk Sewer - Marquam Street MH #20 to Railroad MH #25	15 inch	400	$ 170.00	2	$ 16,000.00	5	$ 17,500.00		$ 101,500.00	$ 10,150.00	$ 20,300.00	$ 10,150.00	$ 142,100.00	$ 142,000	$142,000	$0	$0
G-4	1	North Trunk Sewer - Marquam Street MH #25 to Main St MH #60[2]	12 inch	830	$ 150.00	4	$ 32,000.00	9	$ 31,500.00	$ 80,000.00	$ 268,000.00	$ 26,800.00	$ 53,600.00	$ 26,800.00	$ 375,200.00	$ 375,000	$375,000	$0	$0
G-5	1	South Trunk Sewer - Segment 1 New MH #100 to May Street MH #130	18 inch	1950	$ 180.00	5	$ 40,000.00	10	$ 35,000.00		$ 426,000.00	$ 42,600.00	$ 85,200.00	$ 42,600.00	$ 596,400.00	$ 596,000	$596,000	$0	$0
G-6	2	South Trunk Sewer - May Street MH #130 to MH #135	15 inch	500	$ 170.00	2	$ 16,000.00	6	$ 21,000.00		$ 122,000.00	$ 12,200.00	$ 24,400.00	$ 12,200.00	$ 170,800.00	$ 171,000	$0	$171,000	$0
G-7	2	South Trunk Sewer - Pershing St MH #135 to MH #136	15 inch	325	$ 170.00	1	$ 8,000.00	8	$ 28,000.00		$ 91,250.00	$ 9,125.00	$ 18,250.00	$ 9,125.00	$ 127,750.00	$ 128,000	$0	$128,000	$0
G-8	1	South Trunk Sewer - MH #136 to MH #146 [4]	12 inch	1200	$ 150.00	5	$ 40,000.00	10	$ 35,000.00		$ 255,000.00	$ 25,500.00	$ 51,000.00	$ 25,500.00	$ 357,000.00	$ 357,000	$357,000	$0	$0
G-9	3	Sewer Basin 1 Trunk Sewer	8 inch	2400	$ 130.00	5	$ 40,000.00		$ -		$ 352,000.00	$ 35,200.00	$ 70,400.00	$ 35,200.00	$ 492,800.00	$ 493,000	$0	$0	$493,000
G-10	3	Sewer Basin 2 West Trunk Sewer	8 inch	1400	$ 130.00	4	$ 32,000.00		$ -		$ 214,000.00	$ 21,400.00	$ 42,800.00	$ 21,400.00	$ 299,600.00	$ 300,000	$0	$0	$300,000
G-11	3	Sewer Basin 2 East Trunk Sewer	8 inch	1200	$ 130.00	3	$ 24,000.00		$ -		$ 180,000.00	$ 18,000.00	$ 36,000.00	$ 18,000.00	$ 252,000.00	$ 252,000	$0	$0	$252,000
G-12	3	Sewer Basin 3 Trunk Sewer	8 inch	1600	$ 130.00	4	$ 32,000.00		$ -		$ 240,000.00	$ 24,000.00	$ 48,000.00	$ 24,000.00	$ 336,000.00	$ 336,000	$0	$0	$336,000
G-13	3	Sewer Basin 7 Southwest Trunk Sewer	10 inch	2100	$ 140.00	6	$ 48,000.00	15	$ 52,500.00		$ 394,500.00	$ 39,450.00	$ 78,900.00	$ 39,450.00	$ 552,300.00	$ 552,000	$0	$0	$552,000
															Totals	$ 4,654,000	$ 2,422,000	$ 299,000	$ 1,933,000

Notes
1) Unit cost for manholes = $8,000 each
2) Other costs include 80 feet of bored railroad crossing at $1,000 per foot
3) Unit cost for service laterals = $3,500 each
4) Railroad and highway crossing assumed to be completed by pipe bursting at a cost similar to open cut installation.
5) Other costs include 500 feet of bored highway and railroad crossing and one air/vacuum release station

Mt. Angel Facilities Plan				
Treatment Plant Entrance Road Improvements (Project T-1)				
Construction Costs				
Item	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
Mobilization (percentage of total)	10.0%	LS	$4,600	$4,600
Clearing and Site Preparation	1	LS	$1,500	$1,500
Foundation Stabilization	200	CY	$40	$8,000
Roadway Embankment Fill	275	CY	$30	$8,300
Culvert Extensions [1]	40	LF	$100	$4,000
Gravel Surfacing	500	CY	$40	$20,000
Fence	400	LF	$10	$4,000
Construction Total				$50,000
Soft Costs				
Land Acquisition	1	LS	$8,000	$8,000
Wetland Fill Permitting and Mitigation[1]	1	LS	$12,000	$12,000
Construction Contingencies	10%	LS	$5,000	$5,000
Engineering, Legal, & Admin	20%	LS	$10,000	$10,000
Total Project Budget				**$85,000**
Notes:				
1. Assumes existing culverts are sound and can remain in place.				

Mt. Angel Facilities Plan

New Headworks Planning Level Cost Estimate (Project T-2)

Construction Costs				
Item	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
Mobilization (percentage of total)	10.0%	LS	$36,100	$36,100
Demolish Existing Headworks	1	LS	$8,000	$8,000
Clearing & Grubbing	1	LS	$2,500	$2,500
Earthwork	250	CY	$15	$3,800
Erosion Control	1	LS	$2,500	$2,500
Baserock	45	CY	$35	$1,600
Gravel Surfacing	225	SY	$15	$3,400
Chain Link Fencing	150	LF	$20	$3,000
Chain Link Gate	1	LS	$2,500	$2,500
Bollards	6	EA	$750	$4,500
Piping				
Flow Diversion Manhole	1	LS	$7,500	$7,500
Temporary bypass pipe	30	LF	$150	$4,500
Permanent bypass pipe	60	LF	$200	$12,000
Permanent bypass pipe outlet	1	LS	$2,500	$2,500
Connections to existing pipes	2	LS	$3,000	$6,000
Washdown water piping	100	LF	$40	$4,000
Washdown water stations	3	EA	$1,000	$3,000
Concrete				
Foundation & Footings	20	CY	$500	$10,000
Walls	14	CY	$1,000	$14,000
Flume Filler Concrete	1	CY	$1,000	$1,000
Slabs on Grade	10	CY	$500	$5,000
Slide Gates	2	EA	$3,000	$6,000
Sluice Gates	1	EA	$5,000	$5,000
Misc. Mechanical	1	LS	$25,000	$25,000
Stairs	1	EA	$5,000	$5,000
Handrails	100	LF	$75	$7,500
Grating & Frame	140	SF	$60	$8,400
Parshall Flume	1	LS	$7,500	$7,500
Fiberglass control shelter	1	LS	$20,000	$20,000
Equipment				
Fine Screening Equipment	1	LS	$90,000	$90,000
Influent Sampler	1	LS	$8,500	$8,500
Influent Flow Meter	1	LS	$7,500	$7,500
pH and Temperature Sensor	1	LS	$5,000	$5,000
Rain Gauge	1	LS	$2,500	$2,500
Equipment Installation (20% of Equip. Cost)	1	LS	$22,700	$22,700
Electrical & Controls (12% of Total Cost)	1	LS	$39,000	$39,000
Construction Total				$397,000
Soft Costs				
Construction Contingencies	10%	LS	$40,000	$ 40,000
Engineering, Legal, & Admin	20%	LS	$79,000	$ 79,000
Permitting	3%	LS	$12,000	$ 12,000
Total Project Budget				**$528,000**

Mt. Angel Facilities Plan					
Lagoon Cell 1 Biosolids Removal (Project T-3)					
Construction Costs					
Item	**Qty**	**Unit**	**Unit Cost**	**Total Cost**	
Dredge, Haul, Dispose, & Incorporate	1500	Dry Tons	$500	$750,000	
Construction Total				$750,000	
Soft Costs					
Biosolids Management Plan & Site Authorizations	All	LS	$40,000	$ 40,000	
Construction Contingencies	5%	LS	$38,000	$ 38,000	
Mic Engineering, Legal, & Admin	8%	LS	$60,000	$ 60,000	
Total Project Budget				**$888,000**	

Mt. Angel Facilities Plan

Wetland Outlet Box Bar Screens Planning Level Cost Estimate (Project T-4)

Construction Costs				
Item	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
Wetland inlet header valve rehabiliation	3	EA	$1,500	$4,500
Bar Screen Fabrication & Install	8	EA	$6,000	$48,000
Construction Total				$53,000
Soft Costs				
Construction Contingencies	10%	LS	$5,000	$ 5,000
Engineering, Legal, & Admin	20%	LS	$11,000	$ 11,000
Total Project Budget				**$69,000**

Mt. Angel Facilities Plan					
Effluent Pump Station Confined Space Entry Improvements (Project T-5)					
Construction Costs					
Item	**Qty**	**Unit**	**Unit Cost**	**Total Cost**	
Mobilization (percentage of total)	10.0%	LS	$2,500	$2,500	
Wetwell Clean and Prep	1	LS	$3,000	$3,000	
Sluice Gate over Pump Station Inlet	1	LS	$7,000	$7,000	
Mixer/Meter Vault Valve Modifications	1	LS	$17,500	$17,500	
Construction Total				$30,000	
Soft Costs					
Construction Contingencies	10%	LS	$3,000	$ 3,000	
Engineering, Legal, & Admin	20%	LS	$6,000	$ 6,000	
Total Project Budget				**$39,000**	

Mt. Angel Facilities Plan					
Effluent Pump Station Electrical and Control System Modernization (Project T-6)					
Construction Costs					
Item	**Qty**	**Unit**	**Unit Cost**	**Total Cost**	
Mobilization (percentage of total)	10.0%	LS	$32,200	$32,200	
Replace Existing MCC with VFDs and Other Modern Switchgear	1	LS	$110,000	$110,000	
Ugrade Control System with new PLC Based System	1	LS	$150,000	$150,000	
New SCADA System for Plant Monitoring and Alarm Autodialer	1	LS	$27,000	$27,000	
Miscellaneous Mechanical and Electrical Improvements	1	LS	$35,000	$35,000	
Construction Total				$354,000	
Soft Costs					
Construction Contingencies	10%	LS	$35,000	$ 35,000	
Engineering, Legal, & Admin	20%	LS	$71,000	$ 71,000	
Total Project Budget				**$460,000**	

CITY OF MT. ANGEL
Wastewater System Facilities Plan
Mt. Angel, Oregon

APPENDIX F

WASTEWATER TREATMENT PLANT SITE EARLY 1990S CULTURAL RESOURCE INVESTIGATION DOCUMENTATION

NEIL GOLDSCHMIDT
GOVERNOR

Parks and Recreation Department
STATE HISTORIC PRESERVATION OFFICE
525 TRADE STREET SE, SALEM, OREGON 97310 PHONE (503) 378-5001 FAX (503) 378-6447

February 20, 1991

John Pugh
Westec Engineering Inc
3421 25th Street SE
Salem OR 97302-1191

RE: Ruef Site
Determination of Eligibility
Marion County

Dear Mr. Pugh:

Our office has reviewed the excavation report by Bob Keeler for the testing of the Ruef Site in relationship to the project under contract with your firm for the development of the Mt. Angel sewage system improvements. Based on the testing report, we concur that the site is not eligible for listing on the National Register and therefore the project will have no effect on sites on, or eligible for inclusion on, the National Register of Historic Places. If you have any questions you can contact Dr. Leland Gilsen at 378-5023.

Sincerely,

James M. Hamrick
Deputy SHPO

JMH:jn
JPUGH.LTR

ARCHAEOLOGICAL TEST EXCAVATIONS

AT THE RUEF SITE, MARION COUNTY, OREGON

Robert W. Keeler, PhD
Cultural Resources Consultant

12 February 1991

TEST EXCAVATION NARRATIVE DESCRIPTION

This report supplements the earlier ground surface reconnaissance of this area during which the Ruef Site was located (Keeler 1990). Test excavation was undertaken under contract with Westech Engineering, Inc. of Salem and Portland, Oregon to delineate the horizontal and vertical boundaries of the site and evaluate its significance. This work was done in the field on Sunday, 3 February, Saturday, 9 February and Sunday, 10 February 1991 by the author assisted by Richard P. Matthews, MA. A grid was laid out with markers at 20 meter intervals using tape and compass bearings. The original intent was to drill holes with a power auger, however, the rented machine failed to work properly, so holes were excavated by hand shovelling. This method proved to work well since the plow zone turned out to be much more shallow than anticipated (28-36 cm). Holes approximately 50 cm x 25 cm were dug to a depth of approximately 50 cm into clay subsoil which proved in every case to be sterile. One test pit 1 M x 1 M was excavated to a depth of 1 meter (see unit E3 on site plan) and another test pit measuring 50 cm x 50 cm was dug to a depth of 75 cm (see unit E2 on site plan). The plow zone material from all holes was screened through 1/4 inch mesh and cultural material was bagged and removed from the site. All cultural material will be returned to Max and Marlene Ruef, owners of the site, at the conclusion of this project. Subsoil from each hole was screened separately through 1/4 inch mesh and proved to contain no cultural material. No cultural strata or features were observed in the sidewalls or floors of the test excavation units.

The attached density distribution maps show the concentrations of the two main classes of cultural material found--chipped lithic debitage and fire-cracked rock (FCR). 54 fragments of chipped lithic debitage and 27 fragments of fire-cracked rock were found in the test excavation units. In addition, one unifacially flaked cobble was found in the plow zone of unit F2 (see attached illustration). Calculating the volume of plow zone excavated and screened (subsoil excavated was factored out since it proved to be sterile when screened) we arrive at an overall average site density of 42 pieces of chipped lithic debitage and 21 pieces of fire-cracked rock per cubic meter of plow zone soil.

The flaked lithic debitage consisted of 59% cryptocrystalline silica (CCS), 28% fine grained basalt, and 13% black and grey obsidian. Two obsidian flakes and one basalt flake exhibited minor retouch flaking or use wear flaking along one edge. One CCS core fragment was lumped with the debitage. Several CCS flakes exhibited a waxy luster, craze cracking and potlid fractures--characteristics typical of material that has been heat treated to enhance chipping quality.

The Ruef site lies within the Pudding River drainage, a tributary of the Willamette River. Swanton (1979) notes that the early settlers called the Native people of this area "French Prairie Indians" and "Pudding River Indians," the latter usage adopted by Joel Berreman (1937). Swanton also records the name "Ahantchuyuk" for these people, though he could learn no meaning for the term. The Gibbs and Starling map of 1851 shows the Pudding River drainage as part of the vast territory "bought of the Santiam Band of the Callapooya Tribe of Indians" (Mackey 1974). This territory extended from the Champoeg area on the north, far past Salem on the south and from the east bank of the Willamette to the Cascades. The Santiam Band retained a small reservation, but even that was denied them when, a few years later, they were forced to join the other Kalapuyan

people on the Grand Ronde Reservation.

The General Land Office survey of 1851-52 (GLO 1852) shows the escarpment on which the Ruef site is located, but records no historic structures. The land was part of the G. Sutlemire (spelling varies) Donation Land Claim, but his dwelling is shown on an escarpment about half a mile south of the Ruef site. The low, wet bottomland below the Ruef site escarpment is shown as a seasonal lake and marsh called "Poison Lake." This is differentiated from the "wet bottomlands" nearby and suggests the reason for Native American occupation of the Ruef site may relate to exploitation of lake and marsh resources such as wildfowl, cattail and wappato.

Little archaeological research has been undertaken in this part of the Willamette Valley. The models of settlement and resource exploitation have been developed using data from either the upper valley (Connolly 1983 and White 1975) or from the Portland Basin on the Columbia River near the mouth of the Willamette (Pettigrew 1981). The files of the Oregon State Historic Preservation Office list only one other archaeological site along the Pudding River and it has not been excavated. Presumably the people who occupied the Ruef site lived a seasonal hunting and gathering life in small extended family bands as did their neighbors and linguistic relatives throughout the Willamette Valley. They probably used the Ruef site as a seasonal camp while exploiting the aquatic resources (both floral and faunal) of nearby "Poison Lake." Knowledge of the Ruef site's existence and location adds to our database on the prehistory of the region, but little else can be learned for a reasonable expenditure of effort due to plow disturbance, lack of diagnostic artifacts and sparse density of cultural material.

In summary, the test excavation revealed that:

a) all cultural material was found in the plow zone. The clay subsoil beneath was sterile.

b) there were no artifacts found which can be used diagnostically either to infer time of occupation or site function.

c) the density of cultural material on the site is rather sparse, even in the area with the highest density (see attached distribution maps).

These three facts, taken together, suggest that the Ruef site does not meet the eligibility requirements for the National Register of Historic Places because it has neither the integrity nor the material substance to make a significant contribution to our knowledge of the prehistory of the central Willamette Valley. No futher archaeological mitigation work is recommended.

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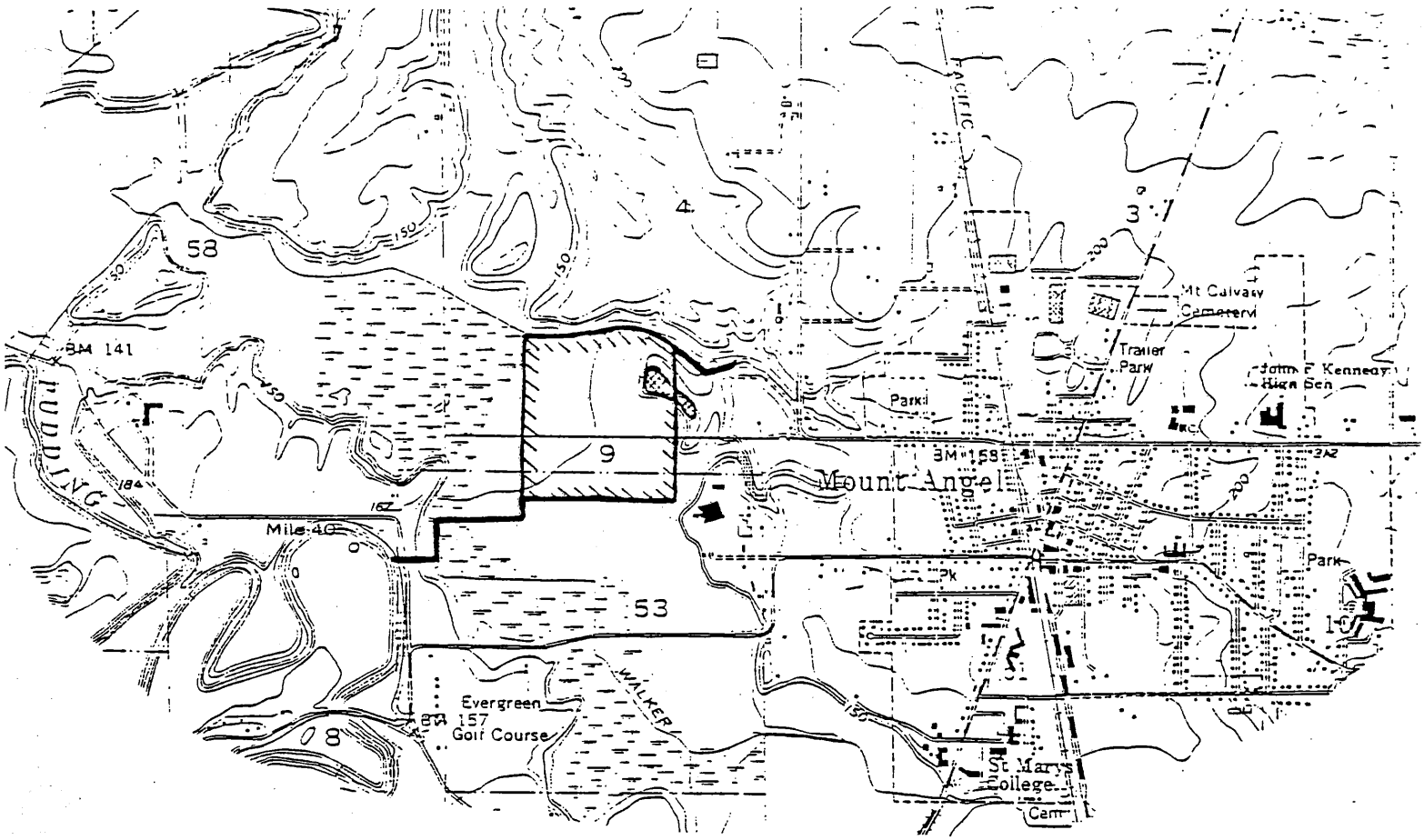
Swanton, John R.
1979 Indian Tribes of Washington, Oregon and Idaho. Ye Galleon Press, Fairfield, Washington. (reprint of excerpt from Bulletin 145, Bureau of American Ethnology, 1952).

White, John R.
1975 A Proposed Typology of Willamette Valley Sites. In Archaeological Studies in the Willamette Valley, Oregon, edited by C. Melvin Aikens. University of Oregon Anthropological Papers, 8: 141-225, Eugene.



SCALE 1:24,000

1 ½ 0 1 MILE

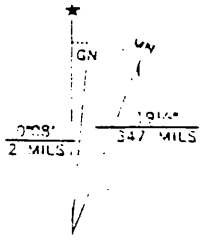
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

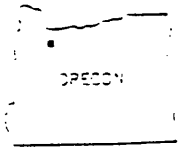
CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

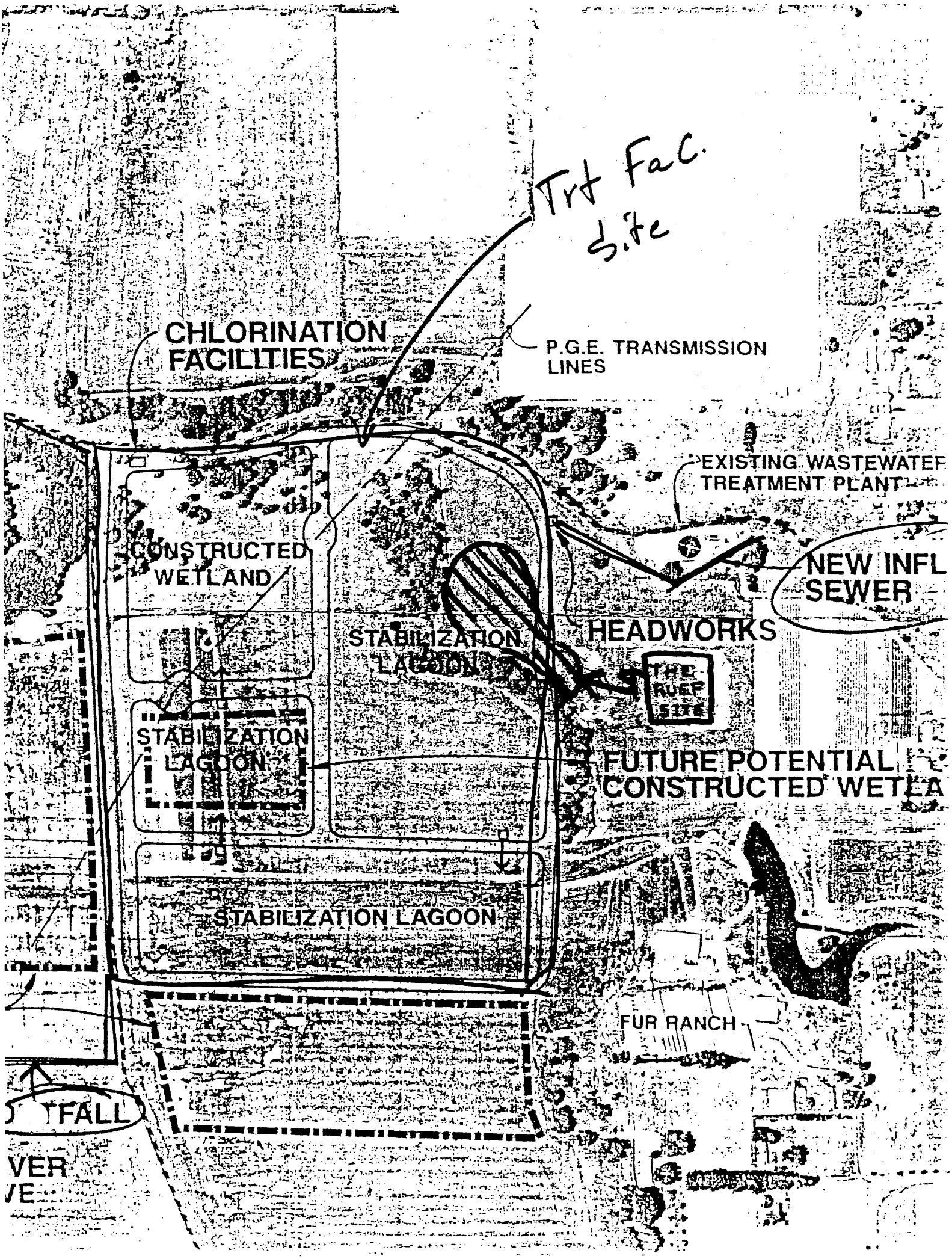
Archaeological Site - The Ruef Site

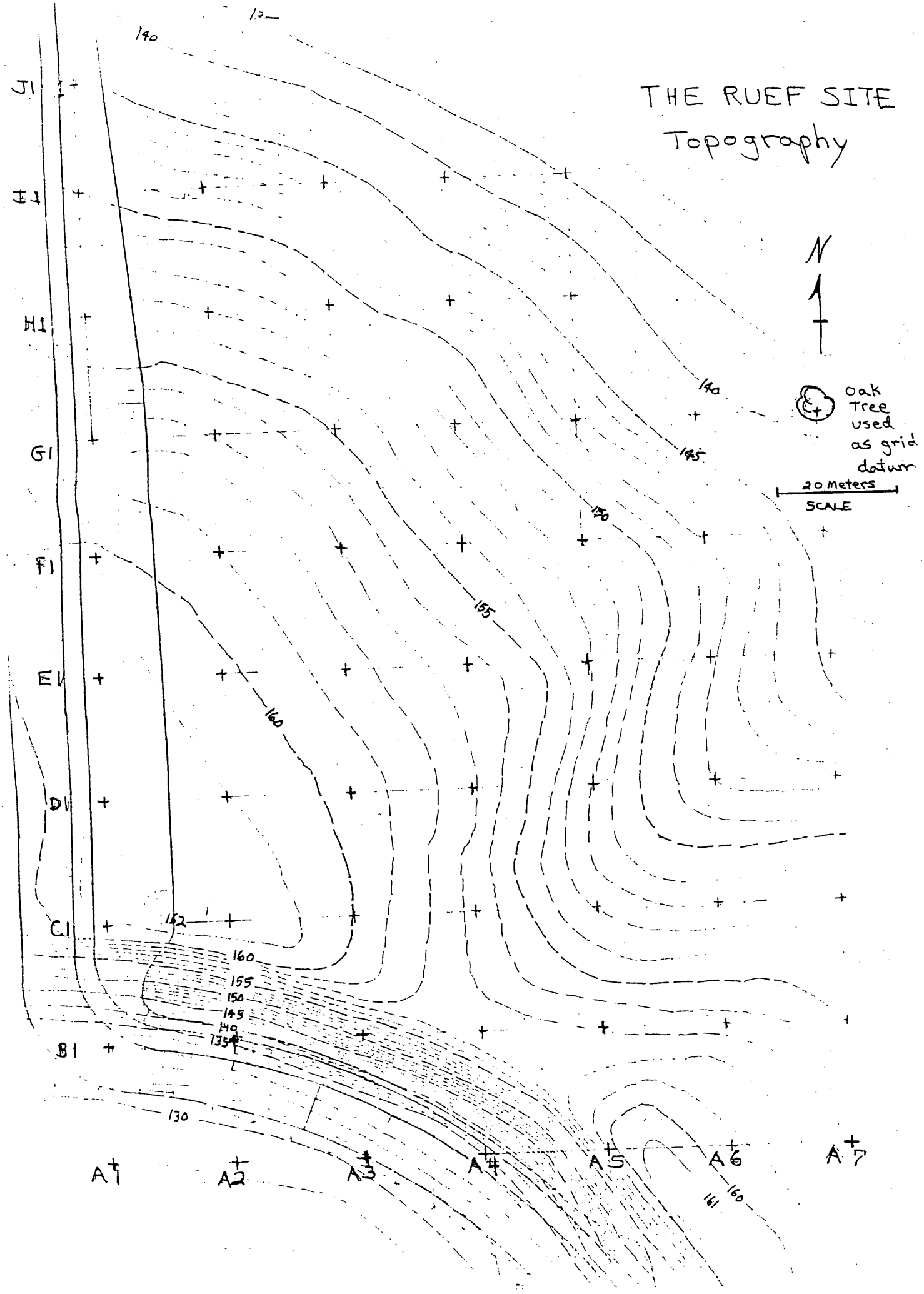
Project Survey Area

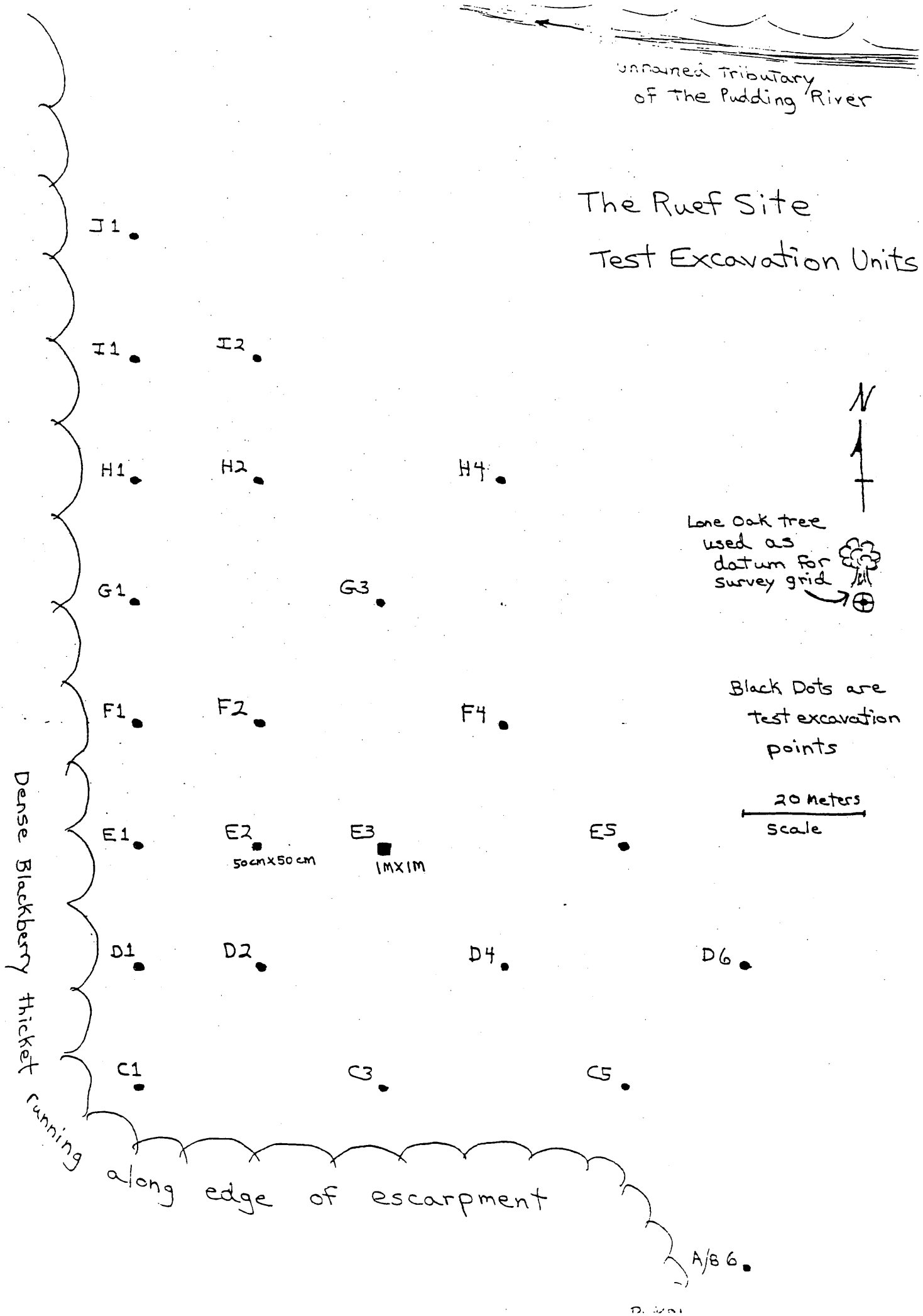


UTM GRID AND 1985 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET




Trt Fac. site
CHLORINATION FACILITIES
P.G.E. TRANSMISSION LINES
EXISTING WASTEWATER TREATMENT PLANT
CONSTRUCTED WETLAND
NEW INFL SEWER
HEADWORKS
STABILIZATION LAGOON
THE RUEP SITE
STABILIZATION LAGOON
FUTURE POTENTIAL CONSTRUCTED WETLA
STABILIZATION LAGOON
FUR RANCH
TFALL
VER
VE


THE RUEF SITE
Topography
N
Oak Tree used as grid datum
20 meters
SCALE
J1
I1
H1
G1
F1
E1
D1
C1
B1
A1
A2
A3
A4
A5
A6
A7
140
145
150
155
160
162
135
130
161


Unnamed Tributary of The Pudding River
The Ruef Site
Test Excavation Units
N
Lone Oak tree used as datum for survey grid
Black Dots are test excavation points
20 Meters
Scale
J1
I1
I2
H1
H2
H4
G1
G3
F1
F2
F4
E1
E2
50cm x 50 cm
E3
1M x 1M
E5
D1
D2
D4
D6
C1
C3
C5
A/B 6
Dense Blackberry thicket running along edge of escarpment

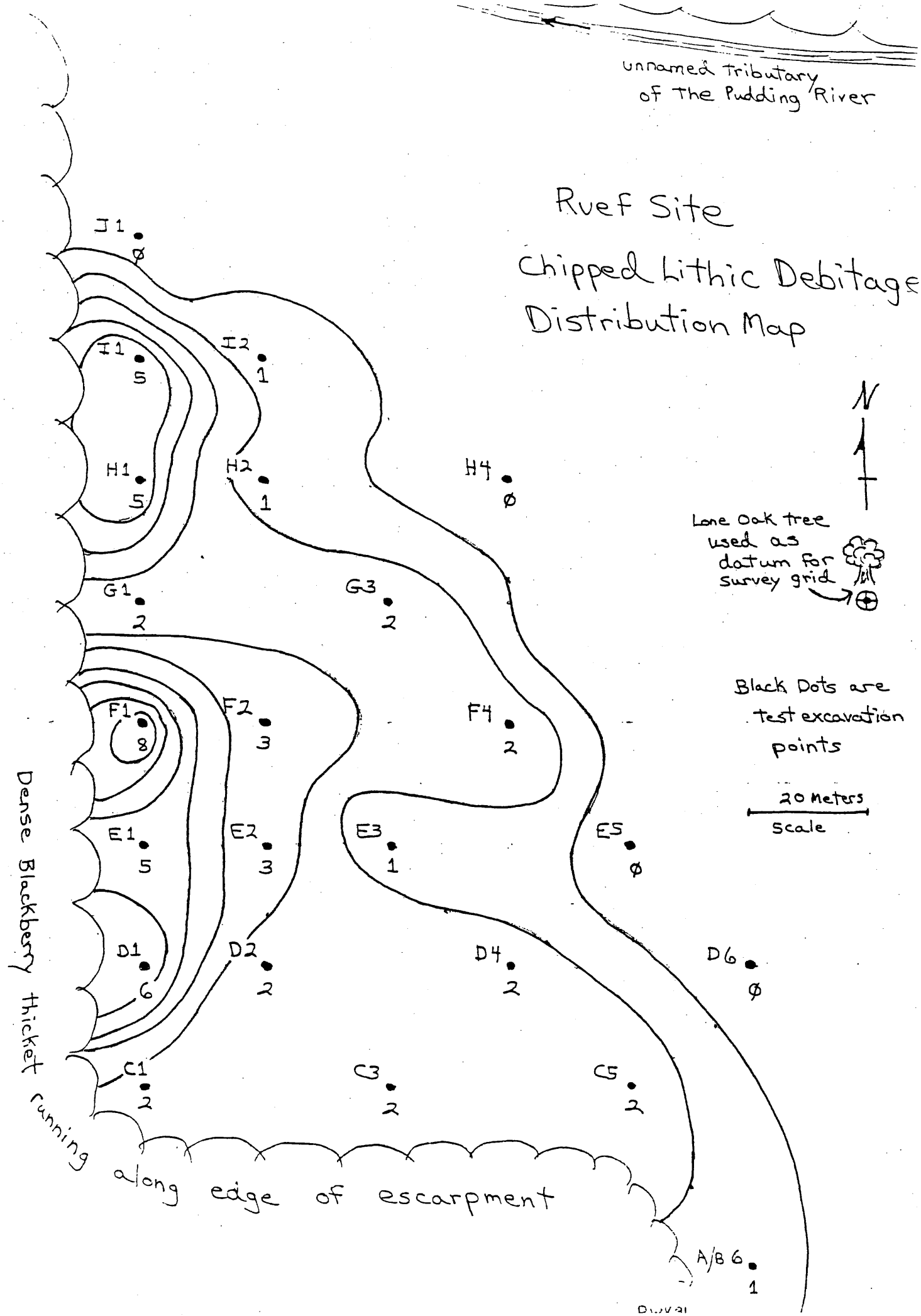
DESCRIPTION OF EXCAVATION UNITS

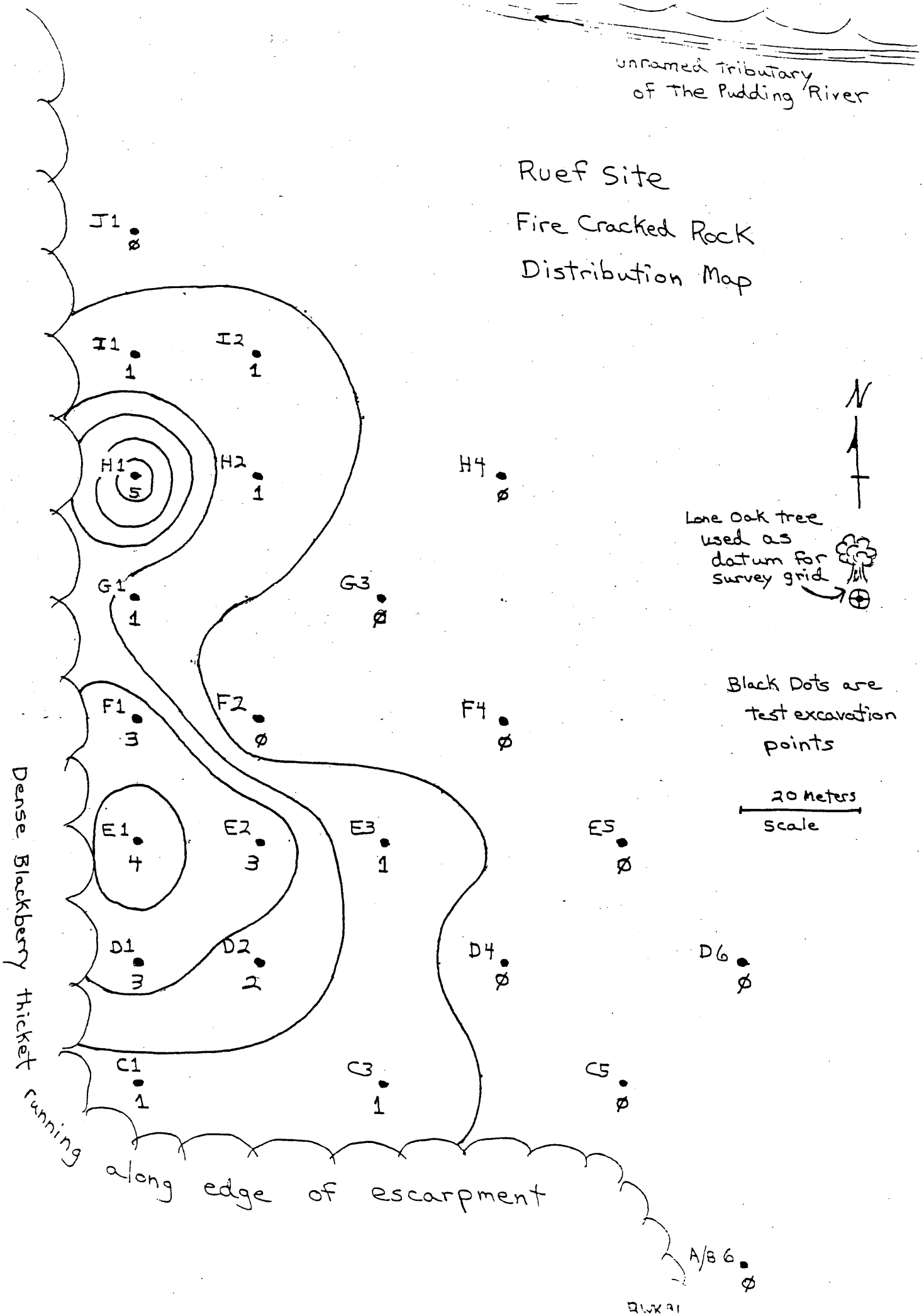
Unit	PZ Depth	Subsoil Description	Chipped Lithic Debitage CCS	Obsidian	Basalt	FCR	Artifacts
C1	36cm	tan clay	1	1		1	
D1	36cm	tan clay	4	1	1	3	
E1	30cm	tan clay	3	1*	1	4	
F1	30cm	tan clay	4		4*	3	
G1	30cm	grey & orange clay	1	1		1	
H1	30cm	grey & orange clay	3		2	5	
I1	30cm	tan clay w/sandy loam	4**		1	1	
J1	33cm	grey & orange clay					
D2	28cm	tan to G&O clay	1	1*		2	
E2	30cm	tan clay			3	3	
F2	28cm	tan clay	2		1		1***
H2	30cm	grey & orange clay	1			1	
I2	30cm	grey & orange clay		1		1	
C3	30cm	tan clay	1	1		1	
E3	30cm	burned tree stump	1			1	
G3	30cm	grey & orange clay	2				
D4	30cm	tan clay	2				
F4	30cm	tan to G&O clay	2				
H4	33cm	grey & orange clay					
C5	36cm	grey & orange clay	1		1		
E5	30cm	tan to G&O clay					
A/B6	28cm	tan clay			1		
D6	30cm	tan to G&O clay					

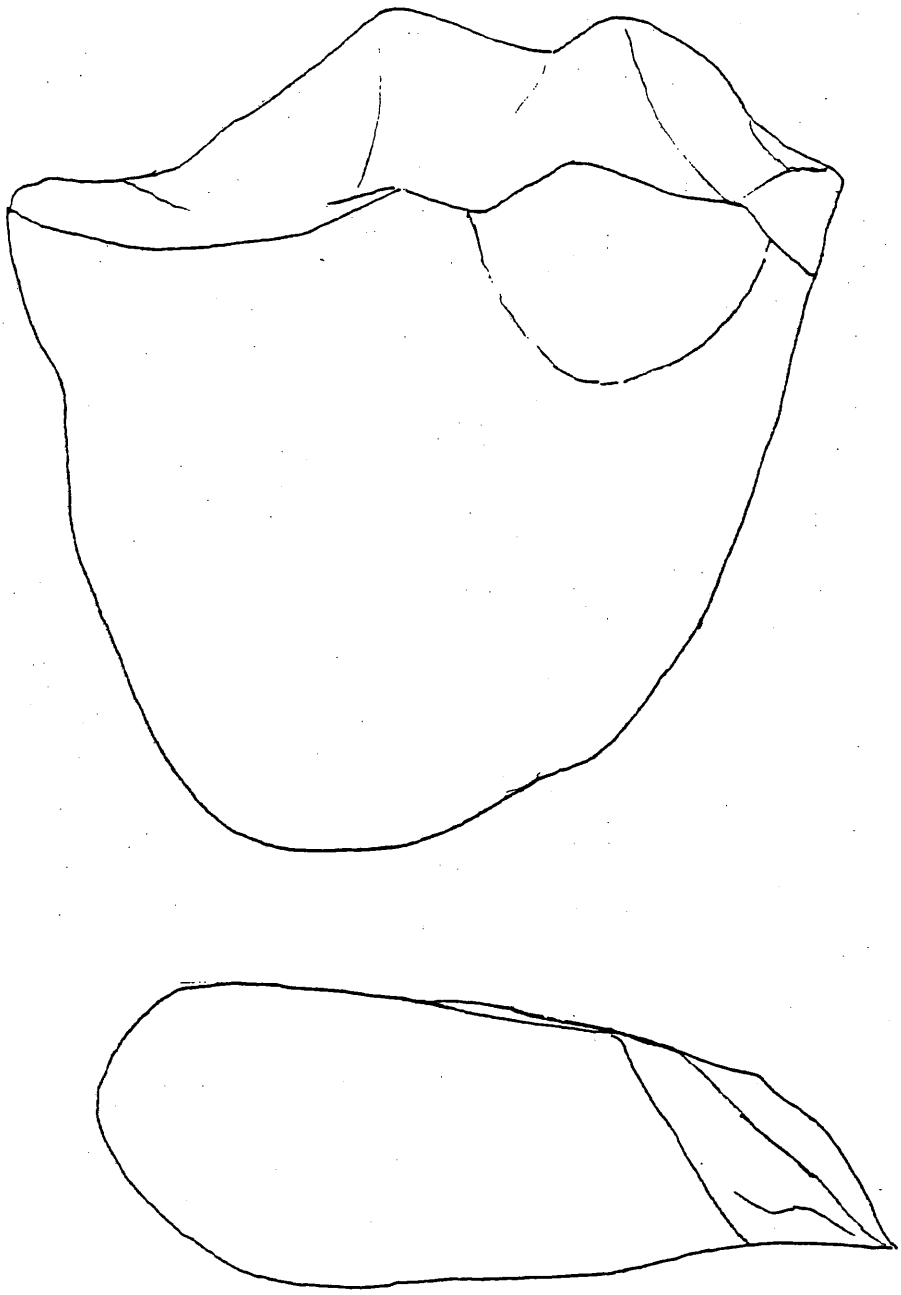
* 1 flake in this group retouched either intentionally or by use wear

** 1 core fragment lumped with this group of debitage

*** unifacially flaked basalt cobble


unnamed tributary of The Pudding River
Ruef Site
Chipped Lithic Debitage Distribution Map
N
Lone Oak tree used as datum for survey grid
Black Dots are test excavation points
20 Meters
Scale
J1 Ø
I1 5
I2 1
H1 5
H2 1
H4 Ø
G1 2
G3 2
F1 8
F2 3
F4 2
E1 5
E2 3
E3 1
E5 Ø
D1 6
D2 2
D4 2
D6 Ø
C1 2
C3 2
C5 2
A/B 6 1
Dense Blackberry thicket running along edge of escarpment


unnamed tributary of The Pudding River
Ruef Site
Fire Cracked Rock Distribution Map
N
Lone Oak tree used as datum for survey grid
Black Dots are test excavation points
20 Meters
Scale
J1 ø
I1 1
I2 1
H1 5
H2 1
H4 ø
G1 1
G3 ø
F1 3
F2 ø
F4 ø
E1 4
E2 3
E3 1
E5 ø
D1 3
D2 2
D4 ø
D6 ø
C1 1
C3 1
C5 ø
A/B 6 ø
Dense Blackberry thicket running along edge of escarpment



UNIFACIALLY FLAKED COBBLE FROM UNIT F2 PLOW ZONE

sketched full size

OREGON ARCHAEOLOGICAL INVENTORY
Modified Oregon SHPO Site Form (August 1990)
PSU/Laboratory of Archaeology & Anthropology
Mt. Hood National Forest Project

1) Smithsonian No. _____
2) Agency No. _____
3) Temporary No. _____
4) County Marion

PART A - ADMINISTRATIVE DATA

5) District or Specific Resource Area _____

6) Site Name Ruef Site

7) Landowner (circle code below) Name Max and Marlene Ruef

BLM - Bureau of Land Management
BOR - Bureau of Reclamation
CO - County
F/S - US Forest Service
(PVT) - Private
ST - State
BIA - Bureau of Indian Affairs
C/E - US Corps of Engineers
CTY - City
F&W - US Fish and Wildlife
RES - Reservation
??? - Unknown

8) Legal Description SE 1/4 of SW 1/4, Section 4, Township 6S, Range 1W
SW 1/4 of SE 1/4 Section 4, Township 6S, Range 1W

9) UTM Zone 10 - 514600 East - 4990850 North

10) USGS Quad Silverton 7.5' series

11) Agency Probability Zone _____

12) Location and Access:
Go west from Hwy 214 in Mt. Angel on West Church Street ½ mile to Ruef lane. Turn right onto Ruef Lane. There is a sign here for the Ruef Fur Farm. Go past the Ruef house to the fur farm office. Ask for either Mr. or Mrs. Ruef or their son Jeff. They can direct you through the paddock to the site area just east of the blackberry hedge at the top of the escarpment. (see attached map) Access also possible through city of Mt. Angel Sewerage Treatment Plant.

PART B - MANAGEMENT DATA

1) Management Objectives City of Mt. Angel will borrow dike construction soil from site are To build new sewerage treatment lagoons

2) National Register Status ____ On ____ Eligible X Insufficient Data X Not Eligible

3) Site referenced in any document (Y/N)? Y Citation Keeler Robert 1990 An Archaeological Reconnaissance the Proposed Wastewater Treat Facility and Related Improv Mt. Angel, Marion County, Or 1991 Archaeological Test excavatio at the Ruef Site, Marion County, Oregon.

4) Site Recorded by Robert W. Keeler

5) Date Site Recorded (MM/DD/YY) 12/15/90
Amended 2/11/91 RWK

PART C - ENVIRONMENTAL DATA

1) Basin (circle) and 2) Sub Basin (circle)

- Deschutes
  - Upper Deschutes
  - Middle Deschutes
  - Lower Deschutes
  - Upper Crooked
  - Lower Crooked
- Goose/Summer Lake
  - Goose Lake
  - Warner Lakes
  - Chewaucan
  - Summer Lake
- Grants Ponds
  - Upper Grande Ronde
  - Middle Grande Ronde
  - Lower Grande Ronde
  - Wallowa
  - Imnaha
- Hood
  - Hood River
  - Wasco
- John Day
  - Upper John Day
  - South Fork
  - Middle John Day
  - Middle Fork
  - North Fork
  - Lower John Day
- Klamath
- Malheur
- Malheur Lake
- Mid Coast
  - Siletz
  - Yaquina
  - Alsea
  - Siuslaw
- North Coast
  - Tillamook
  - Nehalem
  - Columbia
- Owyhee
- Powder
  - Burnt
  - Powder
  - Pine Creek
- Rogue
  - Upper Rogue
  - Little Butte Creek
  - Applegate
  - Middle Rogue
  - Illinois
  - Lower Rogue
- Sandy
- South Coast
  - Chetco
  - Sixes
  - Coquille
  - Coos
- Umatilla
  - Walla Walla
  - Umatilla
  - Willow
- Umpqua
  - South Umpqua
  - North Umpqua
  - Lower Umpqua
- Willamette
  - Tualatin
  - Clackamas
  - Columbia
  - Santiam
  - Coast Range
  - Pudding
  - Coast Fork
  - Middle Fork
  - McKenzie
  - Long Tom

3) Drainage unnamed tributary of the Pudding River

4) Physiographic Province (circle)

Basin/Range	Coast Range	Owyhee Uplands
Blue Mountains	Deschutes/Umatilla Plateau	Snake River Canyon
Cascades	High Lava Plain	Willamette Valley
Coastal Plain	Klamath Mountains	

5) Elevation 160 feet

6) Primary Landform (circle)

Mountain	Rolling Plain	Badland
Hill	Flat Plain	Coastal Plain
Butte	Canyon	Island
Mesa/Tableland	Valley	Other _____

7) Primary Position (circle) Top Slope Base Floor

8) Secondary Landform (circle)

Floodplain	Rimrock	Playa	Dune
Terrace	Talus Slope	Alluvial Fan	Beach
Bench	Bluff	Hill	Estuary
Ridge	Arroyo/Gully	Mountain	Headland
Cliff	Other _____		

9) Secondary Position (circle)

Top	Saddle	Base	Floor
Crest	Slope	Edge	Confluence
Saddle			

10) Landform Description Two small hilltops on gentle backslope of a Floodplain terrace escarpm.

11) Slope 5 % 3 ° 12) Aspect (circle) N E S W 13) Bearing 60 degrees

14) Plant Community agricultural - currently in wheat stubble. oak groves nearby

15) Water Source/Type (circle) 16) Distance to water 100 meters

River	Seep	Lake	Intermittent Stream
Stream	Spring	Marsh	

17) Accessible meadow (Y/N)? N 18) Distance to Meadow _____ meters

19) Soil clay loam plow zone trending to clay subsoil. Some gleying and iron oxide in deeper, wetter subsoil

PART D - CULTURAL RESOURCE DATA

1) SHPO Type lithic scatter

2) Primary Site Type Native American occupation

3) Secondary Site Type _____

4) General Site Information (Y/N responses)

Have site materials been collected? N
Are features present? ~~Y~~ N
Floral remains? ~~Y~~ N
Are cultural remains stratified? ~~Y~~ N
Are human remains present? ~~Y~~ N

Has site been tested? ~~N~~ Y
Faunal remains? Y (none observed in excavation)
Has site been radiocarbon dated? N
Is groundstone present? ~~Y~~ N

one tiny piece of burn. bone observ. during ground surface surv.

5) Site Date (Y/N responses) [* Additions to SHPO form]

Unknown Prehistoric* X	Early Archaic ____	Unknown Historic* X ?
Early Paleo ____	Middle Archaic ____	Early Historic ____
Middle Paleo ____	Late Archaic ____	Middle Historic ____
Late Paleo ____		Late Historic ____

6) Primary Travel Route Willamette Valley

7) Historic Land-Use Periods (Y/N responses) N/A

Exploration ____	Industrialization ____	Post Depression ____
Fur Trade ____	Railroad ____	Contemporary ____
Settlement ____	Motor Travel ____	

8) Historic Themes: (as appropriate)
Theme One N/A
Theme Two ____
Theme Three ____

9) Site surface area 6000 square meters 10) ≅ 1.48 acres (area/4047)

11) Depth of Deposits ? Plow Zone depth 28-36 cm No cultural material beneath plow zone centimeters

12) Formally excavated surface area ~~0~~ 3.85 square meters

13) Volume of excavated deposits ~~0~~ 2.27 cubic meters

14) Integrity (percent of site not destroyed) ~~?~~ 0 % plowed & cultivated field. No cultural material beneath plow zone

15) Lithic Debitage Reported (Y/N)? Y

Estimated Total Quantity (Y/N) N~~Y~~ 10-99 N 500-1000
N 100-499 ~~N~~Y >1000

Estimated Surface Density <1 per square meter

16) Surface Exposure (percent of visible ground) 0-25 %

17) Describe site cultural materials and features.

Surface:
- Two dozen small CCS flakes < 1cm average size. Some heat treated
- Dozen fragments FCR
- Several possible battered cobbles. One possibly ground into shape.
- 1 fragment burned bone - tiny

Excavation:
- No features
- 1 Unifacially flaked cobble
- No ground stone or battered cobbles
- 27 fragments FCR
- 54 fragments chipped lithic debitage (3 retouched)

NEIL GOLDSCHMIDT
GOVERNOR

Parks and Recreation Department
STATE HISTORIC PRESERVATION OFFICE
525 TRADE STREET SE, SALEM, OREGON 97310 PHONE (503) 378-5001 FAX (503) 378-6447

January 11, 1991

John Pugh
Westech Engineering Inc.
3421 25th Street S.E.
Salem, Or 97301-1191

RE: Archaeological Survey
Mt. Angel Wastewater Treatment Facility
Marion County

Dear Mr. Pugh:

I received the archaeological report by Bob Keeler in which an archaeological site was located on the high ground on the east side of the project area.

If the proposed project is able to avoid this location, the State Historic Preservation Office would be willing to give a "no effect" determination.

If, however, the high ground is required for the proposed wastewater treatment facility, the site area would have to be evaluated to determine whether or not it is eligible for listing on the National Register of Historic Places. After testing, if it is found that the site is not eligible, then the project could be declared as a "no effect" situation and proceed.

If, however, the site is determined eligible, then the next step would be to determine how the project would affect those qualities that make the site eligible for listing on the National Register. The usual procedure is then to try to design the project to minimize impact to those qualities and mitigate thoe affects that are negative to those qualities that make the site eligible.

Enclosed is a flow diagram showing the process. If you have any questions, you can contact me at 378-5023.

Sincerely,

Dr. Leland Gilsen
SHPO Archeologist

LG:lr
PUGH.LTR

Enclosure

AN ARCHAEOLOGICAL RECONNAISSANCE

OF THE PROPOSED WASTEWATER TREATMENT FACILITY

AND RELATED IMPROVEMENTS

MT. ANGEL, MARION COUNTY, OREGON

Robert W. Keeler, PhD
Cultural Resources Consultant

December 21, 1990

On Saturday, 15 December 1990, I conducted a pedestrian archaeological ground surface reconnaissance of the site of the proposed Mt. Angel Wastewater Treatment Plant and related improvements under contract with Westech Engineering, Inc. of Salem, Oregon. The area surveyed is located as follows:

Marion County, Oregon
Silverton, Oregon Quadrangle, 7.5' Series USGS
Portions of Sections 4, 8, and 9 of T6S R1W, Willamette Meridian.
Latitude 45 degrees 3' 30" North and Longitude 122 degrees 49' West.

The project is approximately 65 acres in size including a proposed treatment facility, influent sewer from the existing treatment plant and outfall from the new treatment plant to the Pudding River (see attached map of area). The area surveyed coincides with the project area. Field notes from the archaeological survey are in the possession of the author. No cultural materials were collected during the reconnaissance.

The project will involve excavation of three stabilization lagoons, construction of a wetland, headworks, chlorination facilities, a new sewer influent and an outfall from the treatment facility to the Pudding River. The land is currently owned by Max and Marlene Ruef of Mt. Angel who use it for agricultural purposes. Since the proposed project will be partially funded by a grant from the EPA, a pedestrian archaeological investigation is required.

The survey area was examined on foot by making east-west transects at 50 meter intervals. This procedure was varied in examining the escarpment in the northeast portion of the area. In this portion, I walked along the base of the escarpment, again about halfway up and made two passes along the top of the escarpment. Most of the project area is flat bottomland, subject to seasonal flooding. Indeed, much of this area was very wet on the day I examined it. The bottomlands are in grass and are used for pasture and seed grass. No cultural remains were detected in this area. The ground exposure was limited by grass ground cover and in some places standing water. Several small trowel holes were dug to see if there was any sign of cultural material below the ground surface. These holes quickly filled with groundwater. No cultural material was observed. I then refilled the holes.

The escarpment is home to a stand of Douglas Fir, Oak and underbrush. A dirt road follows along its crest and is flanked on the east by a substantial blackberry hedgerow. Ground visibility averaged 60%. No cultural material was observed in the muddy road or on the steep escarpment slope.

I also walked along the route of the proposed outfall to the Pudding River. This course runs southward from the southwest corner of the proposed stabilization lagoon area along a channel called the Walker Ditch. At about 100 meters, the route turns westward for about 350 meters, then south again for 150 meters before turning westward a final time and crossing a levee to the Pudding River. Most of this route runs through wet bottomland. No cultural material was observed either in the bottoms or as the route crosses the levee and empties into the Pudding River.

The proposed sewer influent runs from the existing wastewater treatment plant on an unnamed tributary of the Pudding River, westward to a proposed headworks near the northeast corner of the proposed stabilization lagoon area. I walked

along this route, mostly in plowed field and observed no cultural materials.

The northeastern portion of the project area is a field currently in wheat stubble. Ground visibility ranged from 0-25%. This area consists of two small rolling hilltops on the gentle northeast slope of the escarpment. The hilltops are separated by a shallow saddle which trends northeastward to an unnamed tributary of the Pudding River near the existing treatment plant(see maps). The blackberry hedgerow separates this field from the dirt road along the crest of the escarpment. I started to cover this area in North-South transects spaced 30 meters apart, but switched to transects 10 meters apart when I began encountering cultural material.

Cultural material was found on the ground surface on these two hilltops. This material consisted of about two dozen pieces of cryptocrystalline debitage averaging less than 1cm in size. Some of these flakes had been heat-treated leaving characteristic potlid fractures. About a dozen pieces of fire-cracked rock were present and several possible battered cobble fragments. One tiny piece of burned bone was found. All of these items were left in place on the plowed ground surface.

A copy of the Oregon Archaeological Inventory form has been filled out for this material and is appended to this report.

An examination of the files at the Oregon State Historic Preservation Office in Salem indicates that there are no officially recorded sites in the vicinity of the project area and only one such site along the length of the Pudding River. Clearly, this reflects a lack of archaeological reconnaissance rather than a true picture of Native American land use in the area. Indeed, one branch of the early historic period Kalapuya were known as the Pudding River Band of the Kalapuya.

The options open to the City of Mt. Angel regarding this project would seem to be as follows:

1) redesign of the project to avoid impact on the site area. If design tolerances are tight, this could require that the archaeological site area be reexamined immediately after plowing to maximize ground surface exposure allowing more accurate delineation of site boundaries.

2) mitigation of project impact on the archaeological site by excavation in accordance with requirements of the Oregon State Historic Preservation Office. The first step in this process would also be accurate delineation of site boundaries by reexamination immediately following plowing to enhance ground surface exposure, probably linked with test excavation to determine the depth of the cultural deposits.

The pedestrian archaeological reconnaissance described above was a ground surface only investigation. No subsurface testing was done (except for a small number of shallow trowel holes which were promptly refilled). Ground surface visibility varied with the terrain and current agricultural usage. Therefore, it is possible that cultural materials exist which were not observed in the field. Care should be taken in carrying out ground-disturbing activities in this area, especially on the top and gently sloping northeast side of the escarpment. Should cultural materials such as stone flakes or tools, fire-

cracked rock, shaped or battered cobbles, charcoal, bone, shell or other sign of past human activity be observed, work in the immediate area should cease and the Oregon State Historic Preservation Office in Salem should be notified.

OREGON ARCHAEOLOGICAL INVENTORY
Modified Oregon SHPO Site Form (August 1990)
PSU/Laboratory of Archaeology & Anthropology
Mt. Hood National Forest Project

1) Smithsonian No. _____
2) Agency No. _____
3) Temporary No. _____
4) County Marion

PART A - ADMINISTRATIVE DATA

5) District or Specific Resource Area _____

6) Site Name Ruef Site

7) Landowner (circle code below) Name Max and Marlene Ruef

BLM - Bureau of Land Management
BOR - Bureau of Reclamation
CO - County
F/S - US Forest Service
(PVT) - Private
ST - State
BIA - Bureau of Indian Affairs
C/E - US Corps of Engineers
CTY - City
F&W - US Fish and Wildlife
RES - Reservation
??? - Unknown

8) Legal Description SE 1/4 of SW 1/4, Section 4, Township 6S, Range 1W
SW 1/4 of SE 1/4 Section 4, Township 6S, Range 1W

9) UTM Zone 1 0 - 5 1 4 6 0 0 East - 4 9 9 0 8 5 0 North

10) USGS Quad Silverton 7.5' Series

11) Agency Probability Zone _____

12) Location and Access:

Go west from Hwy 214 in Mt. Angel on West Church Street ½ mile to Ruef lane. Turn right onto Ruef Lane. There is a sign here for the Ruef Fur Farm. Go past the Ruef house to the fur farm office. Ask for either Mr. or Mrs. Ruef or their son Jeff. They can direct you through the paddock to the site area just east of the blackberry hedge at the top of the escarpment. (see attached map)

PART B - MANAGEMENT DATA

1) Management Objectives _____

2) National Register Status ____ On ____ Eligible X Insufficient Data ____ Not Eligible

3) Site referenced in any document (Y/N)? Y Citation Keeler, Robert 1990 An Archaeological Reconnaissance of the Proposed Wastewater Treatment Facility and Related Improvement Mt. Angel, Marion County, Oregon

4) Site Recorded by Robert W. Keeler

5) Date Site Recorded (MM/DD/YY) 12 / 15 / 90

PART C - ENVIRONMENTAL DATA

1) Basin (circle) and 2) Sub Basin (circle)

- Deschutes
  - Upper Deschutes
  - Middle Deschutes
  - Lower Deschutes
  - Upper Crooked
  - Lower Crooked
- Goose/Summer Lake
  - Goose Lake
  - Warner Lakes
  - Chewaucan
  - Summer Lake
- Grants Ponds
  - Upper Grande Ronde
  - Middle Grande Ronde
  - Lower Grande Ronde
  - Wallowa
  - Imnaha
- Hood
  - Hood River
  - Wasco
- John Day
  - Upper John Day
  - South Fork
  - Middle John Day
  - Middle Fork
  - North Fork
  - Lower John Day
- Klamath
- Malheur
- Malheur Lake
- Mid Coast
  - Siletz
  - Yaquina
  - Alsea
  - Siuslaw
- North Coast
  - Tillamook
  - Nehalem
  - Columbia
- Owyhee
- Powder
  - Burnt
  - Powder
  - Pine Creek
- Rogue
  - Upper Rogue
  - Little Butte Creek
  - Applegate
  - Middle Rogue
  - Illinois
  - Lower Rogue
- Sandy
- South Coast
  - Chetco
  - Sixes
  - Coquille
  - Coos
- Umatilla
  - Walla Walla
  - Umatilla
  - Willow
- Umpqua
  - South Umpqua
  - North Umpqua
  - Lower Umpqua
- Willamette
  - Tualatin
  - Clackamas
  - Columbia
  - Santiam
  - Coast Range
  - Pudding
  - Coast Fork
  - Middle Fork
  - McKenzie
  - Long Tom

3) Drainage unnamed tributary of the Pudding River

4) Physiographic Province (circle)

Basin/Range	Coast Range	Owyhee Uplands
Blue Mountains	Deschutes/Umatilla Plateau	Snake River Canyon
Cascades	High Lava Plain	Willamette Valley
Coastal Plain	Klamath Mountains	

5) Elevation 160 feet

6) Primary Landform (circle)

Mountain	Rolling Plain	Badland
Hill	Flat Plain	Coastal Plain
Butte	Canyon	Island
Mesa/Tableland	Valley	Other _____

7) Primary Position (circle) Top Slope Base Floor

8) Secondary Landform (circle)

Floodplain	Rimrock	Playa	Dune
Terrace	Talus Slope	Alluvial Fan	Beach
Bench	Bluff	Hill	Estuary
Ridge	Arroyo/Gully	Mountain	Headland
Cliff	Other _____		

9) Secondary Position (circle)

Top	Saddle	Base	Floor
Crest	Slope	Edge	Confluence
Saddle			

10) Landform Description Two small hilltops on gentle backslope of a floodplain terrace escarpment

11) Slope 5 % 3 ° 12) Aspect (circle) N E S W 13) Bearing 60 degrees

14) Plant Community agricultural

15) Water Source/Type (circle) 16) Distance to water 100 meters

River	Seep	Lake	Intermittent Stream
Stream	Spring	Marsh	

17) Accessible meadow (Y/N)? N 18) Distance to Meadow _____ meters

19) Soil _____

PART D - CULTURAL RESOURCE DATA

1) SHPO Type lithic scatter

2) Primary Site Type Native American occupation

3) Secondary Site Type _____

4) General Site Information (Y/N responses)

Have site materials been collected? N
Are features present? ?
Floral remains? ?
Are cultural remains stratified? ?
Are human remains present? ?

Has site been tested? N
Faunal remains? Y
Has site been radiocarbon dated? N
Is groundstone present? Y ?

5) Site Date (Y/N responses) [* Additions to SHPO form]

Unknown Prehistoric* X	Early Archaic ____	Unknown Historic* X
Early Paleo ____	Middle Archaic ____	Early Historic ____
Middle Paleo ____	Late Archaic ____	Middle Historic ____
Late Paleo ____		Late Historic ____

6) Primary Travel Route ____

7) Historic Land-Use Periods (Y/N responses)

Exploration ____	Industrialization ____	Post Depression ____
Fur Trade ____	Railroad ____	Contemporary ____
Settlement ____	Motor Travel ____	

8) Historic Themes: (as appropriate)
Theme One ____
Theme Two ____
Theme Three ____

9) Site surface area 11,000 square meters 10) 2.7 acres (area/4047)

11) Depth of Deposits ? centimeters

12) Formally excavated surface area ∅ square meters

13) Volume of excavated deposits ∅ cubic meters

14) Integrity (percent of site not destroyed) ? % plowed & cultivated field

15) Lithic Debitage Reported (Y/N)? Y

Estimated Total Quantity (Y/N) (Surface)

Y	10-99	N	500-1000
N	100-499	N	>1000

Estimated Surface Density < 1 per square meter

16) Surface Exposure (percent of visible ground) 0-25 %

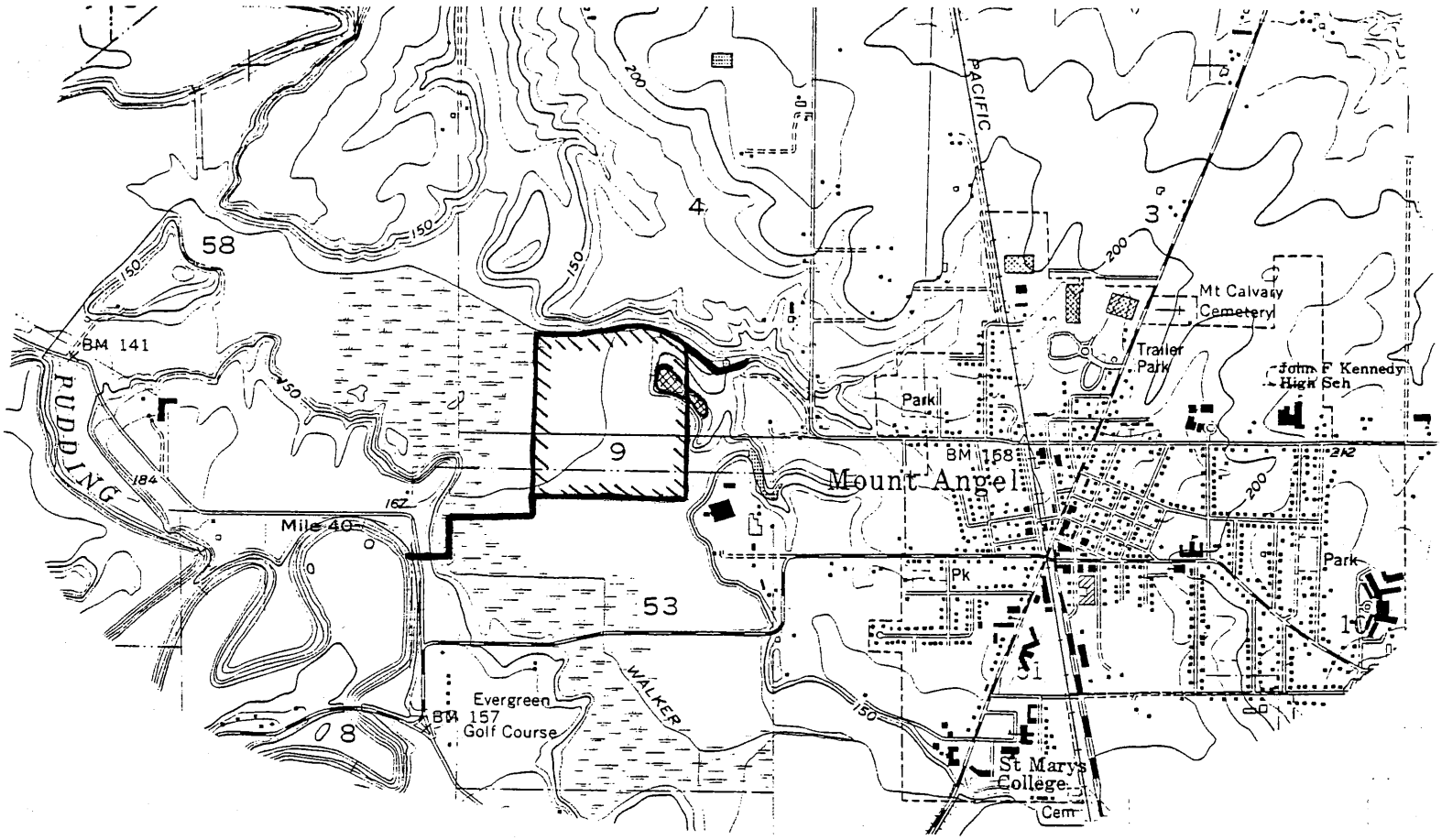
17) Describe site cultural materials and features.

Two dozen small CCS flakes < 1cm average size. Some heat treated

Dozen fragments FCR

Several possible battered cobbles. One possibly ground into shape.

1 fragment burned bone - tiny



SCALE 1:24 000

1 ½ 0 1 MILE

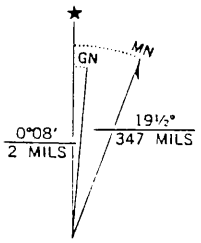
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

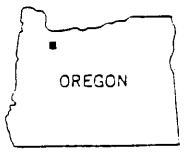
CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Archaeological Site

Project Survey Area



UTM GRID AND 1985 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET



CITY OF MT. ANGEL
Wastewater System Facilities Plan
Mt. Angel, Oregon

APPENDIX G

WASTEWATER UTILITY FINANCIAL ANALYSIS

FINANCIAL PLAN

This memorandum provides a financial plan that will allow the City to implement its capital improvement program while meeting its other financial obligations, including policy objectives. The two components of this plan are (1) the computation of a system development charge (SDC) and (2) a revenue requirement analysis.

SYSTEM DEVELOPMENT CHARGES

SDCs are one-time fees imposed on new and increased development to recover the cost of system facilities needed to serve that growth. This section provides the rationale and calculations for a proposed wastewater SDC.

Methodology

An SDC can include two components: (1) a reimbursement fee and (2) an improvement fee.

Reimbursement Fee

The reimbursement fee, whose calculation is governed by Oregon Revised Statutes (ORS) 223.304(1), is the cost of available capacity per unit of growth that such available capacity will serve. In order for a reimbursement fee to be calculated, unused capacity in existing facilities must be available to serve future growth. For facility types that do not have available capacity, no reimbursement fee may be charged.

The reimbursable portion of the cost of existing facilities is limited not only by available capacity, but also by the means of financing the initial cost. That portion of the cost of existing facilities that was not borne by existing users is not eligible for reimbursement. Costs that were funded by grants and debt (to the extent that debt will be repaid by new users) are not eligible for recovery in a reimbursement fee.

Improvement Fee

The improvement fee, whose calculation is governed by ORS 223.304(2), is the cost of planned capacity-increasing capital projects per unit of growth that those projects will serve. In reality, the capacity added by many projects serves a dual purpose of both meeting existing demand and serving future growth. To compute a compliant improvement fee, growth-related costs must be isolated, and costs related to current demand must be excluded.

We have used the “capacity approach” to allocate costs to the improvement fee basis. Under this approach, the cost of a given project is allocated to growth in proportion to the growth-related capacity that projects of a similar type will create.

Growth should be measured in units that most directly reflect the source of demand. For the City’s wastewater utility, growth is measured in equivalent residential units (ERUs). One ERU represents the wastewater service needs of an average single-family residence.

Adjustments

ORS 223.307(5) authorizes the expenditure of SDCs on "the costs of complying with the provisions of ORS 223.297 to 223.314, including the costs of developing system development charge methodologies and providing an annual accounting of system development charge expenditures." To avoid spending monies for compliance that might otherwise have been spent on projects, this report includes an estimate of compliance costs in its calculated SDC.

A second adjustment is the deduction of existing SDC fund balance(s) from eligible costs. If this adjustment were not made, the City could collect more SDCs than it could legally spend.

Growth

The City's current wastewater customer base is 878 ERUs. Based on the projected growth rate of 1.08 percent per year in the City's new Wastewater System Facilities Plan, the City will add 210 ERUs during the 20-year planning period. This projected growth is the denominator in the calculation of the reimbursement and improvement fees.

Eligible Costs

The City has SDC-eligible costs in both its existing wastewater facilities and its planned capital projects.

Reimbursement Fee

Because the City's wastewater infrastructure has excess capacity that is available to serve growth, the City can charge a reimbursement fee as part of its water SDC. **Exhibit 1** summarizes the SDC-eligible cost of available capacity:

Reimbursement Fee Cost Basis — **Exhibit 1**

Step	Description	Wastewater Treatment Plant Excluding Constructed Wetland	Constructed Wetland	Total
a.	Total construction cost	$ 2,505,558	$ 331,455	$2,837,013
b.	Portion funded by grant	55%	75%	
c.	City cost *(a*(1-b))*	$ 1,127,501	$ 82,864	$1,210,365
d.	Available capacity in 1990	18%	22%	
e.	ERUs in 1990			736
f.	Total capacity in ERUs *(e/(1-d))*	897	942	
g.	ERUs in 2014			878
h.	Available capacity in 2014 *((f-g)/f)*	2%	7%	
i.	Reimbursable cost *(c*h)*	$ 23,359	$ 5,670	$ 29,029

Source: Westech Engineering, PSU Population Research Center, biggestuscities.com

When the SDC-eligible cost of $29,029 is divided by the expected growth of 210 ERUs, the resulting reimbursement fee is $138 per ERU.

Improvement Fee

Based on the capital improvement plan developed by Westech Engineering, the City will construct wastewater facilities with an estimated cost of $6,848,000 over the planning period. However, none of these projects will serve growth exclusively. Only the growth-related portion of each project can be collected as the improvement fee component of an SDC. **Exhibit 2** shows the growth-related portion of the planned wastewater projects:

Improvement Fee Cost Basis **Exhibit 2**

Project Code	Project	Priority	Total Estimated Project Cost	SDC Improvement Fee Eligibility	SDC Improvement Fee Cost Basis
G-1	Main Trunk Sewer--Manhole #5 to Ne Manhole #100	1	$ 612,000	6.88%	$ 42,096
G-2	North Trunk Sewer--Marquam St. MH #100 to Pershing St. MH #20	1	340,000	6.63%	22,543
G-3	North Trunk Sewer--Marquam St. MH #20 to Railroad MH #25	1	142,000	8.57%	12,171
G-4	North Trunk Sewer--Marquam St. MH #25 to Main St. MH #60	1	375,000	11.07%	41,496
G-5	South Trunk Sewer--Segment 1 New MH #100 to May Street MH #13	1	596,000	6.48%	38,637
G-8	South Trunk Sewer--MH #136 to MH #146	1	357,000	8.10%	28,900
G-14	Construct New Line from MH 115 to MH 109	1	50,000	0.00%	-
T-1	Treatment Plan Access Road Improvements	1	85,000	27.27%	23,182
T-4	Wetland Improvements, effluent boxes, influent valves	1	69,000	27.27%	18,818
T-5	Effluent Pump Station Confined Space Entry Improvements	1	39,000	27.27%	10,636
G-6	South Trunk Sewer--May Street MH #130 to MH #135	2	171,000	8.01%	13,699
G-7	South Trunk Sewer--South Pershing Street MH #135 to MH #136	2	128,000	8.01%	10,255
T-2	Headworks Improvements	2	528,000	6.88%	36,318
T-3	Lagoon Cell 1 Biosolids Removal	2	888,000	0.00%	-
T-6	Effluent Pump Station Electrical and Control System Modernizatio	2	460,000	27.27%	125,455
T-7	Facilities Plan Update	2	75,000	27.27%	20,455
G-9	Sewer Basin 1 Trunk Sewer	3	493,000	0.00%	-
G-10	Sewer Basin 2 West Trunk Sewer	3	300,000	0.00%	-
G-11	Sewer Basin 2 East Trunk Sewer	3	252,000	0.00%	-
G-12	Sewer Basin 3 Trunk Sewer	3	336,000	0.00%	-
G-13	Sewer Basin 7 Southwest Trunk Sewer	3	552,000	0.00%	-
			$6,848,000		**$ 444,660**
	Priority 1 projects	1	$2,665,000		$ 238,479
	Priority 2 projects	2	2,250,000		206,181
	Priority 3 projects	3	1,933,000		-
			$6,848,000		**$ 444,660**

Source: Westech Engineering

After deducting the current balance of $236,256 in the Sewer SDC Fund, the remaining improvement fee cost basis is $208,404. When that cost is divided by the expected growth of 210 ERUs, the resulting improvement fee is $990 per ERU.

If the City decides to include one or more capacity-increasing wastewater projects in its capital improvement plan that are not listed in **Exhibit 2**, we recommend that the projects be added to the list and that the eligible portion of those projects be added to the improvement fee cost basis. The revised cost basis should then be used to recalculate the SDC.

Compliance

We estimate the City's annual cost of administering its wastewater SDC program to be $2,767. This includes estimates of both staff time and the amortized cost of an SDC analysis every five years. Based on average customer growth of 10.52 ERUs per year, this administrative cost represents 23.31 percent of revenue from the calculated reimbursement and improvement fees.

Summary

Exhibit 3 summarizes the components of the proposed wastewater SDC of $1,391 per ERU. The proposed SDC represents an increase of 11.31 percent from the current SDC of $1,250 per ERU.

SDC Components — Exhibit 3

Description	Amount
Reimbursement fee	
Cost basis	$ 29,029
Growth in ERUs	210
Reimbursement fee per ERU	**$ 138**
Improvement fee	
Total project costs	$5,960,000
Less SDC-ineligible costs	(5,515,340)
Less SDC fund balance	(236,256)
Net cost basis	208,404
Growth in ERUs	210
Improvement fee per ERU	**$ 990**
Compliance cost per ERU	**$ 263**
Total SDC per ERU	**$ 1,391**

Source: FCS GROUP

Comparisons

Exhibit 4 compares the City's current and proposed wastewater SDC to the SDCs of six comparable cities as of November, 2013:

SDC Comparison — Exhibit 4

City	Sewer SDC for Single-Family Residence
Silverton	$ 4,773
Aumsville	$ 3,968
Hubbard	$ 3,905
Stayton	$ 3,528
Woodburn	$ 2,977
Canby	$ 2,571
Mt. Angel (proposed)	$ 1,391
Mt. Angel (current)	$ 1,250

Source: City websites and staff

REVENUE REQUIREMENT ANALYSIS

This section presents a financial analysis that reveals how much rate revenue would be required to meet operational and capital needs within contractual and policy constraints over the next ten years.

Criteria

At least two separate conditions must be satisfied in order for rates to be sufficient. First, the wastewater utility must generate revenues adequate to meet cash needs. Second, revenues must satisfy bond coverage requirements.

Revenues should be sufficient to satisfy both tests. If revenues are found to be deficient by one or more of the tests, then the greater deficiency drives the rate increase.

Cash Flow

The cash flow test identifies all cash requirements as projected in each given year. Cash requirements include operations and maintenance expenses, debt service payments, policy-driven additions to working capital, and capital improvement costs. If the utility collected replacement funding, it would also be included in the test as an expense. These expenses are compared to the total projected annual

revenues, including interest on fund balances. Shortfalls are then used to estimate the necessary rate increases.

Bond Coverage

The City's wastewater utility currently has no outstanding debt and therefore no existing coverage requirements.

For modeling purposes, we assume that any new debt will be in the form of revenue bonds that will require net revenues to be at least 150 percent of debt service in any year that bonds are outstanding. In our model net revenues are total revenues (excluding SDCs) net of operating expenditures.

Assumptions

A financial model measures the interaction of multiple assumptions over time, and is therefore only as good as those assumptions. The following key assumptions were used in this wastewater utility analysis:

- Salary and wage escalation of 3.00 percent per year
- Employee benefit escalation of 5.00 percent per year
- Materials and services escalation of 3.50 percent per year
- Capital outlay escalation of 3.50 percent per year
- Customer growth of 1.08 percent per year
- Operating fund will maintain 60-90 days of expenditures.
- New debt is modeled at 4.50 percent interest for 20 years with 1.50 debt service coverage.

Projections

Exhibit 5 summarizes the model's output for a ten-year period. Rate increases of five percent per year are required for five fiscal years beginning on July 1, 2015. Thereafter, required rate increases drop to four percent per year.

Projection Summary **Exhibit 5**

Description	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Revenues										
Rate Revenues Under Existing Rates	$ 715,000	$ 722,722	$ 730,527	$ 738,417	$ 746,392	$ 754,453	$ 762,601	$ 770,837	$ 779,162	$ 787,577
Non-Rate Revenues	76,940	502	508	525	646	671	799	922	921	943
Total Revenues	**$ 791,940**	**$ 723,224**	**$ 731,035**	**$ 738,942**	**$ 747,038**	**$ 755,124**	**$ 763,401**	**$ 771,759**	**$ 780,083**	**$ 788,520**
Expenses										
Cash Operating Expenses - City	$ 623,820	$ 633,298	$ 657,699	$ 707,418	$ 741,998	$ 796,459	$ 828,946	$ 830,547	$ 862,188	$ 925,748
Existing Debt Service	453,645	-	-	-	-	-	-	-	-	-
New Debt Service	-	-	-	25,589	25,589	52,540	82,879	82,879	82,879	115,145
Rate Funded System Reinvestment	-	10,337	10,337	22,042	22,042	31,917	39,869	39,869	39,869	53,881
Total Expenses	**$ 1,077,465**	**$ 643,635**	**$ 668,037**	**$ 755,048**	**$ 789,628**	**$ 880,917**	**$ 951,694**	**$ 953,295**	**$ 984,935**	**$ 1,094,774**
Annual Surplus / (Deficiency)	**$ (285,525)**	**$ 79,589**	**$ 62,998**	**$ (16,107)**	**$ (42,591)**	**$ (125,793)**	**$ (188,293)**	**$ (181,536)**	**$ (204,853)**	**$ (306,254)**
Annual Rate Adjustment	**0.00%**	**5.00%**	**5.00%**	**5.00%**	**5.00%**	**5.00%**	**4.00%**	**4.00%**	**4.00%**	**4.00%**
Cumulative Rate Adjustment	**0.00%**	**5.00%**	**10.25%**	**15.76%**	**21.55%**	**27.63%**	**32.73%**	**38.04%**	**43.56%**	**49.31%**
Rate Revenues After Rate Increase	$ 715,000	$ 758,858	$ 805,406	$ 854,810	$ 907,244	$ 962,894	$ 1,012,226	$ 1,064,084	$ 1,118,599	$ 1,175,907
Net Cash Flow After Rate Increase	(285,525)	115,725	137,877	100,286	118,261	82,649	61,331	111,711	134,584	82,076
Coverage After Rate Increases	0.37	n/a	n/a	5.83	6.50	3.20	2.23	2.83	3.12	2.19
Avg. Monthly SFR Bill										
Inside City	$ 37.50	$ 39.38	$ 41.34	$ 43.41	$ 45.58	$ 47.86	$ 49.77	$ 51.77	$ 53.84	$ 55.99
Outside City 50.00%	56.25	59.06	62.02	65.12	68.37	71.79	74.66	77.65	80.75	83.99

Source: FCS GROUP

Rates

With the exception of "high usage customers," the City charges wastewater customers a fixed rate based on (1) the customer's number of ERUs and (2) whether the customer is inside the city or outside the city. According to Resolution No. 1358, customers inside the city are currently charged $37.50 per ERU per month, and customers outside the city are currently charged $56.25 per ERU per month.

As shown at the bottom of **Exhibit 5** above, implementation of the proposed rate increases will result in rates of $39.38 inside the city in fiscal year 2014-15 and $55.99 inside the city by fiscal year 2022-23.

The City's current rate structure of a fixed charge per ERU for most customers has the advantage of minimizing financial risk to the wastewater utility but has the disadvantage of not allowing most customers any control over their wastewater bill. Many wastewater utilities balance the needs for steady revenue and customer control by designing their rates to include both a fixed component and variable component that is based on the customer's water consumption (often a winter average). However, if the community is satisfied with the current rate structure, we recommend no change.

Comparisons

Exhibit 6 compares the City's current and proposed wastewater rates to the rates of six comparable cities as of November, 2013:

Rate Comparison **Exhibit 6**

City	Monthly Sewer Rate for Single-Family Residence inside City
Stayton	$ 55.74
Silverton	$ 55.55
Woodburn	$ 47.01
Canby	$ 41.90
Mt. Angel (proposed)	$ 39.38
Mt. Angel (current)	$ 37.50
Aumsville	$ 36.00
Hubbard	$ 29.42

Source: City websites and staff