Terrebonne Wastewater System Preliminary Engineering Report

Prepared for
Deschutes County

October 2022

Prepared by
Parametrix

This page intentionally left blank.

Terrebonne Wastewater System Preliminary Engineering Report

Prepared for

Deschutes County
61150 SE 27th Street
Bend, Oregon 97702

Prepared by

Parametrix
150 NW Pacific Park Lane, Suite 110
Bend, OR 97701
T. 541.508.7710 F. 1.855.542.6353

www.parametrix.com

Funded in part by

Business Oregon – Infrastructure Finance Authority
775 Summer St., NE, Suite 200
Salem, OR 97301
Ph: 503-986-0123

www.oregon.gov/biz

October 2022 | 297-2509-008

CITATION

Parametrix, 2022. Terrebonne Wastewater System Preliminary Engineering Report. Prepared by Parametrix, Bend, Oregon. October 2022.

ACKNOWLEDGEMENTS

Deschutes County: Chris Doty, Todd Cleveland, Tim Berg, Board of Commissioners

City of Redmond: Ryan Kirchner, Bill Duerden, Jeremy Stachowski

ODOT: Cari Charlton

Business Oregon: Carolyn Meece, Rich Rodriguez, Matthew Mattia, Capi Lewis

DEQ: Greg Svelund, Larry Brown, Chris Marko

USDA-RD: Kimberly Young

Swearingen Group: Linda Swearingen

Galardi Rothstein Group: Deb Galardi

Jordan Ramis PC: Steve Shropshire, Marika Sitz

Terrebonne Sewer Advisory Group: Guy Vernon, Parker Vernon, Tim Brown, Rob Jackson, Kristin Yurdin, Randy Lunsford, Mike Walker, Janet Abbas, Nick Kezele, Keith Bedell, Lauren Redman

This project was funded with a financial award from the Water Fund, funded by the Oregon State Lottery and administered by the State of Oregon, Business Development Department.

CERTIFICATION

The technical material and data contained in this document were prepared under the supervision and direction of the undersigned, whose seal, as a professional engineer licensed to practice as such, is affixed below.

Prepared by Ryan Rudnick, PE

Checked by Seth Rankin, PE

Approved by Jim Frost, PE

DISCLAIMER:
This document provides preliminary engineering information, analysis, opinions of probable cost, and recommendations relevant for funding public wastewater utility projects. This preliminary information offers guidance for sanitary districts and utility managers, and should be interpreted and used in a manner fully consistent with federal and state environmental laws and implementing rules. This document is not legally binding and does not create any rights, duties, obligations, or defenses, implied or otherwise, in any third parties. This document should not be construed as rule, although some of it describes existing state and federal laws. The recommendations contained in this document should not be construed as a financial commitment or a requirement of rule or statute.

This page intentionally left blank.

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

LIST OF FIGURES

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

LIST OF TABLES

TABLE OF CONTENTS (CONTINUED)

LIST OF PHOTOGRAPHS

APPENDICES

ACRONYMS AND ABBREVIATIONS

AAGR	average annual growth rate
BOD	biochemical oxygen demand
CWSRF	Clean Water State Revolving Fund
DEQ	Oregon Department of Environmental Quality
DSCR	debt service coverage ratio
DCCPF	Deschutes County Coordinated Population Forecast
District	future Terrebonne Sanitary District
EDU	equivalent dwelling unit
gpcd	gallons per capita per day
gpm	gallons per minute
gpd	gallons per day
HDPE	High density polyethylene
OAR	Oregon Administrative Rule
OBDD-IFA	Oregon Business Development Department - Infrastructure Finance Authority
ORS	Oregon Revised Statute
PVC	Polyvinyl Chloride
SDC	system development charge
STEG	septic tank effluent gravity
STEP	septic tank effluent pressure
TDWD	Terrebonne Domestic Water District
TSAG	Terrebonne Sewer Advisory Group
TSS	Total suspended solids
USDA-RD	United States Department of Agriculture – Rural Development
WPCF	water pollution control facility
WWTP	wastewater treatment plant

This page intentionally left blank.

1. INTRODUCTION

1.1 Executive Summary

Problem Statement: The unincorporated community of Terrebonne, Oregon, does not currently have a municipal wastewater facility. Consequently, businesses and residents depend on onsite wastewater systems including septic tanks with drainfields, drill holes, and sand filters. The continued use of onsite wastewater disposal systems presents economic, public safety, and environmental health risks to the Terrebonne Community. Onsite septic systems are not a sustainable long-term solution for wastewater management in Terrebonne that can safeguard public health and economic vitality. Installation of a wastewater system would help businesses operate reliably and would facilitate development of new housing, jobs, and commerce in the community.

Community Growth: For the purposes of this study, the Terrebonne service area has been divided into three separate phases of roughly equal size. The proposed wastewater collection system will initially serve the Commercial Core Area in Phase A and can be expanded to serve Phase B and Phase C in the future when desired by constituents in those areas. Below is a table summarizing current and projected population, EDUs, and flows.

Phase	Phase A Core	Phase B West	Phase C East	Total
Current Population Estimates	279	627	487	1,393
20-Year Projected Population at 1.9% Avg. Annual Growth	402	832	792	2,030
Current EDUs	160	250	240	650
20-Year Projected EDUs	320	374	360	1,054
Current Average Daily Flow (gpd)	24,000	37,500	36,000	97,500
20-year Projected Average Daily Flow (gpd)	48,000	56,100	54,000	158,100

Alternatives Considered: Various methods of wastewater collection, treatment, and disposal were reviewed and evaluated for implementation in Terrebonne. The three design alternatives include:

1. Facultative Lagoon and Irrigation Reuse for Effluent Disposal, STEG/STEP Collection
2. Packaged Treatment System with Drainfield for Effluent Disposal, STEG/STEP Collection
3. City of Redmond Wastewater Treatment Wetlands Complex, STEP Collection

Proposed Project: Alternative 3 was determined to be the preferred wastewater alternative for Terrebonne. The proposed STEP collection system and interconnection with the City of Redmond Wetlands Complex will provide Terrebonne with a reliable, quality wastewater system that will maintain regulatory compliance and meet the needs of the Terrebonne community.

Funding: Project costs for the proposed Phase A STEP collection system are expected to range from $2.68 Million to $5.75 Million. The key to implementing the proposed wastewater system improvements is the District's ability to acquire low-interest loan funding and grant funds. This will be critically important to keeping SDCs and monthly user rates affordable. In addition, the District will need to secure a high level of customer participation in the Phase A service area in order to secure loan funding, generate sufficient operating revenues, and cover operating expenses including debt service.

1.2 Purpose of this Report

This engineering report provides guidance to the proposed Terrebonne Sanitary District (District)[1] for providing centralized wastewater collection and treatment solutions for properties within the District's service area. Existing development in this area is currently served by individual onsite wastewater systems. This report studies the feasibility of initially sewering the commercial core area in Terrebonne and considers expanding facilities to residential areas east and west of Terrebonne if it is financially feasible.

This report conforms with current Oregon Department of Environmental Quality (DEQ) regulations and guidelines and meets the requirements of Oregon Administrative Rule (OAR) 123-043-000. This report has been prepared in accordance with the guidelines *Preparing Wastewater Planning Documents and Environmental Reports for Public Utilities*[2] in the case that funding is requested from the Oregon Business Development Department Infrastructure Finance Authority, Oregon Department of Environmental Quality Clean Water State Revolving Fund, or the U.S. Department of Agriculture (USDA) Rural Development. As this report may be used to process funding requests, it describes the District's present situation, analyzes alternatives, and recommends a specific course of action. The depth of analysis within this report was prepared in proportion to the size and complexity of the proposed project.

The primary objectives of this report are to ensure adequate conveyance and treatment capacity is provided to meet the needs of the District's service area, to ensure such facilities minimize adverse impacts to the environment, to protect the health and safety of the affected community, and to accomplish these goals in an economical and efficient manner. Minimum requirements for the collection system are design guidelines and standards developed by DEQ. The approach taken in preparation of this report was to:

- Define environmental and physical conditions in the planning area
- Describe existing facilities, capacity, and constraints
- Describe the need for the project
- Develop flow and waste load projections
- Evaluate alternatives to meet project needs.
- Describe the proposed project, costs, and implementation plan

This report uses information obtained from Deschutes County (County), as well as previous planning and design-related documents. Information provided by County staff described various systems and loading characteristics. It is anticipated that this report will be reviewed by the District, DEQ, stakeholders and applicable funding agencies.

---

[1] See Section 5.6 for more information about the proposed sanitary district.

[2] https://www.rd.usda.gov/files/OR-Guide-PreparingWastewaterPlanningDocuments-07.2018.pdf

1.3 Related Documents, Standards, and Design Criteria

- *Preparing Wastewater Planning Documents and Environmental Reports for Public Utilities*[2], financed by:
  - Infrastructure Finance Authority
  - Oregon Department of Environmental Quality
  - Rural Community Assistance Corporation
  - U.S. Department of Agriculture
- *Terrebonne Sanitary District Wastewater Facilities Plan 1999, 2007 Update HGE, Inc.*
- *Recommended Standards for Wastewater Facilities (10 States Standards) 2014 Edition* [3]
- *Effluent Sewer Design Manual by Orenco Systems Inc., Rev. 3, July 2017* [4]

1.4 Background

The unincorporated community of Terrebonne, Oregon, does not currently have a municipal wastewater facility; businesses and residents depend on onsite wastewater systems (septic tanks with drainfields, drill holes, or sand filters). Aged and failing septic systems, coupled with the low permeability of the soils, is resulting in onsite system failures, surfacing effluent, exorbitant repair and replacement costs, and business closures. The downtown core area of Terrebonne includes both commercial and residential zoned land and is not well suited for onsite wastewater disposal. The area has shallow bedrock that is typically within 24 inches of the ground surface.

The area is platted with small lots that lack adequate drainfield reserve area. Many lots have been denied septic system approval by DEQ and the County due to inadequate lot area or poor soil permeability. These conditions limit the ability of businesses and residences to expand or continue operating in Terrebonne. Onsite septic systems are not a sustainable long-term solution for wastewater management in Terrebonne that can adequately safeguard public health and economic vitality.

A wastewater facilities plan was completed for Terrebonne in 1982 by Century West Engineering. The study advocated for the continued use of drill holes for effluent disposal; it claimed that this approach "will not eventually cause contamination of the underlying aquifer." These conclusions from the 1982 study are no longer tenable in the current regulatory environment.

The Terrebonne Domestic Water District (TDWD) received a grant from the Central Oregon Rural Investment Fund to complete a sewer feasibility study in 1999; the study was prepared by HGE, Inc. This study explored several concepts for wastewater collection and treatment systems, as well as strategies to fund the construction and operation of the infrastructure. This 1999 study failed to result in a wastewater system because of community opposition at the time, primarily due to the estimated costs and lack of risk to the water system. The project team is not aware of any public poll or vote officially documenting the community's former position for or against a public sewer system in Terrebonne.

---

[3] https://www.health.state.mn.us/communities/environment/water/tenstates/standards.html

[4] https://odl.orenco.com/documents/NDA-EFS-1.pdf

Approximately 20 years later, existing onsite systems have further deteriorated; this has resulted in increased operational failures, repair costs, and business closures. This current study was initiated in 2019 by a petition of community members who were struggling with septic system issues and interested in seeing an updated wastewater feasibility study. In response, Deschutes County agreed to fund the feasibility study (with partial grant funding from Business Oregon), but it has no intent to own, operate, or maintain a sewer system in Terrebonne. The County expects that a new sanitary district will be formed to manage these responsibilities.

2. PROJECT PLANNING

2.1 Location

Terrebonne is an unincorporated community located in northeastern Deschutes County; it is approximately 6 miles north of Redmond and 22 miles north of Bend (see Figure 2-1). Terrebonne is recognized by the County and State as a "Rural Community" (defined by OAR 660-022-0010) because of its function as a longstanding rural service center. Founded as a railroad town in 1909, Terrebonne contains residential neighborhoods, a community school, a commercial business district (along US Highway 97), and commercial expansion area. The most recent Terrebonne Community Plan (see Appendix A) includes the following Community Vision Statement:

> **Maintain the livability of Terrebonne as a small town with its rural and scenic character, by encouraging efficient services and safe traveling throughout the community.**

The planning area for this report consists of the area within the existing unincorporated community boundary. This proposed ultimate service area includes TEC (Commercial), TERC (Commercial Rural), and TER (Residential) zones that allow dense residential and commercial development on smaller lots. TER5 zones (Residential 5-acre minimum) in the northwest and southwest corners of the community boundary are excluded from the proposed sewer service area. The zones are shown on Figure 2-2.

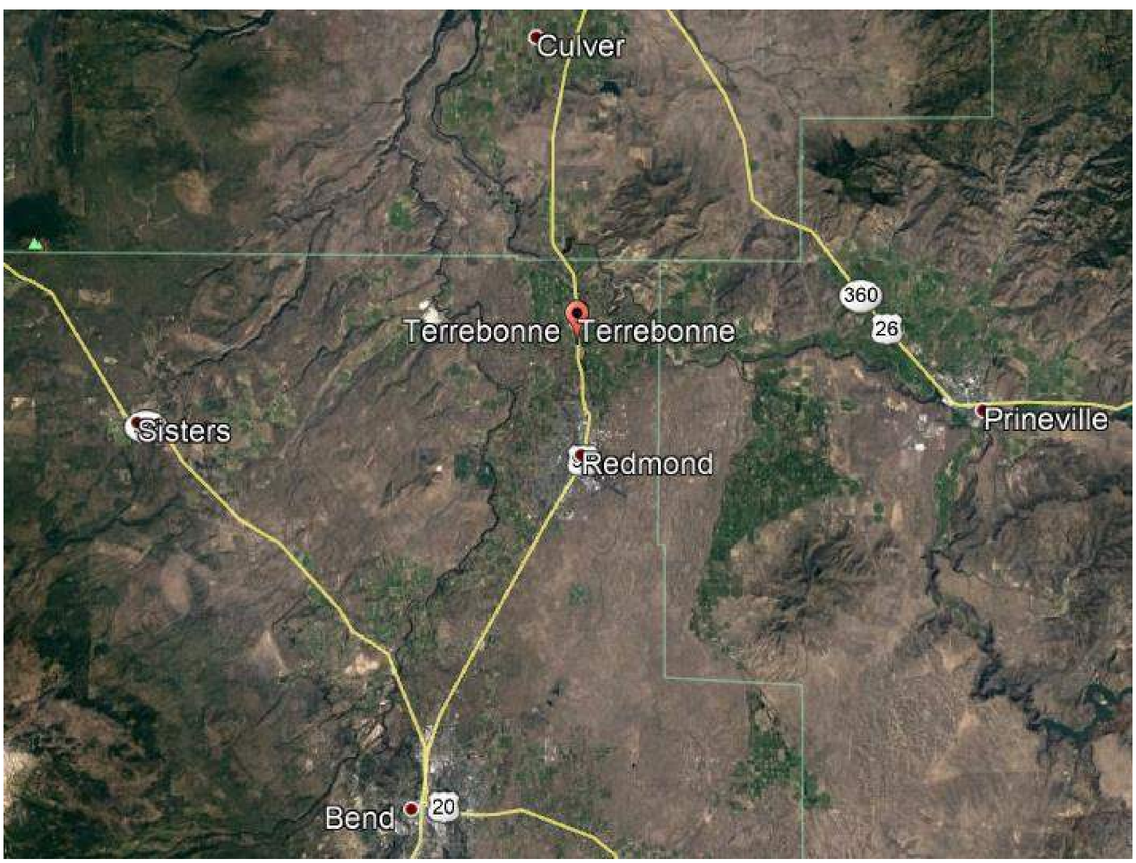


Figure 2-1. Terrebonne Vicinity Map
Source: Google Earth

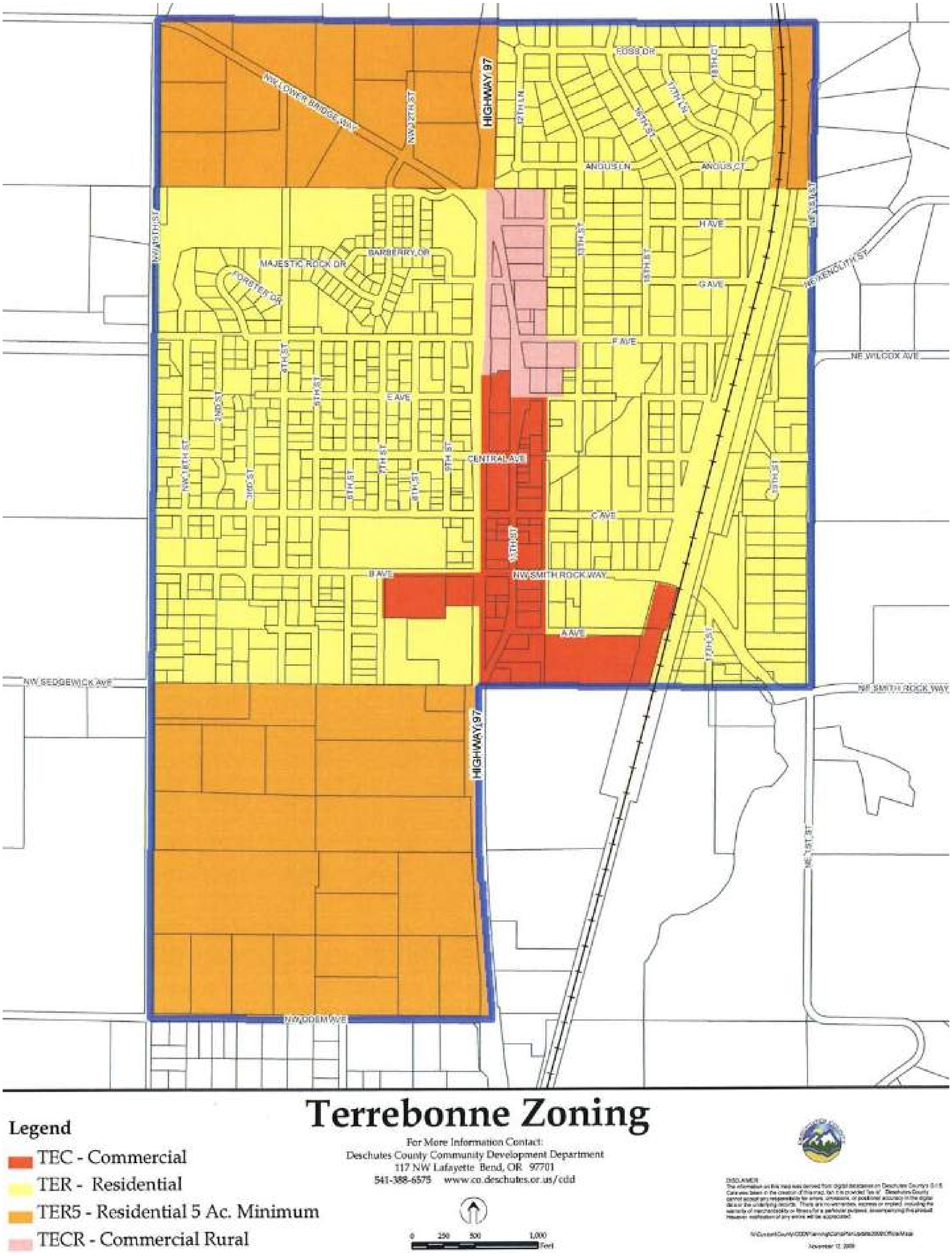


Figure 2-2. Terrebonne Zoning Map

Table 2-1 summarizes the residential units, commercial/industrial developments, vacant parcels, and total parcels in each zone. This information was provided by the Deschutes County Community Development Department; see Appendix B for the full memorandum. Many of the vacant properties cannot be developed because the lots are too small to install an onsite septic system, especially with required reserve space for future repairs or replacements. Even with adequate lot sizes, many of these vacant lots do not have adequate soil conditions to obtain septic approval from the County.

Table 2-1. Land Use Inventory

Zone	Residential Units	Commercial/Industrial Developments	Undeveloped Parcels	Total Number of Parcels
TEC (Commercial)	16	18	18	49
TECR (Commercial Rural)	3	9	10	18
TER (Residential)	556	5	160	686
TER5 (Residential 5-Acre)	40	1	1	40
Total	**615**	**33**	**189**	**793**

Figure 2-3 shows vacant parcels in orange, as well as the boundaries of two private sewer districts for Terrebonne Estates and Angus Acres. These sewer districts were required for development of higher-density residential lots and for areas not suitable for onsite septic systems per the related DEQ standards and Oregon Administrative Rules.

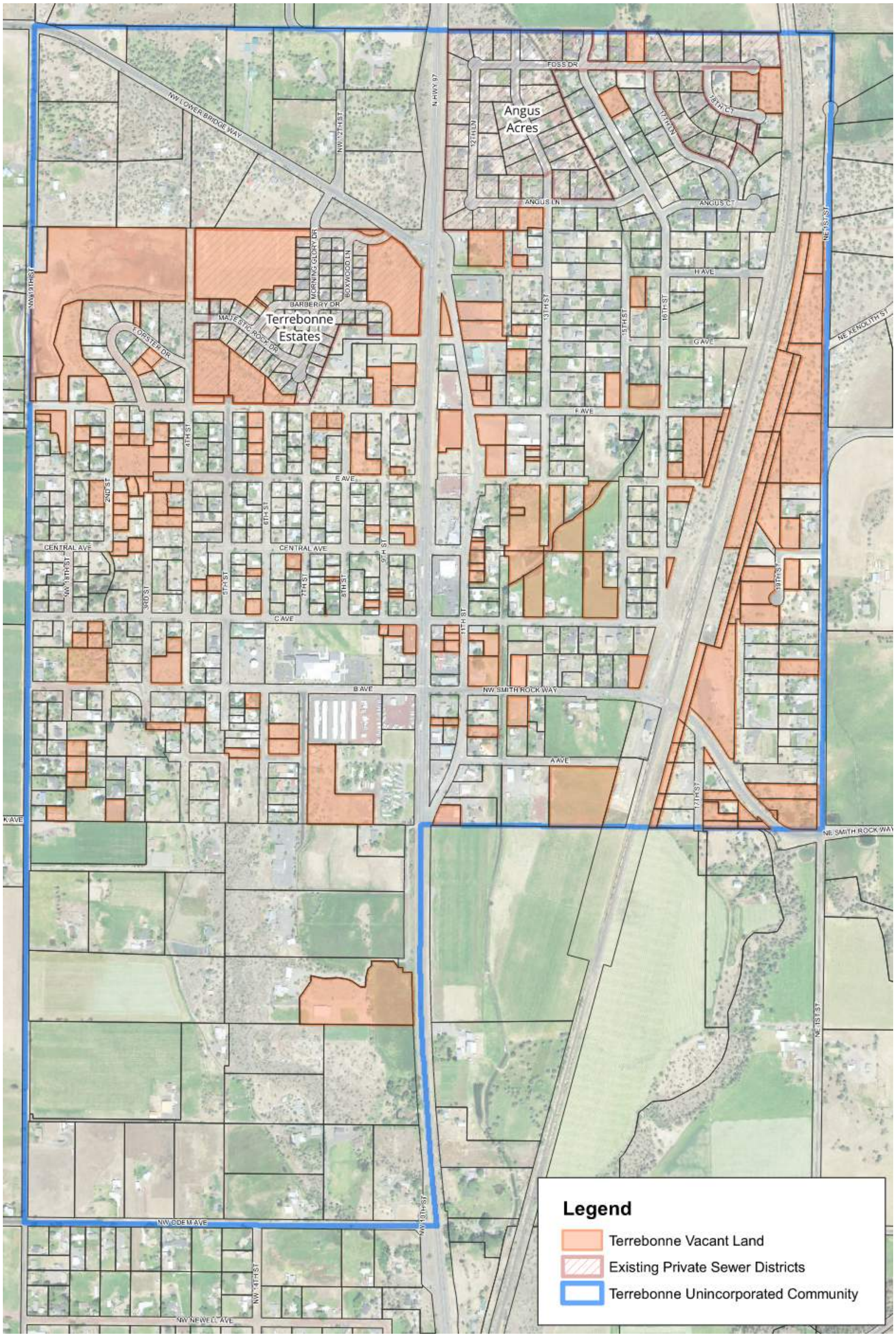


Figure 2-3. Terrebonne Vacant Lands Map
Source: Deschutes County Planning Department

2.2 Environmental Resources Present

2.2.1 Landscape and Topography

Most of Terrebonne lies on top of a relatively flat ridge bordered on the west, east, and part of the north, with a steep rimrock edge that drops to more gently sloped areas below. On the ridgetops, elevations generally range from 2,750 to 2,880 feet. See Figure 2-4 for a topographic map of the Terrebonne community.

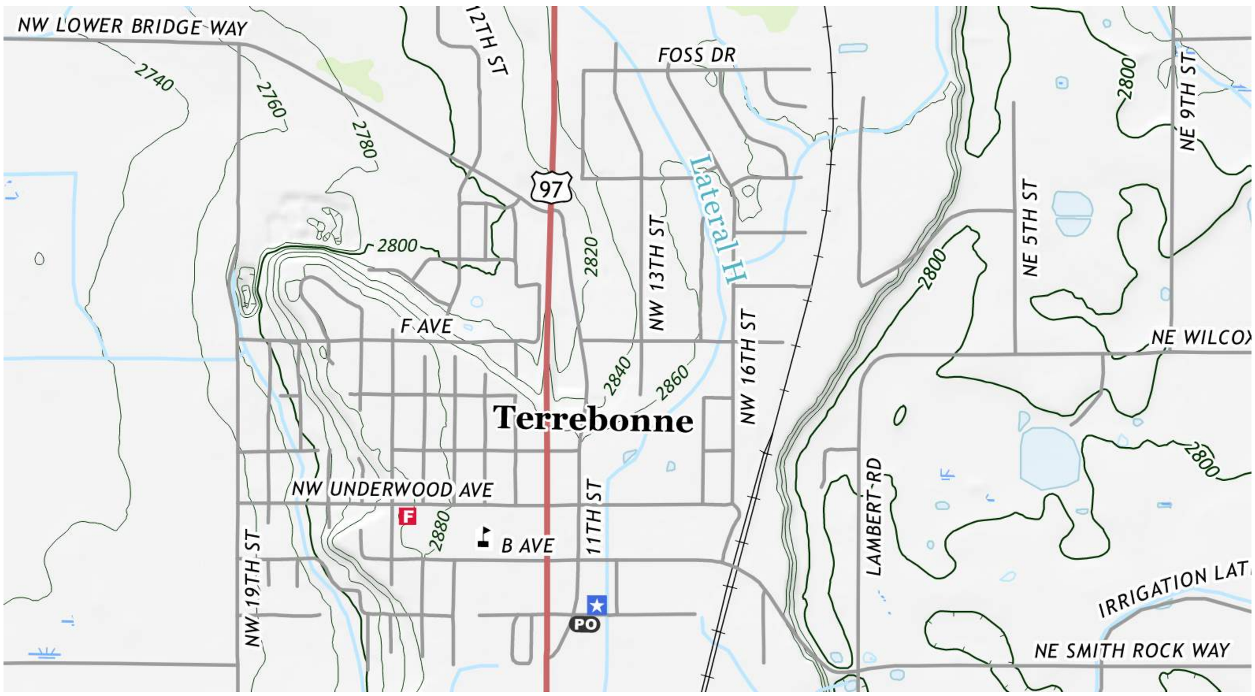


Figure 2-4. USGS Topographic Map of Terrebonne

2.2.2 Soils

Based on information from the Natural Resources Conservation Service (NRCS), soils in the planning area include the Deschutes Series, Madras Series, and scabland or rough stony land. Most of the densely developed parts of the community are on the scablands. Soils are of minimal thickness—on the order of 6 inches to bedrock. While soil depths are greater in the Deschutes and Madras Series soils, at 20 to 40 inches to bedrock, they can also be classified as shallow soils. The shallow rocky soil conditions typical in this region are a key factor in the high failure rate of onsite septic systems. A detailed USDA-NRCS Soils Report is included in Appendix C for reference.

2.2.3 Climate

Terrebonne's climate is semi-arid with average rainfall of approximately 10 inches per year and average snowfall of 14 inches per year. The mean annual temperature is 47.7°F with temperature extremes ranging from near 0°F in winter to over 100°F in summer. See Figure 2-5, Figure 2-6, and Figure 2-7. Appendix D includes Terrebonne area climate data, based on the Redmond Airport Climate Station.

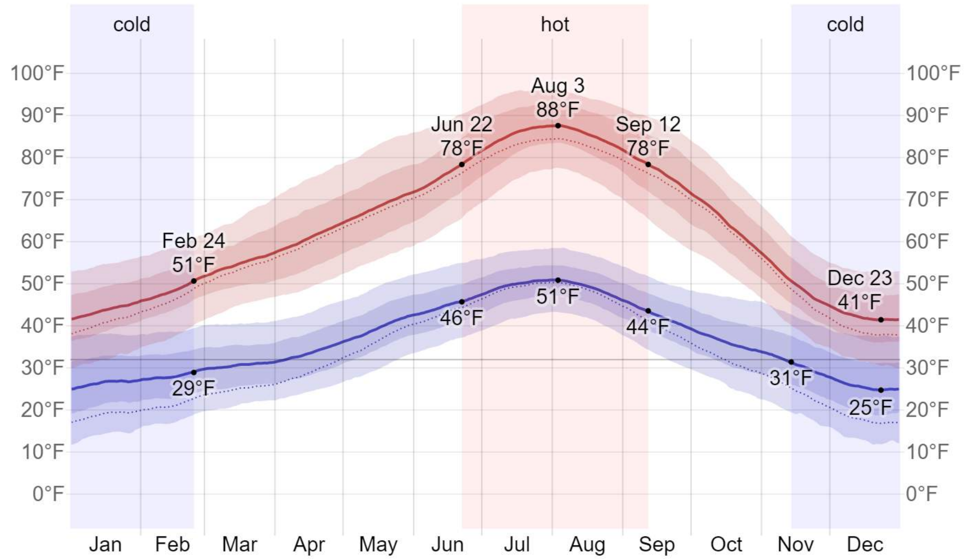


Figure 2-5. Average High and Low Temperature in Terrebonne
Source: https://weatherspark.com/y/1220/Average-Weather-in-Terrebonne-Oregon-United-States-Year-Round#Figures-Temperature

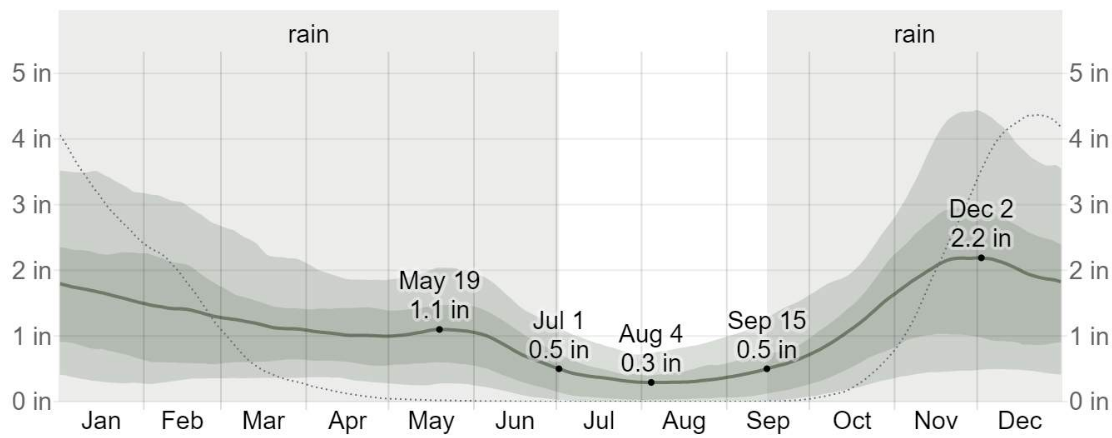


Figure 2-6. Average Monthly Rainfall in Terrebonne
Source: https://weatherspark.com/y/1220/Average-Weather-in-Terrebonne-Oregon-United-States-Year-Round#Figures-Rainfall

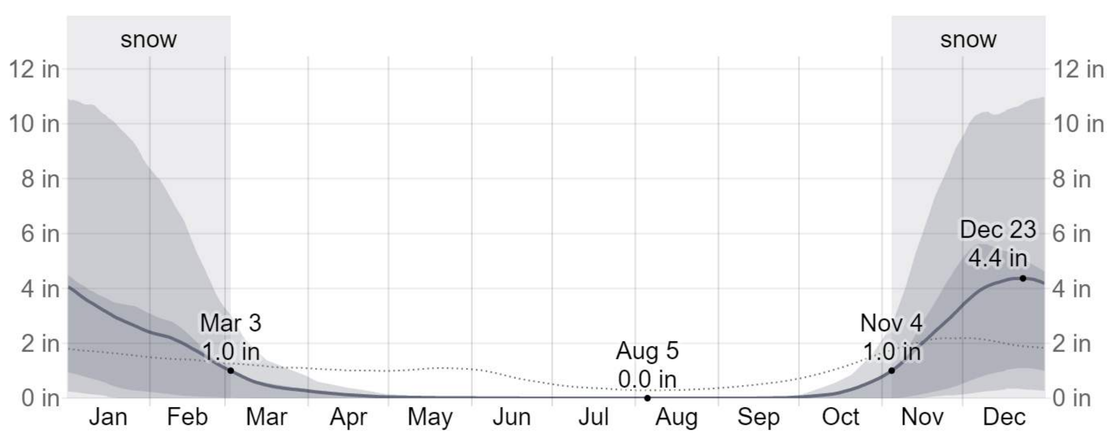


Figure 2-7. Average Monthly Snowfall in Terrebonne
Source: https://weatherspark.com/y/1220/Average-Weather-in-Terrebonne-Oregon-United-States-Year-Round#Figures-Snowfall

2.2.4 Water Resources

Dominant water resources in the area include the Deschutes River to the west of Terrebonne (approximately 3.5 miles) and the Crooked River to the east (approximately 1.5 miles). Water resources in the region are labeled on Figure 2-8. The sewer planning area is also divided by several irrigation ditches that are a part of the Central Oregon Irrigation District (COID). The presence of septic drainfields near these irrigation canals introduces the risk of pathogens and chemical contaminants polluting downstream agricultural uses and the Crooked River. Outside the study area is North Unit Irrigation District (NUID) to the north and the Lone Pine Irrigation District to the east.

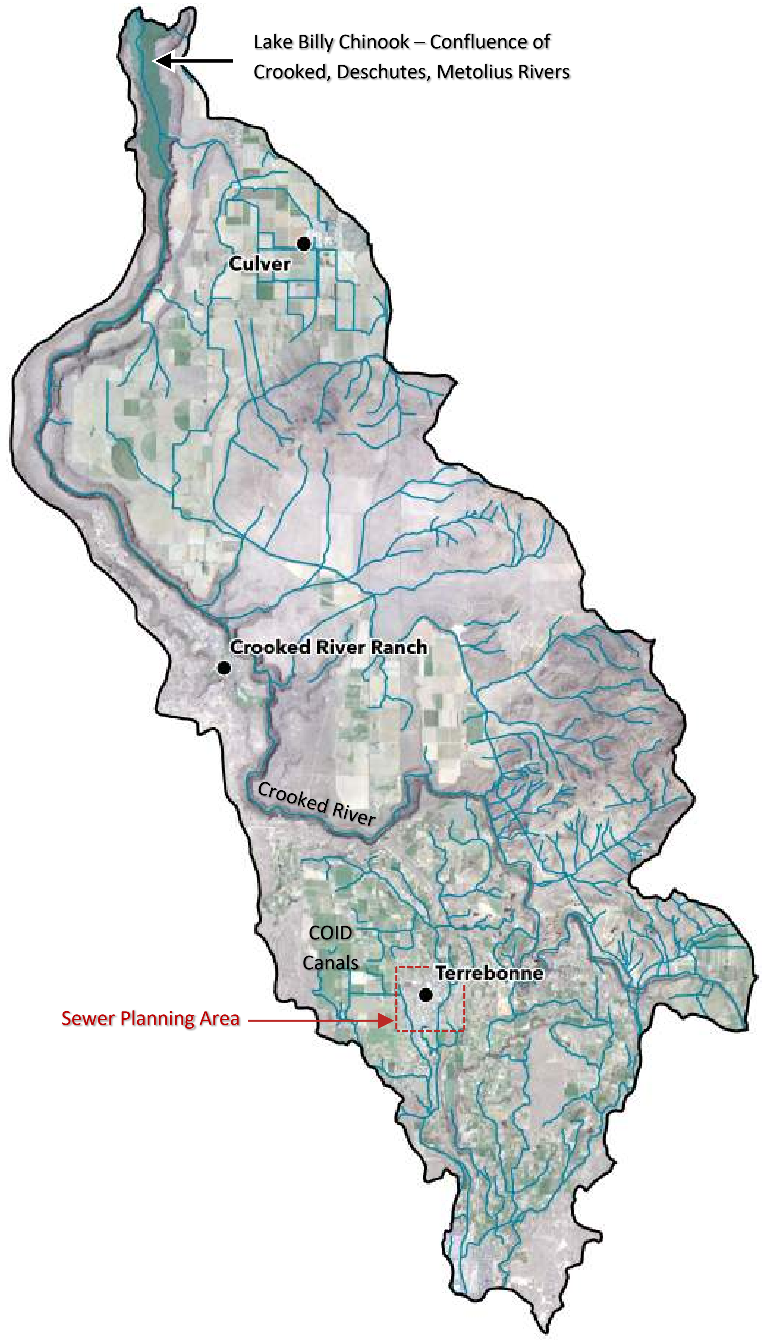


Figure 2-8. Water Resources Map

Several aquifers underlie Terrebonne, which all flow in a northerly direction. Based on lithology data obtained from OWRD well logs, the lower confined aquifer is approximately 315-380 feet below the ground surface and features better protection from groundwater contamination. The uppermost unconfined aquifer is approximately 150-280 feet below ground surface, depending on the location in Terrebonne. This upper aquifer is the focus of concern since it is closest to ground surface and has the highest potential for contamination. Groundwater is the sole source of domestic water in Terrebonne and is pumped via both private and community water system wells.

The Terrebonne Domestic Water District (TDWD) is a municipal corporation that currently serves approximately 579 residences and 29 businesses located in the densely populated areas including the old Hillman Plat, Angus Acres Subdivision, and Terrebonne Estates Subdivision. TDWD uses three municipal water supply wells. Water quality reports from these sources do not currently exceed U.S. Environmental Protection Agency maximum contaminant limits, so the Oregon Health Authority and Deschutes County do not require water treatment measures. TDWD believes that the community water system is not currently at risk of contamination from septic effluent because it withdraws water from the deeper confined aquifer and has not detected any pathogens in recent water quality tests to date.

In addition to TDWD community water supply wells, there are several private wells within Terrebonne that withdraw groundwater from shallower depths that are more susceptible to contamination from onsite wastewater systems. According to Oregon Water Resources Department well records, static water levels generally range from approximately 100 to 500 feet below the ground surface. Given this wide range of well depths, there are varying levels of groundwater contamination risk from onsite wastewater systems in Terrebonne, based on the depths of various water-bearing zones depth and their unique hydrogeologic conditions. See Figure 2-9 for a map of domestic water wells in Terrebonne vicinity that are registered with OWRD.

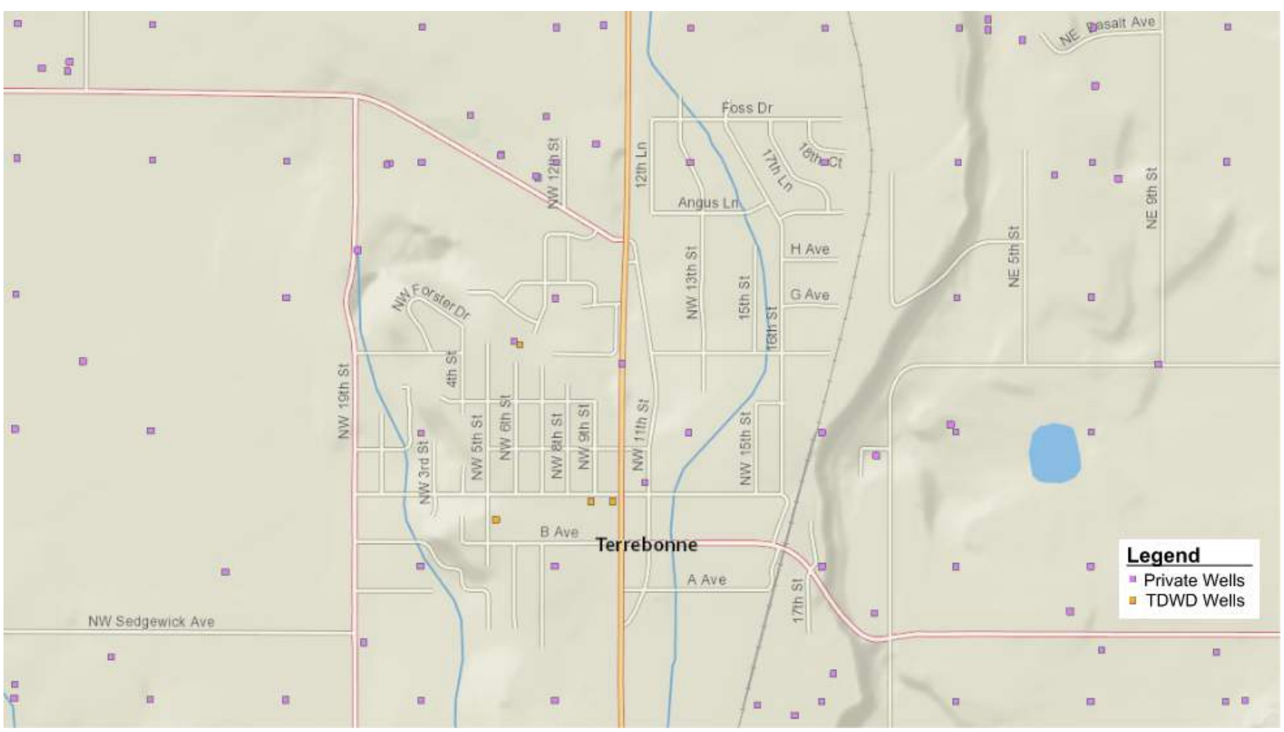


Figure 2-9. Domestic Water Wells in Terrebonne Vicinity
Source: OWRD Well Report Mapping Tool

2.3 Population Trends

Terrebonne is a small unincorporated community within Deschutes County. This particular community has not been studied by the Portland State University Population Research Center with boundaries that are consistent with the planning area of this report. Without this population data specific to Terrebonne, past and present population estimates provided in Table 2-2 for this study are based on the 1999 Wastewater Feasibility Study and U.S. Census Data. Future projections are based on a 1.9 percent average annual growth rate (AAGR), which is the AAGR projected for the Redmond Sub-Area during 2022-2047, according to the 2022 Deschutes County Coordinated Population Forecast (DCCPF). While Terrebonne is an unincorporated community, the pace and patterns of development are expected to resemble Redmond due to its close proximity, similar zoning, and the future availability of public infrastructure (i.e. water, sewer, sidewalks).

See Figure 2-10 for a graph of population and equivalent dwelling unit (EDU) estimates and projections.

See Section 3.6 for discussion on how existing EDUs are defined and calculated in this report.

See Section 4.3 for discussion on how EDUs were projected to account for reasonable growth.

Table 2-2. Population and Equivalent Dwelling Unit Estimates

Year	Population	Equivalent Dwelling Units	Data Source
1999	871	377	1999 Wastewater Feasibility Study by HGE, Inc.
2010	1,173	514	2010 American Community Survey (U.S. Census Data), Table S0101
2020	1,393	650	2020 Decennial Census (U.S. Census Data), Table P1
2030	1,681	838	Projected using 1.9% AAGR (Redmond Sub-Area) per 2022 DCCPF
2040	2,030	1,054	Projected using 1.9% AAGR (Redmond Sub-Area) per 2022 DCCPF

AAGR = average annual growth rate

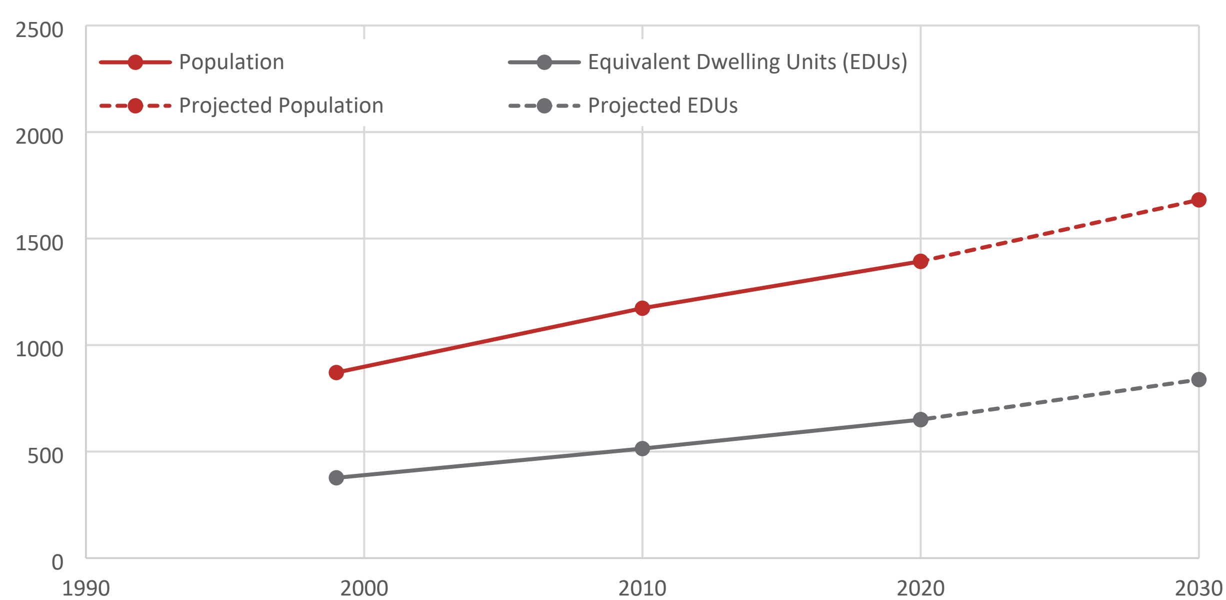


Figure 2-10. Population and Equivalent Dwelling Unit Estimates

2.4 Community Engagement

Community engagement is a critical component to wastewater system planning and implementation. Previous attempts to develop a community sewer system in Terrebonne have not garnered enough public support to move forward with implementation. In September and October 2020, Deschutes County hosted an online virtual open house to share information about septic system problems in Terrebonne and to ask for public input regarding a potential community sewer system. The businesses and residents experiencing septic system issues were generally more interested in a Terrebonne sewer system, while residents not experiencing septic system issues were not interested, and some expressed opposition to public sewer improvements. Below is a summary of the survey participants, responses, and representative comments.

Participants

- 56 percent own property in Terrebonne. Of those:
  - 70 percent own a residence
  - 37 percent own a business

Septic System Operations

- 67 percent of respondents felt that their septic system "Operates well"
- 33 percent of respondents said that their systems "Have had some problems" (22 percent) or "Operate poorly" (11 percent)

Representative Comments

The following comments were received in favor of a sewer system:

I think it would really help business.

Need sewers badly. The sooner the better.

Terrebonne would be much better for everyone if it had a sewer system.

Sewer system is long overdue.

This would be a great solution for both residents and business owners.

The comments below identified other community concerns:

Funds should be directed to other community needs.

I don't believe Terrebonne residents need connection to a sewer system.

This would open the door to developers.

If we can't get water lines in here, how would sewer lines? We're on a huge rock & excavation would be costly & disruptive.

The following questions were included in the comments:

How much do we really need sewers?

I want to know the TOTAL cost to each home: SDCs, monthly cost, other hookup charges.

Will it be terribly expensive?

We need to know what it will cost and if it is feasible.

The open house participants were then invited to participate in the Terrebonne Sewer Advisory Group (TSAG) to solicit more focused input and refine design alternatives. This group included approximately seven to nine stakeholders from the community; they represented the grocery store, mobile home park, vacant development land, a church, and several other businesses and properties. Updated study documents and meeting minutes were regularly posted to the County webpage for public review and comment.

In response to input from the online survey and TSAG, the service area was broken up into three separate phases. The first phase focused on providing sewer services to the commercial core (Phase A) where the greatest need and interest exists. Subsequent Phases B and C primarily include residences and can later be annexed into the sewer system and service area when the majority of residents in these areas request service and additional funding is secured for system expansion.

After over a year of monthly sewer planning meetings with the TSAG and work on the feasibility study, an open house was held on December 15, 2021, at the Terrebonne Grange Hall to update the public on the preferred system design, estimated costs, projected timelines, and the intent to form the Terrebonne Sanitary District. See Photograph 2-1 for a picture from this event. This event was publicized by mailed postcards, and it is estimated that over 60 Terrebonne residents were in attendance. While a couple of attendees expressed opposition to sewer in Terrebonne, attendees were generally very interested, inquisitive, and supportive of the proposed concepts. Some of the recurring questions heard by the presentation team included:

Why will it take so long to build a sewer system?

Will I be required to connect to the sewer system?

What will I have to pay for SDCs, connection costs, and monthly rates?

What if I can’t afford these sewer rates and fees?

Photograph 2-1. Open House held at the Terrebonne Grange on December 15, 2021

This page intentionally left blank.

3. EXISTING FACILITIES

3.1 Location Map

Figure 3-1 shows the locations of septic systems in Terrebonne that have been constructed, denied permits, repaired, and troubled with capacity issues. This data was provided by the Deschutes County Sanitarian, and it is based on permits on record with the County for septic systems. Also shown is the development status of lots in Terrebonne, whether vacant or developed. Several vacant lots are unable to be developed because they were denied a septic permit or are too small (less than a half-acre) for a dwelling, primary drainfield, and reserve drainfield. See Appendix E for a more detailed map provided by Deschutes County with development, onsite system installations, and onsite system repairs colored by the decade in which these activities occurred.

3.2 History

At the time of Terrebonne's initial development in the early 1900s, the financial and technical means were not available to install a community sewer system. At the time, gravity sewer would have been the conventional method of collecting sewage and directing it to a treatment facility (i.e., facultative lagoon). This would have required expensive trenching through shallow bedrock, which is typical in Terrebonne. In addition, the topography in Terrebonne is sloped in different directions and not practical for directing sewage to a single treatment location via gravity sewer collection. Instead, septic systems and drill holes were installed to dispose of wastewater within each developed property.

In 1909, Deschutes County approved the Hillman Plat, which laid out the community in a rectangular urban grid of streets, blocks, and small lots just 2,500 square feet in area (25 feet by 100 feet). Over time, these small lots have been purchased in groups and consolidated; this has resulted in a variety of odd lot shapes and sizes. Septic systems typically require lot sizes of at least 10,000 square feet to fit a dwelling, septic tank, drainfield, and reserve area with required setbacks and clearance requirements. As a result, the smaller "leftover" lots under 10,000 square feet have been unable to install a septic system and then be developed. Many of the small lots that were developed did so with onsite septic systems lacking reserve areas or with unpermitted connections to septic systems on adjacent lots.

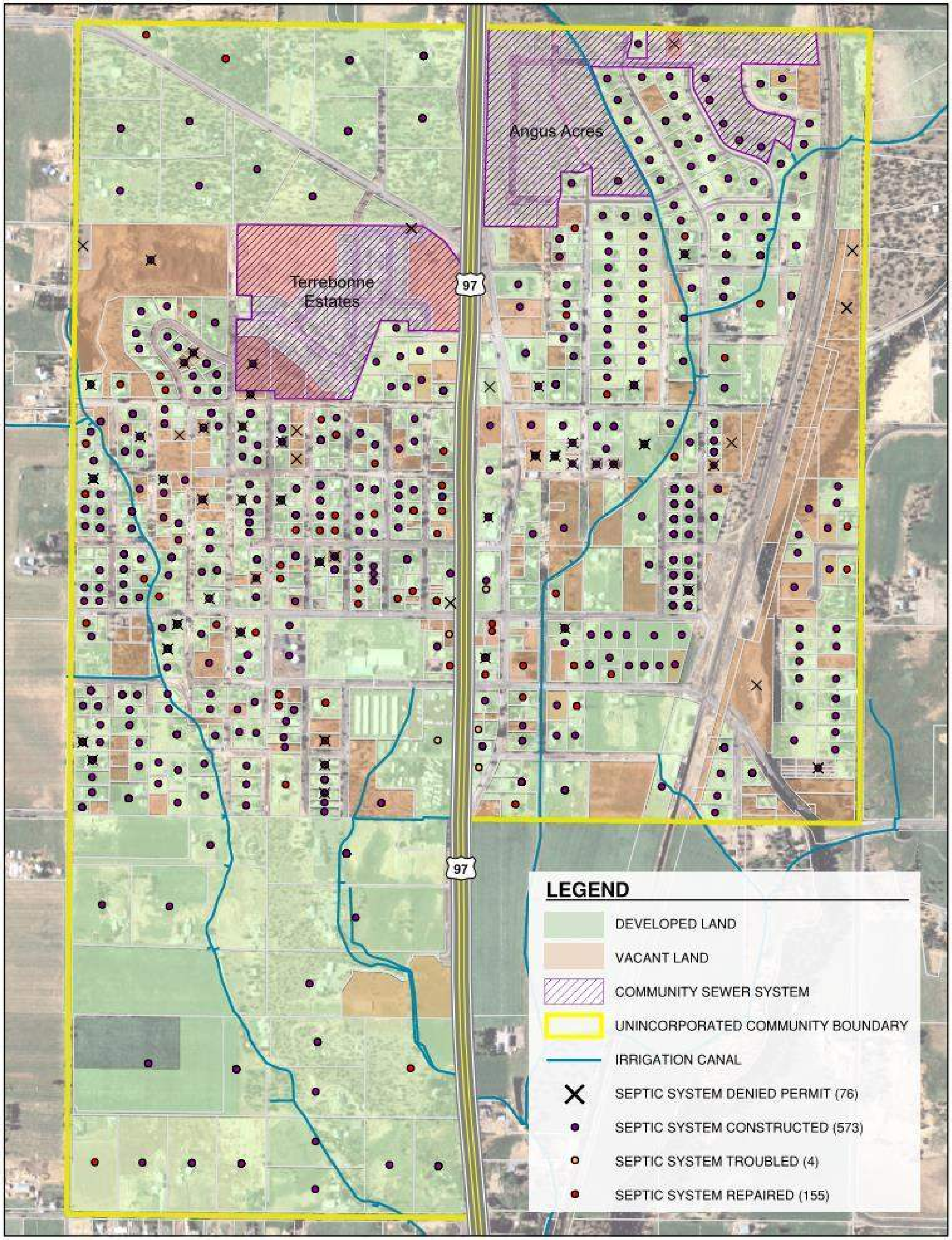


Figure 3-1. Onsite Septic System Permit Map

Of the past five decades, most of the septic systems in Terrebonne were installed in the 1970s. The lifespan of a septic system varies widely—typically from 15 to 40 years. There are many factors that affect the life expectancy of a septic tank and drainfield, including the materials used and whether it has experienced damage from vehicle traffic, soil conditions, or clogging by roots and use over time. Of the 59 septic system repair permits obtained between 2011 and 2020, most were to repair systems installed in the 1970s and 1980s—systems roughly 30 to 50 years old. Figure 3-2 shows repair permits issued from 1980 to 2020.

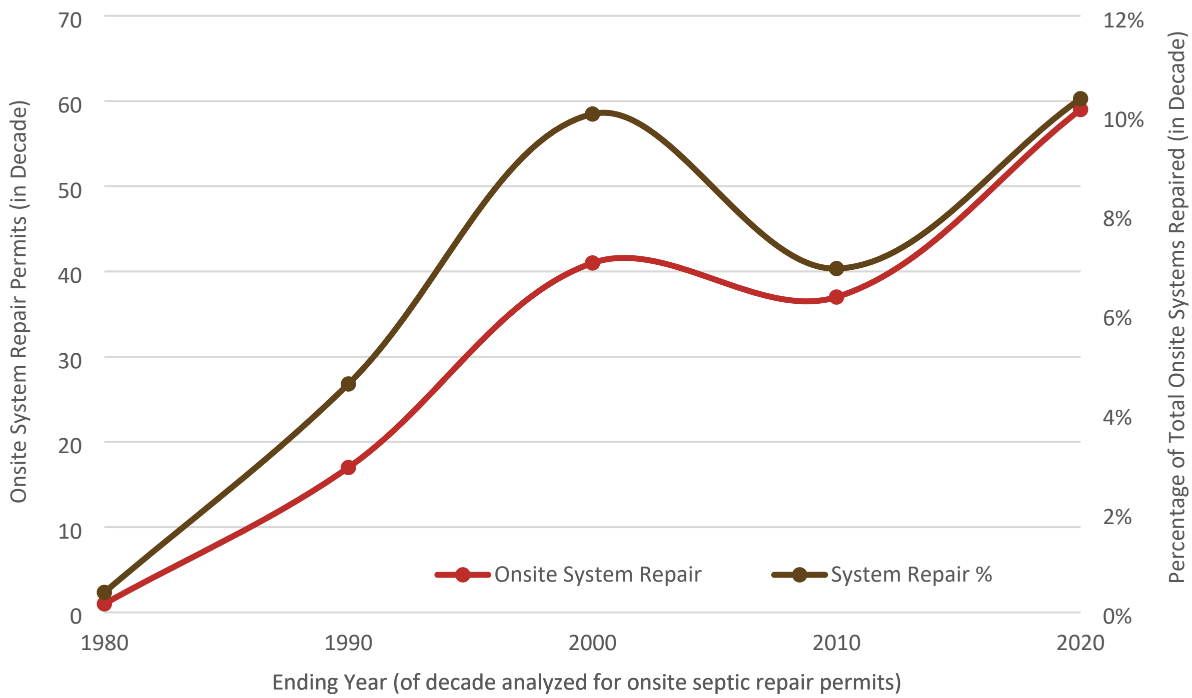


Figure 3-2. Onsite Septic System Repair Permits

3.3 Condition of Existing Facilities

Many of the septic systems in Terrebonne were installed over 30 years ago and are reaching the end of their service lives. The rate of septic system failure is on the rise as systems age and soil permeability decreases from use. The Deschutes County Sanitarian reports a septic repair rate in Terrebonne that is twice that of the rest of Deschutes County. Many of the onsite disposal systems (including drillholes) are unable to meet applicable DEQ effluent disposal and water quality requirements that are enforced by the Deschutes County Environmental Health Division.

According to Environmental Health Division staff, the number of malfunctioning septic systems requiring repairs is increasing (see letter in Appendix F). Over the years, residents and business owners have been inquiring more frequently about malfunctioning systems, development limitations, and aging systems that will require future repairs or replacements to operate, if possible. A major concern is that commercial and residential properties will experience catastrophic onsite septic system failures that cannot be remedied by system repair or replacement. In these cases, businesses would become inoperable, and residences would be deemed uninhabitable.

For example, the only grocery store in Terrebonne (Oliver Lemon's) is dealing with drainfield capacity issues and must vacuum pump and dispose of septage daily; this incurs high operating costs that may cause the store to close if issues are not addressed. In recent years, a restaurant was forced to close for several months to repair its failed septic system. Similarly, several properties in Terrebonne depend on a non-compliant drill holes for effluent disposal and are at risk of closure if DEQ requirements cannot be met.

Due to these poor conditions and constraints, several properties in Terrebonne have implemented makeshift solutions to dispose of their wastewater. In several cases, septic systems receive wastewater from neighboring properties that do not have the soil conditions or available area to infiltrate onsite. A common and unpermitted remedy for clogged drill holes is to pour caustic soda (sodium hydroxide or lye) down the hole. Caustic soda is hazardous and causes an explosive chemical reaction. Some properties that cannot adequately dispose effluent onsite have resorted to frequent vacuum pumping from tanks; septage is then discharged to a nearby wastewater treatment plant at a substantial cost to the owner.

3.4 Financial Information

While onsite septic systems are seen as a low-cost option for wastewater disposal, there are construction, maintenance, and repair costs that are often overlooked. Functioning onsite septic systems typically require vacuum pumping of septic tanks every 5 years at a cost of $300 to $500. However, failing systems require more frequent pumping to dispose of sewage that would otherwise rise to the ground surface and flow offsite. Some businesses in Terrebonne have resorted to having septic tanks pumped out daily due to low percolation rates. Septic system repair, retrofit, and replacement is becoming an increasing challenge for property owners. Residential system repairs typically cost $4,000 to $25,000. Commercial system repairs typically cost $20,000 to $150,000, depending on the system size and type.

Economic impacts to due to septic system failures and limitations are described below:

- Commercial septic system failures can lead to temporary or permanent shutdowns for businesses.
- Residential septic system failures can cost homeowners $4,000 to $25,000 in repair costs, if even feasible.
- Many of the lots in Terrebonne are unbuildable due to inadequate lot size or poor soil conditions.
- The area required for drainfields and reserve areas reduces developable area and excludes high-wastewater businesses such as breweries and hotels.

3.5 Septic Repair Permits

Water, energy, and waste audits typically conducted on existing wastewater systems do not exist for the onsite septic systems within Terrebonne. Septic repair permits are regularly obtained in Terrebonne to restore the function of onsite septic systems. Figure 3-3 below provides the Community Development Department Environmental Soils Division's number of septic system major repairs per year from 1977 through the first 7 months of 2019. The figure does not include repairs of larger onsite wastewater systems permitted by DEQ. In addition, it is highly likely that many property owners repair their septic systems without obtaining the necessary permits so they can avoid related fees and potential regulatory enforcement actions.

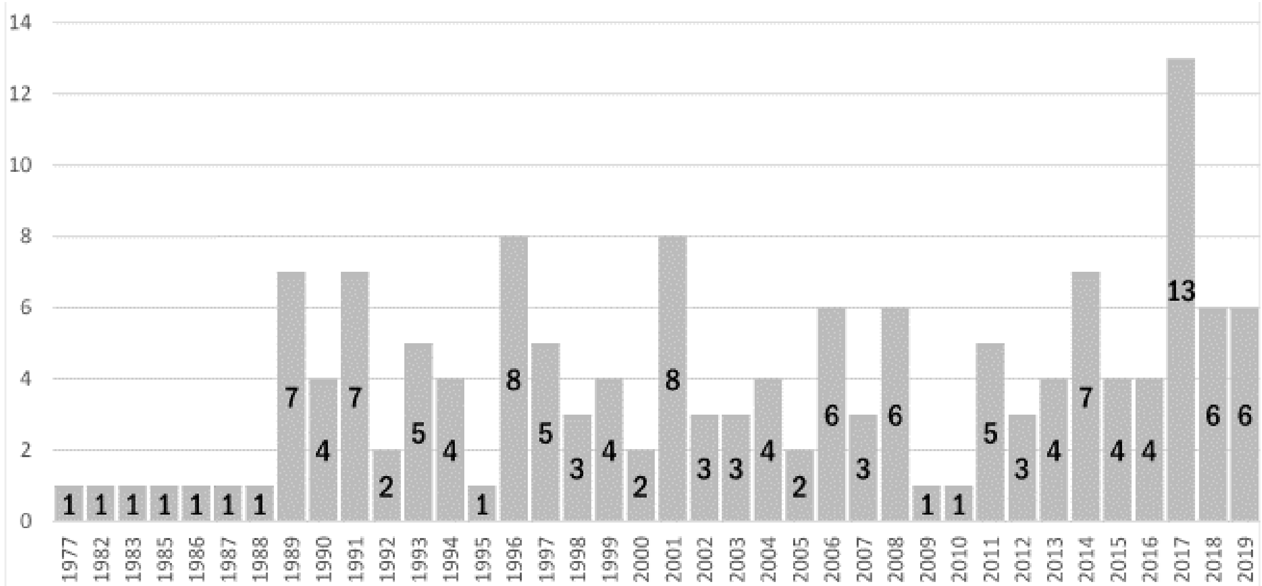


Figure 3-3. Septic System Repair Permits

3.6 Wastewater Generation

This section of the report discusses the methodology used to develop an equivalent dwelling unit (EDU) estimate. This is the average wastewater flow received by the treatment facility for one single-family residential housing unit. EDU are the basis for computing system development charges (SDC) and monthly sewer rates. They are also useful for planning purposes since EDU give an indication of the impacts of nonresidential developments such as commercial properties.

The EDU calculation methodology of OBDD-IFA assumes a wastewater flow of 7,500 gallons per month (250 gpd), whereas the ODEQ and USDA-RD methodology is based on actual water usage records. Water usage data was provided by the Terrebonne Domestic Water District, which includes water meter records for 603 metered accounts during a period of June 2019– July 2020. Of these 603 metered accounts, there are 554 active residential accounts, 29 active commercial accounts, and 20 accounts that are either inactive or irrigation meters.

Analysis of these records indicated that there are approximately 579 existing dwelling units in Terrebonne, including the 554 active residential accounts and 25 additional mobile home units served by a common water meter. Average daily flows are considered, for planning purposes, to be equivalent to the current metered water usage during the non-irrigation season (October-March). The average residential water usage was calculated to be 140 gallons per day per dwelling unit during the non-irrigation period by dividing the average daily residential water use by the existing 579 EDUs. In theory, this average daily flow per EDU equates to 47 gpcd (gallons/capita/day) for a three-person household and 70 gpcd for a two-person household, respectively. These per capita flow rates are typical for

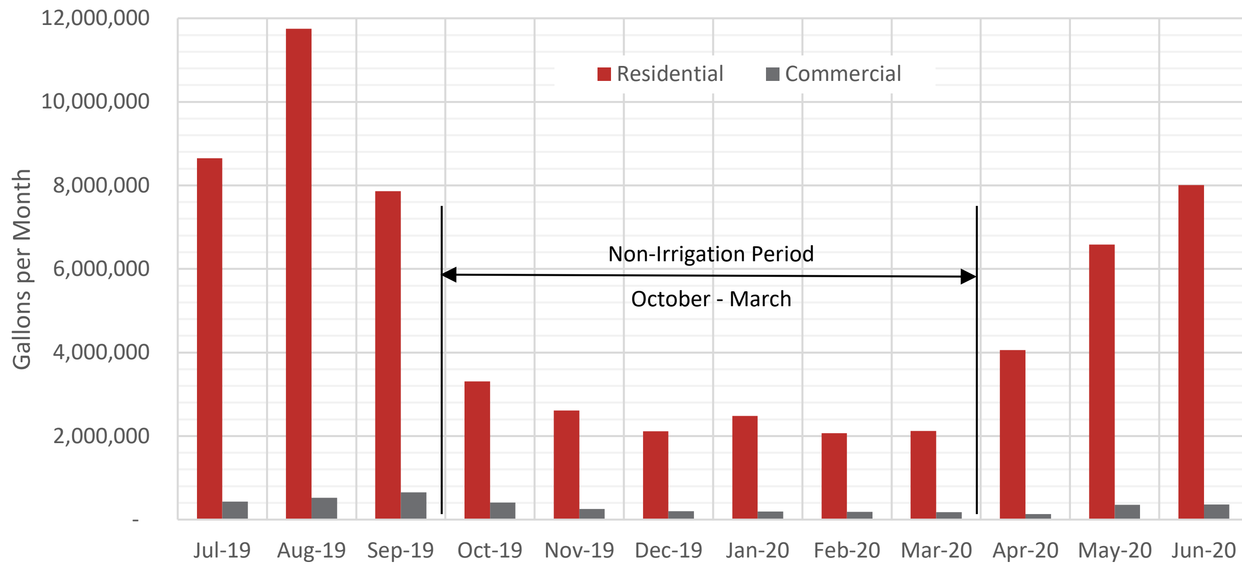


Figure 3-4. Water Usage Data by Category (provided by TDWD)

Figure 3-4 illustrates the monthly water usage metered at residential and commercial users.

Table 3-1 summarizes the flow data and formulas used to calculate average daily flow per EDU.

Table 3-1. Residential Water Use Metered During Non-Irrigation Period (Oct 2019 – Mar 2020)

(A)	Residential Water Usage:	14,710,306 gallons	
(B)	Average Daily Residential Water Use (over 181-day period):	81,272 gallons/day	B = A / 181
(C)	Existing Dwelling Units:	579 Residential EDUs	
(D)	Average Daily Flow per EDU:	140 gallons/day/EDU	D = B / C

To calculate commercial EDUs, the average daily flow of each commercial property was divided by the average daily flow rate of 140 gpd/EDU and rounded up to the nearest whole number, with 1 EDU as the minimum. By this methodology, it is estimated that there are 30 commercial water users in Terrebonne that account for an additional 72 equivalent dwelling units (EDUs). Altogether, including both 579 residential EDUs and 72 Commercial EDUs, it is estimated that there are currently 650 EDUs in Terrebonne. Table 3-2 summarizes the current water system users, average daily flow rates, and estimated Residential and Commercial EDUs, using the criteria discussed in this section.

Table 3-2. Equivalent Dwelling Unit Summary

Type of User	Usage (Gallons/year)	Avg Daily Usage (gpd)	EDUs per IFA[1]	Non-Irrigation Period Avg Daily Usage (gpd)	EDUs per DEQ/RD[2]
Residential	61,622,766	168,829	675	81,272	579
Commercial	3,886,509	10,648	43	7,854	72
Totals	65,509,275	179,477	718	89,127	650

1. IFA methodology for calculating EDUs: the average daily usage for 12-month period was divided by 250 gpd (7,500 gal/mo).
2. DEQ/RD methodology: each existing dwelling was counted as a residential EDU and commercial EDUs were calculated by dividing the average daily usage (non-irrigation period) of each commercial user by the average daily residential flow of 140 gpd, which is based on actual water usage data during non-irrigation period.

4. NEED FOR PROJECT

4.1 Health, Sanitation, Environmental Regulations, and Security

The poor condition of the on-site sewage disposal systems in Terrebonne and the effect on public health and the environment has been an ongoing concern. According to the Deschutes County Sanitarian, many of the systems function marginally, at best, with frequent and reoccurring problems. Several sites in Terrebonne have had wastewater effluent rise to the ground surface due to drainfield capacity issues. This condition poses serious risks to human and environmental health.

If untreated wastewater effluent reaches groundwater supplies through existing drill holes, private drinking water wells could become contaminated. Many of the steel and concrete septic tanks originally installed have degraded severely. Some tanks have even collapsed under vehicle loads and exposed sewage, resulting in deep pits which are particularly dangerous to children and pets.

See Appendix F for a letter from the Deschutes County Sanitarian which describes public health and environmental hazards associated with septic systems in Terrebonne.

OAR 340-044-0010 (2) states the following regarding waste disposal wells (a.k.a., drill holes):

> **The injection of untreated or inadequately treated sewage or wastes to waste disposal wells and particularly to waste disposal wells in the lava terrain of Central Oregon constitutes a threat of serious, detrimental, and irreversible pollution of valuable groundwater resources and a threat to public health. The policy of the Environmental Quality Commission is to restrict, regulate or prohibit the further construction and use of waste disposal wells in Oregon and to phase out completely the use of waste disposal wells as a means of disposing of untreated or inadequately treated sewage or wastes as rapidly as possible in an orderly and planned manner.**

Photograph 4-1. Sewage Overflow in Public Parking Lot

Photograph 4-2. Surfacing Effluent in Drainfield

Photographs 4-1, 4-2, 4-3, and 4-4 in this section show the environmental and health hazards associated with failing septic systems and substandard drill holes that are used in Terrebonne for effluent disposal.

Photograph 4-3. Sewage Overflow in Public Parking Lot

Photograph 4-4. Waste Disposal Well that Injects Sewage into the Ground

4.2 Aging Infrastructure

Many of the septic systems in Terrebonne were installed over 30 years ago and are reaching the end of their life cycles. See Appendix E for a detailed map provided by Deschutes County with development, onsite system installations, and onsite system repairs colored by decade. The rate of septic system failures is on the rise as systems age and soil permeability decreases from use. The Deschutes County Sanitarian reports a septic repair rate in Terrebonne that is twice that of the rest of Deschutes County.

Many lots do not have extra space available for a replacement drainfield, because the reserve area has been built upon or the total lot area is inadequate. If onsite system failure trends continue in the future, more residents and businesses struggle to repair their systems and meet DEQ requirements. A major concern is that over time this could result in homes becoming unhabitable and businesses closing because system it is not technically or financially feasible to install a replacement drainfield and maintain compliance with DEQ standards.

4.3 Reasonable Growth

Central Oregon has been among the fastest growing regions in the nation. In-migration has been the dominating factor in the region's growth with thousands of new residents moving to the area from all over the country every year. At the same time, the region's ability to attract young families has resulted in strong birth rates. Within Central Oregon, Terrebonne is a particularly attractive place to live, due to its unique rural character, proximity to Smith Rock State Park, and panoramic mountain views.

However, commercial, industrial, and residential development in Terrebonne has been and will continue to be severely limited with conventional septic systems as the only available option for wastewater treatment and disposal. Installing a wastewater system will protect the local environment and accommodate future growth, which will further spread the burden of paying for the system. Property values will increase and lots will become more suitable for sale, partitions, and development.

If a public sewer system is constructed in Terrebonne, it is expected that growth will occur at rates higher than in years past. The Deschutes County Community Development reports that there are 188 undeveloped parcels in Terrebonne (excluding 1 parcel with TER5 zoning, which is outside the planning area). See Table 2-1 and Appendix B. When sewer becomes available to these lots, it is anticipated that existing lots will be partitioned and subdivided close to minimum lot sizes in order to maximize housing units. New private development would pay for the additional capacity through connection fees and/or system development charges that will need to be established by the District. New development would also be responsible for the installation of collection system main lines and service connections.

A common document for projecting future sewage flows is the Guidelines for Making Wet-Weather and Peak Flow Projections for Sewage Treatment in Western Oregon, published by DEQ. However, Terrebonne is in Eastern Oregon and wet weather is not expected to have a considerable influence on wastewater flows. Instead, current EDUs (estimated at 650) were projected 10 and 20 years into the future, based on Terrebonne zoning, minimum lot sizes, and the resulting land division potential facilitated by a public sewer system.

The projected growth in EDUs tracks reasonably with population growth projections, and correlates to an approximate average annual growth rate (AAGR) of approximately 2.45%. Although this 2.45% AAGR for EDUs exceeds the 1.9% AAGR used for population projections, this is reasonable because a portion of projected EDUs will be in commercial zoning and will not result in population increases. The ratio of population to EDUs is estimated to be approximately 2 capita/EDU both now and in the future.

For the purposes of this study, the planning period is 20 years and the Terrebonne service area has been divided into three separate phases of roughly equal size. The constructed sewer system will initially serve just the Commercial Core in Phase A and can be expanded to serve Phase B and Phase C in the future when desired by constituents in those areas. Below is a summary of the three proposed system phases:

Phase A: Commercial Core

This area has the highest concentration of septic system issues, businesses, and small residential lots. The terrain in this region gently slopes toward US 97 and NW 11th Street and north toward Lower Bridge Way. There are 160 EDUs existing and 320 EDUs projected at full buildout.

Phase B: Residential West

This area is mostly residential with larger lot sizes and generally fewer septic system issues. Terrain in this region is relatively flat on the plateau and slopes down to the west from the plateau edge. There are approximately 250 EDUs existing and 374 EDUs projected at full buildout, including the potential future annexation of Terrebonne Estates.

Phase C: Residential East

This area is mostly residential with larger lot sizes and generally fewer septic system issues. Terrain in this region is relatively flat, rural, and crossed by several COID irrigation laterals. There are approximately 240 EDUs existing and 360 EDUs projected at full buildout, assuming the potential future annexation of Angus Acres.

Table 4-1 below summarizes the necessary growth capacity for the system based on population and EDU projections

Table 4-1. Current and Projected Growth in Population and Equivalent Dwelling Units

Phase	Phase A Core	Phase B West	Phase C East	Total
Current Population Estimates	279	627	487	1,393
10-Year Projected Population at 1.9% Avg. Annual Growth	336	723	622	1,681
20-Year Projected Population at 1.9% Avg. Annual Growth	402	832	792	2,030
Current EDUs – Based on Metered Water Usage (DEQ/RD)	160	250	240	650
10-Year Projected EDUs	240	303	295	838
20-Year Projected EDUs [a]	320	374	360	1,054

[a] Assuming annexation of Angus Acres and Terrebonne Estates into future sewer service area.

Avg. = average; EDU = equivalent dwelling units

Projected sewage flow and wastewater loads provide a basis for design of collection system and treatment capacity necessary to accommodate existing development and future growth over the next 20 years. Average daily flow per EDU was assumed to be 150 gpd/EDU for sewer planning purposes. According to Metcalf & Eddy[6], maximum month flow (MMF) was calculated with a peaking factor of 1.40 applied to average daily flow (ADF). Average daily loading was calculated for biochemical oxygen demand (BOD) and total suspended solids (TSS). BOD is the amount of oxygen needed for waste decomposition. Table 4-2 summarizes the wastewater flows and characteristics associated with the EDUs for each system phase and the entire system at full buildout, which is assumed to occur in approximately 20 years.

Table 4-2. 20-Year Projected Wastewater Generation Summary

Parameter	Phase A Core	Phase B West	Phase C East	Total
Projected EDUs in 20 years (buildout)	320	374	360	1,054
Average Daily Flow (gpd)	48,000	56,100	54,000	158,100
Maximum Month Flow (gpd)	67,200	78,540	75,600	221,340
Average Design Flow (gpm)	33	39	38	110
Peak Hour Flow (gpm)	166	194	187	547
Average Daily BOD_5 Load (pounds per day)[1]	80	94	90	264
Average Daily TSS Load (pounds per day)[2]	50	58	57	165

BOD_5 = 5-day biochemical oxygen demand; gpd = gallons per day; gpm = gallons per minute; TSS = total suspended solids

1. Assuming BOD concentration of 200 mg/L for septic tank effluent
2. Assuming TSS concentration of 125 mg/L for septic tank effluent

[6] Wastewater Engineering, Metcalf & Eddy, 5th Edition 2014, Figure 3-17.

5. ALTERNATIVES CONSIDERED

A full consideration of all viable alternatives and a transparent selection process is key to the planning process. There are many different ways to collect, treat, and dispose of wastewater. This section of the report will examine the distinct types of sewer system alternatives available to meet the needs of the Terrebonne community. Ultimately, the preferred acceptable alternative must be designed and constructed in accordance with sound engineering practices and must meet the requirements of federal, state, and local agencies.

5.1 Wastewater Collection System Alternatives

Wastewater collection systems differ based on the type of wastewater (raw sewage versus septic tank effluent) and the means of conveyance (gravity flow or mechanically assisted flow). Brief descriptions of the most common systems are provided below.

5.1.1 Conventional Gravity System

This is the oldest and most prevalent type of wastewater collection system. An illustration is shown in Figure 5-1. A conventional gravity system collects and conveys raw wastewater with adequately sloped pipes, which permit flow by gravity. This system is generally the most economical in situations that have relatively dense development, soils that are easy to excavate (minimal rock), and topography that facilitates gravity flow.

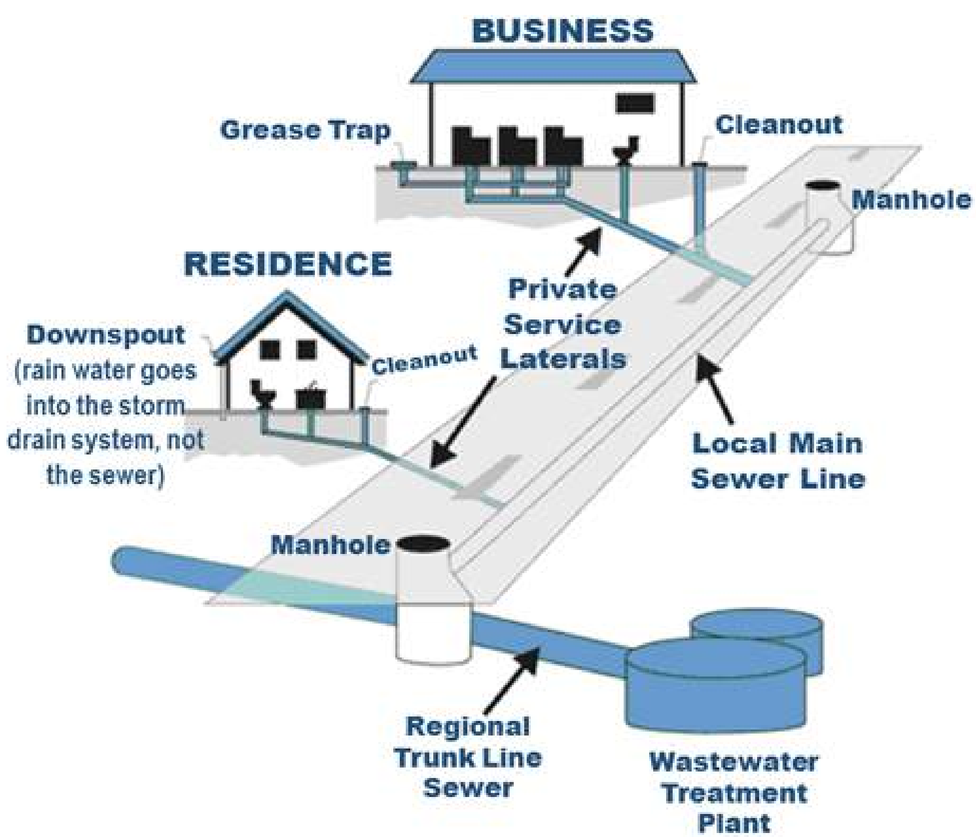


Figure 5-1. Conventional Gravity Sewer Collection System
Source: City of West Des Moines (https://www.wdm.iowa.gov/Home/ShowPublishedImage/2847/635713375226930000)

Conventional sewers generally have a high cost per foot of sewer installed. Where homes are sparse, the resulting cost can be exorbitant. Damage consequential to the installation of deep sewers is a factor. In some cases, blasting is required to install sewers. This may cause upheaval of the road, damage to nearby buried utilities and homes, and disruption to the community. Extremely flat or undulating terrain poses problems to gravity sewer installations since the gravity sewer must continually slope downward. This causes the sewer to become increasingly deep until a lift station is necessary. Both the deep excavations and the lift stations are expensive capital costs. Lift stations also result in considerable operation and maintenance (O&M) expenses.

Deeply buried conventional sewers may intercept and drain groundwater. In many cases the groundwater will enter the gravity sewer as unwanted infiltration. Inflow from surface runoff and infiltration from groundwater flow (I&I) results in increased mainline flows and related costs for increased conveyance and treatment capacity.

5.1.2 Septic Tank Effluent Gravity System (STEG)

A STEG system essentially replaces the drainfield in a conventional onsite system with a gravity collection system. Septic tank effluent is conveyed from onsite tanks via small-diameter gravity service lines to the larger gravity collection system. Septic tank effluent has fewer solids, and consequently, the STEG piping can be smaller in diameter. Pipe grades can be variable and less than with conventional gravity sewers. This system is generally appropriate where connection spacing is sufficient to offset the added cost of the septic tank. Minimum burial depths are generally shallower than with a conventional gravity system; therefore, it is less influenced by depth of groundwater or rock. However, because it is a gravity system, it must be designed to flow downstream with the topography. Any venting or air release valves require odor control measures that must be designed for the corrosive nature of septic tank effluent. See Figure 5-2 for a conceptual illustration of a STEG system.

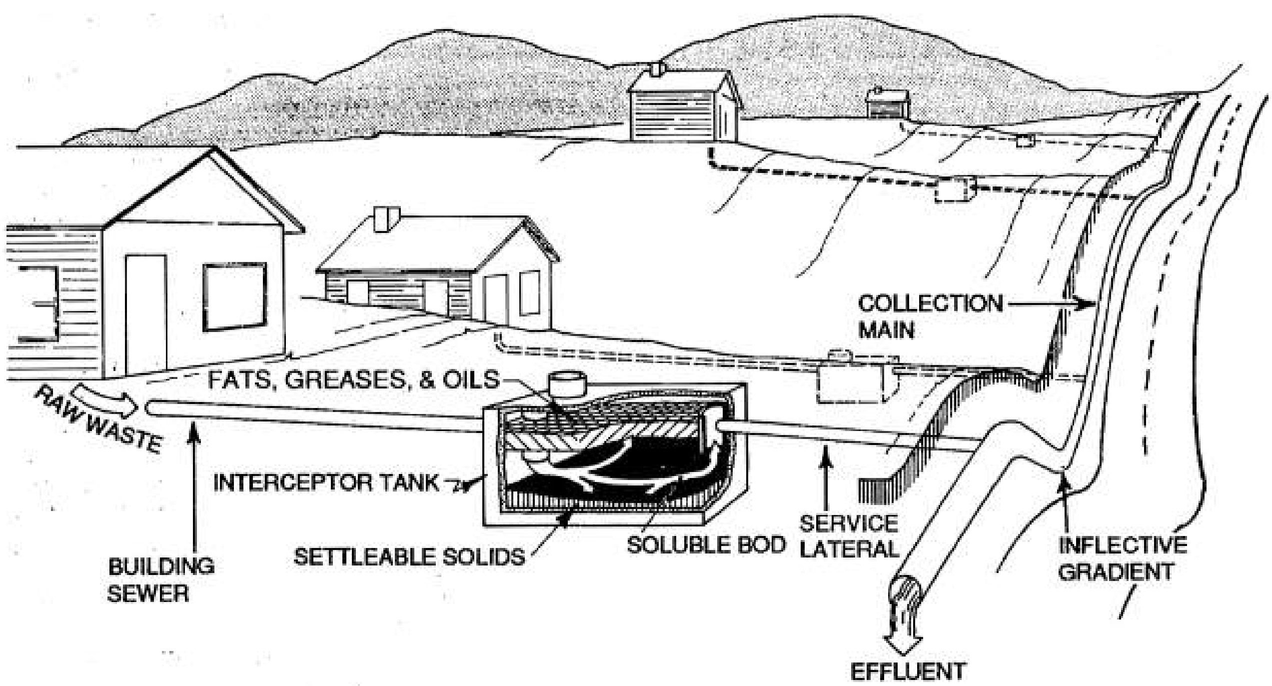


Figure 5-2. STEG Collection System
Source: Alternative Wastewater Collection Systems Manual (EPA/625/1-91-024).

5.1.3 Septic Tank Effluent Pump System (STEP)

STEP systems are similar to STEG systems in that septic effluent is collected downstream of septic tanks and conveyed to an offsite treatment location. However, STEP systems use a pump located inside (or after) the septic tank to pump septic tank effluent under pressure to the collection system, which is also pressurized in a STEP-only system. Septic effluent typically contains less solids, fats, oils, and grease, which are substantially retained in the septic tanks. This reduces the concern for solids deposition and clogging that is common in raw sewer systems and allows for lower flow velocities in pipelines. This is generally most economical in areas with relatively distant spacing between connections and with physical or topographical features such as high groundwater, rock, or areas requiring numerous pump stations for conventional gravity systems. STEP systems are one of the most popular solutions in Oregon as an alternative to conventional gravity sewer collection. See Figure 5-3 for a conceptual illustration of a STEP collection system.

Figure 5-3. STEP Collection System
Source: Orenco Systems, Inc.

5.1.4 Grinder Pump System

This system uses an onsite pump that is designed to grind raw wastewater into a fine slurry. Raw wastewater from the sump passes through the grinder and is pumped to a low-pressure collection system, like a STEP system. See Figure 5-4 for a conceptual illustration. Since the solids have been ground, smaller pipe diameters can be used than with a conventional gravity system. The wastewater is not as septic as in a STEP system, so odors or corrosion are usually less problematic. Because of the high solids concentrations, adequate pipe velocities must be maintained to avoid solids deposition.

This system is generally most economical in areas with relatively distant spacing between connections or topographical features such as groundwater, rock, or areas requiring numerous power stations for conventional systems. System costs are generally comparable to STEP systems, however O&M costs are generally somewhat higher than STEP systems due to issues with clotting and blockage from raw wastewater and debris. Grinder pump systems have generally not been as popular as STEP systems in Oregon.

Figure 5-4. Grinder Pump/Low Pressure Collection System
Source: Environment One Corporation

5.1.5 Vacuum System

In this system, gravity service lines convey raw wastewater to a valve pit that serves multiple customers in the vicinity, typically two to four. As the valve pit fills with sewage, the vacuum valve opens and flow is drawn into the vacuum sewer mains that are kept under vacuum conditions. Wastewater travels at 15 to 18 feet per second in the vacuum sewer main, which is laid with a sawtooth profile to ensure adequate vacuum levels at the end of each line. Due to high flow velocities, smaller pipe diameters can be used and the can buried just below frost depth (approx. 36 inches). Vacuum pumps cycle on and off as needed to maintain a constant level of vacuum on the whole collection system. Wastewater enters the collection tank and fills to a predetermined level and then sewage pumps convey it to the treatment plant via a force main. See Figure 5-5 for an illustration.

Vacuum collection systems are best suited for relatively flat areas to minimize the number of vacuum stations required. The system is also well suited to areas where burial depths are constrained by high groundwater or rock. A key benefit is that raw sewer can be collected to regional vacuum stations that contain the vacuum pumps, collection tank, and sewage tanks in a centralized location, as compared to STEP systems, where the pumping equipment is decentralized at each property. However, the need for gravity services to valve pits and sawtooth main profiles make vacuum systems more complicated to design and build. Although development of this technology over recent decades has led to increased use, vacuum sewer collection systems are still relatively uncommon in Oregon.

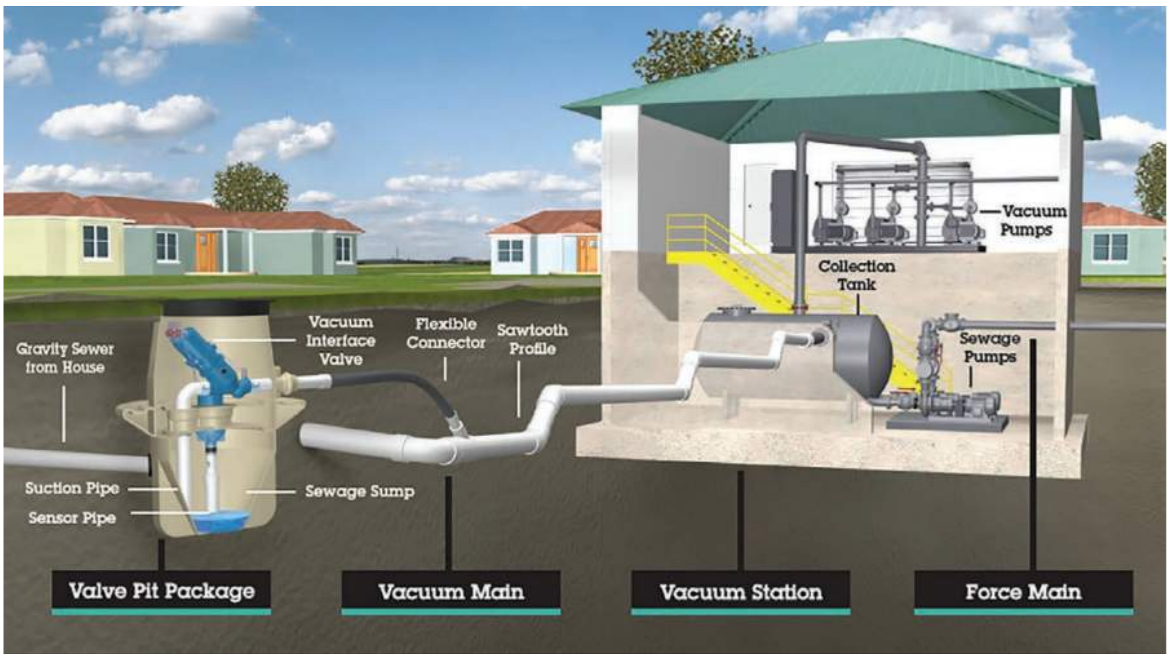


Figure 5-5. Vacuum Sewer Collection System
Source: AIRVAC, Inc

5.1.6 Hybrid Systems

These systems combine two or more of the systems discussed above. Generally, it is advisable to combine systems based on the type of wastewater handled: raw wastewater or septic tank effluent. Natural combinations are STEP and STEG, or conventional gravity and grinder pump systems. The rationale for a hybrid system is to install the type of system that is appropriate and economical for any given sub-area within the proposed sewer service area.

5.2 Design Constraints

- **Soil Characterization:** Terrebonne is characterized by shallow bedrock on the plateau and along rimrock edges, commonly within 20 inches of the ground surface. Some lower elevations and isolated regions, have more soil depth to bedrock—approximately 20 to 40 inches according to the NRCS soil series descriptions. It is anticipated, for planning purposes, that rock excavation will be required for all pipeline installation. Therefore, collection systems that require shallower trenching would be more suitable for Terrebonne.

- **Development Density:** The community is fairly spread out due to the presence of larger lots and the considerable number of lots that are currently unbuildable because of the inability of the lot to accommodate a legal onsite wastewater system. Therefore, collection systems that have a lower installation cost per foot would be more suitable for Terrebonne.
- **Topography:** Topographic constraints include a relatively large flat area on top of the ridge, which includes most of the community. Rimrock borders much of this area with outer portions parts of the service area located at lower elevations surrounding the rimrock. The topography in Terrebonne slopes away in various directions. Therefore, collection systems that can convey wastewater uphill would be more suitable for Terrebonne.
- **Infrastructure:** Other constraints include US Highway 97, COID irrigation laterals, and the Burlington Northern Santa Fe (BNSF) railroad that cuts through the east-most part of the Terrebonne unincorporated community boundary. Therefore, collection systems more capable of navigating around and under existing obstructions would be more suitable for Terrebonne.

5.3 Collection System Alternative Evaluation

The shallow depth to bedrock and diverging topography place severe limitations on the large-scale applicability of a gravity collection system. Table 5-1 below compares gravity sewer and pressure sewer collection systems with regard to additional design considerations.

Table 5-1. Comparison of Gravity and Pressure Sewer Collection Systems

Issue	Gravity Sewer	Pressure Sewer
Infiltration and inflow	Usually encountered	Avoided
Scouring velocity	Required to avoid solid deposition	Not a factor with liquid-only effluent
Minimum diameter	6–8 inches	1.25 inches
Downhill slopes	Must be maintained at all locations	Not required, follow topography
Trench depth	Typically 5–30 feet deep, depending upon the terrain and minimum required slopes	Minimum depth of 3 feet (just below the frost line)
Lift stations	Needed for low areas where downhill slopes cannot be maintained	Minimized or not required
Cleaning access to mainlines	Access ports regularly spaced	Cleanouts minimized
Conflicts with other buried utilities	May require redesign to avoid conflicts	Easily avoided
Ease of construction	Deep and wide trenches go in slowly with traffic disruption	Narrow shallow trenches go in quickly with minimal traffic disruption
Requires onsite tank, pump, and related maintenance	No	Yes

While the relatively flat area on top of the ridge may be suitable for a vacuum system, the isolated lower areas, and the elevation differences of approximately 130 feet in the service area, complicate the feasibility of a vacuum system as an economical alternative. STEP and grinder pump systems are well suited for the physical and topographical constraints, as well as for the relatively low density of existing community development.

A grinder pump collection system could be a feasible option with reasonable construction costs and could be considered further during preliminary design if a treatment system is located close to Terrebonne. It is more likely that a treatment facility would be located a few miles away, or in the case of pumping to Redmond, approximately 2.75 miles away. Force main retention times could exceed one day, depending on the route taken, and could result in potential problems with solids deposition if a raw sewer grinder pump collection system is used.

5.4 Recommended Collection System

For the purpose of planning a wastewater collection system, a STEP system is the recommended alternative. Some regions in Terrebonne may be well suited for a STEG collection system without the use of effluent pumps if the treatment system is located below Terrebonne along Lower Bridge Way (as is the case with Treatment Alternatives 1 and 2). In these cases, the collection system could be a hybrid STEP/STEG system. If effluent is to be pumped to the new Redmond Wetlands Complex (Alternative 3), a STEP-only system would be required as gravity flow is not feasible to this treatment location, which is at a higher elevation than areas of Terrebonne, with undulating topography between.

Since septic tank effluent does not need to flow as rapidly as raw wastewater to keep solids suspended, the STEP system could use smaller pumps and lower flow rates than what would be required in a grinder pump collection system. Lower flow rates result in lower pipeline head losses, which in turn result in lower operational costs. In addition, most properties are already equipped with septic tanks that can continue to be used for primary wastewater treatment in a STEP or STEG system.

5.5 Wastewater Treatment Alternatives

Wastewater disposal options considered in this report include land application (effluent irrigation), drainfield disposal, and discharge to the proposed Redmond Wetlands Complex, which disposes of wastewater via infiltration, evaporation, and land application. Land application (effluent irrigation) is often the disposal method associated with facultative lagoons because the required winter holding storage volume can be conveniently incorporated into the excavated lagoons. A viable option for infiltration of treated effluent from packaged treatment systems is drainfield disposal, which would minimize the visual and odor impacts of a wastewater system in the Terrebonne community.

Due to the environmental sensitivity of the Deschutes River and the Crooked River, direct discharge was not considered as a disposal option in this report, as the required level of treatment is not feasible for a small community with limited resources.

Below is an overview of the alternatives considered for wastewater treatment and disposal:

4. Facultative Lagoon with Winter Storage and Irrigation Reuse for Effluent Disposal
5. Packaged Treatment System with Drainfield for Effluent Disposal
6. City of Redmond Wastewater Treatment Wetlands Complex

5.5.1 Alternative 1 – Facultative Lagoon with Irrigation Reuse

A facultative lagoon system along with land application of the effluent is a common and proven method of treating and disposing of municipal wastewater without discharging into waters of the state. See Photograph 5-1 for an example of an existing facultative wastewater lagoon. The technology associated with facultative lagoons has been in widespread use in the United States for at least 90 years with more than 7,000 facultative lagoons in operation today. Many communities in Central Oregon use this wastewater treatment option including La Pine, Crescent, Sisters, Metolius, and Culver. Although the facultative lagoon concept is land intensive, especially in northern climates, it offers a reliable and easy-to-operate process that is attractive to small rural communities, where land is less expensive.

Photograph 5-1. Facultative Wastewater Lagoon in Eastern Oregon

Facultative waste stabilization ponds, sometimes referred to as lagoons, are usually 4 to 8 feet deep and can be mechanically mixed or aerated for increased treatment capacity. The layer of water near the surface contains dissolved oxygen due to atmospheric re-aeration and algal respiration, which supports aerobic and facultative organisms. The bottom layer of the lagoon includes sludge deposits and supports anaerobic organisms. The intermediate anoxic layer, termed the facultative zone, ranges from aerobic near the top to anaerobic at the bottom. See Figure 5-6 for an illustration of a facultative pond wastewater treatment process.

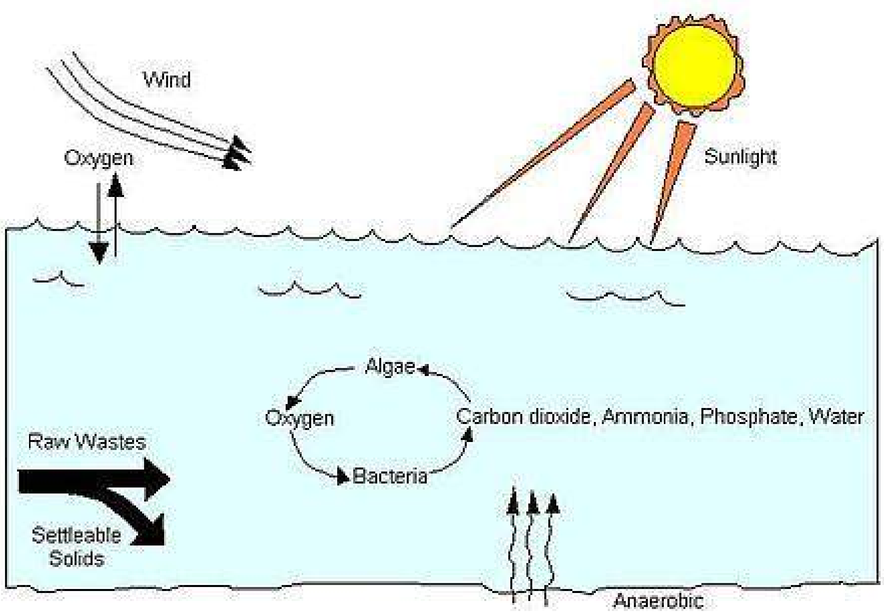


Figure 5-6. Facultative Pond Wastewater Treatment Process

These layers may persist for prolonged periods due to temperature-induced variations in the water density. Inversions can occur in the spring and fall when the surface water layer may have a higher density than lower layers due to temperature fluctuations. This higher density water sinks during these unstable periods, creates turbidity, and can produce objectionable odors—especially if there has been ice cover. However, this period is generally short and can be minimized by appropriately sizing the lagoon.

The presence of algae in the aerobic and facultative zones is essential to the successful performance of facultative ponds. In sunlight, the algal cells use carbon dioxide from the water and release oxygen produced from photosynthesis. On warm, sunny days, the oxygen concentration in the surface water can exceed saturation levels. Conversely, oxygen levels are decreased at night. In addition, the pH of the near surface water can exceed 10 due to the intense use of carbon dioxide by algae, which creates conditions favorable for ammonia removal via volatilization. This photosynthetic activity occurs on a diurnal basis, which causes both oxygen and pH levels to shift from a maximum in daylight hours to a minimum at night.

The oxygen, produced by algae and surface re-aeration, is used by aerobic and facultative bacteria to stabilize organic material in the upper layer of water. Anaerobic fermentation is the dominant activity in the bottom layer in the lagoon. In cold climates, oxygenation and fermentation reaction rates are significantly reduced during the winter and early spring, and effluent quality may be reduced to the equivalent of primary effluent when an ice cover persists on the water surface. As a result, many states in the northern United States prohibit discharge from facultative lagoons during the winter.

See Table 5-2 for a summary of the basic design criteria that influences the sizing and layout of facultative lagoons.

Table 5-2. Facultative Lagoon Design Criteria

Criterion	Value	Source
Typical BOD Loading	46–156 mg/L	Table 3-18, EPA *Onsite Wastewater Treatment Manual,* 2002 [a]
Design Areal Organic Loading	10–20 lb/ac/day	EPA *Design Manual, Municipal Wastewater Stabilization Ponds*, 1983 [b]
Number of Cells	3 minimum	EPA *Wastewater Technology Fact Sheet, Facultative Lagoons* [c]
Hydraulic Residence Time	20–180 days	EPA *Wastewater Technology Fact Sheet, Facultative Lagoons* [c]
Facultative Cell Depth Range	4–8 ft	EPA *Wastewater Technology Fact Sheet, Facultative Lagoons* [c]
Effluent BOD	< 30 mg/L	EPA *Wastewater Technology Fact Sheet, Facultative Lagoons* [c]

BOD = biochemical oxygen demand; EPA = U.S. Environmental Protection Agency; ft = feet; lb/ac/day = pounds per acre per day; mg/L = milligrams per liter

[a] https://www.epa.gov/sites/default/files/2015-06/documents/2004_07_07_septics_septic_2002_osdm_all.pdf

[b] https://nepis.epa.gov/Exe/ZyNET.exe/300044QA.txt?ZyActionD=ZyDocument&Client=EPA&Index=1981%20Thru%201985&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&UseQField=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5CZYFILES%5CINDEX%20DATA%5C81THRU85%5CTXT%5C00000001%5C300044QA.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=hpfr&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1

[c] https://www3.epa.gov/npdes/pubs/faclagon.pdf

A treatment site of approximately 20 acres would be required for a facultative lagoon system sized to treat the maximum-month flow of 221,340 gpd from 1,054 EDUs (full buildout) and store treated effluent during the winter when disposal via irrigation is not available. Although it is possible to contract an agreement with nearby irrigators to receive and apply effluent on their crops, it was assumed in this analysis that the land for irrigation reuse would be owned and operated by the District.

Regulations pertaining to the use of reclaimed water (treated effluent) from sewage treatment plants are stated in OAR Chapter 340, Division 55. Usage restrictions depend on the level of treatment and disinfection provided. Treated effluent from a facultative lagoon system (without effluent polishing) would generally be classified as Class D recycled water, which can be reused for irrigation of select crops that are not intended for human consumption. Initially, alfalfa hay and pasture grass have been assumed as the crops for estimating irrigation requirements. Approximately 50 acres of land would be required for irrigation of either of these crops. The overall land requirement for treatment and disposal is approximately 70 acres; however, it would be prudent to acquire more land to allow for a perimeter site buffer and additional irrigation area during years with higher rainfall or lower evaporation. An 80-acre site is recommended for the purposes of this study.

Inflow from the District's collection system would discharge to a primary pond, then flow into a secondary pond, and then discharge to a storage pond for land use application. See Figure 5-7 for a process flow diagram, and Figure 5-8 for a conceptual lagoon plan. The storage facility would require adequate volume to store the effluent until land application is possible during the growing season. Prior to irrigation, the water would flow from the storage pond to a chlorine contact chamber to kill bacteria. An irrigation pumping facility would be constructed downstream of the chlorine contact chamber. This would be a simple structure of a concrete pad and a self-priming centrifugal pump that pressurizes flow through the sprinkler system. The pump would be on a timer so the operator could set the irrigation applications for the required duration, and the pump would shut off to allow the sprinklers to be drained for movement.

The danger of groundwater contamination frequently imposes seepage restrictions, which necessitates lining or sealing the pond. Facultative ponds have the potential to cause mosquito breeding and unpleasant odors around the treatment site. During the spring and fall, deeper anaerobic or anoxic water and bacterial solids rise to the surface and release volatile, odiferous compounds into the atmosphere. A typical requirement in these cases is to locate such ponds at least one-quarter mile from human habitations. The TSAG expressed concerns that facultative ponds sited west of town could cause persistent odors in town due to prevailing winds from the west.

The most likely location of the lagoon and effluent irrigation site would be somewhere northwest of Terrebonne on a large parcel or several parcels of irrigated farmland near NW Lower Bridge Way. Site acquisition can be a slow and complicated process. Funding agencies generally have specific requirements that must be met. Typical requirements include appraisals and owner notification of rights. These factors could complicate the District's ability to identify, negotiate, and acquire the land required for a suitable treatment and disposal site.

The Alternative 1 collection system would consist of a combination of STEG and STEP piping (see Figure 5-9 for a preliminary layout of this alternative). This approach to wastewater collection minimizes deep trenching, allows for smaller main sizes, and uses the septic tanks that developed properties already have for primary treatment. The central portion of Terrebonne slopes down toward US 97 and is conducive to gravity flow along Lower Bridge Way to a lagoon site to the west. Areas outside this central region would require effluent pumps connected to STEP piping because the existing slopes are either too flat or directed westward from the plateau edge.

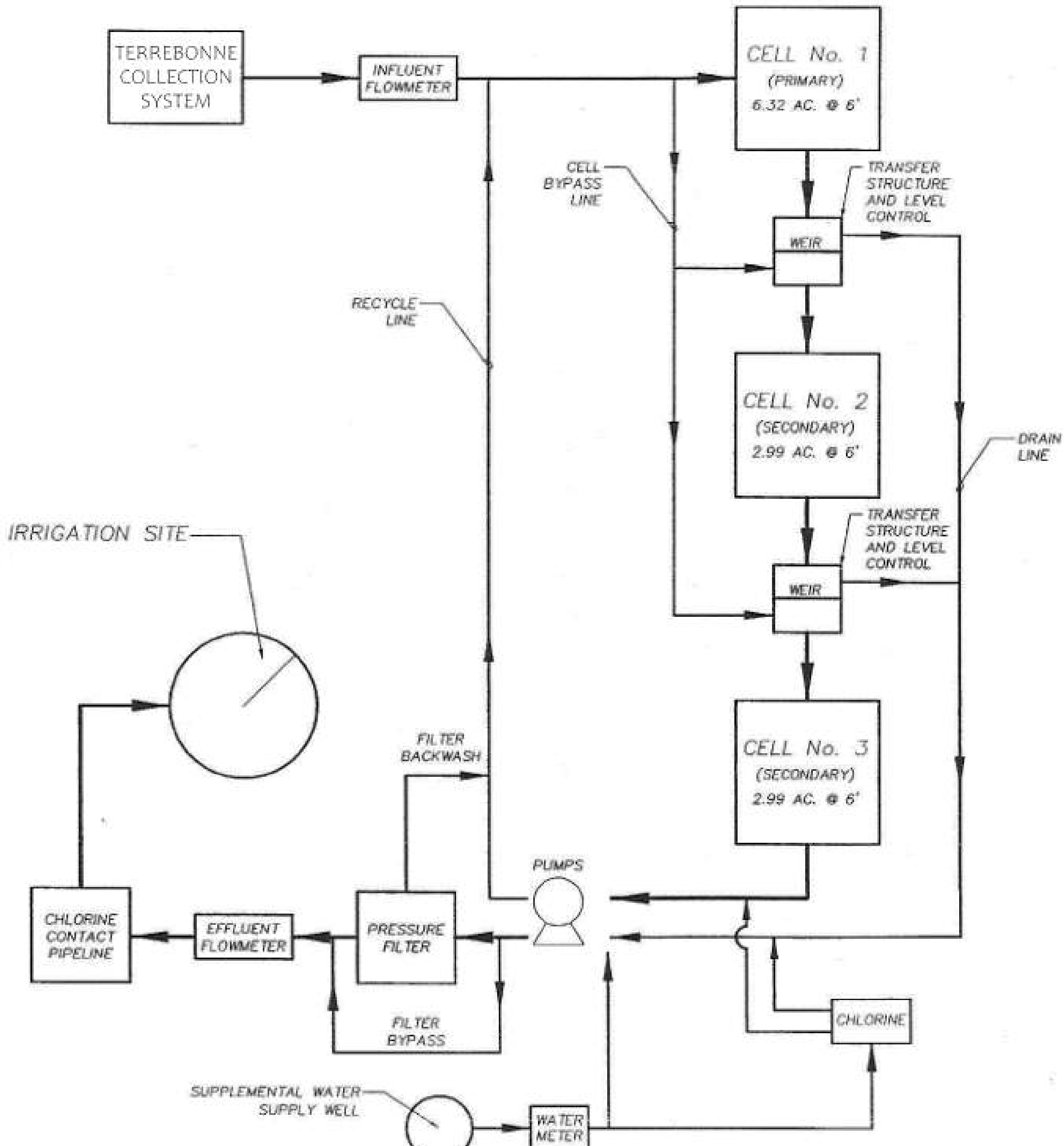


Figure 5-7. Process Flow Diagram of Facultative Lagoon Treatment Facility
Source: Terrebonne Wastewater Feasibility Study 1999 by HGE, Inc.

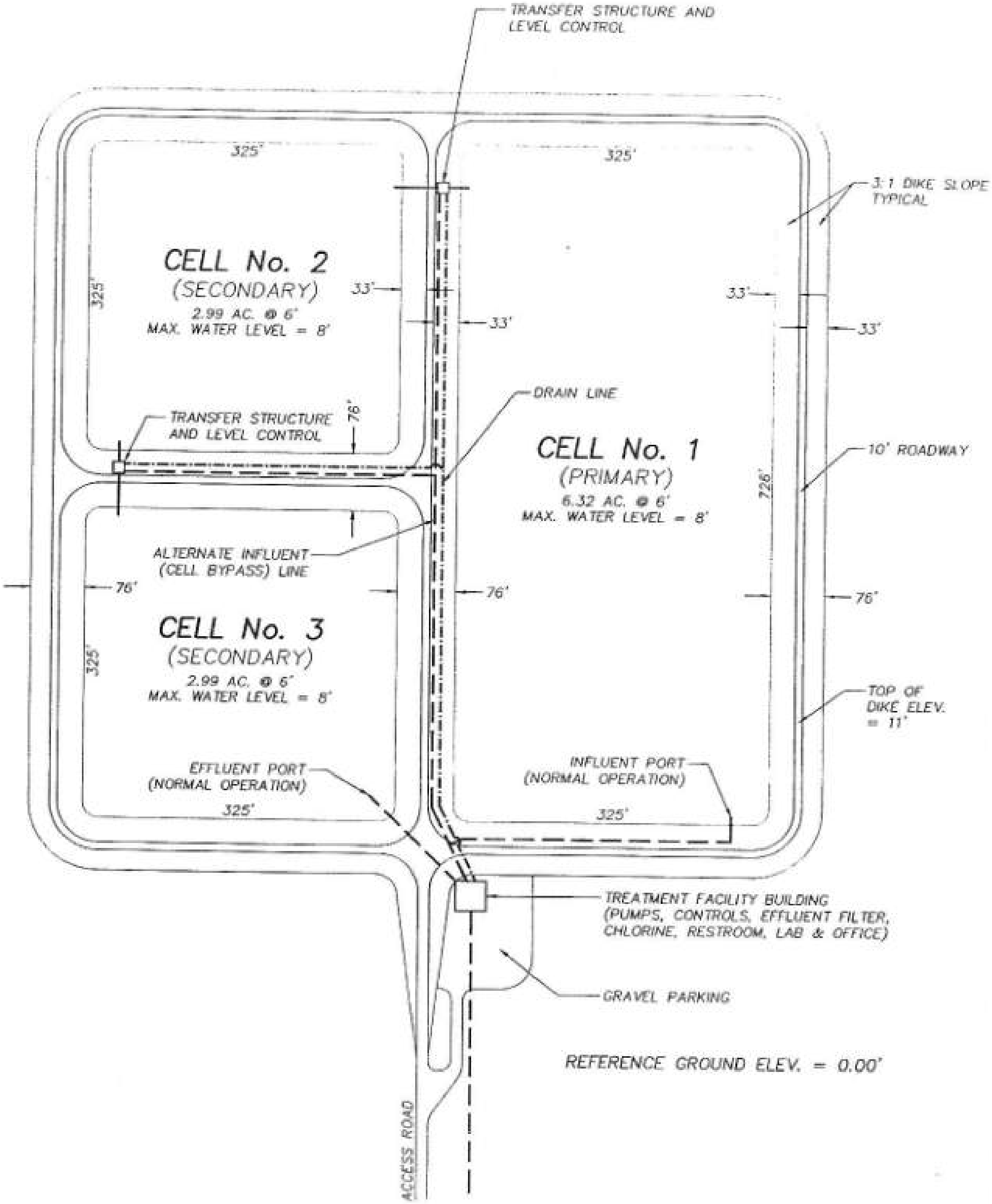


Figure 5-8. Facultative Lagoon Concept Plan
Source: Terrebonne Wastewater Feasibility Study 1999 by HGE, Inc.

Advantages of the facultative pond alternative include:

- Relatively low operating costs and less reliance on mechanical equipment and power. The system is not maintenance intensive and power costs are minimal because no pumps are required for treatment (besides the irrigation pump for treated effluent).
- Although some analytical work is essential to ensure proper operation, an extensive sampling and monitoring program is usually not necessary.
- Moderately effective in removing settleable solids, biochemical oxygen demand (BOD), pathogens, fecal coliform, and ammonia.
- Easy to operate and require little energy; systems are designed to operate with gravity flow.
- The quantity of removed material would be relatively minor compared with other secondary treatment processes.

Disadvantages of the facultative pond alternative include:

- Substantial land requirement for facultative lagoons, winter storage pond, and irrigation reuse crops. Siting and acquiring a large treatment facility like this could be a major obstacle for the District to overcome.
- In addition, the facultative pond system would require a new wastewater pollution control facility (WPCF) permit from DEQ; the permit would need to be renewed annually and would require fees and reporting. The system operator must be knowledgeable of this type of system and would be required to have certification to operate the facility.
- Settled sludges and inert material require periodic removal. It is difficult to control or predict ammonia levels in effluent.
- Sludge accumulation would be higher in cold climates due to reduced microbial activity.
- Mosquitos and similar insect vectors can be a problem if emergent vegetation is not controlled.

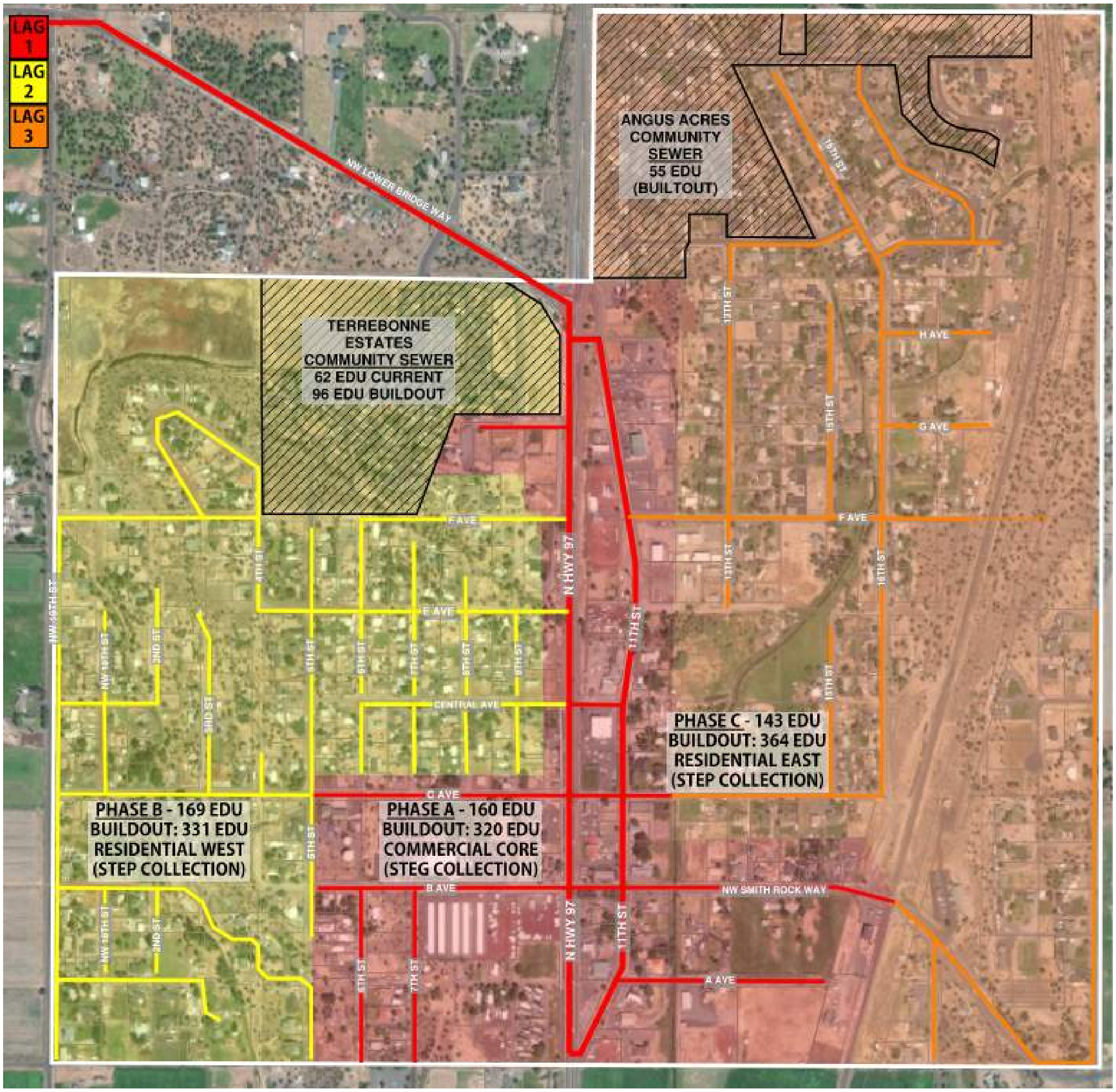


Figure 5-9. Schematic Layout of Alternative 1 – STEP/STEG Collection and Lagoon Treatment System

The engineer's opinion of probable costs for Alternative 1 is summarized below by Table 5-3, followed by a summary of estimated operations & maintenance costs in Table 5-4. Please see Section 8.1 for a breakdown of the 45% allocation for design, legal, admin, permitting, and contingency, as well as descriptions of each. A Class IV project estimate range (1-15% design level, for feasibility study) is provided with expected accuracy of -30% and +50%, as defined by the Association for the Advancement of Cost Engineering (AACE).

Table 5-3. Opinion of Probable Costs for Alternative 1 – Facultative Lagoon

Phase	Construction Item	Quantity	Unit	Unit Price	Estimated Cost
A	STEG Collection System	12,400	lf	$120	$1,488,000
	Land Acquisition	80	ac	$40,000	$3,200,000
	Facultative Lagoon (Phase A construction)	8	ac	$250,000	$2,000,000
				Construction Subtotal	$6,688,000
				Design, Legal, Admin, Permitting, Contingency (45%)	$3,009,600
				Estimated Phase A Total	**$9,697,600**
B	STEP Collection System	25,700	lf	$120	$3,084,000
	Facultative Lagoon (Phase B expansion)	6	ac	$250,000	$1,500,000
				Construction Subtotal	$4,584,000
				Design, Legal, Admin, Permitting, Contingency (45%)	$2,062,800
				Estimated Phase B Total	**$6,646,800**
C	STEP Collection System	14,200	lf	$120	$1,704,000
	Facultative Lagoon (Phase C expansion)	6	ac	$250,000	$1,500,000
				Construction Subtotal	$3,204,000
				Design, Legal, Admin, Permitting, Contingency (45%)	$1,441,800
				Estimated Phase C Total	**$4,645,800**
				Estimated Alternative 1 Total	**$18,316,400**
				Class IV Estimate Low (-30%):	**$14,693,140**
				Class IV Estimate High (+50%):	**$31,485,300**

ac = acres; lf = linear feet; STEG = septic tank effluent gravity; STEP = septic tank effluent pump

Table 5-4. Estimated O&M Costs for Alternative 1 – Facultative Lagoon

Operating Expense Item	Annual Estimated Cost	
Maintenance Staff	$	140,000
Billing/Administrative Services	$	60,000
Personnel Subtotal	**$**	**200,000**
Electricity	$	5,000
Vehicles	$	25,000
Maintenance Equipment	$	25,000
Licensing, Permits, and Fees	$	10,000
Infrastructure Maintenance/Replacement	$	50,000
Materials and Services Subtotal	**$**	**115,000**
Treatment System Infrastructure Fund	$	80,000
Collection System Infrastructure Fund	$	50,000
Capital Outlay Subtotal	**$**	**130,000**
Annual Operating Expense Total	**$**	**445,000**

5.5.2 Alternative 2 – Packaged Treatment System

There are several commercially available packaged treatment plants on the market today which use varying types of technologies to treat wastewater. These systems do a fair job of reducing BOD levels to limits set by state and local regulations. The key benefits of packaged treatment units are that they are relatively compact, expandable, and functional upon installation.

The packaged treatment plant considered for Terrebonne is the AdvanTex® AX-Max Treatment System manufactured by Orenco Systems (see Figure 5-10 for an illustration). These systems are a dependable, proven technology for primary-treated effluent to better-than-secondary treatment standards including nitrogen reduction. They consist of sturdy, watertight fiberglass tanks that incorporate recirculation-blend and discharge storage volume in a single module. Each complete, pre-manufactured unit also includes pumping systems, ventilation, and a lightweight, highly absorbent engineered textile media that facilitates wastewater treatment in a compact space. Unlike other packed-bed filters that use sand, peat, foam, or other materials for the treatment media, the AdvanTex system uses a lightweight, compact, and easy-to-maintain textile that maximizes surface area for microbiological growth.

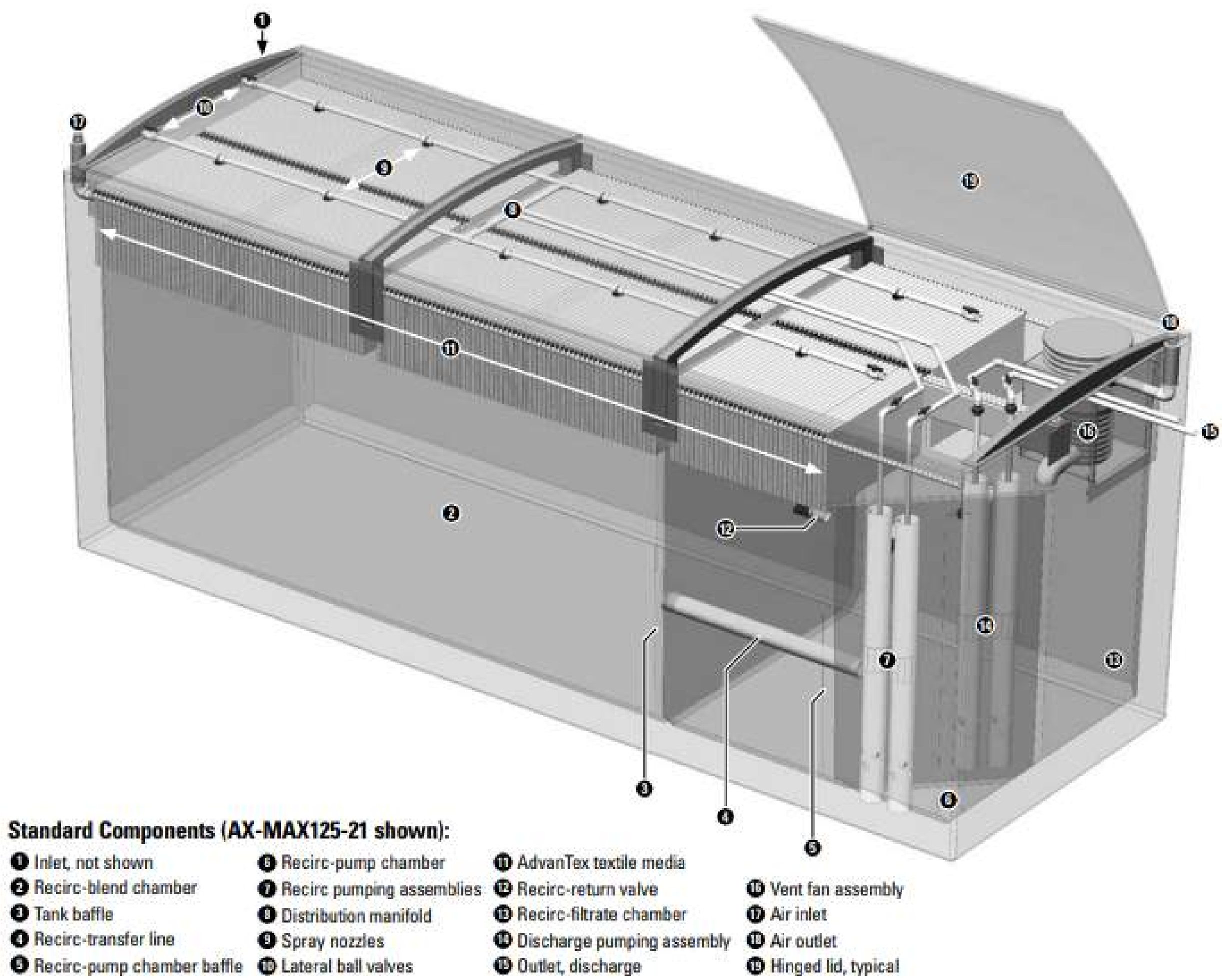


Figure 5-10. Packaged Treatment Plant System Illustration
Source: Orenco Systems, Inc.

AX-Max Treatment Systems are intended for large-flow sites such as commercial and community applications that require an advanced secondary treatment system. They eliminate the need for separate recirculation and discharge tanks by performing both functions within a single module. AX-Max units are ideal for subdivisions, hotels, resorts, schools, churches, businesses, manufactured home parks, recreational vehicle parks, campgrounds, rest areas, and truck stops. Depending on the model, a single AdvanTex AX-Max unit can treat flows of 5,000 to 15,000 gpd. Because AdvanTex treatment systems are modular, they can easily be installed in multi-unit parallel arrays to handle higher flows.

Figure 5-11 below illustrates the basic flow characteristic of a packaged biological treatment plant. The preliminary treatment system layout shown below is sized for an average daily flow of 50,000 gpd (from Phase A customers) and can reduce 140 mg/L BOD and 30 mg/L TSS influent to 20 mg/L effluent limits. The plant would be composed of eight 35-foot-long AX-Max units and one 14-foot unit to house the recirculation pumps, discharge pumps, and ventilation fans. The required footprint for this first phase of the treatment system is an 80- by 50-foot area (4,000 square feet). The treatment system at full buildout would be roughly three times this size, with 24 AX-Max units and an approximately 12,000-square-foot footprint.

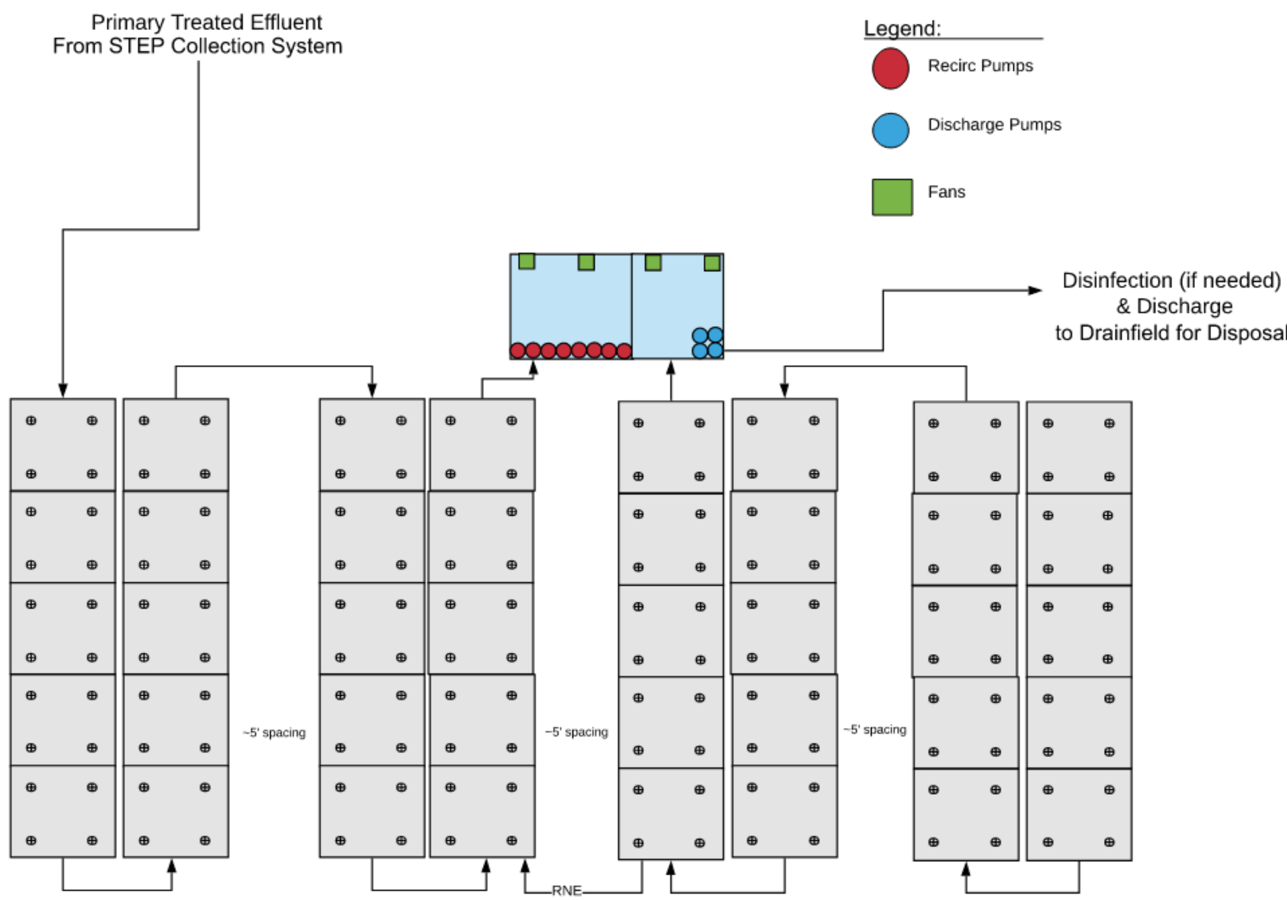


Figure 5-11. Preliminary AX-MAX Treatment System Layout
Source: Orenco Systems, Inc.

A properly sized packaged treatment plant would provide excellent effluent quality and require far less land area than a facultative lagoon system. A treatment site of approximately 1 acre would be required to install this packaged treatment system along with required setbacks, access roads, and utilities. The more significant land requirement related to this alternative is for effluent disposal. Suitable disposal alternatives include land application with winter storage and drainfield disposal. For the purposes of this study, drainfield disposal is considered with Alternative 2, since land application is the means of effluent disposal considered with Alternative 1. In order to adequately infiltrate the estimated maximum month daily effluent flow projected at full buildout, approximately 25 acres would be required either at the treatment site or another suitable remote location. This effluent disposal facility would require a new WPCF permit.

Preliminary system sizing calculations are listed below:

- Advantex Treatment site = 1 acre
- Average of 35 linear feet of infiltration trench per 150 gpd (per DEQ Div. 071, Soil Group A)
- 1,054 EDU total projected in 2040
- Average Daily Flow = 1,054 EDU x 150 gpd/EDU = 158,100 gpd
- Maximum Month Daily Flow = (1.4 factor) X (158,100 gpd) = 221,340 gpd
- Required Drainfield Length = 35 LF x (221,340/150) = 51,646 LF drainfield
- Required Drainfield Area = 51,646 ft x 10 ft footprint = 516,460 square feet = 11.9 acres
- Buffer Area (10% for access roads, setbacks, and distribution boxes) = 1.2 acres
- Total Disposal Site Area (primary, reserve, buffer) = 11.9 + 11.9 + 1.2 acres = 25 acres
- Total Land Acquisition Required for Treatment and Disposal = 1 acre + 25 acres = 26 acres

With this alternative, the collection system would consist of a combination of septic tank effluent gravity (STEG) piping and septic tank effluent pressure (STEP) piping. The central portion of Terrebonne slopes down towards US Highway 97 and is conducive to gravity flow along Lower Bridge Way to the drainfield site to the West. The outer regions would require effluent pumps connected to STEP piping, because the existing slopes are either too flat or directed westward from the plateau edge. See Figure 5-12 for a preliminary layout of a proposed collection and treatment system associated with Alternative 2.

Some advantages with a packaged treatment system include:

- This turn-key system can be installed and operational more quickly than other alternatives.
- Lab-tested effectiveness in removing TSS, BOD, pathogens, fecal coliform, and ammonia.
- Treatment capacity could be easily increased by expanding the treatment system with additional treatment units installed in parallel.
- The treatment system would have relatively minor impacts to land, views, and odors in Terrebonne due to a relatively small footprint and enclosed system components.

Some disadvantages with a packaged treatment system include:

- Electricity is required for ongoing operation of recirculation pumps, discharge pumps, and fans.
- The use of proprietary products limits options for servicing and replacing system components.
- The effluent disposal site would require a DEQ WPCF permit and up to 25 acres of suitable land for a drainfield.

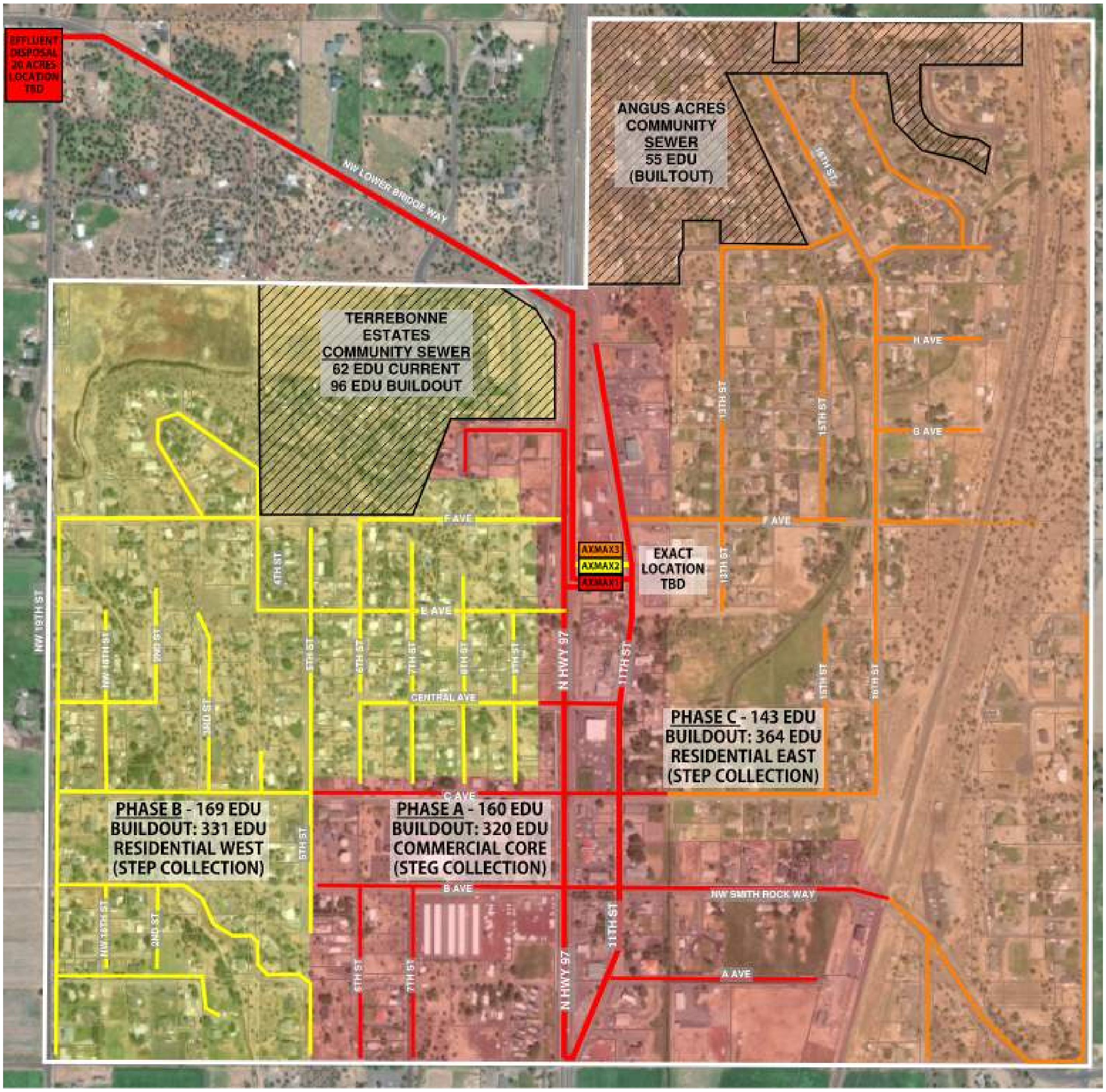


Figure 5-12. Alternative 2 Layout - Packaged Treatment System and STEP/STEG Collection

The engineer's opinion of probable costs for the full buildout of Alternative 2 is summarized below in Table 5-5, followed by a summary of estimated operations & maintenance costs in Table 5-6. Please see Section 8.1 for a breakdown of the 45% allocation for design, legal, administration, permitting, and contingency, as well as descriptions of each. A Class IV project estimate range (for feasibility studies, 1-15% design level) is provided with expected accuracy of -30% and +50%, as defined by the Association for the Advancement of Cost Engineering (AACE).

Table 5-5. Opinion of Probable Costs for Alternative 2 – Packaged Treatment System

Phase	Construction Item	Quantity	Unit	Unit Price	Estimated Cost
A	STEG Collection System	12,400	lf	$120	$1,488,000
	Land Acquisition	26	ac	$40,000	$1,040,000
	AxMax Treatment System (Phase A construction)	8	ea	$180,000	$1,440,000
	Disposal Drainfield (Phase A installation)	13,230	lf	$50	$661,500
				Construction Subtotal	$4,629,500
				Design, Legal, Admin, Permitting, Contingency (45%)	$2,083,275
				Estimated Phase A Total	$6,712,775
B	STEP Collection System	25,700	lf	$120	$3,084,000
	AxMax Treatment System (Phase B expansion)	8	ea	$180,000	$1,440,000
	Disposal Drainfield (Phase B expansion)	13,230	lf	$50	$661,500
				Construction Subtotal	$5,185,500
				Design, Legal, Admin, Permitting, Contingency (45%)	$2,333,475
				Estimated Phase B Total	$7,518,975
C	STEP Collection System	14,200	lf	$120	$1,704,000
	AxMax Treatment System (Phase C expansion)	8	ea	$180,000	$1,440,000
	Disposal Drainfield (Phase C expansion)	13,230	lf	$50	$661,500
				Construction Subtotal	$3,805,500
				Design, Legal, Admin, Permitting, Contingency (45%)	$1,712,475
				Estimated Phase C Total	$5,517,975
				Estimated Alternative 2 Total	**$19,749,725**
				Class IV Estimate Low (-30%)	**$13,824,808**
				Class IV Estimate High (+50%)	**$29,624,588**

ac = acres; ea - each; lf = linear feet; STEG = septic tank effluent gravity; STEP = septic tank effluent pump

Table 5-6. Estimated O&M Costs for Alternative 2 – Packaged Treatment System

Operating Expense Item	Annual Estimated Cost	
Maintenance Staff	$	140,000
Billing/Administrative Services	$	60,000
Personnel Subtotal	**$**	**200,000**
Electricity	$	8,000
Vehicles	$	20,000
Maintenance Equipment	$	25,000
Licensing, Permits, and Fees	$	10,000
Infrastructure Maintenance/Replacement	$	50,000
Materials and Services Subtotal	**$**	**113,000**
Treatment System Infrastructure Fund	$	80,000
Collection System Infrastructure Fund	$	50,000
Capital Outlay Subtotal	**$**	**130,000**
Annual Operating Expense Total	**$**	**443,000**

5.5.3 Alternative 3 – Redmond Wetlands Complex

For 45 years, the City of Redmond (City) has used the Effluent and Biosolids Complex, a 610-acre property to the northwest of the city, to repurpose and discharge all of Redmond's treated wastewater effluent and biosolids. The WPCF, where the wastewater is initially treated, is located at the north end of Dry Canyon (see Photograph 5-2). A copy of the Redmond WPCF Permit is included in Appendix G for reference. The population of Redmond and surrounding areas has grown significantly since the last major WPCF Expansion in 2000 and growth is expected to continue long-term. As such, the City understands that expansion of its treatment facilities is vital to serving growth.

Photograph 5-2. Existing Redmond Water Pollution Control Facility Site
Source: https://redmondwetlandscomplex.com/expansion-site-design/

The City plans to expand the Effluent and Biosolids Disposal Complex and transition its operation to a more sustainable and environmentally friendly treatment alternative. As early as 1984, the complex was identified as a preferred location with long-range opportunities to treat and dispose of wastewater while also offering sustainable development opportunities. The City will be decommissioning the existing mechanical WPCF in Dry Canyon and expanding all operations to 5801 NW Way, Redmond (see Figure 5-13). In addition to the Effluent and Biosolids Disposal Complex, the city leases 35 acres from the Federal Bureau of Land Management, at the site where disinfected water is infiltrated into the ground.

The City is underway with the preliminary design phase of the Redmond Wetlands Complex, with the final design expected to be completed in December 2022 and construction beginning in February 2023. The proposed Redmond Wetlands Complex will use ponds and wetlands that are engineered to treat wastewater.

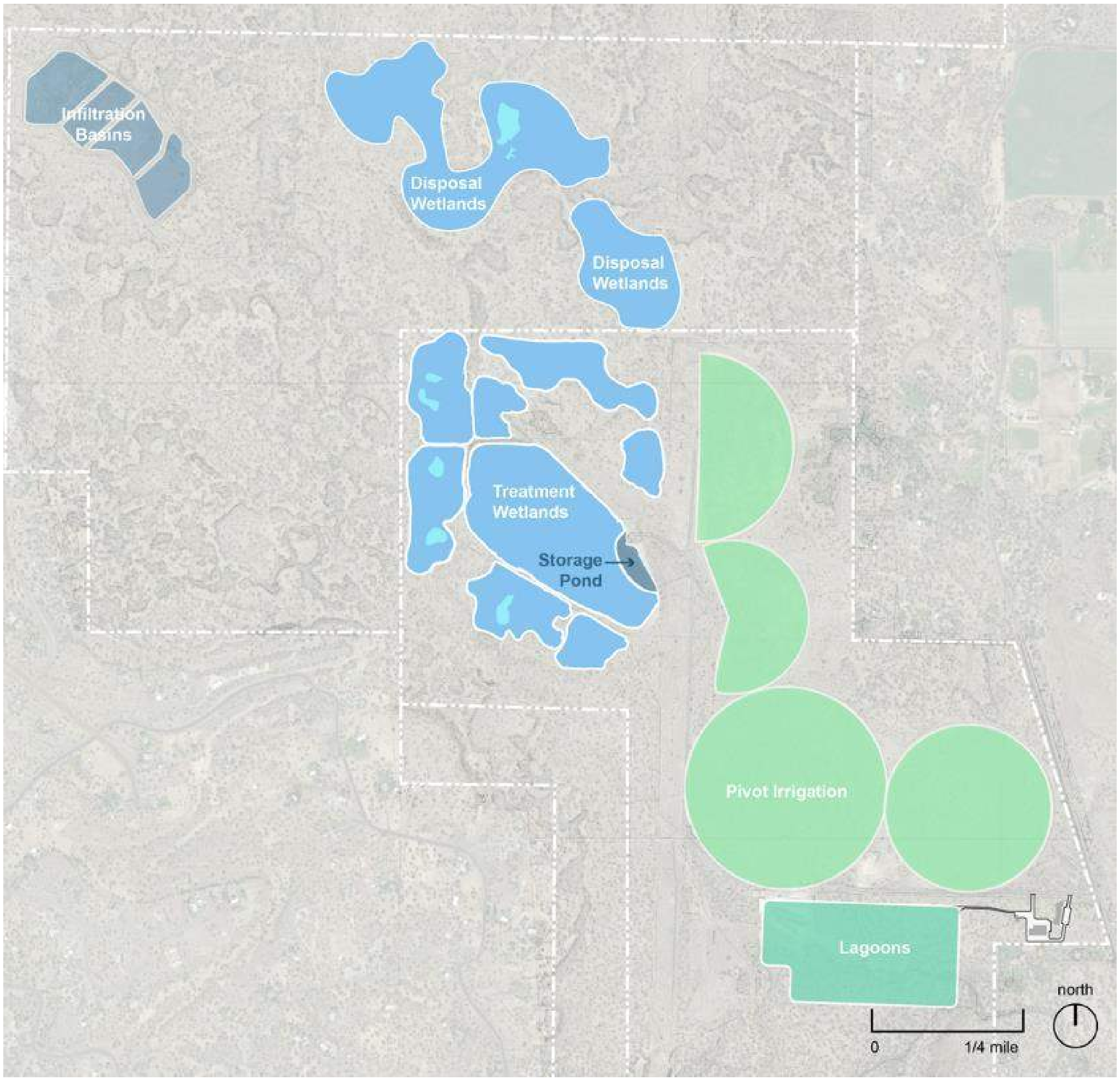


Figure 5-13. Proposed Redmond Wetlands Complex Conceptual Site Map
Source: https://redmondwetlandscomplex.com/expansion-site-design/

Constructed wetlands are increasingly receiving national attention for wastewater treatment and reclamation. Constructed wetlands have proven to be a highly effective method for the treatment of municipal wastewater. They are a sustainable, cost-effective treatment solution that is easily operated and maintained while supporting wetland habitat for birds and other wildlife and offering recreational and educational opportunities.

The wastewater feasibility study conducted by HGE in 1999 examined the possibility of conveying Terrebonne's wastewater over 5 miles to the existing Redmond Effluent and Biosolids Complex as one of the design alternatives. With the new Wetlands Complex proposed north of Redmond and closer to Terrebonne, the distance to convey wastewater would now be approximately 2.75 miles. Preliminary discussions with the City of Redmond Wastewater Division have confirmed that the City is open to the possibility of allowing Terrebonne to connect the new Wetlands Complex.

Over the past few decades, hydraulic pump technology has improved such that effluent can be pumped to treatment sites as far as 10 miles away via onsite effluent pumps and pressure sewer force mains. The effluent pump technology considered with this alternative is manufactured by Orenco Systems, which is headquartered in Sutherlin, Oregon. This wastewater technology manufacturer offers effluent pumps that can be installed in existing septic tanks (ProPak system) or integrated within new septic tanks that have been optimized for this purpose (Prelos system), depending on the condition of existing tanks. Figure 5-14 shows a preliminary STEP collection system layout for Alternative 3.

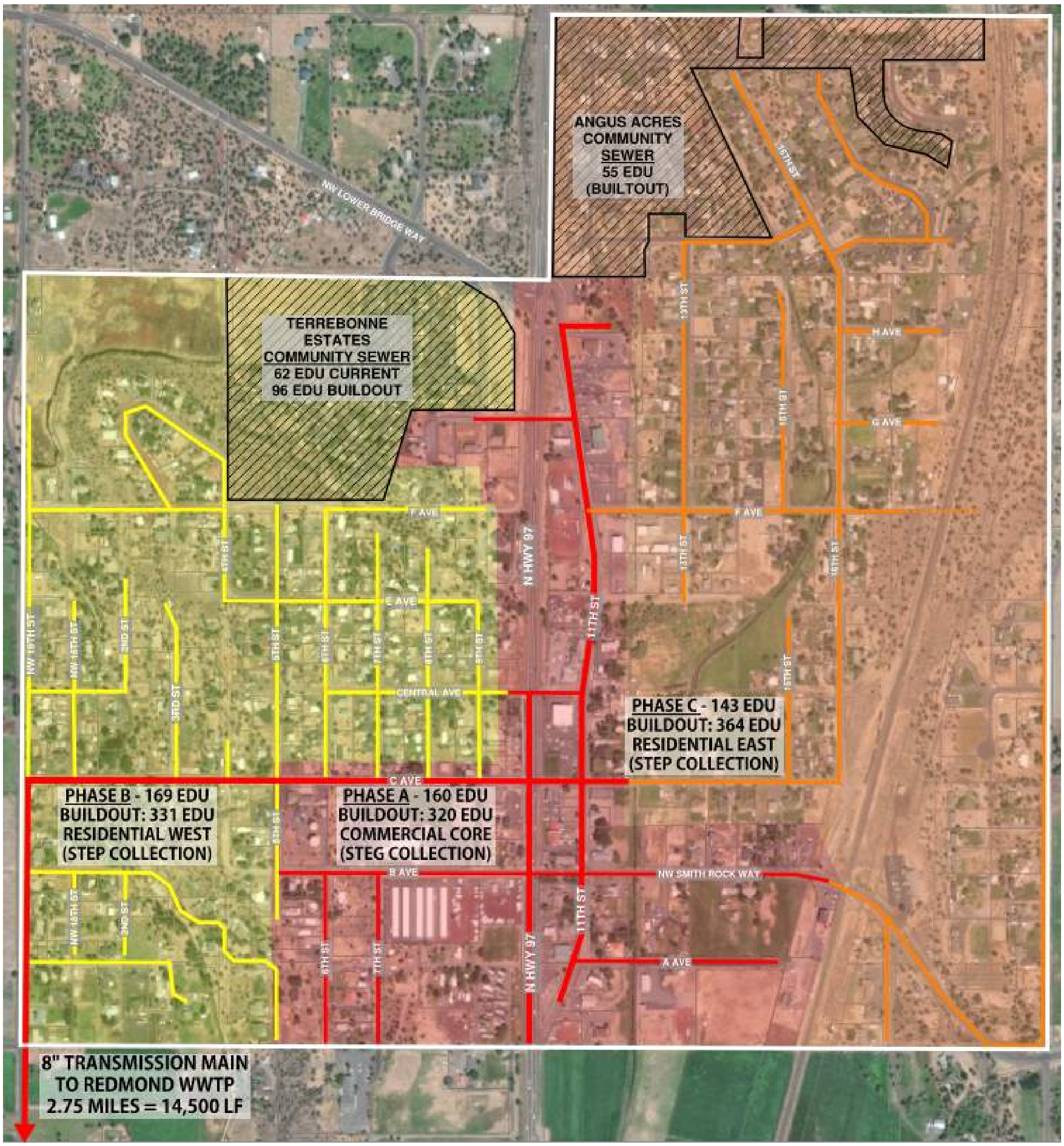


Figure 5-14. Schematic Layout of Alternative 3 – STEP Collection to Redmond Wetlands Complex

These effluent pump systems allow for the use of small-diameter, pressurized pipes that follow the contour of the land with just 3-feet of cover (below frost depth). The cost to make these pressure sewer mains available for connections can be as low as 10 percent of the cost of gravity sewer mains. Mainlines are often installed with shallow trenching or directional boring, which can help to minimize negative impacts to communities and properties. Like water mains, low-pressure sewer mains can be easily extended to specific areas, streets, or new developments that need sewer service connection.

The effluent pumps associated with these systems are lightweight, easily rebuildable, and can last more than 25 years. The pumps are designed for low-flow high-head applications so they can pump against a wide range of system pressures (80 to 210 feet total dynamic head [TDH] = 35 to 91 pounds per square inch) and within a tight range of flow rates (5 to 13 gpm). See Figure 5-15. If system pressures exceed this TDH range during periods of extremely high flows, the pump impellers can spin with no flow ("dead-head") continuously for up to 24 hours with no deterioration in pump life or performance.

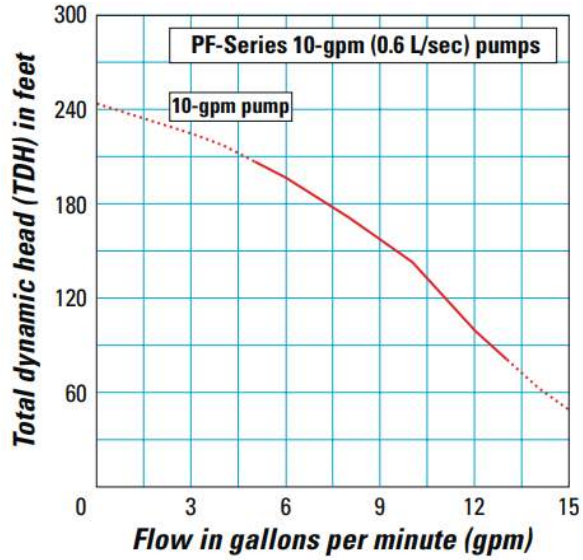


Figure 5-15. Orenco PF-Series 10 gpm Pump Curve
Source: Orenco Systems, inc

Advantages to this alternative include:

- No responsibility on Terrebonne's part for meeting discharge water quality requirements, effluent disposal, or sludge handling and disposal requirements.
- With this treatment alternative, Terrebonne would not need to acquire land for a treatment site or obtain a new WPCF permit from DEQ.
- Growth in Terrebonne could be handled more easily by increasing flows to Redmond rather than expanding an alternate treatment and disposal system.

Disadvantages to this alternative include:

- Long pumping and transmission distance (approximately 2.75 miles).
- Required flow metering and odor mitigation measures at new treatment facility headworks.
- Additional system development charges (SDCs) and sewer rates for treatment.
- Although rate increases are limited by the Public Utilities Commission, the District would be a Redmond wastewater ratepayer and have limited influence over related rate and fee increases.

The engineer's opinion of probable costs for the full buildout of Alternative 3 is summarized below in Table 5-7, followed by a summary of estimated operations & maintenance costs in Table 5-8. Please see Section 8.1 for a breakdown of the 45% allocation for design, legal, administration, permitting, and contingency, as well as descriptions of each. A Class IV project estimate range (for feasibility studies, 1-

15% design level) is provided with expected accuracy of -30% and +50%, as defined by the Association for the Advancement of Cost Engineering (AACE).

Table 5-7. Opinion of Probable Costs for Alternative 3 – STEP System Connected to Redmond WWTP

Phase	Construction Item	Quantity	Unit	Unit Price	Estimated Cost
A	STEP Collection System	12,400	lf	$120	$1,488,000
	8" Sewer Force Main to Redmond	14,500	lf	$125	$1,812,500
	Redmond Treatment System Expansion Cost	320	EDU	$2,186	$699,520
				Construction Subtotal	$4,000,020
				Design, Legal, Admin, Permitting, Contingency (45%)	$1,800,009
				Estimated Phase A Total	$5,800,029
B	STEP Collection System	25,700	lf	$120	$3,084,000
	Redmond Treatment System Expansion Cost	374	EDU	$2,186	$817,564
				Construction Subtotal	$3,901,564
				Design, Legal, Admin, Permitting, Contingency (45%)	$1,755,704
				Estimated Phase B Total	$5,657,268
C	STEP Collection System	14,200	lf	$120	$1,704,000
	Redmond Treatment System Expansion Cost	360	EDU	$2,186	$786,960
				Construction Subtotal	$2,490,960
				Design, Legal, Admin, Permitting, Contingency (45%)	$1,120,932
				Estimated Phase C Total	$3,611,892
				Estimated Alternative 3 Total	**$15,069,189**
				Class IV Estimate Low (-30%)	**$10,548,432**
				Class IV Estimate High (+50%)	**$22,603,783**

EDU = equivalent dwelling unit; lf = linear feet; STEG = septic tank effluent gravity; STEP = septic tank effluent pump; WWTP = wastewater treatment plant

Table 5-8. Estimated O&M Costs for Alternative 3 – STEP System Connected to Redmond WWTP

Operating Expense Item	Annual Estimated Cost	
Maintenance Staff	$	75,000
Billing/Administrative Services	$	60,000
Personnel Subtotal	**$**	**135,000**
Electricity	$	0
Vehicles	$	15,000
Maintenance Equipment	$	12,000
Licensing, Permits, and Fees	$	2,000
Infrastructure Maintenance/Replacement	$	30,000
Service Fees to Redmond (1054 EDU, $240/EDU/yr)	$	252,960
Materials and Services Subtotal	**$**	**311,960**
Treatment System Infrastructure Fund	$	0
Collection System Infrastructure Fund	$	65,000
Capital Outlay Subtotal	**$**	**65,000**
Annual Operating Expense Total	**$**	**511,960**

5.6 System Ownership Alternatives

Several alternatives were considered for both public and private ownership and operation of the Terrebonne wastewater system. The key distinction between public and private system ownership is that public entities are eligible for public infrastructure funds that are typically not available to private companies. As for public system governance, meetings with Deschutes County and the TDWD confirmed that neither party had any interest in constructing, owning, and operating a wastewater system in Terrebonne.

As for private ownership, two private utility companies that own and operate wastewater facilities were contacted to inquire about interest and discuss possibilities. A possible benefit to private ownership is that a qualified private utility company could provide experienced regional staff, equipment, and economy of scale to get a system up and running efficiently. However, at this level of preliminary design, neither company had enough information to seriously consider an investment in infrastructure at this scale. The fact that public funds have already been committed to parts of this project could complicate the legality of publicly funded assets being transferred to private ownership. Due to the preclusion from public infrastructure funding programs and a lack of interest in private system ownership from both parties (companies and TSAG), this was determined to be an unpreferable approach at this time.

Through the course of this feasibility study, it was determined that the most suitable approach to system governance is the formation of a new Terrebonne Sanitary District that will own and operate the proposed collection system. Based on legal counsel provided by Deschutes County and review of ORS Chapter 198, the TSAG determined that the most efficient and appropriate approach to formation of the Terrebonne Sanitary District is via initiation by petition with no permanent tax rate proposed. This approach does not require a formal election unless requested in writing by 15 percent of electors in the District or 100 electors (whichever is less). Instead, the petitioners must obtain signatures from electors (100 or 15 percent, whichever is greater) or landowners in the district (15 or owners of 10 percent of district acreage, whichever is greater).

On April 27, 2022, the Terrebonne Sanitary District formation petitioners filed a prospective petition to the Deschutes County Clerk. This document notified the County of the proposed district boundaries, economic feasibility, and intent to file the formal petition with the required signatures. The petitioners then circulated the petition in the community and gathered 16 landowner signatures. These landowner signatures represent properties that total 29.42 acres, which is approximately 23% of the proposed 126-acre District area. In addition, petition signatures were obtained from 15 electors (not owners of land) to demonstrate citizen support.

On August 4, 2022, the signed formation petition was filed with the County Clerk for review. Once approved, two public hearings will be scheduled with the County Board of Commissioners, after which the board may then issue an order formally creating the Terrebonne Sanitary District. It is anticipated that the persons nominated by the petition and accepting nomination to the governing board will constitute the first board of the District. However, it is possible that a general election will be required to fill the five District board positions. Thereafter, board members will be subject to re-election on a staggered schedule. As a new sanitary district, it is anticipated that the District will contract with certified wastewater maintenance contractors, technical consultants, and billing service providers to help operate and maintain the wastewater system.

6. SELECTION OF AN ALTERNATIVE

This section describes how the proposed wastewater system alternatives were evaluated in light of monetary, non-monetary, and risk factors. These decision factors included cost, O&M, community interests, sustainability, and requirements for land and permitting. A decision matrix was used to evaluate and compare these alternatives by ranking their standing with regard to each factor. The scores were aggregated to identify the wastewater system alternative that best satisfies all five decision factors.

6.1 Monetary Factors

In addition to capital construction costs, O&M costs for all the alternatives were also considered in determining the recommended project. A net present worth cost analysis is provided to compare the relative life cycle costs of the proposed wastewater system alternatives. The net present worth analysis accounts for the time value of money and discounts future cash flows (costs or profits) back to the present. The net present value (NPV) was calculated for each technically feasible alternative as the sum of the capital cost (C) plus the present worth of the uniform series of annual Operations and Maintenance (USPW (O&M)) costs minus the single payment present worth of the salvage value (SPPW(S)), as follows:

NPV = C + USPW (O&M) - SPPW (S)

The analysis period for the project alternatives was 30 years. To find the present worth of each alternative, an interest rate of 3.9% used to discount future cash flows (per the Office of Management and Budget Circular No. A-94, Appendix C). This discount rate was used to determine the present worth of the uniform series of O&M estimated for the feasible alternatives. The wastewater treatment improvements were considered to have useful lives longer than 30 years and the economic lifetimes of the alternatives were assumed to be equivalent. Therefore, salvage value was estimated to be zero dollars at the end of the life cycle. Table 6-1 below shows how the alternatives compare in terms of Total Capital Cost, Annual O&M, Present Worth O&M, and Total Present Worth (by each phase and each alternative).

Table 6-1. Life Cycle–Present-Worth Cost Analysis

Alternative	Description	Construction Cost Estimate	Design, Legal, Admin, Permitting, Contingency	Total Capital Cost	Annual O&M	O&M Present Worth	Total Present Worth (by Phase)	Project Present Worth (by Alternative)
1A	Lagoon and Irrigation Reuse	$6,688,000	$3,009,600	$9,697,600	$178,000	$3,293,701	$12,991,301	$29,224,453
1B		$4,584,000	$2,062,800	$6,646,800	$155,750	$2,881,988	$9,528,788	
1C		$3,204,000	$1,441,800	$4,645,800	$111,250	$2,058,563	$6,704,363	
2A	AxMax Treatment and Drainfield Disposal	$4,629,500	$2,083,275	$6,712,775	$177,200	$3,278,898	$9,991,673	$27,946,970
2B		$5,185,500	$2,333,475	$7,518,975	$155,050	$2,869,036	$10,388,011	
2C		$3,805,500	$1,712,475	$5,517,975	$110,750	$2,049,311	$7,567,286	
3A	Prelos Pressure Sewer to Redmond WWTP	$4,000,020	$1,800,009	$5,800,029	$204,784	$3,789,311	$9,589,340	$24,542,465
3B		$3,901,564	$1,755,704	$5,657,268	$179,186	$3,315,647	$8,972,915	
3C		$2,490,960	$1,120,932	$3,611,892	$127,990	$2,368,319	$5,980,211	

WWTP = wastewater treatment plant

Note: The calculated capital costs from Section 5.5 were used in this analysis (instead of -30% and +50% Class IV estimates), for the purpose of comparing the life cycle costs associated with each alternative.

6.2 Non-Monetary Factors

Non-monetary factors were also considered that relate to the social and environmental aspects of each alternative. These factors included O&M, community interests, sustainability, and land and permitting requirements. See below for further descriptions of the non-monetary decision factors.

- **Operation & Maintenance:** Rural Oregon communities such as Terrebonne would be best served by a simple, effective, and operator-friendly. Examples of such systems are those that have been in use for years in small communities in Oregon and have a good environmental and treatment track record with DEQ. A good O&M system is one that contractors and suppliers in the area are familiar with and that a local operator can be certified to operate.
- **Community Interests:** Factors influencing community interests include providing a facility that will function reliably for an extended period of time (e.g., at least 50 years) and that is cost effective to build and operate. Alternatives that minimize negative impacts to the look and feel of Terrebonne are preferable in terms of community interest.
- **Sustainability** of the design alternatives was considered in terms of long-term environmental health and system operations. Environmental sustainability considerations include water reuse and energy efficiency. Operational sustainability considerations include wastewater system resiliency and operational simplicity for the (relatively) small District that will be responsible for managing the system.

6.3 Risk Factors

Risk is inherent in all projects, so it is important to review potential risk factors up front to so they can be avoided, if possible. Otherwise, proactive action should be taken to mitigate risks that cannot be avoided, to minimize the probability and consequence of their occurrence. Some risks are common to all three proposed design alternatives.

General Schedule Risks - For example, project delays could result from extended funding agency reviews, funding administration, federal permitting requirements, limited availability of qualified contractors, and material supply chain issues. The consequence of project delays for these reasons (or others) would depend on the extent of impacts to schedule and related costs.

General Funding Risks - Unknown at this time is the extent of grant funding, loan rates, and actual projects costs. Consequently, actual monthly rates and connection fees are also unknown at this time (although estimates are provided later in this report, based on reasonable funding assumptions). The risk here is that insufficient grant funding, high loan rates, high project costs, and/or low customer participation in the system could drive up rates and fees beyond what customers can afford.

General Public Engagement Risks - As a new infrastructure project that represents change in the community, there is a risk of public opposition that could result in project delays or even cancellation. There is a risk of electors within the proposed district boundary requesting an election and voting against formation of the Terrebonne Sanitary District. Potential customers within the District may object to connecting to the system due to the connection fees and monthly rates. If the District deems it necessary to mandate connection to the system within the District to generate sufficient system revenues for operations and debt service, there is a risk of pushback from customers who are unwilling to connect, which may require additional administrative and/or legal resources. Clear and frequent communication with members of the public will help mitigate these risks.

General Technical Risks - All three alternatives present technical risks. One of the largest technical risks with any wastewater system is the risk of overflow, which can cause environmental, health, and property damages. Another technical risk is the generation and release of odors (i.e. methane, hydrogen sulfide) resulting in frequent complaints from community members. Proper wastewater system design, QA/QC, construction, testing, inspections, operations, and maintenance are all important for minimizing this the probability and consequence of these technical risks.

Alternative 1 and 2 Risks: Both Alternatives #1 and #2 are particularly exposed to the risks of siting wastewater treatment and disposal facilities, which may result in schedule and cost impacts. Siting and constructing a new wastewater treatment facility will require acquisition of land for treatment and disposal of wastewater. Proper selection of a treatment and disposal site is constrained by zoning, location, topography, acreage requirements, and soil conditions. Identifying and acquiring the required land for these facilities could become time-consuming and costly if suitable sites are limited and/or owners are unwilling to sell at an agreeable price – more so for Alternative 1 (Lagoon/Land Application) than for Alternate 2 (Packaged Treatment/Drainfield Disposal). Permitting a new wastewater treatment/disposal site will involve a WPCF permit from DEQ and land use review by Deschutes County (with public comment period). Improper operation and maintenance of the wastewater treatment and disposal facilities could result in objectionable odors, system malfunction, unmet treatment criteria, and DEQ enforcement actions.

Alternative 3 Risks: is particularly exposed to the risk of delays due to inter-related projects, including the US Hwy 97 project and Redmond Wetland Complex project. This alternative is also contingent upon establishment of an IGA that is agreeable to both the City of Redmond and Terrebonne Sanitary District. Once formed, the District should meet with the City of Redmond to negotiate agreeable terms and conditions of the IGA, including the methodology for future sewer rate increases.

6.4 Evaluation of Alternatives

A meeting was held with the TSAG on May 26, 2021, to present and discuss the proposed wastewater system alternatives. The alternatives were discussed and ranked based on the monetary and non-monetary factors described above, such that the best alternative scored a 1, second best a 2, third best a 3. According to this methodology, the alternative with the lowest total score is the preferred alternative.

Table 6-2. Wastewater Alternatives Decision Matrix

	Alternative	Cost	O&M	Community Interests	Sustainability	Risk Factors	Total Score
1	Lagoon and Irrigation Reuse	3	3	3	2	3	14
2	AxMax Treatment and Drainfield Disposal	2	1	2	3	2	10
3	Pressure Sewer to Redmond WWTP	1	2	1	1	1	6

This page intentionally left blank.

7. PROPOSED PROJECT (RECOMMENDED ALTERNATIVE)

Based on the evaluation of the wastewater system alternatives described and shown above, the recommended alternative for Terrebonne is a STEP collection system and force main that discharges to the Redmond Wetlands Complex (Alternative 3). This alternative presents the most cost-effective solution for the community and minimizes community impacts, environmental impacts, operational costs, and project risks. Meetings with the TSAG have confirmed acceptance of this as the preferred wastewater system alternative. Below is a detailed summary of the preliminary project design, schedule, permit requirements, and terms of interconnection with the City of Redmond's proposed wastewater treatment facility. This section summarizes the preliminary design elements of the proposed project.

7.1 Preliminary Project Design

7.1.1 Onsite Effluent Pumps

For a property to connect to the proposed STEP system, the existing septic system will need to be replaced or retrofitted with an effluent pumping system. The effluent pumping systems proposed for this system are the ProPak Processor and Biotube ProPak units manufactured by Orenco Systems in Sutherlin, Oregon (see Figure 7-1 and Figure 7-2). The pumps are lightweight, reliable, and designed for low-flow high-head applications where they can pump against a wide range of system pressures (80 to 210 feet TDH = 35 to 91 pounds per square inch) within a tight range of flow rates (5 to 13 gpm). Both units come with a control panel and wiring connections. A 120-volt power supply must be extended to the pump control panel from a dedicated 30-amp circuit breaker on the building service panel.

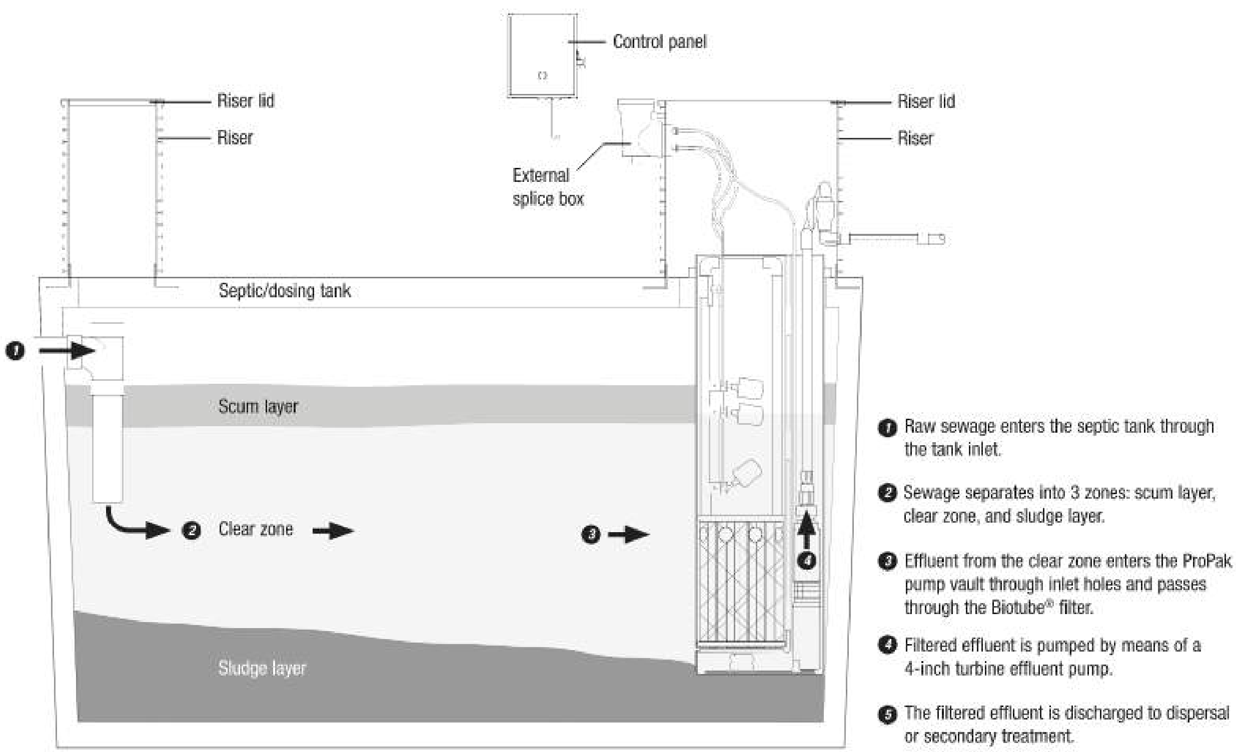


Figure 7-1. ProPak Effluent Pump System Retrofit in Existing Septic Tank
Source: Orenco Systems, Inc

Older septic tanks (installed over 30 years ago) in poor condition (collapsing, leaking, corroded, etc.) should be replaced with the Prelos Processor shown in Figure 7-2, which includes a chamber for primary treatment, a filter, and an effluent pump. After installation of this system, a property will be able to connect to the STEP system. Ultimately, the District will determine the specific criteria for septic tank replacement.

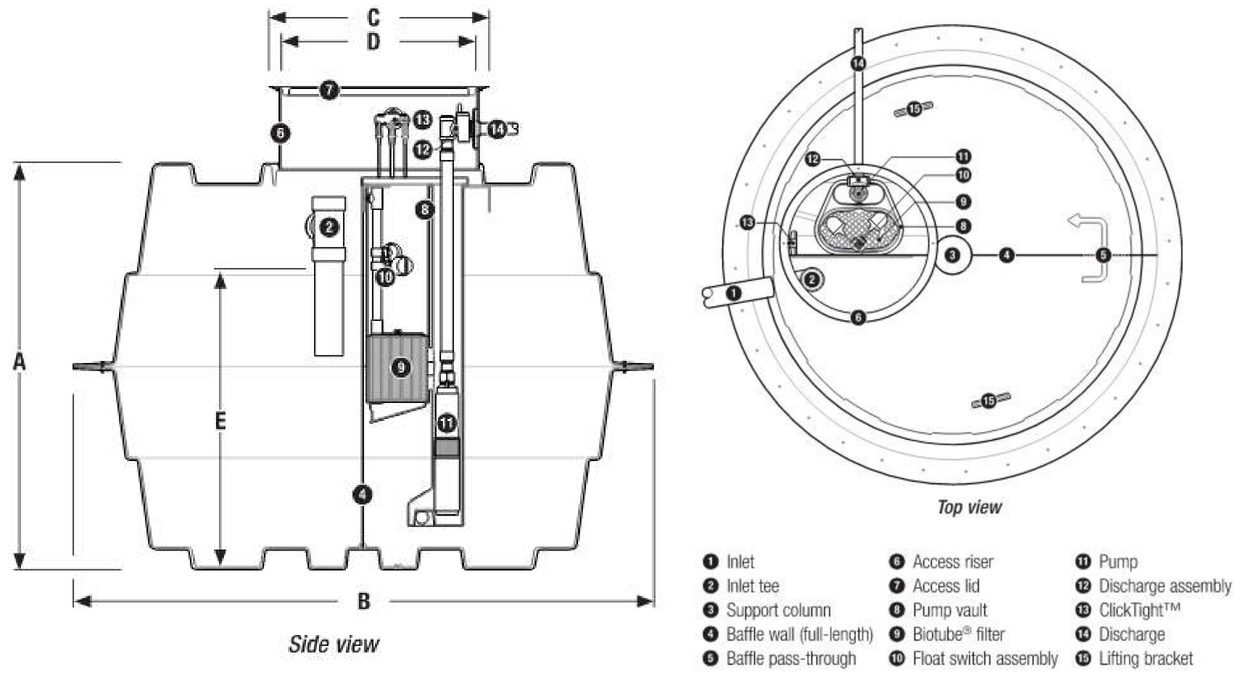


Figure 7-2. Prelos Processor Septic Tank and Effluent Pump System
Source: Orenco Systems, Inc

Newer septic tanks (installed less than 20 years ago) in good condition (no leaks, corrosion, or structural damage) can remain in place and be retrofitted with the Biotube ProPak system. This packaged system is installed inside the downstream access riser from where it filters and pumps effluent into the STEP main located in the street. Below are descriptions of the four most common connection scenarios anticipated in Terrebonne:

- Residential customer with a septic tank in poor condition requiring replacement with a Prelos Processor.
- Residential customer with a septic tank in good condition requiring retrofit installation of a ProPak system (BPP10DD, PF1005 pump).
- Commercial customer (three to five EDUs) with a septic tank in poor condition requiring replacement with a 3,000-gallon septic tank and ProPak system (BPP30DD, PF3010 pump).
- Commercial customer (three to five EDUs) with a septic tank in good condition requiring retrofit installation of a ProPak system (BPP30DD, PF3010 pump).

Please see Section 8.6 for estimated cost ranges for these onsite system upgrade scenarios described above. The costs for these onsite upgrades will likely be borne by the property owner.

Onsite STEP tanks, pumps, wiring, and pressure service piping installations should be inspected and approved by the Sanitary District before connection to the system and startup. Part of the District’s process would include review of onsite system plans and ensuring that appropriate permits are obtained, the tanks are watertight, and that the alarms and pumps are operational. Permits would be required from the Deschutes County Building Division for the sewer connection to the tank/onsite infrastructure and any electrical components, such as pumps and alarms. Regular inspection of STEP tanks, sludge levels, filters, pumps, and alarms should be part of the customer's agreement for connection or a maintenance contract between the District and a DEQ-certified service provider.

7.1.2 Service Connections

Service connections allow for isolation of onsite systems and prevent the main from draining back to private property. The onsite effluent pumps described above are typically connected to the effluent sewer main with a small polyvinyl chloride (PVC) or high-density polyethylene (HDPE) service line, a check valve, a ball valve, and a saddle tap. An isolating toning wire is also installed in the trench for locating underground services in the future. Service connections can be installed before the structure to be serviced is built, so that once ready, a system can be easily connected to the mainline. This removes the need to expose the main, submain, or lateral pipe to "hot tap" or "live tap" in a connection. See Figure 7-3 for an illustration of a typical residential service connection to the STEP system.

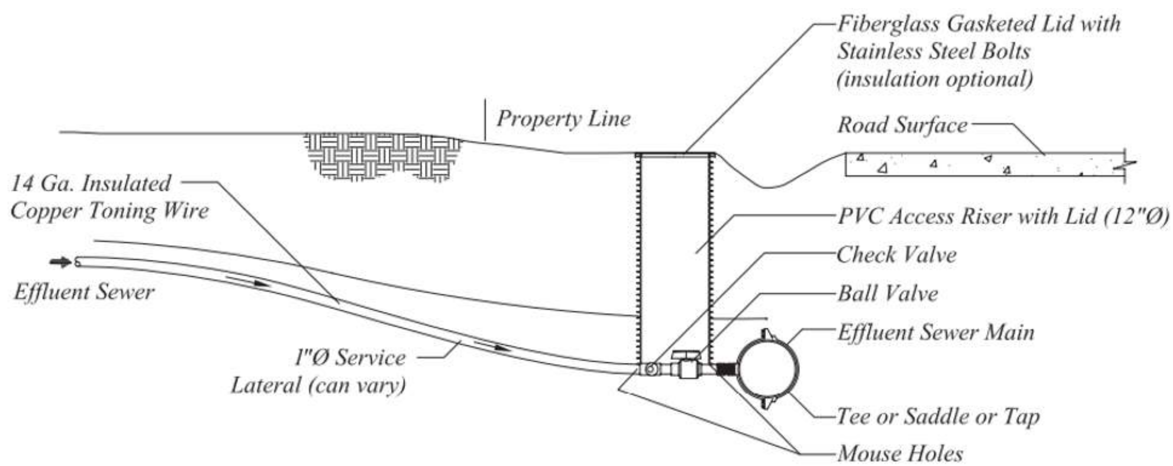


Figure 7-3. Typical Effluent Sewer Service Connection to STEP Main
Source: Orenco Systems, Inc

7.1.3 Collection System

A preliminary STEP collection layout and pipe sizing was prepared to serve the Phase A commercial core area; it has the ability to be expanded to serve Phase B and Phase C residential areas in the future. Figure 7-4 shows the proposed collection system layout, pipe sizes, and phases. A 2.75-mile-long 8-inch diameter force main will be installed to convey effluent from Terrebonne to the Redmond Wetlands Complex for treatment. All proposed mainlines will be installed within the public right-of-way in an alignment that avoids utility conflicts and facilitates convenient maintenance access.

STEP pressure mains are commonly constructed of PVC (C900) or HDPE (DR-11) piping materials. Open trench construction using PVC pipe has been the most common construction method used in effluent sewer projects, but with the trend toward septic tank abatement projects in areas with existing infrastructure, directionally bored HDPE has become more common in the past 10 years. Since Terrebonne has relatively shallow bedrock and minimal underground obstructions in the right-of-way, it is assumed that the primary pipe material will be PVC in open trenches, with the potential for HDPE installation via directional boring in some locations where warranted (i.e., future railway crossing). Main lines can be valved and capped at terminal points so they can be easily extended in the future to serve new areas.

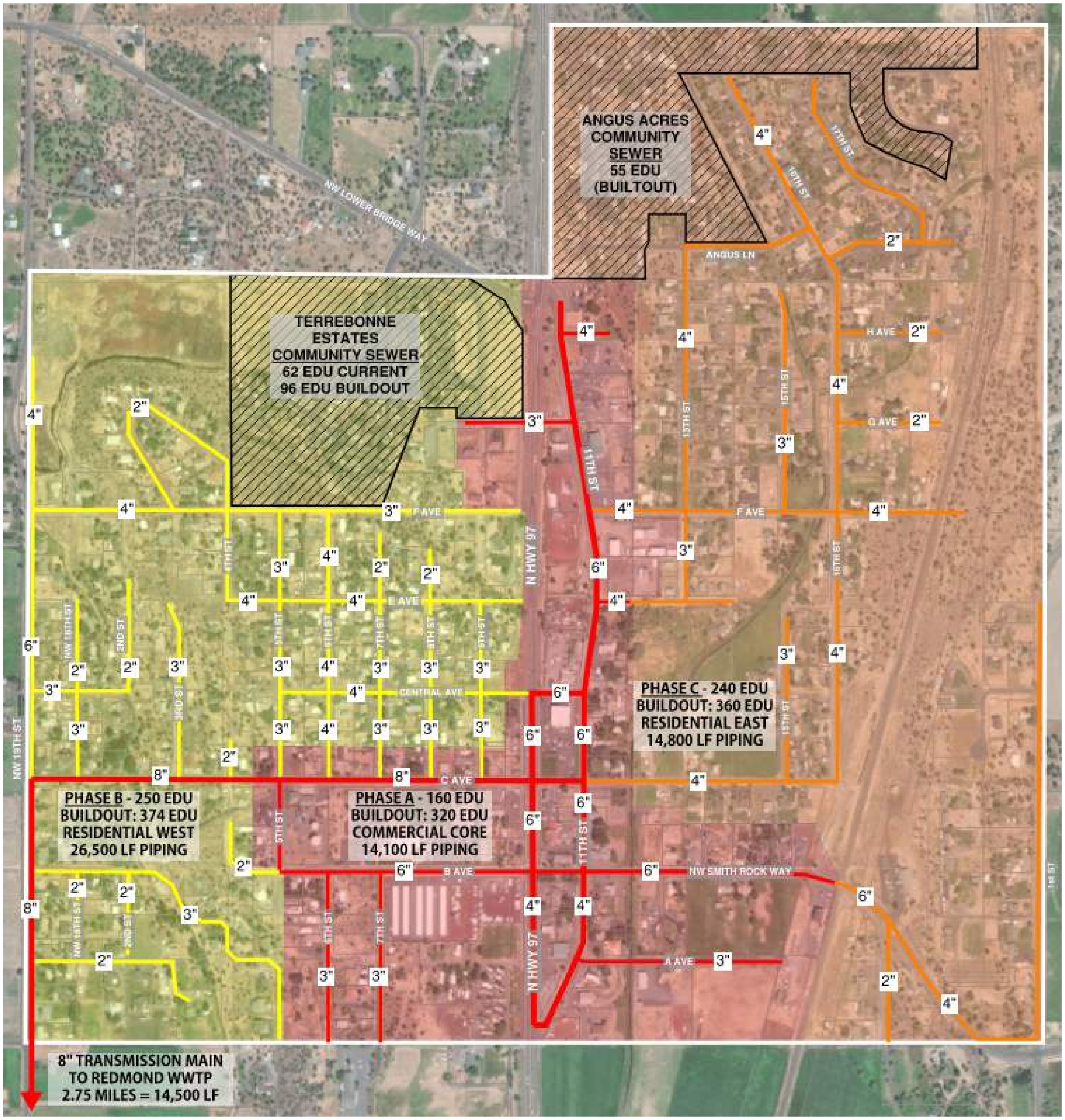


Figure 7-4. Preliminary Collection System Layout and Main Sizing (by Phase)

Table 7-1 below provides a guide for estimating pressure main sizes to handle peak flows from EDUs. Based on this table and estimated EDUs contributing to each pressure sewer main, preliminary pipe sizing has been prepared for the collection system. Because the collection mains for effluent sewer systems are liquid-only and free of solids, sizing lines for future flows is possible without the concern for solids deposition and plugging during the time elapsed until ultimate design flows are achieved. Since maintaining a minimum scouring velocity is unnecessary, the primary design criterion for mainline sizing is to ensure sufficient capacity to convey peak flow at full buildout without excessive head loss.

Table 7-1. Typical Effluent Pressure Mainline Sizing

EDUs	Q_P gpm	Pipe Diameter in (nominal)	PVC Pipe Inner Diameter[1]	Head Loss ft/1000 ft	Velocity ft/s
1–50	15–40	2	2.05	3.6–22.1	1.33–3.54
51–150	40–90	3	3.04	3.3–15.0	1.63–3.67
151–250	90–140	3	3.04	15.0–33.9	3.67–5.70
251–350	140–190	4	4.39	10.0–17.5	3.45–4.68
351–500	190–265	4	4.39	17.5–32.4	4.68–6.53
501–1,000	265–515	6	6.31	4.9–16.9	3.01–5.86
1,001–1,500	515–765	8	8.28	4.7–9.7	3.45–5.13

ft = feet; in = inches; HDPE = high-density polyethylene; PVC = polyvinyl chloride; s = seconds

1. Schedule 40 I.D. assumed for 2”-3” diameter pipe, C900 DR25 I.D. assumed for 4”-8” diameter pipe

Further calculation and analysis confirmed that 8 inches in diameter is the appropriate sizing for the transmission main to Redmond. This pipeline run is approximately 20,000 linear feet from an elevation of 2,755 feet in Terrebonne to an elevation of 2,818 feet at the proposed Redmond Wetlands Complex headworks. This results in an elevation head of 64 feet. Pressure head is 0 feet assuming that effluent will discharge to atmospheric pressure in a manhole near the Redmond headworks. Total Dynamic Head (TDH) was calculated by adding elevation and head losses at various flow rates. At the calculated peak flow rate of 547 gpm, TDH is approximately 158 feet. This system pressure fits comfortably within the 60- to 200-foot TDH range that typical 0.5 hp, 10 gpm residential pumps are rated for (see Figure 7-5).

For context, a pump curve was calculated that approximates the flow characteristics of 50 residential pumps operating simultaneously in parallel. Flow rates associated with TDH values shown on the 0.5 hp residential pump curve were multiplied by 50. This means that the peak flow operating point of 547 gpm at 160 feet TDH would occur when approximately 50 pumps are operating simultaneously.

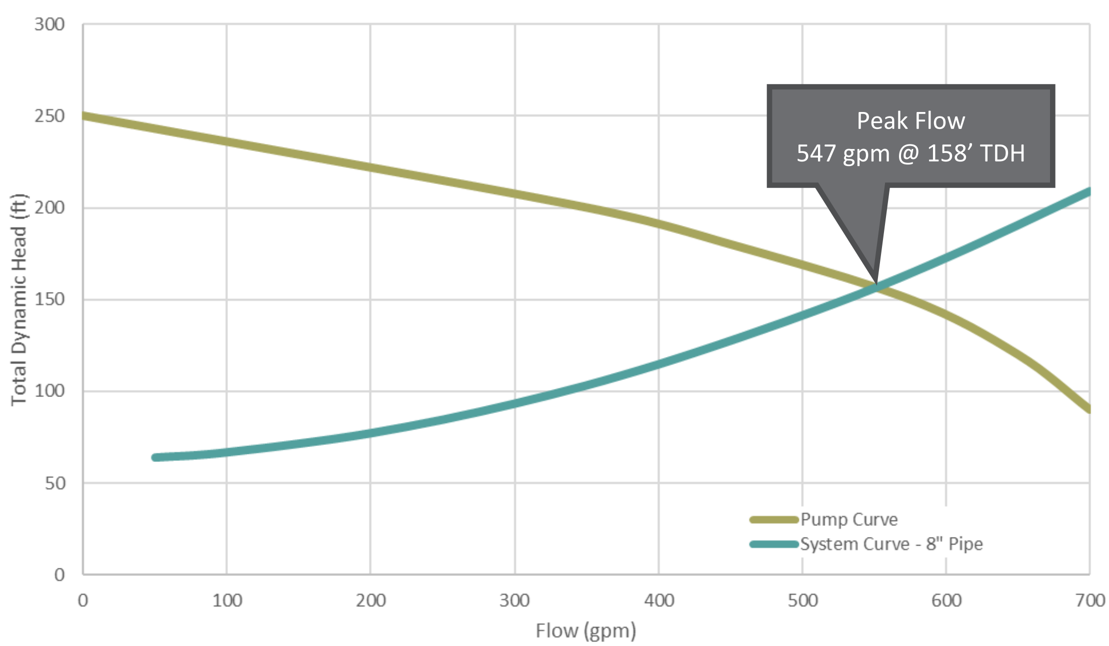


Figure 7-5. 8-Inch Transmission Main Pump and System Curve

Below are the flow calculations for the collection system and 8-inch transmission main at full buildout in terms of average daily flow, maximum daily flow, peak hour flow, and peak hour velocity.

Average daily flow (Q_A) is calculated as follows:

$$\mathbf{Q_A = EDU * Q_{EDU} = (1054\ \mathit{EDU})(150\ \mathit{gpd/EDU}) = 158{,}100\ \mathit{gpd}}$$

where: EDU = Equivalent Dwelling Units = 1054 EDUs projected in Terrebonne at full buildout

Q_{EDU} = 150 gpd/EDU

A conservative design maximum day flow (Q_M) for effluent sewer collection systems is typically calculated by multiplying Q_A by a factor of 2. Therefore:

$$\boldsymbol{Q_M = 2Q_A = (2)(158{,}100\ gpd) = 316{,}200\ gpm}$$

Peak hour flow (Q_P) is calculated by the Simplified Equation below [7]:

$$\boldsymbol{Q_P = AN + B = (0.5)(1054) + 20 = 547\ gpm}$$

where: Q_P = Peak flow in 8-inch transmission main (gpm)

A = Coefficient, typically 0.5

N = Number of Equivalent Dwelling Units = 1054 EDU at full buildout

B = Factor based upon the quantity and type of pumps used, typically 20

Peak hour velocity (V_P) in the 8-inch transmission main is calculated below:

$$\boldsymbol{V_P = \frac{Q_p}{A} = \left(\frac{547\ gpm}{0.332\ ft^2}\right)\left(\frac{1\ cfs}{449\ gpm}\right) = 3.67\ ft/s}$$

where: V_P = Peak velocity in 8-inch transmission main (feet per second)

Q_P = Peak flow in 8-inch transmission main (gpm)

A = Cross sectional area of 8-inch-diameter PVC pipe (C900) = 47.8 in^2 = 0.332 ft^2

Head losses in the 8-inch transmission main at peak flow is calculated below:

$$\boldsymbol{h_L = \frac{10.557L}{d^{4.87}}\left(\frac{Q_p}{C}\right)^{1.85} = \frac{10.557(20{,}000ft)}{(8in)^{4.87}}\left(\frac{547gpm}{150}\right)^{1.85} = 92\ ft}$$

where: h_L = Head loss through the main (feet)

L = Length of line segment (feet) = 20,000 feet, including equivalent length for fittings

d = Inside diameter of pipe (inches) = 8 inches

Q_P = Peak flow in collection line (gpm) = 547 gpm peak flow in transmission main

C = Hazen-Williams coefficient (unitless) = 150 for PVC

---

[7] Source: Alternative Wastewater Collection Systems Manual (EPA/625/1-91-024), Section 2.4.1.1, Equation 2-4

Total Dynamic Head (TDH) during peak flow in the 8-inch transmission main is calculated below:

$$TDH = h_e + h_p + h_L + h_m = 64 + 0 + 92\ ft = 156\ ft$$

where: TDH = Total dynamic head in feet

h_e = Elevation head = 64 feet from Terrebonne (low point) to discharge point Redmond WWTP

h_p = Pressure head at the collection line = 0 ft (discharge to atmospheric pressure)

h_L = Head loss through the main line = 92 feet in 8 inch main at peak flow, calculated above

This equates to a maximum pressure in the main line during peak flow, as calculated below:

$$P_{max} = \frac{TDH}{2.31\ ft/psi} = \frac{156\ ft}{2.31\ ft/psi} = 68\ psi$$

The STEP collection system piping will involve a variety of components installed on the mainlines to operate properly. Unlike gravity collection systems, manholes are not required at every junction or deflection point. Instead, as a pressurized system, collection mains will include many of the components typically required on water system mains. These include pipe restraints, isolation valves, and air release valves. As a pressure sewer system, odor mitigation devices are also necessary.

PVC piping should be restrained during testing to withstand the test pressure, typically 150 psi. For PVC bell and spigot pipe, bell and mechanical joint restraints are recommended rather than thrust blocking. If fusion-welded HDPE pipe is used, no pipe restraints are required. Working pressures in effluent sewer mains are typically well below the test pressures for newly installed mains.

Mainline valves are necessary to isolate sections of lines and to reroute flows in the event of a line break or other emergency. Traditional design guidelines for valve placement in effluent sewers are generally consistent with water main valving. Isolation valves are sometimes placed at the intersection of mains and at the upstream ends of mains to facilitate subsequent main extensions. On long main lines and steep grades, isolation valves are located to accommodate pressure testing requirements. Other isolation valves may be used as a part of the design of other facilities, such as with flow meters or pressure regulating valves.

Ball valves can be used for lines 3 inches and smaller in diameter, but they become cost prohibitive above that size. Gate valves or plug valves can typically be used for line diameters larger than 3 inches. When cast iron or ductile iron valve bodies are used, the interior of the valve should be lined with a material appropriate for wastewater application. Fusion-bonded epoxy is common. To ensure quality, the manufacturer should apply the lining.

To prevent trapped air from plugging effluent flow in pressure mains, air release valves should be installed at high points. Manual air release assemblies can be purchased and installed inexpensively, where infrequent air accumulation is expected and can be released by maintenance staff at regular intervals. Where frequent air accumulation or vacuum conditions are anticipated, an automatic air/vacuum release valve should be used. Most air release assemblies consist of a line tap or a tee and a pipe extended to grade that is terminated in a meter box with an automatically or manually lever-actuated ball valve. Typical air release assemblies are shown in Figure 7-6.

In pressure sewers, dissolved oxygen is limited, and anaerobic bacteria react with wastewater to produce hydrogen sulfide (H_2S). This gas causes foul odors where it is released into the atmosphere. For this project, the key areas of concern for odors are at air release valves and the discharge manhole connected to the Redmond WWTP headworks.

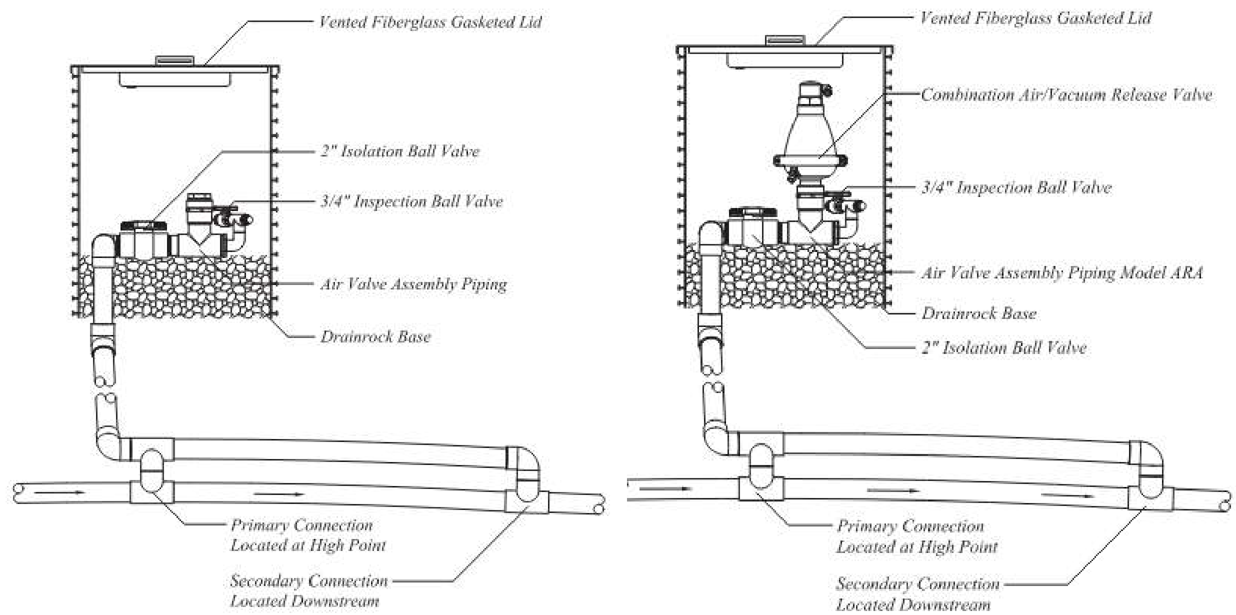


Figure 7-6 Typical Air Release Valve Assemblies

Source: Orenco Systems, Inc

One method for mitigating H_2S odors is mainline air injection. This method can be effective, but only if the line velocity is sufficient to prevent air entrapment in force mains. The 8-inch transmission main will initially have low velocities until more connections contribute to the system, so this option could be problematic. Injecting air into pressure mains is also inefficient. However, this can lead to gas pocket collection at high points, which can result in increased line pressure (head loss). When considering air injection, the cost analysis must address the power consumption required to maintain adequate line velocity and to overcome additional head loss caused by two-phase flow. In most cases, this additional operating cost alone amounts to several hundred dollars per month.

Another option for odor mitigation is injection of chemical supplements into the wastewater stream, supplements such as Cl_2, H_2O_2, $NaNO_3$, $CaNO_3$, O_3, O_2, NO_3^-, etc. These compounds limit the production of sulfides by inhibiting anaerobic microbial activity through disinfection or pH control, by providing a supplemental source of oxygen to support aerobic microbial activity, or by directly reacting with the sulfides in a sacrificial compound. Chemical addition is more expensive than aeration and it requires greater monitoring and maintenance.

Another odor control method is aeration, whereby H_2S is released from solution and sulfides (H_2S, HS^-, S^{2-}) that are not released are further oxidized by the dissolved oxygen. Aeration at the end of the pressure main, before the effluent is discharged to a gravity line or treatment process, is more efficient and manageable than mainline injection especially for effluent sewers where solids and organic strengths are reduced by the primary treatment occurring in the interceptor tanks. End-of-pipe aeration using venturi aspirators has proven to be a cost-efficient method for controlling odors in effluent sewer applications. Gases that are exhausted from air release valves can also be vented through carbon filters, soil beds, or other appropriate odor-scrubbing methods before being exhausted to the atmosphere.

Pressure sustaining devices may also be necessary to prevent vacuum conditions that may occur in sections of pipe with downhill flow above the discharge elevation. High-elevation points in the lines should be carefully evaluated to determine whether pressure sustaining devices are necessary, in order to maintain upstream static pressures in those portions of the system that are higher in elevation than the point of discharge. Pressure sustaining devices can be as simple as an artificial high point (i.e. standpipe) or as sophisticated as back pressure sustaining valves that use hydro-pneumatic pressure or spring action to maintain a minimum upstream static pressure.

7.1.4 Treatment System

While pretreatment will occur in the onsite septic tanks, the remainder of the wastewater treatment will occur at the Redmond Wetlands Complex. As described above in Section 5.5.3, the City of Redmond is upgrading its wastewater treatment plant from the Dry Canyon Effluent and Biosolids Complex to the new Redmond Wetlands Complex at the existing city-owned wastewater disposal site. Constructed wetlands are engineered and managed wetland systems that are increasingly receiving attention for wastewater treatment and reclamation. Constructed wetlands have proven to be an effective method for the treatment of municipal wastewater. Compared with conventional treatment plants, constructed wetlands are cost-effective and easily operated and maintained while supporting wetland habitat for birds and other wildlife and offering recreational and educational opportunities. Figure 7-7 shows a conceptual layout of the proposed lagoons, wetlands, and infiltrations basins, as well as proposed roads and trail facilities.

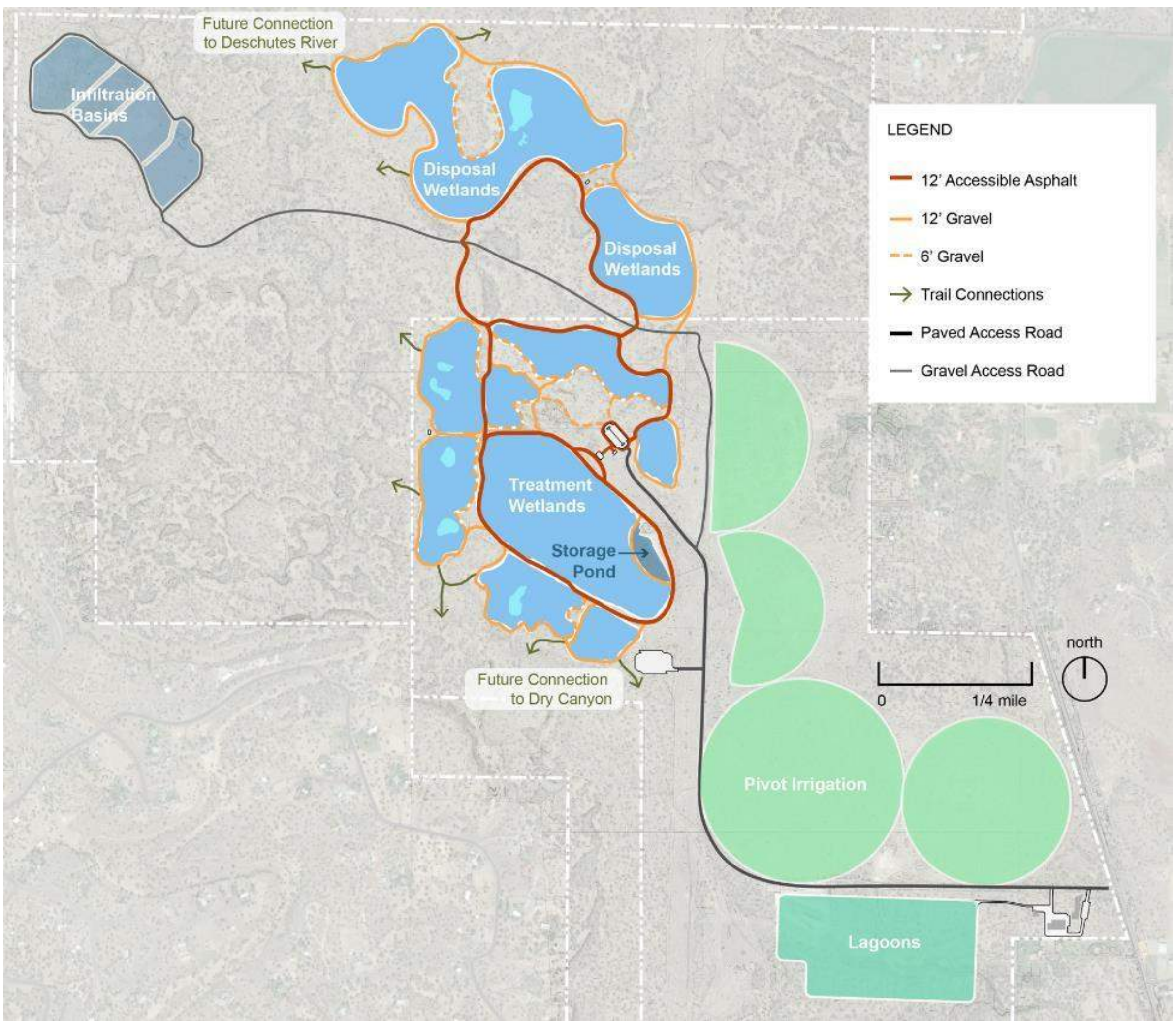


Figure 7-7. Redmond Wetlands Complex and Trail Layout

Source: https://redmondwetlandscomplex.com/expansion-site-design/

After pretreatment in the onsite septic tanks, effluent will arrive at the new complex and enter the headworks for screening and grit removal. The aerated lagoons will facilitate aerobic digestion, and the subsequent facultative lagoons will allow for anaerobic digestion and settling. Wastewater will pass through a chlorine contact chamber, then the flow will be split between the storage lagoon for irrigation reuse and the treatment wetlands for further treatment, wildlife habitat uses, and disposal. The treatment system will meet applicable state and federal requirements, and the City of Redmond will obtain a new or updated DEQ WPCF permit for this facility. Figure 7-8 illustrates the wastewater treatment process.

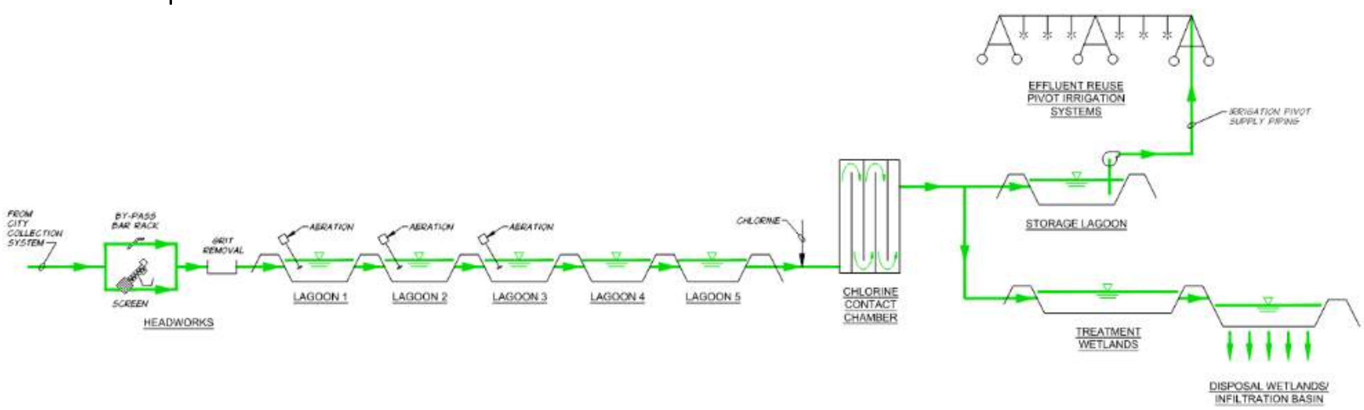


Figure 7-8. Treatment Process Flow Schematic
Source: Lagoon and Wetland Treatment and Disposal Feasibility Evaluation By Anderson-Perry & Associates, Inc.

The City has started preliminary design for the Redmond Wetlands Complex. As part of the design, Redmond City Council has approved sizing the facility to include treatment capacity for the Terrebonne sewer flows projected at full buildout. Construction of the treatment wetlands complex is planned for 2023 to 2026. See Figure 7-9 for the project design and construction schedule provided by the City of Redmond on the project webpage.

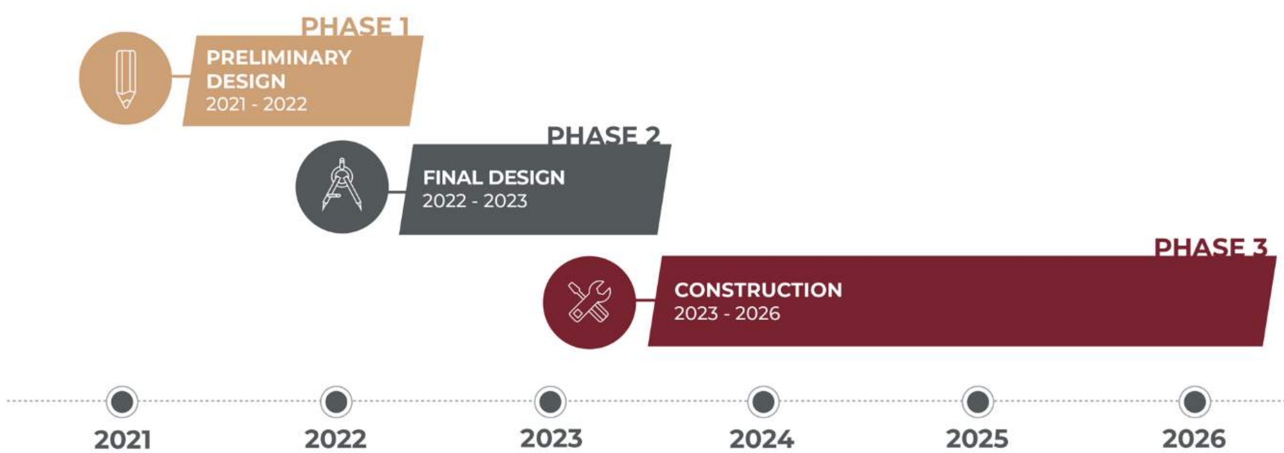


Figure 7-9. Redmond Wetlands Complex Design and Construction Timeline
Source: https://redmondwetlandscomplex.com/project-timeline/

Through a memorandum of understanding signed November 9, 2021, Redmond and the County have agreed to work in good faith toward an intergovernmental agreement to provide wastewater treatment for the Terrebonne community at the City's proposed wetlands complex. The intergovernmental agreement will cover the terms of sewer service and financial obligations for a wastewater collection and treatment system in the unincorporated community of Terrebonne.

The memorandum of understanding outlines that the City of Redmond, Deschutes County, and the Terrebonne Sanitary District will:

1. Meet regularly, as determined necessary, and share project-related information.
2. Define their respective roles and responsibilities for implementation of the memorandum of understanding.
3. Coordinate phasing and timing of City and County projects including anticipated formation of a sanitary district.
4. Identify design considerations and long-term impacts to City treatment facilities.
5. Determine funding requirements, cost-share allocations, and funding sources:
    a. Capital expenditures including reimbursements
    b. O&M
    c. Monthly rates
    d. SDCs and/or connection fees
    e. Loans, grants, American Rescue Plan Act (ARPA), etc.
6. Coordinate on the following items for system operation and governance:
    a. Details related to a single-source connection to City of Redmond treatment facilities
    b. Flow measurement and metering requirements
    c. Pre-treatment requirements
    d. Waste stream monitoring
    e. Billing

7.2 Project Schedule

Three phases are planned for the proposed STEP collection system in Terrebonne: Phase A – Commercial Core, Phase B – Residential West, and Phase C – Residential East. As described in prior sections, the highest concentration of septic system problems and support for a sewer system exists within the Commercial Core, defined by Phase A. See Figure 7-10 for a map of the proposed initial Phase A service area boundary and collection system, as well as subsequent phases that may later be annexed into the district boundaries.

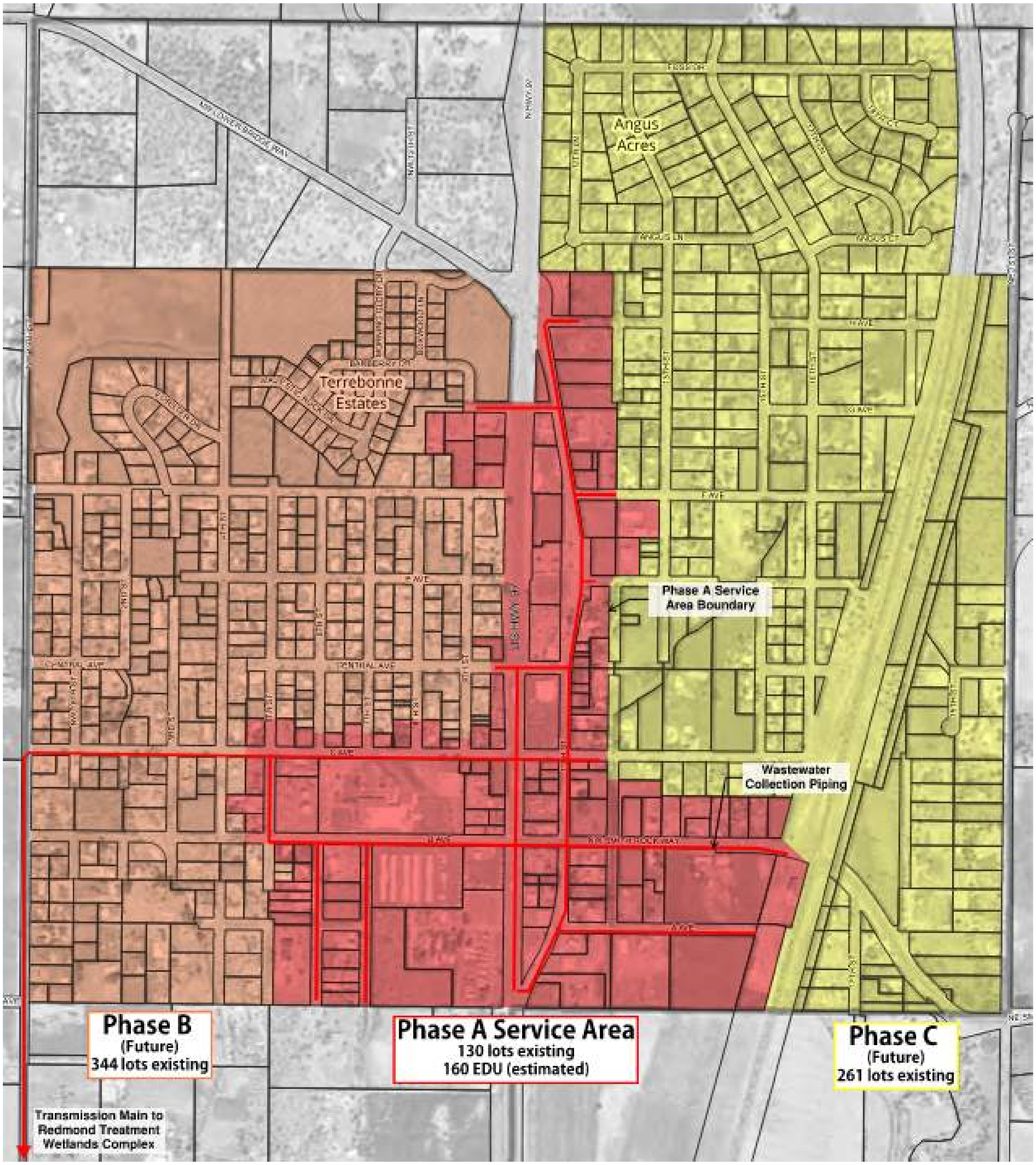


Figure 7-10. Service Area Boundaries by Phase

Properties within Phase A generally include commercial uses and residences on small lots that lack adequate drainfield and reserve areas. Properties outside the commercial core in Phases B and C are generally residential with larger lots, and they had less urgent septic system problems at the time of this study. The STEP collection system is designed with the capacity to serve the entire Terrebonne community at full buildout, but only construction of Phase A is proposed for funding and construction at this time. See Table 7-2 for the proposed phasing schedule and associated EDUs.

Table 7-2. Sewer System Phasing Schedule

Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Phase A																							
Phase B																							
Phase C																							
EDUs added	0	0	160	15	15	15	17	20	20	169	30	30	30	30	30	30	143	50	50	50	50	50	50
Total EDUs	0	0	160	175	190	205	222	242	262	431	461	491	521	551	581	611	754	804	854	904	954	1,004	1,054

To apply and qualify for infrastructure loans and grants, the Terrebonne Sanitary District must be established. This process is anticipated to take approximately 6 months in 2022 including a formal petition and two hearings with the Deschutes County Board of Commissioners. If enough electors in the proposed district boundary request an election regarding the decision to form the District, the timeline for formation would be extended. Figure 7-11 below shows an estimated timeline for completion of key tasks including sanitary district formation, funding applications, collection system design, bidding, construction, system startup, and service connections.

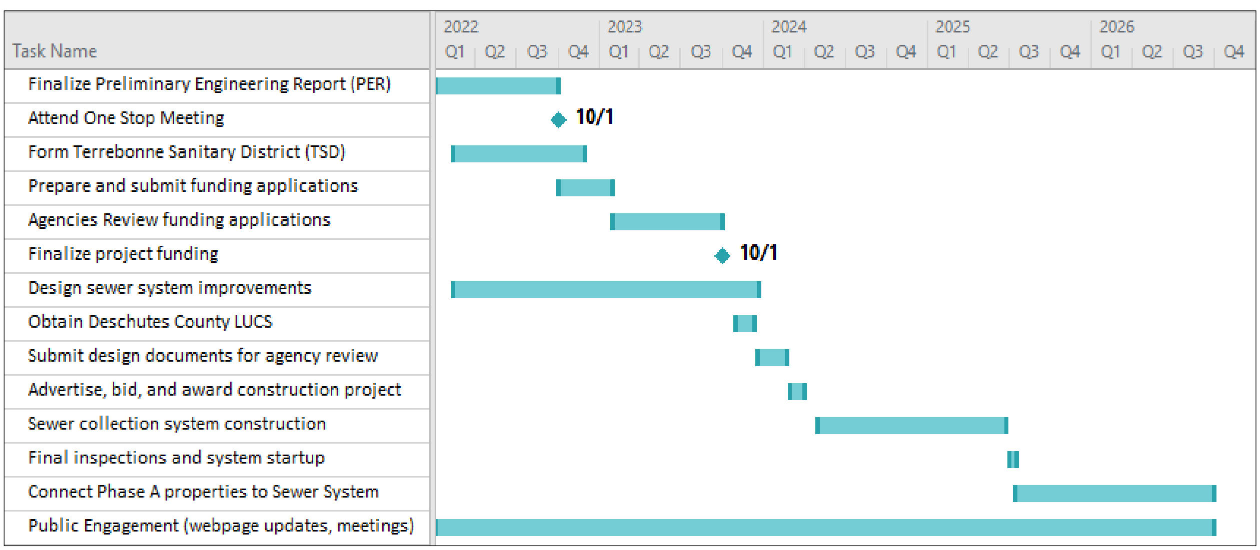
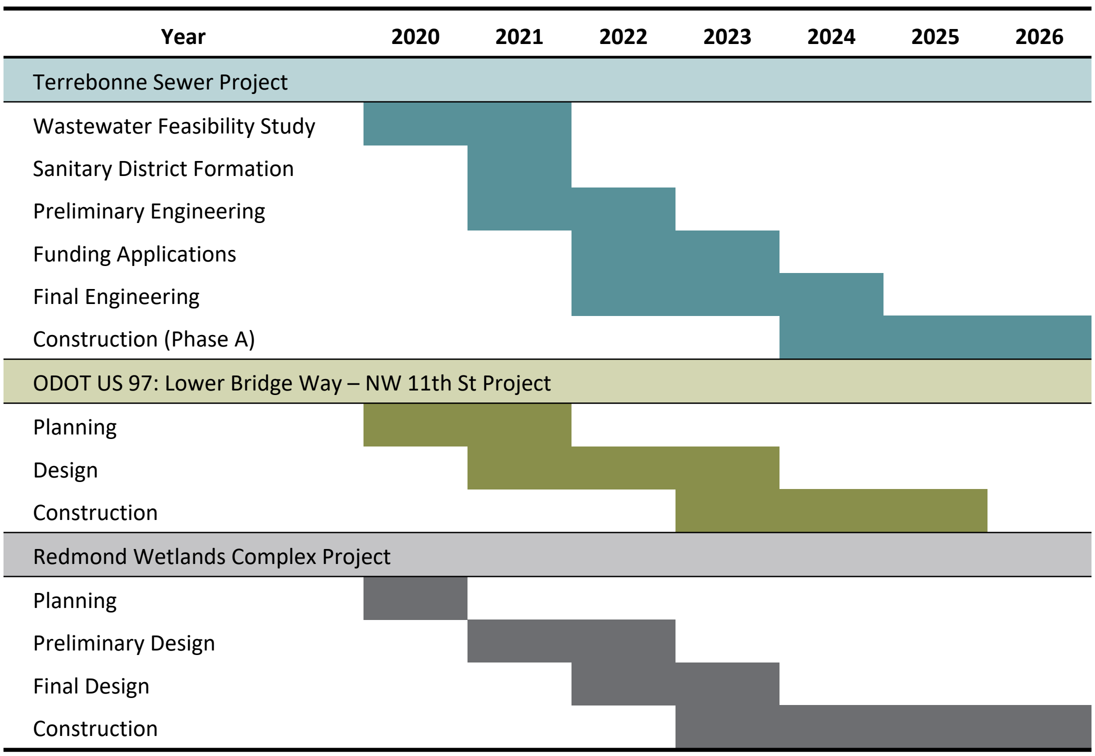


Figure 7-11. Project Schedule for the Phase A Collection System

It should be noted that these implementation steps assume that the District will diligently pursue project funding upon completion of this preliminary engineering report and that project funding is secured relatively quickly. Should delays in completion of any of the identified implementation items occur, completion of the project will likely be delayed.

Coincidentally, there are two other separate projects planned to occur during the proposed planning, design, and construction timeframes for the Terrebonne Sewer Project. The first project is the Redmond Wetlands Complex, which will offer a treatment and disposal option that is closer to Terrebonne than is the existing Dry River Canyon WWTP. The second is an Oregon Department of Transportation (ODOT) project that involves roadway improvements to US 97, NW 11th Street, cross streets between these, and Smith Rock Way. A key part of this project is a new interchange at the intersection of US 97 and Lower Bridge Way. ARPA funding granted to the County has been allocated to ODOT to incorporate the proposed STEP mains into the roadway design. The roadway improvements and sewer infrastructure within this footprint are scheduled for construction in 2023 to 2025. Figure 7-12 below shows the relationship between these three project schedules generally operating in parallel.



Note: These three project schedules are based on the latest information available during preparation of this report and are subject to change.

Figure 7-12. Estimated Schedules for Terrebonne Sewer, ODOT US Hwy 97, and Redmond Wetlands Complex Projects

7.3 Permit Requirements

Because the proposed STEP collection system does not include siting and construction of a new wastewater treatment plant, the Terrebonne Sanitary District will not be required to obtain a DEQ WPCF permit. There is also no proposed discharge to any groundwater or surface water sources, so a National Pollution Discharge Elimination System (NPDES) permit will not be required. The STEP collection system is proposed for construction within public right-of-way under the jurisdiction of ODOT and Deschutes County. Sewer main installation within the ODOT project limits will occur under the permits and road closures necessary for that project. Pipeline installation beyond the ODOT project limits will occur within the County right-of-way and will likely require a Deschutes County land use compatibility statement and a right-of-way permit prior to construction.

State rules (ORS 468B.055) prohibit construction, installation, or modification of disposal systems, treatment works, or sewage systems until plans and specifications are submitted to and approved in writing by DEQ. Plan submittals must contain:

- A completed land use compatibility statement.
- Two copies of engineering plans stamped and signed by an Oregon-registered professional engineer.
- The name of the person who will provide construction engineering/inspection services and certify construction inspection as outlined by Oregon law (OAR 340-52-040).
- A statement from the City [District] that the City [District] agrees to provide sewer service and that the City [District] has the sewage system and treatment capacity to do so as required by OAR 340-52-015(3)(c).
- Technical activities fee to cover the cost of DEQ review.

Based on Oregon law, the system must meet technical design requirements for common sewers (per OAR 340-052, Appendix A). Oregon law requires a written statement that an O&M manual acceptable to the owner and DEQ be prepared and that the manual must be completed prior to system startup. Oregon requires a long-term management and financial plan for the sewage system's continuous maintenance, operation, and replacement. This plan must show how the system will be financed. Generally, the ability to collect fees must be shown by either joining a municipal system or forming a special district. For documentation that a special district has been formed, DEQ requires submittal of a copy of the ordinance for the special district that has been approved by the Oregon Secretary of State. Oregon rules (ORS 340-Division 49) require all domestic wastewater systems, including common sewers, to be supervised by a certified operator.

7.4 Sustainability Considerations

The proposed wastewater collection system is a sustainable solution for Terrebonne that demonstrates environmental stewardship. By offering the community an alternative to septic drainfields and drill holes for disposal, groundwater and surface water sources will be protected from wastewater pollution. In a letter of support (see Appendix F), the Deschutes County environmental health supervisor states that:

> **Given the increasing public health risk, potential impacts to public resources, limited and costly onsite options and future limits on both residential and commercial development, the best solution for the Terrebonne urbanized community is to have a community sewer system. A community sewer will create a safer long-term solution that will provide a healthier and safer community with more economic and residential opportunities.**

The proposed wastewater collection system will allow for abandonment of septic drainfields and infill development at higher densities within the unincorporated community boundary. Enabling development of the vacant lands zoned for residential and commercial use in Terrebonne will help to reduce sprawling development upon farmland or natural spaces surrounding Terrebonne. Concentrating residential and commercial development in planned areas will lead to more efficient use and maintenance of public infrastructure such as roadways, water systems, and sewer systems.

As described in Section 7.1, the proposed wastewater disposal point is the future Redmond Wetlands Complex, which will provide several environmental benefits, including groundwater recharge, wildlife habitat, and public recreational opportunities. Connecting to this facility for treatment will provide operational simplicity for the District by relying on the expertise and economy-of-scale the Redmond Wastewater Division has to properly operate and maintain the treatment facility in compliance with environmental regulations and the WPCF permit. The long-term function and operation of the Terrebonne wastewater collection system will be sustained by an O&M contract with a DEQ-certified wastewater operator. This arrangement will enable the District to react to public health hazard emergencies, conduct maintenance of the step system, and provide pumping and/or repairs when needed.

While the effluent pumps are powered by electricity, they are energy-efficient with a low power demand of only 1,460 watts over an average run time of 20 minutes per day (residential Prelos Processor, 0.5 hp pump, 12.7 amps at 115 VAC). This power consumption is comparable to the typical domestic use of an espresso coffee machine or a dishwasher. Orenco is the manufacturer of the proposed effluent pump systems; it is headquartered in Sutherlin, Oregon. By using Orenco products, the Terrebonne Sanitary District will have reliable access to technical support and replacement parts manufactured in Oregon. Sourcing locally supports Oregon manufacturing jobs and minimizes the use of fossil fuels associated with long-distance product shipping.

8. PROJECT FINANCING AND IMPLEMENTATION

This chapter evaluates the financial capacity of the new Terrebonne Sanitary District and outlines options for financing and implementing the proposed Phase A wastewater collection system improvements. A summary of state and federal funding programs is presented, including a review of funding options available to the District for the Phase A project. To construct the proposed improvements, a financing plan acceptable to the District and its customers must be developed. Due to the high estimated cost of completing the proposed collection system to serve Terrebonne in Phase A, financing resources will likely include a combination of loan and grant funding.

Below is a general summary of the District's estimated infrastructure costs, proposed rate structure, SDCs, and future wastewater system budgets. A summary of debt capacity for various loan terms and interest rates is also provided. Generally, most utility rate structures include funding for periodic minor system improvements and maintenance items, payroll costs for staff, and a regular allocation for larger future improvements. As a new wastewater system with few connections proposed at the outset, there are currently no existing revenue streams, and a relatively high level of grant funding will be necessary to establish this new system with rates and fees that are affordable to Terrebonne customers.

8.1 Total Project Cost Estimate (Engineer's Opinion of Probable Cost)

The opinion of probable cost to construct the proposed Phase A collection system is $3,830,320. This discrete dollar figure for capital costs was used for the purposes of this economic feasibility statement. However, the actual project costs are likely to range from $2.68 Million to $5.75 Million. As is typical of feasibility studies like this, Class IV cost estimating standards were applied (AACE), by which a cost range is presented with the lower limit -30% below the calculated cost and the upper limit is +50% above the calculated cost. See Table 8-1 for a summary of the Phase A Project Cost Estimate.

This opinion of probable cost only accounts for the project costs anticipated to be borne by the District. A significant portion of the Phase A collection system is being designed and constructed concurrently with the ODOT US 97 improvements project in Terrebonne. Approximately $1 million in ARPA grant funding was allocated to ODOT via Representative Bonham and Deschutes County to incorporate sewer system design and construction into the planned transportation improvements. The capital costs for the work associated with the ODOT project are not borne by the District and are therefore not included in this report.

Deschutes County has allocated $1 million in grant funding to reimburse the City of Redmond for additional treatment capacity at the proposed wetlands treatment complex related to the Terrebonne system ($2 million estimated cost borne by Redmond). Per discussions with the City of Redmond, it is anticipated that 50% of the City's Sewer SDC (for 5/8" meter) will be charged to the District for each EDU that is connected to the Terrebonne collection system. This assumes that approximately half of Redmond's sewer SDC revenues are directed towards treatment infrastructure and the other half towards collection infrastructure, which Terrebonne does not participate in or benefit from. Half of the current $4,371 SDC is $2,185.50, which allows approximately 457 EDUs to be covered by the $1 million grant. Once the $1 million grant is fully spent on the discounted Redmond SDCs for the District, the District will be expected to begin reimbursing the City over time for the remaining treatment system capacity per the terms and conditions agreed upon in the forthcoming intergovernmental agreement.

Table 8-1. Phase A Collection System Cost Estimate (Engineer's Opinion of Probable Cost)

Construction Item	Quantity	Unit	Unit Price	Estimated Cost
8-in Effluent Pressure Main	17,660	lf	$120	$2,119,200
6-in Effluent Pressure Main	1,810	lf	$100	$181,000
3-in Effluent Pressure Main	2,680	lf	$80	$214,400
1-in to 2-in Service Stubs w/ Valves	50	ea	$2,000	$100,000
Air Release Valve Assembly with Odor Filter	3	ea	$2,000	$6,000
Vault with Mag Meter, Sampling Port, and pH Monitor	1	ls	$15,000	$15,000
Connection to City of Redmond Manhole	1	ls	$1,000	$1,000
Odor Control	1	ls	$5,000	$5,000
			Construction Subtotal	$2,641,600
			Contingency (20%)	$528,320
			Engineering and Surveying (10%)	$264,160
			Construction and Funding Management (10%)	$264,160
			Legal and Permitting (5%)	$132,080
			Estimated Phase A Total	**$3,830,320**
			Class IV Project Cost Estimate (-30% to +50%)	**$2,681,224 - $5,745,480**

ea = each; lf = linear foot; ls = lump sum

The cost estimate shown in Table 8-1 below includes five main components, each of which is discussed further below. These opinions of probable project costs are preliminary and based on the level of planning presented in this study. Due to the nature of fluctuating economic conditions, the competitive bidding process, the preliminary nature of this planning document, and other unpredictable conditions, actual total project costs may vary from estimates presented here. As the project moves forward, it may be necessary to update the costs as more information becomes available.

8.1.1 Construction Cost

Initial capital costs for Phase A include collection mains, fittings, valves, service stub-outs, metering, system monitoring, odor control, connection to the City of Redmond treatment system, construction contingency, and the related technical services described above.

Opinions of probable cost in this report are based on preliminary layouts of the proposed improvements, actual construction bidding results for similar work, published cost guides, information from material suppliers, and the author's construction cost experience within the state of Oregon. Future changes in the cost of labor, equipment, and materials may justify comparable changes in the opinions of probable cost presented herein. Opinions of probable cost should be updated when funding applications are completed. When the community secures financing, a reserve factor should be added at that time for an estimated increase in cost due to inflation.

8.1.2 Contingency

In recognizing that opinions of probable cost are based on very preliminary design, allowances must be made for variations in final quantities, bidding market conditions, adverse construction conditions, unanticipated specialized investigations, material and labor cost escalation, and other difficulties that cannot be foreseen at this time. A contingency factor of 20 percent of the construction cost has been added to cover these variables.

8.1.3 Engineering and Surveying

Engineering and surveying costs have been assumed at 10 percent of the construction cost. This includes costs for the engineering company to conduct preliminary surveys, perform detailed design analyses, prepare construction drawings, prepare construction specifications, and conduct construction stakeout surveys.

8.1.4 Construction and Funding Administration

Construction and funding management costs have been assumed at 10 percent of the construction cost. This allowance is intended to include project planning and budgeting, advertising construction bids, grant/loan administration, construction observation, reviewing product submittals, processing change orders, reviewing contractor invoices, and preparing as-built record drawings for the project.

8.1.5 Legal, Permitting, Administration

An allowance of 5 percent of the projected construction cost has been added for legal and permitting costs. This allowance is intended to include legal services, contract review, permit fees, and other related expenses associated with the project.

8.2 Public Infrastructure Grant and Loan Programs

Business Oregon facilitates One-Stop meetings to quickly and efficiently identify infrastructure funding solutions for communities. Funding partners such as USDA-RD and DEQ are also included in One-Stop meetings. If the District chooses to finance the wastewater system improvement project through funding sources administered by IFA, USDA-RD, or DEQ, a One-Stop meeting must be scheduled. A One-Stop meeting will provide a forum to evaluate funding opportunities and find the most suitable funding package for the District.

Once the District is formed, it should schedule a One-Stop meeting with IFA and attend with the board members, engineer, partner agency staff, and this report. After the One-Stop meeting, the District will be invited to submit funding applications to the funding programs identified by agencies as the best fit for the proposed project. Most likely, financing will come from a combination of sources. Below is a summary of potential grant and loan funding resources available for wastewater infrastructure projects. Proposed project financing is described further in Section 8.3.

8.2.1 Oregon Business Development Department – Infrastructure Finance Authority

Community Development Block Grant (CDBG) funding is administered through OBDD-IFA. Federal CDBG program rules limit program assistance to activities that are necessary to benefit current residents in a primarily permanent-resident area. The program also requires meeting the federal objective of serving low- and moderate-income persons. This means that the service area of the system must serve an area where more than 51 percent of the permanent residents are low- and moderate-income persons now and into the future. With the available census data, it is uncertain whether incomes in the Terrebonne service area will meet this requirement. “Low income” means income equal to or less than 50 percent of the area median (adjusted by family size). “Moderate income” means income equal to or less than 80 percent of the area median (adjusted by family size).

Applicable income limits are determined by the U.S. Department of Housing and Urban Development on an annual basis for all Oregon counties and metropolitan statistical areas. Because the Terrebonne area is unincorporated, there is limited data available to determine the median income in the area. For the District to be able to apply for CDBG funding, an income study will be required by the funding agencies to determine the community’s income level. The maximum grant available through the program is $2,500,000 (for the category, Public Works Water and Wastewater Improvements).

OBDD-IFA is also responsible for administering the Special Public Works Fund Program, which is funded by capital from the Oregon Lottery. Loan funds are normally available through this program to be used by cities and counties for public utility improvements, and the program also offers grant funds once loan capacity limits are met. The maximum grant is typically $500,000, and the maximum loan is typically $10 million. Grants cannot be more than 85 percent of the total project cost. Funds can be made available for the purpose of improving public facilities so the service provider can serve additional commercial and industrial businesses.

Eligibility for these funds and interest rates are tied very closely to the need for economic growth and the creation of new jobs or retention of jobs. Grant funds are typically limited to $5,000 per job that is retained or created. Depending on the capability of the District to demonstrate the creation of new family-wage jobs or the retention of existing jobs, this funding program may be a viable option for the District.

OBDD-IFA offers low-interest loan options through the Water/Wastewater Financing Program. The 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. In order to be eligible for funding, a system must have received, or be likely to receive, a Notice of Non-Compliance by the appropriate regulatory agency. The maximum loan term is 25 years, and the maximum loan is $10 million. Grants of up to $750,000 may be awarded based upon a financial review and must be matched 1:1 with a loan from the program. A median household income survey is required for this program to determine what the required affordability rate is and any potential for grant assistance.

8.2.2 U.S. Department of Agriculture – Rural Development

RD offers affordable funding to develop essential community facilities in rural areas. It offers direct loan options with terms up to 40 years at annual interest rates at and below market rates. Grant assistance is also provided on a graduated scale with smaller communities with the lowest median household income being eligible for projects with a higher proportion of grant funds. An income study of the project area would determine how much of the project would be eligible for grant assistance. Based on correspondence with USDA, Terrebonne is unlikely to meet income requirements for USDA grant funding.

8.2.3 Oregon Department of Environmental Quality

DEQ provides water/wastewater funding options through the Clean Water State Revolving Fund. This program is expected see an influx of federal funding resulting from passage of the $1.2 trillion Infrastructure Investment and Jobs Act in 2021, which includes $55 billion for water and wastewater infrastructure projects across the country. The program provides low-cost loans to public agencies for the planning, design, or construction of various projects that prevent or mitigate water pollution. DEQ partners with Oregon communities to implement projects that attain and maintain water quality standards and are necessary to protect recreation, fish habitat, boating, irrigation, drinking water and other beneficial uses. A wastewater treatment facility is an eligible project under this program. These loans are offered with 5- to 30-year terms and annual interest rates ranging from 0.60 percent to 2.31 percent.[8] As with the other funding agencies, reduced interest rates may be available depending on the income levels in the project area.

8.3 Annual Operating Budget

For the proposed wastewater system to be financially feasible, it must be able to cover operating expenses and debt service with revenues from sewer rates. The main components of the annual operating budget include income, O&M costs, debt repayment, and reserves. Each of these four components is described further in the sections that follow.

Two financial forecast scenarios were prepared to illustrate 10-year cash flow projections based on various levels of grant funding, sewer rates, and SDCs. Scenario 1 (shown in Table 8-2 and Figure 8-1) assumes a combination of loan and grant funding for the $3.8-million Phase A system improvements. If grant funding is assumed, SDCs and monthly rates are more affordable for Terrebonne customers. Scenario 2 (shown in Table Table 8-3 and Figure 8-2) is based on debt funding alone (no grants); the higher loan principal means SDCs and monthly rates may pose financial hardships to customers.

Both scenarios assume up-front connection charges will be collected from each customer and forecast O&M and future capital outlays. Both financial plan figures detail the rate and EDU assumptions by year. At startup, 160 EDUs are anticipated to connect to the collection system. EDUs are anticipated to increase by approximately 10 EDUs in the commercial core area (Phase A) every year.

Sewer rates have been adjusted year-over-year for inflation assuming a 3 percent annual average cost inflation. Anticipated operating revenue is based on the monthly rates and number of EDUs connected to the sewer system. As a new wastewater system there are no existing revenue streams and it is expected that customer participation in the system will start small and increase over time. Consequently, a relatively high level of grant funding will likely be necessary to establish this new system with rates and fees that are affordable to Terrebonne customers.

[8] Interest rates depend on term, community size, and income per the DEQ website as of May 2022.

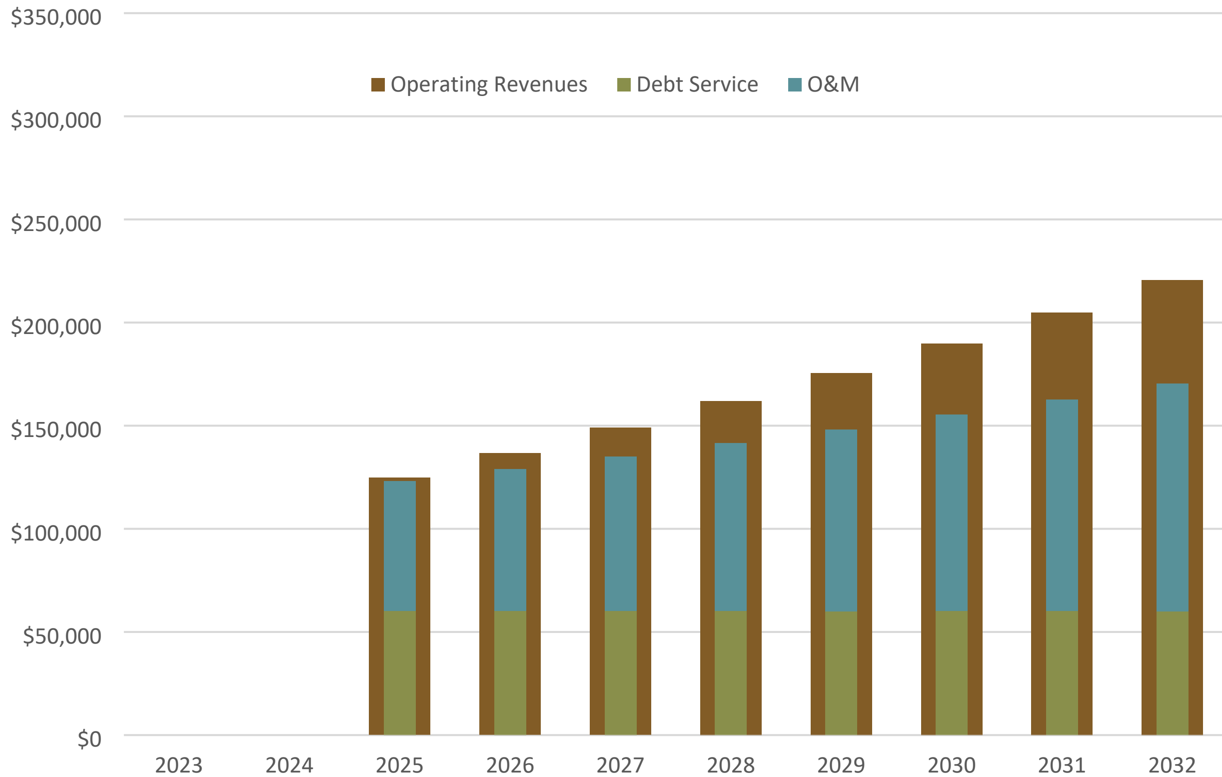


Figure 8-1. Annual Operating Budget, Scenario 1 (Grant Funding Assumed)

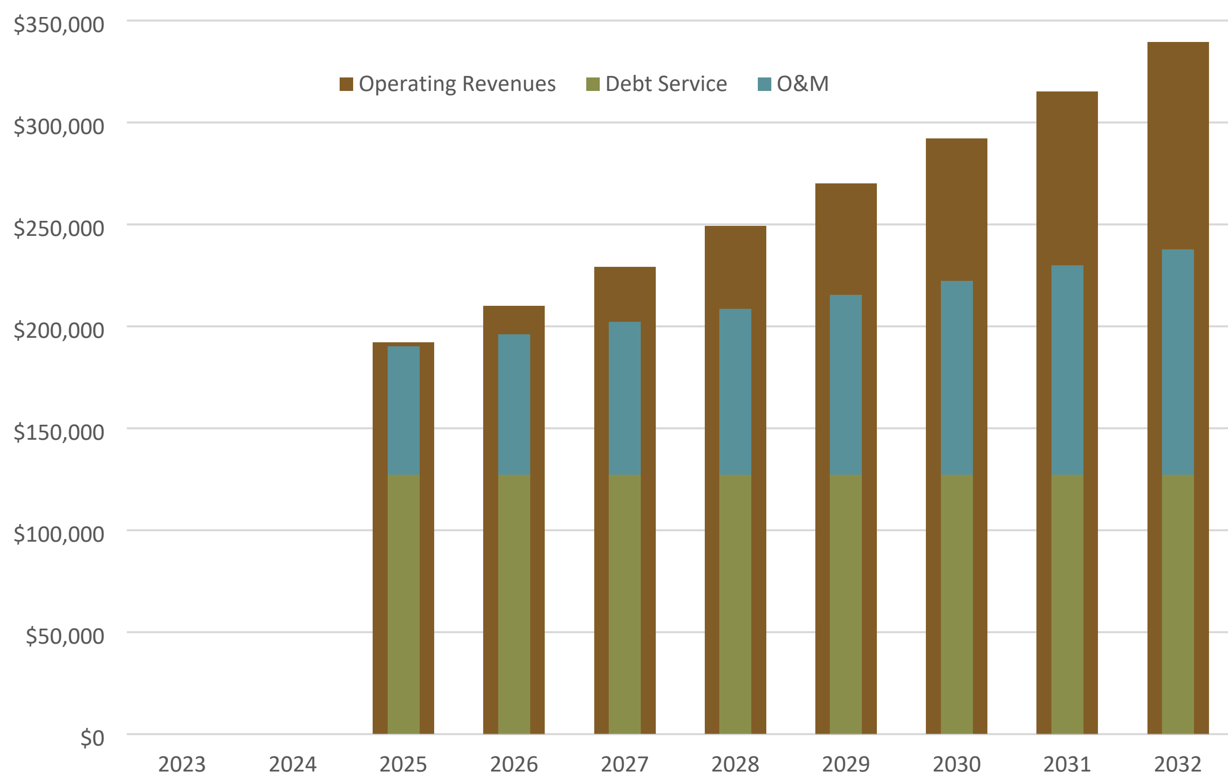


Figure 8-2. Annual Operating Budget, Scenario 2 (No Grant Funding Assumed)

Table 8-2. Annual Operating Budget, Scenario 1 (Grant Funding Assumed)

Year		(funding) 2023	(construction) 2024	(startup) 2025	2026	2027	2028	2029	2030	2031	2032
Cost index (3% cost inflation annual average)				1.00	1.03	1.06	1.09	1.13	1.16	1.19	1.23
EDUs				160	170	180	190	200	210	220	230
Monthly Rate per EDU[3]				$65.00	$66.95	$68.96	$71.03	$73.16	$75.35	$77.61	$79.94
Beginning Balance		**$ -**	**$ 3,166,704**	**$100,000**	**$ 81,781**	**$117,235**	**$158,937**	**$ 207,201**	**$ 262,354**	**$ 324,736**	**$ 394,703**
Operating Revenues											
Charges for Services		$0	$0	$124,800	$136,578	$148,950	$161,942	$175,579	$189,889	$204,899	$220,639
Total Operating Revenues		**-**	**-**	**124,800**	**136,578**	**148,950**	**161,942**	**175,579**	**189,889**	**204,899**	**220,639**
Operation, Maintenance & Replacement Expenses											
Personal Services[5]		$ -	$ -	$ 9,600	$ 10,506	$ 11,458	$ 12,457	$ 13,506	$ 14,607	$ 15,761	$ 16,972
Materials & Services[4]		$ -	$ -	$ 22,000	$ 23,973	$ 26,045	$ 28,220	$ 30,501	$ 32,894	$ 35,404	$ 38,034
Other Operating Expense - COR WW Treatment[1]		$ -	$ -	$ 31,277	$ 34,229	$ 37,329	$ 40,585	$ 44,003	$ 47,589	$ 51,351	$ 55,296
Total OM&R		**$0**	**$0**	**$ 62,877**	**$68,708**	**$74,832**	**$81,262**	**$88,010**	**$95,090**	**$102,516**	**$110,302**
(Average Annual OM&R Expense per EDU)				$ 393	$ 404	$ 416	$ 428	$ 440	$ 453	$ 466	$ 480
Debt Service											
Net Revenue Avail. For Debt Service		$0	$0	$61,923	$67,870	$74,118	$80,680	$87,569	$94,799	$102,383	$110,338
Proposed Debt[2]			$0	$60,142	$60,142	$60,142	$60,142	$60,142	$60,142	$60,142	$60,142
Total Debt Service		**$0**	**$0**	**$60,142**	**$60,142**	**$60,142**	**$60,142**	**$60,142**	**$60,142**	**$60,142**	**$60,142**
Other Activities											
Cash Available After Debt Service		**$0**	**$0**	**$1,781**	**$7,728**	**$13,976**	**$20,538**	**$27,427**	**$34,656**	**$42,241**	**$50,195**
Loan Proceeds/Drawdowns		1,366,704	763,616	0	0	0	0	0	0	0	0
Capital Outlay		0	(3,830,320)	(20,000)	(20,000)	(20,000)	(20,000)	(20,000)	(20,000)	(20,000)	(20,000)
Loan Payoff		0	0	(763,616)	0	0	0	0	0	0	0
Grant	47% Tot Cost	1,800,000	0	0	0	0	0	0	0	0	0
Interest Income		0	0	0	0	0	0	0	0	0	0
SDC revenue	$ 4,773 /EDU	0	0	763,616	47,726	47,726	47,726	47,726	47,726	47,726	47,726
Equipment replacement transfers		0	0	0	0	0	0	0	0	0	0
Net Other Activity		**$3,166,704**	**($3,066,704)**	**($20,000)**	**$27,726**	**$27,726**	**$27,726**	**$27,726**	**$27,726**	**$27,726**	**$27,726**
Adjustments		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Ending Fund Balance		**$3,166,704**	**$ 100,000**	**$ 81,781**	**$117,235**	**$158,937**	**$207,201**	**$ 262,354**	**$ 324,736**	**$ 394,703**	**$ 472,625**
Debt Service Coverage				**1.03**	**1.13**	**1.23**	**1.34**	**1.46**	**1.58**	**1.70**	**1.83**

Notes:

[1] Based on assumed treatment charges of $16.29/EDU/Month=$196/EDU/year (in 2025) to cover City of Redmond charges to TSD by metered volume at $2.63/1000 gallons/month

[2] Based on 30 year term and 0.96% interest rate and including 0.50% annual fee

[3] Monthly rate as % of median household income: 1.37%

[4] Based on estimates from contractor: $127.50/EDU/year plus $1,600/year for collection system maintenance

[5] An estimate based on information received from utility billing service and additional cost required for in-house district personal services

Table 8-3. Annual Operating Budget, Scenario 2 (No Grant Funding Assumed)

Year		(funding) 2023	(construction) 2024	(startup) 2025	2026	2027	2028	2029	2030	2031	2032
Cost index (3% cost inflation annual average)				1.00	1.03	1.06	1.09	1.13	1.16	1.19	1.23
EDUs				160	170	180	190	200	210	220	230
Monthly Rate per EDU[3]				$100.00	$103.00	$106.09	$109.27	$112.55	$115.93	$119.41	$122.99
Beginning Balance		**$ -**	**$ 2,893,459**	**$ 100,000**	**$ 81,796**	**$140,684**	**$ 212,483**	**$ 297,839**	**$ 397,427**	**$ 511,951**	**$ 642,141**
Operating Revenues											
Charges for Services		$0	$0	$192,000	$210,120	$229,154	$249,142	$270,122	$292,137	$315,230	$339,445
Total Operating Revenues		**-**	**-**	**192,000**	**210,120**	**229,154**	**249,142**	**270,122**	**292,137**	**315,230**	**339,445**
Operation, Maintenance & Replacement Expenses											
Personal Services[5]		$ -	$ -	$ 9,600	$ 10,506	$ 11,458	$ 12,457	$ 13,506	$ 14,607	$ 15,761	$ 16,972
Materials & Services[4]		$ -	$ -	$ 22,000	$ 23,973	$ 26,045	$ 28,220	$ 30,501	$ 32,894	$ 35,404	$ 38,034
Other Operating Expense - COR WW Treatment[1]		$ -	$ -	$ 31,277	$ 34,229	$ 37,329	$ 40,585	$ 44,003	$ 47,589	$ 51,351	$ 55,296
Total OM&R		**$0**	**$0**	**$ 62,877**	**$68,708**	**$74,832**	**$81,262**	**$88,010**	**$95,090**	**$102,516**	**$110,302**
	OMR/EDU			$ 393	$ 404	$ 416	$ 428	$ 440	$ 453	$ 466	$ 480
Debt Service											
Net Revenue Avail. For Debt Service		$0	$0	$129,123	$141,412	$154,322	$167,880	$182,112	$197,047	$212,714	$229,143
Proposed Debt[2]			$0	$127,328	$127,328	$127,328	$127,328	$127,328	$127,328	$127,328	$127,328
Total Debt Service		**$0**	**$0**	**$127,328**	**$127,328**	**$127,328**	**$127,328**	**$127,328**	**$127,328**	**$127,328**	**$127,328**
Other Activities											
Cash Available After Debt Service		**$0**	**$0**	**$1,796**	**$14,085**	**$26,995**	**$40,552**	**$54,784**	**$69,719**	**$85,386**	**$101,816**
Loan Proceeds/Drawdowns		2,893,459	1,036,861	0	0	0	0	0	0	0	0
Capital Outlay		0	(3,830,320)	(20,000)	(20,000)	(20,000)	(20,000)	(20,000)	(20,000)	(20,000)	(20,000)
Loan Payoff		0	0	(1,036,861)	0	0	0	0	0	0	0
Grant		0	0	0	0	0	0	0	0	0	0
Interest Income		0	0	0	0	0	0	0	0	0	0
SDC revenue	$ 6,480 /EDU	0	0	1,036,861	64,804	64,804	64,804	64,804	64,804	64,804	64,804
Equipment replacement transfers		0	0	0	0	0	0	0	0	0	0
Net Other Activity		**$2,893,459**	**($2,793,459)**	**($20,000)**	**$44,804**	**$44,804**	**$44,804**	**$44,804**	**$44,804**	**$44,804**	**$44,804**
Adjustments		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Ending Fund Balance		**$ 2,893,459**	**$ 100,000**	**$ 81,796**	**$ 140,684**	**$ 212,483**	**$ 297,839**	**$ 397,427**	**$ 511,951**	**$ 642,141**	**$ 788,761**
Debt Service Coverage				**1.01**	**1.11**	**1.21**	**1.32**	**1.43**	**1.55**	**1.67**	**1.80**

Notes:

[1] Based on assumed treatment charges of $16.29/EDU/Month=$196/EDU/year (in 2025) to cover City of Redmond charges to TSD by metered volume at $2.63/1000 gallons/month

[2] Based on 30 year term and 0.96% interest rate and including 0.50% annual fee

[3] Monthly rate as % of median household income: 2.12%

[4] Based on estimates from contractor: $127.50/EDU/year plus $1,600/year for collection system maintenance

[5] An estimate based on information received from utility billing service and additional cost required for in-house district personal services

8.3.1 Income

A crucial consideration for the District's financial plan is initial funding sources and the District's eligibility for grant funding in order to moderate customer sewer bills. Most likely, the funding for the initial Phase A project construction will come from a combination grants and loans from funding agencies. District representatives will participate in a One-Stop meeting with state and federal agencies to further evaluate funding options (see Section 8.2 for more information).

Lending agencies, such as Business Oregon, generally require utilities to set user rates sufficient to generate net revenues (operating revenues minus operating expenses) in excess of annual debt service to provide some level of funding contingency (referred to as a "debt service coverage"). The financial forecasts presented in the previous section assume a debt service coverage ratio (DSCR) of greater than 1.00. The budget also includes provisions for a debt-service reserve, which is discussed further in Section 8.5.

According to the U.S. Environmental Protection Agency[9], if the annual sewer service cost per household is less than 1.0 percent of the median household income, it is not expected to impose a substantial economic hardship on many households. If the average annual sewer service cost per household exceeds 2.0 percent of median household income, then the project may place an unreasonable financial burden on many of the households within the community. When this ratio (referred to as the "residential indicator") falls between these values, communities are expected to incur mid-range impacts and a secondary test is often performed that includes debt indicators, socioeconomic indicators, and financial management indicators. Various state and national funding agencies have adopted an affordability threshold that falls within this range.

According to the 2020 American Community Survey (U.S. Census Bureau Table S1901), the median household income (MHI) for the Terrebonne Census-Designated Place is $56,736, and the boundary roughly matches the unincorporated community boundary and ultimate sewer service area. It is, therefore, considered a reasonable representation of demographics for the purposes of this study. See Figure 8-3 below.

Figure 8-3. Summary of 2020 Census Data for the Terrebonne CDP
Source: US Census Data Website (Source Tables in Blue), https://data.census.gov/cedsci/profile?g=1600000US4172800

[9] 2021 Financial Capability Assessment Guidance, published by the EPA.

Based on the affordability thresholds described above, a 1 to 2 percent annual sewer service cost as a percentage of Terrebonne MHI would correlate to a monthly sewer service cost between $47.28 and $94.56 (per residential service or one EDU). Therefore, sewer rates should be set within this range to be affordable to ratepayers while also being sufficient to result in a DSCR greater than one for debt repayment.

By definition, each residential dwelling is counted as one EDU. The quantity of EDUs associated with commercial users is calculated by dividing the average water usage of each by the average water usage of residential dwellings in Terrebonne. In the initial Phase A service area, there are approximately 90 residential dwellings and 28 commercial users. Based on metered water usage data, these 28 commercial users account for approximately 70 commercial EDUs. The total of existing residential and commercial EDUs is estimated to be approximately 160 EDU in the Phase A service area.

For the purposes of this study, it was assumed that small businesses with average flows equal to or less than that of an average residence would be charged SDCs (for hookup) and monthly rates for one EDU. Larger businesses with average flows greater than that of an average residence will be charged SDCs (hookup) and monthly rates accordingly, each ranging from 2 EDUs or more, depending on metered water usage. The District may consider alternate methods for calculating commercial EDUs, such as water meter size (for simplicity) or septic system design flows (for more direct correlation to wastewater generation). However, it is important that any alternate EDU calculation method result in sufficient annual operating revenues and SDC revenues to cover operating expenses and capital costs, respectively.

In Scenario 1 ($1.8 million grant funding assumed), the monthly sewer rate per EDU is $65 per EDU, which is comparable to other regional communities. Assuming 160 EDUs in year 1 (2025) at startup, this monthly rate results in an initial annual operating revenue of $124,800. This is sufficient to cover projected annual operating expenses including $62,877 for operation, maintenance, and repair (OM&R) and $60,142 for debt service. This monthly sewer rate of $65/EDU translates to an annual cost per household of roughly $780, which represents 1.37 percent of the median household income in Terrebonne ($56,736 per 2020 U.S. Census Data). At the outset in 2025, the DSCR is calculated to be 1.03 and then increases as connections and operating revenues increase while debt service remains the same year over year.

In Scenario 2 (no grant funding assumed), the monthly sewer rate must be higher at $100 per EDU cover the additional debt service for capital construction. Assuming 160 EDUs in year 1 (2025) at startup, this monthly rate results in an initial annual operating revenue of $192,000. This annual revenue is sufficient to cover projected annual operating expenses including $62,877 for OM&R and $127,328 for debt service. This monthly sewer rate of $100 translates to an annual cost per household of roughly $1,200, which represents 2.12 percent of the median household income in Terrebonne ($56,736). Because this percentage exceeds 2 percent, this monthly rate of $100/month is expected to impose a substantial economic hardship on households. At the outset in 2025, the DSCR is calculated to be 1.01 and then increases as connections and operating revenues increase while debt service remains the same year over year.

If the District is formed and moves forward with the design and construction of the proposed Phase A wastewater collection system project, an SDC will need to be established to help cover costs from this project and allocate funding for past and future capital projects. A detailed SDC analysis is beyond the scope of this preliminary engineering report. This SDC analysis is only preliminary and will need to be reassessed when actual costs, funding sources, etc., are better known. Outlined below is a preliminary SDC analysis to provide a rough estimate of the SDC that would be assessed to Terrebonne customers who connect to the wastewater system. The reimbursement and improvement components below need to be considered first, in order to estimate the total SDC described at the end of the list:

- **Reimbursement** – The reimbursement fee recovers the cost of the customer's fair share of existing system assets with available capacity for wastewater collection, transmission, treatment, and disposal. The reimbursement fee is based on the value of available capacity for wastewater infrastructure that is already constructed or under construction. For Terrebonne, the reimbursement SDC would reimburse the District for costs incurred to construct the proposed Phase A collection system. The estimated Phase A project cost is $3.8 million (in 2022 dollars). The Phase A infrastructure includes pressure sewer mains and the 8-inch force main to Redmond, which is designed to serve the entire Terrebonne community (1,054 EDUs) at full-buildout. Assuming this reimbursable construction cost is divided among the 1,054 EDUs projected at full buildout, the estimated reimbursement SDC would be approximately $3,634 per EDU.
- **Improvement** – Improvement SDCs recover costs associated with capital improvements to be constructed in the future. While phasing plans have been prepared for expanding the collection system to outlying residential areas in Terrebonne, the extent and timing of these projects is uncertain. To allocate funds for future system expansion, improvement costs are assumed to be $3 million. Assuming this improvement cost of $3 million is divided among the 1,054 EDUs projected at full buildout, the Improvement SDC would be approximately $2,846 per EDU.
- **Total SDC** – The total SDCs are the sum of the reimbursement and improvement components. The estimated total SDCs would be $6,480 ($3,634 + $2,846). This total represents a worst-case scenario and assumes the entire project would be paid for through a state or federal loan. Although not guaranteed to be awarded to the District, this amount can be reduced through applying for and acquiring grants to effectively reduce the overall direct capital expenditure by the District. For instance, if the District was to secure $1.8 million in grant funding for Phase A initial reimbursement costs for Phase A would be reduced by $1.8 million and the total SDCs would equate to $4,773. Please see Table 8-4 below for a summary of estimated sewer rates, SDCs, and revenues for both scenarios.

Table 8-4. Estimated Sewer Fees and Initial Revenues

	Scenario 1 ($1.8 M grant funding)	Scenario 2 (no grant funding)
Monthly Rate per EDU	$65	$100
SDC Hookup Fee per EDU	$4,773	$6,480
Initial Operating Revenues (160 EDU in 2025)	$124,800	$192,000
Initial SDC Revenue (160 EDU in 2025)	$763,616	$1,036,861
Annual Sewer Cost % MHI	1.37%	2.12%

EDU = equivalent dwelling unit; M = million; MHI = median household income; SDC = system development charge

8.3.2 Annual Operation and Maintenance Costs

O&M expenses are typically categorized into three types:

- **Personal Services** – This includes utility billing services, personnel costs, administrative costs, accounting, legal fees, interest, utilities, office supplies, printing, and professional services among other tasks. An estimate of $5/EDU/month was used. Because of the small scale of the district area at startup, it is possible that a third-party billing and customer call center service may be beneficial for the District. Estimates from an existing third-party vendor were provided at $1.90/EDU/month for a 2,000-customer system. An additional $3.10 was included to cover economy of scale for the small Terrebonne system, as well as for miscellaneous services performed by District personnel. This results in a budgeted annual administrative expense of $10,185 assuming 160 EDUs at startup in 2025.
- **Materials and Services** – Contractor estimates were solicited for the materials and services portion of the OM&R costs. These were estimated to be $127.50/EDU/year for preventative maintenance, reactive maintenance, repair and replacement, and tank pumping plus an additional $1,600 per year for the collection system maintenance such as pressure main repairs, valve maintenance, odor control, etc. See Appendix H. This results in a budgeted annual OM&R expense of $23,340 assuming t by 160 EDUs at startup in 2025.
- **City of Redmond Treatment Charges** – The proposed wastewater collection system in Terrebonne will benefit from the treatment services provided by the Redmond Wetlands Complex. The District will be responsible for paying related wastewater treatment charges to the City of Redmond. Per coordination with the City of Redmond, the charge will be approximately $2.63/1,000 gallons/month based on metered discharge volume. Assuming a conservative average daily flow of approximately 200 gallons/day/EDU, the budgeted amount for treatment charges (in 2025) is $16.29/EDU/month or $196/EDU/year to cover these City of Redmond charges to the District. This results in a budgeted annual expense of $33,182 for Redmond treatment charges assuming 160 EDUs at startup in 2025.

8.4 Debt Repayments

For purposes of estimating long-term debt service on the infrastructure loans, a 30-year loan was assumed with a 0.96 percent interest rate and a 0.5 percent annual fee on the principal balance. The anticipated long-term loan amounts for both scenarios were decreased by the funding available through SDCs, as described in Section 8.3.1. Therefore, a secondary short-term loan is also included in both budget scenarios based on a 5-year term, 0.60 percent interest rate, and 0.5 percent annual fee on the principal balance. The intent of this secondary loan is to use SDC revenues for deferred coverage of construction costs and thus minimize the long-term loan principal balance and the related annual debt burden on the District and its customers.

These loan terms and rates are typical of Clean Water State Revolving Fund loans for design or construction in small communities below the statewide MHI, as published on the DEQ website for the period of April 1 through June 30, 2022. According to the 2020 American Community Survey (U.S. Census Bureau Table S1901), the MHI for the Terrebonne Census-Designated Place is $56,736 and the statewide Oregon MHI was reported to be $65,667. Please see Appendix I for a Sewer Rate Study that compares the District’s debt capacity at various monthly sewer rates and various loan rates and terms.

Assuming $1.8 million in grant funding is awarded to the project (Scenario 1 as shown in Table 8-2) the proposed debt service is calculated to be $60,142 per year. Assuming no grants are awarded to the project (Scenario 2 as shown in

Table **8-3**), the proposed debt service is calculated to be $127,328 per year. This estimate is based on the following assumptions and estimates for Year 1 of system operation (2025). Table 8-5 below compares the debt repayment information for both scenarios.

Table 8-5. Debt Repayment Scenarios

	Scenario 1	Scenario 2
Estimated total project cost	$3,830,320	$3,830,320
Assumed Grant Funding	$1,800,000	$0
Long-term CWSRF loan balance, repaid over 30 years (0.96% rate with 0.5 % annual fee on principal balance)	$1,366,704	$2,893,459
Short-term CWSRF loan balance, repaid within 5 years (0.60% rate with 0.5% annual fee on principal balance)	$763,616	$1,036,861
Net revenue available for debt service	$61,923	$129,123
Proposed debt service	$60,142	$127,328
Initial DSCR (1.00 minimum) *	1.03	1.01

* Debt Service Coverage Ratio is expected to improve over time as revenues increase with added connections and debt repayment remains the same.
CWSRF=Clean Water Stater Revolving Fund, DSCR=Debt Service Coverage Ratio

8.5 Reserves

In both scenarios, an additional $100,000 is allocated in the long-term loan amounts for the purpose of establishing a debt service reserve. A debt service reserve is an amount specifically set aside to cover debt payments in the event of a disruption of cashflows to the extent that debt cannot be serviced. This debt service reserve is a key component of a project finance model and is usually required by lenders.

In Scenario 1, this $100,000 reserve is 4.7 percent of the $2.1 million total loan principal and roughly 1.5 times greater than the $65,778 annual (long-term) debt service. In Scenario 2, this $100,000 reserve is 2.5 percent of the $3.9 million total loan principal and roughly 72 percent of the annual (long-term) debt service. With this initial debt service reserve allocation, the end fund balance is kept at or above $80,000 for all years in both scenarios.

In both scenarios, $20,000 is set aside per year as capital outlay toward the future replacement of short-lived infrastructure assets (see Table 8-6). For this system, these include a magnetic water meter, pH meter, sampling station, mainline control valves, air release valves, and service valves. It is conservatively assumed that these items may require replacement within 20 years, although they will likely function adequately well beyond this timeframe.

Table 8-6. Short-Lived Asset Reserve

Item	Quantity	Replacement Cost	Subtotal	Replacement Interval	Annual Allocation
Magnetic Water Meter	1	$7,000	$7,000	20	$350
pH Meter	1	$500	$500	20	$25
Sampling Station	1	$500	$500	20	$25
Main Control Valves	40	$3,300	$132,000	20	$6,600
Air Release Valves	5	$2,000	$10,000	20	$500
Service Valves	100	$2,500	$250,000	20	$12,500
				Total Annual Allocation	$20,000

8.6 Onsite Connection Costs

There are four basic scenarios for onsite upgrades that will be necessary for customers to connect to the proposed STEP collection system. The effluent pump sizing and related onsite upgrade costs for properties over 5 EDU will need to be determined on a case-by case basis. Retrofit effluent pump systems (ProPak) and replacement septic tank/effluent pump systems (Prelos) are described further in Section 7.1.1. These are summarized in Table 8-7 with cost ranges based on multiple contractor estimates (see Appendix J, Onsite Installation Cost Estimates):

Table 8-7. Onsite System Upgrade Scenarios and Estimated Costs

Scenario	Description	Estimated Onsite Upgrade Costs (to Property Owner)
R1	Residential property with a good-condition septic tank requiring retrofit installation of a ProPak system (BPP10DD, PF1005 pump)	$8,250–$13,750
R2	Residential property with a poor-condition septic tank requiring replacement with a Prelos Processor	$15,000–$25,000
C1	Commercial property (3–5 EDUs) with a good-condition septic tank requiring retrofit installation of a ProPak system (BPP30DD, PF3010 pump)	$8,500–$14,500
C2	Commercial property (3–5 EDUs) with a poor-condition septic tank requiring replacement with a 3,000-gallon septic tank and ProPak system (BPP30DD, PF3010 pump)	$16,000–$27,00

While these onsite system upgrade costs may be a financial burden for some property owners, there are several strategies the District can consider to help ease this burden. DEQ has initiated a new program called the Onsite Septic Financial Aid Program (OSFAP), which provides grants to low- and moderate-income residents for onsite septic system repairs and upgrades to connect to public sewer. Once formed, the Terrebonne Sanitary District board will be eligible to apply for OSFAP funding on behalf of future Terrebonne customers who will need financial assistance. Other customers who do not qualify for these grants may be able to finance these onsite upgrades with a line of credit that is secured by equity in their property.

9. CONCLUSIONS AND RECOMMENDATIONS

The need for a public wastewater system in the commercial core of the Terrebonne area (Phase A) is well established. The economic, public safety, and environmental health risks with continued use of onsite wastewater disposal systems are serious. Installation of a wastewater system would help businesses operate reliably and would facilitate development of new housing, jobs, and commerce in the community. Properties outside the commercial core area (in Phases B and C) would also benefit from connection to the wastewater collection system, but the need for sewer in these mostly residential areas is generally not as urgent at this time.

Although there are many long-term benefits with a public wastewater system, the connection costs, construction impacts, and the prospect of change present short-term challenges to overcome. It is recommended that the District work closely with its citizens to inform them of the proposed construction project and the upfront and monthly sewer user costs. Clear and regular communications with the community will be important for garnering and maintaining public support.

Nevertheless, there are many factors that make the present a uniquely opportune time for Terrebonne to proceed with the implementation of the proposed wastewater system. This project has dedicated support from Terrebonne commercial property owners, Deschutes County, and DEQ. The City of Redmond Wastewater Division plans to construct its new treatment wetlands complex with additional capacity to receive effluent from Terrebonne. ODOT plans to install pressure sewer mains within the roadways that will be reconstructed as a part of the US 97 Terrebonne/Lower Bridge Way Improvements project. In addition, there has been a substantial increase in public infrastructure funding available for projects like this due to passage of the American Rescue Plan Act and the Bipartisan Infrastructure Law.

The key to implementing the proposed wastewater system improvements is the District's ability to acquire low-interest loan funding <u>and</u> grant funds. This will be critically important to keeping SDCs and monthly user rates affordable. In addition, the District will need to secure a high level of customer participation in the Phase A service area in order to secure loan funding, generate sufficient operating revenues, and cover operating expenses including debt service. Once formed, the District will also have the authority to enact an ordinance that compels all developed properties in the district to connect to the system, if necessary. If connection is not mandated by ordinance, the District should consider strategies to incentivize connections within the service area including early hookup incentives, SDC payment plans, and financial aid programs.

As described in this report, it is feasible to design and construct a wastewater system that serves the commercial core of Terrebonne and has the capacity to be expanded to serve additional areas within the unincorporated community boundary. The recommended design alternative uses existing septic tanks (in good condition), minimizes rock excavation, facilitates collection system expansion, and does not require a new wastewater treatment plant to be sited, constructed, and maintained in Terrebonne. The proposed STEP collection system and interconnection with the City of Redmond Wetlands Complex will provide Terrebonne with a reliable, quality wastewater system that will maintain regulatory compliance and meet the needs of the Terrebonne community for many years to come.

This page intentionally left blank.

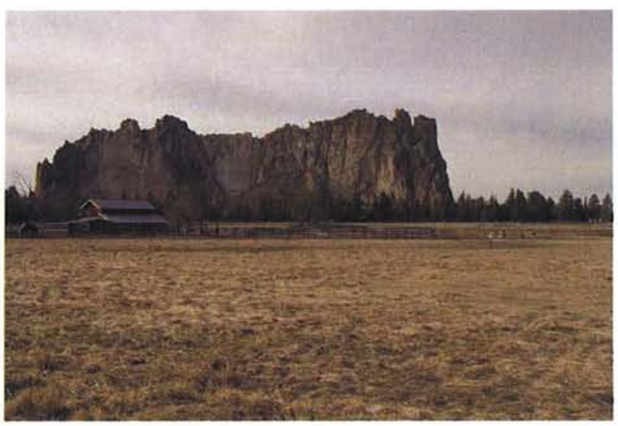
Appendix A

Terrebonne Community Plan

This page intentionally left blank.

Terrebonne

Community



Plan

2010-2030

DESCHUTES COUNTY

2030 COMPREHENSIVE PLAN UPDATE

2030 COMPREHENSIVE PLAN UPDATE

Terrebonne Community Plan 2010-2030

Maps

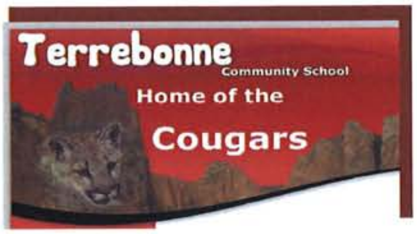
Tables

Introduction

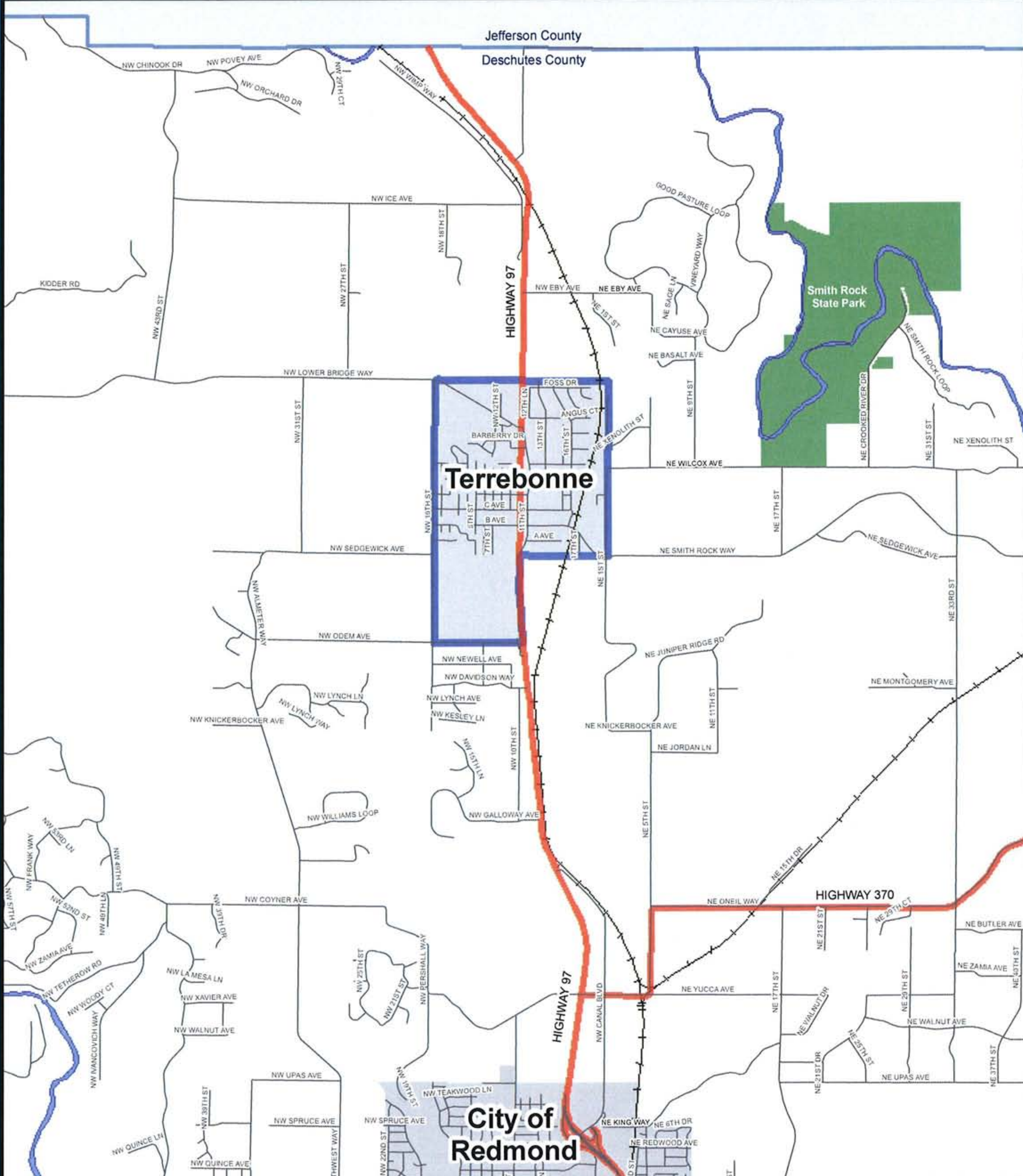
The Terrebonne Community Plan (Community Plan) is an integral part of the Deschutes County Comprehensive Plan and upon adoption by the Board of County Commissioners, constitutes an official chapter. It can only be changed if the Community Plan goes through an official legislative plan amendment process. The Community Plan's goals and policies provide a guide to decision making for land use planning, capital improvements, and physical development during the next 20 years (2010 – 2030). It is anticipated that Deschutes County, Oregon Department of Transportation (ODOT), special districts, residents, and community leaders will consult the Community Plan when preparing land use or transportation projects in Terrebonne.

Terrebonne is a small rural community at the northern edge of Deschutes County. Founded as a railroad town in 1909, Terrebonne contains residential neighborhoods, a community school, a commercial expansion area and two commercial business districts, one fronting U.S. Highway 97 (U.S. 97) and the other abutting 11th Street.. Existing land use and transportation patterns justify the need for a Community Plan. State statute by definition recognizes Terrebonne as a "Rural Community" because it is a longstanding rural service center. Although this Community Plan only addresses the area within the boundaries of Terrebonne, nearby residents and visitors utilize its services given the proximity to U.S. 97, local businesses, Terrebonne Community School, and Smith Rock State Park.

Terrebonne Community School, which is within the Redmond School District, draws 400 students spanning kindergarten through 8th grade. The school's geographic area in addition to Terrebonne covers Crooked River Ranch in Jefferson County, the east side of Smith Rock State Park, and the north side of Cinder Butte, just north of Redmond.



Smith Rock State Park lies three miles east of Terrebonne, encompassing 651 acres on the Oregon high desert plateau. The park which hovers around 3000 feet in elevation, provides a sanctuary of majestic rock spires overlooking the scenic Crooked River Canyon. Containing hundreds of climbing routes, it is an international destination for rock climbers. In addition, the park offers year-round camping, picnicking, fishing, hiking, and wildlife watching.



Terrebonne Vicinity Map

For More Information Contact:
Deschutes County Community Development Department
117 NW Lafayette Bend, OR 97701
541-388-6575 www.co.deschutes.or.us/cdd

- Railroad
- State Highway
- Terrebonne Unincorporated Community
- Smith Rock State Park
- City of Redmond

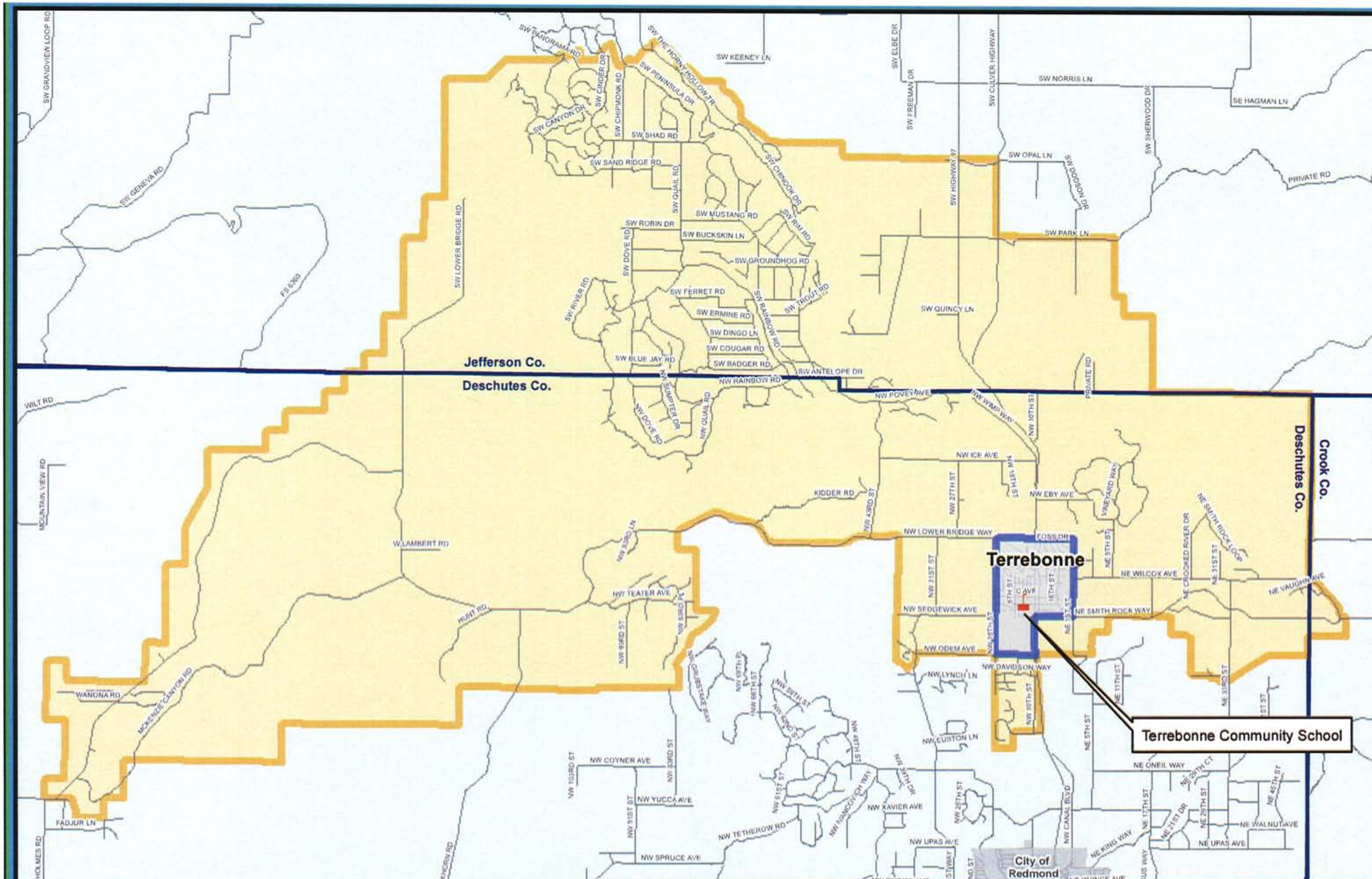
0 0.125 0.25 0.5 0.75 1 Miles

1" = 4,000 Feet

DISCLAIMER
The information on this map was derived from digital databases on Deschutes County's G.I.S. Care was taken in the creation of this map, but it is provided "as is". Deschutes County cannot accept any responsibility for errors, omissions, or positional accuracy in the digital data or the underlying records. There are no warranties, express or implied, including the warranty of merchantability or fitness for a particular purpose, accompanying this product. However, notification of any errors will be appreciated.

N:\ \CompPlanUpdate2008\CommunityPlan\Terrebonne\Terrebonne_Vicinity.mxd

February 17, 2010



Terrebonne Community School Attendance Area

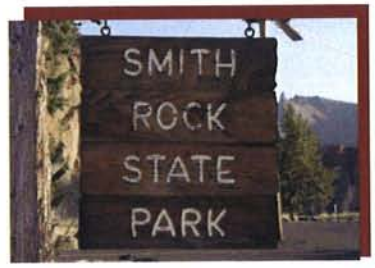
- Terrebonne Elementary School
- Terrebonne Unincorporated Community
- Terrebonne School Attendance Area
- County Boundary

0 1 2 Miles

For More Information Contact:
Deschutes County Community Development Department
117 NW Lafayette Bend, OR 97701
541-388-6575 www.co.deschutes.or.us/cdd

Community Vision Statement

Terrebonne residents set forth this vision with the intent that the Community Plan, developed in cooperation with Deschutes County, shall serve as a framework to realize it.



Maintain the livability of Terrebonne as a small town with its rural and scenic character, by encouraging efficient services and safe traveling throughout the community.

This vision statement is created to ensure that with vigilance and foresight, the unique rural character of Terrebonne can be maintained and enjoyed by present and future generations over the next twenty years.

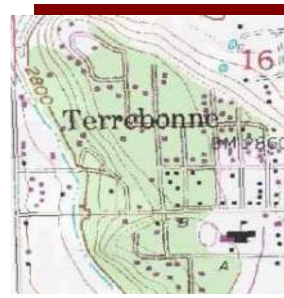
History

Located on the Oregon Trunk Railroad, Terrebonne was originally called Hillman for railroad magnates James Hill and E. H. Harriman, who famously competed to finish a rail line from the mouth of the Deschutes River to Bend in the early 1900s. As news of the Hillman Plat spread across the United States, people speculated and blindly purchased property. A few individuals never actually claimed their lots, while others came to discover that the promises of fertile agricultural land were embellished.

One persistent story regarding the original town site concerns a developer who reportedly sold the same lots, including some that were unbuildable, to several different buyers. When disgruntled buyers caught up with the developer, he was run out of town. As news of this land fraud spread across the country, the residents of Hillman decided to change the name of their town site to improve its reputation. They held a meeting and selected the name "Terrebonne," which means "good earth" in French.

As Terrebonne grew and prospered earlier last century, it boasted a hotel, newspaper, livery stable, bank, blacksmith shop, meat market, realty company, grange hall, school, general stores, barber shops, various feed stores, and churches. Today, legacy buildings from the community of Hillamn include the original Hillman town site platted in 1909 and three historical buildings: Ladies Pioneer Club (1911), Oregon Trunk Railroad Depot (1911) and Grange Hall (1925).

Land Use



The 1979 Deschutes County Comprehensive Plan designated Terrebonne a Rural Service Center (RSC). Comprising 667 acres and 577 tax lots, the 1979 Terrebonne RSC boundary included the Hillman Plat, excluding the portion east of the Oregon Trunk Railroad tracks. The boundary encompassed the area south of the Hillman Plat known as the Circle “C” Acres Subdivision, which occupies land located south of Odem Avenue. The 1979 Terrebonne RSC boundary also included land in the north one-quarter of Section 16, Township 14S, Range 13E, north of the Hillman Plat.

In 1994, the Oregon Land Conservation and Development Commission adopted Oregon Administrative Rule for unincorporated communities, instituting new land use requirements for Terrebonne (OAR 660, Division 22). As part of periodic review, in 1997 Deschutes County updated its Comprehensive Plan and implemented zoning regulations to comply with the state requirements. Terrebonne’s boundary was expanded to include the portion of the old Hillman Plat east of the railroad tracks. Additionally, at the request of Circle “C” Acres Subdivision residents, the boundary excluded their entire subdivision.

Population

Single-family residences are the predominant land use in Terrebonne. Tables 1, 2 and 3 cite Deschutes County Assessor data and an adopted twenty year population forecast to estimate Terrebonne’s 2009, 2030, and future build out population.

Table 1 - 2009 Terrebonne Population Estimate

Developed Residential Tax Lots *	Deschutes County Coordinated Population Forecast (Household Unit Size)	2009 Population Estimate
499	1.9	**948**
* Assessor Data 2009		

Table 2 - Terrebonne Projected Build Out

2009 Population Estimate	Potential Dwelling Units *	Deschutes County Coordinated Population Forecast (Household Unit Size)	Future Population Based on Undeveloped Lots	Build Out Population
948	322	1.9	**612**	**1,560**
* Assessor Data 2009 / Based on land divisions and the number units per acre allowed in each zone				

Table 3 - Terrebonne Population Forecast		
Year	2.2% Forecast	Average Annual Growth Rate *
2010	969	2.2%
2011	990	2.2%
2012	1,012	2.2%
2013	1,034	2.2%
2014	1,057	2.2%
2015	1,080	2.2%
2016	1,104	2.2%
2017	1,128	2.2%
2018	1,153	2.2%
2019	1,178	2.2%
2020	1,204	2.2%
2021	1,231	2.2%
2022	1,258	2.2%
2023	1,286	2.2%
2024	1,314	2.2%
2025	1,343	2.2%
2026	1,372	2.2%
2027	1,403	2.2%
2028	1,433	2.2%
2029	1,465	2.2%
2030	1,497	2.2%
2031	1,530	2.2%
2032	1,564	2.2%
2033	1,598	2.2%
County Population Forecast (Ordinance 2004-012)		

Terrebonne's population projection for 2030 is 1,497. As Table 2 illustrates, a vacant lands inventory performed in 2009 identified 322 undeveloped residential lots. If all 322 undeveloped lots develop and household unit size remains at 1.9, Terrebonne's population would increase by 612 people, bringing its total to 1,590. Under this scenario, Table 3 shows that full build out would occur in 2032.

Land Use Designations and Inventory

Deschutes County Comprehensive Plan designations illustrate general land uses for Terrebonne and provide the legal framework for establishing zoning districts. Zoning regulates land uses that are allowed in each respective district. Table 4 lists Terrebonne comprehensive plan designations and corresponding zoning districts, while Table 5 summarizes the existing land use inventory by district.

Table 4 - Terrebonne Land Use Designations

Comprehensive Plan Designations	Zoning Districts
Residential (TER)	Residential District (TER)
Residential 5 Acre Minimum (TER5)	Residential Five Acre Minimum District (TER5)
Commercial Business District (TECBD)	Commercial District (TEC)
Commercial Expansion Area (TECEA)	Residential District (TER)
Rural Commercial (TERC)	Commercial Rural District (TECR)

Table 5 - Terrebonne Land Use Inventory *

Zone	Residential Units	Commercial / Industrial Developments	Undeveloped Parcels	Total Number of Parcels
TEC	13	21	12	46
TECR	2	8	9	19
TER	502	9	199	694
TER5	38	1	1	39
Total	**555**	**39**	**221**	**798**

* Assessor Data 2009

Described below in greater detail are Terrebonne's Comprehensive Plan designations.

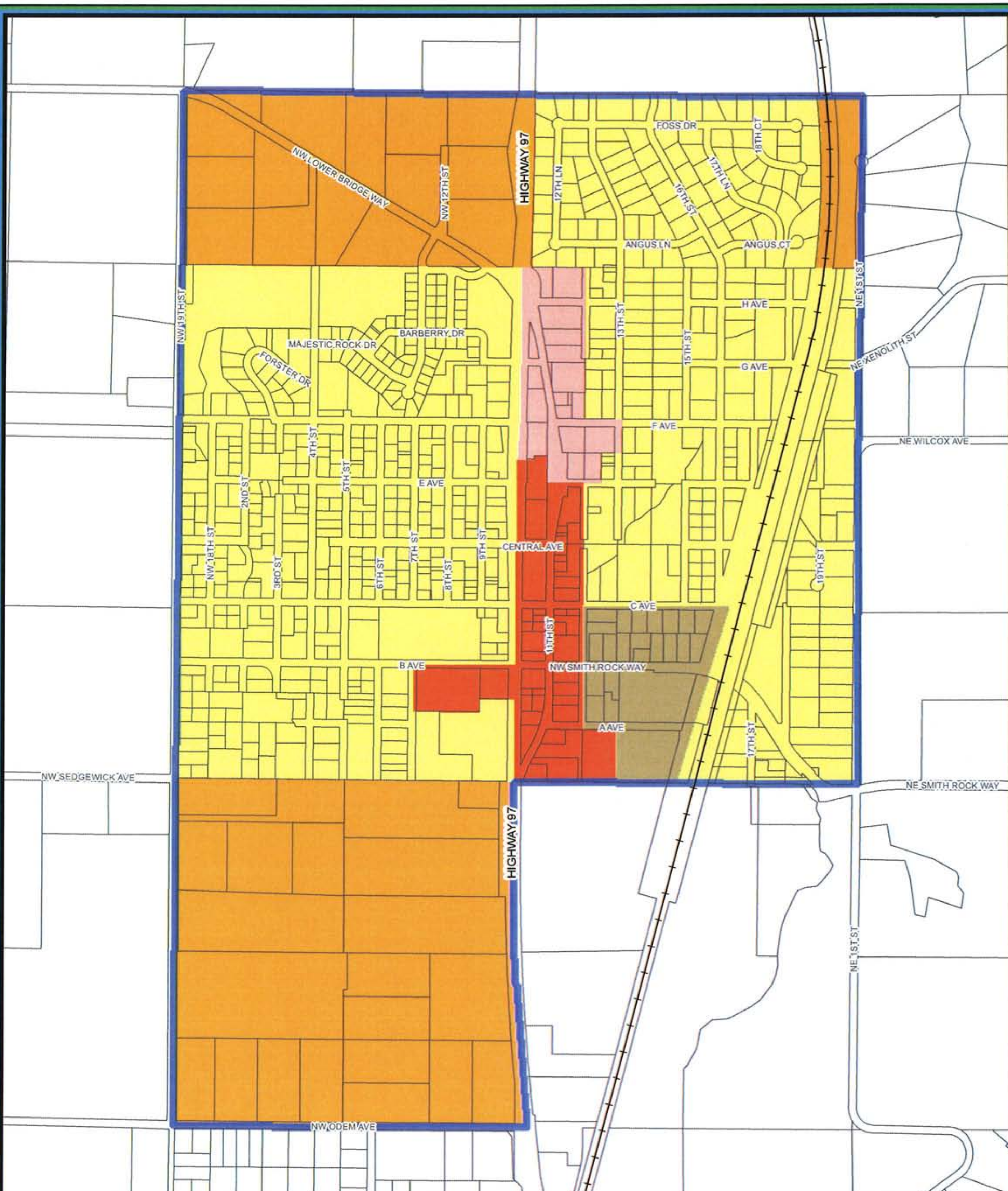
Residential: A "Residential" designation pertains to properties served by community water systems and encompass lots ranging from .5 to 5 acre. The designation corresponds with the boundary of the old Hillman Plat.

Residential 5 Acre Minimum: A "Residential 5 Acre Minimum" designation pertains to properties five acres or greater. These designations are located to the north and south of the Hillman Plat. They maintain the rural character of Terrebonne by retaining large lots in areas where community water is unavailable.

Commercial Business District: A "Commercial Business District" designation represent existing and non-conforming commercial uses located on the east side of U.S. 97, south of B Avenue near the U.S. 97 intersection, and both sides of 11th Street. The designation promotes pedestrian-friendly commercial centers, while discouraging highway strip-commercial development.

Commercial Expansion Area: A "Commercial Expansion Area" designation as name suggests, represents an area for future commercial center expansion. Located east of 11th Street, bound by C and A Avenues, it encourages a connected road network with pedestrian access, away from U.S. 97 to discourage strip-commercial development.

Rural Commercial: A "Rural Commercial" designation represents legal non-conforming, small-scale truck and heavy equipment uses, not generally compatible with a pedestrian-friendly commercial center. When this designation and corresponding zoning districts were applied during the 1997 Comprehensive Plan update, they provided existing businesses with an opportunity that did not exist before: opportunities to initiate site plan and conditional use permits for subsequent expansions or changes of use.



Terrebonne Comprehensive Plan

Legend

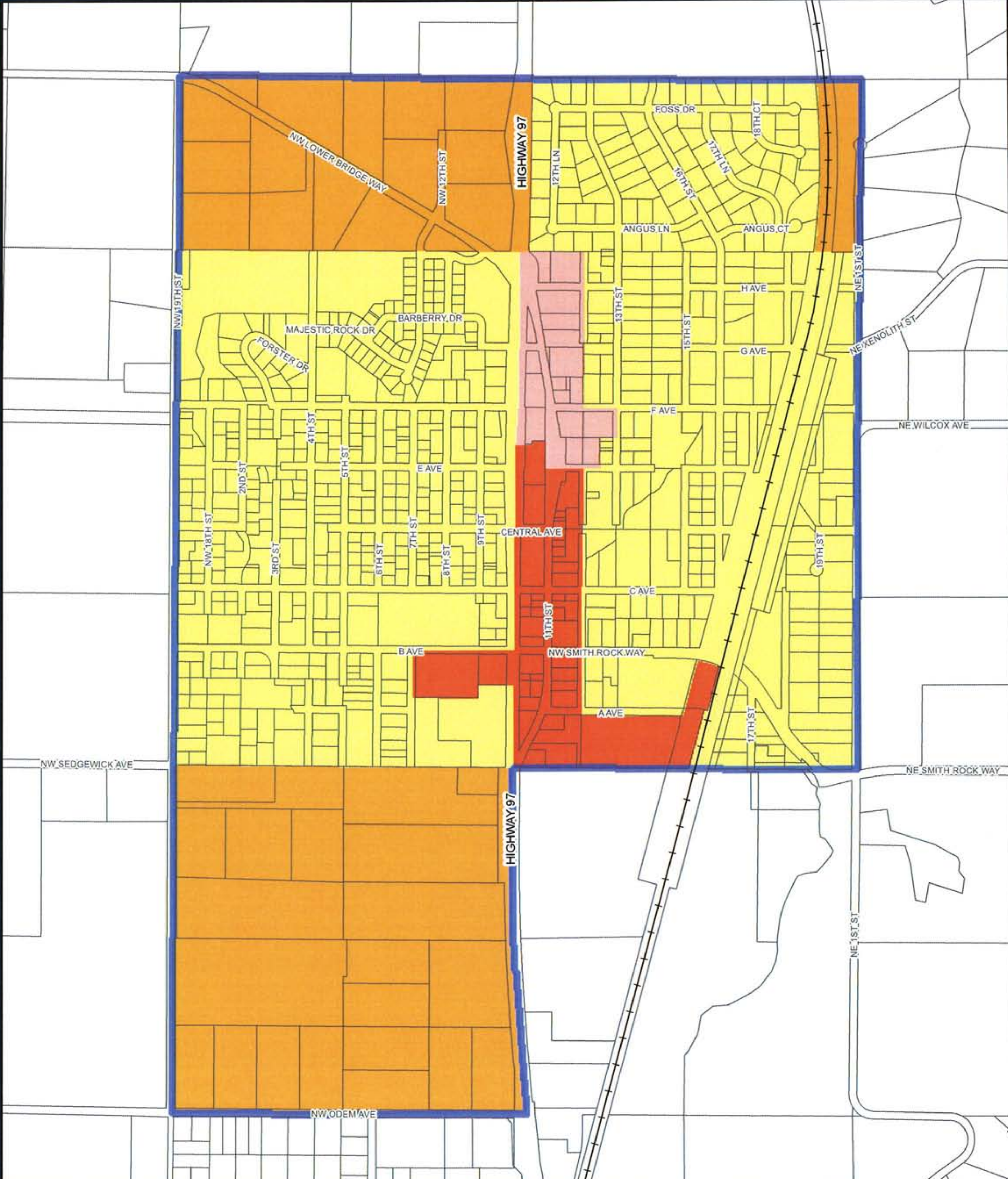
- TERC - Rural Commercial
- TECBD - Commercial Business District
- TECEA - Commercial Expansion Area
- TER - Residential
- TER5 - Residential 5 Acre Minimum

For More Information Contact:
Deschutes County Community Development Department
117 NW Lafayette Bend, OR 97701
541-388-6575 www.co.deschutes.or.us/cdd

0 250 500 1,000 Feet
1" = 1000 Feet

N:\Custom\County\CDD\Planning\CompPlanUpdate2008\OfficialMaps

November 12, 2009



Terrebonne Zoning

Legend

- TEC - Commercial
- TER - Residential
- TER5 - Residential 5 Ac. Minimum
- TECR - Commercial Rural

For More Information Contact:
Deschutes County Community Development Department
117 NW Lafayette Bend, OR 97701
541-388-6575 www.co.deschutes.or.us/cdd

0 250 500 1,000 Feet
1" = 1000 Feet

DISCLAIMER
The information on this map was derived from digital databases on Deschutes County's G.I.S. Care was taken in the creation of this map, but it is provided "as is". Deschutes County cannot accept any responsibility for errors, omissions, or positional accuracy in the digital data or the underlying records. There are no warranties, express or implied, including the warranty of merchantability or fitness for a particular purpose, accompanying this product. However, notification of any errors will be appreciated.

N:\Custom\County\CDD\Planning\CompPlanUpdate2008\OfficialMaps

November 12, 2009

Public Facilities and Services

Terrebonne is served by four special districts: 1) Terrebonne Domestic Water District; 2) Deschutes County Rural Fire Protection District #1; 3) Redmond School District; and, 4) Central Oregon Irrigation District. Terrebonne public facilities and services are described below in greater detail.

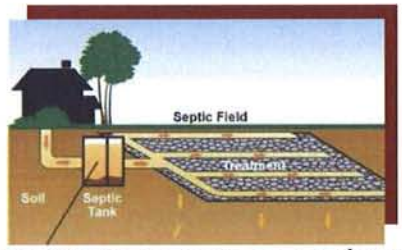
Domestic Water

The Terrebonne Domestic Water District (Water District) is a municipal corporation that currently serves approximately 525 residences and 25 businesses located in the densely populated areas of Terrebonne, including the old Hillman Plat and Angus Acres Subdivision. The Water District currently utilizes three wells. Groundwater beneath Terrebonne does not currently exceed U.S. Environmental Protection Agency maximum contaminant limits. The Oregon Public Health Division and Deschutes County therefore do not require the Water District to treat its water supply. The Water District is however, required to purchase groundwater mitigation credits for its water supply because the Oregon Water Resources Department identifies Terrebonne as a groundwater critical area.

Deschutes County and the Water District have a strong track record for coordinating land use. Last decade, the Water District's board of directors recognized the importance of improving their antiquated water system both for fire protection and domestic use. State law requires that Deschutes County enter into an agreement with the Water District for coordinated review and administration of land use in the their service area (OAR Chapter 660-22, Unincorporated Communities). Deschutes County approved a Community Development Block Grant and state technical assistance grant with the Water District's support in 1993 to develop an updated water system master plan for a 25-year planning horizon. The Water District, with assistance from Deschutes County also received an Oregon Economic Development grant in 1997 to construct priority one improvements to their water system. Two years later the Water District received a loan package to construct further improvements.

Terrebonne residents living outside the Water District rely on private domestic wells for drinking water. State law, ORS 537.54 exempts private wells as long as domestic consumption is less than 15,000 gallons per day and irrigation of a lawn or noncommercial garden is less than one-half acre.

Wastewater



With the exception of Angus Acres and Terrebonne Estates Subdivisions, which are served by community wastewater treatment facilities, Terrebonne residents and businesses rely on onsite wastewater treatment systems. However, certain areas near the Hillman Plat rest on a rocky plateau, making onsite systems inoperable. The soils are shallow – most no deeper than 18 inches – such that a standard septic system becomes infeasible. Alternative systems and advanced onsite treatment systems in these circumstances are necessary for building additions or new development. A few properties in Terrebonne also do not meet the requirements for an onsite system because they are too small, under a 0.5 acre or contain rapidly draining soils. As a result these tax lots cannot be developed or redeveloped. Deschutes County's Comprehensive Plan and zoning regulations restrict the type and intensity of allowed uses to those that can be served by an approved onsite wastewater treatment system. State and County zoning regulations set minimum lot sizes to ensure that onsite systems do not exceed the capacity of the land.

The Water District did receive a grant from the Central Oregon Rural Investment Fund to complete a sewer feasibility study in 1999. The Water District however, never implemented the study due to lack of funding. To date, Terrebonne residents have not reached consensus about the need for a sewer system. While some citizens recognize its importance, both to protect public health and water quality, and to allow development at desired densities, others express an unwillingness to pay for the added cost of operating and maintaining a centralized wastewater treatment system.

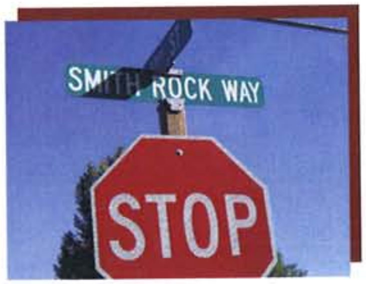
Emergency Services

The Deschutes County Rural Fire Protection District #1 (Fire District) contracts with the City of Redmond for fire suppression and emergency medical services. This is a healthy partnership, which allows both entities to provide services beyond what would be accomplished independently. Station 402 is located on C Avenue in Terrebonne. All Fire District career staff maintain a paramedic level certification. Each fire or ambulance response is staffed by paramedics, who provide advanced life support care and transport.

Irrigation Water

Established in 1918, the Central Oregon Irrigation District (COID) is a municipal corporation of the State of Oregon. The Pilot Butte Canal, one of COID's two, runs north, through Bend, Redmond and Terrebonne. Approximately 83 patrons, residents in Terrebonne owning and receiving irrigated water from COID, irrigate a total of 154.64 acres spanning 83 tax lots.

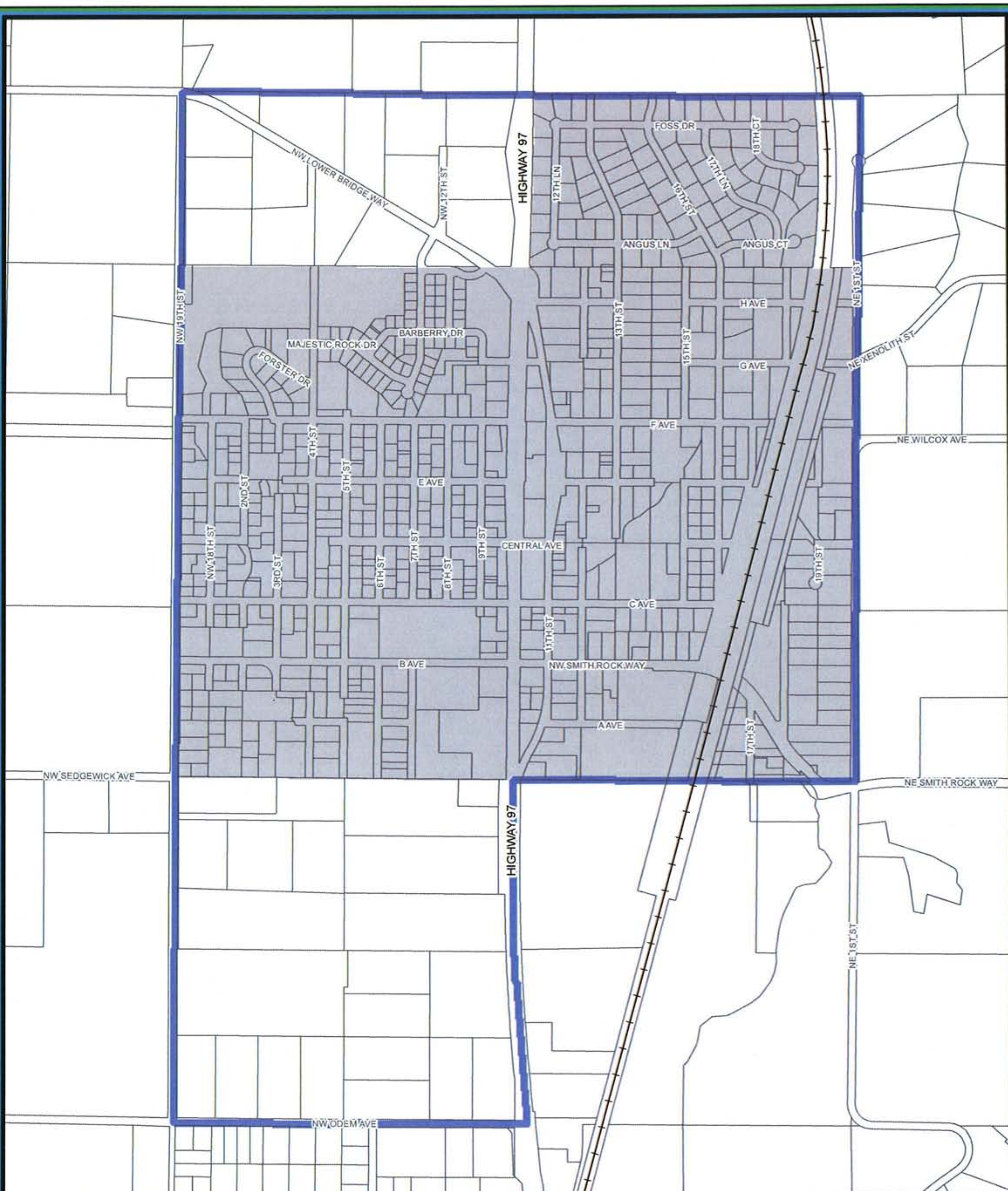
Transportation



Terrebonne depends on the ability of the local and state transportation system to provide safe access to residential and commercial areas and the Terrebonne Community School, while maintaining an efficient regional route carrying travelers and freight through the Central Oregon region. U.S. 97 in Terrebonne contains two travel lanes and a center turn lane with adjoining sidewalks. The other major east-west roads are Smith Rock Way, a County arterial which runs east from U.S. 97 at the south end of town, and Lower Bridge Way, a County arterial which extends to the west of U.S. 97 at the north end of town. For north-south travel there is 19th Street, a County collector on the western edge of Terrebonne, and 11th Street, which parallels U.S. 97 a block to the east of the highway. Within the community, there are a mix of paved and unpaved streets. In 2008, average daily traffic (ADT) counts measured the following vehicles:

- A Avenue and U.S. 97 recorded 16,600 ADT;
- U.S. 97 at the Jefferson and Deschutes County line recorded 12,500 ADT;
- North of O'Neil Highway recorded 8,500 ADT;
- Lower Bridge Way, just west of U.S. 97 recorded 5,288 ADT; and,
- Smith Rock Way jus west of the railroad tracks, recorded 2,373 ADT.

To protect the function of a highway, it is often necessary to limit access and control turning movements. Access control, which normally limits the number of driveways to a state highway, reduces the conflict points where vehicles turning or passing through can collide. By redirecting property access to side streets or alleys, the number of crashes on the highway can be lowered. Implementing additional measures such as traffic calming, improved pedestrian crossings, or reducing the travel speed on the highway can benefit an entire community.



Terrebonne Domestic Water District

For More Information Contact:
Deschutes County Community Development Department
117 NW Lafayette Bend, OR 97701
541-388-6575 www.co.deschutes.or.us/cdd

Legend

Unincorporated Community Boundary
Terrebonne Domestic Water District

0 250 500 1,000 Feet
1" = 1000 Feet

DISCLAIMER
The information on this map was derived from digital databases on Deschutes County's G.I.S. Care was taken in the creation of this map, but it is provided "as is". Deschutes County cannot accept any responsibility for errors, omissions, or positional accuracy in the digital data or the underlying records. There are no warranties, express or implied, including the warranty of merchantability or fitness for a particular purpose, accompanying this product. However, notification of any errors will be appreciated.

N:\Custom\County\CDD\Planning\CompPlanUpdate2008\CommunityPlans\Terrebonne

November 17, 2009

Surrounding Land Use

Residents outside of Terrebonne identify with the community because it is where many certain buy goods and services, send their children to Terrebonne Community School, or attend church. The following Comprehensive Plan designations and related zone districts are within a mile of Terrebonne.

Agriculture

An "Agricultural" designation and EFU zone protects farmlands lands in Deschutes County pursuant to Statewide Planning Goal 3 (Agricultural Lands). As discussed in the Agricultural Lands Section of the Comprehensive Plan, protecting agriculture is one of the primary goals of the Oregon land use system. When the County Comprehensive Plan was first adopted in 1979, there was general consensus for its agricultural goal.

> *"To preserve agricultural land in Deschutes County for the production of farm and forestry products, as well as the public need for open space."*

In 1992, Deschutes County completed a farm study report. The purpose of the study was to ensure that EFU zoning and standards for farm divisions and dwellings were consistent with Goal 3 and relevant administrative rules. The study found that farms in Deschutes County usually contain a mix of irrigated and non-irrigated land, as well as a soils from different classes. The study identified seven agricultural subzones with one near Terrebonne. For each subzone, standards determine minimum parcel sizes for farm divisions to protect the commercial agricultural land base. The subzone that is immediately adjacent to Terrebonne is the EFU - Terrebonne subzone (EFUTE). The minimum acreage for this subzone is 35 irrigated acres. Refer to the Agricultural Lands section of the Comprehensive Plan for more details about agricultural land in Deschutes County.

Rural Residential

A "Rural Residential Exception Area" designation and corresponding Multiple Use Agriculture (MUA-10) and Rural Residential (RR-10) zones applies to lands for which Deschutes County justified an "exception" to Statewide Planning Goal 3 (Agricultural Land). MUA-10 applies to agricultural lands that have been demonstrated to be unsuitable for commercial farming but retain enough agricultural practices that are compatible with rural development. The minimum lot size for new subdivisions in this zoning district is ten acres. Although Terrebonne does not include this zoning district, three MUA-10 subdivisions are within a mile of the boundary. The RR-10 zone is intended to provide areas for residential use in a rural context along with other compatible uses. This zone is directly south of Terrebonne and applies to the Circle "C" Subdivision. The minimum lot size for new subdivisions in this zoning district is ten acres, but all existing lots near Terrebonne are much smaller. Therefore, no additional subdivisions are possible. A number of residents in this subdivision and within Terrebonne believe that maintaining the larger parcel sizes helps create the rural atmosphere they value.

Community Input

Community Planning Process

At the request of the Deschutes County Board of Commissioners, the Community Development Department in 2008 engaged Terrebonne residents in the Comprehensive Plan Update process. Staff began that process in the fall, with the first of four community meetings in Terrebonne. These meetings provided opportunities to meet with residents and stakeholders, answer questions, and explain Oregon land use planning and Deschutes County's existing Comprehensive Plan. In February 2009 at the second meeting, staff asked residents if they supported the creation of a Community Plan and if so, to describe their land use values and expectations for the area. They introduced the following issues:

- Piecemeal development is not furthering the community's overall rural values;
- Continue preserving agricultural lands near Terrebonne;
- Maintain Terrebonne's rural character;
- Water and sewer limitations affect the community's ability to accommodate growth;
- Allow commercial upzoning on the west side of U.S. 97;
- Create a park in Terrebonne;
- Expand Terrebonne's community boundary to include an adjacent residential area; and
- Consider several transportation alternatives to accommodate traffic volumes and promote vehicle safety for U.S. 97, including a traffic signal, a couplet for south and north bound traffic, a grade separation interchange near Lower Bridge Way or a bypass to the east.

A stakeholder group of Terrebonne residents was subsequently established in Spring 2009 to discuss with staff a Community Plan that would encompass land use opportunities over the next twenty years. This group met three times. The purpose was to strategize the format of future community meetings and discuss existing conditions, alternatives for the area and community sentiment. These meetings were beneficial to staff for ultimately presenting growth related options to Terrebonne residents and business owners.

The issues highlighted above were discussed in small groups during a Fall 2009 community meeting, using several different planning stations. Each station allowed area residents and business owners to ask questions and share ideas or insights. Participants could place a dot on a board showing their preferred land use option, and fill out a questionnaire that most reflected their values for Terrebonne over next 20 years. The outcome of these public involvement techniques revealed, qualitatively, an overwhelming desire for little or no change in Terrebonne.

The basis for developing goals and policies cited in this Community Plan are now described below in greater detail. Planning for growth and preparing for its impact represents the best course of action to maintain the unique rural character of Terrebonne.

Community Character and Features

Agricultural activity and open spaces define Terrebonne. Residents clearly stated the importance of maintaining the area's agricultural land base and open spaces. The Community Plan emphasizes the importance of protecting natural features such as ridgelines, and views of the Cascade Mountains and Smith Rock State Park, while supporting opportunities for rural development.

Residential Development

Residential development is likely to increase in Terrebonne over the next twenty years due to Central Oregon's reputation as a desirable place to live and conduct business. While residents expressed concerns that new development could change the rural character of Terrebonne, planning for housing and infrastructure will enable the community to understand its costs and respond proactively to changing circumstances. Land use planning implemented through Deschutes County policies and zoning will enable residents, stakeholders, and property owners to integrate the large number of vacant residential lots into the community.

Commercial Development

Terrebonne residents support locally owned businesses and share a common value that future commercial development be modest in scale, incorporating exterior designs used by newer businesses adjoining U.S. 97. Based on a 2009 buildable land inventory, at the present time there is not a need for additional commercial or light industrial land. Of the 84 commercially zoned properties in Terrebonne, just 49 are developed. Thirty of the 49 developed lots contain single family dwellings. Single family dwellings existing on June 4, 1997 are a permitted use in Terrebonne's two commercial zones. Lastly, while legal nonconforming commercial uses located in a residential zone straddle the west side of U.S. 97, there is support to ensure that Deschutes County's comprehensive plan designation and zoning accurately reflects the current land use.

Recreational Development

Terrebonne residents support recreational programs for all age groups including seniors and school-aged children. Creating Terrebonne's first community park including ball fields and play structures is important and would be an extraordinary asset. While some expressed a desire to rezone residential lands along the west side of U.S. 97 to commercial, others support the concept of redesignating those properties for a greenway.

Traffic and Circulation

As noted earlier, the transportation system in Terrebonne is dominated by U.S. 97, a state highway that bisects the commercial core of town. Traffic is a major issue for Terrebonne residents because the highway traffic volume creates unsafe pedestrian areas and long delays for vehicles entering U.S. 97 from the side streets, especially turning north from Lower Bridge Way or south from Smith Rock Way. Deschutes County and ODOT are currently working to address the needs of Terrebonne to maintain safe and convenient uses of the transportation system. A 2009 paving project by ODOT added sidewalks and bike lanes to U.S. 97 and sidewalks on the north side of B Avenue leading to the Terrebonne Community School.

Regarding county roads, residents expressed concerns about vehicle speeds, particularly on 19th Street and Smith Rock Way. Additionally there are challenges associated with the lack of paved streets, secondary access for Crooked River Ranch, and poor sightlines at 19th, 31st, and 43rd streets, where they intersect Lower Bridge Way. The list below further summarizes Terrebonne's transportation issues:

Local road network:

- Maintain existing roads;
- Provide sidewalks only where they are warranted for safety; and,
- Protect utility trenches located in the public right-of-way from damage by tree roots.

Appropriate local road standards:

- Provide transportation facilities that are practical and cost effective to construct, use and maintain.

U.S. 97 corridor:

- Slow traffic on U.S. 97;
- Provide safe, convenient pedestrian crossings on the highway near the school;
- Reduce misuse of the center turn lane; and,
- Redesign U.S. 97 intersections to balance the needs of truck and pedestrian traffic, particularly at the "B" Avenue, "C" Avenue and 11th Street intersections.

Goals and Policies

The following goals and policies were developed from community and stakeholder meetings, and input from ODOT and the Oregon Department of Land Conservation and Development. Staff also revisited Deschutes County's existing Comprehensive and Transportation System Plans, as well as applicable state law and administrative rules.

Land Use Goal

Preserve open space, natural features and rural character of the Terrebonne Community.

Land Use Policies

1. Conform land use regulations with the requirements of OAR Chapter 660, Division 22, Unincorporated Communities or its successor.
2. Allow the current pattern of development based on the existing zoning that maintains the rural character of the area.
3. Allow residential uses in all zoning districts in Terrebonne.
4. Encourage the preservation of Terrebonne's historical structures: Ladies Pioneer Club (1911), Oregon Trunk Railroad Depot (1911) and Grange Hall (1925).
5. Maintain the existing unincorporated community boundary for Terrebonne.
6. Review Community Plan goal and policies every five years to determine if conditions and circumstances in Terrebonne still meet the current and future needs of its residents and businesses.

Residential Area Policies

7. Designate residential districts on the zoning map for areas designated residential on the comprehensive plan map.
8. Plan and zone for a diversity of housing types and densities suited to the capacity of the land to accommodate water and sewer facilities.
9. Maintain the rural character of the community by retaining large lots where community water and sewer are not available for land designated Residential—5-Acre Minimum.
10. Permit livestock in residential districts subject to use limitations identified in Deschutes County Code Title 18.

Commercial Area Policies

11. Allow small-scale, low-impact commercial and industrial uses in conformance with the requirements of OAR Chapter 660, Division 22, and larger commercial uses, if such uses are intended to serve the community, surrounding rural area or travel needs of people passing through the area.

12. Prohibit industrial uses from dominating the character of the commercial districts.

13. Encourage new development in the commercial districts to become compatible with the rural character of the community by using design standards.

14. Prohibit access to be taken from U.S. 97 when there is an option to use a local road.

15. Structure approval standards for conditional uses in the Commercial Rural District to consider the impact on nearby residential and commercial uses, transportation systems, and other public facilities and services.

16. Allow stand-alone residential uses or residences in conjunction with uses listed in the commercial districts as long as they do not dominate or set development standards for other uses in the area.

17. Prohibit land divisions or replatting for residential purposes in the commercial districts.

18. Prohibit livestock in the commercial districts.

Commercial Expansion Area Policies

19. Support applicant-initiated commercial plan designation and rezoning applications for properties fronting U.S. 97 between B and Central Avenues to expand commercial uses on the west side of U.S. 97 if all of the following characteristics are met.

    a. A home occupation or commercial use existed prior to the adoption date of this plan;

    b. Frontage existed on U.S. 97 prior to the adoption date of this plan; and

    c. ODOT grants access or there is alternative access to a public maintained road.

20. Expand commercial designations only to the Commercial Expansion Area designated on the Terrebonne Comprehensive Plan map, except under the circumstances described in Policy 19.

21. Rezone the Commercial Expansion Area from a residential district to a commercial district only if no commercially zoned land can reasonable accommodate the proposed use. Rezoning may be done without a plan amendment. An applicant for a zone change must demonstrate that:

    a. Road right-of-way improvements and public water facilities to the property are in place or will be in place when the development occurs; or

    b. Road right of way improvements and public water facilities to the property are under construction when a permit is issued; or

    c. Road right of way improvements and public water facilities to the property have been in a local government or special district budget.

    These standards apply in place of the County standards for rezoning contained in Title 18, section 18.136.020 of the Deschutes County Code.

Public Facilities Goal

Ensure water and sewage treatment systems encompass the appropriate scale and cost.

General Public Facility Planning policies

1. Determine residential minimum lot sizes by the capacity of the land to accommodate available water and wastewater facilities.
2. Encourage early planning and acquisition of sites needed for public facilities, including schools, roads and water facilities.

Water Facility Policies

3. The Terrebonne Domestic Water District 1995 Water System Master Plan serves as the public facility plan for water supply in Terrebonne.
4. All commercial development or development including a sprinkler system shall be reviewed by the Terrebonne Domestic Water District.
5. Development requiring land use approval, located in the Terrebonne Domestic Water District service area shall be approved only upon confirmation from the District that the they can provide water to the property.
6. Support improvement of the community water system to meet health and safety needs of Terrebonne residents.
7. Maintain a coordination agreement, consistent with ORS Chapter 195 and OAR 660-22-050(2)(c) for Deschutes County and the Terrebonne Domestic Water District.
8. Encourage all development in the Terrebonne Domestic Water District service area to connect to their water system.

Sewer Facility Policies

9. Allow uses and densities that can be served by an approved on-site wastewater treatment system, until such time as a community sewer system is available.
10. Set minimum lot sizes adequate to ensure that on-site systems do not exceed the capacity of the land, until such a time as a community sewer system is available.
11. Support replatting Hillman Plat lots to create lots large enough to accommodate an approved on-site wastewater treatment system.
12. Help identify funding for a sewer feasibility study.
13. Support the development of a community sewer system if needed to protect public health.
14. Review Community Plan policies related to public services if a sewer system is proposed.

Transportation Goal

Provide a safe and efficient system for all modes of transportation.

Road Network Policies

1. Provide a transportation network that can accommodate local traffic, commuter traffic and regional interstate traffic without detracting from the livability and rural character of Terrebonne.
2. Provide a transportation network that will improve transportation efficiency, convenience and safety, as well as increase transportation choices and decrease conflicts between modes of transportation.
3. Preserve alignments for transportation corridors depicted in the Transportation System Plan for future transportation purposes. The precise alignments will be determined after further study and engineering analysis or during the development of vacant properties.
4. Where they exist, new roads shall take advantage of existing public right-of-way.
5. Preserve existing right-of-way unless a new road cannot be physically constructed, in which case the County will consider vacating the right-of-way.
6. Monitor and enforce vehicle weight limits on 11th Street and Smith Rock Way.
7. Identify and select in the Transportation System Plan, a long-term solution for U.S. 97 from the following options: a traffic signal, a couplet, a grade-separated interchange, or a bypass.

Sidewalk and Bicycle Facility Policies

8. Provide sidewalks that are in keeping with the rural character of the community and will be built property tight.
9. Where sidewalks are specified along County public roads, they shall be constructed without curbs and gutters, set back from the road surface behind a drainage swale at a distance from property lines to allow room for utilities.
10. Construct sidewalks identified on the TSP Map either at the time of development, subject to site plan review, or later through formation of a local improvement district (LID). Applicants electing to defer constructing sidewalks shall be required to submit and record in the County Clerk's office a waiver of remonstrance, signed by the land owner. The waiver shall relinquish the landowner's right to have his/her objection count against the formation of an LID.
11. Protect from damage by tree roots, utility trenches located in the public right-of-way.
12. Where they conflict with existing or planned utility trenches, street trees should not be planted in the public right-of-way.
13. Share the road with automobiles and bicycles on local roads where traffic volumes and speeds are low.

14. Accommodate bicycles on paved shoulder bikeways on Lower Bridge Way and Smith Rock Way, a County arterial and collector road that carries high traffic volumes.

Road Development Standards Policies

15. Provide transportation facilities that are practical and cost effective to construct, use and maintain and in keeping with the rural character of Terrebonne.
16. Implement road development standards for Terrebonne that minimize pavement width and are consistent with the operational needs of the transportation facility.
17. Specific road, bicycle and pedestrian facility improvement projects for the Terrebonne community are listed and described in the TSP respectively. The projects are ranked high, medium and low priority based on perceived need. These priorities shall be flexible to take advantage of development opportunities and funding.

U.S. 97 Corridor Policies

18. Work with ODOT and the community to increase safety on U.S. 97 in Terrebonne by using a combination of enforcement and traffic calming techniques to slow traffic to posted speeds, to safely handle local traffic and to improve pedestrian crossings.
19. Work with ODOT to provide improved pedestrian crossings on U.S. 97, between Central Avenue and the south 11th Street intersection, particularly at the "B" Avenue and "C" Avenue intersections, to increase pedestrian safety in the vicinity of the school.
20. Work with ODOT and the community to evaluate the safety and functionality of 11th Street as needed.
21. Support limiting U.S. 97 to no more than three lanes between the Central Avenue and south 11th Street intersections.
22. Accommodate large trucks with wide turning radius corners where necessary, as determined by truck routes established by TSP, thereby minimizing corner radii at all other intersections. Other design features such as rolled curbs or medians shall be used as necessary to minimally accommodate large trucks in the Terrebonne community.
23. Coordinate with ODOT on improvements to U.S. 97 during rehabilitation or construction projects.

Appendix B

Deschutes County Community Development Septic Memo

This page intentionally left blank.

Deschutes County
Community Development Department
Planning Building Safety Environmental Soils Code Enforcement
P.O. Box 6005 117 NW Lafayette Ave., Bend, OR 97703
Telephone: 541-388-6575
www.deschutes.org/cd

MEMORANDUM

TO: Board of County Commissioners

FROM: Nick Lelack, AICP, Director
Chris Doty, PE, Road Dept. Director
Todd Cleveland, Environmental Health Supervisor

DATE: August 19, 2019

SUBJECT: 1999 Terrebonne Sewer Feasibility Study, Existing Conditions, Public Engagement

---

The purposes of this memorandum are to summarize the:

- 1999 Terrebonne Sewer Feasibility Study (attached);
- Reasons, if known, the study was not implemented;
- Vacant lands and current issues; and
- Options to engage the public to determine community support to initiate a new or updated study.

<u>1999 Terrebonne Sewer Feasibility Study Basic Findings & Staff Perspectives</u>

Please see the attached memorandum from Chris Doty, Road Dept. Director.

<u>Reasons the Study was not Implemented</u>

Based on conversations with CDD's former Environmental Health Director and others, there was overwhelming community opposition primarily due to the costs and lack of risk to the water system.

<u>Existing Conditions: Vacant Lands, Septic System Failures/Repairs & Future Concerns</u>

The attached map and matrix below summarize vacant lands and existing private sewer systems in Terrebonne as of June 2019. Many of the vacant properties appear to be too small to install an on-site septic system, especially with required reserve space for future repairs and/or replacements.

The vacant lands map also shows the boundaries of two private sewer districts for Terrebonne Estates and Angus Acres. These sewer districts were required to develop residential lots in areas not suitable for septic systems per Oregon Administrative Rules regulating septic systems.

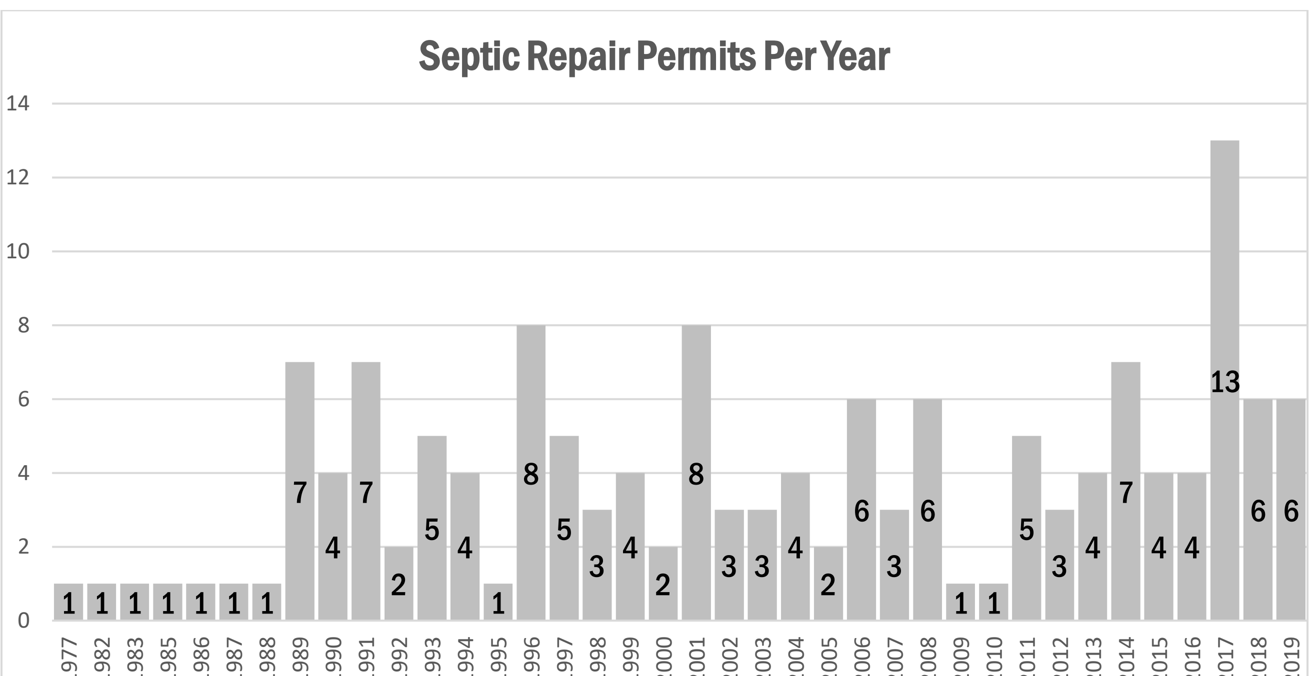
Table 1: Land Use Inventory

Terrebonne Land Use Inventory				
Zone	**Residential Units**	**Commercial / Industrial Developments**	**Undeveloped Parcels**	**Total Number of Parcels**
TEC (Commercial)	16	18	18	49
TECR (Commerical Rural)	3	9	10	18
TER (Residential)	556	5	160	686
TER5 (Residential 5-Acre)	40	1	1	40
Total	**615**	**33**	**189**	**793**

Table 2 below provides the Community Development Department Environmental Soils Division's number of septic system major repairs per year from 1997 through the first seven months of 2019. The table does not include repairs of larger on-site wastewater systems permitted by the Department of Environmental Quality (DEQ).

According to Division staff, the number of malfunctioning systems appears to be increasing requiring repairs as well as inquiries from residents and businesses regarding malfunctioning systems, development limitations, and overall aging systems that will require future repairs, if possible, and/or replacements, if possible. The biggest concern is that commercial properties will experience catastrophic failures of systems that cannot be repaired or replaced.

Table 2: Septic System Repairs



Public Engagement Options

Options to gauge Terrebonne community interest in updating the Sewer Feasibility Study include, but are not limited to, the following – which may be conducted by the County, Terrebonne residents/businesses, and/or other organizations:

1. Conduct stakeholder interviews and focus groups with selected residents and groups (i.e., businesses, home owner associations); and/or
2. Hire a firm to conduct a survey of residents and businesses; and/or
3. Hold a town hall to briefly present basic information and invite public input; and/or
4. All of the above;
5. Some of the above; or
6. Other.

If the Board supports any of these options, staff will:

- Prepare a scope, schedule, and budget/resources (staff time, budget) necessary to perform the tasks and prepare a report of the community input findings; and/or

- Contact Terrebonne residents/businesses and/or other organizations who might perform one or more of these public engagement and reporting tasks.

This page intentionally left blank.

Appendix C

Soil Report – NRCS/USDA

This page intentionally left blank.

United States Department of Agriculture

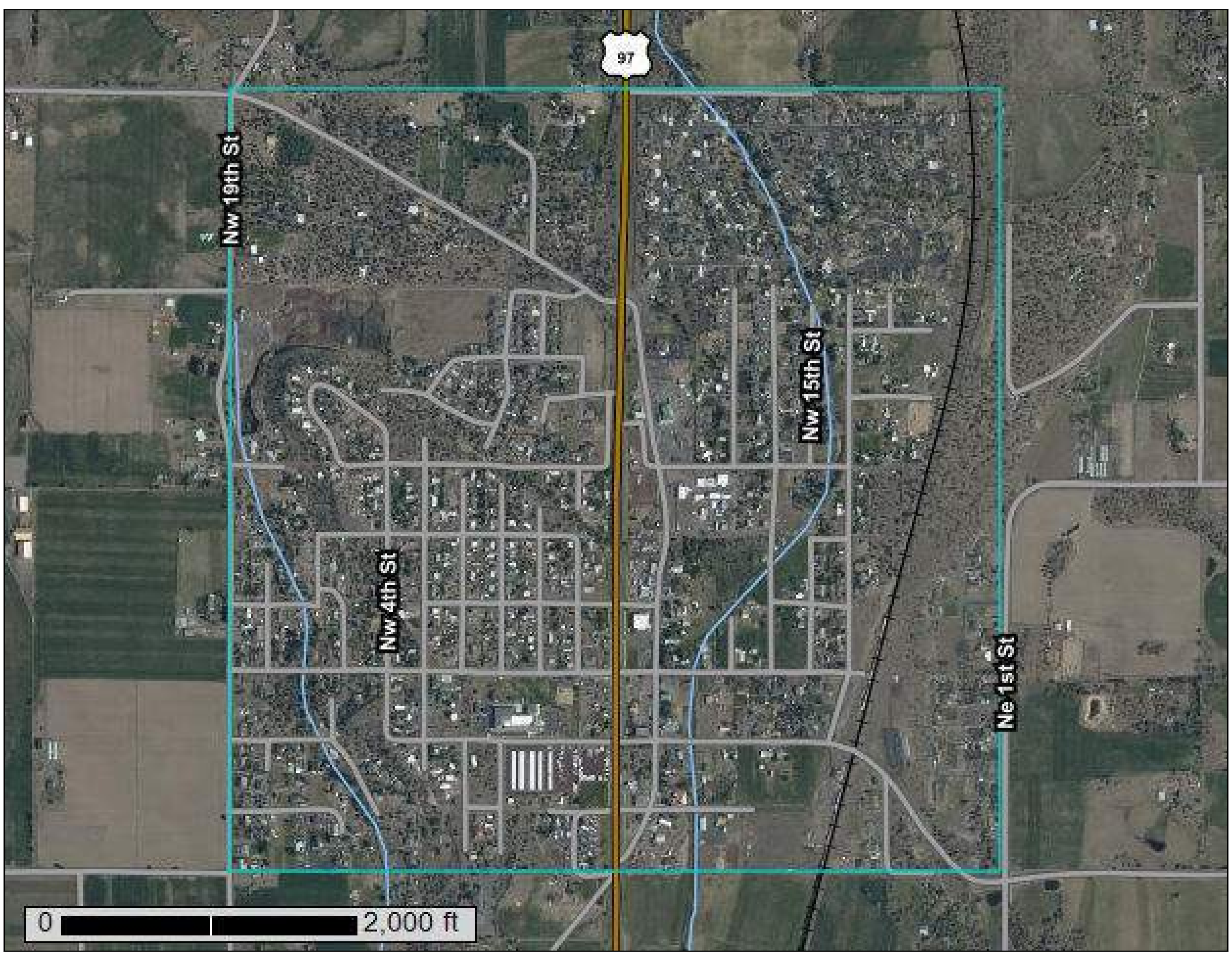
NRCS

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 Upper Deschutes River Area, Oregon, Parts of Deschutes, Jefferson, and Klamath Counties

Terrebonne Soils

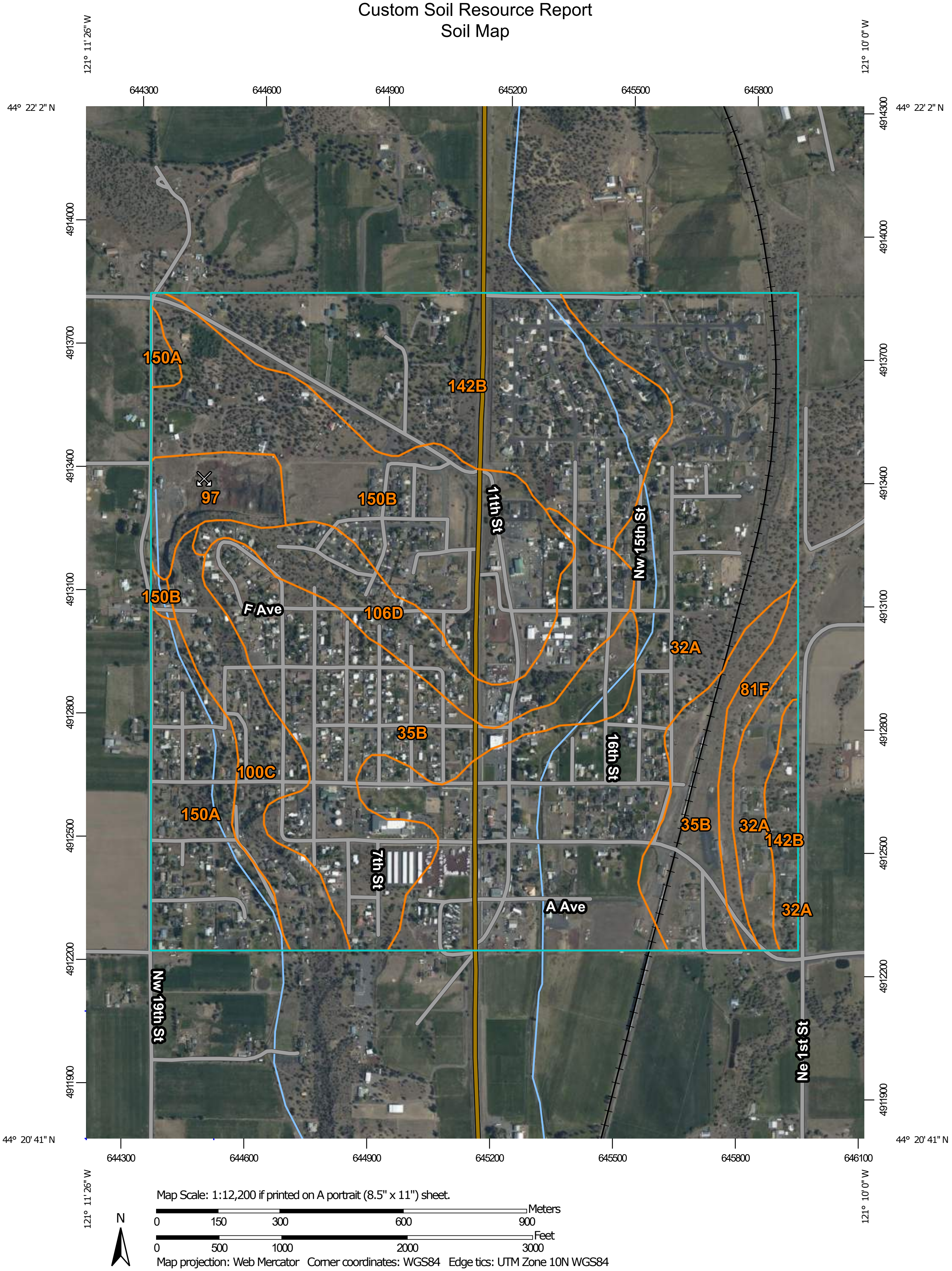


July 7, 2021

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


121° 11' 26" W
121° 10' 0" W
44° 22' 2" N
44° 20' 41" N
644300
644600
644900
645200
645500
645800
646100
4914300
4914000
4913700
4913400
4913100
4912800
4912500
4912200
4911900
150A
142B
97
150B
11th St
Nw 15th St
150B
F Ave
106D
32A
81F
35B
16th St
100C
150A
35B
32A
142B
7th St
A Ave
32A
Nw 19th St
Ne 1st St
Map Scale: 1:12,200 if printed on A portrait (8.5" x 11") sheet.
Meters
0 150 300 600 900
Feet
0 500 1000 2000 3000
N
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: Upper Deschutes River Area, Oregon, Parts of Deschutes, Jefferson, and Klamath Counties
Survey Area Data: Version 17, Sep 14, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 7, 2020—Jun 2, 2020

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

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
32A	Deschutes sandy loam, dry, 0 to 3 percent slopes	184.7	29.5%
35B	Deschutes-Stukel complex, dry, 0 to 8 percent slope	109.0	17.4%
81F	Lickskillet-Rock outcrop complex, 45 to 80 percent slopes	10.1	1.6%
97	Pits	15.5	2.5%
100C	Redcliff-Lickskillet complex, 0 to 15 percent slopes	31.0	4.9%
106D	Redslide-Lickskillet complex, 15 to 30 percent north slopes	40.1	6.4%
142B	Stukel-Rock outcrop-Deschutes complex, dry, 0 to 8 percent slopes	105.2	16.8%
150A	Tetherow sandy loam, 0 to 3 percent slopes	43.6	6.9%
150B	Tetherow sandy loam, 3 to 8 percent slopes	87.9	14.0%
Totals for Area of Interest		**627.2**	**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.

Upper Deschutes River Area, Oregon, Parts of Deschutes, Jefferson, and Klamath Counties

32A—Deschutes sandy loam, dry, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 246j
Elevation: 2,500 to 4,000 feet
Mean annual precipitation: 8 to 10 inches
Mean annual air temperature: 49 to 52 degrees F
Frost-free period: 80 to 100 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Deschutes, dry, and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Deschutes, Dry

Setting

Landform: Lava plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Volcanic ash over basalt

Typical profile

H1 - 0 to 7 inches: sandy loam
H2 - 7 to 17 inches: sandy loam
H3 - 17 to 31 inches: sandy loam
H4 - 31 to 41 inches: unweathered bedrock

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Available water capacity: Low (about 3.7 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: B
Ecological site: R010XA027OR - JUNIPER PUMICE FLAT 8-10 PZ
Hydric soil rating: No

35B—Deschutes-Stukel complex, dry, 0 to 8 percent slope

Map Unit Setting

National map unit symbol: 246x
Elevation: 2,500 to 4,000 feet
Mean annual precipitation: 8 to 10 inches
Mean annual air temperature: 49 to 52 degrees F
Frost-free period: 80 to 100 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Deschutes, dry, and similar soils: 50 percent
Stukel, dry, and similar soils: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Deschutes, Dry

Setting

Landform: Lava plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Volcanic ash over basalt

Typical profile

H1 - 0 to 7 inches: sandy loam
H2 - 7 to 17 inches: sandy loam
H3 - 17 to 31 inches: sandy loam
H4 - 31 to 41 inches: unweathered bedrock

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Available water capacity: Low (about 3.7 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: R010XA027OR - JUNIPER PUMICE FLAT 8-10 PZ
Hydric soil rating: No

Description of Stukel, Dry

Setting

Landform: Lava plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Volcanic ash over basalt

Typical profile

H1 - 0 to 4 inches: sandy loam
H2 - 4 to 11 inches: cobbly sandy loam
H3 - 11 to 18 inches: gravelly sandy loam
H4 - 18 to 28 inches: unweathered bedrock

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 2 percent
Available water capacity: Very low (about 2.2 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: R010XA022OR - JUNIPER LAVA BLISTERS 8-10 PZ
Hydric soil rating: No

81F—Lickskillet-Rock outcrop complex, 45 to 80 percent slopes

Map Unit Setting

National map unit symbol: 24gb
Elevation: 2,000 to 4,500 feet
Mean annual precipitation: 8 to 10 inches
Mean annual air temperature: 49 to 52 degrees F
Frost-free period: 70 to 100 days
Farmland classification: Not prime farmland

Map Unit Composition

Lickskillet and similar soils: 60 percent
Rock outcrop: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Lickskillet

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Colluvium derived from volcanic rock

Typical profile

H1 - 0 to 7 inches: very stony sandy loam
H2 - 7 to 14 inches: very cobbly sandy loam
H3 - 14 to 24 inches: unweathered bedrock

Properties and qualities

Slope: 45 to 80 percent
Depth to restrictive feature: 12 to 20 inches to lithic bedrock
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 capacity: Very low (about 1.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Ecological site: R010XA007OR - JUNIPER PUMICE SOUTH 9-12 PZ
Hydric soil rating: No

Description of Rock Outcrop

Typical profile

R - 0 to 60 inches: unweathered bedrock

Properties and qualities

Slope: 45 to 80 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

97—Pits

Map Unit Setting

National map unit symbol: 24hy

Elevation: 2,500 to 5,000 feet
Mean annual precipitation: 10 to 25 inches
Mean annual air temperature: 41 to 52 degrees F
Frost-free period: 50 to 100 days
Farmland classification: Not prime farmland

Map Unit Composition

Pits: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pits

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

100C—Redcliff-Lickskillet complex, 0 to 15 percent slopes

Map Unit Setting

National map unit symbol: 23yd
Elevation: 2,000 to 4,500 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 47 to 52 degrees F
Frost-free period: 70 to 100 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Redcliff and similar soils: 60 percent
Lickskillet and similar soils: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Redcliff

Setting

Landform: Hillslopes
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from volcanic rock or metavolcanic rock

Typical profile

H1 - 0 to 10 inches: cobbly sandy loam
H2 - 10 to 25 inches: very cobbly sandy loam
H3 - 25 to 34 inches: extremely cobbly sandy loam
H4 - 34 to 44 inches: unweathered bedrock

Properties and qualities

Slope: 0 to 15 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
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 capacity: Low (about 3.0 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: R010XA019OR - SHRUBBY LOAM 8-12 PZ
Hydric soil rating: No

Description of Lickskillet

Setting
Landform: Hillslopes
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from volcanic rock

Typical profile
H1 - 0 to 7 inches: very stony sandy loam
H2 - 7 to 14 inches: very cobbly sandy loam
H3 - 14 to 24 inches: unweathered bedrock

Properties and qualities
Slope: 0 to 15 percent
Depth to restrictive feature: 12 to 20 inches to lithic bedrock
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 capacity: Very low (about 1.0 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Ecological site: R010XA019OR - SHRUBBY LOAM 8-12 PZ
Hydric soil rating: No

106D—Redslide-Lickskillet complex, 15 to 30 percent north slopes

Map Unit Setting
National map unit symbol: 23ys

Elevation: 2,000 to 4,000 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 47 to 52 degrees F
Frost-free period: 70 to 100 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Redslide, north, and similar soils: 50 percent
Lickskillet, north, and similar soils: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Redslide, North

Setting
Landform: Canyons
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Volcanic ash over colluvium derived from volcanic rock

Typical profile
H1 - 0 to 4 inches: stony sandy loam
H2 - 4 to 21 inches: very cobbly sandy loam
H3 - 21 to 34 inches: extremely cobbly sandy loam
H4 - 34 to 44 inches: unweathered bedrock

Properties and qualities
Slope: 15 to 30 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 3 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water capacity: Very low (about 2.4 inches)

Interpretive groups
Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: R010XA083OR - JUNIPER SHRUBBY NORTH 9-12 PZ
Hydric soil rating: No

Description of Lickskillet, North

Setting
Landform: Canyons
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from volcanic rock

Typical profile

H1 - 0 to 7 inches: very stony sandy loam
H2 - 7 to 14 inches: very cobbly sandy loam
H3 - 14 to 24 inches: unweathered bedrock

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: 12 to 20 inches to lithic bedrock
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 capacity: Very low (about 1.0 inches)

Interpretive groups

Land capability classification (irrigated): 7e
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Ecological site: R010XA025OR - JUNIPER SHALLOW NORTH 10-12 PZ
Hydric soil rating: No

142B—Stukel-Rock outcrop-Deschutes complex, dry, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 241j
Elevation: 2,500 to 3,500 feet
Mean annual precipitation: 8 to 10 inches
Mean annual air temperature: 49 to 52 degrees F
Frost-free period: 80 to 100 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Stukel, dry, and similar soils: 35 percent
Rock outcrop: 30 percent
Deschutes, dry, and similar soils: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Stukel, Dry

Setting

Landform: Lava plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Volcanic ash over basalt

Typical profile

H1 - 0 to 4 inches: sandy loam
H2 - 4 to 11 inches: cobbly sandy loam
H3 - 11 to 18 inches: gravelly sandy loam
H4 - 18 to 28 inches: unweathered bedrock

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 2 percent
Available water capacity: Very low (about 2.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: R010XA022OR - JUNIPER LAVA BLISTERS 8-10 PZ
Hydric soil rating: No

Description of Rock Outcrop

Typical profile

R - 0 to 60 inches: unweathered bedrock

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Description of Deschutes, Dry

Setting

Landform: Lava plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Volcanic ash over basalt

Typical profile

H1 - 0 to 7 inches: sandy loam
H2 - 7 to 17 inches: sandy loam
H3 - 17 to 31 inches: sandy loam
H4 - 31 to 41 inches: unweathered bedrock

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock

Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Available water capacity: Low (about 3.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: R010XA027OR - JUNIPER PUMICE FLAT 8-10 PZ
Hydric soil rating: No

150A—Tetherow sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 241w
Elevation: 2,500 to 4,000 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 47 to 52 degrees F
Frost-free period: 70 to 100 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Tetherow and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tetherow

Setting

Landform: Lava plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Volcanic ash over cinders

Typical profile

H1 - 0 to 19 inches: sandy loam
H2 - 19 to 24 inches: cobbly sandy loam
H3 - 24 to 60 inches: cinders

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 14 to 28 inches to strongly contrasting textural stratification
Drainage class: Excessively drained

Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: R010XA009OR - JUNIPER SHRUBBY PUMICE FLAT 10-12 PZ
Hydric soil rating: No

150B—Tetherow sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 241x
Elevation: 2,500 to 4,000 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 47 to 52 degrees F
Frost-free period: 70 to 100 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Tetherow and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tetherow

Setting

Landform: Lava plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Volcanic ash over cinders

Typical profile

H1 - 0 to 19 inches: sandy loam
H2 - 19 to 24 inches: cobbly sandy loam
H3 - 24 to 60 inches: cinders

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 14 to 28 inches to strongly contrasting textural stratification
Drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None

Frequency of ponding: None
Available water capacity: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: R010XA009OR - JUNIPER SHRUBBY PUMICE FLAT 10-12 PZ
Hydric soil rating: No

Appendix D

Precipitation Data – Redmond Airport Climate Station

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service

1981-2010 Station Normals of Temperature, Precipitation, and Heating and Cooling Degree Days

Generated on 02/11/2022

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 3043 ft. Lat: 44.2558° N Lon: -121.1392° W
Station: **REDMOND AIRPORT, OR US USW00024230**

December

DATE	MAX	MIN	AVG	HDD	CDD	PRCP
01	42.7	22.2	32.4	33	0	31.3% a
02	42.4	22.0	32.2	33	0	31.2% a
03	42.1	21.7	31.9	33	0	31.1% a
04	41.8	21.5	31.7	33	0	31.0% a
05	41.6	21.3	31.5	34	0	30.9% a
06	41.4	21.2	31.3	34	0	30.9% a
07	41.1	21.0	31.1	34	0	30.7% a
08	40.9	20.8	30.9	34	0	30.6% a
09	40.8	20.7	30.7	34	0	30.6% a
10	40.6	20.6	30.6	34	0	30.4% a
11	40.4	20.5	30.4	35	0	30.4% a
12	40.3	20.4	30.3	35	0	30.3% a
13	40.2	20.3	30.2	35	0	30.2% a
14	40.1	20.2	30.1	35	0	30.2% a
15	40.0	20.2	30.1	35	0	30.1% a
16	39.9	20.1	30.0	35	0	29.9% a
17	39.9	20.1	30.0	35	0	29.8% a
18	39.8	20.1	30.0	35	0	29.7% a
19	39.8	20.1	29.9	35	0	29.6% a
20	39.8	20.1	29.9	35	0	29.5% a
21	39.8	20.2	30.0	35	0	29.4% a
22	39.8	20.2	30.0	35	0	29.2% a
23	39.8	20.3	30.0	35	0	29.1% a
24	39.8	20.4	30.1	35	0	29.1% a
25	39.9	20.5	30.2	35	0	29.0% a
26	40.0	20.6	30.3	35	0	29.0% a
27	40.0	20.7	30.3	35	0	29.0% a
28	40.1	20.8	30.4	35	0	29.0% a
29	40.2	20.9	30.6	34	0	28.9% a
30	40.3	21.0	30.7	34	0	28.8% a
31	40.4	21.2	30.8	34	0	28.7% a
MNTH	40.5	20.7	30.6	1066	0	1.16 b

January

DATE	MAX	MIN	AVG	HDD	CDD	PRCP
01	40.5	21.3	30.9	34	0	28.7% a
02	40.6	21.5	31.0	34	0	28.6% a
03	40.7	21.6	31.2	34	0	28.5% a
04	40.9	21.8	31.3	34	0	28.4% a
05	41.0	21.9	31.5	34	0	28.3% a
06	41.1	22.1	31.6	33	0	28.2% a
07	41.2	22.3	31.7	33	0	28.1% a
08	41.4	22.4	31.9	33	0	28.0% a
09	41.5	22.5	32.0	33	0	27.9% a
10	41.6	22.7	32.2	33	0	27.8% a
11	41.8	22.8	32.3	33	0	27.7% a
12	41.9	23.0	32.4	33	0	27.6% a
13	42.0	23.1	32.6	32	0	27.5% a
14	42.2	23.2	32.7	32	0	27.4% a
15	42.3	23.3	32.8	32	0	27.2% a
16	42.4	23.4	32.9	32	0	27.1% a
17	42.6	23.5	33.0	32	0	27.0% a
18	42.7	23.6	33.1	32	0	27.0% a
19	42.8	23.7	33.2	32	0	26.9% a
20	42.9	23.7	33.3	32	0	26.9% a
21	43.1	23.8	33.4	32	0	26.9% a
22	43.2	23.8	33.5	31	0	26.9% a
23	43.3	23.9	33.6	31	0	26.9% a
24	43.4	23.9	33.7	31	0	26.9% a
25	43.5	23.9	33.7	31	0	26.9% a
26	43.7	23.9	33.8	31	0	26.9% a
27	43.8	23.9	33.9	31	0	26.9% a
28	43.9	23.9	33.9	31	0	26.9% a
29	44.0	23.9	34.0	31	0	26.8% a
30	44.1	23.9	34.0	31	0	26.8% a
31	44.3	23.9	34.1	31	0	26.8% a
MNTH	42.4	23.1	32.7	1000	0	0.97 b
Winter	43.1	22.5	32.8	2899	0	2.78 b
Annual	62.2	32.2	47.2	6715	223	8.90 b

February

DATE	MAX	MIN	AVG	HDD	CDD	PRCP
01	44.4	23.9	34.1	31	0	26.7% a
02	44.5	23.8	34.2	31	0	26.7% a
03	44.7	23.8	34.2	31	0	26.6% a
04	44.8	23.8	34.3	31	0	26.7% a
05	44.9	23.7	34.3	31	0	26.7% a
06	45.1	23.7	34.4	31	0	26.7% a
07	45.2	23.7	34.5	31	0	26.7% a
08	45.4	23.6	34.5	30	0	26.8% a
09	45.6	23.6	34.6	30	0	26.8% a
10	45.7	23.6	34.7	30	0	26.9% a
11	45.9	23.5	34.7	30	0	26.9% a
12	46.1	23.5	34.8	30	0	27.0% a
13	46.3	23.5	34.9	30	0	27.1% a
14	46.5	23.5	35.0	30	0	27.1% a
15	46.7	23.5	35.1	30	0	27.1% a
16	46.9	23.5	35.2	30	0	27.0% a
17	47.1	23.5	35.3	30	0	27.0% a
18	47.4	23.6	35.5	30	0	27.0% a
19	47.6	23.6	35.6	29	0	26.9% a
20	47.8	23.6	35.7	29	0	26.8% a
21	48.1	23.7	35.9	29	0	26.7% a
22	48.3	23.7	36.0	29	0	26.5% a
23	48.6	23.8	36.2	29	0	26.4% a
24	48.8	23.8	36.3	29	0	26.3% a
25	49.1	23.9	36.5	29	0	26.2% a
26	49.3	24.0	36.7	28	0	26.2% a
27	49.6	24.1	36.8	28	0	26.2% a
28	49.9	24.2	37.0	28	0	26.2% a
MNTH	46.8	23.7	35.2	833	0	0.65 b

a: Probability of precipitation >= 0.01 inches for 29-day windows centered on each day of the year.
b: Long-term averages of seasonal or annual precipitation totals in Inches.

-4444: year-round risk of frost-freeze.
-6666: parameter undefined; insufficient occurrences to compute value.
-7777: a non-zero value that would round to zero.
blank: missing or insufficient data.

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service

Current Location: Elev: 3043 ft. Lat: 44.2558° N Lon: -121.1392° W
Station: **REDMOND AIRPORT, OR US USW00024230**

1981-2010 Station Normals of Temperature, Precipitation, and Heating and Cooling Degree Days

Generated on 02/11/2022

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

March

DATE	MAX	MIN	AVG	HDD	CDD	PRCP
01	50.1	24.3	37.2	28	0	26.4% a
02	50.4	24.4	37.4	28	0	26.4% a
03	50.7	24.5	37.6	27	0	26.4% a
04	51.0	24.6	37.8	27	0	26.4% a
05	51.2	24.7	38.0	27	0	26.4% a
06	51.5	24.8	38.2	27	0	26.3% a
07	51.8	25.0	38.4	27	0	26.3% a
08	52.0	25.1	38.6	26	0	26.2% a
09	52.3	25.2	38.8	26	0	26.1% a
10	52.6	25.3	38.9	26	0	26.0% a
11	52.8	25.5	39.1	26	0	25.8% a
12	53.1	25.6	39.3	26	0	25.8% a
13	53.3	25.7	39.5	25	0	25.7% a
14	53.5	25.8	39.7	25	0	25.7% a
15	53.8	26.0	39.9	25	0	25.7% a
16	54.0	26.1	40.0	25	0	25.7% a
17	54.2	26.2	40.2	25	0	25.7% a
18	54.4	26.3	40.4	25	0	25.6% a
19	54.7	26.4	40.5	24	0	25.7% a
20	54.9	26.5	40.7	24	0	25.7% a
21	55.1	26.6	40.8	24	0	25.8% a
22	55.3	26.7	41.0	24	0	25.9% a
23	55.4	26.8	41.1	24	0	26.0% a
24	55.6	26.9	41.3	24	0	26.0% a
25	55.8	27.0	41.4	24	0	26.1% a
26	56.0	27.1	41.5	23	0	26.0% a
27	56.1	27.2	41.7	23	0	26.0% a
28	56.3	27.3	41.8	23	0	25.9% a
29	56.5	27.3	41.9	23	0	25.9% a
30	56.6	27.4	42.0	23	0	25.8% a
31	56.8	27.5	42.1	23	0	25.8% a
MNTH	53.8	26.0	39.9	778	0	0.66 b

April

DATE	MAX	MIN	AVG	HDD	CDD	PRCP
01	56.9	27.6	42.2	23	0	25.8% a
02	57.1	27.6	42.4	23	0	25.8% a
03	57.3	27.7	42.5	23	0	25.8% a
04	57.4	27.8	42.6	22	0	25.8% a
05	57.6	27.8	42.7	22	0	25.9% a
06	57.7	27.9	42.8	22	0	26.0% a
07	57.9	28.0	42.9	22	0	26.1% a
08	58.0	28.1	43.1	22	0	26.2% a
09	58.2	28.2	43.2	22	0	26.3% a
10	58.4	28.2	43.3	22	0	26.4% a
11	58.5	28.3	43.4	22	0	26.4% a
12	58.7	28.4	43.6	21	0	26.5% a
13	58.9	28.5	43.7	21	0	26.5% a
14	59.1	28.7	43.9	21	0	26.5% a
15	59.3	28.8	44.0	21	0	26.4% a
16	59.5	28.9	44.2	21	0	26.4% a
17	59.7	29.0	44.4	21	0	26.3% a
18	59.9	29.2	44.5	20	0	26.2% a
19	60.1	29.3	44.7	20	-7777	26.1% a
20	60.4	29.5	44.9	20	-7777	26.0% a
21	60.6	29.7	45.1	20	-7777	25.9% a
22	60.8	29.8	45.3	20	-7777	25.8% a
23	61.1	30.0	45.5	19	-7777	25.7% a
24	61.3	30.2	45.8	19	-7777	25.6% a
25	61.6	30.4	46.0	19	-7777	25.5% a
26	61.8	30.6	46.2	19	-7777	25.4% a
27	62.1	30.8	46.5	19	-7777	25.3% a
28	62.4	31.0	46.7	18	-7777	25.2% a
29	62.7	31.3	47.0	18	-7777	25.1% a
30	62.9	31.5	47.2	18	-7777	25.0% a
MNTH	59.6	29.1	44.4	620	-7777	0.73 b
Spring	60.3	30.2	45.2	1823	5	2.42 b
Annual	62.2	32.2	47.2	6715	223	8.90 b

May

DATE	MAX	MIN	AVG	HDD	CDD	PRCP
01	63.2	31.7	47.5	18	-7777	24.9% a
02	63.5	32.0	47.8	17	-7777	24.8% a
03	63.8	32.2	48.0	17	-7777	24.7% a
04	64.1	32.5	48.3	17	-7777	24.5% a
05	64.4	32.7	48.6	17	-7777	24.4% a
06	64.7	33.0	48.8	16	-7777	24.2% a
07	65.0	33.3	49.1	16	-7777	24.1% a
08	65.3	33.5	49.4	16	-7777	24.0% a
09	65.6	33.8	49.7	15	-7777	24.0% a
10	65.9	34.0	50.0	15	-7777	24.0% a
11	66.2	34.3	50.2	15	-7777	24.0% a
12	66.4	34.6	50.5	15	-7777	24.0% a
13	66.7	34.8	50.8	14	-7777	24.0% a
14	67.0	35.1	51.0	14	-7777	24.0% a
15	67.3	35.3	51.3	14	-7777	24.1% a
16	67.6	35.6	51.6	14	-7777	24.2% a
17	67.9	35.8	51.8	13	-7777	24.2% a
18	68.1	36.0	52.1	13	-7777	24.3% a
19	68.4	36.3	52.3	13	-7777	24.3% a
20	68.7	36.5	52.6	13	-7777	24.4% a
21	69.0	36.7	52.8	12	-7777	24.4% a
22	69.2	36.9	53.1	12	-7777	24.4% a
23	69.5	37.1	53.3	12	-7777	24.5% a
24	69.7	37.3	53.5	12	-7777	24.5% a
25	70.0	37.5	53.8	12	-7777	24.5% a
26	70.3	37.7	54.0	11	-7777	24.4% a
27	70.5	37.9	54.2	11	-7777	24.4% a
28	70.8	38.1	54.4	11	-7777	24.3% a
29	71.0	38.2	54.6	11	-7777	24.2% a
30	71.3	38.4	54.8	11	-7777	24.1% a
31	71.5	38.6	55.0	10	-7777	24.0% a
MNTH	67.5	35.4	51.4	425	5	1.03 b

a: Probability of precipitation >= 0.01 inches for 29-day windows centered on each day of the year.
b: Long-term averages of seasonal or annual precipitation totals in Inches.

-4444: year-round risk of frost-freeze.
-6666: parameter undefined; insufficient occurrences to compute value.
-7777: a non-zero value that would round to zero.
blank: missing or insufficient data.

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service
Current Location: Elev: 3043 ft. Lat: 44.2558° N Lon: -121.1392° W
Station: **REDMOND AIRPORT, OR US USW00024230**

1981-2010 Station Normals of Temperature, Precipitation, and Heating and Cooling Degree Days

Generated on 02/11/2022

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

June

DATE	MAX	MIN	AVG	HDD	CDD	PRCP
01	71.8	38.7	55.3	10	-7777	23.8% a
02	72.0	38.9	55.5	10	-7777	23.7% a
03	72.3	39.0	55.7	10	-7777	23.5% a
04	72.6	39.2	55.9	10	-7777	23.2% a
05	72.8	39.3	56.1	9	-7777	22.9% a
06	73.1	39.5	56.3	9	-7777	22.6% a
07	73.4	39.6	56.5	9	-7777	22.3% a
08	73.6	39.8	56.7	9	-7777	21.9% a
09	73.9	39.9	56.9	9	-7777	21.5% a
10	74.2	40.1	57.1	8	-7777	21.1% a
11	74.5	40.2	57.4	8	1	20.7% a
12	74.8	40.4	57.6	8	1	20.3% a
13	75.1	40.5	57.8	8	1	19.8% a
14	75.4	40.7	58.0	8	1	19.4% a
15	75.7	40.8	58.3	7	1	18.9% a
16	76.1	41.0	58.5	7	1	18.5% a
17	76.4	41.1	58.8	7	1	18.1% a
18	76.7	41.3	59.0	7	1	17.7% a
19	77.1	41.5	59.3	7	1	17.3% a
20	77.4	41.6	59.5	6	1	16.9% a
21	77.8	41.8	59.8	6	1	16.5% a
22	78.1	42.0	60.1	6	1	16.1% a
23	78.5	42.2	60.3	6	1	15.8% a
24	78.8	42.4	60.6	5	1	15.5% a
25	79.2	42.6	60.9	5	1	15.2% a
26	79.6	42.8	61.2	5	1	15.0% a
27	80.0	43.0	61.5	5	1	14.7% a
28	80.3	43.2	61.8	5	1	14.5% a
29	80.7	43.4	62.0	4	2	14.2% a
30	81.1	43.6	62.3	4	2	13.9% a
MNTH	76.1	41.0	58.5	217	24	0.64 b

July

DATE	MAX	MIN	AVG	HDD	CDD	PRCP
01	81.5	43.8	62.6	4	2	13.7% a
02	81.8	44.0	62.9	4	2	13.4% a
03	82.2	44.2	63.2	4	2	13.2% a
04	82.6	44.4	63.5	4	2	13.1% a
05	82.9	44.6	63.8	3	2	12.9% a
06	83.3	44.8	64.0	3	2	12.8% a
07	83.6	45.0	64.3	3	2	12.6% a
08	84.0	45.2	64.6	3	3	12.4% a
09	84.3	45.4	64.8	3	3	12.3% a
10	84.6	45.6	65.1	3	3	12.1% a
11	84.9	45.8	65.3	3	3	12.0% a
12	85.2	45.9	65.6	2	3	11.9% a
13	85.5	46.1	65.8	2	3	11.8% a
14	85.7	46.3	66.0	2	3	11.7% a
15	86.0	46.4	66.2	2	3	11.6% a
16	86.2	46.6	66.4	2	3	11.5% a
17	86.4	46.7	66.6	2	3	11.4% a
18	86.6	46.8	66.7	2	4	11.3% a
19	86.8	46.9	66.9	2	4	11.1% a
20	87.0	47.0	67.0	2	4	11.0% a
21	87.1	47.1	67.1	2	4	10.8% a
22	87.3	47.2	67.2	2	4	10.6% a
23	87.4	47.3	67.3	1	4	10.5% a
24	87.5	47.3	67.4	1	4	10.3% a
25	87.5	47.4	67.5	1	4	10.1% a
26	87.6	47.4	67.5	1	4	10.0% a
27	87.6	47.4	67.5	1	4	9.9% a
28	87.6	47.4	67.5	1	4	9.8% a
29	87.6	47.4	67.5	1	4	9.7% a
30	87.6	47.4	67.5	1	4	9.7% a
31	87.6	47.4	67.5	1	4	9.6% a
MNTH	85.6	46.2	65.9	69	97	0.55 b
Summer	82.2	44.2	63.2	367	201	1.69 b
Annual	62.2	32.2	47.2	6715	223	8.90 b

August

DATE	MAX	MIN	AVG	HDD	CDD	PRCP
01	87.5	47.3	67.4	1	4	9.5% a
02	87.4	47.3	67.4	1	4	9.4% a
03	87.4	47.2	67.3	1	4	9.4% a
04	87.3	47.1	67.2	2	4	9.3% a
05	87.1	47.0	67.1	2	4	9.3% a
06	87.0	46.9	67.0	2	4	9.3% a
07	86.9	46.8	66.8	2	3	9.3% a
08	86.7	46.7	66.7	2	3	9.2% a
09	86.5	46.6	66.6	2	3	9.2% a
10	86.3	46.4	66.4	2	3	9.2% a
11	86.2	46.3	66.2	2	3	9.1% a
12	86.0	46.1	66.0	2	3	9.1% a
13	85.7	46.0	65.9	2	3	9.1% a
14	85.5	45.8	65.7	2	3	9.2% a
15	85.3	45.6	65.5	2	3	9.2% a
16	85.1	45.4	65.3	2	3	9.2% a
17	84.8	45.3	65.0	3	3	9.2% a
18	84.6	45.1	64.8	3	2	9.3% a
19	84.3	44.9	64.6	3	2	9.4% a
20	84.1	44.7	64.4	3	2	9.5% a
21	83.8	44.4	64.1	3	2	9.6% a
22	83.6	44.2	63.9	3	2	9.8% a
23	83.3	44.0	63.7	3	2	9.9% a
24	83.0	43.8	63.4	3	2	10.0% a
25	82.7	43.6	63.2	3	2	10.0% a
26	82.5	43.3	62.9	4	2	10.1% a
27	82.2	43.1	62.7	4	1	10.2% a
28	81.9	42.9	62.4	4	1	10.3% a
29	81.6	42.7	62.1	4	1	10.4% a
30	81.4	42.4	61.9	4	1	10.5% a
31	81.1	42.2	61.6	5	1	10.6% a
MNTH	84.8	45.2	65.0	80	80	0.50 b

a: Probability of precipitation >= 0.01 inches for 29-day windows centered on each day of the year.
b: Long-term averages of seasonal or annual precipitation totals in Inches.

-4444: year-round risk of frost-freeze.
-6666: parameter undefined; insufficient occurrences to compute value.
-7777: a non-zero value that would round to zero.
blank: missing or insufficient data.

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service

1981-2010 Station Normals of Temperature, Precipitation, and Heating and Cooling Degree Days

Generated on 02/11/2022

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 3043 ft. Lat: 44.2558° N Lon: -121.1392° W
Station: **REDMOND AIRPORT, OR US USW00024230**

September							October							November						
DATE	MAX	MIN	AVG	HDD	CDD	PRCP	DATE	MAX	MIN	AVG	HDD	CDD	PRCP	DATE	MAX	MIN	AVG	HDD	CDD	PRCP
01	80.8	41.9	61.4	5	1	10.7% a	01	70.5	34.2	52.4	13	-7777	14.2% a	01	55.6	28.7	42.2	23	0	27.1% a
02	80.5	41.7	61.1	5	1	10.8% a	02	70.1	34.0	52.0	13	-7777	14.5% a	02	55.1	28.6	41.9	23	0	27.5% a
03	80.2	41.4	60.8	5	1	10.9% a	03	69.7	33.7	51.7	13	-7777	14.8% a	03	54.7	28.4	41.5	23	0	27.9% a
04	79.9	41.2	60.6	5	1	11.0% a	04	69.2	33.5	51.4	14	-7777	15.0% a	04	54.2	28.3	41.2	24	0	28.3% a
05	79.6	40.9	60.3	6	1	11.1% a	05	68.8	33.3	51.0	14	-7777	15.2% a	05	53.7	28.1	40.9	24	0	28.6% a
06	79.4	40.7	60.0	6	1	11.2% a	06	68.3	33.1	50.7	14	-7777	15.5% a	06	53.2	27.9	40.5	24	0	28.9% a
07	79.1	40.4	59.7	6	1	11.4% a	07	67.9	32.8	50.4	15	-7777	15.8% a	07	52.7	27.7	40.2	25	0	29.2% a
08	78.8	40.2	59.5	6	1	11.5% a	08	67.4	32.6	50.0	15	-7777	16.2% a	08	52.2	27.5	39.9	25	0	29.5% a
09	78.5	39.9	59.2	7	1	11.6% a	09	66.9	32.4	49.7	15	0	16.5% a	09	51.7	27.3	39.5	25	0	29.8% a
10	78.1	39.7	58.9	7	1	11.7% a	10	66.5	32.2	49.4	16	0	16.9% a	10	51.2	27.2	39.2	26	0	30.1% a
11	77.8	39.4	58.6	7	1	11.8% a	11	66.0	32.0	49.0	16	0	17.3% a	11	50.8	26.9	38.9	26	0	30.3% a
12	77.5	39.1	58.3	7	1	11.9% a	12	65.5	31.8	48.7	16	0	17.6% a	12	50.3	26.7	38.5	26	0	30.5% a
13	77.2	38.9	58.0	8	1	12.1% a	13	65.0	31.7	48.4	17	0	18.0% a	13	49.8	26.5	38.2	27	0	30.7% a
14	76.9	38.6	57.7	8	1	12.2% a	14	64.6	31.5	48.0	17	0	18.3% a	14	49.4	26.3	37.8	27	0	30.8% a
15	76.6	38.3	57.5	8	-7777	12.3% a	15	64.1	31.3	47.7	17	0	18.8% a	15	48.9	26.1	37.5	28	0	30.9% a
16	76.2	38.1	57.2	8	-7777	12.4% a	16	63.6	31.1	47.4	18	0	19.2% a	16	48.5	25.8	37.1	28	0	31.1% a
17	75.9	37.8	56.8	9	-7777	12.5% a	17	63.1	31.0	47.0	18	0	19.7% a	17	48.0	25.6	36.8	28	0	31.2% a
18	75.5	37.5	56.5	9	-7777	12.6% a	18	62.6	30.8	46.7	18	0	20.2% a	18	47.6	25.4	36.5	29	0	31.3% a
19	75.2	37.3	56.2	9	-7777	12.7% a	19	62.1	30.7	46.4	19	0	20.8% a	19	47.1	25.1	36.1	29	0	31.5% a
20	74.8	37.0	55.9	9	-7777	12.7% a	20	61.6	30.5	46.1	19	0	21.3% a	20	46.7	24.9	35.8	29	0	31.6% a
21	74.5	36.8	55.6	10	-7777	12.8% a	21	61.1	30.4	45.7	19	0	21.8% a	21	46.3	24.6	35.5	30	0	31.7% a
22	74.1	36.5	55.3	10	-7777	12.9% a	22	60.6	30.2	45.4	20	0	22.3% a	22	45.9	24.4	35.1	30	0	31.7% a
23	73.7	36.2	55.0	10	-7777	13.0% a	23	60.1	30.1	45.1	20	0	22.8% a	23	45.5	24.1	34.8	30	0	31.7% a
24	73.4	36.0	54.7	11	-7777	13.1% a	24	59.6	29.9	44.8	20	0	23.3% a	24	45.1	23.9	34.5	31	0	31.7% a
25	73.0	35.7	54.3	11	-7777	13.2% a	25	59.1	29.8	44.5	21	0	23.9% a	25	44.7	23.6	34.2	31	0	31.6% a
26	72.6	35.4	54.0	11	-7777	13.4% a	26	58.6	29.6	44.1	21	0	24.4% a	26	44.3	23.4	33.8	31	0	31.6% a
27	72.2	35.2	53.7	11	-7777	13.5% a	27	58.1	29.5	43.8	21	0	25.0% a	27	44.0	23.1	33.5	31	0	31.5% a
28	71.8	34.9	53.4	12	-7777	13.6% a	28	57.6	29.3	43.5	22	0	25.4% a	28	43.6	22.9	33.3	32	0	31.4% a
29	71.4	34.7	53.0	12	-7777	13.8% a	29	57.1	29.2	43.2	22	0	25.9% a	29	43.3	22.6	33.0	32	0	31.4% a
30	70.9	34.4	52.7	12	-7777	14.0% a	30	56.6	29.1	42.8	22	0	26.3% a	30	43.0	22.4	32.7	32	0	31.3% a
							31	56.1	28.9	42.5	22	0	26.7% a							
MNTH	76.2	38.2	57.2	250	16	0.41 b	MNTH	63.5	31.3	47.4	546	-7777	0.64 b	MNTH	48.9	25.8	37.4	829	0	0.96 b
							Autumn	62.9	31.8	47.3	1626	16	2.01 b							
							Annual	62.2	32.2	47.2	6715	223	8.90 b							

a: Probability of precipitation >= 0.01 inches for 29-day windows centered on each day of the year.
b: Long-term averages of seasonal or annual precipitation totals in Inches.

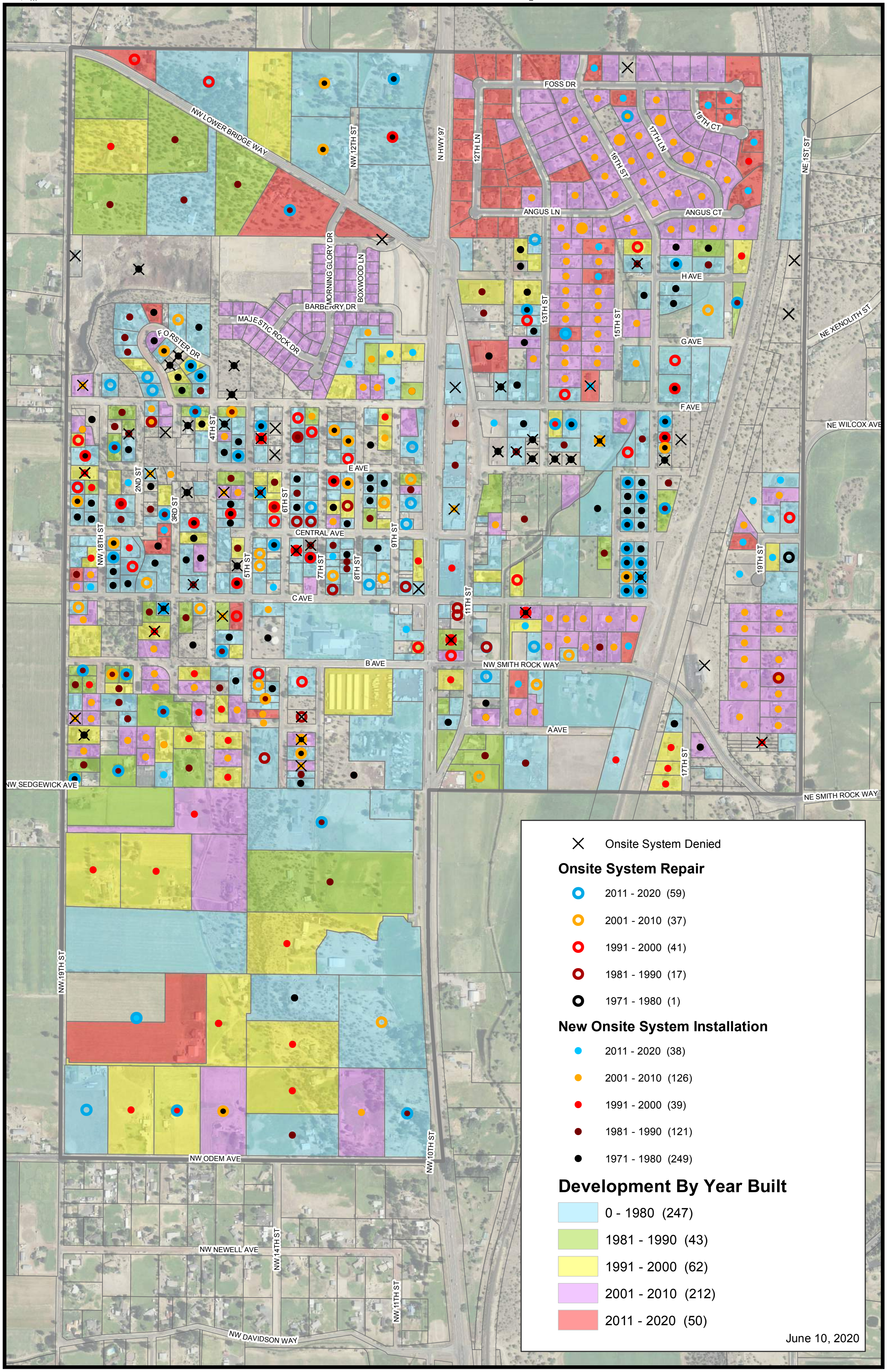
-4444: year-round risk of frost-freeze.
-6666: parameter undefined; insufficient occurrences to compute value.
-7777: a non-zero value that would round to zero.
blank: missing or insufficient data.

Appendix E

Terrebonne Development with Denied Onsite Septic Applications

This page intentionally left blank.

Terrebonne Development



This page intentionally left blank.

Appendix F

Deschutes County Letter in Support of Terrebonne Sewer

This page intentionally left blank.

July 21, 2021

Parametrix
Attn: Ryan Rudnick, PE
150 Northwest Pacific Park Lane Suite 110
Bend, OR 97701

RE: Terrebonne Community Sewer

Dear Mr. Rudnick,

The Terrebonne Community is seeing more and more activity, like all of Central Oregon, placing pressure on the antiquated infrastructure. Terrebonne uses onsite wastewater treatment systems for wastewater infrastructure, and most of those systems are quite aged and on the order of 30-40 years old and sometimes older. The density of development and shallow soil conditions over poorly permeable basalt bedrock raises concerns regarding significant health hazards and the inability to serve both residential and commercial uses.

In the last few years, several commercial businesses in central Terrebonne have been experiencing problems with their onsite wastewater treatment systems. Several businesses have had sudden failures resulting in expensive repairs completed under Oregon Department of Environmental Quality permitting. These repairs have been approved under reasonable installation allowances and typically are not up to normal minimum design or siting requirements. Reasonable repairs place limitations on the businesses and they must be very careful not to overuse a newly repaired system causing malfunction and premature failure. If these systems malfunction or do not perform, significant compliance issues will arise and public health could be at risk. These businesses may be under compliance warnings or penalties, forced to modify their practices or close the business completely.

A few commercial facilities have struggled with wastewater issues in the last year and seem to be in a fragile state. Commercial businesses, particularly food service facilities, with a failing onsite system pose a significant risk to public health as these businesses make and sell food for consumption. Food service facilities produce high strength wastewater that is more complex to treat, and more likely to result in failure of the system. Options for food service facilities will be a greater concern without a community sewer system.

Single family residential properties in Terrebonne have seen the frequency of denials for any type of system and difficult repairs increase in recent years. The biggest concern for onsite wastewater systems serving many of the older residences in Terrebonne is that there are no options for a proper repair. This could require residences to be vacated because the health hazard cannot be corrected. Many of the existing systems are 40 years old and the properties do not have sufficient area for a complete replacement system that will meet current minimum standards. Often, owners cannot improve or expand their homes because the existing onsite system cannot meet minimum requirements and complete replacement options are not available on site.

Many older facilities in Terrebonne may still utilize a waste disposal well or other severely substandard onsite system for sewage disposal. Waste disposal wells are a significant concern identified in Oregon rules for Underground Injection Control, OAR 340-044-0010(2). "*The injection of untreated or inadequately treated sewage or wastes to waste disposal wells and particularly to waste disposal wells in the lava terrain of Central Oregon constitutes a threat of serious, detrimental and irreversible pollution of valuable groundwater resources and a threat to public health. The policy of the Environmental Quality Commission is to restrict, regulate or prohibit the further construction and use of waste disposal wells in Oregon and to phase out completely the use of waste disposal wells as a means of disposing of untreated or inadequately treated sewage or wastes as rapidly as possible in an orderly and planned manner.*"

Given the increasing public health risk, potential impacts to public resources, limited and costly onsite options and future limits on both residential and commercial development, the best solution for the Terrebonne urbanized community is to have a community sewer system. A community sewer will create a safer long-term solution that will provide a healthier and safer community with more economic and residential opportunities.

Below, Deschutes County Environmental Health Supervisors representing Community Development and Health Services have signed this letter. We are obligated to act and require corrective action when untreated sewage is on the ground surface. Health hazards must be corrected to protect the people and resources of the Terrebonne community.

Sincerely,

Todd Cleveland, REHS
Environmental Health Supervisor
Deschutes County Community Development

Eric Mone, REHS
Environmental Health Supervisor
Deschutes County Health Services

Appendix G

City of Redmond WPCF Permit

This page intentionally left blank.

WATER POLLUTION CONTROL FACILITIES PERMIT

Department of Environmental Quality
Eastern Region – Bend Office
475 NE Bellevue Dr. Suite 110, Bend, OR 97701
Telephone: (541) 388-6146

Issued pursuant to ORS 468B.

ISSUED TO:

City of Redmond
3100 NW 19th Street
Redmond, OR 97756

SOURCES COVERED BY THIS PERMIT:

Type of Waste	Outfall Number	Method of Disposal
Domestic Wastewater	001	Moderate Rate Infiltration
Recycled Water Reuse	002	Land Application

FACILITY TYPE AND LOCATION:

Oxidation Ditch
3100 NW 19th Street
Redmond, OR

RIVER BASIN INFORMATION:

Basin: Deschutes
Sub-basin: Middle Deschutes
LLID: 1209151456389-138.9-N
County: Deschutes

Treatment System Class: Level IV
Collection System Class: Level III

Nearest surface stream which would receive waste if it were to discharge: Deschutes River at R.M. 138.9

Issued in response to Application No. 969505 received August 2, 2010.
This permit is issued based on the land use findings in the permit record.

Cheryll Hutchens-Woods
Cheryll Hutchens-Woods, Manager
Water Quality Section
Eastern Region

November 9, 2011
Date

PERMITTED ACTIVITIES

Until this permit expires or is modified or revoked, the permittee is authorized to construct, install, modify, or operate a wastewater collection, treatment, control and disposal system in conformance with all the requirements, limitations, and conditions set forth in the attached schedules as follows:

Page

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

SCHEDULE A

1. The facility must be operated at all times in compliance with the following limitations:

   a. Monthly average daily flow through the treatment facility must not exceed 2.99 MGD.

   b. Wastewater discharged to the moderate rate infiltration basins (Outfall 001), must be treated and disinfected to meet the following limitations:

Parameter	Limitation
BOD-5	20 mg/l monthly average
TSS	20 mg/l monthly average
NO3 + NO2-N	6 mg/l monthly average
Total Nitrogen	9 mg/l monthly average
pH	6.0 - 9.0
E. Coli	Must not exceed a monthly log mean of 126 organisms per 100 ml and no single sample shall exceed 406 organisms per 100 ml.

   c. The moderate rate infiltration basins must be maintained at a depth not to exceed two feet, unless otherwise approved in writing by the Department.

   d. The moderate rate infiltration basins must be properly managed to prevent piping erosion forming a direct conduit between the bottom of the basins and the underlying basalt bedrock.

2. Recycled Wastewater (Outfall 002)

   a. All recycled water must be distributed on land, for dissipation by evapotranspiration and controlled seepage, by following sound irrigation practices so as to prevent:

      (1) Prolonged ponding of treated recycled water on the ground surface;

      (2) Surface runoff or subsurface drainage through drainage tile;

      (3) The creation of odors, fly and mosquito breeding conditions or other nuisance conditions;

      (4) The overloading of land with nutrients, organics, or other pollutant parameters; and,

      (5) Impairment of existing or potential beneficial uses of groundwater.

   b. Prior to land application of the recycled water, it must receive at least Class C treatment as defined in OAR 340-055-0012(5)(b) to:

      Reduce Total Coliform to a 7-day median of 23 organisms per 100 mL, with no greater than 240 organisms per 100 mL in two consecutive samples.

   c. Prior to reuse of Class A recycled water, it must be treated as defined in OAR 340-055 so that: (See Note 1):

      (1) Total Coliform must not exceed a 7-day median of 2.2 organisms/100 ml, and no single sample to exceed 23 organisms/100 ml.

(2) Turbidity must not exceed a 24-hour mean of 2 NTU, and must not exceed 5 NTU for more than 5% of the time during a 24-hour period.

d. Irrigation must conform to the Recycled Water Use Plan approved by the Department.

e. All direct discharges of wastewater to surface waters (including irrigation canals) are prohibited. Treated and disinfected effluent must be preferentially routed to the irrigation storage pond for ultimate spray irrigation (Outfall 002). Excess treated and disinfected effluent must be routed to the moderate rate infiltration basins (Outfall 001) for disposal.

f. Except for processed food crops, treated wastewater must not be applied to food crops destined for direct human consumption or otherwise be made available for a use that is inconsistent with the uses provided for in OAR 340-055.

g. The quantity of effluent irrigated upon land must not exceed that approved by the Department in the Recycled Water Use Plan. The quantity of effluent must be limited to that which would be required using accepted agricultural practices.

3. Groundwater Monitoring Wells-Groundwater concentration limits not to be exceeded at the groundwater compliance point:

Parameter	**Limitation**	**Compliance Wells**
Nitrate (N)	9 mg/l monthly average	MW-#15, MW- #17
Total Dissolved Solids	500 mg/l	MW-#15, MW-#17

Note:

1. Six (6) months prior to producing and disposing of Class A effluent the permittee must submit plans and specifications for related facilities and a Revised Recycled Water Use Plan to the Department for review and approval. In addition, discharge of any effluent to any irrigation canal will require a National Pollutant Discharge Elimination System permit issued by DEQ.

SCHEDULE B

1. Minimum Monitoring and Reporting Requirements

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

a. Influent to treatment facility- Samples must be collected at headworks.

Parameter	Minimum Frequency	Type of Sample
BOD-5	2/Weekly	24hr Composite
TSS	2/Weekly	24hr Composite
Flow	Daily	Measurement
Flow Meter Calibration	Annual	Verification
pH	3/Week	Grab

b. Effluent to Moderate Rate Infiltration Basins (Outfall 001) –Sample collected downstream of the chlorine contact chamber.

Parameter	Minimum Frequency	Type of Sample
BOD-5	2/Weekly	24hr Composite
TSS	2/Weekly	24hr Composite
E. Coli	2/Weekly	Grab
$NO_3 + NO_2$-N	Weekly	24hr Composite
pH	3/Weekly	Grab
Flow Meter Calibration	Annual	Verification
Flow to Infiltration Basins	Daily	Measurement
Quantity Chlorine Used	Daily	Measurement
Total Chlorine Residual	Daily	Grab
NH_3-N	Weekly	24hr Composite
TKN	Weekly	24hr Composite

c. Moderate Rate Infiltration Basins

Parameter	Minimum Frequency	Type of Sample
Water Depth of Each Basin	Daily	Measurement
Hydraulic Loading Rate (MGD/acre-each basin)	Monthly	Calculation

d. Wastewater Irrigation (Outfall 002)

Item or Parameter	Minimum Frequency	Type of Sample
Quantity Irrigated (inches/acre)	Daily	Measurement
Flow Meter Calibration	Annual	Verification
pH	2/Week	Grab
Chlorine Residual	Daily	Grab
Amount Sodium Hypochlorite Used (volume)	Daily	Measurement
Nutrients (TKN,NO2+NO3-N,NH3)	Quarterly	Composite
Total Coliform	1/Week	Grab
Flow to Storage Pond	Daily	Measurement
Turbidity (NTU)	Hourly	Meter (See Note 1)

e. Biosolids Management

Item or Parameter	Minimum Frequency	Type of Sample
Total Solids (% dry wt.) Volatile solids (% dry wt.) Biosolids nitrogen for: NH_3-N; NO_3-N; & TKN (% dry wt.) Phosphorus (% dry wt.) Potassium (% dry wt.) pH (standard units) Total metals including: As, Cd, Cu, Hg, Mo, Ni, Pb, Se & Zn, measured as total in mg/kg	Quarterly	Composite sample to be representative of the product to be land applied from the Dewatered biosolids (See Note 2)
Record locations where biosolids are applied on each DEQ approved site. (Site location maps to be maintained at treatment facility for review upon request by DEQ)	Each Occurrence	Date, volume & locations where biosolids were applied recorded on site location map.
Record quantity and type of alkaline product used to stabilize biosolids (when required to meet federal pathogen and vector attraction reduction requirements in 40 CFR 503.32(b)(3) and 40 CFR 503.33(b)(6))	Each occurrence	Measurement
Record initial time when solids that received alkaline agent ascended to pH ≥ 12	Daily when processing solids	Date, time, and actual pH measurement (corrected to standard at 25°C)
2 hours after initial alkaline addition and sustained at pH ≥12	Daily when processing solids	Date, time, and actual pH measurement (corrected to standard at 25°C)
24 hours after initial alkaline addition and pH ≥11.5 was sustained	Daily when processing solids	Date, time, and actual pH measurement (corrected to standard at 25°C)
Record quantity of biosolids removed from wastewater treatment facility to storage facility.	Each occurrence	Measurement (Dry tons)

f. Groundwater Monitoring

(1) Groundwater Minimum Monitoring and Reporting Requirements

(a) Groundwater monitoring must be conducted in accordance with the most current Department-approved Groundwater Monitoring Plan.

(b) Groundwater sampling procedures must be in accordance with the Department-approved Groundwater Monitoring Plan. At a minimum, the permittee must monitor groundwater for the parameters and at the frequencies as specified below. If the Department approved Groundwater Monitoring Plan requires additional sampling and analysis of other parameters, the permittee must conduct the additional monitoring as required in the Groundwater Monitoring Plan.

Parameter	Minimum Frequency	Type of Sample
Nitrate (N)	Quarterly	Grab/Lab Analysis
Total Dissolved Solids	Quarterly	Grab/Lab Analysis
Chloride	Quarterly	Grab/Lab Analysis
Sulfate	Quarterly	Grab/Lab Analysis
pH	Quarterly	Grab/Field Analysis
Conductivity	Quarterly	Grab/Field Analysis
Water Table Elevation	Quarterly	Grab/Field Analysis

(c) Reporting Requirements

(i) **Quarterly Reporting**: Analytical results of groundwater monitoring for the parameters listed above and for any other parameters identified in the approved Groundwater Monitoring Plan, must be reported quarterly in a Department approved format. At a minimum, the report must contain the quarterly reporting information identified in the approved Groundwater Monitoring Plan. Reports are due to the Department by the 30th day of the month following the sampling quarter.

(ii) **Annual Data Analysis and Reporting**: An annual groundwater data analysis report must be submitted to the Department by March 1. The annual report must contain the annual data analysis and reporting information required by the approved Groundwater Monitoring Plan.

(2) Groundwater Monitoring Resampling Requirements

(a) If monitoring indicates that a concentration limit in Schedule A(3) has been exceeded at a compliance point, the permittee must notify the Department within 10 days of obtaining the monitoring results and shall immediately resample the monitoring well for the exceeding parameter and any other parameters deemed necessary by the Department. The results of both sampling events must be reported to the Department within 10 days of receipt of the laboratory data.

(b) If monitoring indicates an increase (increase or decrease for pH) in the value of a parameter monitored, the permittee must immediately resample the monitoring well for the increased or decreased parameter and other parameters deemed necessary by the Department. If the resampling confirms a change in water quality, the permittee must:

(i) Report the results to the Department within 10 days of receipt of the laboratory data; and

(ii) Prepare and submit to the Department within 30 days of receiving lab results a plan for developing a preliminary assessment unless another time schedule is approved by the Department.

2. Reporting Procedures

a. Monitoring results must be reported on Department-approved forms. The reporting period is the calendar month, except the required monitoring for biosolids management must be reported annually and submitted with the annual report due February 19. Reports must be submitted to the Department's Eastern Region - Bend office by the 15th day of the following month.

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

3. Report Submittals

a. For any year in which biosolids are land applied, a report must be submitted to the Department by February 19 of the following year that describes solids handling activities for the previous year and includes, but is not limited to, the required information outlined in OAR 340-050-0035(6)(a)-(e).

b. By no later than January 15th of each year, the permittee must submit to the Department an annual report describing the effectiveness of the recycled water system to comply with approved recycled water use plan, the rules of Division 55, and the limitations and conditions of this permit applicable to reuse of reclaimed water.

c. Groundwater quarterly and annual reports must be submitted in accordance with 1.f.(1)(c)., above.

NOTES:

1. Turbidity monitoring and reporting is only required when producing and reusing of Class A recycled water.

2. Composite samples of dewatered, lime-stabilized biosolids must be taken from reference areas in the Dewatered biosolids pursuant to Test Methods for Evaluating Solid Waste, Volume 2; Field Manual, Physical/Chemical Methods, November 1986, Third Edition, Chapter 9.

   Inorganic pollutant monitoring must be conducted according to Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Second Edition (1982) with Updates I and II and third Edition (1986) with Revision I.

SCHEDULE D

Special Conditions

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

   All new biosolids application sites must meet the site selection criteria set forth in OAR 340-050-0070 and must be located within Deschutes and Jefferson counties. All currently approved sites are located in Deschutes County. No new public notice is required for the continued use of these currently approved sites. Property owners adjacent to any newly approved application sites must be notified, in writing or by any method approved by DEQ, of the proposed activity prior to the start of application. For proposed new application sites that are deemed by the DEQ to be sensitive with respect to residential housing, runoff potential or threat to groundwater, an opportunity for public comment must be provided in accordance with OAR 340-050-0030.

2. This permit may be modified to incorporate any applicable standard for biosolids use or disposal promulgated under section 405(d) of the Clean Water Act, if the standard for biosolids use or disposal is more stringent than any requirements for biosolids use or disposal in the permit, or controls a pollutant or practice not limited in this permit.

3. The permittee must meet the requirements for use of recycled water under OAR 340 Division 055, including the following:

   (a) No recycled water shall be released by the permittee until a Recycled Water Use Plan is approved by the Department.
   (b) All recycled water must be managed in accordance with the approved Recycled Water Use Plan. No substantial changes shall be made in the approved plan without written approval of the Department.
   (c) Any person having control over the treatment or distribution or both of recycled water may distribute recycled water only for the beneficial purposes identified in this permit and the associated Recycled Water Use Plan. Moreover, all reasonable steps must be taken to ensure that the recycled water is used only in accordance with the standards and requirements of the rules of Division 55, the conditions of this permit, and the Recycled Water Use Plan.
   (d) The permittee must notify the Department within 24 hours if it is determined that the treated effluent is being used in a manner not in compliance with OAR 340-055. When the Department offices are not open, the permittee must report the incident of noncompliance to the Oregon Emergency Response System (telephone number: 800.452.0311)
   (e) No recycled water shall be made available to a person proposing to use recycled water unless that person certifies in writing that they have read and understand the provisions in these rules. This written certification must be kept on file by the sewage treatment system owner and be made available to the Department for inspection.

   All recycled water used at the treatment plant site (or satellite facility operating under the same permit) for landscape irrigation or in plant processes is exempt from the OAR 340 Division 055 rules if:

   (a) The recycled water is an oxidized and disinfected wastewater;
   (b) The recycled water is used at the site where it is generated or at an auxiliary wastewater or sludge treatment facility that is subject to the same NPDES or WPCF permit as the wastewater treatment system. Contiguous property to the parcel of land upon which the treatment system is located is considered the wastewater treatment system site if under the same ownership;

(c) Spray or drift or both from the use does not occur off the site; and
(d) Public access to the site is restricted.

4. Unless otherwise approved in writing by the Department, a deep-rooted, permanent grass cover must be maintained on the land irrigation area at all times. Grass must be periodically cut and removed to ensure maximum evapotranspiration and nutrient capture.

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

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

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

   b. The permittee's wastewater system must not be without supervision (as required by Special Condition 5.a. above) for more than thirty (30) days. During this period, and at any time that the supervisor is not available to respond on-site (i.e. vacation, sick leave or off-call), the permittee must make available another person who is certified at no less than one grade lower than the system classification.

   c. If the wastewater system has more than one daily shift, the permittee must have the shift supervisor, if any, certified at no less than one grade lower than the system classification.

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

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

   f. Upon written request, the Department may grant the permittee reasonable time, not to exceed 120 days, to obtain the services of a qualified person to supervise the wastewater system. The written request must include justification for the time needed, a schedule for recruiting and hiring, the date the system supervisor availability ceased, and the name of the alternate system supervisor as required by 5.b. above.

6. Management and Maintenance of Groundwater Monitoring Wells

   a. The permittee must protect and maintain each groundwater monitoring well so that samples collected are representative of actual conditions.

   b. All monitoring well abandonments, replacements, repairs, and installations must be conducted in accordance with the Water Resources Department Oregon Administrative Rules, Chapter 690, Division 240, and with the Department's guidance "Groundwater Monitoring Well Drilling, Construction, and Decommissioning", dated August 22, 1992. All monitoring well abandonments, replacements, repairs, and installations must be documented in a report prepared by an Oregon registered geologist.

c. If a monitoring well becomes damaged or inoperable, the permittee must notify the Department in writing within 14 days of when the permittee becomes aware of the circumstances. The written report must describe: what problem has occurred, the remedial measures that have been or will be taken to correct the problem, and the measures taken to prevent the recurrence of damage or inoperation. The Department may require the replacement of inoperable monitoring wells.

d. Prior to installation of new or replacement monitoring wells, the placement or design must be approved in writing by the Department. Well logs and a well completion report must be submitted to the Department within 30 days of installation of the well. The report must include a survey drawing showing the location of all monitoring wells, disposal sites, and water bodies.

e. Prior to abandonment of existing wells deemed unsuitable for groundwater monitoring, an abandonment plan must be submitted to the Department for review and approval.

SCHEDULE F

WPCF GENERAL CONDITIONS – DOMESTIC FACILITIES

SECTION A. STANDARD CONDITIONS

1. Duty to Comply with Permit

The permittee must comply with all conditions of this permit. Failure to comply with any permit condition is a violation of Oregon Revised Statutes (ORS) 468B.025 and grounds for an enforcement action. Failure to comply is also grounds for the Department to modify, revoke, or deny renewal of a permit.

2. Property Rights and Other Legal Requirements

Issuance of this permit does not convey any property rights of any sort, or any exclusive privilege, or authorize any injury to persons or property or invasion of any other rights, or any infringement of federal, tribal, state, or local laws or regulations.

3. Liability

The Department of Environmental Quality or its officers, agents, or employees may not sustain any liability on account of the issuance of this permit or on account of the construction or maintenance of facilities or systems because of this permit.

4. Permit Actions

After notice by the Department, this permit may be modified, suspended, or revoked in whole or in part during its term for cause including but not limited to the following:

a. Violation of any term or condition of this permit, any applicable rule or statute, or any order of the Commission;

b. Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts.

5. Transfer of Permit

This permit may not be transferred to a third party without prior written approval from the Department. The Department may approve transfers where the transferee acquires a property interest in the permitted activity and agrees in writing to fully comply with all the terms and conditions of this permit and the rules of the Commission. A transfer application and filing fee must be submitted to the Department.

6. Permit Fees

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

SECTION B. OPERATION AND MAINTENANCE OF POLLUTION CONTROLS

1. Proper Operation and Maintenance

At all times the permittee must maintain in good working order and properly operate as efficiently as possible all treatment or control facilities or systems installed or used by the permittee to comply with the terms and conditions of this permit.

2. Standard Operation and Maintenance

All waste collection, control, treatment, and disposal facilities or systems must be operated in a manner consistent with the following:

a. At all times, all facilities or systems must be operated as efficiently as possible in a manner that will prevent discharges, health hazards, and nuisance conditions.

b. All screenings, grit, and sludge must be disposed of in a manner approved by the Department to prevent any pollutant from the materials from reaching waters of the state, creating a public health hazard, or causing a nuisance condition.

c. Bypassing untreated waste is generally prohibited. Bypassing may not occur without prior written permission from the Department except where unavoidable to prevent loss of life, personal injury, or severe property damage.

3. Noncompliance and Notification Procedures

If the permittee is unable to comply with conditions of this permit because of surfacing sewage; a breakdown of equipment, facilities or systems; an accident caused by human error or negligence; or any other cause such as an act of nature, the permittee must:

a. Immediately take action to stop, contain, and clean up the unauthorized discharges and correct the problem.

b. Immediately notify the Department's Regional office so that an investigation can be made to evaluate the impact and the corrective actions taken, and to determine any additional action that must be taken.

c. Within 5 days of the time the permittee becomes aware of the circumstances, the permittee must submit to the Department a detailed written report describing the breakdown, the actual quantity and quality of waste discharged, corrective action taken, steps taken to prevent a recurrence, and any other pertinent information.

Compliance with these requirements does not relieve the permittee from responsibility to maintain continuous compliance with the conditions of this permit or liability for failure to comply.

4. Wastewater System Personnel

The permittee must provide an adequate operating staff that is duly qualified to carry out the operation, maintenance, and monitoring requirements to assure continuous compliance with the conditions of this permit.

5. Public Notification of Effluent Violation or Overflow

If effluent limitations specified in this permit are exceeded or an overflow occurs that threatens public health, the permittee must take such steps as are necessary to alert the public, health agencies and other affected entities (e.g., public water systems) about the extent and nature of the discharge in accordance with the notification procedures developed under General Condition B.6. Such steps may include, but are not limited to, posting of the river at access points and other places, news releases, and paid announcements on radio and television.

6. Emergency Response and Public Notification Plan

The permittee must develop and implement an emergency response and public notification plan that identifies measures to protect public health from overflows, bypasses or upsets that may endanger public health. At a minimum the plan must include mechanisms to:

a. Ensure that the permittee is aware (to the greatest extent possible) of such events;
b. Ensure notification of appropriate personnel and ensure that they are immediately dispatched for investigation and response;
c. Ensure immediate notification to the public, health agencies, and other affected public entities (including public water systems). The overflow response plan must identify the public health and other officials who will receive immediate notification;
d. Ensure that appropriate personnel are aware of and follow the plan and are appropriately trained;
e. Provide emergency operations; and

f. Ensure that DEQ is notified of the public notification steps taken.

SECTION C. MONITORING AND RECORDS

1. Inspection and Entry

The permittee must at all reasonable times allow authorized representatives of the Department to:

a. Enter upon the permittee's premises where a waste source or disposal system is located or where any records are required to be kept under the terms and conditions of this permit;

b. Have access to and copy any records required by this permit;

c. Inspect any treatment or disposal system, practices, operations, monitoring equipment, or monitoring method regulated or required by this permit; or

d. Sample or monitor any substances or permit parameters at any location at reasonable times for the purpose of assuring permit compliance or as otherwise authorized by state law...

2. Averaging of Measurements

Calculations of averages of measurements required for all parameters except bacteria must use an arithmetic mean; bacteria must be averaged as specified in the permit.

3. Monitoring Procedures

Monitoring must be conducted according to test procedures specified in the most recent edition of **Standard Methods for the Examination of Water and Wastewater**, unless other test procedures have been approved in writing by the Department and specified in this permit.

4. Retention of Records

The permittee must retain records of all monitoring and maintenance information, including all calibrations, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of the sample, measurement, report or application. The Department may extend this period at any time.

SECTION D. REPORTING REQUIREMENTS

1. Plan Submittal

Pursuant to Oregon Revised Statute 468B.055, unless specifically exempted by rule, construction, installation, or modification of disposal systems, treatment works, or sewerage systems may not commence until plans and specifications are submitted to and approved in writing by the Department. All construction, installation, or modification shall be in strict conformance with the Department's written approval of the plans.

2. Change in Discharge

Whenever a facility expansion, production increase, or process modification is expected to result in a change in the character of pollutants to be discharged or in a new or increased discharge that will exceed the conditions of this permit, a new application must be submitted together with the necessary reports, plans, and specifications for the proposed changes. A change may not be made until plans have been approved and a new permit or permit modification has been issued.

3. Signatory Requirements

All applications, reports, or information submitted to the Department must be signed and certified by the official applicant of record (owner) or authorized designee.

4. Twenty-Four Hour Reporting
The permittee must report any noncompliance that may endanger health or the environment. Any information must be provided orally (by telephone) to DEQ or to the Oregon Emergency Response System (1-800-452-0311) as specified below within 24 hours from the time the permittee becomes aware of the circumstances.

a. Overflows.

(1) Oral Reporting within 24 hours.

i. For overflows other than basement backups, the following information must be reported to the Oregon Emergency Response System (OERS) at 1-800-452-0311. For basement backups, this information should be reported directly to DEQ.

a) The location of the overflow;
b) The receiving water (if there is one);
c) An estimate of the volume of the overflow;
d) A description of the sewer system component from which the release occurred (e.g., manhole, constructed overflow pipe, crack in pipe); and
e) The estimated date and time when the overflow began and stopped or will be stopped.

ii. The following information must be reported to the Department's Regional office within 24 hours, or during normal business hours, whichever is first:

a) The OERS incident number (if applicable) along with a brief description of the event.

(2) Written reporting within 5 days.

i. The following information must be provided in writing to the Department's Regional office within 5 days of the time the permittee becomes aware of the overflow:

a) The OERS incident number (if applicable);
b) The cause or suspected cause of the overflow;
c) Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the overflow and a schedule of major milestones for those steps;
d) Steps taken or planned to mitigate the impact(s) of the overflow and a schedule of major milestones for those steps; and
e) (for storm-related overflows) The rainfall intensity (inches/hour) and duration of the storm associated with the overflow.

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

b. Other instances of noncompliance.

(1) The following instances of noncompliance must be reported:

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

(2) During normal business hours, the Department's Regional office must be called. Outside of normal business hours, the Department must be contacted at 1-800-452-0311 (Oregon Emergency Response System).

(3) A written submission must be provided within 5 days of the time the permittee becomes aware of the circumstances. The written submission must contain:

i. A description of the noncompliance and its cause;
ii. The period of noncompliance, including exact dates and times;
iii. The estimated time noncompliance is expected to continue if it has not been corrected;
iv. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance; and
v. Public notification steps taken, pursuant to General Condition B.6.

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

SECTION E. DEFINITIONS

1. *BOD_5* means five-day biochemical oxygen demand.
2. *TSS* means total suspended solids.

3. *FC* means fecal coliform bacteria.
4. *NH_3-N* means Ammonia Nitrogen.
5. *NO_3-N* means Nitrate Nitrogen.
6. *NO_2-N* means Nitrite Nitrogen.
7. *TKN* means Total Kjeldahl Nitrogen.
8. *Cl* means Chloride.
9. *TN* means Total Nitrogen.
10. "*Bacteria*" includes but is not limited to fecal coliform bacteria, total coliform bacteria, and E. coli bacteria.
11. *Total residual chlorine* means combined chlorine forms plus free residual chlorine.
12. *mg/l* means milligrams per liter.
13. *ug/l* means micrograms per liter.
14. *kg* means kilograms.
15. *GPD* means gallons per day.
16. *MGD* means million gallons per day.
17. *Grab sample* means an individual discrete sample collected over a period of time not to exceed 15 minutes.
18. *Composite sample* means a combination of samples collected, generally at equal intervals over a 24-hour period, and based on either time or flow.
19. *Week* means a calendar week of Sunday through Saturday.
20. *Month* means a calendar month.
21. *Quarter* means January through March, April through June, July through September, or October through December.

This page intentionally left blank.

Appendix H

O&M Cost Estimates

This page intentionally left blank.

Contractor Estimate: O&M per Service Connection

Contractor A

Task	Description	Material Cost	Labor Cost	Frequency (years)	Frequency (%)	Annual Cost per Customer	Monthly Cost per Customer
1	PM - Measure interceptor tank scum/sludge levels	$ -	$ 30.00	3	33.3%	$ 10.00	$ 0.83
2	PM - Clean Pump and surrounding effluent filter/screen	$ -	$ 30.00	3	33.3%	$ 10.00	$ 0.83
3	PM - Verify operation of control panel and float switches	$ -	$ 30.00	3	33.3%	$ 10.00	$ 0.83
4	RM - Emergency Maintenance Call Outs	$ 120.00	$ 100.00	11	9.1%	$ 20.00	$ 1.67
5	RR - Pump Replacement or Rebuild (motor or impeller stack)	$ 200.00	$ 400.00	20	5.0%	$ 30.00	$ 2.50
6	RR - Float Replacement	$ 50.00	$ 50.00	10	10.0%	$ 10.00	$ 0.83
7	RR - Misc. Components	$ 25.00	$ 50.00	10	10.0%	$ 7.50	$ 0.63
8	Septic Tank Pumping	$ 50.00	$ 250.00	10	10.0%	$ 30.00	$ 2.50
					O&M Cost Per Customer	**$ 127.50**	**$ 10.63**
						Annually	**Monthly**

Contractor B

Task	Description	Material Cost	Labor Cost	Frequency (years)	Frequency (%)	Annual Cost per Customer	Monthly Cost per Customer
1	PM - Measure interceptor tank scum/sludge levels	$ -	$ 33.33	3	33.3%	$ 11.11	$ 0.93
2	PM - Clean Pump and surrounding effluent filter/screen	$ -	$ 33.33	3	33.3%	$ 11.11	$ 0.93
3	PM - Verify operation of control panel and float switches	$ -	$ 33.34	3	33.3%	$ 11.11	$ 0.93
4	RM - Emergency Maintenance Call Outs		$ 100.00	11	9.1%	$ 9.09	$ 0.76
5	RR - Pump Replacement or Rebuild (motor or impeller stack)	$ 1,000.00	$ 100.00	20	5.0%	$ 55.00	$ 4.58
6	RR - Float Replacement	$ 50.00	$ 50.00	10	10.0%	$ 10.00	$ 0.83
7	RR - Misc. Components	$ 25.00	$ 50.00	10	10.0%	$ 7.50	$ 0.63
8	Septic Tank Pumping		$ 400.00	10	10.0%	$ 40.00	$ 3.33
					O&M Cost to Sanitary District Per Customer	**$ 154.92**	**$ 12.91**
						Annually	**Monthly**

Abbreviations:

PM	Preventative Maintenance	**AVERAGE COST ESTIMATE:**	**$ 141.21**	**$ 11.77**
RM	Reactive Maintenance	**(75%) AVERAGE COST ESTIMATE:**	**$ 105.91**	**$ 8.83**
RR	Repair & Replacement	**(125%) AVERAGE COST ESTIMATE:**	**$ 176.52**	**$ 14.71**

Contractor Estimate: STEP Collection System O&M

Task	Description	Material Cost	Labor Cost	Frequency (years)	Frequency (%)	Annual Cost	Monthly Cost
1	Pressure Main Repairs	$ 500.00	$ 500.00	3	33.3%	$ 333.33	$ 27.78
2	Air Release Valves - removal and cleaning	$ 50.00	$ 200.00	1	100.0%	$ 250.00	$ 20.83
3	Odor Control - Bioxide injection maintenance and readings	$ 50.00	$ 200.00	0.25	400.0%	$ 1,000.00	$ 83.33
					O&M Cost to Sanitary District	**$ 1,583.33**	**$ 131.94**
						Annually	**Monthly**

This page intentionally left blank.

Appendix I

Sewer Use Rate Study

This page intentionally left blank.

Sewer Rate Analysis for Loan Capacity
Terrebonne Wastewater Feasibility Study

Terrebonne MHI: $56,736
Phase A EDU: 160 EDU

Average Monthly Rate per EDU	Annual Sewer Rate Cost/EDU	Annual Sewer Rate Costs as a percentage of Terrebonne MHI[1]	Annual Rate Revenue[2]	Estimated OM&R Costs[3]	Estimated Redmond WW Treatment Charges[4]	Revenue Available for Future Debt Service	CWSRF Loan Capacity (0.96% rate, 30 year term)	USD-RD Loan Capacity (1.75% rate, 30 year term)	SPWF Loan Capacity (2.57% rate, 30 year term)	1% rate 20-yr term	2% rate 20-yr term	3% rate 20-yr term	1% rate 30-yr term	2% rate 30-yr term	3% rate 30-yr term	1% rate 40-yr term	2% rate 40-yr term	3% rate 40-yr term
$60.00	$720	1.27%	$115,200	$31,600	$31,277	$52,323	$1,358,000	$1,213,000	$1,084,000	$944,000	$855,000	$778,000	$1,350,000	$1,171,000	$1,025,000	$1,718,000	$1,431,000	$1,209,000
$61.00	$732	1.29%	$117,120	$31,600	$31,277	$54,243	$1,408,000	$1,257,000	$1,124,000	$978,000	$886,000	$807,000	$1,399,000	$1,214,000	$1,063,000	$1,781,000	$1,483,000	$1,253,000
$62.00	$744	1.31%	$119,040	$31,600	$31,277	$56,163	$1,457,000	$1,302,000	$1,164,000	$1,013,000	$918,000	$835,000	$1,449,000	$1,257,000	$1,100,000	$1,844,000	$1,536,000	$1,298,000
$63.00	$756	1.33%	$120,960	$31,600	$31,277	$58,083	$1,507,000	$1,346,000	$1,204,000	$1,048,000	$949,000	$864,000	$1,498,000	$1,300,000	$1,138,000	$1,907,000	$1,588,000	$1,342,000
$64.00	$768	1.35%	$122,880	$31,600	$31,277	$60,003	$1,557,000	$1,391,000	$1,244,000	$1,082,000	$981,000	$892,000	$1,548,000	$1,343,000	$1,176,000	$1,970,000	$1,641,000	$1,386,000
$65.00	**$780**	**1.37%**	**$124,800**	**$31,600**	**$31,277**	**$61,923**	**$1,607,000**	**$1,435,000**	**$1,284,000**	**$1,117,000**	**$1,012,000**	**$921,000**	**$1,598,000**	**$1,386,000**	**$1,213,000**	**$2,033,000**	**$1,693,000**	**$1,431,000**
$66.00	$792	1.40%	$126,720	$31,600	$31,277	$63,843	$1,657,000	$1,480,000	$1,323,000	$1,152,000	$1,043,000	$949,000	$1,647,000	$1,429,000	$1,251,000	$2,096,000	$1,746,000	$1,475,000
$67.00	$804	1.42%	$128,640	$31,600	$31,277	$65,763	$1,707,000	$1,524,000	$1,363,000	$1,186,000	$1,075,000	$978,000	$1,697,000	$1,472,000	$1,288,000	$2,159,000	$1,798,000	$1,520,000
$68.00	$816	1.44%	$130,560	$31,600	$31,277	$67,683	$1,756,000	$1,569,000	$1,403,000	$1,221,000	$1,106,000	$1,006,000	$1,746,000	$1,515,000	$1,326,000	$2,222,000	$1,851,000	$1,564,000
$69.00	$828	1.46%	$132,480	$31,600	$31,277	$69,603	$1,806,000	$1,613,000	$1,443,000	$1,256,000	$1,138,000	$1,035,000	$1,796,000	$1,558,000	$1,364,000	$2,285,000	$1,904,000	$1,608,000
$70.00	$840	1.48%	$134,400	$31,600	$31,277	$71,523	$1,856,000	$1,658,000	$1,483,000	$1,290,000	$1,169,000	$1,064,000	$1,845,000	$1,601,000	$1,401,000	$2,348,000	$1,956,000	$1,653,000
$71.00	$852	1.50%	$136,320	$31,600	$31,277	$73,443	$1,906,000	$1,702,000	$1,522,000	$1,325,000	$1,200,000	$1,092,000	$1,895,000	$1,644,000	$1,439,000	$2,411,000	$2,009,000	$1,697,000
$72.00	$864	1.52%	$138,240	$31,600	$31,277	$75,363	$1,956,000	$1,747,000	$1,562,000	$1,359,000	$1,232,000	$1,121,000	$1,944,000	$1,687,000	$1,477,000	$2,474,000	$2,061,000	$1,742,000
$73.00	$876	1.54%	$140,160	$31,600	$31,277	$77,283	$2,006,000	$1,791,000	$1,602,000	$1,394,000	$1,263,000	$1,149,000	$1,994,000	$1,730,000	$1,514,000	$2,537,000	$2,114,000	$1,786,000
$74.00	$888	1.57%	$142,080	$31,600	$31,277	$79,203	$2,056,000	$1,836,000	$1,642,000	$1,429,000	$1,295,000	$1,178,000	$2,044,000	$1,773,000	$1,552,000	$2,600,000	$2,166,000	$1,830,000
$75.00	$900	1.59%	$144,000	$31,600	$31,277	$81,123	$2,105,000	$1,880,000	$1,682,000	$1,463,000	$1,326,000	$1,206,000	$2,093,000	$1,816,000	$1,590,000	$2,663,000	$2,219,000	$1,875,000
$76.00	$912	1.61%	$145,920	$31,600	$31,277	$83,043	$2,155,000	$1,925,000	$1,722,000	$1,498,000	$1,357,000	$1,235,000	$2,143,000	$1,859,000	$1,627,000	$2,726,000	$2,271,000	$1,919,000
$77.00	$924	1.63%	$147,840	$31,600	$31,277	$84,963	$2,205,000	$1,969,000	$1,761,000	$1,533,000	$1,389,000	$1,264,000	$2,192,000	$1,902,000	$1,665,000	$2,789,000	$2,324,000	$1,963,000
$78.00	$936	1.65%	$149,760	$31,600	$31,277	$86,883	$2,255,000	$2,014,000	$1,801,000	$1,567,000	$1,420,000	$1,292,000	$2,242,000	$1,945,000	$1,702,000	$2,852,000	$2,376,000	$2,008,000
$79.00	$948	1.67%	$151,680	$31,600	$31,277	$88,803	$2,305,000	$2,058,000	$1,841,000	$1,602,000	$1,452,000	$1,321,000	$2,291,000	$1,988,000	$1,740,000	$2,915,000	$2,429,000	$2,052,000
$80.00	$960	1.69%	$153,600	$31,600	$31,277	$90,723	$2,355,000	$2,103,000	$1,881,000	$1,637,000	$1,483,000	$1,349,000	$2,341,000	$2,031,000	$1,778,000	$2,978,000	$2,481,000	$2,097,000
$81.00	$972	1.71%	$155,520	$31,600	$31,277	$92,643	$2,404,000	$2,148,000	$1,921,000	$1,671,000	$1,514,000	$1,378,000	$2,390,000	$2,074,000	$1,815,000	$3,041,000	$2,534,000	$2,141,000
$82.00	$984	1.73%	$157,440	$31,600	$31,277	$94,563	$2,454,000	$2,192,000	$1,960,000	$1,706,000	$1,546,000	$1,406,000	$2,440,000	$2,117,000	$1,853,000	$3,104,000	$2,586,000	$2,185,000
$83.00	$996	1.76%	$159,360	$31,600	$31,277	$96,483	$2,504,000	$2,237,000	$2,000,000	$1,741,000	$1,577,000	$1,435,000	$2,490,000	$2,160,000	$1,891,000	$3,167,000	$2,639,000	$2,230,000
$84.00	$1,008	1.78%	$161,280	$31,600	$31,277	$98,403	$2,554,000	$2,281,000	$2,040,000	$1,775,000	$1,609,000	$1,463,000	$2,539,000	$2,203,000	$1,928,000	$3,231,000	$2,691,000	$2,274,000
$85.00	$1,020	1.80%	$163,200	$31,600	$31,277	$100,323	$2,604,000	$2,326,000	$2,080,000	$1,810,000	$1,640,000	$1,492,000	$2,589,000	$2,246,000	$1,966,000	$3,294,000	$2,744,000	$2,318,000
$86.00	$1,032	1.82%	$165,120	$31,600	$31,277	$102,243	$2,654,000	$2,370,000	$2,120,000	$1,845,000	$1,671,000	$1,521,000	$2,638,000	$2,289,000	$2,004,000	$3,357,000	$2,796,000	$2,363,000
$87.00	$1,044	1.84%	$167,040	$31,600	$31,277	$104,163	$2,703,000	$2,415,000	$2,159,000	$1,879,000	$1,703,000	$1,549,000	$2,688,000	$2,332,000	$2,041,000	$3,420,000	$2,849,000	$2,407,000
$88.00	$1,056	1.86%	$168,960	$31,600	$31,277	$106,083	$2,753,000	$2,459,000	$2,199,000	$1,914,000	$1,734,000	$1,578,000	$2,737,000	$2,375,000	$2,079,000	$3,483,000	$2,901,000	$2,452,000
$89.00	$1,068	1.88%	$170,880	$31,600	$31,277	$108,003	$2,803,000	$2,504,000	$2,239,000	$1,948,000	$1,766,000	$1,606,000	$2,787,000	$2,418,000	$2,116,000	$3,546,000	$2,954,000	$2,496,000
$90.00	$1,080	1.90%	$172,800	$31,600	$31,277	$109,923	$2,853,000	$2,548,000	$2,279,000	$1,983,000	$1,797,000	$1,635,000	$2,836,000	$2,461,000	$2,154,000	$3,609,000	$3,007,000	$2,540,000
$91.00	$1,092	1.92%	$174,720	$31,600	$31,277	$111,843	$2,903,000	$2,593,000	$2,319,000	$2,018,000	$1,828,000	$1,663,000	$2,886,000	$2,504,000	$2,192,000	$3,672,000	$3,059,000	$2,585,000
$92.00	$1,104	1.95%	$176,640	$31,600	$31,277	$113,763	$2,953,000	$2,637,000	$2,359,000	$2,052,000	$1,860,000	$1,692,000	$2,935,000	$2,547,000	$2,229,000	$3,735,000	$3,112,000	$2,629,000
$93.00	$1,116	1.97%	$178,560	$31,600	$31,277	$115,683	$3,003,000	$2,682,000	$2,398,000	$2,087,000	$1,891,000	$1,721,000	$2,985,000	$2,590,000	$2,267,000	$3,798,000	$3,164,000	$2,673,000
$94.00	$1,128	1.99%	$180,480	$31,600	$31,277	$117,603	$3,052,000	$2,726,000	$2,438,000	$2,122,000	$1,922,000	$1,749,000	$3,035,000	$2,633,000	$2,305,000	$3,861,000	$3,217,000	$2,718,000
$95.00	$1,140	2.01%	$182,400	$31,600	$31,277	$119,523	$3,102,000	$2,771,000	$2,478,000	$2,156,000	$1,954,000	$1,778,000	$3,084,000	$2,676,000	$2,342,000	$3,924,000	$3,269,000	$2,762,000
$96.00	$1,152	2.03%	$184,320	$31,600	$31,277	$121,443	$3,152,000	$2,815,000	$2,518,000	$2,191,000	$1,985,000	$1,806,000	$3,134,000	$2,719,000	$2,380,000	$3,987,000	$3,322,000	$2,807,000
$97.00	$1,164	2.05%	$186,240	$31,600	$31,277	$123,363	$3,202,000	$2,860,000	$2,558,000	$2,226,000	$2,017,000	$1,835,000	$3,183,000	$2,762,000	$2,417,000	$4,050,000	$3,374,000	$2,851,000
$98.00	$1,176	2.07%	$188,160	$31,600	$31,277	$125,283	$3,252,000	$2,904,000	$2,597,000	$2,260,000	$2,048,000	$1,863,000	$3,233,000	$2,805,000	$2,455,000	$4,113,000	$3,427,000	$2,895,000
$99.00	$1,188	2.09%	$190,080	$31,600	$31,277	$127,203	$3,302,000	$2,949,000	$2,637,000	$2,295,000	$2,079,000	$1,892,000	$3,282,000	$2,848,000	$2,493,000	$4,176,000	$3,479,000	$2,940,000
$100.00	**$1,200**	**2.12%**	**$192,000**	**$31,600**	**$31,277**	**$129,123**	**$3,351,000**	**$2,993,000**	**$2,677,000**	**$2,330,000**	**$2,111,000**	**$1,921,000**	**$3,332,000**	**$2,891,000**	**$2,530,000**	**$4,239,000**	**$3,532,000**	**$2,984,000**

Notes:

1. Terrebonne Median Household Income (MHI) is $56,736, according to US Census Data (2020). Monthly rates were multiplied by 12 months for an annual sewer cost and divided by Terrebonne MHI
2. Revenue potential determined by assuming that the District will connect 160 EDUs in Phase A, and using the following formula: Revenue = 160 EDU x 12 months x Monthly Rate per EDU
3. Estimated OM&R costs are based on estimates from contractor: $127.50/EDU/year, $1,600/year for collection system maintenance, and $5/EDU/month for billing and administration
4. Based on assumed rate of $16.29/EDU/month
5. Loan rates and terms are described further in Chapter 6 of the Preliminary Engineering Report

CWSRF = Clean Water State Revolving Fund
EDU = Equivalent Dwelling Unit
OM&R = Operations, Maintenance, and Replacement
SPWF = Special Works Project Fund
USDA = United States Department of Agriculture - Rural Development

Appendix J

Onsite Installation Cost Estimates

This page intentionally left blank.

Contractor Estimate: Residential Connection with Septic Tank Retrofit (R1)

Contractor A

Task	Description	Unit	Quantity	Unit Cost	Subtotal
1	Install Orenco ProPak (BPP10DD, PF1005 pump) in existing septic tank downstream riser	1	LS	$ 3,735.44	$ 3,735.44
2	Install Orenco Control Panel (material included w/ Orenco unit)	1	LS	$ 350.00	$ 350.00
3	Install 30A breaker on service panel, 120 VAC	1	LS	$ 365.00	$ 365.00
4	Route 10 AWG wire in conduit, connect service panel to control panel	50	LF	$ 21.95	$ 1,097.50
5	Install 1" PVC SCH 80 pressure sewer servce piping, 3 ft min cover	100	LF	$ 18.00	$ 1,800.00
6	Install 1" Check Valve	1	EA	$ 100.00	$ 100.00
7	Install 1" Ball Valve	1	EA	$ 100.00	$ 100.00
8	Install 12" Dia. PVC Valve Access riser with Fiberglass Gasketed lid	1	EA	$ 300.00	$ 300.00
9	Connect to 8" pressure main with 1" saddle tap	1	EA	$ 1,150.00	$ 1,150.00
	Construction Subtotal				$ 8,997.94
	Construction Contingency (%)			10	$ 899.79
	Contractor Profit (%)			10	$ 899.79
	GRAND TOTAL				**$ 10,797.53**

Contractor B

Task	Description	Unit	Quantity	Unit Cost	Subtotal
1	Install Orenco ProPak (BPP10DD, PF1005 pump) in existing septic tank downstream riser	1	LS	$ 3,185.44	$ 3,185.44
2	Install Orenco Control Panel (material included w/ Orenco unit)	1	LS	$ 809.60	$ 809.60
3	Install 30A breaker on service panel, 120 VAC	1	LS	$ 352.00	$ 352.00
4	Route 10 AWG wire in conduit, connect service panel to control panel	50	LF	$ 23.93	$ 1,196.50
5	Install 1" PVC SCH 80 pressure sewer service piping, 3 ft min cover	100	LF	$ 26.40	$ 2,640.00
6	Install 1" Check Valve	1	EA	$ 26.79	$ 26.79
7	Install 1" Ball Valve	1	EA	$ 15.00	$ 15.00
8	Install 12" Dia. PVC Valve Access riser with Fiberglass Gasketed lid	1	EA	$ 78.00	$ 78.00
9	Connect to 8" pressure main with 1" saddle tap	1	EA	$ 1,197.00	$ 1,197.00
	Construction Subtotal				$ 9,500.33
	Construction Contingency (%)			10	$ 950.03
	Contractor Profit (%)			10	$ 950.03
	GRAND TOTAL				**$ 11,400.40**

AVERAGE COST ESTIMATE: $ 11,098.96

(75%) AVERAGE COST ESTIMATE: $ 8,324.22

(125%) AVERAGE COST ESTIMATE: $ 13,873.70

Contractor Estimate: Residential Connection with Septic Tank Replacement (R2)

Contractor A

Task	Description	Unit	Quantity	Unit Cost	Subtotal
1	Remove existing 1000 gallon septic tank, dispose of properly	1	LS	$ 3,000.00	$ 3,000.00
2	Install 1000 gallon Prelos Processor, connect to waste line	1	LS	$ 8,550.00	$ 8,550.00
3	Install Orenco Control Panel (material included w/ Orenco unit)	1	LS	$ 350.00	$ 350.00
4	Install 30A breaker on service panel, 120 VAC	1	LS	$ 365.00	$ 365.00
5	Route 10 AWG wire in conduit, connect service panel to control panel	50	LF	$ 21.95	$ 1,097.50
6	Install 1" PVC SCH 80 pressure sewer servce piping, 3 ft min cover	100	LF	$ 18.00	$ 1,800.00
7	Install 1" Check Valve	1	EA	$ 100.00	$ 100.00
8	Install 1" Ball Valve	1	EA	$ 100.00	$ 100.00
9	Install 12" Dia. PVC Valve Access riser with Fiberglass Gasketed lid	1	EA	$ 300.00	$ 300.00
10	Connect to 8" pressure main with 1" saddle tap	1	EA	$ 1,150.00	$ 1,150.00
				Construction Subtotal	$ 16,812.50
			Construction Contingency (%)	10	$ 1,681.25
			Contractor Profit (%)	10	$ 1,681.25
				GRAND TOTAL	**$ 20,175.00**

Contractor B

Task	Description	Unit	Quantity	Unit Cost	Subtotal
1	Remove existing 1000 gallon septic tank, dispose of properly	1	LS	$ 1,800.00	$ 1,800.00
2	Install 1000 gallon Prelos Processor, connect to waste line	1	LS	$ 8,550.00	$ 8,550.00
3	Install Orenco Control Panel (material included w/ Orenco unit)	1	LS	$ 809.60	$ 809.60
4	Install 30A breaker on service panel, 120 VAC	1	LS	$ 352.00	$ 352.00
5	Route 10 AWG wire in conduit, connect service panel to control panel	50	LF	$ 23.93	$ 1,196.50
6	Install 1" PVC SCH 80 pressure sewer service piping, 3 ft min cover	100	LF	$ 26.40	$ 2,640.00
7	Install 1" Check Valve	1	EA	$ 26.79	$ 26.79
8	Install 1" Ball Valve	1	EA	$ 15.00	$ 15.00
9	Install 12" Dia. PVC Valve Access riser with Fiberglass Gasketed lid	1	EA	$ 78.00	$ 78.00
10	Connect to 8" pressure main with 1" saddle tap	1	EA	$ 1,197.00	$ 1,197.00
				Construction Subtotal	$ 16,664.89
			Construction Contingency (%)	10	$ 1,666.49
			Contractor Profit (%)	10	$ 1,666.49
				GRAND TOTAL	**$ 19,997.87**

AVERAGE COST ESTIMATE:	**$ 20,086.43**
(75%) AVERAGE COST ESTIMATE:	**$ 15,064.83**
(125%) AVERAGE COST ESTIMATE:	**$ 25,108.04**

Contractor Estimate: Commercial Connection with Septic Tank Retrofit (C1)

Contractor A

Task	Description	Unit	Quantity	Unit Cost	Subtotal
1	Install Orenco Propak (BPP30DD, PF3010 pump) in existing septic tank downstream riser	1	LS	$ 3,722.00	$ 3,722.00
2	Install Orenco Control Panel (material included w/ Orenco unit)	1	LS	$ 350.00	$ 350.00
3	Install 30A breaker on service panel, 240 VAC	1	LS	$ 365.00	$ 365.00
4	Route 10 AWG wire in conduit, connect service panel to control panel	50	LF	$ 21.95	$ 1,097.50
5	Install 2" PVC SCH 80 pressure sewer servce piping, 3 ft min cover	100	LF	$ 18.00	$ 1,800.00
6	Install 2" Check Valve	1	EA	$ 150.00	$ 150.00
7	Install 2" Ball Valve	1	EA	$ 150.00	$ 150.00
8	Install 12" Dia. PVC Valve Access riser with Fiberglass Gasketed lid	1	EA	$ 300.00	$ 300.00
9	Connect to 8" pressure main with 2" saddle tap	1	EA	$ 1,450.00	$ 1,450.00
			Construction Subtotal		$ 9,384.50
			Construction Contingency (%)	10	$ 938.45
			Contractor Profit (%)	10	$ 938.45
				GRAND TOTAL	**$ 11,261.40**

Contractor B

Task	Description	Unit	Quantity	Unit Cost	Subtotal
1	Install Orenco Propak (BPP30DD, PF3010 pump) in existing septic tank downstream riser	1	LS	$ 3,322.00	$ 3,322.00
2	Install Orenco Control Panel (material included w/ Orenco unit)	1	LS	$ 809.60	$ 809.60
3	Install 30A breaker on service panel, 240 VAC	1	LS	$ 365.00	$ 365.00
4	Route 10 AWG wire in conduit, connect service panel to control panel	50	LF	$ 21.95	$ 1,097.50
5	Install 2" PVC SCH 80 pressure sewer service piping, 3 ft min cover	100	LF	$ 28.01	$ 2,801.00
6	Install 2" Check Valve	1	EA	$ 21.25	$ 21.25
7	Install 2" Ball Valve	1	EA	$ 28.00	$ 28.00
8	Install 12" Dia. PVC Valve Access riser with Fiberglass Gasketed lid	1	EA	$ 78.00	$ 78.00
9	Connect to 8" pressure main with 2" saddle tap	1	EA	$ 1,197.00	$ 1,197.00
			Construction Subtotal		$ 9,719.35
			Construction Contingency (%)	10	$ 971.94
			Contractor Profit (%)	10	$ 971.94
				GRAND TOTAL	**$ 11,663.22**

AVERAGE COST ESTIMATE: $ 11,462.31

(75%) AVERAGE COST ESTIMATE: $ 8,596.73

(125%) AVERAGE COST ESTIMATE: $ 14,327.89

Contractor Estimate: Commercial Connection with Septic Tank Replacement (C2)

Contractor A

Task	Description	Unit	Quantity	Unit Cost	Subtotal
1	Remove existing septic tank, dispose of properly	1	LS	$ 3,000.00	$ 3,000.00
2	Install 3000 gallon Interceptor Tank, connect to waste line	1	LS	$ 5,500.00	$ 5,500.00
3	Install Oreco ProPak (BPP30DD, PF3010 pump) in downstream riser	1	LS	$ 3,722.00	$ 3,722.00
4	Install Orenco Control Panel (material included w/ Orenco unit)	1	LS	$ 350.00	$ 350.00
5	Install 30A breaker on service panel, 240 VAC	1	LS	$ 365.00	$ 365.00
6	Route 12 AWG wire in conduit, connect service panel to control panel	50	LF	$ 21.95	$ 1,097.50
7	Install 2" PVC SCH 80 pressure sewer servce piping, 3 ft min cover	100	LF	$ 18.00	$ 1,800.00
8	Install 2" Check Valve	1	EA	$ 150.00	$ 150.00
9	Install 2" Ball Valve	1	EA	$ 150.00	$ 150.00
10	Install 12" Dia. PVC Valve Access riser with Fiberglass Gasketed lid	1	EA	$ 300.00	$ 300.00
11	Connect to 8" pressure main with 2" saddle tap	1	EA	$ 1,450.00	$ 1,450.00
				Construction Subtotal	$ 17,884.50
			Construction Contingency (%)	10	$ 1,788.45
			Contractor Profit (%)	10	$ 1,788.45
				GRAND TOTAL	**$ 21,461.40**

Contractor B

Task	Description	Unit	Quantity	Unit Cost	Subtotal
1	Remove existing septic tank, dispose of properly	1	LS	$ 2,250.00	$ 2,250.00
2	Install 3000 gallon Interceptor Tank, connect to waste line	1	LS	$ 6,550.00	$ 6,550.00
3	Install Oreco ProPak (BPP30DD, PF3010 pump) in downstream riser	1	LS	$ 2,822.00	$ 2,822.00
4	Install Orenco Control Panel (material included w/ Orenco unit)	1	LS	$ 809.60	$ 809.60
5	Install 30A breaker on service panel, 240 VAC	1	LS	$ 365.00	$ 365.00
6	Route 12 AWG wire in conduit, connect service panel to control panel	50	LF	$ 21.95	$ 1,097.50
7	Install 2" PVC SCH 80 pressure sewer service piping, 3 ft min cover	100	LF	$ 28.01	$ 2,801.00
8	Install 2" Check Valve	1	EA	$ 21.25	$ 21.25
9	Install 2" Ball Valve	1	EA	$ 23.00	$ 23.00
10	Install 12" Dia. PVC Valve Access riser with Fiberglass Gasketed lid	1	EA	$ 78.00	$ 78.00
11	Connect to 8" pressure main with 2" saddle tap	1	EA	$ 1,197.00	$ 1,197.00
				Construction Subtotal	$ 18,014.35
			Construction Contingency (%)	10	$ 1,801.44
			Contractor Profit (%)	10	$ 1,801.44
				GRAND TOTAL	**$ 21,617.22**

AVERAGE COST ESTIMATE: $ 21,539.31

(75%) AVERAGE COST ESTIMATE: $ 16,154.48

(125%) AVERAGE COST ESTIMATE: $ 26,924.14