Lowell City Council
Regular Meeting
Tuesday, March 5, 2024 at 7:00 pm

Lowell Rural Fire Protection District Fire Station 1
389 N. Pioneer Street, Lowell, OR 97452

Members of the public may provide comment or testimony through the following:

- Joining in person or by phone, tablet, or personal computer. For details, click on the event at <www.ci.lowell.or.us>.
- Mailing written comments to PO Box 490, Lowell, OR 97452 or delivering in person at Lowell City Hall located at 70 N. Pioneer St.
- By email to admin@ci.lowell.or.us.

Regular meeting agenda

Call to Order/Roll Call/Pledge of Allegiance
Councilors: Mayor Bennett ____ Harris ____ Stratis ____ Weathers ____ Murray ____

Approval of Agenda

Presentations
1. "Wastewater Facilities Plan."
   Presenters: Matt Wadlington, PE, Principal - Civil West Engineering; Clinton Cheney, PE, Project Manager – Civil West Engineering

New Business
1. First reading and public hearing for Ordinance 312, "An Ordinance to Comply with HB 3115 by Repealing Ordinance 240; Adopting Time, Place, and Manner Regulations for Camping; Amending Regulations Regarding Hauled Wastewater Discharging to Accommodate RV Camping on Residential Property; and Repealing the Offense of Vagrancy from Title Five of the Lowell Revised Code." – Discussion/ Possible action
   a. The public hearing is now open at _____ (state time)
   b. Staff report – City Administrator Jeremy Caudle
   c. Questions/comments from the public
   d. Questions/comments from the City Council
   e. The public hearing is now closed
   f. First reading of Ordinance 312. Recommended motion: "I move to approve a first reading of Ordinance 312 by title only."

The meeting location is accessible to pesons with disabilities. A request for an interpreter for the hearing impaired of other accommodations for persons with disabilities must be made at least 48 hours before the meeting to City Clerk Sam Dragt at 541-937-2157.

g. Schedule second reading. Recommended motion: "I move to schedule a second reading for Ordinance 312 at the March 19, 2024 regular City Council meeting."

Adjourn

Agenda Item Sheet

City of Lowell City Council

Type of item:	Presentation

Item title/recommended action:

"Wastewater Facilities Plan."
Presenters: Matt Wadlington, PE, Principal - Civil West Engineering; Clinton Cheney, PE, Project Manager – Civil West Engineering

Justification or background:

Civil West Engineering is scheduled to present the 95% draft of the "Wastewater Facilities Plan" to City Council. After the presentation, there will be an opportunity for questions from the City Council. The goal of the presentation is to obtain feedback from City Council on the draft plan. Staff will incoporate that feedback into a final draft for approval at a later meeting depending on how many iterations are necessary to address City Council's questions and comments. Approval by the Oregon Department of Environmental Quality will be required to finalize the plan.

Budget impact:

N/A

Department or Council sponsor:

Public Works

Attachments:

Slides for the meeting; copy of the draft plan.

Meeting date:	03/05/2024

City of Lowell
Wastewater Facility Plan

3/5/2024

Lowell

Civil West Engineering Services, Inc.

Agenda

1. Wastewater Facility Planning Process
2. Description of Existing Wastewater Infrastructure
3. Expected Growth during the Planning Period (to 2045)
4. Issues Identified and Solutions
5. Capital Improvement Plan

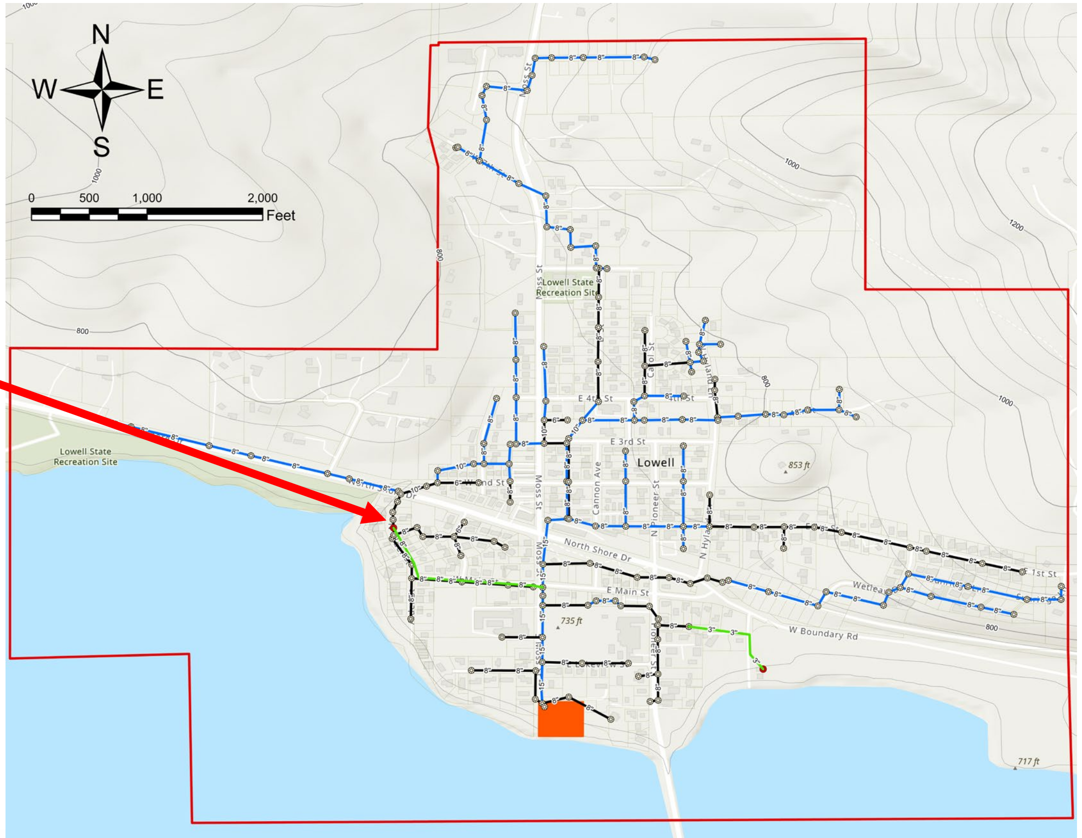
Facility Planning

- Plan wastewater utility improvements for upcoming planning period
- Main steps of the Facility Planning process:
  - Review and assess existing system components
  - Develop growth projections
  - Define regulatory and capacity requirements
  - Identify system deficiencies and review improvement alternatives
  - Select best alternatives and develop Capital Improvement Plan

Existing Facilities - Collection

- 20,000 feet of gravity sewer
- 1 major municipal lift station
  - Recent overflow issues
- Mostly original to the 1950 ACE system
- Significant Inflow and Infiltration
  - >20x peaking factor during 5-year storm events

Alder Street Lift Station



Existing Facilities - Treatment

- Treatment system: Trickling Filter/Solids Contact with chlorine disinfection
- Most recently upgraded 2004
  - New headworks and aerobic digester
- Treated wastewater discharged to penstocks of Dexter Dam
- Biosolids hauled to external facility in Roseburg

Lowell

Expected Growth

- Current Population:1,250
- Population Projection:
  1,618 people in 2045
- Wastewater Flows:
  - Average Day:
    - 0.08 million gallons per day (2023)
    - 0.10 million gallons per day (2045)
  - Peak:
    - 2.7 million gallons per day (2023)
    - 2.8 million gallons per day (2045)

Year	Population	Projected Population Increase
2023	1,250	
2024	1,264	15
2025	1,279	15
2026	1,294	15
2027	1,310	15
2028	1,325	15
2029	1,341	16
2030	1,357	16
2031	1,373	16
2032	1,389	16
2033	1,405	16
2034	1,422	17
2035	1,439	17
2036	1,456	17
2037	1,473	17
2038	1,490	17
2039	1,508	18
2040	1,526	18
2041	1,544	18
2042	1,562	18
2043	1,580	18
2044	1,599	19
2045	**1,618**	**19**
Buildout	4,145	2,527

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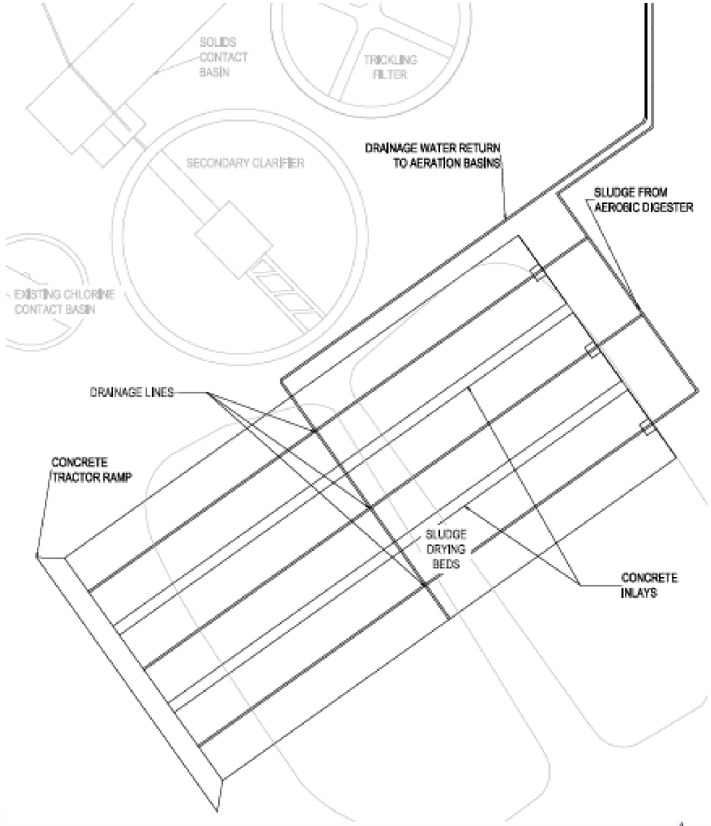
Issues Identified and Proposed Solutions

1. Significant Inflow and Infiltration issues in Collection System
   - Patching/lining of the two main collector pipes for the Alder Street Lift Station
   - CCTV potentially cross-connected stormdrains on the corners of Moss and Lakeview and Moss and Cannon
   - Full manhole replacements: 1st and Wetleau, 4th and Hyland, Main and Pioneer
   - Various Manhole Patching/Grouting projects
   - Consistent CCTV program as budget allows throughout the planning period
2. Aerobic Digester inefficiencies
   - Replace existing rotary lobe blowers and make the necessary improvements to the aeration pipe system to enable isolation of the basins.
   - Downsizing the system would significantly decrease both electricity usage and labor requirements.

Issues Identified and Proposed Solutions

3. Alder Street Lift Station is undersized and has recently experienced overflows
   - Retrofit pump station, increase firm capacity to 490 GPM
4. Sludge drying beds unable to be operated and maintained effectively
   - Difficult for machinery to get into drying beds when clearing
   - No protection for liner or underdrains
   - Recommended to reshape drying beds, add guidewalls, and add rails to protect underdrains



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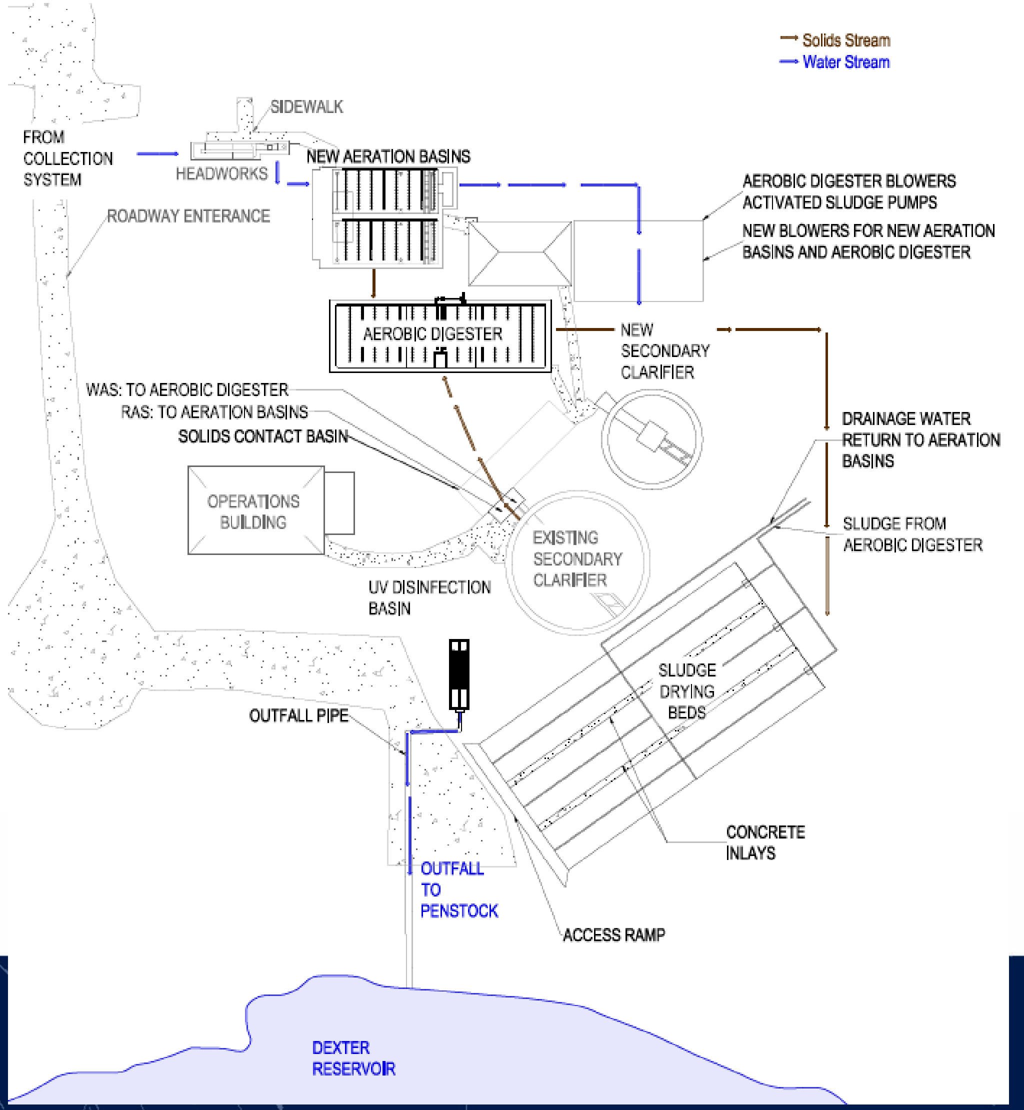
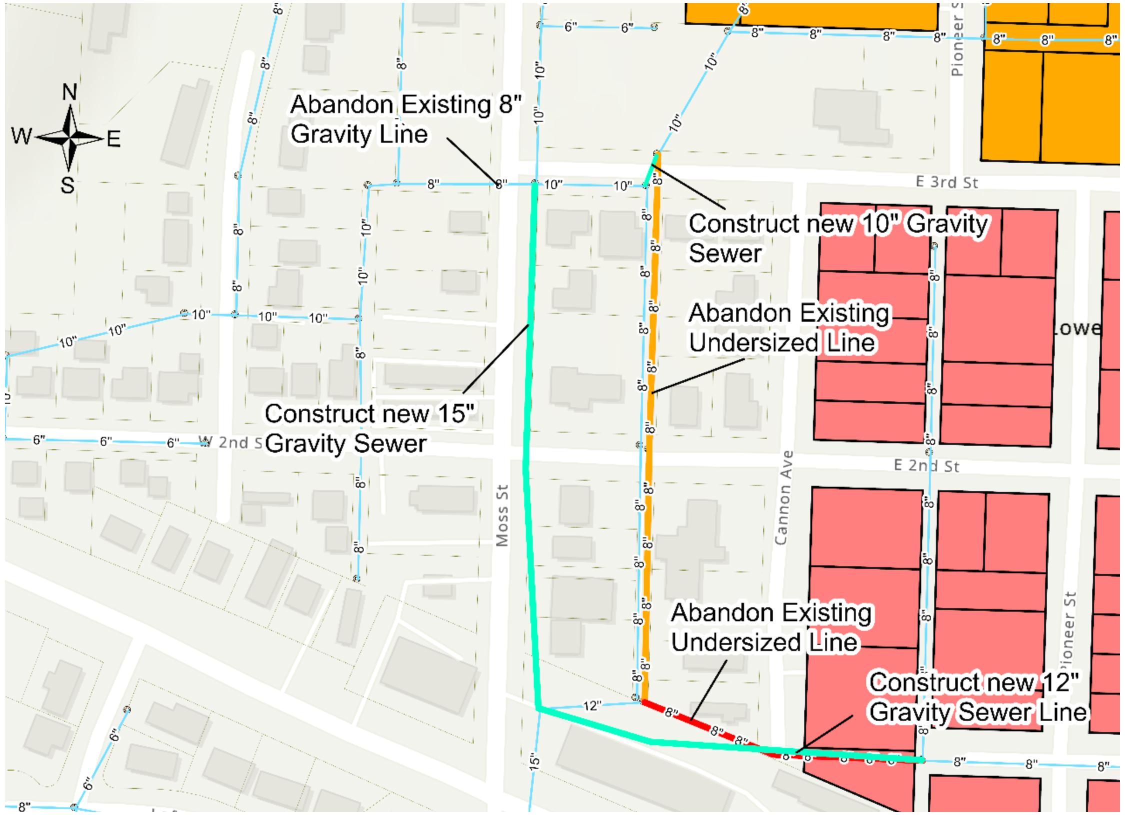
Issues Identified and Proposed Solutions

5. Treatment system lacks redundancy and is not suitable for the large seasonal flow variations
   - Transition to conventional activated sludge system
   - Add diffusers to convert primary clarifiers to aeration basins, construct new secondary clarifier in pad of existing trickling filter
   - Add an alkalinity addition system between headworks and new aeration basins
6. Disinfection system undersized and insufficient to DEQ reliability standards
   - Construct open-channel UV disinfection system and decommission chlorine system



Issues Identified and Proposed Solutions

7. Undersized pipes serving NE Lowell
   - Extend main 15” collector pipe to intersection of Moss and 3rd St
   - Abandon undersized 8” lines and reconnect ~10 properties



Capital Improvement Plan

- Prioritize I/I reduction, treatment plant efficiency upgrades, and upgrading the under-capacity lift station
- Consider fast-tracking treatment plant upgrades for rapid growth/new developments
  - Current facility struggles during high flow periods

Capital Improvement Plan: Budgetary Costs (2023$) and Schedule			
Collection System Improvements - I/I Reduction	**Budget Cost**	**Begin and Complete**	
Collection System - Spot Repair of Sewer Pipe Voids	$24,000	2024	2026
Collection System - Cross-Connection Repair	$168,000	2024	2028
Collection System - Manhole Rehabilitation	$87,200	2024	2030
Collection System - CCTV Surveillance	$22,352	2024	2045
Phase 1 Budget	***$301,552***	***2024***	***2045***
PHASE 1 - Aeration System Improvements			
WWTP - Aeration System Improvements	$280,000	2024	2026
Phase 1 Budget	***$280,000***	***2024***	***2026***
PHASE 2 - Lift Station and Biosolids Improvements			
WWTP - Biosolids Management Improvements	$342,500	2025	2030
Collection System - Alder Street Lift Station Upgrades	$376,000	2025	2030
Phase 2 Budget	***$718,500***	***2025***	***2030***
PHASE 3 - Wastewater Treatment System Upgrades			
WWTP - Activated Sludge Improvement Project	$816,000	2028	2032
WWTP - Secondary Clarifier Construction	$1,281,200	2028	2032
WWTP - Supplemental Alkalinity System	$175,840	2028	2033
WWTP - UV Disinfection System Installation	$564,800	2033	2040
Phase 3 Budget	***$2,273,040***	***2028***	***2040***
PHASE 4 - Collection System Capacity Upgrades			
Collection System - Gravity Sewer Improvements	$469,200	2030	2045
Phase 4 Budget	***$469,200***	***2030***	***2045***
Total CIP Budgetary Cost Estimates	***$4,042,292***		

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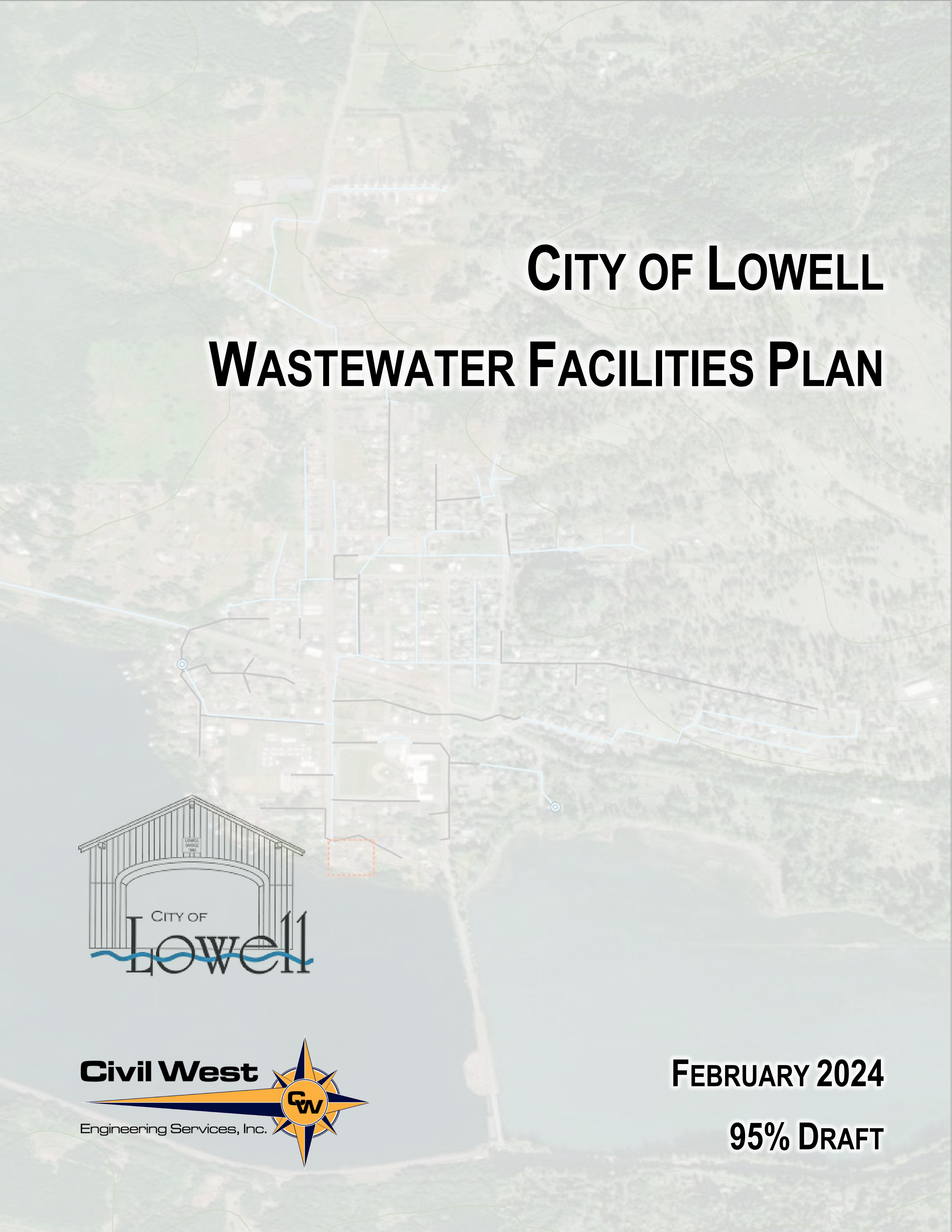
Questions?



City of Lowell

Wastewater Facilities Plan

City of Lowell

Civil West

Engineering Services, Inc.

February 2024

95% Draft

Wastewater Facilities Plan

City of Lowell

Lane County, Oregon

February 2024

City of Lowell

Civil West Engineering Services, Inc.

REGISTERED PROFESSIONAL ENGINEER
093044PE
PRELIMINARY
OREGON
NOVEMBER 14, 2023
CLINTON M. CHENEY
RENEWS: 12/31/2025

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EXECUTIVE SUMMARY

The City of Lowell's wastewater facilities consist of approximately 7 miles of sewer pipe, a major pump station, and one centralized wastewater treatment plant. The City's wastewater utility is fiscally conservative and offers reasonable service rates to its customers. This plan was prepared for the City to efficiently implement wastewater utility improvements that are protective of human health, the environment, and comply with regulatory requirements for an upcoming 20-year planning period.

The facilities are competently operated and mostly in fair condition. However, infrastructure age has caused several issues to develop in the sanitary sewage collection system and the wastewater treatment plant (WWTP). Furthermore, the City is expected to grow considerably over the next 20 years, which will necessitate facility upgrades.

Since the City's previous Wastewater Facility Plan was adopted in 2001, the number of services has increased by over 35%, land use designations in the City have changed, and regulations have become more comprehensive. Because of this, an update to the City's wastewater facility plan was necessary. This document presents several technical evaluations of the City's wastewater facilities, an analysis of alternative improvement projects to address system deficiencies, and a wastewater utility Capital Improvement Plan (CIP) for a planning period ending in 2045.

Planning Criteria

Population growth, regulatory, and land use criteria consistent with the City's Comprehensive Plan were used to guide the development of this plan. The City's population is expected to grow from approximately 1,250 people in 2023 to 1,620 in the year 2045. The City's characteristic wastewater flows are expected to grow commensurate with population (Table ES-1). A significant portion (45-85%) of the City's wastewater flow in the wet season originates from inflow and infiltration (I/I) of rainwater and groundwater throughout the collection system. A summary of current wastewater flowrates, projected 2045 flowrates, and current I/I estimates are provided in Table ES-1.

Table ES-1: Current (2023) and Projected (2045) Wastewater Flowrates in Million Gallons per Day

	2023 Flows	2045 Flows	I/I Flow
Base Sewerage	0.08	0.10	0.00
Average Dry Weather Flow	0.08	0.10	0.00
Average Wet Weather Flow	0.20	0.23	0.09
Maximum Monthly Average Dry-Weather Flow	0.29	0.32	0.18
Maximum Monthly Average Wet-Weather Flow	0.40	0.43	0.29
Peak Daily Average Flow	1.4	1.5	1.2
Peak Hour Flow	2.7	2.8	2.3

The City operates its wastewater facilities through the National Pollutant Discharge Elimination System (NPDES) under wastewater discharge permit #101384. This permit was issued June 30, 2014 (Appendix A). NPDES permits in Oregon are generally issued for 5-year periods; when a permit lapses and a new permit is not issued, as is the case for the City, the permit is administratively extended until a new permit can be issued. The City is expected to have a new discharge permit issued in 2027. At the time this new permit is issued, any changes to federal and state regulations that occurred since the last permit are incorporated.

This plan evaluated the existing facility's capacity to treat current and future wastewater flows and pollutant loads to comply with current and expected regulatory requirements. The existing WWTP facility layout is presented in Figure ES-1. The WWTP processes generally consist of screening, primary clarification, trickling filter/solids contact biological treatment, secondary clarification, and chlorine disinfection. Biosolids are stabilized in an aerobic digester and dewatered in conventional sand drying beds. Dried biosolids are sent to an external facility for additional treatment prior to land application. Treated wastewater effluent is discharged to the penstocks of Dexter Reservoir in the Middle Fork Willamette River.

Need for System Improvements

Several issues were identified in the City's wastewater facilities as in need of improvement:

- The WWTP has had multiple recent exceedances of the Biological Oxygen Demand and Total Suspended Solids limits specified in the NPDES permit. The existing biological treatment system lacks the flexibility and redundancy required for the substantial seasonal flow variations experienced by the City. Frequent violations of the permit necessitate corrective actions, including upgrades to the biological treatment system.
- The Alder Street Lift Station that conveys wastewater from the west and northwest areas of the City to the WWTP is under capacity for peak flows. This has resulted in sewage overflows, causing the City to receive civil penalties. This lift station should be upgraded to increase its firm capacity and prevent future overflows.
- Multiple areas of the City's collection system were determined to have direct sources of stormwater inflow or groundwater infiltration. This results in considerable volumes of water diluting the system and disrupting treatment during wet-weather events. A comprehensive I/I evaluation identified twenty-six direct sources of stormwater inflow and eight sections of the collection system piping with groundwater infiltration issues.
- The existing aerobic digestor that stabilizes biosolids is divided into two equally sized cells. Biological modeling of the treatment system indicates that just one of these cells would provide appropriate treatment capacity for the amount of biosolids produced at projected 2045 pollutant loads. The aeration system would need to be modified to provide operators flexibility to isolate the cells, but this would result in major electricity cost savings and more optimized solids processing.
- The existing solids dewatering process is not optimized from an operations and maintenance standpoint. The drainage pipes and bottom gravel layer in the drying beds have been severely damaged by dried solids removal activities due to a lack of guide walls and entry ramps for the machinery. The current drying beds are also oversized for the needs of the City.

- The existing system was not designed to treat ammonia, which could be required within the planning period in upcoming NPDES permit renewal cycles. Some degree of nitrification currently occurs in the treatment process, evidenced by drops in pH between the influent and effluent wastewater. Compliance with pH has been achieved by operators dosing with soda ash prior to dechlorination. Adding alkalinity prior to biological treatment would be a better solution to improve ammonia removal and provide buffering capacity against drops in pH.
- The hydraulic residence time in the chlorine contact basin is insufficient. This basin is a repurposed clarifier from the original WWTP design that experiences short circuiting due to a lack of baffling. This requires the operator to continuously add chlorine at high doses to compensate, resulting in the City overspending on disinfectant and dechlorination chemicals.

Improvement Recommendations

Multiple alternatives to address the listed issues were analyzed, and approximately $4 million worth of improvements are recommended. These recommendations are briefly described below. The projects are grouped as either I/I reduction projects, or facility improvement projects presented in recommended phases.

Inflow and Infiltration Reduction Projects

As determined via smoke testing, flow mapping, and television surveillance of the City's collection system, nine manholes were identified as having significant infiltration issues, two potential cross-connections with the stormwater drainage system were found, and the significant damage was observed on the two pipes that feed into the Alder Street Lift Station Wet Well. Recommended projects to reduce I/I sources in the City are listed below in order of priority.

- Patching/lining of the two main collector pipes for the Alder Street Lift Station
- CCTV the potentially cross-connected stormdrains on the corners of Moss and Lakeview and Moss and Cannon. Make any necessary patches/repairs.
- Full manhole replacements: 1st and Wetleau, 4th and Hyland, Main and Pioneer
- Various Manhole Patching/Grouting projects (Appendix D)
- Consistent CCTV analysis as budget allows (Appendix D)

Phase 1: Immediate Facility Improvements

Phase 1 consists of a relatively low-cost project that would make considerable improvements to WWTP operation and reduce electricity expenditures. It is recommended to complete this project as soon as possible.

- **Aerobic Digester Improvements:** The City should replace the existing rotary lobe blowers and make the necessary improvements to the aeration pipe system to enable isolation of the basins. Downsizing the system would significantly decrease both electricity usage and labor requirements.

Phase 2: High Priority Facility Improvements

The following Phase 2 improvements are recommended to be completed before 2030. The projects recommended in this phase will increase the capacity of the Alder Street Lift Station and improve the solids management system of the WWTP. Phase 2 consists of the following recommendations:

- **Upgrade Alder Street Lift Station:** The capacity of the lift station should be upgraded to meet DEQ's reliability standards. This will necessitate both pumps to be replaced. Each pump should be sized to meet a projected peak flow of 490 gpm. The upgraded lift station should have a firm pump capacity of 0.70 MGD.
- **Drying Bed Improvements:** This involves construction of concrete guide walls and replacement of the underdrain system to divide the existing pit-style drying beds into three 1,500 square feet beds. Each bed should have an entrance ramp to allow for ease of entry for machinery needed for solids removal.

Phase 3: Wastewater Treatment Facility Improvements

The recommendations in Phase 3 involve the conversion of the existing biological treatment system from a trickling filter/solids contact system into a conventional activated sludge system, and conversion of the chlorine disinfection system to a UV system. This project will improve WWTP effluent quality, reliability, and redundancy as well as simplifying operations at the WWTP. It is recommended to complete this upgrade prior to 2035. Specific timing will depend on the City's ability to obtain funding, since this is the most expensive of the phases at an estimated cost of approximately $2.3 million. Phase 3 consists of the following recommendations:

- **Conversion of Primary Clarifiers to Aeration Basins:** The existing primary clarifiers would be converted into two parallel aeration basins. A fine-pore diffuser aeration system, including new blowers, would be installed.
- **Construct Secondary Clarifier:** A new secondary clarifier would be constructed in the pad of the existing trickling filter, which would be decommissioned. This will require construction of new clarified-water and solids process lines to connect the new clarifier to the treatment system. The existing secondary clarifier would be maintained, and a splitter box would allow operator flexibility in the operation of either clarifier, or both in parallel. The new clarifier would be more appropriately sized for the City's typical wastewater flows.
- **Supplemental Alkalinity Addition:** To improve the nitrification capacity of the treatment system and to ensure compliance with pH standards of the City's NPDES permit, a chemical feed system for magnesium hydroxide should be provided upstream of the new aeration basins.
- **UV Disinfection Conversion:** The City would construct a new UV system for disinfection and decommission the existing chlorine disinfection system. This project would save the City in hypochlorite and thiosulfate chemical costs, with comparably marginal increases in electricity costs.

Phase 4: Collection Facility Improvements

Phase 4 will increase the capacity of the gravity collection system in a growing part of the City. This phase would ideally begin before 2035 and conclude before the end of the planning period in 2045. Phase 4 consists of the following recommendation:

- **Collection System Capacity Upgrade:** This project would involve upgrading two pipes in the collection system that are undersized for future growth. The City's main 15" gravity collector on Moss Street would be extended up to 3rd Street, and minor pipe improvements would connect the properties in the north and east portion of town to this collector. This will have an additional benefit of moving approximately 20 properties from the lift station sewershed to the gravity-only system.

Itemized cost estimates and proposed timelines for the proposed CIP are provided in the following table:

Table ES-2: Recommended Wastewater Utility Capital Improvement Plan

Capital Improvement Plan: Budgetary Costs (2023$) and Schedule			
Collection System Improvements - I/I Reduction	**Budget Cost**	**Begin and Complete**	
Collection System - Spot Repair of Sewer Pipe Voids	$24,000	2024	2026
Collection System - Cross-Connection Repair	$168,000	2024	2028
Collection System - Manhole Rehabilitation	$87,200	2024	2030
Collection System - CCTV Surveillance	$22,352	2024	2045
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Phase 3 Budget	***$2,273,040***	***2028***	***2040***
PHASE 4 - Collection System Capacity Upgrades			
Collection System - Gravity Sewer Improvements	$469,200	2030	2045
Phase 4 Budget	***$469,200***	***2030***	***2045***
Total CIP Budgetary Cost Estimates	***$4,042,292***		

Capital Implementation and Funding

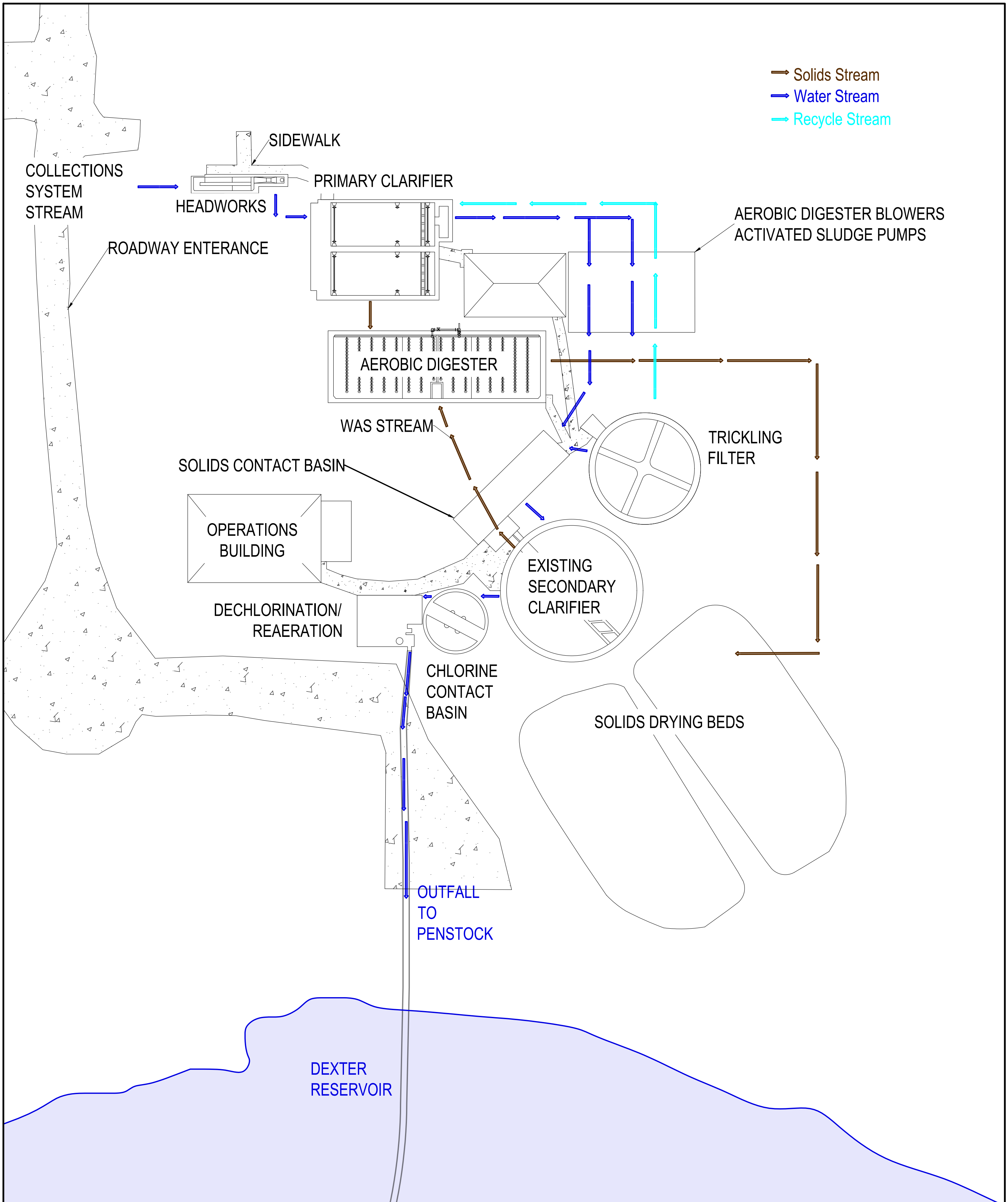
The recommended CIP will require a combination of budget funds, loans, and pursual of grant funds to complete all recommendations by the end of the planning period. A realistic goal for the City is to fund approximately $1.7 million through the City's budget, or approximately $81,000 annually (in 2023$). Most of the improvement projects listed in the CIP, aside from I/I reduction projects and optimization of the aerobic digester system, would be partially system development charge (SDC) eligible because they provide capacity for future development.

The City will likely require loans to fully fund the CIP. By pursuing grants and loans with forgivable portions, the City should aim to keep the annual debt service of the wastewater utility below $100,000 annually. Assuming a nominal 20-year loan at 3.5% interest, the City would need approximately $1.8 million in loans and $1.1 million in grants over the next 20 years to fully fund the CIP. These loan and grants funds are in addition to $1.7 million in funds from the City's capital improvement budget.

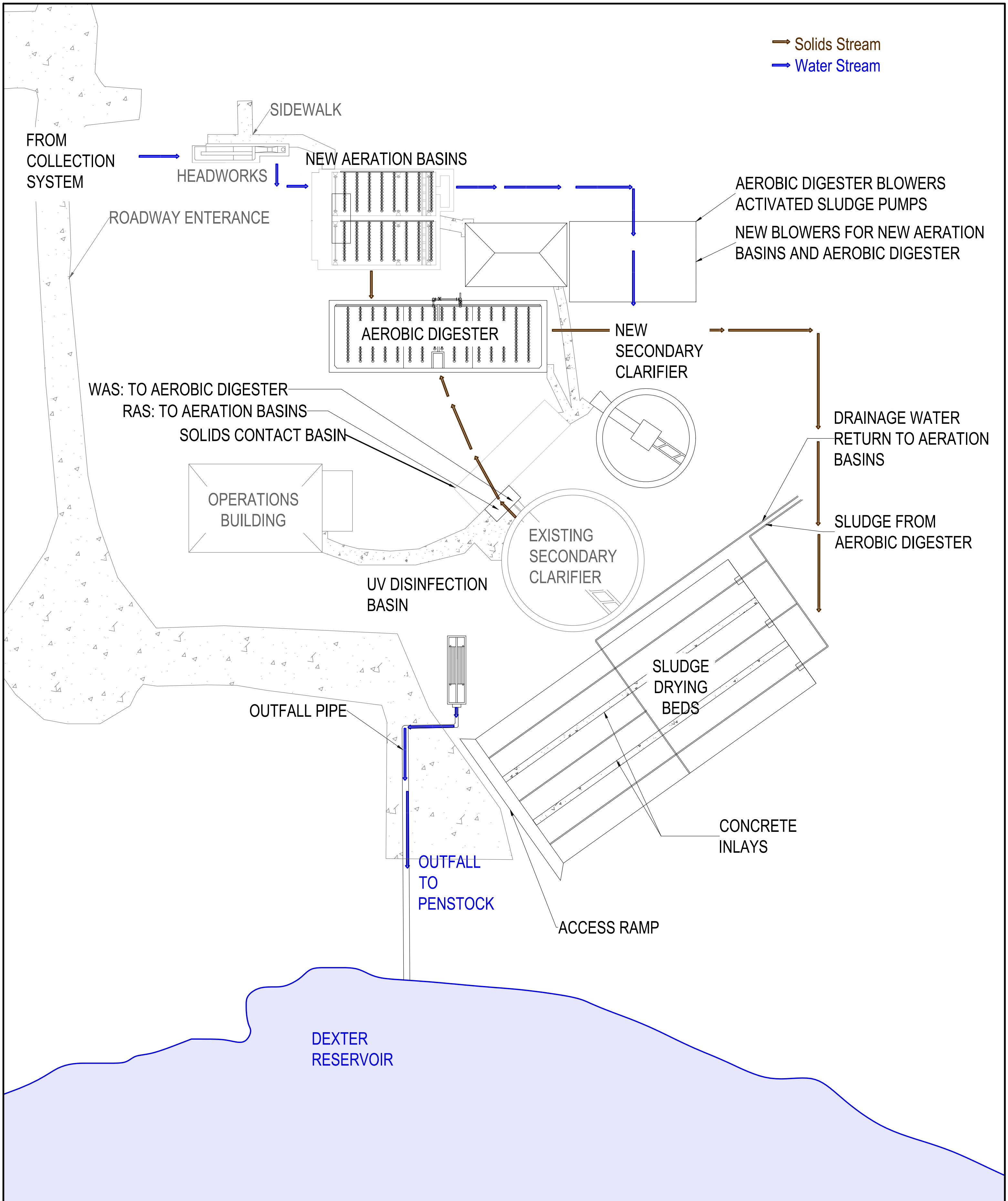
A summary of the recommended funding strategy and estimated impact on rate payers is shown in the table below.

Table ES-3: Funding Strategy and CIP Impacts on Rate Payers

Funding Strategy		
	Total Debt Service:	$1,785,546
	Budgeted Capital Funds:	$1,659,745
	Grant Funds/Forgivable Loans:	$1,124,246
	Total Costs after Financing (2023$)	$4,738,655
Sewer Rate Estimates		
Year	**Projected EDUs**	**Estimated Sewer Rate**
2024	545	$69
2025	551	$77
2030	585	$82
2040	658	$80
2045	697	$80



Civil West Engineering Services, Inc. North Coast | South Coast Willamette Valley | Rogue Valley	Drawn By: DS Date: 12/21/23	0 20 40 SCALE IN FEET 1"=40'	EXISTING WWTP	FIGURE
	LOWELL WASTEWATER FACILITY PLAN		CITY OF LOWELL LOWELL, OREGON	ES-1



Civil West Engineering Services, Inc. North Coast | South Coast Willamette Valley | Rogue Valley	Drawn By: DS Date: 12/21/23	0 20 40 SCALE IN FEET 1"=40'	POST CONSTRUCTION	FIGURE
	LOWELL WASTEWATER FACILITY PLAN		CITY OF LOWELL LOWELL, OREGON	ES-2

1 PLANNING AREA

This section provides a detailed description of the location, environmental resources, and population trends in the City of Lowell. The provision of sewer collection and wastewater treatment services by the City is consistent with the Oregon Department of Land Conservation and Development (DLCD) land use goals and the City's local comprehensive plan. The environmental and socio-economic information provided in this section should be considered in evaluations for planning, design, and operation of the City's wastewater facilities.

1.1 Location

The City is located on the east side of the Southern Willamette Valley in Lane County on the hilly transitional terrain between the Willamette Valley and the Western Cascade Mountains. There are two prominent water features near the City: the Middle Fork Willamette River and Dexter Lake. A vicinity map is provided in Figure 1-1.

As described in the City's Comprehensive Plan (March 2023), the City is approximately 17 miles southeast of Springfield and 22 miles southeast of Eugene. The primary access route to Lowell is Oregon State Highway 58. This highway provides access to the City from a bridge and causeway across Dexter Lake. Two county roads, Jasper-Lowell Road and Pengra Road, provide access to Springfield on the east side of the Middle Fork Willamette River.

1.1.1 History

The area of Lowell was originally settled in 1852 and named Cannon at the time. The town was renamed in 1882 in response to the postal service's confusion with Cannon City, Oregon. The City of Lowell was officially incorporated in 1954. Lowell was primarily a timber town until the late 1980s. Early industries in the area were hop raising, stock raising, and logging. The first population boom occurred with the construction of Lookout Point Reservoir by the U.S. Army Corps of Engineers (ACE) in 1948. Much of the town was relocated when the dam was built. In recent years, Lowell's primary employers have been the U.S. Forest Service, ACE, and the Lowell School District. Because of the City's close proximity to the Eugene-Springfield urban area, it is less than a 30-minute commute to jobs in Eugene and Springfield. To a large extent, Lowell has become primarily a residential community.

1.1.2 Service Area

The City provides utility services, including water and wastewater, to over 1,000 year-round residents. The wastewater service area is limited to the City's Urban Growth Boundary (UGB). The UGB covers an area of approximately 762 acres (1.19 square miles), of which about 290 acres are undeveloped and about 200 acres includes Dexter Lake. The UGB extends from Dexter Lake to just north of Seneca Street from South to North, and from Lowell State Park to Orchard Park from West to East.

1.1.3 Topography

The topography of the service area ranges from relatively flat for most of the town to steeper slopes and hills to the north and west of the City. According to the City's comprehensive plan, Lowell is 741 feet above sea level. Elevations around the community range from 695 feet at the full pool elevation of Dexter Lake to 2,141 feet at the summit of Disappointment Butte, immediately northeast of Lowell. The developed area of Lowell occupies portions of a small plateau 45 feet above the lake. A topographical map of the City is provided in Figure 1-2.

1.1.4 Zoning and Land Use

Land use within the City is mostly residential, with some light commercial properties. The City's Comprehensive Plan defines land use within the City's UGB. The land use definitions and most recently available zoning map are discussed below. There are no land use issues that affect the existing wastewater treatment plant facility.

Most of the City's zoning consists of single-family residential homes. In 2022, the City of Lowell completed an update to its development code resulting in the new zoning districts being added to the City's zoning criteria. The current zoning types are listed as follows:

- Single-Family Residential
- Multi-Family Residential
- Commercial
- Light Industrial
- Public Land
- *Downtown Flex-Use 1*
- *Downtown Flex-Use 2*
- *Downtown Residential Attached*
- *Downtown Residential Detached*
- *Public Lands Downtown*

The zoning types listed above in italics were added to replace the now defunct "downtown commercial" zoning type in the 2022 update to the development code. The most recently available version of the City's zoning map (2012) does not reflect these changes. However, these reclassifications do not significantly affect the scope of this wastewater planning document, since the vast majority of existing and future wastewater flow and pollutant loads are from residential uses from the single-family residential zones.

Existing land use conditions were estimated from aerial photography and from information within the City's comprehensive plan. For simplification, single-family and multi-family residential zonings were combined into one residential classification since less than 5% of the residential zones are multi-family, and that is unlikely to change within this document's planning period. The commercial and downtown zoning criteria were also combined as one commercial zoning. A breakdown of developed and buildable area per zoning type, along with existing equivalent dwelling unit (EDU) estimates, is provided in Table 1-1. A copy of the most recently available zoning map is provided in Figure 1-3.

Table 1-1: Estimates of Developed Area and Buildable Land per Zoning Type

	Developed Area (acres)	EDU Estimate	Buildable Area (acres)
Residential	126	536	66
Commercial	8.25	4	1.59
Industrial	2.07	2	5.35
Public	35.7	4	0.71
Total	**172**	**545**	**74**

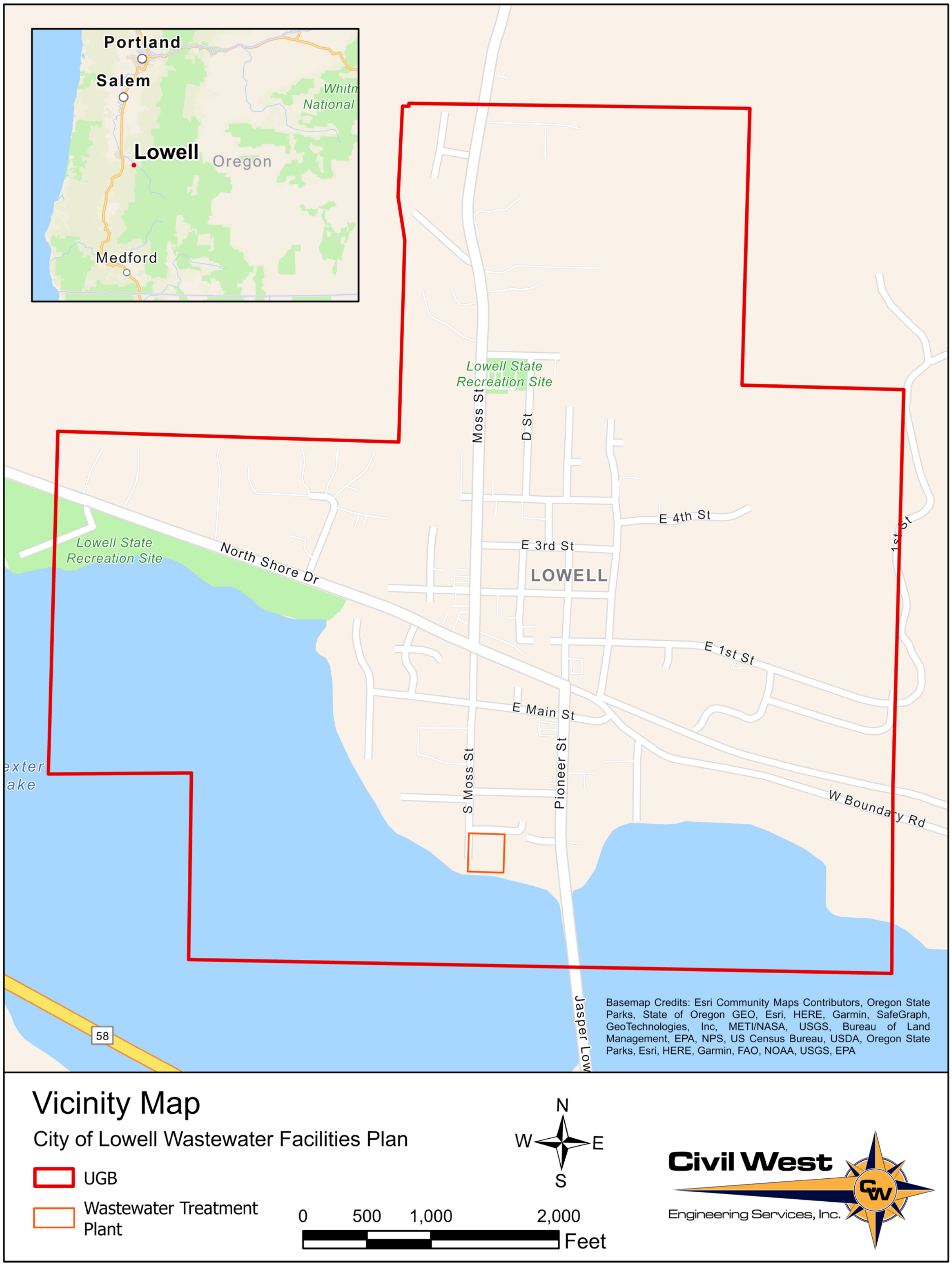


Figure 1-1: Vicinity Map of the City of Lowell

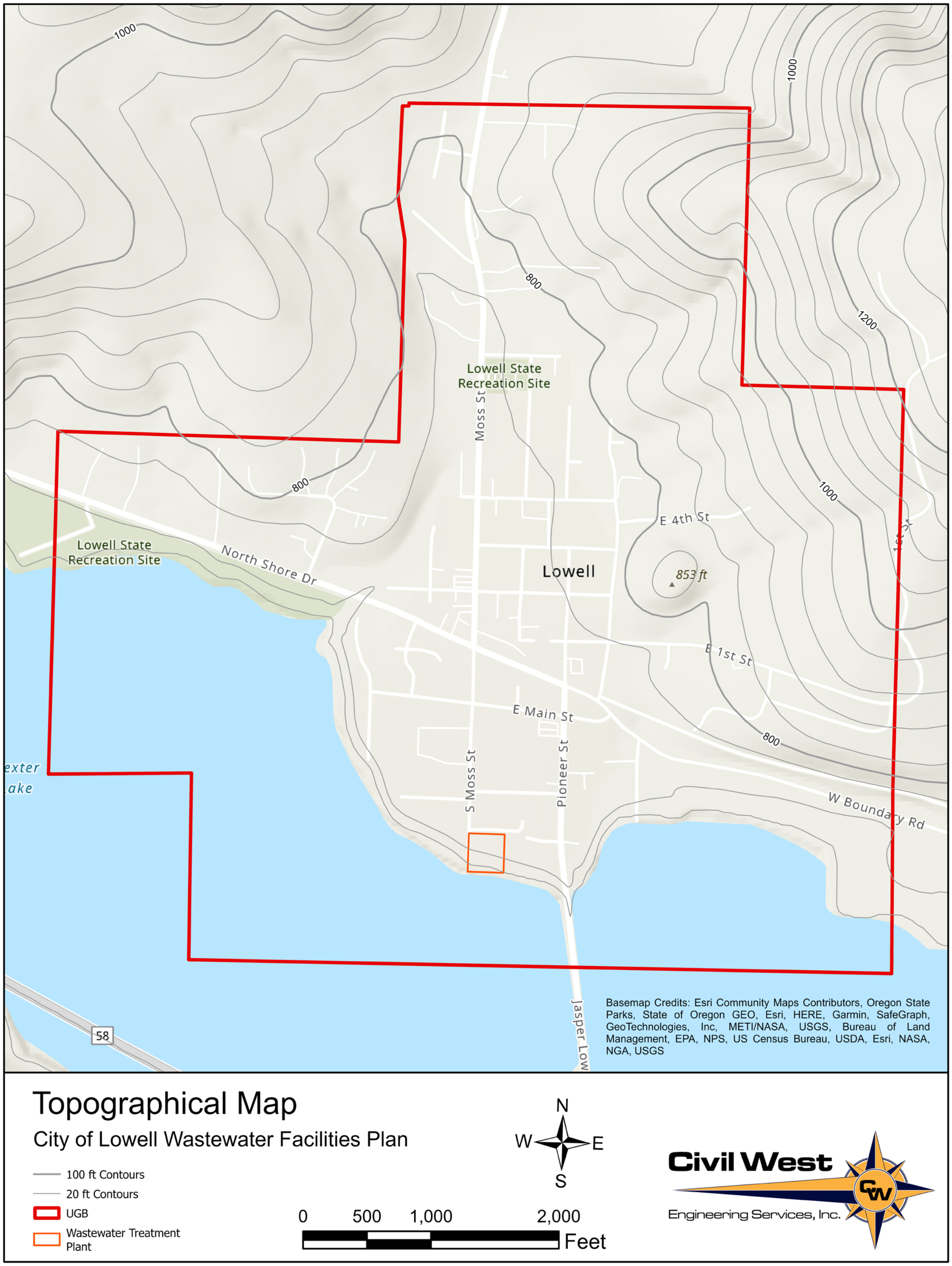


Figure 1-2: Topographical Map of the City of Lowell

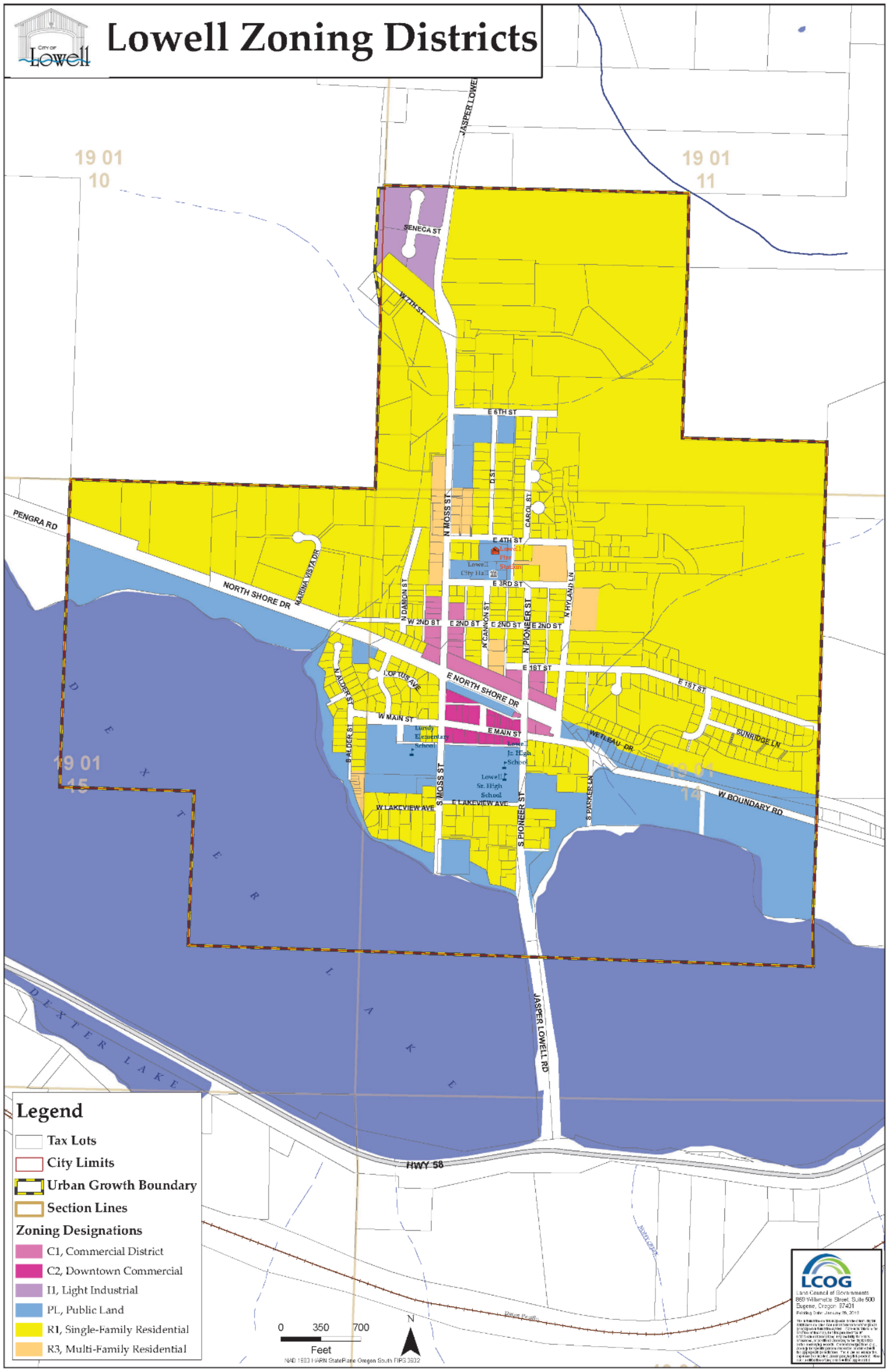


Figure 1-3: Zoning Districts in the City of Lowell

1.2 Environmental Resources

1.2.1 Water Bodies

The largest body of water near the City is Dexter Reservoir. An unnamed creek runs generally north to south toward Dexter Reservoir along the west side of the City near Moss Street. The creek confluences with a second creek that runs east to west north of East 6th Street. The City obtains its potable water from Dexter Reservoir on the east end of the City and discharges treated water from the wastewater treatment plant (WWTP) on the west end of the reservoir near the penstock of Dexter Dam.

1.2.2 Flora and Fauna

Biological resources in the area include numerous fishes, birds, insects, and plants. The U.S Fish and Wildlife Service Information for Planning and Conservation tool was used to identify species listed as endangered, threatened, or candidate and migratory birds that could potentially be affected by activities in Lowell. There were 6 listed species and 10 migratory birds determined to have habitats or migratory paths within the area. Table 1-2 presents the listed species in the planning area; Table 1-3 shows the migratory birds and their approximate breeding seasons.

Table 1-2: Endangered, Threatened, and Candidate Species with Habitats near the City of Lowell

Common Name	Scientific Name	Status
Birds		
Northern Spotted Owl	*Strix occidentalis caurina*	Threatened
Fish		
Bull Trout	*Salvelinus confluentus*	Threatened
Insects		
Fender's Blue Butterfly	*Icaricia icarioides fenderi*	Threatened
Monarch Butterfly	*Danaus plexippus*	Candidate
Flowering Plants		
Kincaid's Lupine	*Lupinus sulphureus ssp. kincaidii*	Threatened
Willamette Daisy	*Erigeron decumbens*	Endangered

Table 1-3: Birds with Migratory Paths near the City of Lowell

Common Name	Scientific Name	Breeding Season
Migratory Birds		
Bald Eagle (Non-BCC Vulnerable)	*Haliaeetus leucocephalus*	Jan 1 - Sep 30
Black Swift	*Cypseloides niger*	Jun 15 - Sep 30
California Gull	*Larus californicus*	Mar 1 - Jul 31
Clark's Grebe	*Aechmophorus clarkii*	Jun 1 - Aug 31
Evening Grossbeak	*Coccothraustes vespertinus*	May 15 - Aug 10
Golden Eagle (Non-BCC Vulnerable)	*Aquila chrysaetos*	Jan 1 - Aug 31
Olive-sided Flycatcher	*Contopus cooperi*	May 20 - Aug 31
Rofous Hummingbird	*selasphorus rufus*	Apr 15 - Jul 15
Western Grebe	*aechmophorus occidentalis*	Apr 15 - Jul 15
Wrentit	*Chamaea fasciata*	March 15 - Aug 10

1.2.3 Climate

Climate data was obtained from the Lookout Point Dam Weather Station located on Lookout Point Dam approximately one mile east of the City. According to the data gathered from National Oceanic Atmospheric Administration (NOAA) between 1999 and 2023, the maximum average monthly temperature of 81°F occurs in the months July and August whereas the minimum average monthly temperature of 37°F occurs in December. As shown in Figure 1-4, temperatures cycle annually with higher temperatures in the summer and lower temperatures in the winter. An annual average total precipitation of 42.3 inches was reported between the period of 1999 and 2023. As shown in Figure 1-5, December historically has the highest average precipitation (7.1 inches), and July has the lowest average precipitation (0.3 inches).

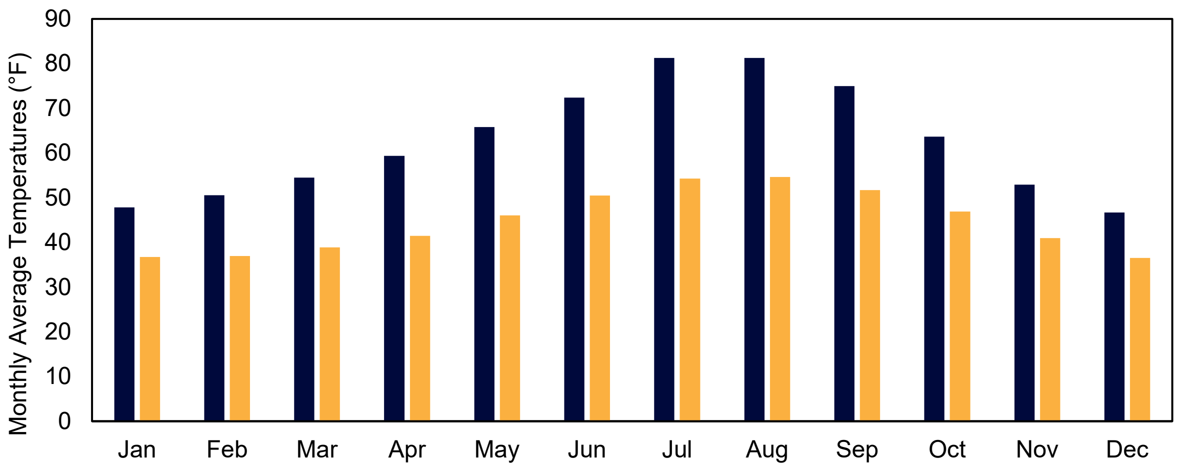


Figure 1-4: Monthly Average High (Dark Blue) and Low (Gold) Temperatures in the City of Lowell.

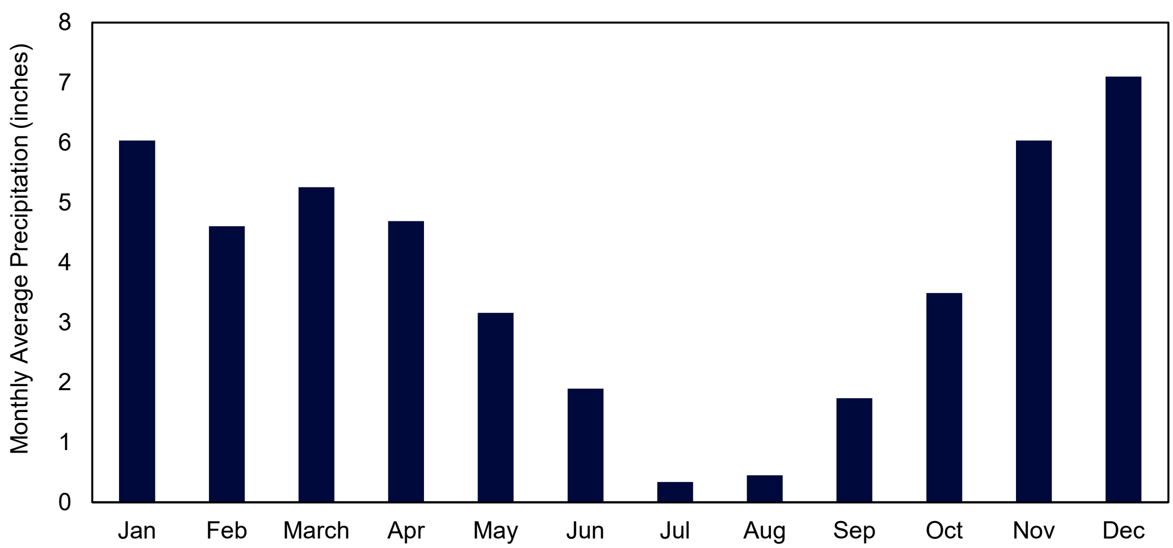


Figure 1-5: Monthly Average Cumulative Precipitation in the City of Lowell

1.2.4 Floodplains

The Federal Emergency Management Agency (FEMA) provides maps of flood zones for areas across the United States called “Flood Insurance Rate Maps” (FIRM). The FIRM detailing flood zones within and near the City of Lowell was acquired from FEMA’s Flood Map Service Center Website and is provided in Appendix B. A 100-year flood zone was identified on this FIRM directly bordering Dexter Lake. No base flood elevation is defined for this flood zone.

1.2.5 Wetlands

The U.S. Fish and Wildlife Service manages the National Wetlands Inventory (NWI) for wetlands and other aquatic habitats that may be subject to regulation under Section 404 of the Clean Water Act or other State/Federal statutes. Future projects must take wetland and aquatic habitat impacts into consideration and avoid disruptions when possible. Figure 1-6 shows the location and boundaries of the wetlands near the City of Lowell. Based on this map, Dexter Lake is the only wetland in close proximity to the City’s wastewater treatment facility.

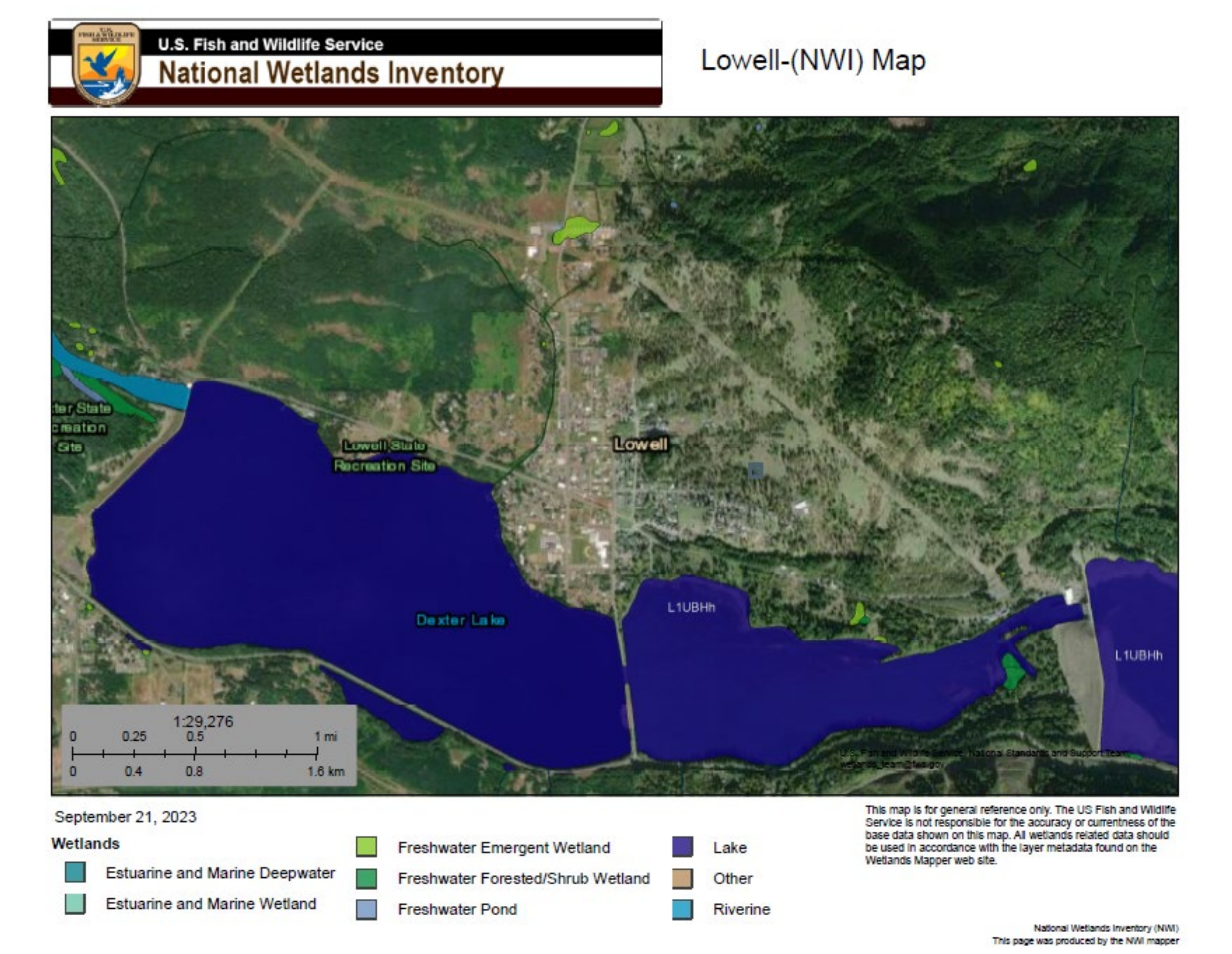


Figure 1-6: National Wetland Inventory for the City of Lowell

1.2.6 Soils

Soil data was obtained from the United States Department of Agriculture Natural Resources Conservation Service Soil Survey Web Mapper tool. A report was generated for the City's service area and is provided in Appendix C. The predominant soils in the area are Dixonville-Philomath-Hazelair complex and Hazelair silty clay loams. A summary map of soil types in the area is provided in Figure 1-7. A summary table of soil types is provided in Table 1-4.

1.2.7 Geological Hazards

Seismic hazard risks near and within the City were evaluated using the Oregon HazVu Statewide Geohazards Viewer maintained by DOGAMI. The majority of the City is classified with a “very strong” shaking hazard level. The greatest seismic risk to the region comes from the Cascadia Subduction Zone along the Pacific Coast due to the possibility of a massive earthquake. The nearest active fault is located about six miles southeast of the City at the highest point of Lookout Point Lake.

1.2.7.1 Landslides

A variety of events such as earthquakes and precipitation can cause landslides to occur. Landslide risks in the City were evaluated using the Oregon HazVu Statewide Geohazards Viewer maintained by DOGAMI. As shown in Figure 1-8, areas of moderate and high suscepitibility to landslides in the City are along the border of Dexter Lake. The Wastewater Treatment Plant is within this area.

1.2.7.2 Soil Liquifaction

Soil liquefaction, an event in which soil destabilizes and behaves more like a liquid than a solid, can be caused by strong seismic activity and can destabilize structures. Soil liquefaction risk was evaluated using the Oregon HazVu Statewide Geohazards Viewer maintained by DOGAMI. The majority of the City is at moderate risk of liquefaction.

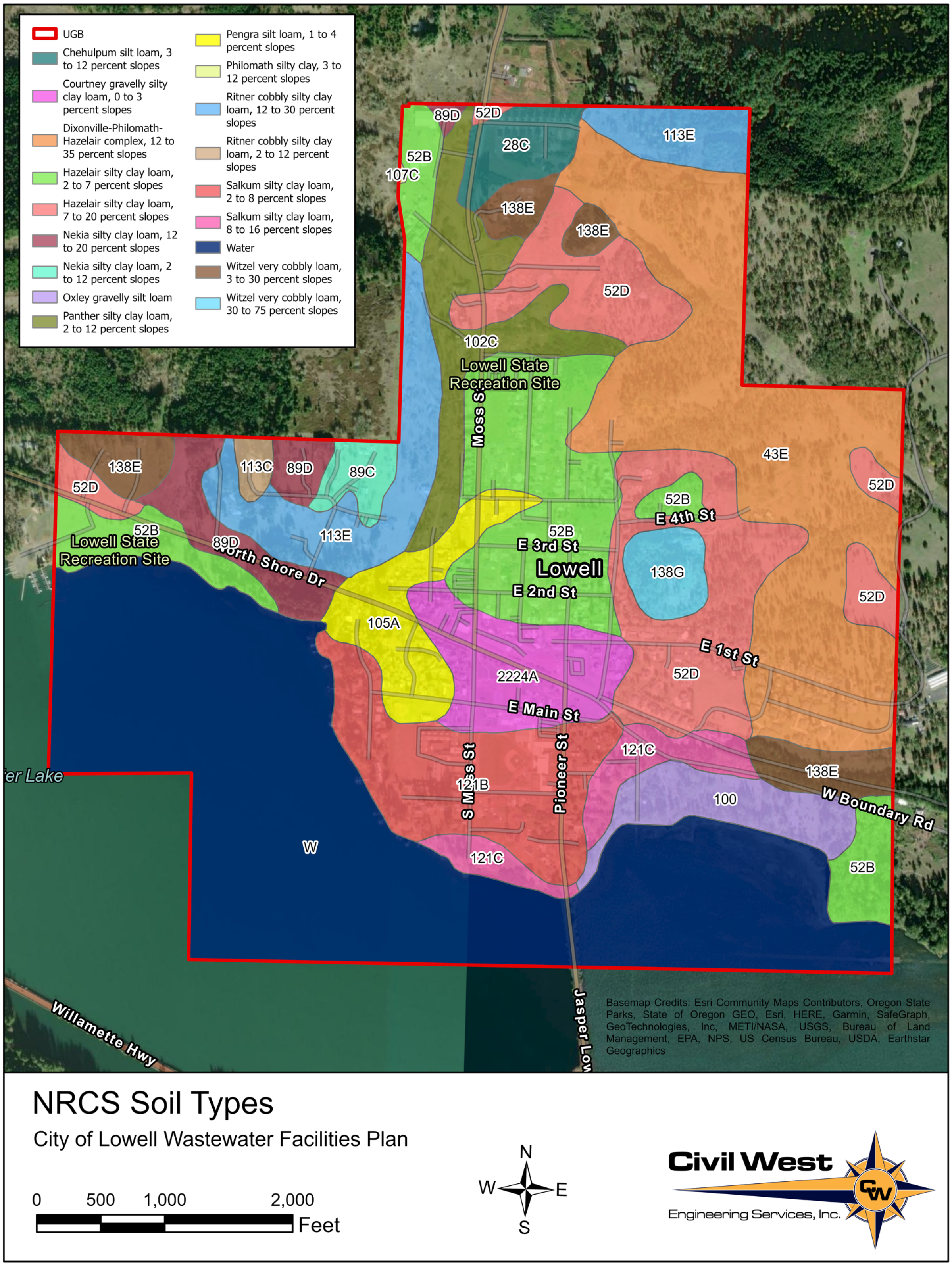


Figure 1-7: Soil Types within the City of Lowell

Table 1-4: Soil Types in the City of Lowell

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
28C	Chehulpum silt loam, 3 to 12 percent slopes	11.7	1.5%
43E	Dixonville-Philomath-Hazelair complex, 12 to 35 percent slopes	119.5	15.7%
52B	Hazelair silty clay loam, 2 to 7 percent slopes	82	10.8%
52D	Hazelair silty clay loam, 7 to 20 percent slopes	76.9	10.1%
89C	Nekia silty clay loam, 2 to 12 percent slopes	6.6	0.9%
89D	Nekia silty clay loam, 12 to 20 percent slopes	19.7	2.6%
100	Oxley gravelly silt loam	18.5	2.4%
102C	Panther silty clay loam, 2 to 12 percent slopes	29.5	3.9%
105A	Pengra silt loam, 1 to 4 percent slopes	22.9	3.0%
107C	Philomath silty clay, 3 to 12 percent slopes	0.2	0.0%
113C	Ritner cobbly silty clay loam, 2 to 12 percent slopes	2.9	0.4%
113E	Ritner cobbly silty clay loam, 12 to 30 percent slopes	41.1	5.4%
121B	Salkum silty clay loam, 2 to 8 percent slopes	46.6	6.1%
121C	Salkum silty clay loam, 8 to 16 percent slopes	15.9	2.1%
138E	Witzel very cobbly loam, 3 to 30 percent slopes	24	3.2%
138G	Witzel very cobbly loam, 30 to 75 percent slopes	9.1	1.2%
2224A	Courtney gravelly silty clay loam, 0 to 3 percent slopes	28.8	3.8%
W	Water	204.2	26.9%
	Totals	**760.1**	**100%**

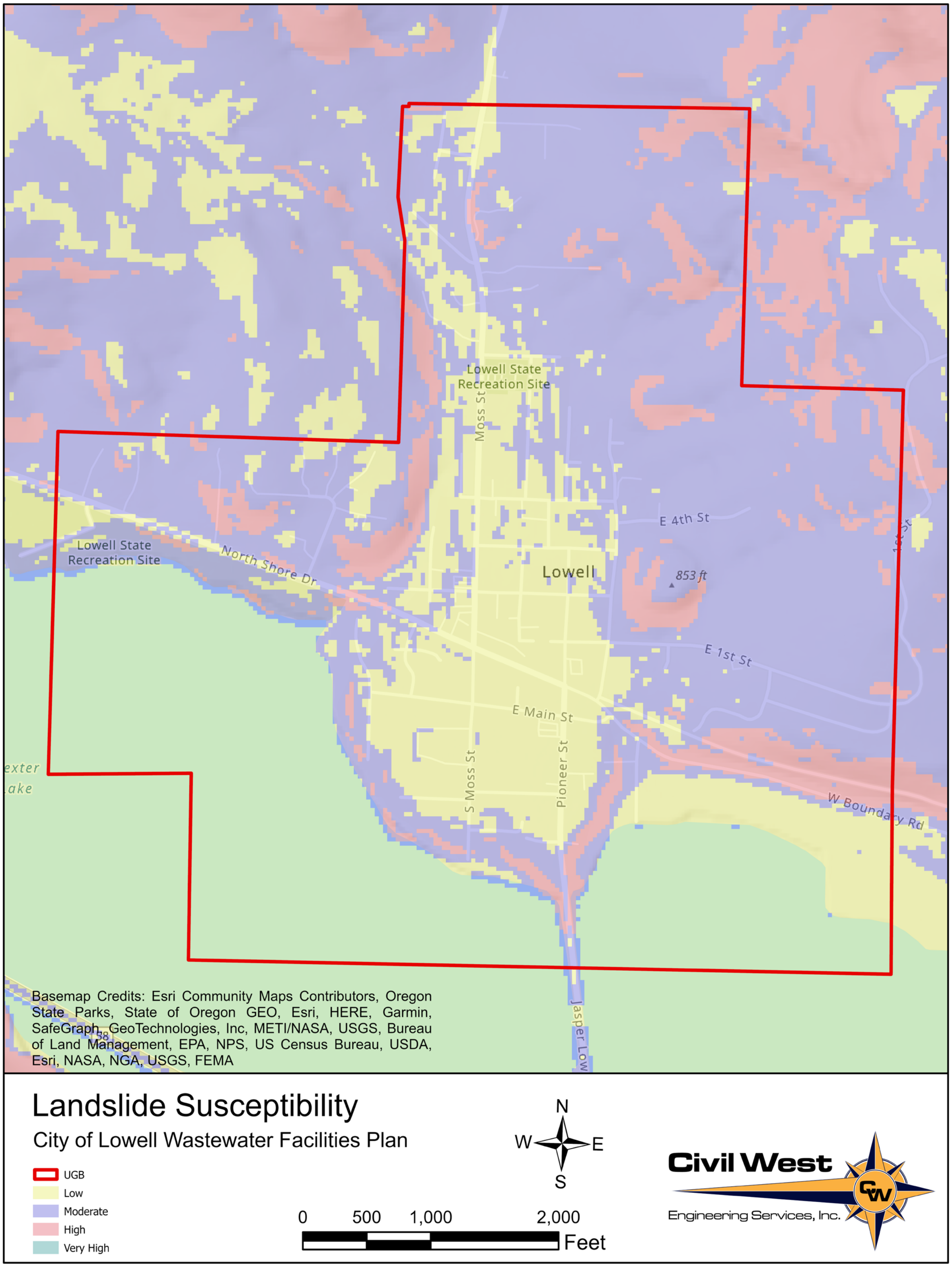


Figure 1-8: Landslide Susceptibility in the City of Lowell

1.3 Socio-Economic Resources

1.3.1 Population and Projections

Reported U.S. Census populations for the City of Lowell dating back to 1990 are presented in Table 1-5.

Table 1-5: Reported US Census Populations for the City of Lowell (1990 to 2020)

Census Year	Population
1990	785
2000	880
2010	1,045
2020	1,217

Population projections for the planning period were made using information collected from the Portland State University Population Research Center (PRC). Between 1990 and 2010, Lowell experienced an average annual growth rate (AAGR) between 1.2% and 1.7%. The PRC projected the AAGR between 2010 and 2020 to be 0.6%. Based on the US Census data of 2010 and 2020, the actual AAGR was 1.4%. The July 1, 2022 PRC population estimate is 1235. From 2020 US census data and the 2022 PRC estimate, the AAGR is approximately 1.6%. Based on the expected AAGR and current population, the population is estimated to be 1,618 people in 2045. Yearly population projections for Lowell are provided in Table 1-6.

Table 1-6: Population Projections from 2023 to 2045

Year	Population	Projected Population Increase
2023	1,250	
2024	1,264	15
2025	1,279	15
2026	1,294	15
2027	1,310	15
2028	1,325	15
2029	1,341	16
2030	1,357	16
2031	1,373	16
2032	1,389	16
2033	1,405	16
2034	1,422	17
2035	1,439	17
2036	1,456	17
2037	1,473	17
2038	1,490	17
2039	1,508	18
2040	1,526	18
2041	1,544	18
2042	1,562	18
2043	1,580	18
2044	1,599	19
2045	**1,618**	**19**
Buildout	4,145	2,527

1.3.2 Cultural Resources

According to the National Register of Historic Places, there are two historic properties located in or near the City. These are listed as:

- Lowell Bridge - near Highway 58 on Dexter Lake
- Lowell Grange - 51 E 2nd St.

Potential impacts to cultural resources should be considered during planning for wastewater collection and treatment system improvements.

1.3.3 Equivalent Dwelling Unit (EDU) Determination

An Equivalent Dwelling Unit (EDU) is used in water and wastewater master planning to show typical monthly residential usage per connection. One EDU represents the average sewer use for a single-family residence or “equivalent dwelling”.

Based on water sales records from January 2016 to December of 2020, the average quantity of water sold to a typical single-family dwelling unit on a 3/4” meter is 4,716 gallons per month. This volume sold per month becomes the basis for Equivalent Dwelling Unit (EDU) calculations with 1 EDU = 4,716 gallons of water used per month based on metered sales.

Other users can then be described as an equivalent number of EDUs based on their relative water consumption. For example, a commercial business that had an average metered consumption of 9,432 gallons per month uses twice the amount of water as the typical single-family dwelling and can be considered 2 EDUs. Total water sold for the same period indicates the total number of system EDUs in the City is 545. A breakdown of EDU types (commercial, residential and industrial) was provided earlier in Table 1-1.

1.3.4 Socioeconomic Conditions and Trends

According to the 2017-2021 American Community Survey (ACS) narrative profile, families make up most households in Lowell (65.71%) with an average household size of 2.51 people. An estimated 96.4% of the City’s population are born in the United States. More than 70% of the residents aged 25 and older had obtained a high school diploma or some community college or associate degree while slightly more than 18% had also obtained a bachelor’s degree (or higher). Figure 1-9 presents the household income distribution for the City. The median household income is $52,431. Approximately 8.4% of the population lives in poverty.

The ACS reported that 417 of 442 housing units in the City were recorded as occupied, with approximately an 80% ownership rate. The biggest portion of housing units is comprised of single-family houses. The distribution of housing unit types is presented in Figure 1-10.

1.4 Community Engagement

This plan was generated with extensive engagement of the City’s public works team. Specific activities included regular meetings, presentation of preliminary results (i.e., smoke testing, flow testing, flow analysis) and discussion of the results with the City, and regular site visits to observe operations.

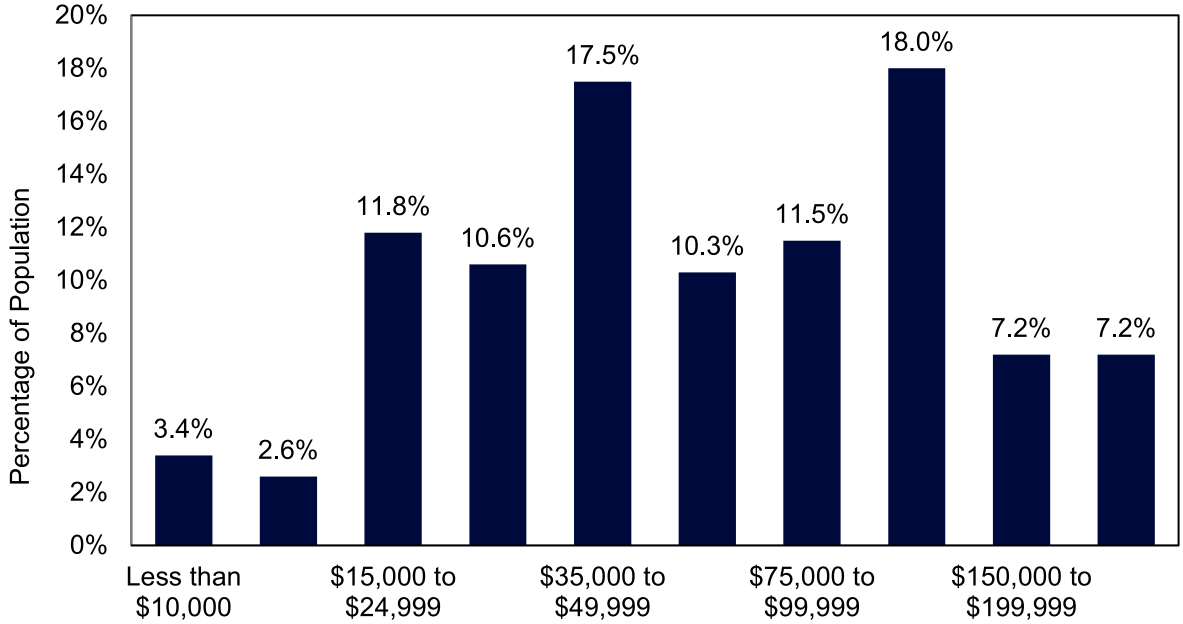


Figure 1-9: Income Distribution of the City's Population

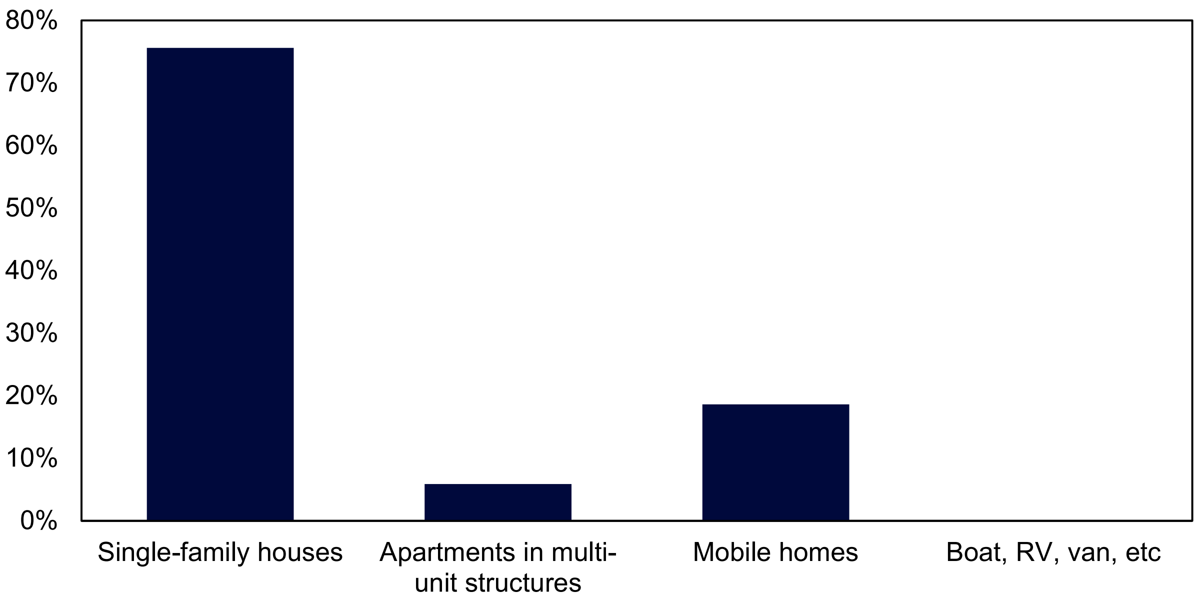


Figure 1-10: Housing Types in the City of Lowell

2 EXISTING FACILITIES

This section provides descriptions of each component of the City's existing wastewater collection and treatment facilities. Also included in this section is a description of the City's financial status with respect to the wastewater system, and an evaluation of the facilities.

2.1 Sanitary Sewer Collection System

2.1.1 Gravity Sewer

Sanitary sewer collection services are available to the population that live within the City's UGB. All wastewater collected within this area is conveyed to the WWTP for treatment and final discharge to the penstocks of Dexter Reservoir. The gravity sewer system consists of approximately 5,000 feet of 8- and 10-inch concrete pipe, 15,000 feet of 8-inch, 10-inch, and 12-inch polyvinyl chloride (PVC) pipe, and approximately 100 precast concrete manholes. The majority of the concrete pipe in the collection system was originally installed in 1950 by the U.S. Army Corps of Engineers. The system has since expanded with development and projects to replace pipe and manholes experiencing inflow and infiltration (I/I) issues. Despite the work done, the system still experiences substantial issues with I/I. An evaluation of areas in the collection system in need of immediate repair as determined by a technical I/I analysis is provided Appendix D. A comprehensive map of the collection system is provided in Figure 2-3.

2.1.2 Pressure Sewer

The Alder Street Pump Station was constructed along with the original collection system in 1950 and serves most of the properties in the City west of Moss Street, except for a few in the furthest northwest portion of the City. The pump station has essentially the same configuration today as the original construction with two pumps in a duplex submersible configuration. The pumps from the original facility were upsized around 2004.

The pumps have the firm capacity to pump 350 gpm with 1 pump operating. The pump control system includes a pressure transducer to monitor the wet well level, a control panel, back-up mercury floats for the high-level alarm, and a 20 kW stand-by generator for emergency power.

An 8" force main discharges from the Lift Station to the main 15" gravity collector on Moss Street.

Figure 2-1: Alder Street Pump Station

Figure 2-2: Alder Street Pump Station Wetwell and Intake (Left) and Emergency Overflow and Weir (Right)

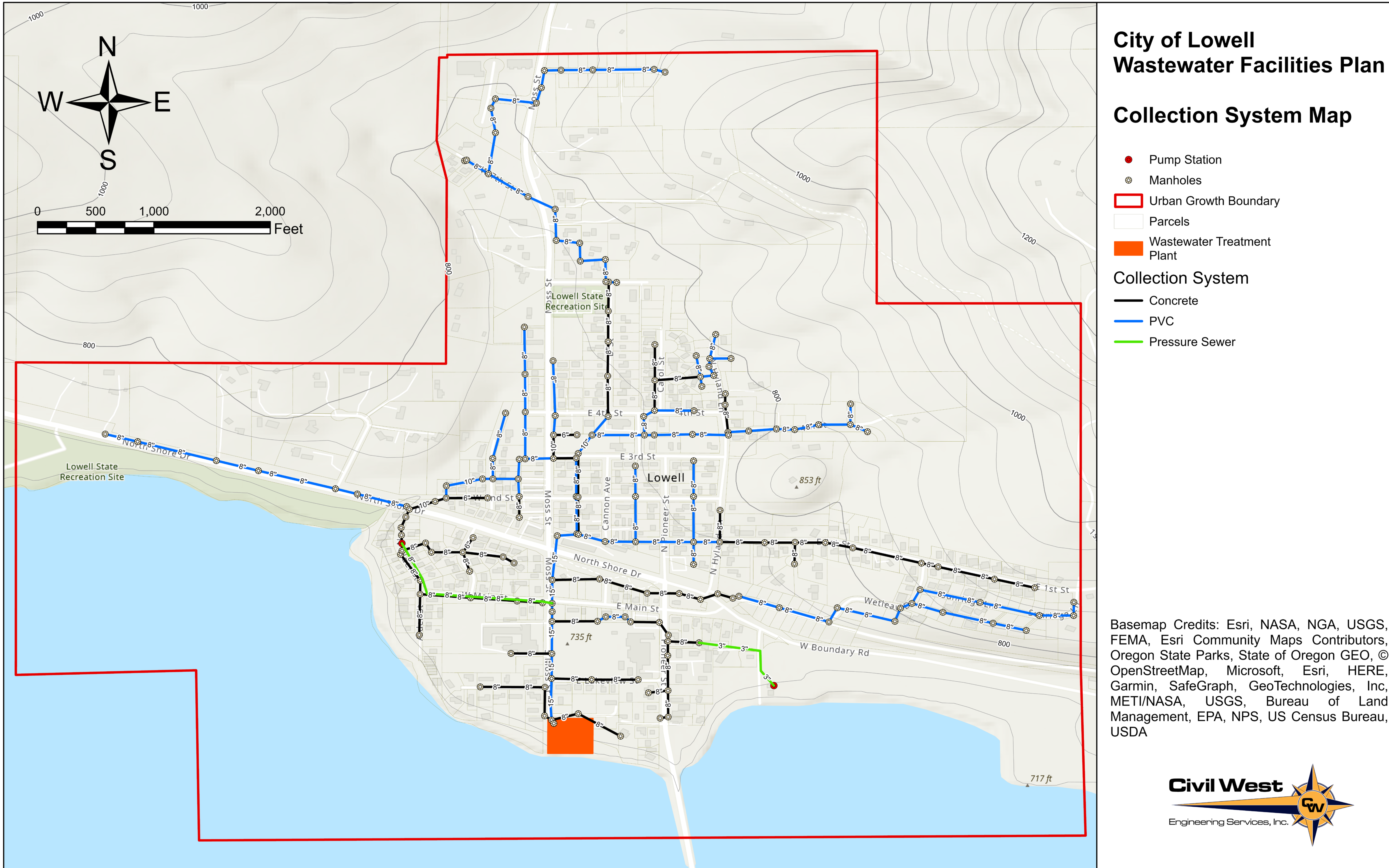


Figure 2-3: The City of Lowell Sanitary Sewer Collection System

2.2 Wastewater Treatment Plant

The WWTP treats domestic sewage by primary clarification, biological treatment, and chlorine disinfection prior to submerged discharge to Dexter Reservoir just upstream of the dam. An annotated aerial photo of the WWTP is provided in Figure 2-4. A hydraulic profile of the WWTP is provided in Figure 2-5.

The facility consists of headworks containing an inclined self-cleaning fine screen, a bypass channel with a bar screen, and a Parshall Flume for flow measurement. A rectangular primary clarifier removes solids, then primary clarified wastewater is biologically treated by a trickling filter and solids contact aeration reactor. Disinfection is accomplished by liquid sodium hypochlorite and excess chlorine is removed via calcium thiosulfate.

Final effluent is conveyed via a submerged outfall that discharges adjacent to the Dexter dam penstock. The penstock, operated by the Army Corps of Engineers (ACE) controls the outflow of the dam into the Middle Fork Willamette River. Separated solids and wasted biological sludge is stabilized via an aerobic digester, and stabilized solids are stored in drying beds prior to being removed every two years for further treatment at Heard Farms near Roseburg, OR.

2.2.1 History

The original treatment facility was designed in 1950 by ACE. At the time, the facility consisted of a bar screen, an Imhoff tank, a trickling filter, a clarifier, a chlorine contact chamber, sludge drying beds and a 10-inch outfall to the Dexter Reservoir approximately 75 feet south of the treatment plant.

The plant was upgraded in 1989 with the addition of a solids contact chamber and a new clarifier following the trickling filter. The original clarifier and chlorine contact chamber were converted to a new chlorine contact chamber and dechlorination chambers, respectively. The original outfall was replaced with the existing submerged outfall that discharges next to the dam's penstock.

In 2004, the original Imhoff tank was converted to an aerobic digester to stabilize solids. The original headworks were decommissioned, and new headworks and the primary clarifier were constructed. The sludge drying beds were deepened to increase volume and a new liner and subdrain system was installed at the base of the drying beds. The rock filter media in the trickling filter was replaced with plastic media. A scrubber was installed in the chemical dosing room to treat chlorine gas in the event of leakage, and a new baffle was installed in the chlorine contact tank to distribute flow along the entire circumference of the circular tank.

Around 2014, the gaseous chlorine disinfection system was retrofitted into a liquid sodium hypochlorite system.

City of Lowell Wastewater Treatment Plant

Wastewater Facilities Plan

0 25 50 100 Feet

N W E S

Civil West Engineering Services, Inc.

Basemap Credits: Maxar

Figure 2-4: Aerial Photography and Overview of the City's WWTP

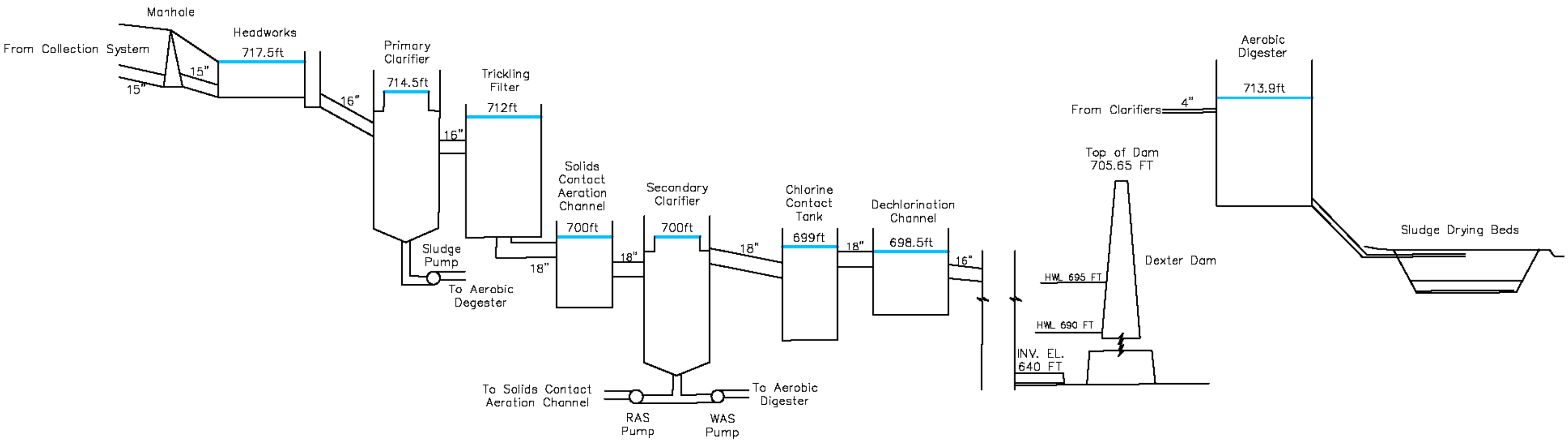


Figure 2-5: Hydraulic Profile of Existing WWTP

2.2.2 Influent Conveyance

The WWTP is gravity fed from the collection system. The lowest manhole in the collection system, with an approximate depth of 6', is located just before the headworks (Figure 2-6). This manhole has an invert elevation of 715.35'. A 15" line connects this manhole to the headworks channel. The water level in the manhole is 2.15' under design conditions.

Figure 2-6: Manhole upstream of the WWTP Headworks

2.2.3 Headworks

The primary purpose of the headworks is to provide initial screening of the influent wastewater. It is necessary to remove rags and large debris that could negatively impact downstream treatment processes, especially the clarifier sludge pumps and the trickling filter. The components located in the headworks include a fine screen, a bypass channel, an influent sampler, and a flow meter. The headworks channel has a design hydraulic head of 717.5'.

2.2.3.1 Fine Screen

The fine screen was supplied by *Treatment Equipment Company*, manufactured by *Parkson Corporation*. It is an automated inclined fine screen with a screen size of ¼". The peak flow capacity of the screen is 2.6 MGD. An ultrasonic sensor upstream of the screen monitors the depth of the channel. When the channel is above a 4' setpoint (which can be controlled by the plant operator), a mechanical brush clears the screenings automatically. The screenings are automatically washed and compacted to prepare for transport to landfill.

Figure 2-7: Inclined Fine Screen

2.2.3.2 Bypass Channel

Flow can be routed around the fine screen through a bypass channel via manually opened stop-gates. There is a grate to provide coarse screening in the bypass channel. Debris smaller than a 2" nominal diameter can pass through the grate in the bypass channel, resulting in much poorer performance than the ¼" fine screen. The bypass channel converges with the main headworks channel, the channel housing the fine-screen, prior to the Parshall flume.

2.2.3.3 Influent Flow Measurement

After the convergence of the fine screen and bypass channel, influent wastewater passes though a 9" Parshall flume for flow measurement. This flume was installed in the 2004 plant upgrades, however it does not currently have a water level sensor installed and is therefore not collecting data. Flow data for the plant is currently collected by a similar flume near the effluent of the disinfection system.

2.2.3.4 Influent Sampler

An influent sampler (*Hach Sigma AWRS*) collects influent samples in the fine screening channel by vacuum through 3/8" flexible tubing. The sampler is automated and collects samples several times per day to make 24-hour composites as required by the plant's NPDES permit. The sample bottle is contained in a temperature-controlled cabinet set at 4°C.

Figure 2-8: Influent Sampler and Fine Screen Control Panel

2.2.4 Primary Clarifier

The primary clarifier was constructed as part of the 2001 WWTP improvements for the purpose of removing excess solids detrimental to the tickling filter. Originally planned as a circular clarifier, the design was finalized as two parallel rectangular clarifiers with a depth of 12', and a combined surface area of 952 square feet. The design overflow rate at the design PDAF is 2027 gpd/sq-ft, and the 2721 gpd/sq-ft at the design PHF. Flow control slide gates control the operation of the clarifier, with both cells able to be taken offline via closing the respective slide gate. Generally, only one of the cells is in operation during the dry season, and both cells are used during high flow periods. Prior to the overflow weir, a scum collection pipe scrapes fat, oil, and grease that collects on the surface of the water and discharges into the aerobic digester. Chain driven flights scrape the settled solids to four sump areas that pump to the aerobic digester.


Figure 2-9: Primary Clarifier Weir and Scum Collector (Left) and Sludge Scraping Mechanism (Right)

2.2.5 Secondary Treatment

2.2.5.1 Trickling Filter

The plant's trickling filter receives flow from the primary clarifier and passes it through polypropylene media for biological treatment. Forced air is pulled through the filter media by a constantly running exhaust fan to supply oxygen to the bacteria growing as a film on the filter media. The trickling filter is 8 feet deep and 33 feet in diameter, with a media volume of 6,840 cubic feet. The capacity of the trickling filter is 868 gpm; flows over this are diverted to the solids contact channel. The hydraulic loading rate is 0.35 gpm/square foot for the design MMDWF and 1.57 gpm/square foot for the design PDF. The average and maximum BOD loading rates are 0.049 lbs/day/cubic foot and 0.089 lbs/day/cubic foot respectively. The hydraulic and BOD loading rate classifies the trickling filter within the range of a "High Rate" filter for the MMDWF, meaning that the expected BOD removal is between 70-90% for plastic media filters (Metcalf and Eddy, 5th Edition).

During the dry weather period, the trickling filter typically operates with a recirculation ratio over 3. This is higher than typical for these types of trickling filters and is due to the large difference between typical summer flowrates and the max month design flow that the trickling filter was designed for. The high recirculation ratio is necessary in the summer months to keep the hydraulic distribution arms of the trickling filter spinning fast enough to wet the entire media surface and maintain the biological film's activity. In contrast, in the winter when flows are high during heavy storm events, the trickling filter does not recirculate at all.

Figure 2-10: Trickling Filter with Polypropylene Media

2.2.5.2 Solids Contact Channel

The Solids Contact Channel is an aerobic bioreactor that treats the trickling filter effluent and the decant water from the aerobic digester. The reactor is split into two sections: the reaeration section and the contact section. In the reaeration section, the return activated sludge (RAS) from the bottom of the secondary clarifier is aerated to supply oxygen to the heterotrophic bacteria in the RAS and to improve the flocculation properties of the sludge. In the contact section, the aerated RAS is mixed with the trickling filter effluent and suspended via fine bubble diffusers. The solids retention time (SRT) of the bioreactor can be adjusted by opening and closing gates that separate the two sections, which allows for controlled short circuiting between the reaeration and contact sections of the reactor. The reactor is typically operated with a SRT of 0.7 to 2 days for wet weather and dry weather flows respectively.

Figure 2-11: Solids Contact Channel

2.2.5.3 Secondary Clarifier

The secondary clarifier receives flow from the solids contact aeration channel. The clarifier has a 40-foot diameter and a 14-foot depth. The original design, as stated in the 1990 O&M Manual, had a design surface overflow rate of 1488 gpd/square foot at peak flow. The length of the overflow weir is 126 feet, and the design peak weir loading rate is 14,840 gpd/foot. There are six uptake pipes with telescoping valves along the collection arm, with three pipes on each side of the center column for sludge collection. The sludge is partitioned into waste activated sludge (WAS) and RAS. WAS is pumped to the aerobic digester via a 1 hp sludge pump with a capacity of 80 GPM. RAS is recirculated through the solids contact aeration channel via two 3 hp sludge pumps, with capacity ranging from 200 to 600 gpm. The catwalk of the secondary clarifier does not reach across the entire diameter of the clarifier, which has created issues with maintenance for the operators.

Figure 2-12: Secondary Clarifier

2.2.6 Disinfection

2.2.6.1 Chlorine Dosing

Chlorine dosing equipment is housed in the control building. A 2” pipe is routed from the chlorine contact chamber through the control building to serve as the dosing point for the contact chamber. Chlorine is dosed via a liquid solidum hypochlorite solution stored in 55-gallon drums. There are two chemical dosing pumps (ProMinent gamma/L 1601 Metering Pumps) each with a capacity of 7 gpd. Typically, the feed rate is 2-3 gpd. During normal conditions (wastewater flows around 50,000 gpd), only one pump is in operation with the second one as a backup. The pump feed rates are set manually by the operator based on the constantly monitored chlorine residual at the contact chamber effluent.

2.2.6.2 Chlorine Contact Chamber

The chlorine contact chamber is constructed inside of the WWTP’s original secondary clarifier. Water is fed at the circumference of the converted clarifier and flows inward to a weir in the center of the chamber. The total volume of the basin is 31,400 gallons and the contact time as stated in the facility’s operation and maintenance manual varies between approximately 20 and 100 minutes at peak day flow and maximum-month dry-weather flow respectively. However, as discussed in Section 2.4.7, these contact times are probably significantly overestimated due to the lack of baffling in the basin.

2.2.6.3 Dechlorination

Dechlorination is accomplished via the addition of a purchased calcium thiosulfate solution (Captor). The Captor is stored in a 55-gallon drum and is pumped via one chemical dosing pump of the same type as the chlorine dosing pumps. Carrier water for the Captor dose is supplied via the City’s potable water. Under normal conditions, approximately 1 gpd is needed to reduce the chlorine residual to levels acceptable according to the plant’s NPDES permit. The Captor dosing rate is set manually by the operator based on the chlorine analyzer results at the end of the basin. The chlorine residual is usually maintained at 1.5 mg/L, and the Captor is dosed at approximately 1/3 of the residual. The reaction time for Captor to remove the residual chlorine is instantaneous. The dechlorination reaction occurs in the dechlorination reaeration chamber

2.2.6.4 Effluent Sampler

The effluent sampler withdraws samples by vacuum through 3/8” flexible tubing. Sampler is automated and collects samples several times per day to make 24-hour composites as required by the plant’s NPDES permit. The sample bottle located in a temperature-controlled cabinet set at 4°C.

2.2.6.5 Effluent Flow Measurement

Similar to the Parshall flume in the headworks discussed in Section 2.2.3.3, effluent flow is recorded near the end of the dechlorination channel. However, this flume is smaller than the influent flume, with a capacity of 2 MGD.

2.2.7 Outfall

The final effluent discharges to Dexter reservoir within 20 feet of the dam's penstock intake trash racks. This outfall was constructed in 1989 and consists of a 16-inch pipe that drains via gravity from the dechlorination chamber to the dam. The discharge location is considered a river discharge into the Middle Fork Willamette for permitting purposes.

2.2.8 Solids Treatment

2.2.8.1 Aerobic Digester

In 2004, the Imhoff tank of the original WWTP was converted into a dual celled aerobic sludge digester. The purpose of the digester is to stabilize the primary sludge and waste activated sludge (WAS) from secondary treatment; by supplying oxygen via fine bubble aeration, the digester reduces pathogens, the quantity of volatile suspended solids in the sludge, and the total volume of solids discharged into the sludge drying beds. The fine bubble aeration system consists of one 30 hp positive displacement blower, air piping, and eighty-eight 9-inch membrane diffusers arranged in a grid at the base of the digester. The original design originally consisted of two 30 hp blowers, with one as a backup. However, operators have expressed frustration with the maintenance and electricity costs associated with the blower configuration. When one of the blowers went out of commission around 2020, the City decided to not replace the blower in-kind after with the hopes that the system can be improved in the near future.

Each cell of the digester contains an adjustable weir to decant or overflow water at the surface back to the Solids Contact Aeration Basin. Decant usually occurs on a daily basis in the winter and 3 times a week during the summer, and discharges about 800 to 1,000 gallons per decant cycle to secondary treatment.

2.2.8.2 Sludge Drying Beds

Figure 2-13: Eastern Sludge Drying Bed

The sludge drying beds receive stabilized solids from the aerobic digester. There are two drying beds with a combined volume of 119,000 gallons. There is a 60 mil HDPE liner at the base of the drying beds with an underdrain system that drains to a sump near the secondary clarifier for treatment through the solids contact aeration basin. The available detention time in the drying beds is 1.8 years, assuming 20 pounds of sludge per capita per year at 5% solids. Solids are ultimately hauled by and disposed to Heard Farms near Roseburg, OR. Heard Farms performs further treatment to the solids to meet Class B biosolids Criteria as required by their Water Pollution Control Facilities Permit (Permit #102449).

2.3 Design Criteria of Existing Facilities

A summary of design criteria for each of the components of the WWTP is provided in Table 2-1. Information compiled in this table was sourced from the City's Operations and Maintenance manual, the 2004 pre-design report, and discussions with operators.

Table 2-1: Design Criteria of WWTP Processes

City of Lowell - Wastewater Treatment Plan Design Criteria	
Headworks	
Fine Screen	
Type	Automated Inclined Fine Screen
Screen Size	0.25 inches
Peak Flow Capacity	2.6 MGD
Screenings Washing and Compaction	Yes
Channel Width	2 feet
Max Depth	4 feet
Design Channel Depth	3 feet
Bypass	
Type	Course Bar Screen
Screen Size	2"
Cleaning	Manually-Cleaned
Flow Diversion	Manually-Operated Stop Gates
Channel Width	2 feet
Max Channel Depth	4 feet
Flow Measurement	
Type	Parshall Flume
Size	9 inches
Flow Measurement	Transducer (Not Installed)
Influent Sampler	
Type	Automated Composite
Temperature	4°C
Primary Treatment	
Primary Clarifier	
Type	Rectangular
# of Cells	2 in parallel
Total Surface Area	952 square feet
Side Water Depth	12 feet
PDAF Surface Overflow Rate	2027 gpd/square foot
PHF Surface Overflow Rate	2721 gpd/square foot

Table 2-1: Design Criteria of WWTP Processes

Primary Sludge Pump	
Type	Progressing Cavity
# of Pumps	2 (1 redundant)
Design Capacity	20 gpm
Average Sludge Production	2400 gpd
Typical Operating Time	2 hour/day
Secondary Treatment	
Trickling Filter	
Type	High-rate, plastic media
Diameter	33 feet
Media	Polypropylene
Media Area	855 square feet
Media Depth	8 feet
Media Volume	6,840 cubic feet
Average BOD Loading	0.049 lbs/day/cubic feet
Max BOD Loading	0.089 lbs/day/cubic feet
Hydraulic Loading at Design MMDWF	0.35 gpm/square foot
Hydraulic Loading at Design PDF	1.57 gpm/square foot
Air Supply	1 HP Exhaust fan
Solids Contact Basin	
Type	Activated Sludge
Basin Depth	6 feet
Contact Channel Width	6 feet
Contact Channel Volume	8600 cubic feet
Design Hydraulic Detention Times:	
ADWF	12 minutes
MMDWF	25 minutes
MMWWF	16 minutes
PDF	6.4 minutes
Reaeration Channel Depth	6 feet
Reaeration Channel Width	2.5 feet
Reaeration Channel Volume	3590 gallons
# of Blowers	2
Blower Capacity	40-150 scfm, each
Design Solids Retention Time	0.7 - 2 days
Secondary Clarifier	
Type	Circular
Total Surface Area	1260 square feet
Diameter	40 feet
Side Water Depth	14 feet
Design Surface Overflow Rate at Peak Flow	1488 gpd/square foot
Design Weir Loading Rate at Peak Flow	14840 gpd/ft
Design Detention Time at ADWF	21.4 hours
Design Detention Time at PIF	1.7 hours

Table 2-1: Design Criteria of WWTP Processes

Activated Sludge Pumps	
# of Return Activated Sludge Pumps	2
RAS Pump Capacity	600 gpm, each
# of Waste Activated Sludge Pumps	1
WAS Pump Capacity	80 gpm
Disinfection	
Disinfection Dosing	
Type	Liquid Sodium Hypochlorite
Chemical Storage	55-gallon drums
Number of Injection Valves	2
Pump Capacity	7 gpd, each
Average Feed Rate	2-3 gpd
Feed Control	Manual
Chlorine Flash Mixer	
Motor Size	1 HP
Velocity Gradient	500 sec^{-1}
Impeller Diameter	13.2"
Chlorine Contact	
Type	Circular Tank with Baffles
Total Volume	31,400 gallons
Contact Time at MMDWF	103 minutes
Contact Time at PDF	23 minutes
Dechlorination	
Type	Calcium Thiosulfate (Captor)
Chemical Storage	55-gallon drums
Number of Injection Valves	1
Pump Capacity	7 gpd
Average Feed Rate	1 gpd
Feed Control	Manual
Effluent Sampler	
Type	Automated Composite
Temperature	4°C
Solids Treatment	
Digestion	
Type	Aerobic
Number of Basins	2
Volume	130,000 gallons, each
Solids Yield	358 lbs/day
SRT (Average at 2% solids)	81 days
Volatile Solids Destruction	38%
Aeration	Fine Bubble Diffusers
Blowers	2, each at 30 HP
Air Rate	580 scfm (at 6.5 psi)
Mixing Air Provided	25 scfm per 1000 cubic feet

Table 2-1: Design Criteria of WWTP Processes

Solids Dewatering	
Type	Gravity Thickening, Drying Beds
Depth	3 feet
Volume	119,000 gallons
Solids Content	5%
SRT	6 months
Liner Material	60 mil HDPE

2.4 Condition of Existing Facilities

2.4.1 Collection System

One of the City's biggest issues with their wastewater system is the excessive amount of wet weather associated inflow and infiltration (I/I) into the collection system. This results in excessively high wet weather flows relative to dry weather flows, which makes operation of the WWTP more difficult since none of the operations are flow paced, and the operator has to adjust operations to accommodate higher flows during storm events. A more comprehensive analysis of I/I in the collection system is discussed in Section 3.2.1.1, and an I/I study was conducted as part of this planning effort to identify areas that can be improved to mitigate this issue (Appendix D).

2.4.1.1 Alder Street Pump Station

The pumps in the Alder Street Pump Station were upgraded in 2004 to accommodate flows of 350 gpm with just one pump in operation. The wet well and the pumps seem to be in good condition. There was one recent overflow into Dexter Reservoir in 2021, which may be indicative of a need to upsize these pumps again. A more comprehensive evaluation of the needed pump capacity is provided in Section 3.3.4.1

2.4.2 Headworks

The headworks were recently updated in 2004. In general, the individual unit operations of the headworks are in good condition and the operator is satisfied with the fine screen that is in place. According to the current operator's experience, the bypass channel is only needed to accommodate excessive influent flow during severe storm events, usually those close to the area's 5-year storm.

The main area of concern with the headworks is that the influent flow measuring Parshall flume is not actively recording data, as the plant reports effluent flow to fulfill monitoring requirements. It is recommended to install the transducer in the flume to collect influent flow data so that each part of the headworks operates as designed.

2.4.3 Primary Clarifier

The primary clarifier was constructed as part of the 2004 upgrades. The clarifier seems to operate well, with generally one cell in operation in the summer and both during high flow events in the winter. There have been no issues reported with the scum removal or sludge collection mechanisms. The sump pumps of the clarifiers have exceeded the typical useful life of pumps (10-20 years), so the City should have a plan to replace these as a general maintenance activity within the next planning period.

2.4.4 Trickling Filter

The exhaust fans of the trickling filter have never been replaced and seem to be in poor to fair condition based on rust on the external housing.

The operation of the trickling filter is most affected by the large variation of flows experienced by the WWTP. A high recirculation ratio is necessary in the summer to sustain the required hydraulic loadings, which likely results in low BOD loadings to the solids contact aeration basin. This could then result in nitrification occurring in the aeration basin, which could explain the low pH values that occur in the dry part of the year (See Section 4.5.3).

In contrast, the trickling filter is not recirculated as designed, and sometimes not at all, during high flow wet-weather periods and does not provide the designed treatment efficiency. This is because high flows typically cooccur with lower temperatures which causes lower biological activity, and the lack of recirculation decreases retention time. Most of the excess flow during these wet-weather periods is a result of rain and groundwater entering the collection system, which causes lower pollutant concentrations and doesn't necessarily require very efficient treatment to meet the current permit limits. However, these limits are subject to change throughout the planning period. It is a valid concern that the trickling filter, designed for a flow that statistically only occurs a couple weeks each year, performs far outside of its design criteria during most of the year because of the large variation in flows.

2.4.5 Solids Contact Aeration Basin

Based on operational sludge testing records, the aeration basin operates consistently with the design MLSS concentration of 1,800 mg/L. While the opening of different gates in the channel between the contact and reaeration sections can be used to modify the solids retention time, the unit has only been operated with the first gate open (the "default" configuration as designed) in the current operator's experience.

There have not been any issues reported with the aeration system, although the blowers are past their expected useful life of 20-25 years. One point of concern with the aeration basin is the lack of redundancy; if the basin needs to be taken offline to replace diffusers or clean the basin, the plant will have to rely only on the trickling filter for treatment. This may be insufficient to meet current or future permit requirements.

2.4.6 Secondary Clarifier

The City is out of compliance with the Oregon Department of Environmental Quality's (DEQ) redundancy requirements by only having one secondary clarifier (See Section 3.2.5). Also, the existing clarifier has safety issues associated with the catwalk only extending half the diameter of the basin. The WAS and RAS pumps, installed in 1989, are past their design life.

2.4.7 Disinfection

The nominal contact time of the chlorine contact chamber of 23 minutes at a flow of 1.93 MGD is greatly overestimated. This contact time was calculated as the volume of the reactor divided by flow rate which inherently assumes plug flow behavior, like in a serpentine contact chamber.

This assumes that no short circuiting within the chamber occurs, which is highly unlikely given the tank's indeterminant length to width ratio.

The City's chlorine contact chamber is a repurposed circular clarifier from the original ACE WWTP. To convert the clarifier to the contact chamber, a baffle was installed around the circumference of the clarifier to distribute the chlorine and secondary effluent mixture. Flow then moves towards the center of the basin and over a weir prior to the dechlorination chamber. The issue with this is that the flow is only baffled when it initially enters the basin. After flowing through that initial baffle, there are no baffles to prevent short circuiting, and the assumption that the entire contact chamber volume is effectively used for disinfection contact is wrong.

According to the EPA's Disinfection Profiling and Benchmarking Guidance Manual, a tank with a single baffle or multiple unbaffled inlets or outlet, and with no intra-basin baffles, a baffling factor of 0.3 should be applied to the basin's volume to correct for short circuiting. This would make the effective contact time at the design flow approximately 8 minutes, which is insufficient to meet DEQ requirements.

2.4.8 Solids Management

The aerobic digester was constructed as part of the 2004 WWTP upgrades. According to the operator, the maintenance requirements of the rotary lobe blower used for aeration are excessive, requiring full oil and gasket replacements monthly and consistent maintenance checks due to overheating in the warm, summer months. The electricity costs of this blower are $1,500 per month, more than half the typical operating costs of the entire WWTP.

The aerobic digester has some signs of concrete deterioration on the outer side of the tank. This is not entirely surprising given the old age of the structure, which was originally the Imhoff tank of the original ACE WWTP.

At the most recent hauling of solids from the drying beds in 2023, it was discovered that one of the underdrain pipes was broken and the felt layer that separates the underdrain layer from the sand buffer and solids storage section has deteriorated. This is likely a sign that the underdrain system has experienced wear throughout the scraping and hauling cycles. It may be feasible to add some guide walls in the solids drying beds to make it easier to perform removal of solids without damaging the underdrain system, although this would likely decrease the total available solids storage volume.

2.5 Finanacial Status of Existing Facilities

Financial data for the City was obtained from *Independent Audit Reports* that are publicly available on the City's website. In these reports, the main accounting method that has been used is modified-cash basis accounting and the data below is based on City of Lowell's Actual and Budget Statements regarding Sewer Funds. The City's Sewer Fund consist of three sub-accounts: an Operating Fund, a System Development Charges (SDC) Fund, and the Reserve Fund. The City invests in the Local Government Investment Pool (LGIP) which is managed by the State Treasurer's office, and the City records the earnings from this pool as Investment Earnings.

Table 2-2 includes the information regarding the city's resources and expenditures. The overall picture is positive. The Debt Service amount reflects the Sewer Revenue Loan annual payments that have been taken from USDA Rural Utilities Service beginning in 2012 with an interest rate of 2.75% and a maturity date of April 6, 2052. Table 2-3 summarizes each sub-account of the Sewer Funds by showing the net change for each of the past few years.

Table 2-4 shows the change in values of the City's wastewater facility assets and liabilities over the past few years, and the net position of the City's sewer utility. This can be an indicator to determine if the City's sewer balance sheet is improving or deteriorating. The numbers show decreasing positive value, which is mostly reflective of accumulated depreciation.

Table 2-2: Resources and Expenditures of the City's Wastewater Facilities

Resources	2019	2020	2021	2022
Sewer Operating Fund	**$376,382**	**$376,664**	**$418,914**	**$430,970**
Charges for Services	$342,844	$361,249	$386,433	$406,487
Sewer Connections and Permits	$1,610	$805	$575	$3,795
Intergovernmental	-	-	$24,364	-
Reimbursement of SDC fees	$6,891	$5,241	$3,090	$19,158
Investment Earnings	$4,655	$1,899	$734	$633
Miscellaneous	$8,212	$2,187	$3,589	$897
Other Financing Sources (balance)	$12,170	$5,283	$129	-
Sewer Reserve Fund	**$1,576**	**$1,580**	**$5,925**	**$21**
Investment Earnings	$1	$5	$5	$21
Other Financing Sources (balance)	$1,575	$1,575	$5,920	-
Sewer SDC Fund	**$128,017**	**$11,728**	**$6,414**	**$33,752**
SDC Fees	$11,942	$9,082	$5,355	$33,201
Investment Earnings	$158	$2,646	$1,059	$551
Other Financing Sources (balance)	$115,917	-	-	-
Total Revenues	**$505,975**	**$389,972**	**$431,253**	**$464,743**
Expenditures				
Current Account				
Personal Services	$133,446	$169,294	$184,402	$189,970
Materials and Services	$121,939	$139,337	$149,747	$215,559
Debt Service				
Principal	$28,489	$29,013	$29,563	$30,139
Interest and other changes	$23,419	$22,220	$20,980	$19,698
Capital Outlay	$14,558	$42,745	-	$23,377
Total Expenditures	**$321,851**	**$402,609**	**$384,692**	**$478,743**

Table 2-3: Wastewater Facility Account Balances

Sewer Operating Fund Summary	2019	2020	2021	2022
Beginning	$121,619	$176,150	$150,205	$184,427
Net Change	$54,531	-$25,945	$34,222	-$100
Ending	$176,150	$150,205	$184,427	$184,327
Sewer Reserve Fund Summary	**2019**	**2020**	**2021**	**2022**
Beginning	$6,670	$8,246	$9,826	$15,751
Net Change	$1,576	$1,580	$5,925	$21
Ending	$8,246	$9,826	$15,751	$15,772
Sewer SDC Fund	**2019**	**2020**	**2021**	**2022**
Beginning	-	$128,017	$139,745	$146,159
Net Change	$128,017	$11,728	$6,414	-$13,921
Ending	$128,017	$139,745	$146,159	$132,238

Table 2-4: Modified Cash Basis of Wastewater Facility Assets

Sewer Fund Balance Sheet (Modified Cash Basis)				
	2019	**2020**	**2021**	**2022**
Assets				
Cash and Cash Equivalents	$312,411	$299,776	$346,337	$330,562
Other current Assets	-	-	-	$1,775
Land	$11,000	$11,000	$11,000	$11,000
Buildings and Facilities	$81,869	$89,114	$89,114	$89,114
Vehicles and Rolling Stock	$34,064	$21,780	$21,780	$21,780
Equipment and Furniture	$33,629	$68,935	$68,330	$91,707
Infrastructure	$4,708,963	$4,708,963	$4,708,963	$4,708,963
Accumulated Depreciation	-$2,757,719	-$2,860,791	-$2,974,881	-$3,090,135
Total non-current Assets	$2,111,806	$2,039,001	$1,924,306	$1,832,429
Total Assets	**$2,424,217**	**$2,338,777**	**$2,270,643**	**$2,164,766**
Liabilities				
Current Liabilities				
Bonds, notes and loan payable	$29,013	$29,563	$30,139	$35,743
Non-current Liabilities				
Bonds, notes and loan payable	$576,682	$547,120	$516,981	$481,238
Total Liabilities	**$605,695**	**$576,683**	**$547,120**	**$516,981**
Position				
Net Investment in Capital Assets	$1,506,111	$1,462,318	$1,377,186	$1,315,448
Restricted for Debt Service	$8,246	$9,826	$15,751	$15,772
Restricted for Capital Projects (SDC)	$128,017	$139,745	$146,159	$132,238
Unrestricted	$176,148	$150,205	$184,427	$184,327
Net Position	**$1,818,522**	**$1,762,094**	**$1,723,523**	**$1,647,785**

2.5.1 Water, Energy, and Waste Audits

The City has not completed any water, energy or waste audits in the past five years.

3 NEED FOR PROJECT

Drivers for wastewater facility capital improvement projects typically fall into one of three categories:

- Protection of human and environmental health;
- Replacing or rehabilitating infrastructure and equipment nearing or exceeding its useful life;
- Accommodation of expected growth in the planning area.

This section describes the current factors influencing each of these drivers with regard to the City of Lowell.

3.1 Health, Sanitation, Environmental Regulations, and Security

Many State and Federal regulations have been established to ensure the health, safety, and security of the public. This section discusses the relevant regulations governing the City's wastewater system facilities.

The federal Clean Water Act (CWA) requires permits for all discharges of wastewater to waters of the state. The CWA is delegated to the State of Oregon and enforced through Oregon Revised Statutes (ORS 468B.050). The City operates its wastewater system under the jurisdiction of the Oregon Department of Environmental Quality (DEQ), with a National Pollutant Discharge Elimination System (NPDES) Waste Discharge Permit (Permit No. 101384) which was issued June 30, 2014 (Appendix A).

NPDES permits in Oregon are issued for 5-year periods. When a permit lapses and a new permit is not issued, as is the case with the City's wastewater treatment plant, the permit is administratively extended until a new permit can be issued. The City of Lowell is expected to have a new permit issued in 2027 according to DEQ's Statewide Permit Issuance Plan. At the time a new permit is issued, any changes to federal and state regulations that occurred since the last permit are incorporated.

3.1.1 Collection System Requirements

Performance requirements for collection system pipelines and lift stations are provided in the appendices to OAR 340-052-0020. These guidelines generally require that collection system infrastructure be designed with adequate capacity to convey the peak flow rates. Additional requirements, including redundancy and reliability requirements for pumping systems, are outlined in those appendices. Regarding the operator certification level required to work on the City's collection system, the City's collection system is classified as "Class II."

3.1.2 Treatment System Requirements

Treatment system performance requirements for facilities that discharge to surface waters are heavily influenced by the need to protect the quality of the receiving water for other beneficial uses. This section reviews the current requirements that the City's WWTP is subject to and future requirements that will impact the WWTP performance requirements. The treatment system is classified pursuant to OAR 340-049 as "Class III."

3.1.2.1 Current Wastewater Treatment Plant Discharge Requirements

Treated effluent quality from the WWTP is governed by the facility's NPDES permit. The current permit was issued in 2014. Final effluent is discharged into the penstock of Dexter Reservoir, located on the Middle Fork Willamette River at River Mile 15.7. The quality of the final effluent has to meet water quality criteria that varies seasonally, based on effluent flowrates of 0.15 MGD (average dry weather) and 0.23 MGD (average wet weather). Table 3-1 provides the waste discharge limits required under the facility's current NPDES permit.

Table 3-1: NPDES Permit Limits for the City of Lowell Wastewater Treatment Plant

Seasonal Effluent Limits					
May 1 - October 31					
	Concentration (mg/L)		**Loading (lb/day)**		
	Monthly Average	Weekly Average	Monthly Average	Weekly Average	Daily Maximum
BOD_5	10	15	13	19	26
TSS	10	15	13	19	26
November 1 - April 30					
	Concentration (mg/L)		**Loading (lb/day)**		
	Monthly Average	Weekly Average	Monthly Average	Weekly Average	Daily Maximum
BOD_5	30	45	58	87	120
TSS	30	45	58	87	120
Year-Round Limits					
E. coli	Must not exceed 126 organisms per 100 mL monthly geometric mean; no single sample can exceed 406 organisms per 100 mL				
BOD_5 and TSS Removal Efficiency	Must not be less than a monthly average of 85%				
pH	Must be within the range of 6.0 and 9.0				
Chlorine, total residual	Must not exceed a monthly average of 0.5 mg/L				

In addition to complying with effluent quality limitations, the NPDES permit also requires regular sampling of the influent for BOD_5, TSS, and pH, and the effluent for flow, BOD_5, TSS, pH, *E. coli*, temperature, and chlorine. The permit allows for land application of biosolids provided that Class B pathogen reduction standards are achieved.

3.1.2.2 Supplemental Requirements

Supplemental water quality requirements for locations in the Willamette River basin are established in OAR 340-041-0340. These are as follows:

- Water quality in the Willamette Basin must be managed to protect the designated beneficial uses shown in Table 3-2.

- Designated fish uses to be protected in the Willamette Basin are shown in Figure 3-1 and Figure 3-2. New or expanded wastewater systems must meet the requirements described above.

Table 3-2: Designated Beneficial Uses - Willamette Basin

Beneficial Uses	Willamette River Tributaries						Main Stem Willamette River			
	Clackamas River	Molalla River	Santiam River	McKenzie River	Tualatin River	All Other Streams & Tributaries	Mouth to Willamette Falls, Including Multnomah Channel	Willamette Falls to Newberg	Newberg to Salem	Salem to Coast Fork
Public Domestic Water Supply[1]	X	X	X	X	X	X	X	X	X	X
Private Domestic Water Supply[1]	X	X	X	X	X	X	X	X	X	X
Industrial Water Supply	X	X	X	X	X	X	X	X	X	X
Irrigation	X	X	X	X	X	X	X	X	X	X
Livestock Watering	X	X	X	X	X	X	X	X	X	X
Fish & Aquatic Life[2]	X	X	X	X	X	X	X	X	X	X
Wildlife & Hunting	X	X	X	X	X	X	X	X	X	X
Fishing	X	X	X	X	X	X	X	X	X	X
Boating	X	X	X	X	X	X	X	X	X	X
Water Contact Recreation	X	X	X	X	X	X	X[3]	X	X	X
Aesthetic Quality	X	X	X	X	X	X	X	X	X	X
Hydro Power	X	X	X	X	X	X	X	X		
Commercial Navigation & Transportation							X	X	X	

[1]With adequate pretreatment and natural quality that meets drinking water standards.

[2]See also Figures 340A and 340B for fish use designations for this basin.

[3]Not to conflict with commercial activities in Portland Harbor.

State of Oregon Department of Environmental Quality

OAR 340-041-0340 – Figure 340A

Fish Use Designations* - Willamette Basin, Oregon

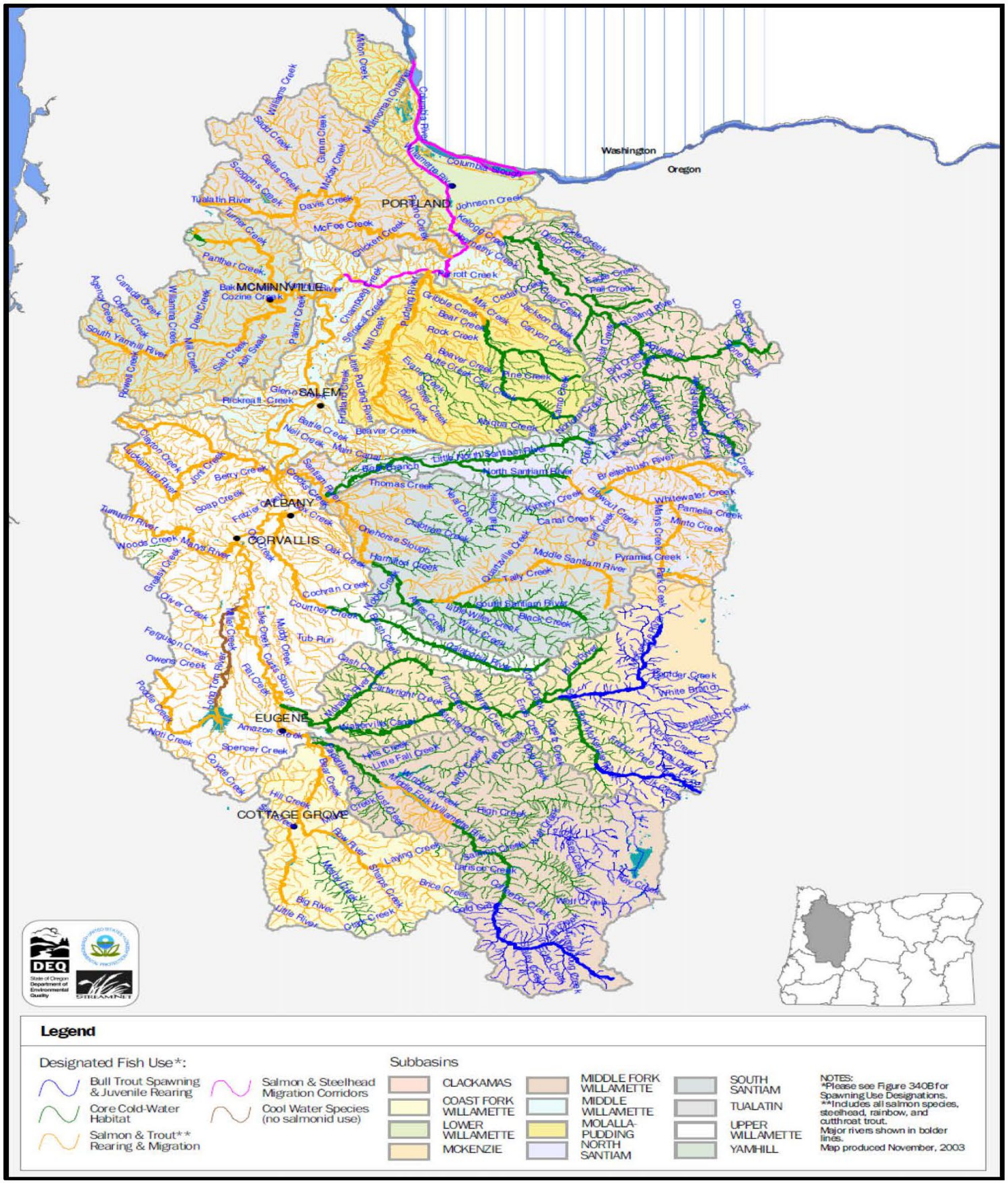


Figure 3-1: Fish Use Designations - Willamette Basin

State of Oregon Department of Environmental Quality

OAR 340-041-0340 – Figure 340B

Salmon and Steelhead Spawning Use Designations*
Willamette Basin, Oregon

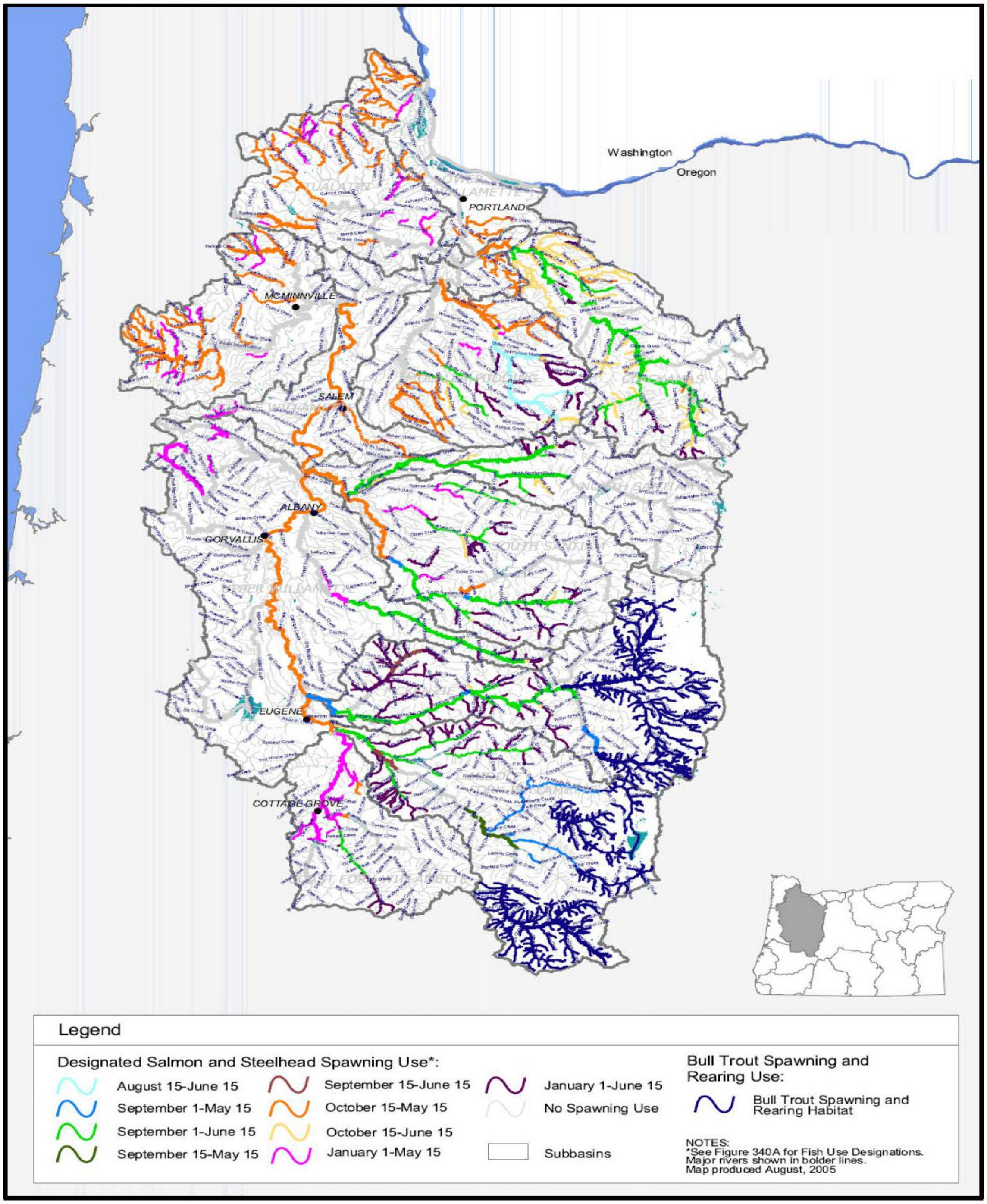


Figure 3-2: Salmon and Steelhead Spawning use Designations - Willamette Basin

3.1.2.3 Management of Sewage Sludge/Biosolids

The wastewater treatment process results in the production of solids referred to as sewage sludge. Sewage sludge that has been treated to comply with pollutant and other limitations established by the State and Federal governments is referred to as biosolids. Management of sewage sludge is regulated under 40 CFR part 503.

All biosolids must be in compliance with the pollutant concentration and loading limits established in 40 CFR part 503.32, the vector attraction standards established in 40 CFR part 503.32, and the pathogen reduction standards established in 40 CFR part 503.33. Final biosolids are classified by 40 CFR part 503.33 as Class A or Class B. Class A biosolids are required to be treated to a higher pathogen removal standard, commonly achieved by raising pH and/or temperature above certain levels for extended periods of time.

The City currently sends stabilized and dried solids to a regional treatment facility near Roseburg for final treatment. Regulations pertaining to the land application of biosolids in Oregon are located in OAR 340-050.

3.1.3 Water Quality Status of the Receiving Waterbody

Per OAR 340-041-0004, the Antidegradation Policy guides decisions that affect water quality such that unnecessary further degradation from new or increased point and nonpoint sources of pollution is prevented and enhances existing surface water quality to ensure the full protection of all existing beneficial uses.

Dexter Reservoir on the Middle Fork Willamette River is the receiving waterbody for treated effluent from the WWTP. For surface water discharge, the City of Lowell is required to comply with Sections 442, 445, and 455 of OAR 340-041, which pertain to the Willamette Basin. The Willamette Basin is far-reaching, conveying water from the Cascade Mountains in the east, Coast Range in the west, and south of Eugene/Springfield north to the Columbia River.

Section 305(b) of the Clean Water Act (CWA) requires DEQ to assess water quality in Oregon and report on the overall condition of waters. DEQ assigns an assessment status category to each water body where data are available to evaluate. Water bodies that do not meet water quality standards are Water Quality Limited and are assigned Category 4 or Category 5. Water bodies in Category 5 need pollutant Total Maximum Daily Loads (TMDLs) developed and comprise the Section 303(d) list.

3.1.3.1 2022 Integrated Report

DEQ presented the Section 305(b) required report most recently 2022 as a story map, available on the department's mapping website (Oregon 2022 Integrated Report - Final (arcgis.com)). This story map shows all of the State water bodies and their status as impaired (not meeting water quality criteria) or attaining (meeting water quality criteria). In this report, Dexter Reservoir was listed as impaired for harmful algal blooms. The Dexter Reservoir-Middle Fork Willamette watershed unit (HUC12: 170900010703) was listed as impaired for dissolved oxygen, *E. coli* and temperature. Directly downstream of Dexter Reservoir, the Middle Fork Willamette River is listed as impaired for dissolved oxygen and temperature.

3.1.3.2 Mercury TMDL

The Middle Fork Willamette River is 303(d) listed for mercury from RM 0 to 82.2. The total mercury load from all minor sewage treatment plant facilities (population < 10,000) was estimated to be essentially 0 percent of the total mercury load in the Willamette Basin. As a minor sewage treatment plant facility, the City of Lowell will not be expected to perform additional mercury control or monitoring at the wastewater treatment plant. Mercury monitoring and treatment requirements may be required if/when the City's population surpasses 10,000 people, flow exceeds 1 million gallons per day, or if a major potential industrial source begins discharging into the City's sewer system, at which point the City would be considered a major sewage treatment plant facility. Compliance with the Mercury TMDL is currently accomplished through a TMDL implementation plan managed by the City's stormwater drainage program.

3.1.3.3 Temperature

The Middle Fork Willamette River is 303(d) listed for temperature from RM 0 to 15.6. This essentially is the confluence of the Middle Fork and Coast Fork to Dexter Dam. Reservoirs and lakes are vitally important to control the temperatures of downstream reaches. According to DEQ's 2006 temperature TMDL, the "load allocation" for Dexter reservoir is essentially no increase beyond the natural thermal potential temperatures, presented as "Monthly Target Temperatures" or seven-day average temperatures. These background temperatures in Dexter Reservoir are 6.5°C in April, 8.6°C in May, 13.2°C in June, 17.4°C in July, 16.5°C in August, 13.9°C in September, 10.2°C in October and November. The City of Lowell is required to monitor effluent temperature, but no load allocation or temperature limit has been defined in the City's most recent NPDES permits.

3.1.3.4 Bacteria

The Middle Fork Willamette River was in attainment of bacteria water quality criteria as of the 2006 bacteria TMDL. New and existing point source dischargers are required to meet the bacteria water quality standard (126 *E. coli* organisms per 100 mL for a monthly log-mean, and not in excess of 406 *E. coli* organisms per 100 mL in any single sample) prior to discharge.

3.1.4 Potential Future Regulations

In addition to the currently applicable regulations previously discussed, several additional regulations may be relevant to the facility during the planning period. This section provides brief discussions of those potential regulations.

3.1.4.1 Temperature

Excessive water temperature concerns in the Willamette Basin are expected to be addressed through the issuance of a new Willamette Subbasins Temperature TMDL. According to discussions with DEQ, Lowell's WWTP is expected to be given a waste load allocation (WLA) for thermal load as part of the new TMDL. The WLA is the maximum amount of heat energy that the City's WWTP could discharge into the Middle Fork Willamette without violating the temperature TMDL. The details of this load allocation are provided in Table 3-3. Note that these are subject to change with the finalization of the TMDL.

Table 3-3: Proposed Thermal Waste Load Allocation from Draft Temperature TMDL

NPDES Permittee WQ File # : EPA #	**Allocated Human Use Allowance (°C)**	**WLA Period Start**	**WLA Period End**	**7Q10 River Flow (CFS)**	**Effluent Discharge (MGD)**	**Effluent Discharge (CFS)**	**WLA (kcal/day)**
Lowell STP 51447 : OR0020044	0.03	1-May	15-Nov	998.4	1.96	3.03	73,505,100

The "7Q10 River Flow" was determined as the flow from the Dexter penstock, and the effluent discharge was the maximum effluent flow reported by DEQ's review team from September 2017. The City should dispute this effluent flowrate being used as the basis for imposing future temperature limits on the City, as the flow records from that date show an average flow closer to 0.05 MGD (Appendix E). It is likely that this flowrate was a mistake during data entry.

The amount of heat energy actually discharged by the WWTP is called the "Excess Thermal Load" or ETL. The ETL must be lower than the WLA for the City to be in compliance with the temperature TMDL. ETL is defined by the following equation:

ETL = QE x (TE-TR) x 3.785

Where,
ETL = Excess Thermal Load, million kcals/day
QE = Daily average effluent flow, MGD
TE = Daily maximum effluent temperature, °C
TR = Applicable criterion, °C (will be listed in the TMDL and in permit renewal)
3.785 = Conversion factor

The past five years of data during the WLA period as reported by the City's DMRs was evaluated using the equation above to calculate ETL based on flowrate and effluent temperature, and an assumed temperature criterion of 12.3°C. This criterion was listed in the draft TMDL as the lowest criterion temperature for the Middle Fork Willamette River; although the actual criterion temperature may end up being slightly higher in the finalized TMDL, this was used for a conservative estimate. As shown by the data presented in Figure 3-3, the City's ETL is much lower than the 73.5 million kcal/day WLA.

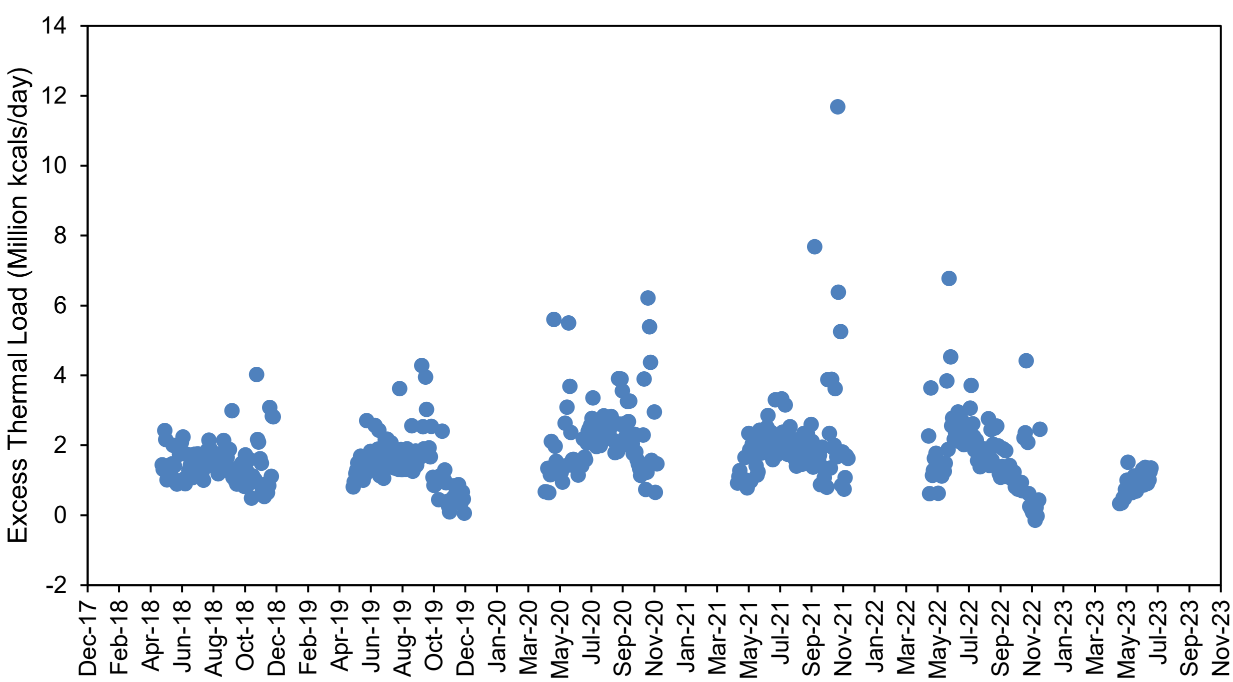


Figure 3-3: Calculated Excess Thermal Load from Previous Five Years of DMRs

To determine if the City will be given a temperature or thermal load limit in future permit renewal cycles, DEQ will most likely perform a "reasonable potential analysis," or RPA. The thermal load from the WWTP is inherently a function of effluent flowrate and temperature. The RPA will involve comparing plant and ambient flows and temperatures to determine if there is a potential for the City to exceed the WLA in future years. While the details are not available yet on what an updated RPA will look like after the new TMDL is finalized, it is unlikely that the City's WWTP's temperatures or flowrates will increase in the next planning period to result in an 85% increase in thermal load from what was seen in the past five years.

After the final temperature TMDL is published, the City should ensure that the plant flowrates used in the RPA are reflective of the plant's design flowrate or consistently observed flows during the WLA period. The 1.96 MGD flowrate used in the draft WLA is not representative of the plant's typical flowrates and was likely not a "real" datapoint to begin with because of an entry error. No flowrate in the WLA period has been near this level in the past five years (2018 – 2023); the maximum flowrate during the WLA period observed in the DMR review period was 0.8 MGD (corresponding with the outlier datapoint in Figure 3-3 in November 2021).

A more appropriate flowrate to use in the RPA would be the max month dry weather flow, or the design dry weather flow of the WWTP. It should be considered that when flows are over 1 MGD, it is likely because of I/I issues associated with a storm event. During storm events, it should be expected that effluent temperatures are lower, and the receiving stream are at higher flows than the 7Q10 low level used in determining the WLA.

3.1.4.2 Ammonia

Considering that Dexter Reservoir is listed as impaired for harmful algal blooms, and nitrogen is often a limiting nutrient for eutrophication, it would be reasonable to expect that limits on nutrient discharges are imposed on the City's WWTP. Ammonia is also considered a toxic substance, and effluent loads of ammonia cannot cause the receiving water body to exceed water quality criteria outside of an established mixing zone. Water quality criteria for ammonia is dependent on pH and temperature.

As the City grows over the next planning period, it is likely that DEQ will require testing of ammonia in the plant effluent, and ammonia, pH, alkalinity, and temperature in the receiving water to support an ammonia RPA. While the data is not available to make a useful estimate on what a future limit might be, the City is recommended to implement treatment alternatives that can support nitrification if an ammonia limit is imposed in future permit revisions.

3.1.4.3 Biocriteria

Addressing concerns associated with biocriteria impairment could take many forms when a TMDL is developed, but may include addressing issues related to temperature, bacteria, pH, and nutrient loading to the waterbody. A biocriteria TMDL for the Middle Fork Willamette subbasin is not listed in the 2022 Integrated Report's TMDL priority list. Therefore, it is unlikely that one will be developed prior to April 2030.

3.2 Aging Infrastructure

Multiple issues that arise for wastewater collection and treatment systems are the result of infrastructure age. Infrastructure aging can lead to a decrease in treatment efficacy and increases in operations and maintenance (O&M) costs. Table 3-4 presents estimates of wastewater infrastructure useful lifespans.

Table 3-4: Typical Useful Life of Common Wastewater Infrastructure

Component	Useful Life (Years)
Collections	80-100
Concrete Structures	50
Mechanical and Electrical	15-25
Force Mains	25
Information obtained from EPA-816-R-02-020	

The following sections summarize age-related deficiencies in the wastewater facilities. It should be noted that detailed structural evaluations were not completed during the development of this planning document. The City should budget for structural evaluations during any design phase for improvement projects that involve significant structures as defined by ORS 672.002 to 672.325. The condition assessments in the following subsections are based on preliminary site inspections, a comparison of the date of construction to the theoretical useful life, and the authoring engineer's judgement. The operating conditions and maintenance history can significantly impact the actual useful life of a structure.

3.2.1 Collection System

As discussed in Section 2.1, the collection system was originally constructed in the 1950s. Since that time, the system has expanded and sections of piping have been replaced, resulting in the current collection system which consists of multiple pipe sizes, materials, and ages. The pipe original to the system bult in the 1950s is expected to near the useful life of 80-100 years towards the end of this planning period. The City should rehabilitate or replace pipes as determined by system evaluations, such as smoke testing, flow testing, and/or CCTV analysis. A comprehensive I/I evaluation was conducted as part of this facility planning process, and the results are provided in Appendix D.

3.2.1.1 Collection System Inflow and Infiltration

Many communities in Oregon struggle with the issue of inflow and infiltration (I/I) within their wastewater collection systems. Inflow and infiltration are defined as follows:

- Inflow: Flows that enter the collection system through above ground paths. Inflow is often related to building downspouts being improperly connected to sanitary sewer service laterals, cross connections with storm drain systems that have not been separated, water flowing over manholes and entering in through the openings in the lids, or area drains being connected to the sewer system, and other surface water sources.
- Infiltration: Flows that enter the collection system through underground paths. Infiltration can be caused by high groundwater levels, rain-induced groundwater, and other sources. Infiltration flows make their way into the collection system through cracks in pipe, open or offset pipe joints, broken piping sections, leaks in manholes, and other below-grade openings in the collection system.

When combined, I/I can result in a significant increase in flow rates during the winter, particularly during prolonged storm events.

Based on EPA I/I guidance documents, the determination of "excessive" or "non-excessive" infiltration is based on a comparison of the highest average daily flow rate recorded during high groundwater conditions relative to benchmark flow volumes. Average daily flowrates during periods of high ground water exceeding 120 gpcd are indicative of excessive infiltration, and average daily flowrates during periods of significant rainfall that exceed 275 gpcd are indicative of excessive inflow (EPA, I/I). Due to western Oregon groundwater remaining low between June and December, the excessive infiltration analysis only considers the months of January through May.

Average per capita flows when precipitation was minimal during the high groundwater period have ranged from 60 to 145 gpcd, with a total average of 80 gpcd, in the past five years. While the total average is below the benchmark of 120 gpcd, there were exceedances of the benchmark within the period of available data. This indicates that infiltration of groundwater could be an issue in the City's collection system but may not be excessive compared to other areas in the Pacific Northwest. In contrast, the average flow during heavy periods of precipitation (antecedent five days with cumulative precipitation over 1 inch) was 501 gpcd. This is well above the 275 gpcd benchmark, indicating the City experiences excessive levels of stormwater inflow.

The I/I analysis resulted in the recommendation of rehabilitating multiple manholes, and CCTV surveillance of 6,300 linear feet of pipe. Most of the pipe recommended to CCTV is original to the system built in 1950s, so it is likely that this pipe has deteriorated over the years. Based on the results of CCTV analysis, a plan should be developed to replace segments of the pipe.

3.2.2 Wastewater Treatment System

Site visits and discussions with WWTP operations staff were used to identify several issues with the current treatment facilities.

3.2.3 Headworks

The headworks are generally in good condition. The Parshall flume at the headworks does not have a transducer in operation, so plant influent flows are not being recorded currently. Electrical and mechanical components, such as the bearings of the influent screen and the influent sampler will exceed their useful life during the planning period. Replacement of these components should be completed.

3.2.4 Primary Clarifier

The mechanisms and piping in the primary clarifier are in good condition. The sump pumps will exceed their useful life during the planning period and should be planned to be replaced at that time.

The structure itself appears to be in good condition. There are a couple of small cracks near the bottom of the wall separating the two cells (Figure 3-4). This is not an immediate concern, but the City should observe these cracks to make sure they aren't increasing in size every year and resulting in the empty cell being filled with water.

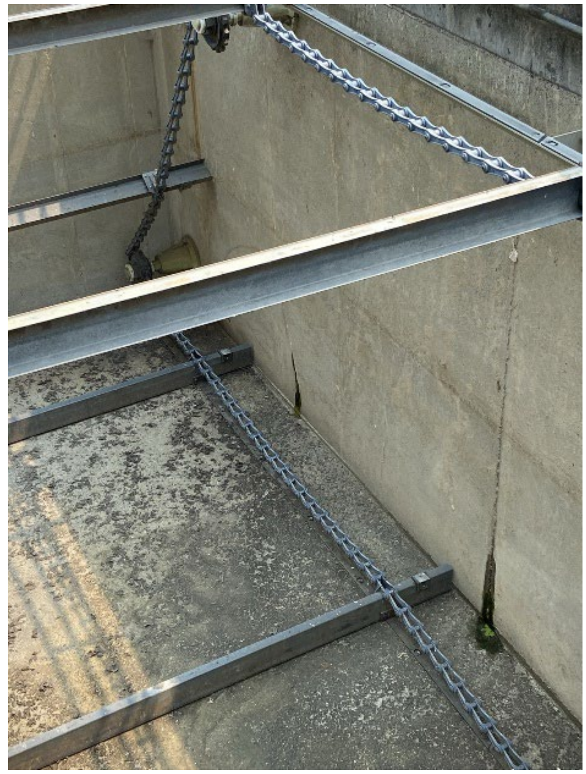


Figure 3-4: Small Cracks in Primary Clarifier Wall

3.2.5 Secondary Treatment

On July 1, 2021, DEQ sent a warning letter to the City detailing nineteen violations of the City's NPDES permit. Multiple of these were violations of the City's dry-season monthly average BOD_5 concentration limit of 10 mg/L (Table 3-5), violation of the dry-season weekly average limit of 15 mg/L, and one violation of the 85% minimum BOD_5 removal efficiency. This warning letter was sent with the indication that future violations of the BOD_5 limits may be inferred to DEQ's Office of Compliance and Enforcement for corrective action, including civil penalties for each day of violation.

The majority of BOD_5 is removed via biological treatment. The previous facilities plan recommended the addition of tertiary filtration to the WWTP to meet then future, and now current, effluent BOD_5 and TSS limits. However, the City has been rightfully hesitant on the addition of filtration units because the process would require extensive pumping, filter replacements, and associated operations costs. Upgrading the biological treatment system to handle current and future limits could potentially be a more attractive option for the City.

The existing solids contact aeration basin lacks control capabilities. The system operates with a DO of 5 mg/L because that's what the existing blower is capable of. Operators have indicated that the small blower for the aeration basin is inadequate for summer flows; when the small blower runs, solids are observed to settle in the aeration basin. It has also been observed that digester decant causes sloughing in the trickling filter. The decant line discharges to the head of the channel, but the trickling filter recirculation pump is located here. It is possible that the digester decant is being recirculated to the trickling filter via proximity. Currently, operators have to harness-and-fall-restrain in order to deploy the decant pump in the secondary clarifier. Ideally, the catwalk should extend across the basin with access stairs from both sides.

Table 3-5: Violations of the City's Monthly Average BOD5 Limit

Monthly Average BOD5 Effluent Concentration (mg/L):					
	2018	**2019**	**2020**	**2021**	**2022**
January	3.2	3.0	4.4	6.1	3.4
February	3.0	2.0	2.8	8.1	5.5
March	2.0	2.3	4.1	4.4	3.7
April	2.8	2.3	6.6	11.2	6.3
May	4.8	3.2	4.3	20.0	4.5
June	3.8	3.8	2.6	15.6	3.7
July	7.5	8.2	8.5	14.1	3.2
August	10.4	10.3	6.8	4.3	5.3
September	11.3	7.0	10.4	6.5	5.6
October	13.8	8.8	7.8	2.6	7.0
November	11.8	12.9	11.6	4.9	5.3
December	3.8	6.9	2.9	3.2	2.7
Monthly Average BOD5 Effluent Loading (ppd):					
	2018	**2019**	**2020**	**2021**	**2022**
January	7.4	3.4	13.0	15.8	7.1
February	3.8	5.8	3.7	16.1	4.6
March	2.8	4.0	3.7	5.6	10.8
April	2.8	4.5	8.2	6.2	9.8
May	3.0	2.2	2.8	14.9	4.7
June	1.5	2.3	1.3	9.3	3.5
July	2.3	3.8	3.7	6.4	2.1
August	4.2	4.5	4.1	2.1	2.2
September	5.3	6.0	7.1	2.9	2.7
October	7.4	4.5	5.0	1.7	3.2
November	9.5	7.5	17.4	12.5	6.3
December	7.0	7.5	5.5	5.7	3.5

The existing trickling filter/solids contact system is not optimal for the high variation in flows experienced by the City, especially given the lack of redundancy with only one filter and one clarifier. During high flow events, water ponds in the trickling filter and colder temperatures inhibit biological activity, requiring the relatively small solids contact basin to act as the primary treatment unit. During the dry season, the trickling filter must be over-recirculated (over a factor of 4) to keep the distribution arms spinning at a rate to keep the entire filter area wetted. Furthermore, with only one secondary clarifier, the facility is out of compliance with DEQ reliability and redundancy criteria. The existing clarifier was sized for peak flows, which makes it oversized for typical dry season flows. Oversized secondary clarifiers can result in settled activated sludge going septic and losing biological activity. This can cause the solids contact aeration basin to not perform to its design standards, even if routine process testing indicates that mixed liquor suspended solids concentrations are in an optimal range.

At a minimum, a more appropriately sized redundant secondary clarifier should be added so that the existing clarifier can be taken offline and properly maintained. While I/I reduction could help the WWTP perform in mitigating issues caused by extreme flow variations, it will likely prove to be more cost-effective for the City to transition to a treatment configuration that is more robust and with a higher degree of operational flexibility.

3.2.6 Disinfection

As discussed in Section 2.4.7, the existing contact chamber has an overestimated contact time and is not in compliance with DEQ redundancy and reliability requirements. Furthermore, the structure itself was constructed in the original WWTP and will approach the 100-year design life for a concrete structure in the planning period. The lack of controls or flow-pacing for chlorine and thiosulfate dosing is also a concern. At worst, this puts the City at risk of exceeding the chlorine residual limit of 0.5 mg/L. At best, it results in overdosing of chemicals and the City wasting money.

3.2.7 Solids Handling

Electricity expenditures for the existing aerobic digester blower are over $1,500 per month, and the digester cells are not able to be isolated with the existing blower configuration. After discussion with vendors, a turbine-style positive displacement blower would be more appropriate to meet the mixing and air requirements for the aerobic digester than the existing rotary lobe. A new blower should be able to operate just one of the cells at a time (with the other being empty) and save the City considerable electricity costs. A turbine-style blower would be appropriate for the digester given the turndown flexibility.

The existing underdrain piping in one of the solids drying beds was observed to be exposed and broken in multiple places. A full rehabilitation of the underdrain system is recommended for at least a short-term fix. The operators have expressed concerns about the difficulty in removing sludge from the drying beds because the plastic liner is completely exposed around the drying bed rim, and the side slopes of the beds are too steep to drive in a tractor without providing gravel fill before clearing the beds. An alternative to modify the drying beds should be evaluated to add runner-walls to help guide equipment during bed clearing and to improve access of equipment into the beds.

3.3 Reasonable Growth

The planning period for this document will end in 2045. During this period, the population of the City is expected to grow significantly. The anticipated population growth will increase the total wastewater volume and pollutant load that must be treated at the WWTP. To estimate future wastewater flow rates and pollutant loading rates during the planning period, the existing flow and loading rates were scaled with the projected population growth rates.

3.3.1 Current Flow Rates

An evaluation of flowrates via the DEQ guidance document "*Guidelines for Making Wet-Weather and Peak Flow Projections for Sewage Treatment in Western Oregon*" was performed using flowrates recorded in the facility's DMRs and precipitation data. The data used in this analysis is documented in Appendix E. A summary of this analysis is provided in the following subsections.

3.3.1.1 Characteristic Flowrate Definitions

The following terms are used to describe characteristic flowrates:

- Dry Weather Period: Defined as the period when the precipitation and streamflow are low. This period is defined as May 1 through October 31.
- Wet Weather Period: Defined as the period when precipitation and streamflow are low. This period is defined as November 1 through April 30.
- Average Annual Flow (AAF) or Average Daily Flow (ADF): Total wastewater flow for a 12-month period, from January 1 through December 31, divided by the total number of days for which data was available (between 363 and 366 days).
- Base Sewerage: Average daily flow for the period between June 1 and September 31. This is used as a basis to evaluate inflow and infiltration (I/I).

- Average Dry Weather Flow (ADWF): Total wastewater flow for the dry-weather period divided by the number of days in the period for which data was available.
- Maximum Month Dry Weather Flow (MMDWF): Total wastewater flow for the month with the highest flow during the dry-weather period, divided by the number of days in the month.
- Average Wet Weather Flow (AWWF): Total wastewater flow for the wet-weather period divided by the number of days in the period for which data was available.
- Maximum Month Wet Weather Flow (MMWWF): Total wastewater flow for the month with the highest flow during the wet-weather period, divided by the number of days in the month.
- Peak Day Average Flow (PDAF): Total flow for the day with the highest wastewater flow during the year.
- Peak Hour Flow (PHF): The maximum flow observed during the peak day.

The following terms will be used in the statistical analysis of flowrates:

- Ten-year Maximum Month Dry Weather Flow ($MMDWF_{10}$): The monthly average dry weather flow with a 10% probability of occurrence.
- Five-year Maximum Month Wet Weather Flow ($MMWWF_5$): The monthly average wet weather flow with a 20% probability of occurrence.
- Five-year Peak Day Average Flow ($PDAF_5$): The peak day average flow associated with a five-year storm event.
- Max Week Flow (MWF): The average weekly flow during a five-year storm event.

3.3.1.2 Max Month Flowrates

Monthly average flows were plotted against monthly cumulative precipitation (Figure 3-5). A linear fit of the data was created and flowrates were estimated at precipitation values of 6.08 inches and 8.69 inches. These precipitations correspond to the 90th percentile May precipitation and the 80th percentile January precipitations at Lookout Point Dam respectively (NOAA Climatography of the United State Number 20, 2001, Appendix F). The flowrates corresponding to these precipitations are equal to $MMDWF_{10}$ (occurs once every 10 years) and $MMWWF_5$ (once in five years) respectively. Data was limited to the most recent year (2023) to avoid population growth from skewing the correlation analysis. The 5-year high of January 2020 was plotted for reference, but not included in the correlation.

3.3.1.3 Peak Day Flow

Daily flowrates were plotted against daily precipitation totals for days where the following criteria were met: antecedent five days prior to the record date had over 1” of cumulative rainfall, and the event occurred during the high groundwater period (January – March). Based on a linear fit of this dataset, the flowrate associated with the precipitation corresponding to a 5-year, 24-hour storm (4.25”, NOAA Atlas 2 Volume X, Appendix G) was calculated at 1.01 MGD as shown in Figure 3-6.

3.3.1.4 Peak Hourly Flow

Peak hourly flow (PHF) was estimated assuming a probability of occurrence once every 8,760 hours (0.011%). The probability of occurrence associated with the other flows shown on Figure 3-7 are as follows: peak monthly (MMWWF5) occurs once every 12 months (8.3%), max weekly (MWF) occurs once every 52 weeks (1.9%), and peak daily (PDAF5) occurs once every 365 days (0.27%).

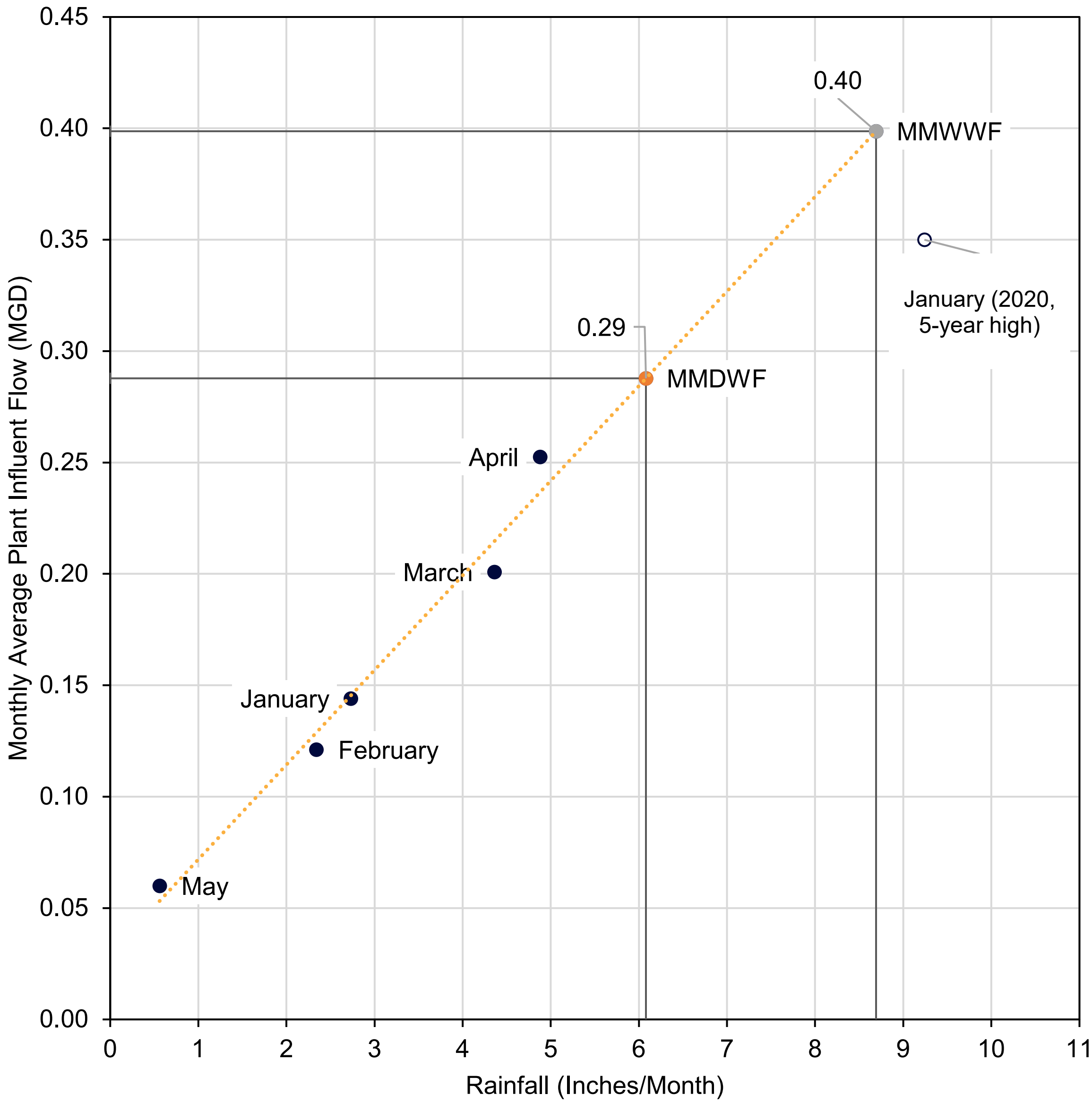


Figure 3-5: DEQ Graph #1, Monthly Average Flowrates and Monthly Precipitation Correlations

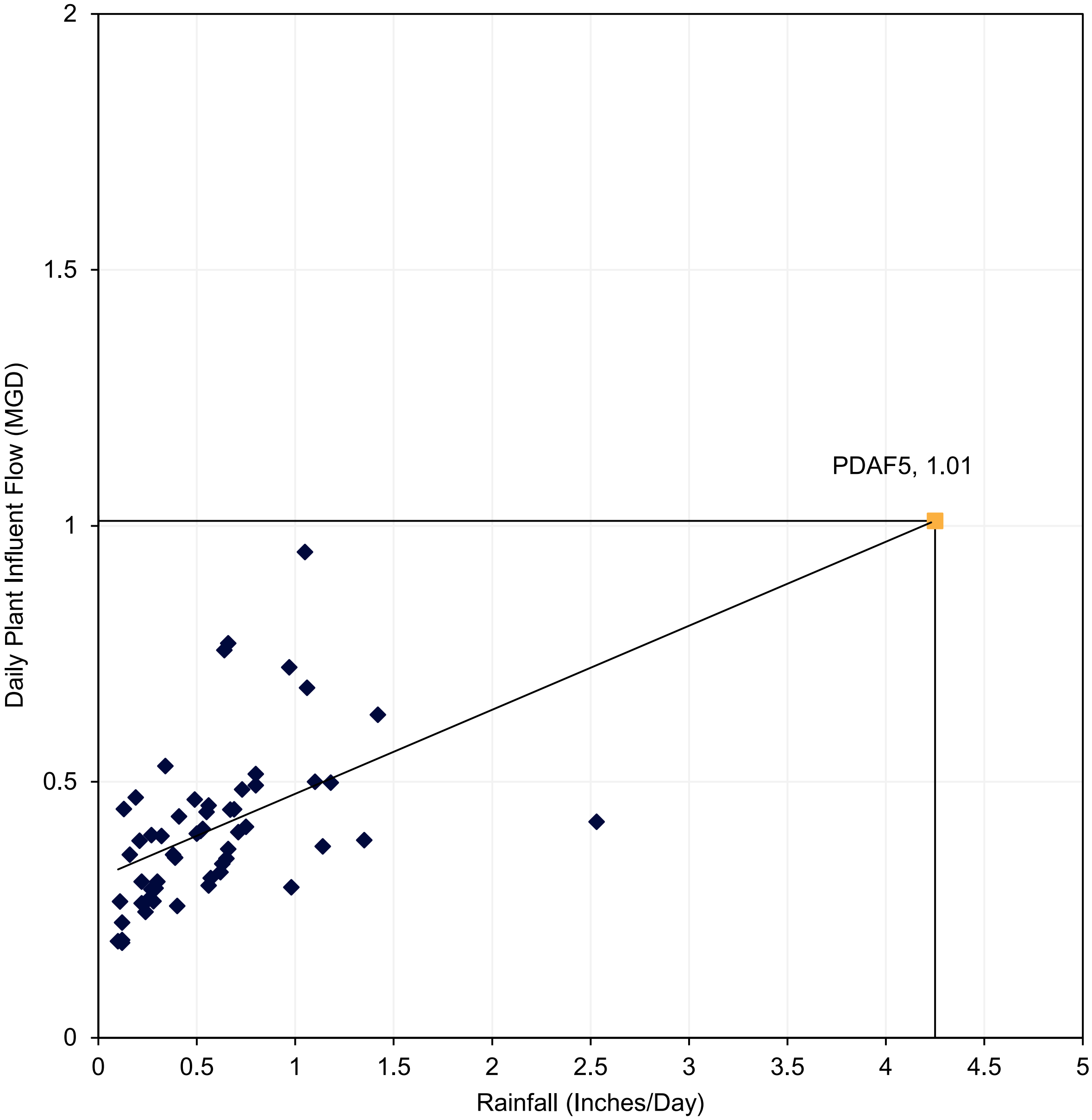


Figure 3-6: DEQ Graph #2, Daily Average Flow correlated to Daily Precipitation

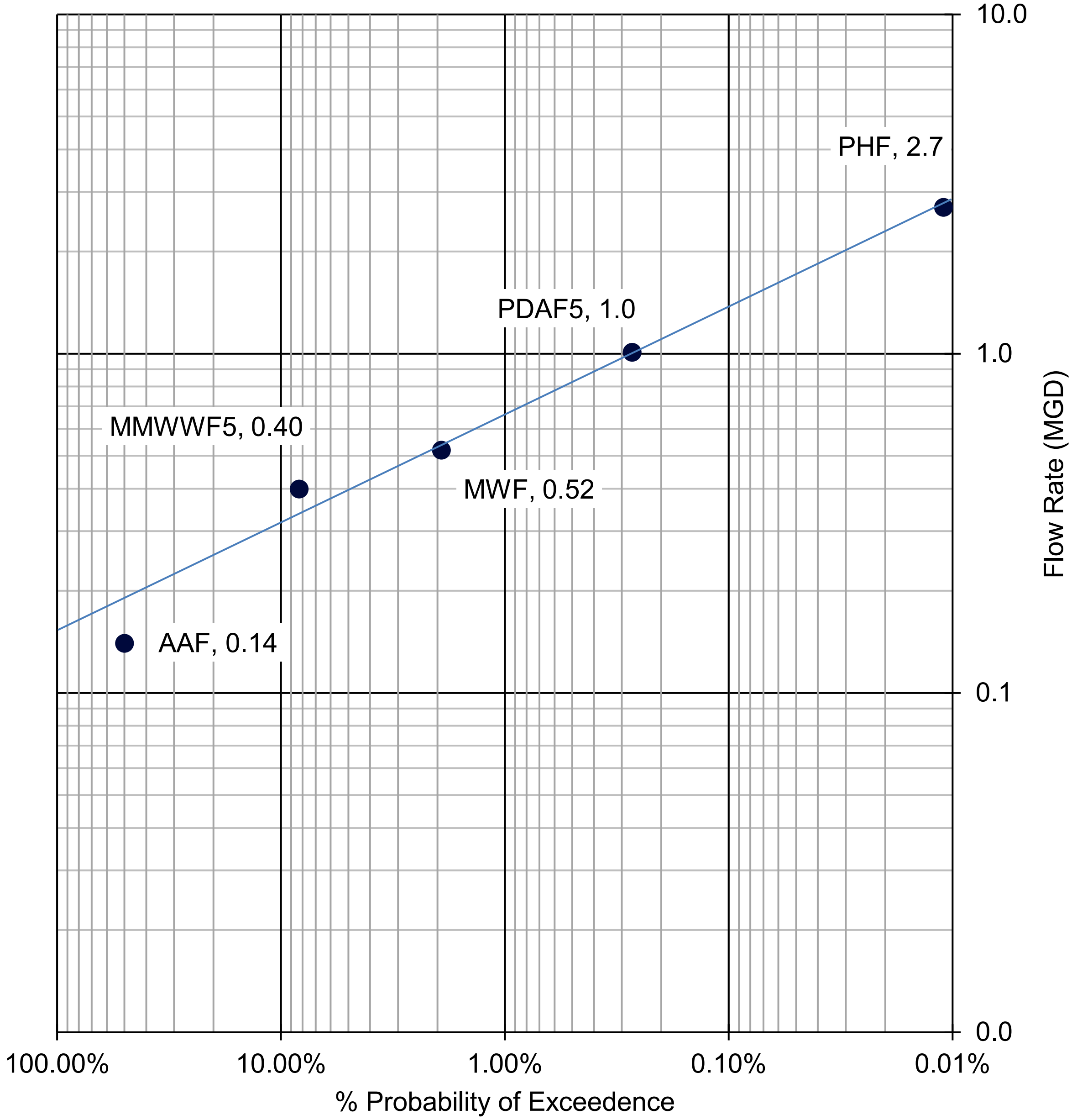


Figure 3-7: DEQ Graph #3, Flow Projections as a function of Exceedance Probability

3.3.1.5 Evaluation of Estimated Current Flows

In addition to the flowrates estimated via DEQ methods, the ADWF and AWWF were estimated by evaluation of the facility's DMRs from the previous 5-year period (2018 – 2023). The AWWF was determined to be 0.20 MGD and ADWF was determined as 0.08 MGD. Together, these average to the AAF of 0.14 MGD. The DEQ estimated flows were compared to all flows recorded in the past five years in Figure 3-8. The estimated flows are generally in agreement with recorded flows. The PDAF estimated using DEQ method seems to underestimate the maximum day average flow by one to four hundred thousand gallons per day. Therefore, the estimated flow was adjusted to the value of the highest observed flow of 1.4 MGD to be conservative. A summary of all current flows are provided in Table 3-6.

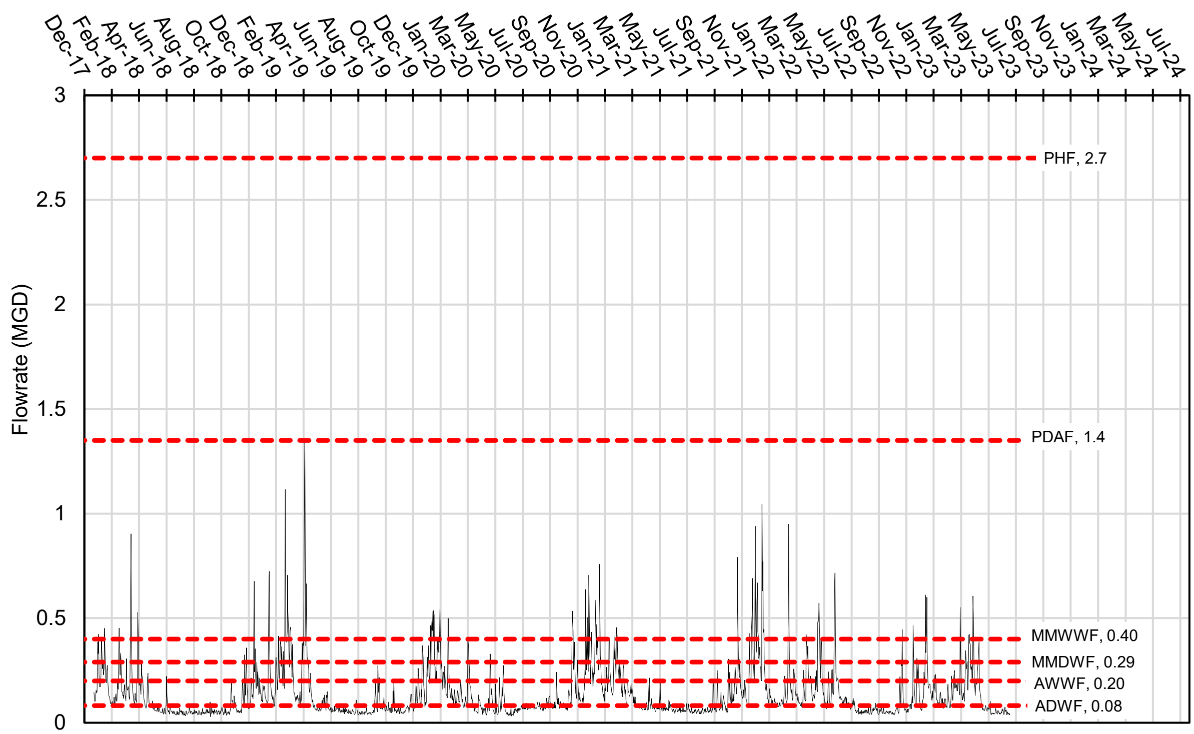


Figure 3-8: Comparison of Estimated Flows with Recorded Flows from Past Five Years

Table 3-6: Summary of Current Flow Estimates

	2023 Flow Estimates (MGD) Population = 1250	Per Capita Flow (GPCD)	Evaluation Method
Base Sewerage	0.08	62	Average between 6/1 and 9/31
Average Dry Weather Flow (ADWF)	0.08	66	Average Flow between 5/1 and 10/31
Average Wet Weather Flow (AWWF)	0.20	158	Average Flow between 11/1 and 4/30
Maximum Monthly Average Dry-Weather Flow (MMDWF)	0.29	230	DEQ Graph 1
Maximum Monthly Average Wet-Weather Flow (MMWWF)	0.40	319	DEQ Graph 1
Peak Daily Average Flow (PDAF)	1.40	1120	Highest Daily Average Flow in past 5-years
Peak Hourly Flow (PHF)	2.70	2160	DEQ Graph 3

3.3.2 Projected Flowrates

To estimate 2045 flowrates, the City's base sewerage (defined as average flow from June 1 to September 1) of 0.08 MGD was scaled commensurately with the expected population growth. A unit per capita sewerage of 62 gal/capita/day was calculated by dividing the base sewerage by the current population of 1,250.

Peaking factors of 2 and 5, based on the water demand peaking factors from the City's Water Master Plan, were used to scale the base sewerage for peak day and peak hour flows respectively. A peaking factor of 1.4, determined by the quotient of average wet weather and average annual flow, was applied to average wet weather and max month sewerages. The expected increase in base sewerage was then added to each of the characteristic flows. A summary of existing plant flowrates and projected 2045 flowrates is provided in Table 3-7.

A brief evaluation of how enrollment growth at the Lowell School District may affect wet weather flows was performed since the school is the largest non-residential discharger to the City's wastewater system during the wet season. The Lowell School District reported an enrollment of 889 students in 2020, and the National Center for Education Statistics reported an eleven-year growth rate of 1% for total public school enrollment between 2010 and 2021 in Oregon. This growth rate was extrapolated for an expected enrollment of 909 students in 2045. A unit flow of 19 gal/student/day was applied to the expected student enrollment growth for an additional flow of 388 gallons per day in 2045. This is less than 2% of the projected increase in AWWF.

As discussed previously, the contributions of I/I volumes are considerable in the City's collection system. The flow projections in Table 3-7 are made under the assumption that I/I volumes will not increase throughout the planning period. This assumption is valid if the City makes efforts to repair the identified sources of I/I from this planning effort, maintains a program to identify and repair I/I sources, and ensures new developments and additions to the collection system are not adding new I/I sources.

Table 3-7: Summary of Projected Flow Rates

	2023 Flows (MGD)	Sewerage Peaking Factor	Per Capita Sewerage (GPCD)	Estimated I/I Volume (MGD)	2045 Flows (MGD)	% I/I
Base Sewerage	0.08	1.0	62	0.00	**0.10**	0%
Average Dry Weather Flow (ADWF)	0.08	1.0	62	0.00	**0.10**	4%
Average Wet Weather Flow (AWWF)	0.20	1.4	86	0.09	**0.23**	39%
Maximum Monthly Average Dry-Weather Flow (MMDWF)	0.29	1.4	86	0.18	**0.32**	56%
Maximum Monthly Average Wet-Weather Flow (MMWWF)	0.40	1.4	86	0.29	**0.43**	68%
Peak Daily Average Flow (PDAF)	1.4	2.0	123	1.25	**1.5**	86%
Peak Hourly Flow (PHF)	2.7	5.0	310	2.31	**2.8**	82%

3.3.3 Pollutant Load Projections

A thorough review of the City's WWTP discharge monitoring reports (DMRs) from 2018 to 2023 was conducted to project influent pollutant loads for the 2045 design year. A full summary of the data from DMRs is provided in Appendix E.

The City's current NPDES permit requires monitoring influent and effluent BOD_5 and TSS for treatment compliance. Influent concentrations and flowrates for BOD_5 and TSS were used to calculate average, max month, and peak day pollutant loads. These loads were divided by Lowell's 2023 population of 1,250 to calculate unit loadings. These unit loadings were then multiplied by expected population in 2045 to calculate design year loads.

An estimate of ammonia loadings was made using a concentration of 20 mg/L as nitrogen, typical of medium strength domestic wastewater (Metcalf and Eddy, 5th edition). A peaking factor of 1.85, calculated from BOD_5 data, was applied to estimate max month ammonia loads. A summary of current and design year loads is provided in Table 3-9.

3.3.3.1 Process Modeling Criteria

A biological model was prepared to estimate the required aeration capacity for treatment of BOD_5 and ammonia, and to estimate biosolids production rates at the design pollutant loads. The model was evaluated to meet BOD_5 limit of 10 mg/L, TSS limit of 10 mg/L, and an ammonia limit of 1 mg/L given the loadings in Table 3-8. The model was evaluated with and without nitrification (removal of ammonia). The results of this model are presented in full in Appendix H, and a summary of design criteria from the modeling is provided in Table 3-9. These criteria were used to evaluate biological treatment improvement alternatives in Section 4. Generally, mixing requirements were limiting regarding aeration rates, except for projected 2045 max month flows.

Table 3-8: Current and Projected Pollutant Loads

	lb/day 2023 (Pop. 1,250)	lb/capita/day	lb/day 2045 (Pop. 1,618)
Five-Day Biochemical Oxygen Demand (BOD_5)			
Annual Average	114	0.091	148
Max Month	213	0.170	276
Peak Day	423	0.338	548
Total Suspended Solids (TSS)			
Annual Average	129	0.103	167
Max Month	235	0.188	304
Peak Day	502	0.402	650
Ammonia			
Annual Average	14	0.011	18
Max Month	25	0.020	33

Table 3-9: Estimated Aeration Requirements and Sludge Production Rates

Aeration Basin Air Requirements (SCFM)		
BOD Treatment Only		
Year	**2023**	**2045**
Aeration Volume	41,300 gal	
Average Dry Weather	138	138
Max Month	138	153
BOD Treatment + Full Nitrification		
Aeration Volume	82,600 gal	
Average Dry Weather	276	276
Max Month	276	319
Sludge Production Rates		
Average Sludge Flow (gpd)	512	693
Average Dry Cake Produced (lb/day)	83	112
Max Month Sludge Flow (gpd)	943	1259
Max Month Dry Cake Produced (lb/day)	153	204

3.3.4 Collection System Capacity

3.3.4.1 Alder Street Pump Station Design Flows

Based on the number and zoning type of properties connected to the Alder Street Pump Station sewerage basin, this lift station serves approximately 147 EDUs. Using the Lane County average of 2.3 people per EDU and the unit flow of 62 gal/capita/day, this results in a base sewerage of 0.02 MGD. This is approximately 25% of the City’s base sewerage. This is reasonable, since the 2001 facilities plan estimated 19% of the City’s flow was sourced from the pump station, and since that plan was published a sizable collection system expansion was added on North Shore Drive northeast of the Alder Street Pump Station. Assuming that I/I is constant throughout the City, a constant ratio of 0.25 was used to determine flows to the lift station relative to the City’s projected 2045 average flow and PHF. These flows are presented in Table 3-10.

Table 3-10: Alder Street Pump Station Current and Projected Flows

	Gallons/Minute	Million Gallons/Day
2023 Average Flow	24	0.04
2023 Peak Flow	469	0.68
2045 Average Flow	29	0.04
2045 Peak Flow	489	0.70

There are two submersible pumps each with a 350 GPM capacity in the Alder Street Pump Station. The total capacity of the station (700 GPM) is nominally enough to handle these flows, however, DEQ reliability standards require that the firm capacity of the pump station be sized for peak flow. Firm capacity is defined as the capacity of the pump station with the largest pump out of service. Therefore, the existing lift station's firm capacity is deficient to the projected 2045 flow by 139 gallons per minute. There has also been an overflow at the lift station relatively recently (2021), which may indicate the pumps in the lift station are not performing to their design criteria. Since these pumps are past the typical 20-year design life, the City should plan to upgrade the lift station pumps relatively soon in the planning period. Furthermore, multiple I/I sources were identified in the sewershed of the lift station during the I/I evaluation. Rehabilitating these manholes and pipes should be prioritized since they present the most risk for unpermitted discharge from the lift station overflow. A map of the lift station sewershed and I/I sources identified is presented in Figure 3-9.

3.3.4.2 Gravity Sewer Capacity

The City's gravity sewer pipes should be sized for the capacity associated with PHF. Using the Lane County average of 2.3 people per household, the City's current EDU total of 545, and an expected population growth of 368 people, approximately 705 EDUs are expected to be served by the City's wastewater facilities in the 2045 design year. At a projected 2045 PHF of 2.81 MGD, this equates to approximately 2.8 gpm per EDU. Assuming that flow is even distributed throughout the City, the number of properties upstream of a pipe in the collection system can be used to estimate wastewater flow during PHF, and this can be compared to the receiving pipe capacity as determined using Manning's equation. If the estimated wastewater flow is greater than the pipe capacity, then that pipe should be upsized.

The main collector truck along Moss Street that connects to the WWTP was upgraded in the early 2000s to a 15" PVC sewer main. This upgraded main has a capacity of about 2100 gpm. With a projected PHF of approximately 1950 gpm, this collector is large enough for the City's expected growth for the planning period.

There are two substantial bottlenecks in the collection system upstream of the main collector that are likely undersized for future growth. Both of these are 8" pipes that serve a significant number of properties in the City, one located in the alleyway between Moss Street and Cannon Avenue, and the other located at the west end of 1st street up to the Moss/Cannon alleyway. The location of these pipes and the areas they serve is shown in Figure 3-10. At a nominal slope of 0.3%, the capacity of an 8" line with an assumed Manning's coefficient of 0.015 is approximately 260 gpm. Estimating the flow for 90 properties with a unit flow of 2.8 gpm per EDU results in about 252 gpm. Both of these lines respectively serve over 90 properties. The areas served by these lines are also the most likely to experience new development, since most of the buildable land within the UGB is located in the northeast portion of the City.

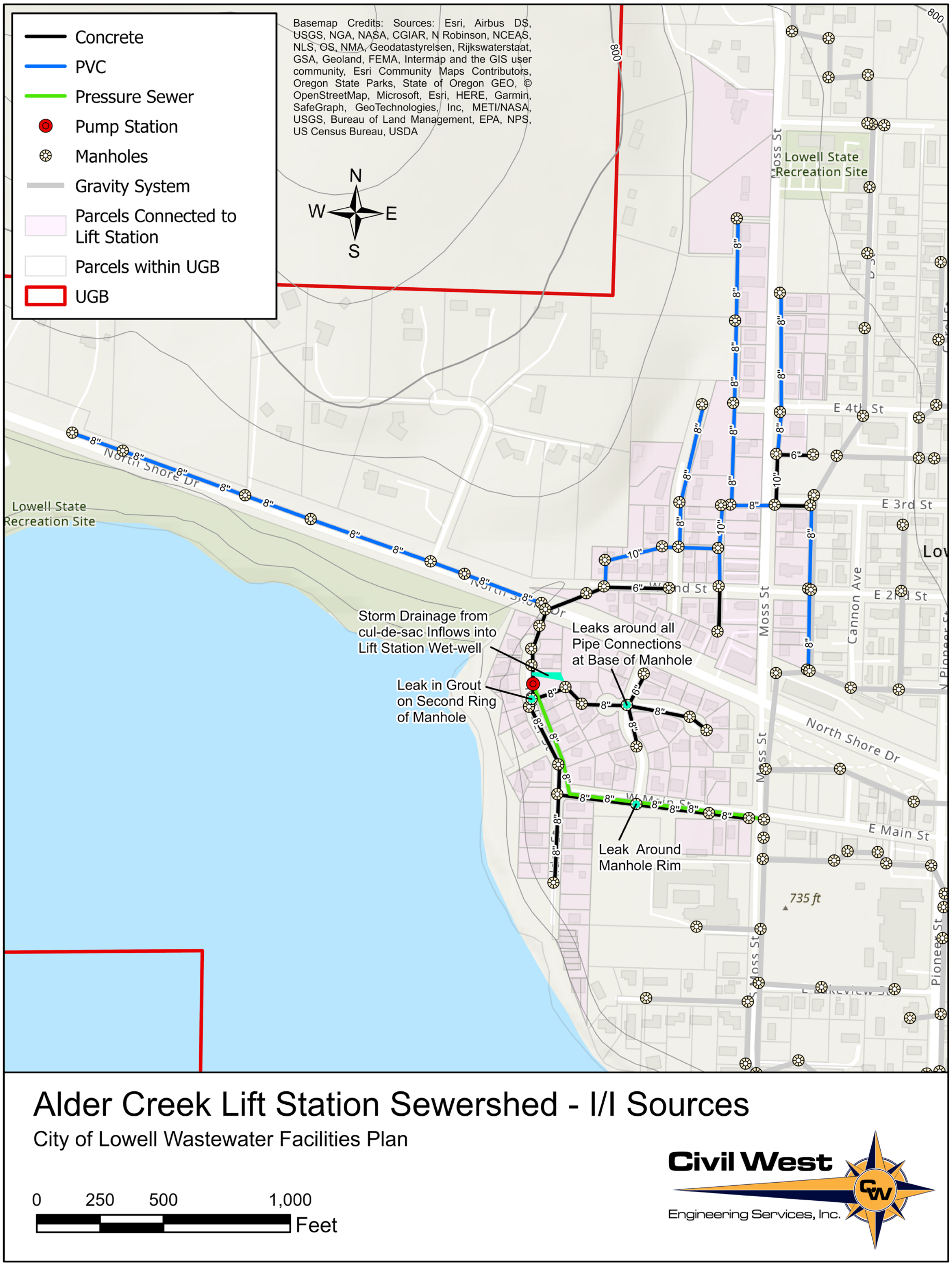


Figure 3-9: Alder Creek lift Station Sewershed and Identified I/I Sources

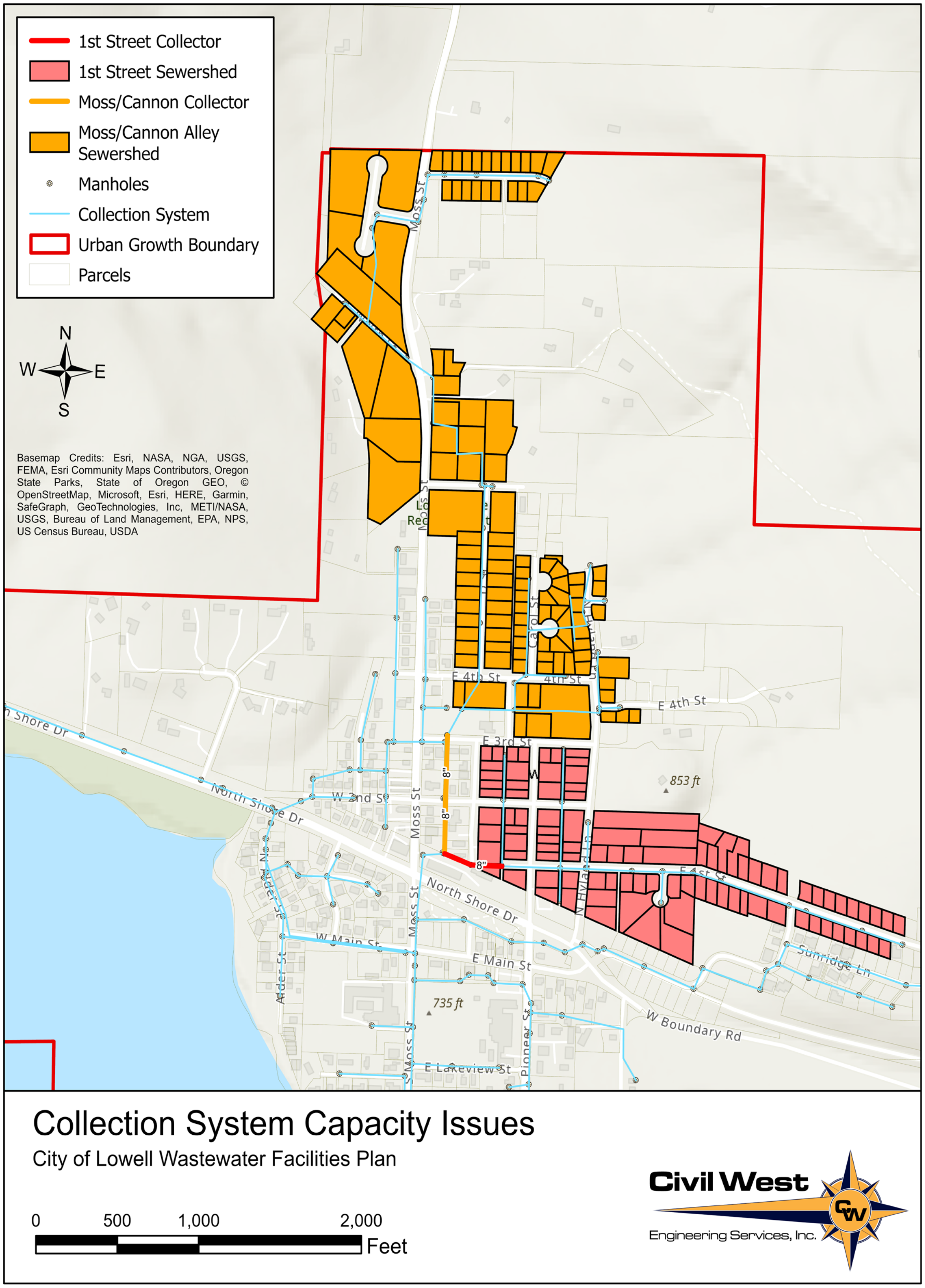


Figure 3-10: Collection System Pipes with Capacity Concerns

4 ALTERNATIVES CONSIDERED

The following issues should be addressed within the next planning period:

- Multiple sources of I/I were discovered in the sanitary sewer collection system;
- The Alder Street Lift Station does meet firm capacity requirements for current and projected peak flow events;
- Two significant sewersheds in the City have collector pipes that are undersized for future projected growth;
- Multiple recent BOD_5 and TSS violations of the City's NPDES permit indicate need for biological treatment system upgrades at the WWTP;
- The facility is not in compliance with State redundancy requirements with only one secondary clarifier;
- The biosolids aeration system is not optimized, costing the City unnecessary electricity and O&M expenditures;
- The underdrains of the sludge drying beds have been damaged over time by regular sludge removal, and;
- The existing disinfection system is undersized for current and 2045 design flows.

Several alternatives were considered to address these issues. This section presents a description of every alternative considered and a discussion of their technical feasibility. Each technically feasible alternative is discussed with respect to planning-level design criteria, cost estimates, environmental impacts, land requirements, and potential construction issues.

4.1 Basis for Cost Estimates

Itemized cost estimates for each technically feasible alternative considered in this section are provided in Appendix I. These cost estimates include capital costs, operations and maintenance costs, and salvage values. Capital costs are typically comprised of four components: construction cost, engineering cost, contingency, and administrative costs. Operations and maintenance costs consist of disposables (chemicals, oil, parts), labor costs, and electricity costs. Salvage values are estimated as the value of each tangible item (i.e., not including installation costs) at the end of the planning period after accounting for design life.

These cost estimates are preliminary and based on the level and detail of planning presented in this study. The goal of planning-level cost estimates is to establish a reasonably conservative budget and to allow fair cost comparisons of alternatives. As projects proceed, site-specific information becomes available, and these estimates should be updated.

4.1.1 Construction Costs

Estimated construction costs were based on construction bidding results from similar work, published cost guides, budget quotes obtained from equipment suppliers, and other construction cost experience. Construction costs are preliminary estimates for budgeting purposes.

Future changes in the cost of labor, equipment, and materials may justify comparable changes in the cost estimates presented herein. For this reason, common engineering practices usually tie the cost estimates to an index that varies in proportion to long-term changes in the national economy. The Engineering News Record (ENR) construction cost index (CCI) is most commonly used. This index is based on the value of 100 for the year 1913. Average values for the past 10 years are summarized in Table 4-1.

Table 4-1: ENR Construction Cost Index History

Year	Average CCI	% Change/Year
2010	8801	2.70%
2011	9070	3.06%
2012	9309	2.64%
2013	9547	2.55%
2014	9807	2.72%
2015	10036	2.34%
2016	10331	2.95%
2017	10681	3.39%
2018	11062	3.56%
2019	11281	1.98%
2020	11457	1.55%
2021	12149	6.04%
2022	13007	7.06%

4.1.2 Contingencies

A contingency factor equal to approximately twenty percent of the estimated construction cost was added to the construction cost estimate. In recognition that the cost estimates presented are based on conceptual planning, allowances must be made for variations in final quantities, bidding market conditions, adverse construction conditions, unanticipated specialized investigation and studies, and other difficulties which cannot be foreseen at this time but may tend to increase final costs. Upon completion of final design, the contingency can be reduced to 10%. A contingency of at least 10% should always be maintained going into a construction project to allow for variances in quantities of materials and unforeseen conditions.

4.1.3 Engineering and Technical Services

Engineering and technical services for major projects typically include surveying, preliminary and final design, preparation of contract/construction drawings and specifications, bidding services, construction management, inspection, start-up services, and the preparation of operation and maintenance manuals. Depending on the size and type of project, engineering costs may range from 18 to 25% of the contract cost when all the above services are provided. The lower percentage applies to large projects without complicated mechanical systems. The higher percentage applies to small or complicated projects.

Engineering costs for basic design and construction services presented in this section were estimated at 20% of the estimated total construction cost. Other engineering costs such as specialized geotechnical explorations, hydro-geologic studies, easement research and preparation, pre-design reports, and other services outside the normal basic services will typically be in addition to the basic engineering fees charged by firms. When it was suspected that a specific project in this report may need any special engineering services, an effort has been made to include additional budget costs for such needs. Specific efforts required for individual basic engineering tasks such as surveying, design, construction management, etc. vary widely depending on the type of project, scheduling and timeframes, level of service desired during construction, and other project/site-specific conditions however an approximate breakdown of the 20% engineering budget is as follows:

- Surveying and Data Collection – 0.5%
- Civil/Mechanical Design – 8%
- Electrical/Controls Design – 1.5%
- Bid Phase Services – 1%
- Construction Management – 4%
- Construction Observation (Inspection) – 5%

4.1.4 Administrative and Legal Services

An allowance of five percent (5%) of construction cost was added for legal and other project management services. This is intended to include internal project planning and budgeting, funding program management, interest on interim loan financing, legal review fees, advertising costs, wage rate monitoring, and other related expenses associated with the project that could be incurred.

4.1.5 Operations and Maintenance Costs

Operations and maintenance (O&M) costs were simplified to include the following:

- Electricity costs for major pieces of equipment were based on the rated horsepower of representative equipment, the anticipated equipment runtime, and an estimated market price for electricity.
- Chemical consumption costs were based on estimated consumption rates for the identified chemical.
- Fees for outside services (such as tipping fees for the landfilling of biosolids) were based on quoted prices.
- Staff hours were estimated using *The Northeast Guide for Estimating Staffing at Publicly and Privately Owned Wastewater Treatment Plants* prepared by the New England Interstate Water Pollution Control Commission (New England Interstate Water Pollution Control Commission, 2008). An hourly labor cost of $30 per hour was used as a base rate.
- Materials costs were estimated from anticipated lifespans and replacement costs for commonly replaced materials.

4.2 General Treatment Alternatives

The alternatives in this subsection describe and discuss the feasibility of general, overarching modifications to the City’s wastewater treatment facilities.

4.2.1 Regionalization

Regionalization involves coordinating with nearby wastewater utilities to consolidate resources and provide treatment at a centralized location. The nearest cities to Lowell (Oakridge, Jasper, Springfield) are too small and/or too far away to be considered feasible for conveying the City's wastewater to a regional treatment facility. Any costs saved from capital investments to improve the existing WWTP would be dwarfed by conveyance costs and the costs to construct a new or upgrade a receiving facility.

The nearby unincorporated community of Dexter recently evaluated regionalization to convey septage to Lowell's treatment facility as part of a recent planning effort. Civil West assisted with this evaluation to provide preliminary cost estimates for their alternative analysis (Appendix I. The estimated cost for a storage basin and lift station to convey septage to the City's WWTP was estimated at $850,000 (2022$). The final results of Dexter's analysis were not made available to the City or Civil West at the time of this plan being finalized. Therefore, it was assumed that Dexter decided on a different alternative than conveying septage to the City's WWTP. The City is open to receiving septage from Dexter, provided the Dexter community is able to fund the necessary conveyance infrastructure.

4.2.2 New Treatment Plant

This alternative involves purchasing new property and constructing a new WWTP. This alternative is not necessary since the existing property is ideally located for the City's WWTP at the lowest elevation in the area. The collection system and outfall would have to be completely redone since there is no suitable property available near the existing site. If the City was to move the location of the WWTP, ownership of the existing property would revert to ACE as it is within their ownership rights associated with the reservoir. This alternative is not feasible compared to rehabilitation of the existing facilities.

4.2.3 Rehabilitate Existing Treatment Plant

Deficiencies in the existing facilities would be corrected and facilities expanded to accommodate design flows and loads. This alternative is the most feasible for the City compared to regionalization and constructing a new WWTP. Several alternatives to upgrade this existing facility are provided in the remainder of this section.

4.3 Headworks Improvements

The existing headworks system consists of a mechanical fine screen, a bypass channel with a manually cleaned bar rack, and a Parshall Flume for flow measurement. The design capacity of each unit is summarized in Table 4-2. The existing headworks system has the capacity to handle the projected peak flow events throughout the planning period, with the caveat that the manually cleaned bar rack will need to be used occasionally during intense rain events. Efforts to eliminate I/I sources in the system should reduce the peak flow events and prevent overwhelming of the City's resources. The following subsections discuss the alternatives of maintaining the existing headworks as-is throughout the planning period (the “do nothing” alternative) and adding a parallel fine screen unit to reduce the facility's use of the bar rack.

Table 4-2: Capacity of Existing Headworks Units

Unit Operation	Capacity
Fine Screen	2.6 MGD
Bar Rack	2.6 MGD
Parshall Flume	3.3 MGD

4.3.1 "Do Nothing" – Keep Headworks As-Is

4.3.1.1 Description

The existing headworks system would continue to be used throughout the planning period without any major changes aside from periodically replacing short-lived assets. This would result in more frequent use of the bypass channel as the City expands and flows increase.

4.3.1.2 Design Criteria

The existing fine screen channel was designed for a maximum flow of 2.6 MGD. Flows over this are designed to overflow into the bypass screen channel. For this preliminary planning effort, it is assumed that the bypass channel would have to be used for 5% of the wet season as a result of not upgrading the headworks.

4.3.1.3 Environmental Impacts

There are no major environmental impacts associated with this alternative.

4.3.1.4 Land Requirements

This alternative would not require additional land.

4.3.1.5 Potential Construction Problems

This alternative would not require construction.

4.3.1.6 Cost Estimates

Detailed cost estimates are provided in Appendix I. As the "do-nothing" alternative, this alternative would have zero associated capital cost. However, the increased use of the bar rack would result in more labor hours. Based on approximately 65 hours per year for maintenance of the fine screen, 20 hours for maintenance of the bar rack, $500 per year for replacement parts for the headworks components, and 6000 kWh for electrical demand for the existing headworks components, the annual O&M cost for this alternative is estimated at approximately $4,400 per year.

4.3.2 Increase Screening Capacity

4.3.2.1 Description

This alternative involves construction of a parallel channel in the headworks and installation of a second fine screen to increase screening capacity.

4.3.2.2 Design Criteria

The maximum flow rate of the existing fine screen is 2.6 MGD (1805 GPM). Within the 2' wide channel, the maximum upstream water level for the screen is 29 inches, associated with a headloss of 16 inches.

This alternative assumes that an identical screen unit would be installed in a channel constructed adjacent to the existing bypass channel, effectively doubling the screening capacity. This alternative would retain the existing bypass channel with the manually screened bar rack, to provide screening in case of total power loss to the headworks and also provide 3' clearance between the two screens for maintenance.

4.3.2.3 Map

A conceptual drawing of this alternative is provided in Figure 4-1.

4.3.2.4 Environmental Impacts

There are no major environmental impacts associated with this alternative.

4.3.2.5 Land Requirements

This alternative would be constructed within the property of the existing treatment plant. No additional land is required.

4.3.2.6 Potential Construction Problems

This project would involve construction onto the existing headworks structure. A full structural evaluation will need to be performed as part of this project to ensure the headworks will be sound during and after construction. Consideration should be made to perform construction during the dry-season.

4.3.2.7 Cost Estimates

Detailed cost estimates are provided in Appendix I. This alternative would have capital costs associated with the construction of a parallel channel for a new screen unit, the screen unit itself, and installation and electrical fees. The capital cost is estimated at approximately $470,000. The salvage value is estimated at approximately $18,000 based on a 20-year planning period (2043$). Based on approximately 65 hours per year for maintenance of the fine screen, 5 hours for maintenance of the bar rack, $750 per year for replacement parts for the headworks components, and 6000 kWh for electrical demand for the headworks components, the annual O&M cost for this alternative is estimated at approximately $4,000 per year.

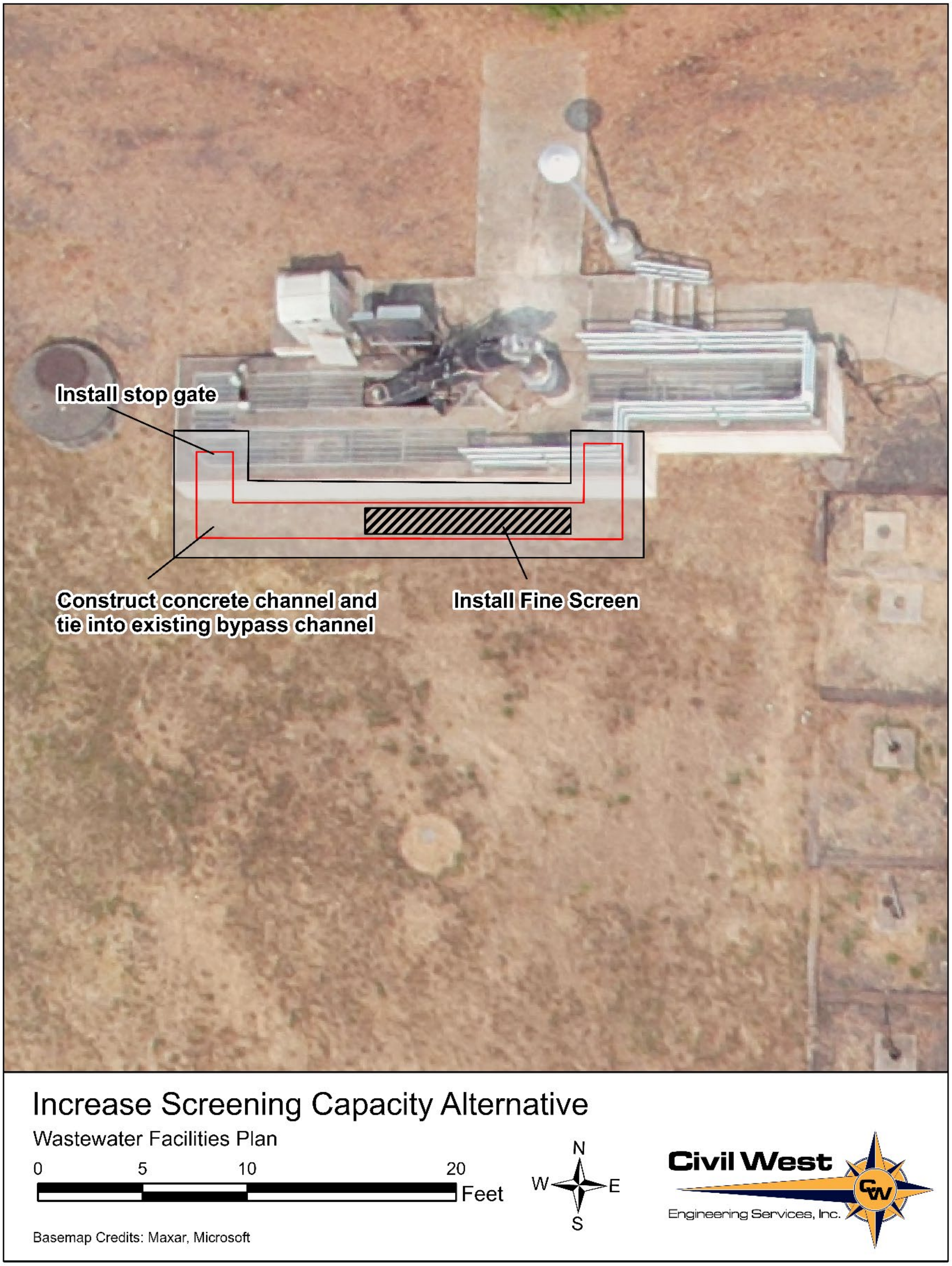


Figure 4-1: Conceptual drawing of adding an additional fine screening unit

4.4 Primary Treatment Improvements

Primary clarifiers should be sized for peak daily flow according to DEQ facilities plan guidelines. The current clarifier, using 2023 peak daily flow, has an overflow rate of 1376 gpd/ft^2. At 2043 design flow, the overflow rate is projected to be 1515 gpd/ft^2. These are within acceptable ranges based on typical design values of 1,200 to 2,000 gpd/ft^2 (Metcalf and Eddy). The detention time of the clarifier is approximately 1.5 hr at the design flow. While detention times closer to 2 hr are ideal, over 1 hr is acceptable for a sedimentation process ahead of secondary treatment (Metcalf and Eddy, 5th ed.).

It is recommended to prioritize upgrading the secondary treatment system and mediating the I/I volumes coming into the plant. The primary clarifiers are not vital to the overall treatment process due to relatively small TSS loads in the City's influent wastewater. The main purpose of constructing the primary clarifiers was to protect the trickling filter process from unnecessary solids loading. However, since the primary clarifiers have been in operation, they have not been instrumental in helping the City meet its permit limits as evidenced by the multiple permit violations in the past decade.

Furthermore, the creation of primary sludge is arguably more trouble than its worth for the City because of the nuisance conditions (scum and odors) created by primary sludge. The conversion of the primary clarifiers to biological aeration reactors was considered as an alternative for secondary treatment improvements, as discussed in Section 4.5.6.2.

4.5 Secondary Treatment Improvements

4.5.1 General Process Considerations

The existing biological treatment system has had issues meeting BOD_5 and TSS removal targets to comply with the City's NPDES permit. Furthermore, multiple deficiencies with the existing system necessitate the consideration of process improvements. These deficiencies include the following:

- A lack of redundant clarification capacity, inconsistent with DEQ and EPA reliability requirements,
- The existing clarifier is oversized for typical summer flows, resulting in sludge retention times that risk the activated sludge going septic in the clarifier bottoms,
- During high flow events, water ponds in the trickling filter and colder temperatures inhibit biological activity, causing the filter to act more as an equalization tank for the small aeration channel than as its own treatment unit. During the dry season, the trickling filter has to be recirculated by a factor of over 4 to keep the arms spinning at a rate so that the entire filter area is wetted.
- The solids contact aeration channel does not provide adequate aeration volume on its own.
- The existing system was not designed to treat ammonia, which could be required within the planning period based on DEQ's analysis in upcoming NPDES permit renewal cycles.

Multiple alternatives were determined in an initial review to be technically infeasible given land availability, operations capacity, and treatment requirements. A brief description of these alternatives and the rationale behind their infeasibility is presented below:

- *Lagoons* – While lagoons are an attractive choice for small communities like Lowell due to the low O&M requirements, they require a substantial amount of area to construct. The topography of the area around Lowell is very hilly, leading to a lack of suitable land to construct a lagoon system. The expected treated effluent quality of lagoons would likely be insufficient to meet the City's NPDES requirements for TSS and BOD, necessitating the City to consider effluent reuse for summer discharge, which would have a high cost for piping and land purchase. Due to the high anticipated costs, land requirements, and likely decrease in effluent quality, lagoons were not considered a feasible alternative.
- *Oxidation Ditch* – Oxidation ditches are an extended aeration system consisting of long, continuous channels that are continuously aerated to treat BOD and ammonia. These systems can provide good treatment, but require a large footprint compared to other extended aeration systems and conventional activated sludge systems. An oxidation ditch would likely require the City to purchase land for a new treatment plant site or demolish many of the existing structures to make room. With these considerations, the oxidation ditch was not considered viable for the City.
- *Rotating Biological Contactor* – RBCs are a fixed-film technology that, similar to a trickling filter, pass primary-clarified wastewater over a zoogleal film to remove BOD and nutrients. Instead of the film growing on filter media like in a trickling filter, the microorganisms grow on rotating plastic discs. These proprietary units have small footprint requirements. However, their performance is highly dependent on temperature and flowrate as those parameters affect biological activity and biofilm-shearing. Given the highly variable nature of Lowell's climate and wastewater flowrates, a complex system of parallel RBC treatment trains would need to be designed for all possible conditions. This would pose a concern given the slow start-up time of fixed-film biological reactors, requiring a high degree of attention by the operators to keep the biology active on the reactors. Because of these considerations, RBCs were considered technically infeasible compared to more conventional biological treatment technologies.
- *Membrane Bioreactor* – These units consist of a conventional activated sludge aeration basin with membrane filters in lieu of secondary clarifiers. The main benefits of membrane bioreactors are that they require a smaller footprint than conventional biological treatment alternatives, they retain larger biomass concentrations in the bioreactors for theoretically better treatment of dissolved organic matter, and they produce effluent with similar quality to plants with tertiary filtration treatment processes. However, they do require extensive pumping and electrical control systems to operate properly, and therefore require more oversight by the operator. Since one of the primary concerns with the existing facilities is the extensive O&M requirements of existing electrical and mechanical systems, it was decided that a system heavily reliant on pumps and mechanical units would compound the City's existing issues. This was therefore considered not a viable alternative for the City.
- *Do Nothing* – the "no action" alternative in this case is not feasible as it would leave the plant out of compliance with redundancy requirements and the City has had NPDES permit compliance issues with the existing treatment system. At a minimum, the City should have a plan to increase clarification capacity and upgrade the biological treatment system to have the capacity to meet design year flows and loads. A cost estimate for the "Do Nothing" alternative is provided (Appendix I) for Net Present Value comparisons in Section 5.1.

Multiple alternatives for upgrading the biological treatment systems were determined to be technically feasible and were evaluated in detail in the following sections. In addition to these broad treatment system alternatives, an analysis of adding a supplemental alkalinity addition system to improve nitrification capacity of the WWTP was evaluated.

4.5.2 Redundant Secondary Clarifier

4.5.2.1 Description

The existing treatment system is out of compliance with redundancy requirements because the WWTP has only one secondary clarifier. This means that the existing clarifier cannot be effectively maintained. Furthermore, the existing clarifier was built for capacity associated with peak day flows. This makes the clarifier oversized for typical dry weather flows, which creates issues associated with sludge age.

It is recommended that a redundant clarifier should be constructed to optimize treatment of summer flows. The existing secondary clarifier is in relatively good condition and is appropriately sized to handle peak and max month wet weather flows. With this alternative, a smaller clarifier would be in operation during the dry season, and the operator could divert flows from the aeration basin to the larger clarifier when the plant's flows increase in the wet season. The operator would also have the flexibility to operate both clarifiers in parallel, although this would probably not be necessary given the projected future flows.

4.5.2.2 Design Criteria

It is recommended to size a new clarifier for the 2045 design MMDWF of 0.3 MGD. A typical design point for dry season flows is 500 gpd/sqft. Applying the design point to the MMDWF results in a clarifier area of 620 sqft, or an equivalent clarifier diameter of 28'. Assuming an MLSS concentration in the aeration basin of 2,500 mg/L, a 28' clarifier results in a solids loading rate of 10 lb/day/sqft at MMDWF.

To meet reliability class II requirements for sedimentation basins, the smaller clarifier unit must be able to handle a capacity of at least 50% of peak day flow. The existing clarifier was sized at 1538 gpd/sf, which is a good design point for a secondary clarifier for peak day flowrates. 50% of the peak day flow is 0.71 MGD. Applying that same design point results in a minimum clarifier diameter of 25 feet (assuming a circular footprint).

With both of these design considerations, a 28' diameter clarifier is appropriately sized for dry-season flows throughout the planning period.

4.5.2.3 Location

The location of a new redundant clarifier will depend on the alternative selected for secondary treatment improvements. The location of the clarifier is clearly noted on each of the applicable alternatives in later subsections.

4.5.2.4 Environmental Impacts

There are no major environmental impacts as a result of this alternative.

4.5.2.5 Land Requirements

This alternative would not require the City to purchase additional land as it would be located on the existing treatment plant lot.

4.5.2.6 Potential Construction Problems

This alternative could be constructed outside of the flood zone, however, projects that involve underground piping should be planned to be constructed in the dry-season to avoid difficulties with managing high groundwater levels.

4.5.2.7 Cost Estimates

Detailed cost estimates are provided in Appendix I. This alternative would have capital costs associated with the construction of a flow splitter, the clarifier, mechanical mechanisms, piping improvements, and RAS/WAS pump improvements. The capital cost is estimated at approximately $1.2 million. The salvage value is estimated at approximately $105,000 based on a 20-year planning period (2043$). Based on approximately 80 hours per year for maintenance and operator labor, and $850 per year for the electricity for the clarifier drive and pump components, the annual O&M cost for this alternative is estimated at approximately $4,000 per year.

4.5.3 Supplemental Alkalinity Addition

4.5.3.1 Description

The City's NPDES permit requires the effluent pH to be between the values of 6.0 and 9.0. The effluent pH has been at the low end of this range at the end of summer and early fall in the last five years, while the influent pH tends to be slightly basic (Figure 4-2). It is likely that nitrification is occurring in the secondary treatment system during low flow periods, which would explain the drop in pH between influent and effluent. Another common cause for pH drops is the use of acidic chemicals (like bisulfite) for dechlorination; however, Lowell uses a non-acidic calcium thiosulfate solution.

The operators have resorted to dosing the secondary effluent with lime to raise the pH prior to discharge to meet permit criteria. It would be more beneficial for the WWTP to dose alkalinity prior to biological treatment. This would improve nitrification in the secondary treatment system and help the City meet potential ammonia limits, and help the City maintain compliance with its NPDES permit.

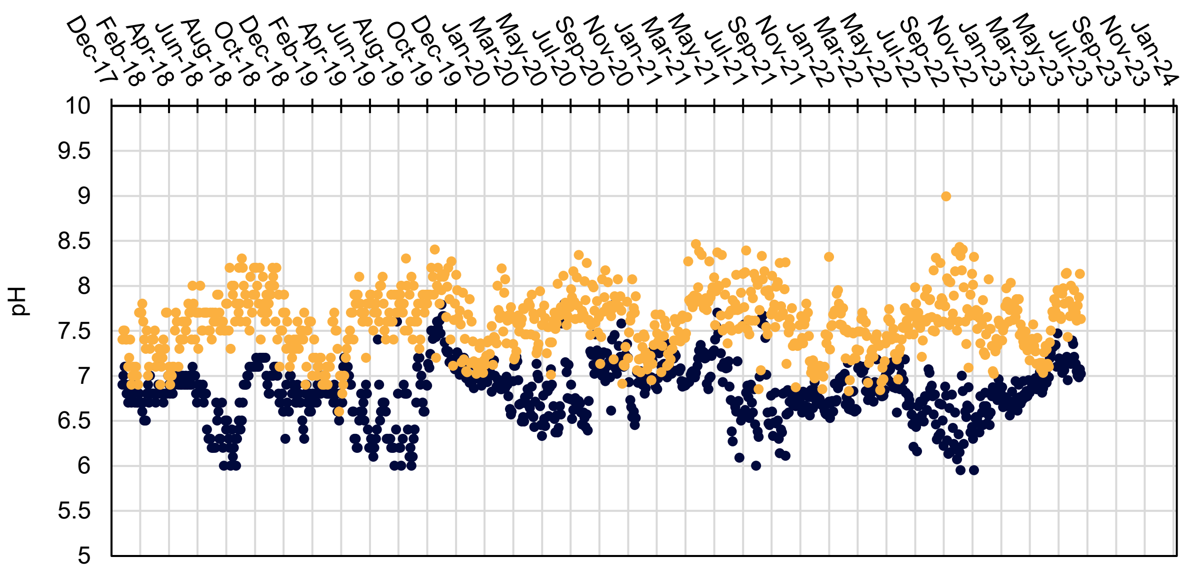


Figure 4-2: Reported pH in WWTP influent (Gold) and effluent (Blue)

4.5.3.2 Design Criteria

This alternative assumes the use of magnesium hydroxide as a supplemental alkalinity source, which is preferred over other alternatives since the solubility characteristics of the chemical reduce the risk of burning out downstream biology. MgOH provides about 13.38 lb of alkalinity as calcium carbonate per gallon. The amount of MgOH required per day to treat an assumed Total Kjeldahl Nitrogen (TKN) loading of 5 lb/day is calculated as shown below. Note that this analysis conservatively assumes that all organic nitrogen will degrade to ammonia and have an alkalinity demand of 7.14 lb alkalinity/lb nitrogen.

$$\text{Influent TKN Loading} = 5\,\frac{\text{lb}}{\text{day}}$$

$$\text{Alkalinity Demand} = 5\,\frac{\text{lb}}{\text{day}} * \frac{7.14\text{ lb Alkalinity Consumed}}{\text{lb Nitrogen}} = 35.7\,\frac{\text{lb Alkalinity Consumed}}{\text{day}}$$

$$\text{MgOH Feed Rate} = \frac{35.7\,\frac{\text{lb Alkalinity Consumed}}{\text{day}}}{13.38\,\frac{\text{lb Alkalinity}}{\text{gal MgOH}}} = 2.7\,\frac{\text{gal MgOH}}{\text{day}}$$

Assuming a 4-month supply of MgOH would be kept on hand, a 500-gallon drum that a mixer can be installed in is recommended. Heating equipment should be provided on the drum and chemical feed lines to prevent freezing during cold weather months. A mixer/agitator should be sized after conferring with chemical suppliers to confirm the level of agitation required to keep the slurry well mixed.

4.5.3.3 Location

A supplemental alkalinity system would be added prior to the secondary treatment system to provide alkalinity required for ammonia removal via nitrification. A logical location for the dosing point would be towards the end of the headworks channel after the influent Parshall Flume, prior to the primary clarifier. The chemical feed equipment could be placed in the existing chemical storage area next to the laboratory.

4.5.3.4 Environmental Impacts

A chemical addition treatment step would result in the need to transport the chemicals on site to the treatment plant. However, the impact of discharging acidic effluent to the river would have larger and more immediate impacts to the natural environment.

4.5.3.5 Land Requirements

This alternative would not require the City to purchase additional land as it would be located on the existing treatment plant lot.

4.5.3.6 Potential Construction Problems

This alternative could be constructed outside of the flood zone, however, projects that involve underground piping should be planned to be constructed in the dry-season to avoid difficulties managing high groundwater levels.

4.5.3.7 Cost Estimates

Detailed cost estimates are provided in Appendix I. This alternative would have capital costs associated with the construction of chemical dosing system, chemical feed piping, electrical and controls, and installation. The capital cost is estimated at approximately $175,840. The salvage value is estimated at approximately $600 based on a 20-year planning period (2043$). Based on 32 hours per year for maintenance and labor, approximately $200 per year for electricity, and

1,000 gallons of MgOH slurry per year, the annual O&M cost for this alternative is estimated at approximately $4,500 per year.

4.5.4 Expand Existing Trickling Filter/Solids Contact System

4.5.4.1 Description

The existing biological treatment system consists of a trickling filter with plastic media and an aeration basin. Expansion of the existing system would involve the construction of a redundant aeration channel and a redundant secondary clarifier. It is not recommended to construct a new, or expand the existing, trickling filter since the existing unit already has issues during low flow periods turning the hydraulic distributor.

4.5.4.2 Design Criteria

The recommended total aeration volume is approximately 41,000 gallons based on biological process modeling. Accounting for treatment provided by the existing trickling filter, doubling the current aeration volume in the existing solids contact aeration basin would be sufficient. The secondary clarifier should be designed following the criteria as described in Section 4.5.2.2.

4.5.4.3 Location

A conceptual site plan for the construction of the aeration basin and secondary clarifier is provided in Figure 4-3.

4.5.4.4 Environmental Impacts

Biological treatment is where the majority of BOD and TSS removal occurs in a standard WWTP. Without meeting redundancy requirements, the components of the system cannot be taken offline for full maintenance, potentially leading to effluent quality issues. Undersized unit operations could also lead to poor effluent quality. Upgrading the treatment system would ensure effluent quality targets can be met throughout the year.

4.5.4.5 Land Requirements

This alternative would not require the City to purchase additional land as it would be located on the existing treatment plant lot.

4.5.4.6 Potential Construction Problems

This alternative could be constructed outside of the flood zone, however, projects that involve underground piping should be planned to be constructed in the dry-season to avoid difficulties managing high groundwater levels.

4.5.4.7 Cost Estimates

Detailed cost estimates are provided in Appendix I. This alternative would have capital costs associated with the construction of a second aeration basin, piping upgrades, a flow splitter for aeration basin selection, and electrical and controls. Capital costs are estimated at approximately $1.2 million. Salvage value is estimated at approximately $55,500 based on a 20-year planning period (2043$). Based on approximately 1300 hours per year for O&M, and $12,000 for electricity associated with aeration, the annual O&M cost for this alternative is estimated at approximately $64,000 per year.

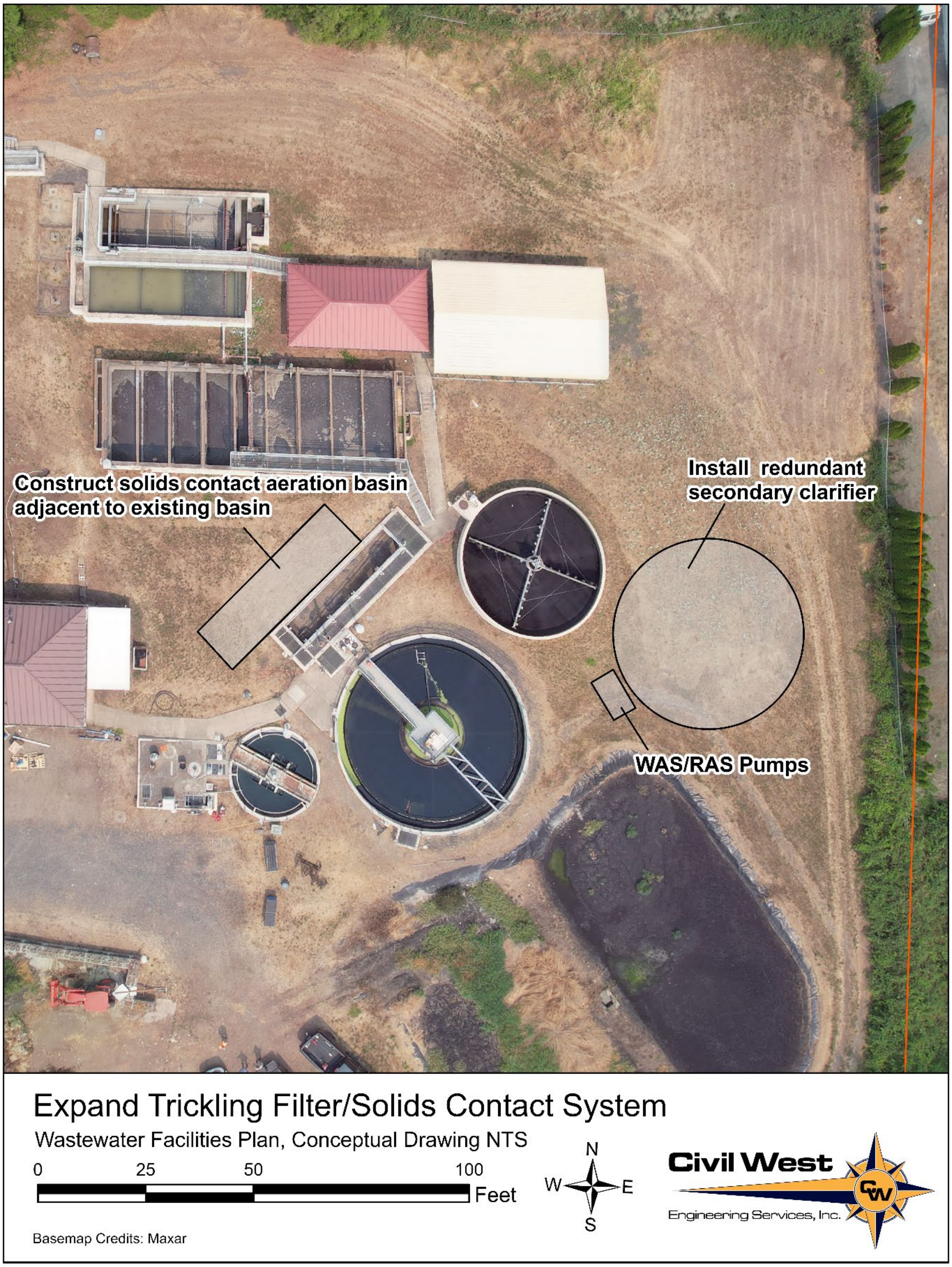


Figure 4-3: Expand Existing Biological Treatment System Alternative

4.5.5 Sequencing Batch Reactors

4.5.5.1 Description

Sequencing Batch Reactors (SBRs) are biological reactors that operate in a sequence of fill – react – settle – decant – idle. These batch systems are attractive compared to continuously mixed or plug flow processes because the reaction and clarification steps both occur within the footprint of one structure. The downsides are that at least two parallel units are required to operate continuously, an equalization basin is required upstream of the reactors to attenuate diurnal flow variations, and a complex controls system and a competent operator are needed to operate effectively. All of these units would require extensive demolition of existing units and regrading of the site.

4.5.5.2 Design Criteria

Planning level design criteria for this alternative are provided in Table 4-4.

Table 4-4: Design Criteria for Sequencing Batch Reactor Alternative

Design Criteria - Sequencing Batch Reactors	
Equalization Basins (Pre and Post)	
Max Water Depth	13.5 ft
Freeboard	1.5 ft
Surface Area	1225 sqft
Reactor Basins	
Number	2
Max Water Depth	13.5 ft
Freeboard	1.5 ft
Surface Area	1225 sqft
Treatment Cycle Duration	5 h
MLSS Concentration	3000 mg/L
Hydraulic Retention Time	1 day
Solids Retention Time	15 days
Air Requirement	150 scfm

4.5.5.3 Location

A conceptual site map of this alternative is provided in Figure 4-4.

4.5.5.4 Environmental Impacts

Upgrading the treatment system would ensure effluent quality targets can be met throughout the year.

4.5.5.5 Land Requirements

This alternative would not require the City to purchase additional land as it would be located on the existing treatment plant lot.

4.5.5.6 Potential Construction Problems

The relatively large depth requirements of the SBR basins would require substantial excavation to keep the water level between the primary clarifier and disinfection unit operations. Temporary treatment facilities or holding tanks would likely need to be installed during construction to provide treatment, because the footprint of the required reactors would necessitate demolishing the entire existing biological treatment system.

4.5.5.7 Cost Estimates

Detailed cost estimates are provided in Appendix I. This alternative would have capital costs associated with the construction of the equalization basins, reactor basins, piping upgrades, and electrical and controls. The capital cost is estimated at approximately \$3.8 million. The salvage value is estimated at approximately \$480,000 based on a 20-year planning period (2043\$). Based on approximately 1200 hours per year for O&M, and \$6,700 for electricity associated with aeration and pumping, the annual O&M cost for this alternative is estimated at approximately \$54,000 per year.

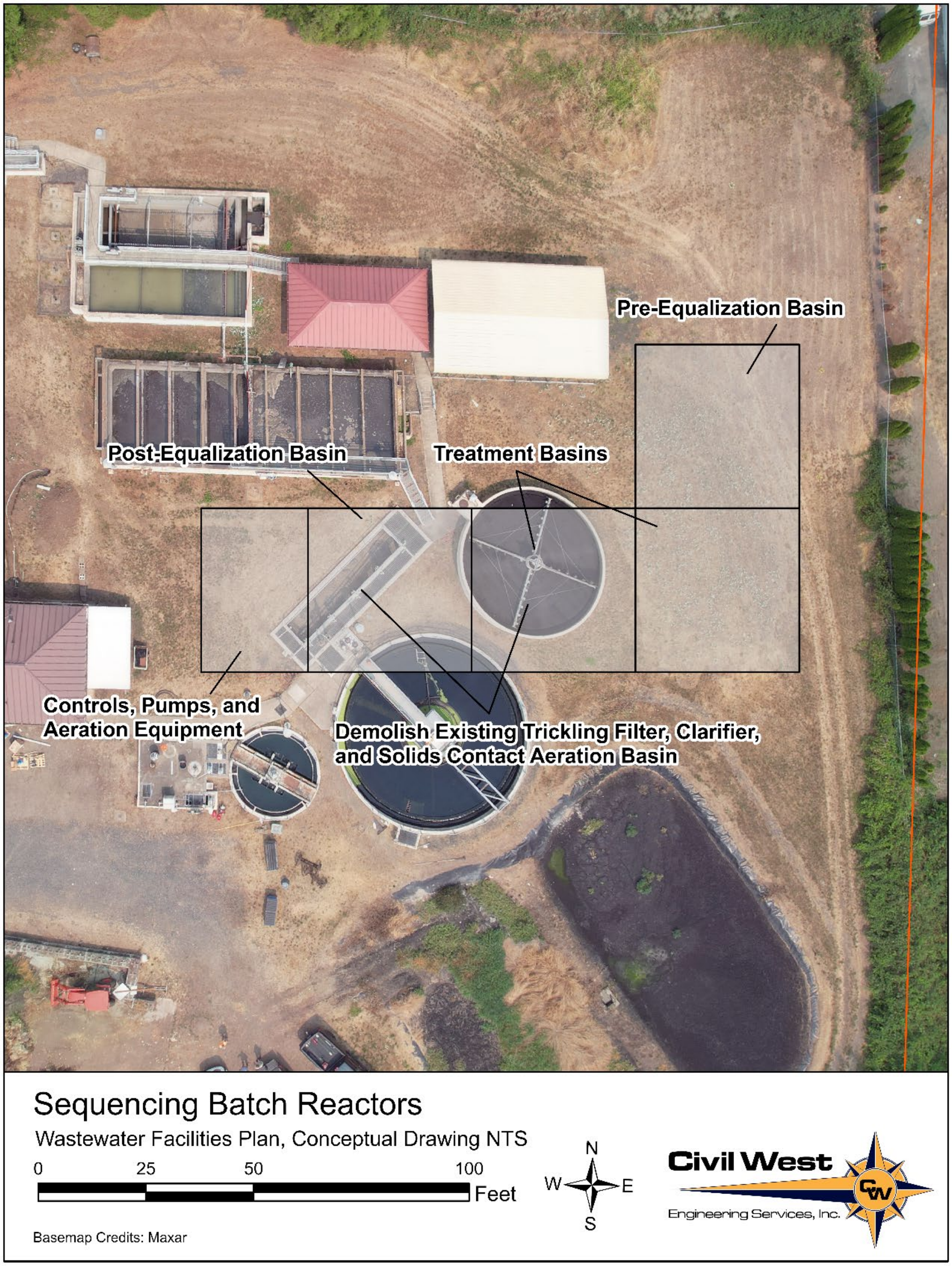


Figure 4-4: Conceptual Site Map for Sequencing Batch Reactors Alternative

4.5.6 Conventional Activated Sludge

4.5.6.1 Description

A conventional activated sludge system would consist of an aeration basin and a clarifier. The aeration basin should be sized for nitrification to occur given uncertainty associated with future permit requirements. There should be a minimum of two aeration basins and two clarifiers for redundancy and to handle a range of seasonal flow variations.

4.5.6.2 Design Criteria

A logical location for aeration basins is to convert the existing primary clarifiers into aeration basins. With this alternative, the flow path is already established, and no hydraulic changes are necessary. As discussed in Section 4.4, the primary clarifier would not be necessary if the trickling filter was decommissioned, and the treatment system was converted to an activated sludge configuration. The clarifier would be split into two equal size basins with the idea that one could provide treatment capacity for typical flows and both basins could be used for high flow events. A secondary clarifier would be constructed as described in Section 4.5.2 for redundancy and for use during dry-season flows. Return activated sludge piping would need to be rerouted to the top of the new aeration basins. Because the trickling filter would be decommissioned as part of this alternative, the pad that the trickling filter sits on currently could be used for the new clarifier location.

4.5.6.3 Location

A conceptual site plan of this alternative is provided in Figure 4-5.

4.5.6.4 Environmental Impacts

Upgrading the treatment system would ensure effluent quality targets can be met throughout the year.

4.5.6.5 Land Requirements

This alternative would not require the City to purchase additional land as it would be located on the existing treatment plant lot.

4.5.6.6 Potential Construction Problems

The existing trickling filter would likely need to be demolished to make room for the new secondary clarifier. The trickling filter pad is approximately the same size as required for the clarifier.

4.5.6.7 Cost Estimates

Detailed cost estimates are provided in Appendix I. This alternative would have capital costs associated with decommissioning the trickling filter, solids contact basin, and primary clarifier, installing aeration equipment and piping, and sludge piping improvements. The capital cost is estimated at approximately $820,000. The salvage value is estimated at approximately $72,000 based on a 20-year planning period (2043$). Based on approximately 960 hours per year for O&M, and $18,500 for electricity associated with aeration, the annual O&M cost for this alternative is estimated at approximately $57,000 per year.

Figure 4-5: Conceptual Site Map of Conventional Activated Sludge Alternative

4.5.7 Proprietary/Package System

4.5.7.1 Description

Proprietary biological treatment systems, such as the Biolac© system by Parkson, have become attractive options for small communities like Lowell given the number of case studies showing these units to be successful, and their relative ease of construction and installation. There's also a significant benefit in the operations support available by the supplier for these units after construction. This alternative would involve purchasing and constructing a proprietary treatment unit. For this analysis, the Biolac© system was evaluated.

4.5.7.2 Design Criteria

Design criteria for this alternative is provided in Table 4-5.

Table 4-5: Design Criteria based on budgetary quote provided by Parkson for a Biolac© System.

Design Criteria - Proprietary Activated Sludge System	
Number of Aeration Basins	1
Approximate Dimensions at Grade (ft)	64x63
Approximate Bottom Dimensions (ft)	49x24
Basin Volume (MG)	0.17
Clarifier Size	65x23
Number of Clarifiers	1
Estimated SOR (lbs/hr)	42
Estimated SCFM	269

4.5.7.3 Map

A conceptual site plan for this alternative is provided in Figure 4-6.

4.5.7.4 Environmental Impacts

Upgrading the treatment system would ensure effluent quality targets can be met throughout the year.

4.5.7.5 Land Requirements

This alternative would not require the City to purchase additional land as it would be located on the existing treatment plant lot.

4.5.7.6 Potential Construction Problems

The existing biological treatment system (trickling filter and solids contact chamber) would likely need to be demolished to make room for the new treatment system.

4.5.7.7 Cost Estimates

Detailed cost estimates are provided in Appendix I. This alternative would have capital costs associated with decommissioning the trickling filter, solids contact basin, and primary clarifier, installing the new system, and sludge piping improvements. The capital cost is estimated at approximately $2.5 million. The salvage value is estimated at approximately $150,000 based on a 20-year planning period (2043$). Based on approximately 960 hours per year for O&M, and $18,500 for electricity associated with aeration, the annual O&M cost for this alternative is estimated at approximately $57,000 per year.

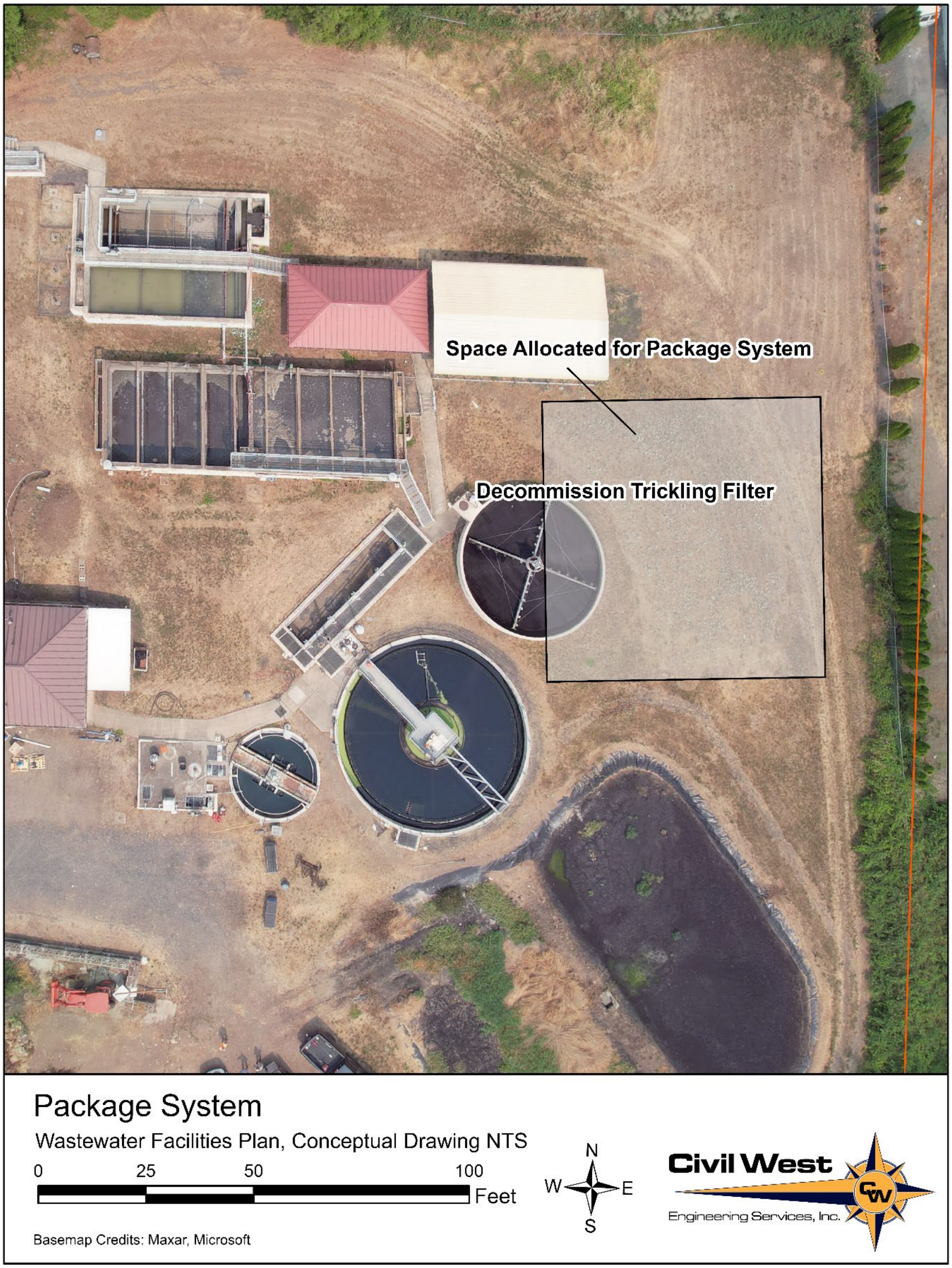


Figure 4-6: Conceptual Site Map for Package System Alternative

4.6 Disinfection Improvements

4.6.1 Do Nothing

This alternative involves no changes to the existing disinfection system. The City would continue to use sodium hypochlorite as the disinfectant and calcium thiosulfate as the dechlorination chemical. The existing chlorine contact and dechlorination basins would be unchanged. A summary of O&M costs associated with the current system is provided in Table 4-6.

Table 4-6: Approximate Operations and Maintenance Costs of Existing Disinfection System

Disinfection "Do-Nothing" Alternative – Current Operations & Maintenance Costs					
No.	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Operator Labor	511	h	$40	$20,400
2	Replacement Parts	1	LS	$1,000	$1,000
3	Hypochlorite	2000	gal	$4.00	$8,000
4	Thiosulfate	750	gal	$4.00	$3,000
5	Electricity Usage	5000	kWh	$0.08	$422
				Estimated Annual O&M (2023$)	**$32,862**

4.6.2 Construct New Chlorine-Based Disinfection System

4.6.2.1 Description

Liquid hypochlorite is one of the most commonly used wastewater disinfection methods. Liquid hypochlorite can be added as a solution formed from sodium hypochlorite or calcium hypochlorite. For this planning effort, it was assumed that bulk 12.5% liquid sodium hypochlorite would be purchased and delivered to the WWTP.

Alternative methods of liquid hypochlorite production could also be used. For example, calcium hypochlorite erosion feeders dissolve tablets to produce a dilute (~ 1.2%) solution of calcium hypochlorite. Also, electrolytic cell-based systems can be used to convert salt brine solutions into 0.8% solutions of sodium hypochlorite. This lower concentration solution is more stable than the 12.5% bulk solution, helping to ensure that a consistent hypochlorite dosage is introduced to the effluent stream. Further consideration of alternative methods of hypochlorite solution production and delivery should be considered during predesign work if a liquid hypochlorite approach is the recommended disinfection alternative.

4.6.2.2 Design Criteria

Design criteria for this alternative is provided in Table 4-7.

4.6.2.3 Map

A conceptual site plan for this alternative is provided in Figure 4-7.

4.6.2.4 Environmental Impacts

Chlorine will need to be removed prior to final discharge to meet NPDES permit requirements and prevent chlorine toxicity to aquatic life downstream of the WWTP.

Table 4-7: Design Criteria for Chlorine Disinfection and Dechlorination System

Hypochlorite Disinfection Preliminary Design Criteria	
Chlorination	
Chemical	Sodium Hypochlorite
Assumed Dosing Concentration	12.50%
Assumed Design Dose	10 mg/L
Number of Chemical Feed Pumps	2
Consumed Per Day @ Design AAF	6.24 gal
Target Residual	1 mg/L
Chlorine Contact Chamber	
Number of Contact Basins	2
Minimum Basin Volume	2100 ft^3
Min. Effective Length of Channel	150 ft
Channel Width	4 ft
Length: Width Ratio	30:1
Dechlorination	
Chemical	Calcium Thiosulfate
Assumed Req'd Design Dose	3 ppm
Number of Chemical Feed Pumps	2
Consumed Per Day	3 lb

4.6.2.5 Land Requirements

This alternative would not require the City to purchase additional land as it would be located on the existing treatment plant lot.

4.6.2.6 Potential Construction Problems

This alternative could be constructed outside of the flood zone, however, projects that involve underground piping should be planned to be constructed in the dry-season to avoid difficulties managing high groundwater levels.

4.6.2.7 Sustainability Considerations

Hypochlorite disinfection is a chemical-intensive process requiring one chemical to disinfect and a second chemical to dechlorinate. During low flow periods, the sodium hypochlorite usage rate may drop. Sodium hypochlorite stability decreases as the concentration of the solution increases, potentially resulting in the degradation of purchased chemical prior to use if it is not used relatively quickly. This results in economic inefficiency and the potential for under-disinfected wastewater if the effluent chlorine residual is not regularly checked.

4.6.2.8 Cost Estimates

Detailed cost estimates are provided in Appendix I. This alternative would have capital costs of site preparation, excavation, site restoration, chlorine basin construction, equipment installation, and electrical and controls installation. The capital cost is estimated at approximately $550,000. The salvage value is estimated at approximately $54,000 based on a 20-year planning period (2043$). Based on approximately 460 hours per year for O&M, and $8,000 for chemicals, the annual O&M cost for this alternative is estimated at approximately $28,000 per year.

Figure 4-7: Conceptual Site Plan of new Chlorine Disinfection System Alternative

4.6.3 Construct UV Disinfection System

4.6.3.1 Description

Disinfection by ultraviolet (UV) light works by exposing microorganisms to wavelengths of light that damage DNA, limiting the ability of the microorganism to reproduce. One of the primary benefits of UV disinfection is that no chemicals are used. This eliminates the need for both chlorination and dichlorination chemicals that are required for hypochlorite-based disinfection systems.

Wastewater UV disinfection is achieved through two styles: open channel and closed vessel. Open channel UV disinfection places ultraviolet bulbs in racks that are submerged in a channel filled with secondary effluent. Closed vessel disinfection mounts the ultraviolet bulbs in a housing slightly larger than the diameter of the pipe. Closed vessel UV systems are particularly well-suited for situations where installation space is limited as the systems can be installed into a pipe; however, the systems typically have a higher capital cost relative to packaged open channel systems.

4.6.3.2 Design Criteria

Planning level design criteria for this alternative is provided in Table 4-8.

Table 4-8: Design Criteria for UV Disinfection System

UV Disinfection Design Criteria	
Style	Open Channel
Number of Banks	2
Minimum Dose @ PHF (All units on)	30 mJ/cm^2
Minimum Dose @ MMDWF	30 mJ/cm^2
Redundancy	Ballast and Controls
Minimum UV Transmittance	65%

4.6.3.3 Map

A conceptual site plan for this alternative is provided in Figure 4-8.

4.6.3.4 Environmental Impacts

Unlike a chlorine disinfection system, UV disinfection requires no chemicals. Additionally, UV does not leave residual chlorine that could be toxic to a receiving waterbody.

UV disinfection systems require regular maintenance and replacement of UV bulbs. UV bulbs contain mercury amalgam and require proper disposal methods to be followed.

4.6.3.5 Land Requirements

This alternative would not require the City to purchase additional land as it would be located on the existing treatment plant lot.

4.6.3.6 Potential Construction Problems

No significant construction problems have been identified for this project alternative.

4.6.3.7 Sustainability Considerations

UV disinfection requires a considerable amount of electricity compared to alternative disinfection methods.

4.6.3.8 Cost Estimates

Detailed cost estimates are provided in Appendix I. This alternative would have capital costs of site preparation, excavation, site restoration, UV basin construction, equipment installation, and electrical and controls installation. The capital cost is estimated at approximately $565,000. The salvage value is estimated at approximately $15,000 based on a 20-year planning period (2043$). Based on approximately 208 hours per year for O&M, and $1,000 for replacement parts, the annual O&M cost for this alternative is estimated at approximately $9,700 per year.

Figure 4-8: Conceptual Site Plan of UV Disinfection Alternative

4.7 Solids Treatment Improvements

4.7.1 Do Nothing

This alternative would involve no changes to the existing solids treatment system. The existing drying bed underdrains have deteriorated, reducing treatment efficacy. It is not feasible to leave the City without a properly functioning underdrain system for the next planning period.

4.7.2 Rehabilitate Drying Bed Underdrains

4.7.2.1 Description

Sludge drying beds are an EPA and DEQ approved process that significantly reduce pathogens, provided the solids have been drying for at least three months. Sludge drying beds require low capital cost and energy consumption while requiring minimal operator skill and attention. T

The current drying beds have some design flaws, including being too deep for a tractor to easily remove solids. Operators have to unload a few yards of gravel to make temporary ramps whenever the beds are being emptied. The underdrains have also been damaged from use in the past planning period, making dewatering not as effective. This alternative involves replacing the bottoms of the drying beds as existing, including the underdrains, gravel fill, fabric layer, and sand.

4.7.2.2 Design Criteria

This alternative would replace the drying bed underlain materials in kind. The design detail from the most recent design (Tetra Tech, 2003) is provided in Figure 4-9.

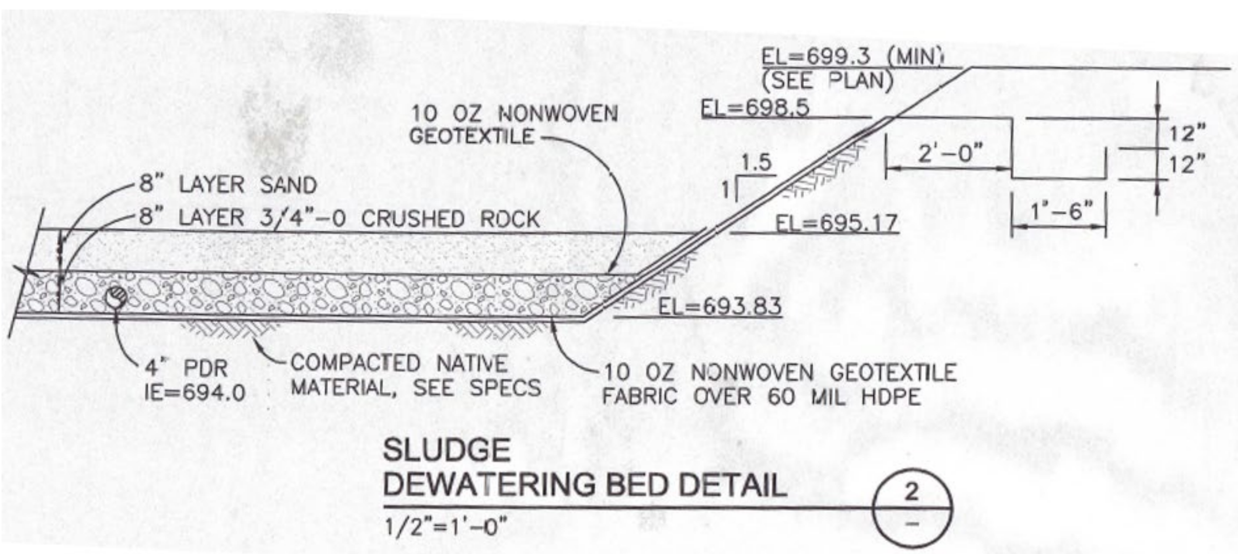


Figure 4-9: Design Details of Existing Sludge Drying Beds

4.7.2.3 Location

The location of the drying beds would remain unchanged from existing conditions.

4.7.2.4 Environmental Impacts

Rehabilitating the drying beds would improve dewatering capabilities of the drying beds.

4.7.2.5 Land Requirements

This alternative would not require the City to purchase additional land as the improvements would be located on the existing treatment plant lot.

4.7.2.6 Potential Construction Problems

No significant construction problems have been identified for this project alternative.

4.7.2.7 Sustainability Considerations

Sludge drying beds require little energy as compared to mechanical dewatering system.

4.7.2.8 Cost Estimates

The City is projected to produce approximately 100 to 200 lb/day of dried solids. Annual hauling fees are approximately $2,500. Along with operator labor and replacement part costs, the total annual O&M is approximately $4,300. The capital costs for rehabilitation were estimated at approximately $39,000 with a salvage value of $8,750.

4.7.3 Reconstruct Drying Beds

4.7.3.1 Description

This alternative involves replacing the bottoms of the drying beds as existing, including the underdrains, gravel fill, fabric layer, and sand, installing guide walls of concrete, and installing concrete ramps to allow easy entry for tractors cleaning the beds.

4.7.3.2 Design Criteria

The two pit-style drying beds will be converted into three smaller beds with a smaller overall footprint. The 3 new bed would be separated by two feet thick concrete walls spaced 15 feet apart. Sludge from the aerobic digester will be fed into the bed along the east side of the bed. Concrete ramps will be installed on the west side of the beds allowing for ease of solids removal. Specific design criteria are provided in Table 4-9.

Table 4-9: New Drying Bed Design Criteria

Construct Improved Drying Beds - Design Criteria	
Length (ft)	100
Width (ft)	50
Channel Width (ft)	15
Surface Area (ft^2)	4500
*Avg Loading Rate (lbs/ft^2*y)	14.6
*Peak Loading Rate (lbs/ft^2*y)	25.55
*Loading Rate per person (ft^2/person)	1.85

**Loading rates calculated assuming two of the three available channels of the drying beds in use. This assumes that one channel will be available for emergency emptying of the aerobic digester.*

4.7.3.3 Location

The new drying beds will be constructed in the footprint of the existing drying beds.

4.7.3.4 Environmental Impacts

Rehabilitating the drying beds would ensure that the solids treatment would be more efficient. Installation of the ramps will prevent tearing of the liner when solids are removed.

4.7.3.5 Land Requirements

This alternative would not require the City to purchase additional land as the improvements would be located on the existing treatment plant lot.

4.7.3.6 Potential Construction Problems

No significant construction problems have been identified for this project alternative.

4.7.3.7 Sustainability Considerations

Sludge drying beds require little energy as compared to mechanical alternatives to dewatering.

4.7.3.8 Cost Estimates

Detailed cost estimates are provided in Appendix I. The City is projected to produce approximately 100 to 200 lb/day of dried solids. Annual hauling fees are approximately $2,500. Along with operator labor and replacement part costs, the total annual O&M is approximately $3,700. The capital costs of the new construction is approximately $342,500, with a salvage value of $117,900.

4.7.4 Rehabilitate Aerobic Digester Aeration System

4.7.4.1 Description

Existing positive displacement rotary lobe blowers require exorbitant maintenance, break easily, and cost $6,000 per blower to replace. Make up most of the plant's expenses in short term assets as they have been replaced approximately every 5 years. No simple way to isolate aeration basins even though only one is needed. Install valving on the aeration system to be able to isolate digesters. Downsize the blower.

4.7.4.2 Design Criteria

The current blowers are oversized for the system, requiring both aeration basins to be run at all times. Downsizing the blowers will allow for basin isolation and improve the energy costs of the blowers. For this project, it is assumed that the existing blowers would be replaced with turbine-style positive displacement blowers with a design point of 300 scfm at 6.5 PSIG. This alternative would have two new blowers for redundancy.

4.7.4.3 Environmental Impacts

There are no major environmental impacts because of this alternative.

4.7.4.4 Land requirements

This alternative would not require the City to purchase additional land as the improvements would be located on the existing treatment plant lot.

4.7.4.5 Potential Construction Problems

No significant construction problems have been identified for this project alternative.

4.7.4.6 Sustainability Impacts

Reducing the size of the blowers and having the capabilities of running an isolated aeration basin will allow for a reduction in the energy consumption of the system.

4.7.4.7 Cost Estimates

Detailed cost estimates are provided in Appendix I. This alternative would have capital costs of replacing the blowers (any other fixes). The capital cost is estimated at approximately $216,000. The salvage value is estimated at approximately $21,000 based on a 20-year planning period (2043$). Based on approximately 52 hours per year for O&M, and $500 for replacement parts, the annual O&M cost for this alternative is estimated at approximately $2,600 per year.

4.8 Collection System Improvements

4.8.1 Rehabilitate Inflow and Infiltration Sources

Multiple areas of the collection system were identified to have issues during the I/I investigation, the results of which are provided in Appendix D. Twenty-six locations were identified as likely sources of stormwater inflow and eight sections of the collection system were identified as likely sources of groundwater infiltration.

It is recommended that the City prioritize two instances of direct connection between the storm drainage system and the collection system, as identified by smoke testing. Specifically, a curb inlet on the corner of Moss Street and Lakeview Street, and a culvert on 2nd street between Moss Street and Cannon Avenue. As a first step, these lines should be CCTV surveyed to identify the direct cause of the cross connection. The City should budget $1,400 to CCTV these lines as soon as possible in the planning period. After the issues are more clearly identified, it is recommended to use the City's stormwater fund for rerouting the problematic storm lines. Assuming that the storm lines will have to be repaired to fix these cross connections, a budgetary estimate for repair is $120,000. A new estimate should be made once CCTV data is available. The City should also plan for CCTV surveillance of approximately 6,300 linear feet of pipe in the collection system. CCTV prioritization should be organized as followed, based on unaccounted for flow volumes measured during flow testing:

1. Alder Street, South of the Lift Station to Main Street
2. 1st Street, West of Cannon Avenue to N Hyland Drive
3. East of Moss Street, from 3rd Street to North of 4th Street to first manhole on D Street.
4. Between 3rd and 4th Streets, West of Pioneer Street to N Hyland Drive
5. South of Main Street, from Moss Street to the first manhole by the School
6. 6th Street to second manhole on 7th Street.
7. North end of Alder Street to 2nd Street, and 2nd Street to Damon Street
8. North end of Cannon Street to Pioneer Street (pipe south of North Shore Drive)

Multiple manholes in the collection system were identified with leaks. Figure 4-10 indicates the location and the specific issue observed with each of these manholes. The recommended reparation project varies for each manhole from simple regrouting to full replacement; a budgetary cost estimate for each manhole is provided in Table 4-10. The identifying numbers in Table 4-10 correspond to the labeled numbers in Figure 4-10.

Table 4-10: Budgetary Cost Estimates for Manhole Reparation Projects

Manhole Number	Type of Repair	Cost Estimate
68	Full Replacement	$15,000
79	Full Replacement	$15,000
17	Full Replacement	$15,000
7	Regrout Ring	$1,500
136	Patch Holes/Regrout Ring	$2,000
126	Regrout Ring	$1,500
57	Patch Holes/Regrout Ring	$2,000
12	Patch Cracks	$1,000
80	Regrout Ring	$1,500
	Total Cost Estimate:	**$54,500**

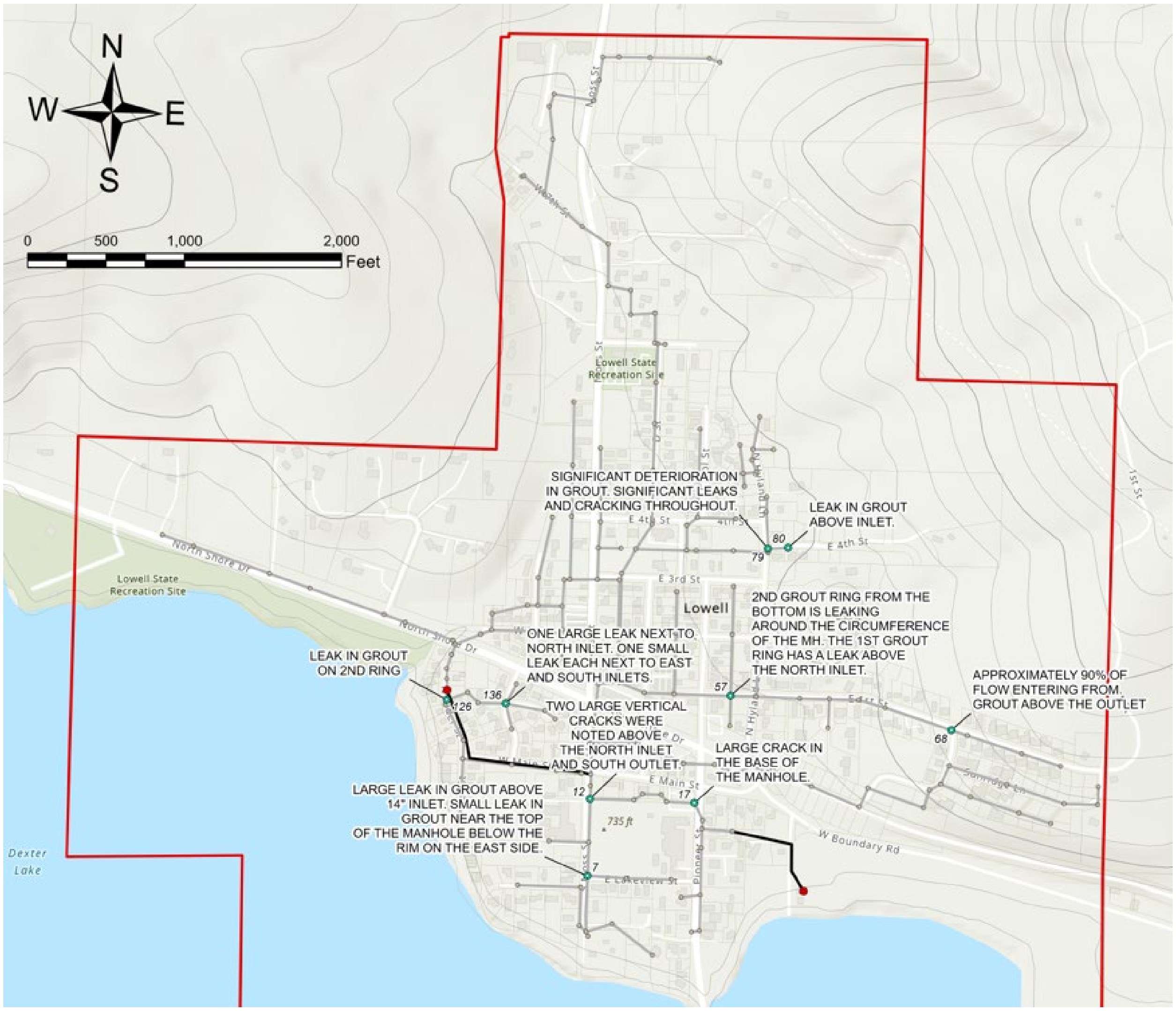


Figure 4-10: Locations of Manholes to Rehabilitate

4.8.2 Upgrade Alder Street Lift Station

Pumps in the lift station should be upgraded to have a capacity of 490 gpm with a total head of 43 feet. There should be two pumps, both selected in order to be installed to fit in the existing mounts. The pump station building and wet well are in relatively good condition and should be maintained. A budgetary cost estimate for this project is approximately $390,000.

4.8.3 Collection System Capacity Upgrades

As discussed in Section 3.3.4.2, two pipes in the collection system that serve a significant number of properties are undersized for the City’s growth projections. To address this, two alternatives were considered. These alternatives are discussed in the following subsections.

4.8.3.1 Alternative 1 – Cannon Avenue

A new 12” line would connect to the junction of 8” lines at the south end of the Moss/Cannon sewershed. This line would run down Cannon Avenue until it meets the existing 8” line that collects the 1st Street sewershed. A new 12” line would replace the undersized 8” line from 1st street to Cannon avenue, and then a new 15” line would collect both the 1St Street and Moss/Cannon sewershed flows. This 15” line would then connect to the existing 15” collector along Moss Street. A conceptual drawing of this alternative is provided in Figure 4-11. Detailed cost estimates are provided in Appendix I. This alternative would have capital costs of site preparation, 12” and 15” PVC gravity sewer line, manhole assemblies, and ACP decommissioning. The capital cost is estimated at approximately $473,000.

4.8.3.2 Alternative 2 – Moss Street

A new 10” line would connect to the manhole at the north end of the undersized 8” collector of the Moss/Cannon sewershed. Then, a new 15” line would be constructed down Moss Street to connect the manhole at the intersection of 3rd Street and Moss Street to the north end of the 15” main collector on Moss. The 8” line that currently drains the manhole at this intersection to the Alder Creek Lift Station sewershed would be abandoned, and the new 15” line would drain the Moss/Cannon sewershed and the approximately twenty properties that currently are served by the lift station to the main gravity collector. A new 12” gravity line would be constructed to replace the undersized 8” collector of the 1st street sewershed. A conceptual drawing of this alternative is provided in Figure 4-12. Detailed cost estimates are provided in Appendix I. This alternative would have capital costs of site preparation, 12” and 15” PVC gravity sewer line, manhole assemblies, and ACP decommissioning. The capital cost is estimated at approximately $470,000.

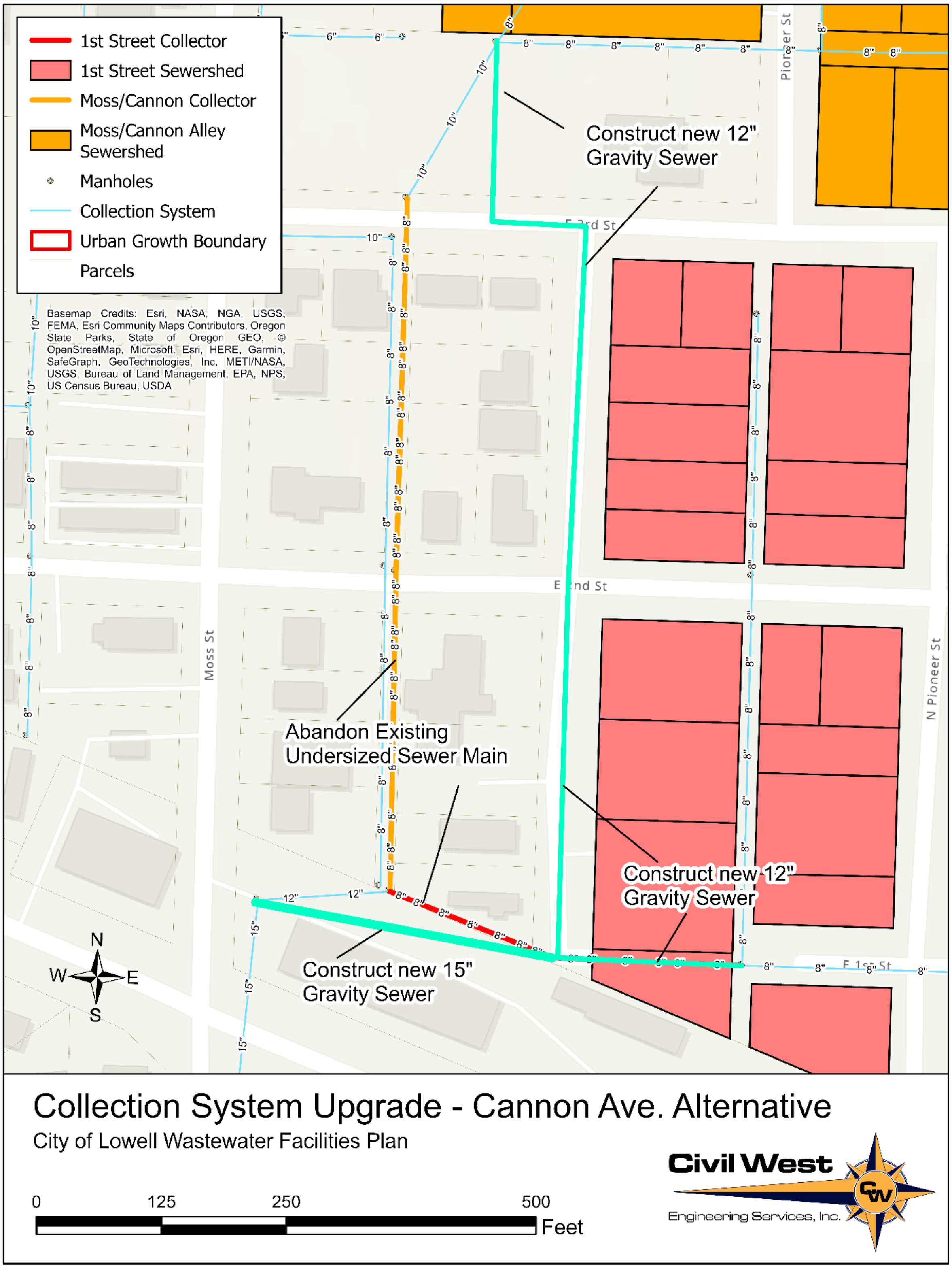


Figure 4-11: Cannon Avenue Collection System Alternative Conceptual Map

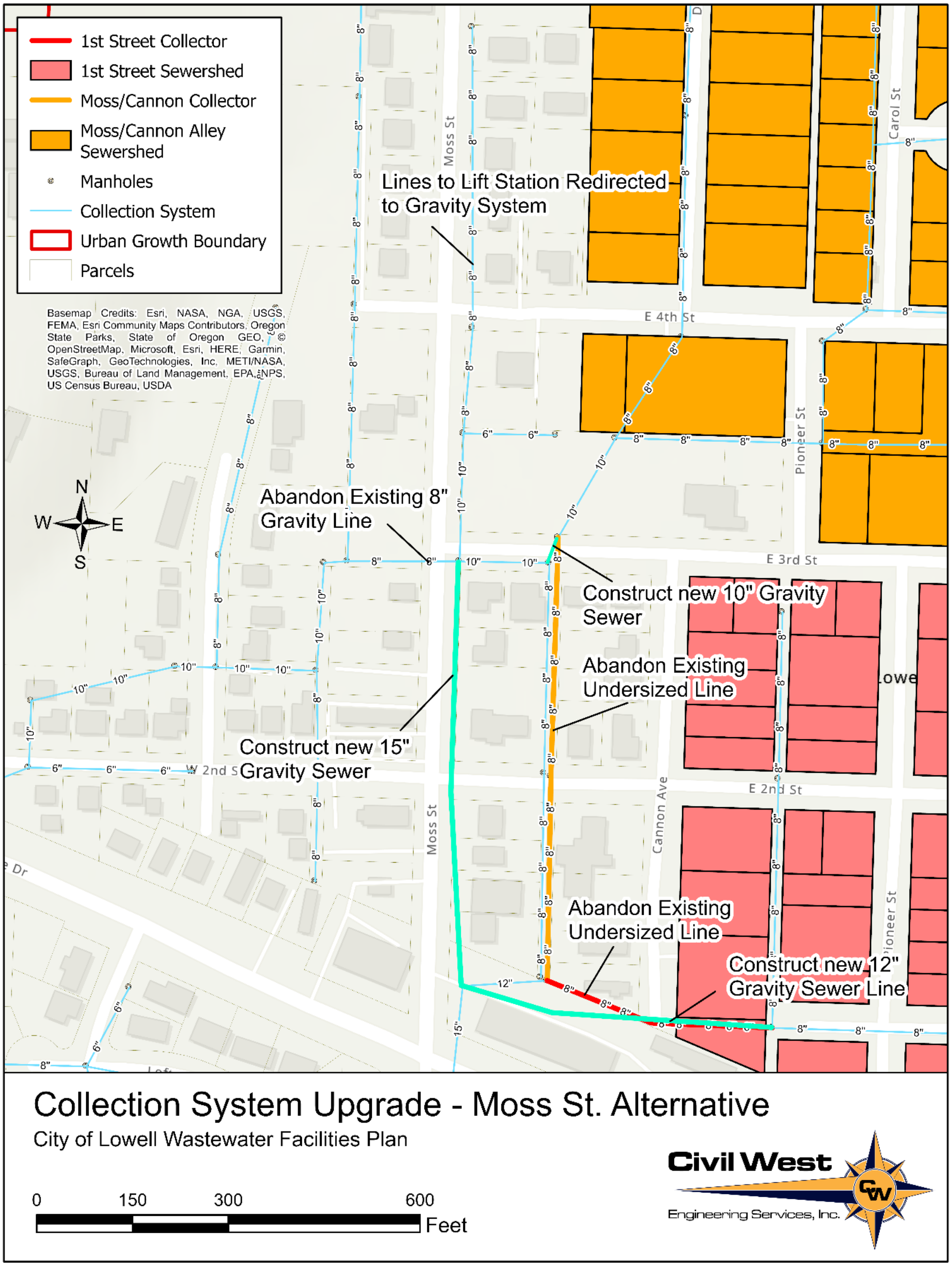


Figure 4-12: Moss Street Collection System Alternative Conceptual Map

5 SELECTION OF ALTERNATIVES

This section presents the results of a net present value analysis of all viable alternatives discussed in Section 4, explains the scoring criteria for selection of the best alternatives for the City, and presents the results of the alternative scoring process for projects that more than one viable alternative exists.

5.1 Net Present Value Analysis

Table 5-1 summarizes the total economic cost (net present value) of each of the viable alternatives. These costs consider O&M costs (chemical, electrical, and labor costs), capital costs, and salvage value of equipment. The net present value was calculated for each alternative as the sum of capital cost and the uniform series of annual O&M costs, minus the present worth of the salvage value. Itemized estimates for each of these costs for each alternative are provided in Appendix I.

Table 5-1: Summary of Net Present Values (in 2023$) for each Viable Alternative

Alternative	Capital Costs	O&M Uniform Series	Salvage Present Worth	Net Present Value
Headworks				
"Do Nothing" - Keep Existing System As-Is	$0	$72,041	$0	**$72,041**
Add a Redundant Fine Screen in a new Parallel Channel	$467,360	$66,318	$12,113	**$521,565**
Biological Treatment				
"Do Nothing" - Keep Existing System As-Is	$0	$950,799	$0	**$950,799**
Supplemental Alkalinity Addition	$175,840	$73,430	$404	**$248,866**
Redundant Secondary Clarifier	$1,281,200	$66,109	$70,662	**$1,276,647**
Trickling Filter - Activated Sludge Rehabilitation	$1,208,320	$1,048,908	$37,350	**$2,219,879**
Sequencing Batch Reactors	$3,800,000	$889,910	$323,026	**$4,366,884**
Convert Primary Clarifiers to Aeration Basins	$816,000	$929,841	$48,454	**$1,697,387**
Package/Proprietary Activated Sludge System	$2,470,400	$929,841	$100,946	**$3,299,295**
Disinfection				
"Do Nothing" - Keep Existing System As-Is	$0	$537,333	$0	**$537,333**
Chlorine Disinfection - New Chlorine Contact Basin	$548,000	$452,165	$36,340	**$963,824**
UV Disinfection	$564,800	$233,245	$10,095	**$787,950**
Solids Management				
"Do Nothing" - Keep Existing System As-Is	$0	$306,655	$0	**$306,655**
Aerobic Digester Aeration System Improvements	$280,000	$200,706	$14,132	**$466,573**
Rehabilitate Drying Bed Underdrains	$46,520	$87,153	$5,885	**$127,788**
Reconstruction of Drying Beds with Guide Walls	$342,520	$61,154	$79,374	**$324,301**
Collection System				
Collection System - I/I Reduction	$301,552	$22,892	$22,006	**$302,438**
Alder Street Lift Station Upgrade	$376,000	$29,433	$16,824	**$388,608**
Capacity Upgrades - Cannon Avenue Alternative	$472,800	$8,830	$110,031	**$371,599**
Capacity Upgrades - Moss Street Alternative	$469,200	$8,830	$109,122	**$368,907**

5.2 Evaluation Criteria

The factors considered during the evaluation process are described in the following sections. A weighted decision matrix was used to evaluate alternatives using monetary and non-monetary factors. Monetary and non-monetary factors were weighted such that monetary factors contributed 40% of the total score and non-monetary factors contributed the remaining 60% of the total score. The following criteria were considered, and the applied weight is shown in parentheses:

- Net Present Value (0.40)
- Effluent Quality/Regulatory Compliance (0.40)
- Ease of Operation (0.20)

5.2.1 Monetary Factors

Recommended improvement projects should be modest with regards to construction costs and the present worth of operations and maintenance costs. The Net Present Value analysis summarized in Table 5-1 are inclusive of these costs, while accounting for value retained by the alternative at the end of the planning period. This cost information is planning level and has an inherent level of uncertainty. To account for this, cost ranges relative to the least-cost improvement alternative were used to develop a monetary score. The scoring associated with cost differences are presented in Table 5-2.

Generally, “do-nothing” alternatives were not considered as the least cost improvement project because they would cause every other alternative, or set of alternatives, to be scored as a zero if evaluated by these criteria. Also, doing nothing does not fit the definition of an improvement project. To properly account for the difference between “do-nothing” alternatives and improvement alternatives, the percent difference between the “do-nothing” alternative and the least-cost improvement alternative was evaluated, and the appropriate score using Table 5-2 was added to the cost score.

Table 5-2: Cost Comparison Scoring Criteria

Scoring for Capital and O&M Cost Comparisons	
Criteria	**Score**
Least Cost Alternative (LCA)	10
<10% Difference from LCA	10
<20% Difference from LCA	9
<30% Difference from LCA	8
<40% Difference from LCA	7
<50% Difference from LCA	6
<60% Difference from LCA	5
<70% Difference from LCA	4
<80% Difference from LCA	3
<90% Difference from LCA	2
<100% Difference from LCA	1
>100% Difference from LCA	0

5.2.2 Non-monetary Factors

For non-monetary factors, professional judgement was used to award points. Secondary treatment alternatives were initially screened based on feasibility and then evaluated using economic and non-economic factors. Cost analyses for construction and operations and maintenance costs were completed for each fully vetted project listed in Section 4. A weighted decision matrix was used to identify a recommended alternative based on economic and noneconomic criteria. Non-monetary criteria considered during the alternative evaluation process included:

Ease of Operation: Higher scores were awarded to treatment systems that are easily automated, require a lower operator classification, and demand less staff hours for O&M as determined by the reference *The Northeast Guide for Estimating Staffing at Publicly and Privately Owned Wastewater Treatment Plants* (NEIWPCC 2008). This criterion was included to account for the difficulty and cost associated with identifying, hiring, and retaining qualified operations staff.

Effluent Quality: Higher scores were awarded to treatment systems that can reliably meet or exceed anticipated NPDES discharge permit requirements. This criterion was included to favor treatment processes that are less likely to be non-compliant with the Clean Water Act.

5.3 Alternative Selection

Twenty alternatives to improve the City's wastewater facilities were considered feasible and discussed in detail in Section 4. For many of these alternatives, including secondary treatment, solids management, disinfection, and collection system capacity improvements, it was necessary to choose the best alternatives for inclusion in the City's capital improvement plan (CIP) using the evaluation criteria described in Section 5.2. Two of the alternatives did not have feasible counterparts for comparison but are recommended to be included in the City's CIP. These are discussed below in terms of why the projects are necessary in lieu of full comparison of alternatives.

- **Alder Street Lift Station Capacity Upgrade** – The existing pumps in the lift station are undersized for the current and projected peak flows associated with storm events. These pumps are also past the typical design life of 20 years. The firm capacity of the existing lift station is not sufficient for current peak flows as evidenced by overflows in recent years. It is expected that similar issues will only become more frequent if the pumps are not upgraded. To comply with DEQ reliability requirements, each pump should be sized for the peak hour flow of 490 gpm. The new pumps should be equipped with variable frequency drives to optimize performance at the various flow scenarios that the station will experience.
- **Inflow and Infiltration Reduction Projects**: As part of the facility planning process, a thorough investigation of the collection system for direct sources of I/I was conducted (Appendix D). This analysis discovered direct sources of I/I and recommended direct fixes and further follow-up activities, including CCTV surveillance. These projects should be completed as part of regular wastewater facility maintenance throughout the next planning period. The implementation of an I/I reduction program will benefit the City's treatment process significantly, avoiding disruptions of the biological treatment system during extreme rain events. The City should start with the rehabilitation projects

identified in this plan, and continue to monitor I/I regularly to fix leaking pipes and manholes throughout the collection system as they arise.

- **Supplemental Alkalinity Addition**: The existing method of dosing soda ash at the end of the treatment train for pH compliance is not efficient or beneficial to the treatment process in general. By implementing a real alkalinity addition system upstream of biological treatment, the City will enhance the nitrification capabilities of the WWTP and be better prepared for ammonia limits in the future. It is recommended to use magnesium hydroxide because of the inability to overdose and burn out downstream biological, but alternative chemicals could be considered as part of the design phase.

For the remainder of the alternatives listed in Table 5-1, many of them directly conflict with each other or would otherwise not be necessary if one is chosen over others. The selection of the alternatives to include in the City's CIP are discussed in the following subsections. The subsections are ordered according to the type of wastewater facility: headworks, biological treatment, disinfection, solids management, and the collection system.

5.3.1 Headworks

The alternatives to address the effects of peak flow events on the existing headworks were scored as shown in Table 5-3. The two alternatives involved the "do nothing" alternative, which involves keeping the existing headworks structure as is throughout the planning period and installing an additional fine screening unit to reduce use of the bypass channel. Ultimately, the results of the alternative scoring show that the costs of expanding the headworks do not outweigh the benefits for infrequent storm events. The existing headworks structure is capable of handling projected peak flow during the wet season. Use of the bypass channel reduces ease of operation because the bar racks must be manually cleaned; however, given the low frequency that the bypass channels used, the improvements to ease of operation are not significant. Similarly, the improvements to final effluent quality are not substantial enough to justify expanding the headworks this planning period.

Table 5-3: Scoring of Headworks Alternatives

	Do Nothing	Additional Fine Screen
Net Present Value (Weight =40%)	20	10
Ease of Operation (Weight = 20%)	8	10
Compliance/Effluent Quality (Weight = 40%)	8	10
	12.8	**10.0**

5.3.2 Biological Treatment

Issues with the existing biological treatment system include a lack of redundant clarification capacity, treatment performance issues, and the need for alkalinity addition prior to the bioreactors. Seven alternatives were considered feasible, including the "do nothing" option of retaining the existing system, and the alkalinity addition system that was already recommended to include in the City's CIP due to a lack of suitable alternatives. For the remaining alternatives, the alternative projects were evaluated in groups depending on necessity. The following secondary treatment projects were grouped for the evaluation process:

- **Do Nothing:** Maintains the existing trickling filter, solids contact aeration channel, and clarifier as they currently exist. Does not include the cost of constructing a new clarifier. Does include the alkalinity addition system, since that is needed regardless for pH compliance.
- **Rehabilitate Existing System:** Involves construction of an aeration basin the same size as the existing solids contact aeration channel, and construction of a new secondary clarifier. Trickling filter will be continued to be used with additional aeration capacity, and a more optimized clarifier for the dry-weather period. This includes the cost of alkalinity addition, redundant secondary clarifier, and the trickling filter – activated sludge rehabilitation alternatives.
- **Sequencing Batch Reactors**: Involves complete decommissioning of the existing biological treatment system and construction of sequencing batch reactors. Secondary clarifiers are not necessary with this system. This includes the cost of the sequencing batch reactors and alkalinity addition.
- **Conversion to Activated Sludge Plant**: Involves decommissioning the primary clarifiers and converting them into activated sludge aeration basins. And constructing a new secondary clarifier. This includes the cost of converting the primary clarifiers into activated sludge, the redundant secondary clarifier, and alkalinity addition.
- **Install Proprietary Activated Sludge System**: Similar to the previous option, this would involve converting the WWTP into an activated sludge system. The difference is that the primary clarifiers would be maintained, and proprietary units would be constructed in the footprint of the existing trickling filter/solids contact system. The redundant clarifier alternative is not necessary with this option because a clarifier is included in the proprietary unit. This includes the cost of package/proprietary system and alkalinity addition.

The scoring of these groups of alternatives is presented in Table 5-4. The lowest cost improvement options were the package system and activated sludge conversion; the "do-nothing" alternative was about 50% the cost of these, so a score of 16 was added to the cost criteria. The alternatives for maintaining the existing system, converting to activated sludge, and installing a package system all scored closely. The "do-nothing" alternative in this case is not recommended, since the existing system has performance issues as evidenced by recent BOD and TSS violations. Therefore, the two options that require further consideration are the conversion of the primary clarifiers to an activated sludge system and the installation of a package system.

The conversion to an activated sludge system, proprietary or not, will improve the WWTP's ability to meet compliance for effluent quality due to the inefficiencies associated with the existing trickling filter system. Repurposing the primary clarifiers to aeration basins would not require any significant hydraulic changes to the system's piping or location of unit operations, while the proprietary system could require significant regrading and piping upgrades. There could also be substantial issues with construction sequencing to install a new proprietary system, since the footprint of the existing biological treatment system would be needed to fit the basin that was quoted. The main benefits of the proprietary system are that the primary clarifier would stay in use, potentially leading to less aeration costs due to the settling of BOD in the primary sludge. Also, O&M assistance would be readily available from the supplying company of a proprietary system.

With all of these considerations, the conversion to activated sludge via the primary clarifiers was chosen as the preferred alternative. The primary clarifiers are not necessary for the City given the relatively low solids loading rates in the influent wastewater, and the creation of primary sludge is more of a nuisance than the benefit primary clarifiers would serve for an activated sludge system. By getting rid of this unit operation, the facility would be more streamlined and likely easier to operate. Furthermore, the proprietary system seems to lack flexibility with only one aeration basin. It is recommended for the City, which experiences significant seasonal flow variations, to have the ability to run one aeration basin or two in parallel to provide the operator flexibility in maintaining biomass concentrations in the system and avoiding washouts.

Table 5-4: Scoring of Biological Treatment Alternatives

	Do Nothing	Rehabilitate Trickling Filter System	Sequencing Batch Reactors	Activated Sludge Conversion	Package System
Net Present Value (Weight = 40%)	16	9	5	10	10
Ease of Operation (Weight = 20%)	5	6	8	9	9
Compliance/Effluent Quality (Weight = 40%)	4	7	10	9	9
	9.0	**7.6**	**7.6**	**9.4**	**9.4**

5.3.3 Disinfection

The scoring of alternatives to rectify issues with the existing disinfection system are presented in Table 5-5. The best alternative as determined by the scoring is to construct a UV disinfection system. This is the best choice for the City for the following reasons. First, the UV disinfection system will improve the system's ability to meet compliance for effluent quality. Second, the costs of the new UV system will be less than those of an entirely new chlorine contact basin after factoring in chemical costs of disinfection and dechlorination and electrical costs. Third, chlorine treatment can lead to issues with chlorine toxicity in the receiving stream if not managed correctly, while UV treatment does not have this issue.

Table 5-5: Scoring of Disinfection Alternatives

	New UV System	Improve Chlorine Contact Basin	Do Nothing
Net Present Value (Weight 40%)	10	8	12
Ease of Operation (Weight = 20%)	8	7	7
Compliance/ Effluent Quality (Weight = 40%)	10	9	5
	9.6	**8.2**	**8.2**

5.3.4 Biosolids Management

Issues with the existing biosolids system include an unoptimized aeration system in the aerobic digester, and deep-pit sand drying beds that are difficult to maintain. Four feasible alternatives were evaluated in detail, including a "do nothing" alternative that would maintain the existing aerobic digester and drying beds. These alternatives were grouped together as followed for evaluation:

- **Do Nothing:** Maintains the existing digester aeration equipment and drying beds as they currently exist. Includes the cost of the "do nothing" solids management alternative as listed in Table 5-1.
- **Improve Digester Aeration and Rehabilitate Drying Beds**: Improves the aeration system by regularly operating only one digester cell and downsizing the blower. Also budgets for complete replacement of the drying bed underdrain system and under layers.
- **Improve Digester Aeration and Improve Drying Beds**: Improves the aeration system by regularly operating only one digester cell and downsizing the blower, and constructs new drying beds that are easier to maintain in the footprint of the existing system.

The score for each of these options are presented in Table 5-6. The best alternative for the City is to improve the aeration system and construct new drying beds. The current aeration system for the digestor does not allow the basins to be used individually. The City could save approximately $100,000 over the planning period on electricity costs by switching to a one-digester cell operation schema. Only one cell is needed with the projected solids wasting as determined by biological modeling. This improvement would significantly improve biosolids processing operations.

The current dried solids removal process is difficult and has resulted in damage to the under-drain system and liner in the past planning period due to the difficulty entering the bed with the excavator. By constructing a ramp for the excavator to enter the bed, the risk of damage to the liner is reduced, ensuring better compliance. Second, with the channel configuration of the proposed drying beds, the WWTP would have the capacity to use two channels year-round and have a third channel available for emergency solids removal from the aerobic digester. Though both rehabilitation and new drying bed construction scored approximately the same, the improvements to the ease of operation outweigh the increased cost of constructing new drying beds.

Table 5-6: Scoring of Biosolids Management Alternatives

	Do Nothing	Improve Digester Aeration & Rehabilitate Drying Beds	Improve Digester Aeration & Improve Drying Beds
Net Present Value (Weight = 40%)	13	10	7
Ease of Operation (Weight = 20%)	4	7	10
Compliance/Effluent Quality (Weight = 40%)	5	8	10
	8	**8.6**	**8.8**

5.3.5 Collection System

As discussed in Section 4.8.3, there are two good alternatives to handle the capacity issues associated with the collector pipes that serve the north and east areas of the City. The scoring for these alternatives is presented in Table 5-7. Both alternatives are approximately equal in terms of capital cost, but the Cannon Avenue alternative is advantageous in that it would result in a significant number of properties being rerouted from the Alder Street Lift Station sewershed and onto the gravity system. This would help with the reduction of flows to the lift station, reducing pump run times and reducing the risk of overflows.

Table 5-7: Scoring of Collection System Capacity Alternatives

	Cannon Avenue Alternative	Moss Street Alternative
Net Present Value (Weight = 40%)	10	10
Ease of Operation (Weight = 20%)	10	8
Compliance/Effluent Quality (Weight = 40%)	10	8
	10	**8.8**

6 PROPOSED PROJECTS

This section summarizes the proposed wastewater facility improvement projects recommended for inclusion in the City's Capital Improvement Plan (CIP). A recommended phasing and funding plan is presented, as well as a summary of funding sources available to the City for implementing the CIP over the next planning period.

6.1 Improvement Project Recommendations

Through the analyses that were completed during this planning effort, numerous project recommendations have been developed. These recommendations include improvements to the WWTP and collections system. The current plant flow diagram can be seen in Figure 6-1.

6.1.1 Wastewater Treatment Plant

6.1.1.1 Activated Sludge Aeration Basins

The primary clarifiers are to be converted to aerated sludge basins. This will change the City's treatment paradigm from a trickling filter/solids contact system to a conventional activated sludge system, which is more appropriate for a system like the City's that experiences major seasonal variations in flow. Both basins would be equipped with fine-pore air diffusers and two new blowers will be required, in addition to underground air piping. A conceptual drawing of this project is provided in Figure 6-2. Additionally, the supplemental alkalinity dosing system would be installed at the time of this project to provide ammonia removal capacity in the new aeration basins.

6.1.1.2 Aerobic Digester Aeration Improvements

A new blower for the aeration system that serves the solids stabilization process is recommended to allow the operator to isolate the digester basins. The current configuration requires the diffusers for both basins to be run in conjunction. A conceptual plan for this project is presented in Figure 6-3. This will save the City considerably in electricity expenditures throughout the planning period, so it is recommended to complete the project as soon as possible.

6.1.1.3 Secondary Clarifier

The trickling filter is to be decommissioned, demolished, and a new secondary clarifier would be constructed in the available pad. This new clarifier would have an internal diameter of 28 feet, appropriately sized for the City's typical flows throughout the planning period. Activated sludge recycle and waste streams will be directed to the existing solids contact aeration channel where the RAS and WAS splitter box is currently located, and RAS and WAS will be sent to the new aeration basins or aerobic digester respectively. Figure 6-4 shows these recommendations in a conceptual drawing.

6.1.1.4 UV Disinfection

The existing chlorine disinfection system is to be replaced with a UV disinfection system, as shown in Figure 6-5. The UV disinfection basin will consist of two parallel channels, each two feet wide. The basin is to be located south of the chlorine contact chamber. The use of UV disinfection will significantly reduce chemical expenditures in the treatment process improving the sustainability of the system.

6.1.1.5 Sludge Drying Bed Improvements

This project involves construction of concrete guide walls and replacement of the underdrain system to divide the existing pit-style drying beds into three 1,500 square feet beds. Each bed should have an entrance ramp to allow for ease of entry for machinery needed for solids removal, and the guide walls will provide protection for the liner and underdrain system. Figure 6-6 shows these recommendations.

6.1.2 Collection System

6.1.2.1 Alder Street Lift Station Upgrades

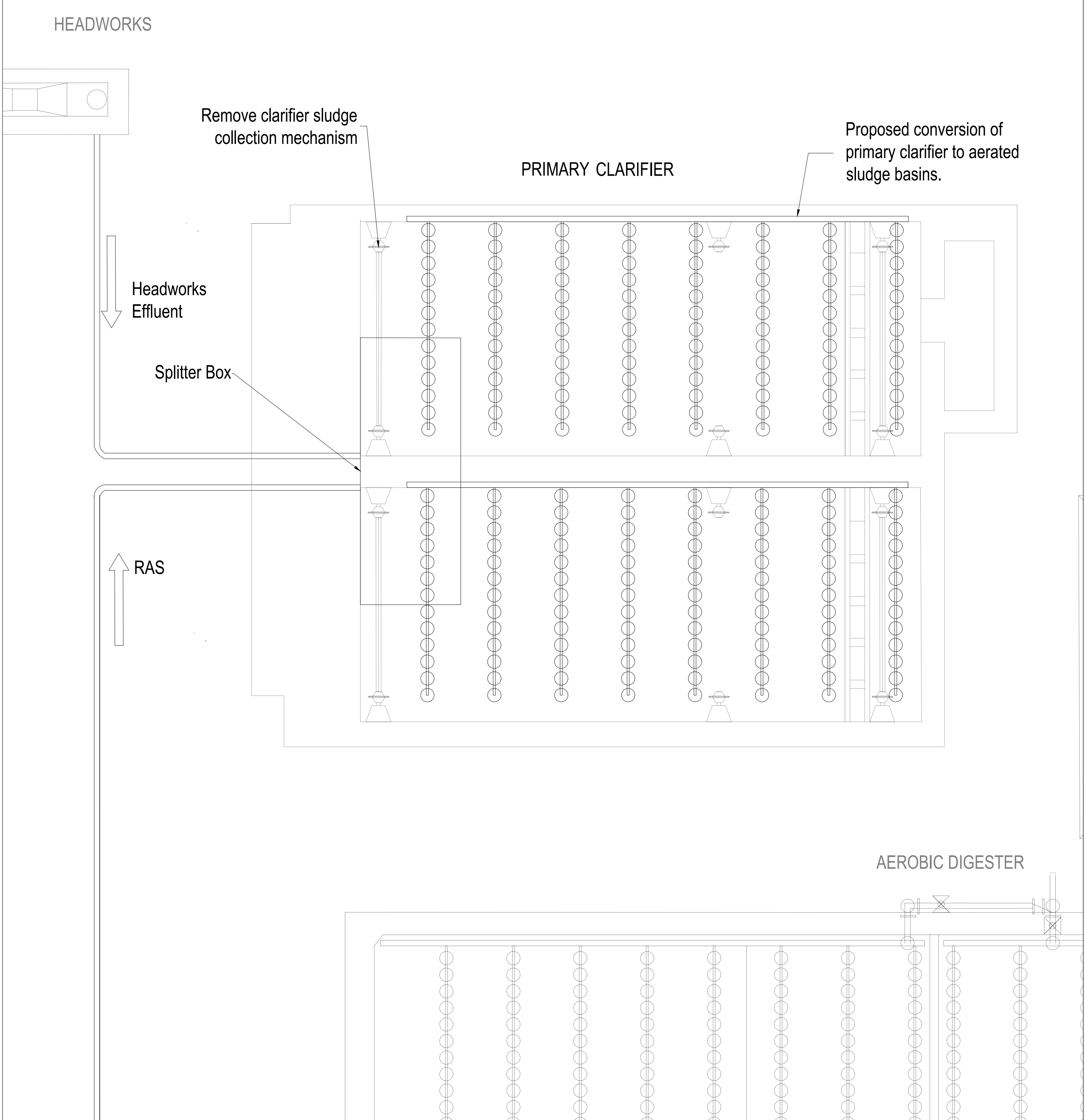
The City should upgrade the capacity of the lift station to meet DEQ’s reliability standards. This will necessitate both pumps to be replaced. Each pump should be sized to meet a projected peak flow of 490 gpm and be equipped with variable frequency drives.

6.1.2.2 Moss Street Gravity Sewer Capacity Upgrades

This project would involve upgrading two pipes in the collection system that are undersized for future growth, while also transitioning approximately 20 properties from the lift station basin to the gravity collection system. The City’s main 15” gravity collector on Moss Street would be extended up to 3rd Street, and minor pipe improvements would connect the properties in the north and east portion of town to this collector.

6.1.2.3 Inflow and Infiltration Reduction Program

The City should budget approximately $25,000 per year for the period 2024-2028 to fix the major identified I/I sources in the collection system. This includes pipe-lining projects near the Alder Street Lift Station, repair of cross-connected storm drains on Moss Street, and manhole replacement projects in the gravity sewer collection system. The City should continue to budget approximately $13,000 annually for I/I reduction from 2028-2045. This will involve routine CCTV surveillance of pipes and repairs to pipes and manholes as needed.



Civil West Engineering Services, Inc.
North Coast | South Coast
Willamette Valley | Rogue Valley

Drawn By: DS
Date: 12/15/23

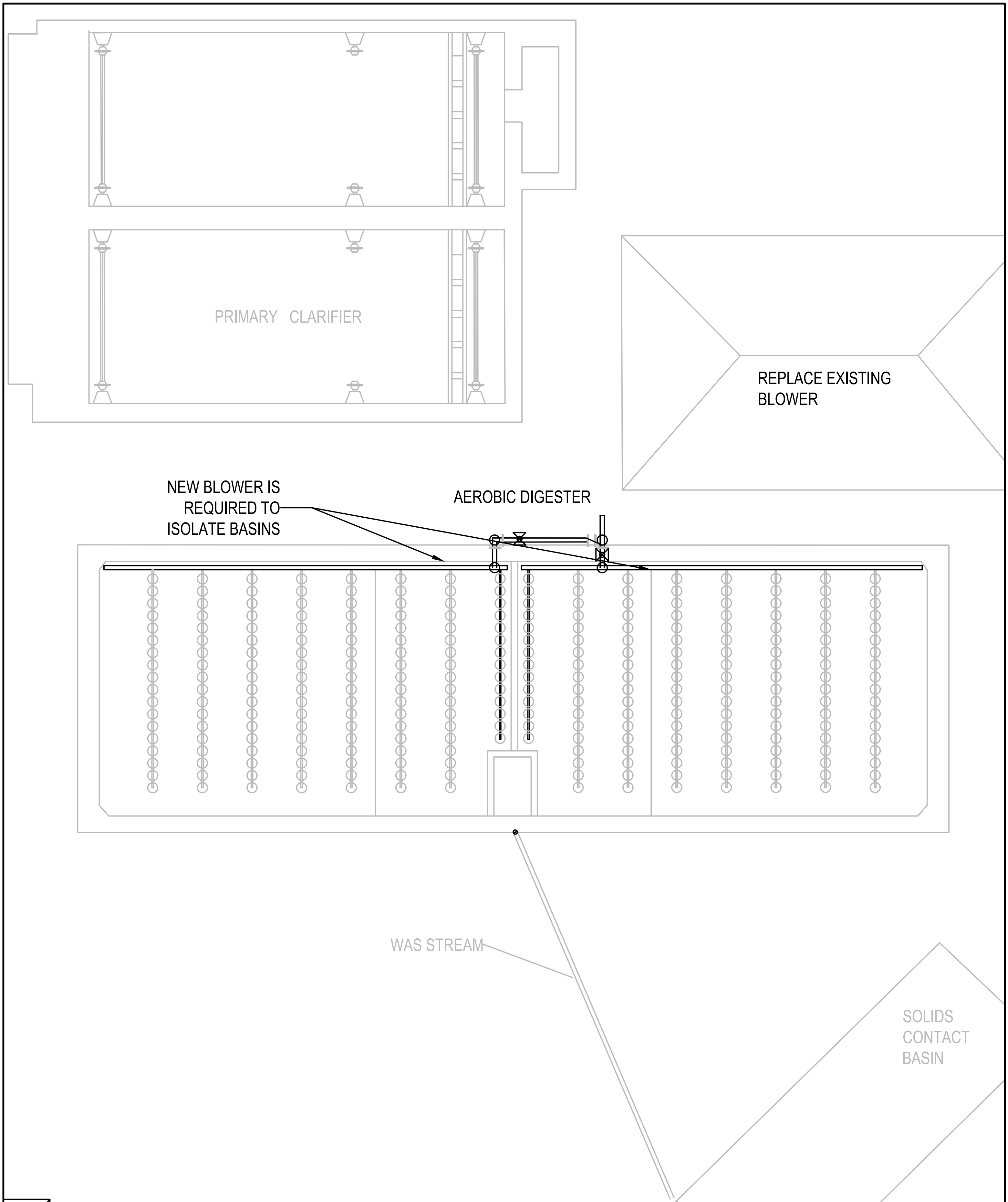
0 4 8
SCALE IN FEET
1"=8'

ACTIVATED SLUDGE AERATION BASINS

FIGURE 6-1

LOWELL WASTEWATER FACILITY PLAN

CITY OF LOWELL
LOWELL, OREGON



Civil West Engineering Services, Inc.
North Coast | South Coast
Willamette Valley | Rogue Valley

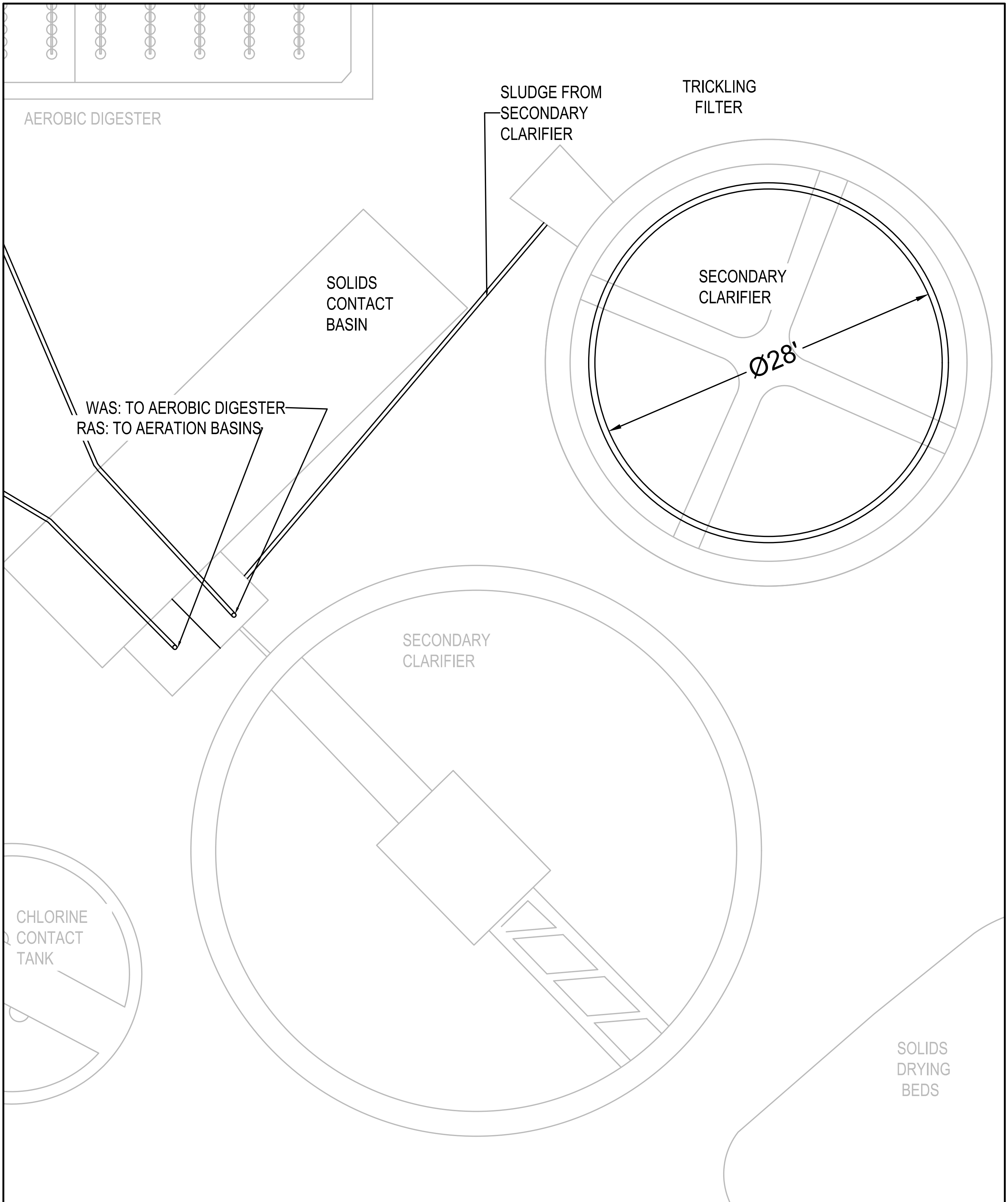
Drawn By: DS
Date: 12/21/23

LOWELL WASTEWATER FACILITY PLAN

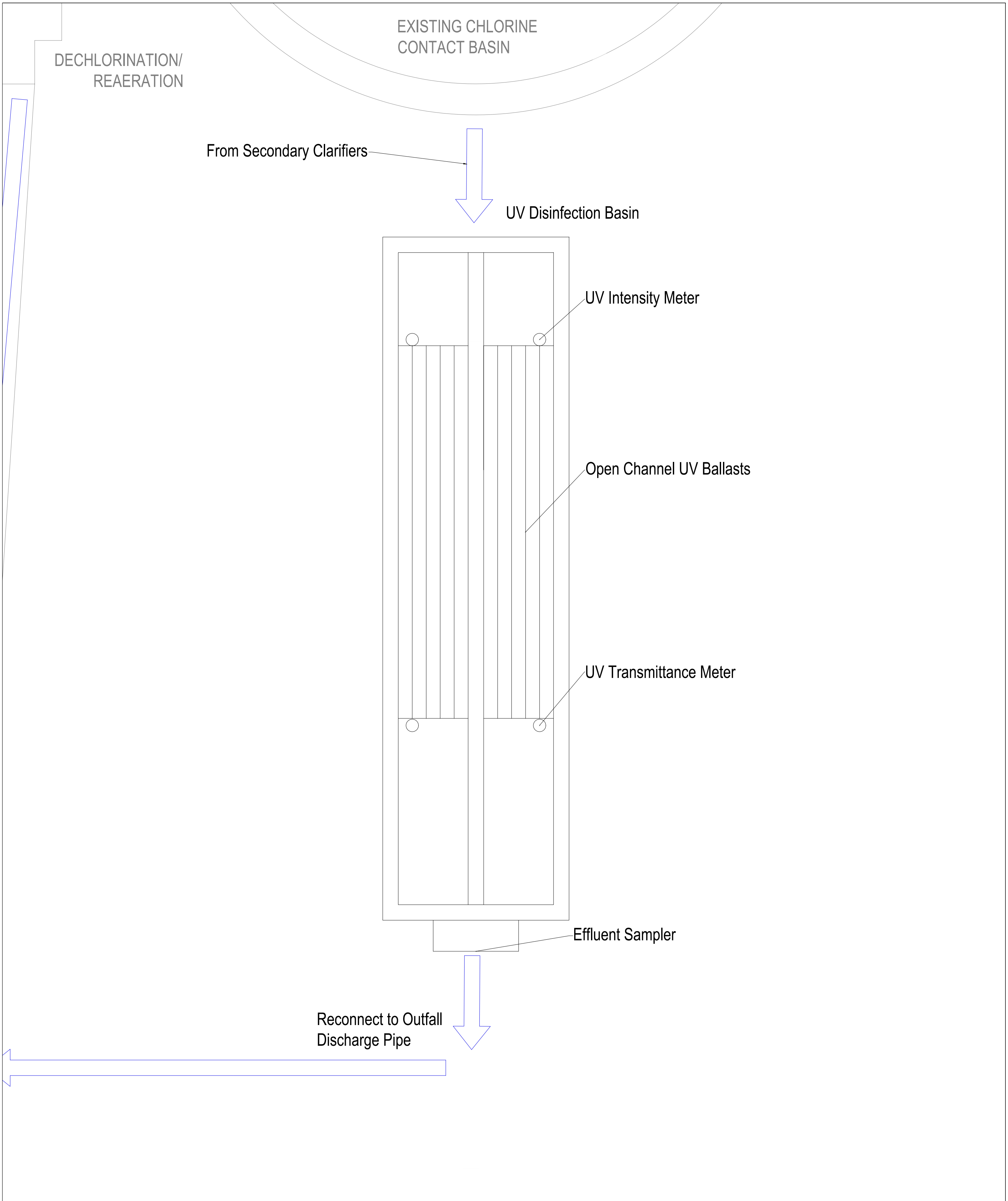
AEROBIC DIGESTER

CITY OF LOWELL
LOWELL, OREGON

FIGURE 6-2



Civil West Engineering Services, Inc. North Coast | South Coast Willamette Valley | Rogue Valley	Drawn By: DS Date: 12/21/23	0 5 10 SCALE IN FEET 1"=10'	SECONDARY CLARIFIER	FIGURE
	LOWELL WASTEWATER FACILITY PLAN		THE CITY OF LOWELL LOWELL, OREGON	6-3



Civil West Engineering Services, Inc.
North Coast | South Coast
Willamette Valley | Rogue Valley

Drawn By: DS
Date: 12/15/23

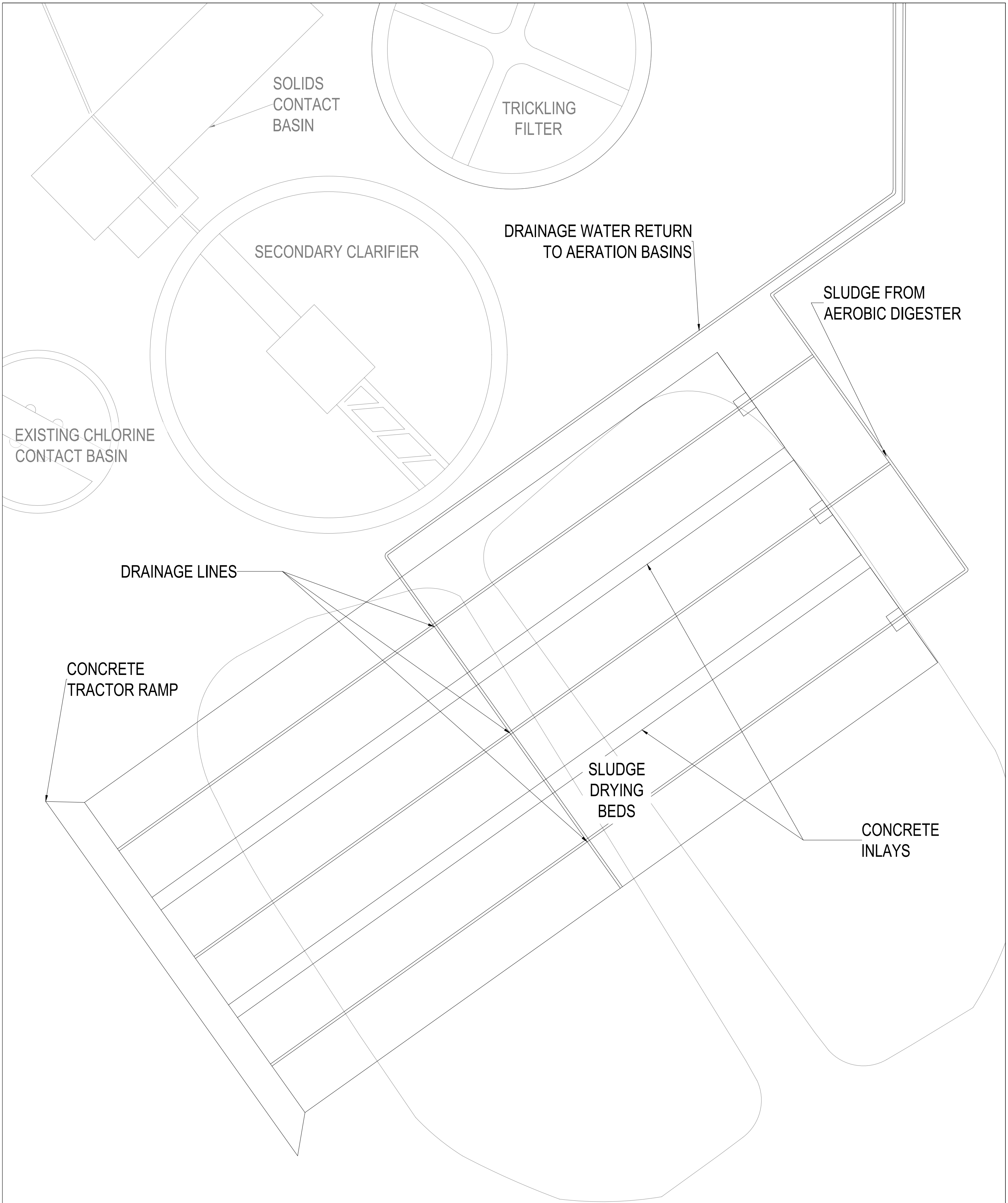
0 2 4
SCALE IN FEET
1"=4'

UV DISINFECTION

FIGURE 6-4

LOWELL WASTEWATER FACILITY PLAN

CITY OF LOWELL
LOWELL, OREGON



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North Coast | South Coast
Willamette Valley | Rogue Valley

Drawn By: DS
Date: 12/15/23

0 8 16
SCALE IN FEET
1"=16'

SLUDGE DRYING BEDS
CONCRETE INLAYS

FIGURE 6-6

LOWELL WASTEWATER FACILITY PLAN

CITY OF LOWELL
LOWELL, OREGON

6.2 Capital Improvement Plan

The recommended CIP for the City's wastewater utility is summarized in Table 6-1.

Table 6-1: Recommended Capital Improvement Plan

Capital Improvement Plan: Budgetary Costs (2023$) and Schedule			
Collection System Improvements - I/I Reduction	**Budget Cost**	**Begin and Complete**	
Collection System - Spot Repair of Sewer Pipe Voids	$24,000	2024	2026
Collection System - Cross-Connection Repair	$168,000	2024	2028
Collection System - Manhole Rehabilitation	$87,200	2024	2030
Collection System - CCTV Surveillance	$22,352	2024	2045
Phase 1 Budget	***$301,552***	***2024***	***2045***
PHASE 1 - Aeration System Improvements			
WWTP - Aeration System Improvements	$280,000	2024	2026
Phase 1 Budget	***$280,000***	***2024***	***2026***
PHASE 2 - Lift Station and Biosolids Improvements			
WWTP - Biosolids Management Improvements	$342,500	2025	2030
Collection System - Alder Street Lift Station Upgrades	$376,000	2025	2030
Phase 2 Budget	***$718,500***	***2025***	***2030***
PHASE 3 - Wastewater Treatment System Upgrades			
WWTP - Activated Sludge Improvement Project	$816,000	2028	2032
WWTP - Secondary Clarifier Construction	$1,281,200	2028	2032
WWTP - Supplemental Alkalinity System	$175,840	2028	2033
WWTP - UV Disinfection System Installation	$564,800	2033	2040
Phase 3 Budget	***$2,273,040***	***2028***	***2040***
PHASE 4 - Collection System Capacity Upgrades			
Collection System - Gravity Sewer Improvements	$469,200	2030	2045
Phase 4 Budget	***$469,200***	***2030***	***2045***
Total CIP Budgetary Cost Estimates	***$4,042,292***		

6.2.1 Improvement Project Phasing

The recommended projects were grouped into two categories: I/I reduction projects and improvement projects. Improvement projects were further divided into four phases to help the City plan and fund the capital projects in a sensible and cost-effective way.

The recommended I/I reduction projects should start with repairing the most egregious I/I issues identified in the collection system: repair of the broken pipes that go into the Alder Street Lift Station wet well, repair of cross-connections with the storm drainage system, and manhole repairs in the order presented in Table 4-10. The highest priority I/I improvements should be completed by end of year 2028. The City should continue to budget for I/I reduction projects after this and complete until all of the recommended manhole and pipe rehabilitation projects identified in the I/I evaluation are completed, and also continue to implement an I/I reduction program via routine CCTV surveillance of sewer pipe and repairing issues as they are identified throughout the entirety of the planning period.

The first phase of improvement projects is considered "low hanging fruit" in the sense that the total estimated cost is relatively low, and the benefits would be immediately beneficial to the

City's wastewater facilities. Phase 1 consists of optimizing the aerobic digester aeration system to save considerable O&M costs. It is recommended to begin engineering and design in 2024 and complete the aeration improvements by Summer 2025

Phase 2 improvement projects are considered high priority. These projects address capacity issues with the Alder Street Lift Station and improve the sludge drying beds to dramatically improve the WWTP's solids management system by reducing labor and material requirements required for maintaining the existing drying beds. It is recommended to begin design and engineering of Phase 2 projects by end of year 2025, and finish construction before 2030.

Phase 3 projects are those associated with the upgrade of the WWTP to convert the existing trickling filter/solids contact system into a conventional activated sludge system. This will involve the conversion of the primary clarifier to aeration basins, the construction of a new secondary clarifier, installation of the supplemental alkalinity system, and construction of a new UV disinfection system. The beginning date of this project will likely depend on the City's ability to obtain funding, but it is recommended to begin working on this phase prior to 2030 and complete the treatment system conversion before 2040.

Phase 4 involves the final CIP items for the City to implement in the second half of the planning period. This includes completion of the recommended gravity sewer capacity upgrades. This phase should be completed before the end of the planning period in 2045.

6.2.1.1 Permit Requirements

Building permits and grading permits will be required for each project involving rehabilitation of existing or construction of new structures on the wastewater treatment plant property, and at the Alder Street Lift Station. Plans for traffic control will be required for manhole rehabilitation projects and any pipe-laying work done for collection system capacity upgrades.

6.3 Financing

6.3.1 Annual Operating Budget

A review of the previous four years of the City's sewer fund was presented in Section 2.5. The City generally budgets between $400,000 to $500,000 for the City's sewer facilities, inclusive of capital projects, debt service, and operations and maintenance costs of the WWTP and collection system.

6.3.1.1 Income

Income for the facilities is provided from rates charges to customers. The rates are charged by equivalent dwelling unit (EDU). The basic monthly service charge per EDU is $68.51 with a greywater disposal fee per gallon of $0.17.

6.3.1.2 Annual Operations and Maintenance Costs

An itemized estimate of O&M costs of proposed projects is presented in Table 6-2. The existing wastewater system's annual O&M costs are estimated at approximately $209,000. With the system upgrades, this should reduce to approximately $183,000. The expected decrease in O&M costs is a function of simplifying the treatment system, reducing chemical costs from disinfection, improving efficiency in the solids dewatering system, and reducing air requirements from the solids digestion process.

Table 6-2: Estimated Operations and Maintenance Costs of Proposed Wastewater Facilities

No.	Item Description	Quantity	Units	Unit Cost ($)	Item Cost ($)
Operations & Maintenance - Headworks					
No.	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Operator Labor - Existing Fine Screen	65	h	$40	$2,600
2	Operator Labor - Bar Rack Maintenance	20	h	$40	$800
3	Replacement Parts	1	LS	$500	$500
4	Electricity Usage	6000	kWh	$0.08	$506
Operations & Maintenance - Supplemental Alkalinity System					
No.	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Operator Labor	32	h	$40	$1,280
2	Electricity Usage	2500	kWh	$0.08	$211
3	MgOH Costs	1000	gal	$3.00	$3,000
Operations & Maintenance - Secondary Clarification (New and Existing Clarifiers)					
No.	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Operator Labor	160	h	$50	$8,000
2	Electricity Usage	10000	kWh	$0.08	$843
Operations & Maintenance - Activated Sludge System					
No.	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Operator Labor	958	h	$50	$47,900
2	Electricity Usage	220000	kWh	$0.08	$18,546
Operations & Maintenance - UV Disinfection					
No.	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Operator Labor	300	h	$50	$15,000
2	Replacement Parts	1	LS	$1,000	$1,000
3	Electricity Usage	15000	kWh	$0.08	$1,265
Operations & Maintenance - Solids Management					
No.	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Operator Labor	40	h	$50	$2,000
2	Electricity Usage	90000	kWh	$0.08	$7,587
3	Replacement Parts	1	LS	$200	$200
4	Solids Hauling	1	LS	$2,500	$2,500
Operations & Maintenance - Collection System					
No.	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Operator Labor	100	h	$50	$5,000
2	Replacement Parts	1	LS	$1,000	$1,000
Operations & Maintenance - Administrative and Laboratory					
No.	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Operator Labor	750	h	$50	$37,500
2	Misc. Materials and Services	1	LS	$25,000	$25,000
				Estimated Annual O&M (2023$)	**$182,237**

6.3.1.3 Debt Repayments

The City's sewer fund, as of June 30, 2023, has $481,238 of debt service. This is inclusive of two Business Oregon loans and one United States Department of Agriculture Rural Utilities Loan. The City generally budgets $60,000 annually for loan repayments.

6.3.1.4 Debt Service Reserve

The completion of the projects described in this section will require the City to identify potential funding sources. These sources will each have unique program requirements including the need to maintain a debt service reserve.

6.3.1.5 Short-Lived Asset Reserve

Items are identified as short-lived assets if their replacement is likely to occur within the 20-year planning period of the facility. As a result, their replacement should be planned for by making an annual deposit into an equipment replacement fund. For reference, Table 6-3 lists the items included in the City's short-lived asset inventory, their replacement timeframe, and estimated costs.

Table 6-3: Short Lived Asset Replacement Costs and Recommended Replacement Periods

Equipment	Replacement Period			Replacement Cost
	0-5 Years	*6-10 Years*	*11-15 Years*	
RAS/WAS Pumps		X		$10,000
Chemical Feed Pumps		X		$7,500
Pump Controls		X		$3,500
Headworks Thrust Bearings		X		$700
Headworks Auger Support Bearings		X		$3,000
Aeration Blowers		X		$45,000
Aeration Diffusers	X			$100
Mechanical Mixers			X	$75,000
UV Lamps	X			$400
UV Electrical Ballast		X		$1,000
Pressure Transducers		X		$750
SCADA Hardware		X		$11,000
Flow Meters			X	$13,000
Laboratory Equipment			X	$50,000
Office Computer and Misc. Equipment		X		$7,500

6.3.2 Financing Options

To implement all of the improvement projects included in the proposed CIP, the City will likely need to secure funding from external sources. Some grant funding may be available to the City, however, loans or the use of available cash reserves may be required for a significant portion of the cost. A description of funding sources available for the City is provided below, followed by an evaluation of a few funding scheme alternatives.

6.3.2.1 External Funding Resources

Some amount of outside funding assistance in the form of grants or low interest loans may be necessary to make the proposed improvement projects affordable for the City. The amount and types of outside funding will dictate the amount of local funding that the City must secure. In evaluating grant and local programs, the major objective is to select a program or combination of programs that is available and the most beneficial for the planning project.

It is recommended that the City schedule a “One-Stop” meeting as a first step after this plan’s approval to find the available alternatives for external funding. Potential funding programs that the City may be eligible for include Oregon’s Water/Wastewater Financing Program, the Clean Water State Revolving Fund, Oregon Department of Energy Small Scale Energy Loan Program, and the Special Public Works Fund. Information gained through the One-Stop meeting can then be used to select the funding sources that the City would then apply for.

6.3.2.2 Local Funding Resources

Several local funding sources are available to the City for sharing the cost of the planned wastewater system improvements. The amount and type of local funding obligations for infrastructure improvements will depend in part on the amount of grant funding anticipated and the requirements of potential loan funding. Local revenues sources for capital expenditures include various types of bonds, capital construction funds, system development charges (SDC), system user fees, and ad valorem taxes. Local revenue sources for operating costs include system user fees and ad valorem taxes.

Any potential sewer rate adjustment will depend on funding packages secured by the City. Interest rates, payback periods on loans, adjusted construction costs after pre-design phases, and many other variables could impact sewer rates. All of the projects included in the CIP, excluding I/I improvement projects, are partially SDC eligible as they provide for increased capacity for future development.

6.3.2.3 Funding Alternatives

To evaluate the impact of implementing the CIP on the City’s capital budget, debt service, and user rates, three funding approaches were evaluated. All dollars are in terms of 2023$ and do not account for inflation. The three alternative funding strategies evaluated were:

- Fully funded via loans at a nominal 20-year payback period and an interest rate of 3.5%;
- Mostly funded via loans at same terms, with approximately $1.7 million secured from grants or forgivable loan portions. Assumes that Phase 1, 2 and 4 projects would be fully loan funded, Phase 3 would be 25% loan funded and 75% funded via grants, and all I/I reduction would be funded internally through the City budget;
- Budget for capital improvements at approximately $81,000 annually for total of $1.7 million over the planning period, obtain approximately the same amount in loans, and obtain approximately $1.1 million in grant funds or forgivable loan portions. This assumes Phase 1 and all I/I reduction projects would be fully funded by the City’s budget, Phase 2 would be 100% grant funded, and Phases 3 and 4 would be 40% budget funded, 40% grant funded, and 20% loan funded.

A summary of debt service requirements, capital fund budget requirements, and the required grant/forgivable loan funds for each of these alternatives in presented in Table 6-4. The estimated impact on user rates for each alternative is also shown.

Table 6-4: Evaluation of Funding Strategy Alternatives

Funding Strategy				
		Fully Loan Funded	**Loan and Partial Grant Funded**	**Capital Investment, Loan, and Grant Funded**
Total Debt Service:		$6,017,806	$3,560,133	$1,785,546
Budgeted Capital Funds:		$0	$301,552	$1,659,745
Grant Funds/Forgivable Loans:		$0	$1,704,780	$1,124,246
Cost after Financing:		$6,017,806	$5,566,465	$4,738,655
Sewer Rate Estimates				
Year	**Projected EDUs**	**Estimated Monthly Sewer Rates (Current = $69)**		
2024	545	$75	$74	$69
2026	558	$83	$82	$77
2028	571	$82	$81	$76
2030	585	$105	$87	$82
2033	606	$103	$86	$81
2040	658	$105	$96	$80
2045	697	$103	$94	$80

As shown in the above table, it is possible for the City to pursue a funding strategy that combines budgeted capital improvement funds, loans, and grants to implement the proposed CIP while maintaining reasonable sewer rates to customers. It is recommended to obtain loans strategically throughout the planning period to keep the City's annual debt service under $100,000. A total grant income of at least $1 million over a 21-year period is a reasonable goal for the City. Any grant funds obtained in excess of this, or loans obtained at more competitive rates, would help the City keep service rates as low as possible. The following subsections describe some of the available programs that the City should consider pursuing to partially fund the proposed CIP.

6.3.2.3.1 Economic Development Administration Public Works Grant Program

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

Projects must be located within an EDA designated Economic Development District. Priority is given to projects that improve opportunities for the establishment or expansion of industry and which create or retain both short-term and long-term private sector jobs. Communities that can demonstrate that the existing system is at capacity (i.e. moratorium on new connections) have a greater chance of being awarded this type of grant. EDA grants are usually in the range of 50 to 80 percent of the project cost. Therefore, some type of local funding also is required. Grants typically do not exceed one million dollars.

6.3.2.3.2 Water and Waste Disposal Loans and Grants

The Rural Utilities Service administers a water and wastewater loan and grant program designed to improve the quality of life and promote economic development in rural America. The Rural Utilities Service programs provide needed facilities to ensure health and safety and stimulate local economy by allowing access to new and advanced services and job opportunities. Program funds can be used for water, sewer, solid waste, and storm drainage projects. The most common uses are to restore deteriorating water supplies, or to improve, enlarge, or modify inadequate water or waste facilities.

Eligible applicants for Rural Utilities funds include public bodies and Indian Tribes. Non-profit corporations with significant ties to the local rural community may also be eligible. Funding is targeted to rural areas with populations of 10,000 or less. Applicants must be unable to obtain commercial financing at reasonable rates and terms or finance the project from existing resources.

The proposed project must serve a rural area not likely to decline in population below that for which the project is designed. The project should serve the present population and provide for foreseeable growth. Proposed projects should be necessary for orderly community development consistent with a comprehensive community or county development plan. Facilities must be modest in design, size, and cost. Water meters, a primary instrument for promoting conservation, are required by the agency. All water and wastewater systems must meet the standards set by the State Department of Environmental Quality.

The Rural Utilities staff review each project to determine need based on various priority points. Prioritization is necessary due to limited funding and to make sure the most deserving projects receive assistance. When possible, loan funds are combined with other federal and state financing to reduce the end cost to users of the system. Depending on median household income (MHI) and need, communities may qualify for grant funds of up to 75% of the eligible project costs. These grants can help reduce water and waste disposal rates to reasonable levels. Rural Utilities loans have a term of up to 40 years or for the useful life of the facility, whichever is less.

Grant fund eligibility is determined based on population, MHI, and user rates. Priority for grant funding is given to projects with populations of less than 5,500. Communities with low MHI may receive grant funding to reduce user costs to a reasonable level for rural residents. User rates are considered reasonable if they are less than or equal to existing prevailing rates in similar communities with similar systems. There are other restrictions and requirements associated with these loans and grants. If the City becomes eligible for grant assistance, the grant will apply only to eligible project costs. Additionally, grant funds are only available after the City has incurred long-term debt resulting in an annual debt service obligation equal to 0.5% of the MHI. In addition, an annual funding allocation limits the Rural Development funds. To receive a Rural Development loan, the City must secure bonding authority, usually in the form of general obligation bonds or revenue bonds.

6.3.2.3.3 Special Public Works Fund

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

- Cities
- Counties
- Domestic water supply districts organized under ORS chapter 264
- Sanitary districts organized under ORS 450.005 to 450.245
- Sanitary authority, water authority or joint water and sanitary authority organized under
- ORS 450.600 to 450.989
- County service districts organized under ORS chapter 451
- Tribal Councils of Indian Tribes in Oregon
- Airport district organized under ORS Chapter 838
- A district as defined in ORS 198.010

To be eligible, the proposed project must be owned by a public entity that is an eligible applicant. The Special Public Works Fund is comprehensive in terms of the types of project costs that can be financed. As well as actual construction, eligible project costs can include costs incurred in conducting feasibility and other preliminary studies and for the design and construction engineering. The Fund is primarily a loan program. Grants can be awarded, up to the program limits, based on job creation or on a financial analysis of the applicant's capacity for carrying debt financing.

The total loan amount per project cannot exceed $10 million. The department can offer very attractive interest rates that typically reflect low market rates. In addition, the department absorbs the associated costs of debt issuance thereby saving applicants even more on the overall cost of borrowing. Loans are generally limited to the usable life of the contracted project, or 25 years from the year of project completion, whichever is less.

For infrastructure projects, grants are offered to projects creating or retaining jobs and are eligible for up to $5,000 per job created or retained. If a grant is offered it cannot exceed 85 percent of the project cost or $500,000, whichever is less. Additional grants may be awarded if there is a gap between the grant for jobs plus the loan and the total project costs.

6.3.2.3.4 Water/ Wastewater Financing Program

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

The public entities that are eligible to apply for the program include: Cities, Counties, County Service districts (organized under ORS Chapter 451), Tribal Councils of Indian tribes, Ports, and Special Districts as defined in ORS 198.010.

Eligible activities include reasonable costs for construction improvement or expansion of drinking water, wastewater or storm water systems. Eligible projects include those related to drinking water source, treatment, storage and distribution; wastewater collection and capacity; stormwater system; purchase of rights-of-way and easements necessary for construction; and design and construction engineering. All projects must ensure that municipal water and wastewater systems comply with the Safe Drinking Water Act or the Clean Water Act.

To be eligible a system must have received, or is likely to soon receive, a Notice of Non-Compliance by the appropriate regulatory agency, associated with the Safe Drinking Water Act or the Clean Water Act. Projects also must meet other state or federal water quality statutes and standards.

The Fund provides both loans and grants, but it is primarily a loan program. The loan/grant amounts are determined by a financial analysis of the applicant's ability to afford a loan (debt capacity, repayment sources and other factors). The Water/Wastewater Financing Program's guidelines, project administration, loan terms and interest rates are similar to the Special Public Works Fund program. The maximum loan term is 25 years, or the useful life of the infrastructure financed, whichever is less. The maximum loan amount is $10,000,000 per project through a combination of direct and/or bond funded loans. Loans are generally repaid with utility revenues or voter approved bond issues. A limited tax obligation pledge may also be required. "Credit worthy" borrowers may be funded through sale of state revenue bonds.

Grant awards can be awarded up to a maximum of $750,000 depending on a financial review. An applicant is not eligible for grant funds if the annual median household income in the affected area is equal or greater than 100 percent of the state average median household income for the same year. Technical assistance funding for preliminary planning, engineering studies and economic investigations are available to municipalities with populations under 15,000 residents. Technical assistance projects must be done in preparation for an eligible construction project and can be awarded loans of up to $50,000 or grants of up to $20,000 per project.

6.3.2.3.5 Clean Water State Revolving Fund (CWSRF)

The Clean Water State Revolving Fund (CWSRF) Loan Program administered by DEQ provides low-cost loans for the planning, design and construction of a variety of projects that address water pollution. The loans through the CWSRF program are available to Oregon's public agencies, including cities, counties, sanitary districts, soil and water conservation districts, irrigation districts and various special districts.

There are several different types of loans available within the program. These include traditional planning, design and construction loans. Each of these loan types has different financial terms and is intended to provide communities with choices when financing water quality improvements. Interest rates are based on the nation's bond buyer's index and fluctuate quarterly. The interest rates of various loans are substantially discounted from the bond rate. For example, with a quarterly bond rate of 5.0%, the CWSRF interest rates (depending on the type of loan) would range from 0.97% to 3.88%. Loan payback periods vary, ranging from 5 to 30 years. Loans do include an annual loan fee of 0.5% of the outstanding balance. Planning loans are exempt from this fee. Eligible projects include:

- Wastewater system plans and studies
- Secondary or advanced wastewater treatment facilities
- Irrigation improvements
- Infiltration and inflow correction
- Major sewer replacement and rehabilitation
- Qualified storm water control
- Onsite wastewater system repairs
- Matching funds for some U.S. Department of Agriculture conservation programs

- Estuary management efforts
- Various nonpoint source projects (stream restorations, animal waste management, conservation easements)
- Qualified brownfields projects

All eligible proposed projects are ranked based upon their application information and entered on the program's Project Priority List. Points are assigned based on specific ranking criteria. Newly ranked projects are integrated into the priority list on a regular basis. The Project Priority List is incorporated within DEQ's annual Intended Use Plan which indicates the proposed use of the funds each year. Projects are funded based on the availability of loan monies. If monies are insufficient to fund all the approved projects, funds are distributed to as many projects as possible based on the Project Priority List. Each time new monies become available, those monies are allocated to as many unfunded or partially funded projects as possible.

APPENDIX A:

National Pollutant Discharge Elimination System
Permit 101384

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
WASTE DISCHARGE PERMIT

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

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

ISSUED TO:
City of Lowell
PO Box 490
Lowell, Oregon 97452

SOURCES COVERED BY THIS PERMIT:

Type of Waste	Outfall Number	Outfall Location
Treated Wastewater	001	R.M. 15.7
Emergency Overflow	002	Alder Street Pump Station

FACILITY TYPE AND LOCATION:
Activated Sludge
Lowell Wastewater Treatment Plant
240 S Moss Street
Lowell
Treatment System Class: Level III
Collection System Class: Level II

RECEIVING STREAM INFORMATION:
Basin: Willamette
Sub-Basin: Middle Fork Willamette
Receiving Stream: Middle Fork Willamette River
LLID: 1230144440225 15.7 D
County: Lane

EPA REFERENCE NO: OR002004-4

Issued in response to Application No.972846 received June 26, 2008.

This permit is issued based on the land use findings in the permit record.

John J. Ruscigno (signature)
John J. Ruscigno, Water Quality Manager
Western Region North

February 23, 2010
Date

PERMITTED ACTIVITIES

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

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

SCHEDULE A: Waste Discharge Limits
(not to be exceeded after permit issuance)

1. Outfall 001 Treated Effluent:

a. May 1 - October 31:

Parameter	Average Effluent Concentrations Monthly	Weekly	Monthly Average lb/day	Weekly Average lb/day	Daily Maximum lbs
BOD_5	10 mg/L	15 mg/L	13	19	26
TSS	10 mg/L	15 mg/L	13	19	26

b. November 1 - April 30:

Parameter	Average Effluent Concentrations Monthly	Weekly	Monthly Average lb/day	Weekly Average lb/day	Daily Maximum lbs
BOD_5	30 mg/L	45 mg/L	58	87	120
TSS	30 mg/L	45 mg/L	58	87	120

Summer mass load limits are based on average dry weather design flow of 0.15 MGD; winter mass load limits are based upon average wet weather design flow of 0.23 MGD. The daily mass load limit is suspended on any day in which the flow to the treatment facility exceeds 0.3 MGD (twice the design average dry weather flow).

c. Year round:

Other parameters	Limits
E. coli bacteria	Must not exceed 126 organisms per 100 mL monthly geometric mean; no single sample can exceed 406 organisms per 100 mL **(See Note A1)**
BOD_5 and TSS, removal efficiency	Must not be less than a monthly average of 85%
pH	Must be within the range of 6.0 - 9.0
Chlorine , total residual	Must not exceed a monthly average of 0.5 mg/L

d. Except as provided for in OAR 340-45-080, no wastes shall be discharged and no activities shall be conducted which violate Water Quality Standards as adopted in OAR 340-41-0445 except in the following defined mixing zone:

The mixing zone is defined as five percent of the stream flow from Dexter Reservoir through Dexter Dam. The zone of initial dilution is defined as one percent of the stream flow from Dexter Reservoir through Dexter Dam.

2. Outfall 002 Emergency Overflow (Alder Street Pump Station):

No wastes shall be discharged from this outfall.

3. Notes:

A1. If a single sample exceeds 406 organisms per 100 mL, then five consecutive re-samples may be taken at four-hour intervals beginning within 48 hours after the original sample was taken. If the geometric mean of the five re-samples is less than or equal to 126 organisms per 100 mL, a violation shall not be triggered.

SCHEDULE B: Minimum Monitoring and Reporting Requirements

1. Monitoring procedures:

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

a. Influent

Influent grab samples, measurements, and composite samples must be taken just after the helisieve headworks.

Parameter	Minimum Frequency	Sample Type
BOD_5, concentration	Weekly	Composite
TSS, concentration	Weekly	Composite
pH	2/Week	Grab

b. Outfall 001 Treated Effluent

Effluent grab samples, measurements, and composite samples must be taken from the dechlorination/re-aeration tank.

Parameter	Minimum Frequency	Sample Type
Flow, total (MGD)	Daily	Measurement
Flow Meter Calibration	Annual	Verification
BOD_5, concentration	Weekly	Composite
BOD_5, pounds discharged	Weekly	Calculation
BOD_5, average removal efficiency	Monthly	Calculation
TSS, concentration	Weekly	Composite
TSS, pounds discharged	Weekly	Calculation
TSS, average removal efficiency	Monthly	Calculation
pH	3/Week	Grab
E. coli	Weekly	Grab
Temperature	3/Week	Grab
Chlorine, quantity used	Daily	Measurement
Chlorine, total residual	Daily	Grab

c. Biosolids Management (Class B biosolids)

Parameter		Minimum Frequency	Sample Type
Total solids,	% dry wt.	Annual	Composite **(see Note B1)**
Volatile solids,	% dry wt.	Annual	Composite **(see Note B1)**
NH_3-N,	% dry wt.	Annual	Composite **(see Note B1)**
NO_3-N,	% dry wt.	Annual	Composite **(see Note B1)**
TKN,	% dry wt.	Annual	Composite **(see Note B1)**
P,	% dry wt.	Annual	Composite **(see Note B1)**
K,	% dry wt.	Annual	Composite **(see Note B1)**
pH,	S.U.	Annual	Composite **(see Note B1)**
Total As	mg/kg	Annual	Composite **(see Note B1)**
Total Cd	mg/kg	Annual	Composite **(see Note B1)**
Total Cu	mg/kg	Annual	Composite **(see Note B1)**
Total Hg	mg/kg	Annual	Composite **(see Note B1)**
Total Mo	mg/kg	Annual	Composite **(see Note B1)**
Total Ni	mg/kg	Annual	Composite **(see Note B1)**
Total Pb	mg/kg	Annual	Composite **(see Note B1)**
Total Se	mg/kg	Annual	Composite **(see Note B1)**
Total Zn	mg/kg	Annual	Composite **(see Note B1)**
Fecal coliform or equivalent per 40CFR503.32	per unit total dry wt. solids	Annual	Composite of at least 7 individual samples; representative of product to be land applied
Locations where applied		Each occurrence	Date, volume, location
Percent total solids achieved by air dry before addition of inert material; note if solids included unstabilized solids from primary wastewater treatment process		Each batch	Composite (see Note B1)

2. Discharge Monitoring Reports:

a. The reporting period is the calendar month.

b. State discharge monitoring reports must:

- be submitted to the appropriate Department office by the 15th day of the month following.the reporting period,
- be reported on approved forms,
- 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,
- identify each system classification as found on page one of this permit,
- record the quantity and method of use of all sludge and biosolids removed from the treatment facility,
- record all applicable equipment breakdowns and bypasses

3. Other Reports:

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

b. For any year in which sludge is landfilled, a report shall 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 340-50-035(6)(a)-(e).

c. The permittee must submit a land application biosolids report for each year by February 19 of the following year.

4. Notes:

B1. Composite samples shall be taken from reference areas in the sludge drying bed pursuant to **Test Methods for Evaluating Solid Waste, Volume 2: Field Manual, Physical/Chemical Methods**, third edition, chapter 9 (November 1986).

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. The permittee must dispose of its sludge as solid waste in a Department approved landfill in accordance with the General Provisions of the Department's Solid Waste Rules (OAR Chapter 340, Division 093). Proper waste monitoring would be prescribed by the landfill in accordance with those rules.

2. The permittee must report transport of sludge on its monthly Discharge Monitoring Reports as well as on its annual sludge report.

3. Any biosolids applied must comply with the federal biosolids regulations (40 CFR Part 503) and biosolids monitoring must be done in accordance with Schedule B of this permit.

4. The permittee must comply with OAR Chapter 340, Division 49, "Regulations Pertaining To Certification of Wastewater System Operator Personnel" and accordingly:

   a. The permittee shall have its wastewater system supervised by one or more operators who are certified in a classification 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 may not be without supervision (as required by Special Condition 4.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 shall 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 shall 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 shall be filed with the Water Quality Division, Operator Certification Program, 811 SW 6th Ave, Portland, OR 97204. This requirement is in addition to the reporting requirements contained under Schedule B of this permit.

   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(s) as required by 4.b. above.

5. The permittee shall not be required to perform a hydrogeologic characterization or groundwater monitoring during the term of this permit provided:

   a. The facilities are operated in accordance with the permit conditions, and;

   b. There are no adverse groundwater quality impacts (complaints or other indirect evidence) resulting from the facility's operation.

6. If warranted, the Department may evaluate the need for a full assessment of the facilities impact on groundwater quality at permit renewal.

7. The permittee shall notify the appropriate DEQ Western Region Office in accordance with the response times noted in the General Conditions of this permit, of any malfunction so that corrective action can be coordinated between the permittee and the Department.

SCHEDULE F

NPDES GENERAL CONDITIONS – DOMESTIC FACILITIES

SECTION A. STANDARD CONDITIONS

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

2. Penalties for Water Pollution and Permit Condition Violations
The permit is enforceable by DEQ or EPA, and in some circumstances also by third-parties under the citizen suit provisions 33 USC §1365. DEQ enforcement is generally based on provisions of state statutes and EQC rules, and EPA enforcement is generally based on provisions of federal statutes and EPA regulations.

ORS 468.140 allows the Department to impose civil penalties up to $10,000 per day for violation of a term,
condition, or requirement of a permit. The federal Clean Water Act provides for civil penalties not to exceed $32,500 and administrative penalties not to exceed $11,000 per day for each violation of any condition or limitation of this permit.

Under ORS 468.943, unlawful water pollution, if committed by a person with criminal negligence, is punishable by a fine of up to $25,000, imprisonment for not more than one year, or both. Each day on which a violation occurs or continues is a separately punishable offense. The federal Clean Water Act provides for criminal penalties of not more than $50,000 per day of violation, or imprisonment of not more than 2 years, or both for second or subsequent negligent violations of this permit.

Under ORS 468.946, a person who knowingly discharges, places, or causes to be placed any waste into the waters of the state or in a location where the waste is likely to escape into the waters of the state is subject to a Class B felony punishable by a fine not to exceed $200,000 and up to 10 years in prison. The federal Clean Water Act provides for criminal penalties of $5,000 to $50,000 per day of violation, or imprisonment of not more than 3 years, or both for knowing violations of the permit. In the case of a second or subsequent conviction for knowing violation, a person shall be subject to criminal penalties of not more than $100,000 per day of violation, or imprisonment of not more than 6 years, or both.

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

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

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

5. Permit Actions

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

a. Violation of any term, condition, or requirement of this permit, a rule, or a statute
b. Obtaining this permit by misrepresentation or failure to disclose fully all material facts
c. A change in any condition that requires either a temporary or permanent reduction or elimination of the authorized discharge
d. The permittee is identified as a Designated Management Agency or allocated a wasteload under a Total Maximum Daily Load (TMDL)
e. New information or regulations
f. Modification of compliance schedules
g. Requirements of permit reopener conditions
h. Correction of technical mistakes made in determining permit conditions
i. Determination that the permitted activity endangers human health or the environment
j. Other causes as specified in 40 CFR 122.62, 122.64, and 124.5
k. For communities with combined sewer overflows (CSOs):
   (1) To comply with any state or federal law, regulation that addresses CSOs that is adopted or promulgated subsequent to the effective date of this permit
   (2) If new information, not available at the time of permit issuance, indicates that CSO controls imposed under this permit have failed to ensure attainment of water quality standards, including protection of designated uses
   (3) Resulting from implementation of the Permittee's Long-Term Control Plan and/or permit conditions related to CSOs.

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

6. Toxic Pollutants

The permittee must comply with any applicable effluent standards or prohibitions established under Oregon Administrative Rules (OAR) 340-041-0033 and 307(a) of the federal Clean Water Act for toxic pollutants, and with standards for sewage sludge use or disposal established under Section 405(d) of the Clean Water Act, within the time provided in the regulations that establish those standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

7. Property Rights and Other Legal Requirements

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

8. Permit References

Except for effluent standards or prohibitions established under Section 307(a) of the federal Clean Water Act and OAR 340-041-0033 for toxic pollutants, and standards for sewage sludge use or disposal established under Section 405(d) of the Clean Water Act, all rules and statutes referred to in this permit are those in effect on the date this permit is issued.

9. Permit Fees

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

SECTION B. OPERATION AND MAINTENANCE OF POLLUTION CONTROLS

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

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

3. Bypass of Treatment Facilities
   a. Definitions
      (1) "Bypass" means intentional diversion of waste streams from any portion of the treatment facility. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, provided the diversion is to allow essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of paragraphs b. and c. of this section.
      (2) "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources that can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.
   b. Prohibition of bypass.
      (1) Bypass is prohibited and the Department may take enforcement action against a permittee for bypass unless:
         i. Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;
         ii. There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate backup equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass that occurred during normal periods of equipment downtime or preventative maintenance; and
         iii. The permittee submitted notices and requests as required under General Condition B.3.c.
      (2) The Department may approve an anticipated bypass, after considering its adverse effects and any alternatives to bypassing, when the Department determines that it will meet the three conditions listed above in General Condition B.3.b.(1).
   c. Notice and request for bypass.
      (1) Anticipated bypass. If the permittee knows in advance of the need for a bypass, a written notice must be submitted to the Department at least ten days before the date of the bypass.
      (2) Unanticipated bypass. The permittee must submit notice of an unanticipated bypass as required in General Condition D.5.

4. Upset

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

b. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the requirements of General Condition B.4.c are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

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

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

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

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

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

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

5. Treatment of Single Operational Upset

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

6. Overflows from Wastewater Conveyance Systems and Associated Pump Stations

a. Definitions

(1) "Overflow" means any spill, release or diversion of sewage including:

i. An overflow that results in a discharge to waters of the United States; and

ii. An overflow of wastewater, including a wastewater backup into a building (other than a backup caused solely by a blockage or other malfunction in a privately owned sewer or building lateral), even if that overflow does not reach waters of the United States.

b. Prohibition of overflows. Overflows are prohibited. The Department may exercise enforcement discretion regarding overflow events. In exercising its enforcement discretion, the Department may consider various factors, including the adequacy of the conveyance system's capacity and the magnitude, duration and return frequency of storm events.

c. Reporting required. All overflows must be reported orally to the Department within 24 hours from the time the permittee becomes aware of the overflow. Reporting procedures are described in more detail in General Condition D.5.

7. 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.8. Such steps may include, but are not limited to, posting of the river at access points and other places, news releases, and paid announcements on radio and television.

8. 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.

9. Removed Substances

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

SECTION C. MONITORING AND RECORDS

1. Representative Sampling

Sampling and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge. All samples must be taken at the monitoring points specified in this permit, and shall be taken, unless otherwise specified, before the effluent joins or is diluted by any other waste stream, body of water, or substance. Monitoring points may not be changed without notification to and the approval of the Department.

2. Flow Measurements

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

3. Monitoring Procedures

Monitoring must be conducted according to test procedures approved under 40 CFR part 136, or in the case of sludge use and disposal, under 40 CFR part 503, unless other test procedures have been specified in this permit.

4. Penalties of Tampering

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

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

6. Additional Monitoring by the Permittee
If the permittee monitors any pollutant more frequently than required by this permit, using test procedures approved under 40 CFR part 136, or in the case of sludge use and disposal, under 40 CFR part 503, or as specified in this permit, the results of this monitoring must be included in the calculation and reporting of the data submitted in the Discharge Monitoring Report. Such increased frequency must also be indicated. For a pollutant parameter that may be sampled more than once per day (e.g., Total Chlorine Residual), only the average daily value must be recorded unless otherwise specified in this permit.

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

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

9. Records Contents
Records of monitoring information must include:

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

10. Inspection and Entry
The permittee must allow the Department or EPA upon the presentation of credentials to:

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

11. Confidentiality of Information

Any information relating to this permit that is submitted to or obtained by DEQ is available to the public unless classified as confidential by the Director of DEQ under ORS 468.095. The Permittee may request that information be classified as confidential if it is a trade secret as defined by that statute. The name and address of the permittee, permit applications, permits, effluent data, and information required by NPDES application forms under 40 CFR 122.21 will not be classified as confidential. 40 CFR 122.7(b).

SECTION D. REPORTING REQUIREMENTS

1. Planned Changes

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

2. Anticipated Noncompliance

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

3. Transfers

This permit may be transferred to a new permittee provided the transferee acquires a property interest in the permitted activity and agrees in writing to fully comply with all the terms and conditions of the permit and the rules of the Commission. No permit may be transferred to a third party without prior written approval from the Department. The Department may require modification, revocation, and reissuance of the permit to change the name of the permittee and incorporate such other requirements as may be necessary under 40 CFR Section 122.61. The permittee must notify the Department when a transfer of property interest takes place.

4. Compliance Schedule

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

5. Twenty-Four Hour Reporting

The permittee must report any noncompliance that may endanger health or the environment. Any information must be provided orally (by telephone) 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.7

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

6. Other Noncompliance

The permittee must report all instances of noncompliance not reported under General Condition D.4 or D.5, at the time monitoring reports are submitted. The reports must contain:

a. A description of the noncompliance and its cause;

b. The period of noncompliance, including exact dates and times;

c. The estimated time noncompliance is expected to continue if it has not been corrected; and

d. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

7. Duty to Provide Information
The permittee must furnish to the Department within a reasonable time any information that the Department may request to determine compliance with the permit or to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit. The permittee must also furnish to the Department, upon request, copies of records required to be kept by this permit.

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

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

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

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

SECTION E. DEFINITIONS

1. *BOD* means five-day biochemical oxygen demand.
2. *CBOD* means five day carbonaceous biochemical oxygen demand
3. *TSS* means total suspended solids.
4. "*Bacteria*" includes but is not limited to fecal coliform bacteria, total coliform bacteria, and E. coli bacteria.
5. *FC* means fecal coliform bacteria.
6. *Total residual chlorine* means combined chlorine forms plus free residual chlorine
7. *Technology based permit effluent limitations* means technology-based treatment requirements as defined in 40 CFR Section 125.3, and concentration and mass load effluent limitations that are based on minimum design criteria specified in OAR Chapter 340, Division 41.
8. *mg/l* means milligrams per liter.
9. *kg* means kilograms.
10. m^3/d means cubic meters per day.

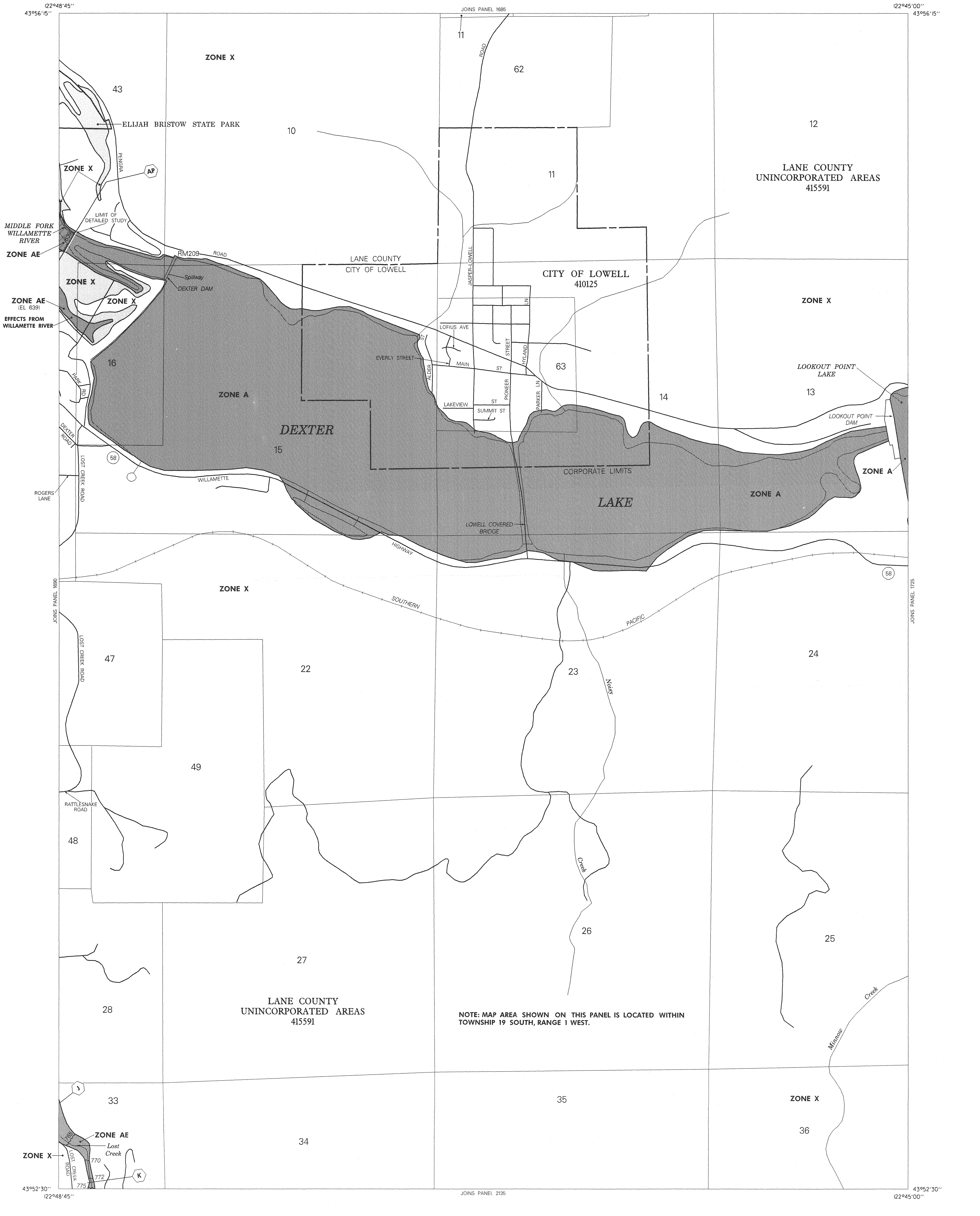
11. *MGD* means million gallons per day.
12. 24-hour *Composite sample* means a sample formed by collecting and mixing discrete samples taken periodically and based on time or flow. The sample must be collected and stored in accordance with 40 CFR part 136.
13. *Grab sample* means an individual discrete sample collected over a period of time not to exceed 15 minutes.
14. *Quarter* means January through March, April through June, July through September, or October through December.
15. *Month* means calendar month.
16. *Week* means a calendar week of Sunday through Saturday.
17. *POTW* means a publicly owned treatment works

APPENDIX B:

Flood Insurance Rate Map FEMA

ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION (FEET NGVD)	DESCRIPTION OF LOCATION
RM209	703.277	A brass cap stamped Elevation 703.277, located approximately 100 feet south of Pengra Road, in northwest abutment, at the north end of Dexter Dam. Set by U.S. Army Corps of Engineers (BM).



LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

ZONE A No base flood elevations determined.

ZONE AE Base flood elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE A99 To be protected from 100-year flood by Federal flood protection system under construction ; no base flood elevations determined.

ZONE V Coastal flood with velocity hazard (wave action); no base flood elevations determined.

ZONE VE Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

ZONE X Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

ZONE X Areas determined to be outside 500-year floodplain.

ZONE D Areas in which flood hazards are undetermined.

UNDEVELOPED COASTAL BARRIERS

Identified 1983 — Identified 1990 — Otherwise Protected Areas

Coastal barrier areas are normally located within or adjacent to Special Flood Hazard Areas.

Floodplain Boundary

Floodway Boundary

Zone D Boundary

Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.

513 — Base Flood Elevation Line; Elevation in Feet. See Map Index for Elevation Datum.

(D)—(D) — Cross Section Line

(EL 987) — Base Flood Elevation in Feet Where Uniform Within Zone. See Map Index for Elevation Datum.

RM7 × — Elevation Reference Mark

● M2 — River Mile

97°07'30", 32°22'30" — Horizontal Coordinates Based on North American Datum of 1927 (NAD 27) Projection.

NOTES

This map is for use in administering the National Flood Insurance Program; it does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all planimetric features outside Special Flood Hazard Areas. The community map repository should be consulted for more detailed data on BFE's, and for any information on floodway delineations, prior to use of this map for property purchase or construction purposes.

Areas of Special Flood Hazard (100-year flood) include Zones A, AE, A1–A30, AH, AO, A99, V, VE and V1–V30.

Certain areas not in Special Flood Hazard Areas may be protected by flood control structures.

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the Federal Emergency Management Agency.

Floodway widths in some areas may be too narrow to show to scale. Refer to Floodway Data Table where floodway width is shown at 1/20 inch.

Coastal base flood elevations apply only landward of 0.0 NGVD, and include the effects of wave action; these elevations may also differ significantly from those developed by the National Weather Service for hurricane evacuation planning.

Corporate limits shown are current as of the date of this map. The user should contact appropriate community officials to determine if corporate limits have changed subsequent to the issuance of this map.

This map may incorporate approximate boundaries of Coastal Barrier Resource System Units and /or Otherwise Protected Areas established under the Coastal Barrier Improvement Act of 1990 (PL 101-591).

For community map revision history prior to countywide mapping, see Section 6.0 of the Flood Insurance Study Report.

For adjoining map panels and base map source see separately printed Map Index.

MAP REPOSITORY

Refer to Repository Listing on Map Index

EFFECTIVE DATE OF

COUNTYWIDE FLOOD INSURANCE RATE MAP:

JUNE 2, 1999

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL:

Refer to the FLOOD INSURANCE RATE MAP EFFECTIVE DATE shown on this map to determine when actuarial rates apply to structures in zones where elevations or depths have been established.

To determine if flood insurance is available, contact an insurance agent or call the National Flood Insurance Program at (800) 638-6620.

APPROXIMATE SCALE IN FEET

1000 0 1000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

LANE COUNTY, OREGON AND INCORPORATED AREAS

PANEL 1695 OF 2975

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LOWELL, CITY OF	410125	1695	F
LANE COUNTY, UNINCORPORATED AREAS	415591	1695	F

MAP NUMBER 41039C1695 F

EFFECTIVE DATE: JUNE 2, 1999

Federal Emergency Management Agency

APPENDIX C:

Natural Resource Conservation Service Soil Report

United States Department of Agriculture

NRCS

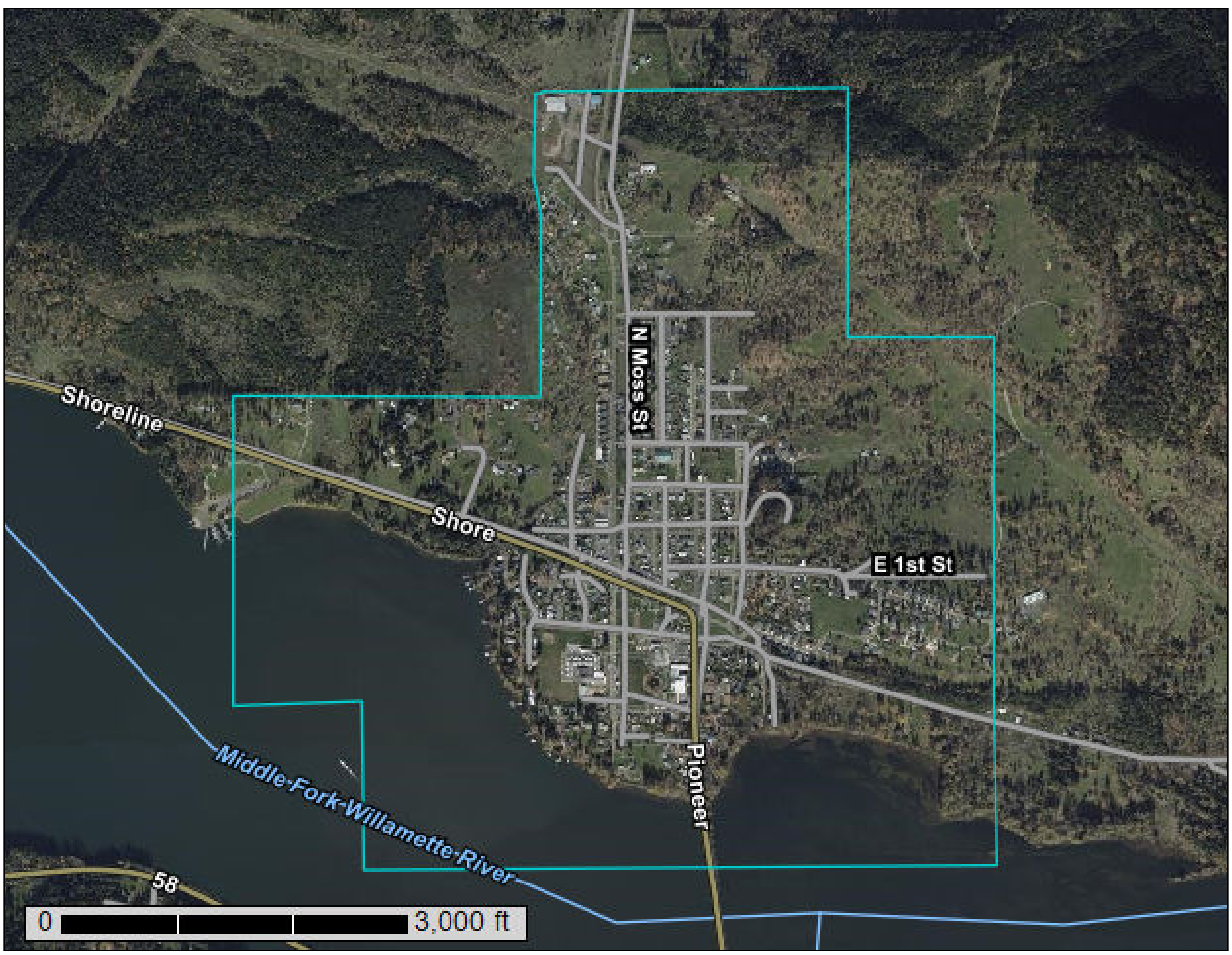
Natural Resources Conservation Service

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

Lane County Area, Oregon

UGB



September 28, 2023

Preface

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

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

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

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

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

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

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

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

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

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

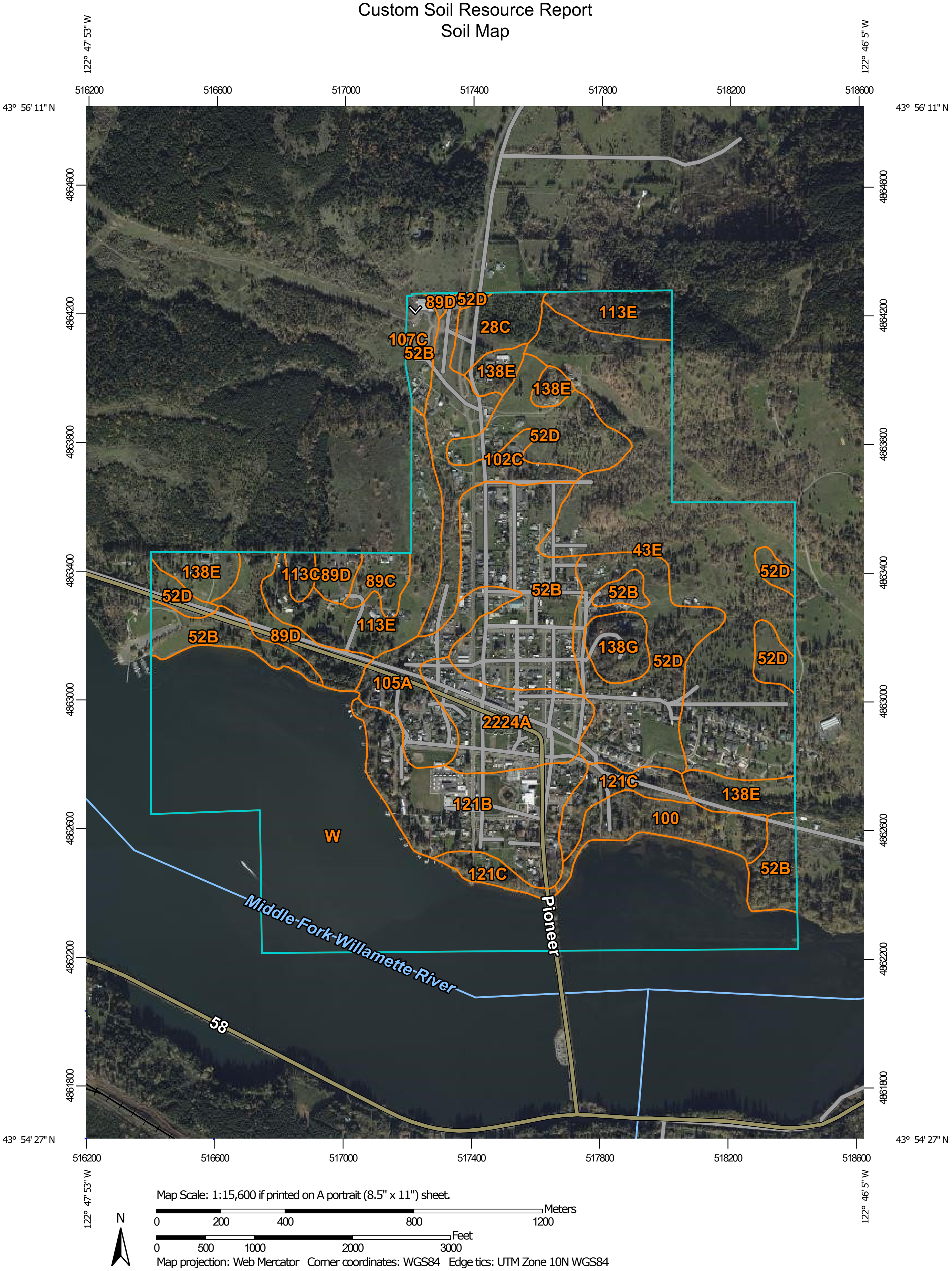
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map


122° 47' 53" W
122° 46' 5" W
516200
516600
517000
517400
517800
518200
518600
43° 56' 11" N
43° 54' 27" N
4864600
4864200
4863800
4863400
4863000
4862600
4862200
4861800
89D
52D
113E
28C
107C
52B
138E
138E
52D
102C
43E
52D
138E
113C
89D
89C
52D
52B
52B
113E
52B
89D
138G
52D
52D
105A
2224A
121C
138E
121B
100
W
52B
121C
Pioneer
Middle-Fork-Willamette-River
58
Map Scale: 1:15,600 if printed on A portrait (8.5" x 11") sheet.
Meters
0
200
400
800
1200
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 1:20,000.

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: Lane County Area, Oregon
Survey Area Data: Version 21, Mar 13, 2023

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

Date(s) aerial images were photographed: Oct 30, 2019—Nov 1, 2019

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
28C	Chehulpum silt loam, 3 to 12 percent slopes	11.7	1.5%
43E	Dixonville-Philomath-Hazelair complex, 12 to 35 percent slopes	119.5	15.7%
52B	Hazelair silty clay loam, 2 to 7 percent slopes	82.0	10.8%
52D	Hazelair silty clay loam, 7 to 20 percent slopes	76.9	10.1%
89C	Nekia silty clay loam, 2 to 12 percent slopes	6.6	0.9%
89D	Nekia silty clay loam, 12 to 20 percent slopes	19.7	2.6%
100	Oxley gravelly silt loam	18.5	2.4%
102C	Panther silty clay loam, 2 to 12 percent slopes	29.5	3.9%
105A	Pengra silt loam, 1 to 4 percent slopes	22.9	3.0%
107C	Philomath silty clay, 3 to 12 percent slopes	0.2	0.0%
113C	Ritner cobbly silty clay loam, 2 to 12 percent slopes	2.9	0.4%
113E	Ritner cobbly silty clay loam, 12 to 30 percent slopes	41.1	5.4%
121B	Salkum silty clay loam, 2 to 8 percent slopes	46.6	6.1%
121C	Salkum silty clay loam, 8 to 16 percent slopes	15.9	2.1%
138E	Witzel very cobbly loam, 3 to 30 percent slopes	24.0	3.2%
138G	Witzel very cobbly loam, 30 to 75 percent slopes	9.1	1.2%
2224A	Courtney gravelly silty clay loam, 0 to 3 percent slopes	28.8	3.8%
W	Water	204.2	26.9%
Totals for Area of Interest		**760.1**	**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.

Lane County Area, Oregon

28C—Chehulpum silt loam, 3 to 12 percent slopes

Map Unit Setting

National map unit symbol: 2363
Elevation: 400 to 1,200 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Chehulpum

Setting

Landform: Low hills
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Crest, nose slope, interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from sedimentary rock

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 13 inches: clay loam
H3 - 13 to 23 inches: weathered bedrock

Properties and qualities

Slope: 3 to 12 percent
Depth to restrictive feature: 10 to 20 inches to paralithic 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 supply, 0 to 60 inches: Very low (about 2.6 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: R002XC009OR - Bald Group
Forage suitability group: Well drained < 15% Slopes (G002XY002OR)
Other vegetative classification: Well drained < 15% Slopes (G002XY002OR)
Hydric soil rating: No

43E—Dixonville-Philomath-Hazelair complex, 12 to 35 percent slopes

Map Unit Setting

National map unit symbol: 236y
Elevation: 400 to 1,800 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Dixonville and similar soils: 35 percent
Philomath and similar soils: 30 percent
Hazelair and similar soils: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dixonville

Setting

Landform: Hills
Landform position (two-dimensional): Summit, shoulder, toeslope
Landform position (three-dimensional): Base slope, nose slope, interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium and residuum derived from basalt

Typical profile

H1 - 0 to 14 inches: silty clay loam
H2 - 14 to 26 inches: silty clay
H3 - 26 to 36 inches: weathered bedrock

Properties and qualities

Slope: 12 to 35 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Ecological site: R002XC011OR - Low Hill Group
Forage suitability group: Well Drained > 15% Slopes (G002XY001OR)
Other vegetative classification: Well Drained > 15% Slopes (G002XY001OR)
Hydric soil rating: No

Description of Philomath

Setting

Landform: Hills
Landform position (two-dimensional): Summit, shoulder, toeslope
Landform position (three-dimensional): Base slope, nose slope, interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium and residuum derived from basic igneous rock

Typical profile

H1 - 0 to 6 inches: cobbly silty clay
H2 - 6 to 14 inches: cobbly silty clay
H3 - 14 to 24 inches: weathered bedrock

Properties and qualities

Slope: 12 to 35 percent
Depth to restrictive feature: 12 to 20 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: R002XC009OR - Bald Group
Hydric soil rating: No

Description of Hazelair

Setting

Landform: Hills
Landform position (two-dimensional): Summit, shoulder, toeslope
Landform position (three-dimensional): Base slope, nose slope, interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from sedimentary rock

Typical profile

H1 - 0 to 11 inches: silty clay loam
H2 - 11 to 15 inches: silty clay
H3 - 15 to 36 inches: clay
H4 - 36 to 46 inches: weathered bedrock

Properties and qualities

Slope: 12 to 35 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: None

Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.8 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Ecological site: R002XC010OR - Claypan Low Hill Group
Hydric soil rating: No

52B—Hazelair silty clay loam, 2 to 7 percent slopes

Map Unit Setting
National map unit symbol: 237b
Elevation: 200 to 2,000 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Hazelair and similar soils: 85 percent
Minor components: 4 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hazelair

Setting
Landform: Mountains, mountains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Mountainbase
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Parent material: Colluvium derived from sedimentary rock

Typical profile
H1 - 0 to 11 inches: silty clay loam
H2 - 11 to 15 inches: silty clay
H3 - 15 to 36 inches: clay
H4 - 36 to 46 inches: weathered bedrock

Properties and qualities
Slope: 2 to 7 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: None
Frequency of ponding: None

Available water supply, 0 to 60 inches: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D
Ecological site: R002XC010OR - Claypan Low Hill Group
Forage suitability group: Moderately Well Drained < 15% Slopes (G002XY004OR)
Other vegetative classification: Moderately Well Drained < 15% Slopes (G002XY004OR)
Hydric soil rating: No

Minor Components

Panther

Percent of map unit: 4 percent
Landform: Swales
Hydric soil rating: Yes

52D—Hazelair silty clay loam, 7 to 20 percent slopes

Map Unit Setting

National map unit symbol: 237c
Elevation: 200 to 2,000 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Hazelair and similar soils: 85 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hazelair

Setting

Landform: Mountains, mountains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Mountainbase
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from sedimentary rock

Typical profile

H1 - 0 to 11 inches: silty clay loam
H2 - 11 to 15 inches: silty clay
H3 - 15 to 36 inches: clay
H4 - 36 to 46 inches: weathered bedrock

Properties and qualities

Slope: 7 to 20 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Ecological site: R002XC010OR - Claypan Low Hill Group
Forage suitability group: Moderately Well Drained < 15% Slopes (G002XY004OR)
Other vegetative classification: Moderately Well Drained < 15% Slopes (G002XY004OR)
Hydric soil rating: No

Minor Components

Panther

Percent of map unit: 3 percent
Landform: Swales
Hydric soil rating: Yes

89C—Nekia silty clay loam, 2 to 12 percent slopes

Map Unit Setting

National map unit symbol: 239g
Elevation: 350 to 1,400 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Nekia

Setting

Landform: Hills
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve, nose slope
Down-slope shape: Linear
Across-slope shape: Linear

Parent material: Colluvium and residuum derived from basalt and tuff

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
H1 - 1 to 11 inches: silty clay loam
H2 - 11 to 36 inches: clay
H3 - 36 to 40 inches: unweathered bedrock

Properties and qualities

Slope: 2 to 12 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 (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: R002XC012OR - Red Hill Group
Forage suitability group: Well drained < 15% Slopes (G002XY002OR)
Other vegetative classification: Well drained < 15% Slopes (G002XY002OR)
Hydric soil rating: No

89D—Nekia silty clay loam, 12 to 20 percent slopes

Map Unit Setting

National map unit symbol: 239h
Elevation: 350 to 1,400 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Nekia

Setting

Landform: Hills
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve, nose slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium and residuum derived from basalt and tuff

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
H1 - 1 to 11 inches: silty clay loam
H2 - 11 to 36 inches: clay
H3 - 36 to 40 inches: unweathered bedrock

Properties and qualities

Slope: 12 to 20 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 (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: R002XC012OR - Red Hill Group
Forage suitability group: Well Drained > 15% Slopes (G002XY001OR)
Other vegetative classification: Well Drained > 15% Slopes (G002XY001OR)
Hydric soil rating: No

100—Oxley gravelly silt loam

Map Unit Setting

National map unit symbol: 2338
Elevation: 170 to 800 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Oxley and similar soils: 85 percent
Minor components: 4 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Oxley

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Mixed gravelly alluvium

Typical profile

H1 - 0 to 17 inches: gravelly silt loam

H2 - 17 to 23 inches: gravelly clay loam
H3 - 23 to 41 inches: very gravelly clay loam
H4 - 41 to 60 inches: extremely gravelly sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.6 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Ecological site: R002XC005OR - High Flood Plain Group
Forage suitability group: Somewhat Poorly Drained (G002XY005OR)
Other vegetative classification: Somewhat Poorly Drained (G002XY005OR)
Hydric soil rating: No

Minor Components

Courtney

Percent of map unit: 4 percent
Landform: Depressions
Hydric soil rating: Yes

102C—Panther silty clay loam, 2 to 12 percent slopes

Map Unit Setting

National map unit symbol: 233b
Elevation: 90 to 1,200 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Not prime farmland

Map Unit Composition

Panther and similar soils: 80 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Panther

Setting

Landform: Swales on hills, benches on hills
Landform position (two-dimensional): Footslope

Landform position (three-dimensional): Base slope
Down-slope shape: Concave, linear
Across-slope shape: Linear
Parent material: Colluvium and residuum derived from basic igneous and sedimentary rock

Typical profile

H1 - 0 to 10 inches: silty clay loam
H2 - 10 to 42 inches: clay
H3 - 42 to 52 inches: weathered bedrock

Properties and qualities

Slope: 2 to 12 percent
Depth to restrictive feature: 40 to 60 inches to paralithic bedrock
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: D
Ecological site: R002XC010OR - Claypan Low Hill Group
Forage suitability group: Poorly Drained (G002XY006OR)
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Minor Components

Bashaw

Percent of map unit: 5 percent
Landform: Terraces
Hydric soil rating: Yes

105A—Pengra silt loam, 1 to 4 percent slopes

Map Unit Setting

National map unit symbol: 233g
Elevation: 170 to 2,000 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 235 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Pengra and similar soils: 85 percent
Minor components: 9 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pengra

Setting

Landform: Fans, hills
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Stratified alluvium

Typical profile

H1 - 0 to 6 inches: silt loam
H2 - 6 to 21 inches: silty clay loam
H3 - 21 to 60 inches: clay

Properties and qualities

Slope: 1 to 4 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 0 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 8.5 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: D
Ecological site: R002XC010OR - Claypan Low Hill Group
Forage suitability group: Poorly Drained (G002XY006OR)
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Minor Components

Panther

Percent of map unit: 3 percent
Landform: Swales
Hydric soil rating: Yes

Natroy

Percent of map unit: 3 percent
Landform: Terraces
Hydric soil rating: Yes

Courtney

Percent of map unit: 3 percent
Landform: Depressions
Hydric soil rating: Yes

107C—Philomath silty clay, 3 to 12 percent slopes

Map Unit Setting

National map unit symbol: 233j
Elevation: 350 to 1,400 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Philomath

Setting

Landform: Hills
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Crest, nose slope, interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium and residuum derived from basic igneous rock

Typical profile

H1 - 0 to 6 inches: silty clay
H2 - 6 to 14 inches: cobbly silty clay
H3 - 14 to 24 inches: weathered bedrock

Properties and qualities

Slope: 3 to 12 percent
Depth to restrictive feature: 12 to 20 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.4 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: R002XC009OR - Bald Group
Forage suitability group: Well drained < 15% Slopes (G002XY002OR)
Other vegetative classification: Well drained < 15% Slopes (G002XY002OR)
Hydric soil rating: No

113C—Ritner cobbly silty clay loam, 2 to 12 percent slopes

Map Unit Setting

National map unit symbol: 233s
Elevation: 400 to 1,800 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Ritner

Setting

Landform: Hills
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Nose slope, interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Cobbly colluvium derived from basic igneous rock

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
H1 - 1 to 8 inches: cobbly silty clay loam
H2 - 8 to 33 inches: very cobbly silty clay loam
H3 - 33 to 37 inches: unweathered bedrock

Properties and qualities

Slope: 2 to 12 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 (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: C
Ecological site: F002XC013OR - Foothill Group
Forage suitability group: Well drained < 15% Slopes (G002XY002OR)
Other vegetative classification: Well drained < 15% Slopes (G002XY002OR)
Hydric soil rating: No

113E—Ritner cobbly silty clay loam, 12 to 30 percent slopes

Map Unit Setting

National map unit symbol: 233t
Elevation: 400 to 1,800 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Ritner

Setting

Landform: Hills
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Nose slope, interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Cobbly colluvium derived from basic igneous rock

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
H1 - 1 to 8 inches: cobbly silty clay loam
H2 - 8 to 33 inches: very cobbly silty clay loam
H3 - 33 to 37 inches: unweathered bedrock

Properties and qualities

Slope: 12 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): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C
Ecological site: F002XC013OR - Foothill Group
Forage suitability group: Well Drained > 15% Slopes (G002XY001OR)
Other vegetative classification: Well Drained > 15% Slopes (G002XY001OR)
Hydric soil rating: No

121B—Salkum silty clay loam, 2 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2347
Elevation: 500 to 1,000 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Salkum and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Salkum

Setting

Landform: Terraces
Landform position (three-dimensional): Tread, riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium derived from glacial outwash material

Typical profile

H1 - 0 to 13 inches: silty clay loam
H2 - 13 to 49 inches: clay
H3 - 49 to 60 inches: silty clay loam

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Ecological site: R002XC011OR - Low Hill Group
Forage suitability group: Well drained < 15% Slopes (G002XY002OR)
Other vegetative classification: Well drained < 15% Slopes (G002XY002OR)
Hydric soil rating: No

121C—Salkum silty clay loam, 8 to 16 percent slopes

Map Unit Setting

National map unit symbol: 2348
Elevation: 500 to 1,000 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Salkum

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium derived from glacial outwash material

Typical profile

H1 - 0 to 13 inches: silty clay loam
H2 - 13 to 49 inches: clay
H3 - 49 to 60 inches: silty clay loam

Properties and qualities

Slope: 8 to 16 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: R002XC011OR - Low Hill Group
Forage suitability group: Well drained < 15% Slopes (G002XY002OR)
Other vegetative classification: Well drained < 15% Slopes (G002XY002OR)
Hydric soil rating: No

138E—Witzel very cobbly loam, 3 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2354
Elevation: 300 to 1,500 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Witzel

Setting

Landform: Hills
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Nose slope, interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium and residuum derived from basic igneous rock

Typical profile

H1 - 0 to 4 inches: very cobbly loam
H2 - 4 to 17 inches: very cobbly clay loam
H3 - 17 to 21 inches: unweathered bedrock

Properties and qualities

Slope: 3 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 (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 1.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: R002XC009OR - Bald Group
Forage suitability group: Well Drained > 15% Slopes (G002XY001OR)
Other vegetative classification: Well Drained > 15% Slopes (G002XY001OR)
Hydric soil rating: No

138G—Witzel very cobbly loam, 30 to 75 percent slopes

Map Unit Setting

National map unit symbol: 2355
Elevation: 300 to 1,500 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Witzel

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope, nose slope
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Parent material: Colluvium derived from basic igneous rock

Typical profile

H1 - 0 to 4 inches: very cobbly loam
H2 - 4 to 17 inches: very cobbly clay loam
H3 - 17 to 21 inches: unweathered bedrock

Properties and qualities

Slope: 30 to 75 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 (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 1.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: R002XC009OR - Bald Group
Hydric soil rating: No

2224A—Courtney gravelly silty clay loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2xpsh
Elevation: 160 to 800 feet
Mean annual precipitation: 39 to 59 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Courtney and similar soils: 85 percent
Minor components: 12 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Courtney

Setting

Landform: Drainageways on stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear
Across-slope shape: Concave
Parent material: Alluvium

Typical profile

A1 - 0 to 8 inches: gravelly silty clay loam
A2 - 8 to 17 inches: gravelly silty clay loam
2Btg1 - 17 to 24 inches: gravelly clay
2Btg2 - 24 to 33 inches: gravelly clay
3Cg - 33 to 48 inches: very gravelly clay loam
4C - 48 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 10 to 19 inches to abrupt textural change
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.01 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water supply, 0 to 60 inches: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: D
Ecological site: R002XC005OR - High Flood Plain Group
Forage suitability group: Poorly Drained (G002XY006OR)
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Minor Components

Awbrig

Percent of map unit: 6 percent
Landform: Drainageways on stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Bashaw

Percent of map unit: 4 percent
Landform: Depressions on stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Conser

Percent of map unit: 2 percent
Landform: Depressions on stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

W—Water

Map Unit Composition

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

Description of Water

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: Unranked

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APPENDIX D:

Inflow and Infiltration Analyses

Civil West
Engineering Services, Inc.

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Coos Bay, OR 97420

Willamette Valley Office
200 Ferry Street SW
Albany, OR 97321

Rogue Valley Office
830 O'Hare Parkway, Suite 102
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North Coast Office
609 SW Hurbert Street
Newport, OR 97365

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▪ TECHNICAL MEMORANDUM ▪

TO	Max Baker Public Works Director City of Lowell	**DATE**	09/11/2023	**JOB #**	2101-015
		RE	City of Lowell Wastewater Facilities Plan Inflow and Infiltration Study		

SUMMARY

The City of Lowell's sanitary sewer collection system was evaluated for sources of inflow and infiltration (I/I) via smoke testing and flow mapping. Twenty-six locations were identified as likely sources of stormwater inflow and eight sections of the collection system were identified as likely sources of groundwater infiltration. This effort resulted in multiple recommendations to rehabilitate the collection system and suggests further study of specific areas.

It is recommended that the City prioritize addressing two instances of the storm drainage system being directly connected to the collection system. Specifically, a curb inlet on the corner of Moss Street and Lakeview Street, and a culvert on 2nd street between Moss Street and Cannon Avenue. Other recommendations include the rehabilitation of nine manholes, varying from grout patching to replacement, and CCTV surveillance of approximately 6,300 linear feet of pipe in the collection system. The City should also notify fourteen property owners to replace/repair cleanout caps on their properties and repair three potentially broken service laterals.

INTRODUCTION

The City of Lowell, based on local precipitation data and wastewater treatment plant discharge monitoring reports, has a unit sewage flow of approximately 500 gallons per capita per day (gpcd) during periods of significant rainfall. When compared to the City's average dry weather flow of approximately 70 gpcd and the US Environmental Protection Agency (EPA) benchmark of 275 gpcd for typical wet-weather flowrates, it is apparent that the City's sanitary sewer collection system experiences significant levels of inflow and infiltration (I/I). The EPA defines I/I as followed:

Inflow- "Water other than sanitary wastewater that enters a sewer system from sources such as roof leaders, cellar/foundation drains, yard drains, area drains, drains from springs and swampy areas, manhole covers, cross connections between storm sewers and sanitary sewers, and catch basins."

Infiltration- "Water other than sanitary wastewater that enters a sewer system from the ground through defective pipes, pipe joints, connections, or manholes."

Source: U.S. Environmental Protection Agency, Guide for Estimating Infiltration and Inflow, June 2014

Minimizing the sources and volume of I/I is critical to ensuring that the sanitary sewage collection system has sufficient capacity to convey waste to the treatment plant, that the treatment plant can maintain adequate treatment during high flow events, and that costs for waste treatment are minimized. In addition to identifying sources of I/I, this study recommends repairs that can be made to decrease water contributions from those sources and locations where further investigation is needed prior to undertaking repair work.

METHODS

Flow Mapping

Flow mapping involves flow rate measurements throughout the collection system to identify sections of pipe where infiltration may be occurring. Flow mapping is accomplished using a flow meter (commonly called a “Flow Poke”) that can be quickly and easily inserted through a manhole into a pipeline as shown in Figure 1. The meter allows for an instantaneous flow measurement in gallons per minute through a sewer pipe. Another flow reading can then be made at an upstream manhole that allows for a comparison between the two manholes. If it is found that there is more flow in the downstream manhole than the upstream manhole, then an infiltration problem may exist between the two manholes.

Figure 1: Flow mapping using a flow meter.

Flow mapping is performed during the midnight hours when domestic flows are significantly reduced and most of the flow in the collection system is infiltration. Additionally, flow mapping occurs after a sustained period of rainfall has saturated the subsurface. The goal is to measure consistent flows generated from underground leaks while avoiding measurement of flows from residential uses.

The flow information is plotted on a map of the system to show the location and amounts of flows in the system at the time the measurements were made. This allows the engineer to review the entire system and determine where additional investigation is warranted.

A two-person team conducted the assessment. The team used the following general procedure:

1. The team would remove the lid from a strategically selected manhole. A visual inspection of the manhole was made, noting any deficiencies.
2. At manholes where flow was visible, an appropriately sized metering insert was selected for the ISCO™ Flow Poke flow measuring device. Due to relatively low flow rates, a v-notch weir plate was attached to the metering insert.
3. The assembled flow meter was inserted into the manhole and the manometer was zeroed.
4. The flow meter was inserted into the inflow pipe to the manhole and the rubber collar was inflated to create a seal.
5. The flow was allowed to stabilize prior to taking a measurement.
6. This process was repeated for each inflow line in a manhole prior to removing the flow meter and replacing the manhole lid.

After completing measurements at a given manhole, the process was repeated at manholes upstream and downstream of the first manhole. Dramatic differences in flow measurements are indicative of the presence of an infiltration source.

Smoke Testing

Smoke testing is used to locate, identify, and classify potential inflow sources to the sanitary sewer system. Smoke testing involves pumping large volumes of white smoke into the collection system through an open manhole. This is accomplished using a blower that sits directly over an open manhole. The blower consists of a custom mounting plate, large fan blades, and is powered by a small internal combustion engine. Smoke is generated using smoke candles. The smoke travels inside the piping under the positive pressure created by the blower. The smoke-filled air then seeks locations to escape. This may include escape points that are normal and acceptable, such as roof vent pipes (plumbing stacks) and manhole lid holes.

Figure 2: Smoke testing the sanitary sewer system to identify inflow sources.

Other points where smoke escapes may be indicative of deficiencies in the system. These may include:

- Leaks in the piping and fissures leading to the ground surface
- Open cleanouts
- Cross-connections to the storm drainage system
- Downspouts on buildings

Smoke testing aims to locate the escape points or "smoke return" locations. Smoke return locations often indicate where inflow from rainfall can enter the system and occasionally reveal infiltration sources.

Flyers were hung on the doors of homes and businesses to notify residents in advance of the test. These flyers informed residents that the smoke would pose no danger to them and provided a phone number for reporting concerns or problems. A four-person team completed the survey. Each team member was outfitted with a camera and clipboard with blank smoke testing result forms. The team utilized the following general pattern during smoke testing.

1. The team removed the manhole lid and placed the smoke blower on a specific and strategically selected manhole. The smoke candle was lit, and the blower was started.
2. Each member of the survey team began walking away from the manhole in a pre-determined direction following the piping runs shown on the sewer system map.
3. Each surveyor watched for smoke escaping from anticipated locations such as roof vents and other manholes.
4. Each surveyor also watched for smoke escaping from anywhere that would not be expected for the sanitary sewer. If there was unexpected smoke found, the surveyor would take a photograph of the smoke return, prepare a smoke testing result form, and continue recording any other problems until the smoke candle burned out.
5. If a surveyor was unsure of a smoke return or found other concerns, an additional smoke candle might be lit to spend more time evaluating the location.
6. The team would confer together and mark notes on field maps including deficiencies identified and other manholes where smoke should be injected.

Upon completion of the field work, the team members prepared a digital smoke testing report of each identified deficiency. The reports are based upon data from the smoke testing results form and photos of the incident.

RESULTS

Potential Infiltration Sources

A summary of flow measurements and pipes that had noticeable increases of flows is presented in Figure 3. Eight sections of the sewer collection system were observed to have increases in flow likely due to infiltration. While flow testing can indicate where in the collection system infiltration is occurring, it may not be cost effective to replace or line an entire stretch of pipe without knowing the root cause. Further evaluation via CCTV surveillance should be performed on the pipes highlighted yellow in Figure 3. Based on total flow volume due to infiltration, the pipe segments to CCTV should be prioritized in the following order:

1. Alder Street, South of the Lift Station to Main Street
2. 1st Street, West of Cannon Avenue to N Hyland Drive
3. East of Moss Street, from 3rd Street to North of 4th Street to first manhole on D Street.
4. Between 3rd and 4th Streets, West of Pioneer Street to N Hyland Drive
5. South of Main Street, from Moss Street to the first manhole by the School
6. 6th Street to second manhole on 7th Street.
7. North end of Alder Street to 2nd Street, and 2nd Street to Damon Street
8. North end of Cannon Street to Pioneer Street (pipe south of North Shore Drive)

It would also be reasonable to prioritize the pipes within the sewershed of the Alder Street lift station (numbers 1 and 7 as listed above) since that station is historically prone to storm-related overflows. Based on the results of CCTV surveillance, a plan can then be made to replace/line segments of the collection system.

During flow testing, multiple manholes were observed to have issues with infiltration. These issues ranged from leaks in grout between manhole rings, cracks in the rings, and full leakage at the manhole base. The locations of these manholes are provided in Figure 4 and associated photos are provided in the section titled "Manhole Rehabilitation Exhibits." Cost estimates to repair these issues are provided in the next section.

Potential Inflow Sources

A summary of likely inflow sources identified via smoke testing are presented in Table 1. Smoke was observed in twenty-six locations indicative of an entry point for stormwater into the sewer collection system. Thirteen of these were identified as broken or missing cleanout caps. Property owners should be notified to repair these cleanouts; the addresses associated with these are italicized in Table 1.

Two of the most significant inflow-related issues were apparent cross-connections between the stormwater drainage system and the sanitary sewer collection system. Smoke was observed emanating from a drainage culvert on 2nd street between Moss Street and Cannon Avenue, on the north side of 2nd street across from East Valley Church as seen in Figure 5. Another case was smoke visible from a curb inlet on the corner of Moss Street and Lakeview Street (Figure 6). The stormwater drain lines in this area should be inspected to identify where the cross connection is and a plan to fix should be developed once more information is available.

There also is an area drain in the Lane County owned parking lot at 570 N Moss Street that is directly connected to the sewer collection system. However, this seems to be a drain for wash and vehicle maintenance for the county. Generally, car wash drains are appropriate to connect to the wastewater system as the wash water contains pollutants. It could be reasonable to require a valve or equivalent on this connection, so that it can be isolated when not in use. This would help prevent all of the area's drainage from entering the wastewater system during the wet season.

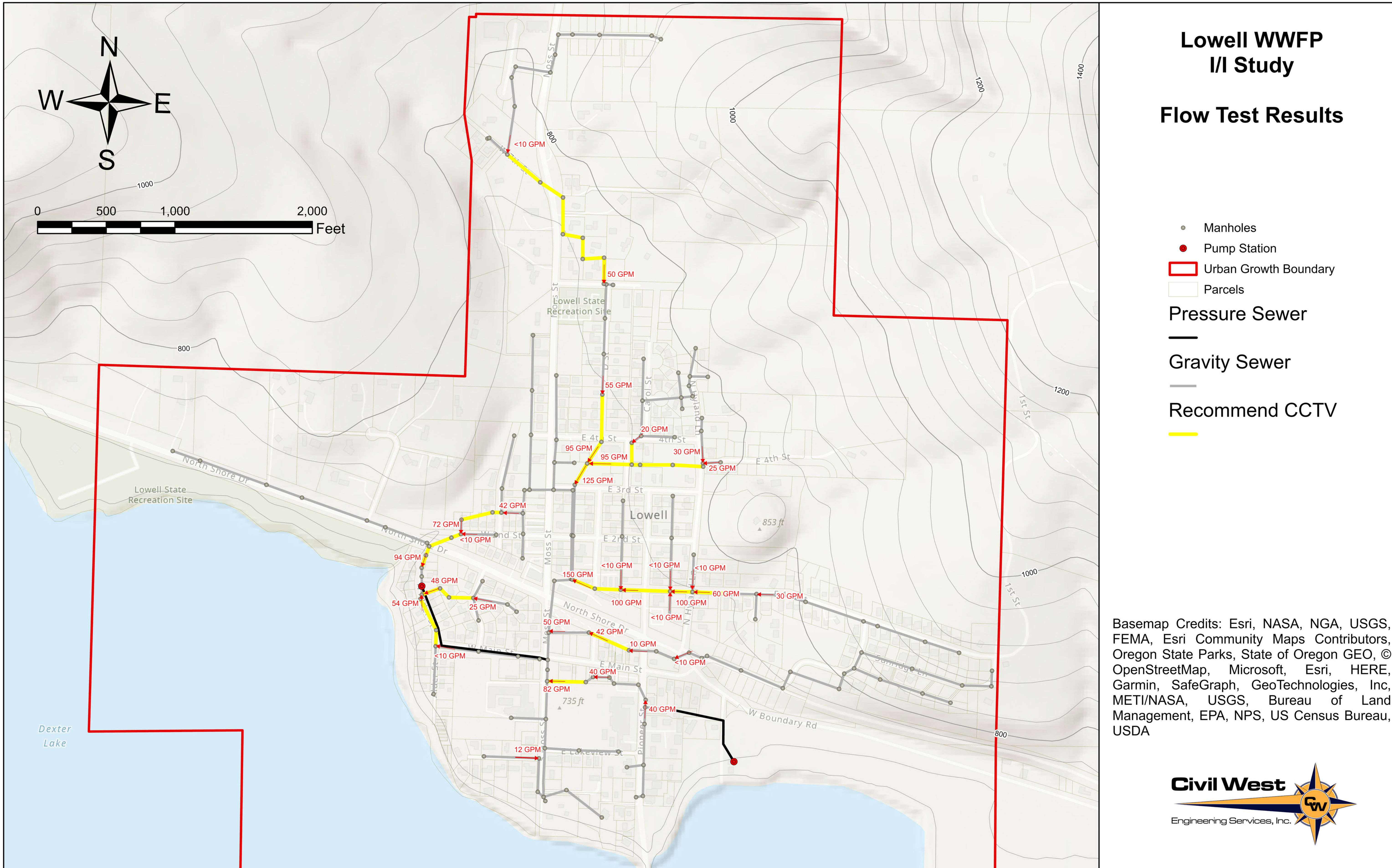

Figure 3: Flow Test Results and CCTV Recommendations

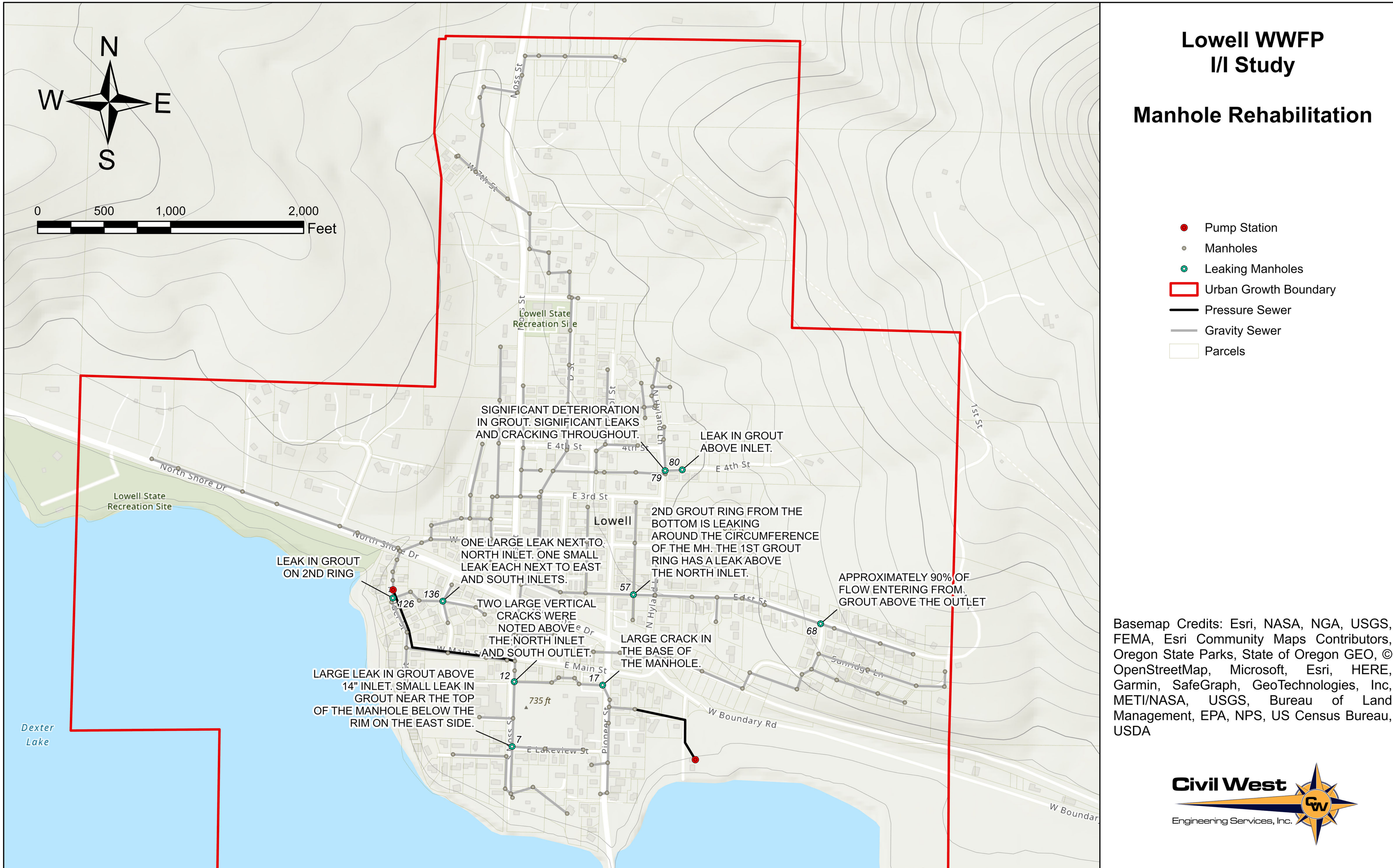

Figure 4: Manhole Rehabilitation Recommendations

Figure 5: Likely Stormwater System Cross Connection; Across from East Valley Church

Figure 6: Curb Inlet Cross Connected to Sewer System; Corner of Moss and Lakeview

Table 1: Smoke Testing Result Summary Table.

Cross connection related issues in bold, private cleanout related issues in italics

Number	Location	Description	Potential Cause
1	*201 S Moss Street*	*Smoke visible from apparent cleanout about 8' above deck.*	*Broken or missing cleanout cap.*
2	*101 E Summit Street*	*Smoke visible from cleanout in front yard.*	*Broken or missing cleanout cap.*
3	*4 Lakeview Street*	*Smoke visible from cleanout in side yard.*	*Broken or missing cleanout cap.*
4	**103 S Moss Street**	**Smoke visible from curb inlet.**	**Possible cross connection.**
5	*13 S Moss Street*	*Smoke visible from cleanout near debris pile.*	*Broken or missing cleanout cap.*
6	*208 E Main Street*	*Visible smoke from sewer main cleanout.*	*Broken or missing cleanout cap.*
7	Rolling Rock Park	Smoke observed rising from cracks in ground.	Cracked or otherwise damaged pipe.
8	*205 W Main Street A*	*Smoke coming from uncapped cleanout on the back side of the structure.*	*Broken or missing cleanout cap.*
9	205 W Main Street B	Smoke coming out of the ground.	Based on location - Old lateral open to the atmosphere.
10	10 Wetleau Drive	Smoke visible in front yard between street and private cleanout.	Possible cracked lateral.
11	*49 Wetleau Drive*	*Smoke visible from cleanout in front yard.*	*Broken or missing cleanout cap.*
12	*70 N Pioneer Street*	*Smoke visible from cleanout between structures.*	*Broken or missing cleanout cap.*
13	72 E 2nd Street	Smoke visible from roof of church.	Source unknown, possible related to bathroom vent installation/location.
14	**75 E 2nd Street**	**Smoke visible from culvert on north side of street.**	**Possible cross connection.**
15	62 E 3rd Street	Smoke discharging from ground.	Break at lateral connection to stub out.
16	107 E 3rd Street	Smoke visible from manhole rim and surrounding sidewalk joints.	Broken rim and/or leaking joints.
17	212 4th Street	Smoke visible in empty lot east of 212 4th St.	Unknown. No noted manhole at location of smoke.
18	23 4th Street	Smoke visible from backyard behind fence.	Cause unknown due to inability to see source.
19	37 W 4th Street	Smoke visible from manhole.	Broken ring or exposed and leaking joints.
20	501 N Moss Street	Visible smoke rising from joint between sidewalk and structure.	Possible cracked or otherwise damaged pipe.
21	*540 Carol Street*	*Smoke visible from cleanout.*	*Broken or missing cleanout cap.*
22	**570 N Moss Street**	**Visible smoke rising from area drain.**	**Possible cross connection.**
23	*41 E 6th Street*	*Smoke visible from cleanout.*	*Broken or missing cleanout cap.*
24	*101 7th Street*	*Smoke visible from cleanout.*	*Broken or missing cleanout cap.*
25	*1181 Industrial Way*	*Smoke visible from elevated cleanout near small structure and at ground level on north side of driveway.*	*Missing or broken cleanout cap.* *Possible damaged cleanout or service line (north of road).*
26	*1160 Industrial Way*	*Smoke visible from cleanout.*	*Broken or missing cleanout cap.*

RECOMMENDATIONS AND COST ESTIMATES

This section provides some cost estimates for the City's planning purposes to budget and prioritize I/I reduction projects.

Manhole Rehabilitation Recommendations and Estimates

The following table presents the manholes in need of rehabilitation by order of priority. This priority is based on severity, primarily a judgement call based on the field observations. Generally, full replacement of the manhole is recommended where significant leaks were observed at the base of the manhole or around the connected pipes. In these instances, patching or adding a layer of grout is unlikely to fix the issue long-term. In other cases, patching or regrouting to rehabilitate small leaks is the recommended fix.

Table 2: Manhole Rehabilitation Cost Estimates

Manhole Number	Type of Repair	Cost Estimate
68	Full Replacement	$15,000
79	Full Replacement	$15,000
17	Full Replacement	$15,000
7	Regrout Ring	$1,500
136	Patch Holes/Regrout Ring	$2,000
126	Regrout Ring	$1,500
57	Patch Holes/Regrout Ring	$2,000
12	Patch Cracks	$1,000
80	Regrout Ring	$1,500
	Total Cost Estimate	**$54,500**

CCTV Survey Recommendations and Estimates

Before developing a plan to rehabilitate the identified cross connections, it will be necessary to investigate the exact nature of each issue. The most straightforward way to do this is via CCTV surveillance, as that will allow the City to identify the location where the cross connection occurs. It will be more cost effective to CCTV the storm drains than the sewer lines in this case. An estimate of the length of storm drain to CCTV and the associated cost is provided in the table below.

For the segments of the collection system that were identified by flow mapping to have infiltration issues, CCTV cost estimates are provided in Table 4. In these cases, CCTV surveillance is necessary to determine if the infiltration is caused by root intrusion, improperly installed laterals, pipe breaks, or other causes. This will help develop the most cost-effective rehabilitation strategy.

Table 3: Cross Connection Investigation Cost Estimate

Location of Cross Connection	Length to CCTV	Cost Estimate
2nd St between Moss St and Cannon Ave	200 feet	$400
Corner of Moss St and Lakeview Ave	500 feet	$1,000
	Total Cost Estimate	**$1,400**

Table 4: CCTV of Sewer Lines Cost Estimates

Location to CCTV	Length (ft)	Cost Estimate
Alder Street, South of the Lift Station to Main Street	790	$1,580
1st Street, West of Cannon Avenue to N Hyland Drive	1165	$2,330
East of Moss Street, from 3rd Street to North of 4th Street to first manhole on D Street.	720	$1,440
Between 3rd and 4th Streets, West of Pioneer Street to N Hyland Drive	1010	$2,020
South of Main Street, from Moss Street to the first manhole by the School	280	$560
6th Street to second manhole on 7th Street.	1290	$2,580
North end of Alder Street to 2nd Street, and 2nd Street to Damon Street	710	$1,420
North end of Cannon Street to Pioneer Street (pipe south of North Shore Drive)	320	$640
	Total Cost Estimate	**$12,570**

MANHOLE REHABILITATION EXHIBITS

The following pictures were taken by technicians in the field during flow mapping. Only seven of the nine manholes identified to have infiltration issues had images that clearly show the issue in need of rehabilitation.

Manhole #12: Cracks above north and south pipes

Manhole #17: Crack in base of manhole

Manhole #57: Leak in grout between 1st and 2nd rings from bottom

Manhole #68: Leak around circumference of outlet pipe

Manhole #79: Significant leaks in grout throughout entire manhole

Manhole #80: Leak above inlet

Manhole #136: Leaks above each inlet

SMOKE TEST REPORTS

The following pages provide the field observations of the crew that performed the smoke testing study. Each report includes a map showing the location of the issue, an associated photo, and field notes.

609 SW Hurbert St. • Newport, OR 97365 • 541/264-7040 • Fax 541/264-7041
486 E Street • Coos Bay, OR 97420 • 541/266-8601 • Fax 541/266-8681
10558 Hwy 62 Suite B-1 • Eagle Point, OR 97524 • 541/326-4828
200 SW Ferry St • Albany, OR 97322 • 541/266-8601

Civil West Engineering Services, Inc.

Inflow and Infiltration Study - Smoke Testing Report

Client: CITY OF LOWELL, OREGON **Date:** 9/15/21 **Time:** 11:21 ☑ a.m. ☐ p.m.

Street Address/Location: 201 S MOSS ST **Smoke from Manhole No.**

Observer: BRAD JONES **Location of Manhole:** S MOSS ST & E SUMMIT ST

Sketch of Area

(Location of MH, Street, any structures, areas smoke was observed, etc.)

X

Observed Smoke Indicator:

SMOKE VISIBLE FROM APPARENT CLEANOUT ABOUT 8' ABOVE DECK.

Probable Cause:

BROKEN OR MISSING CLEANOUT CAP.

Recommendations:

NOTIFY HOMEOWNER TO REPAIR OR REPLACE CLEANOUT CAP.

Inflow and Infiltration Study - Smoke Testing Report Form

Note:

Note:

609 SW Hurbert St. • Newport, OR 97365 • 541/264-7040 • Fax 541/264-7041
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200 SW Ferry St • Albany, OR 97322 • 541/266-8601

Civil West Engineering Services, Inc.

Inflow and Infiltration Study - Smoke Testing Report

Client: CITY OF LOWELL, OREGON **Date:** 9/15/21 **Time:** 11:26 ☑ a.m. ☐ p.m.

Street Address/Location: 101 E SUMMIT ST **Smoke from Manhole No.**

Observer: BRAD JONES **Location of Manhole:** E SUMMIT ST & S MOSS ST

Sketch of Area

(Location of MH, Street, any structures, areas smoke was observed, etc.)

X

Observed Smoke Indicator:

SMOKE VISIBLE FROM CLEANOUT IN FRONT YARD.

Probable Cause:

MISSING OR BROKEN CLEANOUT CAP.

Recommendations:

NOTIFY HOMEOWNER TO REPAIR OR REPLACE CAP.

Inflow and Infiltration Study - Smoke Testing Report Form

Note:

Note:

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Civil West Engineering Services, Inc.

Inflow and Infiltration Study - Smoke Testing Report

Client: CITY OF LOWELL, OREGON **Date:** 9/15/21 **Time:** 10:41 ☑ a.m. ☐ p.m.

Street Address/Location: 4 LAKEVIEW ST **Smoke from Manhole No.**

Observer: BRAD JONES **Location of Manhole:** LAKEVIEW ST & S MOSS ST

Sketch of Area

(Location of MH, Street, any structures, areas smoke was observed, etc.)

X

Observed Smoke Indicator:

SMOKE VISIBLE FROM CLEANOUT IN SIDEYARD.

Probable Cause:

BROKEN OR MISSING CLEANOUT CAP.

Recommendations:

NOTIFY OWNER TO INSPECT AND REPLACE CLEANOUT CAP.

Inflow and Infiltration Study - Smoke Testing Report Form

Note:

Note:

609 SW Hurbert St. • Newport, OR 97365 • 541/264-7040 • Fax 541/264-7041
486 E Street • Coos Bay, OR 97420 • 541/266-8601 • Fax 541/266-8681
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200 SW Ferry St • Albany, OR 97322 • 541/266-8601

Civil West Engineering Services, Inc.

Inflow and Infiltration Study - Smoke Testing Report

Client: CITY OF LOWELL, OREGON **Date:** 9/15/21 **Time:** 11:01 ☑ a.m. ☐ p.m.

Street Address/Location: 103 S MOSS ST **Smoke from Manhole No.**

Observer: BRAD JONES **Location of Manhole:** S MOSS ST & LAKEVIEW ST

Sketch of Area

(Location of MH, Street, any structures, areas smoke was observed, etc.)

X

Observed Smoke Indicator:

SMOKE VISIBLE FROM CURB INLET.

Probable Cause:

POSSIBLE CROSS CONNECTION

Recommendations:

CCTV INSPECTION TO CONFIRM CROSS CONNECTION AND IDENTIFY NEXT STEPS.

609 SW Hurbert St. • Newport, OR 97365 • 541/264-7040 • Fax 541/264-7041
486 E Street • Coos Bay, OR 97420 • 541/266-8601 • Fax 541/266-8681
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Civil West Engineering Services, Inc.

Inflow and Infiltration Study - Smoke Testing Report

Client: CITY OF LOWELL, OREGON **Date:** 9/15/21 **Time:** 12:16 ☐ a.m. ☑ p.m.

Street Address/Location: 13 S MOSS ST **Smoke from Manhole No.**

Observer: BRAD JONES **Location of Manhole:** W MAIN ST

Sketch of Area

(Location of MH, Street, any structures, areas smoke was observed, etc.)

X

Observed Smoke Indicator:

SMOKE VISIBLE FROM CLEANOUT NEAR DEBRIS PILE.

Probable Cause:

BROKEN OR MISSING CLEANOUT CAP.

Recommendations:

NOTIFY OWNER TO INSPECT AND REPLACE CLEANOUT CAP.

Inflow and Infiltration Study - Smoke Testing Report Form

Note:

Note:

609 SW Hurbert St. • Newport, OR 97365 • 541/264-7040 • Fax 541/264-7041
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200 SW Ferry St • Albany, OR 97322 • 541/266-8601

Civil West Engineering Services, Inc.

Inflow and Infiltration Study - Smoke Testing Report

Client: CITY OF LOWELL, OREGON **Date:** 9/15/21 **Time:** 09:53 ☑ a.m. ☐ p.m.

Street Address/Location: 208 E MAIN ST **Smoke from Manhole No.**

Observer: BRAD JONES **Location of Manhole:** IN FRONT OF 26 S PIONEER ST

Sketch of Area

(Location of MH, Street, any structures, areas smoke was observed, etc.)

X

Observed Smoke Indicator:

VISIBLE SMOKE FROM SEWER MAIN CLEANOUT.

Probable Cause:

BROKEN/DAMAGED CAP OR LOOSE SEAL INSIDE CLEANOUT.

Recommendations:

INSPECT THE CLEANOUT TO IDENTIFY POSSIBLE DAMAGE AND REPAIR/REPLACE AS INSPECTION INDICATES.

609 SW Hurbert St. • Newport, OR 97365 • 541/264-7040 • Fax 541/264-7041
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200 SW Ferry St • Albany, OR 97322 • 541/266-8601

Civil West Engineering Services, Inc.

Inflow and Infiltration Study - Smoke Testing Report

Client: City of Lowell, Oregon **Date:** 9/16/21 **Time:** 09:13 ☑ a.m. ☐ p.m.

Street Address/Location: ROLLING ROCK PARK **Smoke from Manhole No.**

Observer: BRAD JONES **Location of Manhole:** ROLLING ROCK PARK NEAR BATHROOM

Sketch of Area

(Location of MH, Street, any structures, areas smoke was observed, etc.)

X

Observed Smoke Indicator:

SMOKE OBSERVED RISING FROM CRACKS IN GROUND.

Probable Cause:

CRACKED OR OTHERWISE DAMAGED PIPE.

Recommendations:

RECOMMEND CCTV IN LINE TO OBSERVE PIPE ISSUES AND IDENTIFY APPROPRIATE REPAIR METHOD.

Inflow and Infiltration Study - Smoke Testing Report Form

Note:

Note:

609 SW Hurbert St. • Newport, OR 97365 • 541/264-7040 • Fax 541/264-7041
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10558 Hwy 62 Suite B-1 • Eagle Point, OR 97524 • 541/326-4828
937 Geary St. No. 3 Albany • OR 97322 • 541/266-8601

Civil West Engineering Services, Inc.

Inflow and Infiltration Study - Smoke Testing Report

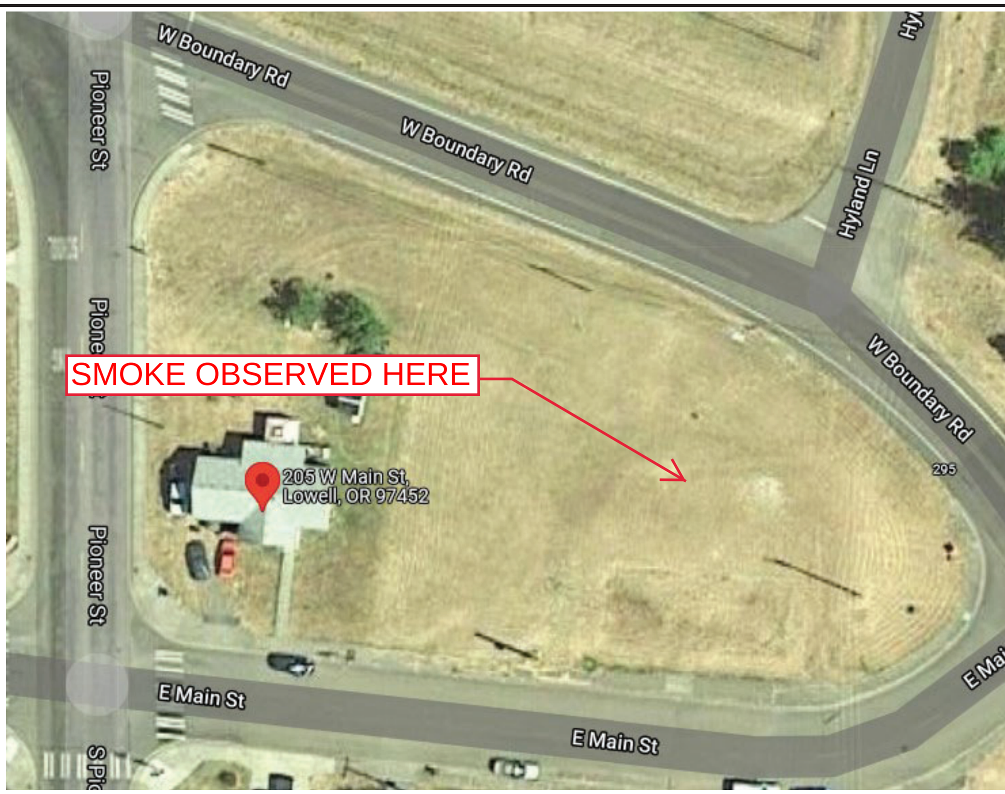
Client: City of Lowell, Oregon **Date:** 9/16/21 **Time:** 09:15 ☑ a.m. ☐ p.m.

Street Address/Location: 205 W MAIN ST **Smoke from Manhole No.**

Observer: MOLTEN **Location of Manhole:** ON EAST SIDE OFPROPERTY

Sketch of Area

(Location of MH, Street, any structures, areas smoke was observed, etc.)



X

Observed Smoke Indicator:

SMOKE COMING OUT OF THE GROUND

Probable Cause:

BASED ON LOCATION, OLD LATERAL THAT IS OPEN TO THE ATMOSPHERE

Recommendations:

EXCAVATE, CAP AND/OR REPAIR LATERAL

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Civil West Engineering Services, Inc.

Inflow and Infiltration Study - Smoke Testing Report

Client: CITY OF LOWELL, OREGON **Date:** 9/16/21 **Time:** 09:15 ☑ a.m. ☑ p.m.

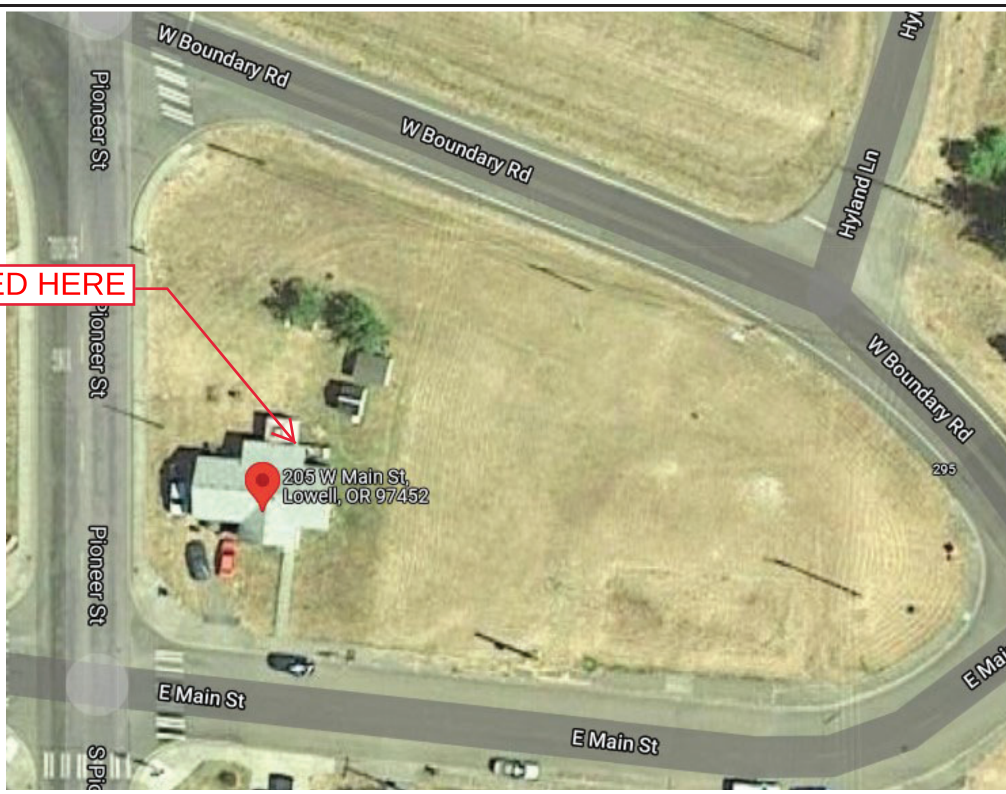
Street Address/Location: 205 W Main St **Smoke from Manhole No.**

Observer: MOLTEN **Location of Manhole:** MANHOLE ON PROPERTY

Sketch of Area

(Location of MH, Street, any structures, areas smoke was observed, etc.)

SMOKE OBSERVED HERE



X

Observed Smoke Indicator:

SMOKE COMING FROM UNCAPPED CLEANOUT ON THE BACK SIDE OF THE STRUCTURE

Probable Cause:

UNCAPPED OR BROKEN CLEANOUT

Recommendations:

REPAIR CLEANOUT OR REPLACE CAP DEPENDING ON NEED

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Civil West Engineering Services, Inc.

Inflow and Infiltration Study - Smoke Testing Report

Client: CITY OF LOWELL, OREGON **Date:** 9/16/21 **Time:** 08:54 ☑ a.m. ☐ p.m.

Street Address/Location: 10 WETLEAU DR **Smoke from Manhole No.**

Observer: BRAD JONES **Location of Manhole:** WETLEAU DR

Sketch of Area

(Location of MH, Street, any structures, areas smoke was observed, etc.)

X

Observed Smoke Indicator:

SMOKE VISIBLE FROM FRONT YARD BETWEEN STREET AND PRIVATE CLEANOUT.

Probable Cause:

POSSIBLE CRACKED PIPE.

Recommendations:

NOTIFY HOMEOWNER. RECOMMEND CONDUCTING AN INSPECTION TO IDENTIFY POTENTIAL CRACKS AND REPAIR ISSUE.

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Civil West Engineering Services, Inc.

Inflow and Infiltration Study - Smoke Testing Report

Client: CITY OF LOWELL, OREGON **Date:** 9/16/21 **Time:** 08:57 ☑ a.m. ☐ p.m.

Street Address/Location: 49 WETLEAU DR **Smoke from Manhole No.**

Observer: BRAD JONES **Location of Manhole:** WETLEAU DR

Sketch of Area

(Location of MH, Street, any structures, areas smoke was observed, etc.)

X

Observed Smoke Indicator:

SMOKE VISIBLE FROM CLEANOUT IN FRONT YARD.

Probable Cause:

MISSING CLEANOUT CAP.

Recommendations:

NOTIFY HOMEOWNER TO INSTALL CLEANOUT CAP.

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Civil West Engineering Services, Inc.

Inflow and Infiltration Study - Smoke Testing Report

Client: CITY OF LOWELL, OREGON **Date:** 9/16/21 **Time:** 02:58 ☐ a.m. ☑ p.m.

Street Address/Location: 70 N PIONEER ST **Smoke from Manhole No.**

Observer: BRAD JONES **Location of Manhole:** E 1ST NEAR PUBLIC LIBRARY

Sketch of Area

(Location of MH, Street, any structures, areas smoke was observed, etc.)

X

Observed Smoke Indicator:

SMOKE VISIBLE FROM CLEANOUT BETWEEN STRUCTURES.

Probable Cause:

BROKEN OR MISSING CLEANOUT CAP.

Recommendations:

CONFIRM CLEANOUT CAP IS MISSING AND REPLACE

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Civil West
Engineering Services, Inc.

Inflow and Infiltration Study - Smoke Testing Report

Client: CITY OF LOWELL, OREGON **Date:** 9/16/21 **Time:** 09:36 ☑ a.m. ☐ p.m.

Street Address/Location: 72 E 2ND ST **Smoke from Manhole No.**

Observer: Sierra Tabaczynski **Location of Manhole:**

Sketch of Area

(Location of MH, Street, any structures, areas smoke was observed, etc.)

X

Observed Smoke Indicator:

SMOKE VISIBLE FROM ROOF OF CHURCH, DIRECTLY ABOVE BATHROOM.

Probable Cause:

SOURCE UNKNOWN. POSSIBLY RELATED BATHROOM VENT INSTALLATION/LOCATION.

Recommendations:

NOTIFY OWNER. RECOMMEND CHECKING BATHROOM PLUMBING VENTILATION AND REPAIRING AS FINDINGS INDICATE.

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Civil West Engineering Services, Inc.

Inflow and Infiltration Study - Smoke Testing Report

Client: CITY OF LOWELL, OREGON **Date:** 9/16/21 **Time:** 11:39 ☑ a.m. ☐ p.m.

Street Address/Location: 75 E 2ND ST **Smoke from Manhole No.**

Observer: BRAD JONES **Location of Manhole:** E 2ND ST NEAR LOWELL GRANGE

Sketch of Area

(Location of MH, Street, any structures, areas smoke was observed, etc.)

X

Observed Smoke Indicator:

SMOKE VISIBLE FROM CULVERT ALONG STREET.

Probable Cause:

POSSIBLE CROSS CONNECTION.

Recommendations:

CCTV THE SEWER MAIN TO IDENTIFY THE POTENTIAL PRESENCE OF A CROSS CONNECTION.

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Civil West Engineering Services, Inc.

Inflow and Infiltration Study - Smoke Testing Report

Client: CITY OF LOWELL, OREGON **Date:** 9/16/21 **Time:** 11:45 ☑ a.m. ☐ p.m.

Street Address/Location: 62 E 3rd St **Smoke from Manhole No.**

Observer: MOLTEN **Location of Manhole:** SECOND ST GRANGE

Sketch of Area

(Location of MH, Street, any structures, areas smoke was observed, etc.)

X

Observed Smoke Indicator:

SMOKE COMING OUT OF GROUND

Probable Cause:

BREAK AT LATERAL CONNECTION TO STUB OUT

Recommendations:

NOTIFY HOMEOWNER TO HAVE LATERAL INSPECTED AND REPAIRED

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Civil West Engineering Services, Inc.

Inflow and Infiltration Study - Smoke Testing Report

Client: CITY OF LOWELL, OREGON **Date:** 9/16/21 **Time:** 09:35 ☑ a.m. ☐ p.m.

Street Address/Location: 107 E 3RD ST **Smoke from Manhole No.**

Observer: BRAD JONES **Location of Manhole:** E 2ND ST NEAR LOWELL GRANGE

Sketch of Area

(Location of MH, Street, any structures, areas smoke was observed, etc.)

X

Observed Smoke Indicator:

SMOKE VISIBLE FROM MANHOLE RIM AND SURROUNDING SIDEWALK JOINTS.

Probable Cause:

BROKEN RIM AND/ OR LEAKING JOINTS.

Recommendations:

CONDUCT FOLLOWUP INSPECTION TO IDENTIFY APPROPRIATE METHOD FOR REHABILITATING MANHOLE VIA RING REPLACEMENT OR GROUTING.

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Civil West Engineering Services, Inc.

Inflow and Infiltration Study - Smoke Testing Report

Client: CITY OF LOWELL, OREGON **Date:** 9/16/21 **Time:** 12:56 ☐ a.m. ☑ p.m.

Street Address/Location: 212 4th Street **Smoke from Manhole No.** ______

Observer: Sierra Tabaczynski **Location of Manhole:** ______

Sketch of Area

(Location of MH, Street, any structures, areas smoke was observed, etc.)

X

Observed Smoke Indicator:

SMOKE VISIBLE IN EMPTY LOT EAST OF 212 4TH STREET.

Probable Cause:

UNKNOWN. NO NOTED MANHOLE AT LOCATION OF SMOKE.

Recommendations:

CLEAR BLACKBERRY BUSH COVERING SITE TO IDENTIFY SOURCE.

Inflow and Infiltration Study - Smoke Testing Report Form

Note:

EXACT SOURCE OF SMOKE UNKNOWN, SITE OBSTRUCTED BY BLACKBERRY BUSH

Note:

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Civil West Engineering Services, Inc.

Inflow and Infiltration Study - Smoke Testing Report

Client: CITY OF LOWELL, OREGON **Date:** 9/16/21 **Time:** 01:56 ☐ a.m. ☑ p.m.

Street Address/Location: 23 4TH ST **Smoke from Manhole No.**

Observer: BRAD JONES **Location of Manhole:** 4TH ST & N MOSS ST

Sketch of Area

(Location of MH, Street, any structures, areas smoke was observed, etc.)

X

Observed Smoke Indicator:

SMOKE VISIBLE FROM BACKYARD BEHIND FENCE.

Probable Cause:

CAUSE UNKNOWN DUE TO LACK OF SOURCE CONFIRMATION.

Recommendations:

NOTIFY HOMEOWNER. IF CLEANOUT IS PRESENT, RECOMMEND INSPECT FOR DAMAGE AND REPAIR/REPLACE AS NEEDED. OTHERWISE, INSPECT SERVICE LATERAL FOR DAMAGE.

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Civil West Engineering Services, Inc.

Inflow and Infiltration Study - Smoke Testing Report

Client: CITY OF LOWELL, OREGON **Date:** 9/16/21 **Time:** 01:30 ☐ a.m. ☑ p.m.

Street Address/Location: 37 W 4TH ST **Smoke from Manhole No.**

Observer: BRAD JONES **Location of Manhole:** W 4TH ST

Sketch of Area

(Location of MH, Street, any structures, areas smoke was observed, etc.)

X

Observed Smoke Indicator:

SMOKE VISIBLE FROM MANHOLE.

Probable Cause:

BROKEN RING OR EXPOSED AND LEAKING JOINTS.

Recommendations:

CONDUCT FOLLOWUP INSPECTION TO IDENTIFY APPROPRIATE METHOD FOR REHABILITATING MANHOLE VIA RING REPLACEMENT OR GROUTING.

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Civil West Engineering Services, Inc.

Inflow and Infiltration Study - Smoke Testing Report

Client: CITY OF LOWELL, OREGON **Date:** 9/16/21 **Time:** 01:33 ☐ a.m. ☑ p.m.

Street Address/Location: 501 N MOSS ST **Smoke from Manhole No.**

Observer: BRAD JONES **Location of Manhole:** W 4TH ST

Sketch of Area

(Location of MH, Street, any structures, areas smoke was observed, etc.)

X

Observed Smoke Indicator:

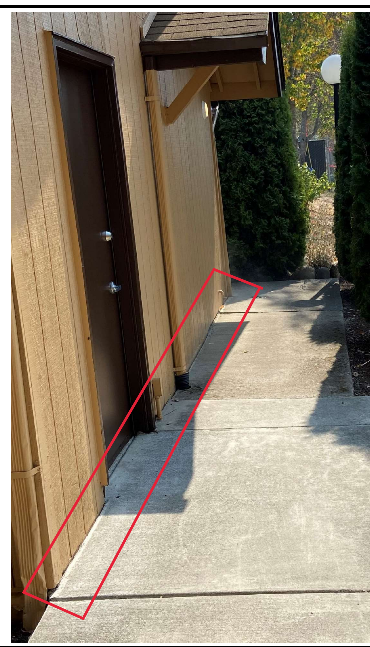
VISIBLE SMOKE RISING FROM JOINT BETWEEN SIDEWALK AND STRUCTURE.

Probable Cause:

POSSIBLE CRACKED OR OTHERWISE DAMAGED PIPE.

Recommendations:

NOTIFY OWNER. INSPECT SEWER LATERAL FOR CRACKS OR DAMAGE AND REPAIR AS INDICATED.



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Civil West Engineering Services, Inc.

Inflow and Infiltration Study - Smoke Testing Report

Client: CITY OF LOWELL, OREGON **Date:** **Time:** 01:15 ☐ a.m. ☑ p.m.

Street Address/Location: 540 CAROL ST **Smoke from Manhole No.**

Observer: MOLTEN **Location of Manhole:** CAROL ST

Sketch of Area

(Location of MH, Street, any structures, areas smoke was observed, etc.)

X

Observed Smoke Indicator:

SMOKE COMING OUT OF FAULTY CLEANOUT

Probable Cause:

FAULTY CLEANOUT OR NO CLEANOUT CAP

Recommendations:

NOTIFY PROPERTY OWNER TO REPAIR CLEANOUT/REPLACE CLEANOUT CAP

Inflow and Infiltration Study - Smoke Testing Report Form

Note:

Note:

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Civil West Engineering Services, Inc.

Inflow and Infiltration Study - Smoke Testing Report

Client: CITY OF LOWELL, OREGON **Date:** 9/16/21 **Time:** 02:39 ☐ a.m. ☑ p.m.

Street Address/Location: 570 N MOSS ST **Smoke from Manhole No.:**

Observer: BRAD JONES **Location of Manhole:** E 6TH ST

Sketch of Area

(Location of MH, Street, any structures, areas smoke was observed, etc.)

X

Observed Smoke Indicator:

VISIBLE SMOKE RISING FROM AREA DRAIN.

Probable Cause:

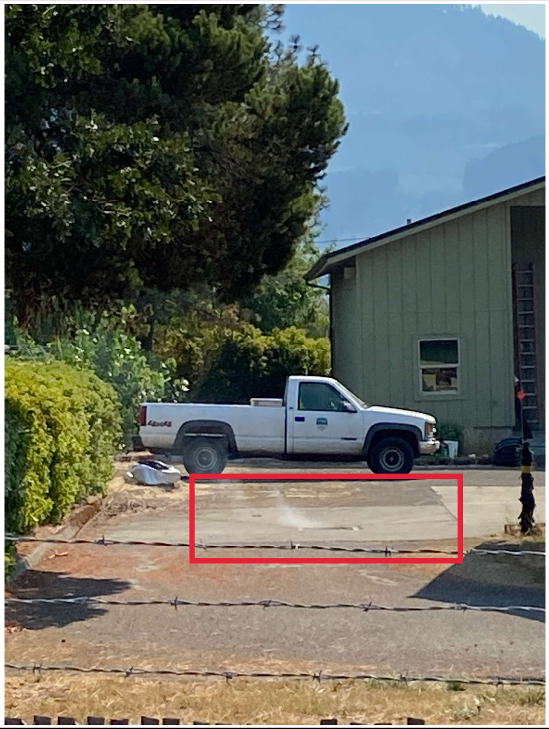
POSSIBLE CROSS CONNECTION.

Recommendations:

NOTIFY OWNER. RECOMMEND CCTV STUDY TO CONFIRM CROSS CONNECTION AND FIX ACCORDINGLY.

Inflow and Infiltration Study - Smoke Testing Report Form

Note:



Note:

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Civil West Engineering Services, Inc.

Inflow and Infiltration Study - Smoke Testing Report

Client: CITY OF LOWELL, OREGON **Date:** 9/16/21 **Time:** 02:27 ☐ a.m. ☑ p.m.

Street Address/Location: 41 E 6TH ST **Smoke from Manhole No.**

Observer: BRAD JONES **Location of Manhole:** E 6TH ST & D ST

Sketch of Area

(Location of MH, Street, any structures, areas smoke was observed, etc.)

X

Observed Smoke Indicator:

SMOKE VISIBLE FROM CLEANOUT.

Probable Cause:

CRACKED AND BROKEN CLEANOUT.

Recommendations:

NOTIFY HOMEOWNER TO REPLACE BROKEN AND MISSING CLEANOUT CAP.

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Civil West Engineering Services, Inc.

Inflow and Infiltration Study - Smoke Testing Report

Client: CITY OF LOWELL, OREGON **Date:** 9/16/21 **Time:** 10:53 ☑ a.m. ☐ p.m.

Street Address/Location: 101 7TH ST **Smoke from Manhole No.**

Observer: BRAD JONES **Location of Manhole:** 7TH ST

Sketch of Area

(Location of MH, Street, any structures, areas smoke was observed, etc.)

X

Observed Smoke Indicator:

SMOKE VISIBLE FROM CLEANOUT.

Probable Cause:

BROKEN OR MISSING CLEANOUT CAP.

Recommendations:

NOTIFY HOMEOWNER TO REPAIR OR REPLACE CLEANOUT CAP.

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Civil West Engineering Services, Inc.

Inflow and Infiltration Study - Smoke Testing Report

Client: City of Lowell, Oregon **Date:** 9/16/21 **Time:** 10:38 ☑ a.m. ☐ p.m.

Street Address/Location: 1181 INDUSTRIAL WAY **Smoke from Manhole No.**

Observer: BRAD JONES **Location of Manhole:** N MOSS ST & SENECA ST

Sketch of Area

(Location of MH, Street, any structures, areas smoke was observed, etc.)

X

Observed Smoke Indicator:

SMOKE VISIBLE FROM ELEVATED (~3') CLEANOUT NEAR SMALL STRUCTURE AND AT GROUND LEVEL ON NORTH SIDE OF DRIVEWAY.

Probable Cause:

MISSING OR BROKEN CLEANOUT CAP (SMOKE NEAR STRUCTURE).

POSSIBLE DAMAGED CLEANOUT OR SERVICE LINE (NORTH OF ROAD).

Recommendations:

NOTIFY OWNER TO REPAIR OR REPLACE CLEANOUT CAP.
RECOMMEND AN INSPECTION TO IDENTIFY POTENTIAL CRACKS AND REPAIR ISSUE.

Inflow and Infiltration Study - Smoke Testing Report Form

Note:

Note:

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Civil West Engineering Services, Inc.

Inflow and Infiltration Study - Smoke Testing Report

Client: City of Lowell, Oregon **Date:** 9/16/21 **Time:** 10:30 ☑ a.m. ☐ p.m.

Street Address/Location: 1160 Industrial Way, Lowell, OR 97452 **Smoke from Manhole No.**

Observer: Molten **Location of Manhole:** INDUSTRIAL X SENECA

Sketch of Area

(Location of MH, Street, any structures, areas smoke was observed, etc.)

SMOKE OBSERVED HERE

X

Observed Smoke Indicator:

SMOKE VISIBLE FROM BROKEN CLEANOUT

Probable Cause:

BROKEN CLEANOUT

Recommendations:

NOTIFY PROPERTY OWNER TO FIX CLEANOUT, REINSTALL BELOW GRADE TO PREVENT MOWER DAMAGE

Inflow and Infiltration Study - Smoke Testing Report Form

Note:

Note:

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Civil West Engineering Services, Inc.

Inflow and Infiltration Study - Smoke Testing Report

Client: CITY OF LOWELL, OREGON **Date:** 9/15/21 **Time:** 12:45 ☐ a.m. ☑ p.m.

Street Address/Location: CITY ALDER ST LIFT STATION **Smoke from Manhole No.**

Observer: MOLTEN **Location of Manhole:** ALDER AVE

Sketch of Area

(Location of MH, Street, any structures, areas smoke was observed, etc.)

X

Observed Smoke Indicator:

SMOKE EXITING GRATING FOR ENGINEERED OVERFLOW FOR LIFT STATION

Probable Cause:

LIFT STATION OVERFLOW IS WITHIN FLOWLINE FOR DITCH

Recommendations:

CONFIRM STORM DRAIN DOES NOT DRAIN INTO LIFT STATION OVERFLOW.

Civil West
Engineering Services, Inc.

South Coast Office
486 E Street
Coos Bay, OR 97420

Willamette Valley Office
200 Ferry Street SW
Albany, OR 97321

Rogue Valley Office
830 O'Hare Parkway, Suite 102
Medford, OR 97504

North Coast Office
609 SW Hurbert Street
Newport, OR 97365

Tel (541)266-8601 • Fax (541)266-8681

▪ TECHNICAL MEMORANDUM ▪

TO	Max Baker Public Works Director City of Lowell	**DATE**	12/20/2023 **JOB #** 2101-015
		RE	City of Lowell Wastewater Facilities Plan CCTV Results

The City of Lowell contracted with C-More Pipe Services in December 2023 to survey segments of the City's storm and sanitary sewer systems via closed-circuit television (CCTV). These pipe segments were identified in earlier inflow and infiltration (I/I) investigation efforts to be potential sources of I/I. This memo summarizes the significant results of this survey and provides budgetary cost estimates to repair identified issues for the City's Wastewater Facilities Plan. The full survey report from C-More is provided as an appendix to this memo.

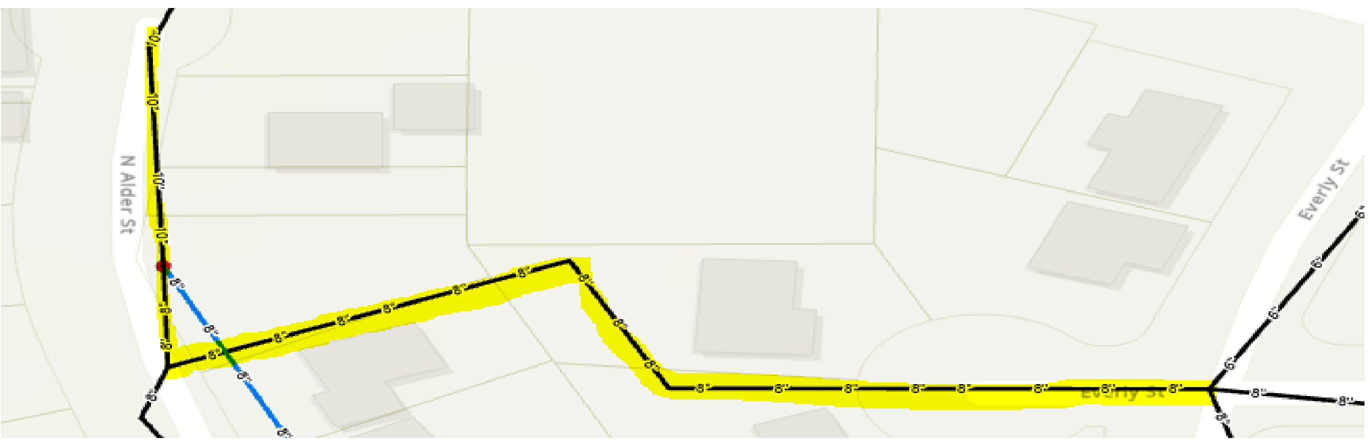


Figure 1: Lift Station Sanitary Sewer Line CCTV Surveyed

Figure 2: Gravity System Sewer Line CCTV Surveyed

Figure 3: Storm Line (Approximate Location) CCTV Surveyed

RESULTS

Lift Station Sewershed

The storm line and sanitary sewer line that drain west from the Everly Street cul-de-sac to Alder Street are in close proximity. The storm line has multiple voids, and both longitudinal and latitudinal cracks throughout the entirety of the surveyed pipe segment. The sanitary sewer line is in mostly fair condition, however a significant gushing void in the joint connecting the southern sewer line and the lift station wet well was observed (Figure 4). The sewer line from the north end of Alder Street going into the wet well was also observed to have a broken joint at the wet well outlet (Figure 5).

Figure 4: Broken Joint at Wet Well, From South

The City had the local fire department dump water from a tanker truck into the storm catch basin at the end of the Everly Street cul-de-sac, and a noticeable amount of water was observed flowing into the lift station wet well. It is probable that the storm line, being in very poor condition, infiltrates a significant portion of stormwater from the drainage basin of Everly Street and Loftus Avenue. A portion of this infiltrated stormwater could potentially enter the sanitary sewer system via the broken joints at the lift station wet well.

Figure 5: Broken Joint at Wet Well, From North

Gravity Sewershed

The sanitary sewer pipe running under Rolling Rock park, south of North Shore Drive seemed to be in mostly good condition. At the transition from concrete to PVC, about 2.3 feet from the manhole invert on Moss Street, there was a break at the joint connection (Figure 6). No other significant issues were observed. This segment of pipe was observed via flow testing to have potential infiltration issues; since the main pipe doesn't seem to have enough cracks or voids to explain the flow increases observed, the City should prioritize fixing the cross-connection issues from private connections to this main that were listed in the previous I/I memo.

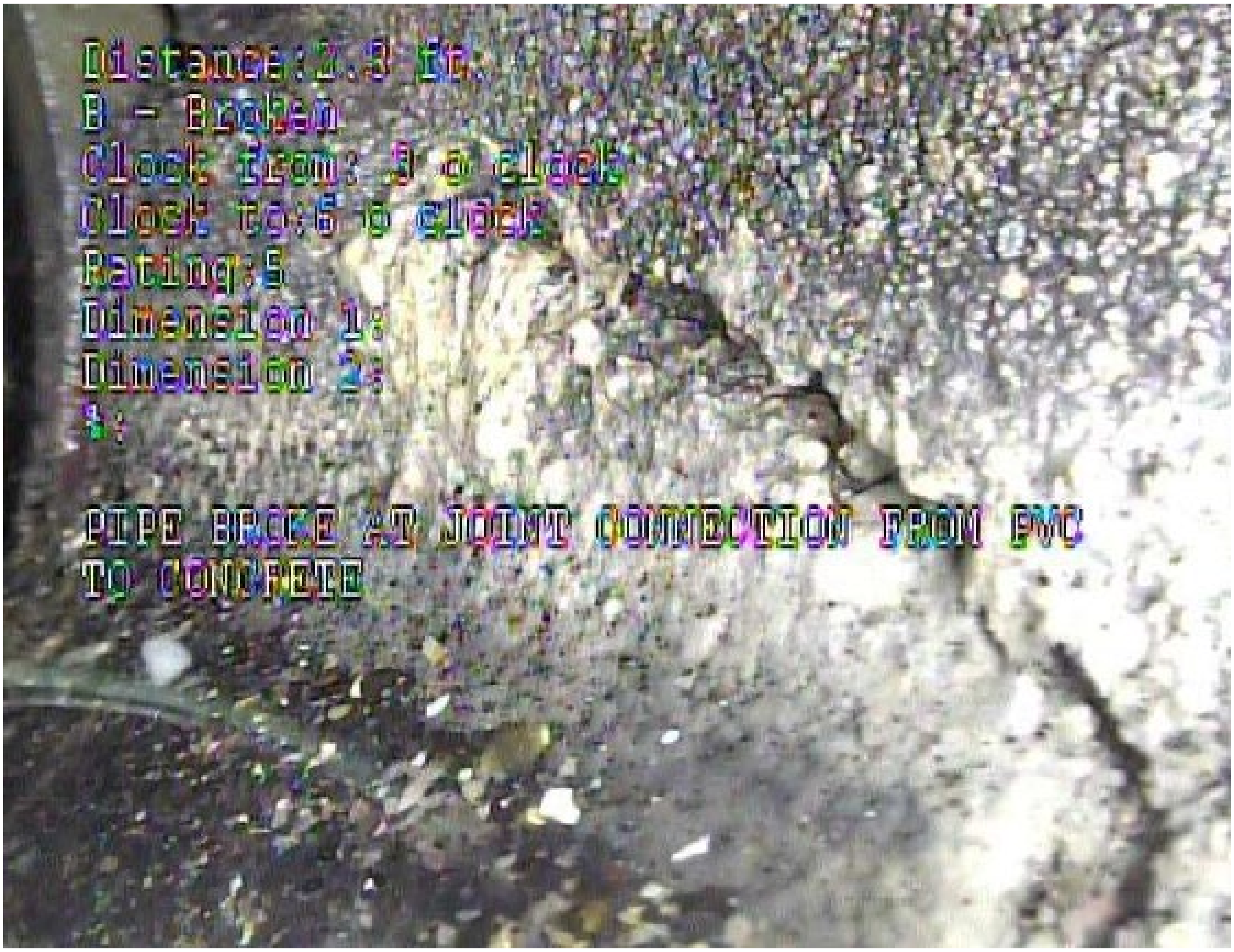


Figure 6: Broken Joint in Gravity Sewer under Rolling Rock Park

RESULTS AND ESTIMATES

As a result of this effort, it is recommended that the City budget for spot repairs of the two sanitary sewer pipes at the inlet into the Alder Street Lift Station. During the wet season, these broken joints are significant sources of infiltration, and also potential inflow sources given the close proximity of the poor-condition storm drainpipe. While full replacement of this storm pipe should be considered, this planning effort is focused on repairs that could potentially be funded via the City's sewer fund. Repairing these joints is likely the most cost-effective strategy to reduce I/I in the Alder Street Lift Station sewershed. The City should also budget to spot repair the crack in the sewer pipe under Rolling Rock park.

Alder Street Lift Station – Spot Repair Budgetary Estimates					
Capital Cost					
No.	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Spot Repair of Sewer Pipe Voids	3	EA	$5,000	$15,000
				Labor and Materials Subtotal	$15,000
				Mobilization, Insurance, Overhead, Bonds (10%)	$1,500
				Administration and Legal (5%)	$750
				Contingency (25%)	$3,750
				Engineering (20%)	$3,000
				Estimated Construction Costs (2023$)	**$24,000**

CUES, Inc.
3600 Rio Vista Avenue
Orlando, FL 32805
Phone: 407-849-0190
Fax: 407-425-1569

Main Inspections Large Photos

Mainline ID:	City:	Street:	Project name:
CB#1-MH#1	**LOWELL, OREGON**	**LOFTUS CT.**	**CITY OF LOWELL**
Start date/time:	Total length:	Weather:	Surveyed by:
11/22/2023 10:45 AM	**108.4 ft.**	**1**	**MIchael NASSCO6**
Upstream MH No:	Depth US:	Downstream MH No:	Depth DS:
CB#1		**MH#1**	
Shape:	Material:	Height:	Width:
C	**CP**	**10 in.**	

Additional info:
CCTV LOOKING FOR DEFECTS

Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
0.0 ft.	**D**		**/**	**ACB**			**CB#1, START INSPECTION AT CB HEADING DOWN STREAM WITH FLOW**
0.0 ft.	**D**		**/**	**MWL**			**0**

Observations

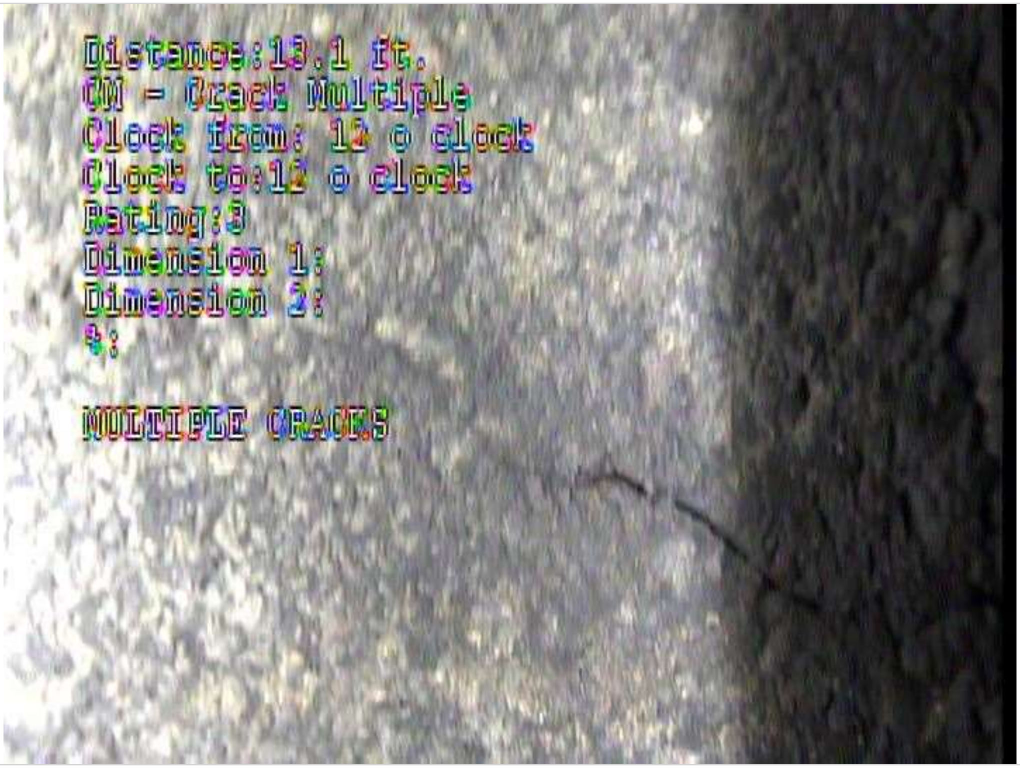
Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
5.7 ft.	**D**		**10 /**	**BSV**		**5**	**PIPED BROKE AT JOINT SOIL AND ROCK VISIBLE.**

Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
5.7 ft.	**D**		**12 /**	**CL**		**2**	**CRACK AT TOP CROWN OF PIPE**

Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
13.1 ft.	**D**		**12 / 12**	**CM**		**3**	**MULTIPLE CRACKS**

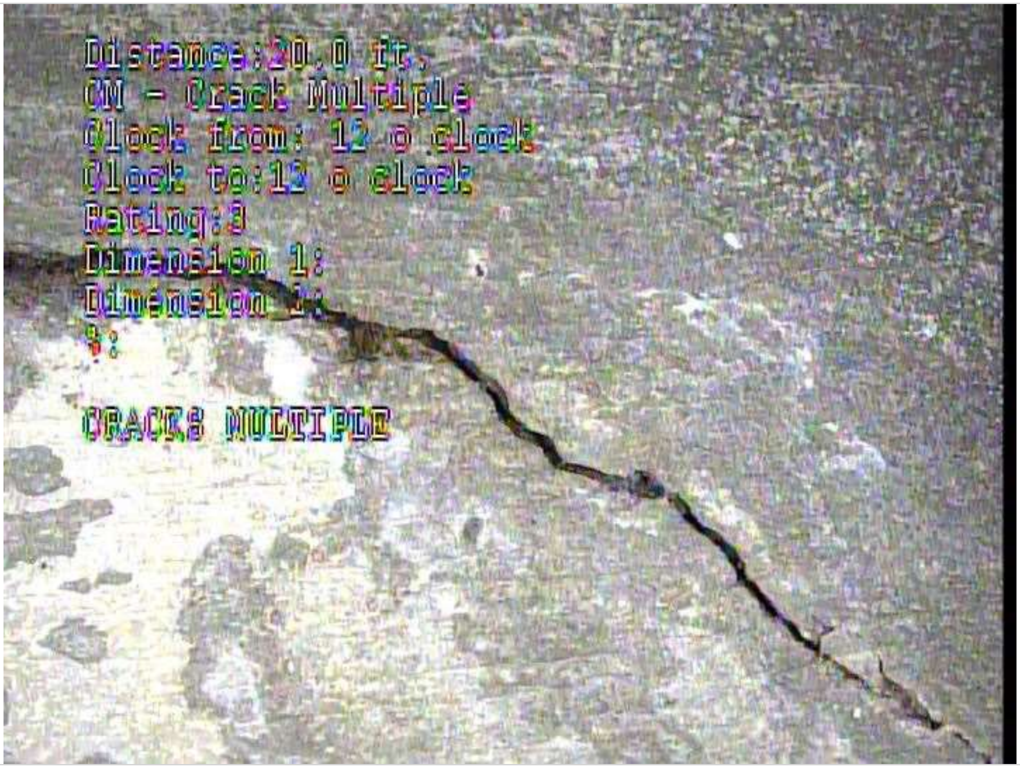


Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
16.9 ft.	D		12 / 12	CM		3	CRACKS MULTIPLE

Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
20.0 ft.	**D**		**12 / 12**	**CM**		**3**	**CRACKS MULTIPLE**



Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
28.1 ft.	**D**		**12 / 1**	**CM**		**3**	

Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
30.5 ft.	**D**		**12 / 12**	**CM**		**3**	

Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
36.2 ft.	D		6 /	CL		2	

Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
108.4 ft.	**D**		**/**	**AMH**			**END INSPECTION IN MIDDLE ON SEWER MH #1**

Main Inspections Large Photos

Mainline ID:	City:	Street:	Project name:
SSMH1 TO SSMH2	**LOWELL, OREGON**	**EVERLY ST.**	**CITY OF LOWELL**
Start date/time:	Total length:	Weather:	Surveyed by:
11/22/2023 11:20 AM	**210.7 ft.**	**1**	**MIchael NASSCO6**
Upstream MH No:	Depth US:	Downstream MH No:	Depth DS:
SSMH#1		**SSMH#2**	
Shape:	Material:	Height:	Width:
C	**CP**	**8 in.**	

Additional info:

CCTV 8" SEWER FOR DEFECTS

Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
0.0 ft.	**D**		**/**	**AMH**			**SSMH#1, START INSPECTION HEADING DOWN STREAM TO SSMH#2 IN BACK YARD OF 69 LOFTUS CT.**
0.0 ft.	**D**		**/**	**MWL**			**5**

Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
61.6 ft.	**D**		**3 /**	**TFA**			**SERVICVE RIGHT,ACTIVE CONCRETE**

Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
68.4 ft.	D		9 /	TFA			SERVICE LEFT, ACTIVE CONCRETE

Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
201.6 ft.	**D**		**9 /**	**TFA**			**SERVICE LEFT, ACTIVE CONCRETE**

Observations

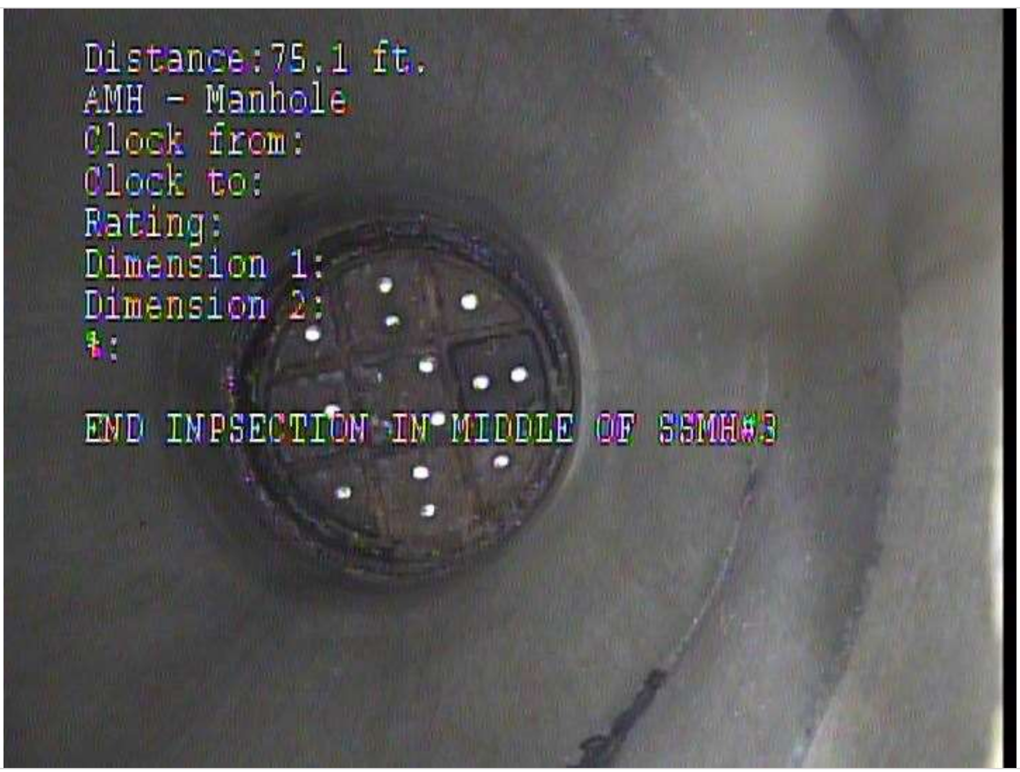
Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
210.6 ft.	**D**		**/**	**AMH**			**END INPSECTION IN MIDDLE OF SSMH #2**

Main Inspections Large Photos

Mainline ID:	City:	Street:	Project name:
SSMH2 TO SSMH3	**LOWELL, OREGON**	**EVERLY ST.**	**CITY OF LOWELL**
Start date/time:	Total length:	Weather:	Surveyed by:
11/22/2023 11:33 AM	**75.1 ft.**	**1**	**MIchael NASSCO6**
Upstream MH No:	Depth US:	Downstream MH No:	Depth DS:
SSMH#2		**SSMH#3**	
Shape:	Material:	Height:	Width:
C	**CP**	**8 in.**	
Additional info:			

Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
0.0 ft.	**D**		**/**	**AMH**			**SSMH#2, START INSPECTION HEADING DOWN STREAM.**
0.0 ft.	**D**		**/**	**MWL**			**5**
75.1 ft.	**D**		**/**	**AMH**			**END INPSECTION IN MIDDLE OF SSMH#3**



Main Inspections Large Photos

Mainline ID:	City:	Street:	Project name:
SSMH3-SSMH4	**LOWELL, OREGON**	**N. ALDER ST**	**CITY OF LOWELL**
Start date/time:	Total length:	Weather:	Surveyed by:
11/22/2023 11:57 AM	**155.1 ft.**	**1**	**MIchael NASSCO6**
Upstream MH No:	Depth US:	Downstream MH No:	Depth DS:
SSMH#3		**SSMH#4**	
Shape:	Material:	Height:	Width:
C	**CP**	**8 in.**	

Additional info:

CCTV 8" FOR DEFECTS

Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
0.0 ft.	U		/	MWL			
0.0 ft.	U		/	AMH			SSMH#4 HEADING UPSTREAM TO SSMH#3 NOTE THAT DIRECTION IS LABLED WRONG AND CCTV IS GOING UP STREAM

Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
19.6 ft.	**U**		**/**	**MWLS**		**2**	

Observations

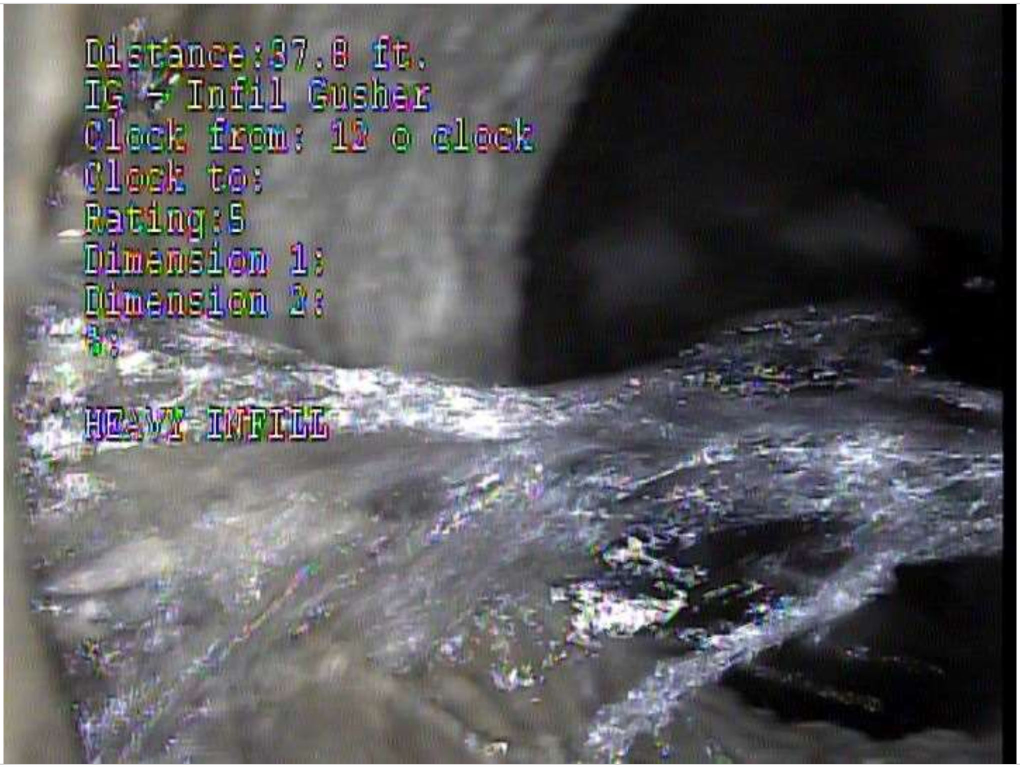
Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
149.1 ft.	**U**		**/**	**AMH**			**END INPSECTION IN CENTER OF SSMH#3**

Main Inspections Large Photos

Mainline ID:	City:	Street:	Project name:
SSMH4 TO PS146	**LOWELL, OREGON**	**N. ALDER ST**	**CITY OF LOWELL**
Start date/time:	Total length:	Weather:	Surveyed by:
11/22/2023 12:10 PM	**38.5 ft.**	**1**	**MIchael NASSCO6**
Upstream MH No:	Depth US:	Downstream MH No:	Depth DS:
SSMH#4		**PS 146**	
Shape:	Material:	Height:	Width:
C	**CP**	**8 in.**	
Additional info:			
CCTV FOR DEFECTS			

Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
0.0 ft.	**D**		**/**	**MWL**			
0.0 ft.	**D**		**/**	**AMH**			**SSMH#4, START INSPECTION AT MH HEADING DOWN STREAM TO PS146**
37.8 ft.	**D**		**12 /**	**IG**		**5**	**HEAVY INFILL**



Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
38.5 ft.	D		/	AMH			END INSPECTION AT PUMP STATION 146

Main Inspections Large Photos

Mainline ID:	City:	Street:	Project name:
SSMH6-SSMH5	**LOWELL, OREGON**	**N. ALDER ST**	**CITY OF LOWELL**
Start date/time:	Total length:	Weather:	Surveyed by:
11/22/2023 12:23 PM	**85.7 ft.**	**1**	**MIchael NASSCO6**
Upstream MH No:	Depth US:	Downstream MH No:	Depth DS:
SSMH#6		**SSMH#5**	
Shape:	Material:	Height:	Width:
C	**PVC**	**8 in.**	

Additional info:
CCTV 8" FOR DEFECTS

Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
0.0 ft.	**D**		**/**	**AMH**			**SSMH#6, START INSPECTION HEADING DOWN STREAM**
0.0 ft.	**D**		**/**	**MWL**			**5**
85.7 ft.	**D**		**/**	**AMH**			**END INSPECITON IN CENTER OF SSMH#5**

Main Inspections Large Photos

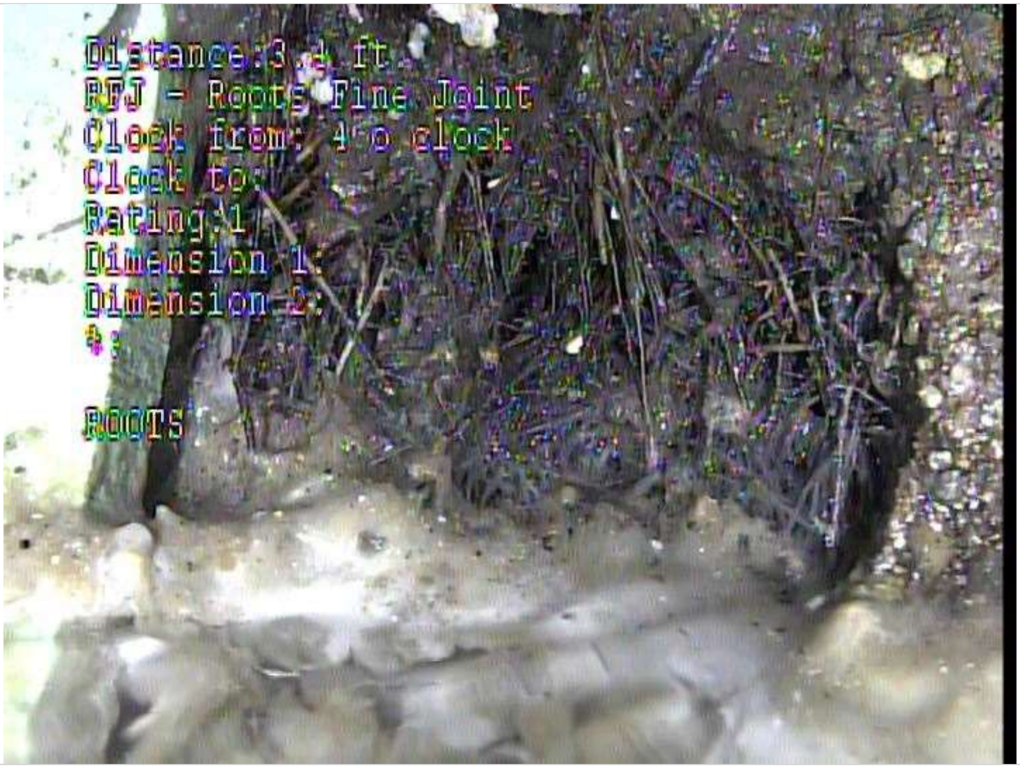
Mainline ID:	City:	Street:	Project name:
SSMH5 TO PS146	**LOWELL, OREGON**	**N. ALDER ST**	**CITY OF LOWELL**
Start date/time:	Total length:	Weather:	Surveyed by:
11/22/2023 12:37 PM	**78.0 ft.**	**1**	**MIchael NASSCO6**
Upstream MH No:	Depth US:	Downstream MH No:	Depth DS:
SSMH#5		**PS 146**	
Shape:	Material:	Height:	Width:
C	**PVC**	**8 in.**	

Additional info:

CCTV 8" FOR DEFECTS

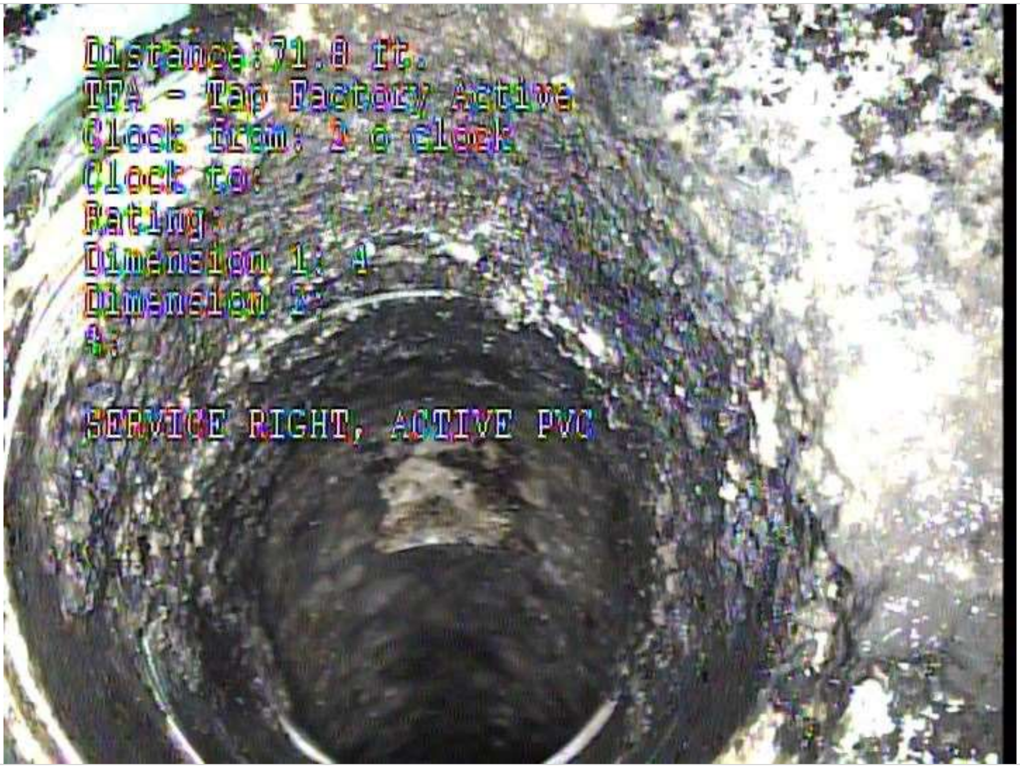
Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
0.0 ft.	**D**		**/**	**AMH**			**SSMH#5, START INSPECTION HEADING DOWN STREAM TO PUMP STATION 146**
0.0 ft.	**D**		**/**	**MWL**			**5**
3.4 ft.	**D**		**4 /**	**RFJ**		**1**	**ROOTS**



Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
71.8 ft.	**D**		**2 /**	**TFA**			**SERVICE RIGHT, ACTIVE PVC**



Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
76.7 ft.	D		4 /	IG		5	INFILTRATION

Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
78.0 ft.	D		/	AMH			END INPSECTION AT PUMP STATION 146

Main Inspections Large Photos

Mainline ID:	City:	Street:	Project name:
RR-1 TO RR-2	**LOWELL, OREGON**	**N. ALDER ST**	**CITY OF LOWELL**
Start date/time:	Total length:	Weather:	Surveyed by:
11/22/2023 1:29 PM	**306.1 ft.**	**1**	**MIchael NASSCO6**
Upstream MH No:	Depth US:	Downstream MH No:	Depth DS:
SSMH-RR-1	**6.0 ft.**	**SSMH-RR-2**	**4.0 ft.**
Shape:	Material:	Height:	Width:
C	**PVC**	**8 in.**	

Additional info:

CCTV 8" FOR DEFECTS

Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
0.0 ft.	**U**		**/**	**AMH**			**SSMH-RR-2, START INPSECTION HEADING UPSTREA TO MH RR-1 AGAINST FLOW**
0.0 ft.	**U**		**/**	**MWL**			**5**

Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
2.3 ft.	**U**		**3 / 6**	**B**		**5**	**PIPE BROKE AT JOINT CONNECTION FROM PVC TO CONCRETE**

Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
86.8 ft.	**U**		**2 /**	**TFA**			**SERVICE RIGHT, ACTIVE PCE TEE**

Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
198.1 ft.	**U**		**2 /**	**TFA**			**SERVICE RIGHT, ACTIVE PVC TEE**

Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
224.3 ft.	**U**		**2 /**	**TFA**			**SERVICE RIGHT, ACTIVE PVC TEE**

Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
306.1 ft.	**U**		**/**	**AMH**			**END INSPECTION CENTER OF SSMH-RR-1**

Main Inspections Large Photos

Mainline ID:	City:	Street:	Project name:
RR-2 TO RR-3	**LOWELL, OREGON**	**N. ALDER ST**	**CITY OF LOWELL**
Start date/time:	Total length:	Weather:	Surveyed by:
11/22/2023 2:00 PM	**301.2 ft.**	**1**	**MIchael NASSCO6**
Upstream MH No:	Depth US:	Downstream MH No:	Depth DS:
SSMH-RR-2	**4.0 ft.**	**SSMH-RR-3**	
Shape:	Material:	Height:	Width:
C	**PVC**	**8 in.**	

Additional info:

Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
0.0 ft.	**D**		**/**	**AMH**			**SSMH-RR-2, START INSPECTION HEADING DOWN STREAM WITH FLOW**
0.0 ft.	**D**		**/**	**MWL**			**5**
20.8 ft.	**D**		**9 /**	**TFA**			**SERVICE LEFT, ACTIVE PVC**

Observations

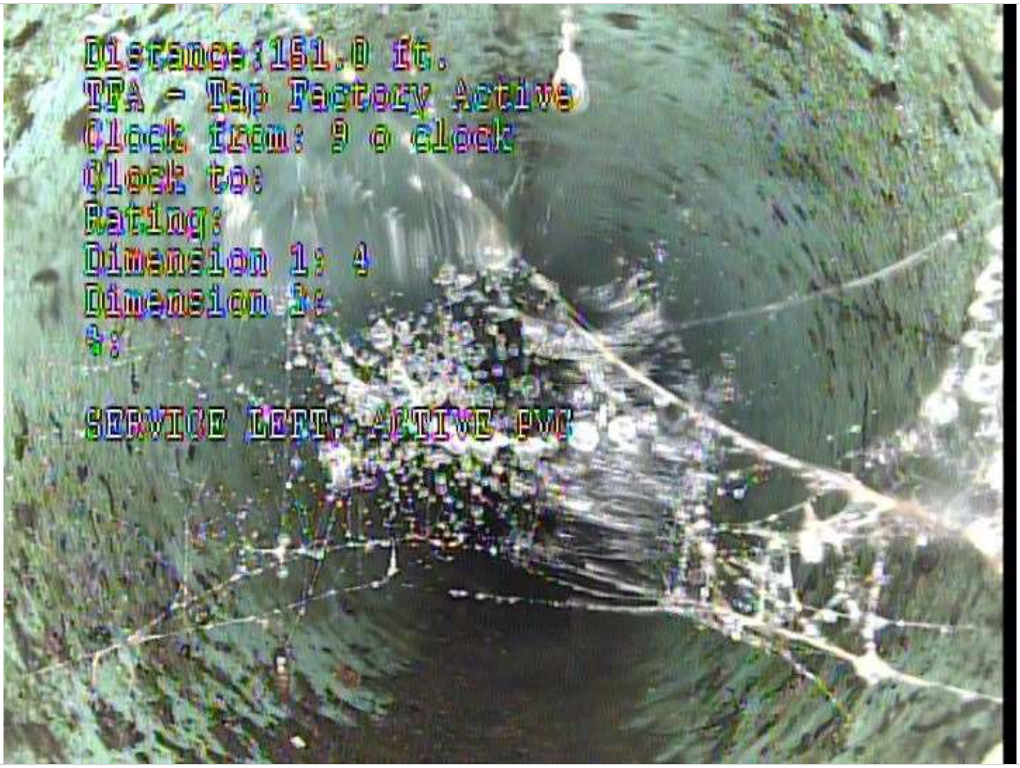
Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
52.1 ft.	D		2 /	TFA			SERVICE RIGHT, PVC

Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
126.4 ft.	**D**		**9 /**	**TFA**			**SERVICE LEFT, ACTIVE PVC**

Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
151.0 ft.	**D**		**9 /**	**TFA**			**SERVICE LEFT, ACTIVE PVC**



Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
268.7 ft.	**D**		**10 /**	**TFA**			**SERVICE LEFT, ACTIVE PVC**

Observations

Distance	Dir.	Length	From/To	Code	Modifier	Rating	Remarks
301.2 ft.	**D**		**/**	**AMH**			**END INSPECTION AT SSMH-RR-3**

APPENDIX E:

Discharge Monitoring Report Summaries and Data used in Flow Analyses

Average Influent BOD Concentration (mg/L):							
	2018	**2019**	**2020**	**2021**	**2022**	**2023**	**Average**
January	588	336	230	287	379	452	379
February	480	202	549	467	524	418	440
March	283	270	388	508	493	327	378
April	335	208	754	900	311	269	463
May	927	720	501	497	382	810	640
June	500	810	522	1030	547	690	683
July	670	870	816	780	660		759
August	810	730	830	770	960		820
September	840	505	800	813	690		730
October	980	950	770	630	710		808
November	570	670	519	400	510		534
December	379	600	362	301	426		414
Annual:	614	573	587	615	549	494	587

Average Influent BOD Loading (ppd):							
	2018	**2019**	**2020**	**2021**	**2022**	**2023**	**Average**
January	325	71	152	160	133	148	165
February	155	139	187	211	112	125	155
March	103	102	89	125	245	89	125
April	83	84	137	125	123	111	110
May	118	91	77	74	100	79	90
June	50	107	56	120	104	72	85
July	58	78	71	89	108		81
August	63	80	125	96	85		90
September	119	96	112	78	85		98
October	96	99	128	101	77		100
November	107	107	173	203	117		141
December	158	161	122	112	102		131
Annual:	120	101	119	124	116	104	114
Max	325	161	187	211	245	148	213
Peaking Factor	2.72	1.59	1.57	1.70	2.12	1.42	1.85

Average Influent TSS Concentration (mg/L):							
	2018	**2019**	**2020**	**2021**	**2022**	**2023**	**Average**
January	115	72	59	70	112	129	93
February	110	59	107	147	113	106	107
March	85	70	89	76	113	81	86
April	81	82	169	215	94	83	121
May	156	170	115	307	112	226	181
June	108	233	127	198	136	228	171
July	163	214	198	188	175		187
August	146	310	243	240	206		229
September	330	165	174	124	209		200
October	174	296	233	173	175		210
November	146	135	112	93	143		126
December	118	160	105	75	108		113
Annual:	144	164	144	159	141	142	152

Average Influent TSS Loading (ppd):							
	2018	**2019**	**2020**	**2021**	**2022**	**2023**	**Average**
January	288	78	198	163	200	170	183
February	154	163	147	277	100	134	163
March	117	104	82	96	292	108	133
April	89	135	155	121	151	143	132
May	99	111	72	176	116	107	114
June	42	130	60	117	135	99	97
July	55	95	89	85	116		88
August	57	132	145	121	87		108
September	162	147	132	63	104		122
October	93	153	155	109	76		117
November	100	87	146	210	133		135
December	207	183	161	139	105		159
Annual:	122	127	129	140	135	127	129
Max	288	183	198	277	292	170	235
Peaking Factor	2.36	1.45	1.54	1.98	2.17	1.34	1.81

Average BOD5 Effluent Concentration (mg/L):							
	2018	**2019**	**2020**	**2021**	**2022**	**2023**	**Average**
January	3.2	3.0	4.4	6.1	3.4	4.9	4
February	3.0	2.0	2.8	8.1	5.5	4.9	4
March	2.0	2.3	4.1	4.4	3.7	2.9	3
April	2.8	2.3	6.6	11.2	6.3	2.4	5
May	4.8	3.2	4.3	20.0	4.5	8.6	8
June	3.8	3.8	2.6	15.6	3.7	8.8	6
July	7.5	8.2	8.5	14.1	3.2		8
August	10.4	10.3	6.8	4.3	5.3		7
September	11.3	7.0	10.4	6.5	5.6		8
October	13.8	8.8	7.8	2.6	7.0		8
November	11.8	12.9	11.6	4.9	5.3		9
December	3.8	6.9	2.9	3.2	2.7		4
Annual:	6	6	6	8	5	5	6

Average BOD5 Effluent Loading (ppd):							
	2018	**2019**	**2020**	**2021**	**2022**	**2023**	**Average**
January	7.4	3.4	13.0	15.8	7.1	6.1	9
February	3.8	5.8	3.7	16.1	4.6	5.7	7
March	2.8	4.0	3.7	5.6	10.8	4.3	5
April	2.8	4.5	8.2	6.2	9.8	4.4	6
May	3.0	2.2	2.8	14.9	4.7	4.0	5
June	1.5	2.3	1.3	9.3	3.5	3.9	4
July	2.3	3.8	3.7	6.4	2.1		4
August	4.2	4.5	4.1	2.1	2.2		3
September	5.3	6.0	7.1	2.9	2.7		5
October	7.4	4.5	5.0	1.7	3.2		4
November	9.5	7.5	17.4	12.5	6.3		11
December	7.0	7.5	5.5	5.7	3.5		6
Annual:	5	5	6	8	5	5	6
Max	10	7	17	16	11	6	11
Peaking Factor	2.01	1.61	2.76	1.95	2.14	1.28	1.96

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Average TSS Effluent Concentration (mg/L):							
	2018	2019	2020	2021	2022	2023	Average
January	1.6	2.8	6.2	4.9	2.0	2.0	3
February	2.8	3.3	6.6	5.3	2.0	2.6	4
March	1.0	2.5	3.8	2.0	2.0	2.0	2
April	1.0	2.5	3.6	4.8	2.5	2.0	3
May	3.4	3.6	2.6	3.5	2.0	2.5	3
June	4.8	3.5	4.0	3.9	2.0	2.0	3
July	4.3	4.0	3.9	2.5	2.0		3
August	2.4	6.3	4.6	2.6	2.0		4
September	2.0	8.3	2.7	3.1	2.0		4
October	2.8	4.6	2.5	2.7	2.9		3
November	2.5	3.2	4.6	2.0	2.0		3
December	4.5	4.6	3.8	2.0	2.0		3
Annual:	3	4	4	3	2	2	3

Average TSS Effluent Loading (ppd):							
	2018	2019	2020	2021	2022	2023	Average
January	4.2	3.2	21.1	15.1	4.9	2.7	9
February	2.8	8.3	8.8	10.5	1.8	2.8	6
March	1.3	4.3	3.4	2.5	5.1	3.1	3
April	1.5	5.5	4.5	2.8	4.4	3.8	4
May	2.2	2.2	1.8	2.8	2.5	1.3	2
June	2.0	2.3	2.5	2.3	2.1	0.8	2
July	1.5	1.8	1.7	1.1	1.3		1
August	1.2	3.3	2.7	1.3	0.9		2
September	1.3	9.3	1.8	1.6	0.9		3
October	1.6	2.4	1.7	1.8	1.4		2
November	2.8	1.9	8.8	5.1	2.8		4
December	8.3	4.0	6.8	4.4	2.7		5
Annual:	3	4	5	4	3	2	4
Max	8	9	21	15	5	4	10
Peaking Factor	3.25	2.30	3.86	3.53	1.98	1.56	2.75

Average Influent Temperature (C°):							
	2018	2019	2020	2021	2022	2023	Average
January	14.5	14.7	13.4	12.7	11.9	12.0	13
February	14.5	12.7	12.9	11.7	11.9	11.5	13
March	14.4	13.1	13.8	12.6	12.5	10.9	13
April	16.2	15.0	15.9	14.7	13.2	11.7	14
May	17.5	16.8	16.6	16.5	14.3	15.5	16
June	18.7	18.3	18.6	19.0	16.4	18.0	18
July	20.8	19.8	20.7	21.0	19.1		20
August	21.3	21.2	21.6	21.7	21.2		21
September	20.3	20.3	21.4	20.6	20.6		21
October	19.2	17.1	19.7	18.0	19.0		19
November	17.4	15.6	16.1	16.1	15.6		16
December	14.8	14.8	13.8	13.9	12.6		14
Annual:	17	17	17	17	16	13	17

Average Effluent Temperature (C°):							
	2018	2019	2020	2021	2022	2023	Average
January	14.7	14.0	13.9	13.1	12.1	11.2	13
February	14.7	12.5	12.9	11.9	11.5	10.8	12
March	14.8	13.2	14.1	12.8	12.7	10.7	13
April	16.3	15.2	16.5	15.0	13.0	11.7	15
May	18.0	17.0	17.5	16.6	14.6	15.8	17
June	19.0	19.1	20.0	19.9	16.9	18.4	19
July	21.1	20.4	21.6	21.7	20.2		21
August	21.3	21.7	21.3	22.0	21.7		22
September	19.2	19.7	20.8	19.9	19.8		20
October	17.8	16.2	18.9	16.9	17.5		17
November	16.1	14.4	16.0	15.4	13.6		15
December	13.6	14.1	14.0	13.9	11.6		13
Annual:	17	16	17	17	15	13	16

Average Effluent E. coli (# per 100 mL):	-	-	-	-	-	-
	2018	**2019**	**2020**	**2021**	**2022**	**2023**	**Average**
January	3.4	1.0	1.2	1.3	97.5	1.0	18
February	1.0	1.0	1.0	7.9	1.0	1.5	2
March	1.0	1.0	1.0	1.0	1.0	4.2	2
April	1.3	1.3	1.2	1.0	1.0	2.8	1
May	1.0	1.6	1.8	2.8	2.3	3.4	2
June	1.0	2.0	1.0	16.3	1.0	1.3	4
July	3.3	2.4	1.4	15.8	1.0		5
August	1.2	2.3	1.0	1.0	1.2		1
September	1.0	1.0	22.4	3.4	1.5		6
October	3.8	12.0	1.3	3.5	1.0		4
November	1.0	12.3	4.0	1.0	1.0		4
December	2.3	47.3	1.0	3.8	1.5		11
Annual:	2	7	3	5	9	2	5

Flow Data for DEQ Graph #1

		Month:	Precipitation (inches/month)	Monthly Average Flow (MGD)
Most Recent Wet-Season (January - May)	2023	January	2.73	0.144
		February	2.34	0.121
		March	4.36	0.201
		April	4.88	0.253
		May	0.56	0.060
		MMDWF	6.08	0.288
		MMWWF	8.69	0.399
5-Year Monthly Precipitation High	2020	January	9.24	0.350

Flow Data for DEQ Graph #2

Date	Precipitation (in/day)	Flow (MGD)
1/19/2019	1.06	0.68
1/20/2019	0.97	0.72
1/21/2019	0.39	0.35
1/23/2019	0.12	0.19
2/4/2019	0.57	0.31
2/5/2019	0.22	0.26
2/25/2019	2.53	0.42
2/26/2019	1.35	0.39
2/27/2019	0.32	0.39
1/4/2020	0.66	0.37
1/6/2020	0.1	0.19
1/8/2020	0.49	0.47
1/9/2020	0.56	0.30
1/11/2020	0.73	0.49
1/12/2020	0.55	0.44
1/13/2020	0.34	0.53
1/14/2020	0.71	0.40
1/16/2020	0.8	0.52
1/18/2020	0.11	0.27
1/24/2020	0.65	0.35
1/26/2020	0.53	0.41
1/27/2020	0.21	0.39
1/28/2020	0.67	0.45
1/30/2020	0.63	0.34
2/2/2020	0.4	0.26
2/16/2020	1.18	0.50
3/31/2020	1.14	0.37
1/3/2021	0.69	0.45
1/5/2021	0.62	0.32
1/6/2021	0.19	0.47
1/7/2021	0.38	0.36
1/8/2021	0.27	0.40
1/9/2021	0.25	0.27
1/12/2021	0.64	0.76
1/13/2021	0.8	0.49
1/28/2021	0.28	0.27
1/29/2021	0.12	0.19
2/3/2021	0.5	0.40
2/13/2021	0.75	0.41
2/14/2021	0.22	0.31
2/15/2021	0.16	0.36
2/16/2021	0.3	0.31
2/17/2021	0.12	0.23
2/19/2021	0.56	0.45
2/20/2021	0.52	0.40
2/23/2021	0.24	0.25
1/4/2022	1.42	0.63
1/5/2022	0.66	0.77
1/6/2022	0.41	0.43
1/7/2022	0.13	0.45
1/8/2022	0.27	0.29
3/2/2022	1.05	0.95
3/3/2022	1.1	0.50
3/14/2023	0.98	0.29
3/28/2023	0.29	0.29

EPA Infiltration Analysis Summary

Date	Flow (MGD)	Precipitation (Inch)	Date	Flow (MGD)	Precipitation (Inch)
2/9/23	0.113	0	2/1/22	0.098	0.09
2/10/23	0.079	0	2/2/22	0.099	0.04
2/11/23	0.081	0	2/3/22	0.094	0
2/12/23	0.072	0	2/4/22	0.087	0
2/13/23	0.146	0.11	2/5/22	0.082	0.03
2/14/23	0.183	0.46	2/6/22	0.095	0
2/15/23	0.139	0	2/7/22	0.089	0
2/16/23	0.114	0	2/8/22	0.077	0
2/17/23	0.084	0	2/9/22	0.076	0
2/18/23	0.072	0	2/10/22	0.097	0
2/19/23	0.073	0	2/11/22	0.082	0
2/20/23	0.077	0	2/12/22	0.079	0
1/23/22	0.114	0	2/13/22	0.081	0
1/24/22	0.099	0	2/14/22	0.114	0
1/25/22	0.084	0	3/17/20	0.100	0
1/26/22	0.107	0	3/18/20	0.113	0
1/27/22	0.092	0	3/19/20	0.090	0
1/28/22	0.089	0	3/20/20	0.075	0
1/29/22	0.081	0	3/21/20	0.073	0
1/30/22	0.115	0	3/22/20	0.076	0
1/31/22	0.101	0.18	3/23/20	0.093	0
			Average (MGD):	**0.101**	
			Gal/Day/Capita:	**80**	< Less than 120 gpcd

EPA Inflow Analysis Summary

Date	Flow (MGD)	Precipitation (Inches)
2/25/19	0.422	2.53
4/8/19	1.354	2.31
1/4/22	0.631	1.42
2/26/19	0.386	1.35
4/7/19	1.175	1.35
2/16/20	0.499	1.18
3/31/20	0.374	1.14
3/3/22	0.500	1.1
1/19/19	0.684	1.06
3/2/22	0.949	1.05
5/1/21	0.214	1.04
5/18/20	0.329	1.03
Average (MGD):	**0.626**	
Gal/Day/Capita:	**501**	> Exceeds 275 gpcd

APPENDIX F:

National Oceanic and Atmospheric Administration
Climatography of the United States

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

Climatography of the United States No. 20 1971-2000

National Climatic Data Center
Federal Building
151 Patton Avenue
Asheville, North Carolina 28801
www.ncdc.noaa.gov

Station: LOOKOUT POINT DAM, OR **COOP ID: 355050**

Climate Division: OR 2 **NWS Call Sign:** **Elevation: 712 Feet** **Lat: 43°55N** **Lon: 122°46W**

Precipitation (inches)

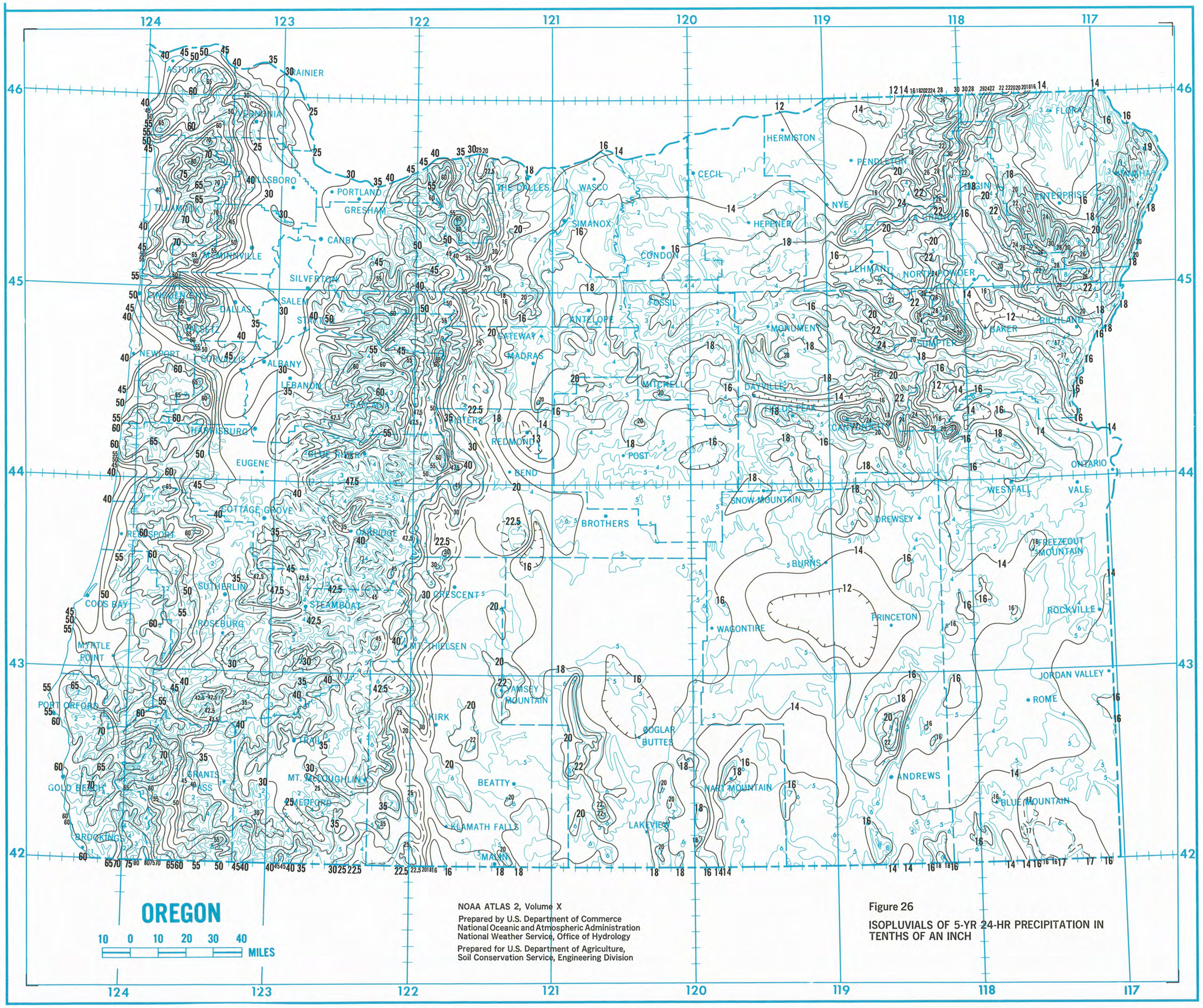
	Precipitation Totals									Mean Number of Days (3)				Precipitation Probabilities (1) Probability that the monthly/annual precipitation will be equal to or less than the indicated amount										
	Means/ Medians(1)		Extremes							Daily Precipitation				Monthly/Annual Precipitation vs Probability Levels These values were determined from the incomplete gamma distribution										
Month	Mean	Med-ian	Highest Daily(2)	Year	Day	Highest Monthly(1)	Year	Lowest Monthly(1)	Year	>= 0.01	>= 0.10	>= 0.50	>= 1.00	.05	.10	.20	.30	.40	.50	.60	.70	.80	.90	.95
Jan	6.03	6.63	3.56	1966	4	11.23	2000	.74	1985	19.2	12.6	4.0	1.1	1.52	2.09	2.97	3.75	4.51	5.32	6.22	7.29	8.69	10.90	12.97
Feb	5.21	4.71	4.05	1961	10	9.96	1986	1.52	1988	18.1	12.0	3.2	.6	1.97	2.45	3.15	3.73	4.28	4.84	5.45	6.16	7.06	8.44	9.71
Mar	5.05	4.81	1.55	1997	2	10.25	1989	1.59	1992	19.9	13.0	3.1	.5	2.28	2.73	3.35	3.85	4.32	4.79	5.29	5.87	6.60	7.70	8.70
Apr	4.23	4.08	2.54	1992	10	7.82	1993	1.66	1987	18.4	11.8	2.4	.2	1.80	2.18	2.72	3.16	3.57	3.99	4.43	4.95	5.60	6.59	7.49
May	3.47	3.17	1.59	1991	8	7.32	1998	.67	1982	14.6	9.2	2.1	.3	1.00	1.33	1.83	2.26	2.68	3.12	3.60	4.18	4.92	6.08	7.16
Jun	2.12	1.77	1.34	1969	26	4.94	1993	.58	1977	9.3	5.9	1.3	.1	.69	.89	1.19	1.44	1.68	1.94	2.21	2.54	2.95	3.60	4.20
Jul	.79	.49	1.49	1987	19	3.52	1987	.01	1972	4.9	2.2	.4	.1	.02	.06	.14	.24	.36	.51	.69	.94	1.29	1.91	2.53
Aug	1.10	.73	2.07	1989	23	4.07	1989	.00+	2000	5.4	2.6	.8	.1	.00	.00	.05	.21	.41	.65	.95	1.34	1.89	2.83	3.80
Sep	1.76	1.62	2.32	1981	27	4.54	1986	.09	1991	7.4	4.8	1.0	.1	.10	.20	.42	.65	.92	1.24	1.63	2.12	2.81	3.99	5.17
Oct	3.28	2.97	2.00	1955	10	7.11	1996	.12	1987	12.2	7.6	2.2	.3	.57	.85	1.33	1.78	2.24	2.74	3.31	4.00	4.92	6.40	7.83
Nov	7.11	6.10	5.50	1996	19	16.92	1973	2.09	1993	20.1	14.1	4.8	1.5	2.25	2.93	3.93	4.78	5.61	6.46	7.40	8.50	9.91	12.12	14.16
Dec	6.57	5.36	4.62	1981	6	15.43	1981	1.23	1976	20.1	13.6	4.3	1.1	1.73	2.35	3.30	4.14	4.96	5.83	6.79	7.94	9.42	11.77	13.96
Ann	46.72	46.22	5.50	Nov 1996	19	16.92	Nov 1973	.00+	Aug 2000	169.6	109.4	29.6	6.0	34.04	36.52	39.68	42.08	44.19	46.24	48.35	50.67	53.48	57.55	61.06

+ Also occurred on an earlier date(s)
# Denotes amounts of a trace
@ Denotes mean number of days greater than 0 but less than .05
** Statistics not computed because less than six years out of thirty had measurable precipitation

(1) From the 1971-2000 Monthly Normals
(2) Derived from station's available digital record: 1955-2001
(3) Derived from 1971-2000 serially complete daily data
Complete documentation available from:
www.ncdc.noaa.gov/oa/climate/normals/usnormals.html

APPENDIX G:

National Oceanic and Atmospheric Administration Isopluvial Map



NOAA ATLAS 2, Volume X

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

Figure 26

ISOPLUVIALS OF 5-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

APPENDIX H:

Biological Model Output Reports

LOWELL PROCESS DESIGN SUMMARY
CONVENTIONAL ACTIVATED SLUDGE
NO PRIMARIES, NON-NITRIFYING

16-Nov-23

	CURRENT YEAR 2023					DESIGN YEAR 2045				
	AVERAGE DRY WEATHER	AVERAGE WET WEATHER	MAX MONTH WW	MAX DAY	MAX HOUR	AVERAGE DRY WEATHER	AVERAGE WET WEATHER	MAX MONTH	MAX DAY	MAX HOUR
RAW WASTEWATER LOADINGS										
Flow, mgd:	0.080	0.20	0.40	1.42	2.40	0.10	0.23	0.43	1.47	2.51
BOD, mg/L:	171	68	64	36		177	77	77	45	
BOD, lbs/day:	114	114	213	423		148	148	276	548	
TSS, mg/L:	193	77	70	42		200	87	85	53	
TSS, lbs/day:	129	129	235	502		167	167	304	650	
NH_3-N, mg/L:	21	8	7	2		22	9	9	3	
NH_3-N, lb/day:	14	14	25	25		18	18	33	33	
TKN, mg/l:	29	12	10	3		30	13	13	4	
TKN, lb/day:	20	20	35	35		25	25	46	46	
RECYCLE STREAM FROM DIGESTERS TO AERATION BASIN										
Flow, gpd:	1,822	2,247	4,163	4,163	4,163	3,082	2,942	5,474	5,474	5,474
BOD, lbs/day:	4.6	4.14	7.70	7.70	-	5.70	5.44	10.16	10.16	-
TSS, lbs/day:	2.7	6.90	12.84	12.84	-	9.49	9.06	16.93	16.93	-
TOTAL LOADINGS TO AERATION BASIN										
Flow, mgd:	0.082	0.20	0.40	1.42	2.40	0.10	0.23	0.44	1.48	2.52
BOD, lbs/day:	118.6	118.1	220.7	430.7	-	153.7	153.4	286.2	558.2	-
BOD, mg/l:	174	70	65	36		179	79	79	45	
TSS, lbs/day:	132	136	248	515	-	176	176	321	667	-
TSS, mg/l:	193	81	74	43		205	91	88	54	
AERATION BASINS - (See detailed calcs. below)										
Basin volume, each of two; gallons:	41,300									
Number basins on line	1	1	1	1	2	1	1	1	1	2
Aeration Volume, gal :	41,300	41,300	41,300	41,300	82,600	41,300	41,300	41,300	41,300	82,600
Detention, hrs:	12.1	4.9	2.5	0.7	0.8	9.6	4.3	2.3	0.7	0.8
SRT, days	3.5	3.5	3.0	1.5		3.5	3.5	3.0	1.5	
Loading, lb BOD/1000 cf/day:	21.5	21.4	40.0	78.0	-	27.8	27.8	51.8	101.1	-
F/M; lb BOD/lb MLVSS:	0.38	0.38	0.45	0.85	-	0.38	0.38	0.45	0.86	-
MLSS, mg/L	1,280	1,290	2,048	2,100	-	1,689	1,669	2,647	2,713	-
Oxygen demand, lb/hr:	4.5	4.4	7.7	10.8	-	5.9	5.7	9.9	13.8	-
Oxygen uptake, mg/L-hr:	13.2	12.8	22.3	31.2	-	17.0	16.6	28.8	40.2	-
Min mixing air (25 scfm/kcf)	138	138	138	138	276	138	138	138	138	276
Air for O_2, scfm:	70	68	119	149	-	90	88	153	192	-
SECONDARY CLARIFIERS										
Number:	1+1									
SC #1 Diameter, ft:	40		SC #1, Surface area, sq. ft:			1,257				
SC #2 Diameter, ft:	28		SC #2, Surface area, sq ft:			616				
Sidewater depth, ft.:	14									
#1 in Service:	0	0	0	1	1	0	0	0	1	1
#2 in Service:	1	1	1	1	1	1	1	1	1	1
Total surfacea area, sq ft:	616	616	616	1,872	1,872	616	616	616	1,872	1,872
Overflow rate, gpd/sf:	133	328	656	761	1,284	167	378	707	788	1,343
Solids load, lb/day/sq ft*:	2.1	5.3	16.8	17.3	-	3.5	7.9	23.4	23.2	-

*Assuming 50% sludge recycle; 30% at max day

	CURRENT YEAR 2023					DESIGN YEAR 2045				
	AVERAGE DRY WEATHER	AVERAGE WET WEATHER	MAX MONTH WW	MAX DAY	MAX HOUR	AVERAGE DRY WEATHER	AVERAGE WET WEATHER	MAX MONTH	MAX DAY	MAX HOUR
PERFORMANCE										
Effluent Quality (Estimated)										
BOD, mg/L:	10	10	10	10	-	10	10	10	10	-
BOD, lb/day:	7	17	33	118	-	8	19	36	123	-
TSS, mg/L:	10	10	10	10	-	10	10	10	10	-
TSS, lb/day:	7	17	33	118	-	8	19	36	123	-
Waste activated sludge										
Assumed TS. %	0.8%	0.8%	0.8%	0.8%		0.8%	0.8%	0.8%	0.8%	
Q, gpd:	1,836	1,776	3,272	6,339		2,427	2,316	4,283	8,415	
TSS, lb/day:	123	119	218	423		162	155	286	561	
VSS, lb/day:	86	83	153	295		113	108	200	391	
SLUDGE PROCESSING										
AEROBIC DIGESTER										
Description: Two basins - 87,000 gals each; one in service										
Volume in Service, gallons:	87,000	87,000	87,000	87,000		87,000	87,000	87,000	87,000	
Estimated VS destruction:	45%	45%	42%	38%		43%	43%	40%	35%	
Assumed TS content with decant:	2.0%	2.0%	2.0%	2.0%		2.0%	2.0%	2.0%	2.0%	
Total Feed (WAS + Drying Bed Drain)										
Flow, gpd	2,335	2,260	4,189	7,256		3,101	2,960	5,509	9,640	
TSS, lb/day	125	121	223	428		165	158	292	568	
VSS, lb/day:	88	85	157	299		116	110	205	396	
Outlet TSS, lb/day:	85	83	157	314		116	110	210	429	
Outlet VSS, lb/day	48	47	91	185		66	63	123	258	
% Volatile	57%	56%	58%	59%		57%	57%	59%	60%	
Outlet Flow, gpd:	512	497	943	1,883		693	662	1,259	2,572	
SRT, days	170	175	92	46		126	131	69	34	
Recycle (Decant to AB))										
Flow, gpd:	1,822	1,763	3,246	3,246	-	2,408	2,298	4,249	4,249	-
TSS, mg/L (assumed)	300	300	300	300	-	300	300	300	300	-
TSS, lb/day:	4.6	4.4	8.1	8.1	-	6.0	5.8	10.6	10.6	-
BOD, lb/day:	2.7	2.6	4.9	4.9	-	3.6	3.5	6.4	6.4	-
TKN, mg/L (assumed)	100	100	100	100	-	100	100	100	100	-
TKN, lb/day	1.5	1.5	2.7	2.7	-	2.0	1.9	3.5	3.5	-
DRYING BEDS										
Volume: 126,000 gallons										
Assumed recovery	97%									
Inlet flow, gpd:	512	497	943	-	-	693	662	1,259	-	-
TS feed, lb/day	85	82.9	157.2	-	-	115.6	110.4	210.1	-	-
Dried cake solids (assumed)	40%	40%	40%	-	-	40%	40%	40%	-	-
Cake, dry lb/day	83	80.5	152.5	-	-	112.1	107.1	203.8	-	-
Cake, wet lb/day	201	195	370	-	-	272	260	494	-	-
Recycle (drain)										
Flow, gpd:	499	484	917	917	-	674	644	1,225	1,225	-
TSS, lb/day:	2.6	2.5	4.7	4.7	-	3.5	3.3	6.3	6.3	-
BOD, lb/day:	1.5	1.5	2.8	2.8	-	2.1	2.0	3.8	3.8	-
TOTAL RECYCLE STREAM										
Flow, gpd:	2,321	2,247	4,163	4,163	4,163	3,082	2,942	5,474	5,474	5,474
TSS, lb/day:	7.1	6.9	12.8	12.8		9.5	9.1	16.9	16.9	
BOD, lb/day:	4.3	4.1	7.7	7.7		5.7	5.4	10.2	10.2	

	CURRENT YEAR 2023					DESIGN YEAR 2045				
	AVERAGE DRY WEATHER	AVERAGE WET WEATHER	MAX MONTH WW	MAX DAY	MAX HOUR	AVERAGE DRY WEATHER	AVERAGE WET WEATHER	MAX MONTH	MAX DAY	MAX HOUR
McKINNEY ACTIVATED SLUDGE MODEL - NON-NITRIFYING										
Nitrifying Yes =1; no =0	0									
Flow, mgd	0.08	0.20	0.40	1.42	2.40	0.10	0.23	0.44	1.48	2.52
Influent BOD, mg/L	174	70	65	36		179	79	79	45	
Influent TSS, mg/L	193	81	74	43		205	91	88	54	
Influent TKN, mg/L	29.4	11.8	10.5	3.0		30.2	13.1	12.9	3.8	
Secondary eff. TSS, mg/L	5	5	5	5		5	5	5	5	
Temperature, deg C	15	15	15	15		15	15	15	15	
Aeration time, hours	12.1	4.9	2.5	0.7	0.8	9.6	4.3	2.3	0.7	0.8
Aeration volume, gallons	41,300	41,300	41,300	41,300	82,600	41,300	41,300	41,300	41,300	82,600
Treatability coefficients										
K_m (20 C)	7.2	7.2	7.2	7.2		7.2	7.2	7.2	7.2	
K_s (20 C)	5.04	5.04	5.04	5.04		5.04	5.04	5.04	5.04	
K_e (20 C)	0.020	0.020	0.020	0.020		0.020	0.020	0.020	0.020	
K_m (@ design temp)	5.09	5.09	5.09	5.09		5.09	5.09	5.09	5.09	
K_s (@ design temp)	3.56	3.56	3.56	3.56		3.56	3.56	3.56	3.56	
K_e (@ design temp)	0.014	0.014	0.014	0.014		0.014	0.014	0.014	0.014	
Mi inf, mg/L	61.8	25.8	23.5	13.9		65.7	29.0	28.3	17.3	
Mii inf, mg/L	48.3	20.1	18.4	10.8		51.3	22.7	22.1	13.5	
Aeration effluent BOD, mg/L	2.8	2.7	4.9	8.0		3.6	3.5	6.3	10.3	
SRT, hrs	84	84	72	36		84	84	72	36	
Ma (active mass), mg/L	379	369	618	679		490	477	796	873	
Me (endogenous mass), mg/L	90	88	126	69		116	113	162	89	
Mi (inorganic mass), mg/L	428	442	691	717		574	572	894	929	
Mii (inert inorg. mass), mg/L	382	391	614	635		509	506	795	822	
MLVSS, mg/L	898	899	1,434	1,465		1,180	1,163	1,853	1,891	
MLSS, mg/L	1,280	1,290	2,048	2,100		1,689	1,669	2,647	2,713	
% Volatile	70.2%	69.7%	70.0%	69.8%		69.9%	69.7%	70.0%	69.7%	
Oxygen uptake, mg/L-hr	13.2	12.8	22.3	31.2		17.0	16.6	28.8	40.2	
Oxygen demand, lb/hr	4.5	4.4	7.7	10.8		5.9	5.7	9.9	13.8	
Lb O_2/Lb BOD_r	0.9	0.9	0.9	0.8		0.9	0.9	0.9	0.8	
Effluent TSS, lb/day	3	8	17	59		4	10	18	62	
Waste sludge, lb/day	123	119	218	423		162	155	286	561	
Waste VSS, lb/day	86	83	153	295		113	108	200	391	
Lb VSS prod/lb BOD rem	0.75	0.75	0.75	0.78		0.76	0.75	0.74	0.78	

LOWELL PROCESS DESIGN SUMMARY
NITRIFYING ACTIVATED SLUDGE
NO PRIMARIES

16-Nov-23

	CURRENT YEAR 2023					DESIGN YEAR 2045				
	AVERAGE DRY WEATHER	AVERAGE WET WEATHER	MAX MONTH WW	MAX DAY	MAX HOUR	AVERAGE DRY WEATHER	AVERAGE WET WEATHER	MAX MONTH	MAX DAY	MAX HOUR
RAW WASTEWATER LOADINGS										
Flow, mgd:	0.080	0.20	0.40	1.42	2.40	0.10	0.23	0.43	1.47	2.51
BOD, mg/L:	171	68	64	36		177	77	77	45	
BOD, lbs/day:	114	114	213	423		148	148	276	548	
TSS, mg/L:	193	77	70	42		200	87	85	53	
TSS, lbs/day:	129	129	235	502		167	167	304	650	
NH_3-N, mg/L:	21	8	7	2		22	9	9	3	
NH_3-N, lb/day:	14	14	25	25		18	18	33	33	
TKN, mg/l:	29	12	10	3		30	13	13	4	
TKN, lb/day:	20	20	35	35		25	25	46	46	
RECYCLE STREAM FROM DIGESTERS TO AERATION BASIN										
Flow, gpd:	1,516	1,947	3,609	3,609	3,609	2,582	2,555	4,950	4,950	4,950
BOD, lbs/day:	3.8	3.60	6.70	6.70	-	4.79	4.73	9.20	9.20	-
TSS, lbs/day:	2.3	6.00	11.16	11.16	-	7.98	7.89	15.34	15.34	-
TOTAL LOADINGS TO AERATION BASIN										
Flow, mgd:	0.082	0.20	0.40	1.42	2.40	0.10	0.23	0.43	1.47	2.51
BOD, lbs/day:	117.8	117.6	219.7	429.7	-	152.8	152.7	285.2	557.2	-
BOD, mg/l:	173	70	65	36		179	79	79	45	
TSS, lbs/day:	131	135	246	513	-	175	175	319	665	-
TSS, mg/l:	193	80	73	43		205	90	88	54	
AERATION BASINS - (See detailed calcs. below)										
Basin volume, each of two; gallons:	41,300									
Number basins on line	2	2	2	2	2	2	2	2	2	2
Aeration Volume, gal :	82,600	82,600	82,600	82,600	82,600	82,600	82,600	82,600	82,600	82,600
Detention, hrs:	24.3	9.8	4.9	1.4	0.8	19.3	8.5	4.6	1.3	0.8
Aerobic SRT, days	14.0	14.0	12.0	5.5		14.0	14.0	9.0	4.0	
Loading, lb BOD/1000 cf/day:	10.7	10.6	19.9	38.9	-	13.8	13.8	25.8	50.5	-
F/M; lb BOD/lb MLVSS:	0.12	0.11	0.13	0.26	-	0.12	0.11	0.17	0.34	-
MLSS, mg/L	2,141	2,251	3,578	3,536	-	2,830	2,914	3,604	3,458	-
Aer. zone O_2 demand, lb/hr:	9.5	9.1	16.2	21.0	-	12.3	11.8	20.7	26.0	-
Aer. zone uptake rate, mg/l-hr	13.7	13.2	23.6	30.4	-	17.8	17.1	30.0	37.8	-
Min mixing air (25 scfm/kcf)	276	276	276	276	276	276	276	276	276	276
Air for O_2, scfm:	146	141	251	291	-	189	182	319	361	-
SECONDARY CLARIFIERS										
Number:	1+1									
SC #1 Diameter, ft:	40		SC #1, Surface area, sq. ft:			1,257				
SC #2 Diameter, ft:	28		SC #2, Surface area, sq ft:			616				
Sidewater depth, ft.:	14									
#1 in Service:	0	0	1	1	1	0	0	1	1	1
#2 in Service:	1	1	0	1	1	1	1	0	1	1
Total surfacea area, sq ft:	616	616	1,257	1,872	1,872	616	616	1,257	1,872	1,872
Overflow rate, gpd/sf:	132	328	321	760	1,284	167	378	346	788	1,343
Solids load, lb/day/sq ft*:	3.5	9.2	14.4	29.1	-	5.9	13.8	15.6	29.5	-

*Assuming 50% sludge recycle; 30% at max day

	CURRENT YEAR 2023					DESIGN YEAR 2045				
	AVERAGE DRY WEATHER	AVERAGE WET WEATHER	MAX MONTH WW	MAX DAY	MAX HOUR	AVERAGE DRY WEATHER	AVERAGE WET WEATHER	MAX MONTH	MAX DAY	MAX HOUR
PERFORMANCE										
Effluent Quality (Estimated)										
BOD, mg/L:	10	10	10	10	-	10	10	10	10	-
BOD, lb/day:	7	17	33	118	-	8	19	36	123	-
TSS, mg/L:	10	10	10	10	-	10	10	10	10	-
TSS, lb/day:	7	17	33	118	-	8	19	36	123	-
Ammonia, mg/L:	1	1	1	5		1	1	1	5	
Waste activated sludge										
Assumed TS. %	0.8%	0.8%	0.8%	0.8%		0.8%	0.8%	0.8%	0.8%	
Q, gpd:	1,528	1,534	2,826	5,748		2,023	2,004	3,863	8,004	
TSS, lb/day:	102	102	189	383		135	134	258	534	
VSS, lb/day:	68	68	127	261		89	89	175	367	
SLUDGE PROCESSING										
AEROBIC DIGESTER										
Description: Two basins - 87,000 gals each; one in service										
Volume in Service, gallons:	87,000	87,000	87,000	87,000		87,000	87,000	87,000	87,000	
Estimated VS destruction:	45%	45%	42%	38%		43%	43%	40%	35%	
Assumed TS content with decant:	2.0%	2.0%	2.0%	2.0%		2.0%	2.0%	2.0%	2.0%	
Total Feed (WAS + Drying Bed Drain)										
Flow, gpd	1,954	1,959	3,632	6,553		2,598	2,571	4,981	9,122	
TSS, lb/day	104	105	193	388		138	137	263	540	
VSS, lb/day:	69	70	130	264		91	92	180	372	
Outlet TSS, lb/day:	73	73	138	287		99	97	192	410	
Outlet VSS, lb/day	38	39	75	164		52	52	108	242	
% Volatile	52%	53%	55%	57%		53%	54%	56%	59%	
Outlet Flow, gpd:	437	438	828	1,723		591	583	1,149	2,456	
SRT, days	199	199	105	51		147	149	76	35	
Recycle (Decant to AB))										
Flow, gpd:	1,516	1,522	2,804	2,804	-	2,007	1,988	3,832	3,832	-
TSS, mg/L (assumed)	300	300	300	300	-	300	300	300	300	-
TSS, lb/day:	3.8	3.8	7.0	7.0	-	5.0	5.0	9.6	9.6	-
BOD, lb/day:	2.3	2.3	4.2	4.2	-	3.0	3.0	5.8	5.8	-
TKN, mg/L (assumed)	100	100	100	100	-	100	100	100	100	-
TKN, lb/day	1.3	1.3	2.3	2.3	-	1.7	1.7	3.2	3.2	-
DRYING BEDS										
Volume: 126,000 gallons										
Assumed recovery	97%									
Inlet flow, gpd:	437	438	828	-	-	591	583	1,149	-	-
TS feed, lb/day	73	73.0	138.1	-	-	98.6	97.2	191.6	-	-
Dried cake solids (assumed)	40%	40%	40%	-	-	40%	40%	40%	-	-
Cake, dry lb/day	71	70.8	134.0	-	-	95.6	94.3	185.8	-	-
Cake, wet lb/day	172	172	325	-	-	232	229	451	-	-
Recycle (drain)										
Flow, gpd:	426	426	806	806	-	575	567	1,118	1,118	-
TSS, lb/day:	2.2	2.2	4.1	4.1	-	3.0	2.9	5.7	5.7	-
BOD, lb/day:	1.3	1.3	2.5	2.5	-	1.8	1.8	3.4	3.4	-
TOTAL RECYCLE STREAM										
Flow, gpd:	1,942	1,947	3,609	3,609	3,609	2,582	2,555	4,950	4,950	4,950
TSS, lb/day:	6.0	6.0	11.2	11.2		8.0	7.9	15.3	15.3	
BOD, lb/day:	3.6	3.6	6.7	6.7		4.8	4.7	9.2	9.2	

	CURRENT YEAR 2023					DESIGN YEAR 2045				
	AVERAGE DRY WEATHER	AVERAGE WET WEATHER	MAX MONTH WW	MAX DAY	MAX HOUR	AVERAGE DRY WEATHER	AVERAGE WET WEATHER	MAX MONTH	MAX DAY	MAX HOUR
McKINNEY ACTIVATED SLUDGE MODEL - NITRIFYING										
Nitrifying Yes =1; no =0	1									
Flow, mgd	0.08	0.20	0.40	1.42	2.40	0.10	0.23	0.43	1.47	2.51
Influent BOD, mg/L	173	70	65	36		179	79	79	45	
Influent TSS, mg/L	193	80	73	43		205	90	88	54	
Influent TKN, mg/L	29.4	11.8	10.5	3.0		30.2	13.1	12.9	3.8	
Secondary eff. TSS, mg/L	5	5	5	5		5	5	5	5	
Temperature, deg C	15	10	10	10		15	10	10	10	
Aeration time, hours	24.3	9.8	4.9	1.4	0.8	19.3	8.5	4.6	1.3	0.8
Aeration volume, gallons	82,600	82,600	82,600	82,600	82,600	82,600	82,600	82,600	82,600	82,600
Anoxic zone, gallons	-	-	-	-	-	-	-	-	-	-
Aerobic zone, gallons	82,600	82,600	82,600	82,600	82,600	82,600	82,600	82,600	82,600	82,600
Treatability coefficients										
K_m (20 C)	7.2	7.2	7.2	7.2		7.2	7.2	7.2	7.2	
K_s (20 C)	5.04	5.04	5.04	5.04		5.04	5.04	5.04	5.04	
K_e (20 C)	0.020	0.020	0.020	0.020		0.020	0.020	0.020	0.020	
K_m (@ design temp)	5.09	3.59	3.59	3.59		5.09	3.59	3.59	3.59	
K_s (@ design temp)	3.56	2.51	2.51	2.51		3.56	2.51	2.51	2.51	
K_e (@ design temp)	0.014	0.010	0.010	0.010		0.014	0.010	0.010	0.010	
Mi inf, mg/L	61.8	25.6	23.4	13.8		65.4	28.9	28.2	17.3	
Mii inf, mg/L	48.3	20.0	18.3	10.8		51.1	22.5	22.0	13.5	
Aeration effluent BOD, mg/L	1.4	1.9	3.5	6.0		1.8	2.5	4.5	7.8	
Aerobic SRT, hrs	336	336	288	132		336	336	216	96	
Total SRT, hrs	336	336	288	132		336	336	216	96	
Ma (active mass), mg/L	289	374	654	864		374	483	779	958	
Me (endogenous mass), mg/L	275	251	376	228		355	324	336	184	
Mi (inorganic mass), mg/L	854	878	1,372	1,311		1,138	1,137	1,335	1,236	
Mii (inert inorg. mass), mg/L	723	748	1175	1133		962	969	1154	1080	
MLVSS, mg/L	1,418	1,502	2,403	2,402		1,868	1,945	2,450	2,378	
MLSS, mg/L	2,141	2,251	3,578	3,536		2,830	2,914	3,604	3,458	
% Volatile	66.2%	66.8%	67.2%	67.9%		66.0%	66.7%	68.0%	68.8%	
Aer zone O_2 total demand, mg/L-hr	13.7	13.2	23.6	30.4		17.8	17.1	30.0	37.8	
Assumed reduction by denit	0%	0%	0%	0%		0%	0%	0%	0%	
Net aer. zone OUR, mg/L-hr	13.7	13.2	23.6	30.4		17.8	17.1	30.0	37.8	
Oxygen demand, lb/hr	9.5	9.1	16.2	21.0		12.3	11.8	20.7	26.0	
Lb O_2/Lb BOD_r	1.9	1.9	1.9	1.4		1.9	1.9	1.8	1.4	
Effluent TSS, lb/day	3	8	17	59		4	10	18	62	
Waste sludge, lb/day	102	102	189	383		135	134	258	534	
Waste VSS, lb/day	68	68	127	261		89	89	175	367	
Lb VSS prod/lb BOD rem	0.59	0.63	0.63	0.70		0.60	0.63	0.66	0.74	

APPENDIX I:

Cost Summaries

Headworks Alternatives:

"Do Nothing" - Keep Existing Headworks As-Is					
Capital Cost					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	"Do Nothing"	1	LS	$0	$0
				Labor and Materials Subtotal	$0
				Mobilization, Insurance, Overhead, Bonds (10%)	$0
				Administration and Legal (5%)	$0
				Contingency (25%)	$0
				Engineering (20%)	$0
				Estimated Construction Costs (2023$)	**$0**
Operations & Maintenance					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Operator Labor - Existing Fine Screen	65	h	$40	$2,600
2	Operator Labor - Bar Rack Maintenance	20	h	$40	$800
3	Replacement Parts	1	LS	$500	$500
4	Electricity Usage	6000	kWh	$0.08	$506
				Estimated Annual O&M (2023$)	**$4,406**
Salvage Value					
#	**Item Description**	**Construction Cost**	**Useful Life**	**Planning Period**	**Salvage Value ($)**
1	"Do Nothing"	$0	0	20	$0
				Estimated Salvage Value (2043$)	**$0**
Net Present Value					
				Discount Rate (2023, OMB Circular No. A-94)	2.0%
				Capital Costs (2023$) **[C]**	$0
				O&M Unified Series Net Worth (2023$) **[OM]**	$72,041
				Salvage Value Present Worth (2023$) **[S]**	$0
				Net Present Value (2023$) [C+OM-S]	**$72,041**

Headworks Alternatives (Continued):

Increase Headworks Screening Capacity					
Capital Cost					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Demo and Site Prep	1	LS	$30,000	$30,000
2	Excavation	30	CY	$90	$2,700
3	Concrete	15	CY	$2,000	$30,000
4	Site Work / Grading / Site Restoration	1	LS	$7,000	$7,000
5	Tie- In to Existing System	1	LS	$5,000	$5,000
6	Mechanical Screen	1	EA	$148,000	$148,000
7	Equipment Installation	1	LS	$44,400	$44,400
8	Electrical and Controls	1	LS	$25,000	$25,000
				Labor and Materials Subtotal	$292,100
				Mobilization, Insurance, Overhead, Bonds (10%)	$29,210
				Administration and Legal (5%)	$14,605
				Contingency (25%)	$73,025
				Engineering (20%)	$58,420
				Estimated Construction Costs (2023$)	**$467,360**
Operations & Maintenance					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Operator Labor - Fine Screen	65	h	$40	$2,600
2	Operator Labor - Bar Rack Maintenance	5	h	$40	$200
3	Replacement Parts	1	LS	$750	$750
4	Electricity Usage	6000	kWh	$0.08	$506
				Estimated Annual O&M (2023$)	**$4,056**
Salvage Value					
#	**Item Description**	**Construction Cost**	**Useful Life**	**Planning Period**	**Salvage Value ($)**
1	Concrete	$30,000	50	20	$18,000
2	Mechanical Screen	$148,000	20	20	$0
3	Electrical and Controls	$25,000	20	20	$0
				Estimated Salvage Value (2043$)	**$18,000**
Net Present Value					
				Discount Rate (2023, OMB Circular No. A-94)	2.0%
				Capital Costs (2023$) **[C]**	$467,360
				O&M Unified Series Net Worth (2023$) **[OM]**	$66,318
				Salvage Value Present Worth (2023$) **[S]**	$12,113
				Net Present Value (2023$) [C+OM-S]	**$521,565**

Secondary Treatment Alternatives:

"Do Nothing" - Keep Existing Biological Treatment System As-Is					
Capital Cost					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	"Do Nothing"	1	LS	$0	$0
				Labor and Materials Subtotal	$0
				Mobilization, Insurance, Overhead, Bonds (10%)	$0
				Administration and Legal (5%)	$0
				Contingency (25%)	$0
				Engineering (20%)	$0
				Estimated Construction Costs (2023$)	**$0**
Operations & Maintenance					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Operator Labor	1296	h	$40	$51,840
2	Replacement Parts	1	LS	$2,000	$2,000
3	Electricity Usage	51100	kWh	$0.08	$4,308
				Estimated Annual O&M (2023$)	**$58,148**
Salvage Value					
#	**Item Description**	**Construction Cost**	**Useful Life**	**Planning Period**	**Salvage Value ($)**
1	"Do Nothing"	$0	0	20	$0
				Estimated Salvage Value (2043$)	**$0**
Net Present Value					
				Discount Rate (2023, OMB Circular No. A-94)	2.0%
				Capital Costs (2023$) **[C]**	$0
				O&M Unified Series Net Worth (2023$) **[OM]**	$950,799
				Salvage Value Present Worth (2023$) **[S]**	$0
				Net Present Value (2023$) [C+OM-S]	**$950,799**

Secondary Treatment Alternatives (Continued):

Redundant Secondary Clarifier					
Capital Cost					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Demo and Site Prep	1	LS	$20,000	$20,000
2	Excavation	85	CY	$90	$7,650
3	Site Work / Grading / Site Restoration	1	LS	$300,000	$300,000
4	Flow Diversion/Splitter	1	EA	$25,000	$25,000
5	Clarifier Structure	1	EA	$150,000	$150,000
6	Clarifier Mechanism and Accessories	1	EA	$60,600	$60,600
7	Clarifier Equipment Install	1	LS	$48,500	$48,500
8	RAS/WAS Pumping Systems	1	LS	$89,000	$89,000
9	Electrical and Controls	1	LS	$100,000	$100,000
				Labor and Materials Subtotal	$800,750
				Mobilization, Insurance, Overhead, Bonds (10%)	$80,075
				Administration and Legal (5%)	$40,038
				Contingency (25%)	$200,188
				Engineering (20%)	$160,150
				Estimated Construction Costs (2023$)	**$1,281,200**
Operations & Maintenance					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Operator Labor	80	h	$40	$3,200
2	Electricity Usage	10000	kWh	$0.08	$843
				Estimated Annual O&M (2023$)	**$4,043**
Salvage Value					
#	**Item Description**	**Construction Cost**	**Useful Life**	**Planning Period**	**Salvage Value ($)**
1	Flow Diversion/Splitter	$25,000	50	20	$15,000
2	Clarifier Structure	$150,000	50	20	$90,000
3	Clarifier Mechanism and Accessories	$60,600	20	20	$0
4	RAS/WAS Pumping Systems	$89,000	20	20	$0
5	Electrical and Controls	$100,000	20	20	$0
				Estimated Salvage Value (2043$)	**$105,000**
Net Present Value					
				Discount Rate (2023, OMB Circular No. A-94)	2.0%
				Capital Costs (2023$) **[C]**	$1,281,200
				O&M Unified Series Net Worth (2023$) **[OM]**	$66,109
				Salvage Value Present Worth (2023$) **[S]**	$70,662
				Net Present Value (2023$) [C+OM-S]	**$1,276,647**

Secondary Treatment Alternatives (Continued):

Supplemental Alkalinity Addition					
Capital Cost					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Demo and Site Prep	1	LS	$10,000	$10,000
2	Excavation	10	CY	$90	$900
3	Site Work / Grading / Site Restoration	1	LS	$3,000	$3,000
4	Site Piping	20	LF	$50	$1,000
5	Supplemental Alkalinity Dosing System	1	LS	$70,000	$70,000
6	Equipment Installation	1	LS	$10,000	$10,000
7	Electrical and Controls	1	LS	$15,000	$15,000
				Labor and Materials Subtotal	$109,900
				Mobilization, Insurance, Overhead, Bonds (10%)	$10,990
				Administration and Legal (5%)	$5,495
				Contingency (25%)	$27,475
				Engineering (20%)	$21,980
				Estimated Construction Costs (2023$)	**$175,840**
Operations & Maintenance					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Operator Labor	32	h	$40	$1,280
2	Electricity Usage	2500	kWh	$0.08	$211
3	MgOH Costs	1000	gal	$3.00	$3,000
				Estimated Annual O&M (2023$)	**$4,491**
Salvage Value					
#	**Item Description**	**Construction Cost**	**Useful Life**	**Planning Period**	**Salvage Value ($)**
1	Site Piping	$1,000	50	20	$600
2	Supplemental Alkalinity Dosing System	$70,000	20	20	$0
3	Electrical and Controls	$15,000	20	20	$0
				Estimated Salvage Value (2043$)	**$600**
Net Present Value					
				Discount Rate (2023, OMB Circular No. A-94)	2.0%
				Capital Costs (2023$) **[C]**	$175,840
				O&M Unified Series Net Worth (2023$) **[OM]**	$73,430
				Salvage Value Present Worth (2023$) **[S]**	$404
				Net Present Value (2023$) [C+OM-S]	**$248,866**

Secondary Treatment Alternatives (Continued):

Trickling Filter - Activated Sludge Rehabilitation					
Capital Cost					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Demo and Site Prep	1	LS	$25,000	$25,000
2	Excavation	30	CY	$90	$2,700
3	Site Work / Grading / Site Restoration	1	LS	$300,000	$300,000
4	Flow Splitter	1	LS	$50,000	$50,000
5	Aeration Basin - Base	30	CY	$750	$22,500
6	Aeration Basin - Walls	40	CY	$1,000	$40,000
7	Aeration Basin Diffusers and Blowers	1	LS	$150,000	$150,000
8	Aeration Basin Equipment Install	1	LS	$75,000	$75,000
9	WAS/RAS Piping	1	LS	$30,000	$30,000
10	Electrical and Controls	1	LS	$60,000	$60,000
				Labor and Materials Subtotal	$755,200
				Mobilization, Insurance, Overhead, Bonds (10%)	$75,520
				Administration and Legal (5%)	$37,760
				Contingency (25%)	$188,800
				Engineering (20%)	$151,040
				Estimated Construction Costs (2023$)	**$1,208,320**
Operations & Maintenance					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Operator Labor	1296	h	$40	$51,840
2	Electricity Usage	146000	kWh	$0.08	$12,308
				Estimated Annual O&M (2023$)	**$64,148**
Salvage Value					
#	**Item Description**	**Construction Cost**	**Useful Life**	**Planning Period**	**Salvage Value ($)**
1	Flow Splitter	$50,000	50	20	$30,000
2	Aeration Basin - Base	$22,500	50	20	$13,500
3	Aeration Basin - Walls	$40,000	50	20	$24,000
4	Aeration Basin Diffusers and Blowers	$150,000	20	20	$0
5	WAS/RAS Piping	$30,000	50	20	$18,000
6	Electrical and Controls	$60,000	20	20	$0
				Estimated Salvage Value (2043$)	**$55,500**
Net Present Value Analysis					
				Discount Rate (2023, OMB Circular No. A-94)	2.0%
				Capital Costs (2023$) **[C]**	$1,208,320
				O&M Unified Series Net Worth (2023$) **[OM]**	$1,048,908
				Salvage Value Present Worth (2023$) **[S]**	$37,350
				Net Present Value (2023$) [C+OM-S]	**$2,219,879**

Secondary Treatment Alternatives (Continued):

Sequencing Batch Reactors					
Capital Cost					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Demo and Site Prep(5%)	1	LS	$180,000	$180,000
2	Excavation	3000	CY	$90	$270,000
3	Site Work / Grading / Site Restoration	1	LS	$300,000	$300,000
4	Site Piping	1	LS	$50,000	$50,000
5	SBR Basin Structures	1	LS	$750,000	$750,000
6	SBR Basin Equipment	1	LS	$315,000	$315,000
7	SBR Basin Equipment Install	1	LS	$130,000	$130,000
8	Electrical and Controls	1	LS	$80,000	$80,000
				Labor and Materials Subtotal	$2,075,000
				Mobilization, Insurance, Overhead, Bonds (10%)	$207,500
				Administration and Legal (5%)	$103,750
				Contingency (25%)	$518,750
				Engineering (20%)	$415,000
				Estimated Construction Costs (2023$)	**$3,320,000**
Operations & Maintenance					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Operator Labor	1192	h	$40	$47,680
2	Electricity Usage	80000	kWh	$0.08	$6,744
				Estimated Annual O&M (2023$)	**$54,424**
Salvage Value					
#	**Item Description**	**Construction Cost**	**Useful Life**	**Planning Period**	**Salvage Value ($)**
1	Site Piping	$50,000	50	20	$30,000
2	SBR Basin Structures	$750,000	50	20	$450,000
3	SBR Basin Equipment	$315,000	20	20	$0
4	Electrical and Controls	$80,000	20	20	$0
				Estimated Salvage Value (2043$)	**$480,000**
Net Present Value Analysis					
				Discount Rate (2023, OMB Circular No. A-94)	2.0%
				Capital Costs (2023$) **[C]**	$3,320,000
				O&M Unified Series Net Worth (2023$) **[OM]**	$889,910
				Salvage Value Present Worth (2023$) **[S]**	$323,026
				Net Present Value (2023$) [C+OM-S]	**$3,886,884**

Secondary Treatment Alternatives (Continued):

Conventional Activated Sludge - Convert Primary Clarifiers to Aeration Basins					
Capital Cost					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Demo and Site Prep	1	LS	$15,000	$15,000
2	Baffle Wall Concrete	20	CY	$1,000	$20,000
3	Flow Splitter	1	LS	$50,000	$50,000
4	Aeration Basin Diffusers and Blowers	1	LS	$200,000	$200,000
5	Aeration Basin Equipment Install	1	LS	$100,000	$100,000
6	WAS/RAS Piping	1	LS	$50,000	$50,000
7	Electrical and Controls	1	LS	$75,000	$75,000
				Labor and Materials Subtotal	$510,000
				Mobilization, Insurance, Overhead, Bonds (10%)	$51,000
				Administration and Legal (5%)	$25,500
				Contingency (25%)	$127,500
				Engineering (20%)	$102,000
				Estimated Construction Costs (2023$)	**$816,000**
Operations & Maintenance					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Operator Labor	958	h	$40	$38,320
2	Electricity Usage	220000	kWh	$0.08	$18,546
				Estimated Annual O&M (2023$)	**$56,866**
Salvage Value					
#	**Item Description**	**Construction Cost**	**Useful Life**	**Planning Period**	**Salvage Value ($)**
1	Baffle Wall Concrete	$20,000	50	20	$12,000
2	Flow Splitter	$50,000	50	20	$30,000
3	Aeration Basin Diffusers and Blowers	$200,000	20	20	$0
4	WAS/RAS Piping	$50,000	50	20	$30,000
5	Electrical and Controls	$75,000	20	20	$0
				Estimated Salvage Value (2043$)	**$72,000**
Net Present Value Analysis					
				Discount Rate (2023, OMB Circular No. A-94)	2.0%
				Capital Costs (2023$) **[C]**	$816,000
				O&M Unified Series Net Worth (2023$) **[OM]**	$929,841
				Salvage Value Present Worth (2023$) **[S]**	$48,454
				Net Present Value (2023$) [C+OM-S]	**$1,697,387**

Secondary Treatment Alternatives (Continued):

Package/Proprietary Activated Sludge System					
Capital Cost					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Demo and Site Prep	1	LS	$125,000	$125,000
2	Excavation	1600	CY	$90	$144,000
3	Site Work / Grading / Site Restoration	1	LS	$150,000	$150,000
4	Package System	1	EA	$250,000	$250,000
5	Equipment Installation	1	LS	$850,000	$850,000
6	Electrical and Controls	1	LS	$25,000	$25,000
				Labor and Materials Subtotal	$1,544,000
				Mobilization, Insurance, Overhead, Bonds (10%)	$154,400
				Administration and Legal (5%)	$77,200
				Contingency (25%)	$386,000
				Engineering (20%)	$308,800
				Estimated Construction Costs (2023$)	**$2,470,400**
Operations & Maintenance					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Operator Labor	958	h	$40	$38,320
2	Electricity Usage	220000	kWh	$0.08	$18,546
				Estimated Annual O&M (2023$)	**$56,866**
Salvage Value					
#	**Item Description**	**Construction Cost**	**Useful Life**	**Planning Period**	**Salvage Value ($)**
1	Package System	$250,000	50	20	$150,000
2	Electrical and Controls	$25,000	20	20	$0
				Estimated Salvage Value (2043$)	**$150,000**
Net Present Value Analysis					
				Discount Rate (2023, OMB Circular No. A-94)	2.0%
				Capital Costs (2023$) **[C]**	$2,470,400
				O&M Unified Series Net Worth (2023$) **[OM]**	$929,841
				Salvage Value Present Worth (2023$) **[S]**	$100,946
				Net Present Value (2023$) [C+OM-S]	**$3,299,295**

Disinfection Alternatives:

Do Nothing – Disinfection Improvements					
Capital Cost					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	"Do Nothing"	1	LS	$0	$0
				Labor and Materials Subtotal	$0
				Mobilization, Insurance, Overhead, Bonds (10%)	$0
				Administration and Legal (5%)	$0
				Contingency (25%)	$0
				Engineering (20%)	$0
				Estimated Construction Costs (2023$)	**$0**
Operations & Maintenance					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Operator Labor	511	h	$40	$20,440
2	Replacement Parts	1	LS	$1,000	$1,000
3	Hypochlorite	2000	gal	$4.00	$8,000
4	Thiosulfate	750	gal	$4.00	$3,000
5	Electricity Usage	5000	kWh	$0.08	$422
				Estimated Annual O&M (2023$)	**$32,862**
Salvage Value					
#	**Item Description**	**Construction Cost**	**Useful Life**	**Planning Period**	**Salvage Value ($)**
1	"Do Nothing"	$0	0	20	$0
				Estimated Salvage Value (2043$)	**$0**
Net Present Value					
				Discount Rate (2023, OMB Circular No. A-94)	2.0%
				Capital Costs (2023$) **[C]**	$0
				O&M Unified Series Net Worth (2023$) **[OM]**	$537,333
				Salvage Value Present Worth (2023$) **[S]**	$0
				Net Present Value (2023$) [C+OM-S]	**$537,333**

Disinfection Alternatives (Continued):

Construct New Chlorine-Based Disinfection System					
Capital Cost					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Demo and Site Prep	1	LS	$30,000	$30,000
2	Excavation	250	CY	$90	$22,500
3	Site Work / Grading / Site Restoration	1	LS	$100,000	$100,000
4	Chlorine Basin, Base	20	CY	$750	$15,000
5	Chlorine Basin, Walls	50	CY	$1,000	$50,000
6	Equipment Installation	1	LS	$100,000	$100,000
7	Electrical and Controls	1	LS	$25,000	$25,000
				Labor and Materials Subtotal	$342,500
				Mobilization, Insurance, Overhead, Bonds (10%)	$34,250
				Administration and Legal (5%)	$17,125
				Contingency (25%)	$85,625
				Engineering (20%)	$68,500
				Estimated Construction Costs (2023$)	**$548,000**
Operations & Maintenance					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Operator Labor	460	h	$40	$18,400
2	Replacement Parts	1	LS	$1,000	$1,000
3	Hypochlorite	1500	gal	$4.00	$6,000
4	Thiosulfate	500	gal	$4.00	$2,000
5	Electricity Usage	3000	kWh	$0.08	$253
				Estimated Annual O&M (2023$)	**$27,653**
Salvage Value					
#	**Item Description**	**Construction Cost**	**Useful Life**	**Planning Period**	**Salvage Value ($)**
1	Chlorine Basin, Base	$15,000	50	20	$9,000
2	Chlorine Basin, Walls	$50,000	50	20	$30,000
3	Electrical and Controls	$25,000	50	20	$15,000
				Estimated Salvage Value (2043$)	**$54,000**
Net Present Value Analysis					
				Discount Rate (2023, OMB Circular No. A-94)	2.0%
				Capital Costs (2023$) **[C]**	$548,000
				O&M Unified Series Net Worth (2023$) **[OM]**	$452,165
				Salvage Value Present Worth (2023$) **[S]**	$36,340
				Net Present Value (2023$) [C+OM-S]	**$963,824**

Disinfection Alternatives (Continued):

Construct UV Disinfection System					
Capital Cost					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Demo and Site Prep	1	LS	$10,000	$10,000
2	Excavation	25	CY	$90	$2,250
3	Site Work / Grading / Site Restoration	1	LS	$12,000	$12,000
4	UV Channel Structure, Base	5	CY	$750	$3,750
5	UV Channel Structure, Walls	10	CY	$1,000	$10,000
6	UV Channel Structure, Cover	1	LS	$25,000	$25,000
7	UV Modules	1	LS	$180,000	$180,000
8	Equipment Installation	1	LS	$25,000	$25,000
9	Electrical and Controls	1	LS	$85,000	$85,000
				Labor and Materials Subtotal	$353,000
				Mobilization, Insurance, Overhead, Bonds (10%)	$35,300
				Administration and Legal (5%)	$17,650
				Contingency (25%)	$88,250
				Engineering (20%)	$70,600
				Estimated Construction Costs (2023$)	**$564,800**
Operations & Maintenance					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Operator Labor	300	h	$40	$12,000
2	Replacement Parts	1	LS	$1,000	$1,000
3	Electricity Usage	15000	kWh	$0.08	$1,265
				Estimated Annual O&M (2023$)	**$14,265**
Salvage Value					
#	**Item Description**	**Construction Cost**	**Useful Life**	**Planning Period**	**Salvage Value ($)**
1	UV Channel Structure, Base	$3,750	50	20	$2,250
2	UV Channel Structure, Walls	$10,000	50	20	$6,000
3	UV Channel Structure, Cover	$25,000	50	20	$15,000
4	UV Modules	$180,000	20	20	$0
5	Electrical and Controls	$85,000	20	20	$0
				Estimated Salvage Value (2043$)	**$15,000**
Net Present Value Analysis					
				Discount Rate (2023, OMB Circular No. A-94)	2.0%
				Capital Costs (2023$) **[C]**	$564,800
				O&M Unified Series Net Worth (2023$) **[OM]**	$233,245
				Salvage Value Present Worth (2023$) **[S]**	$10,095
				Net Present Value (2023$) [C+OM-S]	**$787,950**

Solids Treatment Alternatives:

Do Nothing – Solids Treatment Improvements					
Capital Cost					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	"Do Nothing"	1	LS	$0	$0
				Labor and Materials Subtotal	$0
				Mobilization, Insurance, Overhead, Bonds (10%)	$0
				Administration and Legal (5%)	$0
				Contingency (25%)	$0
				Engineering (20%)	$0
				Estimated Construction Costs (2023$)	**$0**
Operations & Maintenance					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Operator Labor	52	h	$40	$2,080
2	Electricity Usage	180000	kWh	$0.08	$15,174
3	Replacement Parts	1	LS	$1,500	$1,500
				Estimated Annual O&M (2023$)	**$18,754**
Salvage Value					
#	**Item Description**	**Construction Cost**	**Useful Life**	**Planning Period**	**Salvage Value ($)**
1	"Do Nothing"	$0	0	20	$0
				Estimated Salvage Value (2043$)	**$0**
Net Present Value					
				Discount Rate (2023, OMB Circular No. A-94)	2.0%
				Capital Costs (2023$) **[C]**	$0
				O&M Unified Series Net Worth (2023$) **[OM]**	$306,655
				Salvage Value Present Worth (2023$) **[S]**	$0
				Net Present Value (2023$) [C+OM-S]	**$306,655**

Solids Treatment Alternatives (Continued):

Rehabilitate Drying Bed Underdrains					
Capital Cost					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Site Prep	1	LS	$10,000	$10,000
2	Excavation	50	CY	$50	$2,500
3	Drain Pipe	320	LF	$35	$11,200
4	Gravel	25	CY	$85	$2,125
5	Sand	25	CY	$50	$1,250
6	Landscape Fabric	1	LS	$2,000	$2,000
				Labor and Materials Subtotal	$29,075
				Mobilization, Insurance, Overhead, Bonds (10%)	$2,908
				Administration and Legal (5%)	$1,454
				Contingency (25%)	$7,269
				Engineering (20%)	$5,815
				Estimated Construction Costs (2023$)	**$46,520**
Operations & Maintenance					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Operator Labor	52	h	$40	$2,080
2	Replacement Parts	1	LS	$750	$750
3	Solids Hauling	1	LS	$2,500	$2,500
				Estimated Annual O&M (2023$)	**$5,330**
Salvage Value					
#	**Item Description**	**Construction Cost**	**Useful Life**	**Planning Period**	**Salvage Value ($)**
1	Drain Pipe	$11,200	50	20	$6,720
2	Gravel	$2,125	50	20	$1,275
3	Sand	$1,250	50	20	$750
4	Landscape Fabric	$2,000	20	20	$0
				Estimated Salvage Value (2043$)	**$8,745**
Net Present Value Analysis					
				Discount Rate (2023, OMB Circular No. A-94)	2.0%
				Capital Costs (2023$) **[C]**	$46,520
				O&M Unified Series Net Worth (2023$) **[OM]**	$87,153
				Salvage Value Present Worth (2023$) **[S]**	$5,885
				Net Present Value (2023$) [C+OM-S]	**$127,788**

Solids Treatment Alternatives (Continued):

Reconstruct Drying Beds					
Capital Cost					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Site Prep	1	LS	$15,000	$15,000
2	Excavation	50	CY	$50	$2,500
3	Drainpipe	320	LF	$35	$11,200
4	Gravel	25	CY	$85	$2,125
5	Sand	25	CY	$50	$1,250
6	Landscape Fabric	1	LS	$2,000	$2,000
7	Concrete for Guide Walls	100	CY	$1,500	$150,000
8	New Sludge Distribution System	1	LS	$30,000	$30,000
				Labor and Materials Subtotal	$214,075
				Mobilization, Insurance, Overhead, Bonds (10%)	$21,408
				Administration and Legal (5%)	$10,704
				Contingency (25%)	$53,519
				Engineering (20%)	$42,815
				Estimated Construction Costs (2023$)	**$342,520**
Operations & Maintenance					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Operator Labor	26	h	$40	$1,040
2	Replacement Parts	1	LS	$200	$200
3	Solids Hauling	1	LS	$2,500	$2,500
				Estimated Annual O&M (2023$)	**$3,740**
Salvage Value					
#	**Item Description**	**Construction Cost**	**Useful Life**	**Planning Period**	**Salvage Value ($)**
1	Drainpipe	$11,200	50	20	$6,720
2	Gravel	$2,125	50	20	$1,275
3	Sand	$1,250	50	20	$750
4	Landscape Fabric	$2,000	50	20	$1,200
5	Concrete for Guide Walls	$150,000	50	20	$90,000
6	New Sludge Distribution System	$30,000	50	20	$18,000
				Estimated Salvage Value (2043$)	**$117,945**
Net Present Value Analysis					
				Discount Rate (2023, OMB Circular No. A-94)	2.0%
				Capital Costs (2023$) **[C]**	$342,520
				O&M Unified Series Net Worth (2023$) **[OM]**	$61,154
				Salvage Value Present Worth (2023$) **[S]**	$79,374
				Net Present Value (2023$) [C+OM-S]	**$324,301**

Solids Treatment Alternatives (Continued):

Aeration System Improvements for Aerobic Digester					
Capital Cost					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Site Prep	1	LS	$5,000	$5,000
2	Blowers	2	EA	$60,000	$120,000
3	Aeration Pipe Upgrades	1	LS	$25,000	$25,000
4	Valves and Appurtenances	1	LS	$10,000	$10,000
5	Installation	1	LS	$15,000	$15,000
				Labor and Materials Subtotal	$175,000
				Mobilization, Insurance, Overhead, Bonds (10%)	$17,500
				Administration and Legal (5%)	$8,750
				Contingency (25%)	$43,750
				Engineering (20%)	$35,000
				Estimated Construction Costs (2023$)	**$280,000**
Operations & Maintenance					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Operator Labor	52	h	$40	$2,080
2	Electricity Usage	115000	kWh	$0.08	$9,695
3	Replacement Parts	1	LS	$500	$500
				Estimated Annual O&M (2023$)	**$12,275**
Salvage Value					
#	**Item Description**	**Construction Cost**	**Useful Life**	**Planning Period**	**Salvage Value ($)**
1	Blowers	$120,000	20	20	$0
2	Aeration Pipe Upgrades	$25,000	50	20	$15,000
3	Valves and Appurtenances	$10,000	50	20	$6,000
				Estimated Salvage Value (2043$)	**$21,000**
Net Present Value Analysis					
				Discount Rate (2023, OMB Circular No. A-94)	2.0%
				Capital Costs (2023$) **[C]**	$280,000
				O&M Unified Series Net Worth (2023$) **[OM]**	$200,706
				Salvage Value Present Worth (2023$) **[S]**	$14,132
				Net Present Value (2023$) [C+OM-S]	**$466,573**

Collection System Alternatives:

Collection System - I/I Reduction					
Capital Cost					
No.	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Manhole Rehabilitation	1	LS	$54,500	$54,500
2	CCTV Surveillance	1	LS	$13,970	$13,970
3	Cross-Connection Repair	1	LS	$105,000	$105,000
4	Spot Repair of Sewer Pipe Voids	3	EA	$5,000	$15,000
				Labor and Materials Subtotal	$188,470
				Mobilization, Insurance, Overhead, Bonds (10%)	$18,847
				Administration and Legal (5%)	$9,424
				Contingency (25%)	$47,118
				Engineering (20%)	$37,694
				Estimated Construction Costs (2023$)	**$301,552**
Operations & Maintenance					
No.	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Operator Labor	10	h	$40	$400
2	Replacement Parts	1	LS	$1,000	$1,000
				Estimated Annual O&M (2023$)	**$1,400**
Salvage Value					
No.	**Item Description**	**Construction Cost**	**Useful Life**	**Planning Period**	**Salvage Value ($)**
1	Manhole Rehabilitation	$54,500	50	20	$32,700
2	Cross-Connection Repair	$105,000	50	20	$63,000
				Estimated Salvage Value (2043$)	**$32,700**
Net Present Value Analysis					
				Discount Rate (2023, OMB Circular No. A-94)	2.0%
				Capital Costs (2023$) **[C]**	$301,552
				O&M Unified Series Net Worth (2023$) **[OM]**	$22,892
				Salvage Value Present Worth (2023$) **[S]**	$22,006
				Net Present Value (2023$) [C+OM-S]	**$302,438**

Collection System Alternatives (Continued):

Upgrade Alder Street Lift Station					
Capital Cost					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Site Preparation	1	LS	$25,000	$25,000
2	Pump Upgrades	1	LS	$125,000	$125,000
3	Electrical and Controls	1	LS	$85,000	$85,000
				Labor and Materials Subtotal	$235,000
				Mobilization, Insurance, Overhead, Bonds (10%)	$23,500
				Administration and Legal (5%)	$11,750
				Contingency (25%)	$58,750
				Engineering (20%)	$47,000
				Estimated Construction Costs (2023$)	**$376,000**
Operations & Maintenance					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Operator Labor	20	h	$40	$800
2	Replacement Parts	1	LS	$1,000	$1,000
				Estimated Annual O&M (2023$)	**$1,800**
Salvage Value					
#	**Item Description**	**Construction Cost**	**Useful Life**	**Planning Period**	**Salvage Value ($)**
1	Pump Upgrades	$125,000	25	20	$25,000
				Estimated Salvage Value (2043$)	**$25,000**
Net Present Value Analysis					
				Discount Rate (2023, OMB Circular No. A-94)	2.0%
				Capital Costs (2023$) **[C]**	$376,000
				O&M Unified Series Net Worth (2023$) **[OM]**	$29,433
				Salvage Value Present Worth (2023$) **[S]**	$16,824
				Net Present Value (2023$) [C+OM-S]	**$388,608**

Collection System Alternatives (Continued):

Capacity Upgrades - Cannon Avenue Alternative					
Capital Cost					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Site Preparation	1	LS	$20,000	$20,000
2	12" PVC Gravity Sewer	1200	LF	$150	$180,000
3	15" PVC Gravity Sewer	300	LF	$200	$60,000
4	Manhole Assemblies	5	EA	$6,500	$32,500
5	ACP Decommissioning	1	LS	$3,000	$3,000
				Labor and Materials Subtotal	$295,500
				Mobilization, Insurance, Overhead, Bonds (10%)	$29,550
				Administration and Legal (5%)	$14,775
				Contingency (25%)	$73,875
				Engineering (20%)	$59,100
				Estimated Construction Costs (2023$)	**$472,800**
Operations & Maintenance					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Operator Labor	1	h	$40	$40
2	Replacement Parts	1	LS	$500	$500
				Estimated Annual O&M (2023$)	**$540**
Salvage Value					
#	**Item Description**	**Construction Cost**	**Useful Life**	**Planning Period**	**Salvage Value ($)**
1	12" PVC Gravity Sewer	$180,000	50	20	$108,000
2	15" PVC Gravity Sewer	$60,000	50	20	$36,000
3	Manhole Assemblies	$32,500	50	20	$19,500
				Estimated Salvage Value (2043$)	**$163,500**
Net Present Value Analysis					
				Discount Rate (2023, OMB Circular No. A-94)	2.0%
				Capital Costs (2023$) **[C]**	$472,800
				O&M Unified Series Net Worth (2023$) **[OM]**	$8,830
				Salvage Value Present Worth (2023$) **[S]**	$110,031
				Net Present Value (2023$) [C+OM-S]	**$371,599**

Collection System Alternatives (Continued):

Capacity Upgrades - Moss Street Alternative					
Capital Cost					
#.	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Site Preparation	1	LS	$20,000	$20,000
2	10" PVC Gravity Sewer	50	LF	$125	$6,250
3	12" PVC Gravity Sewer	500	LF	$150	$75,000
4	15" PVC Gravity Sewer	750	LF	$200	$150,000
5	Manhole Assemblies	6	EA	$6,500	$39,000
6	ACP Decommissioning	1	LS	$3,000	$3,000
				Labor and Materials Subtotal	$293,250
				Mobilization, Insurance, Overhead, Bonds (10%)	$29,325
				Administration and Legal (5%)	$14,663
				Contingency (25%)	$73,313
				Engineering (20%)	$58,650
				Estimated Construction Costs (2023$)	**$469,200**
Operations & Maintenance					
#	**Item Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**
1	Operator Labor	1	h	$40	$40
2	Replacement Parts	1	LS	$500	$500
				Estimated Annual O&M (2023$)	**$540**
Salvage Value					
#	**Item Description**	**Construction Cost**	**Useful Life**	**Planning Period**	**Salvage Value ($)**
1	10" PVC Gravity Sewer	$6,250	50	20	$3,750
2	12" PVC Gravity Sewer	$75,000	50	20	$45,000
3	15" PVC Gravity Sewer	$150,000	50	20	$90,000
4	Manhole Assemblies	$39,000	50	20	$23,400
				Estimated Salvage Value (2043$)	**$162,150**
Net Present Value Analysis					
				Discount Rate (2023, OMB Circular No. A-94)	2.0%
				Capital Costs (2023$) **[C]**	$469,200
				O&M Unified Series Net Worth (2023$) **[OM]**	$8,830
				Salvage Value Present Worth (2023$) **[S]**	$109,122
				Net Present Value (2023$) [C+OM-S]	**$368,907**

Agenda Item Sheet

City of Lowell City Council

Type of item:	Ordinance

Item title/recommended action:

First reading and public hearing for Ordinance 312, "An Ordinance to Comply with HB 3115 by Repealing Ordinance 240; Adopting Time, Place, and Manner Regulations for Camping; Amending Regulations Regarding Hauled Wastewater Discharging to Accommodate RV Camping on Residential Property; and Repealing the Offense of Vagrancy from Title Five of the Lowell Revised Code." – Discussion/ Possible action

Justification or background:

This is the camping ordinance as presented to you at the February 6, 2024 meeting. In accordance with Chatper VIII of the City Charter, staff advertised the availability of the ordinance in the Register Guard on February 25, 2024. Staff also placed the notice at City Hall and two other public places on February 23, 204. Staff recommend a second and final hearing on March 19, 2024.

Budget impact:

N/A

Department or Council sponsor:

Administration

Attachments:

Ordinance 312, public notice.

Meeting date:	03/05/2024

CITY OF LOWELL, OREGON
NOTICE OF PROPOSED ORDINANCE
AND PUBLIC HEARING FOR
ORDINANCE 312

Pursuant to Chapter VIII of the City of Lowell Charter of 1984, notice is hereby given of the availability of proposed Ordinance 312, "An Ordinance to Comply with HB 3115 by Repealing Ordinance 240; Adopting Time, Place, and Manner Regulations for Camping; Amending Regulations Regarding Hauled Wastewater Discharging to Accommodate RV Camping on Residential Property; and Repealing the Offense of Vagrancy from Title Five of the Lowell Revised Code."

Proposed Ordinance 312 is available for public inspection at Lowell City Hall, 70 N. Pioneer St., Lowell, OR 97452 during normal business hours, Monday through Thursday, 8:00 am to 5:30 pm. The Lowell City Council's public hearing and readings for Ordinance 312 will occur as follows:

- Public hearing and first reading. DATE AND TIME: March 5, 2024 at 7:00 pm. LOCATION: Lowell Fire Department, 389 N Pioneer St, Lowell, OR 97452.
- Second reading and possible vote of approval. DATE AND TIME: March 19, 2024 at 7:00 pm. LOCATION: Lowell Fire Department, 389 N Pioneer St, Lowell, OR 97452.

Interested members of the public may comment on the proposed ordinance at the public hearing or by submitting written testimony by mail at PO Box 490, Lowell OR, 97452, in person at Lowell City Hall, or by email to admin@ci.lowell.or.us. Written comments received by 4:00 pm on March 4, 2024 will be included in the record for the March 5, 2024 public hearing. Questions? Contact City Administrator Jeremy Caudle at the email address just listed or by calling (541) 937-2157.

CITY OF LOWELL, OREGON

ORDINANCE 312

AN ORDINANCE TO COMPLY WITH HB 3115 BY REPEALING ORDINANCE 240; ADOPTING TIME, PLACE, AND MANNER REGULATIONS FOR CAMPING; AMENDING REGULATIONS REGARDING HAULED WASTEWATER DISCHARGING TO ACCOMMODATE RV CAMPING ON RESIDENTIAL PROPERTY; AND REPEALING THE OFFENSE OF VAGRANCY FROM TITLE FIVE OF THE LOWELL REVISED CODE.

The City of Lowell ordains as follows:

Section 1. Ordinance 240, "An Ordinance Adopting Sections 5.240 through 5.247 of the Lowell Revised Code Relating to Camping and Occupancy, Parking and Storage of Recreational Vehicles within the City of Lowell," is repealed.

Section 2. The following sections of the Lowell Revised Code are adopted and replace Sections 5.240, *et seq.*, related to "Camping and Recreational Vehicles."

5.240 Time, manner, and place regulations for camping.

5.241 Purpose of the Lowell Camping Code.
The intent behind sections 5.240 through 5.251 is to protect residents' health and safety and to institute reasonable time, place, and manner regulations for camping within the City limits. These sections may be referred to as the "Lowell Camping Code."

5.242 Definitions.
"Camp" or "camping" is the activity of living outdoors temporarily and includes pitching, erecting, creating, using, or occupying a campsite. This usually involves the use of camp equipment within a campsite.

"Camp equipment" means the various items used for camping. This encompasses, but is not restricted to, beds, blankets, cots, hammocks, mattresses, sleeping bags, tents, tarpaulins, utensils, and similar gear.

"Campsite" means a temporary living space outdoors for habitation—a place used for camping. A campsite generally comprises a space for overnight sleeping and the storage of camp equipment and personal property for camping needs.

"Designated camping area" refers to public property authorized for camping, identified by the Lowell City Council through the adoption of a resolution.

"Highway" means every public way, road, street, thoroughfare within the boundaries of the city, open, used or intended for use of the general public for vehicles or vehicular traffic as a matter of right.

“Motor vehicle” is any self-propelled or designed-for-self-propulsion means of land transportation powered by an engine or motor. This includes, but is not limited to, automobiles, trucks, and similar vehicles.

“Overnight sleeping areas” refers to public property authorized for camping in the absence of a designated camping area or when designated camping areas are closed.

“Personal property” means items identifiable as belonging to an individual and possessing apparent value or utility.

“Public property” means any real property or structures owned, leased, or managed by the City, including public rights-of-way.

“Public rights-of-way” include, but are not limited to, streets, roads, highways, bridges, alleys, sidewalks, trails, paths, public easements and all other public ways or areas, including subsurface and air space over these areas.

"RV" or "Recreational Vehicle" means a vehicle with or without motive power that is designed for use as temporary living quarters, to be easily transported and set up on a daily basis. Examples include motor homes, camping trailers, camper vans, and similar structures. Further definitions are provided by the Oregon Department of Transportation in Chapter 735 OAR, Division 022.

“Shoulder” means the portion of a highway, whether paved or unpaved, contiguous to the roadway that is primarily for use by pedestrians, for the accommodation of stopped vehicles, for emergency use and for lateral support of base and surface courses.

“Store” or “storage” means the act of setting aside or accumulating items for future use, placing them for safekeeping, or leaving them in a particular location.

“Vehicle,” within Sections 5.243 through 5.251, means a motor vehicle or recreational vehicle.

“Vehicle camping” refers to the act of camping inside a motor vehicle or recreational vehicle.

5.243 Camping permitted.

(a) People who do not have a permanent residence and are involuntarily homeless are allowed to camp subject to the time, place, and manner rules set forth in Sections 5.243 through 5.251.
(b) The rules in Sections 5.243 through 5.251 do not apply to the following circumstances:
    (1) Camping that occurs in accordance with a duly executed emergency declaration made by the City Council, Mayor, or designate.
    (2) Camping that occurs in accordance with a special event authorized by the City Council or City Administrator.
    (3) Camping on public property owned or controlled by federal, state, county, or other local agencies where camping is permitted under their rules and otherwise complies with City ordinances.

5.244 Designated camping areas.

(a) Designated camping areas. Camping in designated camping areas is allowed subject to the time, place, and manner restrictions in this section.
(b) Time.
    (1) Use of designated camping areas is allowed between the hours of 7:00 p.m. and 7:00 a.m.

(2) Enforcement of time restrictions may be suspended by the City Administrator or designee for severe weather events or when necessary or appropriate to respond to an individual's medical condition, disability, or unique circumstances.

(c) Place.

(1) Signs indicating the boundary of the designated camping area and the permissible hours of use must be consistently displayed.

(2) Prior to any enforcement action, information sufficient to identify the location of the designated camping area shall be distributed to any individual seeking to lay down or sleep with protection from the elements during the relevant time period.

(3) Campsites must not impede the use of public rights-of-way or access to and from public or private property.

(d) Manner.

(1) Camping equipment may be used or erected within the designated camping area(s) during the allowed time periods.

(2) Camping equipment must not be tied to, secured to, staked or anchored, or propped against any permanent structures or ground located at a designated camping area.

(3) Camping equipment and all personal property must be removed from the designated camping area during times when the area is not designated for use under this section. Any camping equipment or personal property that remains within the designated camping areas during periods of time when the area is not open will be considered abandoned and handled in compliance with state law.

(4) Camping equipment and personal property must be stored completely within the designated camping area.

(5) Individuals must not accumulate, discard, or leave behind garbage, debris, unsanitary or hazardous materials, or other items of no apparent utility in the designated camping areas.

(6) No person shall in any designated camping area, build, light or maintain any fire.

(7) Digging, excavation, terracing of soil, alteration of ground or infrastructure, or damage to vegetation or trees is prohibited.

(e) Campsites are restricted to dimensions of 10 feet by 10 feet.

(f) The City Administrator is authorized to close a designated camping area in the event of any emergency, on the advice of law enforcement, for health and safety concerns, or on the recommendation of the Lowell Rural Fire Protection District’s Fire Chief.

Section 5.245 Overnight sleeping areas.

(a) Overnight Sleeping Area. In the absence of a City Council resolution identifying a designated camping area, or the closure of the City’s designated camping areas, then camping in overnight sleeping areas is allowed subject to the time, place, and manner restrictions in this section.

(b) Time.

(1) Camping in overnight sleeping areas is allowed between 7:00 p.m. and 7:00 a.m.

(2) Enforcement of time restrictions may be suspended by the City Administrator or designee for severe weather events or when necessary or appropriate to respond to an individual's medical condition, disability, or unique circumstances.

(c) Place.

(1) Camping pursuant to this section is prohibited in the following locations:

(i) City owned property that is not open to the public.

(ii) Within 20 feet of the property line of a lot or parcel containing a dwelling.

(iii) Sidewalks and landscape planter strips in all zones.

(iv) Within two hundred feet of a school.

(v) Any place where the act of protecting oneself from the elements, which may include the use of camping equipment, creates a physical impediment to emergency or nonemergency ingress, egress, or access to property, whether private or public, or which impedes the safe use of all public rights-of-way or access to and from public or private property.

(vi) Any vehicle lane, bicycle lane or roundabout within any public right-of-way.

(vii) Within City owned parking lots, including landscaped areas within and around the perimeter of the parking lot.

(viii) Any location that has been determined by the Lowell Rural Fire Protection District Fire Chief, fire marshal, or designee to constitute an elevated threat of fire at a particular time of the year.

(d) Manner.

(1) Camping equipment may be used or erected within the overnight sleeping area(s) during the allowed time periods.

(2) Camping equipment and personal property must not be tied to, secured to, staked or anchored, or propped against any permanent structures or ground located at a designated camping area.

(3) Camping equipment and personal property must be dismantled within the overnight sleeping area during times which the area is not designated for overnight sleeping use under this chapter.

(4) Individuals must not accumulate, discard, or leave behind garbage, debris, unsanitary or hazardous materials, or other items of no apparent utility.

(5) No person shall in any overnight sleeping area, build, light or maintain any fire.

(6) Digging, excavation, terracing of soil, alteration of ground or infrastructure, or damage to vegetation or trees is prohibited.

(e) Campsites are restricted to dimensions of 10 feet by 10 feet.

5.246 Vehicle camping on highway shoulder.

Vehicle camping while parked in the shoulder of a highway is permitted, subject to the following restrictions:

(a) Vehicle camping must adhere to the regulations outlined in Title Six of the Lowell Revised Code.

(b) Vehicles used for camping on the highway shoulder must be in working order and legally drivable.

(c) Vehicles used for camping on the highway shoulder must be relocated at least 200 feet every 24 hours.

(b) All camp equipment and personal property must be kept inside the vehicle. No personal property, camp equipment, garbage, or debris shall be stored in the right-of-way.

(c) Discharging blackwater and graywater into the sewer system or stormwater system, including ditches, while vehicle camping is prohibited.

(d) In residential zones, vehicle camping for RVs is limited to a maximum of 72 hours within a 14-day period. Moving an RV from one location on the highway within the residential zone to another location shall not extend the parking time limits.

(e) Upon receiving notice from the City regarding exceeding the time limit requirements for vehicle camping on highway shoulders, campers are allowed a 4-hour window to relocate their vehicles accordingly.

5.247 Camping on commercial or industrial property, or property owned or controlled by a nonprofit or religious institution.

(a) The owner of a commercial or industrial property, a nonprofit, or a religious institution/place of worship may allow camping, including vehicle camping, provided all of the following conditions are met:

(1) The property owner must first notify the City of their intent to allow camping, and of their ability to comply with the other requirements in this section. An inspection must be

performed by the City to confirm that sanitary facilities are in place, required setbacks are met, and any storage areas are screened, before vehicle or tent camping commences.
(2) Such accommodations must be made free of charge.
(3) Occupancy is limited to three or fewer vehicles or campsites at the same time, in any combination.
(4) Vehicles or campsites must be located within an on-premises parking lot, and are spaced at least 10 feet apart.
(5) All personal property must be stored in vehicles or tents or in a separate storage area that is screened from view from adjacent properties and public rights-of-way.
(6) Campers must be provided access to sanitary facilities, including a toilet, handwashing and trash disposal facilities, with such facilities being at least 20 feet from the property line of a residential use property if not fully contained within a building.

(b) A property owner who allows camping pursuant to subsection (a) of this section may revoke that permission at any time and for any reason.

(c) Notwithstanding the provisions of this section, the City Administrator may:
(1) Revoke the right of a property owner to allow camping on property described in subsection (a) of this section upon finding that the property owner or a camper has violated any applicable law, ordinance, regulation or agreement, or that any activity occurring on that property by a camper is incompatible with the use of the property.
(2) Permission revoked by the City Administrator under this subsection is subject to notice. Notice will be provided in writing, mailed to the address of record and posted at the site. Notice will include information on how to appeal the decision. A property owner wanting to appeal the decision must submit their appeal in writing to the City within 10 days of the notice of decision. The appeal will be reviewed by the City Council in the next available meeting, but no sooner than seven days after the written appeal was received by the City. The decision rendered by the City Council on any appeal made pursuant to this subsection shall be final and binding.

(d) Any person whose permission to camp on property has been revoked pursuant to subsection (b) or (c) of this section must vacate and remove all belongings from the property within four hours of receiving such notice.

(e) All persons participating in a camping program described in subsection (a) of this section do so at their own risk, and nothing in this section creates or establishes any duty or liability for the City or its officers, employees, or agents, with respect to any loss related to bodily injury (including death) or property damage.

5.428 Recreational vehicle camping on residential property.

Recreational vehicle camping or temporary residency within recreational vehicles is permitted on privately owned residential property subject to the following restrictions:

(a) Individuals intending to vehicle camp or temporarily reside on private residential property in an RV must register with the City before camping can commence.

(b) Vehicle camping on residential property requires written permission from the property owner. The property owner is allowed to rescind permission at any time.

(c) RVs used for vehicle camping on residential property shall be placed in the side or rear yard or in a paved or graveled driveway.

(d) Vehicle camping on residential property shall occur only in RVs.

(e) The placement of RVs used for vehicle camping on residential property must comply with the setbacks identified in the Lowell Development Code for accessory structures, unless the camper first applies to the City for a variance, and if that application is approved.

(f) RV connection to the City's water distribution system must comply with Title Four of the Lowell Revised Code.

(g) RV connection to the wastewater collection system and discharge from RVs into the wastewater collection system must comply with Title Four of the Lowell Revised Code.
(h) No personal property shall be stored outside the RV unless it is contained in another structure such as a shed.
(i) No more than one such RV is allowed on any residential property.

Section 5.249 Scheduling and notice of campsite cleanup.
(a) The City Administrator is authorized to schedule cleanup of illegal campsites in coordination with either the Lane County Sheriff's Office or City of Oakridge Police Department.
(b) The City Administrator or designee shall post notice of cleanup for illegal campsites at least 72 hours prior to a cleanup event. Signs shall be posted on adjacent buildings if feasible, or on stakes in the ground stating the time and date of the cleanup and the time and date of the notice posting. Campers must remove camping equipment and personal property within 72 hours from that time or they become subject to removal, confiscation, or destruction.
(c) Notwithstanding subsections (a) and (b) of this section, cleanup of campsites may occur immediately and without notice if the Lane County Sheriff's Office, City of Oakridge Police Department, or other applicable public safety or health agencies determine that either of the following conditions exists:
  (1) An emergency such as possible site contamination by hazardous materials or where there is an immediate danger to human life or safety.
  (2) Illegal activity other than camping.
(d) At the cleanup event, the City Administrator or designee shall post and distribute information on how to retrieve camping equipment and personal property that was retained during the event.
(e) Written notices shall be in both English and Spanish.
(f) Copies of all notices shall be provided to the Oregon Department of Human Services and/or the Lane County Human Services Department.

Section 5.250 Violation – penalty.
A violation of a provision of Sections 5.240 through 5.249, or an order issued under authority of those sections, is a Class D violation.

Section 5.251 Separate violations.
Each day's violation of Sections 5.240 through 5.249, or an order issued under authority of those sections, constitutes a separate offense.

Section 3. Section 4.245 "Hauled wastewater" of the Lowell Revised Code is amended to read as follows:

Section 4.245 – Hauled wastewater.
Discharging septic tank waste or other holding tank or hauled waste into the City's collection system is prohibited, except under the following conditions:
a) The City may grant approval for public or private recreational vehicle holding tank dump sites that comply with the pretreatment requirements set by the City.
b) Recreational vehicle camping or temporary residency, as outlined in LRC 5.247, is exempt from this prohibition, provided the recreational vehicle camping is properly registered and the collection system connection is inspected and approved by the Public Works Director.

Section 4. Section 5.013 "Vagrancy" of the Lowell Revised Code is repealed.

Section 5. An emergency exists that requires the immediate implementation of this ordinance. Therefore, this Ordinance shall take effect immediately upon passage and approval.

Adopted by the City Council of the City of Lowell this ____ day of ____________ 2024.

AYES: ______

NOES: ______

APPROVED:

____
Don Bennett, Mayor

ATTEST:

____
Jeremy Caudle, City Recorder

First reading: __________

Second reading: __________

Adopted: __________

Signed: __________

Effective date: __________