CITY OF SUTHERLIN
DOUGLAS COUNTY, OREGON

WATER MASTER PLAN
DECEMBER 2017

The Dyer Partnership
Engineers & Planners, Inc.

Project No. 146.48

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City of Sutherlin

Douglas County, Oregon

Water Master Plan

December 2017

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Table of Contents

LIST OF TABLES

LIST OF FIGURES

APPENDICES

SECTION 1:
EXECUTIVE SUMMARY

SECTION 1: **EXECUTIVE SUMMARY**

This Water Master Plan (WMP) was compiled to provide guidance to address the City of Sutherlin's future water needs. This Plan summarizes the components of the existing water distribution system, analyzes local water demand patterns, evaluates the performance of the water system with respect to critical service standards, and identifies the improvements necessary to remedy system deficiencies and accommodate future growth. This Plan recommends specific projects for inclusion in the water distribution system Capital Improvement Program (CIP). Also presented is a financing plan that will facilitate successful implementation of the recommended CIP.

The 2017 Water Management and Conservation Plan completed by GSI Water Solutions Inc. under separate cover, was developed in conjunction with the WMP. Although these are independent documents, the data on which the evaluations are based will be the same data. Shared data includes, but is not limited to: water system configuration, existing demands, projected demands, population growth rates, and allocated water rights.

Source of Supply and Water Supply Rights

Raw water is currently diverted from two sources and treated at two separate facilities: Calapooya Creek at the Nonpareil Water Treatment Plant (WTP) and Cooper Creek Reservoir at the Cooper Creek WTP. The City has water rights for diversion of 4.0 cfs from Calapooya Creek and 5.0 cfs from Cooper Creek. The City also has access to storage water rights of 500-acre feet from the Cooper Creek reservoir. In addition to water rights and permits from these sources, the City has a water right permit for diversion of 3.0 cfs from the North Umpqua River.

The City holds water right certificates for 3.0 cfs on Calapooya Creek; the rest of the water rights are permits. Two of the water rights (1.0 cfs on Calapooya Creek and 3.0 cfs on North Umpqua River) are junior to instream water rights.

Existing System

The City provides water to City residents, the Union Gap Water District, and 17 users located along the Nonpareil water main. The population currently being served by the City's water system is 8,578. Raw water diversion, water production, and water consumption quantities were tabulated. Current water demand production is calculated to be 1.44 million gallons per day (MGD) on an annual average with a maximum month and daily demand of 2.18 MGD and 3.07 MGD, respectively. The combined capacity of the City's WTPs is 6.3 MGD. The average of non-account (water sold less water produced) in the City's system is approximately ten percent.

Distribution and Storage System

The Nonpareil WTP is utilized year-round while the Cooper Creek WTP is used only in the high demand months of summer (June through September) Booster pumps at each WTP convey water to the City's distribution system that consists of approximately 64 miles of piping ranging from 4-inch to 18-inch diameter mains. The City has four service areas with different pressures. These service areas include six booster pump stations and ten potable water storage tanks ranging in capacity from 0.012 to 1.25 million gallons (MG).

Water Demand

Future water demand was primarily based on current water production/consumption parameters, projected growth within the City, and anticipated nonaccount water (10 - 15%). Population growth was projected using the County's adopted 1.5 percent annual growth for the City over a 20-year period, which is the same rate used in the City's Wastewater Facilities Plan. In consideration of users outside the City (approximately 553), the anticipated potable water use populations for the Year 2036 is 11,362. The projected water demand production in the Year 2036 (assuming less than15% nonaccount water) in terms of maximum month and daily demand are 2.89 and 4.07 MGD, respectively.

Based on the projected maximum daily demand (MDD), the City's existing water rights on Calapooya Creek and Cooper Creek should be sufficient to meet the City's demand through the planning Year 2036.

Distribution System Modeling

The City's water distribution system was evaluated using a hydraulic computer model, with emphasis on selected vital or high fire flow areas within the City. Based on the results of this model, the following vital areas were shown to have less than required fire flow: Middle School, Best Western, Murphy Plywood Mill, Orenco Systems, East School, and West School. Proposed projects to improve fire flows within the City's distribution include instillation of larger diameter mains along 4^{th} Avenue, Myrtle Street, 6^{th} Avenue, Southside Road, and Jones Buckley Road.

Storage capacity of the entire water storage system within the City was evaluated and the total amount of existing storage was found to be currently sufficient. However, some low and mid-level reservoirs are currently lacking the required storage volume to serve their specific service areas. By the Year 2036, the City's storage system will be approximately 0.5 MG deficient in storage unless new storage tanks are constructed.

A number of new storage tanks were recommended to handle the City's current and future storage requirements. Improvements, such as cathodic protection and tank reconditioning, to several of the existing storage tanks are also recommended.

Financing and Implementation Plan

A total of 23 improvements were recommended in the Capital Improvement Plan. Total estimated cost for installation and construction of these improvements is $27,502,000. These improvements were prioritized into two phases. Recommended Phase I Improvements include construction of a new Cooper Creek WTP raw water intake, improvements to the Nonpareil WTP, and distribution system improvements to improve fire flow and storage. Total estimated cost for the Phase I Improvements is $11,194,000.

Recommended Phase II Improvements include, new reservoir tanks, distribution system projects to improve fire flow, water system projects to develop the Umpqua River water right, and an inter-tie connection with the City of Oakland's water system. Total cost for Phase II Improvements is $16,308,000.

Various funding programs were evaluated for financing the Phase I Improvements through the use of either low-interest loans or a combination of low-interest loans and grants. Projected monthly debt service ($/EDU) from viable funding programs ranged from $5.96 to $12.66. Projected monthly user rates, including debt reserve and system O&M costs, are estimated to be approximately $51.12 per EDU. Recommendations for implementing the elements of this Water Master Plan include the following:

- Submit Plan to the Oregon Health Authority and Department of Water Resources for review and approval.
- Schedule and attend "One-Stop" Meeting to discuss financing options for the proposed Phase I Improvements.
- Submit necessary applications to the funding agencies requesting loans and grants to finance the Phase I Improvements.
- Authorize the development of Environmental Report to regulatory standards, for the proposed Phase I Improvements.
- Initiate study of user rates for water system and implement proposed changes.
- Submit system information to private funding sources for consideration of private financing.
- Following favorable review by the selected financing agencies, secure the authority to issue revenue or general obligation bonds in the amount needed to finance the Phase I Improvements.
- Authorize detailed design of recommended improvements, and preparation of plans and specifications for the Phase I improvements. Secure the necessary special use permits for construction.
- Revise system development charges (SDCs) and rates for the water system based on the CIP given in this study.
- Submit completed plans and specifications to the Oregon Health Authority for approval.
- Advertise for Phase I construction bids.
- Receive construction bids and award contracts for Phase I Improvements.
- Complete construction of Phase I Improvements.

A tentative schedule identifying key activities and approximate implementation date for the Water Master Plan over the next three years is shown in Table 1.1.1.

TABLE 1.1.1
PROJECT IMPLEMENTATION SUMMARY

Item No.	Key Activity	Implementation Date
1	Council Adopt Water Master Plan-Submit Plan to OHD for Review and Approval	August 2017
2	Submit Plan to Health Division & Department of Water Resources	September 2017
3	Approval of Plan by Health Division & Department of Water Resources	December 2017
4	Start Environmental Evaluation/Notice	March 2018
5	Submit Application for Financing for Phase I and Associated Environmental Evaluation/Notice for Project	July 2018
6	Obtain Financing for Phase	August 2018
7	Start Preparation of Plans, Specifications for Phase I	March 2018-February 2019
8	Complete Design & Preparation of Plans, Specifications, & Contract	February 2019
9	Health Division Approval of Plans & Specifications	April 2019
10	Advertise for Phase I Construction Bids	May 2019
11	Receive Construction Bids for Phase I	June 2019
12	Start Construction of Phase I	July 2019
13	Complete Construction of Phase I Improvements	November 2020

SECTION 2:

INTRODUCTION

SECTION 2: **INTRODUCTION**

2.1 Background

The original water system for the City of Sutherlin was constructed in 1913 and consisted of an intake on Sutherlin Creek with wood stave pipe for transmission and distribution. Water from the Luce Land Company Irrigation Ditch and Calapooya Creek augmented the Sutherlin Creek source. In 1925, a diversion line from Sutherlin Creek to Calapooya Creek was completed to the site of the present day Nonpareil WTP. New intakes were built in the late 1940s and distribution lines were replaced with steel pipe from the late 1940s to the mid 1950s. The Cooper Creek WTP, along with the earth impoundment dam, was constructed in 1971, and upgrades to the plant were made to increase the plant capacity from 0.8 to 2.0 MGD in the years that followed. In 1983, the new Nonpareil WTP was completed to provide the City with another 2.3 MGD capacity. In 2014, the new Cooper Creek WTP was completed increasing the capacity of the WTP to 4.0 MGD. Today, the Nonpareil WTP remains as the City's primary supply of potable water. The Cooper Creek WTP serves as a secondary source of water when Nonpareil WTP is not in service and supplements potable water production during the peak water demand in summer.

Since the development of the 2006 Water Master Plan although the population has increased; the population growth rate has decreased, as has the water usage per capita. Given these evolving variables, and the 11 year period since the completion of the previous WMP, the City determined there was a need for an updated assessment of their water system. The Water Master Plan will provide an evaluation of the City's current water system facilities, project future water needs and recommend improvements to satisfy the anticipated water demand.

The City recently renewed its permit for the Cooper Creek water right with the Oregon Department of Water Resources. One of the stipulations of the permit renewal is that a Water Management and Conservation Plan (WMCP) be completed by July 1, 2017. To address this requirement, the City authorized GSI Water Solutions Inc. to develop a WMCP alongside this document. These documents will be independent, but will use the same water system data for their evaluations and formulation of their recommendations.

2.2 Study Objective

The purpose of the Plan is to provide the City of Sutherlin with a comprehensive planning document that provides engineering assessment and planning guidance for the successful management of its water system over the next 20 years and beyond. This document satisfies the Oregon Health Authority requirement for communities with 300 or more service connections to have a current master plan (OAR 333-061-0060). The principal objectives include:

- Evaluation of the existing water system components
- Prediction of future water demands
- Evaluation of the capability of the existing system to meet future needs
- Recommendations for improvements needed to meet future needs and/or address deficiencies

The Plan outlines water system improvements necessary to comply with state and federal standards and to provide for anticipated growth. The capital improvements are presented as projects with estimated costs to allow the City to plan and budget as needed. Supporting technical documentation is included to aid in grant and loan funding applications and meets the requirements of the Oregon Economic and Community Development Department (OECDD), the Oregon Water Resource Department, Rural Development (RD), as well as the Oregon Health Authority (OHA).

2.3 Scope of Study

Planning Period

The planning period for this Plan is 20 years, ending in the Year 2036. The period is short enough for current users to benefit from system improvements, yet long enough to provide reserve capacity for future growth and increased demand.

Planning Area

The City's Urban Growth Boundary (UGB) plus the additional limits of the system defined by raw water sources and transmission is considered the Study Area in this Plan.

Work Tasks

In compliance with Oregon Health Authority and Water Resource Department (WRD) plan elements and standards, this study provides descriptions, analysis, projections, and recommendations for the City's water system over the next 20 years. The following elements are included:

- **Executive Summary.** Provides a summary of the conclusions and recommendations from this study.

- **Study Area Characteristics.** Identifies applicable Study Area characteristics, land use, population trends and projections.

- **Regulatory Requirements.** Identifies current and future regulatory requirements/regulations that affect the planning, operation and maintenance of community water systems.

- **Existing Facilities.** Description and evaluation of the existing water system including supply, treatment, storage, and distribution.

- **Water Use and Projected Demand.** Determines the City's future water demand based on current use, projected population and economic growth.

- **Alternatives/Capital Improvement Plan.** Identification and evaluation of various alternatives for the City's water system. Selects the most cost-effective program that will meet the City's water needs within the planning periods. Identifies and describes a Capital Improvement Plan (CIP) for the water system with a recommended implementation schedule.

- **Improvement Phasing and Financing.** Identifies various local financing mechanisms and the most applicable funding programs. Develops a financing program for proposed improvements. The financing program will propose a monthly rate structure, implementation schedule, and System Development Charges (SDC).

2.4 Authorization

The City of Sutherlin contracted with The Dyer Partnership, Engineers & Planners, Inc. on October 25, 2016 to prepare the Water Master Plan and an independent Water Management and Conservation Plan. The scope of this Plan was based on a Scope of Engineering Services that was included in the contract with the City.

2.5 Past Studies and Reports

Documents that discuss the City's water system and facilities have been used in the preparation of and analyses in this Plan. A list of these studies and reports, with a brief summary of their conclusions, is listed below.

Oakland-Sutherlin Water Study by Robert E. Meyer Consultants, Inc. for Douglas County, December 1979.

The following is a summary of conclusions presented in this report with respect to the City's water system.

- City should investigate a suitable location for a small dam site above one of their existing intakes. Usable storage should be approximately 600 acre-feet.
- City should start a testing program for the best treatment process to remove excess manganese from source water removed from Cooper Creek Reservoir.
- If a suitable small dam site is not found, the City should consider the proposed Pollock Creek Dam as a source of stored water.
- City should proceed with plans to expand its water treatment facilities and water system in general.
- A method of providing a reliable source of water to the community of Union Gap should be found, with or without an intertie between the Cities of Oakland and Sutherlin.

Water, Wastewater, and Stormwater Engineering Study, Part II – Water by HGE Engineers and Planners, Inc., 1997

The following is a summary of conclusions and recommendations made in this report with respect to the City's water system.

Water Supply

- Request and secure an additional 500 acre-feet of storage from Cooper Creek Reservoir (application pending).
- Initiate Phase I Feasibility Study of Gassy-Norris Creek Impoundment. If results of this study are encouraging, proceed with detailed field investigations.

- Complete a Predesign Report for installing a hypolimnetic aeration system in Cooper Creek Reservoir.

- If additional storage at Cooper Creek cannot be secured and construction of the Gassy-Norris Creek appears unfeasible, then develop the City's existing water rights on the North Umpqua River.

Water Treatment

- A new 3.2 MGD treatment facility is to be constructed at the Cooper Creek site.

- Upgrade of Nonpareil Water Treatment Plant (WTP) primarily centered on updated electrical controls and automated systems.

Water Storage

- Construct a 2.0 million gallon (MG) concrete reservoir south of Plat M Road. (Priority I)

- Construct a 1.0 MG steel reservoir north of St. John's Street, and a 70,000 gallon reservoir north of 6^{th} Avenue as part of the extended Upper Umpqua pressure zone. (Priority II).

- Construct a 0.5 MG reservoir north of Highway 138. (Priority III)

Water Transmission and Distribution

- A total of 23 distribution improvements to improve flow capacity, and correct existing system deficiencies.

Capital Improvement Plan

- Plan consisted of three priorities with the following estimated costs (rounded):

Priority I	$9.6 million
Priority II	$3.0 million
Priority III	$3.3 million
Total	$15.9 million

Modeling and Analysis of Cooper Creek Reservoir Water Quality by Wells, S.A.; Annear, R.L.; Berger, C.; Systma, M; March 2000 (Wells' Report).

A summary of this report is given below.

- Cooper Creek Reservoir is strongly stratified during the summer months.

- Oxygen depletion in the hypolimnion layer begins in late winter and is anoxic by summer.

- Reservoir water quality is thought to be negatively impacted by septic tank leachate from the recreational areas and urea applications to fertilize surrounding forestland.

- Aeration of the hypoliminion layer will reduce internal loading of nutrients and may reduce phytoplankton productivity in the epilimnion layer in the summer. Increased water clarity may be offset by an increase in aquatic plant growth.

- Suggestions for improving water quality include a sewer for the two recreational areas, restrict fertilizer application to forestlands, capture inflow particles from upstream watershed, and limit clear-cutting in the watershed basin.

Letter Report on Cooper Creek Hypolimnetic Aeration Project by B. Bogus of Kennedy/Jenks Consultants to D. Philippi, BTS Engineering & Surveying, August 14, 2003; & Cooper Creek Reservoir Hypolimnetic Aeration Considerations and Calculations, Tetra Tech Inc., July 30, 2003.

A summary of the letter report is given below:

- Hypolimnetic aeration in the reservoir would meet the hypolimnetic oxygen demand, reduce soluble iron, manganese, and hydrogen sulfide levels in the water supply, reduce concentrations of phosphorus in the hypolimnion, and provide an oxygenated bottom water habitat for aquatic organisms.

- Recommend acquisition of a sole-source hypolimnetic aeration system with micro-bubble diffusers.

- Estimated cost for a hypolimnetic aeration system ranged from approximately $376,000 to $576,000 depending on whether it was a custom system or sole source system.

City of Sutherlin, Water Master Plan by Dyer Partnership Inc., 2006

The following is a summary of conclusions and recommendations made in this report with respect to the City's water system.

Water Supply

- Show commitment to use North Umpqua Water Right by investing in Umpqua Basin Water Association's WTP. (Priority I)

- Add multi-level component to raw water intake. This would allow the system to draw from shallower depths of the Cooper Creek reservoir when the manganese has settled near the bottom. (Priority II)

- Construct a hypolimnetic aeration system for adding oxygen to the waters of the Cooper Creek reservoir. (Priority III)

Water Treatment

- A new 3.2 MGD treatment facility using adsorption clarifier and media filtration technologies to be constructed at the Cooper Creek site. (Priority I)

- Upgrade of Nonpareil Water Treatment Plant with new concrete backwash pond. (Priority II)

Water Storage

- Construct a 2.3 million gallon (MG) concrete reservoir near Plat M Road. (Priority I)
- Install cathodic protection on reservoirs. (Priority I)
- Construct a 1.0 MG glass-fused-to-steel reservoir for Oak Hills. (Priority II)
- Construct a 0.5 MG reservoir north of Highway 138. (Priority III)
- Construct a 2.0 MG reservoir north of Sherwood Street. (Priority III)
- Install Supervisory Control and Data Acquisition (SCADA) systems at Tanglewood reservoir and pump station, Upper Umpqua reservoir and pump station, Ridgewater reservoirs, and Schoon Mountain reservoirs and pump station. (Priority II)

Water Transmission and Distribution

- A total of 11 distribution improvements to improve flow capacity, and correct existing system deficiencies.

Capital Improvement Plan

- Plan consisted of three priorities with the following estimated costs (rounded):

Priority I	$12.1 million
Priority II	$3.6 million
Priority III	$11.5 million
Total	$27.2 million

2.6 Acknowledgements

This Plan is the result of contributions made by a number of individuals and agencies. We wish to acknowledge the efforts of Brian Elliott, Community Development Director; Randy Harris, Public Works Supervisor; Allen Taylor, Water Treatment Plant Operator; and Charles Perdomo, Fire Chief. The assistance of the City of Sutherlin office staff was invaluable in compiling information on City services and the community.

SECTION 3:
STUDY AREA CHARACTERISTICS

SECTION 3: STUDY AREA CHARACTERISTICS

3.1 Study Area

As with some of the other communities in Douglas County, Sutherlin and the surrounding area were initially settled for agricultural endeavors. Fendel Sutherlin established the community in 1851 after traveling west to join the California gold rush. The timber industry eventually overtook agriculture as the area's primary activity and continues to be a prominent economic activity in the area.

The City of Sutherlin is located next to Interstate-5 (I-5) in the north-central portion of Douglas County, approximately 55 miles south of Eugene and 12 miles north of Roseburg (Figure 3.1.1). The City of Sutherlin is surrounded on the north and south by forested hills and to the west and east by Sutherlin Valley that consists of spotted timber, open agricultural use, and minor rural development. The area has a number of nearby water bodies including Sutherlin Creek, Calapooya Creek, Cooper Creek, Umpqua River, Cooper Creek Reservoir, Plat I Reservoir, and Fords Pond.

The area encompassed within the City Limits is approximately 3,259 acres or over five square miles. The study area for this Master Plan includes the City Limits and the Urban Growth Boundary (UGB), and the City's existing water sources as shown on Figure 3.1.2.

3.2 Physical Environment

The following provides information about the physical environment in and around the City of Sutherlin.

Climate

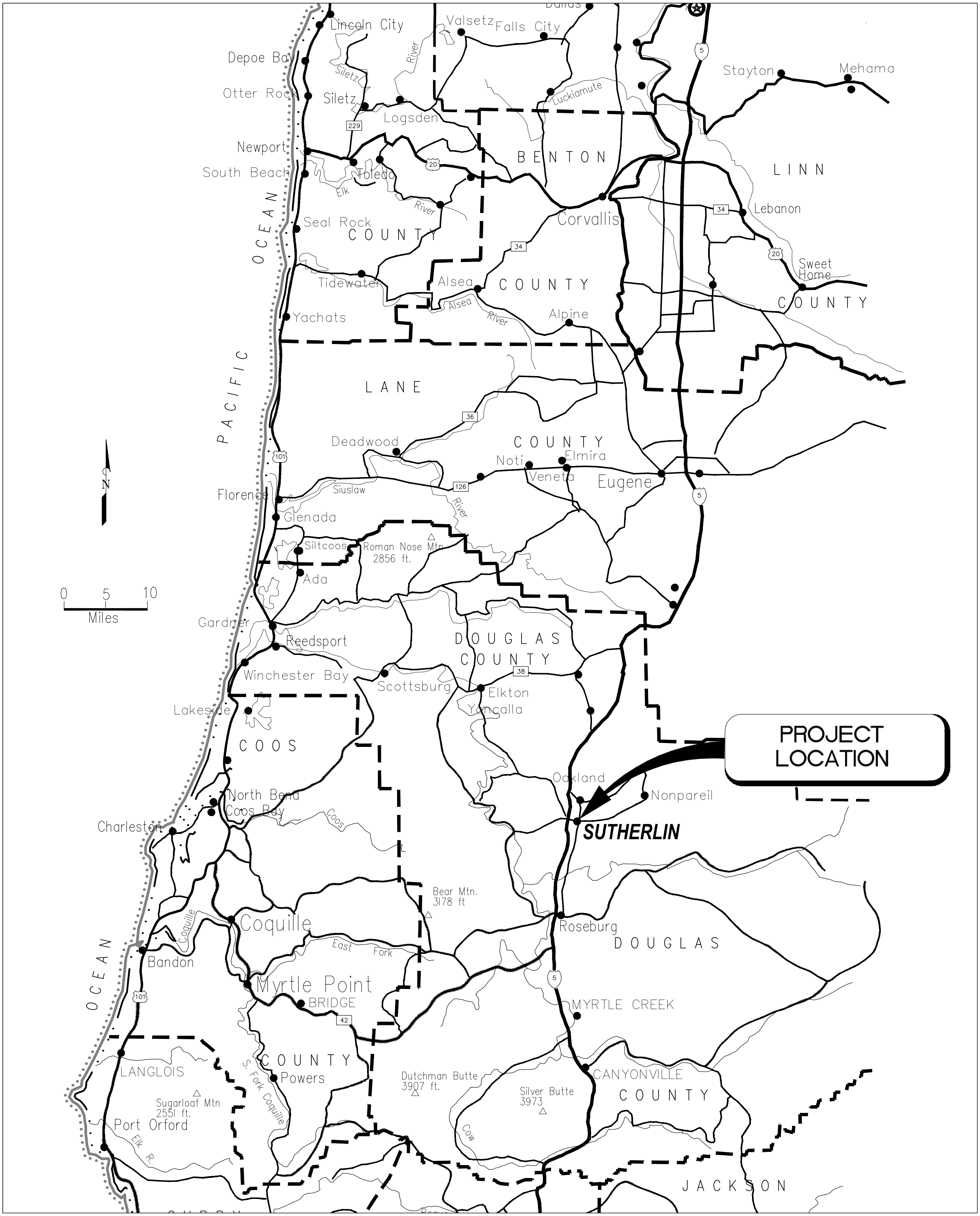
Sutherlin is located in a climatic zone that has greater temperature extremes than many of the other parts of Oregon. Like others in the region, Sutherlin experiences the most precipitation from November through April. Even though partially protected by coastal mountains from maritime weather patterns, Sutherlin experiences a significant amount of rainfall (approximately 40-inches per year). Rainfall amounts for November, December, and January average 6.46-inches per month. The wettest month is December with a historic average of 7.19-inches of rainfall. The driest month is July with a historic average of approximately 0.52-inch of rainfall. Records show that the maximum 24-hour rainfall is 2.5-inches.

Sutherlin is in a transition climate area between the climate zones of the Willamette Valley and the drier Rogue Basin. However based on its extended dry periods and vegetation types, it more closely resembles the Mediterranean-like patterns of the Rogue Basin. Temperatures average 41°F in January and 68°F in August. The yearly mean temperature is approximately 54°F. The average low temperature is 43.6°F, while the average high temperature is 64.8°F. Extreme temperatures range from 5 to 106°F. The City of Sutherlin experiences prevailing winds of approximately 13 miles per hour all year long.

Soils

There are many general classifications of surficial geologic formations found in the local Sutherlin area. A map showing these formations is included in Appendix A. The formations are described as follows.

- **Nonpareil Series.** The Nonpareil series consists of shallow, well drained soils that formed in colluvium and residuum weathered from sandstone and siltstone. Nonpareil soils are on ridgetops, hill slopes and convex foot slopes and have slopes ranging from 3 to 90 percent.



THE DYER PARTNERSHIP ENGINEERS & PLANNERS, INC.	***CITY OF SUTHERLIN*** ***WATER MASTER PLAN***	FIGURE NO.
DATE: MARCH, 2017 PROJECT NO.: 146.48	***LOCATION MAP***	***3.1.1***

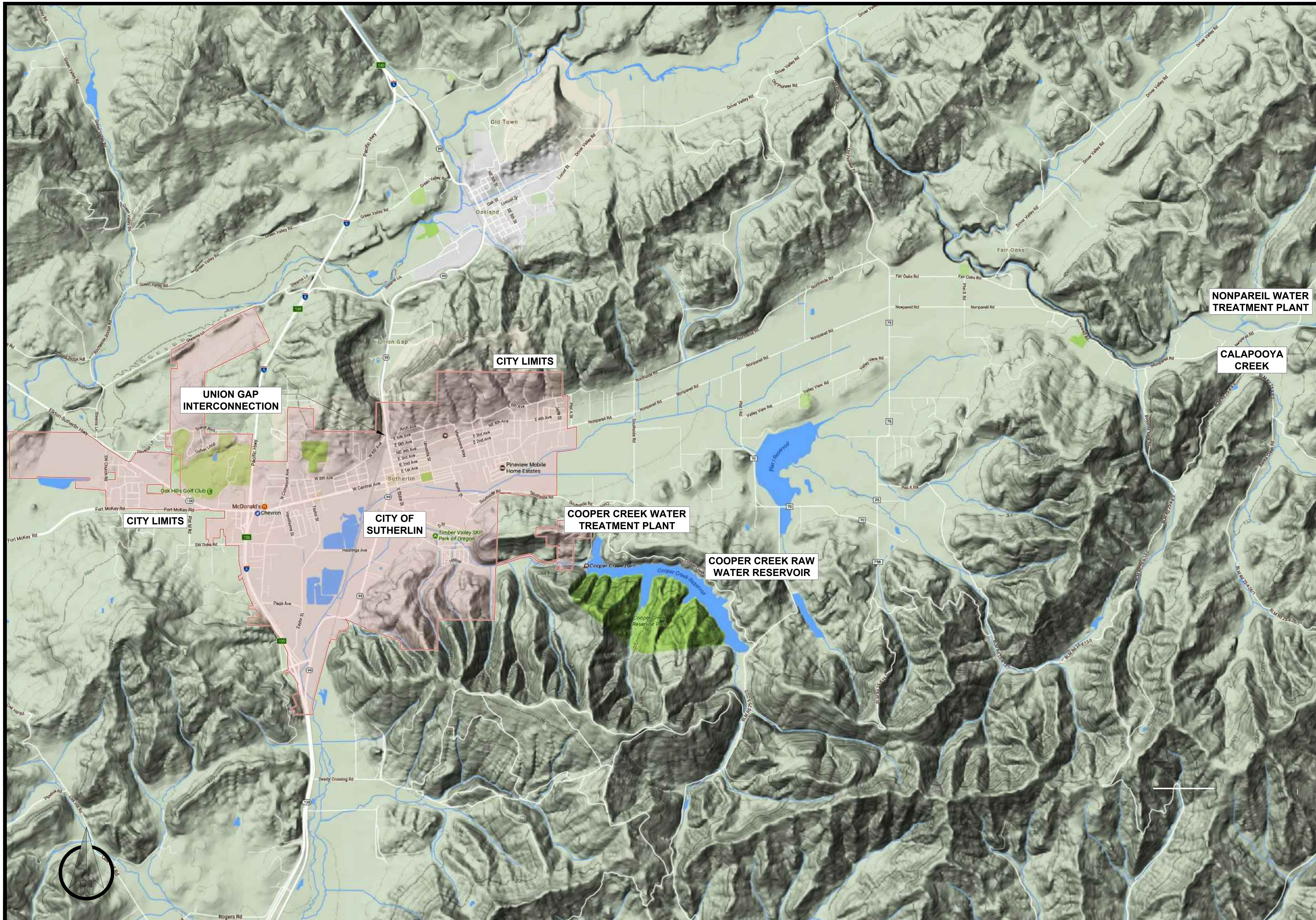


FIGURE NO. 3.1.2

SUTHERLIN WATER MASTER PLAN

STUDY AREA MAP

THE DYER PARTNERSHIP
ENGINEERS & PLANNERS

DATE: MARCH 2017

PROJECT NO.: 146.48

- **Conser Series.** The Conser series consists of very deep, poorly drained soils that formed in silty and clayey mixed alluvium from sedimentary and basic igneous materials. Conser soils are in depressions on low alluvial stream terraces. Slopes are 0 to 3 percent.

- **Chapman Series.** The Chapman series consists of very deep well drained soils that formed in mixed alluvium. These soils are on low stream terraces and flood plains. Slopes are 0 to 3 percent.

- **Sutherlin Series.** The Sutherlin series consists of very deep, moderately well drained soils that formed in mixed alluvium and colluvium over residuum weathered from sandstone and siltstone. Sutherlin soils are on foot slopes, hill slopes and drainage ways and have slopes of 3 to 60 percent.

- **Oakland Series.** The Oakland series consists of moderately deep, well drained soils that formed in colluvium and residuum weathered from sedimentary rocks. Oakland soils are on hillsides and broadly convex foot slopes and ridges and have slopes of 3 to 60 percent.

- **Waldo Series.** The Waldo series consists of very deep, poorly drained soils that formed in alluvium from mixed, but dominantly basic igneous materials. These soils are on narrow flood plains and fans. Slopes are 0 to 3 percent.

- **Coburg Series.** The Coburg series consists of very deep, moderately well drained soils that formed in mixed alluvium. Coburg soils are on stream terraces and have slopes of 0 to 7 percent.

- **Pengra Series.** The Pengra series consists of very deep, somewhat poorly drained soils that formed in clayey alluvium. These soils are on foot slopes, toe slopes or alluvial fans of foothills. Slopes are 1 to 30 percent.

- **Rosehaven Series.** The Rosehaven series consists of very deep, well drained soils that formed in colluvium and residuum weathered from sandstone, conglomerate sandstones, and siltstone. Rosehaven soils are on uplands and have slopes ranging from 3 to 90 percent.

- **Atring Series.** The Atring series consists of moderately deep, well drained soils that formed in colluvium and residuum weathered from sandstone, siltstone and metasedimentary rocks. Atring soils are on ridges and side slopes of mountains. Slopes are 12 to 90 percent.

- **Bateman Series.** The Bateman series consists of very deep well drained soils that formed in colluvium weathered from sandstone and siltstone. Bateman soils are on foothills and mountains. Slopes are 3 to 60 percent.

- **Stockel Series.** The Stockel series consists of very deep, somewhat poorly drained soils that formed in mixed alluvium and colluvium. Stockel soils are on foot slopes and in swales and narrow drainageways dissecting old alluvial terraces and have slopes of 3 to 12 percent.

- **Dickerson Series.** The Dickerson series consists of very shallow, well drained soils that formed in material weathered from sandstone and siltstone. Dickerson soils are on rounded ridgetops, foothills and mountains. Slopes are 3 to 90 percent.

- **Sibold Series.** The Sibold series consists of very deep, somewhat poorly drained soils that formed in mixed alluvium. Sibold soils are on high flood plains and have slopes of 0 to 5 percent.

- **Malabon Series.** The Malabon series consists of very deep well drained soils formed in mixed alluvium. Malabon soils are on stream terraces. Slopes are 0 to 3 percent.

- **Veneta Series.** The Veneta series consists of very deep, moderately well drained soils that formed from old mixed alluvium. Veneta soils are on old alluvial terraces and have slopes of 0 to 20 percent.

- **Packard Series.** The Packard series consists of very deep, well drained soils that formed in alluvium. They are on low stream terraces and flood plains and have slopes of 0 to 5 percent.

Geologic Hazards

There are several areas within Sutherlin that are susceptible to geologic hazards. These hazards include river flooding, earthquakes, high groundwater and erosion. A discussion of each hazard and expected locations are discussed below. Specific hazard maps are included in Appendix A.

- **River Flooding**. The Federal Emergency Management Agency (FEMA) has declared the City of Sutherlin a 'No Special Flood Hazard Area.' All areas within the UGB have been designated Zone C, areas of minimal flood hazard (FEMA Map 2010).

- **Earthquakes**. Earthquakes are the products of deep-seated geologic faulting and the subsequent release of large amounts of energy. The relative earthquake hazard includes factors such as earthquake induced landslides, liquefaction and shaking amplification.

  Based on the online, interactive maps, referred to as Hazard Viewer and developed by the Oregon Department of Geology and Mineral Industries (DOGAMI), there are no liquefaction or amplification hazards within the area examined in and around Sutherlin. Although there are no predicted hazards, there are two unnamed faults north of the City of Sutherlin. These faults move less than 2 mm per year, and are therefore not deemed to be a threat.

- **Landslides.** With respect to landslides, there exists medium to high hazard risks on the hills surrounding the City of Sutherlin. The high landslide hazard areas are found on some of the slopes southwest of the City, southwest of Cooper Creek on the upper ridge, and northeast of town on the Union Gap side of the ridge.

- **High Groundwater.** High groundwater is apparent in specific areas within the City of Sutherlin UGB. This water may be due to land contours, springs, hillside seepage, or saturated soil conditions following periods of wet weather.

- **Erosion.** Erosion within the UGB of the City of Sutherlin does not present a significant geologic hazard.

Water Resources

Water resources within the Study Area include both surface waters and groundwater. The majority of the resources utilized within the Study Area are surface waters.

Surface Waters

The City of Sutherlin is located in the North Umpqua Drainage Basin. Major water courses in the Study Area include Sutherlin Creek, Cooper Creek, Calapooya Creek, and North Umpqua River. Major water bodies include Plat I Reservoir, Cooper Creek Reservoir, Fords Pond, and the log ponds along Calapooya Avenue. The City's municipal water supply comes from upper Calapooya Creek at Nonpareil and from impounded water from Cooper Creek Reservoir. The City also has a water right permit for withdrawal of water from the North Umpqua River. The City's water rights and withdrawals are discussed later in the report (Sections 5.1).

Sutherlin Creek, where it flows through Sutherlin's City Limits, is not within its natural channel. The creek was excavated and diverted to its present course by the Luse Land and Development Company in 1906 to drain the Sutherlin Valley for orchard cultivation. Later in 1966, the Soil Conservation Service modified the creek bed further and a water control district was established to maintain the watercourse. Overtime, the creek channel has become overgrown and natural features as wetlands and riparian areas have become established.

Calapooya Creek and its tributaries stretch a maximum of 13 miles north to south, and 27 miles east to west, encompassing approximately 157,300 acres. Calapooya Creek flows through the town of Oakland before joining the Main Umpqua River near the community of Umpqua approximately six miles west of the City of Sutherlin. The northwestern section of the City is also within the Calapooya Creek Watershed.

North Umpqua River originates on the west slope of the central Cascade Range in southwest Oregon and drains approximately 1,350 square miles before it joins the South Umpqua River just west of Roseburg. There are eight dams on the upper North Umpqua River and two major tributaries that are part of the North Umpqua Hydroelectric Project. During the summer months, all of the North Umpqua River's flow passes through Pacific Corp's Soda Springs powerhouse, which is located approximately 60 miles east of Roseburg near Toketee. On the lower North Umpqua River, the Winchester Dam is located approximately seven miles upstream from the mouth of the North Umpqua River and provides water to the city of Roseburg and for recreational use. The origins of this dam date back to the 1890s.

The Cooper Creek Reservoir was built in 1970 and has 4,385 acre-feet of active storage. Of that total, approximately 3,400 acre-feet are used for recreation, 500 acre-feet provides additional water supply to Sutherlin for municipal and industrial water use and 485 acre-feet are for flood control. The dam for this reservoir blocks fish passage in Cooper Creek. The Oregon Department of Fish and Wildlife (ODFW) stocks rainbow trout in both Plat I and Cooper Creek Reservoirs.

One potential water resource is a proposed impoundment on Grassy Creek, which is a tributary of Calapooya Creek. The potential impoundment would have 9,200 acre-feet of storage at normal pool elevation of 928 feet, and have a surface area at normal pool elevation of approximately 194 acres (Douglas County 1997).

Water quality within the North Umpqua Drainage Basin is generally good. However, all of the surface water resources within the Study Area are considered 'water quality limited' to some extent and are on the DEQ's 303(d). A summary of the water quality limited water bodies and water quality limited parameters within the Study Area is given in Table 3.2.1.

Oregon DEQ and US Environmental Protection Agency (EPA) have completed a number of investigations on the extent of arsenic and mercury contamination in the Calapooya and Sutherlin Creek watersheds. The following is a summary of the preliminary findings of these agencies (DEQ unknown date). The sources of arsenic and mercury in these watersheds appear to be from natural deposits of cinnabar and other mineral-rich rocks related to geothermal and volcanic activity and from past mining activities. Past mining activities from ore at the Bonanza and Nonpariel Mines appear to be contributing to the arsenic and mercury contamination of the watersheds. The Bonanza Mine operated until 1960 and had a total production of approximately 1,500 tons. In 1940, this mine was considered the second largest producer of mercury in the United States. The Nonpareil Mine closed in 1932 and produced approximately 13 tons of mercury over the course of its operation. It has been reported that tailings from the Bonanza Mine were used to construct the railroad grade by Weyerhaeuser, which is now a dirt road, known as Red Rock Road. It also appears that the dam for Plat I Reservoir was also constructed with tailings from the Bonanza mine.

TABLE 3.2.1
SUMMARY OF WATER QUALITY LIMITED WATER BODIES IN THE STUDY AREA

Parameter	River Mile (RM)	Season
Sutherlin Creek		
Lead, Iron. Manganese, Arsenic	0 – 16	Year Around
Copper	4.6 – 10	Year Around
Cooper Creek \ Cooper Creek Reservoir		
Iron	2.4 – 4	Year Around
Mercury, water column	2.4 – 4	Year Around
Mercury, fish tissue	2.4 – 4	Year Around
Manganese	2.4 – 4	Year Around
Calapooya Creek		
Iron	0 – 36.2	Year Round
Dissolved Oxygen	0 – 24.8	Winter/Fall/Spring
North Umpqua River(1)		
Temperature	35.1 – 41.4	Summer
Aquatic Weeds or Algae	91.8 – 94.2	Undefined
Plat I Reservoir		
Mercury, fish tissue	0 - 0	Year Around

(1) N. Umpqua River has other water quality limited segments upstream RM 23 to 78.

Groundwater

Withdrawal of groundwater is highly dependent upon the underlying geology. Information on groundwater resources within the Study Area was obtained from a USGS report on groundwater availability in the Sutherlin area (Robison 1975).

Within the Study Area there are three basic geologic units: Alluvium, Tyee Formation, and Umpqua Formation (Robison 1975). Alluvium consists of sand gravel, and silt deposited by rivers and streams including Sutherlin, Calapooya Creeks, and the Umpqua River. Thickness of this geologic layer is generally less than 30 feet and permeable in nature. However, the saturated thickness is generally small except in a few places, such as adjacent to the Umpqua River in the Cleveland Rapids area. In this area, the Alluvium is sufficient to yield at least 10 gpm to most wells. However, this area is the only location where Alluvium can ordinarily be anticipated to serve as an aquifer.

The Tyee Formation consists of thin-bedded and massive sandstone and siltstone. The rocks are marine in nature with a thickness of 2,000 feet in the areas. This formation underlines the area northwest of the Study Area.Wells are less than 300 feet deep and yields ranges from less than one gpm to as much as 20 gpm.

The Umpqua Formation is the most prevalent geologic unit within the Study Area. This formation contains diverse rock types but consists predominantly of thin-bedded siltstone and sandstone within the Study Area, with some sandstone containing pebbles. In the southern and southeastern part of the Study Area, the major rock type is basalt. The Umpqua Formation is deformed into a series of parallel northeast-trending anticlines and synclines. Average dip of this formation is 25 to 30 degrees. Consequently, wells drilled only short distances apart may penetrate completely different beds of the formation and, therefore, may differ substantially in quantities of water yield. Well yields range from less than one gpm to more than 15 gpm. Siltstone beds generally have a lower yield and a higher incidence of unsuccessful wells than do other well types.

Groundwater quality in the Study Area is diverse in chemical nature with no real recognizable pattern. The only exception to this observation is that waters with high concentration of dissolved mineral matter are most of the sodium chloride type. Iron and manganese are slightly excessive in some groundwater that is otherwise of good quality and are significantly excessive in some waters with other constituents in excess. Excessive sulfate and chloride have been observed in some waters. Arsenic has also been detected in some wells.

Overall, groundwater is present within the Study Area. However, as is the case in much of Douglas County, it is difficult to accurately predict and obtain a well of sufficient yield and water quality for large water consumption. Many wells within the Study Area may be adequate for rural domestic usage but have too low a yield and power consumption too high for practical use of well water for commercial irrigation or as a significant municipal supply.

Flora and Fauna

The majority of the Study Area is in what is considered as the Umpqua Interior Foothills Ecoregion. In this Ecoregion, valley bottoms have been converted from native prairie and savanna to urban and rural residential areas, grazing lands and agricultural lands. With favorable soil and sufficient moisture, the uplands support Douglas fir, madrone, bigleaf maple, California black oak, incense cedar, and Oregon white oak. In drier soils, madrone and oaks are the dominant species with some Douglas fir, ponderosa pine, and incense cedar. Invasive species such as the Himalayan blackberry and Scotch broom are common.

The following fish are viable, reproducing populations or with annual runs in the Calapooya Creek and Lower North Umpqua River watersheds: summer and winter steelhead, fall and spring chinook, Coho, cutthroat trout, Umpqua chub, Western brook lamprey), Pacific lamprey, Umpqua dace, sculpin, redside shiner, speckled dace, Umpqua pike minnow, and largescale sucker. Warm water fish, including largemouth bass, smallmouth bass, yellow perch, bluegill and brown bullhead have been reported in the watershed. These fish were introduced into the river systems from private ponds or enter the water shed from Umpqua River during summer months. Stream temperatures in the area prevent these species from establishing reproducing populations.

Wetlands and floodplains provide habitat for many water fowl: mallard, pintail, widgeon, coot, ruddy duck, canvasback, green-winged teal, gadwall, redhead, ring-necked duck, scaup, and merganser. Other animals found in the study area include beaver, muskrat, river otter, raccoon, mink, skunk, squirrel, deer, elk and bear.

The riparian communities act as important buffers for water users and urban development. They are important to wildlife for shelter, food, and ecosystem diversity. The clearing of vegetation causes considerable effect on the diversity and stability of the ecosystem of an area. Removal can also bring about the loss of a significant ecotone (transition between water related environments and upland areas).

Environmentally Sensitive Areas

Sutherlin not only lies near sensitive environmental areas, but also affects those downstream. The combination of forests, rangeland, pasture and other wetlands provide a unique surrounding for the City and within the Study Area that should be considered and protected in facilities planning. A discussion of environmentally sensitive areas and environmental topics pertinent to public facilities planning is presented below.

Wetlands

There are a number of significant wetland areas within the City. These areas are shown in Appendix A. Other areas within the Study Area that are considered significant wetlands include along Sutherlin Creek to the south of town, between Exit 135 and Wilbur area (10 acres); the upper end of Copper Creek Reservoir at its inlet (10 acres); Fords Pond located on the west end of Sutherlin (2 acres); and Plat I Reservoir (40 acres, Douglas County 1997). All of these wetlands are considered to be good to excellent quality. To ensure that significant wetlands are adequately protected, the County applied a 50-foot setback standard around these wetlands.

Riparian Zones

The transition zone between creeks and uplands are also sensitive. They should be protected for erosion control, cover for animals, and shading for reducing water temperatures. In addition to exceeding the physical tolerance levels of fish, high temperatures lower the oxygen concentration, increase disease potential for aquatic life, and produce conditions for competing fish.

Douglas County has adopted a Riparian Vegetation Corridor Overlay Zone that applies to lands located 50 feet from the bank of all identified perennial and intermittent water courses. This Overlay Zone requires all structural development to have a 50-foot setback from the streambank unless Oregon Department of Fish and Wildlife staff agrees that this setback is unnecessary or a reduction in the setback would not jeopardize streambank, stability, water quality, etc.

Special Bird Habitats

The natural surroundings in Douglas County supports a wide range of bird habitats; four of which the County (Land Use Development Ordinance, 2014) has designated as requiring special consideration including eagle nesting sites, great blue heron rookeries, osprey nest sites, and pigeon mineral springs. Within the Study Area, osprey nest sites have been identified adjacent to Cooper Creek Reservoir and just north of Cooper Creek. To assist in the protection of osprey special bird habitats for activities not regulated by the Forests Practice Act (FPA), Douglas County will apply a Special Bird Habitat Overlay Zone. Within these overlay zones; the County will manage the osprey special bird habitats through consultation with ODFW.

Natural Areas

Within its Comprehensive Plan, Douglas County (2013) has also identified Natural Areas to assist in protecting ecologically distinct ecosystems, habitats, and organisms. One such site has been identified within the Study Area: Wilbur-Rodgers Road White Camas Site. This site, which is approximately 21 acres in area, is located east of Interstate-5 between the Interstate-5 and Old Highway 99. This site, being adjacent to Sutherlin Creek, provides excellent habitat for growing the white camas variety endemic to the Roseburg area (Leichtlin’s white camas, or Camassia Leichtlinii var. Lechtlinii). The County has employed a Natural Area Overlay designation to protect this white camas site. This overlay zone shall permit only uses which would not permanently destroy the white camas habitat. The overlay zone may allow conditional use for such temporary uses as gravel stockpiling or grazing provided that these uses do not occur between February and June 1st, the growing season for the white camas.

Air Quality and Noise

Air quality within the City of Sutherlin area is excellent. Favorable prevailing winds, low population with corresponding low auto emissions, and absence of heavy industrial development result in few air quality problems. Noise levels within the area are quite low, except near Interstate-5. Automobile and truck traffic along Interstate-5 would likely be the source of any future air quality or noise problems in the City.

Energy Production and Consumption

No major energy resources have been identified in the Study Area. Energy consumption is expected to increase within the Study Area due to population growth during the planning period. Pacific Power serves the Study Area with electrical energy.

Rare, Threatened and Endangered Species

A number of rare, threatened and endangered species are known to reside near or within the Study Area. A list of these species within the Study Area is provided in Table 3.2.2. This list is based on information obtained from the Oregon Natural Heritage Information Center (March 2016) and the Oregon Department of Fish and Wildlife.

TABLE 3.2.2
LIST OF THREATENED AND ENDANGERED SPECIES IN THE STUDY AREA

Common Name	Scientific Name	Status (Federal/State)[(1)]
Coho Salmon (Oregon Coast ESU)	Oncorhynchus kistuch	LT/LE
Rough Popcorn Flower	Plagiobothrys hirtus	LE
Umpqua Chub	Oregonichthys kalawatseti	SOC/SC
Steelhead (Oregon Coast ESU winter run)	Oncorhynchus mykiss	SOC/SV
Pacific Lamprey	Lampetra tridentata	SOC/SV
Red-root Yampah	Perideridia erythrorhiza	SOC/C
Purple Martin	Progne subis	SOC/SC
Foothill Yellow-Legged Frog	Rana boylii	SOC/SV

[(1)] Federal: LT – listed threatened, LE – listed endangered, C – candidate, SOC – species of concern;
State: LE – listed threatened, SC - sensitive-critical, SV – sensitive vulnerable, C- Candidate

Coho Salmon Oregon Coast Evolutionary Significant Unit (ESU, Oncorhynchus kistuch) is an anadromous fish found along the Pacific Coast from Alaska to Monterey Bay, California, and in freshwater streams and rivers. Adult and juvenile Oregon Coast Coho salmon are found in the Calapooya Creek and Umpqua River watersheds. Coho salmon utilizes the tributaries of Calapooya Creek and the North Umpqua River for spawning and rearing.

Rough Popcorn Flower (Plagiobothrys hirtus) was listed as endangered on January 25, 2000 and is found only in the Umpqua River drainage in Douglas County at sites ranging from 330 to 750 feet in elevation (Federal Register 2003). Naturally occurring populations of this species occur along the Sutherlin Creek drainage from Sutherlin to Wilbur, adjacent to Calapooya Creek west of Sutherlin, and in roadside ditches near Yoncalla Creek, just north of the City of Rice Hill. Until 1998, all known sites were east of Interstate-5 but at that time a site was discovered 0.5 miles west of the Interstate-5 at the junction of Stearns Lane and Highway 138. The easternmost extent of the Rough Popcorn Flower population is just east of Plat K Road outside of the City of Sutherlin. Historic populations have been observed east near Nonpareil but not seen in recent surveys (Ibid 2003). The Rough Popcorn Flower is a perennial herbaceous plant, but can be annual depending on environmental conditions. The species occurs in seasonal wetlands. The majority of sites occur on the Conser-type soil series that is characterized as poorly drained flood plain soils. Urban and agriculture development, invasion of non-native species, habitat fragmentation and degradation, and other human-caused losses have contributed to substantial losses of seasonal wetland habitat throughout the species' historic range (Ibid 2003).

Umpqua Chub (Oregonichthys kalawatsei) is a small minnow endemic to the Umpqua River basin. Based on characteristics of its sibling Oregon Chub, these minnows typically occupy off-channel habitats such as beaver ponds, oxbows, side channels, backwater sloughs, low gradient tributaries, and flooded marshes. The habitat usually has little or no water flow, silty and organic substrate, and considerable aquatic vegetation as cover for hiding and spawning.

Steelhead, Oregon Coast ESU, winter run (Oncorhynchus mykiss) occupies streams along coastal Oregon and in the lower Columbia Basin. Adult and juvenile Oregon Coast Steelhead are found in the Calapooya Creek and Umpqua River watersheds. Winter Steelhead spend one or two years in the Pacific Ocean before returning to spawn. Most returning adults enter the river system in November through February and move quickly upstream. Most spawning takes place from March through April with fry hatching in April and May. Juveniles generally spend two years in freshwater before their smolt and migration to the ocean. Winter steelhead and Coho salmon use many of the same stream reaches (0 to 4% gradient) but at different times of the year.

Pacific Lamprey (Lampetra tridentate) is a long parasitic fish found in coastal and Columbia River drainages. With its circular toothed mouth, this lamprey feeds on salmonids and whales. This species migrates upstream to spawn between July and September and stay in freshwater streams till March of the following year to spawn. Spawning habitat is similar to salmonids including, cool, flowing water and clean gravel, while rearing areas are slow-moving backwaters with fine sediment. Larvae spend several years in freshwater before transforming and migrating to the ocean. Based on counts at Winchester Dam on the North Umpqua River, the Pacific Lamprey population is showing a clear declining trend.

Red-root Yampah (Perideridia erythrorhiza) is found on both sides of the Cascade Range in southwestern Oregon. The population on the west side of the Cascades, which includes the Study Area, is more threatened, even though it is more numerous. They are highly fragmented and many populations are small. The Red-root Yampah is found growing in low swales, moist prairies, valleys, and pastureland at lower elevations. It is often found in heavy, poorly drained soils.

Purple Martin (Progne subis) can be found in most of the United States. This martin prefers open areas near marsh, open woodlands, or water where it will feed on ants, grasshoppers, wasps, bees, beetles, flies, moths, and butterflies. Between the months of August and December, the purple martin migrates to South America to winter. The martin uses natural tree cavities or bird houses built specifically for nesting habitat. Breeding typically starts between April and July. After the birds have hatched, they are fed by both parents for about a month, and congregate at a pre-migratory roost with the parents before flying south for the winter.

Foothill Yellow Legged Frog (Rana boylii) lives in an aquatic environment preferably consisting gravelly or sandy streams with sunny banks and open woodlands nearby. This frog is present from sea level to an elevation of approximately 6,000 feet. Breeding occurs from March to May, when streams have slowed after winter runoff. Egg clusters are attached to downstream submerged rocks.

Wild and Scenic River System

There are no Wild and Scenic Rivers within the Study Area.

Historic Sites

Within Sutherlin's City Limits, there is only one structure listed in the National Register of Historic Places: the Sutherlin Bank Building on Central Avenue. This building was constructed in 1910 of rock-cut stone in an area not even incorporated in the City at the time. The building played a key role in City of Sutherlin's commercial development.

Douglas County has applied a Historic Resources Overlay for one historic bridge in the Study Area: Rochester Bridge that crosses Calapooya Creek west of town.

3.3 Socioeconomic Environment

The future need for water service and facilities within the City of Sutherlin depends upon the socioeconomic conditions within the City and surrounding area. In this sub-section, the local economic conditions, trends, population, land use, and public facilities will be discussed.

Economic Conditions and Trends

Regional economic conditions and trends will likely affect population growth and future water consumption in the City of Sutherlin. Major industrial or commercial development can create a large, immediate demand for water and sewer services. On the other hand, depressed economic conditions can affect employment opportunity and the number of families moving into a community.

The economy of the City of Sutherlin id tied to a very large extent to the regional economy. Lumber and wood products, agriculture, trade and service industries are considered the primary industries in and around the City. The most dominant economic sector in Douglas County is the lumber and wood products industry. Nearly 68 percent of the County's economy is dependent upon this industry. Future growth in this sector will be challenged by reductions in the available timber supply both from public and private industry lands. Agriculture in the Sutherlin Valley will continue to contribute to the local economy. However, growth in this sector is limited to the existing soils and availability of water. Trade and services industries will likely increase in importance since the demand for goods and services is increasing rapidly with the rise in the standard of living. Continued development of the City's industrial zones lands will also contribute to employment opportunities for City residents. The largest employers within the City include Murphy Plywood, wood products industry; and Orenco Systems, Inc, manufacturer of onsite sewage systems and equipment.

Based on the Year 2010 Census, median household income level in the City of Sutherlin was slightly less than that of Douglas County ($36,605 vs. $41,312).

Population

Since 1990 the City of Sutherlin has experienced a growth rate higher than most other communities in Oregon. Economic conditions were difficult in the early 1980s due to the decline of the forest products industry, and some uncertainty remains over the availability of timber and lumber. The City's livability characteristics, however, especially for retired persons and those enjoying outdoor recreation, have attracted a long-term growing populace regardless of the local economic climate.

Based on United States Census data, the City of Sutherlin's population increased from 6,669 to 7,810 between 2000 and 2010. This increase equates to an average annual growth rate of 1.6%. During this same period, the average County growth rate was 0.7%. Growth is expected to continue at a rate similar to that experienced in the community during the last decade. Growth over the last decade was much more moderate than in the previous. The updated coordinated population projection of 1.5% per year has been recommended by Douglas County for the next 25 years (to the year 2035). Figure 3.3.1 represents the historic and projected population growth for the City of Sutherlin.

TABLE 3.3.1
CURRENT POPULATION ESTIMATE AND POPULATION PROJECTIONS

Year	2000	2010	2016	2021	2026	2031	2036
Residential Population	6,669	7,810	8,025	8,645	9,313	10,033	10,809

Potable Water Use Population

In addition to the City's residents, there are a total of 260 residential water connections outside the City limits. Assuming each residential connection is a single-family dwelling, there are a total of 260 EDUs outside the City. Based on representative Year 2010 Census data for Census Tract 500.01, the average of number of persons per household ranges from approximately 2.5 to 2.6 (Block Group 3; Block Group 4). Assuming 2.6 persons per EDU and 133 EDUs with water service outside the City, the estimated population of potable water users outside the City limits is 553. City staff considers future growth of potable water users in these currently served areas to be minimal or non-existent. The current and future total number of potable water users on the City's system is summarized in Table 3.3.2.

TABLE 3.3.2
CURRENT AND FUTURE POTABLE WATER USE POPULATION

Year	Population Projections		
	Exist. Future City Users	Exist. Outside Users	Total
2016	8,025	553	8,578
2021	8,645	553	9,198
2026	9,313	553	9,866
2031	10,033	553	10,586
2036	10,809	553	11,362

Land Use

Land use within Sutherlin is categorized into five general categories: residential, commercial, industrial, public facilities, and special district and other lands. There is an estimated 3,259 acres within the current UGB. The City of Sutherlin zoning map is shown in Figure 3.3.1. The five land use categories are briefly discussed.

Residential Lands

City of Sutherlin residential lands are throughout the community and on each side of Interstate-5. Residential lands also occupy the elevated surrounding hills on the north side of the UGB and new subdivisions are being constructed in the areas surrounding town. Residential land use ranges from single-family dwellings to multi-family dwellings to bed and breakfast and motel land uses. Detailed descriptions of each residential land use zone are described below.

1. **RH – Residential Hillside District.** This district preserves the visual and physical identity of the hills, as well as the native geologic conditions so far as practicable through larger lot sizes and special construction standards, while permitting single family residential development.

2. **R-1 – Low Density Residential District.** This district is a low density area that protects established single family neighborhoods and preserves the residential quality, environmental privacy, light, air and outdoor space that is meant to conform to systems and facilities which support the residential quality of the area.

3. **R-2 – Medium Density Residential District.** This district is a low density area that protects established single family neighborhoods and preserves the residential quality, value identity environmental privacy, light, air and outdoor space that is meant to conform to systems and facilities which support the residential quality of the area.

4. **R-3 – High Density Residential District.** This district is a medium to high density area meant to serve as a general residential district allowing a large variety of housing and densities without conflict together with certain nonresidential uses.

Commercial Lands

The commercial properties are clustered around Interstate-5 and Highway 138 (Central Avenue). Commercial activities generally include retail and tourist related services. Small shops and restaurants catering to the tourist market make up the majority of the commercial properties in the City.

1. **C-1 – Commercial Downtown District.** This district is intended to serve as a downtown retail and service center. This area provides the more common everyday goods and services for both the surrounding area and the existing City and to concentrate uses for the walking public. All commercial uses shall be conducted wholly within an enclosed building.

2. **C-3 – Commercial Community District.** This district is intended to be a general commercial zone, providing large goods and services to the area residents and traveling public. Off-street parking is required as well as design curtailments of adverse effects.

Industrial Lands

The industrial properties are dispersed throughout the City, but specifically around Interstate-5 and Highway 138 (Central Avenue). Commercial activities generally include retail and tourist related services. Small shops and restaurants catering to the tourist market make up the majority of the commercial properties in the City.

1. **M-1 – Industrial Light District.** This district is intended for the location of non-noxious industry. Such industries that do not produce noise, odor, smoke, fumes or other nuisances will be permitted to locate in this area. Should there be any doubt concerning the creation of a nuisance by a particular building or use, the planning commission shall determine whether a specific use or structure shall be permitted.

2. **M-2 – Industrial Heavy District.** This district is intended for the location of heavier industry but in no case shall an industry which would create any noise, odor, smoke or other nuisances having an effect on nearby nonindustrial areas, be allowed to locate in this district.

Public Facilities Lands

Public lands consist of those required for government offices, schools, hospital, transportation facilities, parks, and recreation areas. The wastewater treatment plant and City shops are included within the public facilities lands.

Special District and Other Lands

The City has adopted special district and other zoning land use types. Summary of these zoning types are below.

1. **FR 75 – Forest Resource District.** The forestry classification is intended to preserve lands with high forest resource potential. The resource zone is applied to rural areas where urbanization is untimely and services.

2. **CS – General Community Services Special District.** This district is intended to provide for the review and location of public facilities and related uses which by necessity, character or effect will be compatible with surrounding uses.

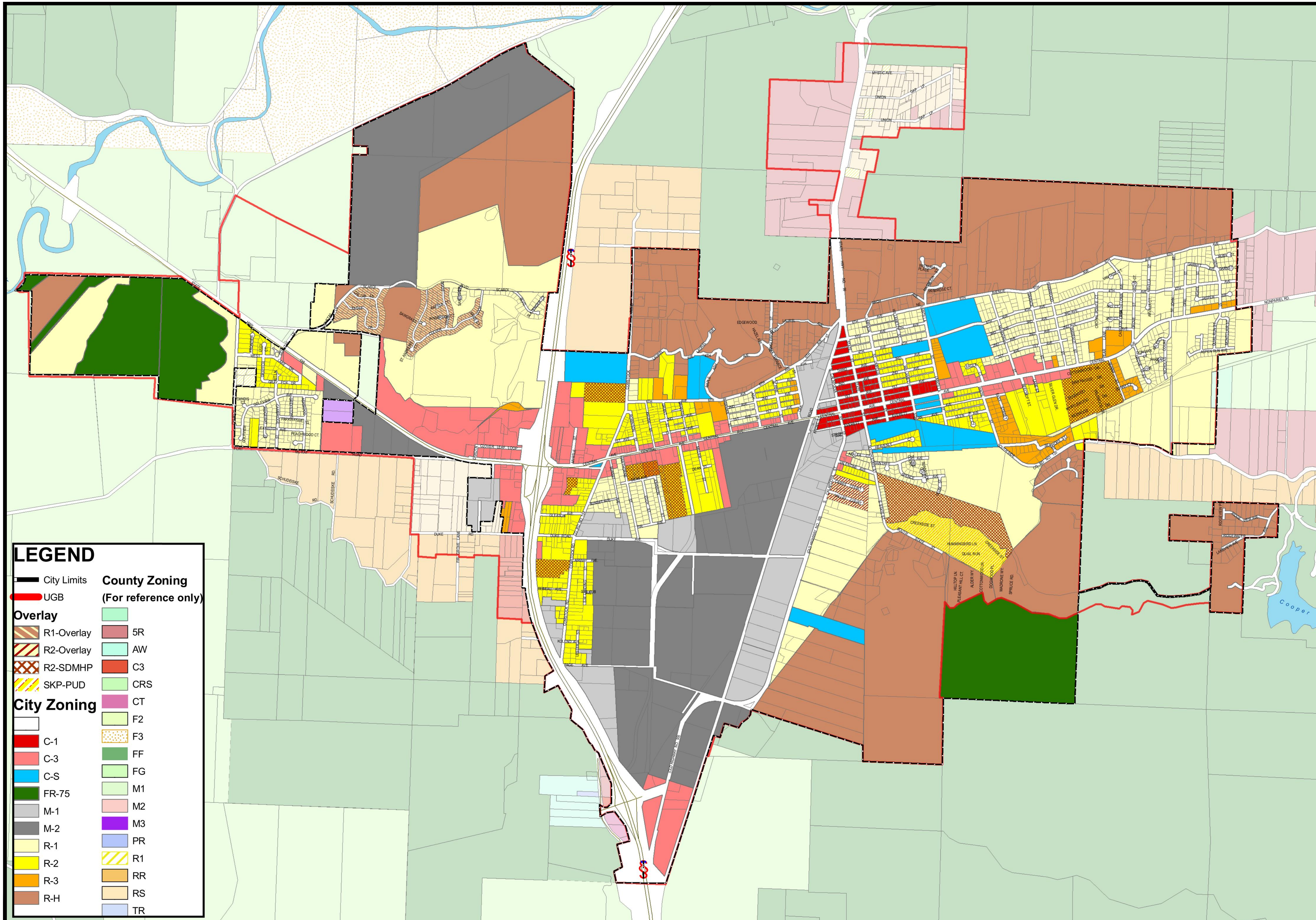


FIGURE NO.
3.3.1

SUTHERLIN WATER MASTER PLAN

ZONING MAP

THE DYER PARTNERSHIP
ENGINEERS & PLANNERS

DATE: MARCH 2017

PROJECT NO.: 146.48

SECTION 4:

REGULATORY ENVIRONMENT

SECTION 4: **REGULATORY ENVIRONMENT**

4.1 Municipal Water Management Plans

The Oregon Water Resources Department has developed rules that govern water management planning (Water Management and Conservation Plans; OAR Chapter 690, Division 86). Included in these rules are groundwater management, hydroelectric power development, instream flow protection, interstate cooperation, water resources protection on public riparian lands, conservation and efficient water use, water allocation, and water storage. The Water Resources Commission has adopted a statewide policy on Conservation and Efficient Water Use (Statewide Water Resource Management; OAR 690-410). The policy requires major water users and suppliers to prepare water management plans. Municipal water suppliers are encouraged to prepare water management plans, and are required to do so if a Plan is prescribed by a condition of a water use permit. The following elements are to be included in the Plan: description of the water system, a water conservation element, a water curtailment element, and a long-range water supply element.

A Water Management and Conservation Plan meeting all requirements of OAR 690-086-0125 to 0150 has been developed as a separate document alongside this Water Master Plan.

Description of the Water System

The Management and Conservation Plan shall include sources of water, storage and regulation facilities, transfer and exchange agreements, and intergovernmental cooperation agreements. System capacity, limitations and opportunities for expansion under existing water rights are to be included. Water use shall be discussed including current average annual water use, peak seasonal demand, average and peak day demands, and quantities of water used from a source. Customer information is required such as estimated numbers and general water use characteristics of residences, commercial, industrial, and other users. Also required is a schematic of the system which shows the sources of water, storage facilities, treatment facilities, major transmission and distribution lines, pump stations, interconnections with other municipal supply systems, and the service area.

4.2 Public Water System Regulations

Drinking water regulations were established in 1974 with the signing of the Safe Drinking Water Act (SDWA). This Act and subsequent regulations were the first to apply to all public water systems in the United States. The Environmental Protection Agency (EPA) was authorized to set standards and implement the Act. With the enactment of the Oregon Drinking Water Quality Act in 1981, the State of Oregon accepted primary enforcement responsibility for all drinking water regulations within the State. Requirements are detailed in OAR Chapter 333, Division 61. Since its inception, the SDWA and associated regulations have been amended a number of times, with the most recent amendments in August 2016.

One of the main elements of these drinking water regulations is the establishment of maximum contaminant levels (MCLs) for inorganic, organic, microbiological, and radionuclide contaminants and turbidity. An MCL is the maximum allowable level of a contaminant in water delivered to the users of a public water system. Concentrations above the MCL for a contaminant are considered violations and require the water supplier to perform immediate corrective action and notify the public of such violations.

Surface Water Treatment Rule (SWTR)

The Surface Water Treatment Rule (SWTR) is one amendment to the Safe Drinking Water Act (SDWA). This rule affects all public water systems using surface water sources and established, among other requirements, that water must be treated through filtration and disinfection. This rule is required for all water providers using a surface water source unless certain water quality criteria and site-specific requirements are met. Treatment requirements, performance standards and MCLs are generally summarized as follows (excluding MCLs for inorganic materials, radioactive substances, and secondary contaminants) for a water system:

- For conventional filtration treatment, the turbidity level of representative samples of filtered water must at no time exceed 1 NTU, measured as specified in OAR 333-061-0030(3)(b). That is to say, zero percent of the turbidity measurements can exceed 1 NTU. Turbidity is monitored continuously with results reported every four hours.

- For conventional filtration treatment, the turbidity level of representative samples of filtered water must be less than or equal to 0.3 NTU in at least 95 percent of the measurement taken each month, measured as specified in OAR 333-061-0030(3)(b). That is to say, the turbidity levels can rise above 0.3 NTU no more than five percent of the time.

- Total coliform-positive (coliform present) samples shall not exceed more than one sample collected during a month. Nine monthly samples are required. A set of at least three repeat samples is required for each positive sample. Repeat sampling continues until the MCL is exceeded or a set of repeat samples with negative results (coliform absent) is obtained. Confirmed presence of fecal coliform or *E. coli* requires immediate notification of the public.

- At least 99.9 percent (3-log) inactivation and/or removal of *Giardia lamblia* cysts at a point downstream at or before the first customer.

- At least 99.99 percent (4-log) inactivation and/or removal of viruses at a point downstream at or before the first customer.

- A free chlorine residual of 0.2 mg/L after 30 minutes of contact time shall be achieved under all flow conditions before the first customer. 333-061-0050(5)(c)(B)

- The residual disinfectant concentration in the distribution system, measured as total chlorine, combined chlorine, or chlorine dioxide, as specified in OAR 333-061-0032(3)(d) cannot be undetectable in more than five percent of the samples each month, for any two consecutive months.

The adoption of the 1989 SWTR has improved the quality of drinking water and greatly reduced the number of infections caused by water borne pathogens. The SWTR set standards to reduce water concentration of *Giardia* and viruses, with a goal to reduce the risk of infection to less than one in 10,000 people per year. However, some water sources have a high concentration of pathogens that, even when treated to the levels required by the rule, do not meet the health goal. Specifically, the rule does not specifically control the protozoan *Cryptosporidium*, which has been linked to at least 50 deaths of *Cryptosporidium*-caused illness outbreaks in Milwaukee, Nevada, Oregon, and Georgia. Although the public health benefits of disinfection are significant and well recognized, it has been found that the disinfection byproducts also pose health risks at certain levels. The SDWA Amendments, signed by President Clinton in August 1996, mandated the establishment of a series of new drinking water regulations in response to these and other concerns. Since the enactment of the Amendments, EPA has been busy developing, proposing, and finalizing regulatory actions. Some of the recent regulatory actions are summarized below.

Long Term 1 Enhanced Surface Water Treatment Rule

One of the first rules developed by EPA under the SDWA amendments was the Interim Enhanced Surface Water Treatment Rule (IESWTR). The IESWTR was promulgated to address health risks from microbial contaminants without significantly increasing the potential risks from chemical contaminants. This rule applies to public water systems that use surface water or ground water under the direct influence of surface water (GWUDI) and serve at least 10,000 people. For water systems with a population of less than 10,000, the Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR) was adopted. This rule was adopted in January 2002 and includes the following provisions:

- Maximum contaminant level goal (MCLG) is set at zero.
- Filtered systems must comply with strengthened Combined Filter Effluent (CFE) turbidity performance requirements to assure 2-log removal of *Cryptosporidium*.
- Conventional and direct filtration systems must continuously monitor the turbidity of individual filters and comply with follow-up activities based on this monitoring.
- Specific combined filter effluent (CFE) turbidity requirements depend on the type of filtration. For conventional and direct filtration, the CFE shall be less than 0.3 NTU 95 percent of the time, and at no time higher than 1 NTU.
- Perform CFE turbidity monitoring at least every four hours; record continuous individual turbidity effluent (IFE) measurements (at least every 15 minutes).
- Disinfection profiling and benchmarking provisions to ensure continued microbial protection.
- Requirements for covers on new finished water reservoirs.

Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR)

The Long Term 2 Enhances Surface Water Treatment Rule (LT2ESWTR) was proposed and reviewed by a Federal Advisory Committee at the same time as the Stage 2 Disinfectants/Disinfection Byproducts Rule (Stage 2 DBPR). The requirements of this rule would pertain to all public water systems that use surface waters or GWUDI. The rule would incorporate system specific treatment requirements for one of four categories or “bins” depending upon the results of source water *Cryptosporidium* monitoring. Treatment requirements for each system would depend on system’s existing treatment equipment and removal capabilities. To comply with additional treatment requirements, water providers would choose technologies from a “toolbox” of options. Proposed treatment requirements for average *Cryptosporidium* are presented in Table 4.2.1.

For small systems monitoring requirements, it is anticipated that source water *E. coli* concentrations would be utilized for *Cryptosporidium* monitoring. Observed *E. coli* concentrations above certain levels would trigger *Cryptosporidium* monitoring. The recommended *E. coli* monitoring for small systems would begin 2.5 years after rule promulgation and would include 24 samples over one year. After six years of the system characterization, a second round of monitoring is proposed.

This rule only applies to public water systems serving populations greater than 10,000; therefore the City of Sutherlin is not currently required to monitor *Cryptosporidium*. In the future, this rule may expand its reach and begin to impact City of Sutherlin's existing treatment and monitoring processes.

TABLE 4.2.1
PROPOSED TREATMENT REQUIREMENTS FOR AVERAGE *Cryptosporidium* CONCENTRATIONS

Bin No.	Ave. *Cryptosporidium* Concentration	Additional Treatment Requirements(1)
1	< 0.075/ liter	No action
2	0.075/ liter < x < 1.0/ liter	1-log treatment (any technology or technologies)
3	1.0/ liter < x < 3.0/ liter	2.0 log treatment (must achieve at least 1-log of treatment using specific technology (2)
4	> 3.0/ liter	2.5 log treatment (must achieve at least 1-log treatment using specific technology (2)

(1) For systems with conventional treatment that are in full compliance with IESWTR.
(2) Acceptable technologies include ozone, chlorine dioxide, ultraviolet (UV), membranes, bag/cartridge filters, or in-bank filtration.

In summary, the rules are getting tougher with increased treatment standards, lower MCLs, and more regulated substances. Water suppliers must stay informed of upcoming standards and requirements to ensure that their system will stay in compliance. Proper preparation is critical. When upcoming MCLs are established, a supplier should begin to test for these materials to determine if compliance will be a problem. Advanced planning will allow a utility more time to make necessary modifications to treatment techniques. Additional information on recent and pending regulations can be found at www.epa.gov/safewater/standards.html.

Stage 1 Disinfectants/Disinfection Byproducts Rule (Stage 1 DBPR)

Stage 1 DBPR was published along with the IESWTR to control disinfectants and formation of their harmful byproducts. This rule establishes Maximum Residual Disinfectant Level Goals (MRDLGs) and Maximum Residual Disinfectant Levels (MRDLs) for three disinfectants: chlorine (4.0 mg/l), chloramines (4.0 mg/l), and chlorine dioxide (0.8 mg/l). The rule also establishes Maximum Contaminant Level Goals (MCLGs) and Maximum Contaminant Levels (MCLs) for specific disinfection byproducts as given in Table 4.2.2.

TABLE 4.2.2
MCLGs AND MCLs FOR STAGE 1 DISINFECTANTS

Disinfection By-Product	MCLG (mg/l)	MCL (mg/l)	Time Period
Total trihalomethanes (TTHM)	N/A	0.08	Annual Average
Bromodichloromethane	0	0.08	Annual Average
Dibromochloromethane	0.06	0.08	Annual Average
Bromoform	0	0.08	Annual Average
Haloacectic acids (HAA5)	N/A	0.06	Annual Average
Dichloroacetic acid	0	0.06	Annual Average
Trichloroacetic acid	0.02	0.06	Annual Average
Chlorite	0.8	1	Monthly Average
Bromate	0	0.01	Annual Average

Water system providers must monitor and control the use of disinfectants and meet the requirements for total trihalomethanes (TTHM) and the sum of five Haloacetic Acids (HAA5). In addition, water systems that use surface water or GWUDI and use conventional filtration treatment are required to also remove a specified percentage of organic materials, measured as Total Organic Carbon (TOC) that may react with disinfectants to form disinfection byproducts.

Furthermore, Oregon's decision to join the States of Utah, Washington and EPA Region 10 in participation in the Area Wide Optimization Program (AWOP) is anticipated to create more stringent treatment standards which the existing Nonpareil Water Treatment Plant can now meet only under ideal conditions. The AWOP performance goals are listed below in Table 4.2.3.

TABLE 4.2.3
AWOP PERFORMANCE GOALS

Sedimentation	Turbidity	Criteria
Settled water	Less than 2 NTU, 95% of the time	Avg. annual raw water turbidity > 10 NTU
Settled water	Less than 1 NTU, 95% of the time	Avg. annual raw water turbidity <= 10 NTU
Filtration	**Turbidity**	**Criteria**
Filtered water	< 0.1 NTU, 95% of the time	Based on 4-hour incremental max valves
		(15 min. period following backwash excluded)
Filtered water	Max. 0.3 NTU following backwash	Return to < 0.1 NTU < 15 minute of backwash

The objective of the AWOP is to achieve "performance goals" without major capital expenditures. While these goals are not currently tied to regulatory compliance requirements, it is anticipated that they will be in time. Statements by the State such as "to achieve optimized treatment and provide maximum protection of public health, you must achieve the described AWOP performance goals" suggests that these goals would better protect the public, and therefore should be adhered to.

Stage 2 Disinfection Byproduct Rule (Stage 2 DBPR), Effective March 6, 2006

The Stage 2 DBPR is being promulgated simultaneously with the Long Term 2 Enhanced Surface Water Treatment Rule to address concerns about risk tradeoffs between pathogens and Disinfection Byproducts (DBPs). Stage 2 DBPR builds upon the Stage 1 DBPR to address higher risk public water systems for protection measures beyond those required for existing regulations. These rules strengthen protection against microbial contaminants, especially *Cryptosporidium*, and at the same time, reduce potential health risks of DBPs. The final Stage 2 DBPR contains maximum contaminant level goals for chloroform, monochloroacetic acid and trichloroacetic acid. National Primary Drinking Water Regulations, which consist of Maximum Contaminant Levels (MCLs) and monitoring, reporting, and public notification requirements for total trihalomethanes and haloacetic acids; and revisions to the reduced monitoring requirements for bromate. This document also specifies the best available technologies for the final MCLs. The EPA is also approving additional analytical methods for the determination of disinfectants and DBPs in drinking water. The Stage 2 DBPR rule is intended to reduce potential cancer and reproductive and developmental health risks from DBPs in drinking water. The requirements of this rule apply to community water systems and non-transient, non-community water systems that add and/or deliver water that is treated with a primary or residual disinfectant other than UV.

For public water systems serving fewer than 10,000 people, subpart V (Stage 2) compliance monitoring began October 1, 2013, with an additional two-year extension available to systems requiring capital improvements.

An Initial Distribution System Evaluation (IDSE), conducted by the water provider, is intended to select new compliance monitoring sites that reflect locations with system high total trihalomethanes (TTHM) and five haloacetic acids (HAA5) concentrations. Water providers would recommend new or revised monitoring sites based on their IDSE study. The results from the IDSE study would not be used for compliance purposes. For surface water systems with less than 10,000 people, water providers must monitor either quarterly (population from 500-9,999) or semi-annually (population <500) for one year at two distribution system sites per plant. These sites must be in addition to the Stage 1 DBPR compliance monitoring sites. Water providers that certify to the State that all samples taken in the last two years were below 40 mg/l TTHM / 30 mg/l HAA5 are not required to conduct the IDSE.

For long-term compliance monitoring, the principles of reduced compliance monitoring strategy (for very low DBP levels) utilized in Stage 1 DBPR would continue in the Stage 2 DBPR. Water providers would collect paired samples (TTHM and HAA5) at the site representing the highest TTHM and the highest HAA5 locations in the distribution system, as identified under the IDSE. If the highest levels of TTHM and HAA5 are observed at the same location, then only one sample would be needed. Monitoring would be either quarterly (population from 500 – 9,999) or annually (population <500). The Federal Advisory Committee also recommended that EPA propose that all wholesale and consecutive systems comply with the provisions of the Stage 2 DBPR on the same schedule of the system serving the largest population in the combined distribution system. Additional information on this regulation can be found at: www.epa.gov/safewater/disinfection/stage2/index.html

Filter Backwash Recycle Rule

The Environmental Protection Agency is required to regulate the recycling of filter backwash within the treatment process of a public water system. The filter backwash recycle rule provisions impact all conventional and direct filtration systems which recycle filter backwash and use of surface water or GWUDI. Under the rule, the following provisions will be required.

- Recycle water from filter backwash, supernatant from sludge thickening, and liquids from sludge dewatering must pass through all filtration processes for treatment.

Specific information on the regulations concerning public water systems may be found in the Oregon Administrative Rules (OAR), Chapter 333, Division 61. The rules can be found on the internet at: http://public.health.oregon.gov/HealthyEnvironments/DrinkingWater/Rules/Documents/pwsrules.pdf

Arsenic and Clarifications to Compliance and New Source Monitoring Rule

In January 2001, the Arsenic and Clarifications to Compliance and New Source Monitoring Rule was enacted. The major features of this rule included the following:

- Include health effects statements in Consumer Confidence Reports for arsenic levels from 5 to 50 ug/l and when systems are in violation of the arsenic MCL of 10 ug/l.

- All new systems/sources must collect initial monitoring samples for all inorganic contaminants (IOCs), synthetic organic contaminants (SOCs), and volatile organic contaminants (VOCs).

- The new arsenic MCL of 10 ug/l became effective on January 23, 2006.

- One sample must be taken and analyzed after effective date of MCL. Surface water systems must take annual samples.

- A system with a sampling point result above the MCL must collect quarterly samples at that sampling point, until the system is reliably and consistently below the MCL.

4.3 Responsibilities as a Water Supplier

Per OAR 333-061-0025, water suppliers are responsible for taking all reasonable precautions to assure that the water delivered to water users does not exceed maximum contaminant levels, to make certain that water system facilities are free of public health hazards, and to verify that water system operation and maintenance are performed as required by these rules. This includes, but is not limited to, the following:

- Routinely collecting and submitting water samples for laboratory analyses at the frequencies prescribed by OAR 333-061-0036;
- Taking immediate corrective action when the results of analyses or measurements indicate that maximum contaminant levels have been exceeded and report the results of these analyses as prescribed by OAR 333-061-0040;
- Reporting as prescribed by OAR 333-061-0040, the results of analyses or measurements which indicate that maximum contaminant levels have not been exceeded;
- Notifying all customers of the water system and the general public in the service area, as prescribed by OAR 333-061-0042, when the maximum contaminant levels have been exceeded;
- Notifying all customers served by the water system, as prescribed by OAR 333-061-0042, when reporting requirements are not being met, when public health hazards are found to exist in the system, or when the operation of the system is subject to a permit or a variance;
- Maintaining monitoring and operating records and making these records available for review when the system is inspected;
- Maintaining a pressure of at least 20 pounds per square inch (psi) at all service connections at all times;
- Following up on complaints relating to water quality from users and maintaining records and reports on actions undertaken;
- Conducting an active program for systematically identifying and controlling cross connections;
- Submitting, to the Oregon Health Authority, plans prepared by a Professional Engineer registered in Oregon for review and approval before undertaking the construction of new water systems or major modifications to existing water systems, unless exempted from this requirement;
- Assuring that the water system is in compliance with OAR 333-061-0032 relating to water treatment;
- Assuring that the water system is in compliance with OAR 333-061-0210 through OAR 333-061-0272 relating to certification of water system operators; and
- Assuring that Transient Non-Community water systems utilizing surface water sources or groundwater sources under the influence of surface water are in compliance with OAR 333-061-0065(2)(c) relating to required special training.

SECTION 5:

EXISTING WATER SYSTEM

SECTION 5: **EXISTING WATER SYSTEM**

The City of Sutherlin's existing water system consists of sources of raw water supply and facilities, treatment plant facilities, treated water storage, and treated water transmission main and distribution system. These components are discussed in detail below. A water systems map is shown in Figure 5.1.1.

5.1 Water Rights and Raw Water Supply

The nature and status of existing raw water supplies and water rights is crucial to the formulation of a successful long-range plan for the City. The following is a discussion of the sources, availability, and reliability of the City's raw water sources.

Raw Water Sources

Presently, the City of Sutherlin has three available sources of raw water: Calapooya Creek, Cooper Creek Reservoir, and the North Umpqua River. An overall map of the Study Area showing the Calapooya Creek, and Cooper Creek Reservoir, is displayed in Figure 3.1.2.

Calapooya Creek

The first and primary source is the Calapooya Creek at Nonpareil, approximately eight miles east of the City. The Calapooya Creek source is generally of excellent water quality and is used throughout the year although the creek turbidity can be high (> 500 NTUs) for short periods of time during winter storms.

Cooper Creek Reservoir

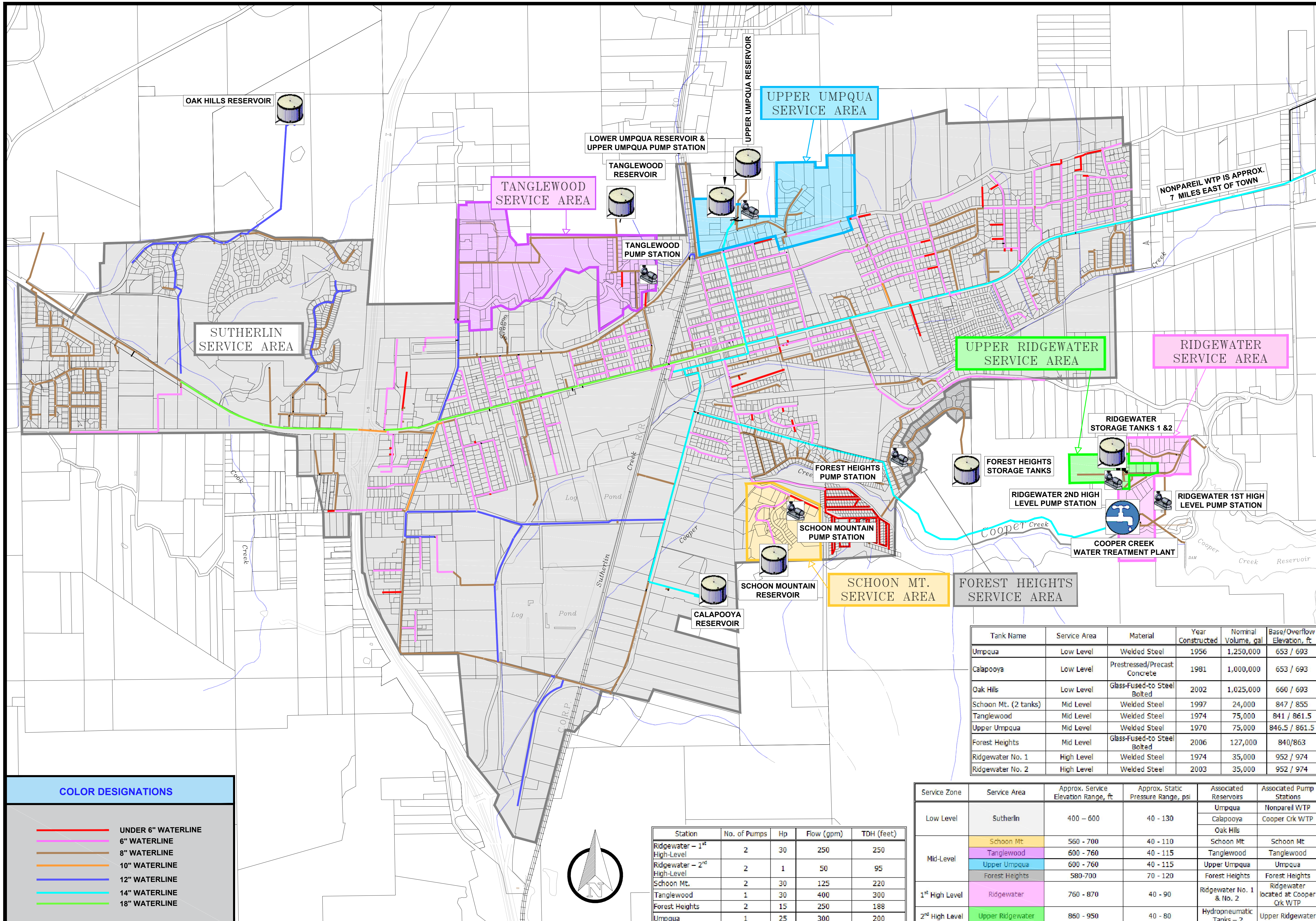
During the dry season months, the City withdraws and treats water from Cooper Creek Reservoir to keep up with water demand. Cooper Creek Reservoir is located southeast of Sutherlin on Cooper Creek, which is a tributary of Sutherlin Creek. Water quality in Cooper Creek Reservoir is generally poorer than in Calapooya Creek. Raw water at the City's Water Treatment Plant (WTP) often has zero Dissolved Oxygen (DO), elevated concentrations of iron and manganese, and noticeable levels of hydrogen sulfide. The reservoir is eutrophic with high concentrations of algae and growth of an evasive weed, Egeria densa.

North Umpqua River

The City has an undeveloped municipal water right on the North Umpqua River of 3.0 cfs. The two points of diversion are located downstream of Whistlers Bend, and at the Umpqua Basin Water Associations WTP site near the Gardner Valley Bridge. Water quality from the North Umpqua River is considered excellent and flows are generally reliable even in summer.

Water Rights

All water in Oregon is publicly owned. Based on this public ownership, a water right is generally required for anyone to use water, whether it originates from surface or underground sources. Oregon's water laws are based on the principal of prior application. That is, if a person obtains a water right on a particular source before someone else, the person would then possess a "senior" water right that would permit them first use of the water during times of lower flows or droughts. A "junior" water right is one that is obtained after other water rights for a particular source have been assigned. A water right may be both senior to some and junior to others. During periods of low water availability, a water right holder may use as much water as their water right allows as long as the use is truly beneficial and all senior water rights are satisfied. This method of resource appropriation governs all water used until the water is exhausted.



Tank Name	Service Area	Material	Year Constructed	Nominal Volume, gal	Base/Overflow Elevation, ft
Umpqua	Low Level	Welded Steel	1956	1,250,000	653 / 693
Calapooya	Low Level	Prestressed/Precast Concrete	1981	1,000,000	653 / 693
Oak Hills	Low Level	Glass-Fused-to Steel Bolted	2002	1,025,000	660 / 693
Schoon Mt. (2 tanks)	Mid Level	Welded Steel	1997	24,000	847 / 855
Tanglewood	Mid Level	Welded Steel	1974	75,000	841 / 861.5
Upper Umpqua	Mid Level	Welded Steel	1970	75,000	846.5 / 861.5
Forest Heights	Mid Level	Glass-Fused-to Steel Bolted	2006	127,000	840/863
Ridgewater No. 1	High Level	Welded Steel	1974	35,000	952 / 974
Ridgewater No. 2	High Level	Welded Steel	2003	35,000	952 / 974

Station	No. of Pumps	Hp	Flow (gpm)	TDH (feet)
Ridgewater – 1st High-Level	2	30	250	250
Ridgewater – 2nd High-Level	2	1	50	95
Schoon Mt.	2	30	125	220
Tanglewood	1	30	400	300
Forest Heights	2	15	250	188
Umpqua	1	25	300	200

Service Zone	Service Area	Approx. Service Elevation Range, ft	Approx. Static Pressure Range, psi	Associated Reservoirs	Associated Pump Stations
Low Level	Sutherlin	400 – 600	40 - 130	Umpqua	Nonpareil WTP
				Calapooya	Cooper Crk WTP
				Oak Hills	
Mid-Level	Schoon Mt	560 - 700	40 - 110	Schoon Mt	Schoon Mt
	Tanglewood	600 - 760	40 - 115	Tanglewood	Tanglewood
	Upper Umpqua	600 - 760	40 - 115	Upper Umpqua	Umpqua
	Forest Heights	580-700	70 - 120	Forest Heights	Forest Heights
1st High Level	Ridgewater	760 - 870	40 - 90	Ridgewater No. 1 & No. 2	Ridgewater located at Cooper Crk WTP
2nd High Level	Upper Ridgewater	860 - 950	40 - 80	Hydropneumatic Tanks – 2	Upper Ridgewater

SUTHERLIN WATER MASTER PLAN

EXISTING WATER SYSTEM

FIGURE NO. 5.1.1

THE DYER PARTNERSHIP
ENGINEERS & PLANNERS

DATE: JAN. 2017

PROJECT NO.: 146.48

The City currently holds surface water right certificates and permits on the Calapooya Creek, Cooper Creek (as part of Sutherlin Water Control Board) and Umpqua River totaling 12.0 cfs or approximately 7.76 Million Gallons (MG) per day. In addition, the Sutherlin Water Control Board holds a water right to store 500 ac-ft of water at the Cooper Creek Reservoir.

A brief summary of each listed water right is given below. For more water right information, please see the 2017 Water Management and Conservation Plan (WMCP). Water right documentation is provided in Appendix B. Table 5.1.1 summarizes the City's water rights.

TABLE 5.1.1
WATER RIGHTS DOCUMENTATION SUMMARY

Location	Application	Permit	Certificate	Magnitude (cfs)	Priority Date
Calapooya Creek	S9945	S6610	6344	0.75	7/1/1926
Calapooya Creek	S19502	S15016	19629	2.25	9/5/1941
Calapooya Creek	S58288	S44066	-	1	1/29/1979
Cooper Creek (1)	S44016	S32426	-	5	8/29/1967
North Umpqua River	S59416	S44926	-	3	10/15/1979

Calapooya Creek

A total of approximately 37 cfs of water rights are allocated on Calapooya Creek. Six cfs are municipal rights split between the City of Oakland (2.0 cfs) and Sutherlin (4.0 cfs). The City of Oakland's water right has the most senior water right on Calapooya Creek. The majority of the remaining water rights (approximately 75%) are for irrigation. Minimum instream flows for Calapooya Creek were established by the State in 1958, and increased in 1974 to reflect seasonal requirements, as an attempt to maintain minimum flows necessary to sustain aquatic life. Of the City's water rights, the 1.0 cfs water right obtained in 1979 is junior to these minimum instream flows. Consequently if the streamflow in Calapooya Creek drops below minimum instream flows, the City may not be able to utilize this 1.0 cfs right until stream flows are restored above the minimum instream levels.

A comparison of long-term flow statistics for Calapooya Creek downstream of Oakland, with the 2008 minimum instream flows, is presented in Table 5.1.2 (water gauge data for Calapooya Creek ended in 2000).

TABLE 5.1.2
HISTORICAL PROBABILITY OF FLOW AND MINIMUM INSTREAM FLOWS
CALAPOOYA CREEK

Month	Flow (cfs)/ Probability of Exceedence					2016 Minimum Instream Flow
	95%	90%	80%	50%	40%	
June	53	71	95	181	217	50
July	22	29	41	71	83	30
August	6.1	7.5	10	20	25	20
September	1.9	2.8	1.3	8.5	10	18.6
October	1.7	2.9	4.2	9.4	12	17.5
	5.7	7.2	11	24	30	29
November	21	28	48	150	235	70
December	54	97		613	850	70

Based on this historical streamflow data, there is less than a 40 percent probability of the streamflow in the Calapooya (downstream of Oakland) exceeding the minimum instream flow in August. In other words, over six out of ten years in the month of August, the County Watermaster would have the authority to enforce minimum instream flow requirements and restrict any water rights junior to the instream requirements. To date, there are only two known instances in which the County Watermaster has requested the City to restrict their diversion of water from Calapooya Creek: July 16, 1985 and August 15, 1990. The lowest streamflow on record for this location is zero (no) flow in September 1966.

As mentioned above, City of Sutherlin's most recent water right (1.0 cfs, 1978) is junior to the minimum instream flows and will likely (>90% probability) be available between the months of December through April. During the remaining months (May through November), the City may be requested to restrict its diversion using this water right during drought conditions. For planning purposes, it will be assumed for this report that this junior right of 1.0 cfs will not be available for the City's diversion during the summer and late fall months. The City's other water rights on Calapooya Creek (3.0 cfs) predate the minimum instream flows and are only impacted by other more senior water rights.

Cooper Creek

Sutherlin has 5.0 cfs of water rights on Cooper Creek plus 500 acre-feet (ac-ft) storage on Cooper Creek Reservoir. The initial allocation of storage on Cooper Creek Reservoir included 500 ac-ft for municipal use and 3,400 ac-ft for recreational use.

In April of 2016 a permit extension was given which limited the allowed diversion. The diversion from Cooper Creek is now limited to 3.0 cfs with an additional 2.0 cfs subject to the requirements of "persistence of listed fish". These requirements will stipulate a minimum flow required in the creek throughout the year. Any flow within the creek above these defined values will be available for diversion up to 2.0 cfs. The 2016 permit reduced the available storage from 500 ac-ft to 179 ac-ft.

North Umpqua River

The City of Sutherlin has a permit dated October 15, 1979 for diversion of water (3.0 cfs) from the North Umpqua River. The two points of diversion are located downstream of Whistlers Bend, and at the Umpqua Basin Water Associations WTP site near the Gardner Valley Bridge. For the Lower North Umpqua River watershed, municipal use is the largest user at approximately 35 percent, followed by irrigation (32 percent). The City's water right is junior to the minimum instream water rights. A comparison of long-term flow statistics for the North Umpqua River near Glide, with the 2008 minimum instream flows, is presented in Table 5.1.3.

TABLE 5.1.3
HISTORICAL PROBABILITY OF FLOW AND MINIMUM INSTREAM FLOWS FOR THE NORTH UMPQUA RIVER

Month	Flow (cfs)/ Probability of Exceedance					2016 Minimum Instream Flow
	95%	90%	80%	50%	40%	
June	1,782	1,897	1,936	2,355	2,548	1,350
July	1,076	1,104	1,148	1,260	1,318	1,290
August	935	938	952	977	985	996
September	929	933	937	950	972	983
October	1,050	1,050	1,062	1,110	1,162	1,190 (10/1-15)
	1,140	1,154	1,208	1,480	1,530	1,350 (10/16-31)
November	1,872	1,970	2,244	3,360	4,150	1,350

Stream flow in the North Umpqua River historically exceeds the minimum instream flows during the low flow months with the exception of August, September, and October. During these months, the streamflow has historically been below minimum instream flows for 30 to 60 percent of the time. Consequently every three to six years out of a ten year timeframe in the months of August through October, the County Water

Master would have the authority to enforce minimum instream flow requirements and restrict the City's water right which is junior to the instream requirements.

Diverted Water

The City utilizes Calapooya Creek as its primary source for a majority of the year and supplements use from the Cooper Creek source during the dry season months (June through October). While the City has flowmeters on both raw water sources, there is concern about the accuracy of these meters. Based on a cursory comparison of the calculated flows, the sum of the water pumped to the City and backwash is typically greater than the reported water diverted from the raw water source. In the case of the Nonpareil WTP, City staff reports that debris occasionally becomes lodged in the meter (typically in the winter) requiring removal, which distorts the flow readings.

The estimated amount of water diverted from this source and the estimated amount from the City sources for the Water Years 2013 to 2016 is presented in Table 5.1.4.

TABLE 5.1.4
HISTORICAL WATER DIVERSION (2013 – 2016)

Parameter/Year	2013	2014	2015	2016
Nonpareil WTP - Calapooya Creek				
Total Gallons, MG	437	354	385	437
Ave. Daily cfs	1.20	0.97	1.06	1.20
Max. Month, cfs	1.90	1.31	1.48	1.61
Peak Week, cfs	1.98	1.65	1.63	1.79
Max. Daily, cfs	2.12	2.05	1.77	1.95
Total Water Rights, cfs	4			
Cooper Creek WTP - Cooper Creek Reservoir				
Total Gallons, MG	0	99	95	88
Ave. Daily cfs	0	0.27	0.26	0.24
Max. Month, cfs	0	0.79	0.75	0.86
Peak Week, cfs	0	1.01	0.78	1.02
Max. Daily, cfs	0	1.21	0.99	1.59
Total Water Rights, cfs	5			

Based on the historical water diversion, the rate of withdrawal from Calapooya Creek at the Nonpareil WTP is below the allocated senior water rights (3.0 cfs). With respect to Cooper Creek Reservoir, all water withdrawals have been considerably less than the City's water right of 5.0 cfs.

Watershed for Raw Water Sources

The City's Calapooya Creek watershed extends approximately 71 miles in an easterly direction and includes approximately 85.4 square miles. The area within the watershed includes Calapooya Creek and the following tributaries: Long Valley, Pelland, Cantell, Gassy, Hinkle, Jeffers, Timothy, Corn and White Creeks. The dominant land used within Calapooya Creek watershed consists of agricultural land uses and privately owned managed forestlands. Potential contamination sources identified in this watershed include rural homesteads, Red Rock Road (potential runoff from mine tailings), grazing animals, clear cuts, road density, stream crossings, areas of slope instability, and managed forestlands.

The Cooper Creek Reservoir portion of the watershed extends upstream approximately three to four miles in a southeasterly direction and includes a total of 4.5 square miles. The watershed includes the reservoir and its tributaries, including Cooper Creek. The Cooper Creek watershed is primarily dominated by recreation and forestland uses with interspersed residential land use. Potential contaminant sources within this watershed include grazing animals, clear cuts, areas of slope instability, managed forestlands, recreation areas (parks), large capacity septic systems, a stormwater outfall and retention basin, and a rural residential area.

The North Umpqua River watershed extends upstream approximately 190 miles in an easterly direction and encompasses a total area of approximately 200 square miles. Tributaries to the main stem include Cooper, Huntley, Dixon, Clover, Oak, Buckhorn Creeks, and the Little River and its tributaries. Activities and impacts in the Roseburg, Glide, Toketee Village, and Wolf Creek Job Corps drinking water protection areas have the potential to impact downstream users. The North Umpqua River watershed is dominated by commercial, residential/municipal, agricultural, and forestland uses. Potential contaminant sources within the watershed include a number of commercial land uses, six schools, a wastewater treatment plant, two water treatment plants, a transfer station, a fire station, parks, three transportation corridors, a ranger station, grazing, irrigated crops, and clear-cuts.

5.2 Raw Water Facilities

The raw water facilities consist of diversion structures and impoundments, and raw water transmission mains. These facilities are discussed in detail below.

North Umpqua River Intake

The current access to the North Umpqua River water rights is through the intake owned by the Umpqua Basin Water Associations. The intake is located along the North Umpqua River near the Gardner Valley Bridge. During the construction of the new intake and WTP, the City contributed funds allowing for increased capacity of the intake and WTP. As it is new construction, the intake is in excellent condition.

Although this intake is not currently drawing water for the City of Sutherlin, as water demand rises within the City, this will change. When the City water demand exceeds the water rights from the Calapooya Creek, and Cooper Creek, the City will then begin drawing from the Umpqua Basin Water Associations water system.

Nonpareil WTP Intake

The raw water intake structure for the Nonpareil WTP is located behind a small concrete dam on Calapooya Creek. The raw water intake consists of a fine-slotted screen that is oriented parallel with the creek flow. This screen is used to reduce the amount of solids entering the raw water main. An air compressor and storage tank located in an adjacent concrete block building is used to provide air scour to clear the screen of solids. During wet weather events when the turbidity of the creek water is high (up to 200 NTUs and greater), air scours are needed every 45 to 60 minutes. As it takes 45 minutes for the air compressor to fill the air storage tank, larger or dual compressors are needed to provide timely cleaning of the intake screens.

From the intake screens, water flows by gravity through a concrete channel to the raw water wet well. The wet well itself is an approximately eight foot square concrete vault with a metal lid. Submersible pumps, with large solids clearance are utilized to pump the water to the treatment plant via 14-inch diameter pipe. A turbine meter is located in a concrete vault on the west side of the WTP building which is used to measure the raw water flow. City staff reports that this water meter is occasionally plugged with small sticks that have cleared the raw water intake screens and raw water submersible pumps. The water right is for 4 cfs (2.59 MGD) including a 1 cfs (.647 MGD) junior water right.

Cooper Creek WTP Intake

The raw water intake for the Cooper Creek WTP lies at an elevation of 630 feet Mean Sea Level (MSL) approximately 38 feet below the permanent pool elevation of 668 feet MSL. The intake consists of a concrete riser with a 12-inch sluice gate on the top. Reservoir water enters through the gate and drops into a 24-inch diameter reinforced concrete pipe that is connected upstream to a sediment drain riser. The sediment drain riser is used to clear sediment from the bottom of the reservoir; this riser is located at 613 feet MSL. The 24-inch diameter pipe penetrates the dam and terminates downstream with an outlet to Cooper Creek. For the municipal feed, water is diverted from the 24-inch main at a tee with 18-inch diameter main. The size of this main pipe reduces to 14-inch diameter, then reduces to a 10-inch diameter, then increases in size to a 14-inch diameter pipe. The transition from 14-inch to 10-inch and 10-inch to 14-inch diameter pipe occurs approximately 750 and 200 lineal feet from the WTP respectively. The location of the 18-inch to 14-inch diameter main transition is not known.

The set removal point leads to poor raw water quality which increases the cost to treat. A variable level intake should be investigated to allow for lower year round treatment costs. The elevation head between the reservoir (approx. 668 ft) and the treatment plant (approx. 610 ft) is adequate to supply raw water flow rates required to deliver the maximum daily water supply equal to the City’s water right of 5 cfs (3.23 MGD). However, the limiting factor is the size of the intake and raw water piping. At 3.2 MGD, the velocity within the 10-inch main is approximately nine feet per second (fps), which is too high. To minimize pipe velocity, the 10-inch water main should be replaced with at least a 14-inch diameter main.

5.3 Water Treatment Facility

The City of Sutherlin has two potable water treatment plants (WTPs): Nonpareil WTP and Cooper Creek WTP. The City utilizes the Nonpareil WTP year-round while the Cooper Creek WTP is used to supplement water production during the high water demand months in the summer. Water availability and treatment capability from the City’s two water sources (Calapooya Creek and Cooper Creek Reservoir) provides the City with redundancy and backup reliability in the event of an emergency.

Nonpareil WTP

The Nonpareil WTP was built in 1982 with a net design capacity of 2.3 MGD, including backwash. This plant utilizes chemical coagulation and polymer addition, a solids contact clarifier for flocculation and clarification, multimedia filtration with surface wash, and disinfection with chlorine gas. The WTP design capacity is shown in Figure 5.3.1, and existing design data is given in Table 5.3.1. A site plan of the Nonpareil WTP site is presented in Figure 5.3.2. Photographs of the Nonpareil WTP are presented in Figures 5.3.3 and 5.3.4. Design data for the water treatment unit is provided in Table 5.3.1.

FIGURE 5.3.1
DESIGN CAPACITY OF NONPAREIL WTP

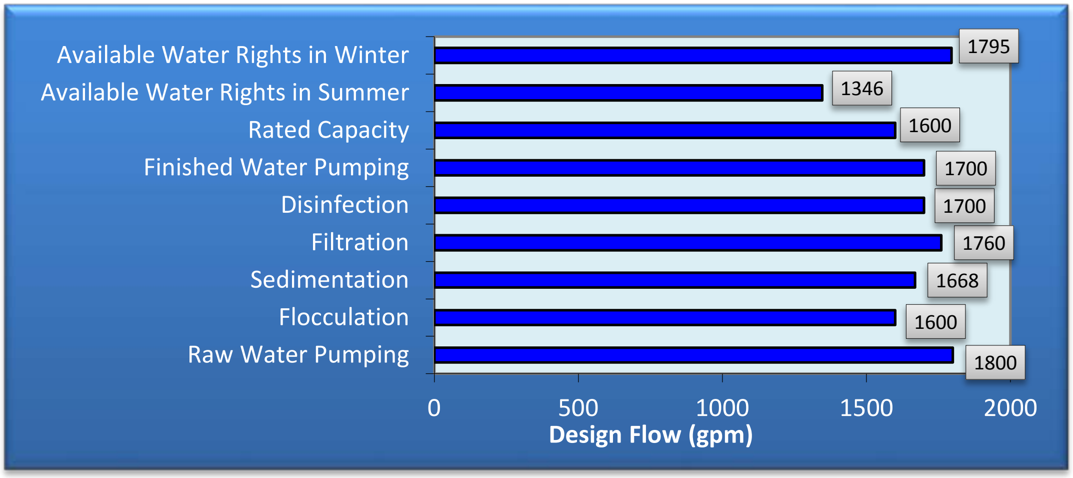


TABLE 5.3.1
EXISTING DESIGN DATA – NONPAREIL WTP

Parameter	Value/Description
General Design Data	
Year Constructed	1982
Demand Flow / Design Plant Capacity (w/backwash)	1,450 gpm (2.1 MGD) / 1,600 gpm (2.3 MGD)
Health Division Performance Rating	2.0 log for treatment, 1.0 log for disinfection
Raw Water Pumps (only one runs at a time)	3 submersible, 1,800 gpm @ 18.5 TDH
Raw Water Chemical Feed	
Coagulant	Polyaluminum chloride (PAC)
Polymer	Anionic Polymer, 1986 N
Solids Contact Clarifier	
Flocculation Chamber Volume/Detention Time	16,000 gallons / 10 minutes
Sedimentation Area	1,390 sq. ft. w/ settling tubes
Upflow Rate	1.2 gpm/sq. ft.
Filters	
Number of Units	4
Depth & Type of Media	18" Anthraciite, 14" Sand, 13" Gravel
Surface Area	110 sq. ft. each; 440 sq. ft. total
Filtration Rate	4 gpm / sq. ft.
Backwash Rate (one filter)	17 gpm/ sq. ft.
Treated Water Pumps	3 vertical turbine, 75 Hp, 850 gpm @ 255 TDH
Clearwell Volume	50,000 gallons
Backwash	
Pumps	1 vertical turbine, 30 Hp, 1,875 gpm @ 41 TDH
Ponds - Number/Approx. Surface Area	3 / 14,000 sq.ft. (estimated)
Disinfection	Gaseous Chlorine
Treated Water Chemical Feed	Polyphosphate for corrosion control

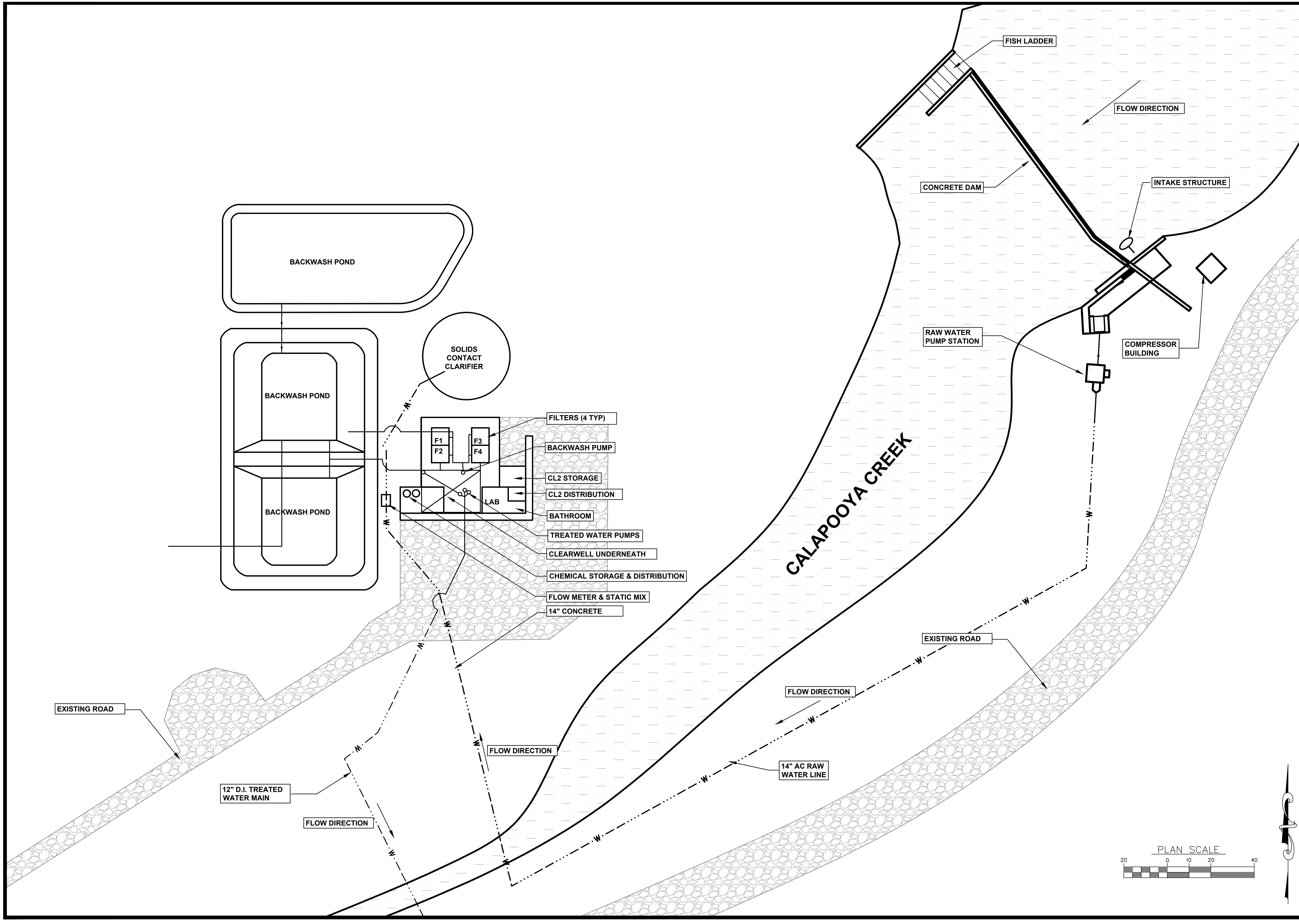


FIGURE NO. 5.3.2

SUTHERLIN WATER MASTER PLAN

NONPAREIL WTP EXISTING SITE PLAN

THE DYER PARTNERSHIP
ENGINEERS & PLANNERS

DATE: MARCH 2017

PROJECT NO.: 146.48

FIGURE 5.3.3
NONPAREIL WTP BUILDING

FIGURE 5.3.4
NONPAREIL WTP TREATED WATER PUMPS

Plant Operation

Raw water is delivered to the WTP via the raw water pumps located on the south side of Calapooya Creek and a 14-inch diameter AC water main. Polyaluminum Chloride (PAC) is added to the raw water prior to an inline, static mixer by chemical metering pump. The amount of PAC introduced into the raw water is adjusted based on readings from a streaming current monitor on the raw water line. After the static mixer, the raw water travels to the solids contact clarifier. This unit is a circular concrete basin with an inner metal circular well. Raw water flows into the inner circular well for flocculation and then to the outer well for sedimentation. Inside the outer well there are tube settlers to aid in sedimentation. Clarified water travels thorough effluent launders to the filters. There are four filter units, each of which is designed to have anthracite, sand, and gravel as media. The clarified water travels through the filters and is injected with chlorine prior to entering the clearwell. The clearwell serves three purposes: 1) temporary storage, 2) contact time for disinfection, and 3) source of backwash water for the treatment unit. Water is then pumped into the City's treated water transmission main and distribution system via the treated water pumps located over the WTP clearwell. Turbidity of the filtered water is measured off the effluent from each filter and from a composite of the effluent.

Ultimately, treated water production is controlled by the water level in the Umpqua or Calapooya Reservoir Tanks in town and radio telemetry. When the water level in these tanks drops to a predetermined level, the treated water pumps located above the Nonpareil WTPs clearwell start and pump water to town. When water level in the clearwell reaches a predetermined level, the filter effluent valves will open and place the filters into operation. As the level falls in the filter bays and inlet flume, a level probe in the filter flume will start the raw water pump and chemical feed system. Treated water from the solids contact clarifier will flow to the filters and the plant will operate until shut down by: 1) high level switch from the clearwell, 2) automatic call for backwash, 3) manual shutdown by the Operator, or high level in the filter flume.

The backwash operation of the filters is automatically initiated by the pressure switch at the filter outlet, after a preset loss of head is registered for several minutes. Once the cycle is started, a programmed timer controls all functions in the following sequence: 1) media filter effluent valve closes, 2) surface wash system is initiated, 3) backwash valve opens slowly and the backwash pump starts, 4) after a preset time (4-6 minutes) the surface wash and backwash valves and pumps are shut down and the filter plant is returned to normal service. The WTP has no filter for waste capabilities. Backwash water is directed to one to three ponds adjacent to the WTP. These ponds are operated in series with the overflow from the southern-most pond discharging to a nearby creek that discharges to Calapooya Creek. City staff periodically takes the primary pond out of service during the summer to dry and remove the accumulated solids.

Metering

The raw and treated water streams are measured with turbine water meters. The raw water meter periodically requires removal of accumulated debris during the months of high creek flows. With the accumulated debris, accuracy of this flow meter is in question. There are no water measurements made on the backwash water, surface wash water, or general water usage (sanitation, pump seals, chemical make-up, water quality measurements, etc.) at the WTP. Water used for backwash and surface wash is estimated from the product of the pump capacity and number of pump operating hours.

Water Production and Backwash

A summary of historical water pumped to the City, amount of backwash, amount of water produced, and percentage of backwash (based on total water production) is given in Table 5.3.2.

TABLE 5.3.2
HISTORICAL WATER PRODUCTION & BACKWASH FOR THE NONPAREIL WTP

Parameter	Year				Average
	2013	2014	2015	2016	
Water Pumped, MG	407	332	372	407	379
WTP Backwash, MG	30	23	13	30	24
Total WTP Production, MG	437	354	385	437	403
WTP Backwash, %	6.8%	6.4%	3.4%	6.9%	5.9%

Operation and Maintenance Issues

A number of operational issues were identified during site visits and discussions with City staff. These operational issues are discussed below.

Solids Contact Clarifier
The metal components on the Clarifier are showing wear and need to be recoated. Refurbishment of the flocculator components may be needed. A number of cracks and weeping is evident on the outside concrete wall of the clarifier. Staff indicates that solids periodically boil up on the north side of the clarifier in the afternoon during the summer months. Staff installed new tube settlers in the sedimentation part of the clarifier in 2006.

Filters
The filters appear to be in satisfactory condition and operating well. Flow to the filters does not appear to be evenly distributed between the filter bays. The filter bays (No. 1 & No. 3) closest to the solids contact clarifier appear to be getting more flow than the other bays as these units need to be backwashed more often. It appears that the filter media was last replenished in 1998. The media has reached the end of its typical service life.

Filter to Waste
There is no filter-to-waste capability at this plant. Consequently when the filter backwash is completed, the filter is immediately placed into service. Filter-to-waste piping and controls would allow diversion of the first water treated through the filter after backwash to the backup backwash pond, and eliminate any solids carryover to the clearwell.

Backwash Pump
The backwash process includes treated water flushing through the media filter from bottom to top. The water being pushed up through the filter removes the particles trapped in the lower levels of the filter. This system is in good condition. There is currently no backwash pump to assure continued water production if the existing pump fails.

Surface Wash
The surface wash mechanism sprays the top layers of the media bed during the backwash process. The surface wash helps to remove particles from the top layers of the filter. Although this system is in good condition, other alternatives have been developed that are more effective in removing trapped particles from filter media.

Disinfection
Staff indicates that the chlorine injector needs replacement. Chlorine gas, injected into water, is utilized for disinfection. Chlorine gas is a hazardous substance requiring a number of operating precautions and equipment to monitor for chlorine gas.

Backwash Ponds
It is difficult for staff to remove solids from the backwash ponds. When the primary pond is out of service to let the solids dry out, the secondary ponds become overloaded. The northern-most backwash pond does not have a fence around it.

Potable Water Pump
WTP operation is dependent upon a single potable water pump, which is a submersible pump located in the clearwell. If this pump fails, the WTP cannot operate and no water is available to nearby residents. A redundant pump is needed.

System Piping
The piping within the treatment plant has been in place for 35 years. As a result, the piping is beginning to corrode, leak at joints, and slow production. Additionally, given the piping’s age, none of the valves are fitted with electronic actuators.

Nonpareil WTP Service Lines
Currently three services are connected to the pressure tank within the WTP. If the plant is taken out of service to complete the recommended improvements, these services will be without water.

Electrical Equipment
Electrical equipment is old and should be upgraded. Installation of a Supervisory Control And Data Acquisition (SCADA) system would allow City staff to remotely access WTP data and control operations.

Generator
The existing generator is currently functioning; however it has reached the end of its typical service life. The generator is in need of replacement. Currently there is no automatic transfer switch at the WTP.

Pressure Tank and Associated Piping
The pressure tank holding treated water for the WTP and three residential services is past its service life. The tank and associated piping will need to be replaced during the planning period.

Monitoring and Processing Equipment
Much of the equipment within the WTP is nearing the end of its service life. More specifically, the streaming current monitor, chlorine analyzer, and turbidity monitors are functioning properly, but will need to be replaced early in the planning period.

Cooper Creek WTP

The Cooper Creek WTP was built in 2014 with a design capacity of 4.0 MGD. This plant is a Siemens Packaged Water Treatment Plant (Trident Model HS-2800A), and utilizes chemical coagulation and polymer addition, an up-flow clarifier for flocculation, multimedia filtration with air scour, and disinfection with a Miox mixed oxidant generation system. The clearwell from the new WTP and the prior WTP were combined into one clearwell. Design data for the water treatment unit is provided in Table 5.3.3. A summary of the design capacity of the selected hydraulic and process equipment for the Cooper Creek WTP is shown in Figure 5.3.5. A site plan of the Cooper Creek WTP site is presented in Figure 5.3.6. Selected photographs of the Cooper Creek WTP facility are provided in Figures 5.3.7 and 5.3.8.

FIGURE 5.3.5
DESIGN CAPACITY OF COOPER CREEK WTP

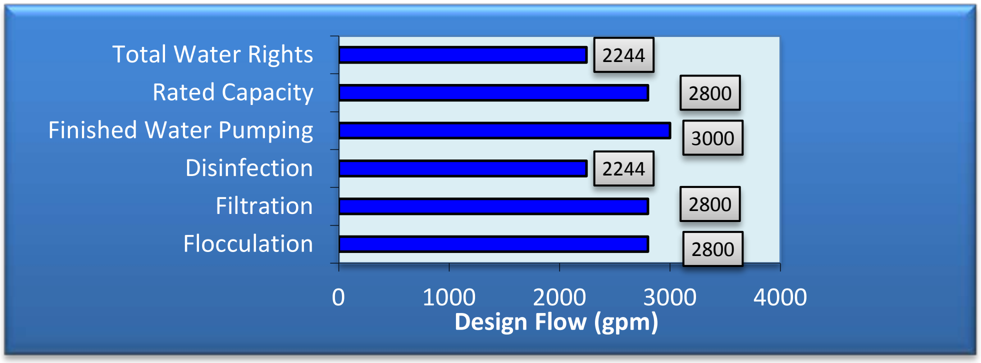


TABLE 5.3.3
EXISTING DESIGN DATA – COOPER CREEK WTP

Parameter	Value/Description
General Design Data	
Year Constructed	2014
Demand Flow / Design Plant Capacity (w/backwash)	2,200 gpm (3.2 MGD) / 2,800 gpm (4.0 MGD)
Health Division Performance Rating	2.5 log for treatment
Raw Water Chemical Feed	
Coagulant	Polyaluminum chloride (PAC)
Manganese and Iron Treatment	Potassium Permanganate
PH Treament	Sodium Hydroxied
Polymer	Anionic Polymer, 1986 N
Up-Flow Clarifier	
Flocculation Chamber Volume	9,330 gallons
Total Area Square Feet	93.3 sq. ft.
Upflow Rate	7.5-15 gpm/sq. ft.
Air Scour Rate, scfm/basin	420
Filters	
Number of Units	2
Depth & Type of Media	18” Anthraciite, 9” Sand, 4” Garnet
Surface Area	280 sq. ft. each; 560 sq. ft. total
Filtration Rate	2.5-5 gpm / sq. ft.
Backwash Rate (one filter)	15 gpm/ sq. ft.
Air Scour Rate, scfm/basin	840
Air Scour System	
Number of Blowers	2
Capacity, scfm	420 @ 4.1 psi
Treated Water Pumps	3 vertical turbine, 100 Hp, 1,500 gpm @ 197 TDH
Clearwell Volume	125,000 gallons
Backwash	
Pumps	1 vertical turbine, 50 Hp, 4,200 gpm @ 32 TDH
Ponds - Number/Approx. Surface Area	3 / 14,000 sq.ft. (estimated)
Disinfection	Miox mixed oxidant generation system
Treated Water Chemical Feed	Polyphosphate for corrosion control

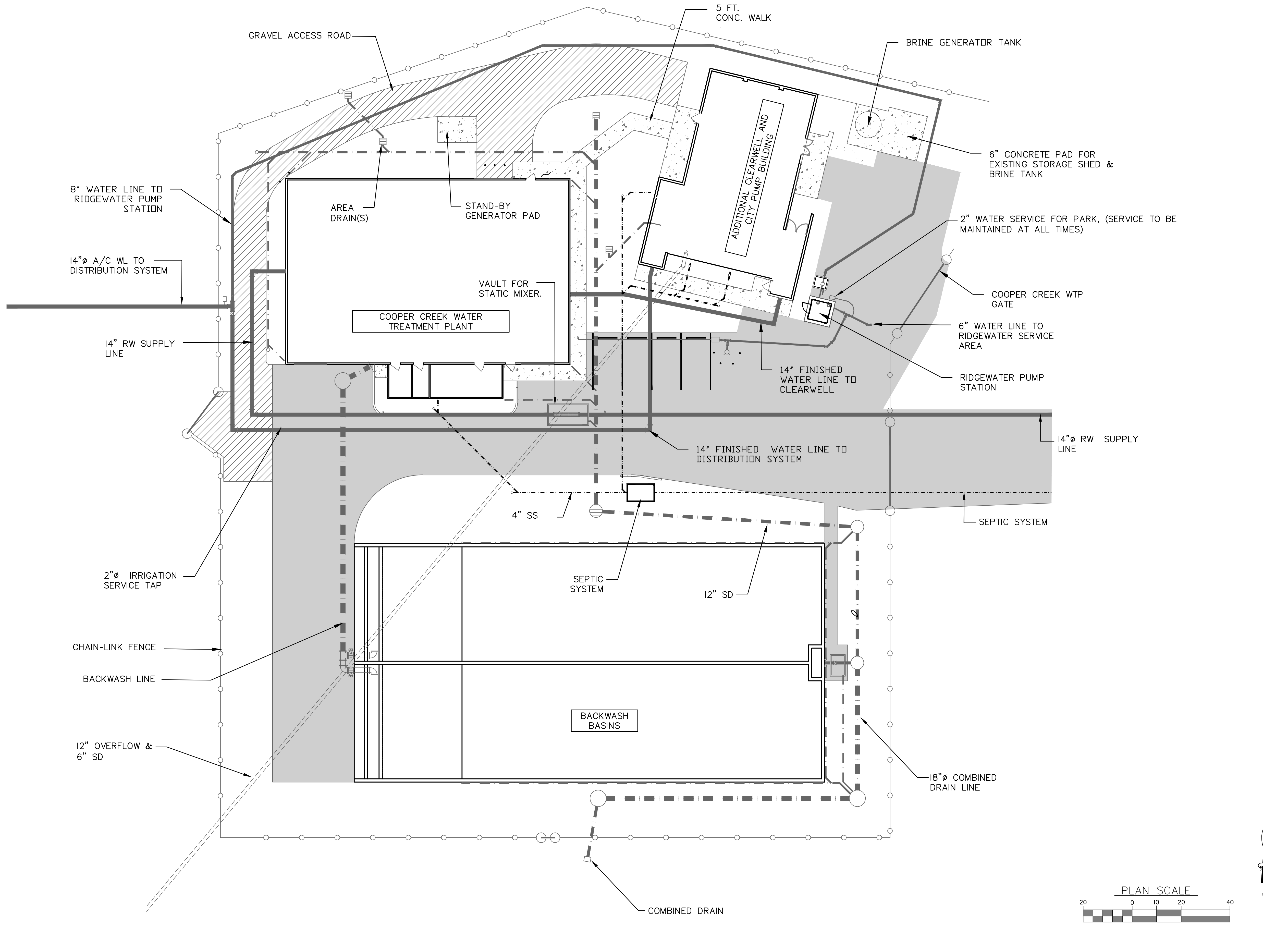


FIGURE NO. 5.3.6

SUTHERLIN WATER MASTER PLAN

COOPER CREEK WTP SITE PLAN

THE DYER PARTNERSHIP ENGINEERS & PLANNERS

DATE: MARCH 2017

PROJECT NO.: 146.48

FIGURE 5.3.7
COOPER CREEK WTP BUILDING

FIGURE 5.3.8
COOPER CREEK WTP FILTER UNIT AND PIPING

Plant Operation

Raw water is delivered to the WTP by gravity via a combination of 10-inch and 14-inch diameter water main. Potassium permanganate and PAC, pH adjuster and polymer 1986 is added to the raw water prior to an in-line, static mixer by chemical metering pump. Potassium permanganate is added to oxidize soluble iron and manganese in the raw water to insoluble precipitates. The amount of PAC introduced into the raw water adjusted based on readings from a streaming current monitor on the raw water line. The pH adjuster is added to maintain an acceptable pH in the raw water. The polymer is added to bind particles together better enabling the settling tubes and filter to remove particles and attached contaminants from the raw water. After the static mixer, the raw water travels to the tube clarification basin. The tube clarification stage reduces influent solids concentration prior to the adsorption clarifier stage. Following the tube settler, the water travels to the adsorption clarifier. Flocculated water travels up through the buoyant media and fixed media filters within the adsorption clarifier and into the mixed media filter. There are two filter units, each of which is designed to have anthracite, sand and garnet as media. The clarified water travels through the filters and is injected with chlorine, corrosion inhibitor, and a pH adjuster prior to entering the clearwell. The clearwell from the prior WTP has been combined with the clearwell under the new WTP. The clearwell serves three purposes: 1) temporary storage, 2) contact time for disinfection, and 3) source of backwash water for the treatment unit. Water is then pumped into the City’s treated water transmission main and distribution system via the treated water pumps located over the WTP clearwell. Turbidity of the filtered water is measured off the effluent from each filter and from a composite of the effluent.

As with the Nonpareil WTP, treated water production is controlled by the water level in the Umpqua or Calapooya Reservoir tanks in town and radio telemetry. When the water level in these tanks drops to a predetermined level, the treated water pumps located above the Cooper Creek WTPs clearwell start and pump water to town. When water level in the clearwell reaches a predetermined level, the filter effluent valves will open and place the filters into operation.

The pressure loss switch at the adsorption clarifier and the filter outlet automatically initiates the flush operation at the clarifier and the backwash operation of the filters after a preset loss of head is registered for several minutes. Once the flush cycle is started, a programmed timer controls all functions in the following sequence: 1) raw water and clarifier flow is maintained, 2) air scour valves open slowly and the compressor starts 3) the waste valve is opened 4) after a preset time (4-6 minutes) the air scour system is shut down, the valves are closed, and the clarifier is returned to normal service. Once the backwash cycle is started, a programmed timer controls all functions in the following sequence: 1) raw water pump is shutdown, 2) backwash valve opens slowly and the backwash start, 3) after a preset time (4-6 minutes) the backwash valves and pumps are closed and shutdown and the filter is returned to normal service. During the air sour/backwash process, water is removed from the top of the filters and discharged to the backwash pond. Backwash water is directed to the pond adjacent to the WTP. This pond is operated with the overflow discharging to Cooper Creek. City staff periodically pumps sludge out of these ponds for removal of accumulated solids.

Metering

The raw and treated water streams are measured with magnetic flow meters. There are also flow measurements made on the backwash water, clarifier waste, and filter waste.

Water Production and Backwash

A summary of historical water production and backwash for the Cooper Creek WTP is given in Table 5.3.4.

TABLE 5.3.4
HISTORICAL WATER PRODUCTION AND BACKWASH
FOR THE COOPER CREEK WTP

Parameter	Year			Average
	2014	2015	2016	
Water Pumped, MG	82	78	51	53
WTP Processing Water, MG	17	17	37	18
Total WTP Production, MG	99	95	88	70
WTP Processing Water, %	16.8%	18.2%	41.9%	19.2%

From 2014 to 2016, the Cooper Creek WTP operated on average of 161 days, ranging from 119 days to 186 days. The low utilization of this facility is due to poor water quality during the drier months of the year.

Operation and Maintenance Issues

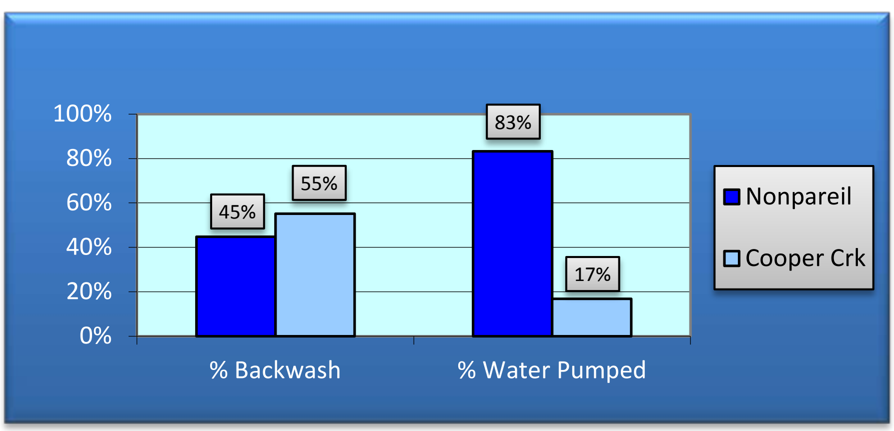
The Cooper Creek WTP has been recently constructed, and for this reason there are no deficiencies related to general condition, or faulty equipment. All systems are operating as designed without error. Although the WTP is functioning as intended, there is one point of concern related to the WTP operation. This issue is discussed below.

High Level of Chemicals Required for Treatment of Manganese
The high levels of manganese in the Cooper Creek Reservoir require the use of large quantities of chemicals in the treatment process, and frequent backwashing. Examination of non-chemical alternatives for removing manganese from the raw water is necessary.

Overview of WTPs

The Nonpareil WTP is the City's primary source of potable water; approximately 83 percent of the City's water is produced at this facility. Overall, this WTP is in fair condition. However, the Nonpareil WTP is in need of an overhaul to maintain and enhance its continued operation. The Cooper Creek WTP is used to handle peak water consumption during the summer months. This plant is in good condition and operates smoothly, but has some potential areas of improvement. A comparison of the WTP operation is presented in Figure 5.3.9.

FIGURE 5.3.9
COMPARISON OF WTP OPERATION



5.4 Treated Water Storage

The purpose of treated water storage reservoirs or tanks is to provide: 1) a sufficient amount of water to average or equalize the system's daily demand, 2) adequate pressures throughout the system, 3) sufficient storage for fire flows demand and 4) reserve storage for periods when the City is without a water supply. The City's water system has a total of ten storage tanks providing a nominal capacity of 3,646,000 gallons of storage. A summary of relevant reservoir data is provided in Table 5.4.1. A brief description of each tank is provided below.

TABLE 5.4.1
TREATED WATER RESERVOIRS

Tank Name	Service Area	Material	Year Constructed	Nominal Volume, gal	Base/Overflow Elevation, ft
Umpqua	Low Level	Welded Steel	1956	1,250,000	659 / 693
Calapooya	Low Level	Prestressed/Precast Concrete	1981	1,000,000	653 / 693
Oak Hills	Low Level	Glass-Fused-to Steel Bolted	2002	1,025,000	660 / 693
Schoon Mt. (2 tanks)	Mid Level	Welded Steel	1997	24,000	847 / 855
Tanglewood	Mid Level	Welded Steel	1974	75,000	841 / 861.5
Upper Umpqua	Mid Level	Welded Steel	1970	75,000	846.5 / 866.5
Forest Heights	Mid Level	Glass-Fused-to Steel Bolted	2006	127,000	840/863
Ridgewater No. 1	High Level	Welded Steel	1974	35,000	952 / 974
Ridgewater No. 2	High Level	Welded Steel	2003	35,000	952 / 974

A brief site inspection of the City's reservoir tanks was made on February 2017, which primarily consisted of a review of the outside of the tanks and associated appurtenances. No observations were made of the inside of the tanks or of the tank roofs. The following is a summary of the site observations and comments from City staff.

Low Level Tanks

The low level tanks, consisting of Umpqua, Calapooya, and Oak Hills, provide a total of 3,275,000 gallons of storage for the majority of the City's service area. Elevations within this service area range from approximately 400 feet to 600 feet. Water levels within the Umpqua or Calapooya Tanks are utilized to call for the operation of the City's WTPs (Nonpareil and Cooper Creek). The finished water pumps at each WTP feed these reservoir tanks.

Oak Hills Tank
The tank was built in 2002, is a glass-fused-to-steel reservoir, and is in good condition. An altitude valve controls the maximum water level in this tank. There is no cathodic protection, or seismic valving at this reservoir.

Calapooya Tank
This tank appears to be in good condition. Access to this tank site is on a steep, narrow road above the City's Public Works Shop. Cracks were observed in the asphalt driveway on the downhill side of the tank. Survey markers have been placed on the downhill side of the tank to monitor any movement of the ground surface. Due to accumulated material on the southern fence line of the tank site, one may be able to scale the existing chain link fence at this location. There is no cathodic protection at this reservoir.

Umpqua Tank
Tank appeared to be in excellent condition. No cathodic protection was observed at the tank.

Mid-Level Tanks

The mid-level tanks, consisting of Schoon Mountain, Forest Heights, Tanglewood, and Upper Umpqua, provide a total of 301,000 gallons of storage for pressure zones above the City's low level service area. Elevations within this service area range from approximately 600 feet to 700 feet for Schoon Mountain area, approximately 580 to 700 feet for the Forest Heights are, and approximately 600 to 760 feet for Tanglewood and Upper Umpqua area. Individual booster pump stations (Schoon Mountain, Tanglewood, and Umpqua) maintain the water levels within these tanks.

Schoon Mountain Tanks
These tanks (12,000 gallons each) were originally pressure filters utilized by the City of Roseburg. These tanks were rehabilitated and put into operation around 1997. The lengths of these tanks lay horizontally which only gives approximately eight feet of vertical head in the tanks. The Schoon Mountain Pump Station fills this reservoir tank based on pressure at the pump station. There is no cathodic protection at this reservoir.

Forest Heights Tank
This 127,000 gallon steel bolted glass-fused tank serves residences along Valley Vista Street, and several along Forest Heights Street. This tank was constructed ten years ago, and is in good condition. The reservoir is filled from the Forest Heights Pump Station which is controlled by reservoir levels. There is no cathodic protection at this reservoir.

Tanglewood Tank
This 75,000 gallon welded tank serves an area generally encompassed by Sixth Street to the south, the railroad tracks to the east, and Comstock Road to the west. With the exception of some recently placed graffiti, the tank appeared to be in good condition. The Tanglewood Pump Station fills this reservoir tank based on pressure at the pump station. With the tank off-line, the pump station continues to operate based on pressure with a pressure reducing valve, on the mainline near the tank, preventing excessive pressures from building up in the system. This arrangement results in frequent pump starts that over a long period of time would be detrimental to the pumps. However for one to two day outages, this arrangement has proven to be satisfactory. There is no cathodic protection at this reservoir.

Upper Umpqua Tank
This 75,000 gallon welded steel tank serves an area generally encompassed by Sixth Street to the south, and the railroad tracks to the west. This tank appeared to be in good condition except for numerous bullet marks on the tank. These marks are showing signs of rust and the outside should be recoated. The Umpqua Pump Station fills this reservoir tank based on pressure at the pump station. With the tank off-line, this pump station operates in a fashion similar to the Tanglewood Pump Station with a pressure relief valve located next to the Upper Umpqua Tank. There is no cathodic protection at this reservoir.

High-Level Tanks

There are two high-level tanks (35,000 gallons each); both of which serve the Ridgewater Estates. Elevations within the high-level service area served by these tanks range from approximately 760 feet to 870 feet. A booster pump station located at the Cooper Creek WTP maintains the water levels within these tanks. These tanks also act as reservoir storage for the Upper Ridgewater Pump Station which services customers at elevations from 860 to 950 feet.

Ridgewater Tank No. 1
This tank has been in service for a number of years. The outside coating of this tank needs refurbishment. The tank also has a single inlet/outlet which does not promote mixing within the tank. Seismic foundation charis/bolts were recently added to the tank. At that time, the interior of the tank was recoated. There is no cathodic protection on this tank.

Ridgewater Tank No. 2
This tank was constructed 13 years ago. This tank appears to be in excellent condition. The tank has separate inlet/outlet lines and has seismic foundation chairs/bolts. Some of the seismic bolts at the foundation need a coating for corrosion protection. This tank does not have cathodic protection and should have some additional security measures installed (e.g. gate covering the ladder cage, and/or ladder shield) at the ladder to prevent access to the top of the tank.

Summary

Overall, the City's water storage tanks appear to be in good condition. The most concerning tank item is the lack of cathodic protection of the steel tanks. Some tanks, such as the Upper Umpqua and Ridgewater No. 1, are in need of maintenance.

5.5 Water Distribution System

An overview of the City's water distribution system is presented in Figures 5.5.1A-4B. The City of Sutherlin's water distribution system is a combination of pipe materials and sizes. The distribution system consists of 14-inch main lines from the City's Water Treatment Plants (WTPs), an 18-inch diameter main line extending west along Central Ave., and 2 to 14-inch diameter lateral pipe with service lines consisting of ¾ and 1-inch diameter pipe. The most prevalent pipe within the distribution system (36 percent) consists of 6-inch diameter pipe.

In addition to varying by diameter, the water distribution system is also composed of a variety of pipeline materials. The material that was used to construct water lines over the years depended primarily on the accepted and available materials of the time. In the 1940's and 1950s, cast iron, steel, and galvanized piping was commonly used. In 1951, concrete cylinder pipe was installed for the Nonpareil water main. Later, Asbestos Cement (AC) piping was utilized for water main construction in the 1970s. Today ductile iron, PVC and polyethylene (PE) pipe materials are used almost exclusively in the construction of new water lines. The City's piping consists primarily of AC and PVC pipe for lateral pipes, and galvanized steel and polyethylene pipe for service lines. A summary of the distribution system pipe size and material inventory (not including service lines) is given in Table 5.5.1. Current materials of choice for replacement are PVC pipe for lateral mains and PE pipe for service lines.

The existing condition of the distribution system depends greatly on the materials that were used to construct the system as well as the level of workmanship at the time of construction. Although a historical log of distribution system repairs has not be maintained, City staff believe that the majority of recent leaks in the distribution system have been observed with 6-inch diameter cast iron pipe in the blocks bounded by Mardonna St., Sherwood St., E. 4th Ave., and E. First Avenue. The piping in the alleyway between N. State St. and Willamette St., and E 1st. St. and E. Central Ave. has also been problematic.

In addition to the leakage observed in the areas previously described other areas where cast iron pipe has been installed. These pipelines should be investigated to determine whether these lines leak. If they are found to be leaking, these mains should be removed and replaced.

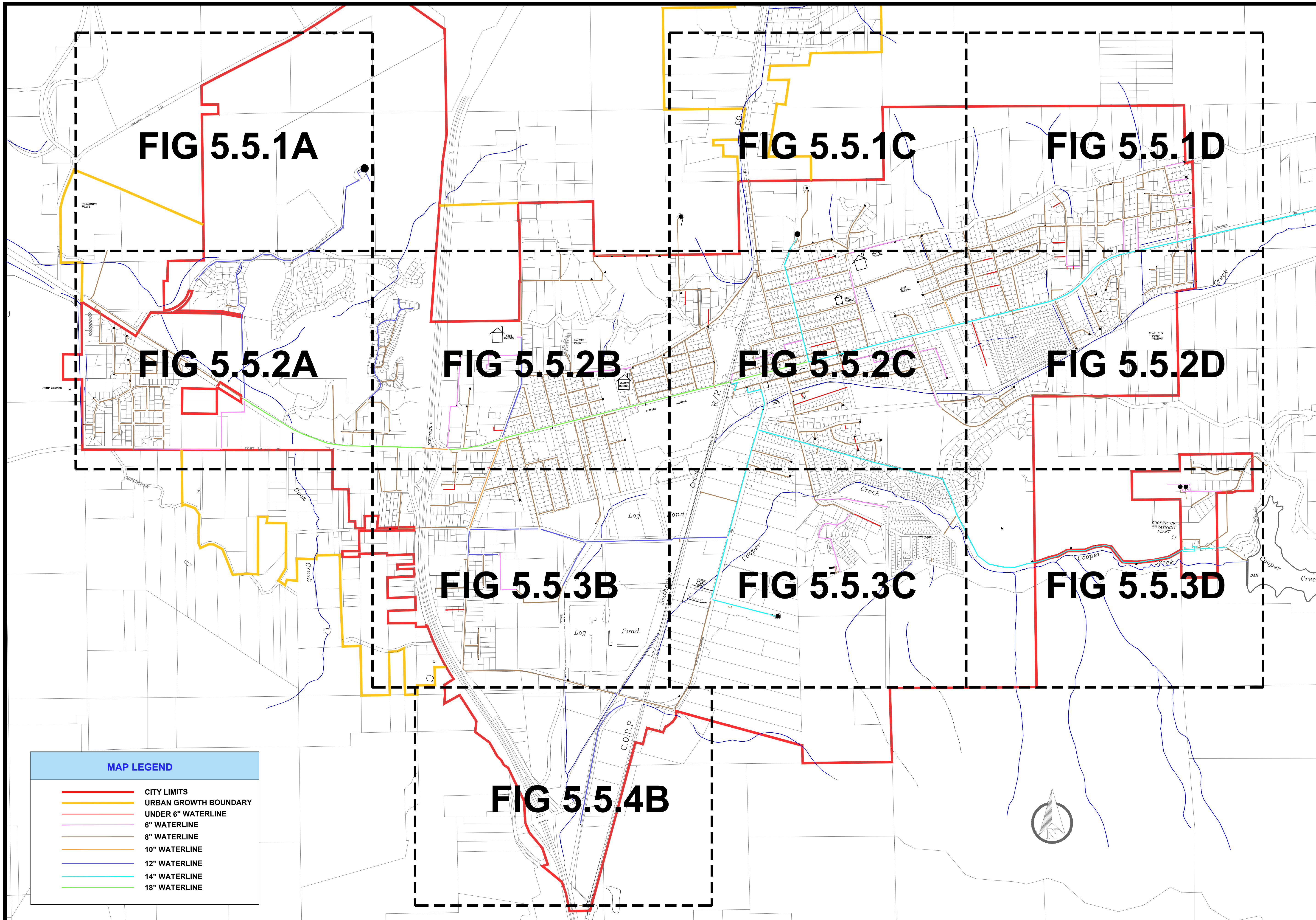


FIGURE NO. 5.5.1

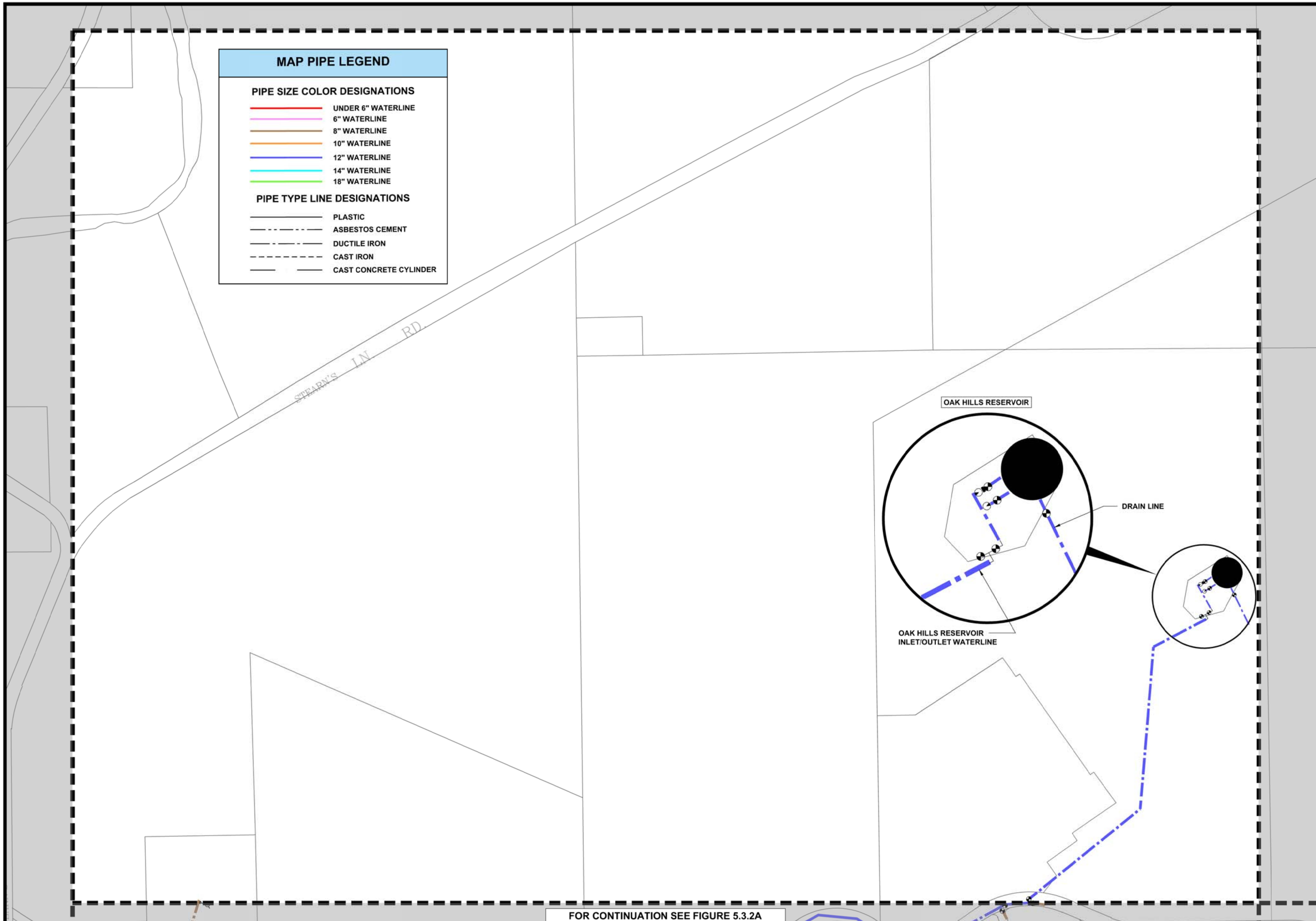
SUTHERLIN WATER MASTER PLAN

EXISTING WATER SYSTEM - FIGURE INDEX

THE DYER PARTNERSHIP ENGINEERS & PLANNERS

DATE: JAN. 2017

PROJECT NO.: 146.48



FOR CONTINUATION SEE FIGURE 5.3.2A

FIGURE NO.
5.5.1A

SUTHERLIN WATER MASTER PLAN

EXISTING WATER SYSTEM

THE DYER PARTNERSHIP
ENGINEERS & PLANNERS

DATE: JAN. 2017

PROJECT NO.: 146.48

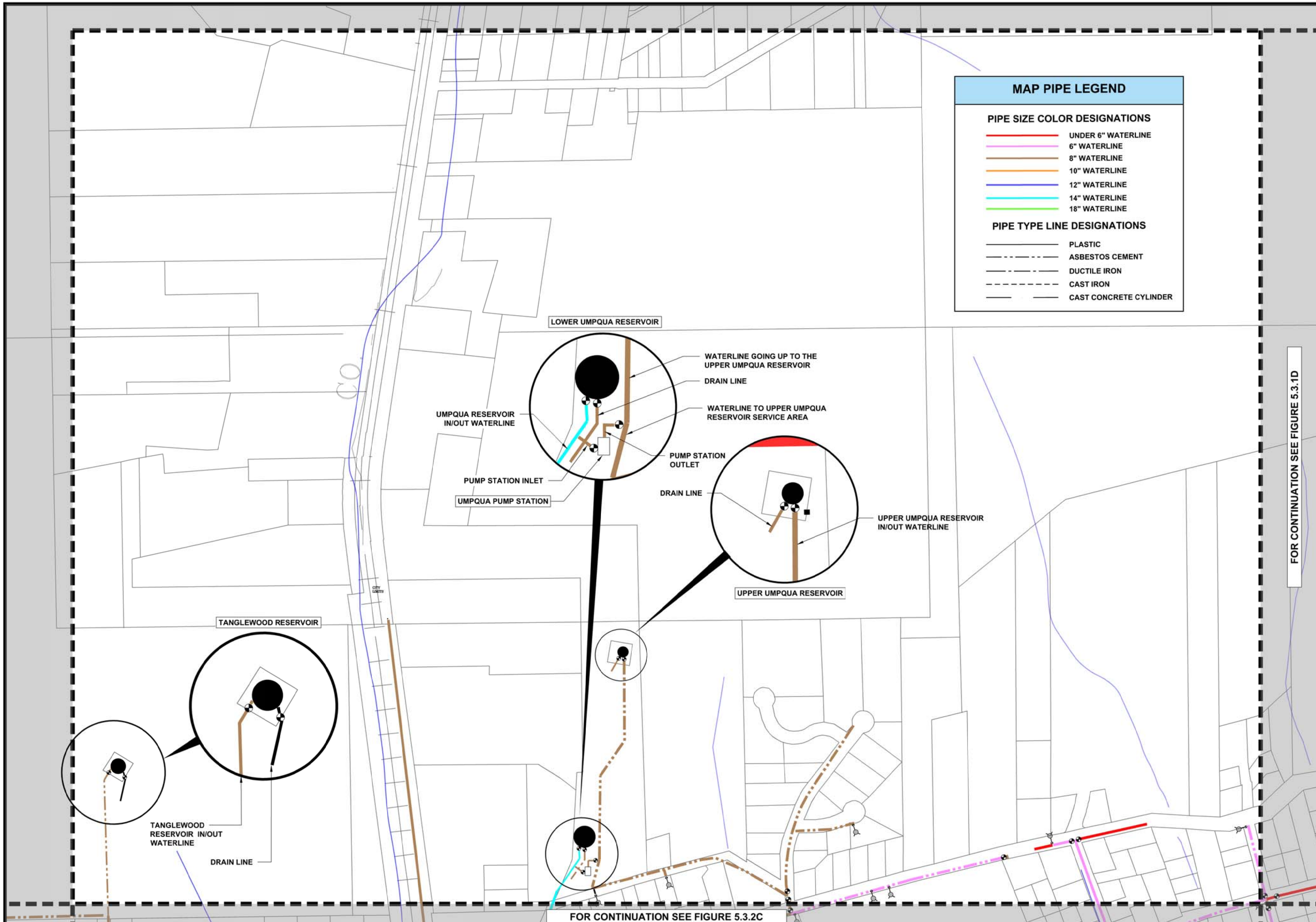


FIGURE NO. 5.5.1C

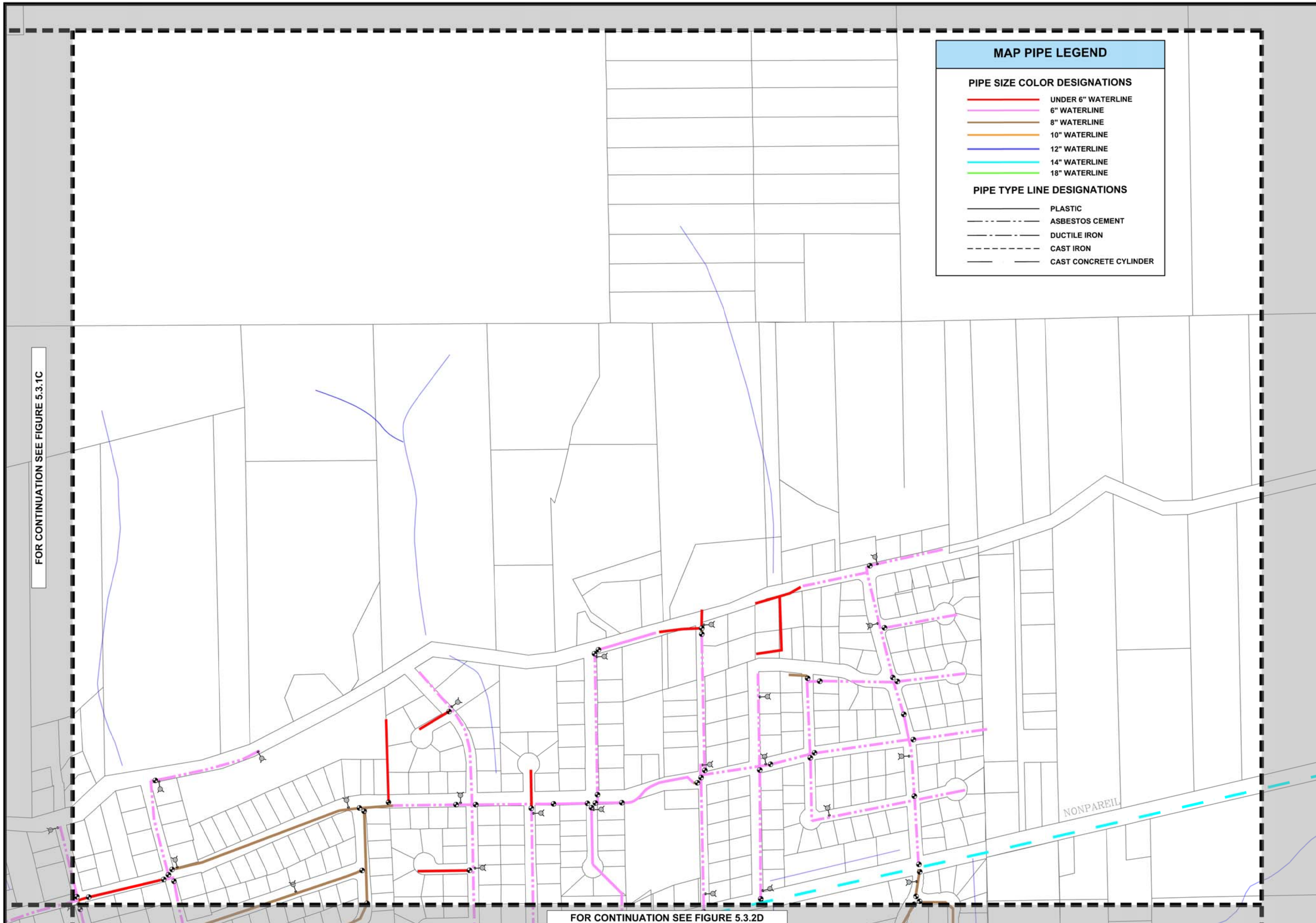
SUTHERLIN WATER MASTER PLAN

EXISTING WATER SYSTEM

THE DYER PARTNERSHIP ENGINEERS & PLANNERS

DATE: JAN. 2017

PROJECT NO.: 146.48



FOR CONTINUATION SEE FIGURE 5.3.1C

FOR CONTINUATION SEE FIGURE 5.3.2D

FIGURE NO. 5.5.1D

SUTHERLIN WATER MASTER PLAN

EXISTING WATER SYSTEM

THE DYER PARTNERSHIP
ENGINEERS & PLANNERS

DATE: JAN. 2017

PROJECT NO.: 146.48

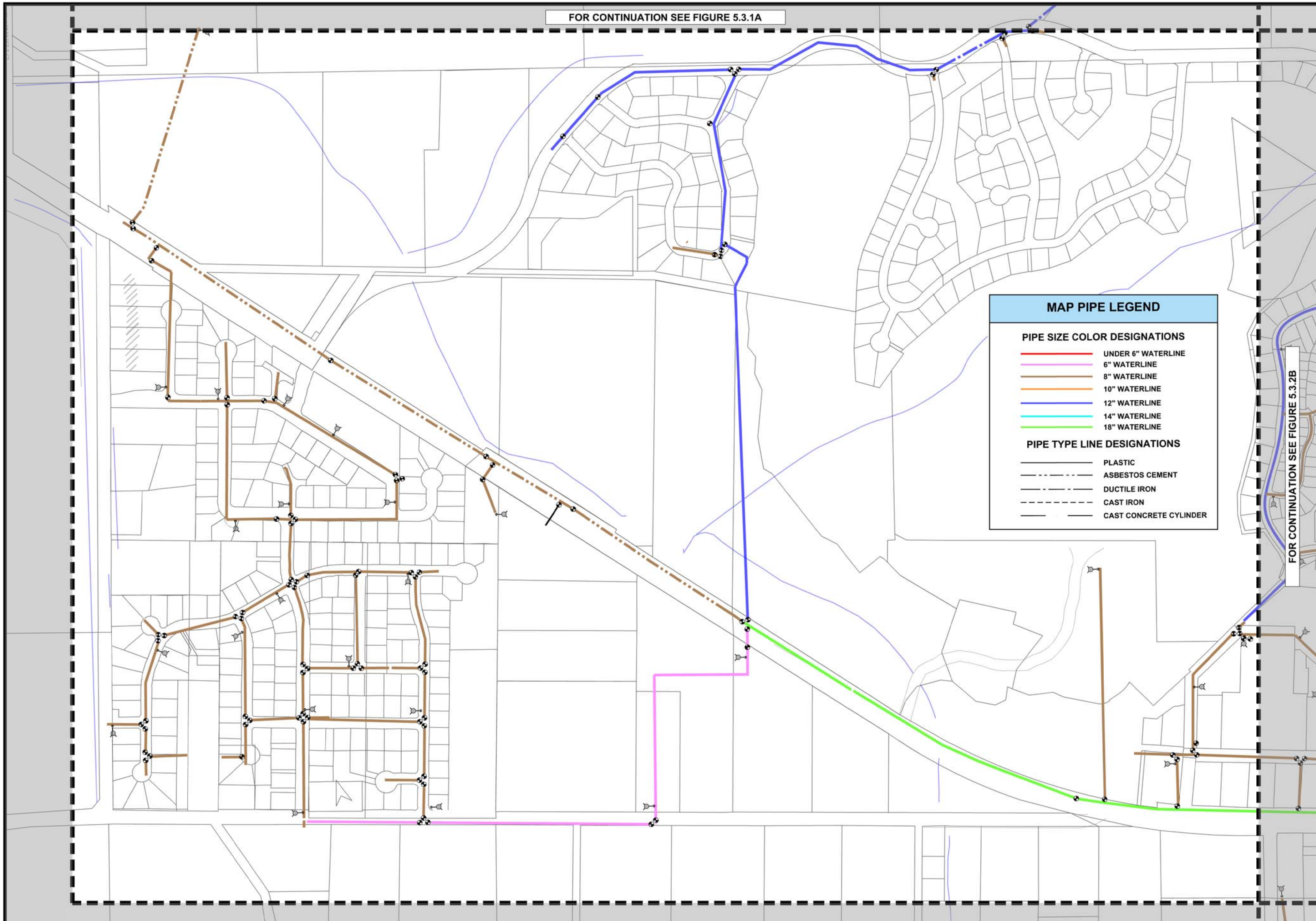


FIGURE NO. 5.5.2A

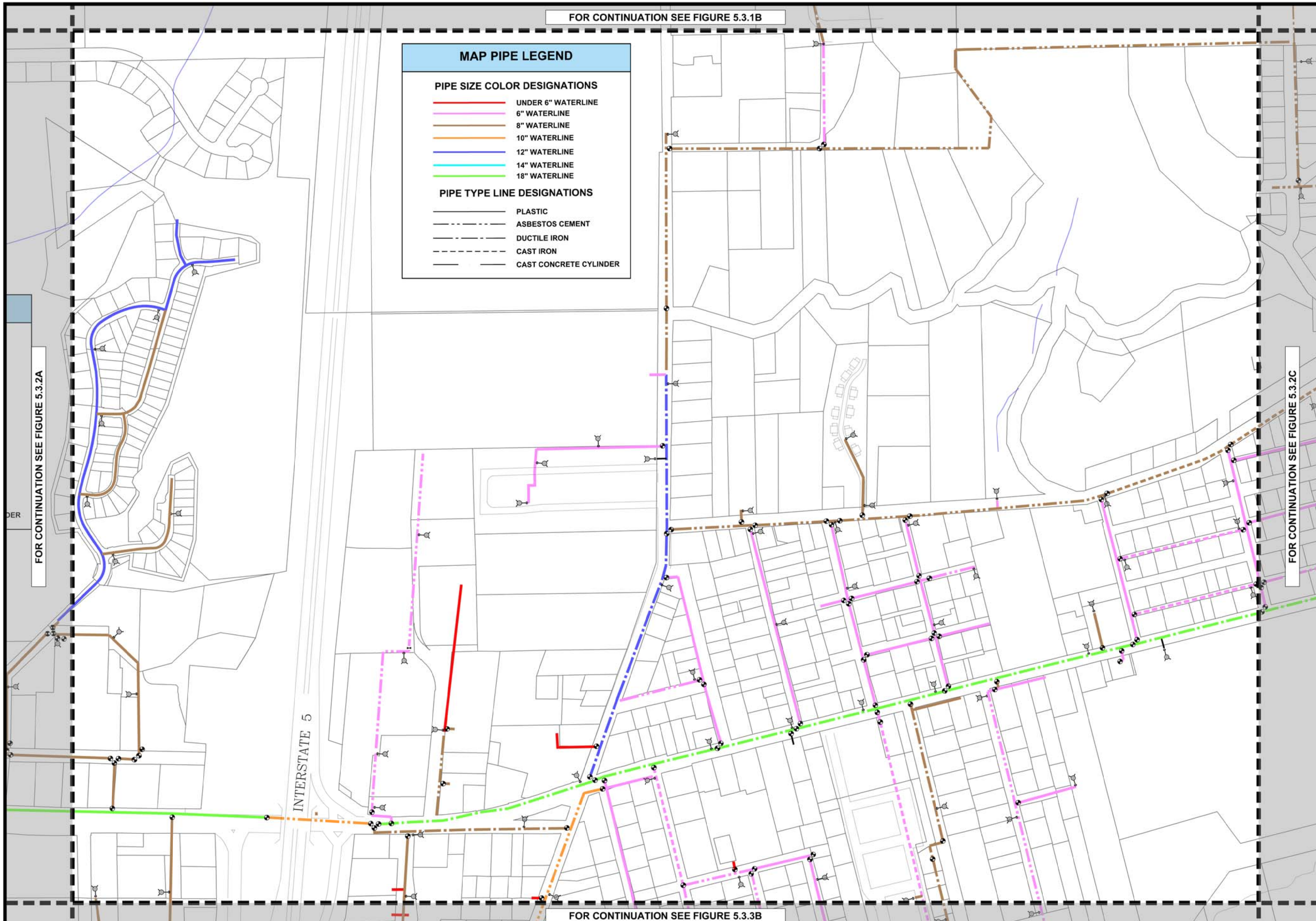
SUTHERLIN WATER MASTER PLAN

EXISTING WATER SYSTEM

THE DYER PARTNERSHIP
ENGINEERS & PLANNERS

DATE: JAN. 2017

PROJECT NO.: 146.48



FOR CONTINUATION SEE FIGURE 5.3.1B
FOR CONTINUATION SEE FIGURE 5.3.2A
FOR CONTINUATION SEE FIGURE 5.3.2C
FOR CONTINUATION SEE FIGURE 5.3.3B

FIGURE NO. 5.5.2B

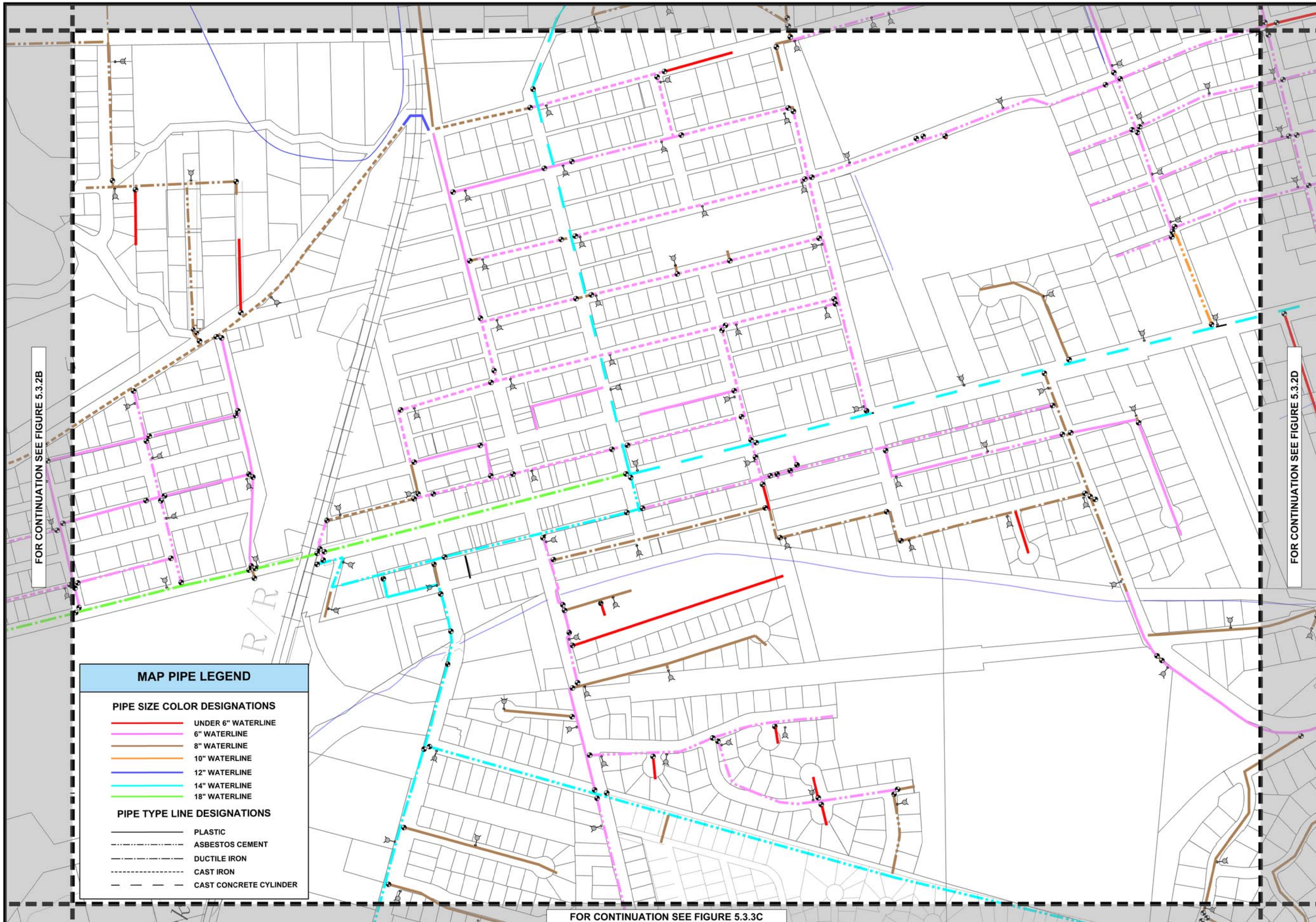
SUTHERLIN WATER MASTER PLAN

EXISTING WATER SYSTEM

THE DYER PARTNERSHIP
ENGINEERS & PLANNERS

DATE: JAN. 2017

PROJECT NO.: 146.48



SUTHERLIN WATER MASTER PLAN

EXISTING WATER SYSTEM

FIGURE NO. 5.5.2C

THE DYER PARTNERSHIP ENGINEERS & PLANNERS

DATE: JAN. 2017

PROJECT NO.: 146.48

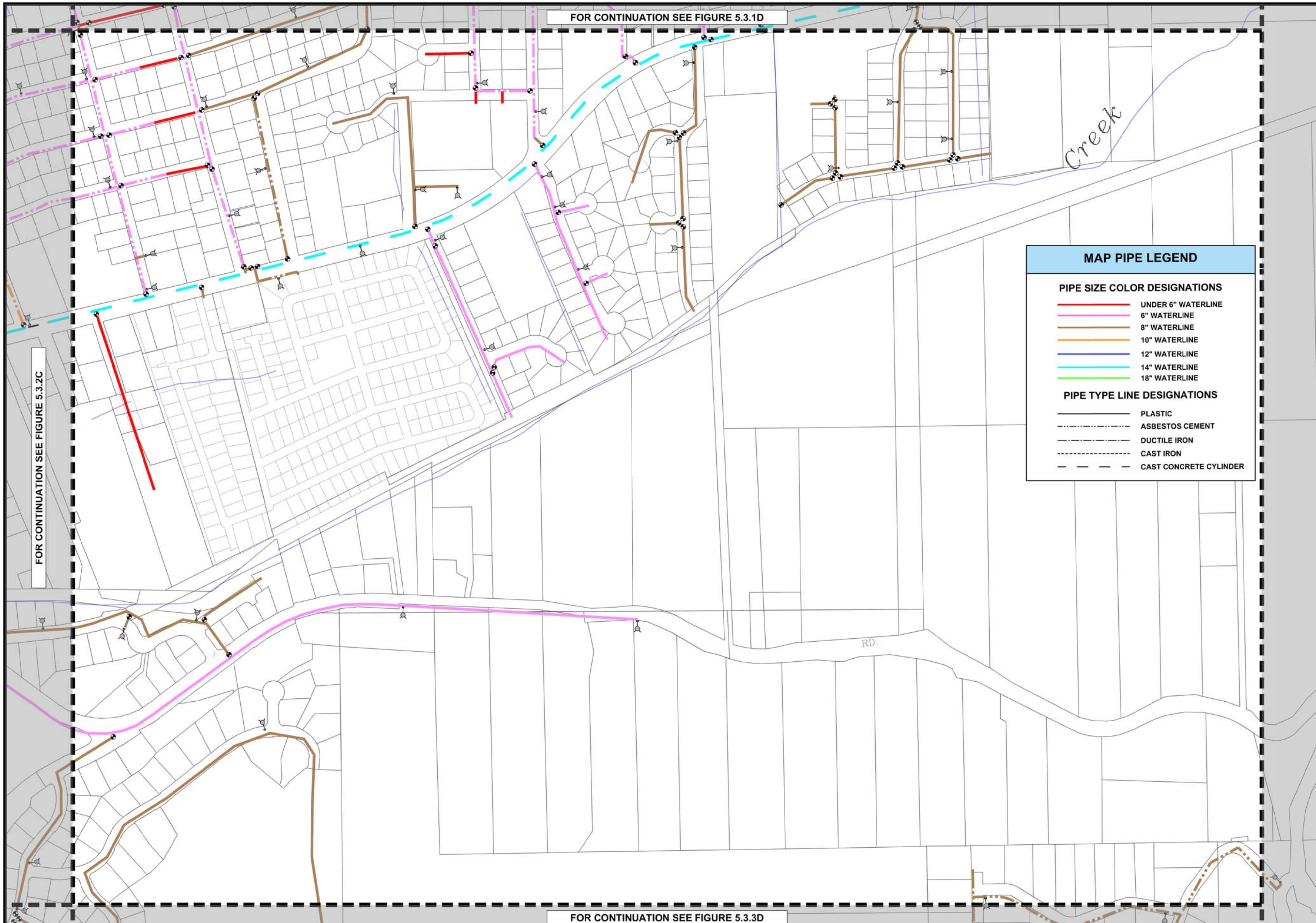


FIGURE NO. 5.5.2D

SUTHERLIN WATER MASTER PLAN

EXISTING WATER SYSTEM

THE DYER PARTNERSHIP
ENGINEERS & PLANNERS

DATE: JAN. 2017

PROJECT NO.: 146.48

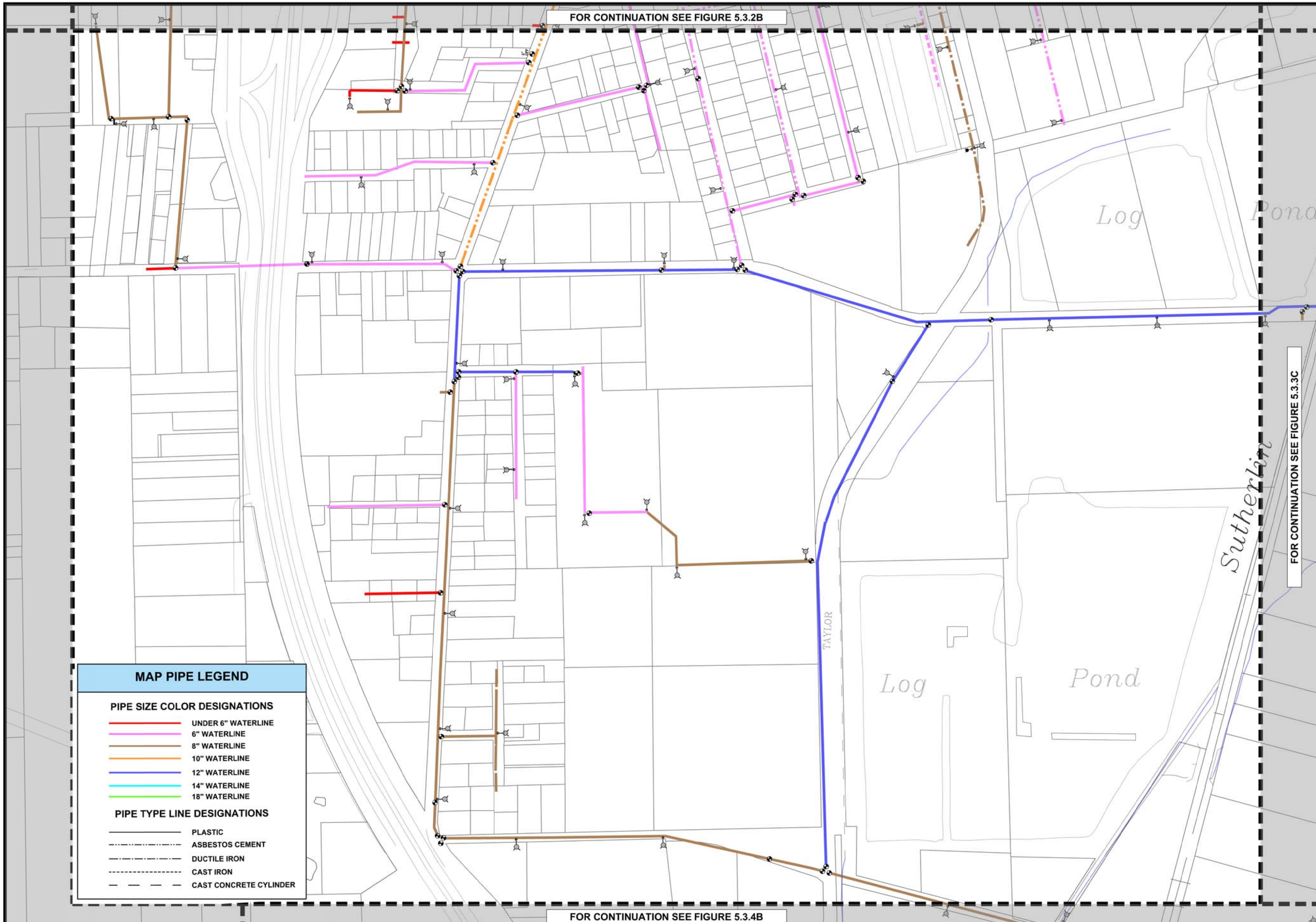


FIGURE NO. **5.5.3B**

SUTHERLIN WATER MASTER PLAN

EXISTING WATER SYSTEM

THE DYER PARTNERSHIP
ENGINEERS & PLANNERS

DATE: JAN. 2017

PROJECT NO.: 146.48

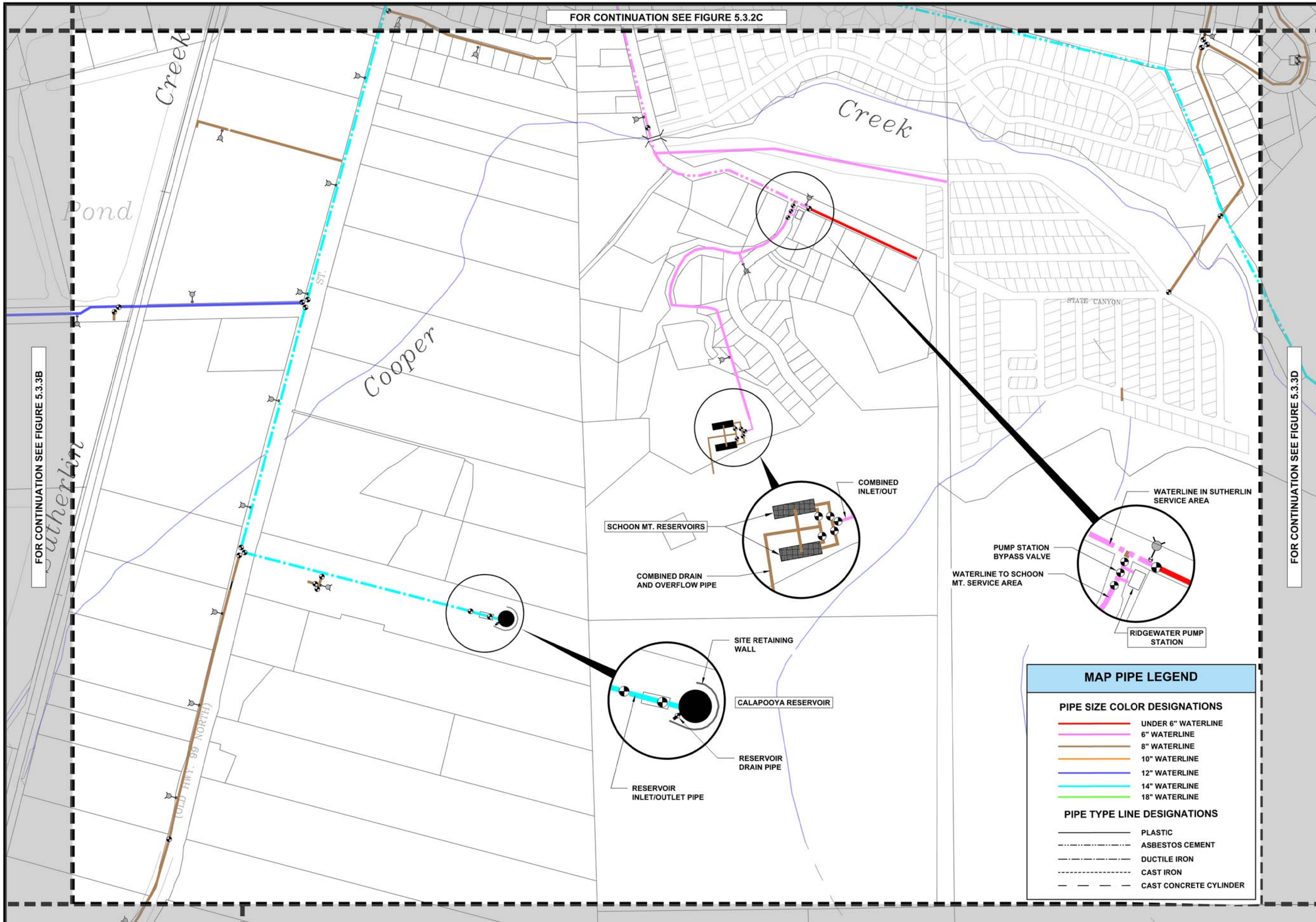


FIGURE NO. 5.5.3C

SUTHERLIN WATER MASTER PLAN

EXISTING WATER SYSTEM

THE DYER PARTNERSHIP
ENGINEERS & PLANNERS

DATE: JAN. 2017

PROJECT NO.: 146.48

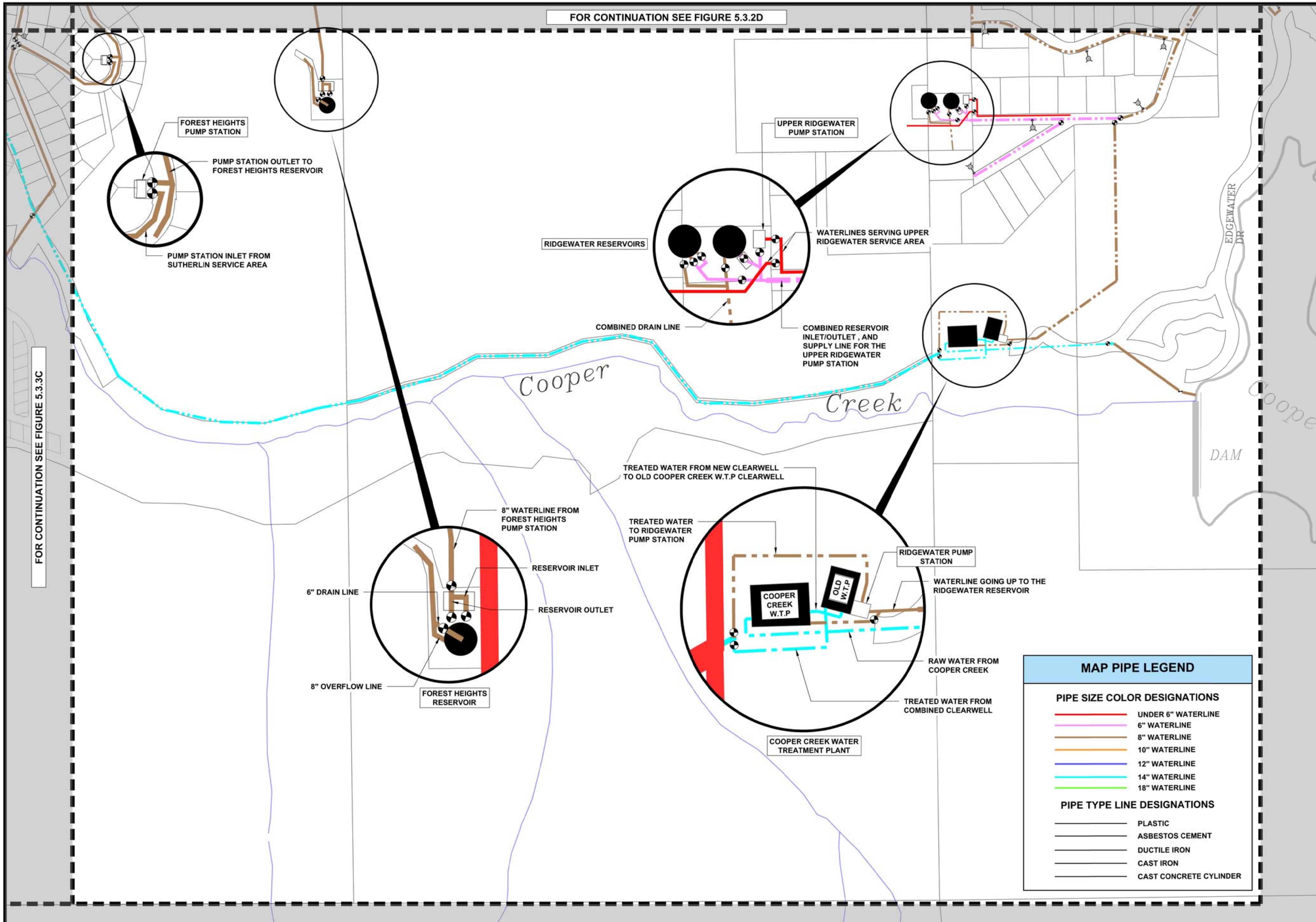


FIGURE NO. 5.5.3D

SUTHERLIN WATER MASTER PLAN

EXISTING WATER SYSTEM

THE DYER PARTNERSHIP ENGINEERS & PLANNERS

DATE: JAN. 2017

PROJECT NO.: 146.48

FOR CONTINUATION SEE FIGURE 5.3.3B

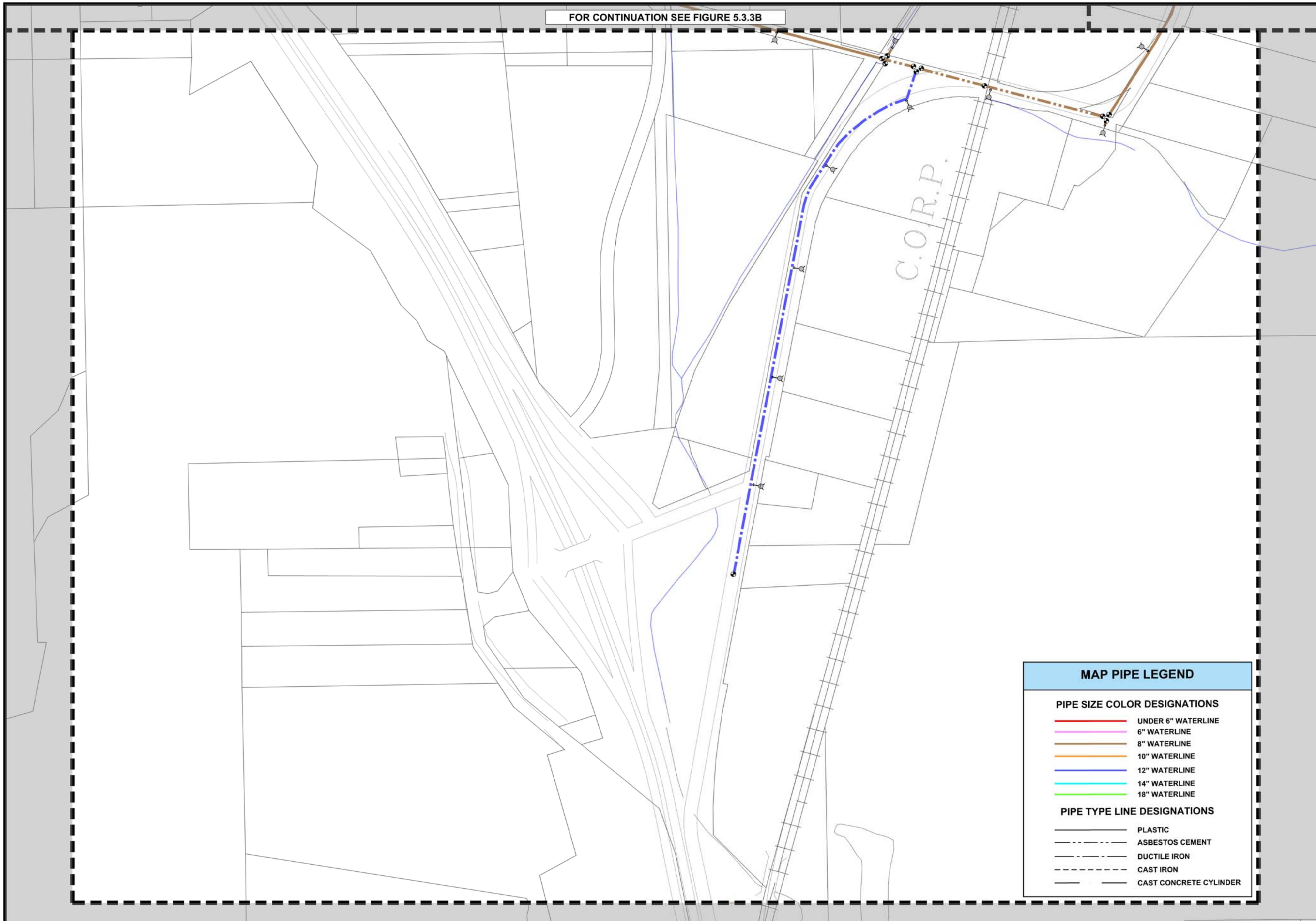


FIGURE NO. 5.5.4B

SUTHERLIN WATER MASTER PLAN

EXISTING WATER SYSTEM

THE DYER PARTNERSHIP
ENGINEERS & PLANNERS

DATE: JAN. 2017

PROJECT NO.: 146.48

The condition of the 14-inch water line extending from the Nonpareil WTP to the City is also a concern for the City. This line has a number of corporation stops. As the pipe continues to age, it could become a source of leaks, and require frequent maintenance. This pipe is beyond its service life, and therefore the condition of the pipe needs to be assessed.

Computer modeling was conducted to analyze the performance of the existing City of Sutherlin water system. Hydraulic analysis software called WaterCAD by Haestad Methods was used to perform the complex calculations necessary to analyze the water system. The diameter and materials of each pipeline section was input to the computer model. A discussion on the computer modeling results of the distribution system is presented in Section 8.

TABLE 5.5.1
DISTRIBUTION SYSTEM SIZE AND MATERIAL INVENTORY

Pipe Diameter, in.	Materials of Construction							
	PVC	Cast Iron	Ductile Iron	Asbestos-Cement	Concrete Cylinder	Steel/Copper	Total	% of Total
2	1,326	-	-	-	-	2,284	3,610	1.3%
4	-	1,978	-	600	-	-	2,578	0.9%
6	32,239	14,006	7,226	38,256	860	-	92,587	32.6%
8	57,379	4,838	7,323	25,396	5,210	-	100,146	35.3%
10	-	-	-	1,769	-	-	1,769	0.6%
12	11,400	-	11,139	483	-	-	23,022	8.1%
14	-	-	8,286	9,233	42,617	-	60,136	21.2%
18	-	-	9,673	-	-	-	9,673	3.4%
Total	102,344	20,822	33,974	75,737	48,687	3,210	283,848	100%
% of Total	36.1%	7.3%	12.0%	26.7%	17.2%	1.1%	100%	-

Service Areas

The City's distribution system is currently divided into four service zones to keep pressures within commonly accepted pressure ranges. These service zones are referred to the following designations (HGE 1997): 1) low-level, 2) mid-level, 3) 1st high-level, and 4) 2nd high-level. A summary of each service zone with approximate elevations served, estimated static pressures, and associated reservoir tanks and booster pump stations is provided in Table 5.5.2.

TABLE 5.5.2
SUMMARY OF SERVICE AREAS

Service Zone	Service Area	Approx. Service Elevation Range, ft	Approx. Static Pressure Range, psi	Associated Reservoirs	Associated Pump Stations
Low Level	Sutherlin	400 – 600	40 - 130	Umpqua	Nonpareil WTP
				Calapooya	Cooper Crk WTP
				Oak Hills	Cooper Crk WTP
Mid-Level	Schoon Mt	560 - 700	40 - 110	Schoon Mt	Schoon Mt
	Tanglewood	600 - 760	40 - 115	Tanglewood	Tanglewood
	Upper Umpqua	600 - 760	40 - 115	Upper Umpqua	Umpqua
	Forest Heights	580-700	70 - 120	Forest Heights	Forest Heights
1st High Level	Ridgewater	760 - 870	40 - 90	Ridgewater No. 1 & No. 2	Ridgewater located at Cooper Crk WTP
2nd High Level	Upper Ridgewater	860 - 950	40 - 80	Hydropneumatic Tanks – 2	Upper Ridgewater

Booster Pump Stations

Booster pump stations are utilized to pump water to reservoir tanks and boost pressures from lower level service areas to higher service areas. A summary of the booster pump stations within the City to pump water from the low-level service area to mid-level and high-level service areas is given in Table 5.5.3.

TABLE 5.5.3
EXISTING BOOSTER PUMP STATIONS

Station	No. of Pumps	Hp	Flow (gpm)	TDH (feet)
Ridgewater – 1st High-Level	2	40	350/600	250
Ridgewater – 2nd High-Level	2	5	40/56	95
Schoon Mt.	2	30	125/175	220
Tanglewood	2	30	400/560	300
Forest Heights	2	10	135/235	188
Umpqua	2	20	200/280	200

Tanglewood Pump Station
This underground pump station was built in 1974, and is in good condition given its age. The pump station houses two 30 hp pumps capable of 400/560 gpm at 300 TDH. These pumps currently operate in a lead/lag configuration.

One specific concern related to the current condition of the pump station is the outlet pipe. The outlet pipe recently failed near the wall of the pump station. Upon repair of the water leak, the City noted that there was minimal pipe extending from the pump station wall. This did not allow for an ideal connection between the new and old pipe. This connection is liable to break again when stressed.

Although the pump station is not currently experiencing any critical failures, the pump station is over 40 years old, and is well beyond its life expectancy. Due to the requirements of confined spaces, maintenance and monitoring of this facility is difficult and expensive.

FIGURE 5.5.5
6th AND OAK BOOSTER PUMP STATION

Upper Umpqua Pump Station
This pump station was built in 2013, and is in exceptional condition. The pump station houses two 20 hp pumps capable of 400 gpm at 200 TDH. These pumps currently operate in a lead/lag configuration.

FIGURE 5.5.6
UPPER UMPQUA BOOSTER PUMP STATION

Schoon Mountain Pump Station

This pump station was built in 1997, and is in good condition. The pump station houses two 30 hp pumps capable of 125/175 gpm at 220 TDH. These pumps currently operate in a lead/lag configuration. Although the pump station is not currently experiencing any critical failures, the pump station is over 20 years old, and may begin developing problems related to age.

FIGURE 5.5.7
SCHOON MOUNTAIN BOOSTER PUMP STATION

Forest Heights Pump Station

This pump station was built in 2006, and is in good condition. The pump station houses two 10 hp pumps capable of 135/235 gpm at 188 TDH. These pumps currently operate in a lead/lag configuration, and are controlled by the level of water in the Forest Heights Reservoir.

FIGURE 5.5.8
FOREST HEIGHTS BOOSTER PUMP STATION

Ridgewater 1st High-Level Pump Station
This pump station was built in 2014, and is in good condition. The pump station houses two 40 hp pumps capable of 350/600 gpm at 250 TDH. These pumps currently operate in a lead/lag configuration, and are controlled by the level of water in the Ridgewater No. 1 storage tank.

FIGURE 5.5.9
RIDGEWATER 1st HIGH-LEVEL BOOSTER PUMP STATION

Ridgewater 2ND High-Level Pump Station
This pump station was built in 2014, and is in great condition. The pump station houses two 5 hp pumps capable of 40/56 gpm at 95 TDH. The pump station has a 450 gallon pressure tank. These pumps currently operate in a lead/lag configuration, and are controlled by the pressure in the pressure tank. This pump station does not have a fire flow pump that will provide fire flow to the 2nd High-Level service area.

FIGURE 5.5.10
RIDGEWATER 2ND HIGH-LEVEL BOOSTER PUMP STATION

5.6 Financial Management

The financial management of the City's water system was reviewed by examining the current system charges, revenue, and operations and maintenance budget.

System Charges and Revenue

The City collects water system charges to retire debt and finance the operation and maintenance of the water system. A summary of the current system charges is given below in Table 5.6.1.

TABLE 5.6.1
MONTHLY WATER SYSTEM CHARGES

Service	Base Rate	Variable Rate $/1,000 gals.
Multiple Units Behind Meter (per unit)	$12.02	$3.08
¾- Inch	$24.06	$3.08
1- Inch	$48.13	$3.08
1½ -Inch	$84.24	$3.08
2- Inch	$132.39	$3.08
3- Inch	$324.98	$3.08
4- Inch	$469.43	$3.08
6- Inch	$1,456.49	$3.08
10- Inch	$2,407.40	$3.08

(1) Charges shown in this table do not show for of the individualized accounts.

The City collects other revenue for the water system operation from user deposit refunds, service fees, new connections and other miscellaneous sources. A summary of the revenue budget for the fiscal year 2016-2017 is presented in Table 5.6.2.

TABLE 5.6.2
WATER OPERATIONS REVENUE: FUND 32 (2016-2017 BUDGET)

Item	Amount ($)
Users Fees	$1,935,300
Connection Charges	$10,000
Penalties	$40,000
SDC's Water	$1,500
Interest Earned	$1,000
Beginning Fund Balance	$98,000
Miscellaneous	$33,375
Total Resources	$2,119,175

Operation and Maintenance Budget

Each fiscal year, the City proposes, approves and adopts an Operation and Maintenance (O&M) budget for the water system. The Public Works Operations Fund is an internal service fund, which acts as a cost center for personnel, equipment and materials to the other internal divisions. A portion of the O&M budget is directed to the Water Reserve Fund, which was created for the distribution of funds required by the Division's Capital Improvement Plan. Additional funds are distributed to the Water Debt Service Fund for the purpose of timely payments of long-term financing of water system improvements. Some monies must also be appropriated to the General Fund. The City has an additional Water Construction Fund created to account for the receipt and distribution of funds for major replacement or additions to the water system infrastructure.

TABLE 5.6.3
WATER OPERATIONS REQUIREMENTS: FUND 32 (2016-2017 BUDGET)

Item	Amount ($)
Public Works Operations	$599,000
Materials & Services	$395,950
Water Rights	$10,000
Debt Service Fund	$425,000
General Fund	$344,200
Water Construction Fund	$200,000
Contingency	$145,025
Total Expenditures	$2,119,175

SECTION 6:

WATER USE AND PROJECTED DEMANDS

SECTION 6: **WATER USE AND PROJECTED DEMANDS**

6.1 Description and Definitions

Water demand can be defined as the quantity of water delivered to the system over a period of time to meet the needs of consumers, provide filter backwashing water, and to supply the needs of firefighting and system flushing. In addition, virtually all systems have an amount of leakage or loss that cannot be feasibly or economically reduced or eliminated. Total demand, therefore, includes all consumption and lost water. Demand varies seasonally with the lowest usage in winter months and the highest usage during summer months. Variations in demand also occur with respect to time of day (diurnal) with higher usage occurring during the morning and early evening periods and lowest usage during nighttime hours.

The objective of this Section is to determine the current water demand characteristics and to project future demand requirements that will establish system component adequacy and sizing needs. Water demand is described in the following terms:

Average Annual Demand (AAD)
The total volume of water delivered to the system in a full year expressed in gallons. When demand fluctuates up and down over several years, an average is used.

Average Daily Demand (ADD)
The total volume of water delivered to the system over a year divided by 365 days. The average use in a single day expressed in gallons per day.

Dry Season Daily Demand (DDD)
The gallons per day average during the months of June through October.

Maximum Monthly Demand (MMD)
The gallons per day average during the month with the highest water demand. The highest monthly usage typically occurs during a summer month.

Peak Weekly Demand (PWD)
The greatest seven day average demand that occurs in a year. Expressed in gallons per day.

Maximum Day Demand (MDD)
The largest volume of water delivered to the system in a single day expressed in gallons per day. The MDD is commonly used to size facilities to provide capacity for periods of high demand. The MDD usually occurs during the warmest part of the year when agriculture, irrigation, and recreational uses of potable water are at their greatest and, commonly, associated with a holiday, such as Fourth of July, or during an event, such as a County Fair.

Peak Hourly Demand (PHD)
The maximum volume of water delivered to the system in a single hour expressed in gallons per day. Distribution systems should be designed to adequately handle the peak hourly demand. During this peak usage, storage reservoirs supply the demand in excess of the maximum day demand. Peak hour demand is commonly experienced during the early morning hours when many water users are bathing, cooking, and engaging in other activities that require widespread water use.

Demands described above, expressed in gallons per day (gpd), can be divided by the population served to come up with a demand per person or a per capita demand which is expressed in gallons per capita per day (gpcd). Per capita demands can be multiplied by future population projections to determine future water demands.

In addition to water demand parameters, various terms are used and values calculated that are related to water conservation. These water conservation terms are described below (EPA 1998).

Loss/Lost Water
Metered source water less revenue producing water and authorized unmetered water uses.

Nonaccount Water
Metered supply water less metered consumption.

Unaccounted for Water
The amount of nonaccount water less known or estimated losses and leaks.

For most communities, the known or estimated losses and leaks within a water system are not known. Rather the amount of system lost or leakage is estimated based on an audit of water usage within the system. To the extent possible, we will utilize the above water conservation terms in this WMP.

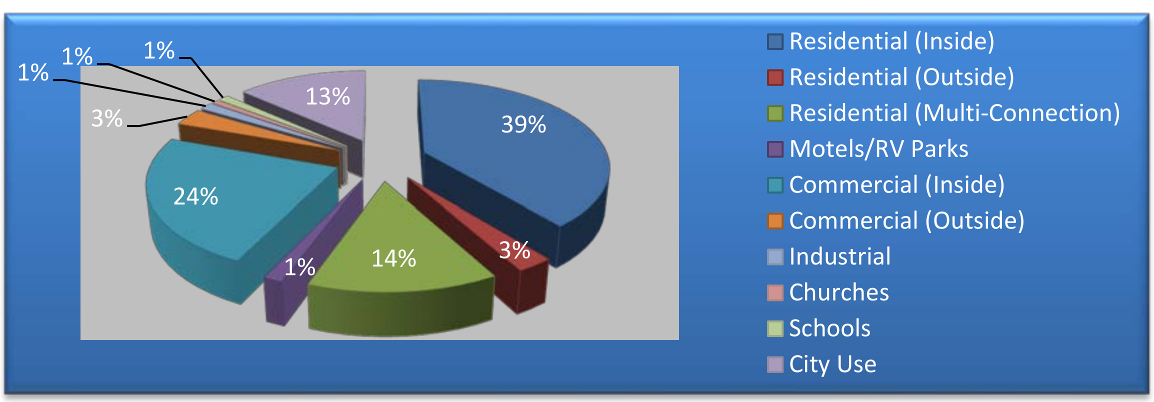
6.2 Current Water Demand

For the purposes of this study, current water demand was evaluated from three different perspectives: water consumption, water treated, and water diverted. These different water demands are discussed in detail below.

Water Consumption

Water consumption or sales records allow for determination of actual water consumption by the City's water users, calculation of an Equivalent Dwelling Unit (EDU) and provide measurement of nonaccount water when compared with plant production records. Figure 6.2.1 shows the average consumption levels within the system per user type.

FIGURE 6.2.1
PERCENT USAGE PER SOURCE



All losses, nonaccount water, and other water uses are not accounted for within the consumption data shown in Figure 6.2.1. Water system planning requires that all water diverted from the source be analyzed and considered as total water system consumption.

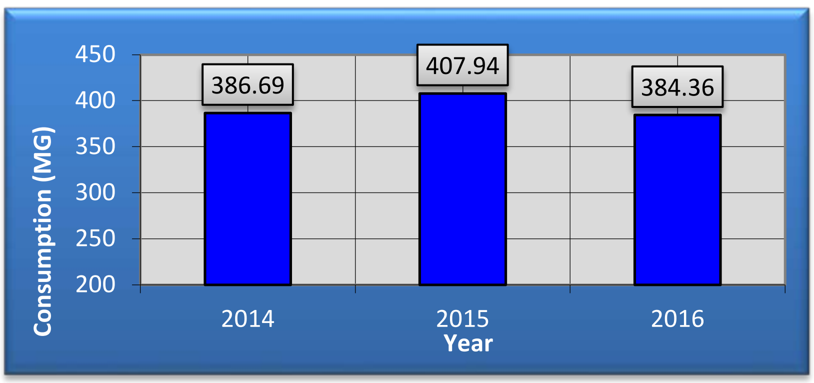
Residential sources account for approximately 56 percent of all water consumed within the City. The remaining system users (i.e. commercial/industrial, schools, and public/non-profit) utilize 44 percent of the metered water. Users within the City account for approximately 94 percent of the water consumed; approximately six percent of the water users are outside the City Limits.

Water Sales

For this study, water consumption is based on the City's water consumption records for the Years 2014 through 2016. A graph of the total annual amount of water sold to customers, including bulk water sales, is presented in Figure 6.2.2.

The largest amount of water consumed was in the Year 2015. The amount of water consumed by different users (residential, commercial, etc.) within the distribution system is discussed below under Equivalent Dwelling Units (EDU).

FIGURE 6.2.2
TOTAL METERED CONSUMPTION 2014 - 2016



Equivalent Dwelling Units Based on Usage

The number of EDUs or residential housing units within a system is determined to calculate the average cost for water services to a typical residence. The average cost per residential connection is not only used to inform the system users but is also used by regulatory and funding agencies for comparing costs with other communities. Since a water system typically consists of commercial, institutional, and industrial users, the most common method of calculating the average residential user cost is to evaluate each source on the basis of water consumption relative to the typical residential account or EDUs.

Total water consumption data for users within the City is compiled over a period of time (typically a year). Residential usage is determined by subtracting commercial and industrial contributions from the total water usage. The average water usage per EDU is calculated by dividing the total usage for all ¾-inch residential services divided by the total number of ¾-inch residential connections.

For the EDU calculation, the different sources or sectors within the City were divided into the following categories.

- Residential (single family dwellings, mobile home parks, multi-family, and assisted living).
- Commercial/Industrial (e.g. supermarkets, motels, etc.)
- Schools (e.g. grade, middle and high schools).
- Public/non-profit (e.g. post office, Bureau of Land Management, Douglas County, churches, etc.).

While the high school and grade schools are public, these schools were separated from the public/non-profit sources because of their significant water consumption within the City. In addition to these categories, the EDU calculation was also subdivided by inside and outside the City Limits to document the amount of water consumed outside the City.

The estimated number of EDUs is summarized in Table 6.2.1. The estimated annual residential water consumption per EDU (3/4-inch residential connection), based upon calendar year 2016, is 67,059 gallons per EDU per year. The total number of EDUs per demand source was calculated from the quotient of the total annual water consumption for each source by the annual usage per EDU. For example, industrial usage within the City was 58,150,447 gallons per year. Therefore, total EDUs for this usage is 58,150,447 gallons divided by 67,059 gallons per EDU (867).

TABLE 6.2.1
ESTIMATED NUMBER OF EDUS BASED ON WATER CONSUMED (Year 2016)

Connection Type	Number of Connections	Usage		Units	EDU [1] (USAGE)	EDU (BILLING)	EDU[2] (FUNDING)
		Annual	ADD				
Residential					**Residential**		
Single 3/4" Residential Services-Inside City	2,363	158,633,300	434,612	2,363	2,366	2,363	1763
Single 3/4" Residential Services-Outside City	129	8,478,930	23,230	129	126	129	94
Total	**2,492**	**167,112,230**	**457,842**	**2,492**	**2,492**	**2,492**	**1857**
Mobile Homes-Multi-Family	95	51,668,688	141,558	990	770	816	574
Other	41	43,718,623	119,777	41	652	--	486
Total	**136**	**95,387,311**	**261,335**	**1,031**	**1,422**	**--**	**1060**
Commercial/Industrial					**Commercial/Industrial**		
Inside Urban Growth Boundary	230	58,150,447	159,316	--	867	898	646
Non-Profit					**Non-Profit**		
Inside Urban Growth Boundary	20	2,585,570	7,084	--	39	--	29
Schools					**Schools**		
Inside Urban Growth Boundary	10	3,936,219	10,784	--	59	--	44
City Usage-Non Billable					**City Usage-Non Billable**		
Inside Urban Growth Boundary	15	50,318,000	137,858	--	750	--	559
Total	**2,862**	**377,489,777**	**914,442**	**--**	**5,629**	**--**	**4,194** [1]

[1] Number of EDUs based on 67,059 gallons per EDU per year
[2] Number of EDUs based on 90,000 gallons per EDU per year

Equivalent Dwelling Units for Billing Purposes

Total number of EDUs can also be determined based upon the annual cost of water services. This process involves determining the average annual cost for residential services with a 3/4-inch connection. This number was determined to be $495. The total number of EDUs associated with each non-‘3/4- inch residential service’ was then tabulated by dividing their annual cost by the average cost per 3/4-inch residential connection. For example: if a commercial account spent $2,475 a year, the total EDUs for that account would be five ($2475/$495).

A significant variation between the calculated EDUs based upon usage, and billing conveys an imbalance in the billing structure. The distribution of EDUs based on cost is summarized in Table 6.2.1. In this table it can be seen that the determined EDUs based upon both 'usage' and 'billing' are similar, and therefore suggests that the current rate structure is well balanced.

As can be seen in Table 6.2.1 EDUs based on billing was only determined for multi-connection and commercial/industrial service types. This process requires evaluation of each account, and therefore was only completed for the most significant usage types.

Equivalent Dwelling Units for Funding Purposes

Many funding agencies do not see the usage per EDU to be unique to the specific planning area, but rather employ the use of a more generalized usage rate per EDU. The usage rage assumed by many of these agencies is 7,500 gallons per month (90,000 gallons per year) per dwelling unit. The distribution of EDUs based on funding requirements is summarized in Table 6.2.1.

Water Treated

For planning purposes, demand projections and unit design factors for water consumption should be based on the City's yearly water production data rather than historical customer water consumption records (meter readings). This methodology incorporates all system losses and unmetered usage in the projected water requirements developed later in this Master Plan. The amounts of treated water produced, pumped to the City for consumption, and utilized for backwash are discussed below.

Water Treatment Plant Production

The amount of water produced at the water treatment plants and sent to the City for consumption is based on daily records maintained by the City staff. The amount of treated water produced at a WTP is typically equal to the sum of the amount of water sent to the City for consumption plus the amount of water used for backwash, and miscellaneous water usage at the WTP (e.g. for pump seals, sanitary usage, etc.). As the City does not currently record miscellaneous water usage at the WTPs, this miscellaneous usage at the WTP is not known. Consequently for this study, water treatment plant production will be based on the sum of water pumped to the City for consumption and the amount of water used for backwash.

Water production rates were derived from the plant data for Average Annual Demand (AAD), Average Daily Demand (ADD), dry Season Daily Demand (DDD), Maximum Monthly Demand (MMD), Peak Weekly Demand (PWD), and Maximum Daily Demand (MDD). A definition of each of these water demand parameters was previously given in Section 6.1. A summary of the compiled water demand parameters for the Years 2013 to 2016 is presented in Table 6.2.2. The maximum water production for the time periods reviewed was observed in the Year 2016.

TABLE 6.2.2
ANNUAL, MONTHLY, WEEKLY AND DAILY WATER PRODUCTION WITH BACKWASH

Year	AAD (gpy)	ADD (gpd)	DDD (gpd)	MMD (gpd)	PWD (gpd)	MDD (gpd)
2013	436,888,380	1,196,954	1,500,352	1,901,207	1,977,759	2,123,220
2014	452,940,570	1,240,933	1,604,397	1,830,231	1,956,799	2,301,173
2015	479,894,287	1,314,779	1,718,952	2,067,140	2,160,686	2,658,385
2016	525,226,752	1,438,977	1,801,358	2,185,057	2,389,748	3,072,155
Average	473,737,497	1,297,911	1,656,265	1,995,909	2,121,248	2,538,733

AAD/ADD
Over the past four years, the overall annual average water production has ranged from 437 to 525 Million Gallons (MG) per year or approximately 1.20 to 1.43 MGD. The average water production over this period was 1.30 MGD or approximately 474 MG per year. The highest water production was observed in the Year 2016.

DDD
The DDD value represents the daily water production during the dry season months (June through October), which includes the highest water demand months (usually July or August). Although this value is not typically calculated for water systems, it is presented in this WMP to allow a comparison of dry season production with available water to be diverted from the City's raw water sources. The DDD over the time period reviewed averaged approximately 1.66 MGD with a maximum flow of 1.80 MGD observed in Year 2016.

MMD
The MMD represents the highest flow produced over a month. For the City of Sutherlin, the MMD typically occurs in the months of July or August. From the Year 2013 to 2016, the MMD ranged from approximately 1.90 to 2.19 MGD. The average MMD flow for this period was 2.00 MGD.

PWD
The PWD is the peak water production over a week. This flow usually occurs during the month of the highest water production (i.e. July or August). The PWD over the last four years has ranged from 1.98 to 2.39 MGD and averaged 2.12 MGD.

MDD
The MDD values given in Table 6.2.2 are the highest daily water production rates for the given time periods. The MDD typically occurs the month and peak week of maximum water production. Over the last four years, the MDD has ranged from approximately 2.12 to 3.07 MGD. The average MDD over this time period was approximately 2.54 MGD.

Peaking factors are commonly used to develop relationships between the ADD and the other planning criteria. These factors are used primarily for calculating future water demand. Peaking factors tend to be consistent from one water system to another. Typically, MMD is approximately 1.5 times the ADD while the PWD is generally between 1.5 and 2.0 times the ADD. Peaking factors between 2 and 2.5 are commonly used for MDD. As the DDD is a unique value for this study, there are no typical peaking values for comparison. A summary of the calculated flow peaking factors is presented in Table 6.2.3.

TABLE 6.2.3
SUMMARY OF TREATED WATER FLOW PEAKING FACTORS WITH BACKWASH

Time Period	DDD/ADD	MMD/ADD	PWD/ADD	MDD/ADD
2013	1.25	1.59	1.65	1.77
2014	1.29	1.47	1.58	1.85
2015	1.31	1.57	1.64	2.02
2016	1.25	1.52	1.66	2.13

Water Pumped to the City for Consumption

The water pumped to the City for consumption represents the amount of water leaving the WTP and conveyed to the City. This value does not take into account water utilized at the WTP (e.g. backwash and miscellaneous water usage).

The amount of water pumped to the City was derived from the plant data for Average Annual Demand (AAD), Average Daily Demand (ADD), Maximum Monthly Demand (MMD), Peak Weekly Demand (PWD), and Maximum Daily Demand (MDD). A summary of the compiled water demand parameters for water pumped to the City (Years 2013 to 2016) is presented in Table 6.2.4.

TABLE 6.2.4
ANNUAL, MONTHLY, WEEKLY AND DAILY WATER PUMPED TO THE CITY

Year	AAD (gpy)	ADD (gpd)	DDD (gpd)	MMD (gpd)	PWD (gpd)	MDD (gpd)
2013	406,137,000	1,112,704	1,399,523	1,723,032	1,777,429	1,901,000
2014	413,803,129	1,133,707	1,445,224	1,691,908	1,804,511	2,192,616
2015	449,319,521	1,231,012	1,595,679	1,925,052	2,013,650	2,554,206
2016	458,206,099	1,255,359	1,575,806	1,926,347	2,072,247	2,435,680
Average	431,866,437	1,183,196	1,504,058	1,816,585	1,916,959	2,270,876

The Peak Hourly Demand (PHD) is often used in the computer modeling process to ensure that the storage and distribution system will continue to function during short, peak demand situations. This value may be calculated by plotting the probability of occurrence of demand versus the various water demand values. From this logarithmic plot, the PHD value can be extrapolated.

The PHD was estimated by means of an extrapolation based on probability. Such a projection is based on the principle that an average monthly flow is likely to occur 6/12 of the time or 50%, and a peak monthly flow occurs 1/12 of the time or 8.3%. Likewise, peak weekly flow will take place 1/52 of the time or 1.9%. Peak daily flow occurs once in 365 days or 0.27%, a peak hour flow happens once in 8,760 hours or .011%. Using this method and the flow data for the Year 2016 (MDD = 2.43 MGD; PWD = 2.07 MGD; MMD = 1.93 MGD; ADD = 1.26 MGD), the PHD for the City of Sutherlin was estimated to be 3.6 MGD. The calculated peaking factor (PHD/ADD) is 2.86, which is slightly less than the range of peak factors of 3 to 5 commonly used for PHD. A summary of the calculated flow peaking factors is presented in Table 6.2.5.

TABLE 6.2.5
SUMMARY OF TREATED WATER PUMPED TO CITY FLOW PEAKING FACTORS

Time Period	DDD/ADD	MMD/ADD	PWD/ADD	MDD/ADD	PHD/ADD
2013	1.26	1.55	1.60	1.71	2.25
2014	1.27	1.49	1.59	1.93	2.47
2015	1.30	1.56	1.64	2.07	2.84
2016	1.26	1.53	1.65	1.94	2.86

Nonaccount Water

Water sold is typically less than the amount of water produced at the plant due to system leaks, unmetered use at the WTP (backwash water, turbid meter water, wash down, etc.), unmetered use within the distribution system, inaccuracies in customer meters, and other unmetered use such as fire flows and system flushing. A comparison of the amount of water treated (sum of water pumped to the City and backwash), and the amount of water consumed is given in Table 6.2.6.

TABLE 6.2.6
COMPARISON OF WATER PRODUCED, BACKWASH, PUMPED AND CONSUMED

Time Period	Water Produced	Backwash	Water Pumped	Water Consumed	% Nonaccount[1]
2014	452,940,570	39,137,441	413,803,129	386,688,928	6.6%
2015	479,894,287	30,574,766	449,319,521	407,936,109	9.2%
2016	525,226,752	67,020,653	458,206,099	384,360,893	16.1%
Average	486,020,536	45,577,620	440,442,916	392,995,310	10.6%

(1) Percent unaccounted is based on the quotient of the water consumed and water pumped to the City.

Over the last three years, the average amount of nonaccount water pumped to the City is approximately 10.6 percent. Previously, the percent of nonaccount water within the City has been reported as 27.5 percent in 1995-96, and 39 percent in 1974. Potential sources of lost treated water include the following:

- Leakage within the City's water distribution system.
- Inaccurate water meters.
- Unauthorized use or connections without meters
- Unmetered water for firefighting and operations such as street cleaning, water main flushing and testing.

The Oregon Administrative Rules (OAR) Section 690-86, states that all water systems should work to reduce system leakage levels to 15 percent or less. If the reduction of system leakage to 15 percent is found to be feasible, the water provider should work to reduce system leakage to ten percent. With the amount of nonaccount water within its system, the City has met regulatory standards and requirements. However, the City should continue to strive to account and maintain the nonaccount water. Reductions in lost water can result in increased revenues, reduced expenses, and improved water system performance.

Water Diverted

As part of the auditing process, the City must account for all water diverted from each source. This is typically accomplished through a metering device at or near the point of diversion. OAR 690-085-0015 requires that, "Where practical, water use shall be measured at each point of diversion." However, the rule also states that:

"…measurements may be taken at a reasonable distance from the point of diversion if the following conditions are met:

- *The measured flow shall be corrected to reflect the flow at the point of diversion. The correction will be based on periodic flow measurements at the point of diversion taken in conjunction with flow measurements at the usual measuring point;*
- *If the measured flow includes flow contributions from more than one point of diversion, the measured flow shall be proportioned to reflect the flow at each point of diversion using the method prescribed subsection (a) of this section;*
- *A description of the correction method shall be submitted with the annual report the first time it is used and any time it is changed, or once every five years, whichever is shorter."*

If the point of diversion is relatively close to the water treatment plant, it is common for many communities to use a single influent meter at the water plant to measure the amount of water that is diverted.

As mentioned in Section 5.1, there is concern about the accuracy of the raw water flow meters. For this WMP, the amount of diverted water from each source was calculated based on the sum of the amount of water pumped to the City, and backwash water, which is the WTP water production.

Summary

The current water demand parameters for water production and water pumped to the City were compiled and are provided in Tables 6.2.7 and 6.2.8. These parameters were based on the water demand data for 2016. This water demand criteria will serve as the basis for the planning criteria of this Master Plan.

TABLE 6.2.7
SUMMARY OF CURRENT RAW WATER DEMAND

Demand Paramenter	Total, GPD	Peacking Factor	Per Capita Demand, gpcd
Average Daily Demand, ADD	1,438,977	1	168
Dry Season Daily Demand, DDD	1,801,358	1.25	210
Maximum Monthly Demand, MMD	2,185,057	1.52	255
Peak Weekly Demand, PWD	2,389,748	1.66	279
Maximum Daily Demand, MDD	3,072,155	2.13	358
Peak Hourly Demand, PHD	4,111,364	2.86	479

(1) Based on population of 8,578 in Year 2016.

TABLE 6.2.8
SUMMARY OF CURRENT DEMAND OF WATER PUMPED TO THE CITY

Demand Paramenter	Total, GPD	Peacking Factor	Per Capita Demand, gpcd
Average Daily Demand, ADD	1,255,359	1	146
Dry Season Daily Demand, DDD	1,575,806	1.26	184
Maximum Monthly Demand, MMD	1,926,347	1.53	225
Peak Weekly Demand, PWD	2,072,247	1.65	242
Maximum Daily Demand, MDD	2,435,680	1.94	284
Peak Hourly Demand, PHD	3,586,741	2.86	418

(1) Based on population of 8,578 in Year 2016.

6.3 Projected Water Demand

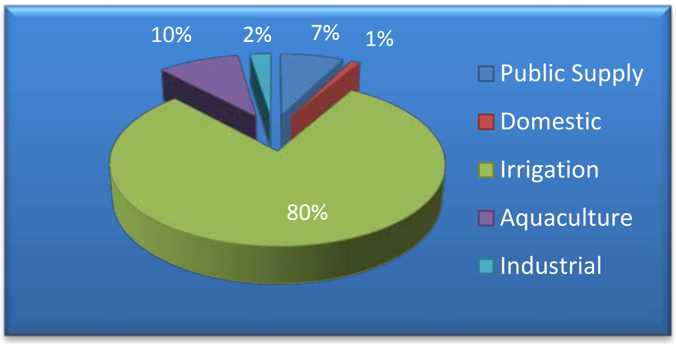
Water demands are projected into the future using the past records of water produced and water sold along with projected population estimates and anticipated additional water demand (i.e. industry). The goal of projecting future water demand is not to build larger facilities to accommodate excessive water consumption, but rather to evaluate the capability of existing components and to size new facilities for reasonable demand rates. Large amounts of leakage and excessive water consumption should not be projected into the future estimates. Rather, efforts should be made to reduce leakage and lost water to a reasonable level and utilize lower, more acceptable demand rates for planning efforts. Water demand projections should be based on acceptable water loss quantities, reasonable conservation measures, and the community’s expected water use characteristics.

There is a degree of uncertainty associated with future water demand projections for any community. Uncertainties in projections exist because of the estimates used to define the community's current water use and the built-in assumptions made with respect to anticipated growth in a community. The impact of water conservation measures on a community's future water consumption also is difficult to predict.

Future per Capita Water Usage and Growth

The U.S. Department of the Interior documented the per capita water use in Oregon as 113 gpcd. A total of 6,730 MGD of water was used by Oregon in 2010. Total water withdrawals are separated by water-use category. The categories with their representative water use amounts are shown in Figure 6.3.1. The Department of the Interior documented the per capita water use for Oregon in the 2010 U.S. Geological Survey – Circular 1405.

FIGURE 6.3.1
STATE OF OREGON USAGE



Based on raw water diversion records, the average per capita use in the City of Sutherlin is 168 gpcd (this includes all domestic, commercial, and City use divided by population). For this study, future water demand for water pumped to the City will be based on the current water pumped parameters (per capita usage), projected growth within the City (see Section 3.3), and anticipated unaccounted water. This methodology assumes that water demand characteristics within the City will basically remain the same as the existing per capita basis with consideration for changes in anticipated nonaccount water. The future anticipated nonaccount water is discussed below.

Anticipated Lost Water

Responsible water planning should not include the propagation of high lost water levels into water demand projections. According to OAR 690-86-140, a water system should endeavor to reduce system leakage to 15 percent or less of the total water diverted from their raw water sources. As developed previously in this Section, the nonaccount water within the City is well below 15 percent. As the City is already in compliance with OAR, Division 86, the City is not required to reduce their level of nonaccount water. Therefore, for the demand projections, the level of nonaccount water assumed to be constant throughout the planning period, and will have no impact on the demand projections.

Summary of Future Water Demand

The ADD projections were calculated by multiplying the projected population by the per capita usage (168 gpcd). The DDD, MMD, MWD, and PWD were then determined by multiplying the ADD by their respective peaking factors. A summary of the water production demand projections is presented in Table 6.3.1.

TABLE 6.3.1
FUTURE WATER PRODUCTION DEMAND

Future Raw Water Demand					
Parameter/Year	**2016**	**2021**	**2026**	**2031**	**2036**
Total Population	8,578	9,198	9,866	10,586	11,362
% Nonaccount Water	10%	10%	10%	10%	10%
Water Demand					
ADD, gpd	1,438,977	1,543,018	1,655,099	1,775,842	1,905,917
DDD, gpd	1,801,358	1,931,599	2,071,906	2,223,056	2,385,888
MMD, gpd	2,185,057	2,343,041	2,513,233	2,696,580	2,894,096
PWD, gpd	2,389,748	2,562,531	2,748,667	2,949,189	3,165,208
MDD, gpd	3,072,155	3,294,277	3,533,566	3,791,347	4,069,052
PHD, gpd	4,111,364	4,408,623	4,728,855	5,073,836	5,445,478

SECTION 7:
DESIGN CRITERIA AND COST BASIS

SECTION 7: **DESIGN CRITERIA AND COST BASIS**

7.1 Design Life of Improvements

The design life of a water system component is sometimes referred to as its useful life or service life. The selection of a design life is based on such factors as the type and intensity of use, type and quality of materials used in construction, and the quality of workmanship during installation. The estimated and actual design life for any particular component may vary depending on the above factors. The establishment of a design life provides a realistic projection of service upon which to base an economic analysis of new capital improvements.

As discussed in Section 2, the base planning period for this Master Plan is 20 years, ending in the year 2036. The planning period is the time frame during which the recommended water system is expected to provide sufficient capacity to meet the needs of all anticipated users. The required system capacity is based on population, water demand projections, and land use considerations. The planning period for a water system and the design life for its components may not be identical. For example, a properly maintained steel storage tank may have a design life of 60 years, but the projected fire flow and consumptive water demand for a planning period of 20 years determine its size. At the end of the initial 20-year planning period, water demand may be such that an additional storage tank is required; however, the existing tank with a design life of 60 years would still be useful and remain in service for another 40 years. The typical design life for system components are discussed below.

Raw Water Intakes and Transmission

Intake structures including concrete impoundments should have design lives of 50 to 100 years when properly constructed and maintained. Water transmission piping should easily have a design life of 40 to 60 years if quality materials and workmanship are incorporated into the construction. Modern PVC and cement mortar-lined ductile iron piping can last up to 100 years when properly designed and installed.

Water Treatment Facility

Major structures and buildings should have a design life of approximately 50 years. Pumps and equipment usually have a useful life of about 15 to 20 years. The useful life of treatment equipment can be extended when properly maintained if additional treatment capacity is not required. Filter media normally has a design life of 10 to 15 years. Flow meters typically have a design life of 10 to 15 years. Valves usually need to be replaced after 15 to 20 years of use.

Treated Water Transmission and Distribution Piping

Water transmission and distribution piping should easily have a design life of 40 to 60 years if quality materials and workmanship are incorporated into the construction. Modern PVC and cement mortar lined ductile iron piping can last up to 100 years when properly designed and installed.

Treated Water Storage

Distribution storage tanks should have a design life of 50 to 60 years (steel construction) to 70 to 80 years (concrete and welded steel construction). Steel tanks with a glass-fused coating can have a design life similar to concrete construction. Actual design life will depend on the quality of materials, the workmanship during installation, and the timely administration of maintenance activities. Several practices, such as the use of cathodic protection, regular cleaning and frequent painting can extend or assure the service life of steel reservoirs.

7.2 Sizing and Capacity Criteria

Demand projections presented in Section 6.3 are based on population projections offered in Section 3.3. The projections assume an average 1.5 percent annual growth rate until the Year 2036.

Accurately predicting growth is difficult, especially beyond 20 years into the future. As time progresses, all of the projections should be updated to reflect actual population and demand. The analysis and presentation of recommended improvement alternatives can be found in Section 8.

Raw Water Source

The water sources and reservoirs must be capable of meeting Maximum Daily Demand (MDD) of the system over a period of many years. The selection of a source is a long-term commitment that cannot be easily changed. Water rights are becoming more critical as Oregon's population and water demand increases and the number of viable water sources remains constant. Typically, water sources and reservoirs are evaluated to ensure there is enough water to meet the MDD 20 years into the future. In the City of Sutherlin's case, the water sources need to be sufficient to handle the water demand during the dry season months (June through October). The appropriate design parameter for this dry season evaluation would be the MDD.

Intake and Pumping Facilities

Intake piping and wet wells are not easily expanded and should be sized to meet the anticipated maximum day demand well into the future. A design life of 50 years is common for such facilities.

Pumps and other mechanical equipment can be expected to last no more than 20 years under normal conditions before extensive maintenance or replacement is necessary. Commonly, two pumps are installed in a pumping station, each having capacity equal to the capacity of a water treatment plant or the MDD predicted within a planning period. Duplex pumping systems can be designed to alternate after each cycle to extend the life of the equipment. If future demands increase beyond the ability of a single pump, the second pump can serve as a lag pump in parallel to sustain higher flow rates during peak demand times.

Transmission Piping

The long distances and high replacement cost of the transmission lines warrant an analysis for demand beyond the normal 20-year period. The existing transmission lines must have the ability to handle at least the 20-year MDD. The capacity of the raw water and treated water transmission piping will be evaluated against the 20-year MDD.

Water Treatment Facility

Water treatment plants are typically designed to handle the 20-year MDD flow since these facilities can be expanded and typically have an overall design life of around 20 years. The existing treatment plant components will be evaluated against the 20-year MDD flow.

Treated Water Storage

Total storage capacity must include reserve storage for equalization storage, and emergency storage and fire reserve. An alternative method to analyzing the treated water storage requirements suggests itemizing the potential requirements for treated water within the system. A discussion of these various needs follows.

Equalization Storage
To meet fluctuations of the supply capacity of the treatment plant and peak demand of the distribution system equalization storage is used. Equalizing storage is typically set at 25 percent of the MDD of the water system.

Emergency Storage
To protect against a total loss of water supply that could occur with a broken transmission main, a prolonged electrical outage, treatment plant breakdown, or source contamination emergency storage is required. The emergency storage reserve is set at one MDD or three Average Daily Demand (ADD). With one MDD storage criteria, it is assumed that supply disruption will occur on a day of maximum demand and be corrected within 24 hours.

Fire Reserve Storage
To provide sufficient water for fire suppression in the water system fire reserve storage is utilized. The amount of fire reserve is based on the maximum flow and duration of flow needed to confine a major fire. Guidelines for determining the required fire flow and duration are generally determined using the Fire Suppression Rating Schedule by the Insurance Services Office (ISO) and/or the International Fire Code adopted by the State of Oregon. The needed fire flow and associated fire reserve storage dictated by these two methods can vary considerably.

The ISO needed fire flow is calculated using factors related to type of construction, type of occupancy, exposure to connected buildings, and building affective area. Using their formula a single wood framed dwelling totaling 2,400 square feet would require approximately 1,000 gpm for two hours.

The 2014 Oregon Fire Code recommends fire flows of 1,000 gpm for a minimum of one hour for one or two family dwellings not exceeding two stories in height or 3,600 square feet. Generally for rural residential dwellings, 500 gpm is utilized as a basis for fire flow suppression. Most residences within the City of Sutherlin are less than 3,600 square feet. Therefore, for this study, the fire reserve storage required for residential areas will be calculated using fire flows of 1,000 gpm and duration of one hour.

Commercial, industrial, and institutional buildings typically require higher fire flows with longer durations. Determination of these flows are unique to each building under consideration and will depend upon such factors as the square footage of the floor area, and the type of construction based on the International Building Codes (IBC) classifications.

Another important design parameter for reservoirs is elevation. Ideally, reservoirs should be located at similar elevations to allow hydraulic balance within the distribution system. Within a given service area, the need for altitude valves, check valves, pressure reducing valves (PRVs), booster pumps, pumper trucks for extracting fire flows, and other control devices is reduced when a consistent water surface is maintained in all reservoirs. Distribution reservoirs should also be located at an elevation that maintains adequate water pressure throughout the system; sufficient water pressures at high elevations and reasonable pressures at lower elevations. The pressure range in the system should stay within the range of 25 to 100 psi and never drop below 20 psi at any usage rate.

All of the above criteria will be used to evaluate the adequacy of existing storage and the need, if any, for future additional storage in Section 8.4.

Distribution System

Distribution mains are typically sized for fire flow and 20-year population demand, or fire flow and saturation development demand. The mains should be at least 6-inch diameter to provide minimum fire flow capacity. All pipelines should be large enough to sustain a minimum line pressure of approximately 25 psi. The State of Oregon requires a water distribution system be designed and installed to maintain a pressure of at least 20 psi at all service connections at all times. The distribution system must be sized to handle the peak hourly flows and to provide fire flows while maintaining minimum pressures.

In addition to the above design criteria, the following general guidelines are recommended for the design of water distribution systems.

- 8-inch diameter lines - minimum sized lateral water main for gridiron (looped) system and dead-end mains.

- 8-inch diameter lines - minimum size for permanently dead-ended mains supplying fire hydrants and for minor trunk mains.

- 10-inch and larger diameter - as required for trunk (feeder) mains.

The distribution system lateral mains should be looped whenever possible. A lateral main is defined as a main not exceeding 8-inch diameter, which is installed to provide water service and fire protection for a local area including the immediately adjacent property. The normal size of lateral mains for single-family residential areas is 6-inch diameter. However, 8-inch diameter or greater lateral mains may be required to meet both the domestic and fire protection needs of an area.

The installation of permanent dead-end mains and dependence of relatively large areas on a single main should be avoided. For the placement of a fire hydrant on a permanently dead-ended main, the minimum size of such laterals should be 8-inch diameter. However, 6-inch diameter mains may be used for a stub out not exceeding 500 feet in length supplying a single fire hydrant not on a public street and for internal fire protection. On new construction, the minimum size lateral main for supplying fire hydrants within public ways should be 6-inch diameter provided 6-inch diameter mains are looped.

A computer model of the distribution system was developed as part of this Master Plan. The model utilized actual pipe sizes, system configuration, and materials as well as system pipe junction elevations and storage tank elevations. A computer model of the City’s distribution system was checked to determine the maximum flow rate available at various locations within the system. The model was developed using a software program called WaterCAD (Version 8XM) offered by Haestad Methods.

The requirements for firefighting within the City were developed by consulting with the City’s Fire Chief. For a detailed discussion of the distribution system performance and fire flow analysis, see Section 8.5.

7.3 Basis for Cost Estimates

The cost estimates presented in this Plan will typically include four components: construction cost, engineering cost, contingency, and legal and administrative costs. Each of the cost components are discussed in this Section. The estimates presented herein are preliminary and are based on the level and detail of planning presented in this WMP. As projects proceed and as site specific information becomes available, the estimates may require updating. System improvements that are recommended in the City of Sutherlin are detailed in this Section along with associated costs.

Construction Costs

The estimated construction costs in this Plan are based on actual construction bidding results from similar work, published cost guides, other construction cost experience, and material prices. Reference was made to the as-built drawings, and system maps of the existing facilities to determine construction quantities, elevations of the reservoirs and major components, and locations of distribution lines. Where required, estimates will be based on preliminary layouts of the proposed improvements.

Future changes in the cost of labor, equipment, and materials may justify comparable changes in the cost estimates presented herein. For this reason, common engineering practices usually tie the cost estimates to a particular index that varies in proportion to long-term changes in the national economy. The Engineering News Record (ENR) construction cost index is most commonly used. This index is based on the value of 100 for the year 1913. Average yearly values for the past ten years are summarized in Table 7.3.1.

TABLE 7.3.1
ENR CONSTRUCTION COST INDEX – 2006 TO 2016 (1)

Year	Index	Change
2016	10,338	2.83%
2015	10,054	2.53%
2014	9,806	2.71%
2013	9,547	2.57%
2012	9,308	2.62%
2011	9,070	3.08%
2010	8,799	2.67%
2009	8,570	3.13%
2008	8,310	4.32%
2007	7,966	2.77%
2006	7,751	4.10%
Average Annual %		**3.03%**

(1) Index based on July of each year at 20-city average labor rates and material prices.

Cost estimates presented in this Plan for construction performed should be projected with a minimum increase of three percent per year. Future yearly ENR indices can be used to calculate the cost of projects for their construction year based on the annual growth in the ENR index.

It is also recommended that in the event other public works projects are being performed in the same location, (i.e., sewer, street, storm, etc.), planning priority be given to combining these water projects with the projects at hand. By proceeding in this manner, the City will save money by eliminating repetitive mobilization, demolition, and road patching in the same locations.

Contingencies

A planning level contingency factor equal to approximately 15 percent of the estimated construction cost has been added. In recognition that the cost estimates presented are based on conceptual planning, allowances must be made for variations in final quantities, bidding market conditions, adverse construction conditions, unanticipated specialized investigation and studies, and other difficulties which cannot be foreseen at this time but may tend to increase final costs.

Engineering

The cost of engineering services for major projects typically includes special investigations, a predesign report, surveying, foundation exploration, preparation of contract drawings and specifications, bidding services, construction management, inspection, construction staking, start-up services, and the preparation of operation and maintenance manuals. Depending on the size and type of project, engineering costs may range from 15 to 25 percent of the contract cost when all of the above services are provided. The lower percentage applies to large projects without complicated mechanical systems. The higher percentage applies to small, complicated projects.

Additional engineering services may be required for specialized projects. This could include geotechnical evaluations, structural evaluations, and other specialized consulting activities.

Legal and Administrative

An allowance of seven percent of construction costs have been added for legal and administrative services. This allowance is intended to include internal project planning and budgeting, grant administration, liaison, interest on interim loan financing, legal services, review fees, legal advertising, and other related expenses associated with the project.

Land Acquisition

Some projects may require the acquisition of additional right-of-way or property for construction of a specific improvement. The need and cost for such expenditures is difficult to predict and must be reviewed as a project is developed. Effort was made to include costs for land acquisition, where expected, within the cost estimates included in this Plan.

Environmental Review

In order for a project to be eligible for federal and/or state grants and loans, a review of anticipated environmental impacts of the proposed improvements is required. The primary goal of the environmental review is to help public officials make decisions that are based on the understanding and consideration of the environmental consequences of their actions, and to take actions that protect, restore, and enhance the environment. To accomplish these tasks, the National Environmental Policy Act (NEPA) was promulgated. The NEPA requires federal agencies or monies originating from federal programs to either prepare or have prepared written assessments or statements that describe the: 1) affected environment and environmental consequences of a proposed project, 2) reasonable or practicable alternatives to the proposed project, and 3) any mitigation measures necessary to avoid or minimize adverse environmental effects.

The environmental review will include one of the following four levels in the order of increasing complexity.

- Determination of categorical exclusion without an environmental impact or assessment report.

- Determination of categorical exclusion with an environmental impact or assessment report.

- Preparation of an environmental impact or assessment report.

- Preparation of an environmental impact statement.

Within this Plan, the cost for performing the anticipated environmental review was estimated based on the projects being financed with publicly financed grants and loans. The cost for the environmental review will be based on previous experience in preparing the required documents. If funding is obtained from a public funding agency, then the City will likely be required to submit some form of environmental report that examines the potential impact of the proposed improvements on local habitat and species. Review and approval by the affected agencies could take up to twelve (12) months or more.

Permitting

Permitting is important because many activities associated with constructing and maintaining the water system requires permits to comply with state and federal requirements for work within wetland areas or waterways. Typically, Oregon Division of State Lands and U.S. Corps of Engineers are required in these instances. Compliance with storm water, erosion control, flood plain, and other various environmental requirements are often involved with the construction of transmission lines, raw water intakes, discharge facilities, raw and finished water reservoirs, and other items. Permits with various road system agencies may be necessary to install water lines within a road right-of-way. For the cost estimates prepared in this WMP, it was assumed that the General Contractor would bear the cost of permitting. Therefore, no permitting costs are included in these estimates.

SECTION 8:

ANALYSIS AND IMPROVEMENT ALTERNATIVES

SECTION 8: **ANALYSIS AND IMPROVEMENT ALTERNATIVES**

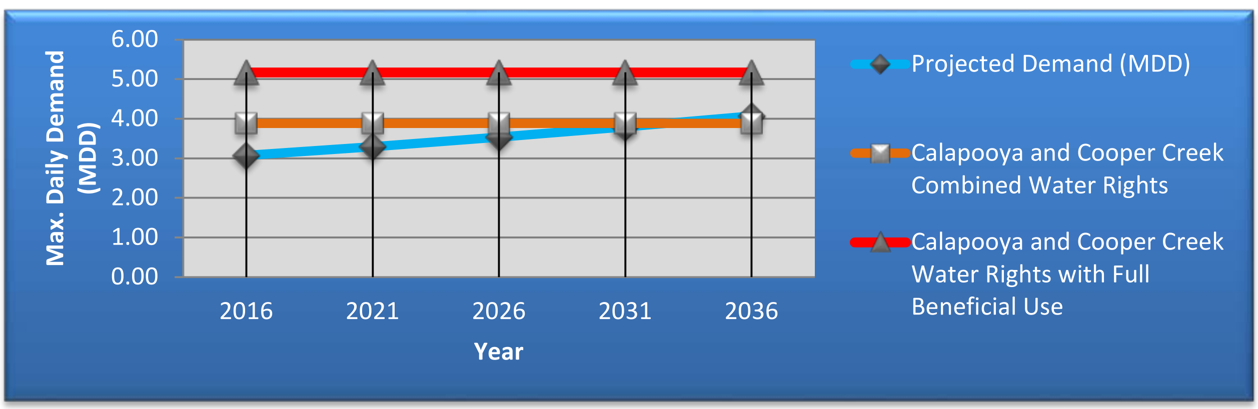
This Section of the Master Plan presents detailed analyses of each component within the system and, where appropriate, provides an evaluation of proposed alternatives and recommended option(s). Preliminary cost estimates are presented in this Section for some of the alternatives. Cost estimates for the recommended improvements are given in the Capital Improvement Plan (see Section 9). Improvement phasing and potential impacts to ratepayers are discussed in Section 10.

8.1 Raw Water Sources and Water Rights

As presented in Section 5.1, the City has water rights for 4.0 cfs on Calapooya Creek (only 3.0 cfs are available during summer months), 5.0 cfs on Cooper Creek with 500 acre-feet of storage in Cooper Creek Reservoir (currently limited to 3.0 cfs and 179 acre-feet), and 3.0 cfs on the North Umpqua River.

The need to develop additional raw water sources will depend on whether the current City sources and reservoir are sufficient to handle the anticipated water demand. Based on the present and projected water demands discussed in Sections 6.2 and 6.3, the City has not had any difficulty in meeting its water requirements during the wet season months (November through April) because demand is low and the raw water supply is sufficient. The City is not anticipated to have any future difficulty in meeting projected water demands in the wet season months for the same reason. The most critical time for the City to obtain water is during the dry season months (June through October) when demand is high and the supply of raw water is limited. A plot of projected maximum daily demand versus time is presented in Figure 8.1.1.

FIGURE 8.1.1
RAW WATER MAX. DAILY DEMAND (MDD) AND CITY WATER RIGHTS(1) VS. YEAR



(1) Water rights for Calapooya Creek do not include its junior right (1.0 cfs) due to instream rights.

Based on the projected Maximum Daily Demand (MDD), the City's existing water rights on Calapooya Creek and Cooper Creek should be sufficient to meet the City's demand through the year 2031. Beyond that point, full beneficial use of the Cooper Creek water right will be necessary to meet system demands.

Although there are sufficient water rights available through the planning period, the City will need to begin examining and pursuing the development of further water rights as the planning period comes to a close. Two possible sources for further water right development is the City of Oakland and the North Umpqua River.

North Umpqua River

As discussed in Section 5.1, the City has an undeveloped municipal water right on the North Umpqua River for 3.0 cfs with a seniority date of 10/15/1979. Point of diversion is located between the Interstate-5 bridge at Winchester (downstream) and Whistlers Bend (upstream).

To develop this water right, it will require improvements to both the Umpqua Basin Water Association's (UBWA) and the City of Sutherlin's water systems. Various improvement alternatives were explored in the 2006 WMP, and the most cost effective choice was determined. This solution incorporated improvements to the UBWA intake and WTP, and construction of a booster pump station and a large pipeline linking the two water systems. Since the development of the 2006 WMP, intake and WTP improvements were completed that will facilitate future development of this water right.

City of Oakland

The possibility of the City leasing or purchasing water rights from the City of Oakland has been proposed and discussed in the past for a number of reasons. These reasons include the proximity of the two cities, Oakland's senior water right on Calapooya Creek, and available water under the City of Oakland's water right. An intertie between the city's two water systems appears feasible with the installation of a water main between the City of Oakland's system and the Union Gap Water District's system.

As the holder of the senior water right on Calapooya Creek, the City of Oakland has the ability to fulfill its 2.0 cfs diversion at the expense of other water rights during low flow conditions. In the mid-1990s, the City of Oakland was using approximately 0.7 cfs of the 2.0 cfs water right, and thus, currently has excess water source capacity at this time (HGE 1997). However as development occurs, the water demand within the City of Oakland is anticipated to eventually match or exceed its water right. The projected 25-year and ultimate water demand in Oakland is 1.7 cfs and 3.2 cfs, respectively. In the short term, the City could benefit by having access to more senior water rights then their own on the Calapooya Creek. However in the long run, there is no net benefit for the City of Sutherlin to lease the City of Oakland's water rights as Oakland will eventually need these rights.

8.2 Raw Water Improvements – Cooper Creek Reservoir

Multi-Level Reservoir Intake Structure

The primary problem with the Cooper Creek Reservoir raw water source is the water quality. The high levels of iron and manganese within the water currently entering the Cooper Creek WTP requires considerable chemicals to treat, and forces additional backwashes to maintain filter function.

Reduction in the required chemical treatment, and filter backwashes can be accomplished be reducing the amount of iron and manganese in the raw water, and by oxidizing the water before it enters the WTP.

Currently, the raw water intake from Cooper Creek Reservoir is located approximately 38 feet below the permanent pool elevation on the upstream face of the dam. At this depth there is significant build-up of various particles within the water. This proposed improvement would be to construct an intake system that would allow the City to withdraw water from various depths above the current intake elevation. By varying the depth of the intake, raw water quality could be optimized. Further evaluation and testing is needed to verify the most effective depths or range for the proposed intake.

In addition to water quality concerns at the existing intake, functionality is also a concern of the City. Currently, the intake pipe for the WTP also serves as the drain line for the reservoir. This configuration does not allow the reservoir to be flushed while the WTP is in use, nor can the WTP be in use while the reservoir is being flushed. Relocating the WTP intake pipe would allow the systems to be independent and operate at the same time if necessary. Final location of new intake is to be coordinated with Sutherlin Water Control District.

The newly relocated intake will employ the use of a track system to vary its depth. This system will include a concrete structure to which the tracks are shored, the tracks which extend from the structure along the sloped bank to the lowest desired water depth, a motor to adjust intake elevations, an intake screen, flex pipe going from the intake to a hard pipe protruding from the bank, the raw water pipe running from the flex pipe to the WTP, and a Control Building that will house motor controls and an air burst system for the intake. Much of this work would require the creation of a dry-work area. This would be accomplished with sheet piling. A preliminary layout is shown in Figure 9.2.1.

To address the water quality within the reservoir a SolarBee Hypolimnetic Circulator should be installed near the new intake location. The iron and manganese must precipitate and fall out of the water column. The SolarBee solution uses hypolimnetic withdrawal in the deepest hole near the intake. By pulling up the anoxic, highly concentrated iron / manganese bottom water and exposing it to the oxygen-rich epilimnion, SolarBee circulation facilitates precipitation and can help make the incoming water more easily treatable.

If the raw water quality was not fully addressed by the proposed improvements discussed above, an aeration system should be constructed downstream of the intake. The basin would oxidize the manganese thereby allowing the filters within the plant to remove the remaining manganese from the water.

Intake Alignment Reroute

Due to the relocation of the intake, new piping will be required to convey the raw water from the intake to the WTP. This new pipe will extend from the intake location, across the parking lot, and along the access road to the WTP. Near the end of the access road, the new pipe will intersect the existing intake line. At that junction, the two intake pipes will be connected. The existing intake line upstream of the junction will be isolated, but will stay in place for redundancy. The proposed alignment is shown in Figure 9.2.1.

8.3 Water Treatment Facilities

A number of operational issues with both of the city's water treatment facilities were presented in Section 5. Proposed improvements to these WTPs are described below.

Nonpareil WTP

Nonpareil water treatment plant supplies the majority of the City's water. The plant continues to function well considering its age. In order to ensure that the treatment plant continues to operate and deliver high-quality water to the City's customers, improvements must be made to the plant. The current operations and maintenance issues at the Nonpareil WTP were outlined in Section 5.3. The following improvements were developed to address these highlighted deficiencies.

Raw Water Intake
The current compressor used to clean the intake screen is not large enough, and needs to be replaced. Also, the current raw water flow meter often clogs, and skews the readings. This meter should be replaced.

Contact Clarifier
The metal structure of the clarifier should be sand blasted, then repainted. The clarifier tank should be sand blasted, pressure grouted, then coated. This process will seal all existing leaks.

Filters
Filter-to-waste piping and controls would allow diversion of the first water treated through the filter after backwash to the backwash pond, and eliminate any solids carryover to the clearwell. This piping should be added to the WTP.

The use of air scour is more effective means of fluidizing and cleaning the filter bed and would reduce the amount of potable water use during backwash. An air-scour system should be added to the media filter when the media is being replaced. Surface wash system should be removed.

Mixed Media
Replacement of mixed media is necessary.

Disinfection
A bulk hypochlorite system should replace the existing gas disinfection system.

Backwash Ponds
Construction of new backwash ponds in the current backwash pond location will allow the sludge to be removed without backwash water overflowing the ponds.

Potable Water Pump
Install a redundant potable water pump above clearwell.

System Piping
All mechanical piping needs to be replaced, and the valves need to be replaced with electronically actuated valves.

Electrical Equipment
Electrical equipment is old and should be upgraded. Installation of a Supervisory Control And Data Acquisition (SCADA) system similar to the Cooper Creek WTP would allow City staff to remotely access WTP data and control WTP operations.

Generator
The generator should be replaced, and an automatic transfer switch added to the system.

Monitoring Equipment
The existing monitoring equipment is beyond its service life, and should be replaced within the planning period. This equipment includes the streaming current monitor, chlorine analyzer, and turbidity meters.

Cooper Creek WTP

The treatment process at the Cooper Creek WTP requires considerable volumes of potassium permanganate to treat the high levels of manganese present in the raw water. The manganese in the raw water will be treated prior to entering the WTP. No improvements are necessary within the WTP to address this concern. Improvements designed to address the manganese issues are discussed in Section 8.2.

8.4 Treated Water Storage

The City currently has a total treated water storage capacity of 3,646,000 gallons provided by ten storage tanks, not counting a total of 175,000 gallons stored in the clearwells at the WTPs. Regular inspection and maintenance of each tank is required to extend the useful life of the infrastructure. The interior of each tank should be inspected every three to five years and deficiencies repaired as required.

Aside from capacity, cathodic protection is also an issue for the City of Sutherlin reservoirs. Currently, none of the storage tanks have cathodic protection system installed. The proposed improvements will include the installment of cathodic protection on all existing and future reservoirs. See Section 9 for a development of the costs for and phasing of the recommended reservoir options.

Lower Level Tanks

The lower level tanks represent the bulk of the City's treated water storage. The tanks in this pressure zone include Oak Hills, Calapooya, and Umpqua. The Oak Hills Tank is the newest tank in this pressure zone.

The Umpqua and Oak Hills Tank appeared to be in excellent condition. The only recommended improvement is the installation of cathodic protection for these tanks.

The issues with the Calapooya Tank were cracks observed in the pavement on the downhill side of the tank and accumulated material against the fence. The cracks in the pavement need to be repaired and the accumulated material against the fence should be removed.

Mid-Level Tanks

The tanks in this pressure zone include Schoon Mountain, Tanglewood, Forest Heights, and Upper Umpqua. All of these tanks are constructed of steel and lack cathodic protection. Installation of cathodic protection is recommended, especially at the Tanglewood and Upper Umpqua Tanks. With the exception of graffiti at the Tanglewood Tank and bullet marks on the Upper Umpqua Tank, these tanks appear to be in good condition. Recoating of the Upper Umpqua Tank is recommended. The reliance of a pressure relief valve for temporary outage of the Tanglewood Tank and Upper Umpqua Tank is acceptable but does result in unaccounted for water loss. For longer outages (as in the case of recoating a tank), the City will need to either install a smaller tank next to the existing tank or bring in a temporary storage tank to serve as the reservoir for this pressure zone.

High-Level Tanks

Ridgewater No. 1 and No. 2 tanks comprise the high-level tanks. Ridgewater No. 1 has been in service a number of years and is in need of maintenance. The outside of the tank should be recoated, and cathodic protection of the tank should be added.

Ridgewater No. 2 tank is new and in excellent condition. Improvements to this tank include additional coating of some of the seismic bolts around the foundation, installation of cathodic protection, and installation of additional security measures to prevent access to the top of the tank.

Design Storage Capacity

As discussed in Section 7.2, there are three parameters used to determine the treated water storage requirements of a given water system. For all evaluations the equalization was set at 25% of MDD and emergency storage was set at 1 MDD. The MDD for the individual reservoir assessments was based on the MDD per capita, and the population served in each service area. The fire storage must match the largest fire flow demand within the given service area. Fire storage varied depending on the service area of the given reservoir. The fire flow demand for the overall system storage analysis was set at 4,500 gpm with duration of two hours. For reservoirs serving residential areas, the fire flow demand was set at 1,000 gpm with duration of one hour.

Multiple storage evaluations were completed. The primary analysis involved an evaluation of the entire system. This is shown in Table 8.4.1. Additionally, several storage evaluations were done for the mid and high-level reservoirs. These are shown in Tables 8.4.2 through 8.4.8. These evaluations analyzed only their respective service areas, and were intended to calculate the storage needs at their locations. Given that the overall system is deficient at the end of the planning period, upsizing these mid-high level reservoirs to meet their storage requirements will reduce the amount of additional storage required to address the overall deficiency. Low-level reservoirs were not individually analyzed; as all additional storage required to address the remaining deficiency will be added to the low-level service area.

TABLE 8.4.1
ENTIRE SYSTEM ASSESSMENT
DESIGN TREATED WATER STORAGE

Parameter/Year	2016	2021	2026	2031	2036
Water Demand (MGD)					
MDD	2.28	2.36	2.53	2.71	2.90
Necessary Storage (MG)					
Emergency Storage (1 x MDD)	2.28	2.36	2.53	2.71	2.90
Equalization (.25 x MDD)	0.57	0.59	0.63	0.68	0.73
Fire Reserve (4500 GPM @ 2 Hours)	0.54	0.54	0.54	0.54	0.54
Total Required Storage	3.40	3.49	3.70	3.93	4.17
Storage Assessmant (MG)					
Existing Storage	3.65	3.65	3.65	3.65	3.65
Insufficient (-)/Surplus Storage	0.25	0.16	-0.05	-0.28	-0.53

TABLE 8.4.2
SCHOON MOUNTAIN RESERVOIR ASSESSMENT
DETERMINED NECESSARY WATER STORAGE

Parameter/Year	2015	2020	2025	2030	2035
Water Demand, Gallon per Day					
Number of Served Residences	50	60	70	80	100
Total MDD for Service Area	31,500	37,800	44,101	50,401	63,001
Necessary Storage (Gal.)					
Emergency Storage (1 x MDD)	31,500	37,800	44,101	50,401	63,001
Equalization (.25 x MDD)	7,875	9,450	11,025	12,600	15,750
Fire Reserve (1000 GPM @ 1 Hour)	60,000	60,000	60,000	60,000	60,000
Total Required Storage	99,375	107,251	115,126	123,001	138,751
Storage Assessmant (Gal.)					
Existing Storage	24,000	24,000	24,000	24,000	24,000
Insufficient (-)/Surplus Storage	-75,375	-83,251	-91,126	-99,001	-114,751

TABLE 8.4.3
UPPER UMPQUA RESERVOIR ASSESSMENT
DETERMINED NECESSARY WATER STORAGE

Parameter/Year	2015	2020	2025	2030	2035
Water Demand, Gallon per Day					
Number of Served Residences	50	60	70	80	100
Total MDD for Service Area	31,500	37,800	44,101	50,401	63,001
Necessary Storage (Gal.)					
Emergency Storage (1 x MDD)	31,500	37,800	44,101	50,401	63,001
Equalization (.25 x MDD)	7,875	9,450	11,025	12,600	15,750
Fire Reserve (1000 GPM @ 1 Hour)	60,000	60,000	60,000	60,000	60,000
Total Required Storage	99,375	107,251	115,126	123,001	138,751
Storage Assessmant (Gal.)					
Existing Storage	75,000	75,000	75,000	75,000	75,000
Insufficient (-)/Surplus Storage	-24,375	-32,251	-40,126	-48,001	-63,751

TABLE 8.4.4
TANGLEWOOD RESERVOIR ASSESSMENT
DETERMINED NECESSARY WATER STORAGE

Parameter/Year	2015	2020	2025	2030	2035
Water Demand, Gallon per Day					
Number of Served Residences	56	60	64	68	72
Total MDD for Service Area	35,280	37,800	40,320	42,840	45,361
Necessary Storage (Gal.)					
Emergency Storage (1 x MDD)	35,280	37,800	40,320	42,840	45,361
Equalization (.25 x MDD)	8,820	9,450	10,080	10,710	11,340
Fire Reserve (1000 GPM @ 1 Hour)	60,000	60,000	60,000	60,000	60,000
Total Required Storage	104,101	107,251	110,401	113,551	116,701
Storage Assessmant (Gal.)					
Existing Storage	75,000	75,000	75,000	75,000	75,000
Insufficient (-)/Surplus Storage	-29,101	-32,251	-35,401	-38,551	-41,701

TABLE 8.4.5
FOREST HEIGHTS RESERVOIR ASSESSMENT
DETERMINED NECESSARY WATER STORAGE

Parameter/Year	2015	2020	2025	2030	2035
Water Demand, Gallon per Day					
Number of Served Residences	22	40	53	67	80
Total MDD for Service Area	13,860	25,200	33,390	42,210	50,401
Necessary Storage (Gal.)					
Emergency Storage (1 x MDD)	13,860	25,200	33,390	42,210	50,401
Equalization (.25 x MDD)	3,465	6,300	8,348	10,553	12,600
Fire Reserve (1000 GPM @ 1 Hour)	60,000	60,000	60,000	60,000	60,000
Total Required Storage	77,325	91,500	101,738	112,763	123,001
Storage Assessmant (Gal.)					
Existing Storage	127,000	127,000	127,000	127,000	127,000
Insufficient (-)/Surplus Storage	49,675	35,500	25,262	14,237	3,999

TABLE 8.4.6
RIDGEWATER RESERVOIR ASSESSMENT
DETERMINED NECESSARY WATER STORAGE

Parameter/Year	2015	2020	2025	2030	2035
Water Demand, Gallon per Day					
Number of Served Residences	22	25	29	32	36
Total MDD for Service Area	13,860	15,750	18,270	20,160	22,680
Necessary Storage (Gal.)					
Emergency Storage (1 x MDD)	13,860	15,750	18,270	20,160	22,680
Equalization (.25 x MDD)	3,465	3,938	4,568	5,040	5,670
Fire Reserve (1000 GPM @ 1 Hour)	60,000	60,000	60,000	60,000	60,000
Total Required Storage	77,325	79,688	82,838	85,200	88,350
Storage Assessmant (Gal.)					
Existing Storage	70,000	70,000	70,000	70,000	70,000
Insufficient (-)/Surplus Storage	-7,325	-9,688	-12,838	-15,200	-18,350

TABLE 8.4.7
UPPER RIDGEWATER RESERVOIR ASSESSMENT
DETERMINED NECESSARY WATER STORAGE

Parameter/Year	2015	2020	2025	2030	2035
Water Demand, Gallon per Day					
Number of Served Residences	4	6	6	6	6
Total MDD for Service Area	2,520	3,780	3,780	3,780	3,780
Necessary Storage (Gal.)					
Emergency Storage (1 x MDD)	2,520	3,780	3,780	3,780	3,780
Equalization (.25 x MDD)	630	945	945	945	945
Fire Reserve (1000 GPM @ 1 Hour)	60,000	60,000	60,000	60,000	60,000
Total Required Storage	63,150	64,725	64,725	64,725	64,725
Storage Assessmant (Gal.)					
Existing Storage	0	0	0	0	0
Insufficient (-)/Surplus Storage	-63,150	-64,725	-64,725	-64,725	-64,725

TABLE 8.4.8
ASSESSMENT SUMMARY FOR MID AND HIGH-LEVEL TANKS

Reservoirs	Storage Defeciencies (MG)				
	2016	2021	2026	2031	2036
Combined Storage System					
Reservoir System (MG)	0.25	0.16	-0.05	-0.28	-0.53
Individual Mid and High Level Reservoirs					
Schoon Mountain Res.	-0.08	-0.08	-0.09	-0.10	-0.11
Upper Umpqua Res.	-0.02	-0.03	-0.04	-0.05	-0.06
Tanglewood Res.	-0.03	-0.03	-0.04	-0.04	-0.04
Forest Heights Res.	0.05	0.04	0.03	0.01	0.00
Ridgewater Res.	-0.01	-0.01	-0.01	-0.02	-0.02
Upper Ridgewater Res.	-0.06	-0.06	-0.06	-0.06	-0.06

Recommended Storage Capacity

A number of issues should be considered when sizing new treated water reserve components. The above analyses can be used to develop the requirements for treated water reserve system both now and at the end of the planning period based on current and predicted system demands. A summary of the recommended and existing storage capacity within the City is given in Table 8.4.9.

TABLE 8.4.9
ASSESSMENT SUMMARY FOR EXISTING AND FUTURE STORAGE

Tank Improvements			
Reservoir	**Existing Storage**	**Additional Storage**	**Total Storage**
Schoon Mountain Res.	24,000	111,000	135,000
Upper Umpqua Res.	75,000	75,000	150,000
Tanglewood Res.	75,000	40,000	115,000
Ridgewater Res.	70,000	20,000	90,000
Forest Heights Res.	127,000	0	127,000
Low Level Reservoirs	3,275,000	300,000	3,575,000
Total	3,646,000	546,000	4,192,000

New Treated Water Tanks

Based on the above recommended storage capacity, the City of Sutherlin's storage system will be deficient in the Year 2026. By the end of the planning period, an additional 0.53 million gallons of storage is needed to obtain the recommended capacity within the City. Alternatives addressing tank construction and location are addressed below.

Currently all the mid-level, to 2nd high-level water storage tanks with the exception of Forest Heights storage tank, are lacking sufficient storage. Additional tanks, or larger replacement tanks should be installed to address this issue. If storage capacity is increased at the mid and high-level reservoir tank sites (Schoon Mountain, Upper Umpqua, etc.), the required size of the additional lower level reservoir would be reduced to 0.3 million gallons.

Tank Construction

Tanks for storage of treated water are usually constructed with one of the following materials: wood, concrete, or steel. Each type of tank material has its advantages and disadvantages.

Wood tanks have historically been associated with smaller water systems such as campgrounds, parks and small communities. These tanks are usually constructed of redwood, less expensive than concrete or steel, and typically found in sizes of 100,000 gallons or less. Wood tanks usually have a concrete base, circular steel hoops for perimeter support, and use the natural swelling of wet wood to provide a near watertight seal. Leakage and the tendency of wood reservoirs to encourage the growth of bacteria, especially *Klebsiella*, are some of the disadvantages of this type of tank. The Oregon Health Authority rules require that redwood tanks be provided with separate inlet/outlet and continuously chlorinated.

There are a number of different designs and methods of constructing a concrete tank. Some tanks use reinforced concrete while others use a prestressed, post-tensioned design. Tanks can also be constructed with poured-in-place concrete or utilize precast concrete. The advantages of concrete tank include the ability to withstand seismic forces, ability to fully or partially backfill against the tank, and less maintenance. The disadvantages of concrete tanks are the greater load this type of tank applies to the underlying soil and cost.

Steel tanks are constructed with structural steel that is either welded or bolted together. Typically, the steel is manufactured offsite, and then delivered and assembled onsite. To protect against corrosion, a coating is applied to both the exterior and interior of the tank. Interiors of steel tanks are typically coated with an epoxy or enamel type finish that have a typical life expectancy of approximately 20 years with proper care and maintenance. One type of tank that has been popular in recent years is glass-fused-to-steel bolted tanks. With this type of tank, a 10-14 mil glass coating is applied to steel to provide a protective coating. Life expectancy of this type of tank has been estimated to be over 50 years. The main advantage of steel tanks is they typically have lower construction and installation costs than concrete. The primary disadvantage of steel tanks is the associated maintenance. Cathodic protection and periodic refurbishing of the steel tank surfaces are required to maintain the tank. While the glass-fused-to-steel bolted tanks do not need periodic refurbishing of the tank walls, these types of tanks generally cost more than epoxy coated bolted tanks. For smaller size tanks (<60,000 gallons), stainless steel tanks may be a viable option.

Tank Location

Site selection for treated water tanks is based on a number of factors, the most important of which are as follows.

Elevation
There generally exists an optimum preferred elevation for a reservoir, which will provide acceptable pressure to customers located within the widest range of elevations. In the City of Sutherlin's case, the optimum tank height for the majority of the City would be to match the overflow elevation of the reservoir tanks that service the low level service area (693 feet).

Topography
The optimum site is flat or gently sloping. Steep topography or areas susceptible to landslides are not desirable since such sites require extensive earthwork and associated costs. Locating tanks on cut/fill sections will require additional geotechnical investigations and site work to avoid differential settlement. Generally, the site should accommodate the tank (plus room for another tank), a perimeter access road (minimum 15 feet width), and space to store the materials to build the tank.

Proximity to Other Land Uses
Locating a tank in close proximity to other types of land use, including residential areas is considered acceptable. Paint color, reservoir height, and landscaping are all considerations for sites within residential areas.

Location Relative to Service Areas/Other Tanks
Tank sites located long distances from the primary demand centers are not favored. Generally, system hydraulics and water main costs can be minimized by the utilization of a site close to the areas of maximum water demand. In addition, the relative location of the existing treated water tanks should also be considered. While it is typically more cost-effective to construct a new tank adjacent to an existing one, a separate location may be preferred to provide system redundancy at another location and improve the hydraulics of the distribution system (see Section 8.5).

Recommended Tank Locations

Using the above site selection criteria, several general areas for a new treated water tank were identified. These potential tank locations include the following:

Plat M Road Reservoir Site
This tank would be located in the southwest portion of the City off Plat M Road. The Oak Hills Tank currently serves this area. A tank at this location would provide redundant tank storage for the west side of the City. Ideally, the tank site would accommodate two tanks ranging from 0.3 to 0.5 MG. An evaluation of any proposed sites for geologic hazards is recommended especially since in this portion of the City has identified some areas in the foothills in this region to be susceptible to landslides during a seismic event (Madin & Wang 2000).

Oak Hills Tank Site
The present location for the Oak Hills Tank site has room for another 1.0 MG reservoir. The main advantage of this site is that it is already developed and has the existing infrastructure (i.e. 12-inch diameter water main) for providing reservoir service.

Umpqua Tank Site
The present location of the Umpqua Tank site has room for another reservoir tank. As with the Oak Hills site, this tank site is already developed and served by an existing water main (14-inch diameter).

Sherwood Street Site
The location of this proposed tank site is north of Sherwood Street in the foothills northeast of town. This tank would primarily serve the central and eastern portion of the City.

Of the above potential tank sites identified, the Plat M Road Reservoir Tank site is considered as the preferred site for construction of the City's next reservoir tank. This site would provide reservoir storage to the southwest portion of the City thus, providing additional storage to the west of Interstate-5. In conjunction with the construction of the Plat M Road Reservoir Tank, additional large diameter water mains would have to be installed to gain the maximum benefit of the storage and fire flow capabilities provided by a tank at this location. The larger diameter water mains should be installed to connect the tank with the water main along Central Avenue and to connect with a large water main along Duke Road.

8.5 Distribution System

The distribution system in the City of Sutherlin is comprised of a variety of pipe materials and sizes. The majority of the system consists of 8-inch diameter pipe, which is generally adequate for a well-looped system. A hydraulic model was utilized to assist in evaluating the capability of the City's existing water system in providing proper water flows (primarily fire flow) to selected areas in town. The basis for and results from the hydraulic model along with proposed water distribution system improvements are discussed below.

Hydraulic Modeling

With the advent of computer hydraulic models, an entire municipal water system can be mathematically analyzed with respect to existing hydraulic characteristics and "what if" scenarios. The mapping, calibration, and analysis of the City's water distribution system using a computer hydraulic model are discussed below.

Mapping

The City provided a map of the existing distribution system in an AutoCAD 2016 format. Elevation data of the City was determined using Google Earth, and County GIS contours. The contours were, transferred into AutoCAD format, and overlaid on the existing distribution system piping map. In addition to the City's existing maps, as-builts for sub-divisions and water improvements constructed after 2006, plans for the City's Water Treatment Plants (WTP), Nonpareil water main, and Oak Hills Reservoir were also consulted and utilized in developing an overall base map.

Calibration of Computer Model

The existing distribution piping network was evaluated with a computer model; specifically, Water CAD software by Haestad Methods. Water CAD is a state-of-the art software tool primarily used in the analysis and modeling of water distribution systems. This program employs mathematical algorithms based on hydraulic principles to predict system pressures and flow rates within a water system. Fire flows are of particular interest since the magnitude of these flows dictates the necessary hydraulic capacity of the water system.

Information on the current operating parameters was entered into the computer model. Input parameters included daily system flows, pump flow rates or and/or flow curves, and operating pressures at pump stations and water treatment plants. Generally, user demand was allocated evenly to each node of the existing system.A more refined allocation of the demand is not necessary as the projected user demand, even at peak flows, is substantially less than fire flow requirements.

A model is a representation of an existing system used to predict the behavior of the system upon real changes. A model is only useful if it can be calibrated and validated. The accuracy of the model output with existing conditions was checked or calibrated using water pressures and flows observed and collected in the field by the City's Fire Department. The hydraulic model solves for pressures and flows available in the main lines and not from hydrants. Pressures were calibrated for the system first by adjusting friction factors until the pressures in the model closely approximated measured pressures in the real system. In general, calibration is within approximately ten percent, which is considered a reasonable level of accuracy given the uncertainties in the model data.

Hydraulic Analysis of the Existing System

The existing distribution system was modeled using a hydraulic computer modeling software. This model included current piping, pump stations, reservoirs, and water treatment plants. The model contained 500 pipe elements and 392 nodes or junctions. Due to adequate system pressures and a relatively well-looped distribution network, hydraulic performance of the system is adequate in most areas. Residual pressures of 20 psi were used as a constraint on the system. This is a requirement of the Oregon Health Authority. Greater fire flows may be attained due to the lack of this constraint in the physical system.

Performance of the distribution system with respect to maximum available fire flow capabilities was specifically examined at selected vital areas within the City that were identified with the assistance of the City's Fire Department staff. The locations examined were chosen for a number of reasons including potential fire suppression (e.g. Murphy Mill, schools), representation of a portion of the City, and identification of potentially undersized lines. The actual fire flow requirements for each of these vital areas and use were determined using the 2014 Oregon Fire Code. The required fire flow for each vital area was determined using building square footage, and construction type. That value was then multiplied by hazard type, and reduction type flow factors. A summary of the specific fire flow requirements under State Fire Code at vital locations within the City is presented in Table 8.5.1.

The fire flow model was run with the requirement of maintaining minimum residual pressures of 20 psi throughout the system during a fire flow event. A summary of the available fire flows at various locations within the City is provided in Table 8.5.2. A map displaying existing fire hydrant locations can be found in Figure 8.5.1. Existing fire flows throughout the City are shown in Figure 8.5.2.

TABLE 8.5.1
FIRE FLOW PARAMETERS FOR VITAL AREAS

Location	Area (ft^2)	Construction Type	Req. Fire Flow	Hazard Type	Hazard Modifier	Reduction Type	Reduction Coeff.	Required Flow
Best Wetsern Hotel	57,000	3B	5,000	LH	0.75	N/A	1.00	3,750
GuestHouse Inn	36,000	3B	4,000	LH	0.75	Sprinklers	0.50	1,500
Murphy Plywood Mill	257,000	2B	6,000	EH1	1.15	Sprinklers	0.50	3,450
Orenco Systems	161,600	3B	8,000	OH2	1.00	Sprinklers	0.50	4,000
Sutherlin Plaza	36,250	3B	4,000	OH1	0.85	Sprinklers	0.50	1,700
High School	73,000	3B	6,250	LH	0.75	Sprinklers	0.50	2,344
Middle School	23,000	3B	4,500	LH	0.75	N/A	1.00	3,375
East School	34,500	3B	4,000	LH	0.75	N/A	1.00	3,000
West School	14,500	3B	2,500	LH	0.75	N/A	1.00	1,875

TABLE 8.5.2
SUMMARY OF CURRENTLY AVAILABLE FIRE FLOWS

Location	Required Flow (GPM)	Fire Flow Avail. (GPM)	Fire Flow Meter	Amount Deficient
Best Wetsern Hotel	3,750	1,739	No	2011
GuestHouse Inn	1,500	1,765	Yes	
Murphy Plywood Mill	3,450	1,812	No	1638
Orenco Systems	4,000	2,061	No	1939
Sutherlin Plaza	1,700	1,739	Yes	
High School	2,344	2,407	Yes	
Middle School	3,375	2,290	No	1085
East School	3,000	2,459	No	541
West School	1,875	1,059	No	816

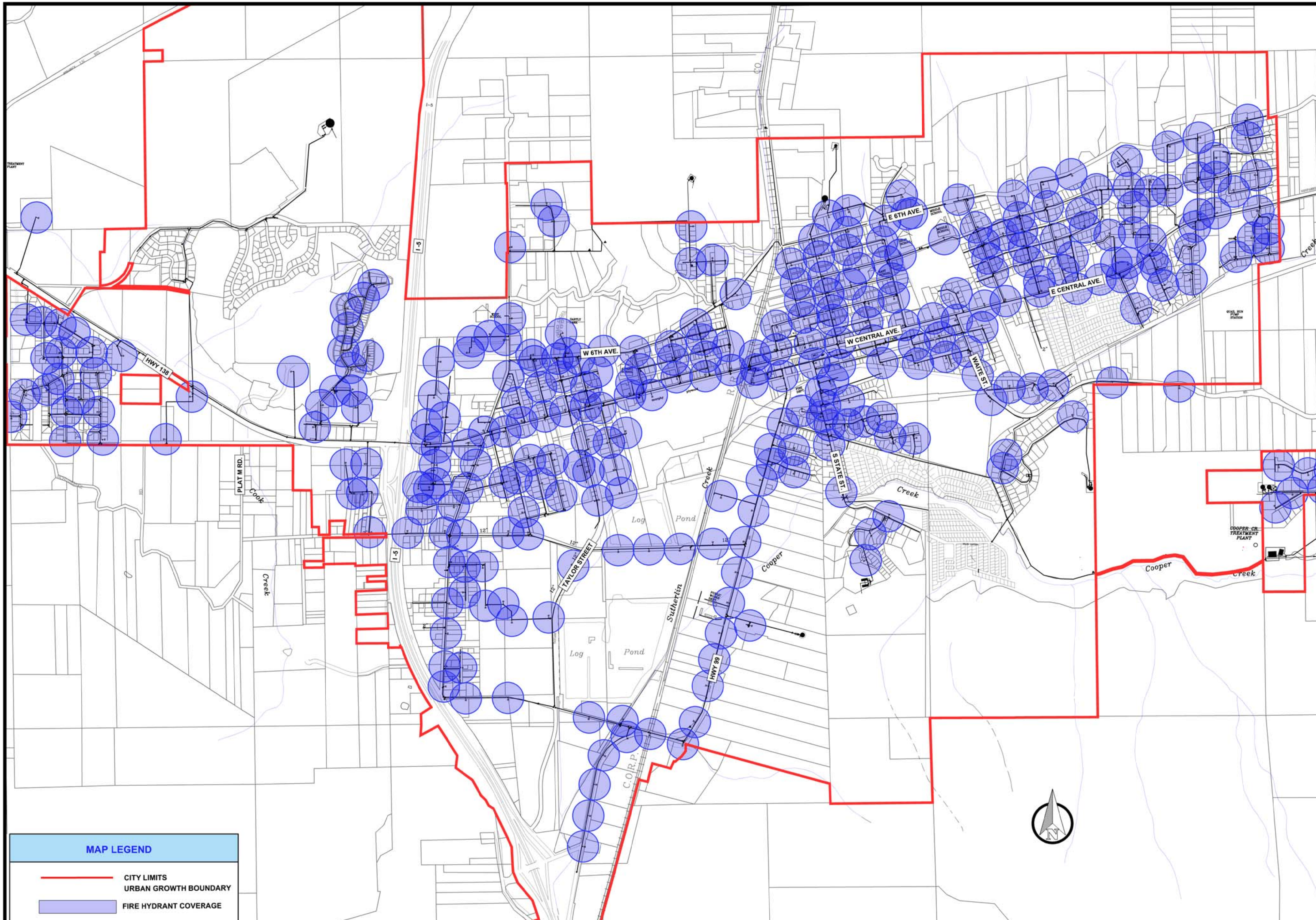
The available fire flow at a number of the identified vital areas was significantly less than the required fire flow for these areas. The vital areas with less than required fire flow include the Best Western Hotel, Murphy Plywood Mill, Orenco Systems, Middle School, East School, and the West School.

Proposed Improvements

Based on the results from the computer hydraulic model, and discussions with City staff, several proposed improvements were identified for the City's distribution system. The three improvements that have the largest impact on the available fire flows at the vital areas are the High School/Middle School Improvement, the 6th Avenue Main Improvement, and the Jones Buckley Avenue Improvement. These three improvements alone will increase the fire flow to acceptable levels in all vital areas currently found to be deficient. These and other proposed improvements are discussed below.

High School / Middle School Improvement

Fire flow requirements for Sutherlin High School and Sutherlin Middle School will be met if a 14-inch diameter line size upgrade loop is installed. This line will begin at the intersection of North Umpqua Street and East 4th Avenue, where it will tap the existing 14-inch diameter reinforced concrete line. The line will continue east on East 4th Avenue and turn south on Mardonna Street. The line will tap the existing 14-inch diameter concrete water line at the intersection of Mardonna Street and East Central Avenue. The total length of the improvement is approximately 3,900 feet.



SUTHERLIN WATER MASTER PLAN

EXISTING HYDRANT COVERAGE

FIGURE NO. 8.5.1

THE DYER PARTNERSHIP ENGINEERS & PLANNERS

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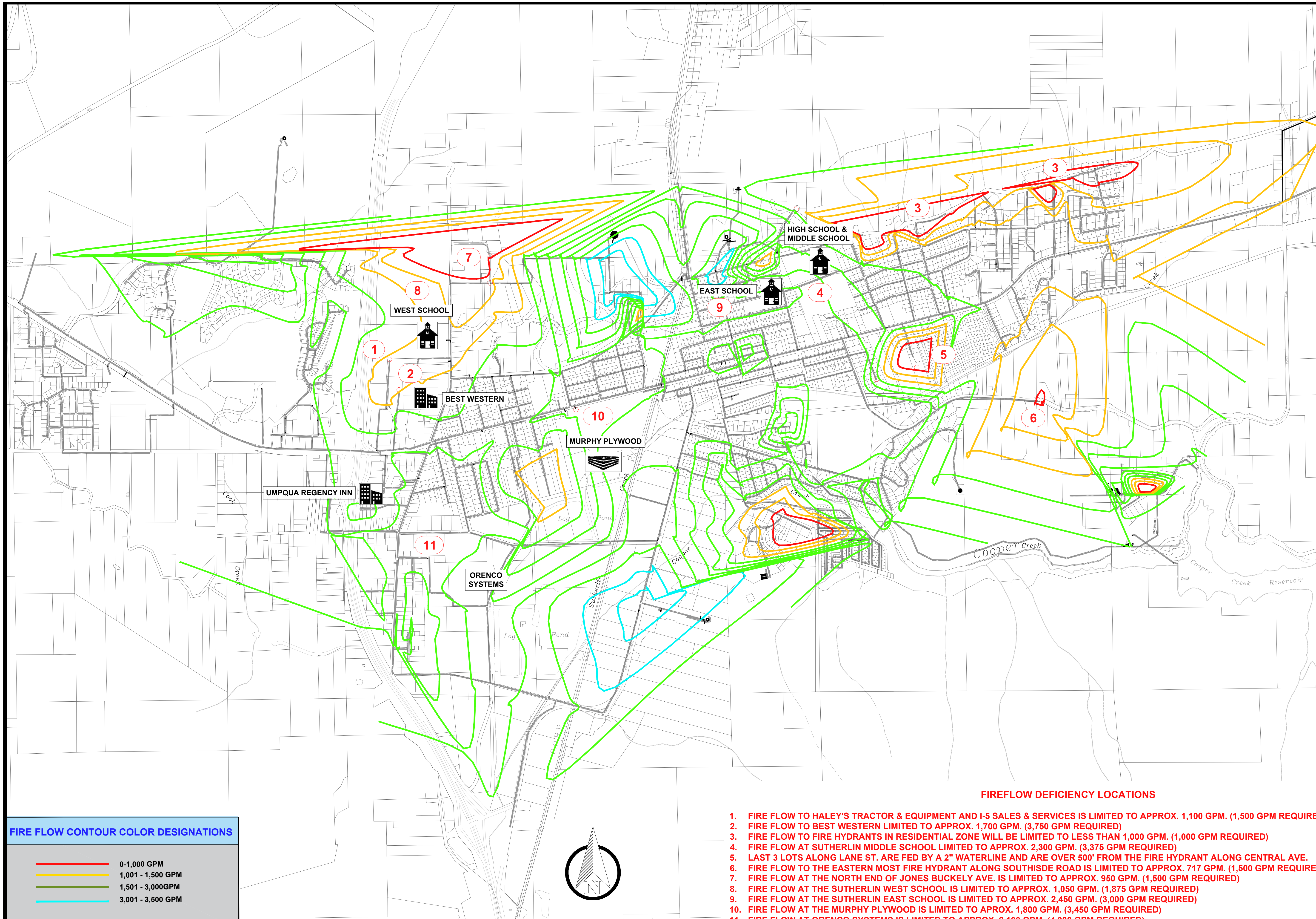
PROJECT NO.: 146.48



FIRE FLOW CONTOUR COLOR DESIGNATIONS

- 0-1,000 GPM
- 1,001 - 1,500 GPM
- 1,501 - 3,000GPM
- 3,001 - 3,500 GPM

FIREFLOW DEFICIENCY LOCATIONS

1. FIRE FLOW TO HALEY'S TRACTOR & EQUIPMENT AND I-5 SALES & SERVICES IS LIMITED TO APPROX. 1,100 GPM. (1,500 GPM REQUIRED)
2. FIRE FLOW TO BEST WESTERN LIMITED TO APPROX. 1,700 GPM. (3,750 GPM REQUIRED)
3. FIRE FLOW TO FIRE HYDRANTS IN RESIDENTIAL ZONE WILL BE LIMITED TO LESS THAN 1,000 GPM. (1,000 GPM REQUIRED)
4. FIRE FLOW AT SUTHERLIN MIDDLE SCHOOL LIMITED TO APPROX. 2,300 GPM. (3,375 GPM REQUIRED)
5. LAST 3 LOTS ALONG LANE ST. ARE FED BY A 2" WATERLINE AND ARE OVER 500' FROM THE FIRE HYDRANT ALONG CENTRAL AVE.
6. FIRE FLOW TO THE EASTERN MOST FIRE HYDRANT ALONG SOUTHSIDE ROAD IS LIMITED TO APPROX. 717 GPM. (1,500 GPM REQUIRED)
7. FIRE FLOW AT THE NORTH END OF JONES BUCKELY AVE. IS LIMITED TO APPROX. 950 GPM. (1,500 GPM REQUIRED)
8. FIRE FLOW AT THE SUTHERLIN WEST SCHOOL IS LIMITED TO APPROX. 1,050 GPM. (1,875 GPM REQUIRED)
9. FIRE FLOW AT THE SUTHERLIN EAST SCHOOL IS LIMITED TO APPROX. 2,450 GPM. (3,000 GPM REQUIRED)
10. FIRE FLOW AT THE MURPHY PLYWOOD IS LIMITED TO APROX. 1,800 GPM. (3,450 GPM REQUIRED)
11. FIRE FLOW AT ORENCO SYSTEMS IS LIMITED TO APPROX. 2,100 GPM. (4,000 GPM REQUIRED)

FIGURE NO. 8.5.2

SUTHERLIN WATER MASTER PLAN

FIRE FLOW MAP-EXISTING DISTRIBUTION SYSTEM

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DATE: JAN. 2017

PROJECT NO.: 146.48

6th Avenue Main Improvement

Currently fire flows are not sufficient along much of the northeast section of 6th Avenue. The water main along 6th Ave. must be upsized in order to deliver required fire flows and accommodate future growth. This new 12-inch diameter line will begin at the existing 6-inch water main located at the intersection of Mardonna Way and East 6th Avenue. The line will continue northeast on East 6th Avenue to the Jade St. and E. 6th Ave. intersection. The total improvement length is approximately 4,750 feet.

Jones Buckley Avenue Improvement

Current fire flows to the residences along Foster Ave. are insufficient. Additionally, with the current system configuration, the services at the north end of Jones Buckley Avenue falls below 20 psi when trying to achieve the required fire flows at many of the designated vital areas. By increasing the pipe size to this point, it will dramatically increase the available fire flows along Foster Ave., and throughout much of the system. To address this issue, a 12-inch water line should replace the existing 8-inch water line extending west from the north end of Tanglewood Dr. to the Jones Buckley and Foster Ave. intersection. The total improvement length is approximately 2,800 feet.

Nonpareil Service Lateral Improvement

As discussed in Section 5.3, there are currently three residential services supplied by a pressure tank within the Nonpareil WTP. Water is pumped from the WTP clearwell into the pressure tank. If the recommended improvements are to be completed at the Nonpareil WTP, there would be no plant production for months. With the current configuration, this would result in these services being out of water. There are two alternatives that would supply these services with water while the Nonpareil WTP is not producing water.

The first includes installing a bypass system that would allow water from the 14-inch water main to flow into the clearwell. This would require a pipe extending from the main, into the clearwell with a valve that would be opened when the plant was shut down for any extended period of time. If the water level in the clearwell reached a pre-described height, the valve would close, and then reopen when the clearwell was low. The pump inside the WTP that currently pumps water from the clearwell into the pressure tank would stay in operation while the WTP was not producing treated water.

The second alternative includes the installation of a single pump station near the City limits. This pump would draw from the City side of the 14-inch main line, and pump back toward Nonpareil WTP. When the WTP was off, this pump would pressurize the line between the pump station and the WTP. With this alternative the three services would need to be rerouted from the WTP to the 14-inch main line. This configuration would increase the pressure beyond what is acceptable for the current individual pressure boosters now located on ten of the services downstream of the Nonpareil WTP. This alternative would require the removal of these pressure boosters.

Although both alternatives address the problem, we are recommending the first alternative. Cost, feasibility, and system maintenance are the factors that were used to determine the optimal alternative.

Upper Ridgewater Pump Station Improvement

Current fire flows to two residences served by the upper Ridgewater Pump Station are insufficient. To address this issue, a fire flow pump would need to be added to the pump station. Additionally, a 6-inch water main and fire hydrant would need to be installed.

Myrtle Street Improvement

Current fire flows to the Best Western Hotel are insufficient. To address this issue, a 12-inch water line should replace the existing 8-inch water line extending north along Myrtle St. from West Central Avenue. The total improvement length is approximately 400 feet.

State Street Improvement

Current fire flows to the residence at the south end of State Street are insufficient. To address this issue, an 8-inch water line should replace the existing 6-inch water line extending south along State St. from the State St. and D St. intersection to the south end of the existing water line. The total improvement length is approximately 1,200 feet.

Waite Street and South Side Road Improvement

Current fire flows to the residences along Forest Heights St. and South Side Road are insufficient. To address this issue, a 12-inch water line should replace the existing 6-inch water line extending south along Waite St. from the Cooper Creek Crossing, then East along South Side Road to the end of the existing line. The total improvement length is approximately 3,000 feet.

Improvement Impacts

A WaterCAD model was developed with the described improvements. Flows at the key points within the system were reevaluated. The resulting fire flows at the various locations are shown in Table 8.5.3. Figure 8.5.3 displays the fire flow throughout the City following the completion of the recommended projects.

TABLE 8.5.3
SUMMARY OF AVAILABLE FIRE FLOWS AFTER PROPOSED IMPROVEMENTS

Location	Required Flow (GPM)	Fire Flow Avail. (GPM)	Fire Flow Met
Best Wetsern Hotel	3,750	5,555	Yes
GuestHouse Inn	1,500	3,898	Yes
Murphy Plywood Mill	3,450	5,981	Yes
Orenco Systems	4,000	6,868	Yes
Sutherlin Plaza	1,700	5,555	Yes
High School	2,344	6,023	Yes
Middle School	3,375	5,680	Yes
East School	3,000	6,135	Yes
West School	1,875	2,860	Yes

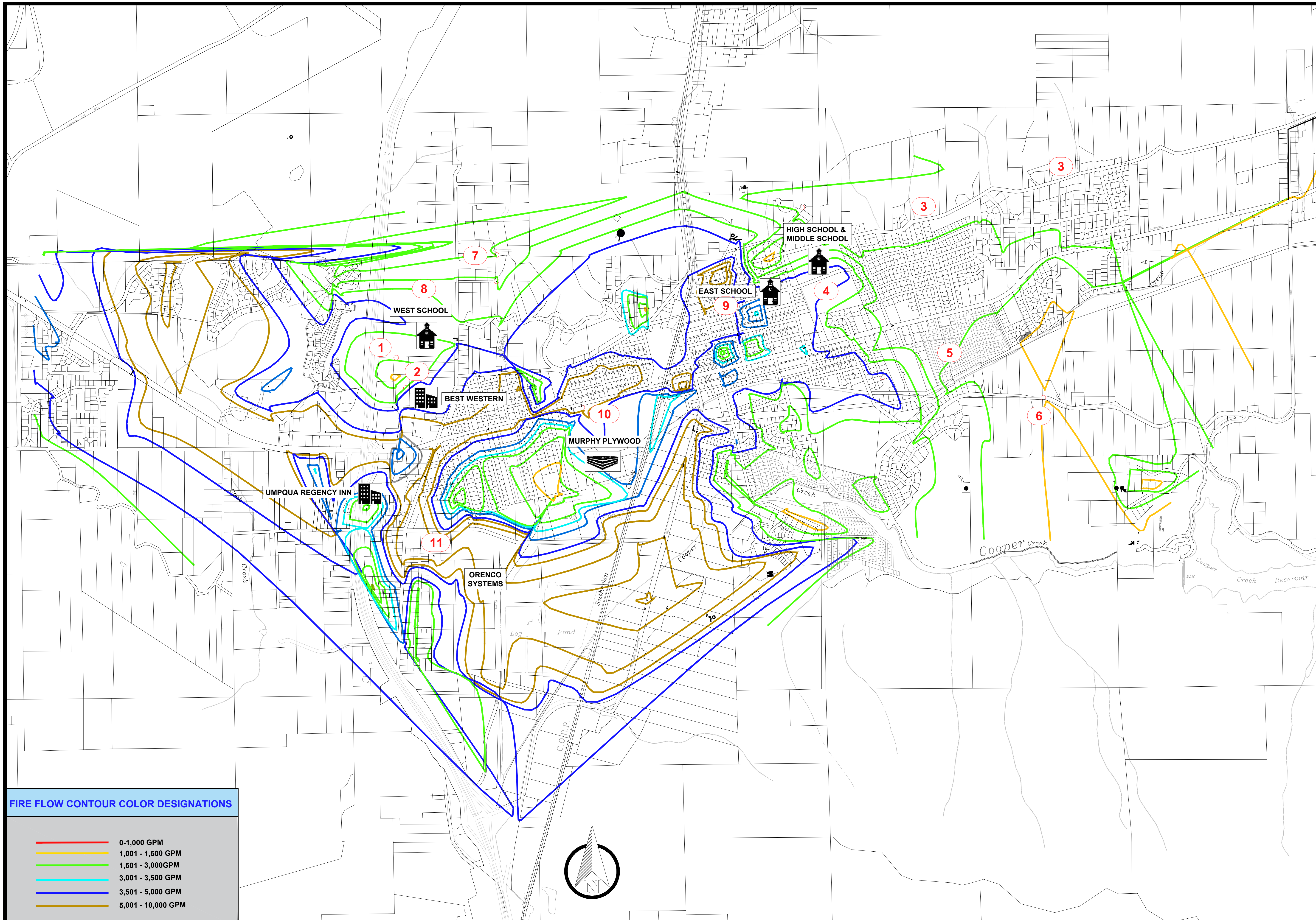


FIGURE NO.
8.5.3

SUTHERLIN WATER MASTER PLAN
FIRE FLOW MAP-RECOMMENDED SYSTEM

THE DYER PARTNERSHIP
ENGINEERS & PLANNERS

DATE: JAN. 2017
PROJECT NO.: 146.48

SECTION 9:

CAPITAL IMPROVEMENT PLAN

SECTION 9: **CAPITAL IMPROVEMENT PLAN**

9.1 Background

A Capital Improvement Plan (CIP) is a long term program for replacement of existing or installation of new infrastructure required to improve a system's function or maintenance. The Capital Improvement Plan, for water and wastewater systems, provides the City Council, staff and residents with a systematic approach to dealing with its short-term and long term infrastructure needs and demands.

Under ORS 223.309 (1), a Capital Improvement Plan, public facilities plan, Water Master Plan or comparable plan must be prepared before the adoption of System Development Charges (SDCs). This Plan must list the capital improvements that may be funded with improvement fee revenues and include the estimated cost and timing of each improvement. Oregon Revised Statutes discuss which improvements may be funded by SDC revenues (ORS 223.307) and what types of projects qualify for credit purposes. The Capital Improvement Plan may be modified at any time pursuant to ORS 223.309 (2).

Water system improvements recommended in the City of Sutherlin are provided in this Plan along with associated costs. The recommended improvements for the City's Capital Improvement Plan were derived from the analysis presented in Sections 8.

9.2 Project Phasing

To assist the City in its planning efforts, the proposed capital improvements have been assigned into one of two phases with Phase I being the most critical projects and Phase II being long term projects. A brief description of each phase and the types of projects within that phase is provided below.

Phase I
Projects are considered the most critical and should be undertaken as soon as funding can be made available. These projects include improvements that are considered to maintain the quality of the system, maintain health guidelines, bring the system into regulatory compliance, and increase fire flow and storage capacity.

Phase II
Projects should be implemented as needed to address new development, population growth, annexations, development of water rights, and/or new regulatory requirements. Phase II projects include improvements that may not be considered critical but improve system efficiency and operation.

The phase of each improvement was presented and discussed with City staff and Council. The estimates presented are preliminary and are based on the level and detail of planning presented in this WMP. As projects proceed and as site specific information becomes available, the estimates may require updating.

Assembling of an environmental report is typically a requirement of government organizations funding infrastructure improvements. The purpose of this environmental report is to consider any adverse effects that the project may have on the surrounding environment and propose mitigation measures to minimize these impacts. The estimated cost for compiling an environmental report for each phase was included in this CIP.

A brief description of each phase of improvements including recommended improvements, associated costs, and estimated percentage and cost eligibility for improvement System Development Charges is discussed below. Detailed cost estimates for the CIP project reside in Appendix D.

Phase I Improvements

Phase I improvements represent the highest priority projects that require addressing, in order, to ensure the effective treatment and distribution of water for the City's residents and customers. These improvements include improvements to the Cooper Creek intake and Nonpareil WTP site, construction of new and repair of existing system reservoirs, distribution system improvements to improve fire flow, and a Nonpareil clearwell diversion line.

Project Descriptions

1. Cooper Creek Multi-Level Intake Upgrade (Approx. Cost: $2,169,000)

The improvements recommended for the Cooper Creek intake were developed to enhance the raw water quality thereby optimizing the WTP operations. This improvement included constructing a new intake line and a variable depth water intake, and installing SolarBee units within the reservoir. Recommended intake location and pipe alignment is shown in Figure 9.2.1. Although the recommended location for the intake is a feasible option, it is recommended that a study be completed verifying that it is the optimal location for all those with vested interest in the project site.

2. Nonpareil Clearwell Diversion Line (Approx. Cost: $99,000)

Currently there are services stemming directly from a pressure tank within the Nonpareil WTP. In its current configuration, the WTP cannot be shut down without running these services out of water. This improvement includes constructing a water line that will fill the clearwell with treated water from the distribution system when the plant is shut down.

3. Nonpareil Water Treatment Plant Improvements (Approx. Cost: $3,800,000)

While this WTP is in fair condition, improvements are needed to improve its reliability and treatment efficiency. Proposed WTP improvements include the following:

- a. Compressor upgrade for cleaning intake screen.
- b. New magnetic flow meter for the raw water influent line.
- c. Refurbish clarifier metal structure with sandblasting, and repainting.
- d. Refurbish contact clarifier through sandblasting pressure grouting of cracks, and coating.
- e. Replacement of settling tubes within the clarifier.
- f. Replace filter media and install an air scour system into the existing filters.
- g. Installation of a bulk hypochlorite system.
- h. Construction of a new concrete backwash pond.
- i. Addition of a redundant potable water pump.
- j. Installation of filter-to-waste piping.
- k. Replacement of existing WTP piping with the addition of electric actuated valves.
- l. Installation of an updated controls system utilizing Supervisory Control and Data Acquisition (SCADA).
- m. Installation of new generator with automatic transfer switch.
- n. Replacement of system monitoring equipment.

INTAKE ALIGNMENT REROUTE

MULTI-LEVEL RESERVOIR INTAKE STRUCTURE LAYOUT

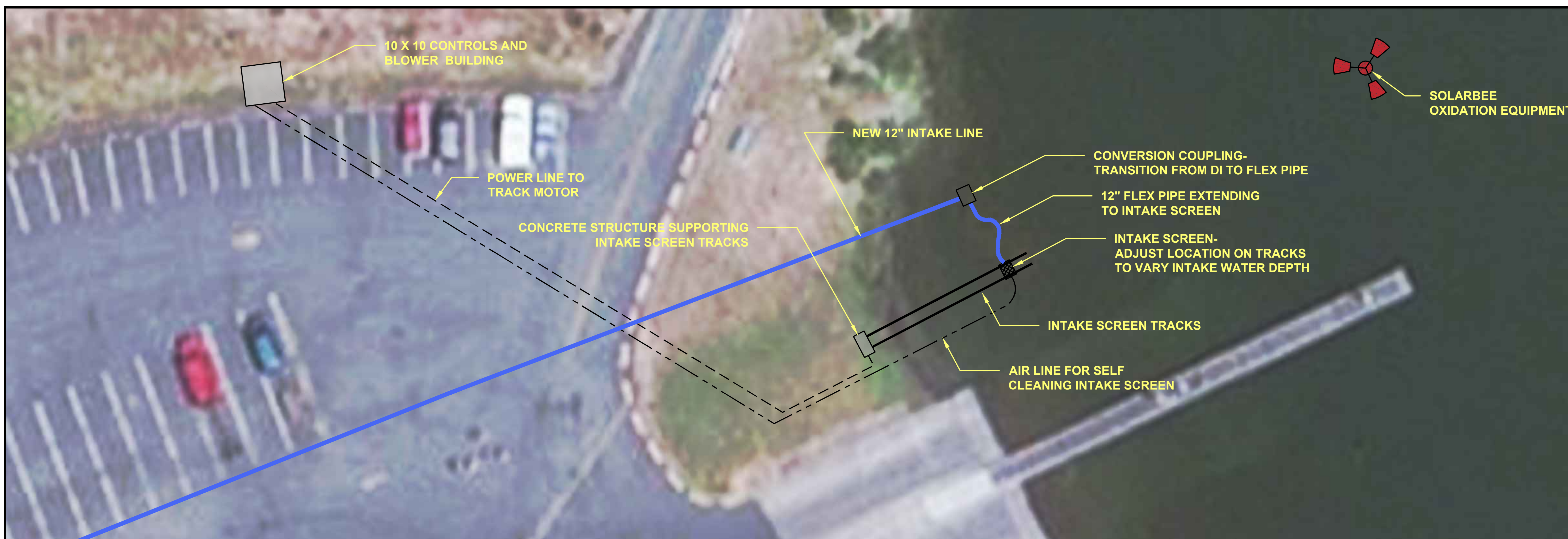


FIGURE NO. 9.2.1

SUTHERLIN WATER MASTER PLAN

NEW COOPER CREEK WTP RAW WATER INTAKE

THE DYER PARTNERSHIP
ENGINEERS & PLANNERS

DATE: JAN. 2017

PROJECT NO.: 146.48

4. Schoon Mountain Storage Reservoir Improvement (Approx. Cost: $617,000)

To achieve the total 134,000 gallon storage requirement for the Schoon Mountain reservoir, the existing two 12,000 gallon tanks will be removed, and a single 135,000 gallon tank will be constructed in their place. The cost for this tank was based on a glass-fused-to-steel tank with an aluminum dome roof. Estimated project cost includes anticipated contingency, engineering, legal and administration, and geotechnical investigation expenses.

5 Cathodic Protection for Water Reservoirs (Approx. Cost: $523,000)

With the exception of the Calapooya Reservoir, all of the City's water reservoirs are without cathodic protection. This improvement provides cathodic protection to all steel and glass-fused reservoirs that are currently missing this feature.

6. Jones Buckley Road Water Line Improvement (Approx. Cost: $376,000)

A 12-inchwater line will replace the 8-inch water line extending west from the north end of Tanglewood Dr. to the Jones Buckley and Foster Ave. intersection. The total pipe length is approximately 2,800 lineal feet.

7. High School/Middle School Water Main Improvements (Approx. Cost: $602,000)

This water main improvement is proposed to provide sufficient fire flows to both the Sutherlin High School and Sutherlin Middle School with the installation of a 14-inch diameter main. The proposed 14-inch diameter PVC main will begin at the intersection of North Umpqua Street and East 4th Avenue, where it will connect to the existing 14-inch reinforced concrete pipe. The main will continue east on East 4th Avenue to Mardonna Street. The total length of the improvement is approximately 2,600 lineal feet.

8. 6th Avenue Water Line Improvement (Approx. Cost: $806,000)

This new 12-inch diameter line will begin at the existing 6-inch water main located at the intersection of Mardonna Way and East 6th Avenue. The line will continue northeast on East 6th Avenue to the Jade St. and E. 6th Ave. intersection. The total improvement length is approximately 4,750 lineal feet.

9. Myrtle Street Water Line Improvement (Approx. Cost: $89,000)

This new 12-inch water line will replace the existing 8-inch water line extending north along Myrtle St. from West Central Avenue. The total improvement length is approximately 400 lineal feet.

10. Upper Umpqua Reservoir Storage Improvement (Approx. Cost: $629,000)

To achieve the total 135,000 gallon storage requirement for the Upper Umpqua reservoir, an additional 75,000 gallon tank will be constructed alongside the existing 75,000 gallon tank. The cost for this tank was based on a glass-fused-to-steel tank with an aluminum dome roof. Estimated project cost includes anticipated contingency, engineering, legal and administration, and geotechnical investigation expenses.

11. Tanglewood Storage Improvement (Approx. Cost: $587,000)

To achieve the total 115,000 gallon storage requirement for the Tanglewood reservoir, an additional 40,000 gallons of storage is required. This project includes adding another 40,000 gallon storage tank. Estimated project costs include: anticipated contingency, engineering, legal and administration, and geotechnical investigation expenses.

12. Tanglewood Pump Station Improvement (Approx. Cost: $366,000)

Given the age of the existing Tanglewood Pump Station, and the maintenance issues that accompany confined spaces, it is our recommendation that the existing pump station be abandoned, and that a new pump station be constructed above grade. The new pump station would have the same pumping capacity, but would incorporate an updated SCADA system allowing remote control of the pump station. This process will require land acquisition.

13. Upper Ridgewater Pump Station Improvements (Approx. Cost: $208,000)

A fire flow pump will be added to the pump station. A 6-inch water main 200 lineal feet and a fire hydrant will be installed in a centralized location between the residences that are being served. Based on aerial images, one fire hydrant can be placed within 250 feet of all houses within the Upper Ridgewater service area.

14. Southside Road Water Line Improvement (Approx. Cost: $323,000)

The two fire hydrants at the east end of Southside Road cannot meet Oregon State fire flow requirements. To address this, an 8-inch water line should replace the existing 6-inch water line extending east along South Side Road to the end of the existing line. The total improvement length is approximately 1,950 lineal feet.

A summary of Phase I water system improvements, associated cost and SDC eligibility is given in Table 9.2.1.

TABLE 9.2.1
SUMMARY OF PHASE I WATER SYSTEM PROJECTS

No.	Project Description	Est. Cost ($)
1	Cooper Creek Multi-Level Intake	$2,169,000
2	Nonpareil Additional Clearwell Inlet	$99,000
3	Nonpareil Miscellaneous Upgrades and Repairs	$3,800,000
4	Schoon Mt. Storage Improvements	$617,000
5	Cathodic Protection for Water Reservoirs	$523,000
6	Jones Buckley Road Waterline Improvements	$376,000
7	High School / Middle School Water Main Upsizing Improvements	$602,000
8	6th Avenue Waterline Improvement	$806,000
9	Myrtle Street Waterline Improvement	$89,000
10	Upper Umpqua Reservoir Storage Improvement	$629,000
11	Tanglewood Storage Improvement	$587,000
12	Tanglewood Pump Station Improvement	$366,000
13	Upper Ridgewater Pump Station Improvements	$208,000
14	Southside Road Waterline Improvement	$323,000
Total		$11,194,000

Phase II Improvements

Phase II improvements of this CIP represent important projects that require addressing once Phase I Improvements have been addressed and financing is available. These projects include a new 0.5 MG reservoir, various water distribution improvements, and a reservoir reconditioning project. These improvements are discussed in detail below.

Project Descriptions

1. E. 1st Street Water Line Improvement (Approx. Cost: $273,000)

This new 8-inch water line will replace the existing 6-inchwater line extending east along the alleyway between E. Central Ave. and E. 1st St. running from N. State St. to N. Umpqua Street. The total improvement length is approximately 1,200 lineal feet.

2. Mardonna St. and Sherwood St. Water Line Improvement (Approx. Cost: $1,048,000)

This new 8-inch water line will replace the existing 4-inch and 6-inch water line in the area bound by Sherwood St., E. 1st Avenue, Mardonna St., and E. 4th Avenue. The total improvement length is approximately 4,600 feet and includes replacement of valves and fire hydrants, and reconnection of service laterals.

3. Water Reservoirs Reconditioning (Approx. Cost: $192,000)

During site visits to the City's reservoirs, two of the City's tanks were identified as needing reconditioning: 1) North Umpqua and 2) Ridgewater Tank No. 1. The estimated costs for these tanks include surface preparation and recoating both the inside and outside of the tanks (assuming there is no lead based coatings).

4. Ridgewater Reservoir Storage Improvement (Approx. Cost: $589,000)

To achieve the total 90,000 gallon storage requirement for the Upper Ridgewater reservoirs, an additional 20,000 gallons of storage is required. This project includes removing the 35,000 gallon tank built in 1974 and replacing it with a 55,000 gallon reservoir. The site room is limited. Estimated project costs include anticipated contingency, engineering, legal and administration, and geotechnical investigation expenses.

5. New 0.3 MG Reservoir – Plat M Road (Approx. Cost: $1,726,000)

To achieve the total 2.9 MG storage requirement for the City of Sutherlin system, an additional 0.3 million gallons of storage is required. As previously discussed the best location for a future tank is the Plat M site. Although only 0.3 million gallons is required at this site, the total cost per gallon for construction is considerably higher for smaller tanks. Therefore we recommend constructing a new 0.3 MG water reservoir at the Plat M Road site. The cost for this tank was based on a glass-fused-to-steel tank with an aluminum dome roof. Estimated project costs include anticipated contingency, engineering, legal and administration, and geotechnical investigation expenses.

6. Reservoir Piping – Plat M Road Reservoir (Approx. Cost: $1,048,000)

This improvement connects the proposed new 0.3 MG reservoir planned in Item No. 5 of this Phase II CIP list to the Central Ave. water main. This project involves the installation of approximately 4,500 feet of 18-inch diameter PVC pipe from the new west side main along Plat M Road south to the new reservoir location.

7. Reservoir Piping – Duke Road Water Main Improvements (Approx. Cost: $1,039,000)

This improvement provides a new 18-inch diameter PVC water main from the proposed Plat M Reservoir Main (Item No. 3, Phase I) along West Duke Road east to the intersection of Duke Road and South Comstock Road. Total length of this water main is approximately 3,400 lineal feet. Horizontal Directional

Drill (HDD) will be required to cross I-5. This main is needed to provide adequate looping of the 18-inch water mains within the City's distribution system.

8. Development of North Umpqua Water Right - Umpqua Basin Water Treatment Plant Improvements (Approx. Cost: $9,774,000)

This improvement is needed to fully develop and utilize the City's North Umpqua River water right. The improvement consists of: 1) upgrades to the Umpqua Basin Water Association's WTP, and 2) construction of a new booster pump station and 3) approximately 3.5 miles of transmission main to convey water from the Umpqua Basin's distribution system to the City's system. The cost for the treatment plant upgrades to handle the City of Sutherlin's 3 cfs water right is for upgrading Umpqua Basin's WTP capacity from 6 MGD to 8 MGD. These upgrades include an additional 2 MGD membrane system with chemical clean-in-place equipment, a higher capacity onsite chlorine generation system, additional site piping, new pumps for finished water pump station, larger concrete clearwell, and larger standby generator. The booster pump station would be a duplex unit housed in a Concrete Masonry Unit (CMU) building along old Highway 99 somewhere between Wilbur and the southern part of the City of Sutherlin (Exit 135 on Interstate-5). The proposed transmission main would be 20-inch outer diameter HDPE pipe (16-inch inner diameter) located in the roadway with controlled density backfill.

9. Oakland Tie-in (Approx. Cost: $619,000)

Although acquiring a portion of the City of Oakland's water right on the Calapooya Creek does appear to be viable for the City, an interconnection via the Union Gap Water District could be beneficial to one or both parties in the case of an emergency. An intergovernmental agreement acceptable to and approved by all parties would have to be executed prior to construction of this project. The proposed project includes installation of approximately 3,000 lineal feet of 8-inch diameter water main for the inter-tie connection.

A summary of Phase II water system improvements is given in Table 9.2.2.

TABLE 9.2.2
SUMMARY OF PHASE II WATER SYSTEM PROJECTS

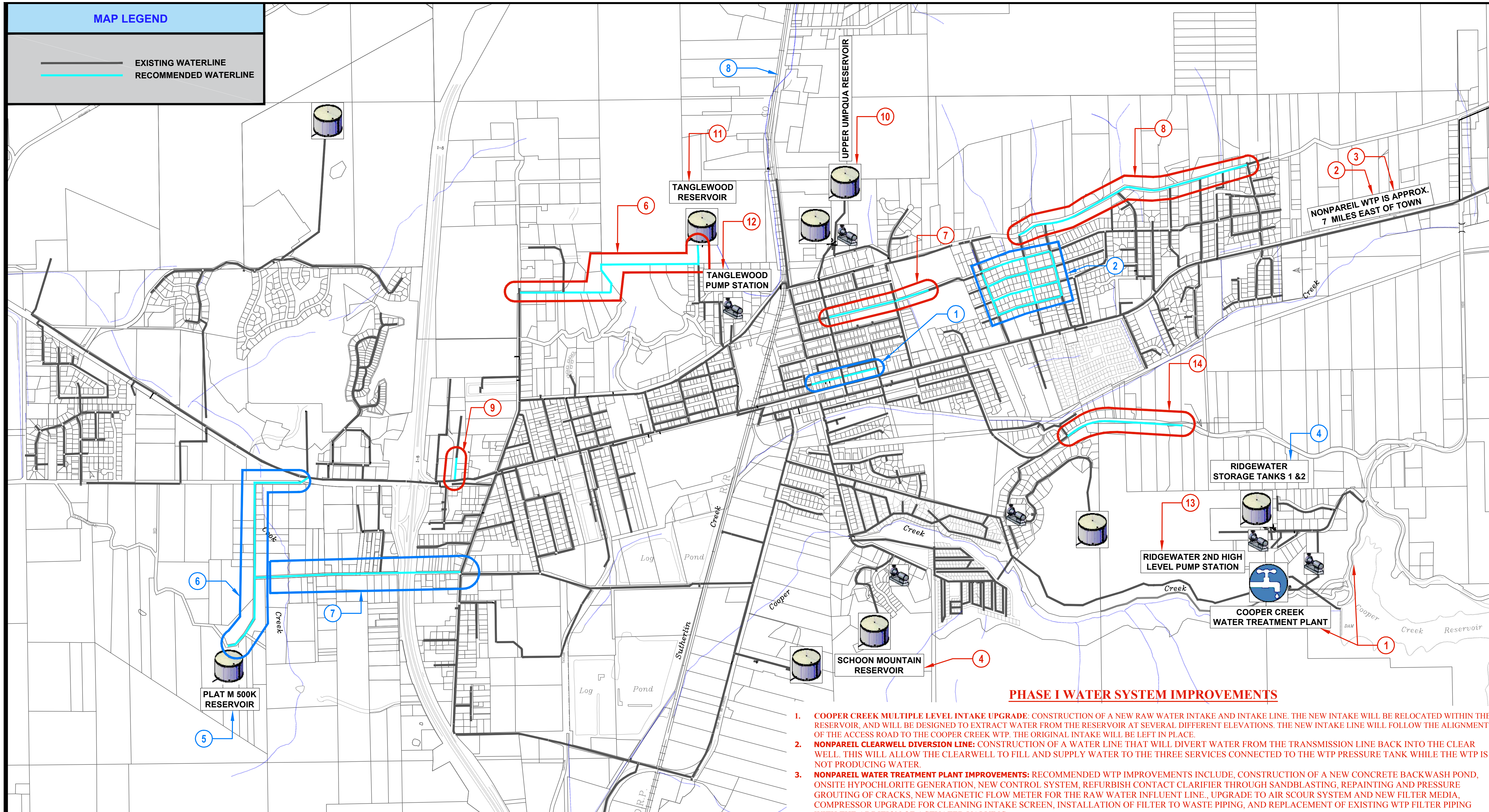
No.	Project Description	Est. Cost ($)	Est. % SDC	SDC Eligible, $
1	E. 1st Street Waterline Improvement	$273,000	0%	$0
2	Mardonna & Sherwood St. Waterline Improvement	$1,048,000	0%	$0
3	Water Reservoir Reconditioning	$192,000	0%	$0
4	Ridgewater Reservoir Storage Improvement	$589,000	25%	$147,250
5	New 0.5 MG Reservoir – Plat M Road	$1,726,000	100%	$1,726,000
6	Reservoir Piping – Plat M Road Reservoir	$1,048,000	100%	$1,048,000
7	Reservoir Piping – Duke Road Water Main Improvements	$1,039,000	80%	$831,200
8	Umpqua River Water Right Development	$9,774,000	100%	$9,774,000
9	City of Oakland Water System Tie-in	$619,000	0%	$0
Total		$16,308,000		$13,526,450

9.3 Summary of Phased Improvements

A summary of all the costs of the recommended capital improvements is provided in Table 9.3.1. A map showing the distribution improvements is given in Figure 9.3.1.

TABLE 9.3.1
IMPROVEMENT PHASING AND COSTS

Phase I	Project Description	Est. Cost ($)
1	Cooper Creek Multi-Level Intake	$2,169,000
2	Nonpareil Additional Clearwell Inlet	$99,000
3	Nonpareil Miscellaneous Upgrades and Repairs	$3,800,000
4	Schoon Mt. Storage Improvements	$617,000
5	Cathodic Protection for Water Reservoirs	$523,000
6	Jones Buckley Road Waterline Improvements	$376,000
7	High School / Middle School Water Main Upsizing Improvements	$602,000
8	6th Avenue Waterline Improvement	$806,000
9	Myrtle Street Waterline Improvement	$89,000
10	Upper Umpqua Reservoir Storage Improvement	$629,000
11	Tanglewood Storage Improvement	$587,000
12	Tanglewood Pump Station Improvement	$366,000
13	Upper Ridgewater Pump Station Improvements	$208,000
14	Southside Road Waterline Improvement	$323,000
	Phase I Total Costs	$11,194,000
Phase II	**Project Description**	**Est. Cost ($)**
1	E. 1st Street Waterline Improvement	$273,000
2	Mardonna & Sherwood St. Waterline Improvement	$1,048,000
3	Water Reservoir Reconditioning	$192,000
4	Ridgewater Reservoir Storage Improvement	$589,000
5	New 0.5 MG Reservoir – Plat M Road	$1,726,000
6	Reservoir Piping – Plat M Road Reservoir	$1,048,000
7	Reservoir Piping – Duke Road Water Main Improvements	$1,039,000
8	Umpqua River Water Right Development	$9,774,000
9	City of Oakland Water System Tie-in	$619,000
	Phase II Total Costs	$16,308,000



PHASE I WATER SYSTEM IMPROVEMENTS

1. **COOPER CREEK MULTIPLE LEVEL INTAKE UPGRADE**: CONSTRUCTION OF A NEW RAW WATER INTAKE AND INTAKE LINE. THE NEW INTAKE WILL BE RELOCATED WITHIN THE RESERVOIR, AND WILL BE DESIGNED TO EXTRACT WATER FROM THE RESERVOIR AT SEVERAL DIFFERENT ELEVATIONS. THE NEW INTAKE LINE WILL FOLLOW THE ALIGNMENT OF THE ACCESS ROAD TO THE COOPER CREEK WTP. THE ORIGINAL INTAKE WILL BE LEFT IN PLACE.
2. **NONPAREIL CLEARWELL DIVERSION LINE:** CONSTRUCTION OF A WATER LINE THAT WILL DIVERT WATER FROM THE TRANSMISSION LINE BACK INTO THE CLEAR WELL. THIS WILL ALLOW THE CLEARWELL TO FILL AND SUPPLY WATER TO THE THREE SERVICES CONNECTED TO THE WTP PRESSURE TANK WHILE THE WTP IS NOT PRODUCING WATER.
3. **NONPAREIL WATER TREATMENT PLANT IMPROVEMENTS:** RECOMMENDED WTP IMPROVEMENTS INCLUDE, CONSTRUCTION OF A NEW CONCRETE BACKWASH POND, ONSITE HYPOCHLORITE GENERATION, NEW CONTROL SYSTEM, REFURBISH CONTACT CLARIFIER THROUGH SANDBLASTING, REPAINTING AND PRESSURE GROUTING OF CRACKS, NEW MAGNETIC FLOW METER FOR THE RAW WATER INFLUENT LINE., UPGRADE TO AIR SCOUR SYSTEM AND NEW FILTER MEDIA, COMPRESSOR UPGRADE FOR CLEANING INTAKE SCREEN, INSTALLATION OF FILTER TO WASTE PIPING, AND REPLACEMENT OF EXISTING WTP FILTER PIPING WITH THE ADDITION OF ACTUATED VALVING
4. **SCHOON MOUNTAIN STORAGE RESERVOIR IMPROVEMENT:** DEMOLISH THE TWO 12,000 GALLON TANKS. CONSTRUCT A 135,000 GALLON STORAGE TANK IN THEIR PLACE. .
5. **CATHODIC PROTECTION FOR WATER RESERVOIRS:** INSTALLATION OF CATHODIC PROTECTION ON ALL CITY STORAGE TANKS WITH THE EXCEPTION OF CALAPOOYA. THIS IMPROVEMENT IS NOT SHOWN ON MAP.
6. **JONES BUCKLEY ROAD WATERLINE IMPROVEMENT:** ABANDONMENT OF EXISTING 8" WATERLINE. CONSTRUCTION OF A 12" WATERLINE EXTENDING WEST FROM THE NORTH END OF TANGLEWOOD DR. TO THE JONES BUCKLEY AND FOSTER AVE. INTERSECTION.
7. **HIGH SCHOOL/MIDDLE SCHOOL WATER MAIN IMPROVEMENTS:** ABANDONMENT OF EXISTING 6" WATERLINE. CONSTRUCTION OF A 14" DIAMETER PVC MAIN WHICH WILL BEGIN AT THE INTERSECTION OF NORTH UMPQUA STREET AND EAST 4TH AVENUE, WHERE IT WILL CONNECT TO THE EXISTING 14" REINFORCED CONCRETE PIPE. THE MAIN WILL CONTINUE EAST ON EAST 4TH AVENUE TO MARDONNA STREET.
8. **6TH AVENUE WATERLINE IMPROVEMENT:** ABANDONMENT OF EXISTING WATERLINE. CONSTRUCTION OF A 12-INCH DIAMETER LINE THAT WILL BEGIN AT THE EXISTING 6-INCH WATER MAIN LOCATED AT THE INTERSECTION OF MARDONNA WAY AND EAST 6TH AVENUE. THE LINE WILL CONTINUE NORTHEAST ON EAST 6TH AVENUE TO THE JADE ST. AND E. 6TH AVE. INTERSECTION.
9. **MYRTLE STREET WATERLINE IMPROVEMENT:** ABANDONMENT OF EXISTING 8" WATERLINE. CONSTRUCTION OF A 12" WATERLINE EXTENDING NORTH ALONG MYRTLE ST. FROM WEST CENTRAL AVENUE. .
10. **UPPER UMPQUA RESERVOIR STORAGE IMPROVEMENT:** CONSTRUCT AN ADDITIONAL 75,000 GALLON TANK ALONGSIDE THE EXISTING 75,000 GALLON TANK.
11. **TANGLEWOOD STORAGE IMPROVEMENT:** REMOVAL OF THE EXISTING 75,000 GALLON STORAGE TANK AND CONSTRUCTING A NEW115,000 GALLON STORAGE TANK.
12. **TANGLEWOOD PUMP STATION IMPROVEMENT:** DEMOLITION OF EXISTING TANGLEWOOD PUMP STATION. CONSTRUCTION OF A NEW PUMP STATION HOUSED IN A BLOCK BUILDING.
13. **UPPER RIDGEWATER PUMP STATION IMPROVEMENTS:** CONSTRUCTION OF AN ENCLOSED PACKAGED PUMP STATION CAPABLE OF PROVIDING FIRE FLOWS. THIS PUMP STATION WILL BE LOCATED ALONGSIDE THE EXISTING UPPER RIDGEWATER PUMP STATION CMU BUILDING.
14. **SOUTHSIDE ROAD WATERLINE IMPROVEMENT:** REMOVAL AND REPLACEMENT OF THE 6" LINE EXTENDING EAST FROM THE INTERSECTION OF SEA STREET AND SOUTHSIDE ROAD TO THE END OF THE EXISTING WATERLINE.. THIS PIPE WILL BE REPLACED WITH 8" PIPE.

PHASE II WATER SYSTEM IMPROVEMENTS

1. **E. 1ST STREET WATERLINE IMPROVEMENT:** ABANDONMENT OF EXISTING WATERLINE. CONSTRUCTION OF 8" ALONG THE ALLEYWAY BETWEEN E. CENTRAL AVE. AND E. 1ST ST. RUNNING FROM N. STATE ST. TO N. UMPQUA STREET.
2. **MARDONNA ST. & SHERWOOD ST. WATERLINE IMPROVENT:** ABANDON EXISTING WATERLINE. CONSTRUCTION OF NEW 8" WATERLINE IN THE AREA BOUNDED BY SHERWOOD ST, E 1ST AVE., MARDONNA ST., AND E 4TH AVENUE.
3. **WATER RESERVOIRS RECONDITIONING:** APPLY NEW COATINGS TO INTERIOR AND EXTERIOR OF NORTH UMPQUA, AND RIDGEWATER STORAGE TANKS.
4. **RIDGEWATER RESERVOIR STORAGE IMPROVEMENT:** REMOVAL OF EXISTING 35,000 GALLON RESERVOIR CONSTRUCTED IN 1974. CONSTRUCTION OF NEW 55,000 GALLON RESERVOIR.
5. **NEW 0.3 MG RESERVOIR - PLAT M ROAD:** CONSTRUCTION OF A NEW 0.3 MG WATER RESERVOIR AT THE PLAT M ROAD SITE.
6. **RESERVOIR PIPING - PLAT M ROAD RESERVOIR:** CONSTRUCTION OF ANEW 18" WATERLINE CONNECTING THE 0.3 MG RESERVOIR TO THE CENTRAL AVE. WATER MAIN.
7. **RESERVOIR PIPING - DUKE ROAD WATER MAIN IMPROVEMENTS:** CONSTRUCTION OF A NEW 18" DIAMETER PVC WATER MAIN FROM THE PROPOSED PLAT M RESERVOIR MAIN ALONG WEST DUKE ROAD EAST TO THE INTERSECTION OF DUKE ROAD AND SOUTH COMSTOCK ROAD.
8. **OAKLAND TIE-IN:** AN INTERCONNECTION BETWEEN THE TO OAKLAND VIA THE UNION GAP WATER DISTRICT. THE RECOMMENDED PROJECT INCLUDES INSTALLATION OF APPROXIMATELY 3,000 LINEAL FEET OF 8-INCH DIAMETER WATER MAIN FOR THE INTER-TIE CONNECTION.

FIGURE NO. 9.3.1

SUTHERLIN WATER MASTER PLAN

SUTHERLIN WATER SYSTEM RECOMMENDED IMPROVEMENTS

THE DYER PARTNERSHIP
ENGINEERS & PLANNERS

DATE: JAN. 2017

PROJECT NO.: 146.48

SECTION 10:

IMPROVEMENT PHASING AND FINANCING

SECTION 10: **IMPROVEMENT PHASING AND FINANCING**

10.1 Grant and Loan Programs

Outside funding assistance, in the form of grants or low interest loans, will be necessary to make some of the proposed improvements affordable to the residents of the City of Sutherlin. The amount and types of outside funding will dictate the amount of local funding the City will have to secure. In evaluating grant and local programs, the major objective is to select a program, or a combination of programs, which are most applicable and available for the intended project.

A brief description of the major federal and state funding programs, which are typically utilized to assist qualifying communities in the financing of major water system improvement programs, is given below. Each of the government assistance programs has particular prerequisites and requirements. With each program's requirements, not all communities or projects may qualify for each of these programs.

Economic Development Administration (EDA) Public Works Grant Program

The EDA Public Works Grant Program, administered by the US Department of Commerce, is aimed at projects which directly create permanent jobs or remove impediments to job creation in the project area. Thus, to be eligible for this grant, a community must be able to demonstrate the potential to create jobs from the project. Potential job creations are assessed with a survey of businesses to demonstrate the prospective number of jobs that might be created if the proposed project was completed.

Proposed projects must be located within an EDA-designated Economic Development District. Priority consideration is given to projects that improve opportunities for the establishment or expansion of industry and projects that create or retain private sector jobs in both the short and long term. Communities which can demonstrate the existing system is at capacity (i.e. moratorium on new connections), have a greater chance of being awarded this type of grant. The EDA grants are usually in 50% or less of the project cost; therefore some type of local funding is also required. Grants typically do not exceed one million dollars.

Rural Water Loans and Grants

The Rural Development Administration (Rural Development) manages the loans and grants for water programs that were formerly overseen by the Farmers Home Administration. While these programs are administered by a new agency, the program requirements are essentially the same. The Rural Utilities Service (RUS) is one of three entities that comprise the USDA's Rural Development mission area. The RUS supports various programs that provide financial and technical assistance for development and operation of safe and affordable water supply systems.

Rural Development has the authority to make loans to public bodies and non-profit corporations to construct or improve essential community facilities, including water systems. Grants are also available to applicants who meet the Median Household Income (MHI) requirements. While eligible applicants must have a population less than 10,000, priority is given to public entities in areas with populations less than 5,500 people, for improvements to restore a deteriorating water conveyance system, or to improve, enlarge, or modify a water facility. Preference is also given to requests that involve the merging of small facilities and those serving low-income communities.

In addition, borrowers must meet the following stipulations:

- Be unable to obtain needed funds from other sources at reasonable rates and terms.

- Legal capacity to borrow and repay loans, to pledge security for loans, and to operate and maintain the facilities or services.

- Financially sound and able to manage the facility effectively.

- Financially sound facility based on taxes, assessments, revenues, fees, or other satisfactory sources of income to pay all facility costs including Operation and Maintenance (O&M), and to retire the indebtedness and maintain a reserve.

- Water and waste disposal systems must be consistent with any development plans of state, multi-jurisdictional area, county, or municipality in which the proposed project is located. All facilities must comply with federal, state, and local laws including those concerned with zoning regulations, health and sanitation standards, and the control of water pollution.

  Loan and grant funds may be used for the following types of improvements:

- Construct, repair, improve, expand, or otherwise modify waste collection, conveyance, treatment, storage, or other disposal facilities.

- Legal and engineering costs connected with the development of facilities, and other costs associated with facility development including the acquisition of right-of-way and easements, and the relocation of roads and utilities.

- Water and waste disposal systems must be consistent with any development plans of state, multi-jurisdictional area, county, or municipality in which the proposed project is located. All facilities must comply with federal, state, and local laws including those concerned with zoning regulations, health and sanitation standards, and the control of water pollution.

- Finance facilities in conjunction with funds from other agencies or those provided by the applicant.

Interim commercial financing will normally be used during construction and Rural Development funds will be available when the project is completed. If interim financing is not available or if the project cost is less than $50,000, multiple advances of Rural Development funds may be made as construction progresses.

The maximum term on all loans is 40 years. However, no repayment period will exceed any statutory limitation on the organization's borrowing authority, nor the useful life of the improvement of the facility to be financed. Interest rates are set quarterly and are based on current market yields for municipal obligations. Current interest rates may be obtained from any Rural Development office.

The following rates currently apply for the Rural Development program:

> ***Market rate.*** Those applicants pay the market rate whose Median Household Income (MHI) of the service area is more than the $52,855 (Oregon non-metropolitan MHI). The market rate is currently 3.375%.

Intermediate rate. The intermediate rate is paid by those applicants whose MHI of the service area is less than 80% of the Oregon non-metropolitan MHI.

Poverty line rate. Those applicants whose MHI of the service area is below $32,984 (80% of the State MHI) pay the lowest rate. Improvements must also be required by a governing agency to correct a regulatory violation or health risk. The current poverty line rate is 2.25%.

The grants are calculated on the basis of eligible costs that do not include the costs attributable to reserve capacity or interim financing. In addition, grant funds cannot be used to reduce total user costs below that of comparable communities funded by RUS.

TABLE 10.1.1
RURAL DEVELOPMENT GRANT FUNDS/INTEREST RATES
BASED ON MEDIAN HOUSEHOLD INCOME

Median Household Income (MHI)	Maximum Grant (a)	Interest Rate (b)
<$42,284	75%	2.00%
$42,285 - $52,285	45%	2.75%
>$52,285	0%	3.38%

[(a)] MHI<42,284 may be considered for a grant up to 75% of eligible project cost if the project is needed to alleviate a health or sanitary problem.
[(b)] Rates are current as of February of 2017.

Eligibility for the Rural Water and Waste Disposal grants and loans is currently based on 2010 Census data. The 2010 MHI for the City of Sutherlin is $33,800. At this MHI, the City of Sutherlin may be eligible for a maximum grant of up to 45%. If any of the projects were required by a governing agency for the health and safety of the service population, those projects would be at a two percent interest rate, and could receive a grant of up to 75%.

Other restrictions and requirements may be associated with these loans and grants. If the City becomes eligible for grant assistance, the grant will apply only to eligible project costs and is only available after a City has incurred long-term debt resulting in an annual debt service obligation equal to one-half of one percent of the MHI. To receive a Rural Utilities Service Loan, the City must secure bonding authority, usually in the form of general obligation or revenue bonds.

Applications for financial assistance are made at area offices of Rural Development. For additional information on Rural Development loans and grant programs, call 541-673-0136 or visit the RUS website at http://www.rurdev.usda.gov/UWEP_HomePage.hmtl. The Oregon Rural Development website is http://www.rurdev.usda.gov/OR_Home.html.

Technical Assistance Grants (TAG)

Available through the USDA Rural Utilities Service (RUS) as part of the water and waste disposal programs, technical assistance grants are intended to provide technical assistance to associations on a wide range of issues relating to the delivery of water and waste disposal services.

Rural communities with populations of less than 10,000 persons are eligible along with private, nonprofit organizations that have been granted tax-exempt status by the IRS. Technical Assistance Grant funds may be used for the following activities:

- Identify and evaluate solutions to water and/or waste related problems for associations in rural areas.
- Assist entities with preparation of applications for water and waste disposal loans and grants.
- Provide training to association personnel in order to improve the management, operation and maintenance of water and/or waste disposal facilities.
- Pay expenses related to providing the technical assistance and/or training.

Grants may be made for up to 100% of the eligible project costs. Applications are filed with any USDA Rural Development office. For additional information on Rural Development loans and grant programs, call 541-673-0136 or visit the RUS website at http://www.rurdev.usda.gov/UWP-wwtat.htm.

Oregon Community Development Block Grant (CDBG) Program

The Community Development Block Grant Program (CDBG) section of the Infrastructure Finance Authority (IFA) administers the CDBG Program. Grants and technical assistance are available to develop livable urban communities for persons of low and moderate incomes by expanding economic opportunities and providing housing and suitable living environments.

Non-metropolitan cities and counties in rural Oregon can apply for and receive grants. Oregon Tribes, urban cities (Ashland, Bend, Corvallis, Eugene, Gresham, Hillsboro, Medford, Portland, Salem and Springfield) and counties (Clackamas, Multnomah, and Washington) receive funds directly from Housing and Urban Development (HUD).

All projects must meet one of three national objectives:

- The proposed activities must benefit low and moderate income individuals.
- The activities must aid in the prevention or elimination of slums or blight.
- There must be an urgent need that poses a serious and immediate threat to the health or welfare of the community.

Funding amounts are based on:

- The applicant’s need;
- the availability of funds; and
- other restrictions defined in the program’s guidelines.

The following are the maximum grants possible for any individual project, by category:

- Economic Development: $750,000
- Microenterprise: $100,000
- Public Works

  - Water and Wastewater Improvements: $2,500,000 except preliminary/engineering planning grants: $150,000

  - Downtown Revitalization: $400,000

  - Offsite Infrastructure: $225,000

- Community/Public Facilities: $1,500,000

- Community Capacity/Technical Assistance: no specific per-award-limit but limited overall funds

- Emergency Grants: $500,000

- Regional Housing Rehabilitation: $400,000

- Emergency Projects: $500,000

For additional information on the CDBG programs, call 866-467-3466 or visit the IFA website at http://www.orinfrastructure.org/Infrastructure-Programs/CDBG/ttp://www.orinfrastructure.org/Learn-About-Infrastructure-Programs/Interested-in-a-Community-Development-Project/Community-Development-Block-Grant/.

Oregon Special Public Works Fund

The Special Public Works Fund (SPWF) provides funds for publically owned facilities that support economic and community development in Oregon. Special Public Works Funds provide funding for construction and/or improvement of infrastructure needed to support industrial, manufacturing and certain types of commercial development. Funds are available to public entities for:

- Planning;

- designing;

- purchasing;

- improving and constructing publically owned facilities;

- replacing publically owned essential community facilities; and

- emergency projects as a result of a disaster.

Public agencies that are eligible to apply for funding are:

- Cities;

- counties;

- county service districts (organized under ORS Chapter 451);

- Tribal councils;

- ports;
- districts as defined in ORS 198.010; and
- airport districts (ORS 838).

Facilities and infrastructure projects that are eligible for funding are:

- Airport facilities;
- buildings and associated equipment;
- restoration of environmental conditions on publically owned industrial lands;
- port facilities, wharves and docks;
- the purchase of land, rights-of-way and easements necessary for a public facility;
- telecommunications facilities;
- railroads;
- roadways and bridges;
- solid waste disposal sites;
- storm drainage systems;
- water and wastewater systems

Loans
Loans for development (construction) projects range from less than $100,000 to $10 million. Infrastructure Finance Authority offers very attractive interest rates that reflect tax-exempt market rates for highly qualified borrowers. Current the SPWF interest rates for borrowers that do not qualify is 3.54% (February 2017). Initial loan terms can be up to 25 years or the useful life of the project, whichever is less.

Grants
Grants are available for construction projects that create or retain trade sector jobs. They are limited to $500,000 or 85% of the project cost, whichever is less, and are based on up to $5,000 per eligible job created or retained. As this grant is dependent on job creation, it is not ideal for municipal water infrastructure projects.

Limited grants are available to plan industrial site development for publically owned sites and for feasibility studies.

For additional information on IFA programs, call 503-986-0123 or visit the IFA website at http://www.orinfrastructure.org/Learn-About-Infrastructure-Programs/Interested-in-a-Community-Development-Project/Special-Public-Works-Fund/**.**

Water/Wastewater Financing Program

Water/wastewater financing is available for construction and/or improvements of water and wastewater systems to meet state and federal standards. This loan program funds the design and construction of public infrastructure needed to ensure compliance with the Safe Drinking Water Act or the Clean Water Act.

The public entities that are eligible to apply for the program are:

- Cities;
- counties;
- county service districts (organized under ORS Chapter 451);
- Tribal councils;
- ports; and
- special districts as defined in ORS 198.010.

The proposed project must be owned and operated by a public entity as listed above. Allowable funded project activities may include:

- Reasonable costs for construction improvement or expansion of drinking water system, wastewater system or stormwater system;
- water source, treatment, storage and distribution;
- wastewater collection, treatment and disposal facilities;
- storm water system;
- purchase of rights-of-way and easements necessary for construction;
- design and construction engineering; or
- planning/technical assistance for small communities.

To be eligible for funding:

- A system must have received, or is likely to soon receive, a Notice of Non-Compliance by the appropriate regulatory agency or is for a facility plan or study required by a regulatory agency; and
- A registered Professional Engineer will be responsible for the design and construction of the project.

Funding and Uses
Loan and grant amounts are determined by a financial analysis of the applicant's ability to afford a loan (debt capacity, repayment sources and other factors).

Loans
Program guidelines, project administration, loan terms and interest rates are similar to the Special Public Works Fund program. The maximum loan term is 25 years or the useful life of the infrastructure financed, whichever is less. The maximum loan amount is $10 million per project through a combination of direct and/or bond-funded loans. Recently IFA, was offering lower, reduced interest rates for municipalities whose household income is less than the statewide median income. The current (February 2017) terms of this loan are for 25 years at 3.54% interest.

Loans are generally repaid with utility revenues or voter-approved bond issues. A limited tax general obligation pledge also may be required. "Creditworthy" borrowers may be funded through the sale of state revenue bonds.

Grants
Grant awards up to $750,000 may be awarded based on a financial review.

An applicant is not eligible for grant funds if the applicant's annual median household income is equal to or greater than 100% of the state average median household income for the same year.

Funding for Technical Assistance
The Infrastructure Finance Authority offers technical assistance with financing for municipalities with populations of less than 15,000. The funds may be used to finance preliminary planning, engineering studies and economic investigations.

Technical assistance projects must be in preparation for a construction project that is eligible and meets the established criteria.

- Grants up to $20,000 may be awarded per project.
- Loans up to $50,000 may be awarded per project.

Interested applicants should contact the Oregon Business Development Department (OBDD) prior to submitting an application. Applications are accepted year-round.

Safe Drinking Water Revolving Loan Fund (SDWRLF)

Each year the state of Oregon Health Authority receives an allotment from the federal government for the Safe Drinking Water Revolving Loan Fund. The funds along with a 20% state match are used to make low interest loans to finance needed drinking water system improvements. Funds may be used for the following types of activities:

Planning
Master plans, pilot studies, and feasibility studies that are part of compliance related construction project.

Preliminary and Final Engineering and Design
Engineering and design includes: surveying, legal review, preparation of engineering drawings, and specifications for construction. Also, costs necessary for recipients to contract environmental review services.

Construction Costs
All aspects of a public water system, includes construction costs, from source of supply, filtration, treatment, storage, transmission, and metering.

Source Water Protection
As part of a source water management plan for a watershed or a delineated source water protection area for a well.

Property Acquisition
The acquisition of real property directly related to or necessary for the proposed project including rights-of-way, easements, and facility sites.

While many activities are eligible for SDWRLF financing, the following activities are considered ineligible activities. These activities include dams or rehabilitation of dams, purchase of water rights unless owned on a system that is being purchased through a consolidation project, finished water reservoirs, administrative costs, operation and maintenance expenses, and projects primarily intended to supply or attract future growth.

The program's financing is available to all sizes of water systems. Municipal, nonprofit and privately owned community water systems are eligible, as well as nonprofit non-community systems. Terms of the loan are 20 years at 80% of the state/local bond rate. This rate is currently 2.83% (February 2017). Financially disadvantaged applicants can get up to a 30-year loan at an interest rate of one percent, as well as the possibility of some principal forgiveness.

The Oregon Health Authority and the Oregon Economic and Community Development Department (OECDD) rate proposed projects. Highest ratings are given to projects that present the following:

- Addresses the most serious risk to human health.
- Necessary to ensure Safe Drinking Water Act compliance.
- Applicant has the greatest financial need, on a per household basis, according to affordability criteria.

Special consideration is given to projects at small water systems that serve 10,000 or fewer people, consolidating or merging with another system as a solution to a compliance problem, and which have an innovative solution to the stated problem.

Additional consideration will be given to disadvantaged communities. The definition of a disadvantaged community has changed to one in which the average annual water rate will exceed 1.25% of local median household income. The above ratio is subject to adjustment with the availability of 2010 Census figures and inflation indexing thereafter (see Section 10.5).

Applicants with 300 or more service connections are eligible for assistance with final design and construction projects only if they maintain a current, approved master plan that evaluates the needs of the water system for at least a twenty-year period and includes the major elements outlined in OAR 333-061-0060(5). Systems with less than 300 service connections may receive funding for an engineering feasibility analysis instead of a master plan.

Oregon Department of Energy, Business Energy Tax Credit

The Business Energy Tax Credit was revamped in 2001 to allow public entities to participate. The State of Oregon Department of Energy offers a tax credit of 35% of project costs, taken over a five-year period, for qualifying capital improvements that reduce energy use. Requirements for projects are similar to that of the Oregon Department of Energy's Small Scale Energy Loan Program (SELP) program. Public entities do not pay taxes and so are not eligible for a direct tax credit, but may sell their credit to private businesses at a discounted rate, usually about 28%. Lighting retrofits, Variable Frequency Drives (VFD), efficient motors, and controls are typical projects that qualify for funding.

10.2 Local Funding Sources

The amount and type of local funding obligations for water system improvements will depend, in part, on the amount of grant funding anticipated and the requirements of potential loan funding. Local revenue sources for capital expenditures include *ad valorem* taxes, various types of bonds, water service charges, connection fees, and system development charges. Local revenue sources for operating costs include *ad valorem* taxes, and water service charges. The following sections identify those local funding sources and financing mechanisms that are most common and appropriate for the improvements identified in this study.

General Obligation Bonds

A General Obligation (G.O.) bond is back by the full faith and credit of the issuer. For payment of the principal and interest on the bond, the issuer may levy *ad valorem* general property taxes. Such taxes are not needed if revenue from assessments, user charges or some other sources are sufficient to cover debt service.

Oregon Revised Statutes limit the maximum term to 40 years for cities. Except in the event that Rural Utilities Service will purchase the bonds, the realistic term for which general obligation bonds should be issued is 15 to 20 years. Under the present economic climate, the lower interest rates will be associated with the shorter terms.

Financing of water system improvements by general obligation bonds is usually accomplished by the following procedure:

- Determination of the capital costs required for the improvement.
- An election authorizing the sale of general obligation bonds.
- Following voter approval, the bonds are offered for sale.
- The revenue from the bond sale is used to pay the capital costs associated with the projects.

From a fund raising viewpoint, general obligation bonds are preferable to revenue bonds in matters of simplicity and cost of issuance. Since the bonds are secured by the power to tax, these bonds usually command a lower interest rate than other types of bonds. General obligation bonds lend themselves readily to competitive public sale at a reasonable interest rate because of their high degree of security, tax-exempt status, and general acceptance.

These bonds can be revenue-supported wherein a portion of the user fee is pledged toward payment of the debt service. Using this method, the need to collect additional property taxes to retire the obligated bonds is eliminated. Such revenue-supported general obligation bonds have the most of the advantages of revenue bonds, but also maintain the lower interest rate and ready marketability of general obligation bonds.

Other advantages of general obligation bonds over other types of bonds are as follows.

- The laws authorizing general obligation bonds are less restrictive than those governing other types of bonds.
- By the levying of taxes, the debt is repaid by all property benefited and not just the system users.
- Taxes paid in the retirement of these bonds are IRS deductible.
- General obligation bonds offer flexibility to retire the bonds by tax levy and/or user charge revenue.

The disadvantage of general obligation bond debt is that it is often added to the debt ratios of the underlying municipality, thereby restricting the flexibility of the municipality to issue debt for other purposes. Furthermore, general obligation bonds are normally associated with the financing of facilities that benefit an entire community, must be approved by a majority vote and often necessitate extensive public information programs. A majority vote often requires waiting for a general election in order to obtain an adequate voter turnout. Waiting for a general election may take years, and too often a project needs to be undertaken in a much shorter amount of time.

Revenue Bonds

Revenue bonds are becoming a frequently used option for long-term debt. These bonds are an acceptable alternative and offer some advantages to general obligation bonds. Revenue bonds are payable solely from charges made for the services provided. These bonds cannot be paid from tax levies or special assessments; their only security is the borrower's promise to operate the system in a way that will provide sufficient net revenue to meet the debt service and other obligations of the bond issue.

Many communities prefer revenue bonding, as opposed to general obligation bonding, because its insures that no tax will be levied. In addition, debt obligation will be limited to system users since repayment is derived from user fees. Another advantage of revenue bonds is that they do not count against a municipality's direct debt, but instead are considered “overlapping debt.” This feature can be a crucial advantage for a municipality near its debt limit or for the rating agencies, which consider very closely the amount of direct debt when assigning credit ratings. Revenue bonds also may be used in financing projects extending beyond normal municipal boundaries. These bonds may be supported by a pledge of revenues received in any legitimate and ongoing area of operation, within or without the geographical boundaries of the issuer.

Successful issuance of revenue bonds depends on the bond market evaluation of the revenue pledged. Revenue bonds are most commonly retired with revenue from user fees. Recent legislation has eliminated the requirement that the revenues pledged to bond payment have a direct relationship to the services financed by revenue bonds. Revenue bonds may be paid with all or any portion of revenues derived by a public body or any other legally available monies. In addition, if additional security to finance revenue bonds was needed, a public body may mortgage grant security and interests in facilities, projects, utilities or systems owned or operated by a public body.

Normally, there are no legal limitations on the amount of revenue bonds to be issued, but excessive issue amounts are generally unattractive to bond buyers because they represent high investment risks. In rating revenue bonds, buyers consider the economic justification for the project, reputation of the borrower, methods and effectiveness for billing and collecting, rate structures, provision for rate increases as needed to meet debt service requirements, and track record in obtaining rate increases historically. In addition, other factors considered include adequacy of reserve funds provided in the bond documents, supporting covenants to protect projected revenues, and the degree to which forecasts of net revenues are considered sound and economical.

Municipalities may elect to issue revenue bonds for revenue producing facilities without a vote of the electorate (ORS 288.805-288.945). In this case, certain notice and posting requirements must be met and a 60-day waiting period is mandatory. A petition signed by five percent of the municipality's registered voters may cause the issue to be referred to an election.

Improvement Bonds

Improvement (Bancroft) bonds can be issued under an Oregon law called the Bancroft Act. These bonds are an intermediate form of financing that is less than full-fledged general obligation or revenue bonds. However, these types of bonds are quite useful especially for smaller issuers or for limited purposes.

An improvement bond is payable only from the receipts of special benefit assessments, not from general tax revenues. Such bonds are issued only where certain properties are recipients of special benefits not accruing to other properties. For a specific improvement, all property within the improvement area is assessed on an equal basis, regardless of whether it is developed or undeveloped. The assessment is designed to apportion the cost of improvements, approximately in proportion to the afforded direct or indirect benefits, among the benefited property owners. This 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 semi-annual installments with interest. Cities and special districts are limited to improvement bonds not exceeding three percent of true cash value.

With improvement bond financing, an improvement district is formed, the boundaries are established, and the benefited properties and property owners are determined. The Engineer usually determines an approximate assessment, either on a square foot or a front-foot basis. Property owners are then given an opportunity to object to the project assessments. The assessments against the properties are usually not levied until the actual cost of the project is determined. Since this determination is normally not possible until the project is completed, funds are not available from assessments for the purpose of making monthly payments to the Contractor. Therefore, some method of interim financing must be arranged, or a pre-assessment program, based on the estimated total costs, must be adopted. Commonly, warrants are issued to cover debts, with the warrants to be paid when the project is complete.

The primary disadvantage to this source of revenue is that the property to be assessed must have a true cash value at least equal to 50% of the total assessments to be levied. As a result, owners of undeveloped property usually require a substantial cash payment. In addition, the development of an assessment district is very cumbersome and expensive when facilities for an entire community are contemplated. In comparison, general obligation bonds can be issued in lieu of improvement bonds, and are usually more favorable.

Capital Construction (Sinking) Fund

Sinking funds are often established by budget for a particular construction purpose. Budgeted amounts from each annual budget are carried in a sinking fund until sufficient revenues are available for the needed project. Such funds can also be developed with revenue derived from system development charges.

A City may wish to develop sinking funds for each sector of the public services. This fund can be used to rehabilitate or maintain existing infrastructure, construct new infrastructure elements, or to obtain grant and loan funding for larger projects.

The disadvantage of a sinking fund is that it is usually too small to undertake any significant projects. Also, setting aside money generated from user fees without a designated and specified need is not generally accepted in municipal or public utility budgeting processes.

Connection Fees

Most cities charge connection fees to cover the cost of connecting new development to water systems. Based on recent legislation, connection fees can no longer be programmed to cover a portion of capital improvement costs.

System Development Charges

A System Development Charge (SDC) is a fee collected as each piece of property is developed and is used to finance the necessary capital improvements and municipal services required by the development. Such a fee can only be used to recover only the capital costs of infrastructure. Operating, maintenance, and replacement costs cannot be financed through system development charges.

Two types of charges are permitted under the Oregon Systems Development Charges Act: improvement fees, and reimbursement fees. The SDCs utilized before construction are considered improvement fees and are used to finance capital improvements to be constructed. After construction, SDCs are considered reimbursement fees and are collected to recapture the costs associated with capital improvements already constructed or under construction. A reimbursement fee represents a charge for utilizing excess capacity in an existing facility paid for by others. The revenue generated by this fee is typically used to pay back existing loans for improvements.

Under the Oregon SDC Act, methodologies for deriving improvement and reimbursement fees must be documented and available for review by the public. A Capital Improvement Plan must also be prepared which lists the capital improvements that may be funded with improvement fee revenues and the estimated cost and timing of each improvement. Thus, revenue from the collection of SDCs can only be used to finance specific items listed in a Capital Improvement Plan. In addition, SDCs cannot be assessed on portions of the project paid for with grant funding.

Local Improvement District (LID)

Improvement bonds issued for Local Improvement Districts (LIDs) are used to administer special assessments for financing local improvements in cities, counties, and some special districts. Common improvements financed through an LID include storm and sanitary sewers, street paving, curbs, sidewalls, water mains, recreational facilities, street lighting, and off-street parking. The basic principle of special assessment is that it is a charge imposed upon property owners who receive special benefits from an improvement beyond the general benefits received by all citizens in the community. A public agency should consider three “principles of benefit” when deciding to use special assessment: 1) direct service, 2) obligation to others, and 3) equal sharing/basis. Cities are limited to improvement bonds not exceeding three percent of true cash value.

The Oregon Legislature has provided cities with a procedure for special assessment financing (ORS 223.387-399), which applies when City charter or ordinance provisions do not specify otherwise. To establish an LID, an improvement district is formed, the boundaries are established, and the benefited properties and property owners are determined. An approximate assessment to each property is determined based on the above three principles of benefit, and is documented in a written report. Property owners are then given an opportunity to object to the project assessments. The assessments against the properties are usually not levied until the actual cost of the project is determined. Since this determination is normally not possible until the project is completed, funds are not available from assessments for the purpose of making monthly payments to the Contractor. Therefore, some method of interim financing must be arranged based on the estimated total costs.

The primary disadvantage to this source of revenue is that the property to be assessed must have a true cash value at least equal to 50% of the total assessments to be levied. As a result, owners of undeveloped property usually require a substantial cash payment. In addition, the development of an assessment district is very cumbersome and expensive.

Ad Valorem Taxes

Ad valorem property taxes are often used as revenue source for utility improvements. Property taxes may be levied on real estate, personal property or both. Historically, *ad valorem* taxes were the traditional means of obtaining revenue to support all local governmental functions.

A marked advantage of these taxes is the simplicity of the system; it requires no monitoring program for developing charges, additional accounting and billing work is minimal, and default on payments is rare. In addition, *ad valorem* taxation provides a means of financing that reaches all property owners that benefit from a water system, whether a property is developed or not. The construction costs for the 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. Public hearings and an election with voter approval would be required to implement *ad valorem* taxation.

User Fees

User fees can be used to retire general obligation bonds, and are commonly the sole source of revenue to retire revenue bonds and to finance operation and maintenance. User fees represent monthly charges of all residences, businesses, and other users that are connected to the water system. These fees are established by resolution and can be modified, as needed, to account for increased or decreased operating and maintenance costs. The monthly charges are usually based on the class of user (e.g. single family dwelling, multiple family dwelling, schools, etc.) and the quantity of water through a user's connection.

Assessments

Under special circumstances, the beneficiary of a public works improvement may be assessed for the cost of a project. For example, a City may provide some improvements or services that directly benefit a particular development. A City may choose to assess the industrial or commercial developer to provide up-front capital to pay for the administered improvements.

10.3 Financing Strategy

A financing strategy or plan must provide a mechanism to generate capital funds in sufficient amounts to pay for the proposed improvements over the relatively short duration in design and construction, generally two years. The financing strategy must also identify the manner in which annual revenue will be generated to cover the expense for long-term debt repayment and the on-going operation and maintenance of the system. The objectives of a financial strategy include the following:

- Identify the capital improvement cost for the project and the estimated expense for operation and maintenance.
- Evaluate the potential funding sources and select the most viable program.
- Determine the availability of outside funding sources and identify the local cost share.
- Determine the cost to system users to finance the local share and the annual cost for operation and maintenance.

With any of the proposed funding sources within the financial strategy, the City is advised to confirm specific funding amounts with the appropriate funding agencies prior to making local financing arrangements.

A financial strategy to address financing of the Phase I Improvements within the Capital Improvement Plan is discussed below.

Grants and Low Interest Loans

Four types or programs of project funding were identified as viable for funding the City's proposed Phase I Improvements: 1) Rural Development Rural Water and Waste Disposal Grants and Loans, 2) OECDD Water/Wastewater Financing Program, 3) Drinking Water State Revolving Fund, and 4) private financing. Based on these funding programs, four alternative funding packages were compiled and evaluated. These alternatives are designated as A, B, C and D alternatives. Due to the size of the proposed Phase I Improvements, anticipated funding from Rural Development was supplemented with funding from OECDDs Water/Wastewater Financing Program. A summary of the funding alternatives for these improvements is given in Table 10.3.1.

TABLE 10.3.1
FUNDING ALTERNATIVES FOR PHASE I IMPROVEMENTS

Funding Source	Grant Amount, $ (1)	Loan Amount, $ (1)	Loan Term, yrs	Interest Rate, %	Rate Increase, $/EDU/mth (2)
Alternative A – Rural Development (RD)/Water/Wastewater Financing Program Grants & Loans					
RD 25/75 (Grant/Loan)	$1,500,000	$4,500,000	40	2.75	$3.20
W/WW Financing Program	$750,000	$4,444,000	25	3.54	$4.23
Total	$2,250,000	$8,944,000	25	--	**$7.43**
Alternative B – Water/Wastewater Financing Program Grants & Loans					
RD 25/75 (Grant/Loan)	2,798,500	8,395,500	40	2.75	**$5.96**
Alternative C – Drinking Water SRF Loan					
SDWRLF	--	11,194,000	30	2.83	**$9.54**
Alternative D – Private Loan					
Private Funding	--	11,194,000	25	4.35	**$12.66**

(1) Amount based on current dollars.
(2) Based on 4,840 EDUs. EDUs associated with non-profit or City use was not included in the total EDU tabulation.

The projected rate increases anticipated from the funding options range from $5.12 to $10.88 per EDU per month. These rate increases are very similar in magnitude and should be investigated further at a “One-Stop” meeting with the funding agencies and with discussions with private funding sources. For the purposes of this financing plan, further evaluation will be made with the most conservative value, which is $10.88 per EDU per month.

Local Financing Requirements

The financing plan for the Phase I Improvements is based on the City securing authorization to issue bonds ranging from $8,395,000 to $11,194,000. A breakdown of approximate monthly water user costs for the improvements, based on present worth costs and including current water O&M budget and debt reserve is given in Table 10.3.2. For this table, it was assumed that the City’s debt service for the Phase I Improvements would be $11,194,000 with private loan funding (Alternative D).

The estimated total monthly average cost to each EDU is anticipated to be approximately $51.12. A grant for Alternative A or B improvements is conditional upon the determination of Rural Development and OECDD of the City’s eligibility for funding. The grants funds will not be offered by Rural Development if the City does not acquire authorization to issue bonds in the minimum amount required by the agency.

TABLE 10.3.2
APPROXIMATE MONTHLY USER COSTS

Item	Annual Cost	Monthly User Cost/EDU [1]
Debt Service on $11,194,000	$735,248	$12.66
Debt Service @ 10%	$73,525	$1.27
O&M Cost – Yr 2015-16 Budget	$2,160,220	$37.19
Total	$2,281,565	$51.12

[1] Based on 4,840 EDUs. EDUs associated with non-profit or City use was not included in the total EDU tabulation.

System Development Charges

In addition to the proposed financing strategy consisting of grants and low interest loans, the City should revise its System Development Charges (SDC) to assist in financing necessary capital improvements to the water system required by growth and development.

The SDCs may be developed and assessed as reimbursement and/or improvement fees. The reimbursement fee approach is based on the premise that new customers are entitled to water service at the same cost as existing customers. Consequently, the reimbursement SDC is calculated as the average water system investment per customer. Calculation of a reimbursement SDC is beyond the scope of this study as research and documentation is needed to determine the total investment made to the City’s water system, contributed capital, and debt service payments.

A SDC improvement fee is based on the projected improvements needed to increase system capacity. Approximately 11% of Phase I proposed improvement costs were attributed to future growth demands. With a SDC improvement fee, new users of the City’s water system would be assessed approximately 11% of the projected cost to design and construct these improvements. The present cost for the future improvements presented in Section 9 is estimated to be $11,194,000. The current SDC and rate structure should be re-evaluated and adjusted to account for the improvements described herein.

Affordability

One major consideration in deciding on any proposed capital improvements is the user's ability to support the full cost, including debt repayment, of utility service. Several measures of household affordability or ability-to-pay have been proposed or are currently being utilized.

The majority of affordability indicators are largely a function of income and rates. One of the most common affordability indicators is the ratio of annual user charges to the median household income. The threshold of affordability for this ratio varies from 1.5 to 2.5% of median household income. The OECDD utilizes 1.39% of the median household income as a threshold for qualifying for grant monies.

Affordability of rates and projected rate increases are also factors when bond rating agencies are determining credit quality. Fitch Ratings generally considers combined water and sewer service rates higher than 2% of median household income (or one percent for individual water and wastewater utilities) to be financially taxing (Water and Sewer Revenue Bond Rating Guidelines, Fitch Ratings September 3, 2015).

A summary of affordability measures and thresholds from selected studies is provided in Table 10.3.3.

TABLE 10.3.3
SUMMARY OF AFFORDABILITY MEASURES AND THRESHOLDS

Source	Indicator(s)	Threshold
Future Investment in Drinking Water & Wastewater Infrastructure (2002)	Ratio of annual user charge & median household income	2.5% of MHI
Rural Utilities Service Water & Waste Disposal Loans & Grants	Debt service portion of annual user charge & median household income (MHI)	>0.5% & MHI below poverty line or >1.0% & MHI between 80 & 100% of statewide non-metropolitan MHI
Department of Housing & Urban Development	Ratio of water & sewer bills, & household income	1.3 to 1.4%
National Consumer Law Center "The Poor and the Elderly – Drowning in the High Cost of Water", circa 1991	Ratio of sum of water & sewer bills & household income	>2.00 %
EPA Economic Guidance for Water Quality Standards Workbook (1995)	Ratio of annual user charge & median household income	<1.0% - no hardship expected 1.0 – 2.0% - mid-range >2.0% may be unreasonable burden
Affordability Criteria For Small Drinking Water Systems: An EPA Science Advisory Board Report (2002)	Discussion of affordability threshold, expenditure baselines, and differences in cost, income, and benefits	1. >1.0% must provide additional security. 2. >2.5% - system probably cannot issue debt
National Drinking Water Advisory Council Affordability Recommendations (2003)	EPA national affordability threshold given size category	grounds for consideration of measures other than median income
State of Idaho Assessment Tools for SRF Loans	Ratio of annual user charge & median household income	1.5% MHI

Abbreviations: AUC – Annual User Charge
MHI – Median Household Income

One limitation of using the ratio of annual user charges to the Median Household Income (MHI) is the determination of a representative MHI for a community. Currently, most funding agencies still utilize the 2010 Census data for making this determination. We have chosen to use the estimated 2015 MHI value from the Census Bureau in combination with the Consumer Price Index (CPI) for all urban consumers (CPI-U) to approximate the current MHI. The underlying assumption is that wages in the area have increased in a similar manner to that of the CPI-U. Data for the CPI-U was taken for the years 2015 through 2016 for the month of December. The percentage increase in the CPI-U between 2015 and 2016 was applied to the estimated 2015 MHI. This resulted in an estimated 2016 MHI of $34,006. The affordability of existing and future water rates within the City of Sutherlin is summarized in Table 10.3.4.

TABLE 10.3.4
AFFORDABILITY OF PROJECTED WATER USER COSTS FOR THE CITY OF SUTHERLIN

AFFORDABILITY TABULATIONS	
Median Household Income (MHI)	$34,006
Current Rates	
Estmated Monthly User Charge/EDU ($)	$37.19
Annual User Charge/ MHI (%)	1.32%
Projected Rates	
Estmated Monthly User Charge/EDU ($)	$51.12
Annual User Charge/ MHI (%)	1.81%

10.4 Recommendations

The following recommendations are made to the City Council to implement the elements of this Water Master Plan.

1. Submit Plan to the Oregon Health Authority and Department of Water Resources for review and approval.

2. Schedule and attend “One-Stop” Meeting to discuss financing options for the proposed Phase I Improvements.

3. Submit system information to private funding sources for consideration of private financing.

4. Submit necessary applications to the funding agencies requesting loans and grants to finance the Phase I Improvements.

5. Following favorable review by the selected financing agencies, secure the authority to issue revenue or general obligation bonds in the amount needed to finance the Phase I Improvements.

6. Authorize detailed design of recommended improvements and preparation of plans and specifications for the Phase I Improvements. Secure the necessary special use permits for construction.

7. Receive construction bids and award contracts for Phase I Improvements.

8. Initiate study of user rates for water system and implement proposed changes.

9. Revise System Development Charges and rates for the water system based on the CIP given in this WMP.

10.5 Project Implementation

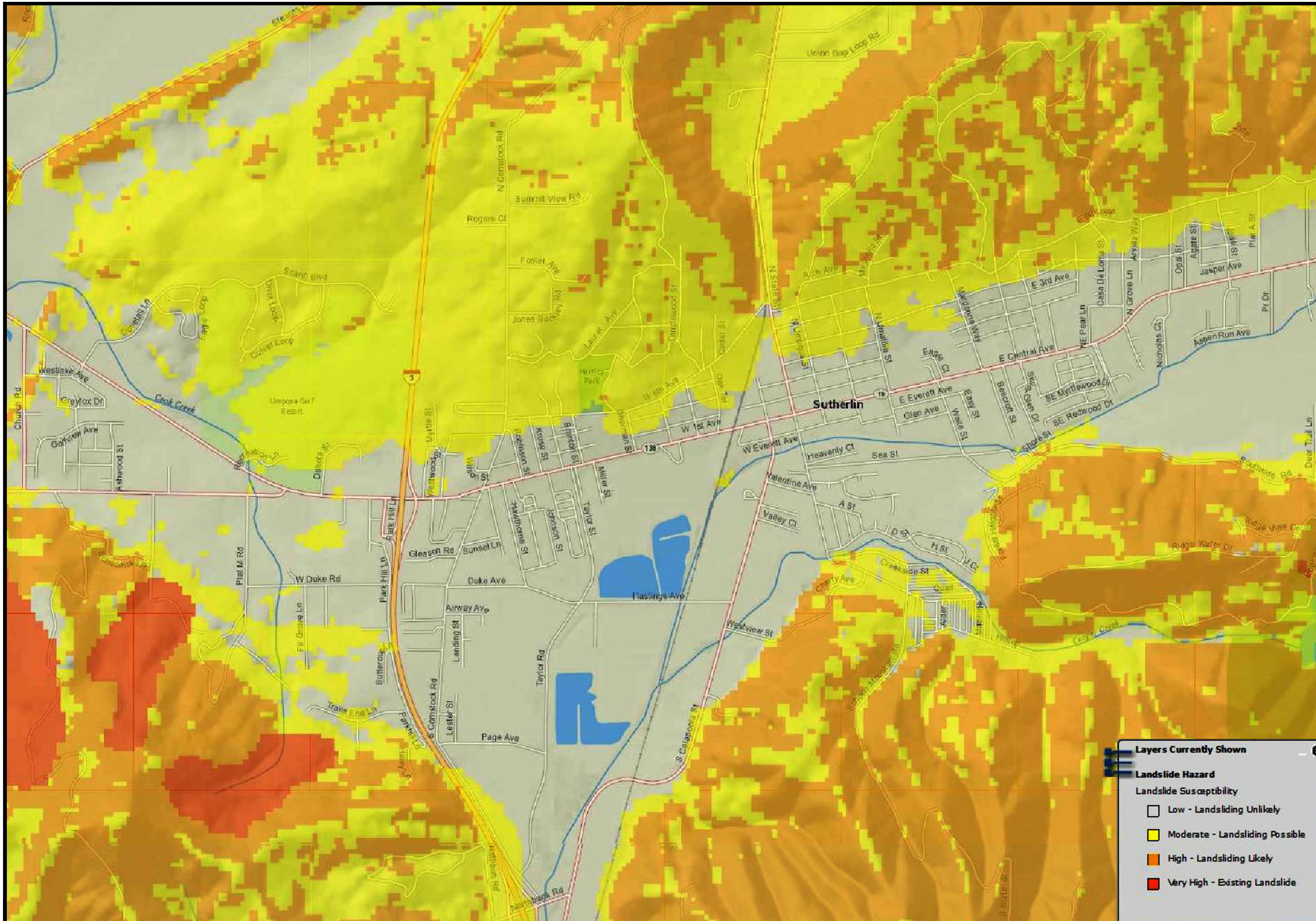
A tentative schedule, identifying the key activities and approximate implementation date for the Water Master Plan over the next three years, is presented in Table 10.5.1 on the following page.

TABLE 10.5.1
PROJECT IMPLEMENTATION SUMMARY

Item No.	Key Activity	Implementation Date
1	Council Adopt Water Master Plan-Submit Plan to OHD for Review and Approval	August 2017
2	Submit Plan to Health Division & Department of Water Resources	September 2017
3	Approval of Plan by Health Division & Department of Water Resources	December 2017
4	Start Environmental Evaluation/Notice	March 2018
5	Submit Application for Financing for Phase I and Associated Environmental Evaluation/Notice for Project	July 2018
6	Obtain Financing for Phase	August 2018
7	Start Preparation of Plans, Specifications for Phase I	March 2018-February 2019
8	Complete Design & Preparation of Plans, Specifications, & Contract	February 2019
9	Health Division Approval of Plans & Specifications	April 2019
10	Advertise for Phase I Construction Bids	May 2019
11	Receive Construction Bids for Phase I	June 2019
12	Start Construction of Phase I	July 2019
13	Complete Construction of Phase I Improvements	November 2020

APPENDICES

APPENDIX A: Study Area Information



SUTHERLIN WATER MASTER PLAN

LAND SLIDE HAZARD MAP

FIGURE NO. A.1

THE DYER PARTNERSHIP
ENGINEERS & PLANNERS

DATE: MARCH 2017

PROJECT NO.: 146.48

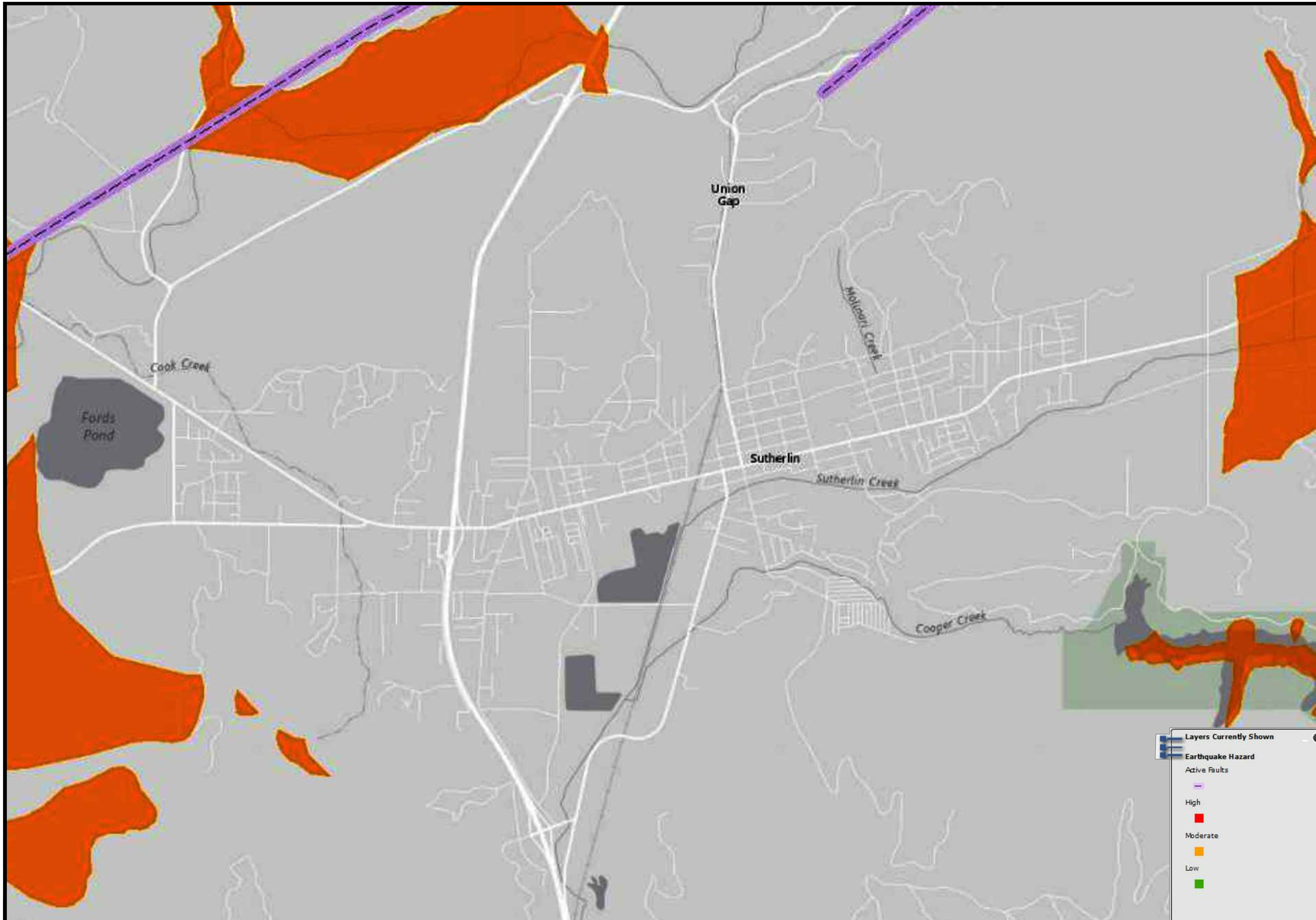


FIGURE NO.
A.2

SUTHERLIN WATER MASTER PLAN

EARTH QUAKE HAZARD MAP

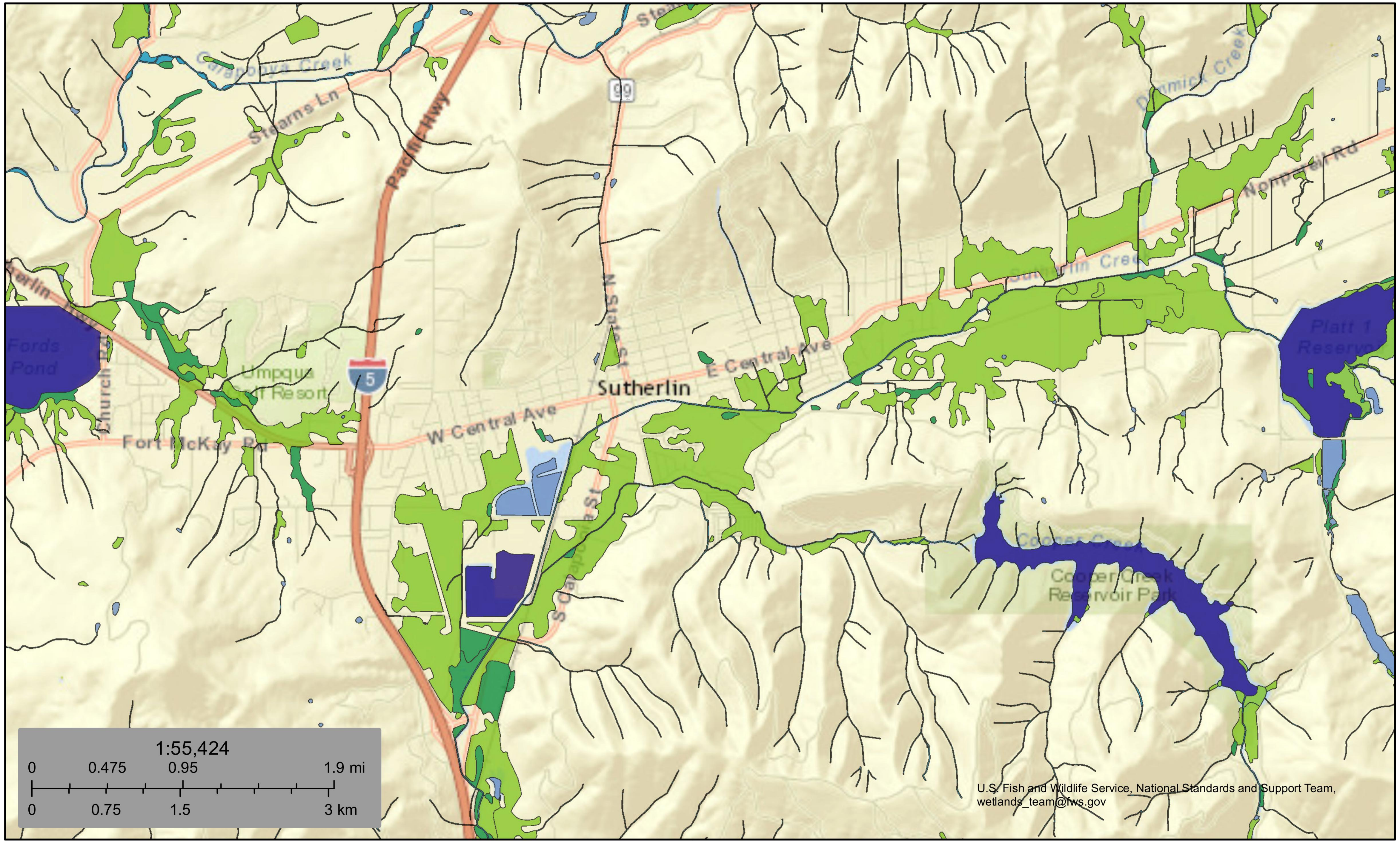
THE DYER PARTNERSHIP
ENGINEERS & PLANNERS

DATE: MARCH 2017

PROJECT NO.: 146.48

U.S. Fish and Wildlife Service

National Wetlands Inventory



June 15, 2017

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

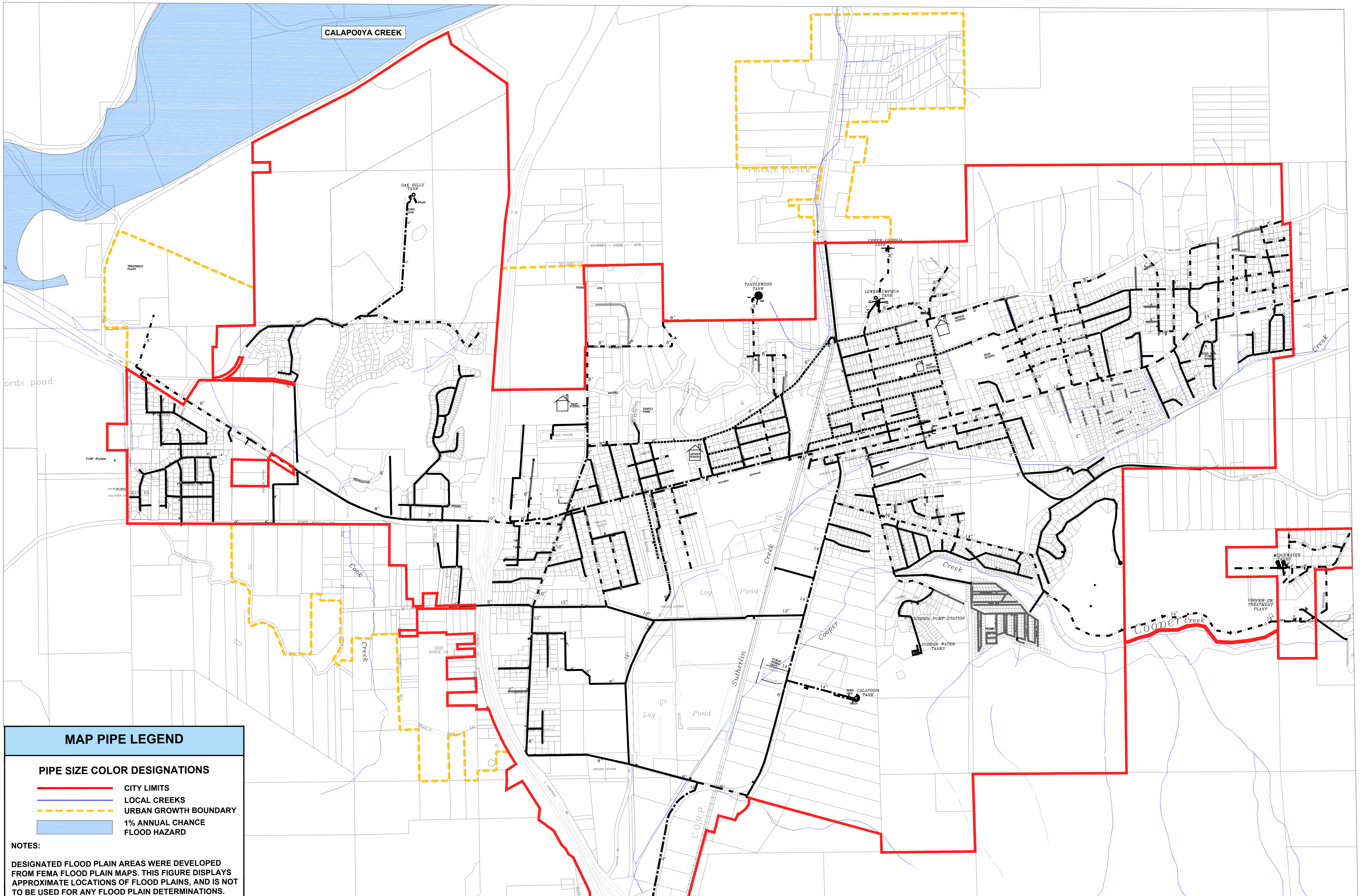
National Wetlands Inventory (NWI)
This page was produced by the NWI mapper

FIGURE NO. A.3

SUTHERLIN WATER MASTER PLAN

WETLAND MAP

THE DYER PARTNERSHIP
ENGINEERS & PLANNERS
DATE: MARCH 2017
PROJECT NO.: 146.48



MAP PIPE LEGEND

PIPE SIZE COLOR DESIGNATIONS

- CITY LIMITS
- LOCAL CREEKS
- URBAN GROWTH BOUNDARY
- 1% ANNUAL CHANCE FLOOD HAZARD

NOTES:

DESIGNATED FLOOD PLAIN AREAS WERE DEVELOPED FROM FEMA FLOOD PLAIN MAPS. THIS FIGURE DISPLAYS APPROXIMATE LOCATIONS OF FLOOD PLAINS, AND IS NOT TO BE USED FOR ANY FLOOD PLAIN DETERMINATIONS.

FIGURE NO.
A.4

SUTHERLIN WATER MASTER PLAN

FIRM MAP

THE DYER PARTNERSHIP
ENGINEERS & PLANNERS

DATE: MARCH 2017
PROJECT NO.: 146.48

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NRCS

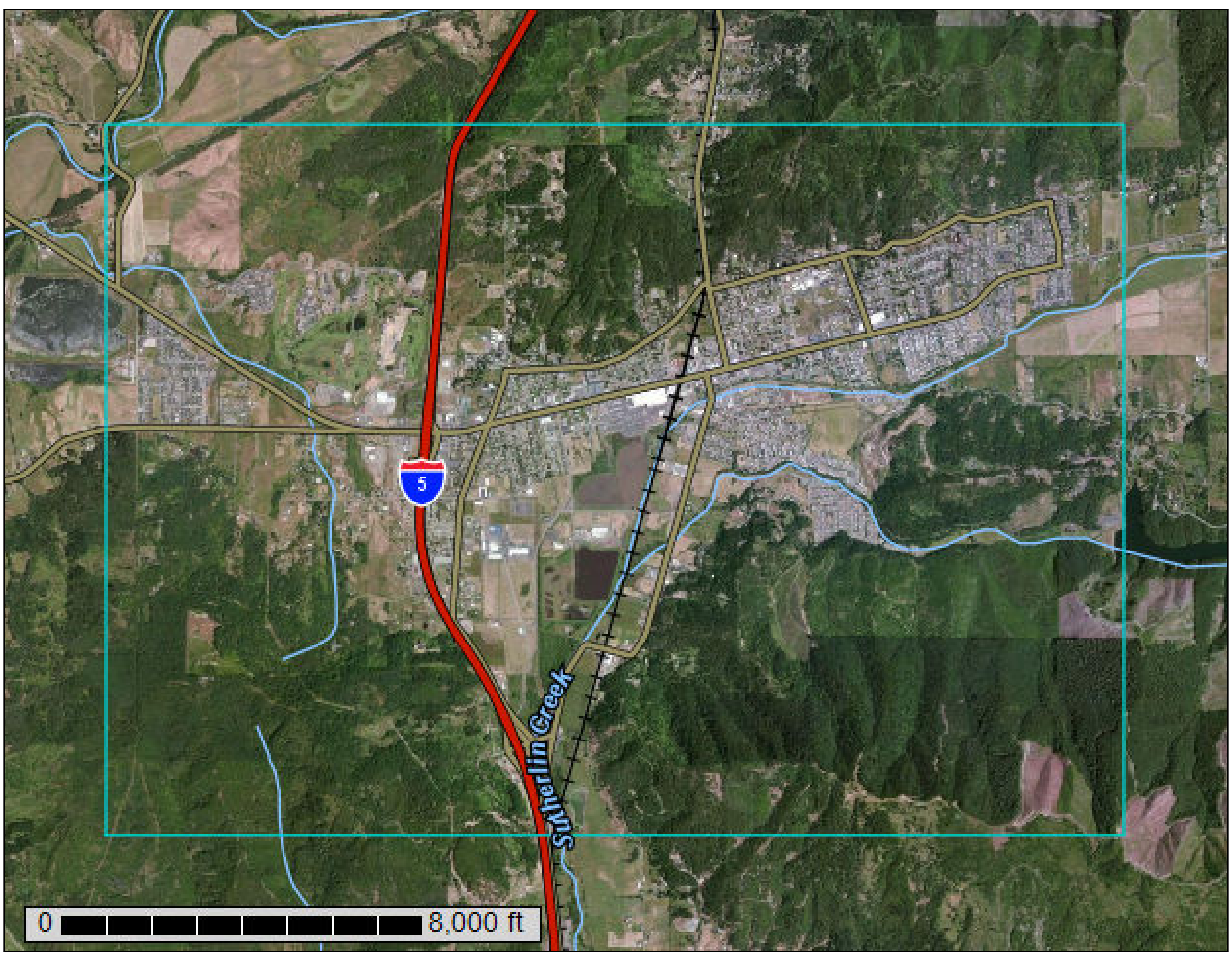
Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Douglas County Area, Oregon

Sutherlin WMP Soils Report



March 2, 2017

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

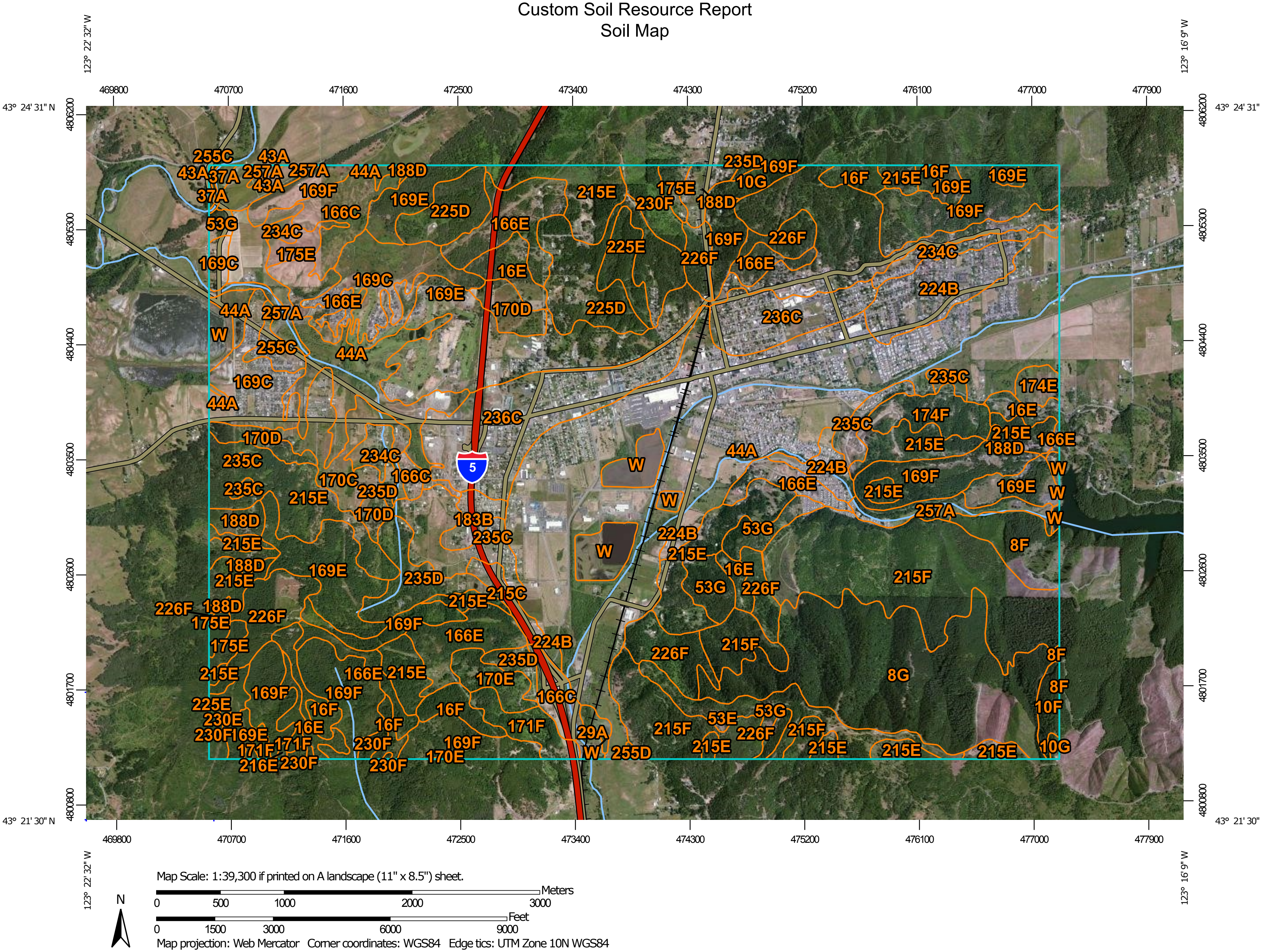
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map


123° 22' 32" W
123° 16' 9" W
43° 24' 31" N
43° 21' 30" N
469800
470700
471600
472500
473400
474300
475200
476100
477000
477900
4806200
4805300
4804400
4803500
4802600
4801700
4800800
255C
43A
37A
257A
43A
257A
44A
188D
43A
37A
169F
169E
225D
53G
166C
234C
166E
175E
169C
166E
16E
169C
169E
44A
257A
166E
170D
225D
W
255C
44A
169C
44A
236C
170D
235C
234C
166C
235C
170C
215E
235D
5
170D
183B
188D
235C
215E
188D
169E
235D
215E
215E
215C
226F
188D
175E
226F
169F
166E
224B
175E
235D
215E
166E
215E
170E
169F
169F
166C
225E
16F
230E
16E
16F
16F
230F
169E
171F
171F
230F
169F
171F
216E
230F
230F
170E
215E
235D
169F
10G
175E
230F
188D
169F
226F
225E
226F
166E
236C
225D
16F
215E
16F
169E
169E
169F
234C
224B
235C
174E
174F
16E
235C
215E
215E
188D
166E
44A
W
224B
166E
169F
169E
W
215E
W
257A
W
W
53G
224B
215E
8F
W
16E
53G
226F
215F
215F
226F
8F
8G
8F
10F
53E
53G
215F
29A
226F
215F
215E
215E
215E
215E
10G
W
255D
Map Scale: 1:39,300 if printed on A landscape (11" x 8.5") sheet.
Meters
0
500
1000
2000
3000
N
Feet
0
1500
3000
6000
9000
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Douglas County Area, Oregon
Survey Area Data: Version 14, Sep 16, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Data not available.

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Douglas County Area, Oregon (OR649)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
8F	Atring gravelly loam, 30 to 60 percent slopes	76.3	1.0%
8G	Atring gravelly loam, 60 to 90 percent slopes	486.7	6.3%
10F	Atring-Larmine complex, 30 to 60 percent slopes	23.8	0.3%
10G	Atring-Larmine complex, 60 to 90 percent slopes	28.0	0.4%
16E	Bateman silt loam, 12 to 30 percent slopes	119.1	1.5%
16F	Bateman silt loam, 30 to 60 percent slopes	85.8	1.1%
29A	Brand silty clay loam, 0 to 3 percent slopes	18.0	0.2%
37A	Chapman-Chehalis complex, 0 to 3 percent slopes	7.5	0.1%
43A	Coburg silty clay loam, flooded, 0 to 3 percent slopes	32.9	0.4%
44A	Conser silty clay loam, 0 to 3 percent slopes	1,361.8	17.7%
53E	Dickerson loam, 3 to 30 percent slopes	95.1	1.2%
53G	Dickerson loam, 30 to 90 percent slopes	90.8	1.2%
166C	Nonpareil loam, 3 to 12 percent slopes	124.9	1.6%
166E	Nonpareil loam, 12 to 30 percent slopes	339.0	4.4%
169C	Nonpareil-Oakland complex, 3 to 12 percent slopes	227.2	3.0%
169E	Nonpareil-Oakland complex, 12 to 30 percent slopes	726.9	9.5%
169F	Nonpareil-Oakland complex, 30 to 60 percent slopes	526.0	6.8%
170C	Oakland silt loam, 3 to 12 percent slopes	91.9	1.2%
170D	Oakland silt loam, 12 to 20 percent slopes	78.2	1.0%
170E	Oakland silt loam, 20 to 30 percent slopes	42.0	0.5%
171F	Oakland silt loam, 30 to 60 percent north slopes	74.6	1.0%

Douglas County Area, Oregon (OR649)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
174E	Oakland-Nonpareil-Sutherlin complex, 12 to 30 percent slopes	23.0	0.3%
174F	Oakland-Nonpareil-Sutherlin complex, 30 to 60 percent slopes	62.9	0.8%
175E	Oakland-Sutherlin complex, 12 to 30 percent slopes	53.2	0.7%
183B	Packard gravelly loam, 0 to 5 percent slopes	32.5	0.4%
188D	Pengra silt loam, 2 to 20 percent slopes	79.7	1.0%
215C	Rosehaven loam, 3 to 12 percent slopes	26.8	0.3%
215E	Rosehaven loam, 12 to 30 percent slopes	542.6	7.1%
215F	Rosehaven loam, 30 to 60 percent slopes	563.6	7.3%
216E	Rosehaven-Atring complex, 12 to 30 percent slopes	1.8	0.0%
224B	Sibold fine sandy loam, 0 to 5 percent slopes	166.6	2.2%
225D	Speaker loam, 2 to 20 percent slopes	226.4	2.9%
225E	Speaker loam, 20 to 30 percent slopes	43.0	0.6%
226F	Speaker loam, 30 to 60 percent north slopes	230.3	3.0%
230E	Speaker-Nonpareil complex, 3 to 30 percent slopes	27.5	0.4%
230F	Speaker-Nonpareil complex, 30 to 60 percent slopes	66.2	0.9%
234C	Stockel fine sandy loam, 3 to 12 percent slopes	70.0	0.9%
235C	Sutherlin silt loam, 3 to 12 percent slopes	136.6	1.8%
235D	Sutherlin silt loam, 12 to 20 percent slopes	112.9	1.5%
236C	Sutherlin-Oakland complex, 3 to 12 percent slopes	355.1	4.6%
255C	Veneta loam, 0 to 12 percent slopes	26.2	0.3%
255D	Veneta loam, 12 to 20 percent slopes	2.9	0.0%
257A	Waldo silty clay loam, 0 to 3 percent slopes	73.3	1.0%
W	Water	110.1	1.4%
Totals for Area of Interest		**7,689.8**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Douglas County Area, Oregon

8F—Atring gravelly loam, 30 to 60 percent slopes

Map Unit Setting

National map unit symbol: 27sz
Elevation: 250 to 2,600 feet
Mean annual precipitation: 40 to 55 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Not prime farmland

Map Unit Composition

Atring and similar soils: 75 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Atring

Setting

Landform: Mountains
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium derived from sandstone

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
H1 - 2 to 11 inches: gravelly loam
H2 - 11 to 37 inches: very gravelly loam
H3 - 37 to 47 inches: weathered bedrock

Properties and qualities

Slope: 30 to 60 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Hydric soil rating: No

8G—Atring gravelly loam, 60 to 90 percent slopes

Map Unit Setting

National map unit symbol: 27t0
Elevation: 250 to 2,600 feet
Mean annual precipitation: 40 to 55 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Not prime farmland

Map Unit Composition

Atring and similar soils: 75 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Atring

Setting

Landform: Mountains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium derived from sandstone

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
H1 - 2 to 11 inches: gravelly loam
H2 - 11 to 37 inches: very gravelly loam
H3 - 37 to 47 inches: weathered bedrock

Properties and qualities

Slope: 60 to 90 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Hydric soil rating: No

10F—Atring-Larmine complex, 30 to 60 percent slopes

Map Unit Setting

National map unit symbol: 26xs
Elevation: 250 to 2,600 feet
Mean annual precipitation: 40 to 55 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Not prime farmland

Map Unit Composition

Atring and similar soils: 45 percent
Larmine and similar soils: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Atring

Setting

Landform: Mountains
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium derived from sandstone

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
H1 - 2 to 11 inches: gravelly loam
H2 - 11 to 37 inches: very gravelly loam
H3 - 37 to 47 inches: weathered bedrock

Properties and qualities

Slope: 30 to 60 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Hydric soil rating: No

Description of Larmine

Setting

Landform: Mountains

Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Mountainflank, mountaintop
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium derived from sandstone

Typical profile

H1 - 0 to 3 inches: gravelly loam
H2 - 3 to 19 inches: very gravelly loam
H3 - 19 to 23 inches: unweathered bedrock

Properties and qualities

Slope: 30 to 60 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Hydric soil rating: No

10G—Atring-Larmine complex, 60 to 90 percent slopes

Map Unit Setting

National map unit symbol: 26xt
Elevation: 250 to 2,600 feet
Mean annual precipitation: 40 to 55 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Not prime farmland

Map Unit Composition

Atring and similar soils: 40 percent
Larmine and similar soils: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Atring

Setting

Landform: Mountains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Convex
Across-slope shape: Convex

Parent material: Colluvium derived from sandstone

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
H1 - 2 to 11 inches: gravelly loam
H2 - 11 to 37 inches: very gravelly loam
H3 - 37 to 47 inches: weathered bedrock

Properties and qualities

Slope: 60 to 90 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Hydric soil rating: No

Description of Larmine

Setting

Landform: Mountains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium derived from sandstone

Typical profile

H1 - 0 to 3 inches: gravelly loam
H2 - 3 to 19 inches: very gravelly loam
H3 - 19 to 23 inches: unweathered bedrock

Properties and qualities

Slope: 60 to 90 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Hydric soil rating: No

16E—Bateman silt loam, 12 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2750
Elevation: 250 to 2,600 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Bateman and similar soils: 75 percent
Minor components: 1 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bateman

Setting

Landform: Mountains
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Mountaintop, lower third of mountainflank
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium and residuum derived from sandstone and siltstone

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 50 inches: silty clay loam
H3 - 50 to 63 inches: gravelly silty clay loam

Properties and qualities

Slope: 12 to 30 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 11.0 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Other vegetative classification: Well Drained > 15% Slopes (G002XY001OR)
Hydric soil rating: No

Minor Components

Pengra

Percent of map unit: 1 percent
Landform: Alluvial fans
Hydric soil rating: Yes

16F—Bateman silt loam, 30 to 60 percent slopes

Map Unit Setting

National map unit symbol: 2751
Elevation: 250 to 2,600 feet
Mean annual precipitation: 40 to 55 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Not prime farmland

Map Unit Composition

Bateman and similar soils: 75 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bateman

Setting

Landform: Mountains
Landform position (two-dimensional): Summit, backslope
Landform position (three-dimensional): Mountainflank, mountaintop
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium and residuum derived from sandstone and siltstone

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 50 inches: silty clay loam
H3 - 50 to 63 inches: gravelly silty clay loam

Properties and qualities

Slope: 30 to 60 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 11.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: C
Hydric soil rating: No

29A—Brand silty clay loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 27gr
Elevation: 100 to 1,500 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Brand and similar soils: 85 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Brand

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Clayey alluvium

Typical profile

H1 - 0 to 15 inches: silty clay loam
H2 - 15 to 26 inches: clay
H3 - 26 to 60 inches: clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water storage in profile: High (about 9.3 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Other vegetative classification: Poorly Drained (G005XY009OR)
Hydric soil rating: Yes

Minor Components

Waldo

Percent of map unit: 3 percent
Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G005XY009OR)
Hydric soil rating: Yes

37A—Chapman-Chehalis complex, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 27k5
Elevation: 100 to 1,600 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Chapman and similar soils: 50 percent
Chehalis and similar soils: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chapman

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium from mixed sources

Typical profile

H1 - 0 to 8 inches: loam
H2 - 8 to 25 inches: loam
H3 - 25 to 40 inches: loam
H4 - 40 to 60 inches: loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Occasional
Frequency of ponding: None

Available water storage in profile: Moderate (about 9.0 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 1
Hydrologic Soil Group: B
Other vegetative classification: Well Drained < 15% Slopes (G005XY004OR)
Hydric soil rating: No

Description of Chehalis

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium from mixed sources

Typical profile

H1 - 0 to 16 inches: silt loam
H2 - 16 to 60 inches: silty clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water storage in profile: High (about 11.5 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: B
Other vegetative classification: Well Drained < 15% Slopes (G005XY004OR)
Hydric soil rating: No

43A—Coburg silty clay loam, flooded, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 27kx
Elevation: 100 to 1,500 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Coburg, flooded, and similar soils: 75 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Coburg, Flooded

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium from mixed sources

Typical profile

H1 - 0 to 17 inches: silty clay loam
H2 - 17 to 60 inches: silty clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water storage in profile: High (about 11.4 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C
Other vegetative classification: Moderately Well Drained < 15% Slopes (G005XY006OR)
Hydric soil rating: No

Minor Components

Waldo

Percent of map unit: 5 percent
Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G005XY009OR)
Hydric soil rating: Yes

44A—Conser silty clay loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 27l0
Elevation: 100 to 1,500 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Conser and similar soils: 90 percent
Minor components: 1 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Conser

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Clayey alluvium

Typical profile

H1 - 0 to 4 inches: silty clay loam
H2 - 4 to 63 inches: clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water storage in profile: High (about 9.2 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Other vegetative classification: Poorly Drained (G005XY009OR)
Hydric soil rating: Yes

Minor Components

Waldo

Percent of map unit: 1 percent

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G005XY009OR)
Hydric soil rating: Yes

53E—Dickerson loam, 3 to 30 percent slopes

Map Unit Setting

National map unit symbol: 27nb
Elevation: 350 to 2,500 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Not prime farmland

Map Unit Composition

Dickerson and similar soils: 85 percent
Minor components: 1 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dickerson

Setting

Landform: Hills
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium and residuum derived from sandstone and siltstone

Typical profile

H1 - 0 to 5 inches: loam
H2 - 5 to 9 inches: unweathered bedrock

Properties and qualities

Slope: 3 to 30 percent
Depth to restrictive feature: 5 to 10 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 0.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D

Hydric soil rating: No

Minor Components

Pengra

Percent of map unit: 1 percent
Landform: Alluvial fans
Hydric soil rating: Yes

53G—Dickerson loam, 30 to 90 percent slopes

Map Unit Setting

National map unit symbol: 27nc
Elevation: 500 to 2,500 feet
Mean annual precipitation: 30 to 55 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Not prime farmland

Map Unit Composition

Dickerson and similar soils: 75 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dickerson

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium and residuum derived from sandstone and siltstone

Typical profile

H1 - 0 to 5 inches: loam
H2 - 5 to 9 inches: unweathered bedrock

Properties and qualities

Slope: 30 to 90 percent
Depth to restrictive feature: 5 to 10 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 0.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s

Hydrologic Soil Group: D
Hydric soil rating: No

166C—Nonpareil loam, 3 to 12 percent slopes

Map Unit Setting

National map unit symbol: 274q
Elevation: 300 to 2,500 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Not prime farmland

Map Unit Composition

Nonpareil and similar soils: 75 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nonpareil

Setting

Landform: Hills
Landform position (two-dimensional): Toeslope, summit
Landform position (three-dimensional): Side slope, interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium and residuum derived from sandstone and siltstone

Typical profile

H1 - 0 to 4 inches: loam
H2 - 4 to 17 inches: loam
H3 - 17 to 27 inches: weathered bedrock

Properties and qualities

Slope: 3 to 12 percent
Depth to restrictive feature: 10 to 20 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Other vegetative classification: Well Drained < 15% Slopes (G005XY004OR)
Hydric soil rating: No

Minor Components

Pengra

Percent of map unit: 3 percent
Landform: Alluvial fans
Hydric soil rating: Yes

166E—Nonpareil loam, 12 to 30 percent slopes

Map Unit Setting

National map unit symbol: 274r
Elevation: 300 to 2,500 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Not prime farmland

Map Unit Composition

Nonpareil and similar soils: 75 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nonpareil

Setting

Landform: Hills
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Interfluve, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium and residuum derived from sandstone and siltstone

Typical profile

H1 - 0 to 4 inches: loam
H2 - 4 to 17 inches: loam
H3 - 17 to 27 inches: weathered bedrock

Properties and qualities

Slope: 12 to 30 percent
Depth to restrictive feature: 10 to 20 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Other vegetative classification: Well Drained > 15% Slopes (G005XY003OR)
Hydric soil rating: No

Minor Components

Pengra

Percent of map unit: 2 percent
Landform: Alluvial fans
Hydric soil rating: Yes

169C—Nonpareil-Oakland complex, 3 to 12 percent slopes

Map Unit Setting

National map unit symbol: 274v
Elevation: 300 to 2,500 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Not prime farmland

Map Unit Composition

Nonpareil and similar soils: 45 percent
Oakland and similar soils: 30 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nonpareil

Setting

Landform: Hills
Landform position (two-dimensional): Toeslope, summit
Landform position (three-dimensional): Base slope, interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium and residuum derived from sandstone and siltstone

Typical profile

H1 - 0 to 4 inches: loam
H2 - 4 to 17 inches: loam
H3 - 17 to 27 inches: weathered bedrock

Properties and qualities

Slope: 3 to 12 percent
Depth to restrictive feature: 10 to 20 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None

Frequency of ponding: None
Available water storage in profile: Very low (about 2.9 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Other vegetative classification: Well Drained < 15% Slopes (G005XY004OR)
Hydric soil rating: No

Description of Oakland

Setting
Landform: Hills
Landform position (two-dimensional): Toeslope, summit
Landform position (three-dimensional): Interfluve, base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium and residuum derived from sandstone and siltstone

Typical profile
H1 - 0 to 5 inches: silt loam
H2 - 5 to 24 inches: silty clay loam
H3 - 24 to 28 inches: gravelly silty clay
H4 - 28 to 38 inches: weathered bedrock

Properties and qualities
Slope: 3 to 12 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.2 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Other vegetative classification: Well Drained < 15% Slopes (G005XY004OR)
Hydric soil rating: No

Minor Components

Pengra
Percent of map unit: 2 percent
Landform: Alluvial fans
Hydric soil rating: Yes

169E—Nonpareil-Oakland complex, 12 to 30 percent slopes

Map Unit Setting

National map unit symbol: 274w
Elevation: 300 to 2,500 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Not prime farmland

Map Unit Composition

Nonpareil and similar soils: 45 percent
Oakland and similar soils: 30 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nonpareil

Setting

Landform: Hills
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Side slope, interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium and residuum derived from sandstone and siltstone

Typical profile

H1 - 0 to 4 inches: loam
H2 - 4 to 17 inches: loam
H3 - 17 to 27 inches: weathered bedrock

Properties and qualities

Slope: 12 to 30 percent
Depth to restrictive feature: 10 to 20 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Other vegetative classification: Well Drained > 15% Slopes (G005XY003OR)
Hydric soil rating: No

Description of Oakland

Setting

Landform: Hills
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Side slope, interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium and residuum derived from sandstone and siltstone

Typical profile

H1 - 0 to 5 inches: silt loam
H2 - 5 to 24 inches: silty clay loam
H3 - 24 to 28 inches: gravelly silty clay
H4 - 28 to 38 inches: weathered bedrock

Properties and qualities

Slope: 12 to 30 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Other vegetative classification: Well Drained > 15% Slopes (G005XY003OR)
Hydric soil rating: No

Minor Components

Pengra

Percent of map unit: 2 percent
Landform: Alluvial fans
Hydric soil rating: Yes

169F—Nonpareil-Oakland complex, 30 to 60 percent slopes

Map Unit Setting

National map unit symbol: 274x
Elevation: 300 to 2,500 feet
Mean annual precipitation: 30 to 55 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days

Farmland classification: Not prime farmland

Map Unit Composition

Nonpareil and similar soils: 45 percent
Oakland and similar soils: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nonpareil

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium and residuum derived from sandstone and siltstone

Typical profile

H1 - 0 to 4 inches: loam
H2 - 4 to 17 inches: loam
H3 - 17 to 27 inches: weathered bedrock

Properties and qualities

Slope: 30 to 60 percent
Depth to restrictive feature: 10 to 20 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Hydric soil rating: No

Description of Oakland

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Parent material: Colluvium and residuum derived from sandstone and siltstone

Typical profile

H1 - 0 to 5 inches: silt loam
H2 - 5 to 24 inches: silty clay loam
H3 - 24 to 28 inches: gravelly silty clay
H4 - 28 to 38 inches: weathered bedrock

Properties and qualities

Slope: 30 to 60 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock

Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.2 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Hydric soil rating: No

170C—Oakland silt loam, 3 to 12 percent slopes

Map Unit Setting
National map unit symbol: 2754
Elevation: 300 to 2,500 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Oakland and similar soils: 75 percent
Minor components: 6 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Oakland

Setting
Landform: Hills
Landform position (two-dimensional): Toeslope, summit
Landform position (three-dimensional): Interfluve, base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium and residuum derived from sandstone and siltstone

Typical profile
H1 - 0 to 5 inches: silt loam
H2 - 5 to 24 inches: silty clay loam
H3 - 24 to 28 inches: gravelly silty clay
H4 - 28 to 38 inches: weathered bedrock

Properties and qualities
Slope: 3 to 12 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)

Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.2 inches)

Interpretive groups
Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Other vegetative classification: Well Drained < 15% Slopes (G005XY004OR)
Hydric soil rating: No

Minor Components

Pengra
Percent of map unit: 2 percent
Landform: Alluvial fans
Hydric soil rating: Yes

Aqualfs
Percent of map unit: 2 percent
Landform: Hills
Hydric soil rating: Yes

Panther
Percent of map unit: 2 percent
Landform: Swales on hillslopes
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear, concave
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G005XY009OR)
Hydric soil rating: Yes

170D—Oakland silt loam, 12 to 20 percent slopes

Map Unit Setting
National map unit symbol: 2755
Elevation: 300 to 2,500 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Oakland and similar soils: 75 percent
Minor components: 6 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Oakland

Setting

Landform: Hills
Landform position (two-dimensional): Toeslope, summit
Landform position (three-dimensional): Interfluve, base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium and residuum derived from sandstone and siltstone

Typical profile

H1 - 0 to 5 inches: silt loam
H2 - 5 to 24 inches: silty clay loam
H3 - 24 to 28 inches: gravelly silty clay
H4 - 28 to 38 inches: weathered bedrock

Properties and qualities

Slope: 12 to 20 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.2 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Other vegetative classification: Well Drained < 15% Slopes (G005XY004OR)
Hydric soil rating: No

Minor Components

Pengra

Percent of map unit: 2 percent
Landform: Alluvial fans
Hydric soil rating: Yes

Aqualfs

Percent of map unit: 2 percent
Landform: Hills
Hydric soil rating: Yes

Panther

Percent of map unit: 2 percent
Landform: Swales on hillslopes
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear, concave
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G005XY009OR)
Hydric soil rating: Yes

170E—Oakland silt loam, 20 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2757
Elevation: 300 to 2,500 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Oakland and similar soils: 75 percent
Minor components: 4 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Oakland

Setting

Landform: Hills
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Interfluve, side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium and residuum derived from sandstone and siltstone

Typical profile

H1 - 0 to 5 inches: silt loam
H2 - 5 to 24 inches: silty clay loam
H3 - 24 to 28 inches: gravelly silty clay
H4 - 28 to 38 inches: weathered bedrock

Properties and qualities

Slope: 20 to 30 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Other vegetative classification: Well Drained > 15% Slopes (G005XY003OR)
Hydric soil rating: No

Minor Components

Pengra, 2-20% slopes

Percent of map unit: 2 percent
Landform: Alluvial fans
Hydric soil rating: Yes

Panther

Percent of map unit: 2 percent
Landform: Swales on hillslopes
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear, concave
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G005XY009OR)
Hydric soil rating: Yes

171F—Oakland silt loam, 30 to 60 percent north slopes

Map Unit Setting

National map unit symbol: 2758
Elevation: 300 to 2,500 feet
Mean annual precipitation: 30 to 55 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Not prime farmland

Map Unit Composition

Oakland, north, and similar soils: 75 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Oakland, North

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium and residuum derived from sandstone and siltstone

Typical profile

H1 - 0 to 5 inches: silt loam
H2 - 5 to 24 inches: silty clay loam
H3 - 24 to 28 inches: gravelly silty clay
H4 - 28 to 38 inches: weathered bedrock

Properties and qualities

Slope: 30 to 60 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock

Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Hydric soil rating: No

174E—Oakland-Nonpareil-Sutherlin complex, 12 to 30 percent slopes

Map Unit Setting

National map unit symbol: 275c
Elevation: 300 to 2,000 feet
Mean annual precipitation: 30 to 55 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Oakland and similar soils: 40 percent
Nonpareil and similar soils: 25 percent
Sutherlin and similar soils: 15 percent
Minor components: 1 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Oakland

Setting

Landform: Hills
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium and residuum derived from sandstone and siltstone

Typical profile

H1 - 0 to 5 inches: silt loam
H2 - 5 to 24 inches: silty clay loam
H3 - 24 to 28 inches: gravelly silty clay
H4 - 28 to 38 inches: weathered bedrock

Properties and qualities

Slope: 12 to 30 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Other vegetative classification: Well Drained > 15% Slopes (G005XY003OR)
Hydric soil rating: No

Description of Nonpareil

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium and residuum derived from sandstone and siltstone

Typical profile

H1 - 0 to 4 inches: loam
H2 - 4 to 17 inches: loam
H3 - 17 to 27 inches: weathered bedrock

Properties and qualities

Slope: 12 to 30 percent
Depth to restrictive feature: 10 to 20 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Other vegetative classification: Well Drained > 15% Slopes (G005XY003OR)
Hydric soil rating: No

Description of Sutherlin

Setting

Landform: Hills
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Alluvium and colluvium derived from sandstone and siltstone

Typical profile

H1 - 0 to 16 inches: silt loam
H2 - 16 to 30 inches: silty clay loam
H3 - 30 to 60 inches: silty clay

Properties and qualities

Slope: 12 to 30 percent
Depth to restrictive feature: 24 to 36 inches to abrupt textural change
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Other vegetative classification: Moderately Well Drained > 15% Slopes (G005XY005OR)
Hydric soil rating: No

Minor Components

Aqualfs

Percent of map unit: 1 percent
Landform: Hills
Hydric soil rating: Yes

174F—Oakland-Nonpareil-Sutherlin complex, 30 to 60 percent slopes

Map Unit Setting

National map unit symbol: 275d
Elevation: 300 to 2,000 feet
Mean annual precipitation: 30 to 55 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Not prime farmland

Map Unit Composition

Oakland and similar soils: 40 percent
Nonpareil and similar soils: 25 percent
Sutherlin and similar soils: 15 percent
Minor components: 1 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Oakland

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium and residuum derived from sandstone and siltstone

Typical profile

H1 - 0 to 5 inches: silt loam
H2 - 5 to 24 inches: silty clay loam
H3 - 24 to 28 inches: gravelly silty clay
H4 - 28 to 38 inches: weathered bedrock

Properties and qualities

Slope: 30 to 60 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Hydric soil rating: No

Description of Nonpareil

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium and residuum derived from sandstone and siltstone

Typical profile

H1 - 0 to 4 inches: loam
H2 - 4 to 17 inches: loam
H3 - 17 to 27 inches: weathered bedrock

Properties and qualities

Slope: 30 to 60 percent
Depth to restrictive feature: 10 to 20 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Available water storage in profile: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Hydric soil rating: No

Description of Sutherlin

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Alluvium and colluvium derived from sandstone and siltstone

Typical profile

H1 - 0 to 16 inches: silt loam
H2 - 16 to 30 inches: silty clay loam
H3 - 30 to 60 inches: silty clay

Properties and qualities

Slope: 30 to 50 percent
Depth to restrictive feature: 24 to 36 inches to abrupt textural change
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Aqualfs

Percent of map unit: 1 percent
Landform: Hills
Hydric soil rating: Yes

175E—Oakland-Sutherlin complex, 12 to 30 percent slopes

Map Unit Setting

National map unit symbol: 275j
Elevation: 300 to 2,000 feet
Mean annual precipitation: 30 to 55 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Oakland and similar soils: 50 percent
Sutherlin and similar soils: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Oakland

Setting

Landform: Hills
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium and residuum derived from sandstone and siltstone

Typical profile

H1 - 0 to 5 inches: silt loam
H2 - 5 to 24 inches: silty clay loam
H3 - 24 to 28 inches: gravelly silty clay
H4 - 28 to 38 inches: weathered bedrock

Properties and qualities

Slope: 12 to 30 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Other vegetative classification: Well Drained > 15% Slopes (G005XY003OR)

Hydric soil rating: No

Description of Sutherlin

Setting

Landform: Hills
Landform position (two-dimensional): Footslope, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Alluvium and colluvium derived from sandstone and siltstone

Typical profile

H1 - 0 to 16 inches: silt loam
H2 - 16 to 30 inches: silty clay loam
H3 - 30 to 60 inches: silty clay

Properties and qualities

Slope: 12 to 30 percent
Depth to restrictive feature: 24 to 36 inches to abrupt textural change
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Other vegetative classification: Moderately Well Drained > 15% Slopes (G005XY005OR)
Hydric soil rating: No

183B—Packard gravelly loam, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2767
Elevation: 300 to 950 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Packard and similar soils: 75 percent
Minor components: 4 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Packard

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Alluvium derived from mixed sources

Typical profile

H1 - 0 to 12 inches: gravelly loam
H2 - 12 to 32 inches: very gravelly clay loam
H3 - 32 to 60 inches: extremely gravelly clay loam

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: B
Other vegetative classification: Well Drained < 15% Slopes (G005XY004OR)
Hydric soil rating: No

Minor Components

Aquolls

Percent of map unit: 4 percent
Landform: Hills
Hydric soil rating: Yes

188D—Pengra silt loam, 2 to 20 percent slopes

Map Unit Setting

National map unit symbol: 276f
Elevation: 300 to 2,500 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Pengra and similar soils: 75 percent
Minor components: 4 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pengra

Setting

Landform: Alluvial fans, hills
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Side slope, base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium and colluvium derived from sandstone and siltstone over residuum weathered from sandstone and siltstone

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 16 inches: silty clay loam
H3 - 16 to 60 inches: clay

Properties and qualities

Slope: 2 to 20 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 0 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.0 inches)

Interpretive groups

Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: D
Other vegetative classification: Somewhat Poorly Drained < 15% Slopes (G005XY008OR)
Hydric soil rating: Yes

Minor Components

Pengra, 20-30% slopes

Percent of map unit: 2 percent
Landform: Alluvial fans
Hydric soil rating: Yes

Panther

Percent of map unit: 2 percent
Landform: Swales on hillslopes
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear, concave
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G005XY009OR)
Hydric soil rating: Yes

215C—Rosehaven loam, 3 to 12 percent slopes

Map Unit Setting

National map unit symbol: 278z
Elevation: 250 to 2,600 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Rosehaven and similar soils: 75 percent
Minor components: 6 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rosehaven

Setting

Landform: Hills
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Mountainbase
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium and residuum derived from sandstone and siltstone

Typical profile

H1 - 0 to 12 inches: loam
H2 - 12 to 63 inches: clay loam

Properties and qualities

Slope: 3 to 12 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 11.1 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Other vegetative classification: Well drained < 15% Slopes (G002XY002OR)
Hydric soil rating: No

Minor Components

Pengra

Percent of map unit: 3 percent
Landform: Alluvial fans
Hydric soil rating: Yes

Aqualfs

Percent of map unit: 3 percent
Landform: Hills
Hydric soil rating: Yes

215E—Rosehaven loam, 12 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2791
Elevation: 250 to 2,600 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Rosehaven and similar soils: 75 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rosehaven

Setting

Landform: Hills
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Side slope, interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium and residuum derived from sandstone and siltstone

Typical profile

H1 - 0 to 12 inches: loam
H2 - 12 to 63 inches: clay loam

Properties and qualities

Slope: 12 to 30 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Available water storage in profile: High (about 11.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Other vegetative classification: Well Drained > 15% Slopes (G002XY001OR)
Hydric soil rating: No

Minor Components

Pengra

Percent of map unit: 2 percent
Landform: Alluvial fans
Hydric soil rating: Yes

215F—Rosehaven loam, 30 to 60 percent slopes

Map Unit Setting

National map unit symbol: 2792
Elevation: 250 to 2,600 feet
Mean annual precipitation: 40 to 55 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Not prime farmland

Map Unit Composition

Rosehaven and similar soils: 75 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rosehaven

Setting

Landform: Mountains
Landform position (two-dimensional): Summit, backslope
Landform position (three-dimensional): Mountaintop, mountainflank
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium and residuum derived from sandstone and siltstone

Typical profile

H1 - 0 to 12 inches: loam
H2 - 12 to 63 inches: clay loam

Properties and qualities

Slope: 30 to 60 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches

Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 11.1 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Hydric soil rating: No

216E—Rosehaven-Atring complex, 12 to 30 percent slopes

Map Unit Setting
National map unit symbol: 2793
Elevation: 250 to 2,600 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Rosehaven and similar soils: 45 percent
Atring and similar soils: 30 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rosehaven

Setting
Landform: Mountains
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Mountaintop, mountainflank
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium and residuum derived from sandstone and siltstone

Typical profile
H1 - 0 to 12 inches: loam
H2 - 12 to 63 inches: clay loam

Properties and qualities
Slope: 12 to 30 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 11.1 inches)

Interpretive groups
Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Other vegetative classification: Well Drained > 15% Slopes (G002XY001OR)
Hydric soil rating: No

Description of Atring

Setting

Landform: Mountains
Landform position (two-dimensional): Footslope, shoulder
Landform position (three-dimensional): Lower third of mountainflank, mountaintop
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium derived from sandstone

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
H1 - 2 to 11 inches: gravelly loam
H2 - 11 to 37 inches: very gravelly loam
H3 - 37 to 47 inches: weathered bedrock

Properties and qualities

Slope: 12 to 30 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Pengra

Percent of map unit: 2 percent
Landform: Alluvial fans
Hydric soil rating: Yes

224B—Sibold fine sandy loam, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 279w
Elevation: 100 to 2,000 feet

Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Sibold and similar soils: 75 percent
Minor components: 4 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sibold

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from mixed sources

Typical profile

H1 - 0 to 6 inches: fine sandy loam
H2 - 6 to 49 inches: loam
H3 - 49 to 63 inches: silty clay

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: Rare
Frequency of ponding: None
Available water storage in profile: High (about 10.4 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Other vegetative classification: Somewhat Poorly Drained < 15% Slopes (G005XY008OR)
Hydric soil rating: No

Minor Components

Aquolls

Percent of map unit: 2 percent
Landform: Mountains
Hydric soil rating: Yes

Conser

Percent of map unit: 2 percent
Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G005XY009OR)

Hydric soil rating: Yes

225D—Speaker loam, 2 to 20 percent slopes

Map Unit Setting

National map unit symbol: 279y
Elevation: 350 to 2,500 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Speaker and similar soils: 75 percent
Minor components: 4 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Speaker

Setting

Landform: Hills
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Side slope, interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium and residuum derived from sandstone, siltstone, and metamorphic rock

Typical profile

H1 - 0 to 10 inches: loam
H2 - 10 to 31 inches: loam
H3 - 31 to 41 inches: weathered bedrock

Properties and qualities

Slope: 2 to 20 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Other vegetative classification: Well Drained < 15% Slopes (G005XY004OR)
Hydric soil rating: No

Minor Components

Pengra

Percent of map unit: 2 percent
Landform: Alluvial fans
Hydric soil rating: Yes

Aqualfs

Percent of map unit: 2 percent
Landform: Mountains
Hydric soil rating: Yes

225E—Speaker loam, 20 to 30 percent slopes

Map Unit Setting

National map unit symbol: 27b0
Elevation: 350 to 2,500 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Speaker and similar soils: 75 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Speaker

Setting

Landform: Hills
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Interfluve, side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium and residuum derived from sandstone, siltstone, and metamorphic rock

Typical profile

H1 - 0 to 10 inches: loam
H2 - 10 to 31 inches: loam
H3 - 31 to 41 inches: weathered bedrock

Properties and qualities

Slope: 20 to 30 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches

Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Other vegetative classification: Well Drained > 15% Slopes (G005XY003OR)
Hydric soil rating: No

Minor Components

Pengra

Percent of map unit: 2 percent
Landform: Alluvial fans
Hydric soil rating: Yes

Aqualfs

Percent of map unit: 1 percent
Landform: Mountains
Hydric soil rating: Yes

226F—Speaker loam, 30 to 60 percent north slopes

Map Unit Setting

National map unit symbol: 27b2
Elevation: 350 to 2,500 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Not prime farmland

Map Unit Composition

Speaker, north, and similar soils: 75 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Speaker, North

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Parent material: Colluvium and residuum derived from sandstone, siltstone, and metamorphic rock

Typical profile

H1 - 0 to 10 inches: loam

H2 - 10 to 31 inches: loam
H3 - 31 to 41 inches: weathered bedrock

Properties and qualities

Slope: 30 to 60 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Pengra

Percent of map unit: 2 percent
Landform: Alluvial fans
Hydric soil rating: Yes

230E—Speaker-Nonpareil complex, 3 to 30 percent slopes

Map Unit Setting

National map unit symbol: 27bb
Elevation: 350 to 2,500 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Speaker and similar soils: 50 percent
Nonpareil and similar soils: 35 percent
Minor components: 1 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Speaker

Setting

Landform: Hills
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Side slope, interfluve
Down-slope shape: Linear
Across-slope shape: Linear

Parent material: Colluvium and residuum derived from sandstone, siltstone, and metamorphic rock

Typical profile

H1 - 0 to 10 inches: loam
H2 - 10 to 31 inches: loam
H3 - 31 to 41 inches: weathered bedrock

Properties and qualities

Slope: 3 to 30 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Other vegetative classification: Well Drained > 15% Slopes (G005XY003OR)
Hydric soil rating: No

Description of Nonpareil

Setting

Landform: Hills
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Side slope, interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium and residuum derived from sandstone and siltstone

Typical profile

H1 - 0 to 4 inches: loam
H2 - 4 to 17 inches: loam
H3 - 17 to 27 inches: weathered bedrock

Properties and qualities

Slope: 3 to 30 percent
Depth to restrictive feature: 10 to 20 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Other vegetative classification: Well Drained > 15% Slopes (G005XY003OR)
Hydric soil rating: No

Minor Components

Pengra

Percent of map unit: 1 percent
Landform: Alluvial fans
Hydric soil rating: Yes

230F—Speaker-Nonpareil complex, 30 to 60 percent slopes

Map Unit Setting

National map unit symbol: 27bd
Elevation: 350 to 2,500 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Not prime farmland

Map Unit Composition

Speaker and similar soils: 45 percent
Nonpareil and similar soils: 40 percent
Minor components: 1 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Speaker

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Parent material: Colluvium and residuum derived from sandstone, siltstone, and metamorphic rock

Typical profile

H1 - 0 to 10 inches: loam
H2 - 10 to 31 inches: loam
H3 - 31 to 41 inches: weathered bedrock

Properties and qualities

Slope: 30 to 60 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Hydric soil rating: No

Description of Nonpareil

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Colluvium and residuum derived from sandstone and siltstone

Typical profile

H1 - 0 to 4 inches: loam
H2 - 4 to 17 inches: loam
H3 - 17 to 27 inches: weathered bedrock

Properties and qualities

Slope: 30 to 60 percent
Depth to restrictive feature: 10 to 20 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Pengra

Percent of map unit: 1 percent
Landform: Alluvial fans
Hydric soil rating: Yes

234C—Stockel fine sandy loam, 3 to 12 percent slopes

Map Unit Setting

National map unit symbol: 27bn
Elevation: 300 to 2,500 feet

Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Stockel and similar soils: 85 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Stockel

Setting

Landform: Alluvial fans, hills
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium and colluvium derived from sandstone and siltstone

Typical profile

H1 - 0 to 9 inches: fine sandy loam
H2 - 9 to 43 inches: loam
H3 - 43 to 63 inches: clay

Properties and qualities

Slope: 3 to 12 percent
Depth to restrictive feature: 39 to 60 inches to abrupt textural change
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.0 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: B/D
Other vegetative classification: Somewhat Poorly Drained < 15% Slopes (G005XY008OR)
Hydric soil rating: No

Minor Components

Pengra

Percent of map unit: 1 percent
Landform: Alluvial fans
Hydric soil rating: Yes

Aqualfs

Percent of map unit: 1 percent
Landform: Hills
Hydric soil rating: Yes

Panther

Percent of map unit: 1 percent
Landform: Swales on hillslopes
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear, concave
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G005XY009OR)
Hydric soil rating: Yes

235C—Sutherlin silt loam, 3 to 12 percent slopes

Map Unit Setting

National map unit symbol: 27bp
Elevation: 300 to 2,500 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Sutherlin and similar soils: 75 percent
Minor components: 4 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sutherlin

Setting

Landform: Alluvial fans, hills
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, riser
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Parent material: Alluvium and colluvium derived from sandstone and siltstone

Typical profile

H1 - 0 to 16 inches: silt loam
H2 - 16 to 30 inches: silty clay loam
H3 - 30 to 60 inches: silty clay

Properties and qualities

Slope: 3 to 12 percent
Depth to restrictive feature: 24 to 36 inches to abrupt textural change
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Other vegetative classification: Moderately Well Drained < 15% Slopes (G005XY006OR)
Hydric soil rating: No

Minor Components

Pengra

Percent of map unit: 2 percent
Landform: Alluvial fans
Hydric soil rating: Yes

Panther

Percent of map unit: 2 percent
Landform: Swales on hillslopes
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear, concave
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G005XY009OR)
Hydric soil rating: Yes

235D—Sutherlin silt loam, 12 to 20 percent slopes

Map Unit Setting

National map unit symbol: 27bq
Elevation: 300 to 2,500 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Sutherlin and similar soils: 75 percent
Minor components: 4 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sutherlin

Setting

Landform: Alluvial fans, hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Side slope, riser
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Parent material: Alluvium and colluvium derived from sandstone and siltstone

Typical profile

H1 - 0 to 16 inches: silt loam
H2 - 16 to 30 inches: silty clay loam
H3 - 30 to 60 inches: silty clay

Properties and qualities

Slope: 12 to 20 percent
Depth to restrictive feature: 24 to 36 inches to abrupt textural change
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Other vegetative classification: Moderately Well Drained < 15% Slopes (G005XY006OR)
Hydric soil rating: No

Minor Components

Pengra

Percent of map unit: 2 percent
Landform: Alluvial fans
Hydric soil rating: Yes

Panther

Percent of map unit: 2 percent
Landform: Swales on hillslopes
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear, concave
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G005XY009OR)
Hydric soil rating: Yes

236C—Sutherlin-Oakland complex, 3 to 12 percent slopes

Map Unit Setting

National map unit symbol: 27bx
Elevation: 300 to 2,500 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Sutherlin and similar soils: 45 percent
Oakland and similar soils: 30 percent
Minor components: 4 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sutherlin

Setting

Landform: Hills
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Alluvium and colluvium derived from sandstone and siltstone

Typical profile

H1 - 0 to 16 inches: silt loam
H2 - 16 to 30 inches: silty clay loam
H3 - 30 to 60 inches: silty clay

Properties and qualities

Slope: 3 to 12 percent
Depth to restrictive feature: 24 to 36 inches to abrupt textural change
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Other vegetative classification: Moderately Well Drained < 15% Slopes (G005XY006OR)
Hydric soil rating: No

Description of Oakland

Setting

Landform: Hills
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium and residuum derived from sandstone and siltstone

Typical profile

H1 - 0 to 5 inches: silt loam
H2 - 5 to 24 inches: silty clay loam
H3 - 24 to 28 inches: gravelly silty clay
H4 - 28 to 38 inches: weathered bedrock

Properties and qualities

Slope: 3 to 12 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.2 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Other vegetative classification: Well Drained < 15% Slopes (G005XY004OR)
Hydric soil rating: No

Minor Components

Pengra

Percent of map unit: 2 percent
Landform: Alluvial fans
Hydric soil rating: Yes

Panther

Percent of map unit: 2 percent
Landform: Swales on hillslopes
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear, concave
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G005XY009OR)
Hydric soil rating: Yes

255C—Veneta loam, 0 to 12 percent slopes

Map Unit Setting

National map unit symbol: 27dj
Elevation: 100 to 2,500 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Veneta and similar soils: 75 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Veneta

Setting

Landform: Hills
Landform position (three-dimensional): Riser, tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium and colluvium derived from sandstone and siltstone

Typical profile

H1 - 0 to 18 inches: loam
H2 - 18 to 38 inches: clay loam
H3 - 38 to 63 inches: clay

Properties and qualities

Slope: 0 to 12 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 48 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Other vegetative classification: Moderately Well Drained < 15% Slopes (G005XY006OR)
Hydric soil rating: No

Minor Components

Pengra

Percent of map unit: 2 percent
Landform: Alluvial fans
Hydric soil rating: Yes

Panther

Percent of map unit: 2 percent
Landform: Swales on hillslopes
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear, concave
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G005XY009OR)
Hydric soil rating: Yes

Aqualfs

Percent of map unit: 1 percent
Landform: Hills
Hydric soil rating: Yes

255D—Veneta loam, 12 to 20 percent slopes

Map Unit Setting

National map unit symbol: 27dk
Elevation: 100 to 12,030 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Veneta and similar soils: 75 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Veneta

Setting

Landform: Hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Side slope, riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium and colluvium derived from sandstone and siltstone

Typical profile

H1 - 0 to 18 inches: loam
H2 - 18 to 38 inches: clay loam
H3 - 38 to 63 inches: clay

Properties and qualities

Slope: 12 to 20 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 48 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Other vegetative classification: Moderately Well Drained > 15% Slopes (G005XY005OR)
Hydric soil rating: No

Minor Components

Pengra

Percent of map unit: 2 percent
Landform: Alluvial fans
Hydric soil rating: Yes

Panther

Percent of map unit: 2 percent
Landform: Swales on hillslopes
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear, concave
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G005XY009OR)
Hydric soil rating: Yes

Aqualfs

Percent of map unit: 1 percent
Landform: Hills
Hydric soil rating: Yes

257A—Waldo silty clay loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 27dq
Elevation: 100 to 1,500 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Waldo and similar soils: 75 percent
Minor components: 7 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Waldo

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Clayey alluvium from mixed sources

Typical profile

H1 - 0 to 11 inches: silty clay loam
H2 - 11 to 60 inches: clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water storage in profile: High (about 10.0 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Other vegetative classification: Poorly Drained (G005XY009OR)
Hydric soil rating: Yes

Minor Components

Conser

Percent of map unit: 7 percent
Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G005XY009OR)
Hydric soil rating: Yes

W—Water

Map Unit Composition

Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

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APPENDIX B: Water Rights Certificates and Permits

STATE OF OREGON

COUNTY OF DOUGLAS

CERTIFICATE OF WATER RIGHT

This Is to Certify, *That* SUTHERLIN WATER CONTROL DISTRICT

of P. O. Box 459, Sutherlin *, State of* Oregon, 97479 *, has made*

proof to the satisfaction of the Water Resources Director, of a right to store the waters of Cooper Creek, tributary Sutherlin Creek appropriated under Permit No. 32425 in Cooper Creek Reservoir

for the purposes of recreation and Permit 32426 for municipal

under Reservoir Permit No. R-4965 *, and that said right to store said waters has been perfected in accordance with the laws of Oregon; that the priority of the right hereby confirmed dates from* January 27, 1960 for 3440 a.f. and March 31, 1964 for 460.0 a.f.

that the amount of water entitled to be stored each year under such right, for the purposes aforesaid, shall not exceed 3900.0 acre feet, being 3400 a.f. for recreation and 500 a.f. for municipal

The reservoir is located in

S½ NW¼
N½ SW¼
SE¼
Section 22
W½ SW¼
SE¼ SW¼
Section 23
SW¼ NE¼
N½ NW¼
SE¼ NW¼
Section 26
T. 25 S., R. 5 W., W. M.

WITNESS the signature of the Water Resources Director, affixed this date. October 5, 1979

James E. Sexson

Water Resources Director

Recorded in State Record of Water Right Certificates, Volume 42 *, page* 48586

2M—4-66

* Reservoir Permit No. R 4965

Application for a Permit to Construct a Reservoir and to Store for Beneficial Use the Unappropriated Waters of the State of Oregon

I, Sutherlin Water Control District
(Name of Applicant)

of P. O. Box 459, Sutherlin,
(Mailing Address)

State of Oregon, do hereby make application for a permit to construct the following described reservoir and to store the unappropriated waters of the State of Oregon, subject to existing rights.

If the applicant is a corporation, give date and place of incorporation created by order of the Douglas County Court @ Roseburg, Oregon on June 16, 1959

1. The name of the proposed reservoir is Cooper Creek Reservoir

2. The name of the stream from which the reservoir is to be filled and the appropriation made is Cooper Creek

tributary of Sutherlin Creek

3. The amount of water to be stored is 3900 acre feet. including 500 acre feet for minicipal use by City of Sutherlin

4. The use to be made of the impounded water is Recreation and Municipal
(Irrigation, power, domestic supply, etc.)

5. The location of the proposed reservoir will be in Sec. 22, 23, and 26
(Give sections or townships to be submerged)

Tp. 25 S, R. 5 W, W.M., in the county of Douglas

(a) State whether situated in channel of running stream and give character of material at outlet

In channel - Valley Alluvium (sand, silt, gravel and clay)

(b) If not in channel of running stream, state how it is to be filled. If through a feed canal, give name and dimensions

6. The dam will be located in NW¼ SW¼, Sec. 22,
(Smallest legal subdivision)

Tp. 25 S, R. 5 W, W.M. The maximum height will be 88.5 feet above stream bed or ground surface on center line of dam. The length on top will be 440 feet; length on bottom 1 feet; width on top 26 feet; slope on front or water side 3½ (Feet horizontal to 1 vertical); slope on back 2½ (Feet horizontal to 1 vertical); height of dam above water line when full 10 feet. (at design capacity for the emergency spillway)

* A different form of application should be used for the appropriation of stored water to beneficial use. Such forms can be secured without charge, together with instructions, by addressing the State Engineer, Salem, Oregon 97310.

R 4965

7. The construction of dam, the material of which it is to be built, and method of protection from waves are as follows: Earth fill protected by rock riprap

8. The location of wasteway with dimensions are as follows: The outlet will be a 24" (State whether over or around the dam) R/C conduit. The principal spillway will be twin 30" R/C conduits on the right abutment. The emergency spillway will be a 30' R/C chute spillway on the right abutment.

9. The location of outlet from the proposed reservoir, with character of construction and dimensions, are as follows: The outlet conduit under the dam will be 24" R/C pipe with two risers - one W/a 24" slide gate for draining the reservoir - one w/a 12" slide gate for release of minicipal water.
(All dams across natural stream channels must be provided with an outlet conduit, of such capacity and location to pass the normal flow of the stream at any time)

10. The area submerged by the proposed reservoir, when full, will be 140 acres, with a maximum depth of water of 85.5 feet; and approximate mean depth of water 27.9 feet.

11. The estimated cost of the proposed work is $590,000

12. Construction work will begin on or before September 1967

13. Construction work will be completed on or before November 1968

(Signature of applicant)

Sect.

STATE OF OREGON, }
County of Marion, } ss.

This is to certify that I have examined the foregoing application, together with the accompanying maps and data, and return the same for

In order to retain its priority, this application must be returned to the State Engineer, with corrections on or before ...., 19....

WITNESS my hand this .... day of ...., 19....

STATE ENGINEER

By ....
ASSISTANT

R 4965

Remarks:

STATE OF OREGON, }
County of Marion, } *ss.*

This is to certify that I have examined the foregoing application and do hereby grant the same, subject to the following limitations and conditions: The right herein granted is limited to the construction of Cooper Creek Reservoir and storage of water from Cooper Creek to be appropriated under application No. 44015, permit No. 32425 for recreation and application No. 44016 (permit No. 32426) for municipal being 3400 acre feet for recreation and 500 acre feet for municipal and the dam shall be constructed under the supervision of a registered professional engineer

The right hereunder shall be limited to the storage of 3900.0 *acre feet.*

The priority date of this permit is January 27, 1960 for 3440 af March 31, 1964 for 460.0 af

Actual construction work shall begin on or before October 19, 1968 *and shall thereafter be prosecuted with reasonable diligence and be completed on or before October 1, 19*69

Extended to Oct. 1, 1970

WITNESS my hand this 19th *day of* October, *19*67 Extended to Oct. 1 197[illegible]

STATE ENGINEER

pc

Amended Copy of

Application No. R 33574

Reservoir Permit No. R 4965

PERMIT

To construct a reservoir and store for beneficial use the unappropriated waters of the State of Oregon.

This instrument was first received in the office of the State Engineer at Salem, Oregon, on the 17th *day of* July, 1967, *at* 10:35 *o'clock* A. *M.*

Returned to applicant:

Approved:

October 19, 1967

Recorded in Book No. .... *of Reservoirs, on Page* R 4965

CHRIS L. WHEELER
State Engineer

Drainage Basin No. 16 *page* 28C

Fees 38.50

SP*12987-119

BEFORE THE STATE ENGINEER OF OREGON

DOUGLAS COUNTY

IN THE MATTER OF THE APPLICATION OF THE CITY OF SUTHERLIN, OREGON, FOR APPROVAL OF A CHANGE IN POINT OF DIVERSION OF WATER FROM CALAPOOYA CREEK.)	O R D E R APPROVING APPLICATION

On June 4, 1942, the city of Sutherlin, Oregon, filed an application for approval of a change in point of diversion of water from Calapooya Creek.

Certificate of water right recorded at Page 6344, Volume 6, State Record of Water Right Certificates, was issued to the City of Sutherlin, confirming a right to the use of 0.75 cubic foot per second of water from Calapooya Creek for municipal water supply within the corporate limits of the City of Sutherlin, with a date of priority of December 3, 1924, through the city's pipe-line, the point of diversion of said pipeline being located south 24° 02' east 1,606 feet from the northeast corner of the Clinton Sutherlin D.L.C. #49, in Township 25 South, Range 4 West, W. M.

The applicant herein proposes to change the present point of diversion to a point to be located approximately north 86° 24' east 2,113.2 feet from the northeast corner of the Clinton Sutherlin D.L.C. #49, in Township 25 South, Range 4 West, W. M.

Notice by publication was given in the Sutherlin Sun, a newspaper of general circulation in Douglas County, for a period of at least three weeks and not less than one publication each week, being the issues of June 19, 26, July 3 and 10, 1942.

No objections having been filed, it appears that the proposed change in point of diversion of water may be made without injury to existing rights and the application should be approved.

NOW, THEREFORE, it hereby is ORDERED that the present point of diversion located south 24° 02' east 1,606 feet from the northeast corner of the Clinton Sutherlin D.L.C. #49 in Township 25 South, Range 4 West, W. M., be and the same hereby is changed to a point upstream to be located north 86° 24' east 2,113.2 feet from the northeast corner of the Clinton Sutherlin D.L.C. #49 in Township 25 South, Range 4 West, W. M.

It is further ordered that construction work shall be completed on or before October 1, 1947, or such extension of time as may be granted by the State Engineer for good cause shown.

Dated at Salem, Oregon, this 29th day of October, 1942.

Chas E Stricklin
CHAS. E. STRICKLIN
State Engineer

Notation made on
Certificate # 6344

PERMIT—30193—500—12-25.

STATE OF OREGON

COUNTY OF DOUGLAS

CERTIFICATE OF WATER RIGHT

This is to Certify, *That* City of Sutherlin *of* Sutherlin, *State of* Oregon, *has made proof to the satisfaction of the STATE ENGINEER of Oregon, of a right to the use of the waters of* Calapooia Creek *a tributary of* Umpqua River *for the purpose of* Municipal *under Permit No.* 6610 *of the State Engineer, and that said right to the use of said waters has been perfected in accordance with the laws of Oregon; that the priority of the right hereby confirmed dates from* December 3, 1924;

that the amount of water to which such right is entitled and hereby confirmed, for the purposes aforesaid, is limited to an amount actually beneficially used for said purposes, and shall not exceed 0.75 cubic foot per second;

The use hereunder for irrigation shall conform to such reasonable rotation system as may be ordered by the proper state officer.

The amount of water used for irrigation, together with the amount secured under any other right existing for the same lands, shall be limited to one-eightieth of one cubic foot per second per acre, or its equivalent in case of rotation.

A description of the lands irrigated under the right hereby confirmed, and to which such right is appurtenant (or, if for other purposes, the place where the water is put to beneficial use), is as follows: Northeast Quarter of the Southeast Quarter ($NE\frac{1}{4}SE\frac{1}{4}$), Northwest Quarter of the Southeast Quarter ($NW\frac{1}{4}SE\frac{1}{4}$), Southwest Quarter of the Southeast Quarter ($SW\frac{1}{4}SE\frac{1}{4}$), and Southeast Quarter of the Southeast Quarter ($SE\frac{1}{4}SE\frac{1}{4}$) of Section Seventeen (17), Township Twenty-five South, Range Five West of the Willamette Meridian, in Douglas County, Oregon.

Change in pt. of div. approved:
See Sp. Or. Vol. 2 p. 275.

The right to the use of the water for irrigation purposes is restricted to the lands or place of use herein described.

Rights to the use of water for power purposes are limited to a period of forty years from the date of priority of the right, as herein set forth, subject to a preference right of renewal under the laws existing at the date of the expiration of the right for power purposes, as hereby confirmed and limited.

WITNESS the signature of the State Engineer,

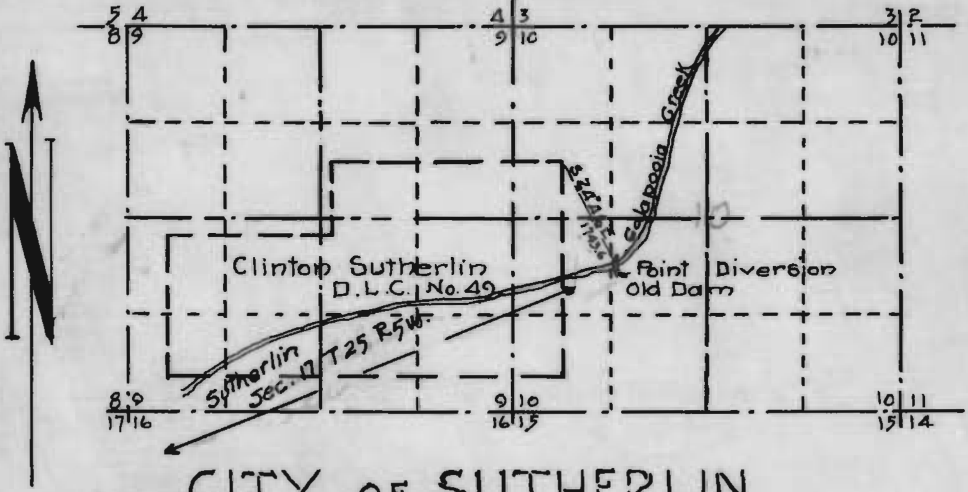
affixed this 1st *day*

of July, 1926.

RHEA LUPER,

State Engineer.

Recorded in State Record of Water Right Certificates, Volume 6, *page* 6344.



CITY OF SUTHERLIN

WATER SUPPLY

Sec. 10 T. 25 S. R. 4 W.

Douglas Co. Oregon.

Scale 2 in. = 1 mile

CERTIFICATE OF SURVEYOR.

I, H. L. Eppstein, of Roseburg, Ore., do hereby certify that this map was made from notes taken during an actual survey made by me and that it correctly represents the works described in the accompanying application, together with the location of streams in the immediate vicinity.

H. L. Eppstein

Registered Professional Engineer

License No. 1011

Nov. 8. 1920

STATE ENGINEER
RECEIVED
DEC 3 1924
SALEM OREGON

Application No. 9945

Permit No. 6610

*Permit No. 6 6 1 0

CERTIFICATE NO. 6344

APPLICATION FOR A PERMIT

To Appropriate the Public Waters of the State of Oregon

I, City of Sutherlin
(Name of Applicant)

of Sutherlin, *County of* Douglas,
(Postoffice)

State of Oregon, *do hereby make application for a permit to appropriate the following described public waters of the State of Oregon subject to existing rights:*

If the applicant is a corporation, give date and place of incorporation
City incorporated Aug. 22, 1911

1. *The source of the proposed appropriation is* Calapooia Creek
(Name of stream)

tributary of Umpqua River,

2. *The amount of water which the applicant intends to apply to beneficial use is* .75 *cubic feet per second.*

3. *The use to which the water is to be applied is* (Irrigation, power, mining, manufacturing, domestic supplies, etc.)
City Water Supply

4. *The point of diversion is located* S 24° 46' E 1743. 6 feet from the NE cor. of Clinton Sutherlin D.L.C. NO. 49 T 25 S R 4 W.W.M.
(Give distance and bearing to section corner)

Change in point of Diversion Approved.
See Sp. Or. Vol. 4, P. 275.

being within the NE¼ SW¼ *of Sec.* 10, *Tp.* 25 S
(Give smallest legal subdivision) (No. N. or S.)

R. 4 W, *W. M., in the county of* Douglas
(No. E. or W.)

5. *The* ditch & pipeline *to be* 8 *miles* approx.
(Main ditch, canal or pipe line)

in length, terminating in the NE¼ SE¼, NW¼ SE¼ SW¼ of SE¼ SE¼ SE¼ *of Sec.* 17, *Tp.* 25 S
(Smallest legal subdivision) (No. N. or S.)

R. 5 W, *W. M., the proposed location being shown throughout on the accompanying map.*
(No. E. or W.)

6. *The name of the ditch, canal or other works is*
City of Sutherlin Water supply.

DESCRIPTION OF WORKS

DIVERSION WORKS—

7. (a) *Height of dam* 10 *feet, length on top* 150 *feet, length at bottom* 140 *feet; material to be used and character of construction* (Loose rock, concrete, masonry, rock and brush, timber crib, etc., wasteway over or around dam)
Concrete. Dam in place.

(b) *Description of headgate* Concrete.
(Timber, concrete, etc., number and size of openings)

* A different form of application is provided where storage works are contemplated. These forms can be secured without charge, together with instructions, by addressing the State Engineer, Salem, Oregon.

CANAL SYSTEM—

8. (a) *Give dimensions at each point of canal where materially changed in size, stating miles from headgate. At headgate: Width on top (at water line)* .... *feet; width on bottom* .... *feet; depth of water* .... *feet; grade* .... *feet fall per one thousand feet.*

(b) *At* .... *miles from headgate. Width on top (at water line)* .... *feet; width on bottom* .... *feet; depth of water* .... *feet; grade* .... *feet fall per one thousand feet.*

Size of pipe to be installed for city of Sutherlin 6 inch.

Tatal fall from dam to city limits of Sutherlin is 28 feet,

or approximately 20 inches fall to 1000 ft.

FILL IN THE FOLLOWING INFORMATION WHERE THE WATER IS USED FOR:

IRRIGATION—

9. *The land to be irrigated has a total area of* .... *acres, located in each smallest legal subdivision, as follows:* ....
(Give area of land in each smallest legal subdivision which you intend to irrigate)

(If more space required, attach separate sheet)

POWER, MINING, MANUFACTURING, OR TRANSPORTATION PURPOSES—

10. (a) *Total amount of power to be developed* .... *theoretical horsepower.*

(b) *Total fall to be utilized* .... *feet.*
(Head)

(c) *The nature of the works by means of which the power is to be developed* ....

(d) *Such works to be located in* .... *of Sec.*............................, *Tp.*............................, *R.*............................, *W. M.*
(Legal subdivision) (No. N. or S.) (No. E. or W.)

(e) *Is water to be returned to any stream?* ....
(Yes or No)

(f) *If so, name stream and locate point of return* .... , *Sec.*............................, *Tp.*............................, *R.*............................, *W. M.*
(No. N. or S.) (No. E. or W.)

(g) *The use to which power is to be applied is* ....

(h) *The nature of the mines to be served* ....

MUNICIPAL SUPPLY—

11. *To supply the city of* S U T H E R L I N

Douglas *County, having a present population of* 800,
(Name of)

and an estimated population of 1500 *in 19*29.

(Answer questions 12, 13, 14 and 15 in all cases)

12. *Estimated cost of proposed works, $* 22000.°°

13. *Construction work will begin on or before* June 1, 1926,

14. *Construction work will be completed on or before* June 1, 1927

15. *The water will be completely applied to the proposed use on or before* June 1, 1927

Duplicate maps of the proposed ditch or other works, prepared in accordance with the rules of the State Water Board, accompany this application.

Claud D. Allen, Mayor,
(Name of applicant)
Will J. Haynes, Recorder,
City of Sutherlin, Oregon.

Signed in the presence of us as witnesses:

(1) H. L. Eppstein, (Name) — Roseburg, Ore. (Address of Witness)

(2) W. Metcham, (Name) — Sutherlin, Ore. (Address of Witness)

Remarks:

STATE OF OREGON,
County of Marion, } *ss.*

This is to certify that I have examined the foregoing application, together with the accompanying maps and data, and return the same for correction or completion, as follows:

In order to retain its priority, this application must be returned to the State Engineer, with corrections, on or before ....

WITNESS my hand this .... *day of* ....

....
State Engineer.

6610(c)

16

Application No. 9 9 4 5

Permit No. 6 6 1 0

PERMIT

TO APPROPRIATE THE PUBLIC WATERS OF THE STATE OF OREGON

District No. ....

This instrument was first received in the office of the State Engineer at

Salem, Oregon, on the 3 *day of* December, *192*4,

at 8:30 *o'clock* A *M.*

Returned to applicant for correction

....

Corrected application received

....

Approved:

January 21, 1925.

Recorded in Book No. 23 *of Permits, on Page* 6610

RHEA LUPER

State Engineer.

1 map ER

$8.00

STATE OF OREGON,
County of Marion, } *ss.*

This is to certify that I have examined the foregoing application and do hereby grant the same, subject to the following limitations and conditions: If for irrigation, this appropriation shall be limited to one-eightieth of one cubic foot per second, or its equivalent, for each acre irrigated, and shall be subject to such reasonable rotation system as may be ordered by the proper state officer.

The right herein granted is limited to the appropriation of water from Calapooia Creek for municipal purposes.

The amount of water appropriated shall be limited to the amount which can be applied to beneficial use and not to exceed 0.75 *cubic feet per second, or its equivalent in case of rotation. The priority date of this permit is* December 3 1924.

Actual construction work shall begin on or before January 21, 1930 *and shall thereafter be prosecuted with reasonable diligence and be completed on or before* January 21, 1930

Complete application of the water to the proposed use shall be made on or before January 21, 1931

WITNESS my hand this 21st *day of* January, 1925.

Rhea Luper,

State Engineer.

Permits for power development are subject to the limitation of franchise as provided in Section 5728, Oregon Laws, and the payment of annual fees as provided in Section 5803, Oregon Laws.

This form approved by the State Water Board, March 11, 1909.

STATE OF OREGON

COUNTY OF DOUGLAS

CERTIFICATE OF WATER RIGHT

This Is to Certify, *That* CITY OF SUTHERLIN

of Sutherlin *, State of* Oregon *, has made proof to the satisfaction of the STATE ENGINEER of Oregon, of a right to the use of the waters of* Calapooia River *a tributary of* Umpqua River *for the purpose of* municipal use *under Permit No.* 15016 *of the State Engineer, and that said right to the use of said waters has been perfected in accordance with the laws of Oregon; that the priority of the right hereby confirmed dates from* September 5, 1941 ;

that the amount of water to which such right is entitled and hereby confirmed, for the purposes aforesaid, is limited to an amount actually beneficially used for said purposes, and shall not exceed 2.25 cubic feet per second,

or its equivalent in case of rotation, measured at the point of diversion from the stream.

The point of diversion is located in the NE¼ SW¼, Section 10, Township 25 South, Range 4 West, W. M.

The amount of water used for irrigation, together with the amount secured under any other right existing for the same lands, shall be limited to - - - - *of one cubic foot per second per acre,*

and shall conform to such reasonable rotation system as may be ordered by the proper state officer.

A description of the place of use under the right hereby confirmed, and to which such right is appurtenant, is as follows:

All of Section 16;
S½ & S½ NE¼
Section 17;
SE¼ Section 18;
E½ Section 19;
All of Section 20;
W½ Section 21;
N½ N½ Section 29;

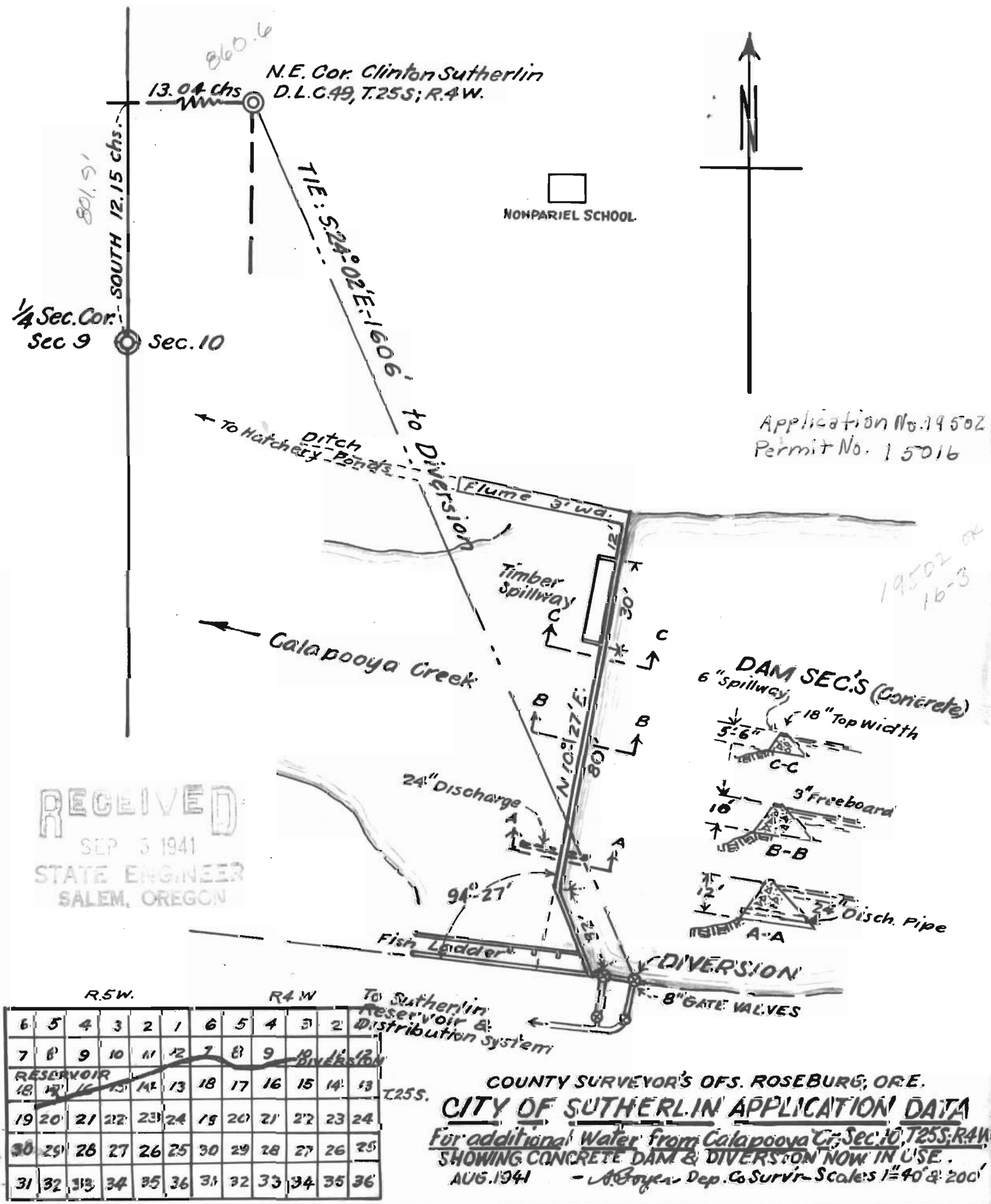
All in Township 25 South, Range 5 West, W. M.

The right to the use of the water for the purposes aforesaid is restricted to the lands or place of use herein described.

WITNESS the signature of the State Engineer, affixed this 31st *day of* May *,* 1951 .

CHAS. E. STRICKLIN
State Engineer

Recorded in State Record of Water Right Certificates, Volume 14 *, page* 19629



860.6
N.E. Cor. Clinton Sutherlin
D.L.C.49, T.25S; R.4W.
13.04 chs
801.9
SOUTH 12.15 chs.
1/4 Sec. Cor.
Sec 9
Sec. 10
TIE: S.24°02'E.-1606' to Diversion
NONPARIEL SCHOOL
N
Application No. 19502
Permit No. 15016
19502 OK
16-3
To Hatchery Ponds
Ditch
Flume 3' wd.
12'
Timber Spillway
30'
C
C
Calapooya Creek
B
B
N10°27'E.
80'
DAM SEC'S (Concrete)
6" Spillway
18" Top Width
5'-6"
C-C
3" Freeboard
10'
B-B
12'
24" Disch. Pipe
A-A
24" Discharge
A
A
94°-27'
32'
Fish Ladder
DIVERSION
8" GATE VALVES
To Sutherlin Reservoir & Distribution System
R.5W.
R4W
6 5 4 3 2 1 6 5 4 3 2
7 8 9 10 11 12 7 8 9 10 11 12
RESERVOIR
DIVERSION
18 17 16 15 14 13 18 17 16 15 14 13
T.25S.
19 20 21 22 23 24 19 20 21 22 23 24
30 29 28 27 26 25 30 29 28 27 26 25
31 32 33 34 35 36 31 32 33 34 35 36
RECEIVED
SEP 5 1941
STATE ENGINEER
SALEM, OREGON
COUNTY SURVEYOR'S OFS. ROSEBURG, ORE.
CITY OF SUTHERLIN APPLICATION DATA
For additional Water from Calapooya Cr; Sec.10, T25S; R4W.
SHOWING CONCRETE DAM & DIVERSION NOW IN USE.
AUG. 1941
- A. Goyer - Dep. Co. Survr. - Scales 1"=40' & 200'

* APPLICATION FOR A PERMIT

To Appropriate the Public Waters of the State of Oregon

I, CITY OF SUTHERLIN (Name of applicant)

of Sutherlin (Post office), *County of* Douglas,

State of Oregon, *do hereby make application for a permit to appropriate the following described public waters of the State of Oregon, SUBJECT TO EXISTING RIGHTS:*

If the applicant is a corporation, give date and place of incorporation ....

1. The source of the proposed appropriation is Calapooia Creek (Name of stream) *, a tributary of* The Umpqua River

2. The amount of water which the applicant intends to apply to beneficial use is 2.25 *cubic feet per second.* (If water is to be used from more than one source, give quantity from each)

***3. The use to which the water is to be applied is* Municipal Supply (Irrigation, power, mining, manufacturing, domestic supplies, etc.)

4. The point of diversion is located ..... *ft.* ..... (N. or S.) *and* ..... *ft.* ..... (E. or W.) *from the* ..... *corner of* ..... (Section or subdivision)

Diversion is S. 24° 02' E. 1606. ft. from the North East Corner of the Clinton (If preferable, give distance and bearing to section corner)

Sutherlin Donation Land Claim No. 49. T. 25 S., R. 4 W., W. M., (If there is more than one point of diversion, each must be described. Use separate sheet if necessary)

being within the NE¼ SW¼ (Give smallest legal subdivision) *of Sec.* 10, *Tp.* 25 S. (N. or S.),

R. 4 W. (E. or W.), *W. M., in the county of* Douglas

5. The Pipe-line (Main ditch, canal or pipe line) *to be* is approx. 8 mi. (Miles or feet)

in length, terminating in the NW¼ of the SE¼ (Smallest legal subdivision) *of Sec.* 17, *Tp.* 25 S. (N. or S.),

R. 5 W. (E. or W.), *W. M., the proposed location being shown throughout on the accompanying map.*

DESCRIPTION OF WORKS

Diversion Works—

6. (a) Height of dam aver. 9 *feet, length on top* 154 *feet, length at bottom* 154 *feet; material to be used and character of construction* concrete (Loose rock, concrete, masonry, rock and brush, timber crib, etc., wasteway over or around dam)

NOTE: This dam has been in use for a period of years by the City of Sutherlin for its municipal water supply.

(b) Description of headgate ..... (Timber, concrete, etc., number and size of openings)

(c) If water is to be pumped give general description The intention now is to increase flow (present flow) by installing a 4 inch Fairbanks Morse centrifugal pump with a 40 H.P. electric motor. (Size and type of pump) (Size and type of engine or motor to be used, total head water is to be lifted, etc.)

* A different form of application is provided where storage works are contemplated.

** Applications for permits to appropriate water for the generation of electricity, with the exception of municipalities, must be made to the Hydro-electric Commission. Either of the above forms may be secured, without cost, together with instructions by addressing the State Engineer, Salem, Oregon.

15016

Canal System or Pipe Line—

7. (a) *Give dimensions at each point of canal where materially changed in size, stating miles from headgate. At headgate: width on top (at water line)* .... *feet; width on bottom* .... *feet; depth of water* .... *feet; grade* .... *feet fall per one thousand feet.*

(b) *At* .... *miles from headgate: width on top (at water line)* .... *feet; width on bottom* .... *feet; depth of water* .... *feet; grade* .... *feet fall per one thousand feet.*

(c) *Length of pipe,* approx. 8 mi. *ft.; size at intake,* 8 *in.; size at* app. 8 mi. *ft. from intake* 8 *in.; size at place of use* 6 (2800 ft. of 6 inch into reservoir *in.; difference in elevation between intake and place of use,* approx. 186 *ft. Is grade uniform?* yes *Estimated capacity,* to be ultimately increased to 3 c.f.s. .... *sec. ft.*

8. *Location of area to be irrigated, or place of use* ....

Township	Range	Section	Forty-acre Tract	Number Acres To Be Irrigated
25 South	5 West	17	NE¼ SE¼ - NW¼ SE¼	
			SE¼ SE¼ and SW¼ SE¼	tot. 160
"	"	20	NE¼ NW¼	40

(If more space required, attach separate sheet)

(a) *Character of soil* ....

(b) *Kind of crops raised* ....

Power or Mining Purposes—

9. (a) *Total amount of power to be developed* .... *theoretical horsepower.*

(b) *Quantity of water to be used for power* .... *sec. ft.*

(c) *Total fall to be utilized* .... (Head) *feet.*

(d) *The nature of the works by means of which the power is to be developed* ....

(e) *Such works to be located in* .... (Legal subdivision) *of Sec.* ...., *Tp.* .... (No. N. or S.), *R.* .... (No. E. or W.), *W. M.*

(f) *Is water to be returned to any stream?* .... (Yes or No)

(g) *If so, name stream and locate point of return* ...., *Sec.* ...., *Tp.* .... (No. N. or S.), *R.* .... (No. E. or W.), *W. M.*

(h) *The use to which power is to be applied is* ....

(i) *The nature of the mines to be served* ....

Municipal or Domestic Supply—

10. (a) To supply the city of Sutherlin

Douglas (Name of) *County, having a present population of* app. 600

and an estimated population of 1500 *in 19* 42.

(b) If for domestic use state number of families to be supplied 400 families & 3 Saw Mills

(Answer questions 11, 12, 13, and 14 in all cases)

11. Estimated cost of proposed works, $ 2500.00

12. Construction work will begin on or before October 1, 1941

13. Construction work will be completed on or before January 1, 1942. If equipment can be delivered.

14. The water will be completely applied to the proposed use on or before January 1, 1942

City of Sutherlin
(Signature of applicant)

C. C. Holman, Water Superintendent

Signed in the presence of us as witnesses:

(1) P. J. Davis, Councilman (Name), Sutherlin, Oregon (Address of witness)

(2) B. S. Slack, City Recorder (Name), Sutherlin, Oregon (Address of witness)

Remarks: The concrete dam, valves for diversion, pipe line and reservoir are constructed and now in use; the motor and pump are to be installed.

0.75 c.f.s. has already been permitted to the City of Sutherlin for municipal use; 2.25 c.f.s. is now being applied for to make a total of 3 c.f.s.

Permit No. 6610 as recorded in State Record of Water Right Certificates, Vol 6, Pg. 6344, applies to the above mentioned 0.75 c.f.s.

STATE OF OREGON,
County of Marion, } *ss*

This is to certify that I have examined the foregoing application, together with the accompanying maps and data, and return the same for ....

In order to retain its priority, this application must be returned to the State Engineer, with corrections on or before ...., *194*...

WITNESS my hand this .... *day of* ...., *194*...

....
STATE ENGINEER

Application No. 19502

Permit No. 15016

PERMIT

TO APPROPRIATE THE PUBLIC WATERS OF THE STATE OF OREGON

Division No. .... District No. ....

This instrument was first received in the office of the State Engineer at Salem, Oregon on the 5th day of September, 1941, at 1:00 o'clock P. M.

Returned to applicant:

....

Corrected application received:

....

Approved:

October 3, 1941

Recorded in book No. 37 of Permits on page 15016

CHAS. E. STRICKLIN
STATE ENGINEER

Drainage Basin No. 16 Page 3

Fees Paid $12.00

STATE OF OREGON } ss
County of Marion, }

PERMIT

This is to certify that I have examined the foregoing application and do hereby grant the same, SUBJECT TO EXISTING RIGHTS and the following limitations and conditions:

The right herein granted is limited to the amount of water which can be applied to beneficial use and shall not exceed 2.25 cubic feet per second measured at the point of diversion from the stream, or its equivalent in case of rotation with other water users, from Calapooya Creek

The use to which this water is to be applied is Municipal

If for irrigation, this appropriation shall limited to - - - of one cubic foot per second ....

and shall be subject to such reasonable rotation system as may be ordered by the proper state officer.

The priority date of this permit is September 5, 1941

Actual construction work shall begin on or before October 3, 1942 and shall thereafter be prosecuted with reasonable diligence and be completed on or before October 1, 1943 Extended to Oct. 1, 1945

Complete application of the water to the proposed use shall be made on or before October 1, 1944 Extended to Oct. 1, 1946

WITNESS my hand this 3rd day of October, 1941

CHAS. E. STRICKLIN
STATE ENGINEER

Permits for power development are subject to the payment of annual fees as provided in sections 1 and 2, chapter 74, Oregon Laws 1933.

5M—

Permit No. 32426

*APPLICATION FOR PERMIT

To Appropriate the Public Waters of the State of Oregon

I, City of Sutherlin
(Name of applicant)

of P.O. Box 459 Sutherlin,
(Mailing address)

State of Oregon, *do hereby make application for a permit to appropriate the following described public waters of the State of Oregon, SUBJECT TO EXISTING RIGHTS:*

If the applicant is a corporation, give date and place of incorporation

1. *The source of the proposed appropriation is* Cooper Creek & Cooper Creek Reservoir
(Name of stream)
, a tributary of Sutherlin Creek

2. *The amount of water which the applicant intends to apply to beneficial use is* 5.0 *cubic feet per second.* from Cooper Creek and 500.0 acre feet from Cooper Creek Reservoir
(If water is to be used from more than one source, give quantity from each)

**3. *The use to which the water is to be applied is* domestic, municipal & industrial
(Irrigation, power, mining, manufacturing, domestic supplies, etc.)
(Industrial use from stored water only)

4. *The point of diversion is located* 2,097.29 *ft.* N. (N. or S.) *and* 4,174.00 W. (E. or W.) *from the corner of* Sections 22, 23, 26 & 27
(Section or subdivision)

(If preferable, give distance and bearing to section corner)

(If there is more than one point of diversion, each must be described. Use separate sheet if necessary)

being within the NW¼ SW¼ (Give smallest legal subdivision) *of Sec.* 22, *Tp.* 25S (N. or S.),
R. 5W (E. or W.), *W. M., in the county of* Douglas

5. *The* (Main ditch, canal or pipe line) *to be* (Miles or feet) *in length, terminating in the* (Smallest legal subdivision) *of Sec.* , *Tp.* (N. or S.),
R. (E. or W.), *W. M., the proposed location being shown throughout on the accompanying map.*

DESCRIPTION OF WORKS

Diversion Works—

6. *(a) Height of dam* ~~XXXX~~ 88 *feet, length on top* 446 *feet, length at bottom* 100 *feet; material to be used and character of construction* earth fill
(Loose rock, concrete, masonry, rock and brush, timber crib, etc., wasteway over or around dam)

(b) Description of headgate 12" slide gate on a 3.5 foot square riser on a 24" R/C conduit under the dam.
(Timber, concrete, etc., number and size of openings)

(c) If water is to be pumped give general description
(Size and type of pump)

(Size and type of engine or motor to be used, total head water is to be lifted, etc.)

*A different form of application is provided where storage works are contemplated.

**Application for permits to appropriate water for the generation of electricity, with the exception of municipalities, must be made to the Hydroelectric Commission. Either of the above forms may be secured, without cost, together with instructions by addressing the State Engineer, Salem, Oregon.

Canal System or Pipe Line—

7. *(a) Give dimensions at each point of canal where materially changed in size, stating miles from headgate. At headgate: width on top (at water line)* .... *feet; width on bottom* .... *feet; depth of water* .... *feet; grade* .... *feet fall per one thousand feet.*

(b) At .... *miles from headgate: width on top (at water line)* .... *feet; width on bottom* .... *feet; depth of water* .... *feet; grade* .... *feet fall per one thousand feet.*

(c) Length of pipe, 4000 *ft.; size at intake,* 12 *in.; size at* 4000 *ft. from intake* 12 *in.; size at place of use* 12 *in.; difference in elevation between intake and place of use,* 300 *ft. Is grade uniform?* yes *Estimated capacity,* 5.0 *sec. ft.*

8. *Location of area to be irrigated, or place of use* ....

Township North or South	Range E. or W. of Willamette Meridian	Section	Forty-acre Tract		Number Acres To Be Irrigated
25 - South	5 West	15 — 16 - 17 - 18	~~SE1/4~~	~~NW 1/4~~	~~Recreation~~
		19 - 20 - 21	~~NE 1/4~~	~~SW 1/4~~	~~"~~
		No. ½ 29	~~NW 1/4~~	~~SW 1/4~~	~~"~~
		& 30 -	~~All SE 1/4~~		~~"~~
Municipal use	in		~~NW 1/4~~	~~SW 1/4~~	~~"~~
the City	of Sutherlin		~~SW 1/4~~	~~SW 1/4~~	~~"~~
			~~SE 1/4~~	~~SW 1/4~~	~~"~~
			~~NW 1/4~~	~~NE 1/4~~	~~"~~
			~~SW 1/4~~	~~NE 1/4~~	~~"~~
			~~NE 1/4~~	~~NW 1/4~~	~~"~~
			~~NW 1/4~~	~~NW 1/4~~	~~"~~
			~~SE 1/4~~	~~NW 1/4~~	~~"~~

(If more space required, attach separate sheet)

(a) Character of soil ....

(b) Kind of crops raised ....

Power or Mining Purposes—

9. *(a) Total amount of power to be developed* .... *theoretical horsepower.*

(b) Quantity of water to be used for power .... *sec. ft.*

(c) Total fall to be utilized .... (Head) *feet.*

(d) The nature of the works by means of which the power is to be developed ....

(e) Such works to be located in .... (Legal subdivision) *of Sec.* ...., *Tp.* .... (No. N. or S.), *R.* .... (No. E. or W.), *W. M.*

(f) Is water to be returned to any stream? .... (Yes or No)

(g) If so, name stream and locate point of return ...., *Sec.* ...., *Tp.* .... (No. N. or S.), *R.* .... (No. E. or W.), *W. M.*

(h) The use to which power is to be applied is ....

(i) The nature of the mines to be served ....

Municipal or Domestic Supply— 32426

10. (a) To supply the city of Sutherlin

(Name of) County, having a present population of 2,874

and an estimated population of 7,891 in 19 82.

(b) If for domestic use state number of families to be supplied 1,261

(Answer questions 11, 12, 13, and 14 in all cases)

11. Estimated cost of proposed works, $ (573,000 Estm. Cost of Dam)

12. Construction work will begin on or before September 1967

13. Construction work will be completed on or before November 1968

14. The water will be completely applied to the proposed use on or before

November 1978

(Signature of applicant)

City Manager City of Sutherlin

Remarks:

STATE OF OREGON,
County of Marion, } ss.

This is to certify that I have examined the foregoing application, together with the accompanying maps and data, and return the same for Correction and Completion

In order to retain its priority, this application must be returned to the State Engineer, with corrections on or before November 27th, 19 67

WITNESS my hand this 25th day of September, 19 67

CHRIS L. WHEELER
STATE ENGINEER

By
ASSISTANT

PERMIT

STATE OF OREGON,
County of Marion, } ss.

This is to certify that I have examined the foregoing application and do hereby grant the same, SUBJECT TO EXISTING RIGHTS and the following limitations and conditions:

The right herein granted is limited to the amount of water which can be applied to beneficial use and shall not exceed 5.0 *cubic feet per second measured at the point of diversion from the stream, or its equivalent in case of rotation with other water users, from* Cooper Creek and from 500.0 acre feet of stored water in Cooper Creek Reservoir to be constructed under application No. R-33574, permit No. R- 4965

The use to which this water is to be applied is municipal

If for irrigation, this appropriation shall be limited to ---------------- *of one cubic foot per second or its equivalent for each acre irrigated*

and shall be subject to such reasonable rotation system as may be ordered by the proper state officer.

The priority date of this permit is August 29, 1967

Actual construction work shall begin on or before October 19, 1968 *and shall thereafter be prosecuted with reasonable diligence and be completed on or before October 1, 19*69 → 10-1-2010

Extended to Oct. 1 1980 Extended to Oct. 1985 Extended to October 1, 1990, 10-1-95, 10-1-2000 Extended to Oct. 1, 1970 Extended to Oct. 1 1971

*Complete application of the water to the proposed use shall be made on or before October 1, 19*70

Extended to Oct. 1 1980 Extended to Oct. 1985 Extended to October 1, 1990, 10-1-95, 10-1-2000 Extended to Oct. 1 1971 10-1-2010

WITNESS my hand this 19th *day of* October, *19*67

Chris L. Wheeler
STATE ENGINEER

Application No. 44016
Permit No. 32426

PERMIT

TO APPROPRIATE THE PUBLIC WATERS OF THE STATE OF OREGON

This instrument was first received in the office of the State Engineer at Salem, Oregon, on the 29th *day of* August, *19*67, *at* 8:00 *o'clock* A. *M.*

Returned to applicant:

Approved: October 19, 1967

Recorded in book No. 32426 *of Permits on page*

CHRIS L. WHEELER
STATE ENGINEER

Drainage Basin No. 16 *page* 6

Fees

State Printing 98137

Application No. 58288 Permit No. 44066

RECEIVED
JAN 29 1979
WATER RESOURCES DEPT.
SALEM, OREGON

STATE OF OREGON WATER RESOURCES DEPARTMENT

Application for Permit to Appropriate Surface Water

I, CITY OF SUTHERLIN (Name of Applicant)

of P.O. Box 459 (Mailing Address), Sutherlin (City)

State of Oregon, (Zip Code) Phone No. 459-2856 do hereby

make application for a permit to appropriate the following described waters of the State of Oregon:

1. The source of the proposed appropriation is Calapooia Creek

, a tributary of Umpqua River

2. The point of diversion is to be located 1182 ft. South (N. or S.) and 2224 ft. East (E. or W.)

from the Northwest corner of Section 10 (Public Land Survey Corner)

(If there is more than one point of diversion, each must be described)

being within the North E. ¼ of the N. West ¼ of

Sec. 10 Tp. 25S (N. or S.) R. 4 W. (E. or W.), W. M., in the county of Douglas

3. Location of area to be irrigated, or place of use if other than irrigation.

Township	Range	Section	List ¼ ¼ of Section	List use and/or number of acres to be irrigated
City	of	Sutherlin		Municipal Water
25S	5W	15	D.L.C. #40 NW ¼ - NW ¼	
25S	5W	16	NW ¼ - NW ¼ SE ¼ - NW ¼	NE ¼ - NW ¼ SW ¼ - NW ¼
			SW ¼ - NE ¼ NW ¼ - SE ¼	NE ¼ - NE ¼ SW ¼ - SE ¼
25S	5W	17	D.L.C. #50 NW ¼ - SW ¼	D.L.C. #40 NE ¼ - SW ¼
			SE ¼ - SW ¼ SE ¼ - NE ¼	SW ¼ - NE ¼ D.L.C. #52
25S	5W	18	D.L.C. #50 NW ¼ - SW ¼	SW ¼ - SW ¼
25S	5W	18	NE ¼ - SW ¼ SW ¼ - SE ¼	SE ¼ - SW ¼ SE ¼ - NE ¼
			NE ¼ - SE ¼ D.L.C. #53	D.L.C. #52
25S	5W	19	D.L.C. #53 D.L.C. #37	D.L.C. #52 D.L.C. #39

Form 690-1-0-1-77

25S	5W	20	NW ¼ - SE ¼ SW ¼ - SE ¼	NE ¼ - SE ¼ D.L.C. #39	SE ¼ - SE ¼ D.L.C. #51
25S	5W	21	D.L.C. #52 NE ¼ - NE ¼ NW ¼ - SW ¼ D.L.C. #51	SE ¼ - NE ¼ SW ¼ - SW ¼	NE ¼ - SW ½ SE ¼ - SW ¼

4. *The amount of water which the applicant intends to apply to beneficial use is* 1

cubic feet per second.
(If water is to be used from more than one source, give quantity from each)

5. *The use to which the water is to be applied is* Municipal [redacted]

6. *DESCRIPTION OF WORKS*

Include dimensions and type of construction of diversion dam and headgate, length and dimensions of supply ditch or pipeline, size and type of pump and motor, type of irrigation system to adequately describe the proposed distribution system.

Water is diverted by a concrete dam 135 feet wide on Calapooia Creek. Water is then carried by a 14" pipeline to the Water Treatment Plant. After treatment, the water is carried by a 14" pipeline to the City of Sutherlin.

If for domestic use state number of families to be supplied 1000

7. *Construction work will begin on or before* March 1980

8. *Construction work will be completed on or before* March 1981

9. *The water will be completely applied to the proposed use on or before* June 1981

Application No. 58288 *Permit No.* **44066**

Township	Range	Section	List ¼ - ¼ Section or D.L.C.
25S	5W	22	SW ¼ - NW ¼ NW ¼ - SW ¼
25S	5W	29	NW ¼ - NE ¼ NE ¼ - NE ¼ D.L.C. #39 D.L.C. #38
25S	5W	30	SE ¼ - NE ¼ NE ¼ - SE ¼ SE ¼ - SE ¼ D.L.C. #37 D.L.C. #39 D.L.C. #38
25S	6W	13	D.L.C. #59

Application No. 58288
Permit No. 44066

RECEIVED
APR 23 1979
WATER RESOURCES DEPT.
SALEM, OREGON

Remarks: The 1 C.F.S. of water applied for is for winter time use only.
This is the only time of year that the water is available.
The 1 C.F.S. applied for plus the 3 C.F.S. of current rights would allow the City to use the Calapooia for winter demand and the use our Cooper Creek Storage and the Calapooia for peak summer demand.

Signature of Applicant
City Manager

This is to certify that I have examined the foregoing application, together with the accompanying maps and data, and return the same for completion and clarification

In order to retain its priority, this application must be returned to the Water Resources Director with corrections on or before May 8, *19* 79

WITNESS my hand this 8th *day of* March, *19* 79

James E. Sexson *Water Resources Director*

By Vestal R. Garner

RECEIVED
APR 23 1979
WATER RESOURCES DEPT.
SALEM, OREGON

This instrument was first received in the office of the Water Resources Director at Salem, Oregon, on the 29th *day of* January, *19*79, *at* 11:00 *o'clock* A *M.*

Application No. 58288 *Permit No.* 44066

Application No. 58288 *Permit No.* 44066

Permit to Appropriate the Public Waters of the State of Oregon

This is to certify that I have examined the foregoing application and do hereby grant the same SUBJECT TO EXISTING RIGHTS INCLUDING THE EXISTING FLOW POLICIES ESTABLISHED BY THE WATER POLICY REVIEW BOARD and the following limitations and conditions:

The right herein granted is limited to the amount of water which can be applied to beneficial use and shall not exceed 1.0 *cubic feet per second measured at the point of diversion from the stream, or its equivalent in case of rotation with other water users, from* Calapooia Creek,

The use to which this water is to be applied is municipal.

If for irrigation, this appropriation shall be limited to .... *of one cubic foot per second or its equivalent for each acre irrigated*

and shall be subject to such reasonable rotation system as may be ordered by the proper state officer.

The priority date of this permit is January 29, 1979

Actual construction work shall begin on or before May 11, 1980 *and shall thereafter be prosecuted with reasonable diligence and be completed on or before October 1, 19*81

Extended to Oct. 1985 **Extended to October 1, 1990**, 10-1-95, 10-1-2000, 10-1-2010

*Complete application of the water to the proposed use shall be made on or before October 1, 19*82

Extended to Oct. 1985 **Extended to October 1, 1990**, 10-1-95, 10-1-2000, 10-1-2010

WITNESS my hand this 11th *day of* May, *19*79

James E. Sexson

Water Resources Director

Oregon Water Resources Department
Water Right Services Division

Water Rights Application
Number S-59416

Final Order
Extension of Time for Permit Number S-44926
Permit Holder: City of Sutherlin

Permit Information
Application File S-59416/ Permit S-44926
Basin 16 – Umpqua Basin / Watermaster District 15
Date of Priority: October 15, 1979

Authorized Use of Water

Source of Water:	The North Umpqua River, Tributary to the Umpqua River
Purpose or Use:	Municipal Use
Maximum Rate:	3.0 Cubic Feet per Second (CFS)

This Extension of Time request is being processed in accordance with Oregon Revised Statute 537.230 and 539.010(5), and Oregon Administrative Rule Chapter 690, Division 315

Appeal Rights
This is a final order in other than a contested case. This order is subject to judicial review under ORS 183.484. A request for judicial review must be filed within the 60 day time period specified by ORS 183.484(2). Pursuant to ORS 536.075 and OAR 137-004-0080 you may either file for judicial review, or petition the Director for reconsideration of this order. A petition for reconsideration may be granted or denied by the Director, and if no action is taken within 60 days following the date the petition was filed, the petition shall be deemed denied.

Application History
Permit S-44926 was issued by the Department on July 14, 1980. The permit called for completion of construction by October 1, 1982, and complete application of water to beneficial use by October 1, 1983. The most recent extension authorized completion of construction and complete application of water to beneficial use by October 1, 2009. On September 29, 2009, City of Sutherlin submitted an application to the Department for an extension of time for

Permit S-44926. In accordance with OAR 690-315-0050(2), on September 23, 2014, the Department issued a Proposed Final Order proposing to extend the time to complete construction to October 1, 2050, and the time to fully apply water to beneficial use to October 1, 2050. The protest period closed November 7, 2014, in accordance with OAR 690-315-0060(1). No protest was filed.

FINDINGS OF FACT

The Department adopts and incorporates by reference the findings of fact in the Proposed Final Order dated September 23, 2014.

At time of issuance of the Proposed Final Order the Department concluded that, based on the factors demonstrated by the applicant, the permit may be extended subject to the following conditions:

CONDITIONS

1. **Development Limitations**

Diversion of any water up to 3.0 cfs from the North Umpqua River under Permit S-44926 shall only be authorized upon issuance of a final order approving a Water Management and Conservation Plan (WMCP) under OAR Chapter 690, Division 86 that authorizes access to a greater rate of diversion of water under the permit consistent with OAR 690-086-0130(7). The required WMCP shall be submitted to the Department within 3 years of this Final Order. The amount of water used under Permit S-44926 must be consistent with this and subsequent WMCP's approved under OAR Chapter 690, on file with the Department.

The deadline established in the Extension Final Order for submittal of a WMCP shall not relieve a permit holder of any existing or future requirement for submittal of a WMCP at an earlier date as established through other orders of the Department. A WMCP submitted to meet the requirements of the final order may also meet the WMCP submittal requirements of other Department orders.

2. **Conditions to Maintain the Persistence of Listed Fish**

A. Fish Persistence Target Flows

a. Fish persistence target flows in the North Umpqua River as recommended by ODFW are in Table 1, below; flows are to be measured in the North Umpqua River at Winchester, Oregon (USGS Gage Number 14319500, or its equivalent).

Table 1

ODFW's Recommended Fish Persistence Target flows in the North Umpqua River Measured at USGS Gage 14319500, North Umpqua River At Winchester, Oregon	
Month	Cubic Feet per Second
January – June	1350
July	1290
August	996
September	982
October	1190
November – December	1350

b. Alternate Streamflow Measurement Point

The location of a target flow measurement point as established in these Conditions to Maintain the Persistence of Listed Fish may be revised if the City provides evidence in writing that ODFW has determined that persistence flows may be measured at an alternate streamflow measurement point and provides an adequate description of the location of the alternate streamflow measurement point, and the Water Resources Director concurs in writing.

B. Determining Water Use Reductions – Generally

The maximum amount of the undeveloped portion of Permit S-44926 that can be diverted as a result of this fish persistence condition is determined in proportion to the amount by which the flows shown in Table 1 are missed based on a seven day rolling average[1] of mean daily flows as determined or measured by the water user in the North Umpqua River at Winchester (USGS Gage Number 14319500, or its equivalent). The percent of missed target flows is defined as:

$$(1 - [(Q_A - E) / Q_T]) \times 100\%,$$

where Q_A is the actual flow measured at the designated gage based on the seven day rolling average, E is the undeveloped portion of the permit, and Q_T is the target flow (from Table 1).

The percent by which the target flow is missed applied to the undeveloped portion of the permit provides the maximum amount of undeveloped portion of

[1] Alternatively, the water user may use a single daily measurement.

the permit that can be diverted as a result of this fish persistence condition, and is defined as:

$$E - (E \times \%\text{ missed target flows}),$$

where E is the undeveloped portion of the permit, being 3.0 cfs.

When $Q_A - E \geq Q_T$, the amount of the undeveloped portion of the permit that can be diverted would not need to be reduced as a result of this fish persistence condition.

C. <u>Consumptive Use Percentages</u>

a. <u>Initial Consumptive Use Percentages</u>
The City of Sutherlin has not identified any Consumptive Use Percentages based on the return of flows to the North Umpqua River through effluent discharge. Thus, at this time the City may not utilize Consumptive Use Percentages for the purpose of calculating the maximum amount of the undeveloped portion of Permit S-49649 that can be diverted as a result of this fish persistence condition.

b. <u>First Time Utilization of Consumptive Use Percentages</u>
Utilization of Consumptive Use Percentages for the purpose of calculating the maximum amount of the undeveloped portion of Permit S-49649 that can be diverted as a result of this fish persistence condition may begin after the issuance of the Final Order for this extension of time.

First time utilization of Consumptive Use Percentages is contingent upon the City (1) providing evidence in writing that ODFW has determined that withdrawal points and effluent discharges are within reasonable proximity to each other, such that fish habitat between the two points is not impacted significantly, and (2) submitting monthly Consumptive Use Percentages and receiving the Water Resources Director's concurrence with the proposed Consumptive Use Percentages. Utilization of Consumptive Use Percentages is subject to an approval period described in 2.C.f., below.

Consumptive Use Percentages submitted to the Department for review must (1) be specified as a percentage (may be to the nearest 1/10 percent) for each month of the year and (2) include a description and justification of the methods utilized to determine the percentages. The proposed Consumptive Use Percentages should be submitted on the *Consumptive Use Percentages Update Form* provided with the Final Order for this extension of time.

c. <u>Consumptive Use Percentages Updates</u>
Continuing the utilization of Consumptive Use Percentages for the purpose of calculating the maximum amount of the undeveloped portion of Permit S-49649 that can be diverted as a result of this fish persistence condition beyond an approval period (as described in 2.C.f., below) is contingent upon

the City submitting updated Consumptive Use Percentages and receiving the Water Resources Director's concurrence with the proposed Consumptive Use Percentages Updates. Utilization of Consumptive Use Percentages Updates is subject to an approval period described in 2.C.f., below.

The updates to the Consumptive Use Percentages must (1) be specified as a percentage (may be to the nearest 1/10 percent) for each month of the year and (2) include a description and justification of the methods utilized to determine the percentages. The updates should be submitted on the *Consumptive Use Percentages Update Form* provided with the Final Order for this extension of time.

d. Changes to Wastewater Technology and/or Wastewater Treatment Plant Practices
If there are changes to either wastewater technology or the practices at the City's waste water treatment facility resulting in 25% or more reductions in average monthly return flows to the North Umpqua River, then the Consumptive Use Percentages in effect at that time may no longer be utilized for the purposes of calculating the maximum amount of the undeveloped portion of Permit S-49649 that can be diverted as a result of this fish persistence condition. The 25% reduction is based on a 10-year rolling average of monthly wastewater return flows to the North Umpqua River as compared to the average monthly wastewater return flows from the 10 year period just prior to date of the first approval period described in 2.C.f., below.

If such changes to either wastewater technology or the practices at the City's waste water treatment facility occur resulting in 25% reductions, further utilization of Consumptive Use Percentages is contingent upon the City submitting Consumptive Use Percentages Updates as per 2.C.c., above, and receiving the Water Resources Director's concurrence with the proposed Consumptive Use Percentages.

e. Relocation of the Point(s) of Diversion(s) and/or Return Flows
If the point(s) of diversion(s) and/or return flows are relocated, Consumptive Use Percentages in effect at that time may no longer be utilized for the purposes of calculating the maximum amount of the undeveloped portion of Permit S-49649 that can be diverted as a result of this fish persistence condition.

After relocation of the point(s) of diversion(s) and/or return flows, further utilization of Consumptive Use Percentages is contingent upon the City (1) providing evidence in writing that ODFW has determined that any relocated withdrawal points and effluent discharge points are within reasonable proximity to each other, such that fish habitat between the two points is not impacted significantly, and (2) submitting Consumptive Use Percentages

Updates as per 2.C.c., above, and receiving the Water Resources Director's concurrence with the proposed Consumptive Use Percentages.

f. Approval Periods for Utilization of Consumptive Use Percentages
The utilization of Consumptive Use Percentages for the purpose of calculating the maximum amount of the undeveloped portion of Permit S-49649 that can be diverted as a result of this fish persistence condition may continue for a 10 year approval period that ends 10 years from the Water Resources Director's most recent date of concurrence with Consumptive Use Percentages Updates as evidenced by the record, unless sections 2.C.d., or 2.C.e. (above) are applicable.

Consumptive Use Percentages (first time utilization or updates) which are submitted and receive the Director's concurrence will begin a new 10 year approval period. The approval period begins on the date of the Water Resources Director's concurrence with Consumptive Use Percentages Updates, as evidenced by the record. The City at its discretion may submit updates prior to the end of an approval period.

D. Examples

Example 1: Target flow met.

On September 15, the last seven mean daily flows were 975, 990, 1001, 1017, 1015, 1010 and 1008 cfs. The seven day rolling average (Q_A) is 1002 cfs. Given that the undeveloped portion of this permit (E) is 3.0 cfs, then the 7 day average of mean daily flows minus the undeveloped portion is greater than the 982 cfs target flow (Q_T) for September 15. In this example, $Q_A - E \geq Q_T$.

$$1002 - 3.0 \geq 982$$

The amount of the undeveloped portion of the permit that can be diverted would not be reduced because the target flow is considered met.

Example 2: Target flow missed.

Step 1: Given that the undeveloped portion of this permit (E) is 3.0 cfs, if on August 15, the average of the last seven mean daily flows (Q_A) was 800 cfs, and the target flow (Q_T) is 996 cfs, then the target flow would be missed by 20.0%.

$$(1 - [(800.0 - 3.0) / 996.0]) \times 100\% = 20.0\%$$

Step 2: Assuming the Consumptive Use Percentage is 62.2%[2] during the month of August and the utilization of this percentage is authorized, and the target flow is missed by 20.0% (from Step 1), then the amount of the undeveloped portion of the permit that could be diverted would be reduced by 12.4%.

$$(62.2\% \times 20.0\%) / 100 = 12.4\%$$

(If adjustments are not to be made by a Consumptive Use Percentage, then the undeveloped portion of the permit would be reduced only by the % by which the target flow is missed – 20.0% in this example).

Step 3: Given that the undeveloped portion of this permit (E) is 3.0 cfs, and the undeveloped portion of the permit needs to be reduced by 12.4% (from Step 2), or 0.4 cfs, then the maximum amount of the undeveloped portion of Permit S-44926 that could be diverted as a result of this fish persistence condition is 2.6 cfs. (This maximum amount may be limited as illustrated in Step 4, below.)

$$(3.0 \times 12.4\%) / 100) = 0.4$$

$$3.0 - 0.4 = 2.6$$

Step 4: The calculated maximum amount of water that could be diverted due to the fish persistence condition may not exceed the amount of water to which the City is legally entitled to divert. In this example, if the amount of water legally authorized for diversion under this permit is 1.5 cfs (for example, authorization provided through a WMCP), then 1.5 cfs would be the maximum amount of diversion allowed under this permit, rather than 2.6 cfs from Step 3.

(Conversely, if the amount of water legally authorized for diversion under this permit is 3.0 cfs, then 2.6 cfs (from Step 3) would be the maximum amount of diversion allowed under this permit.)

3. **Fish Screening Condition**

The permittee shall install, maintain and operate fish screening and by-pass devised as required by the Oregon Department of Fish and Wildlife (ODFW) to prevent fish from entering the proposed diversion. The required screens and by-pass devices are to be in place, functional and approved by an ODFW representative prior to diversion of any water.

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[2] Currently, the City of Sutherlin may not utilize Consumptive Use Percentages for the purpose of calculating the amount of the undeveloped portion of Permit S-49765 that can be diverted as a result of this fish persistence condition. The utilization of the Consumptive Use Percentage 62.2% is only for illustrative purposes in this example.

CONCLUSION OF LAW

The applicant has demonstrated good cause for the permit extension pursuant to ORS 537.230, 539.010(5) and OAR 690-315-0080(3).

ORDER

The extension of time for Application S-59416, Permit S-44926, therefore, is approved subject to conditions contained herein. The deadline for completing construction is extended from October 1, 2009 to October 1, 2050. The deadline for applying water to full beneficial use within the terms and conditions the permit is extended from October 1, 2009 to October 1, 2050.

DATED: November 14, 2014

Dwight French
Water Right Services Division Administrator, for
Thomas M. Byler Director,
Oregon Water Resources Department

If you have any questions about statements contained in this document, please contact Ann L. Reece at (503) 986-0834.

If you have other questions about the Department or any of its programs, please contact our Water Resources Customer Service Group at (503) 986-0900

"Consumptive Use Percentages" Update Form

Oregon Water Resources Department
725 Summer Street NE, Suite A
Salem Oregon 97301-1266
(503) 986-0900
www.wrd.state.or.us

TO THE WATER RIGHTS ADMINISTRATOR
OF THE OREGON WATER RESOURCES DEPARTMENT

Re: Fish Persistence Condition Applicable to:
Application S-59416 / Permit S-44926
Permit Holder: City of Sutherlin

"Consumptive Use Percentages" Updates

1. For each month listed below, provide the consumptive use percentage for the purpose of calculating the maximum total amount of the undeveloped portion of Permit S-44926 that can be diverted as a result of the fish persistence condition on the extension Final Order Dated November 14, 2014.

Month	Consumptive Use Percentage	Month	Consumptive Use Percentage
January	%	July	%
February	%	August	%
March	%	September	%
April	%	October	%
May	%	November	%
June	%	December	%

2. Provide a description and justification of the methods utilized to determine the percentages. Please attach additional pages as necessary.

3. The use of these "Consumptive Use Percentages" for the purposes stated above may continue for a 10 year approval period unless further utilization of Consumptive Use Percentages is contingent upon the City submitting Consumptive Use Percentages Updates due to changes in wastewater technology and/or the wastewater treatment plant or due to relocation of the point(s) of diversion(s) and/or return flows.

Signature____________________________________ Date________________

For OWRD use only

WRD Concurs with these "Consumptive Use Percentages" Updates ☐ Yes ☐ No

Approved by: ________________________ Date: ________________________
for the Water Resources Director

BEFORE THE WATER RESOURCES DEPARTMENT
OF THE
STATE OF OREGON

In the Matter of the Proposed Water Management and Conservation Plan for City of Sutherlin, Douglas County, Oregon	))))	FINAL ORDER APPROVING WATER MANAGEMENT AND CONSERVATION PLAN

Authority

OAR Chapter 690, Division 086, establishes the process and criteria for approving water management and conservation plans required under the conditions of permits, permit extensions and other orders of the Department. An approved water management plan may authorize the diversion and use of water under a permit extended pursuant to OAR Chapter 690, Division 315.

Background

On Dec 23, 2005, the City of Sutherlin submitted a draft Water Management and Conservation Plan for review under OAR Chapter 690, Division 086 (November 2002). Submittal of the plan was required under Permit extension for permits S 32426, S 44066 and S 59416.

The Department published notice of receipt of the plan on January 3, 2006. No public comments were received.

The Department provided comments on the plan to the City on April 12, 2006 and, in response, the City submitted a revised plan on October 17, 2006.

Findings of Fact

1. The City of Sutherlin Water Management and Conservation Plan contains all of the plan elements required under OAR 690-086-0125.

2. The projections of future water needs in the plan demonstrate a need for over eight cfs of water available under permits S 32426, S 44066 and S 59416 to meet demands for the population anticipated in 20 years. These projections are reasonable and consistent with the City's land use plan.

3. The plan includes 5-year benchmarks for implementation of Annual Water Audits, Public Education, Leak Detection and water reuse. The system is fully metered and the rate

This is a final order in other than contested case. This order is subject to judicial review under ORS 183.484. Any petition for judicial review must be filed within the 60 day time period specified by ORS 183.484(2). Pursuant to ORS 536.075 and OAR 137-004-0080 you may either petition for judicial review or petition the Director for reconsideration of this order. A petition for reconsideration may be granted or denied by the Director, and if no action is taken within 60 days following the date the petition was filed, the petition shall be deemed denied.

structure includes a base rate and volumetric charge. System leakage is estimated at 15 percent.

4. The plan includes 5-year benchmarks for evaluation, development, and implementation of programs to December 23, 2015.

5. The plan identifies the North Umpqua River, Cooper Creek and Calapooya Creek as the source of the City's water rights and accurately describes Pacific Lamprey, Steelhead, Coho Salmon and Umpqua Chub as listed species.

6. The water curtailment element included in the plan satisfactorily promotes water curtailment practices and includes a list of four stages of alert with concurrent curtailment actions.

7. The diversion of water under permits S 32426, S 44066 and S 59416 will be initiated during the next 20 years and consistent with OAR 690-086-0130(7):

    a. The plan includes a schedule for development of conservation measures that provide water at a cost that is equal to or lower than the cost of other identified sources, or the supplier has provided sufficient justification for the factors used in selecting other sources for development.

    b. Increased use from the source is the most feasible and appropriate water supply alternative available, which includes a intergovernmental agreement with the Umpqua Water Users Association.

    c. The plan contains documentation that the supplier has no current mitigation requirements.

Conclusion of Law

The water management and conservation plan submitted by the City of Sutherlin is consistent with the criteria in OAR Chapter 690, Division 086.

Now, therefore, it is ORDERED:

1. The City of Sutherlin Water Management and Conservation Plan is approved and shall remain in effect until December 31, 2016, unless this approval is rescinded pursuant to OAR 690-086-0920.

2. The limitation of the diversion of water under permits S 32426, S 44066 and S 59416 established by the extension of time approved on February 26, 2002 is removed and, subject to other limitations or conditions of the permit, the City of Sutherlin is authorized to divert up to 1 cfs under permit S 44066, 5 cfs under permit S 32426, and 3 cfs under permit S 59416.

3. The City of Sutherlin shall submit an updated plan within ten years and no later than December 31, 2016 and shall submit progress reports containing the information required under OAR 690-086-0120(4) by December 15, 2011.

Dated at Salem, Oregon this 8th day of August, 2007.

Phillip C. Ward, Director

Mailing date: AUG 13 2007

Application No. 59416 Permit No. 44926

STATE OF OREGON WATER RESOURCES DEPARTMENT

Application for Permit to Appropriate Surface Water

I, City of Sutherlin (Name of Applicant)

of P.C. Box 459 (Mailing Address), Sutherlin (City)

State of Oregon, 97479 (Zip Code) Phone No. 459-2856 do hereby make application for a permit to appropriate the following described waters of the State of Oregon:

1. The source of the proposed appropriation is North Umpqua River, a tributary of Umpqua River

2. The point of diversion is to be located 1120 ft. N (N. or S.) and 2320 ft. E (E. or W.) from the SW corner of Section 11 (Public Land Survey Corner)

(If there is more than one point of diversion, each must be described)

being within the SE ¼ of the SW ¼ of Sec. 11 Tp. 26 S (N. or S.) R. 5 W (E. or W.), W. M., in the county of Douglas

3. Location of area to be irrigated, or place of use if other than irrigation.

Township	Range	Section	List ¼ ¼ of Section	List use and/or number of acres to be irrigated
25 S	5 W	15 16	W½NW¼ All	Municipal Water
		17	S½NE¼ S½	" "
		18	SE¼NE¼ SW¼	
			NE¼SE¼ S½SE¼	
		19	E½ N½NW¼	
		20	SE¼NW¼ All	
		21 22	W½ SW¼NW¼	
		29	NW¼SW¼ N½NE¼	
			N½NW¼ SW¼NW¼	
		30	W½SW¼ NE¼	

Form 690-1-0-1-77

25 S	6 W	13	E½SE¼ N½SE¼ SE¼SE¼
		24	NE¼NE¼

4. *The amount of water which the applicant intends to apply to beneficial use is* Three

cubic feet per second
(If water is to be used from more than one source, give quantity from each)

5. *The use to which the water is to be applied is* Municipal Water Supply

6. *DESCRIPTION OF WORKS*

Include dimensions and type of construction of diversion dam and headgate, length and dimensions of supply ditch or pipeline, size and type of pump and motor, type of irrigation system to adequately describe the proposed distribution system.

Diversion System shallbe submerged inlet with a concrete sump for pumping purposes. A diversion dam or headgate will not be necessary. Water will be stage pumped up approximately 480' through a 12" line 10500' tothe crest of the Cooper Creek Drainage, then gravity flow through a 12" pipe line an additional 5600' to discharge into the southeast end of Cooper Creek Reservoir. Water will then be taken out of the Cooper Creek Reservoir below the dam at the existing City Water Treatment facility at Cooper Creek.

If for domestic use state number of families to be supplied 3000

7. *Construction work will begin on or before* See Remarks

8. *Construction work will be completed on or before*

9. *The water will be completely applied to the proposed use on or before*

Application No. 59416 *Permit No.* 44926

Remarks: After water right is approved, the process of financing and construction will begin.

This permit, when issued, is for the beneficial use of water. By law, the land use associated with this water use must be in compliance with statewide land-use goals and any local acknowledged land-use plan. It is possible that the land use you propose may not be allowed if it is not in keeping with the goals and the acknowledged plan. Your city or county planning agency can advise you about the land-use plan in your area.

Signature of Applicant

City Manager

This is to certify that I have examined the foregoing application, together with the accompanying maps and data, and return the same for ....

In order to retain its priority, this application must be returned to the Water Resources Director with corrections on or before ...., 19........

WITNESS my hand this .... *day of* ...., *19*........

.... *Water Resources Director*

By ....

This instrument was first received in the office of the Water Resources Director at Salem, Oregon, on the 15th *day of* OCT. , *19* 79 , *at* 11:00 *o'clock* A *M.*

Application No. 59416 *Permit No.* 44926

EXTENDED C09

Application No. 59416 Permit No. 44926

Permit to Appropriate the Public Waters of the State of Oregon

This is to certify that I have examined the foregoing application and do hereby grant the same SUBJECT TO EXISTING RIGHTS INCLUDING THE EXISTING FLOW POLICIES ESTABLISHED BY THE WATER POLICY REVIEW BOARD and the following limitations and conditions:

The right herein granted is limited to the amount of water which can be applied to beneficial use and shall not exceed 3.0 *cubic feet per second measured at the point of diversion from the stream, or its equivalent in case of rotation with other water users, from* North Umpqua River

The use to which this water is to be applied is municipal

If for irrigation, this appropriation shall be limited to .... *of one cubic foot per second or its equivalent for each acre irrigated*

and shall be subject to such reasonable rotation system as may be ordered by the proper state officer.

The priority date of this permit is October 15, 1979

Actual construction work shall begin on or before July 14, 1981 *and shall*

Extended to October 1987, 10-1-97

*thereafter be prosecuted with reasonable diligence and be completed on or before October 1, 19*82

Extended to October 1987, 10-1-97

*Complete application of the water to the proposed use shall be made on or before October 1, 19*83

Extended to October 1987, 10-1-97

WITNESS my hand this 14th *day of* July, 1980

James E. Sexson

Water Resources Director

THE DYER PARTNERSHIP
ENGINEERS & PLANNERS, INC.

759 W Central
Sutherlin, Oregon 97479
Ph: (541) 459-4619
www.dyerpart.com

MEMORANDUM

DATE	August 19, 2015	
TO	Brian Elliot, Utilities Superintendent Randy Harris, Utilities Supervisor City of Sutherlin 126 E. Central Ave. Sutherlin, Oregon 97479	COPY TO
FROM	Barbara Negherbon, P.E. BN	
PROJECT NAME	Status of Water Rights	
PROJECT NO.	146.00D	

I reviewed the water rights held by the City of Sutherlin and the following is a summary of the current status of the water rights:

1. Application No. S-44016 / Permit No. S-32426 / Cooper Creek 5.0 cfs
   Water Right Extension application submitted to Oregon Water Resources Department (OWRD) by Dyer in 2011, but was put on hold in according to Ann Reece, OWRD, due to a change in the Certified Water Rights Examiner that would prepare the application. A new Water Right Extension application is currently being prepared by attorney, Richard Glick, Davis Wright Tremaine, LLP and Adam Sussman, GSI Water Solutions. Depending upon determination of extent of use, this right may be eligible for an application for Claim of Beneficial Use.

2. Application No. S-58288 / Permit No. S-44066 / Calapooia Creek 1.0 cfs (winter use only)
   Water Right Extension application submitted to Oregon Water Resources Department (OWRD) by Dyer in 2011, but was put on hold in according to Ann Reece, OWRD, due to a change in the Certified Water Rights Examiner that would prepare the application. A new Water Right Extension application is being prepared by attorney, Richard Glick, Davis Wright Tremaine, LLP and Adam Sussman, GSI Water Solutions. Depending upon determination of extent of use, this right may be eligible for an application for Claim of Beneficial Use.

3. Application No. S-59416 / Permit No. S-44926 / North Umpqua River 3.0 cfs
   Water Right Extension application submitted to OWRD in 2009, but is still pending fish persistence review by Oregon Department of Fish and Wildlife (ODFW). This application will extend the Completion Date to October 1, 2050. A change in the point of diversion (POD) has not been completed at this time.

4. Application No. S-9945 / Permit No. S-6610 / Certificate No. 6344 Calapooia Creek 0.75 cfs
   Certificated.

5. Application No. S-19502 / Permit No. S-15016 / Certificate No. 19629 Calapooia Creek 2.25 cfs
   Certificated.

The Sutherlin Water Control District holds the following water right that includes municipal use for the City of Sutherlin:

1. Application No. R-33574 / Permit No. R-4965 / Certificate No. 48586 Cooper Creek Reservoir 500 acre-feet. Certificated.

The City should work with the Sutherlin Water Control District to request the assignment for the water storage right to be in the City's name.

Attached is a spread sheet showing the water rights being used by the City of Sutherlin, including locations of point(s) of diversions, the priority dates, completion dates, current listed extension dates, and water uses and a spread sheet showing the water rights listed in order of Priority Date.

The City of Sutherlin has an approved Water Management and Conservation Plan (WCMP), dated August 8, 2007 recorded with OWRD. WCMPs are required within three (3) years of requesting an extension application and are required every ten (10) years for extended water rights. Progress Reports (which list the yearly water system improvements and the associated costs) must be submitted every five (5) years for extended water rights. The City needs to budget for the completion of this work.

APPENDIX C: Water Treatment Plant Flow Data

Nonpareil WTP Water Pumped to City

Month	2011	2012	2013	2014	2015	2016	Ave
January	23.40	23.62	24.65	26.09	27.18	30.25	25.86
February	21.10	22.42	22.04	20.30	24.70	27.65	23.03
March	23.16	24.03	24.72	19.45	23.93	28.47	23.96
April	22.71	24.47	27.42	20.07	16.49	27.26	23.07
May	25.63	29.86	36.50	33.17	15.78	36.68	29.60
June	31.62	32.39	42.32	33.66	37.98	39.98	36.32
July	41.49	42.04	53.41	37.60	43.05	41.03	43.10
August	46.00	48.32	49.11	30.73	44.12	37.20	42.58
September	39.14	43.45	39.20	35.68	41.24	43.44	40.36
October	24.37	30.19	30.08	29.32	36.64	33.84	30.74
November	22.42	23.75	27.32	21.02	30.87	30.15	25.92
December	24.49	24.88	30.45	24.59	29.84	30.94	27.53
Total	345.53	369.40	407.22	331.66	371.82	406.87	372.08

Nonpareil WTP Water Backwash

Month	2011	2012	2013	2014	2015	2016	Ave
January	1.21	1.56	2.25	0.81	2.16	3.32	1.89
February	2.42	2.53	2.03	0.19	2.04	0.85	1.68
March	-0.16	3.55	2.71	1.74	0.95	0.60	1.56
April	2.07	4.26	1.46	2.42	0.68	0.70	1.93
May	2.58	3.30	2.79	3.26	1.01	1.49	2.40
June	2.85	-3.08	3.33	3.21	1.99	2.93	1.87
July	3.04	4.49	5.52	2.97	2.11	3.79	3.66
August	4.28	6.71	2.54	1.39	1.72	3.77	3.40
September	8.65	4.73	2.07	2.58	2.58	4.79	4.23
October	3.26	7.17	1.96	3.72	2.23	3.25	3.60
November	4.68	5.64	1.40	1.40	2.85	2.73	3.12
December	3.88	-2.03	1.61	-1.16	-7.05	1.81	-0.49
Total	38.77	38.84	29.67	22.51	13.28	30.03	28.85

Nonpareil WTP Water Production

Month	2011	2012	2013	2014	2015	2016	Ave
January	24.61	25.18	26.90	26.90	29.33	33.57	27.75
February	23.52	24.95	24.06	20.49	26.74	28.51	24.71
March	23.00	27.58	27.43	21.18	24.88	29.07	25.52
April	24.78	28.73	28.88	22.49	17.17	27.96	25.00
May	28.21	33.15	39.28	36.42	16.79	38.17	32.01
June	34.48	29.30	45.66	36.87	39.98	42.91	38.20
July	44.53	46.53	58.94	40.57	45.16	44.82	46.76
August	50.29	55.03	51.65	32.11	45.84	40.97	45.98
September	47.79	48.18	41.27	38.26	43.82	48.23	44.59
October	27.63	37.36	32.04	33.04	38.87	37.09	34.34
November	27.10	29.39	28.72	22.42	33.71	32.87	29.03
December	28.37	22.85	32.06	23.43	22.80	32.74	27.04
Total	384.29	408.24	436.89	354.17	385.09	436.91	400.93

Nonpareil WTP % Backwash

Month	2011	2012	2013	2014	2015	2016	Ave
January	4.9%	6.2%	8.4%	3.0%	7.4%	9.9%	6.6%
February	10.3%	10.1%	8.4%	0.9%	7.6%	3.0%	6.7%
March	-0.7%	12.9%	9.9%	8.2%	3.8%	2.1%	6.0%
April	8.3%	14.8%	5.1%	10.8%	4.0%	2.5%	7.6%
May	9.1%	9.9%	7.1%	8.9%	6.0%	3.9%	7.5%
June	8.3%	-10.5%	7.3%	8.7%	5.0%	6.8%	4.3%
July	6.8%	9.7%	9.4%	7.3%	4.7%	8.5%	7.7%
August	8.5%	12.2%	4.9%	4.3%	3.7%	9.2%	7.1%
September	18.1%	9.8%	5.0%	6.7%	5.9%	9.9%	9.2%
October	11.8%	19.2%	6.1%	11.2%	5.7%	8.8%	10.5%
November	17.3%	19.2%	4.9%	6.2%	8.4%	8.3%	10.7%
December	13.7%	-8.9%	5.0%	-5.0%	-30.9%	5.5%	-3.4%
Average	9.7%	8.7%	6.8%	6.0%	2.6%	6.5%	6.7%

Cooper Creek WTP Water Pumped to City

Month	2014	2015	2016	Ave
January	1.22	0.54	0.00	0.59
February	3.98	0.45	0.00	1.48
March	7.20	4.50	1.04	4.25
April	6.50	11.04	3.73	7.09
May	0.42	19.86	0.94	7.07
June	8.84	11.60	8.39	9.61
July	11.24	16.63	10.68	12.85
August	21.72	11.38	22.52	18.54
September	9.57	1.51	4.04	5.04
October	2.76	0.00	0.00	0.92
November	5.78	0.00	0.00	1.93
December	2.91	0.00	0.00	0.97
Total	82.15	77.50	51.33	70.33

Cooper Creek WTP Water Backwash

Month	2014	2015	2016	Ave
January	0.19	1.19	1.37	0.92
February	1.56	0.27	5.18	2.34
March	1.20	1.23	5.35	2.60
April	0.91	2.01	3.90	2.27
May	0.30	3.44	4.73	2.82
June	1.40	2.36	4.32	2.69
July	1.80	2.29	5.01	3.03
August	2.90	1.80	4.25	2.98
September	2.61	1.44	1.46	1.84
October	1.78	0.34	0.94	1.02
November	1.32	0.15	0.00	0.49
December	0.64	0.79	0.48	0.64
Total	16.62	17.30	36.99	23.64

Cooper Creek WTP Water Production

Month	2014	2015	2016	Ave
January	1.41	1.73	1.37	1.50
February	5.55	0.72	5.18	3.82
March	8.40	5.73	6.39	6.84
April	7.41	13.04	7.63	9.36
May	0.72	23.30	5.67	9.90
June	10.24	13.96	12.71	12.30
July	13.04	18.92	15.68	15.88
August	24.63	13.17	26.77	21.52
September	12.18	2.94	5.50	6.88
October	4.54	0.34	0.94	1.94
November	7.10	0.15	0.00	2.42
December	3.56	0.79	0.48	1.61
Total	98.77	94.80	88.32	93.97

Cooper Creek WTP % Backwash

Month	2014	2015	2016	Ave
January	13.8%	68.6%	100.0%	60.8%
February	28.2%	37.2%	100.0%	55.1%
March	14.3%	21.4%	83.7%	39.8%
April	12.2%	15.4%	51.1%	26.2%
May	41.7%	14.8%	83.4%	46.6%
June	13.6%	16.9%	34.0%	21.5%
July	13.8%	12.1%	31.9%	19.3%
August	11.8%	13.6%	15.9%	13.8%
September	21.5%	48.8%	26.6%	32.3%
October	39.2%	100.0%	100.0%	79.7%
November	18.6%	100.0%	100.0%	72.9%
December	18.1%	100.0%	100.0%	72.7%
Average	20.6%	45.7%	68.9%	45.1%

Total WTP Water Pumped to City

Month	2011	2012	2013	2014	2015	2016	Ave
January	23.40	23.62	24.65	53.27	27.72	30.25	30.48
February	21.10	22.42	22.04	45.00	25.15	27.65	27.23
March	23.16	24.03	24.72	43.38	28.44	29.51	28.87
April	22.71	24.47	27.42	36.56	27.53	31.00	28.28
May	25.63	29.86	36.50	48.95	35.64	37.62	35.70
June	31.62	32.39	42.32	71.64	49.58	48.36	45.99
July	41.49	42.04	53.41	80.65	59.68	51.70	54.83
August	46.00	48.32	49.11	74.85	55.50	59.72	55.58
September	39.14	43.45	39.20	76.92	42.74	47.48	48.15
October	24.37	30.19	30.08	65.96	36.64	33.84	36.85
November	22.42	23.75	27.32	51.88	30.87	30.15	31.06
December	24.49	24.88	30.45	54.43	29.84	30.94	32.50
Total	345.53	369.40	407.22	703.47	449.32	458.21	455.52

Total WTP Water Backwash

Month	2011	2012	2013	2014	2015	2016	Ave
January	1.21	1.56	2.25	2.97	5.48	5.20	3.11
February	2.42	2.53	2.03	2.23	2.90	2.53	2.44
March	-0.16	3.55	2.71	2.69	1.55	2.16	2.08
April	2.07	4.26	1.46	3.10	1.38	2.63	2.48
May	2.58	3.30	2.79	4.27	2.50	3.90	3.22
June	2.85	-3.08	3.33	5.21	4.92	4.80	3.01
July	3.04	4.49	5.52	5.08	5.91	7.45	5.25
August	4.28	6.71	2.54	3.10	5.49	7.17	4.88
September	8.65	4.73	2.07	5.16	7.37	9.02	6.17
October	3.26	7.17	1.96	5.95	5.48	6.85	5.11
November	4.68	5.64	1.40	4.25	5.57	5.84	4.56
December	3.88	-2.03	1.61	-8.21	-5.24	1.32	-1.44
Total	38.77	38.84	29.67	35.79	43.31	58.88	40.88

Total WTP Water Production

Month	2011	2012	2013	2014	2015	2016	Ave
January	24.61	25.18	26.90	56.23	62.90	61.32	42.86
February	23.52	24.95	24.06	47.23	55.25	53.22	38.04
March	23.00	27.58	27.43	46.07	53.95	54.60	38.77
April	24.78	28.73	28.88	39.66	45.13	52.96	36.69
May	28.21	33.15	39.28	53.21	54.96	70.17	46.50
June	34.48	29.30	45.66	76.85	82.88	81.10	58.38
July	44.53	46.53	58.94	85.73	89.98	91.57	69.55
August	50.29	55.03	51.65	77.95	86.81	86.95	68.11
September	47.79	48.18	41.27	82.07	92.05	92.82	67.36
October	27.63	37.36	32.04	71.91	75.95	71.42	52.72
November	27.10	29.39	28.72	56.13	66.58	61.91	44.97
December	28.37	22.85	32.06	46.22	55.54	59.79	40.80
Total	384.29	408.24	436.89	739.26	822.00	837.84	604.75

Total WTP % Backwash

Month	2011	2012	2013	2014	2015	2016	Ave
January	4.9%	6.2%	8.4%	5.3%	8.7%	8.5%	7.0%
February	10.3%	10.1%	8.4%	4.7%	5.2%	4.8%	7.3%
March	-0.7%	12.9%	9.9%	5.8%	2.9%	4.0%	5.8%
April	8.3%	14.8%	5.1%	7.8%	3.1%	5.0%	7.3%
May	9.1%	9.9%	7.1%	8.0%	4.6%	5.6%	7.4%
June	8.3%	-10.5%	7.3%	6.8%	5.9%	5.9%	3.9%
July	6.8%	9.7%	9.4%	5.9%	6.6%	8.1%	7.7%
August	8.5%	12.2%	4.9%	4.0%	6.3%	8.2%	7.4%
September	18.1%	9.8%	5.0%	6.3%	8.0%	9.7%	9.5%
October	11.8%	19.2%	6.1%	8.3%	7.2%	9.6%	10.4%
November	17.3%	19.2%	4.9%	7.6%	8.4%	9.4%	11.1%
December	13.7%	-8.9%	5.0%	-17.8%	-9.4%	2.2%	-2.5%
Average	9.7%	8.7%	6.8%	4.4%	4.8%	6.7%	6.9%

APPENDIX D: Improvement Alternative Cost Analysis

PHASE I IMPROVEMENTS

City of Sutherlin Water Master Plan

Cooper Creek Multi-Level Intake

Item	Description	Unit	Quantity	Unit Cost	Total Cost
1	Construction Facilities & Temporary Controls	LS	1	$ 157,705	$ 157,705
2	Mobilization/Demobilization	LS	1	$ 53,620	$ 53,620
3	Site Preparation	LS	1	$ 50,065	$ 50,065
4	CMU Building	LS	1	$ 50,000	$ 50,000
5	Electrical-Controls	LS	1	$ 40,000	$ 40,000
6	Sheet Piling for Dry Work Area	SF	7500	$ 50	$ 375,000
7	Concrete Support Structure for Screen Tracks	CY	11	$ 1,000	$ 11,000
8	Intake Track Installation, (Materails., Grading, Anchors..etc)	LS	1	$ 250,000	$ 250,000
9	Intake Screen Adjustment Mechanism (Motor, Enclosure Belt System)	LS	1	$ 75,000	$ 75,000
10	Intake Screen with Self Cleaning Air System	EA	1	$ 65,000	$ 65,000
11	12" Flex Pipe	LF	80	$ 50	$ 4,000
12	12" Flex Fitting	EA	1	$ 1,200	$ 1,200
13	Coversion Coupling	EA	1	$ 3,500	$ 3,500
14	12" Waterline (20+ Deep)	LF	650	$ 120	$ 78,000
15	12" Waterline	LF	550	$ 80	$ 44,000
16	14" x 12" Tee	EA	1	$ 1,000	$ 1,000
17	14" Gate Valve	EA	1	$ 1,900	$ 1,900
18	12" Gate Valve	EA	1	$ 1,700	$ 1,700
19	Solarbee System	LS	1	$ 145,000	$ 145,000
				Subtotal	$ 1,407,689
		Contingency @ 15%			$ 211,153
		Engineering @ 20%			$ 281,538
		Legal, Admin, Financing @ 7%			$ 98,538
		Sampling-Water Quality Study			$ 30,000
		Community Impact Study			$ 40,000
		Environmental-Permitting			$ 100,000
				Total	$ 2,169,000

City of Sutherlin Water Master Plan

Nonpareil Additional Clearwell Inlet

Item	Description	Unit	Quantity	Unit Price	Total
1	Construct Facilities & Temporary Controls	LS	1	$ 8,318	$ 8,318
2	Site Preparation	LS	1	$ 5,268	$ 5,268
3	14" x 6" Hot Tap w ith Gate Valve	LS	1	$ 5,500	$ 5,500
4	6" Gate Valve	EA	1	$ 1,200	$ 1,200
5	Valve Vault	EA	1	$ 8,000	$ 8,000
6	6" Actuated Valve	EA	1	$ 10,000	$ 10,000
7	6" Waterline	EA	100	$ 40	$ 4,000
8	6" 90 Degree Elbow	EA	3	$ 550	$ 1,650
9	6" Misc. Fittings	EA	2	$ 550	$ 1,100
10	Clear w ell Penetration	LS	1	$ 4,000	$ 4,000
11	Valve Control System	LS	1	$ 20,000	$ 20,000
				Subtotal	$ 69,035
		Contingency @ 15%			$ 10,360
		Engineering @ 20%			$ 13,810
		Legal. Admin./Finan @ 7%			$ 4,830
				Total	$ 99,000

City of Sutherlin Water Master Plan

Nonpareil Miscellaneous Upgrades and Repairs

Item Category	Item	Description	Unit	Quantity	Unit Price	Total
Setup Costs	1	Construct Facilities & Temporary Controls	LS	1	$ 333,933	$ 333,933
	2	Site Preparation	LS	1	$ 166,967	$ 166,967
Filter Improv.	3	Filter Media Removal and Replacement	LS	1	$ 200,000	$ 200,000
	4	Air Scour System With Underdrain	LS	1	$ 100,000	$ 100,000
	5	Blow er, Piping & Installation	LS	1	$ 95,000	$ 95,000
Clari. Improv.	6	Sandblasting & Repainting	LS	1	$ 110,000	$ 110,000
	7	Tube Replacement	SF	1450	$ 20	$ 29,000
	8	Clarifier Coating	LS	1	$ 45,000	$ 45,000
	9	Pressure Grouting per Foot (Contact Clarifier)	EA	250	$ 300	$ 75,000
Actuator Impov.	10	10" Actuated Buttefly Valves	EA	12	$ 10,000	$ 120,000
Replacement Backwash Piping	11	10" D.I. Pipe Spools	LF	8	$ 750	$ 6,000
	12	10" D.I. Tees	EA	7	$ 1,000	$ 7,000
	13	10" D.I. 90 Degree Elbow	EA	6	$ 700	$ 4,200
	14	10" x 8" Reducer	EA	4	$ 750	$ 3,000
	15	8" Pipe Spools	EA	8	$ 650	$ 5,200
	16	8" Flow Control Valve	EA	4	$ 10,000	$ 40,000
	17	8" D.I. 45 Degree Elbow	EA	4	$ 400	$ 1,600
	18	Misc. Pipe	LS	1	$ 5,000	$ 5,000
	19	Clearw ell Header	LS	1	$ 15,000	$ 15,000
	20	Backw ash Pump	EA	1	$ 27,500	$ 27,500
Replacement Treated Water Piping	21	Treated Pump	EA	3	$ 86,500	$ 259,500
	22	8" Pump Contorl Valve	EA	3	$ 10,250	$ 30,750
	23	8" Actuated Butterfly Valve	EA	3	$ 9,000	$ 27,000
	24	8" Wye	EA	2	$ 700	$ 1,400
	25	8" x 12" D.I. 90 Degree Elbow	EA	1	$ 2,500	$ 2,500
	26	4" Gate Valve	EA	1	$ 600	$ 600
	27	4" Surge Control Valve	EA	1	$ 6,200	$ 6,200
	28	4" D.I. 90 Degree Elbow	EA	1	$ 300	$ 300
	29	8" x 4" D.I. Tee	EA	1	$ 650	$ 650
	30	2" Air Vaccuum Release Valve	EA	1	$ 1,200	$ 1,200
Replacement Raw Water Piping	31	12" Flow Control Valve	EA	1	$ 20,000	$ 20,000
	32	12" Static Mixer	EA	1	$ 8,200	$ 8,200
Filter to Waste Piping	33	6" D.I. Pipe	LF	100	$ 80	$ 8,000
	34	6" D.I. Tees	EA	7	$ 390	$ 2,730
	35	10" D.I. Pipe	LF	40	$ 150	$ 6,000
	36	6" Actuated Butterfly Valve	EA	4	$ 8,000	$ 32,000
	37	6" D.I 90 Degree Elbow s	EA	9	$ 265	$ 2,385
Monitoring Equipment	38	Streming Current Monitor	EA	1	$ 14,000	$ 14,000
	39	Chlorine Analyzer	EA	1	$ 4,250	$ 4,250
	40	Turbidimeter Controller	EA	2	$ 4,250	$ 8,500
	41	Turbidimeter	EA	4	$ 875	$ 3,500
Misc. Improv.	42	200KW Generator and ATS	EA	1	$ 65,000	$ 65,000
	43	Intake Magnetic Meter	EA	1	$ 6,000	$ 6,000
	44	Grout	CY	8	$ 100	$ 800
	45	Control System Upgrade	LS	1	$ 187,000	$ 187,000
	46	Bulk Hypochlorite System	LS	1	$ 105,000	$ 105,000
	47	Air Compressor System Upgrade	EA	1	$ 17,000	$ 17,000
	48	Redundant Potable Water Pump	LS	1	$ 6,500	$ 6,500
	49	Pressure Tank Replacement and Piping	LS	1	$ 15,000	$ 15,000
Backwash Pond	50	Backw ash Pond Construction	LS	1	$ 495,758	$ 495,758
					Subtotal	$ 2,727,123
		Contingency @ 15%				$ 409,070
		Engineering @ 17%				$ 463,610
		Legal. Admin./Finan @ 7%				$ 190,900
					Total	$ 3,800,000

City of Sutherlin Water Master Plan
Schoon Mt. Storage Improvements

Item	Description	Unit	Quantity	Unit Price	Total
1	Construction Facilities and Temp. Controls	ALL	LS	$55,875	$55,875
2	Demolition and Site Prep.	ALL	LS	$27,938	$27,938
3	Electrical-SCADA System	1	LS	$25,000	$25,000
4	Foundation Stabilization	1	LS	$5,000	$5,000
5	New 135K Gallon Reservoir	1	LS	$240,000	$240,000
6	Cathodic Protection	1	LS	$30,000	$30,000
7	Excavation, Site Grading	1	LS	$20,000	$20,000
8	Individual PRVs	15	EA	$500	$7,500
9	Misc. Piping/Tees/Valves	1	LS	$35,000	$35,000
10	Landscaping	1	LS	$10,000	$10,000
				Subtotal	$456,313
		Contingency @ 15%			$68,447
		Engineering @ 20%			$91,263
				Total	$617,000

City of Sutherlin Water Master Plan
Cathodic Protection for Water Reservoirs

Item	Description	Unit	Quantity	Unit Price	Total
1	Construction Facilities & Temporary Controls	LS	1	$ 45,953	$ 45,953
2	Mobilization/Demobilization	LS	1	$ 15,624	$ 15,624
3	Umpqua Tank	LS	1	$ 68,450	$ 68,450
4	Tanglewood Tank	LS	1	$ 20,950	$ 20,950
5	Upper Umpqua Tank	LS	1	$ 20,950	$ 20,950
6	Oak Hills Reservoir	LS	1	$ 40,500	$ 40,500
7	Calapooia Reservoir	LS	1	$ 45,400	$ 45,400
8	Cooper Creek Estates	LS	1	$ 40,500	$ 40,500
9	Ridgewater No. 1 & No. 2	LS	2	$ 34,800	$ 69,600
				Subtotal	$ 367,926
		Contingency @ 15%			$ 55,189
		Engineering			$ 73,585
		Legal, Admin, Financing @ 7%			$ 25,755
				Total	$ 523,000

City of Sutherlin Water Master Plan

Jones Buckley Road Waterline Improvements

Item	Description	Unit	Quantity	Unit Price	Total
1	Construct Facilities & Temporary Controls	LS	1	$ 31,886	$ 31,886
2	Waterline Demolition & Abandonment	LS	1	$ 15,943	$ 15,943
3	Site Preparation	LS	1	$ 4,251	$ 4,251
4	Foundation Stabilization	CY	20	$ 50	$ 1,000
5	AC Pavement R & R	TON	11	$ 140	$ 1,591
6	12-inch Waterline, Class C	LF	2800	$ 65	$ 182,000
7	1" Service Connections	EA	5	$ 700	$ 3,500
8	12" Valves	EA	2	$ 3,500	$ 7,000
9	12" X 8" Tees	EA	2	$ 650	$ 1,300
10	12" 90 Degree Elbow	EA	2	$ 620	$ 1,240
11	12" 45 Degrree Elbow	EA	2	$ 620	$ 1,240
12	12" Miscellaneous Fittings	EA	2	$ 650	$ 1,300
13	8" Miscellaneous Fittings	EA	2	$ 450	$ 900
14	Combination Air Valve	EA	1	$ 3,000	$ 3,000
15	Hydrant Reconnection	EA	1	$ 2,500	$ 2,500
16	Landscaping	LS	1	$ 6,000	$ 6,000
				Subtotal	$ 264,651
		Contingency @ 15%			$ 39,700
		Engineering @ 20%			$ 52,930
		Legal. Admin./Finan @ 7%			$ 18,530
				Total	$ 376,000

City of Sutherlin Water Master Plan

High School / Middle School Water Main Upsizing Improvements

Item	Description	Unit	Quantity	Unit Price	Total
1	Construct Facilities & Temporary Controls	LS	1	$ 51,017	$ 51,017
2	Waterline Demolition & Abandonment	LS	1	$ 25,509	$ 25,509
3	Site Preparation	LS	1	$ 6,802	$ 6,802
4	Foundation Stabilization	CY	50	$ 50	$ 2,500
5	AC Pavement R & R	TON	295	$ 140	$ 41,366
6	14-inch Waterline, Class C	LF	2600	$ 70	$ 182,000
7	8-Inch Class C	LF	100	$ 55	$ 5,500
8	2" Waterline, Class C	LF	50	$ 45	$ 2,250
9	2" Connections	EA	6	$ 950	$ 5,700
10	1" Service Connections	EA	40	$ 700	$ 28,000
11	1" Service Line @ 20'/conn.	LF	40	$ 150	$ 6,000
12	14" Valves	EA	3	$ 3,500	$ 10,500
13	14" Tees	EA	1	$ 2,100	$ 2,100
14	14" X 8" Tees	EA	1	$ 2,100	$ 2,100
15	14" 90 Degree Elbow	EA	1	$ 1,200	$ 1,200
16	14" Miscellaneous Fittings	EA	6	$ 1,650	$ 9,900
17	8" Miscellaneous Fittings	EA	6	$ 600	$ 3,600
18	Hydrant Reconnection	EA	8	$ 2,500	$ 20,000
19	Combination Air Valve	EA	1	$ 5,000	$ 5,000
20	Landscaping	LS	1	$ 5,000	$ 5,000
21	Concrete	LS	1	$ 7,300	$ 7,300
22	Gravel Surfacing	CY	5	$ 20	$ 100
				Subtotal	$ 423,445
		Contingency @ 15%			$ 63,520
		Engineering @ 20%			$ 84,690
		Legal. Admin./Finan @ 7%			$ 29,640
				Total	$ 602,000

City of Sutherlin Water Master Plan

6th Avenue Waterline Improvement

Item	Description	Unit	Quantity	Unit Price	Total
1	Construct Facilities & Temporary Controls	LS	1	$ 68,352	$ 68,352
2	Waterline Demolition & Abandonment	LS	1	$ 34,176	$ 34,176
3	Site Preparation	LS	1	$ 9,114	$ 9,114
4	Foundation Stabilization	CY	20	$ 50	$ 1,000
5	AC Pavement R & R	TON	540	$ 140	$ 75,573
6	12-inch Waterline, Class C	LF	4750	$ 65	$ 308,750
7	1" Service Connections	EA	5	$ 700	$ 3,500
8	12" Valves	EA	11	$ 3,500	$ 38,500
9	12" X 6" Tees	EA	4	$ 1,450	$ 5,800
10	12" 45 Degrree Elbow	EA	3	$ 620	$ 1,860
11	12" Miscellaneous Fittings	EA	2	$ 650	$ 1,300
12	6" Miscellaneous Fittings	EA	2	$ 450	$ 900
13	Combination Air Valve	EA	1	$ 5,000	$ 5,000
14	Hydrant Reconnection	EA	3	$ 2,500	$ 7,500
15	Landscaping	LS	1	$ 6,000	$ 6,000
				Subtotal	$ 567,325
		Contingency @ 15%			$ 85,100
		Engineering @ 20%			$ 113,470
		Legal. Admin./Finan @ 7%			$ 39,710
				Total	$ 806,000

City of Sutherlin Water Master Plan

Myrtle Street Waterline Improvement

Item	Description	Unit	Quantity	Unit Price	Total
1	Construct Facilities & Temporary Controls	LS	1	$ 7,540	$ 7,540
2	Waterline Demolition & Abandonment	LS	1	$ 3,770	$ 3,770
3	Site Preparation	LS	1	$ 1,005	$ 1,005
4	AC Pavement R & R	TON	45	$ 140	$ 6,364
5	12-inch Waterline, Class C	LF	400	$ 65	$ 26,000
6	2" Service Connections	EA	3	$ 1,000	$ 3,000
7	12" Valves	EA	1	$ 3,500	$ 3,500
8	12" Tee	EA	1	$ 1,450	$ 1,450
9	12" Miscellaneous Fittings	EA	1	$ 1,000	$ 1,000
10	Miscellaneous Fittings	EA	1	$ 450	$ 450
11	Hydrant Reconnection	EA	1	$ 2,500	$ 2,500
12	Landscaping	LS	1	$ 6,000	$ 6,000
				Subtotal	$ 62,579
		Contingency @ 15%			$ 9,390
		Engineering @ 20%			$ 12,520
		Legal. Admin./Finan @ 7%			$ 4,380
				Total	$ 89,000

City of Sutherlin Water Master Plan

Upper Umpqua Reservoir Storage Improvement

Item	Description	Unit	Quantity	Unit Price	Total
1	Construction Facilities and Temp. Controls	1	LS	$55,350	$55,350
2	Demolition and Site Prep.	1	LS	$18,450	$18,450
3	Electrical-SCADA System	1	LS	$25,000	$25,000
4	Foundation Stabilization	1	LS	$5,000	$5,000
5	New 75K Gal. Reservoir	1	LS	$225,000	$225,000
6	Cathodic Protection	1	LS	$30,000	$30,000
7	Excavation, Site Grading	1	LS	$35,000	$35,000
8	Misc. Piping/Tees/Valves	1	LS	$30,000	$30,000
9	Remove, and Replace Fencing	200	LF	$45	$9,000
10	Landscaping	1	LS	$10,000	$10,000
		Total Construction Cost			$442,800
		Contingency @ 15%			$66,420
		Engineering @ 20%			$88,560
		Legal. Admin./Finan @ 7%			$30,996
				Total	$629,000

City of Sutherlin Water Master Plan
Tanglewood Storage Improvement

Item	Description	Unit	Quantity	Unit Price	Total
1	Construction Facilities and Temp. Controls	ALL	LS	$51,600	$51,600
2	Demolition and Site Prep.	ALL	LS	$17,200	$17,200
3	Electrical-SCADA System	1	LS	$25,000	$25,000
4	Reservoir Foundation	1	LS	$5,000	$5,000
5	New 40K Gal. Reservoir	1	LS	$200,000	$200,000
6	Cathodic Protection	1	LS	$30,000	$30,000
7	Excavation, Site Grading	1	LS	$30,000	$30,000
8	Misc. Piping/Tees/Valves	1	LS	$35,000	$35,000
9	Remove, and Replace Fencing	200	LF	$45	$9,000
10	Landscaping	1	LS	$10,000	$10,000
				Subtotal	$412,800
		Contingency @ 15%			$61,920
		Engineering @ 20%			$82,560
		Legal. Admin./Finan @ 7%			$28,896
				Total	$587,000

City of Sutherlin Water Master Plan
Tanglewood Pump Station Improvement

Item	Description	Unit	Quantity	Unit Price	Total
1	Construct Facilities & Temporary Controls	LS	1	$ 25,941	$ 25,941
2	Pump Station Demolition & Abandonment	LS	1	$ 12,970	$ 12,970
3	Site Preparation	LS	1	$ 10,000	$ 10,000
4	Site Piping	LS	1	$ 10,000	$ 10,000
5	CMU Building	LS	1	$ 38,000	$ 38,000
6	Packaged Pump Station	LS	1	$ 77,688	$ 77,688
7	SCADA	LS	1	$ 5,000	$ 5,000
8	Flow Meter	EA	1	$ 9,500	$ 9,500
9	AC for Parking Area	Ton	11	$ 110	$ 1,250
10	Fencing	LF	200	$ 60	$ 12,000
11	Fence Gate	EA	1	$ 2,500	$ 2,500
12	Electrical	EA	1	$ 15,000	$ 15,000
13	Landscaping	LS	1	$ 2,000	$ 2,000
				Subtotal	$ 221,849
		Contingency @ 15%			$ 33,280
		Land Acquisition			$ 50,000
		Engineering @ 20%			$ 44,370
		Legal. Admin./Finan @ 7%			$ 15,530
				Total	$ 366,000

City of Sutherlin Water Master Plan

Upper Ridgewater Pump Station Improvements

Item	Description	Unit	Quantity	Unit Price	Total
1	Construct Facilities & Temporary Controls	LS	1	$ 17,618	$ 17,618
2	Waterline Demolition & Abandonment	LS	1	$ 8,809	$ 8,809
3	Site Preparation	LS	1	$ 2,129	$ 2,129
4	8-Inch Class C	LF	200	$ 55	$ 11,000
5	6" Tee	EA	2	$ 400	$ 800
6	6" Elbow	EA	6	$ 275	$ 1,650
7	Fire Hydrant	EA	1	$ 7,500	$ 7,500
8	6" Gate Valve	EA	2	$ 1,000	$ 2,000
9	Misc. Site Piping	LS	5	$ 700	$ 3,500
10	Packaged Pump Station w ith Enclosure	EA	1	$ 66,000	$ 66,000
11	Electrical Service Updgrade	EA	1	$ 25,000	$ 25,000
				Subtotal	$ 146,005
		Contingency @ 15%			$ 21,900
		Engineering @ 20%			$ 29,200
		Legal. Admin./Finan @ 7%			$ 10,220
				Total	$ 208,000

City of Sutherlin Water Master Plan

Southside Road Waterline Improvement

Item	Description	Unit	Quantity	Unit Price	Total
1	Construct Facilities & Temporary Controls	LS	1	$ 27,392	$ 27,392
2	Waterline Demolition & Abandonment	LS	1	$ 13,696	$ 13,696
3	Site Preparation	LS	1	$ 3,652	$ 3,652
4	Foundation Stabilization	CY	20	$ 50	$ 1,000
5	AC Pavement R & R	TON	222	$ 140	$ 31,025
6	8-inch Waterline, Class C	LF	1950	$ 65	$ 126,750
7	1" Service Connections	EA	6	$ 700	$ 4,200
8	8" Gate Valve	EA	4	$ 1,500	$ 6,000
9	8" X 6" Tees	EA	2	$ 650	$ 1,300
10	8" 45 Degrree Elbow	EA	2	$ 620	$ 1,240
11	8" Miscellaneous Fittings	EA	1	$ 650	$ 650
12	6" Miscellaneous Fittings	EA	1	$ 450	$ 450
13	Combination Air Valve	EA	1	$ 5,000	$ 5,000
14	Hydrant Reconnection	EA	2	$ 2,500	$ 5,000
				Subtotal	$ 227,355
		Contingency @ 15%			$ 34,100
		Engineering @ 20%			$ 45,470
		Legal. Admin./Finan @ 7%			$ 15,910
				Total	$ 323,000

PHASE II IMPROVEMENTS

City of Sutherlin Water Master Plan

E. 1st Street Waterline Improvement

Item	Description	Unit	Quantity	Unit Price	Total
1	Construct Facilities & Temporary Controls	LS	1	$ 22,979	$ 22,979
2	Waterline Demolition & Abandonment	LS	1	$ 11,489	$ 11,489
3	Flaggers	HR	80	$ 55	$ 4,400
4	AC Pavement R & R	TON	136	$ 140	$ 19,092
5	8-inch Waterline, Class C	LF	1200	$ 75	$ 90,000
6	1" Service Connections	EA	25	$ 700	$ 17,500
7	8" Gate Valve	EA	3	$ 1,500	$ 4,500
8	14" Butterfly Valve	EA	2	$ 4,000	$ 8,000
9	14" X 8" Cross	EA	1	$ 2,000	$ 2,000
10	8" X 6" Tee	EA	1	$ 650	$ 650
11	14" Transition Cplg.	EA	2	$ 1,500	$ 3,000
12	8" Transition Cplg.	EA	1	$ 1,000	$ 1,000
13	14" Spool	EA	2	$ 700	$ 1,400
14	8" Spool	EA	1	$ 550	$ 550
15	8" Miscellaneous Fittings	EA	2	$ 650	$ 1,300
16	14" Miscellaneous Fittings	EA	2	$ 850	$ 1,700
17	Hydrant Reconnection	EA	1	$ 2,500	$ 2,500
				Subtotal	$ 192,060
		Contingency @ 15%			$ 28,810
		Engineering @ 20%			$ 38,410
		Legal. Admin./Finan @ 7%			$ 13,440
				Total	$ 273,000

City of Sutherlin Water Master Plan

Mardonna & Sherwood St. Waterline Improvement

Item	Description	Unit	Quantity	Unit Price	Total
1	Construct Facilities & Temporary Controls	LS	1	$ 88,843	$ 88,843
2	Waterline Demolition & Abandonment	LS	1	$ 44,421	$ 44,421
3	Flaggers	HR	220	$ 55	$ 12,100
4	AC Pavement R & R	TON	523	$ 140	$ 73,186
5	8-inch Waterline, Class C	LF	4600	$ 75	$ 345,000
6	1" Service Connections	EA	120	$ 700	$ 84,000
7	8" Gate Valve	EA	28	$ 1,500	$ 42,000
8	8" Cross	EA	10	$ 650	$ 6,500
9	8" Tee	EA	2	$ 650	$ 1,300
10	8" x 6" Reducer	EA	11	$ 500	$ 5,500
11	6" Pipe Spool	EA	11	$ 500	$ 5,500
12	6" Tranistion Coupling	EA	11	$ 300	$ 3,300
13	8" Miscellaneous Fittings	EA	10	$ 600	$ 6,000
14	Hydrant Reconnection	EA	8	$ 2,500	$ 20,000
				Subtotal	$ 737,651
		Contingency @ 15%			$ 110,650
		Engineering @ 20%			$ 147,530
		Legal. Admin./Finan @ 7%			$ 51,640
				Total	$ 1,048,000

City of Sutherlin Water Master Plan
Water Reservoir Reconditioning

Item	Description	Unit	Quantity	Unit Price		Total	
1	North Umpqua Tank						
	Exterior	SF	2270	$	15	$	34,050
	Interior	SF	2940	$	25	$	73,500
	Bolt Replacement	LS	1	$	5,000	$	5,000
				Subtotal		$	112,550
2	Ridgew ater No. 1						
	Exterior	SF	1287	$	15	$	19,305
	Bolt Replacement	LS	1	$	5,000	$	5,000
				Subtotal		$	24,305
				Subtotal		$	136,855
		Contingency @ 15%				$	20,528
		Engineering				$	25,000
		Legal, Admin, Financing @ 7%				$	9,580
				Total		$	192,000

City of Sutherlin Water Master Plan
Ridgewater Reservoir Storage Improvement

Item	Description	Unit	Quantity	Unit Price	Total
1	Construction Facilities and Temp. Controls	ALL	LS	$50,775	$50,775
2	Demolition and Site Prep.	ALL	LS	$25,388	$25,388
3	Electrical-SCADA System	1	LS	$25,000	$25,000
4	Foundation Stabilization	1	LS	$5,000	$5,000
5	New 55K Gal. Reservoir	1	LS	$225,000	$225,000
6	Excavation, Site Grading	1	LS	$30,000	$30,000
7	Misc. Piping/Tees/Valves	1	LS	$30,000	$30,000
8	Remove, and Replace Fencing	300	LF	$45	$13,500
9	Landscaping	1	LS	$10,000	$10,000
				Subtotal	$414,663
		Contingency @ 15%			$62,199
		Engineering @ 20%			$82,933
		Legal. Admin./Finan @ 7%			$29,026
				Total	$589,000

City of Sutherlin Water Master Plan

New 0.5 MG Reservoir – Plat M Road

Item	Description	Unit	Quantity	Unit Price	Total
1	Construction Facilities & Temporary Controls	LS	1	$ 74,675	$ 74,675
2	Mobilization/Demobilization	LS	1	$ 50,890	$ 50,890
3	500,000 GFTS Tank w / Alum Dome Roof	LS	1	$ 500,000	$ 500,000
4	Access Road	LS	1	$ 79,000	$ 79,000
5	Earthw ork/Gravel Surfacing	LS	1	$ 110,000	$ 110,000
6	Site Piping	LS	1	$ 120,000	$ 120,000
7	Interior Piping	LS	1	$ 55,000	$ 55,000
8	Exterior Liquid Level Indicator	LS	1	$ 5,000	$ 5,000
9	Elec. Liquid Level Indicator	LS	1	$ 6,500	$ 6,500
10	Handrail	LF	45	$ 63	$ 2,835
11	Chain Link Fence	LF	1000	$ 30	$ 30,000
12	16' Double Sw ing Gate	EA	1	$ 2,000	$ 2,000
13	Siesmic Valving	LS	1	$ 25,000	$ 25,000
14	Electrical On-site	LS	1	$ 7,500	$ 7,500
15	Electrical - New Service	LS	1	$ 30,000	$ 30,000
16	Telemetry	LS	1	$ 25,000	$ 25,000
				Subtotal	$ 1,123,400
		Contingency @ 15%			$ 168,510
		Engineering @ 20%			$ 224,680
		Legal, Admin, Financing @ 7%			$ 78,638
		Geotech Investigations			$ 30,000
		Land Acquisition			$ 100,000
				Total	$ 1,726,000

City of Sutherlin Water Master Plan

Reservoir Piping – Plat M Road Reservoir

Item	Description	Unit	Quantity	Unit Price	Total
1	Construct Facilities & Temporary Controls	LS	1	$ 92,216	$ 92,216
2	Site Preparation	LS	1	$ 30,739	$ 30,739
3	Foundation Stabilization	CY	100	$ 50	$ 5,000
4	Electrical / Controls	LS	1	$ 5,000	$ 5,000
5	AC Pavement R & R	TON	511	$ 140	$ 71,595
6	18-Inch Waterline, Class B	LF	2000	$ 85	$ 170,000
7	18-inch Waterline, Class C	LF	2500	$ 95	$ 237,500
8	18" Butterfly Valve	EA	4	$ 5,500	$ 22,000
9	18" Tee	EA	1	$ 3,500	$ 3,500
10	18" 90 Degree Elbow	EA	2	$ 3,000	$ 6,000
11	18" 45 Degree Elbow	EA	4	$ 2,500	$ 10,000
12	18" Wye	EA	1	$ 3,000	$ 3,000
13	18" Gate Valve	EA	5	$ 8,500	$ 42,500
14	18" Spool	EA	2	$ 700	$ 1,400
15	18" Transition Coupling	EA	2	$ 1,000	$ 2,000
16	18" Miscellaneous Fittings	EA	3	$ 3,500	$ 10,500
17	8-Inch Class C	LF	50	$ 55	$ 2,750
18	2" Waterline, Class C	LF	4	$ 45	$ 180
19	2" Connections	EA	4	$ 1,000	$ 4,000
20	1" Service Connections	EA	21	$ 700	$ 14,700
21	1" Service Line @ 20'/conn.	LF	21	$ 150	$ 3,150
				Subtotal	$ 737,730
		Contingency @ 15%			$ 110,660
		Engineering @ 20%			$ 147,550
		Legal. Admin./Finan @ 7%			$ 51,640
				Total	$ 1,048,000

City of Sutherlin Water Master Plan

Reservoir Piping – Duke Road Water Main Improvements

Item	Description	Unit	Quantity	Unit Price	Total
1	Construct Facilities & Temporary Controls	LS	1	$ 91,452	$ 91,452
2	Site Preparation	LS	1	$ 30,484	$ 30,484
3	Foundation Stabilization	CY	100	$ 50	$ 5,000
4	Electrical / Controls	LS	1	$ 5,000	$ 5,000
5	AC Pavement R & R	TON	345	$ 140	$ 48,367
6	18-inch Waterline, Class C	LF	3040	$ 95	$ 288,800
7	18" Butterfly Valve	EA	3	$ 5,500	$ 16,500
8	18" x 6" Tee	EA	4	$ 3,100	$ 12,400
9	6" Gate Valve	EA	1	$ 1,000	$ 1,000
10	6" Pipe Spool	EA	1	$ 500	$ 500
11	6" Transition Coupling	EA	1	$ 300	$ 300
12	18" x 10" Tee	EA	1	$ 3,500	$ 3,500
13	10" Gate Valve	EA	2	$ 2,300	$ 4,600
14	10" Pipe Spool	EA	2	$ 600	$ 1,200
15	10" Tranition Coupling	EA	2	$ 600	$ 1,200
16	18" 90 Degree Elbow	EA	2	$ 2,500	$ 5,000
17	18" 45 Degree Elbow	EA	4	$ 3,000	$ 12,000
18	18" Wye	EA	1	$ 8,500	$ 8,500
19	18" Miscellaneous Fittings	EA	6	$ 3,500	$ 21,000
20	18" HDD across I-5	LF	360	$ 375	$ 135,000
21	8-Inch Class C	LF	50	$ 55	$ 2,750
22	2" Waterline, Class C	LF	7	$ 45	$ 315
23	2" Connections	EA	7	$ 1,000	$ 7,000
24	1" Service Connections	EA	35	$ 700	$ 24,500
25	1" Service Line @ 20'/conn.	LF	35	$ 150	$ 5,250
				Subtotal	$ 731,618
		Contingency @ 15%			$ 109,740
		Engineering @ 20%			$ 146,320
		Legal. Admin./Finan @ 7%			$ 51,210
				Total	$ 1,039,000

City of Sutherlin Water Master Plan
City of Oakland Water System Tie-in

Item	Description	Unit	Quantity	Unit Price	Total
1	Construct Facilities & Temporary Controls	LS	1	$ 34,798	$ 34,798
2	Waterline Demolition & Abandonment	LS	1	$ 15,466	$ 15,466
3	Site Preparation	LS	1	$ 7,733	$ 7,733
4	Foundation Stabilization	CY	50	$ 20	$ 1,000
5	AC Pavement R & R	LF	3000	$ 35	$ 105,000
6	8-inch Waterline, Class C	LF	3000	$ 75	$ 225,000
12	8" Valves	EA	6	$ 1,500	$ 9,000
13	8" Tees	EA	1	$ 650	$ 650
15	8" 90 Degree Elbow	EA	3	$ 700	$ 2,100
15	8" 45 Degree Elbow	EA	4	$ 625	$ 2,500
16	8" Miscellaneous Fittings	EA	10	$ -	$ -
8	2" Waterline, Class C	LF	1	$ 40	$ 40
9	2" Connections	EA	1	$ 1,000	$ 1,000
10	1" Service Connections	EA	1	$ 700	$ 700
11	1" Service Line @ 20'/conn.	LF	1	$ 150	$ 150
19	New Hydrant & Connection	EA	3	$ 5,000	$ 15,000
18	Hydrant Reconnection	EA	1	$ 2,500	$ 2,500
19	Combination Air Valve	EA	3	$ 2,000	$ 6,000
20	Landscaping	LS	1	$ 7,500	$ 7,500
21	Concrete	LS	1	$ 7,500	$ 7,500
22	Gravel Surfacing	CY	50	$ 20	$ 1,000
				Subtotal	$ 444,636
		Contingency @ 15%			$ 66,700
		Engineering @ 17%			$ 75,590
		Legal. Admin./Finan @ 7%			$ 31,120
				Total	$ 619,000

APPENDIX E: Comments