Kennedy Jenks

1500 NE Irving Street, Suite 200
Portland, Oregon 97232
503-423-4000

City of Sandy
Facility Plan Amendment
(2026 Plan Amendment)

1 April 2026

REGISTERED PROFESSIONAL ENGINEER
67045PE
OREGON
01/15/2002
ROBERT SCOTT PEACOCK
EXPIRES: 12/31/2026

Prepared for

SANDY

City of Sandy
39250 Pioneer Boulevard
Sandy, Oregon 97055

KJ Project No. 2276020.00

Table of Contents

Table of Contents

Table of Contents (cont'd)

Table of Contents (cont'd)

List of Tables

Table of Contents (cont'd)

Table of Contents (cont'd)

List of Figures

List of Appendices

List of Acronyms and Abbreviations

%	percent
AAF	Average Annual Flow
ADA	American Disability Act
ADWF	Average Dry Weather Flow
ASCE	American Society of Civil Engineers
ASSB	Aerated Sludge Storage Basin
AWWF	Average Wet Weather Flow
BFP	Belt Filter Press
BOD	Biochemical Oxygen Demand
CAS	Conventional Activated Sludge
CFR	Code of Federal Regulations
CIP	Capital Improvement Program
City	City of Sandy
CMOM	Capacity, Management, Operation and Maintenance
CUP	Conditional Use Permit
CWSRF	Clean Water State Revolving Fund
DDAE	Detailed Discharge Alternatives Evaluation Report
DEQ	Department of Environmental Quality
DMR	Discharge Monitoring Report
ERUs	Equivalent Residential Units
EPA	US Environmental Protection Agency
EQ	Equalization
gpd/sf	gallons per day per square foot
gpm	gallons per minute
HVAC	Heating, Ventilation and Air Conditioning
I&I	Inflow & Infiltration
IBC	International Building Code
IFC	International Fire Code
Leeway	Leeway Engineering Solutions
MBR	Membrane Bioreactor
MCLs	Maximum Contaminant Levels
MG	million gallons
mg/L	milligrams per liter
MGD	million gallons per day
MMDWF	Maximum Month Dry Weather Flow

MMWWF	Maximum Month Wet Weather Flow
NEC	National Electrical Code
NFPA	National Fire Protection Association
NPDES	National Pollutant Discharge Elimination System
Nursery	Iseli Nursery
O&M	Operation & Maintenance
OEESC	Oregon Energy Efficiency Specialty Code
OESC	Oregon Electrical Specialty Code
OFC	Oregon Fire Code
OPCC	Opinion of Construction Cost
OPSC	Oregon Plumbing Specialty Code
OSSC	Oregon Structural Specialty Code
OSU	Oregon State University
PDAF5	Peak Daily Average Flow: 5-year return period
PDR	Preliminary Design Report
PFAS	Per- and Polyfluoroalkyl Substances
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctane Sulfonate
PGE	Portland General Electric
PHF	Peak Hour Flowrate
PIF	Peak Instantaneous Flowrate
ppcpd	pound per capita per day
ppd	pounds per day
PWF	Peak Week Flow
R&R	Rehabilitation and Replacement
RAS	Return Activated Sludge
SCADA	Supervisory Control and Data Acquisition
scfm	Standard Cubic Feet Per Minute
SDC	System Development Charge
SDCs	System Development Charges
SRT	Solids Retention Times
TM	Technical Memorandum
TSS	Total Suspended Solids
UGB	Urban Growth Boundary
UPC	Uniform Plumbing Code
UV	Ultraviolet
VFD	Variable Frequency Drive

VSS	Volatile Suspended Solids
WAS	Waste Activated Sludge
WES	Water Environment Services
WIFIA	Water Infrastructure Finance Innovation Act
WWF	Wet Weather Flow
WWTP	Wastewater Treatment Plant

Reports:

2019 Plan	2019 City of Sandy Wastewater Systems Facility Plan
2020 PDR	2020 Preliminary Design Report
2026 Plan Amendment	2026 City of Sandy Wastewater Systems Facility Plan Amendment (This Report)
Recommended Plan	Recommended Plan within the 2019 Plan
2019 Condition Assessment	Sandy WWTP Condition Assessment Improvements Project

Executive Summary

ES.1 Introduction

The City of Sandy (City) currently discharges wastewater effluent from its wastewater treatment plant (WWTP) to Tickle Creek in the winter (wet weather). and provides filtered water to a local nursery for beneficial reuse in the summer (dry weather). These means of effluent discharge and reuse are constrained by the Three Basin Rule, which prohibits increases in mass load discharge to Tickle Creek, as well as limited demand for effluent during the spring and fall shoulder seasons.

To address these challenges, the recommended approach in the 2019 Plan was for the City to construct a satellite WWTP and convey treated effluent from this WWTP to the new Sandy River outfall. A subsequent Detailed Discharge Alternatives Evaluation (DDAE) Report evaluated options for locating a new outfall to the Sandy River and determined that the Ten Eyck Road and Revenue Bridge site had the most favorable hydrologic and geomorphologic conditions and limited fisheries impacts compared with other potential sites. At that time, this recommendation was deemed unaffordable, and the City had elected to pursue additional alternatives. The evaluation of new alternatives was also required as part of a Consent Decree signed in 2023 to resolve past claims and effluent discharge violations and allow Sandy to develop a long-term wastewater discharge strategy.

This Facility Plan Amendment (2026 Plan Amendment) has been prepared to examine the wastewater treatment and discharge alternatives identified in the Consent Decree and establish a recommended long-term discharge strategy that best meets the City's needs. The City needs to address three challenges in the near-term: (1) mass limits, (2) minimum dilution requirement and (3) shoulder months discharge restrictions. The facility improvements contained within the 2026 Plan Amendment has been developed over several phases of investigation to identify a pathway that is both technically feasible and financially viable for the City to implement.

The 2026 Plan Amendment documents new flow projections reflecting the reduction in infiltration and inflow (I&I) achieved through recent collection system rehabilitation efforts and evaluates alternatives for providing treatment improvements required to maintain treatment at the existing WWTP. Ongoing activities and recent improvements in the collection system and at the WWTP are documented, treatment alternatives are evaluated, and a proposed Capital Improvement Plan (CIP) is identified to meet both near- and long-term needs.

ES.1.1 Purpose

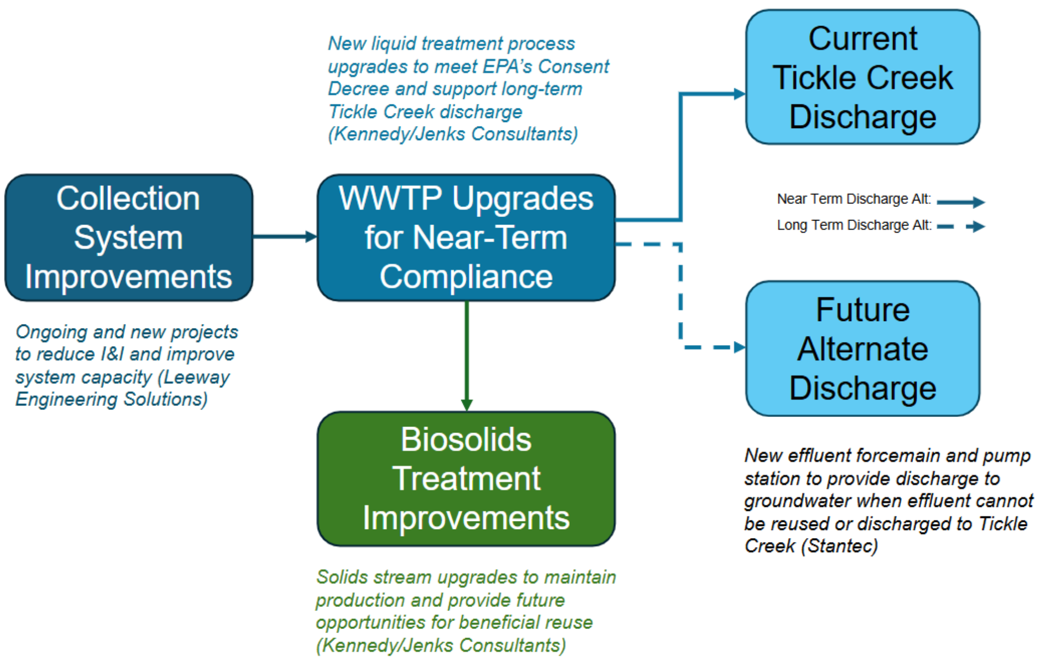
The overarching goal of the 2026 Plan Amendment is to provide the City with an affordable long-term WWTP solution that meets current and future compliance requirements, updates aging infrastructure, and satisfies the reliability criteria required by the Consent Decree with the US Environmental Protection Agency (EPA). This 2026 Plan Amendment builds on the adopted Recommended Plan contained in the 2019 Plan and presents an evaluation of additional wastewater treatment alternatives to meet the

City's goal of remaining in compliance with the NPDES Permit and water quality rules, and a parallel goal accommodating growth.

Key objectives of this effort are to amend the 2019 Plan, to reflect recent and ongoing updates to the wastewater system, and to propose near- and long-term improvements to accommodate future growth and anticipated regulations. The 2026 Plan Amendment updates influent flowrate projections, reflecting the reduction in I&I achieved through recent collection system rehabilitation efforts, and evaluates alternatives to maintain wastewater facilities at the existing site. Specifically, the 2065 Plan Amendment evaluates five alternatives for liquid process improvements and five solid treatment solutions that will replace or expand facilities at the existing treatment plant site, to the southeast or northeast.

Figure ES - 1 illustrates the major components of the 2026 Plan Amendment and anticipated improvements needed to meet growth goals and achieve near- and long-term compliance.

Figure ES - 1: 2026 Plan Amendment Components



ES.1.2 Organization

The 2026 Plan Amendment is intended to supplement, not reproduce the 2019 Plan document. In doing so, this document mirrors the 2019 Plan outline and planning horizon, focusing on updates to the following sections to reflect new information relevant to the development of alternatives:

- Section 1 – Introduction
- Section 8 – Existing Wastewater Treatment Plant Evaluation
- Section 9 – Initial Wastewater Systems Alternatives Evaluation
- Section 10 – Long Term Wastewater Systems Evaluation
- Section 11 – Recommended Capital Improvement Program

All sections start with a brief summary of 2019 Plan content for that section with new information added, as appropriate, to provide context and memorialize activities over the last five years.

The long-term wastewater systems evaluation was completed over several phases of analysis:

1. Screening phase (2024) producing two preferred technical alternatives,
2. Investigation phase (2025) further analyzing the top two alternatives, and
3. Reassessment phase (2026) re-examining long-term strategies when the preferred alternative from the Screening Phase was deemed to be financially inviable.

ES.2 Discharge Compliance Drives the Need for Facility Upgrades

The City's NPDES Permit was last renewed on January 23, 2010, allowing discharge of treated effluent to Tickle Creek during the winter (wet weather) months, November through April, and to Iseli Nursery for irrigation in the summer (dry weather) months of May through October. Permit requirements restrict discharge to Tickle Creek during the winter months to only when a 10 to 1 dilution of the effluent can be achieved. This permit expired as of November 30, 2013 and has been administratively extended. The City submitted a timely application for renewal, and DEQ has issued an applicant review draft of the updated permit which retains the current numerical and seasonal discharge limitations. The City is continuing to engage with DEQ to pursue potential modifications to the NPDES permit.

ES.2.1 Three Basin Rule Mass Load Limitations

Tickle Creek is within the "Three Basin Rule" area, which prohibits increases in mass load discharge to Tickle Creek. The purpose of the Three Basin Rule is to protect three river basins that serve as the primary source of drinking water for a large portion of Oregon's population. The mass load discharge limits provided in the 2010 NPDES Permit cannot be increased under the Three Basin Rule.

Oregon DEQ went through a rulemaking process in 2025 to consider changes to the Three Basin Rule, and the City of Sandy provided written input and was represented on the rulemaking advisory committee. Through the rulemaking process, Sandy and other stakeholders in the Three Basin area provided testimony and input expressing the significant limitations imposed by the Three Basin Rule and potential benefits of modifying the requirements of the rule while continuing to protect water resources in the area. Unfortunately, the changes recommended by DEQ and adopted by the Environmental Quality Commission largely focused on new dischargers. NPDES permit limitations for existing dischargers were not changed, however, the amendments to the rule allow for new “functionally equivalent discharges”. Based on the outcome of the rulemaking process, it is anticipated that requirements of the Three Basin Rule will continue to be in effect throughout the planning period for this Facility Plan Amendment.

ES.2.2 Statewide Dilution Limitations

In addition, the Statewide Narrative Criteria (OAR 340-041-007) dictate that a treated effluent discharge cannot exceed 10% of the total stream flow (have less than 10 to 1 dilution). The City has discussed the possibility of waiving the requirements of this rule with Oregon DEQ. However, given the sensitivity of the streams in the Three Basin area, it is unlikely the permit will be written to exclude the dilution requirement. Therefore, the City will pursue other discharge alternatives, including underground injection to groundwater, and a bridging strategy to permit construction of the new discharge alternative while maintaining compliance with its NPDES permit.

ES.2.3 Wet Weather Influence on Mass Loads

Historically, during the Winter Season, treated discharge from the WWTP occasionally resulted in biochemical oxygen demand (BOD) and total suspended solids (TSS) mass load limitation violations. During the Summer Season, when stream flow is low, no discharge is permitted into Tickle Creek. Beneficial reuse of treated effluent is accomplished by delivering recycled water to the Iseli Nursery for irrigation of nursery stock during summer. This can help alleviate storage constraints during April and October, however, this can be an issue when these months receive significant rain and irrigation water is not needed.

The mass load requirements in the new NPDES permit will remain unchanged. To comply with the terms of the permit, the City must treat its wastewater to an increasingly higher standard and accommodate more influent volume as more residential connections are added to the system. Based on the growth projections, the City is expected to exceed the dilution criteria in the future with most exceedances happening during lower flow events that correspond to low river flow conditions.

The current NPDES permit currently constrains the City in the following ways:

1. Requires higher levels of treatment as the City grows and more connections are added.
2. Discharge to Tickle Creek is restricted when Tickle Creek flowrates are low and result in dilution rates of less than 10 to 1.
3. Prohibits discharge to Tickle Creek during periods when irrigation ponds are full and water is not needed for irrigation.

These challenges are significant and detailed in this 2026 Plan Amendment. This analysis also proposes approaches to solving these challenges including additional treatment alternatives, storage alternatives, and discharge alternatives.

The City signed a Consent Decree with the EPA on September 11, 2023 to bring the WWTP into compliance until a long-term discharge solution could be implemented. The Consent Decree requires the City to evaluate five new additional treatment alternatives, which is a focus of the 2026 Plan Amendment.

ES.3 Planning for Growth

The City is growing, and with growth comes increased wastewater volumes to the wastewater collection system, increased waste loads, and corresponding increased discharges from the treatment plant. Under the Consent Decree, the City has been allowed a limited number of new connections that do not exceed the capacity of the WWTP as established by the EPA and ODEQ under the Consent Decree. After these connections are exhausted, the City will be under a moratorium until the long-term wastewater discharge strategy is implemented. Discharge effluent loading requirements can be met in the short term through wastewater treatment plant upgrades but meeting discharge requirements long-term will require a new discharge alternative for periods when effluent reuse is not feasible and discharge to Tickle Creek is not allowed. In addition, there are anticipated regulations and drivers that will influence the City's approach to managing biosolids from the wastewater treatment facility, creating an opportunity for beneficial reuse but also a recognized risk related to potential requirements related to emerging contaminants.

The current wastewater system has a design capacity to treat 9.3 million gallons per day (MGD). Projected peak hour wet weather flows were anticipated to increase to 12.2 MGD by 2040 before the moratorium, indicating a treatment gap of nearly 3 MGD. The increased wastewater volumes account for an annual population growth rate of 2.8% and future I&I into the collection system based on additional collection system modeling. Given that a future moratorium will limit growth during the planning horizon, improvements to treat and discharge 2040 projected flow and loading will actually provide sufficient capacity beyond 2040 – possibly until as late as 2050.

With increased population comes increased influent waste loads, which can stress the treatment facilities ability to handle additional loading, particularly due to BOD_5 and TSS. BOD_5, which indexes the concentration of organics, is an essential metric in wastewater treatment processes to assess how effective the treatment process is. TSS, or non-dissolved particles, is also an important metric for assessing the effectiveness of the wastewater treatment process. The City's average influent BOD_5 loading is anticipated to increase 60% between 2024 and 2040 as the City population is projected to grow, from 3,300 pounds per day (ppd) to 5,300 ppd. Influent TSS loading is similarly anticipated to increase by 63%, from 3,000 ppd to 4,800 ppd. Treatment upgrades are necessary to address these increasing loads to maintain compliance for current discharges to Tickle Creek as well as to meet future anticipated discharge requirements to an alternative location (e.g., the Sandy River or subsurface injection).

ES.4 Using Value Engineering to Balance Costs and Risks

The 2019 Plan combined the WWTP and collections system into a unified plan to find the best balance investments for the wastewater system as a whole. This 2026 Plan Amendment considers the investments made to the wastewater system since the 2019 Plan, updated flow and load projections, and anticipated future regulations to evaluate a range of facility improvements to meet near- and long-term needs in an affordable way that reduces the City's risk of non-compliance.

The 2026 Plan Amendment makes conservative assumptions based on site constraints and implementation considerations to set reasonable targets and provide a buffer for uncertainties related to regulatory risks and cost influences. The City continues to implement projects that reduce loads on current facilities, repair and replace aging facilities, and plan for future anticipated requirements. However, the necessary improvements for long-term compliance are costly and rehabilitation and process optimization alone will not bring the City to long-term compliance. Thus, the City, their operations team, program management team, and supporting consultants have worked together to address a complicated problem and identify a phased approach to move forward.

The City is continuing to pursue a near-term approach and a long-term approach to collecting and treating wastewater for mass load limits, dilution ratio, and a seasonal discharge period. The City is working in collaboration with the DEQ to develop a bridging strategy as part of the NPDES permit renewal that would enable the City to maintain permit compliance while long-term improvements are being implemented. The following sections describe ongoing activities, and the screening of concepts and alternatives that lead to the recommendations to support an updated, phased CIP.

ES.5 Collection System

In most cases, every dollar spent on collection system improvements equates to additional capacity at the treatment plant. In other words, projects that reduce I&I into the collection system result in lower peak flowrates entering the WWTP.

The 2019 Plan identified improvements to the collection system to provide capacity required to serve the projected growth under the recommended activities at that time. Since adoption of the 2019 Plan, the City has undertaken significant efforts to reduce I&I in the system and has initiated capacity improvements to address needs of the system.

The City has also implemented a Capacity, Management, Operation and Maintenance (CMOM) Program as a comprehensive strategy for managing the wastewater collection system. The City continues to implement collection system repair and rehabilitation projects as well as to identify new projects based on the recent collection system improvements.

ES.6 Discharge Compliance Plan for the Near- and Long-Term

Compliance with current and anticipated future discharge requirements requires near-term improvements at the WWTP, continued reuse of effluent in the summer months and optimization of available storage.

The City is committed to implementing treatment plant upgrades that will achieve effluent BOD and TSS concentrations that will maintain compliance with the NPDES Permit and enable the City to pursue a lower dilution ratio. The treatment alternatives being explored as part of the 2026 Plan Amendment are intended to address the requirements of EPA's Consent Decree and allow for current and future discharge compliance.

The City will need a strategy to manage discharges of effluent to Tickle Creek and irrigation at Iseli Nursery. The apparent trend of decreasing stream flow in Tickle Creek appears to be extending low stream flow during the discharge season, resulting in dilution issues. The shoulder seasons make irrigation challenging, as weather may eliminate the need to irrigate. Coordination with Iseli Nursery to empty ponds to the extent possible each April to provide maximum storage is a critical component of meeting seasonal discharge restrictions.

The City is also committed to securing an alternative discharge as soon as reasonably possible. Three discharge alternatives considered in this Facility Plan Amendment are:

- Constructing a new outfall to a different receiving stream with assimilation capacity. The Sandy River has been selected as the preferred receiving stream. A conceptual design of a pump station and pipeline are the basis of cost estimates used for the planning level costs in this Plan.

- Installing groundwater injection wells to divert effluent from Tickle Creek during peak flow events and the shoulder seasons when discharge to Tickle Creek is not permitted.

- Conveying the City's wastewater to a regional treatment plant. The City has begun discussions with the City of Gresham to understand availability of treatment plant capacity, wholesale customer requirements, and connection fee for wholesale customers. The conceptual design and cost estimates were further developed by the Sandy Clean Water Program team to investigate implementation of this plan at a greater level of detail.

It is possible for any of these alternatives to be permitted, constructed, and in service by approximately 2033, though the timeframe for gaining regulatory approval for a new outfall is much less certain than the timeframe for construction of conveyance to a regional treatment plant.

The first alternative faces a compliance issue while discharging to Tickle Creek because the 10:1 dilution requirement may not be met if low streamflow occurs during the discharge season. The City is pursuing a flow-based discharge limit in the renewed NPDES Permit to maintain compliance.

The second alternative allows for an additional discharge point to groundwater that would not be permitted to surface water under the NPDES permit. Groundwater injection wells would alleviate stress on Tickle Creek and replenish the area aquifers. Injection wells will require additional investigation into the subsurface as well as pilot studies to determine if groundwater injection is an attainable discharge solution.

The third alternative provides an opportunity to contract wastewater treatment and compliance with a larger utility and removes most of the NPDES permit compliance burden from the City and has a more certain timeframe for completion, however, it comes at a greater cost.

The City will take several steps to implement the recommended discharge alternative, including:

- Negotiating a permit that provides greater flexibility for meeting the state's dilution requirement for discharge to Tickle Creek
- Conducting a groundwater infiltration study to determine injection well feasibility
- Negotiating the addition of a new discharge to the existing NPDES permit.

Based on the overall evaluation of treatment alternatives, the City is pursuing groundwater discharge as the preferred alternative while retaining the option of building a new outfall to the Sandy River.

ES.7 Treatment Alternatives - EPA's Consent Decree

The 2026 Plan Amendment explores the WWTP improvements necessary to meet the EPA's Consent Decree, which requires the City to evaluate new additional treatment alternatives, located on or near the existing WWTP site. A concept-level screening approach is applied to the following five possible wastewater treatment project concepts to identify economic, regulatory, implementation, and resiliency challenges:

- **Alternative 1 - Conventional Activated Sludge (CAS):** Expansion of the current CAS process with tertiary treatment (additional aeration trains, secondary clarifier) and tertiary filtration.
- **Alternative 2 - Membrane Bioreactor (MBR):** Conversion of the existing plant to an MBR treatment technology that combines a biological treatment process with membrane filtration.
- **Alternative 3 - Hybrid MBR/CAS**: Conversion of the existing plant to a hybrid installation of an MBR train plant and CAS by converting the existing aeration basin, secondary clarifier, and tertiary filtration train to wet weather operation only.
- **Alternative 4 - Regional Treatment Plant:** Pumping wastewater to an adjacent treatment facility by constructing a new pump station at the existing WWTP site and constructing a pipeline to a WWTP owned and operated by another municipality. This option would include shutting down most of the existing WWTP but maintaining the option to treat and discharge effluent to Tickle Creek.
- **Alternative 5 - Collection System Storage:** This concept includes detention of raw wastewater in a new equalization basin and pump station, or within the existing collection system, then metering the sewage to treatment after peak flowrates and loadings have passed. Select process units will require upgrade to remain in service.

Alternatives 1, 2, and 3 would be implemented at the existing plant site. Alternative 4 would be implemented at the existing plant site, but wastewater would be pumped to another facility for treatment. Alternative 5 would be implemented off site, and the existing plant liquid stream would be maintained (and updated as described) on site.

Alternative 4, the **Regional Treatment Plant concept** would involve the construction of a new pump station and 14-mile long forcemain. With the additional connection charge, this alternative is not the lowest cost option. However, the capital cost may decrease if the City can negotiate a lower connection charge as a wholesale customer to the City of Gresham.

Alternative 5, the **Collection System Storage concept**, would likely meet current regulatory requirements by building more storage to reduce peak flows during high flow events that have previously forced the plant to operate above the available capacity. However, storing more wastewater would not resolve the treatment issue, would be unable to alleviate capacity concerns as growth occurs and waste loads increase, and would have challenging ongoing maintenance requirements to address odor issues and regular cleaning of facilities.

Thus, Alternatives 1, 2, 3 and 4 move forward for additional evaluation and a more comprehensive screening process to score, weight and rank four viable alternatives. The outcomes of the alternatives screening are presented in Table ES-1 and discussed below.

Table ES - 1: Application of Screening Criteria for Liquid Process Alternatives

Criteria	Sub-Criteria	Alt 1: CAS	Alt 2: MBR	Alt 3: Hybrid MBR/CAS	Alt 4: Regional Treat Plant
ECONOMIC	Financial Implementability	1	4	2	1
	Annual Cost Effectiveness	4	3	2	3
PERMIT COMPLIANCE RISK	Near Term Regulatory Risk	2	2	2	4
	Future Regulatory Risk	1	1	1	4
OPERATIONAL CONSIDERATIONS	Operational Complexity	3	2	2	4
	Operational Impacts During Construction	2	4	2	4
	Operational Staffing	3	2	2	4
IMPLEMENTATION	Construction Schedule	2	4	3	4
RESILIENCY	Compliance	1	3	2	4
	Vulnerability	4	4	4	4
	Total Weighted Score:	**2.15**	**3.10**	**2.25**	**3.30**

Score	Legend:
4	Fully Meets Criteria
3	Mostly Meets Criteria
2	Somewhat Meets Criteria
1	Does Not Meets Criteria

Alternative 1: CAS scored lowest overall in the rating scoresheet. The CAS process has the highest construction cost due to the large amount of concrete, new pumps, and need for a separate effluent filtration step. This cost includes construction of the Sandy River outfall and associated pump station. Staffing would remain roughly the same and current Operator certification level would not change. The implementation schedule is also longer due to time needed to construct the basins and challenges associated with operational impacts during construction, because the existing solids process would be interrupted to make the process upgrades. This alternative also requires changing the way the process works while keeping it online, requiring pumping to the clarifiers rather than by gravity. There is also a greater regulatory risk as an upset in the clarifiers could result in losing solids, which would upset the downstream ultrafiltration process, requiring additional cleaning cycles that are more intense than normal operations. In a worst case after an upset condition, without an additional barrier like a submerged membrane, the system could be unable to perform.

Alternative 2: MBR scored the second highest overall. An MBR plant has the benefit of a smaller footprint, lowest cost, and the ability to construct and startup without disrupting current operations. This cost includes construction of the Sandy River outfall and associated pump station. Staffing would remain roughly the same, however, the treatment process requires a higher level of Operator certification. The submerged membrane performs a physical barrier to the sludge, removing toxics and ammonia from the treated effluent. An MBR facility would require higher certification for operators, but due to built-in automation, the plant could be operated by the same number of staff. Overall, a single MBR solution would provide improved operation, compliance, and resiliency.

Alternative 3: Hybrid MBR/CAS scored third, blending the benefits and limitations of Alternatives 1 and 2. Staffing would remain roughly the same, however, the treatment process requires a higher level of Operator certification. Having two processes is more complex to operate, has a mid-range cost and would require more staff along with higher certified staff for the MBR. This cost includes construction of the Sandy River outfall and associated pump station. During wet weather, half of the wastewater would go to the MBR and half to the CAS, and the upset challenges associated with Alternative 1 are not as significant and there will be better removal of ammonia in the portion treated by the MBR. The cost to construct two new treatment components is less than the CAS along but still greater than MBR alone.

Alternative 4: Regional Treatment Plant scored the highest overall and had the lowest construction cost, but the highest overall cost due to the additional initial cost of connection charges. Staffing would potentially be reduced because there would be less equipment to operate and maintain, and the Operator certification would likely revert to a collection system certification only. Pumping sewage 14 miles to treatment at the City of Gresham Wastewater Treatment Plant reduces the risk of permit violation and minimizes operational complexity. The added cost of connection charges could be negotiated significantly lower if the City were to become a wholesale customer with Gresham.

Following this screening phase analysis, two alternatives were carried forward for analysis: **Alternative 2 MBR** and **Alternative 4 Regional Treatment Plant.** An **Investigation Phase** was completed to further evaluate these alternatives with a focus on conducting additional technical analysis of the conveyance and treatment improvements needed to implement this alternative, confirming that the City of Gresham was open to pursuing this alternative, and determining a mutually-agreeable connection charge for service to Sandy. At the end of the Investigation Phase, it was concluded that neither alternative was financially viable, leading to a final **Reassessment Phase** recommending a phased approach centered on upgrading the existing City of Sandy WWTP to MBR treatment while pursuing a new groundwater discharge to augment the existing Tickle Creek discharge and allow the City’s existing beneficial reuse program to continue.

ES.7 Long-Term Biosolids Management and Anticipated Regulations

The 2026 Plan Amendment explores biosolids treatment upgrades needed to maintain production of Class B biosolids given increasing loading and to upgrade to Class A processing to increase beneficial reuse. The biosolids treatment process currently used by the City cannot reliability produce Class B biosolids and the biosolids produced cannot be beneficially reused (land applied) without additional treatment. The City currently stabilizes and dewaters biosolids, which are disposed at a landfill. The biosolids land application site certifications and agreement have expired, and the City is unable to land apply until new sites are certified and landowner agreements have been signed. The City needs a viable long-term solution for biosolids management, which could be sending them to a landfill. Ideally, the biosolids management solution would be one that provides opportunities for beneficial reuse of biosolids.

A concept-level screening approach is applied to the following four solids treatment concepts to identify economic, regulatory, implementation, resiliency and disposal challenges to assess the viability of solids treatment solutions:

1. Class A Aerobic Digestion, Dewatering, and Dryer
2. Class A Non-Digested with ASSB, Dewatering, and Dryer
3. Class B Aerobic Digestion and Dewatering
4. Non-Digested with ASSB and Dewatering

Concept 1 has the highest capital and operating costs but offers unrestricted beneficial use of biosolids. Concept 4 has the lowest cost but does not address future regulatory risks and the product solids cake cannot be used for land application.

Concept 4 most closely resembles the current approach of hauling partially digested and dewatered solids to the landfill during the planning horizon of the Facility Plan Amendment. This approach does not currently require any capacity-related improvements; however, it is recommended that the City consider implementing the recommendations included in Concept 4 (repair of the storage area canopy, replacement of the dewatered solids pump with an inclined screw conveyor) as reliability and maintenance improvements as funding is available.

The City continues to track potential future regulatory requirements related to per- and polyfluoroalkyl substances (commonly referred to as PFAS) limitations for biosolids. Neither Oregon nor the EPA have set any type of regulation on PFAS in biosolids, however, some states have already implemented their own rules and guidelines, offering a glimpse of what potential regulations could affect the City's biosolids.

EPA is conducting a perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) in biosolids risk assessment slated to be completed and released to the public in Winter 2024. The risk assessment will be the basis for determining if there will be regulations on PFOA and PFOS in biosolids.

ES.8 Capital Improvement Plan

This 2026 Plan Amendment brings together ongoing activities with near- and long-term solutions to balance costs and risks and determine a viable CIP for treatment and biosolids while continuing to implement collection system improvements and plan for a discharge relocation to the Sandy River. The foundation of this work is to be responsive to the EPA's Consent Decree while also developing a realistic CIP to be a road map for the City to meet its growth goals and maintain its assets.

The following sections summarize the CIP projects for the collection system, WWTP and biosolids treatment facilities.

ES.8.1 Collection System CIP

The *Draft TM – 2024 Wastewater Collection System Update* (Stantec 2024a), included as Appendix A.2, identifies ongoing and upcoming activities and provides an updated CIP for collection system activities that are included in this 2026 Plan Amendment. The City has four completed projects, 12 ongoing projects and three monitoring projects related to pipeline capacity, I&I, storage and pump station improvements. The collection system CIP projects, costs and anticipated years of completion are listed in Table ES-2.

Table ES - 2: Collection System Rehabilitation Program Projects

Project Name	CIP Cost Estimate (2026 dollars)	Anticipated Year(s) of Completion
Northside Pump Station Upgrades	$0.49M	2026
Pump Station Capacity Evaluation	$0.17M	2027
Flow Monitoring and Model Recalibration	$0.22M	2028
Citywide Manhole Grouting	$0.44M	2029
Basins 3, 9, 10 Rehabilitation	$10.8M	2030
Pump Station Condition and Capacity Upgrades	$2.2M	2031
Total	**$14.3M**	

Source: *Draft TM – 2024 Wastewater Collection System Update* (Stantec 2024a)

ES.8.2 Near-Term Wastewater Treatment CIP

The City is completing interim improvements to allow the existing WWTP to reliably utilize the existing capacity documented through recent stress testing and to maintain permit compliance. These improvements include replacing or upgrading critical processes that are aging and failing and addressing specific capacity limitations. Anticipated projects relevant to this 2026 Plan Amendment include:

- EQ Basin Expansion. This project has increased the maximum water surface elevation in the equalization (EQ) basin by five feet, creating 800,000 gallons of additional equalization volume. The additional storage volume allows the City to use the EQ basin to manage both poor-settling sludge and peak flow conditions. Construction of the EQ Basin Expansion was completed at the end of 2025.

- Process Improvements. The City has completed an in-kind replacement of the existing aeration Blower No. 4 and out-of-service anoxic mixers. A Process Improvements project is also under design to replace WAS pumps and provide WAS flow monitoring for improved process control. Construction of this project will be completed in 2026.

- UV System Replacement. The City is replacing the existing obsolete ultraviolet (UV) disinfection system with a new system that will improve reliability and provide year-round disinfection with UV light to mitigate the risk of release of chlorinated effluent. Construction of this project will be completed in 2027.

- Effluent Pump Station Expansion. The capacity of the Effluent Pump Station is being expanded by replacing the three existing pumps and installing a fourth new pump. These improvements provide firm pumping capacity to convey effluent during the summer design storm conditions. Construction of this project will be completed in 2026.

ES.8.3 Long-term Wastewater Treatment CIP – Initial Recommendation and Alternative Vetting

The Draft Facility Plan Amendment competed in November 2024 identified two preferred alternatives: Alternative 4 – Regional Treatment Plant and Alternative 2 – Membrane Bioreactor (with discharge to a new Sandy River outfall) as the result of the Screening Assessment. The Regional Treatment Plant alternative had a slightly higher total cost but offered the greatest schedule certainty and limited the City of Sandy's risk relative to both near-term permitting and construction of new effluent discharge and long-term compliance with future permit requirements.

As part of the Investigation Phase, the City met with the City of Gresham to discuss the possibility of becoming a customer of Gresham's wastewater treatment plant. The City also identified a preferred location to tie into the City of Gresham's collection system and developed a conceptual design to convey flow to this location through dual force mains and gravity interceptor construction. The cost of this alternative was significantly higher than estimated during the Screening Phase analysis, therefore following the Investigation Phase, the City halted negotiations to connect to a neighboring plant.

The City is pursuing Alternative 2 to construct complete wastewater treatment improvements on the existing plant site and is pursuing discharge to groundwater as a potentially more cost-effective and environmentally beneficial discharge strategy. The total project cost for an MBR expansion at the Sandy WWTP is estimated to be $76M.

Implementing Alternative 2 also requires construction of a new conveyance pipeline to the point of discharge, and potentially additional effluent polishing to meeting groundwater discharge standards that are more stringent than the existing NPDES permit. These improvements are estimated to cost between $58M and $71M, but the final project cost will be determined based on the discharge location and specific effluent polishing requirements. Table ES-3 provides a summary of the program costs for all viable alternatives considered from the Screening through Reassessment phase of the Facility Plan Amendment.

Table ES - 3: Summary of Long-term Wastewater Alternative Costs (2026)

Project Element	Alt. 1 CAS/ Sandy River	Alt 2 MBR/ Sandy River	Alt. 3 Hybrid MBR/ CAS/ Sandy River	Alt 4 City of Gresham (Low)	Alt 4 City of Gresham (High)	Alt 2A MBR/ Reuse/ Tickle Creek/ Groundwater[1]
WWTP Improvements	$82.7M	$67.7M	$79.7M	n/a	n/a	$59.6M
Advanced WWTP Improvements	n/a	n/a	n/a	n/a	n/a	$23.3M
Sandy River Discharge	$66.2M	$67.7M	$79.7M	n/a	n/a	n/a
Groundwater Discharge Improvements	n/a	n/a	n/a	n/a	n/a	$26.0M
Sandy to Gresham Pump Station	n/a	n/a	n/a	$21.6M	$21.6M	n/a
Sandy to Gresham Force Main	n/a	n/a	n/a	$87.7M	$87.7M	n/a
Sandy to Gresham Gravity Main	n/a	n/a	n/a	$25.3M	$25.3M	n/a
Construction Costs	**$148.9M**	**$133.9M**	**$145.9M**	**$134.6M**	**$134.6M**	**$108.9M**
Gresham Connection Fee	n/a	n/a	n/a	$18M	$29M	n/a
Capacity Purchase Costs	**n/a**	**n/a**	**n/a**	**$18M**	**$29M**	**n/a**
Program Management	$6.0M	$5.4M	$5.8M	$5.4M	$5.4M	$4.4M
Construction Management & Inspection	$8.9M	$8.0M	$8.8M	$8.1M	$8.1M	$6.5M
Management Reserve	$14.9M	$13.4M	$14.6M	$13.5M	$13.5M	$10.9M
Soft Costs (Finance, Legal, etc.)	$4.5M	$4.0M	$4.4M	$4.0M	$4.0M	$3.3M
Program Overhead Costs	$34.3M	$30.8M	$33.6M	$31.0M	$31.0M	$25.0M
TOTAL PROJECT COSTS	**$183.2M**	**$164.7M**	**$179.5M**	**$183.5M**	**$194.5M**	**$133.9M**

1. Cost based on advanced polishing for groundwater discharge using filtration with granular activated carbon. If reverse osmosis is required, total project cost increases to $147M.

The City will continue with the feasibility study needed to identify the most suitable area for groundwater discharge and will work with DEQ and Water Resources to determine the most suitable permitting pathway for this discharge. If the effluent polishing requirements, groundwater injection feasibility, or permitting requirements result in this discharge option being less favorable than construction of a new outfall to the Sandy River, the City can proceed with implementing a new Sandy River discharge.

ES.8.5 Capital Improvement Plan Summary

Wastewater treatment system upgrades to provide secure, long-term treatment and discharge of wastewater from the City of Sandy include upgrading the existing WWTP to provide MBR treatment, identifying and securing easements for a new groundwater discharge location and effluent conveyance pipeline, and constructing the new effluent discharge system as well as effluent polishing systems to provide the appropriate advanced treatment for the selected groundwater discharge. The potential cost of effluent polishing and conveyance varies widely based on the location selected and the associated water quality of the underlying aquifer, and the timeframe for completing these final projects also varies depending on the time needed to determine effluent water quality requirements and obtain easements and construction permits.

The expected cost to construct the recommended alternative (in 2026 dollars) is summarized in Table ES - 4. Costs are presented for the initial Phase 1 expansion consisting of treatment plant improvements only (MBR expansion with complete nitrification/denitrification), followed by a Phase 2 expansion including additional effluent polishing and the final groundwater discharge system. The cost of effluent polishing is shown as a range to reflect the potential different treatment technologies that may be required to meet standards for the selected discharge location.

Table ES - 4: Wastewater Treatment and Discharge Projects

Project Element	CIP Cost Estimate (2026 dollars)	Year(s) of Completion
Initial WWTP Upgrade	$62M	2033
Effluent Polishing Improvements	$23-$34M	TBD
Effluent Conveyance and Groundwater Discharge	$24M	TBD
Treatment and Discharge Construction Cost	**$109-$120M**	
Program Management	$4.4-$4.8M	
Construction Management & Inspection	$6.5-$7.2M	
Management Reserve	$11-$12M	
City Administrative Costs	$3.3-$3.6M	
Treatment and Discharge Total Cost	**$134-$147M**	

Currently, the Iseli Nursery is the only recycled water user within the City's service area. The City will monitor development and identify new potential users of recycled water to approach within the City and near existing distribution infrastructure. The City intends to maximize the use of the recycled treated wastewater effluent to offset potable water consumption wherever possible. As new commercial and industrial businesses develop in and around Sandy, the City will communicate with applicants to determine the feasibility of extending the existing Recycled Water program to new users.

Section 1: Introduction

2019 PLAN | SECTION 1 SUMMARY

- Introduces the City of Sandy (City), its wastewater collection system and wastewater treatment plant (WWTP) infrastructure.
- Describes the purpose of the 2019 Plan to develop a strategy to provide wastewater services that accommodate population growth while staying in compliance with environmental regulations and permits.
- Provides an overview of the Sandy wastewater system.
- Outlines the scope and organization of the 2019 Plan to combine the WWTP and the collection system into a unified plan with investments balanced between collection and treatment.

1.1 Introduction

The Introduction section of the 2025 City of Sandy Wastewater Systems Facility Plan Amendment (2026 Plan Amendment) describes the purpose of the updated plan, the current state of facility planning, and new work completed since the 2019 City of Sandy Wastewater Systems Facility Plan (2019 Plan) (Murraysmith 2019).

This document is intended to supplement the 2019 Plan and updates the following sections:

- Section 1 – Introduction
- Section 8 – Existing Wastewater Treatment Plant Evaluation
- Section 9 – Initial Wastewater Systems Alternatives Evaluation
- Section 10 – Long-Term Wastewater Systems Evaluation
- Section 11 – Recommended Capital Improvement Program

These updated sections reflect new information relevant to the development of additional alternatives. Minor updates to other sections are noted as appropriate. All sections start with a brief summary of 2019 Plan content for that section. Subheader numbering and content is in some cases unique to this document.

Since the first draft of this Facility Plan Amendment in 2024 the City has met with stakeholders and regulatory agencies to determine the viability of the proposed alternatives. The initial Screening Phase evaluation considered pumping wastewater to a regional treatment plant partner as the preferred alternative, and treatment with a Sandy River outfall as the secondary alternative. Though these alternatives were technically viable, they are not financially feasible for Sandy to implement.

In early 2026, the City began exploring a variation on Alternative 2 that has the potential to provide a more affordable long-term solution. This approach starts with expansion of the existing WWTP to MBR treatment, adding further polishing and groundwater injection for flow that cannot be reused or discharged to Tickle Creek. This approach has the advantage of maintaining the existing beneficial reuse program, allowing the high-quality, valuable treated effluent to remain in the existing watershed, and reducing the effluent conveyance and discharge costs.

1.1.1 Wastewater Facility Planning Recent History

The City currently discharges treated effluent from its WWTP to Tickle Creek in the winter months (wet weather), November through April, under a National Pollutant Discharge Elimination System (NPDES) Permit, and provides filtered water to a local nursery (Iseli Nursery) for beneficial reuse in the summer months (dry weather), May through October. Current NPDES permit wet weather discharge limits are summarized in Table 1-1.

Table 1-1: Tickle Creek Wet Weather Discharge Limits

Parameter	Average Effluent Concentrations		Monthly Average (lb/day)	Weekly Average (lb/day)	Daily Maximum (lbs)(1)
	Monthly	Weekly			
BOD_5	10 mg/L	15 mg/L	125	187	250
TSS	10 mg/L	15 mg/L	125	187	250
E. coli Bacteria	Shall not exceed 126 organisms per 100 mL monthly geometric mean. No single sample shall exceed 406 organisms per 100 mL.				
pH	Shall be within the range of 6.0 – 9.0				
BOD_5 and TSS Removal Efficiency	Shall not be less than 85% monthly average for BOD5 and 85% monthly for TSS.				
Ammonia (NH_3-N)	Shall not exceed 10.9 mg/L daily maximum or 3.7 mg/L monthly average.				

(1) The daily mass load limit is suspended on any day in which the flow to the treatment facility exceeds 2.5 MGD (twice the design ADWF).

Effluent discharge and reuse are constrained by the “Three Basin Rule” (OAR 340-041-0350), prohibiting increases in mass load discharge to Tickle Creek. In addition to permit requirements and Three Basin Rule requirements, Oregon Water quality policy includes a minimum dilution requirement for discharge to surface waters (including Tickle Creek). The current NPDES permit prohibits discharge when stream flow is less than 10 times the effluent flowrate. In addition, there is limited demand for effluent during the spring and fall shoulder season months, so conveying recycled water to Iseli Nursery during these months is not required. The NPDES permit was renewed on January 23, 2010, and expired as of November 30, 2013. Although the City submitted a timely application for renewal, a renewed permit has not been issued to date. As a result, the Sandy WWTP has been operating under the existing permit, which has been administratively extended.

Historically, during the Winter Season, discharges from the WWTP resulted in biochemical oxygen demand (BOD) and total suspended solids (TSS) mass load limitation violations. During the Summer Season, when stream flow decreases, no discharge is permitted into Tickle Creek. In effect, during the Summer Season no increase in wasteload discharge from the City of Sandy will be permitted into the

Clackamas River Basin under the Three Basin Rule, and the number of mass load violations will increase with increased flows associated with growth without significant changes to the wastewater system.

In addition, the WWTP's permit does not allow for discharge to Tickle Creek when the calculated dilution value is less than 10. Based on growth projections, the City is expected to exceed the dilution criteria in the future, with most exceedances happening during wet weather peak events that occur during low river flow conditions.

Mass load requirements in the new NPDES permit are expected to remain unchanged. Therefore, to comply with the terms of the permit, the City must treat its wastewater to an increasingly higher standard as more residential connections are added to the system.

Additionally, Iseli Nursery's ability to receive and use treated effluent is limited during the "shoulder" months of May/June and October, when discharge to Tickle Creek is not permitted, irrigation ponds are full, and soil conditions do not require irrigation of nursery stock. The nursery irrigation issue is simply an issue of storage of water until the irrigation season when it is needed.

To address these challenges, the recommended approach in the 2019 Plan was for the City to construct a satellite WWTP and convey treated effluent from the WWTP to a new Sandy River outfall. The recommendation for a satellite WWTP was deemed unaffordable and not practical for a small city. The City has elected to maintain treatment at the existing WWTP and build a new Sandy River outfall to provide a reliable long-term discharge solution.

A subsequent *Detailed Discharge Alternatives Evaluation (DDAE) Report* (Murraysmith 2021) evaluated options for locating a new outfall to the Sandy River. The DDAE Report determined that the Ten Eyck Road and Revenue Bridge site was the preferred location for a new Sandy River Outfall because it had the most favorable hydrologic and geomorphologic conditions and limited fisheries impacts compared with other potential sites. The City signed a Consent Decree with the US Environmental Protection Agency (EPA) on September 11, 2023, that provides a schedule for improving the collection and treatment systems. The City of Sandy has been making improvements to the existing treatment plant to improve it's functionality and treatment performance. However, these improvements alone will not enable the City to meet the requirements of the NPDES permit. The Consent Decree also requires the City to evaluate five new additional treatment alternatives included in this Amendment. This Facility Plan Amendment addresses this requirement and provides a recommended plan for long-term wastewater improvements.

1.2 Project Goals and Purpose of the 2026 Plan Amendment

The goal of the 2026 Plan Amendment is to provide the City with a more affordable WWTP that meets compliance requirements, updates aging infrastructure, and satisfies the reliability criteria addressed in the Consent Decree with the EPA. This report presents an evaluation of wastewater treatment alternatives assessing the feasibility of a complete recommended plan that meets NPDES discharge permit limits for concentration and wasteload. This Amendment is also intended to determine the feasibility of meeting water quality standards with respect to dilution in Tickle Creek and effluent storage at Iseli Nursery.

The 2026 Plan Amendment updates influent flowrate projections, reflecting the reduction in inflow and infiltration (I&I) achieved through recent pipeline rehabilitation efforts, and evaluates alternatives for providing improvements required to maintain treatment at the existing WWTP site. Specifically, the 2026 Plan Amendment evaluates five alternatives for liquid process improvements and five solids treatment solutions that will replace or expand facilities at the existing treatment plant site, to the southeast or northeast. With the treatment alternatives, the 2026 Plan considered several discharge/reuse alternatives.

In summary, key objectives of this effort are to update the 2019 Plan, to provide recent and ongoing updates to the wastewater system, and to propose near- and long-term improvements to accommodate future growth and anticipated regulations.

1.3 Consent Decree Requirements

The City signed a Consent Decree with EPA on September 11, 2023 to bring the WWTP into compliance. The Consent Decree requires the City to evaluate five new additional treatment alternatives, including four located on the existing WWTP site. The specific liquid stream treatment alternatives to be evaluated are:

1. Expansion of current Conventional Activated Sludge (CAS) process with secondary treatment (additional aeration trains, secondary clarifier), tertiary filtration, and disinfection;
2. Conversion of the existing plant to a Membrane Bioreactor System (MBR);
3. Conversion of the existing plant to a hybrid installation of an MBR plant with conversion of the existing aeration basin, secondary clarifier, and tertiary filtration train to wet weather operation only;
4. Pumping wastewater to adjacent treatment facility by constructing a new pump station at the existing WWTP site and constructing a pipeline to a WWTP owned and operated by another municipality.
5. Detention of raw wastewater in a new equalization basin and pump station located in the collection system.

Alternatives 1, 2, and 3 would be implemented at the existing plant site. Alternative 4 would be implemented at the existing plant site, but wastewater would be pumped to another facility for treatment. Alternative 5 would be implemented off site, and the existing plant liquid stream would be maintained (and updated as described) on site with select process improvements to replace failing equipment.

As part of the alternative evaluation, the Kennedy Jenks team also evaluated and refined solids stream treatment alternatives to provide Class B and Class A biosolid alternatives.

1.4 New Studies Completed Since the 2019 Plan

Since the completion of the 2019 Plan, the City has completed a number of studies and projects to implement the adopted recommendations. Table 1-2 lists recent studies, summarizing the relevance to the 2026 Plan Amendment. Section 8 summarizes recent process updates and anticipated or in-progress projects at the WWTP.

Table 1-2: Recently Completed Studies Relevant to the 2026 Plan Amendment

Title	Author Date	Relevance to 2026 Plan Amendment
Detailed Discharge Alternatives Evaluation (DDAE) Final Report	Murraysmith, June 2021	• Builds on the adopted recommendations from the 2019 Plan. • Identifies and evaluates discharge options in lieu of or in combination with a direct year-round discharge to the Sandy River.
Preliminary Design Report (PDR) Sandy WWTP Immediate Needs Upgrade Project	Murraysmith, July 2020	• Presented preliminary design for improvements required at the WWTP to implement recommendations from the 2019 Facilities Plan.
Sandy Wastewater Collection System Model Predicted flows for 2023 and 2040	Leeway Engineering Solutions (Leeway), November 2023	• Presented results from collection system modeling following the 2023 collection system repairs and one wet season of flow monitoring. • Provided updated influent wastewater flowrates under projected conditions from 2023 and 2040 that were used in process sizing for this 2026 Plan Amendment.
NPDES Permitting Support Subsurface Infiltration Feasibility Study	Parametrix, November 2022	• Assessed the feasibility of infiltrating effluent from the WWTP to one or more areas for disposal based on technical, regulatory, and cost constraints.
Sandy WWTP Condition Assessment Improvements Project (2019 Condition Assessment)	West Yost, March 2021	• Evaluated and modifies the recommendations from the 2019 Facility Plan Update. • Identified a "wish list" of improvements the City wants to complete at the WWTP. • Established cost-saving approaches to maximize investment in existing plant.
Preliminary Evaluation of Sandy Wastewater Treatment Capacity	West Yost, November 2023	• Defined current flows and loads and identifies limitations in the current WWTP capacity. • Modeled anticipated future flows and loads and identifies how much can be reliably processed at the WWTP.

Title	Author Date	Relevance to 2026 Plan Amendment
Wastewater Facility Plan Detailed Discharge Alternatives Evaluation Market Potential for Sandy's Recycled Water.	Barney & Worth, Inc. and Globalwise, Inc., May 2020	• Evaluated market options and identifies potential users for the City's recycled water in both the near and long term. • Discussed discharge alternatives for the City's recycled water.
Summary of Regional Treatment Investigations Technical Memorandum	Stantec, December 2025	• Provided conceptual evaluation of pump station, force main, and gravity conveyance options to determine recommended conveyance improvements. • Documented available capacity at Gresham WWTP.

1.5 Current State of Facility Planning

The 2019 Plan serves as the basis of this 2026 Plan Amendment. Collection system improvements have reduced the I&I driven peak flowrates and allowed the City to increase the number of new connections (ERUs). The 2026 Plan Amendment is intended to provide a road map to carry the City through a 2040 planning window. The following are significant elements considered in this 2026 Plan Amendment.

- The existing NPDES Permit expired in 2013 and has been administratively extended. The City is currently in discussions with DEQ regarding the applicant draft NPDES Permit.

- The City has been in conversations with Oregon DEQ and EPA regarding permit limit exceedances and signed a Consent Decree in 2023 outlining the steps and schedule to achieve permit compliance.

- The WWTP improvement projects completed in 2022 have improved effluent quality that permit the plant to operate in compliance when wet-weather flowrates do not cause an exceedance of dilution rate or mass load.

- The City conducted a series of stress tests at the WWTP in 2023. The purpose of the stress tests were to update the City's understanding of process unit capacity following recent plant updates prior to 2023. West Yost prepared a *Draft Sandy Wastewater Treatment Plant Capacity Evaluation Report* dated September 2023 summarizing the results of improvements, calibration of a process model, and summary of plant capacity. This report recommended next steps for the treatment plant to meet reliability requirements.

- The biosolids process currently used will not reliably produce Class B biosolids through the planning window, and biosolids cannot be beneficially reused (land application) without additional treatment.

- The City currently stabilizes and dewaters biosolids, which are disposed at a landfill. The biosolids land application site certifications and agreement have expired, and the City is unable to land apply until new sites are certified and landowner agreements have been signed.

- Several of the unit processes require upgrades to meet EPA redundancy and reliability requirements for a major discharger.

- The 2025 Amendments to the Three Basin Rule and the State's renewed focus on developing recycled water use provide a new pathway and options for beneficial use of treated effluent. This provides the City with at least one additional discharge alternative that is considered within the 2026 Plan. The recommended treatment alternatives offer the City the technology to maximize reuse opportunities.

This 2026 Plan Amendment provides cost-effective solutions to address these issues.

Section 2: Study Area Characterization

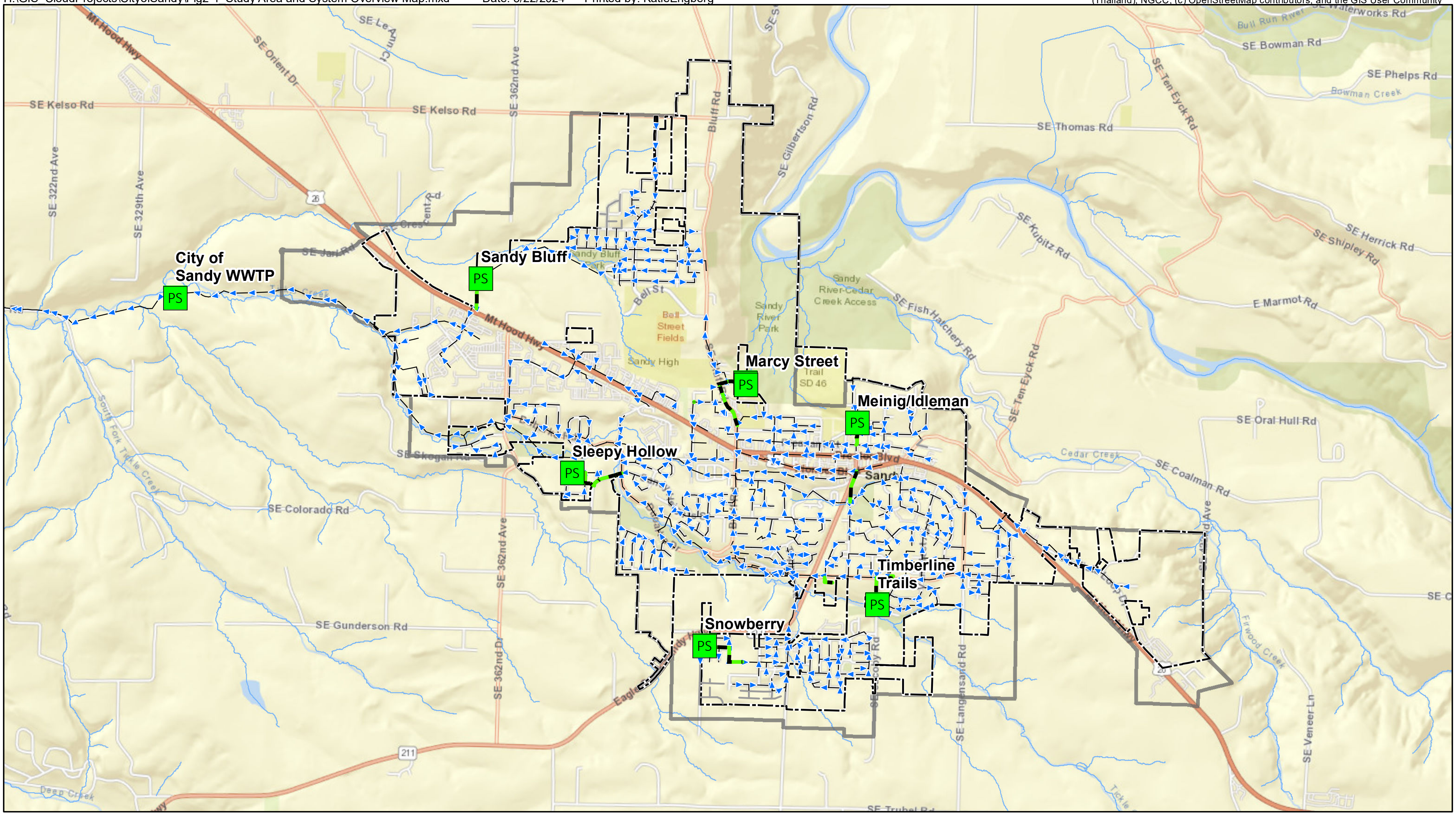
2019 PLAN | SECTION 2 SUMMARY

- Outlines the wastewater system study area characteristics, including geography, topography, climate, general soil conditions, and zoning designations.
- Documents the City's socioeconomic conditions, including a discussion on the major sources of commerce within the City and the historical population trends.

There are no notable changes to the study area characterization from the 2019 Plan. For reference, Figure 2-1 illustrates the City's current wastewater service area, components of the wastewater collection and treatment system, and shows key geographic features referenced in this report.

H:\GIS_CloudProjects\CityofSandy\Fig2-1_Study Area and System Overview Map.mxd   Date: 5/22/2024   Printed by: KatieEngberg

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Legend

- PS Pump Station
- City Limits
- Study Area
- Sewer Force Mains
- Sewer Gravity Mains
- Sewer pipe - not modeled
- Streams

N

0 1,600 3,200

Scale: Feet

Kennedy Jenks

City of Sandy, Oregon
Wastewater System Facility Plan

Study Area and System Overview Map

2276020*00

Figure 2-1

Section 3: Existing System Description

2019 PLAN | SECTION 3 SUMMARY

- Describes the City's existing sanitary sewer collection and treatment systems.
- The existing sanitary sewer collection system includes approximately 40 miles of gravity sewer, 1,100 manholes, 1.2 miles of force main, and six public pump stations (lift stations).
- Wastewater is collected by smaller service pipelines and is conveyed to the Sandy WWTP via a trunk sewer located along Tickle Creek, a tributary of Deep Creek and the Clackamas River.
- Treatment processes include preliminary treatment, activated sludge secondary treatment process, secondary clarification, disk cloth filtration, and disinfection.
- The WWTP is rated for a peak flow rate of 7 million gallons per day (MGD).

Post-treatment effluent discharges to Tickle Creek during the winter and is applied to agricultural land during the summer.

The City has completed improvements to the WWTP since the 2019 Plan. Updates to the WWTP were completed in 2021 and 2022 to rehabilitate failing existing process equipment. A summary of recent updates and anticipated in-progress projects are summarized in Section 8 with additional detail provided in *Preliminary Design Report (PDR) Sandy WWTP Immediate Needs Upgrade Project* (Murraysmith 2021).

Section 4: Regulatory Requirements

2019 PLAN | SECTION 4 SUMMARY

- Summarizes the current and future regulatory requirements for the City's WWTP and collection system.
- The following elements are discussed in detail:
  - Review of current NPDES Permit
  - Permit Compliance Evaluation and Findings
  - Future Estimated Discharges
  - EPA Reliability Evaluation
  - Review of Pre-Treatment Regulation
  - Collection System Regulations
  - Biosolids Management Regulations

4.1 NPDES Discharge Permit Limits

As described in Section 1.1.1 the existing NPDES permit for the Sandy WWTP expired as of November 30, 2013. The City submitted a timely application for renewal, and a permit renewal is currently being prepared. In addition to BOD_5, TSS, pH, and E. coli, it is anticipated that DEQ will assess the need to include discharge limits for the following pollutants according to current water quality standards:

- Ammonia-Nitrogen
- Copper using the Biotic Ligand Model
- Metals – Zinc, Cadmium, and Nickel
- Trace Organics – Volatile and semi-volatile compounds

The Sandy WWTP has been operating under the existing permit, which has been administratively extended. This amendment generally references the existing permit limits.

4.1.1 Tickle Creek Outfall Discharge Limits Update

There are no predicted changes to current and future water quality requirements or predicted NPDES Permit limits from the 2019 Plan that are relevant to the 2026 Plan Amendment. The planning team primarily used existing permit limits as targets with consideration of anticipated water quality limits for ammonia and total nitrogen based on best available treatment capabilities of activated sludge with tertiary filtration. The NPDES permit and discharge evaluation update are further discussed in Section 9.

4.1.2 Sandy River Outfall Discharge Limits Update

The 2019 Plan recommended the City pursue an outfall to the Sandy River under its next NPDES Permit Renewal to allow the City to increase the volume of treated effluent and also extend the discharge period to year-round. The *TM – Sandy River Pump Station Forcemain and Outfall* (Stantec 2024), included in Appendix A.1, provides additional details about the City's plan to construct a pump station and forcemain to convey treated effluent to the Sandy River.

Tickle Creek has more restrictions related to water quality, and therefore, has more stringent discharge limits. The Sandy River is larger and has fewer water quality limitations. Therefore, the Tickle Creek limits will be used as the basis of design for this 2026 Plan Amendment as a conservative approach.

4.1.3 Injection Well Discharge Limits

The DEQ sets minimum requirements for treated wastewater effluent discharged to groundwater under OAR 340-040-0020. Additional field investigation is needed to determine if it is feasible to discharge the projected volumes to the subsurface as groundwater recharge during the shoulder months, as well as input from DEQ on the required groundwater protection procedures that will need to be included in a groundwater monitoring plan. The groundwater contaminant that would drive treatment process requirements is the Nitrate-N concentration. The Maximum Contaminant Level (MCL) allowed in groundwater is 10 mg/L, and effluent concentration limits are anticipated to range from 5 to 10 mg/L Nitrate-N. Under the Amended Three Basin Rule, a new Water Pollution Control Facilities (WPCF) permit also may be issued for treatment facilities that do not discharge to surface waters and meet all ground water quality protection requirements.

4.1.4 Summer Irrigation with Recycled Water

In the summer season, the City conveys treated effluent to Iseli Nursery where it is stored and used for irrigation. This generally coincides with the NPDES permit, which prohibits discharge of effluent to Tickle Creek from May through October. During unusually wet years, Iseli Nursery does not require irrigation during April or October, and their ponds may already be filled completely.

The Kennedy Jenks team evaluated discharge alternatives, including increasing storage at Iseli Nursery. Increasing storage at the Nursery could allow storage of effluent during the shoulder seasons, the months immediately before and after the summer season, while the nursery does not require irrigation. The results of this evaluation are summarized in Section 9.1.2.

4.1.5 Interim Permit Limits

The City is pursuing a near-term approach and a long-term approach to collecting and treating wastewater for mass load limits, dilution ratio, and a seasonal discharge period. The City is working in collaboration with the DEQ to develop a bridging strategy that would enable the WWTP effluent concentrations to meet current discharge requirements while long-term improvements are being implemented. Having a regulatory pathway to achieve permit compliance while implementing the long-term wastewater management strategy is critical to the City's wastewater program.

4.2 Reliability Requirements

As part of the *Preliminary Evaluation of Sandy Wastewater Treatment Capacity Evaluation Report* (West Yost 2023), reliability requirements for the WWTP are discussed. Oregon does not have specific requirements for redundancy and reliability but does point to the EPA's reliability requirements. These were published in 1974 and do not address technological advancements, such as membrane bioreactor process equipment. Therefore, West Yost (2023) incorporated concepts from the following documents:

- Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability, EPA, 1974.
- Recommended Standards for Wastewater Facilities ("Ten State Standards"), Wastewater Committee of the Great Lakes-Upper Mississippi River and Board of State and Provincial Public Health and Environmental Managers, 2014.
- Criteria for Sewage Works Design, ("Orange Book"), Washington State Department of Ecology, 2008.

West Yost assessed each process unit against EPA Reliability Class 1, which is generally considered as the following:

> *Works which discharge into navigable waters that could permanently or unacceptably be damaged by effluent which was degraded in quality for only a few hours. Examples of Reliability Class 1 works might be those discharging near drinking water reservoirs, into shellfish waters, or in close proximity to areas used for water contact sports.*

Reliability Class 1 applies to this facility because it discharges within the Clackamas River Basin, which serves as a drinking water supply for a significant population in the Portland metropolitan area. West Yost's assessment included the assumption that the WWTP is a "small" plant, with an annual average influent flowrate that averages less than 2 MGD. While this may be true, Section 6 of this report summarizes projected flowrates prepared since the 2019 Plan and concludes that the annual average flowrate in 2040 will be 2.2 MGD. For these reasons, this 2026 Plan Amendment has been prepared for a "large" plant with an average annual flow (AAF) greater than 2.0 MGD.

For this 2026 Plan Amendment, it is assumed the City's WWTP discharging into a sensitive drinking water source requires firm capacity of all critical processes. Firm capacity means the WWTP will have hydraulic capacity to treat up to the Peak Instantaneous Flowrate (PIF) as appropriate. Table 4-1 summarizes the reliability requirements applied to Sandy's WWTP. The first three table columns are from West Yost (2023), while the last column presents the 2040 planning approach.

Table 4-1: Summary of Reliability Requirements

WWTP Process/ Component	Reliability Requirement	Status of Existing WWTP in 2023 Relative to Reliability Requirement [1]	How this Plan Addresses Reliability Requirements for 2040 [2]
Influent Screening	A backup bar screen, designed for mechanical or manual cleaning, shall be provided.	**Partially Meets:** The WWTP relies on both screens to treat the PIF. However, the entire PIF can hydraulically pass through the manual bar screen.	Replace existing failing mechanical screen with two mechanical screens to treat PIF and one manually cleaned bar screen to meet Firm Capacity requirements (12.2 MGD).
Grit Removal	For small facilities (less than 2 MGD average design flow), only one unit may be installed, with provisions for bypassing.	**Meets:** WWTP is considered a small facility.	No Action Required: Existing grit system has a capacity of 7 MGD, which is significantly more than the MMWWF. Grit removal is effective for long term protection of WWTP equipment but is not critical to operation under peak flow conditions, therefore, in our judgement, the existing system meets reliability requirements.
Utility Pump Station	A backup pump shall be provided for each set of pumps performing the same function. The pumps shall have capacity to handle peak flow with any one pump out of service.	**Potentially Meets:** The Utility Pump Station is equipped with two, equally sized utility pumps. These pumps are used to convey flow from the EQ basin to the treatment process. With one utility pump in operation, the EQ basin could be emptied in 2.5 days.	No Action Required: Utility Pumps are adequate for current conditions; however, utility pumps will be evaluated for size during pre-design based on secondary treatment process capacity.
Caustic Addition	All chemical feed equipment must have a backup system.	**Meets:** The WWTP has two equally sized caustic flow pumps, either of which is sufficient to provide sufficient caustic at the peak design flowrate (see Table 8-1).	No Action Required: Chemical Systems are adequate to meet projected 2040 requirements. Biological process design will include alkalinity recovery prior to caustic feed.
Aeration Basins	A backup basin will not be required; however, at least two equal- volume basins shall be provided.	**Meets:** The WWTP has two equally sized aeration basins.	Additional aeration trains will be included to expand capacity. Process modeling indicates biological capacity can be provided at MMWWF with one train out of service for a short duration.
Aeration Basin Blowers	Multiple blowers must be provided.	**Meets:** The WWTP has three, equally sized blowers for the aeration basins, plus one slightly smaller blower.	No Action Required: Plant currently has 3 centrifugal blowers and one positive displacement blower.
	The number of blowers and their capacities must be such that the maximum air requirements can be met with the largest blower out of service.	**Meets:** Blower capacity with the largest unit out of service is 3,899 scfm, above the estimated design capacity maximum day aeration demand of 3,000 scfm.	Recent upgrades to the aerators has reduced aeration demand. Existing plant includes 3 centrifugal blowers and one rotary lobe blower that can meet the 2040 demand with no redundancy. To provide adequate redundancy, provide one additional blower with an approximate capacity of 2,000 scfm.
	Because blowers consume considerable energy, the design should provide for varying the volume of air delivered in proportion to the demand.	**Meets:** The blowers have VFDs.	New blower will be operated using a VFD using dissolved oxygen-based control.
	The air diffusion system for each aeration basin shall be designed so that the largest section of diffusers can be isolated without measurably impairing the oxygen transfer capability of the system.	**Partially Meets:** If the largest bank of diffusers is taken offline in one basin, 60% of diffuser capacity would remain. The remaining 750 diffusers in the affected basin could still convey the 3,700 scfm maximum air flow required without exceeding the per diffuser capacity of 6 scfm per diffuser. The system is also configured so that loads could be shifted to the unimpacted basin.	New aeration basins will be equipped with aerators constructed in sections to permit isolation as needed.
Secondary Clarification	The units shall be sufficient in number and size so that, with the largest-flow-capacity unit out of service, the remaining units shall have a design flow capacity of at least 75% of the total design flow. DEQ staff have previously indicated that ADWF is considered the relevant total design flow for satisfying this criterion.	**Meets:** Two units are installed, and a single clarifier can treat 3.25 MGD (half of 6.5 MGD) operating at the worst-case MLSS concentrations of 2,200 mg/L.	New secondary clarifiers will be constructed for treatment alternatives where the conventional activated sludge biological treatment is expanded, so mixed liquor can be diverted to any clarifier from any aeration basin to permit effective hydraulic distribution. Clarifiers will be sized to operate within recommended loading ranges with the largest unit out of service.

WWTP Process/ Component	Reliability Requirement	Status of Existing WWTP in 2023 Relative to Reliability Requirement (1)	How this Plan Addresses Reliability Requirements for 2040 (2)
Secondary Clarification: RAS Pumping	A backup pump shall be provided for each set of pumps performing the same function. The remaining pumps shall have capacity to handle peak flow with any one pump out of service.	**Partially Meets:** The WWTP has two RAS pumps, with one pump dedicated to each clarifier. They have a combined capacity of 2.6 MGD, which may be needed under peak flow conditions. However, one pump can be used to convey flow from both clarifiers. With one pump out of service, RAS pumping can convey about 1.7 MGD, which can accommodate a 50 percent return at an influent flow at 3.5 MGD. This influent flowrate is slightly higher than the anticipated future MMWWF of 3.4 MGD.	RAS will be combined in a single pump station where a set of pumps will convey return mixed liquor to each basin. The RAS pumps will be configured in N+1 so firm capacity is provided with the largest pump out of service.
Secondary Clarification: WAS Pumping		**Meets:** The WWTP has two, 100-gpm WAS pumps with one pump dedicated to each clarifier. However, one pump could be used to convey flow from both clarifiers. One pump has sufficient capacity to convey WAS flows under the design capacity MMWWL conditions (see Table 8-2).	WAS will be combined in a single pump station where a set of pumps will convey wasted sludge to the Aerated Sludge Stabilization Basin (ASSB). The new diversion pump station will be designed with pumps in N+1 configuration so firm capacity is provided with largest pump out of service.
Diversion Pump Station	A backup pump shall be provided for each set of pumps performing the same function. The pumps shall have capacity to handle peak flow with any one pump out of service.	**Partially Meets:** The Diversion Pump Station is used to convey flows to the new tertiary filter. Flow must be equalized if one of the Diversion Pumps is not in operation during peak flow events.	Filters added to the WWTP will require a new diversion pump station to convey secondary effluent to new filters. The new diversion pump station will be designed with pumps in N+1 configuration so firm capacity is provided with largest pump out of service.
Tertiary Filtration	The filter system should be comprised of multiple units so that at least one unit can be backwashed or removed from service without overloading the remaining units.	**Partially Meets:** The WWTP has three, equally sized filters. All three units must be online during peak flow events. (Note that the filter units can complete a backwash cycle while in operation.) Flow must be equalized if one of the filters is not in operation during peak flow events.	New tertiary filters will be designed to meet PIF capacity with one unit out of service based on average and peak loading allowances.
	If pumped backwash is used, at least one standby backwash pump must be provided.	**Meets**: There are four backwash pumps for the three filter units.	New filters will have backwash pumps in N+1 configuration so firm capacity is provided.
UV Disinfection	Multiple reactor trains may be necessary to accommodate large flow variations.	**Meets:** The WWTP has two UV trains, one for flows up to 3.5 MGD and one train with two banks that can handle flows up to 7.0 MGD.	New UV units will be provided to ensure PIF can be treated with largest UV unit out of service.
	At least two banks in series shall be provided in each channel to ensure uninterrupted service during tube cleaning or other required maintenance.	**Partially Meets:** The open channel UV train has two banks in series, but the new, closed vessel UV has only one bank of lamps. Thus, the UV system can treat 7.0 MGD with any one bank out of service.	The existing aging in-channel UV unit will be replaced with an equivalent in-channel unit. Additional Capacity will be provided in closed units below.
	The units shall be sufficient in number and size so that, with the largest-flow-capacity unit out of service, the remaining units shall have a design flow capacity of at least 50% of the total design flow (PIF or Peak WWTP Hydraulic Capacity).	**Partially Meets:** The UV treatment capacity with the largest train out of service is 3.5 MGD, which is less than 40% of the design flow. However, if the largest train were out of service, flows to the treatment plant could equalized.	The existing aging in-channel UV unit will be replaced with a new open-channel unit (2 banks in series). Two new closed-vessel units will be installed to provide total firm capacity of 14 MGD. These units will be fed by a new diversion pump station with duplex pumps.
Chlorine Contact Basin	The units shall be sufficient in number and size so that, with the largest-flow-capacity unit out of service, the remaining units shall have a design flow capacity of at least 50% of the total design flow.	**Partially Meets:** Chlorine contact requirements are met using the effluent pipeline, for which there is no redundancy. However, the City could rely on the UV system as a backup disinfection system, if needed.	No action required; transmission pipeline provides adequate disinfection and residual.
Chlorine Feed Pump	All chemical feed equipment must have a backup system.	**Meets:** The WWTP has two chlorine pumps dedicated to effluent disinfection.	No action required; Chemical Systems are adequate to meet projected 2040 requirements.

WWTP Process/ Component	Reliability Requirement	Status of Existing WWTP in 2023 Relative to Reliability Requirement [1]	How this Plan Addresses Reliability Requirements for 2040 [2]
Effluent/ Irrigation Pump Station	A backup pump shall be provided for each set of pumps performing the same function. The pumps shall have capacity to handle peak flow with any one pump out of service.	**In Progress of Meeting:** There are three Effluent/Irrigation Pumps. Flows exceeding the pumping capacity must be diverted to the EQ basin (either using the EQ Pump Station or through gravity diversion at the headworks). Currently, there is not adequate EQ capacity to accommodate influent flows during a peak storm event given the capacity of the Effluent/Irrigation Pumps. As previously discussed, the City and its consultants are designing upgrades to the Effluent/Irrigation Pump station to increase capacity. In parallel with the design work, the City will calibrate the collection system model to determine the dry weather response for the 10-year storm, and size the Effluent/Irrigation Pump Station improvements so that adequate capacity is provided to accommodate the design storm flows with the largest pump out of service. The treated effluent transmission line had 4 breaks in 2023/2024 and may be nearing the end of its useful life.	Existing effluent pump motors are suited for inside use; however, they are installed outside under cover. These pumps require replacement and will be replaced with pumps with TEFC motors. The capacity will be increased to convey additional effluent to Iseli Nursery's irrigation ponds. The recycled water pressure main to Iseli Nursery is near its capacity. Iseli has capacity for more water than is being received through the irrigation system during the dry season. If the City and Iseli coordinate pumping, storage, and irrigation to maximize Iseli's irrigation use, additional capacity in the pressure main could be useful. The City is including variable frequency drives (VFDs) a surge tank to limit pressure fluctuations in the pipeline to maximize its useful life.
EQ Pump Station (Storage Basin)		**Meets:** The EQ Pump Station is used to divert treated flows to the Storage Basin and is typically used during the dry season only. Screened influent wastewater can also be diverted to the Storage Basin from the headworks (without pumping). Therefore, operation of the EQ Pump Station is not critical for operations.	No action required. 2023-2024 upgrades provide additional equalization capacity to the Storage Basin (now 3.2 MG). Additional aeration and pumping capacity were also provided as part of this upgrade. Existing utility pumps are installed in an N+1 configuration for firm capacity when the largest pump is out of service.
Aerobic Digestion	Multiple digestion units capable of independent operation are desirable and shall be provided in all plants where the design average flow exceeds 100,000 gallons per day (380 cubic meters per day). All plants not having multiple units shall provide alternate sludge handling and disposal methods.	**Partially Meets:** While the aerobic digester has two active cells, it is operated as a plug flow system and one cell cannot be bypassed. However, solids storage capacity is available in the aerobic digester if a system component were out of service and impacting performance.	If the City wishes to produce Class B biosolids, additional digestion volume would be required. Class A biosolids may be achieved without additional digesters if Class A characteristics have been met using heat treatment for drying.
Solids Dewatering	The number of mechanical dewatering facilities (e.g., Belt Filter Press) should be sufficient to dewater the biosolids produced with the largest unit out of service.	**Partially Meets:** The WWTP has only one belt filter press, with no redundancy. However, solids storage capacity is available in the aerobic digester if the press were out of service.	Solids dewatering will be revised significantly and will include two dewatering units, a single dryer (if selected), and dewatered/dried solids storage. If dewatered solids does not meet Class B characteristics, it may be disposed in a landfill.
Waste Pump Station	A backup pump shall be provided for each set of pumps performing the same function. The remaining pumps shall have capacity to handle peak flow with any one pump out of service.	**Meets:** The available firm pumping capacity of the Waste Pump Station will be sufficient to handle the anticipated peak flow.	No action required.

[1] From West Yost, 2023.
[2] Projected requirement for meeting Reliability Requirements for year 2040.

Section 5: Basis of Planning

2019 PLAN | SECTION 5 SUMMARY

- Describes the methodology for developing, evaluating, and selecting alternatives for the collection system and the treatment plant.
- The basis of planning includes the following considerations:
  - The alternatives and costs are based on future flow projections.
  - The collection system evaluation includes costs for I&I reduction alternatives along with conveyance deficiency.
  - The WWTP alternatives are developed for each unit process based on the range of flows associated with each I&I reduction alternative.
- The integrated alternatives combine the costs and other criteria associated with WWTP modifications to determine the recommended alternative.

5.1 Introduction

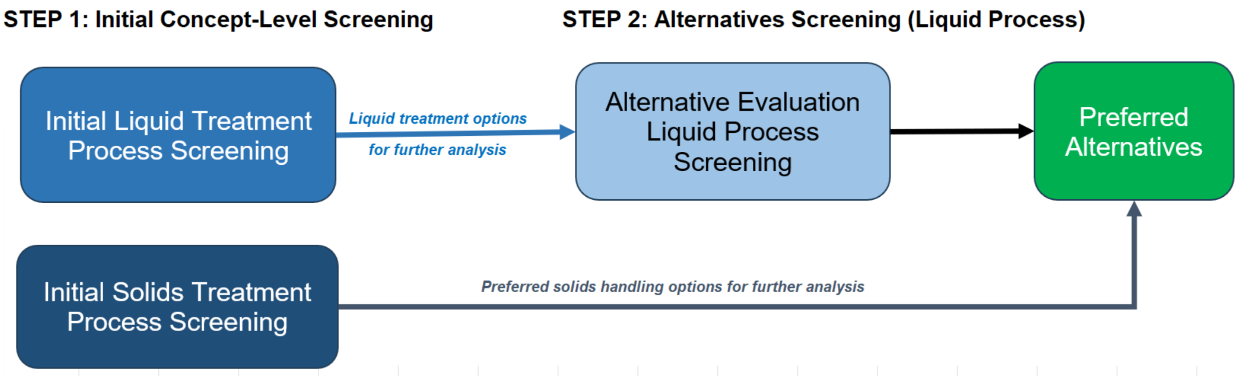
There are no notable changes to the basis of planning approach used in the 2019 Plan; however, there have been some improvements completed since the 2019 Plan in the collection system and at the WWTP, which are highlighted in Sections 7 and 8, respectively. Following collection system repairs, the 2023 and 2040 design influent flowrates were updated utilizing a calibrated collection system model (Leeway 2023), which is further described in Section 6. The updated flowrates and waste loads were used to develop the treatment alternatives presented in Sections 9 and 10.

This section summarizes the approach that the Kennedy Jenks team took to evaluate five alternatives and select the most beneficial to proceed with a detailed analysis. The 2026 Plan Amendment introduces and applies a two-step screening methodology to evaluate and compare liquid and solid treatment processes. This section describes the screening approach and criteria that are applied to evaluate concepts and alternatives in Sections 9 and 10.

5.2 2026 Plan Amendment Screening Approach

A two-step screening approach was applied, as illustrated in Figure 5-1. STEP 1 screens a broad set of alternatives for liquid and solids upgrades to meet project goals. STEP 2 evaluates a short list of liquid upgrades alternatives based on costs, benefits, limitations, and other decision criteria.

Figure 5-1: Two-Step Screening Approach



5.3 STEP 1: Initial Concept Level Screening

STEP 1: Initial Concept-Level Screening approach identifies economic, regulatory, implementation, and resiliency challenges that would make a liquid process treatment solution concept non-viable or infeasible. A similar set of criteria are applied to assess the viability of solids treatment solutions with disposal options (landfill or land application) and beneficial reuse included as an additional criterion.

Screening criteria for the initial liquid process concepts and initial solids treatment options are presented in Table 10-2 and Table 9-8, respectively. Concepts that are unable to meet one or more of the criteria are deemed not viable or infeasible and are eliminated from further consideration. Those concepts that are deemed viable or feasible are further evaluated and moved forward to the second screening step.

Table 5-1: Initial Liquid Process Screening Criteria

Initial Concept-Level Screening Criteria	Consideration for Assessing Viability/Feasibility
ECONOMIC	Is the concept affordable and within the City's current budgetary constraints?
CURRENT REGULATORY RISK	Will the concept be able to meet current NPDES permit requirements and biosolids regulations?
FUTURE REGULATORY RISK	Will the concept be flexible to address potential future permit requirements, changes to discharge points, anticipated biosolids regulations, PFAS regulations?
IMPLEMENTATION	Can the concept be constructed to comply with the consent decree timeline?
RESILIENCY	Does the concept offer the City flexibility to adapt for growth?

Table 5-2: Initial Solids Treatment Screening Criteria

Initial Concept-Level Screening Criteria	Consideration for Assessing Viability/Feasibility
ECONOMIC	Is the concept affordable compared to City's current solids handling/disposal costs?
CURRENT REGULATORY RISK	Will the concept be able to meet current NPDES permit requirements and biosolids regulations?
FUTURE REGULATORY RISK	Will the concept be flexible to address potential future permit requirements, anticipated biosolids regulations, PFAS regulations?
IMPLEMENTATION	Is this a proven technology/solution the City/industry has experience working with?
RESILIENCY	Does the concept offer the City flexibility to adapt for growth?
LANDFILL DISPOSAL	Are solids likely to be accepted for landfill disposal?
LAND APPLICATION	Can solids be treated to meet land application characteristics (Class B or A)?
BENEFICIAL REUSE	Will the concept be suitable or flexible to offer future market opportunities for beneficial reuse, partnerships, and public acceptance?

5.4 STEP 2: Alternatives Screening

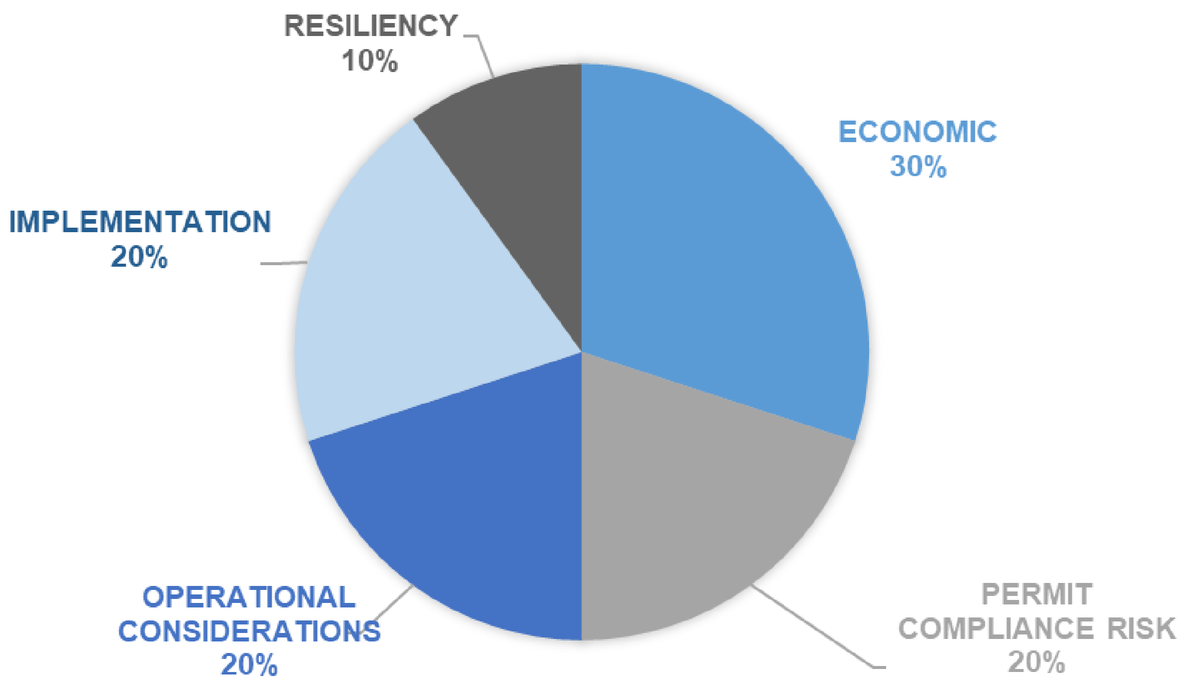
Following the initial concept-level screening, a more in-depth alternatives evaluation and comparison is performed to rank the treatment concepts identified for further consideration. STEP 2: Alternatives Screening (Liquid Process) includes a "scorecard" approach used to compare the alternatives using qualitative and quantitative information applied to a set of decision criteria. The alternative evaluation includes a scoring, weighting, and ranking process as described in Table 5-2. The weighting of each criterion is shown in Figure 5-2.

Kennedy Jenks

Table 5-3: Screening Criteria for Comparing Liquid Process Alternatives

Criteria	Sub-Criteria	Considerations	Fully Meets Criteria (Highest Scoring)	Numeric Scoring Generally Meets Criteria	Unable to Meet Criteria (Lowest Scoring)
			4	2 to 3	1
ECONOMIC	Financial Implementability	Relative capital investment	Lowest Construction Cost	Mid-Range Construction Cost	Highest Construction Cost
	Annual Cost Effectiveness	Relative operations & maintenance (O&M) costs	Lowest O&M Cost	Mid-Range O&M Cost	Highest O&M Cost
PERMIT COMPLIANCE RISK	Near-Term Regulatory Risk	Relative risk in ability to meet current NPDES permit requirements	Minimal Risk	Some Risk	High Risk
	Future Regulatory Risk	Relative risk to meet future regulatory requirements (2040) (e.g. ammonia, copper, toxics, PFAS)	Minimal Risk	Some Risk	High Risk
OPERATIONAL CONSIDERATIONS	Operational Complexity	Relative impact to current wastewater operations and responsibilities, suitable for gravity timeline	Minimal potential impacts	Range of potential impacts	Significant potential impacts.
	Operational Impacts During Construction	Relative impact to current operations during construction	Minimal potential impacts	Range of potential impacts	Significant potential impacts.
	Operational Staffing	Ability to maintain routine plant operation (number of staff and certification level needed)	Fewest daily staff required, highly automated, easy to understand	More daily staff than 4, highly automated, relatively low amount of process adjustments required.	Requires more staff, more process monitoring and adjustments.
IMPLEMENTATION	Construction Schedule	Ability to expedite construction and increase capacity	Accelerated construction schedule would provide an early capacity buffer	Construction Schedule would provide a limited capacity buffer.	Construction schedule would not provide a capacity buffer.
RESILIENCY	Compliance	Ability to maintain effluent limits under peak flow/loading conditions	Low risk of mixed liquor loss, filter plugging, disinfection failure	Requires significant effort to recover functionality after peak event.	Upset is likely under peak conditions, may result in poor treatment or process failure.
	Vulnerability to Supply Disruptions	Consumable chemicals and maintenance materials could limit ability to comply with permit requirements	Relatively low consumable chemicals, easy to acquire routine replacement parts, or replacement parts will be stocked at the plant	Consumable chemicals can be retained for long periods, manufactured locally, parts can be secured with some notice through multiple suppliers.	Chemicals have been historically difficult to source, long lead times, replacement parts are available from only one supplier.

Figure 5-2: Criteria Weighting for Liquid Process Alternatives



STEP 1 initial solids screening criteria are applied in Section 9.2.5 and the initial liquid process screening criteria are applied in Section 10.3. STEP 2 liquid process alternatives screening are applied in Section 10.5.

Section 6: Flow and Load Projections

2019 PLAN | SECTION 6 SUMMARY

- Documents the existing and projected flowrates and wastewater characterization in the wastewater collection system for the Sandy WWTP.
- The flow projections consider existing and future customers within the project study area and highlight potential growth within the Urban Growth Boundary (UGB) for the time period ending at the year 2040.
    - Flow characterization is based on per capita wastewater usage, unit flow factor development, and flow projections.
    - The flow projections, together with the hydraulic analysis of the collection system are used to identify opportunities to reduce I&I, size capacity improvements in the collection system, and estimate influent volumes at the WWTP.
- Two methods are used to develop the current flow characteristics and future flow projections:
    - **Collection System Method:** based on analysis and modeling of the existing collection system, which allows for more robust flow projections because it considers population forecasts and designated land use as well as collection system characteristics including pipe degradation.
    - **DEQ Guidelines Method:** based on the guidelines from the *Making Wet-Weather and Peak Flow Projections for Sewage Treatment in Western Oregon* (Oregon Department of Environmental Quality, 1996). This method is used to confirm the validity of the collection system modeling estimation.
- The summary of loads focuses on the mass load of biochemical oxygen demand (BOD) and total suspended solids (TSS) into the WWTP.
    - Current mass loads are calculated using recent historical influent data for TSS and BOD.
    - The 2040 load projections are scaled from the current loads using a per capita basis analysis.

The 20-year capital projects in the 2019 Plan were identified to improve and expand the City's wastewater collection and treatment facilities to meet future flow and load projections.

6.1 Introduction

The flow and load projections for the 2019 Plan have been updated to support the 2026 Plan Amendment. A detailed discussion of population, flow, and loading estimates is included in Section 6 of the 2019 Plan. This section summarizes the updated flow and load projections (Leeway 2023), which were updated and applied to evaluate concepts and alternatives in Sections 9 and 10.

Additional supporting information for the flow and load evaluations is provided in Appendix B.1.

6.2 2026 Plan Amendment Updated Flow and Load Projections

This section summarizes the updated predictions of flowrates and waste loads for 2023 and 2040 based on recent repairs to the collection system, observed reductions in I&I, and additional collection system modeling. The updated projections are presented in Table 6-1 (Leeway 2023) with additional detail included in Appendix B.1.

Table 6-1: Updated Predicted Flowrates for the WWTP

Design Condition	Projected Design Flowrate in 2023(1)	Projected Design Flowrate in 2040(2)
Peak Hour Wet Weather Flow (WWF)(4)	9.3 MGD	12.2 MGD
Maximum Month WWF (MMWWF)	2.0 MGD	3.6 MGD
Average Dry Weather Flow (ADWF)	0.9 MGD	2.2 MGD
Assumptions		
Population Annual Growth Rate		2.80%
Residential 2040 Population		22,600
Base Wastewater Peaking Factor for New Connections		1.6
Wastewater Demand for New Population (gallons per capita per day)		92.6
Peaking Factor for I&I assumed for new pipe to serve new population		1.5
I&I growth rate for old and new pipes (not rehabbed)(3)		5%

1 Value estimated by Kennedy/Jenks.
2 Value estimated by collection system modeling (Leeway, 2023).
3 A 5% increase in infiltration and inflow assumption is incorporated for older pipes per decade in addition to anticipated connections to the sanitary sewer system as they age (Leeway, 2023).
4 Assumed to be equivalent to PIF.

WWTP data from 2019 through 2022 were used to project the BOD and TSS waste loads into the plant by 2040. Influent TSS and BOD discharge monitoring report (DMR) data collected from 2019- 2022 were compared to the City population for the corresponding year to produce the BOD_5 and TSS loading factors in pound per capita per day (ppcpd). The maximum and average monthly loading factors for each year are presented in Table 6-2.

Table 6-2: Updated Influent Waste Load Contribution Data

	Per Capita Waste Load Contribution (ppcpd)					
	2019	2020	2021	2022	Max	Average
BOD						
Max Month	0.32	0.29	0.35	0.35	**0.35**	--
Average Day	0.22	0.23	0.27	0.20	--	**0.23**
TSS						
Max Month	0.33	0.25	0.33	0.30	**0.33**	--
Average Day	0.21	0.18	0.25	0.19	--	**0.21**

The 2030 population was estimated from the anticipated population and population growth rate in Table 6-1. The average and maximum TSS and BOD_5 loads to the plant in 2024, 2030, and 2040 were determined using the population estimates and above loading factors. The estimated influent loads, shown in pounds per day (ppd), are presented in Table 6-3.

Table 6-3: Projected Influent Waste Loads

	Influent Waste Loads (ppd)		
	2024	2030	2040
BOD			
Average	3,300	4,000	5,300
Maximum	5,000	6,000	7,900
TSS			
Average	3,000	3,600	4,800
Maximum	4,700	5,700	7,500

These projected influent flows and loads assume the City will grow steadily over the planning period. In reality, the City's growth is constrained by the Consent Decree. The City was under a moratorium from October 2022 until April 2024 when EPA and DEQ conditionally approved the addition of 570 ERUs to the existing system. An additional 190 ERUs will be approved when the City completes agreed-upon interim improvements to fully utilize the capacity documented under the Capacity Assurance Program. Following this period, the City will not be able to approve more ERUs until long-term wastewater improvements have been completed and the plant has achieved three years of continuous permit compliance. Because of these impacts, the capacity provided to meet projected 2040 demands will likely actually provide sufficient capacity until 2046-2050.

Section 7: Sanitary Sewer Collection System Evaluation

2019 PLAN | SECTION 7 SUMMARY

- Summarizes the pump station condition assessment, the wastewater collection system capacity analysis, and the hydraulic model assumptions.
    - System capacity is evaluated based on established design criteria for maximum allowable flow depth during dry and wet weather conditions, maximum velocity, and pump station capacity.
    - The hydraulic model is developed, calibrated, and used to simulate system responses for existing and future flows and to evaluate and recommend collection system capital improvement alternatives.
- Wet weather impacts to the system from the design storm event are evaluated, and capacity deficiencies and improvements are identified for the current system.
- The capacity improvement alternatives are developed at graduated levels of wet weather flow reduction, then combined and evaluated with corresponding treatment plant alternatives.
- A longer-term Rehabilitation and Replacement (R&R) program is recommended for on-going system maintenance.
- All improvements are evaluated at the master planning level for accuracy, which determines budget-level cost estimates for calculating system development charges (SDCs) and rates (user fees) to support the Capital Improvement Program (CIP).

Additional evaluation of sanitary sewer collection system improvements has been performed under separate contracts as part of the 2026 Plan Amendment. The *Draft Technical Memo (TM) - 2024 Wastewater Collection System Update (Stantec 2024a)*, is included in Appendix A.2 and briefly summarized herein.

The 2019 Plan identified improvements to the collection system to provide capacity required to serve the projected growth under the recommended activities at that time. Since adoption of the 2019 Plan, the City has undertaken significant efforts to reduce I&I in the system and initiated capacity improvements to address needs of the system. The City has also implemented a Capacity, Management, Operation and Maintenance (CMOM) Program as a comprehensive strategy for managing the wastewater collection system, with efforts documented in the 2023 CMOM Implementation Report (Leeway 2024a) and companion 2024 CMOM Strategic Plan (Leeway 2024b). These documents define objectives and activities associated with the CMOM Program along with performance goals and schedules to meet those goals.

Stantec (2024a) documents improvements that have been completed since the 2019 Plan, identifies ongoing and upcoming activities, and provides an updated CIP for collection system activities, which are listed in Section 11.2.

Section 8: Existing Wastewater Treatment Plant Evaluation Update

2019 PLAN | SECTION 8 SUMMARY

- Provides an overview of the existing WWTP, review of applicable codes, and capacity evaluation of current WWTP and unit processes.
- Evaluates the existing WWTP based on a field evaluation and condition assessment of major unit processes.
- Identifies deficiencies and provides recommendations to address challenges impacting facility operations and maintenance upgrades necessary to keep the WWTP in good working order.
- Culminates in a list of recommended WWTP upgrades at the existing facility to maintain facility performance, simplify operations, and assure compliance with the City's current NPDES Permit requirements.

8.1 Introduction

This section of the 2026 Plan Amendment focuses on updates to the existing WWTP since the 2019 Plan, providing information on new facilities, updating the condition of existing assets based on operator feedback, giving an updated capacity review and updates on other rehabilitation, repair and replacement efforts.

Additional evaluation of WWTP improvements has been performed under separate contracts as part of the 2026 Plan Amendment. The *TM – Near-Term Plant Improvements at the WWTP (Stantec 2024b)*, is included Appendix A.3 and briefly summarized herein.

8.2 Existing WWTP Evaluation Update

This section highlights some of the updates to the existing WWTP based on the evaluation and outcomes of the 2019 Plan.

8.2.1 WWTP Process Updates

Major updates to the existing WWTP in the last five years (since the 2019 Plan) are listed in Table 8-1.

Table 8-1: Process Updates Since the 2019 Plan

Project	Status	Relevance to 2026 Plan Amendment
Aeration Basin Plug Flow & Aeration Improvements	Installed in 2021-2022	Improved secondary treatment capacity, more efficient aeration
Storage Pond Improvements	Installed in 2022	Mitigates filamentous bacteria growth, improved sludge quality, maintains surge capacity.
Secondary Clarifier Mechanism Rehabilitation	Installed in 2022	Improved sludge collection and reduced TSS carryover
New Caustic Feed System	Installed in 2022	Mitigates low pH conditions during nitrification season
Waste Pump Station Rehabilitation	Installed in 2022	Replaced
New tertiary disk filters and diversion pump station	Installed in 2022	Increase hydraulic capacity, reduce effluent TSS, provide filtration redundancy
UV Closed Vessel Units	Installed in 2022	Provide additional treatment capacity and redundancy to existing UV system
Aerated Sludge Stabilization Basin Rehabilitation	Installed in 2022	Improve sludge quality before dewatering, reduce volatile solids.

8.2.1.1 Process Improvement Outcomes

In the time since the completion of the 2019 Facilities Plan was published, the treatment processes at the plant have been modified to improve treatment efficacy. Significant improvements include:

- Improved aeration control through blower valve modulation
- Replaced diffusers in aeration basins
- Added baffle walls in aeration basins
- Replaced and balanced clarifier mechanisms

As a result of these improvements:

- Dissolved oxygen levels in the aeration basins are consistently 2-3 mg/L
- Mixed liquor suspended solids concentration has been improved in the secondary processing
- Secondary clarifiers are getting improved settling and sludge blanket compaction
- Tertiary filtration working better
- UV disinfection working better

Since these improvements, the plant has been able to consistently achieve TSS and BOD concentrations less than 10 mg/L.

8.2.1.2 Ongoing Improvements

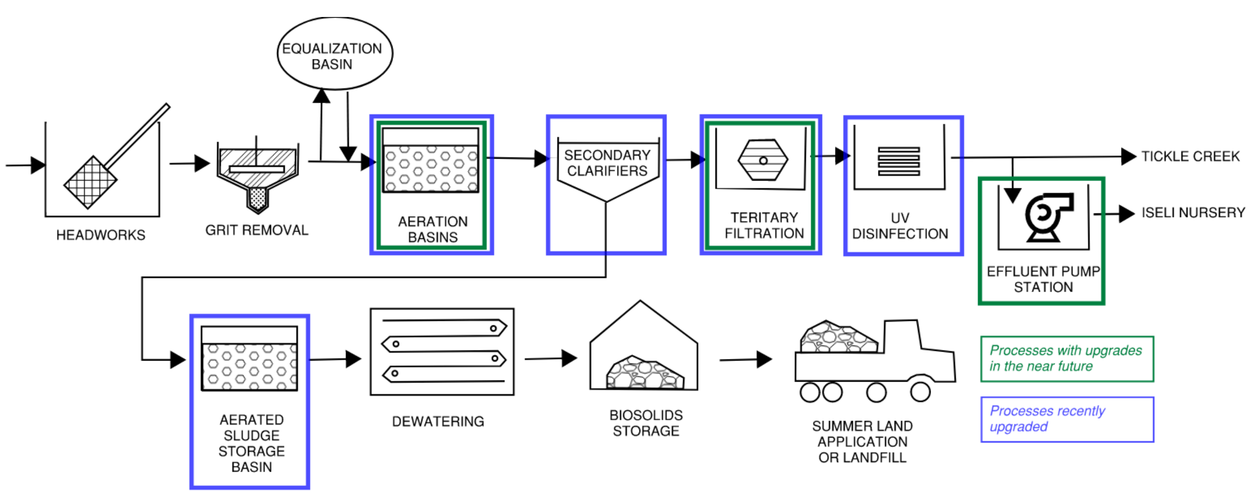
The City is planning to make interim improvements prior to final design of the upgraded WWTP to replace or upgrade critical processes that are aging and failing. These process units are summarized in Table 8-2.

Table 8-2: Anticipated or In-Progress Projects Relevant to the 2026 Plan Amendment

Project	Status	Relevance to 2026 Plan Amendment
Replace medium-pressure ultraviolet (UV) disinfection	Planned 2026	Improve disinfection, provide redundancy
Recycled Effluent/Irrigation Pump Station Expansion	Planned 2026	Expand firm capacity to accommodate summer storm events
Refurbish or replace Aeration Blower 4	Completed 2025	Optimizes aeration when demand is low for process air
New Aeration Mixers	Completed 2025	Improves biological process efficiency and consistency
New WAS Pump	Planned 2026	Improve reliability with electric-driven pumps and add flow metering and SCADA programming
New Flow Meters and SCADA Programming	Planned 2026	Improve process control of recycled flows to anoxic zone
Storage Pond Expansion	Completed 2025	Added an additional 800,000 gallon storage capacity to cut peak influent flows
W3 Pump Station	Planned 2025	Being completed as part of Effluent Pump Station expansion

Figure 8-1 illustrates recently updated process areas and process units designated for upgrades in the near future.

Figure 8-1: Existing WWTP Schematic Highlighting Recent and Future Process Updates



8.2.2 Condition Assessment Updates

The 2019 Plan included a comprehensive condition assessment and a list of recommended WWTP upgrades. In July 2020, Murraysmith developed the *Immediate Needs Improvements Project Preliminary Design Report* (2020 PDR). The 2020 PDR presented a preliminary design for the improvements required at the WWTP based on the recommendations in the 2019 Plan, the findings of the 2019 Condition Assessment (part of the 2019 Plan Update), and the improvements were implemented in 2021 and 2022 (West Yost 2021b).

West Yost prepared a Condition Assessment Improvements Project Report (2021 Condition Assessment), which identified additional immediate project needs beyond those identified in the 2019 Plan. The City then performed several operational and mechanical improvements to the WWTP after completion of the 2021 Condition Assessment. These improvements are summarized in Table 8-1.

The *Sandy Wastewater Treatment Facilities – Conditions Assessment Improvements Project* (West Yost 2021) was prepared to evaluate the recommendations in the 2020 PDR and present a modified set of recommended improvements to more efficiently utilize the City's budget while also effectively addressing the current operational and maintenance deficiencies at the WWTP. These improvements were to be implemented under the City's WWTP Condition Assessment Improvements Project and completed in 2022. This report includes a "Wish List" that is intended to be a living document that can be changed over time to keep track of small and large improvements that the City wishes to complete.

8.2.3 Spare Parts, Repair, Replacement and Refurbishment Updates

The *City of Sandy Wastewater Treatment Facilities - Spare Parts and Repair, Replace, Refurbishment Prioritization Report* (Waterdude Solutions 2022) evaluates the current WWTP facilities and develops a prioritized list of spare parts, as well as a list of identified repairs, replacements, and refurbishment needs. The primary objective of this effort was to identify current critical needs at the facility, increase reliability, maintain compliance, and prepare for an upcoming treatment system performance (stress) test.

- Spare parts are intended to facilitate rapid return to service upon a failure or detection of impending failure. The report includes a spare parts prioritization list and recommends a complete physical inventory of spare parts and a dedicated storage area to keep spare parts together.

- The report includes a prioritized list of identified repairs, replacements, and refurbishment needs, favoring current needs over the future considerations. Several repair and refurbishment projects led by the operators are underway at the WWTP.

Operation and Maintenance of the WWTP has been performed by contracted operators over the past several years. The current operations team, Veolia, began work in 2019. In 2021, a WWTP improvements project began and was completed in 2022. A treatment system performance test was conducted in 2023. As part of the next steps, the City, Veolia, Leeway, and Waterdude are continuing to coordinate to track the repair budget, review expenditures of high-cost processes, and develop thresholds to support decision making.

8.2.4 Operator Feedback on Asset Conditions

As part of the 2026 Plan Amendment development, Kennedy Jenks received input from operators on asset conditions that impacted operations during and after interim improvements completed in 2022. Table 8-3 provides additional information on the condition of key WWTP components base on operator feedback in 2023. The Wastewater Program Team subsequently worked with the City and Operations Team to develop a list of process improvements that will be effective in extending the utility of the existing Plant. Where feasible, we have incorporated these concepts into the alternatives considered in Section 9 and 10. Additional consideration will be given in the Pre-Design and Final Design phases of Engineering.

Table 8-3: Operator Feedback on Asset Conditions from 2023

WWTP Component	Operator Input
Headworks	• Operators requested minimizing critical underwater equipment in screening, as well as installation that allows removal of the underwater components so they can be easily inspected and serviced. • Operators would like the grit system replaced with stacked plate settlers and no submerged equipment.
Aeration Basins	• Update anoxic zone mixers. • Install aeration basin instrumentation to monitor pH, ammonia, and alkalinity. • Install high-speed turbo blowers to improve efficiency, and reduce noise, vibration, footprint demands, and oil usage. • Add a spray system for the MLR zones and clarifier effluent channels to prevent scum accumulation and algae growth.
Secondary Clarifiers	• Update the scum removal system and pumps to avoid disruptions. • Install a sludge blanket level indicator. • Improve access to the inboard launders on the secondary clarifier for maintenance or prevent algae build-up via covers or a brush system.
RAS/WAS Pump Station	• Replace WAS air diaphragm pumps with electric motor pumps and reconfigure them for suction out of the RAS lines instead of aeration basin sumps. • Add RAS flow monitoring to each basin and WAS flow monitoring.
Equalization Basin	• Add instrumentation to monitor flowrate of wastewater pumping from the equalization basin. • Upsize the equalization basin to accommodate storm flows.
Tertiary Filters	• Reduce the maintenance requirements of the disc filters, which damage filter fabric pile where the backwash shoe touches the fabric.
UV Disinfection	• The UV system is failing, lamps are difficult to procure, and the UV unit is no longer supported by the manufacturer.
Dewatering and Solids Storage	• Add additional digesters.

WWTP Component	Operator Input
	• Minimize the amount of dewatered solids going to landfills by improving the processing to produce Class B biosolids and make efforts to move towards Class A processing. • Minimize the time demand of maintenance for the dewatered biosolids conveyor. • Improve the efficiency of and capability of the dewatering system.
Chemical Storage and Metering Facilities	• Replace chlorine supply tubing with rigid pipe to avoid the hazards of running the line above ground. • Evaluate and upgrade the chlorine storage tanks operation and seismic resilience. • Improve accessibility of pumps for maintenance. • Include instrumentation to monitor suspended solids, turbidity, and chlorine residual throughout the plant. • Chlorinate W3 water. • Replace jib cranes with swivel arm cranes.
Plant Air Compressor	• Wear on the current compressor concerns indicate replacement and/or removal of air-operated equipment.
Other	• Install solar panels to reduce energy costs. • Include a ceiling-mounted, mobile gantry in all applicable buildings. • Include hose reels for washdown in all process areas. • Remove unused buildings and equipment. • Additional exterior receptacles to minimize extension cord use. • Upgrade the interior lighting to LEDs to improve efficiency and reduce maintenance. • Prevent air from entering the water line from the potable well and inspect the line for leaks. • Evaluate the sufficiency of the generator power supply to support equipment during power failures. • Improve accessibility of yard hydrants. • Replace valves that are difficult to operate. • Remove encroaching dead trees. • Repair damaged fencing. • Improve break areas for crew members.

8.3 Existing WWTP Code Review

The existing WWTP code review from the 2019 Plan remains relevant to the 2026 Plan Amendment. The following Codes were referenced in the 2019 Plan and have since been updated. For further information, go to the applicable organization website for the latest code documents.

- Oregon Structural Specialty Code (OSSC), 2022
    - International Building Code (IBC)

- Oregon Fire Code (OFC), 2022
  - International Fire Code (IFC)
  - National Fire Protection Association (NFPA) Chapter 820
- Oregon Plumbing Specialty Code (OPSC), 2023
  - Uniform Plumbing Code (UPC)
- Oregon Electrical Specialty Code (OESC), 2023
  - National Electrical Code (NEC)
  - NFPA 70
- OR-OSHA (Oregon Occupational Safety and Health)
- Oregon Energy Efficiency Specialty Code (OEESC), 2024
- American Disability Act (ADA)
- Code of Federal Regulations (CFR)
- American Society of Civil Engineers (ASCE) 7 for Seismic Anchorage Design
- Local Land Use Requirements

At the time of the 2019 Plan, the following four items were recognized as needing additional analysis beyond the scope of the Facilities Plan review to further evaluate compliance at the Sandy WWTP. These items will receive a comprehensive review as part of Pre-Design:

- HVAC compliance
- Energy Efficiency Code
- Seismic Anchoring
- Electrical Code

In addition, the 2019 Plan identified that the following three conditions were not being met at the Sandy WWTP. These items have been addressed in the areas of the facility that have been updated since the 2019 Plan, however the rest of the WWTP is still in need of updates to address these deficiencies:

- Tepid eyewash/shower stations – current eyewash stations in the office/laboratory space do meet code requirements but are plumbed through the sink which is not ideal in emergency situations.

- Electrical clearances – a minimum of 42 inches of clearance should be provided in front of electrical panels and conspicuous signage shall be displayed in the working space.
- Hydrant requirements – portable fire extinguishers and hydrant protection must be provided as outlined in the 2019 Plan.

8.4 Electrical Capacity Considerations

The Sandy WWTP is served by a 480-volt, 3-phase, 4-wire electrical power distribution system. Standby emergency power is provided via a 750 KW diesel engine-generator with a 1200 ampere power output circuit breaker. The facility receives its power supply from a 12,470-volt, 3-phase overhead distribution line. A Portland General Electric (PGE)-owned 750 KVA transformer steps the transmission primary voltage down to the 480-volt secondary utilization voltage required for the WWTP.

A 2,000-ampere service entrance rated switchgear is the main distribution center for the electrical power system. In the time since the 2019 Plan, improvements to the WWTP have resulted in an existing load of approximately 1,810 amperes, leaving just under 200 amperes of spare capacity left for additional upgrades.

Any upgrades to the WWTP that will increase electrical load will require a larger electrical service. A discussion of electrical loads and existing capacities is presented for the complete recommended alternative in Section 10.6 to confirm the viability and size of electrical service, transformer, switch gear, and generator for the WWTP.

8.5 Existing WWTP Capacity Evaluation Update

For the 2026 Plan Amendment, three key flowrate criteria were updated following collection system repairs and one season of wet weather monitoring. The design flowrates and loadings were based on projections summarized in Table 6-1 and Table 6-3. Other influent parameters, such as ammonia-nitrogen, were developed from 2019 through 2022 influent DMR data.

8.5.1 Existing Plant Deficiencies

The existing plant processes are undersized for the projected peak flows and loading. As the City grows, additional connections will be made to the sanitary sewer thus increasing dry weather wastewater volumes. The City's CMOM program will mitigate some of the I&I; however, wet weather impacts to the collection system will increase as the system ages. Capacity upgrades are required to accommodate future dry weather and I&I wastewater volumes.

8.5.1.1 Headworks

8.5.1.1.1 *Screening*

A single inclined automatic rotary rake coarse screen (1/4-inch aperture) captures and removes debris from the influent stream. A manually cleaned bar screen (3/4-inch aperture) provides backup screening to the automatic screen. The current screen has a firm capacity of 6.6 MGD, and if flowrate exceeds this value, the overflow passes through the manual bar screen.

The headworks does not currently have the capacity to accommodate current or projected peak flowrates, nor does it have space to install a second automatic fine screen. For this plant, at least two screens are recommended to provide redundancy of operation, and the two screens can be sized so firm capacity can treat the peak flowrate with the largest screen out of service and a manual screen to provide redundancy.

8.5.1.1.2 *Grit Removal*

No redundancy is required for grit removal systems, which can store 76 cubic feet of grit. The capacity of the existing 10-foot diameter grit chamber is 7.0 MGD. While grit removal is important for long-term protection of basins, piping, and equipment, short periods exceeding the process capacity, such as those encountered under peak conditions, are not anticipated to adversely affect plant's longer performance or NPDES Permit compliance.

The grit classifier has a challenging role handling the most abrasive wastewater stream in the plant. The existing grit classifier has recently been rebuilt to extend its useful life.

8.5.1.2 Aeration Basins

The existing basins and blowers are adequately sized to treat current waste loads at average and maximum month flowrates and waste loads with surplus capacity. New diffusers in the aeration basin have improved efficiency, and blower control has improved so the plant can operate using much lower power consumption and dissolved oxygen is controlled to maintain desirable concentrations. As a result, sludge quality has improved, and foaming is not a routine issue. The Operations team has developed procedures to produce high quality mixed liquor that settles well, with sludge volumes typically in the range of 130 to 175 mL/g. Reliability requirements dictate at least two aeration basins shall be provided, and this condition is met. As the influent loading increases, more aeration basin volume will be required, and the existing blowers will need to be adjusted accordingly. In addition, the aeration basins will require additional volume to support biomass and associated solids retention time to provide reliable BOD_5 removal and nitrification.

Return activated sludge (RAS) pumps are currently slightly oversized and cannot be turned down enough to pace with the flowrate of the aeration basins at low influent flowrates. An ideal configuration would use multiple smaller pumps to meet the RAS demand over its entire projected range.

8.5.1.3 Secondary Clarifiers

The secondary clarifiers are adequately sized to treat current average and maximum month flowrates. The clarifiers have recently rebuilt sludge and scum collecting mechanisms and perform well. Historically, projected peak day and peak hour flowrates would exceed recommended surface loading rates, resulting in sludge blanket loss and permit limits exceeded. However, recent process updates and Operator changes to process control have improved the mixed liquor concentration and sludge settling and compaction to avoid these occurrences.

8.5.1.4 Disinfection

The disinfection system is currently sized to treat 10.5 MGD, which is approximately equivalent to the current PIF with no standby capacity. Redundancy requirements call for a minimum of two units with a minimum dose of 30 mJ/cm^2 at peak flowrate with all units online. However, if one unit were to fail during a PIF event, it could cause a permit limit to be exceeded.

8.5.1.4.1 *Tertiary Filtration*

The existing plant has three disc filter units with a total capacity of 10.5 MGD. Redundancy requirements call for more than one filter to be installed so that at least one unit can remain in operation during backwash and service events. However, if one unit were to fail during a PIF event, it could cause a permit limit to be exceeded.

8.5.1.4.2 *Chlorine Residual*

Recycled water irrigation requires a chlorine residual before pumping to the Iseli Nursery. Concentrated (12.5%) Sodium hypochlorite is pumped to the effluent chlorination chamber before pumping. The existing system has redundant sodium hypochlorite pumps and meets redundancy requirements.

8.5.1.5 Tickle Creek Outfalls

Outfall 001 to Tickle Creek is located approximately 7,350 feet downstream of the WWTP and has a capacity of 4.0 MGD. During the discharge seasons, when Outfall 001’s capacity is exceeded, emergency Outfall 003 can be activated to pass an additional 7.0 MGD. This will allow the current PIF to pass, however, it will not pass the 2040 PIF of 12.2 MGD. Under 2040 PIF conditions, the limited outfall capacity would result in raising water surfaces in the treatment basins and diversion of screened/de-gritted influent to the equalization basin. If the peak flowrate were to occur for an extended time, the aeration basins and secondary clarifier levels would rise and could overflow. Therefore, additional outfall capacity will be required.

8.5.1.6 Effluent Pumps

Existing effluent/irrigation pumps are capable of pumping 2.5 MGD to Iseli Nursery with one pump out of service. The ADWF is currently 0.9 MGD and the Maximum Month Dry Weather Flowrate (MMDWF) was projected in the 2019 Plan to be 2.4 MGD by 2040. The effluent pumps are adequate under most conditions, however, there were two major wet weather events in 2021 that resulted in higher dry weather flowrates which exceeded the effluent pumping capacity. In addition, wet weather events during the non-discharge season can overwhelm Iseli Nursery’s ponds. This evaluation considered pumping more recycled water to Iseli Nursery working under the understanding that they can accept up to 5 MGD.

8.5.2 Existing Process Unit Summary

A summary of process unit limitations and needs is provided in Table 8-4.

Table 8-4: Hydraulic Capacity Limitations

Unit Process	Existing Capacity (MGD)	Additional Capacity Required (MGD)	Notes
Fine Screening	6.6	5.6	Manual bar screen provides standby capacity
Manual Screening	6.6	--	Estimated
Grit Removal	7.0		Standby not required for short times
Aeration Basin	7.0	5.2	Plan to treat MMWWF with 1 train out of service
Secondary Clarifiers	6.9	5.8	Assuming 1,600 gpd/sf peak surface loading rate
Tertiary Filtration	9.5	2.7	Recommend treat MMWWF with 1 train of service
UV-Disinfection	10.5	7.0	Recommend treat MMWWF with 1 train out of service
Gravity Outfall 001	4.0	--	
Gravity Outfall 003	7.0	1.2	Emergency Use
Effluent Pumps Outfall 002	2.5	2.5	Iseli Nursery

Section 9: Initial Wastewater Systems Alternatives Evaluation Update

2019 PLAN | SECTION 9 SUMMARY

- Evaluates wastewater system alternatives available to the City to most cost-effectively manage the wastewater collections, treatment, and discharge for the planning horizon from 2019 through 2040 and beyond.
- Initial alternatives evaluation assumes continued discharge to Tickle Creek in the winter months, summer irrigation at Iseli Nursery, and expansion of the current secondary-only treatment process.
- The primary goal of this initial alternatives evaluation is to identify the appropriate balance of investments in the City's wastewater system.
- The evaluation includes the following elements:
  - NPDES Permit and discharge evaluation for continued Tickle Creek winter discharge with summer irrigation at Iseli Nursery;
  - Collection system, discharge, and storage requirements alternatives for a range of I&I and WWTP peak flow reductions; and
  - WWTP upgrades for treating the full range of flows for the collection system alternatives.

This section of the 2026 Plan Amendment focuses on updates to the discharge requirements and initial wastewater systems alternatives evaluations since the 2019 Plan, providing new information on summer and winter discharge options.

9.1 NPDES Permit and Discharge Evaluation Update

From November through April, the NPDES Permit allows the City to discharge treated effluent to Tickle Creek. The permit stipulates that in the dry season months of May to October, alternate discharge locations for the treated WWTP effluent must be utilized, and no discharge to Tickle Creek is allowed.

To understand and compare the expected discharges to Tickle Creek from the WWTP to the existing NPDES permit limits, an analysis of future waste loads and potential treatment processes was completed. This analysis is detailed in Appendix B.3 and summarized in the following sections.

9.1.1 Winter Discharge

Tickle Creek is located in the Clackamas River Basin and subject to Oregon's Three Basin Rule (OAR 340-041-003) as described in Section 1. Tickle Creek discharges to Deep Creek, which then flows to the Clackamas River. Tickle Creek flowrate is recorded twice per week during the wet weather season and is reported in the WWTP's DMRs. This flow data was used in conjunction with the WWTP effluent discharge data to determine the dilution ratio for the wet weather seasons from May 2019 through April 2021. The minimum allowed dilution ratio of stream flowrate to WWTP effluent discharge is 10 to 1.

When the ratio of Creek flowrate to effluent flowrate is less than 10 to 1, the discharge exceeds permitted limits and could result in a permit violation. To mitigate this exceedance, a portion of the effluent could be stored and recycled for beneficial use.

This section also summarizes an analysis of discharge to Deep Creek and to an effluent storage pond at Iseli Nursery. Details of the analysis are provided in Appendix A.3.

9.1.1.1 Tickle Creek Discharge Limitations

Tickle Creek flowrate was used to develop an understanding of its seasonal discharge. This data was used to calculate the dilution ratio for the wet weather seasons from May 2019 through April 2021. The evaluation revealed that (on days the stream gauge was read) 15% of the calculated dilution ratios were less than the permitted minimum value of 10.

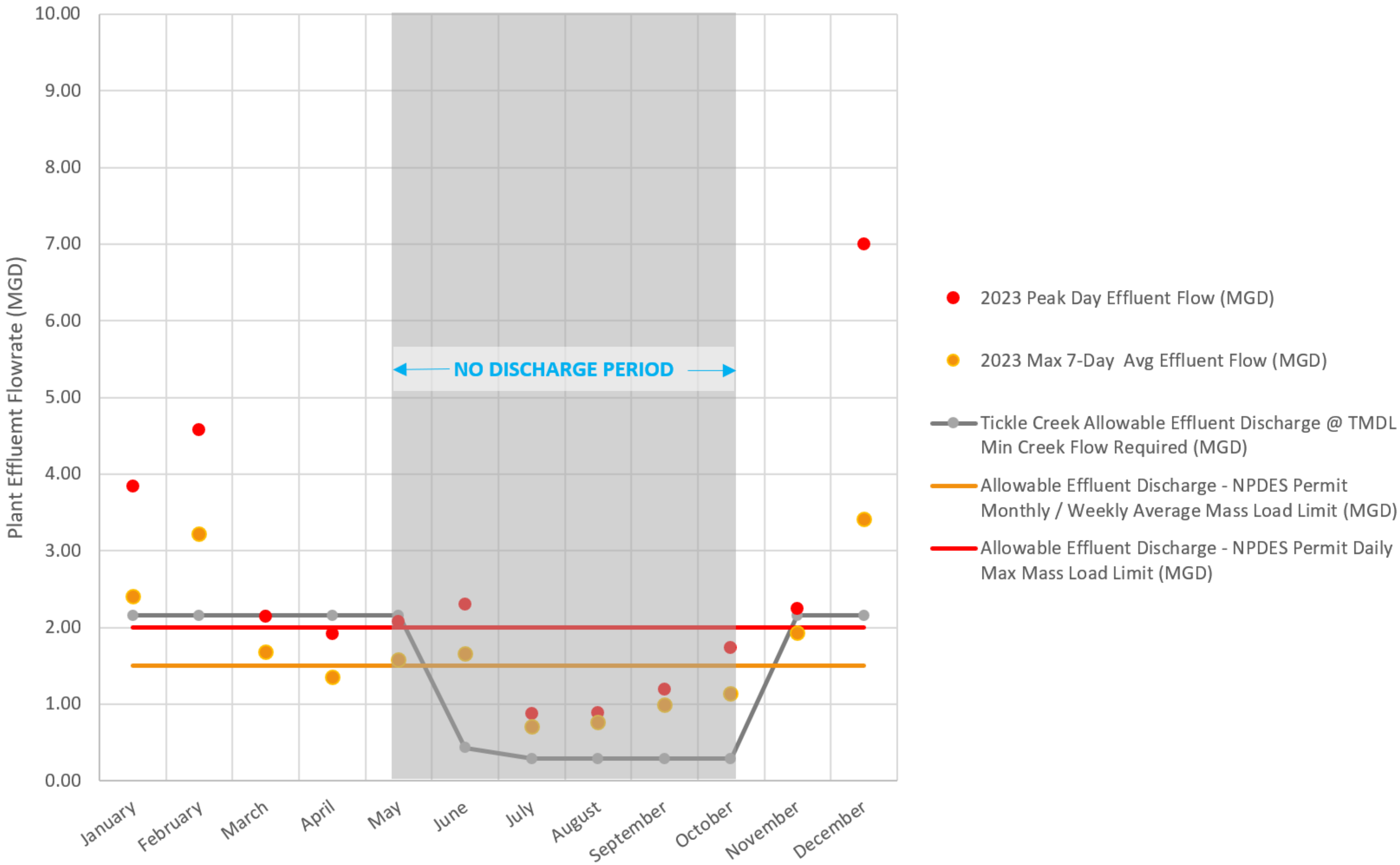
WWTP effluent flowrates were extrapolated 20 years using an estimated wet weather flow increase of 55% and compared against recorded creek flows (based on peak day flow projections). The dilution ratio was recalculated for future wet weather seasons from May 2039 through April 2041. Figure 9-1 shows the allowable discharge flowrates based on the current permit daily and weekly mass load limits, as well as allowable discharge flowrate to meet the 10 to 1 dilution requirement.

The USGS streamflow database (StreamStats) for Tickle Creek and DMR reported effluent discharge flowrate indicate in the spring, near the end of the WWTP effluent discharge season, the flowrate in Tickle Creek declines relatively quickly, while rainfall impacts on I&I have historically remained high well into early summer. Based on StreamStats and the reported discharge flowrates during April 2023, as many as 28% of days have experienced discharges resulting in a dilution ratio less than 10 to 1. This finding also aligns with the 2019 Plan findings.

Figure 9-1 illustrates the allowable effluent discharge based on dilution (gray line), based on weekly average BOD/TSS limits (orange line), and based on Daily Maximum BOD/TSS limits (red line). The gray line indicates there may be some days in November (during the discharge season) when Tickle Creek flowrate is too low to provide 10 to 1 dilution to the WWTP's effluent.

Kennedy Jenks

Figure 9-1: Tickle Creek Capacity Evaluation for Current (2023) Conditions



To comply with the 10 to 1 dilution limit, the WWTP would need to discharge into a larger stream. Alternatively, if the City can negotiate a lower dilution ratio, the facility may be allowed to continue to discharge if mass loadings do not increase. Improving the treatment capacity of the plant would provide an argument for a lower dilution ratio. With lower effluent BOD concentrations, the dilution factor could be reduced under OAR 340-041-0007(15)(a)(A)(i).

Section 9.1.1.2 summarizes an evaluation of extending the outfall to Deep Creek to take advantage of greater stream flowrate.

9.1.1.2 Deep Creek Discharge Limitations

Similar to Tickle Creek, Deep Creek is within the Three Basin area, and also subject to no increase in mass load limitations. Tickle Creek is a tributary to Deep Creek, which is larger and has a greater stream flowrate documented in the Deep Creek StreamStats. For this analysis, no change to effluent mass load limits was assumed, and the 10 to 1 dilution ratio would also apply to Deep Creek discharge. The analysis found that, like Tickle Creek, 9% of the calculated dilution ratios in April would fall below the allowed minimum value of 10.

This WWTP effluent data was then extrapolated 20 years using an estimated wet weather flow increase of 55% and compared against recorded creek flows. The dilution ratio was recalculated for the wet weather seasons from May 2039 through April 2041. It is estimated that by the end of the planning period, 21% of the dilution ratios would be below the permitted minimum value of 10. This indicates that discharging solely to Deep Creek during wet weather is not a viable option, and alternate options should be considered.

Figure 9-2 shows the results of this comparison and overlays dilution limits, mass load limits, historical creek flow data, and plant effluent data all in terms of plant effluent flow. Note that current maximum 7-day average flows and peak day flows consistently exceed the discharge limits in the NPDES Permit. This indicates that as plant effluent flows increase over time, discharge to Deep Creek would also result in exceedances of permit limits, and there would be little benefit to the City relocating Outfall 001 to Deep Creek under the 10 to 1 dilution minimum.

9.1.1.3 Tickle Creek and Deep Creek Conclusions

Discharges to Tickle Creek or Deep Creek were evaluated for dilution capacity based on available stream data. The data comparison between StreamStats (USGS) and effluent DMR data at the plant is reasonable for the “planning-level” assessment. The collection system responds quickly resulting in high effluent peak flowrates during the shoulder seasons (April and November). Based on storm events in 2021 through 2023, this could result in discharges that do not meet the 10 to 1 dilution ratio requirement. The changing nature of weather in the Pacific Northwest indicates storm patterns could continue to drive wastewater peaks that result in issues with dilution in Tickle Creek and in Deep Creek.

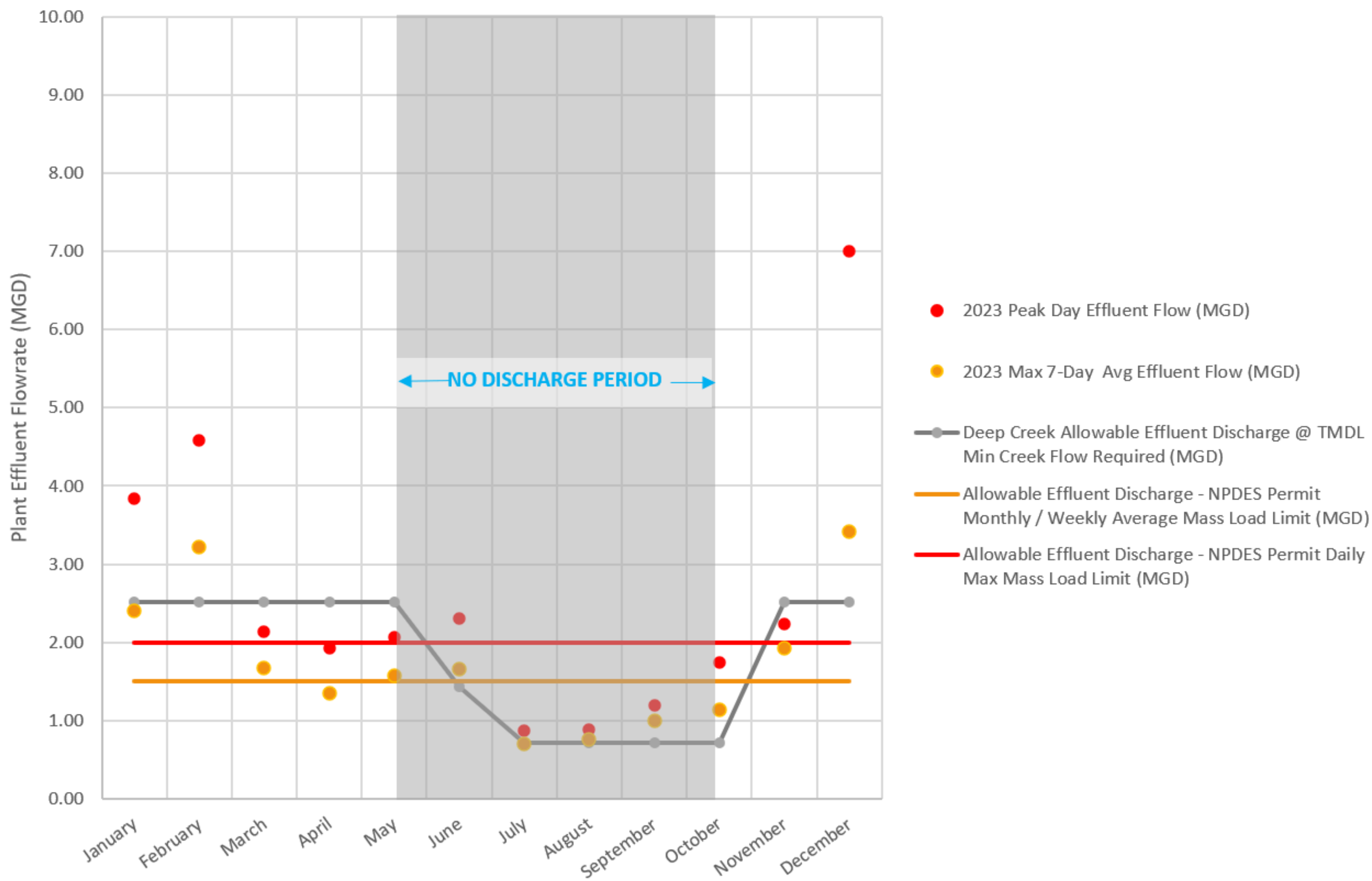
Options for continued discharge to Tickle Creek include:

- Increased storage during the shoulder seasons to attenuate effluent volumes, and discharge of a portion of the effluent to another basin, such as the Sandy River
- Subsurface infiltration of effluent under a revised permit.

- Pursuing a lower allowed dilution ratio may allow the City to discharge to Tickle Creek through Outfall 001 for a greater length of the discharge season. Such a reduced dilution ratio requires study to assess discharge of BOD_5, TSS, and Ammonia-N during lower streamflow periods for their impacts on threatened or endangered species in Tickle Creek, Deep Creek, and the Clackamas River.

These options are discussed in subsequent sections.

Figure 9-2: Deep Creek Capacity Evaluation



9.1.2 Summer Discharge Options

9.1.2.1 Iseli Nursery

The City has an agreement in place to send Class B recycled water to the Iseli Nursery from May through October. Recycled water is pumped to Pond 4, where it is distributed to three other ponds and used for irrigation. With effluent flowrates anticipated to increase over time, the existing storage or Nursery usage will need to increase to store the recycled water during the summer months and provide storage for flows exceeding permit limitations during the winter months.

9.1.2.1.1 *Iseli Expansion*

The City and Nursery held discussions to assess interest and feasibility of expanding their existing storage ponds and increasing recycled water usage. This included an expansion of existing Pond 4 from 1.7 MG to 3.7 MG, construction of a new 33-MG Pond 5, and construction of a new pump station at Pond 5 to transfer recycled water to the other irrigation ponds. A summary of the total potential storage, including the existing storage at the WWTP and proposed recycled water ponds at the nursery, is summarized below in Table 9-1.

Table 9-1: Total Available Pond Storage

Name	Storage (MG)
Existing Pond 1	1.8
Existing Pond 2	3.1
Existing Pond 3	14.7
Existing Pond 4	1.7
Existing WWTP Storage Pond	3.2
Total Existing Storage	**24.5**
Pond 5 Phase 1	11.9
Pond 5 Phase 2 [1]	32.6
Total Planned Storage	**44.5**
Total Existing and Planned Storage	**69.0**

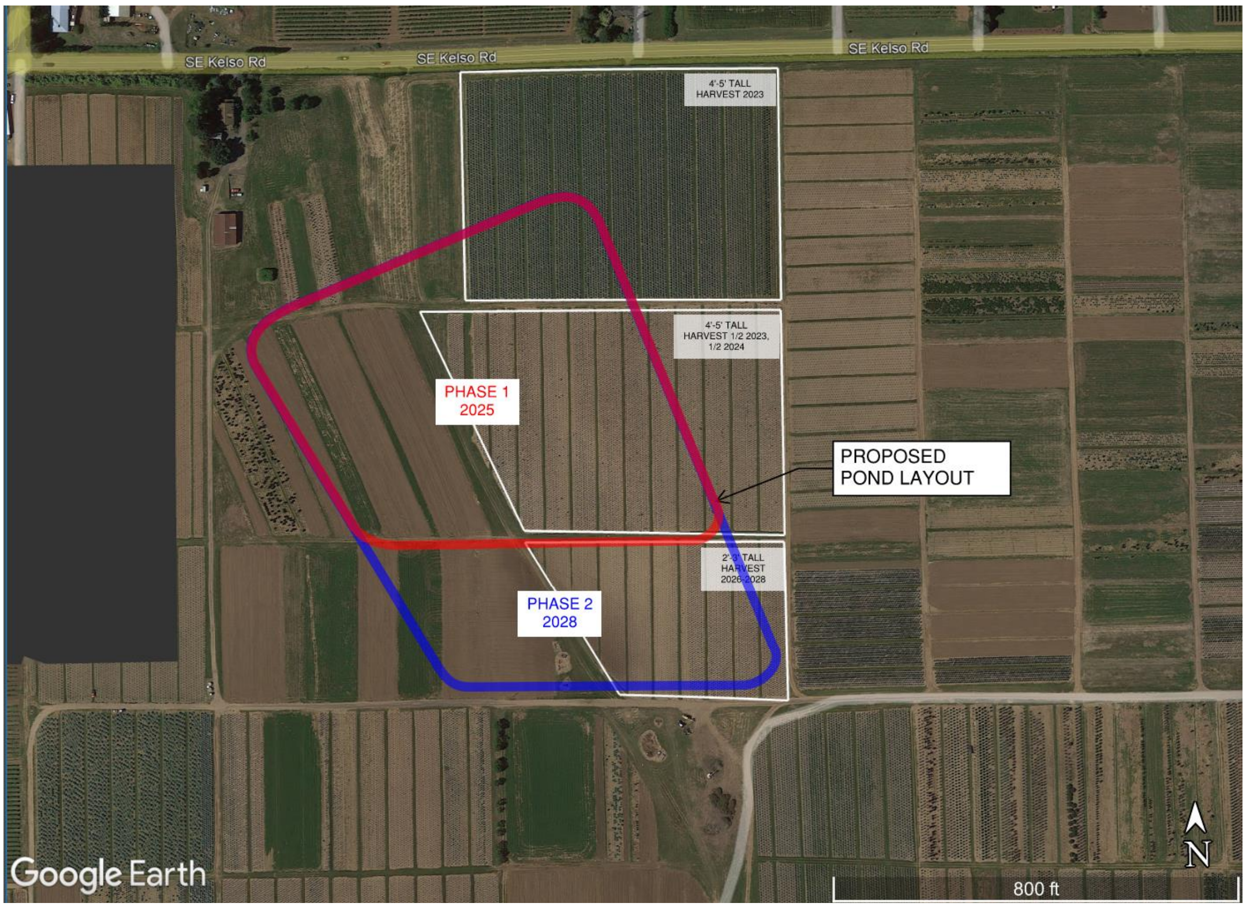
[1] This 2nd phase will be constructed in 10 years after newly planted saplings are grown.

Expansion of Pond 4, where the Nursery stores the City's treated effluent, would be accomplished by expanding the footprint slightly and raising the top of dike elevations. The feasibility of this work has not been assessed and depends significantly on the geotechnical conditions. Pond 4 sits near a slope, and the Nursery is not aware of a geotechnical assessment completed for this pond. There may be risks related to expanding this pond horizontally or vertically, and any consideration of this option would require field investigation and development of a preliminary design for use in evaluating stability of the pond. The amount of storage required is approximately 70 MG, so adding 3.7 MG in Pond 4 would improve the storage conditions but the unknown geotechnical conditions may carry with it significant risk. For this reason, this report focuses on a new Pond 5.

Figure 9-3 shows the proposed Pond 5 at Iseli Nursery that would allow storage for an additional 48 MG and would attenuate discharge of effluent to Tickle Creek for approximately 5 years. The phasing of the pond is based on storage need and the harvest schedule for the plantings. By 2028, all plantings in the areas proposed for the pond would be harvested and available if the Nursery agreed to dedicate this land to the pond. It is estimated that there is approximately 39.3 MG of total potential storage for recycled water in the near future and 71.9 MG within the next 10 years.

The downstream (North) end of proposed Pond 5 would border a mapped wetland, which may require mitigation. This and other permitting considerations may impact the project schedule.

Figure 9-3: Proposed Effluent Storage Pond at Iseli Nursery



9.1.2.2 Iseli Expansion Cost

The total cost to construct the storage pond shown in Figure 9-3 is $35 million, and includes demolition, excavation, fill, gates, wetland mitigation, polyethylene liner, pumps and controls, piping, and electrical service.

The cost to construct the 33 MG Pond 5 is considerable and would not extend the Tickle Creek discharge beyond approximately 5 years before the pond capacity was exceeded due to wastewater growth from the growing City. Based on the cost and limited benefit, the City determined storage is not a good investment, considering the Sandy River outfall is a viable option.

9.1.3 Effluent Infiltration

The team considered shallow infiltration as an option for treated effluent. Project Geotechnical Engineering partner Shannon & Wilson conducted test pits near the location of proposed Pond 5. The infiltration rate in the native soils of the nursery were low, and the presence of a drain tile system throughout the nursery resulted in shallow groundwater observed in multiple test pits. The Nursery's practices resulting in shallow groundwater presents an ongoing obstacle to surface infiltration of effluent at the site. For this reason, infiltration is not feasible at this site.

9.1.4 Groundwater Injection

Groundwater injection wells were considered as a potential discharge option to divert a portion of effluent away from Tickle Creek during wet weather peaks or all effluent during the non-discharge season when effluent flow exceeds irrigation demand. Sandy and Iseli Nursery lie in the Sandy-Boring Groundwater Restricted Area (GRA), which is a designated area where groundwater levels have declined due to historic over-pumping, primarily for agricultural uses. Injecting groundwater into the affected aquifer could help restore the groundwater in the area.

Groundwater in the Sandy-Boring GRA is not known to be impacted by contaminants, and widespread groundwater quality issues are not present at this time. This makes deep injection of treated effluent suitable for consideration. The efficacy of this option is dependent on hydrogeologic analysis and may require higher quality effluent limits to be determined as part of an Effluent Injection feasibility Study that will be required to assess the viability of this discharge alternative. The feasibility study will consist of research on the area hydrogeology, identification of aquifers available for injection composed of material with sufficient permeability to accept injected water, and at least one test well upon which injection testing can be implemented.

Negotiation of discharge limits for groundwater injection will require consultation with DEQ and Oregon Department of Water Resources to develop discharge criteria for the treatment plant. Nitrate-N is expected to be the primary driver for process design to achieve effluent concentrations of 5 to 10 mg/L to avoid negative water quality impact to the aquifer.

9.1.5 Discharge Option Conclusions

Winter discharge of effluent in 2040 can meet current permitted mass load limits if secondary treatment and tertiary filtration can meet a 1.5 milligrams/Liter (mg/L) BOD_5 and TSS concentration, respectively. The 10 to 1 dilution ratio may not be met in November. Summer discharge will not be allowed due to current permit requirements and dilution requirements (see Section 1.1), though the City has a longstanding effluent reuse partner that will continue to use available effluent when irrigation water is needed. The City is developing options to augment discharge to Tickle Creek, including groundwater injection wells or the Sandy River Outfall. These alternatives will require time to implement, thus it is critical that the updated NPDES discharge permit for Tickle Creek include provisions that allow the City to continue to operate in compliance.

Until an alternate discharge can be secured, the City is continuing to seek the inclusion of interim limits and conditions in the discharge to Tickle Creek that reflect the current capabilities of the WWTP and the limited options for effluent management during the spring and fall shoulder season when there is little or no demand for recycled water. Interim measures could include the following:

- Permitting higher BOD_5 and TSS mass loads for near-term flows and current treatment capabilities.
- Authorizing discharge to Tickle Creek during the late spring (i.e., May/June) and early fall (i.e., October) period when there is little or no demand for recycled water and effluent storage is full.
- Modifying the dilution requirement in the permit to reflect the existing dilution requirement in the Oregon Administrative Rule, or to waive the dilution requirement as has been allowed in effluent-dominated streams in Oregon.

The Sandy River outfall was included in the 2019 Facilities Plan as a discharge option for the City. However, underground injection wells are now also being discussed as another alternative that will allow for year-round discharge. It is anticipated that underground injection could be less expensive than constructing a new outfall to the Sandy River, therefore the injection wells are the recommended discharge strategy.

9.2 Recommended Long-Term Biosolids Approach

The 2019 Plan recommended the City move to a biosolids process that not only provides for greater volatile destruction (e.g. digestion) and a smaller footprint but also produces a marketable Class A biosolids product. The 2019 Plan further indicates that this product will significantly reduce the long-term solids storage space needed onsite and provide opportunities to market the product locally for beneficial reuse.

The 2026 Plan Amendment revisits the options for long-term biosolids management by exploring four biosolids treatment concepts applying the initial biosolids treatment process screening approach introduced in Section 5.

The City currently sends dewatered biosolids to landfill year-round. If the City continues to operate the existing process and continues to landfill biosolids, the facility remains in compliance with both NPDES permit limits and Biosolids “503” regulations. If the City wishes to land-apply biosolids, significant upgrades to the solids treatment process would be required to meet Class B or A biosolids characteristics to comply with biosolids regulations. If the City wishes generate Class A biosolids that can be used without restriction, the cost to upgrade the biosolids treatment process would be significantly higher, as described in Section 9.2.3.1.

9.2.1 Current Solids Treatment Concept

Currently, sludge is stored in the aerated sludge storage basin (ASSB) and is pumped to a belt filter press for dewatering using a submersible pump inside the storage basin. The existing ASSB is comprised of repurposed package treatment plant basins. There is a center basin surrounded by two wells. The center basin and two surrounding cells have been retrofitted into an aerobic digester. The center cell of the aerated sludge storage basin has a storage volume of 90,000 gallons. All cells pump decant to the headworks. The projected 2040 flows and loading will require 603,000 gallons of digester volume to maintain minimum solids retention times (SRT) of 40 to 60 days. Based on this requirement, the existing stabilization and storage basins have insufficient volume for aerobic digestion of 2040 projected solids.

On the northeast side of the plant, a solids handling building houses a belt filter press, biosolids conveyance equipment, polymer mixdown equipment, and instrumentation and controls. Sludge from the ASSB is pumped to the belt filter press feed pump. The belt filter press feed pump sends sludge into the belt filter press. After passing through the belt filter press, the dewatered sludge exits into a hopper with a dewatered sludge pump. The dewatered sludge pump moves dewatered sludge through a series of piping before discharging into the solids storage area on the south side of the solids building. The building is comprised of a concrete slab, concrete blocks, a metal canopy, and an outdoor covered dewatered sludge storage slab.

The aerated sludge storage basin is in fair condition and was recently rehabilitated to provide improved aeration and sludge transfer capability. The belt filter press (BFP) was recently rehabilitated and is performing well. There is a single BFP, which meets reliability requirements; however, the City may consider a secondary method of dewatering in the future to provide some redundancy during maintenance of the BFP. The primary issue with the dewatering system is the system conveying dewatered cake, which frequently fails. All of the biosolids alternatives presented in this report include a new conveyor system to replace the existing pump and conveyor.

9.2.2 Biosolids Treatment Goals

The City has a stated goal of producing Class A biosolids. The EPA 503 Rule establishes requirements for final use or disposal of biosolids. Class A biosolids are biosolids that are safe for handling and use by the general public and could be made available for public use as a soil amendment or fertilizer. In addition, after a Class A biosolids distribution program is established, this could be a revenue source for the City. There is a need for fertilizer production in the region, so there is potential demand for a Class A product.

Subpart D of the EPA 503 rule sets pathogen and vector attraction reduction requirements to achieve each biosolids classification. Class A biosolids are treated so that that there are no detectable pathogens, while Class B biosolids have a reduced level of pathogens. To achieve Class A biosolids, the facility would need to implement advanced sludge stabilization. Typical methods to achieve Class A biosolids pathogen and vector reduction requirements include alkaline stabilization with a supplemental heat source, anaerobic or aerobic digestion with thermal drying, or alkaline stabilization with composting.

Anaerobic digestion is not practical in a WWTP that does not produce primary sludge, therefore aerobic digestion is the most practical approach to digestion for the city specifically. Class A biosolids can be achieved without digestion, though it is more common to reach Class A via digestion prior to drying. The resulting Class A dried product is suitable for public use and requires no physical setbacks for agricultural application. Accomplishing Class A biosolids within the site constraint limits will likely require the installation of new dewatering equipment and a solids dryer.

9.2.3 Solids Treatment Concepts

The 2026 Plan Amendment includes a review of several concepts for expanding the sludge dewatering, stabilization/drying, and biosolids storage system and arrived on four possible solids treatment concepts listed below from highest to lowest level of treatment.

1. Class A Aerobic Digestion, Dewatering, and Dryer
2. Class A Non-Digested with ASSB, Dewatering, and Dryer
3. Class B Aerobic Digestion and Dewatering
4. Non-Digested with ASSB and Dewatering

The City discontinued the use of lime at the facility several years ago. Therefore, alkaline stabilization methods were immediately ruled out.

Preliminary conceptual level costs for these concepts were developed, and summarized herein with detailed cost tables and assumptions provided in Appendix C.

9.2.3.1 Concept 1: Class A Aerobic Digestion, Dewatering, and Dryer

Concept 1 produces the highest quality biosolids, with the following components:

- Aerobic digestion in a new set of aerobic digesters to reduce volatile solids content and stabilize biosolids.

- Dewatering with new solids processing equipment that will increase solids content from 12% to 18%.

- Thermal Drying in heat producing equipment to increase solids content between 80% to 90%.

Aerobic digestion provides stabilization and the added benefit of end-product odor control. Thermal drying provides additional pathogen and vector attraction reduction. Thermal drying would require improvements to the sludge dewatering system. This concept is a reliable way to meet Class A pathogen and vector attraction requirements.

9.2.3.1.1 *Aerobic Digester*

Preliminary design calculations indicate that the aerobic digester would require a volume of approximately 600,000 gallons to maintain an SRT of 40 to 60 days year-round through the 2040 plan year. An SRT of 40 to 60 days is typically the minimum SRT for aerobic digestion, depending on the season. The existing ASSB does not have the volume necessary to achieve the required SRT for aerobic digestion throughout the plan year.

The new digester will be a set of rectangular concrete tanks with a wall height of approximately 20 feet, and a length and width of 100 feet by 50 feet. There is no available space at the plant for a digester of this size within the developed areas of the plant, and available space around the liquid treatment areas will need to be used for expansion of the liquid stream processes. The area northeast of the existing biosolids handling building is relatively flat and has no existing structures. This area is large enough for the digester and is the most suitable location.

9.2.3.1.2 *Biosolids Dewatering*

Screw presses and fan presses were considered for dewatering. Screw presses provide a consistent and reliable solids concentration of 15% to 18% solids which is acceptable solids concentration for most dryers. Screw presses are simple to operate and inexpensive to maintain but have a significant capital cost. Energy costs are typically low for screw presses.

Fan presses, also known as rotary presses, are an inexpensive option that may be more suitable for the City. Rotary presses are modular and can expand as flows and loads increase. They require more maintenance than screw presses but do provide a relatively consistent solids concentration of 16-18% solids. Rotary presses typically have higher energy costs than screw presses.

Dewatering requires use of a polymer product to improve dewatering characteristic of the biosolids. Bulk polymer will be stored in totes and prepared for use in a package polymer make-down unit before mixing with biosolids.

9.2.3.1.3 *Biosolids Drying*

Thermal drying is applied to the dewatered biosolids to produce a product that is 80% to 90% solids in content and resembles soil in texture. This evaluation considered belt dryers and paddle dryers. Paddle dryers operate at higher temperature than belt dryers and should be operated 24-hours per day until the sludge is completely processed. Generally, paddle dryers have lower operating and maintenance costs and have more manageable maintenance schedules than other methods. Paddle dryers also have smaller footprints than belt dryers, which is a significant limiting factor for this facility.

Belt dryers are a low-temperature option and can be operated intermittently and are commonly operated 8- to 12-hours per day. They generally require more operation and maintenance labor than paddle dryers and often have a capital cost higher than paddle dryers. Belt dryers have a larger footprint that increases significantly with the solids feed rate.

9.2.3.1.4 *Dewatered/Dried Biosolids Storage*

The facility stores dewatered biosolids on a concrete slab under a metal canopy, contained by concrete blocks. Biosolids are loaded from the storage area to trucks by a contracted service and then hauled to a landfill for disposal. This method of storage is effective for the current practice; however, the City is subject to rising costs for loading/hauling and landfill disposal.

The City prefers to continue using the bulk storage area method, but the existing canopy is damaged, and the area does not have adequate space for long-term storage. A simple solution would be to build a similar storage bay directly northeast of the new dryer room, with a concrete pad, CMU blocks, and canopy to protect biosolids from weather. An inclined screw conveyor would transfer biosolids from the dryer to the storage area.

9.2.3.1.5 *Biosolids Concept 1 Summary*

Biosolids Concept 1 is summarized below:

- Digestion - Build aerobic digester and digester control building with blowers and pumps northeast of the existing solids building. Digestion will reduce VSS content and stabilize biosolids. Continue to use existing ASSB for additional storage and aeration volume.
- Dewatering - Remove belt filter press, hopper, polymer feed system, and conveyance system from dewatering building and replace with two screw presses.
- Dryer - Convert solids storage area into dryer room by finishing walls and new roof with electrical, plumbing, and ventilation. Install paddle a dryer to generate Class A biosolids. Install a dried solids conveyor system to transport solids from the dryer to new solids storage area.
- Biosolids Storage Building – Construct a new concrete slab/CMU building with ventilation northeast of new digester. Stockpile dried solids in the building for periodic load out and disposal.

The process outlined for Concept 1 produces the highest quality biosolids that can be used without restriction, can be used by the public without concern, and offers the City the most flexibility with disposal options.

The total estimated capital cost for this Solids Concept 1, with contracting, engineering, contingency, and escalation included, is approximately $43 million.

Operating Energy Costs for Biosolids Concept 1 are summarized in Table 9-2. Costs for polymer would be equivalent amongst all dewatering alternatives and were not included in operating estimates.

Table 9-2: Summary of Biosolids Concept 1 Energy Costs

Unit Process	Type	Operating Hours Per Week	Weekly Power Consumption (kWh)	Estimated Weekly Energy Cost
ASSB	Existing ASSB	168	8,960	$900
Aerobic Digester	New Digesters	168	50,740	$5,800
Dewatering Unit	Screw Press	120	270	$30
Dryer Unit	Paddle Dryer	120	5,420	$1,200[1]
WEEKLY ENERGY COST				**$7,930**

[1]Includes Electrical and Natural Gas Costs at year 2040

The annual cost to operate Concept 1 is approximately $250,000 before inflation. The net-present value over the course of the 20-year planning period for operations and maintenance is approximately $3,690,000, assuming a 3% annual inflation rate.

9.2.3.2 Concept 2: Class A Non-Digested with ASSB, Dewatering, and Dryer

Concept 2 produces high quality biosolids, with the following components:

- Retain existing ASSB for storage of approximately 15 days of sludge in 2040. Continue to aerate sludge.

- Dewatering using new solids processing equipment that will increase solids content to 12% to 18%.

- Thermal Drying in heat producing equipment to increase solids content to 80% to 90%.

9.2.3.2.1 *Aerated Sludge Stabilization Basin*

Existing Aerated Sludge Stabilization Basin will be retained for partial volatile suspended solids (VSS) destruction and storage of up to 270,000 gallons of sludge to feed biosolids processing equipment. This volume will store approximately 15 days of sludge from estimated 2040 flows and loading.

9.2.3.2.2 *Biosolids Dewatering*

Dewatering of stabilized sludge will take place in the same manner as described in Section 9.2.3.1.2.

9.2.3.2.3 *Biosolids Drying*

Drying of stabilized sludge will take place in the same manner as described in Section 9.2.3.1.3.

9.2.3.2.4 *Dewatered/Dried Biosolids Storage*

Storage of dried biosolids will take place in the same manner as described in Section 9.2.3.2.4.

9.2.3.2.5 *Biosolids Concept 2 Summary*

Biosolids Concept 2 is summarized below:

- Retain the existing ASSB, but do not upgrade to aerobic digestion. The existing ASSB does not have enough volume to reliably produce Class B biosolids. However, it can provide some VSS destruction and minimizes odors from stored sludge.
- Dewatering - Remove belt filter press, hopper, polymer feed system, and conveyance system from dewatering building and replace with two screw presses or a fan/rotary press.
- Dryer - Convert solids storage area into dryer room by finishing walls and new roof with electrical, plumbing, and ventilation. Install paddle a dryer to generate Class A biosolids. Install a dried solids conveyor system to transport solids from the dryer to new solids storage area.
- Biosolids Storage Building – Construct a new concrete slab/CMU building with ventilation northeast of new digester. Stockpile dried solids in the building for periodic load out and disposal.

The process outlined for Concept 2 produces Class A biosolids that can be used without restriction and offers the City many options for disposal. The primary drawback from the use of the biosolids product from this concept is that the lack of VSS destruction can result in odors when the product becomes wet after use.

The total estimated capital cost for Biosolids Concept 2, with contracting, engineering, contingency, and escalation included, is approximately $30 million.

Operating Energy Costs for Biosolids Concept 2 are summarized in Table 9-3.

Table 9-3: Summary of Biosolids Concept 2 Energy Costs

Unit Process	Type	Operating Hours Per Week	Weekly Power Consumption (kWh)	Estimated Weekly Energy Cost
ASSB	Existing ASSB	168	8,960	$900
Dewatering Unit	Screw Press	120	270	$30
Dryer Unit	Paddle Dryer	120	5,420	$1,500[1]
WEEKLY ENERGY COST				**$2,430**

[1] Includes Electrical and Natural Gas Costs

The annual cost to operate Concept 2 is approximately $70,000 before inflation. The net-present value over the course of the 20-year planning period for operations and maintenance is approximately $1,000,000, assuming a 3% annual inflation rate.

9.2.3.3 Concept 3: Class B Aerobic Digestion and Dewatering

Concept 3 produces Class B biosolids with the following components:

- Digestion – Build aerobic digester and digester control building with blowers and pumps northeast of the existing solids building. Digestion will reduce VSS content and stabilize biosolids.

- Dewatering – Replace belt filter press with new solids processing equipment that will increase solids content to 12% to 18%.

Aerobic digestion provides stabilization, and the added benefit of end-product odor control. Dewatering produces solids with a solids content between 12% and 18%. This concept is a reliable way to meet Class B pathogen and vector attraction requirements.

9.2.3.3.1 *Aerobic Digester*

Aerobic digestion of sludge will take place in the same manner as described in in Section 9.2.3.1.1.

9.2.3.3.2 *Biosolids Dewatering*

Dewatering of stabilized sludge will take place in the same manner as described in in Section 9.2.3.1.2.

9.2.3.3.3 *Biosolids Drying*

This concept does not include biosolids drying or other stabilization methods that could produce Class A biosolids.

9.2.3.3.4 *Dewatered Biosolids Storage*

For this solids concept, the existing biosolids storage area can continue to be used although some improvements are required. The damaged canopy over the existing biosolids storage area should be replaced with a new canopy, and the dewatered solids pump should be replaced with an inclined conveyor for more reliable conveyance.

9.2.3.3.5 *Biosolids Concept 3 Summary*

Biosolids Concept 3 is summarized below:

- Sludge Storage – Retain the existing ASSB, but do not upgrade to aerobic digestion. The existing ASSB does not have enough volume to reliably produce Class B biosolids, however, it can offer some volatile suspended solids destruction and minimizes odors from stored sludge.

- Digestion - Build aerobic digester and digester control building with blowers and pumps northeast of the existing solids building.

- Dewatering - Remove belt filter press, hopper, polymer feed system, and conveyance system from dewatering building and replace with two screw presses.

- Biosolids Storage Building – Continue to use the existing biosolids storage area after replacing damaged canopy and replacing dewatered sludge pumps with inclined conveyors.

The process outlined for Concept 3 produces Class B biosolids that can be beneficially used as a soil amendment with some specific limitations. Class B biosolids are typically used on forest land, grass fields, and crops not grown for human consumption. Class B biosolids cannot be handled by the general public and can only be used for commercial or industrial purposes. There are setback requirements for application fields that reduce the effective application area. However, Class B biosolids can also be disposed at a landfill, offering some flexibility for disposal.

The total estimated capital cost for this Solids Concept 3, with contracting, engineering, contingency, and escalation included, is approximately $20 million.

Operating Energy Costs for Biosolids Concept 3 are summarized in Table 9-4.

Table 9-4: Summary of Biosolids Concept 3 Energy Costs

Unit Process	Type	Operating Hours Per Week	Weekly Power Consumption (kWh)	Estimated Energy Cost (assume 10 cents/kWh)
Aerobic Digester	New Digesters	168	50,740	$5,800
Dewatering Unit	Screw Press	120	270	$30
WEEKLY ENERGY COST				**$5,830**

The annual cost to operate Concept 3 is approximately $200,000 before inflation. The net-present value over the course of the 20-year planning period for operations and maintenance is approximately $2,740,000, assuming a 3% annual inflation rate.

9.2.3.4 Concept 4: Non-Digested with ASSB and Dewatering

Concept 4 produces partially stabilized dewatered biosolids, with the following components:

- Retain existing ASSB for storage of approximately 15 days of sludge production in 2040.
- Dewatering with new solids processing equipment that will increase solids content to 12% to 18%.

This concept is the lowest cost alternative. It does not allow for production of Class A or Class B biosolids, is not suitable for any beneficial use, and assumes that the end-product will be hauled to a landfill. While this concept costs much less to implement than others, it has the disadvantage of limited disposal options. If for some reason landfill disposal is no longer a viable option for disposal, there are no other options for end-product disposal.

9.2.3.4.1 *Aerated Sludge Stabilization Basin*

Storage and aeration of sludge will take place in the same manner as described in in Section 9.2.3.2.1.

9.2.3.4.2 *Biosolids Dewatering*

Dewatering stabilized sludge will take place in the same manner as described in Section 9.2.3.1.2.

9.2.3.4.3 *Dewatered/Dried Biosolids Storage*

For this solids concept, the existing biosolids storage area can continue to be used although some improvements are required. The damaged canopy over the existing biosolids storage area should be replaced with a new canopy, and the dewatered solids pump should be replaced with an inclined conveyor for more reliable conveyance.

9.2.3.4.4 *Biosolids Concept 4 Summary*

Biosolids Concept 4 is summarized below:

- Sludge Storage – Retain the existing ASSB, but do not upgrade to aerobic digestion. The existing ASSB does not have enough volume to reliably produce Class B biosolids, however, it can offer some volatile suspended solids destruction and minimizes odors from stored sludge.
- Dewatering – Remove belt filter press, hopper, polymer feed system, and conveyance system from dewatering building and replace with two screw presses.
- Biosolids Storage – Continue to use the existing biosolids storage area. Stockpile dewatered solids in the building for periodic load out and disposal.

Dewatering provides the benefit of reducing the volume of the biosolids to reduce storage space needed for the end-product. Like Concepts 2 and 3, this concept allows for continued use of biosolids storage in the existing biosolids storage area. The damaged canopy will be replaced, and the dewatered solids pumps and piping will be replaced with an inclined conveyor.

9.2.3.4.5 *Biosolids Concept 4 Summary*

Biosolids Concept 4 is summarized below:

- Retain the existing ASSB, but do not upgrade to aerobic digestion. The existing ASSB does not have enough volume to reliably produce Class B biosolids, however, it can offer some volatile suspended solids destruction and minimizes odors from stored sludge.
- Dewatering - Remove belt filter press, hopper, polymer feed system, and conveyance system from dewatering building and replace with two screw presses.
- Biosolids Storage – Continue to use the existing biosolids storage area. Stockpile dewatered solids in the building for periodic load out and disposal.

The process outlined for Biosolids Concept 4 produces dewatered solids that are not suitable for beneficial use and can only be disposed at a landfill.

The total estimated capital cost for this Biosolids Concept 4, with contracting, engineering, contingency, and escalation included, is approximately $10 million.

Operating Energy Costs for Biosolids Concept 4 are summarized in Table 9-5.

Table 9-5: Summary of Biosolids Concept 4 Energy Costs

Unit Process	Type	Operating Hours Per Week	Weekly Power Consumption (kWh)	Estimated Energy Cost
ASSB	Existing ASSB	168	8,960	$900
Dewatering Unit	Screw Press	120	270	$30
	WEEKLY ENERGY COSTS			**$930**

The annual cost to operate Concept 4 is approximately $40,000 before inflation. The net-present value over the course of the 20-year planning period for operations and maintenance is approximately $470,000, assuming a 3% annual inflation rate.

9.2.4 Biosolids Concept Cost Comparison

Capital costs and operations and maintenance costs were estimated for each alternative. Economic criteria accounts for the capital investment for each solids concept, and the energy costs for each concept over the 20-year planning period. The capital costs account for equipment, materials, and labor costs. Capital costs also account for the cost of additional items calculated based on a percentage of the subtotal. These include Division 1 specification costs (12% of subtotal), contractor overhead & profit (8%), contingency (30%), engineering/legal/administrative fees (25%), market contingency (10%), and escalation to the midpoint of construction (13%). Costs are compared in Table 9-6.

Table 9-6: Biosolids Concept Cost Comparison

	Concept 1	Concept 2	Concept 3	Concept 4
Capital Cost	$ 43 M	$ 31 M	$ 20 M	$ 8.1M
20-Year Operating Cost	$ 6.7 M	$ 1.0 M	$ 2.8 M	$ 0.5 M
Total Life Cycle Cost	**$ 49.7 M**	**$ 32.0 M**	**$22.8 M**	**$ 8.6 M**

9.2.4.1 Biosolids Hauling and Disposal Costs

Currently, the City pays a vendor to haul dewatered solids to the Wasco County Landfill located approximately 90 miles from the Sandy WWTP. The picking and hauling costs are $100/ton, and the landfill tipping fee is $22/ton. Overall, the total cost for pickup, hauling, and disposal is approximately $122/ton. Assuming the hauling cost is about half of the $100/ton fee, the disposal cost of a ton per mile is approximately $0.56/ton-mile. Current biosolids hauling and disposal costs are summarized below.

- Pickup Costs: $50/ton
- Hauling Costs: $50/ton ($0.56/ton-mile)
- Landfill Tipping Fee: $22/ton
- Total: $122/ton

If the City were to identify a disposal location within 20 miles of the treatment facility, or a landfill with a lower tipping fee, disposal costs could be similar to costs summarized below.

- Pickup Costs: $50/ton
- Hauling Costs: $0.56/ton-mile @ $20 miles =$11.20/ton
- Landfill Tipping Fee: $15/ton
- Total: $76.20/ton

A summary of estimated annual biosolids disposal costs for year 2040 is provided in Table 9-7.

Table 9-7: Comparison of Annual Biosolids Disposal Costs for Year 2040

	Annual Biosolids Disposal Cost[1]			
	Concept 1	Concept 2	Concept 3	Concept 4
Landfill Disposal[2]	$160,000	$160,000	$650,000	$650,000
Land Application[3]	$100,000	$100,000	$410,000	--[(4)]

(1) All costs rounded to nearest $1,000.
(2) Assumes $122/ton as described above.
(3) Assumes $76.20/ton as described above.
(4) Land application is not allowed for Concept 4 solids, as they do not meet Class B biosolids characteristics.

The City may benefit from identifying a disposal location closer to the treatment facility to save on disposal costs. If the City implements a Class B or Class A biosolids end-product that can be used for commercial or industrial purposes, the disposal location does not need to be a landfill. It is important to note that if the City elects to implement Concept 4, the disposal location can only be a landfill.

9.2.5 Initial Solids Concept Treatment Screening

As described in Section 5, an Initial Concept-Level Screening approach is applied to identify economic, regulatory, implementation, resiliency, and disposal challenges to assess the viability of solids treatment solutions. The outcomes of the initial screening of solids treatment concepts are presented in Table 9-8**.**

Table 9-8: Application of Screening Criteria for Initial Solids Treatment Concepts

Initial Solids Concept Criteria 🡓	Concept 1: Class A Aerobic Digestion, Dewatering, and Dryer	Concept 2: Class A Non-Digested with ASSB, Dewatering, and Dryer	Concept 3: Class B Aerobic Digestion and Dewatering	Concept 4: Non-Digested with ASSB and Dewatering
ECONOMIC	✗	~	~	✓
CURRENT REGULATORY RISK	✓	✓	✓	✓
FUTURE REGULATORY RISK	✓	✓	~	~
IMPLEMENTATION	~	~	~	✓
RESILIENCY	✓	✓	✓	✓
LANDFILL DISPOSAL	✓	✓	✓	✓
LAND APPLICATION	✓	✓	✓	✗
BENEFICIAL REUSE	✓	~	~	✗

The colored boxes indicate whether the concept can meet (green), likely to meet (yellow), or unable to meet (red) the criteria as indicated in the following legend:

LEGEND: Viable or Feasible	
YES	✓
Likely	~
NO	✗

The biosolids treatment concepts 1 through 4 have decreasing treatment capabilities. Concept 1 provides the highest level of treatment, capable of producing Class A biosolids. However, it requires the most space and would incur the greatest amount of capital and operating expenditure. Concept 4 is the lowest cost alternative, reusing much of the existing solids processing equipment, and assumes the end-product will be hauled to a landfill. This concept retains the existing ASSB and replaces the existing dewatering equipment to increase solids content prior to storage in the existing biosolids storage area. The modifications to the existing solids process does not enable the production of Class A or B biosolids but can be implemented quickly for lowest cost, as a short-term solution. The new screw presses can be reused in more robust biosolids processing if the City decides to move to Class A biosolids production.

9.2.6 Recommended Biosolids Approach

Concept 4 can be an initial phase for any of the biosolids treatment alternatives. The low capital costs, operating costs, and space requirements of implementing the upgrades to dewater and stabilize solids for landfilling make this alternative the desired approach. While this concept does not have the advantage of biosolids production for beneficial reuse, each of its parts can be reused and upgraded as funding becomes available to treat to higher solids quality. If additional value engineering is necessary during the design phase of the project, the screw press dewatering system could be switched out for a rotary press system. This concept will be applied to all three liquid stream treatment alternatives for the complete alternatives analysis.

The following is a summary of the initial phase of the recommended biosolids approach:

- Retain existing ASSB and continue to use for additional sludge storage and aeration
- Remove existing belt filter press and replace with screw presses. If necessary to reduce capital costs, consider a fan/rotary press for dewatering.
- Replace the canopy over the biosolids storage area.

The total estimated cost for the complete recommended biosolids approach is **$8.1M** as summarized in Table 9-9.

Table 9-9: Estimated Probable Construction Costs – Biosolids Unit Processes

Process Area	Cost
Dewatering	$8.0M
Drying	$--
Solids Storage	$0.1M
TOTAL BIOSOLIDS COST	**$8.1M**

The recommended biosolids alternative is applied to all liquid stream alternatives in the following sections summarizing the recommend treatment plant expansion projects.

9.2.7 PFAS in Biosolids

Per- and polyfluoroalkyl substances (PFAS) are contaminants of concern in drinking water and are under consideration for regulation for land application of biosolids. PFAS compounds in biosolids are not currently regulated in Oregon or at the Federal level and impacts of PFAS compounds is currently unknown. Given the uncertainty, the City should continue to track potential PFAS implications, but the priority for funding at this time should be the treatment process improvements recommended in this Plan Amendment.

9.2.7.1 Federal Action on PFAS/PFOS

In April of 2024, EPA set Maximum Contaminant Levels (MCLs) for six different types of PFAS in drinking water, however the establishment of national standards regarding PFAS in biosolids is still ongoing. Of the many groups of chemicals classified as PFAS, perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) have been identified as the most prevalent forms in biosolids. EPA is conducting a PFOA and PFOS in biosolids risk assessment slated to be completed and released to the public in Winter 2024. The risk assessment will be the basis for determining if there will be regulations on PFOA and PFOS in biosolids (*Final PFAS National Primary Drinking Water Regulation*, EPA 2024a).

Ongoing research components of the risk assessment include understanding the fate and transport of PFAS in land-applied biosolids, management strategies for land-applied biosolids, and studying the effectiveness of potential destruction and disposal options. Updated interim destruction and disposal guidance published by the EPA in April 2024 focuses on thermal treatments, landfills, and underground injection; however, there are several information gaps yet to be addressed. (*Interim Guidance on the Destruction and Disposal of Perfluoroalkyl and Polyfluoroalkyl Substances and Materials Containing Perfluoroalkyl and Polyfluoroalkyl* Substances— Version 2, EPA, 8 April 2024b).

EPA published a draft questionnaire in March 2024 intended to send to 400 Publicly-Owned Treatment Works (POTWs) dischargers. No sample results are required for the questionnaire response, instead, it inquires about industrial users, methods of discharge, and biosolids management practices. A subset of up to 300 respondents will be selected to participate in a two-phase sampling program of liquid and biosolids streams to help EPA build a database to assess PFAS prevalence.

In addition, the EPA is in the final stages of validating a method to test for PFAS in several mediums including wastewater and biosolids. Rulemaking based on this methodology is likely to start in 2024 and is already being recommended in some NPDES permits (*Joint Principles for Preventing and Managing PFAS in Biosolids*, EPA 2024c).

9.2.7.2 State Action on PFAS

Oregon has been actively researching PFAS in water systems and is working towards developing a greater understanding of PFAS in biosolids, particularly on how they may impact both public health and the environment. The Biosolids Bill (HB 4049) is currently waiting to be passed by the Oregon legislature and would offer funding to research the occurrence, distribution, fate, and transport of PFAS in land-applied biosolids derived from wastewater. The Oregon State University (OSU) Extension and OSU College of Agricultural Sciences would conduct the study and, if the bill gets passed, will publish a report by December 15, 2025 (*Biosolids, PFAS and Oregon Agriculture*, Karen Lewotsky, 22 February 2024).

While neither Oregon nor the EPA are yet to set any type of regulation on PFAS in biosolids, some states have already implemented their own rules and guidelines. These regulations are summarized in Table 9-10 and are provided to contextualize what potential regulations could affect Sandy's biosolids management in the future.

Table 9-10: Summary of Current State PFAS Regulations

State	Regulation
Colorado	Established monitoring requirements for biosolids preparers with a threshold for PFOS. If PFOS level is ≥ 50 µg/kg, biosolids preparers must develop and implement a Source Control Program. (Regulation 64 – Biosolids Program) Note that 50 µg/kg is not a risk-based threshold.
Maine	Complete ban on biosolids land application from sludge or septage generated from a municipal, commercial, or industrial wastewater treatment plant unless it can be demonstrated that the biosolids are PFAS free. (HP 1417 – LD 1911)
Massachusetts	Requires quarterly monitoring of PFAS in residuals with an Approval of Suitability (AOS) and are permitted to be used through land application.
Michigan	Implemented classifications for PFAS impacted biosolids: • Industrially impacted: PFOS or PFOA concentrations of 100 µg/kg or higher. Unable to be land applied and require further actions including notification and source reduction plans. • Elevated concentrations: PFOS or PFOA concentrations between 20 µg/kg and 100 µg/kg. Require reduced land application rates or alternative risk mitigation strategies. • Below 20 µg/kg: biosolids with PFOS or PFOA concentrations below 20 µg/kg may be land applied with no additional requirements. • Exceptional Quality (EQ): Must maintain combined PFOS and PFOA concentrations below 20 µg/kg. Michigan also requires quarterly monitoring of PFAS in residuals with an AOS for land application.
New Hampshire[(1)]	Depending on PFOS and PFOA concentrations, biosolids are classified as industrially impacted, elevated, or below specific thresholds. New Hampshire Department of Environmental Services works individually with each generator of biosolids permittee in the state. Each generator is required in their annual report to describe measures taken to reduce concentrations of PFAS present in their biosolids.

[1] Developing standards for the land application of biosolids.

The determination of PFAS limits for land application of biosolids in Oregon and federally are pending. There is no defined time frame on when that will be made, and the liquid stream process improvements must proceed. The City conducted PFAS sampling of the influent, effluent and biosolids in May 2024 as part of a study conducted by the Oregon Association of Clean Water Agency, and PFAS/PFOS compounds were observed. The results of this study will inform ACWA's position on regulations related to the compounds.

Recent literature indicates significant thermal destruction of PFAS compounds requires temperatures greater than 700 degrees Fahrenheit (*High-Temperature Pyrolysis for Elimination of Per-and Polyfluoroalkyl Substances (PFAS) from Biosolids*, Hanieh Bamdad, et al., 25 October 2022). Temperatures in this range can cause pyrolysis or combustion, which leads to PFAS destruction. The methods proposed for treatment in this Plan Amendment will not destroy PFAS compounds. If limits on PFAS are identified for biosolids, the City will have two immediate options:

- Investigate Treatment Options Available – Ongoing research will develop effective methods of PFAS destruction. At the time DEQ and EPA publish draft limitations on

PFAS in biosolids land-application, the City should then further investigate available treatment options.

- Dispose of biosolids in a landfill – The City is currently disposing of biosolids in a landfill and could continue this practice.

One of the wastewater treatment alternatives considered in this report includes Alternative 4, conveyance and treatment at a regional treatment plant. This reduces the City's exposure to PFAS/PFOS regulations; however, the receiving treatment plant will take on the regulations and may share some of the source control requirements with the City through the agreement between the two parties.

9.3 Wastewater System Upgrades Cost Effectiveness Evaluation

The 2019 Plan focused on comparing collection system upgrades to treatment process upgrades. The City has implemented a significant portion of the collection system rehabilitation projects and the reduction in I&I was observed in the flow projections prepared for the Plan Amendment. This collection system cost effectiveness analysis no longer applies for the 2026 Plan Amendment.

9.4 Conclusions from Comprehensive WW System Alternatives Evaluation

The 2019 Plan focused on the conclusions from comparing collection system upgrades to treatment process upgrades. Substantial collection and treatment upgrades have been completed. Therefore, the 2019 Plan analysis no longer applies for the 2026 Plan Amendment.

9.5 Recommendations from Comprehensive WW System Alternatives Evaluation

The 2019 Plan focused on the recommendations from comparing collection system upgrades to treatment process upgrades. Substantial collection and treatment upgrades have been completed. Therefore, the 2019 Plan analysis no longer applies for the 2026 Plan Amendment.

Section 10: Long-Term Wastewater Treatment Alternatives Evaluation Update

2019 PLAN | SECTION 10 SUMMARY

- The alternatives analysis in Section 9 concluded that:
  - The most cost-effective option for wastewater system upgrades is a balanced approach to address the City's challenges associated with wastewater collections, treatment, and discharge.
  - The recommended approach incorporated full rehabilitation of two sewersheds, including sewer main and lateral rehabilitation, to reduce 2040 projected peak wastewater system flow from 17.1 MGD to approximately 14.0 MGD coupled with expansion of wastewater treatment capacity.
  - It also concluded that expansion of the City's current wastewater treatment process incorporating secondary treatment, tertiary filtration, aerated sludge storage, and lime stabilized Class B biosolids is not viable long-term primarily because the current intermittent discharge to Tickle Creek is not viable long-term as the City continues to grow.
- Thus, pursuing a year-round discharge to the Sandy River has been identified as the best long-term discharge option for the City.
- This section further developed and evaluated additional wastewater treatment alternatives:
  - Considering the limitations of the current WWTP site and discharge, planning for future discharge to the Sandy River and eventual production of a marketable Class A Biosolids product that will reduce the storage needed for lime stabilized Class B Biosolids and provide a more marketable biosolids product for distribution by the City.
  - The alternatives also consider capacity improvements or deferments needed for the various options considered.
  - Lastly, the evaluation also considers the impact of these scenarios on the required collection system and effluent infrastructure improvements.

10.1 Introduction

The 2019 Plan recommendations led to project costs that were far beyond the City's available budget. The 2026 Plan Amendment revisits the prior alternatives with a focus on maintaining treatment plant upgrades at the existing site rather than a satellite location, and develops new alternatives with a focus on affordability and phasing to comply with current regulatory requirements while preparing for future growth.

The Long-term Treatment Alternatives were developed through several phases of updates to the Facility Plan Amendment. This phased development was necessary because of the high cost of the alternatives and the need to find a pathway that is technically viable and financially feasible for Sandy. These phases of development were:

1. Screening Phase: initial development of alternatives documented in the 2024 Draft Facility Plan Amendment. This phase identified WWTP expansion using MBR with discharge through a new Sandy River outfall as the lowest cost alternative but

determined that treatment at a regional plant (Gresham WWTP) had a comparable cost and more certain implementation pathway. Additional investigation of the regional treatment option was required to confirm the improvements needed, evaluate impacts on the Gresham WWTP, and confirm the intergovernmental framework and connection cost for implementing this option.

2. Investigation Phase: investigation of the regional treatment option. This phase, conducted through 2025, prepared a more detailed evaluation of the pumping and conveyance alternatives for sending flow from the Sandy WWTP to the City of Gresham, examined potential points of connection into the City of Gresham's collection system, and determined the impacts of accepting flow from Sandy on the Gresham WWTP. This phase also included discussions with the City of Gresham to establish a framework for an intergovernmental agreement and determine an appropriate connection charge.

3. Reassessment Phase: The Investigation Phase determined that neither the Regional WWTP alternative or upgrade of the Sandy WWTP and construction of an outfall to the Sandy River are financially feasible. Concurrently, Oregon DEQ has been investigating opportunities to promote increased effluent reuse. These considerations led the City of Sandy to reassess opportunities for local beneficial use of treated effluent through groundwater augmentation.

The long-term wastewater treatment concepts evaluated through these phases are sized to treat projected 2040 flow and loading but could provide sufficient capacity until 2050 depending on the impacts of a future moratorium on growth in the community.

10.2 Wastewater Treatment Concepts (Liquid Stream Update)

The 2019 Plan developed four alternatives to further evaluate wastewater treatment requirements and associated collection system capacity upgrades for the 2040 planning horizon. These were complex projects with high costs that were deemed to be unaffordable given the City's current budgetary constraints. Since the 2019 Plan was approved, the City invested in repairs to its collection system, which has reduced I&I. These efforts reduced peak wet weather flowrates, extending the utility of the City's existing WWTP.

The 2026 Plan Amendment revisits the options for improving wastewater treatment to address economic, regulatory, implementation, and resiliency challenges. As required by the Consent Decree, five possible wastewater treatment project concepts are identified and summarized in this section.

- Alternative 1 - Conventional Activated Sludge (CAS)
- Alternative 2 - Membrane Bioreactor (MBR)
- Alternative 3 - Hybrid MBR/CAS
- Alternative 4 - Regional Treatment Plant
- Alternative 5 - Collection System Storage Concept

Preliminary conceptual level costs for these concepts were developed and are summarized herein, with detailed cost tables and assumptions provided in Appendix C.

10.2.1 Conventional Activated Sludge Concept

Alternative 1 will expand the existing activated sludge process to include additional aeration basins to improve BOD and ammonia removal. The proposed CAS system consists of the following components:

- Influent Screening – Two automatically cleaned basket fine screens to remove large and floatable materials from the influent stream, with a manual bar screen as standby.
- Grit removal – Existing grit removal system remains in service to remove sand, gravel, and other heavy items from the influent. All parts of existing system are in good working order.
- Aerobic Treatment – The existing conventional activated sludge process will be expanded with additional aeration trains to provide additional secondary biological treatment capacity.
- Secondary Clarification – A third secondary clarifier will be constructed to provide additional treatment capacity.
- Tertiary Filtration – Secondary clarifier effluent will be conveyed to ultrafiltration tertiary membrane filters to remove most of the remaining suspended solids. Filtered solids will be returned to the plant influent for additional treatment.
- UV Disinfection – Tertiary effluent will be disinfected using ultraviolet light to deactivate pathogens.
- Recycled Water Chlorination – Recycled water will be chlorinated before pumping to Iseli Nursery to comply with Class B recycled water requirements.
- Biosolids Upgrades – Sludge will continue to be aerated in the ASSB. The dewatering system will be replaced, a dryer will be added, and a new storage area will be constructed per Biosolids Concept 2 described in Section 9.
- Electrical Upgrades – Electrical upgrades to support upgrades described above.

A process flow diagram is provided in Figure 10-1.

PRELIMINARY DESIGN PHASE
NOT FOR CONSTRUCTION

THIS DOCUMENT IS AN INTERIM DOCUMENT AND NOT SUITABLE FOR CONSTRUCTION. AS AN INTERIM DOCUMENT, IT MAY CONTAIN DATA THAT IS POTENTIALLY INACCURATE OR INCOMPLETE AND IS NOT TO BE RELIED UPON WITHOUT THE EXPRESS WRITTEN CONSENT OF THE PREPARER.

NO	REVISION	DATE	BY

SCALES
0 — 1"
0 — 25mm
IF THIS BAR IS NOT DIMENSION SHOWN, ADJUST SCALES ACCORDINGLY.

PRELIMINARY NOT FOR CONSTRUCTION

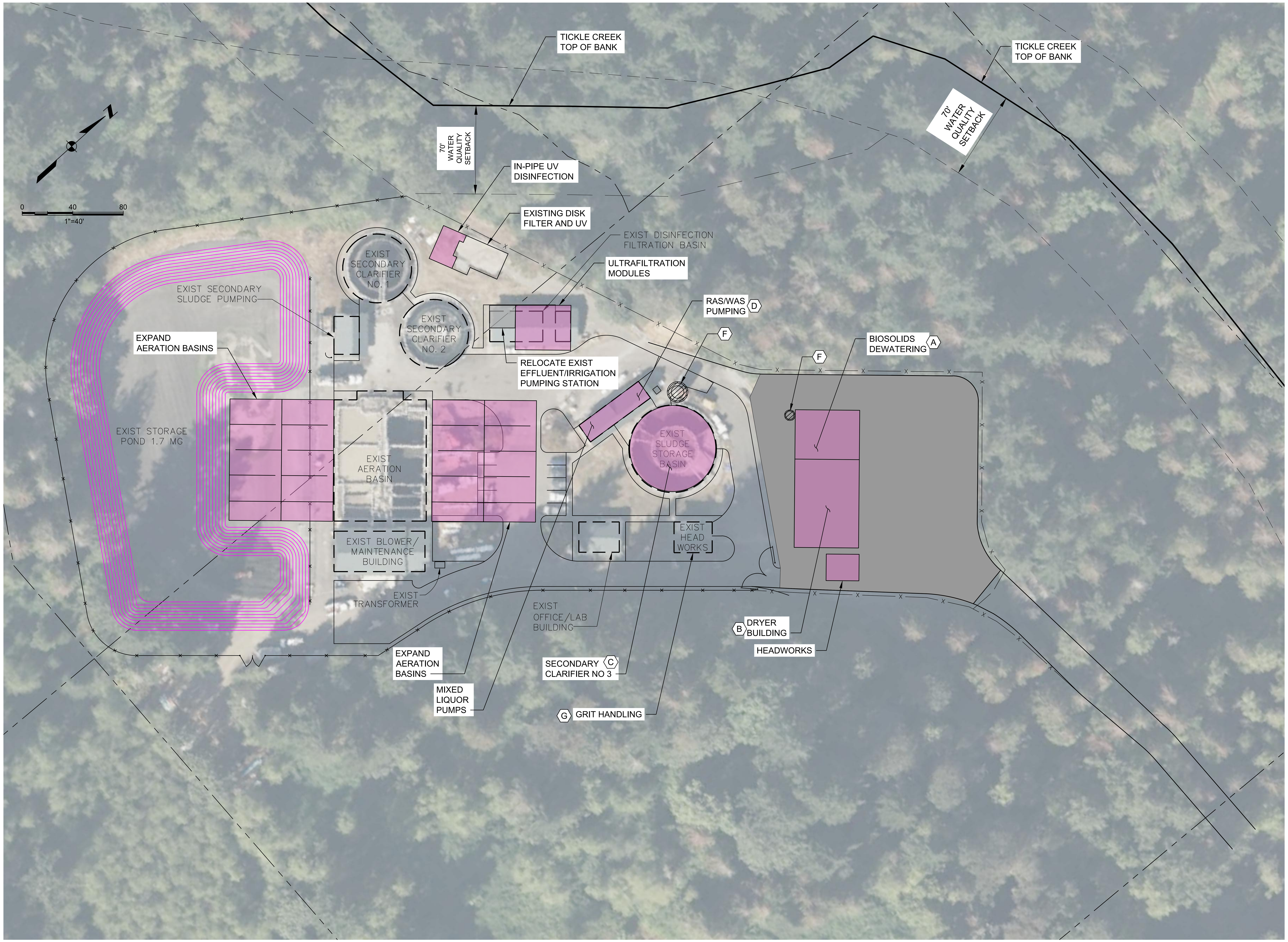
DESIGNED AM
DRAWN RLH
CHECKED RSP

CITY OF SANDY, OREGON
WASTEWATER SYSTEM FACILITY PLAN
FACILITY PLAN AMENDMENT
WWTP IMPROVEMENTS ALTERNATIVES

Kennedy Jenks

ALTERNATIVE - 1 CONVENTIONAL ACTIVATED SLUDGE EXPANSION

SCALE NTS
JOB NO 2276020.00
DATE DECEMBER 2025
SHEET OF ---
FIG-10-1



GENERAL SHEET NOTES

1. NEW PAVEMENT TO BE ADDED AROUND THE DEWATERING, DRYER, AND BIOSOLIDS STORAGE BUILDING.

SHEET KEYNOTES

A. DEMO BELT FILTER PRESS. INSTALL TWO SCREW PRESSES FOR DEWATERING.

B. REHAB BUILDING AND USE AS DRYER BUILDING. INSTALL PADDLE DRYER.

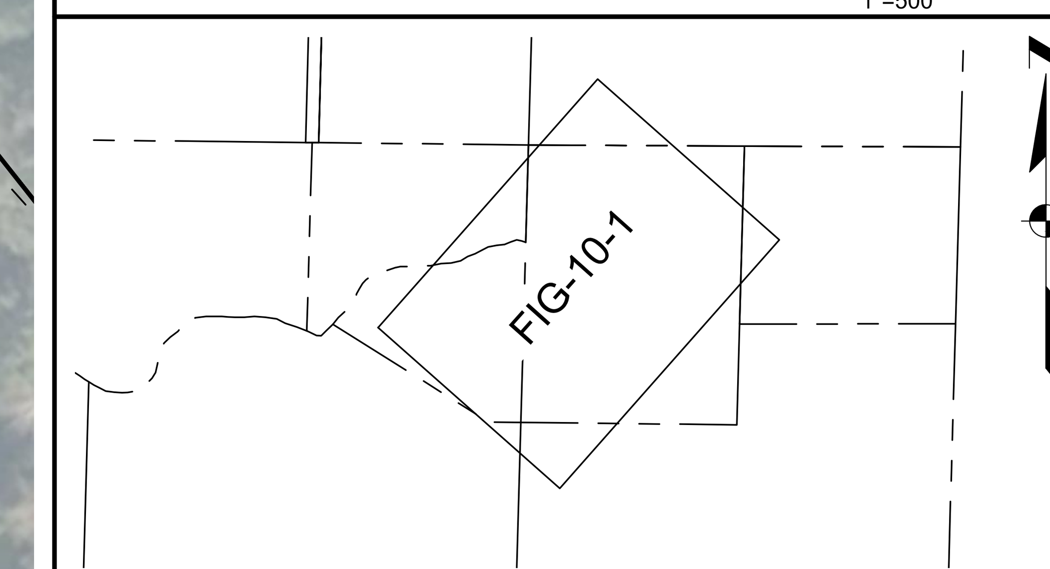
C. DEMO BASIN, REPLACE WITH THIRD SECONDARY CLARIFIER.

D. EXPAND SLUDGE PUMPING.

E. DEMO EXISTING HEADWORKS SCREEN.

F. DEMO SLUDGE TANK AND LIME SILO.

KEY PLAN



LEGEND

NEW/UPDATED PROCESS AREA

ASPHALT

PRELIMINARY DESIGN PHASE

NOT FOR CONSTRUCTION

THIS DOCUMENT IS AN INTERIM DOCUMENT AND NOT SUITABLE FOR CONSTRUCTION. AS AN INTERIM DOCUMENT, IT MAY CONTAIN DATA THAT IS POTENTIALLY INACCURATE OR INCOMPLETE AND IS NOT TO BE RELIED UPON WITHOUT THE EXPRESS WRITTEN CONSENT OF THE PREPARER.

NO	REVISION	DATE	BY

SCALES: 0 — 1"; 0 — 25mm. IF THIS BAR IS NOT DIMENSION SHOWN, ADJUST SCALES ACCORDINGLY.

PRELIMINARY NOT FOR CONSTRUCTION

DESIGNED: AM
DRAWN: RLH
CHECKED: RSP

CITY OF SANDY, OREGON
WASTEWATER SYSTEM FACILITY PLAN
FACILITY PLAN AMENDMENT
WWTP IMPROVEMENTS ALTERNATIVES

Kennedy Jenks

SITE PLAN
ALTERNATIVE 1: CONVENTIONAL ACTIVATED SLUDGE TREATMENT

SCALE: 1" = 40'
JOB NO: 2276020.00
DATE: DECEMBER 2025
SHEET OF ---
FIG-10-2

Plot Date: 12/30/2025 1:57 PM
User: RICHARD HILLS
pw:\\kjce-pw.bentley.com:kjce-pw\Documents\Clients\Sandy, City of OR\Projects\Wastewater Facility Plan Amendment_2276020.00\10-Design\10.06-Drawings\Civil\Misc\2276020.00-C-FIG-10-2

10.2.2 Membrane Bioreactor Concept

Alternative 2 will replace the existing CAS process with a higher density activated sludge process that replaces secondary clarifiers with membrane filters that allow operators to maintain higher mixed liquor concentrations. The MBR conceptual design is the treatment alternative that can most closely meet groundwater discharge requirements (NO3-N between 5 and 10 mg/L).

The proposed MBR treatment process consists of the following components:

- Influent Screening – Three automatically cleaned basket fine screens will remove floatable materials from the influent wastewater.
- Grit removal – Existing grit removal system will remain in service to remove sand, gravel, and other heavy items from the influent.
- Aerobic Treatment – The half of the existing conventional activated sludge process will be converted to an MBR style aeration basin to provide biological secondary treatment capacity. The other portion of the existing basin will remain for additional storage during peak flows.
- Membrane Filtration – Secondary Clarifiers will be repurposed and replaced with membrane filters, which both separate secondary effluent from mixed liquor, and provide tertiary filtration in one step.
- UV Disinfection – Tertiary effluent will be disinfected using ultraviolet light to deactivate pathogens.
- Recycled Water Chlorination – Recycled water will be chlorinated before pumping to Iseli Nursery to comply with Class B recycled water requirements.
- Biosolids Upgrades – Sludge will continue to be aerated in the ASSB. The dewatering system will be replaced, a dryer will be added, and a new storage area will be constructed per Biosolids Concept 2 described in Section 9.
- Electrical Upgrades – Electrical upgrades to support upgrades described above.

A process flow diagram is provided in Figure 10-3.

PRELIMINARY DESIGN PHASE
NOT FOR CONSTRUCTION

THIS DOCUMENT IS AN INTERIM DOCUMENT AND NOT SUITABLE FOR CONSTRUCTION. AS AN INTERIM DOCUMENT, IT MAY CONTAIN DATA THAT IS POTENTIALLY INACCURATE OR INCOMPLETE AND IS NOT TO BE RELIED UPON WITHOUT THE EXPRESS WRITTEN CONSENT OF THE PREPARER.

NO	REVISION	DATE	BY

SCALES
0 1"
0 25mm
IF THIS BAR IS NOT DIMENSION SHOWN, ADJUST SCALES ACCORDINGLY.

PRELIMINARY NOT FOR CONSTRUCTION

DESIGNED AM
DRAWN RLH
CHECKED RSP

CITY OF SANDY, OREGON
WASTEWATER SYSTEM FACILITY PLAN
FACILITY PLAN AMENDMENT
WWTP IMPROVEMENTS ALTERNATIVES

Kennedy Jenks

ALTERNATIVE - 2 MEMBRANE BIOREACTOR PROCESS

SCALE NTS
JOB NO 2276020.00
DATE DECEMBER 2025
SHEET OF ---
FIG-10-3

Plot Date: 12/30/2025 2:03 PM

User: RICHARD HILLS

pw:\\kjce-pw.bentley.com:kjce-pw\Documents\Clients\Sandy, City of OR\Projects\Wastewater Facility Plan Amendment_2276020.00\10-Design\10.06-Drawings\Civil\Misc\2276020.00-C-FIG-10-4

GENERAL SHEET NOTES

1. NEW PAVEMENT TO BE ADDED AROUND THE DEWATERING, DRYER, AND BIOSOLIDS STORAGE BUILDING.

SHEET KEYNOTES

A. DEMO BELT FILTER PRESS. INSTALL TWO SCREW PRESSES FOR DEWATERING.

B. REHAB BUILDING AND USE AS DRYER BUILDING. INSTALL PADDLE DRYER.

C. RETROFIT CLARIFIER FOR ANOXIC TREATMENT. TAKE ADDITIONAL CLARIFIER OFF-LINE.

D. DEMO EXISTING DISK FILTERS, ADD ADDITIONAL IN-PIPE UV TREATMENT.

E. DEMO AERATION BASIN. PLACE MBR TREATMENT TANKS AND EQUIPMENT ROOM.

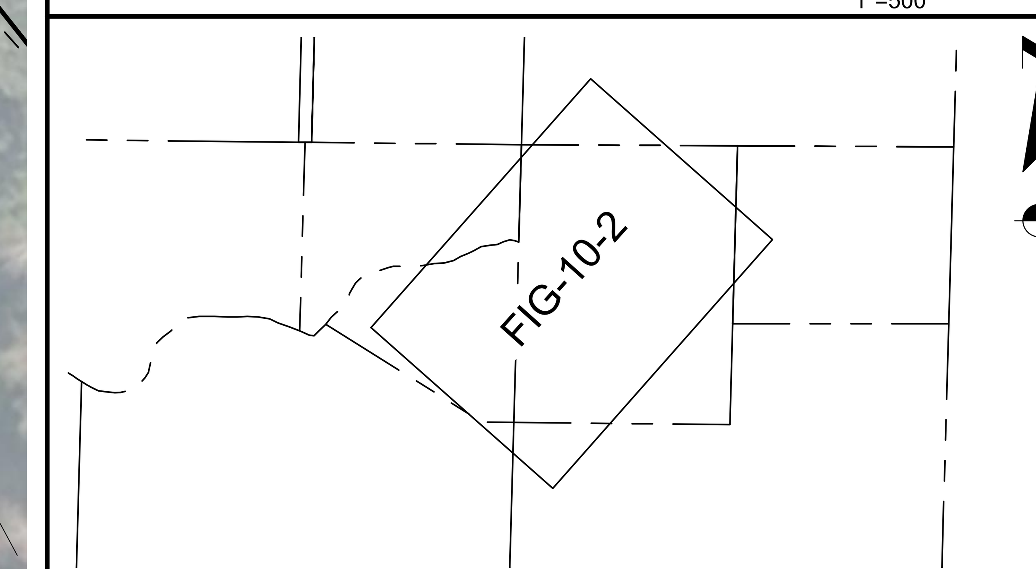
F. DEMO HEADWORKS SCREEN.

G. DEMO SLUDGE TANK AND LIME SILO.

H. REPLACE EFFLUENT/IRRIGATION PUMPS FOR GREATER CAPACITY.

KEY PLAN

0 500 1000
1"=500'



LEGEND

NEW/UPDATED PROCESS AREA

ASPHALT

PRELIMINARY DESIGN PHASE
NOT FOR CONSTRUCTION

THIS DOCUMENT IS AN INTERIM DOCUMENT AND NOT SUITABLE FOR CONSTRUCTION. AS AN INTERIM DOCUMENT, IT MAY CONTAIN DATA THAT IS POTENTIALLY INACCURATE OR INCOMPLETE AND IS NOT TO BE RELIED UPON WITHOUT THE EXPRESS WRITTEN CONSENT OF THE PREPARER.

NO	REVISION	DATE	BY

SCALES
0 1"
0 25mm
IF THIS BAR IS NOT DIMENSION SHOWN, ADJUST SCALES ACCORDINGLY.

PRELIMINARY NOT FOR CONSTRUCTION

DESIGNED AM
DRAWN RLH
CHECKED RSP

CITY OF SANDY, OREGON
WASTEWATER SYSTEM FACILITY PLAN
FACILITY PLAN AMENDMENT
WWTP IMPROVEMENTS ALTERNATIVES

Kennedy Jenks

SITE PLAN
ALTERNATIVE 2: MEMBRANE BIOREACTOR TREATMENT

SCALE 1" = 40'
JOB NO 2276020.00
DATE DECEMBER 2025
SHEET OF ---
FIG-10-4

10.2.3 Hybrid CAS/MBR Concept

Alternative 3 will replace the existing CAS process with a higher density activated sludge process that replaces secondary clarifiers with membrane filters that allow operators to maintain the higher mixed liquor concentrations. The proposed MBR process will consist of the following components:

- Influent Screening – Three automatically cleaned basket fine screens to remove floatable materials from the influent wastewater.
- Grit removal – Existing grit removal system will remain in service to remove sand, gravel, and other heavy items from the influent.
- Aerobic Treatment
  - CAS Expansion – The existing conventional activated sludge process will remain to provide secondary biological treatment capacity.
  - MBR Addition – MBR style aeration basins will be constructed in parallel with the CAS aeration basins to add capacity to the biological treatment.
- Secondary Clarifiers – Existing secondary clarifiers will remain in use.
- Ultra Filtration – One membrane train (with redundant cassettes) will be provided to treat dry weather volumes from the CAS trains.
- UV Disinfection – Tertiary effluent will be disinfected using ultraviolet light to deactivate pathogens.
- Recycled Water Chlorination – Recycled water will be chlorinated before pumping to Iseli Nursery to comply with Class B recycled water requirements.
- Biosolids Upgrades – Sludge will continue to be aerated in the ASSB. The dewatering system will be replaced, a dryer will be added, and a new storage area will be constructed per Biosolids Concept 2 described in Section 9.
- Electrical Upgrades – Electrical upgrades to support upgrades described above.

A process flow diagram is provided in Figure 10-5.

Plot Date: 12/30/2025 1:49 PM
User: RICHARD HILLS
pw:\\kjce-pw.bentley.com:kjce-pw\Documents\Clients\Sandy, City of OR\Projects\Wastewater Facility Plan Amendment_2276020.00\10-Design\10.06-Drawings\Civil\Misc\2276020.00-C-FIG-10-5

PRELIMINARY DESIGN PHASE
NOT FOR CONSTRUCTION

THIS DOCUMENT IS AN INTERIM DOCUMENT AND NOT SUITABLE FOR CONSTRUCTION. AS AN INTERIM DOCUMENT, IT MAY CONTAIN DATA THAT IS POTENTIALLY INACCURATE OR INCOMPLETE AND IS NOT TO BE RELIED UPON WITHOUT THE EXPRESS WRITTEN CONSENT OF THE PREPARER.

NO	REVISION	DATE	BY

SCALES
0 1"
0 25mm
IF THIS BAR IS NOT DIMENSION SHOWN, ADJUST SCALES ACCORDINGLY.

PRELIMINARY NOT FOR CONSTRUCTION

DESIGNED AM
DRAWN RLH
CHECKED RSP

CITY OF SANDY, OREGON
WASTEWATER SYSTEM FACILITY PLAN
FACILITY PLAN AMENDMENT
WWTP IMPROVEMENTS ALTERNATIVES

Kennedy Jenks

ALTERNATIVE - 3 HYBRID TREATMENT PROCESS

SCALE NTS
JOB NO 2276020.00
DATE DECEMBER 2025
SHEET OF ---
FIG-10-5

GENERAL SHEET NOTES

1. NEW PAVEMENT TO BE ADDED AROUND THE DEWATERING, DRYER, AND BIOSOLIDS STORAGE BUILDING.

SHEET KEYNOTES

A. DEMO BELT FILTER PRESS. INSTALL TWO SCREW PRESSES FOR DEWATERING.

B. REHAB BUILDING AND USE AS DRYER BUILDING. INSTALL PADDLE DRYER.

C. DEMO EXISTING DISK FILTERS, ADD ADDITIONAL IN-PIPE UV TREATMENT.

D. ADD MBR TREATMENT TANKS AND EQUIPMENT ROOM.

E. DEMO EXISTING HEADWORKS SCREEN.

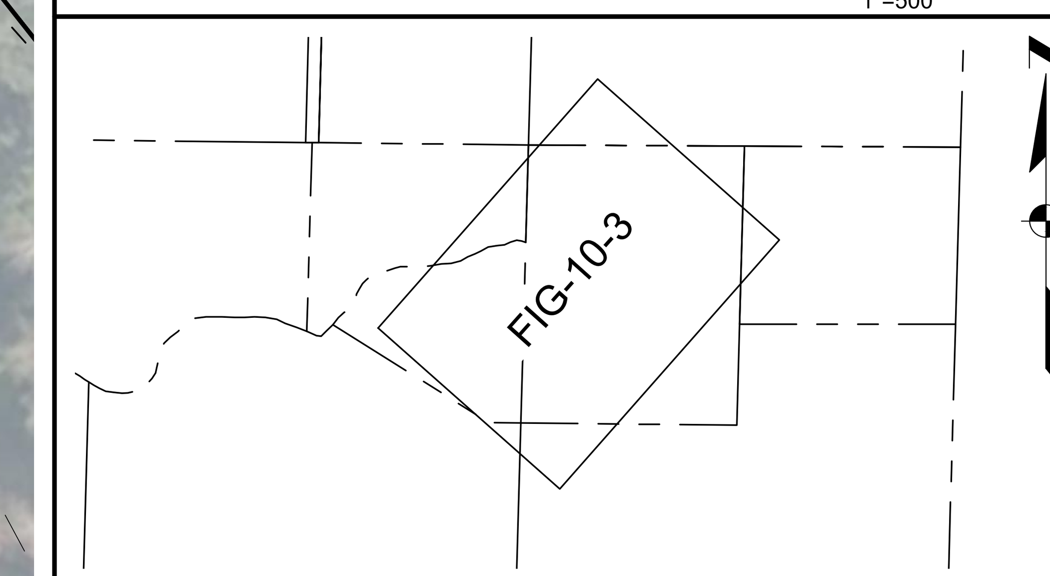
F. DEMO SLUDGE TANK AND LIME SILO.

G. DEMO THE EXISTING DISINFECTION FILTRATION BASIN. REPLACE THE DISK FILTERS WITH ULTRAFILTRATION MODULES UNDER THE EXISTING CANOPY.

H. REPLACE EFFLUENT/IRRIGATION PUMPS FOR GREATER CAPACITY.

KEY PLAN

0 500 1000
1"=500'



LEGEND

NEW/UPDATED PROCESS AREA

ASPHALT

PRELIMINARY DESIGN PHASE NOT FOR CONSTRUCTION
THIS DOCUMENT IS AN INTERIM DOCUMENT AND NOT SUITABLE FOR CONSTRUCTION. AS AN INTERIM DOCUMENT, IT MAY CONTAIN DATA THAT IS POTENTIALLY INACCURATE OR INCOMPLETE AND IS NOT TO BE RELIED UPON WITHOUT THE EXPRESS WRITTEN CONSENT OF THE PREPARER.

NO	REVISION	DATE	BY

SCALES
0 1"
0 25mm
IF THIS BAR IS NOT DIMENSION SHOWN, ADJUST SCALES ACCORDINGLY.

PRELIMINARY NOT FOR CONSTRUCTION

DESIGNED	AM
DRAWN	RLH
CHECKED	RSP

CITY OF SANDY, OREGON
WASTEWATER SYSTEM FACILITY PLAN
FACILITY PLAN AMENDMENT
WWTP IMPROVEMENTS ALTERNATIVES

Kennedy Jenks

SITE PLAN
ALTERNATIVE 3: CAS/MBR TREATMENT HYBRID

SCALE	1" = 40'
JOB NO	2276020.00
DATE	DECEMBER 2025
SHEET	OF ---
	FIG-10-6

Plot Date: 12/30/2025 2:04 PM
User: RICHARD HILLS
pw:\\kjce-pw.bentley.com:kjce-pw\Documents\Clients\Sandy, City of OR\Projects\Wastewater Facility Plan Amendment_2276020.00\10-Design\10.06-Drawings\Civil\Misc\227602000-C-FIG-10-6

10.2.4 Regional Treatment Plant Concept

Alternative 4 involves collecting the City's wastewater at the existing plant site and pumping to a regional wastewater treatment provider, such as Clackamas Water Environment Services (WES), Tri-City WWTP, or the City of Gresham WWTP. For planning purposes, the physical components of Alternative 4 are assumed to include the following:

- Influent Pump Station – The new pump station will include a concrete wet well, two submersible low flow pumps (60 hp each) and three submersible high flow pumps (335 hp each) to convey wastewater primarily along public highway and street rights-of-way to the designated treatment plant.
- Forcemain – The forcemain considered in the Screening Phase analysis will include a 30-inch cement mortar-lined ductile iron pipe equipped with regularly spaced plug valves, air release valves, cleanouts, and surge tanks to transport raw wastewater to the regional plant. Later evaluation during the Investigation Phase recommended redundant dual force mains.

10.2.4.1 Tri-City WWTP

The forcemain alignment to **Clackamas WES Tri-City WWTP** is approximately 17 miles long and discharges to an interceptor that connects to the Tri-City WWTP. Significant obstacles would include major intersections, railroad crossings, and creek crossings. The Tri-City WWTP discharges to the Willamette River and is regulated for the discharge of BOD, TSS, ammonia-nitrogen, temperature, and bacteria. The plant is owned and operated by Clackamas Water Environment Services (WES), a municipal partnership consisting of the former Tri-City Service District, Clackamas County Service District No. 1, and the Surface Water Management Agency of Clackamas County.

Major costs would include:

- Construction of the forcemain, pump station, and downstream gravity/pump station upgrades.
- The SDC for Clackamas WES treatment is $8,860 per ERU. A connection fee would be required, roughly equivalent to the SDC charge.

10.2.4.2 City of Gresham WWTP

The **City of Gresham** concept includes a forcemain alignment that is approximately 14-miles long. The pipe would run most of its length along Highway 26, avoiding as many large intersections as possible before ending at the Gresham WWTP. The Gresham WWTP was constructed to serve more large industrial dischargers than are currently located in or anticipated to be located in the City, so current average and peak flows are well under the rated capacity of 15 MGD average and 75 MGD peak. The plant discharges to the Columbia River and effluent discharge is regulated for BOD, TSS, and bacteria. The Gresham WWTP has invested in renewable energy production through co-digestion of fats, oils, grease, and food waste and through a solar photovoltaic array, and been a net producer of energy since 2015.

Major costs would include:

- Construction of the forcemain, pump station, and downstream gravity/pump station upgrades.
- The SDCs for Gresham treatment is $7,451 per ERU. A connection fee would be required, roughly equivalent to the SDC.

10.2.4.3 Alternative 4 Discussion

Based on the length of forcemain and connection charges, it is apparent that the capital and related fees to connect to the City of Gresham WWTP would be less than the Clackamas WES connection. For the purposes of this analysis, the treatment cost is assumed to be similar and would not be a significant factor in this selection.

The capacity of the pump station would be 12.2 MGD with the largest pump out of service.

Given the length and diameter of the forcemain, and the pressures at the pump station, it is anticipated that surge will be an issue, and one or more surge tanks may be required to mitigate pressure spikes that could occur during pump startup or shutdown and a power failure. Pipeline characteristics and estimated costs to construct and connect are summarized in Table 10-1.

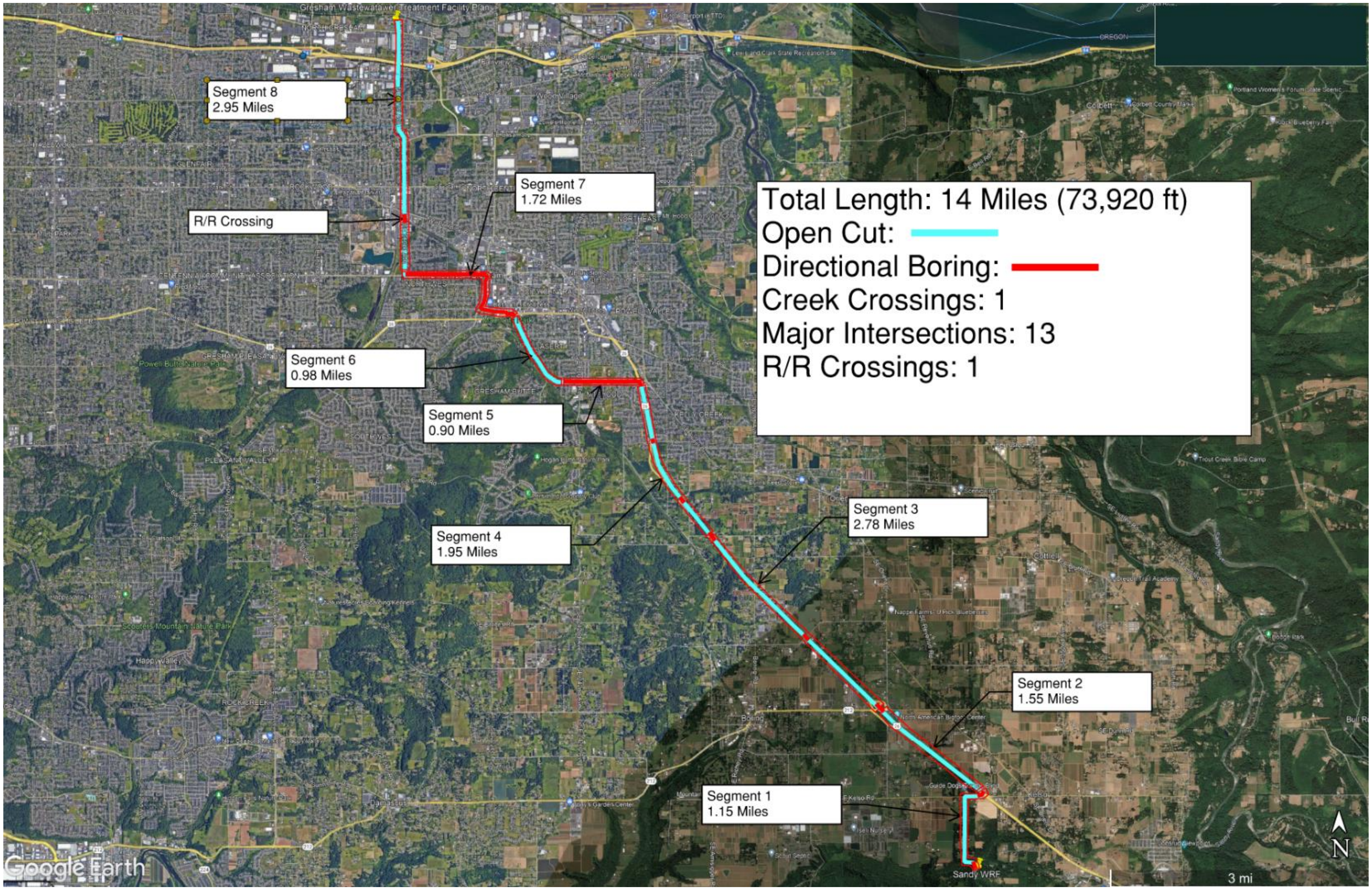
Table 10-1: Alternative 4 Summary of Forcemain and Pump Station Design Information and Total Cost

Treatment Plant	Pipeline Length	Number of Crossings	Major Inter-sections	Construction Cost	Pump Station Cost	Connection Charge	Total Cost
WES Tri-City	17 Miles (96,624 ft)	2 Creek, 1 River, 1 Railroad	14	$74M	$19M	$75M	$168M
Gresham	14 Miles (73,920 ft)	1 Railroad, 1 Creek	13	$64M	$19M	$59M	$142M

The connection charge for the two alternatives are applied to all existing and new connections and represent the largest component of the costs for each alternative. The collection system element of the connection charge cost may not apply to the City. The actual cost for the connection charges could be negotiated if the City becomes a wholesale customer of the City of Gresham. Without the connection charge, the Gresham alternative falls into the cost range of Alternatives 1, 2, and 3, and will be carried forward to preliminary screening.

A preliminary alignment for the forcemain to the Gresham WWTP, used for the purposes of evaluating this alternative, is shown in Figure 10-7.

Figure 10-7: Gresham Pipeline Alignment to Wastewater Treatment Plant



10.2.4.4 Alternative 4 Discussion

Alternative 4 includes construction of a pump station at the existing plant, and a 14-mile pipeline to Gresham's WWTP. Gresham has capacity for Sandy's wastewater; however, each connection (existing and new) will be required to pay the connection charge for each ERU to pay for their portion of the treatment plant capacity.

The WES option includes similar construction of a pump station and a 17-mile pipeline. WES's connection charge cost for existing and new connections would be $75M. Drawbacks to this alternative include significant maintenance on long pipelines, public disturbance at unavoidable intersections, and cost. In addition, the Tri-City WWTP has less available capacity and more stringent effluent discharge requirements than the Gresham WWTP.

Capital and connection charge costs for discharge to the City of Gresham are comparable to upgrading the Sandy WWTP and constructing a new outfall to the Sandy River. The cost of constructing the pump station and pipeline to the Gresham WWTP was estimated during the screening phase at $83M, with a connection charge of $59M resulting in a total alternative cost of $142M. This connection charge is based on the rate charged to new customers in the City of Gresham and covers existing capacity and anticipated future capacity in both the collection system and the wastewater treatment plant. Gresham has existing wholesale customers (Fairview and Wood Village) who discharge wastewater directly to the Gresham WWTP and have wholesale connection charges that reflect their use of the Gresham WWTP. Potential connection charges using a tailored wholesale connection charge were examined in later development of the Gresham WWTP alternative. In addition to capital and connection charge costs, the City and wastewater customers would be subject to monthly sewer charges from the City of Gresham.

Gresham currently has two wholesale wastewater customers (Fairview and Wood Village) and has established unique rates for these customers based on annual flow, BOD, and TSS load. Sandy may be able to negotiate a similar cost and payment structure if the City pursues becoming a wholesale customer of the City of Gresham,

10.2.5 Collection System Storage Concept

Alternative 5 is a collection system storage concept that considers diverting wastewater from the collection system to an offline equalization basin within the collection system to store wastewater during peak wet weather events. When the peak condition subsides, stored wastewater will be fed back to the collection system to be treated. This allows the plant to treat peak flow volumes without a major process expansion by spreading the peak flowrate over several days.

10.2.5.1 Storage Volume Estimates

This concept includes construction of a raw sewage equalization basin in the collection system, a pump station, a pipeline connecting the collection system to the equalization basin, and a forcemain conveying wastewater back to the gravity collection system. This scenario considered an equalization basin sizing requirement to manage peak flows for the existing plant capacity of 7 MGD. Effort included identifying possible locations for the equalization tank near the treatment facility.

Peak flowrate hydrographs were analyzed for two storms in January 2022, as provided by Leeway Engineering Solutions. The analysis is presented in Appendix B.2. Two methods were used to determine the required storage volume, and the results were similar. Both methods yielded an estimated storage volume of approximately 3.0 MG.

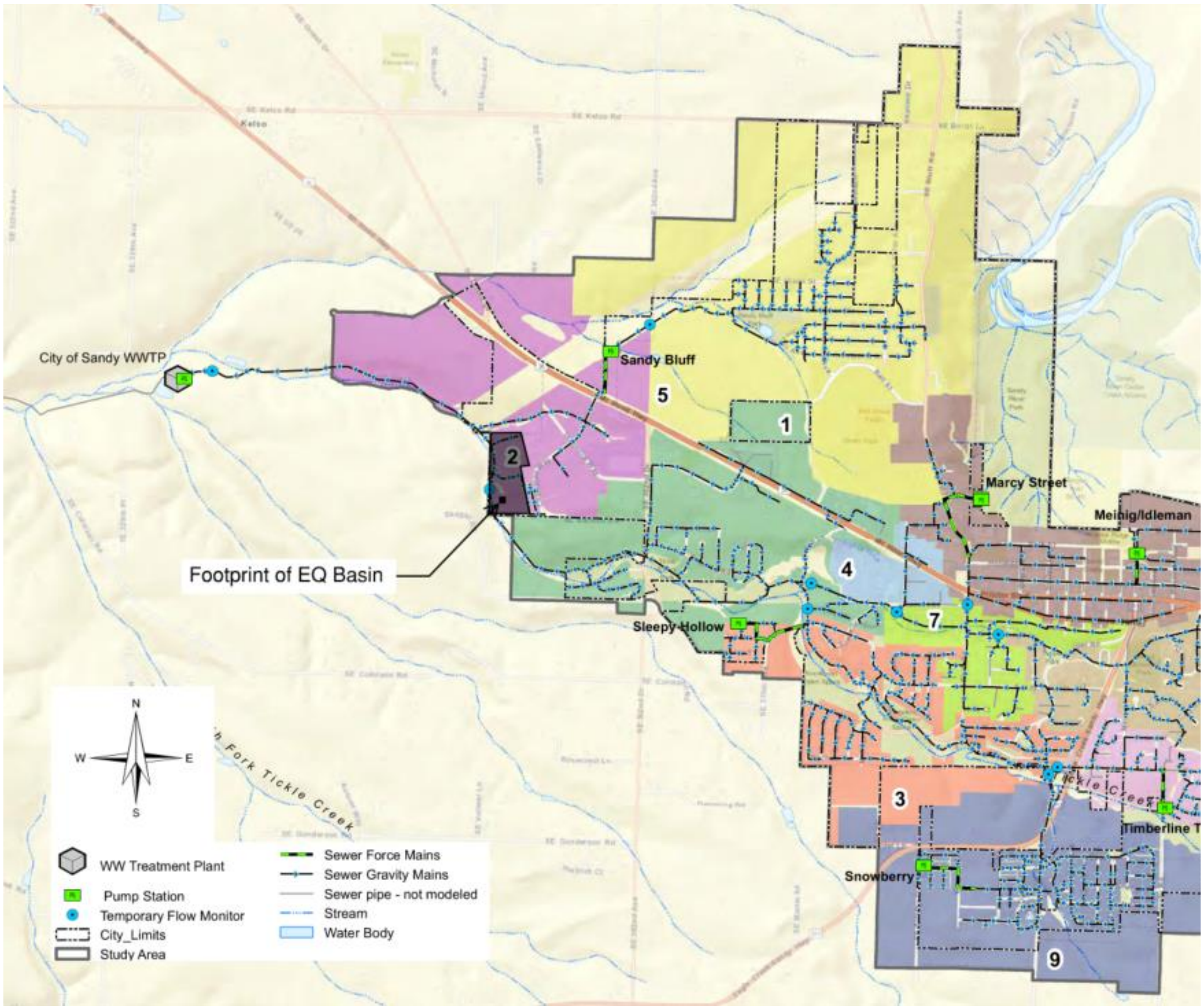
10.2.5.2 Storage Tank Site Location

The second portion of the storage system concept study included scouting for sites near the treatment facility. A square-based storage tank was sized to 100 feet by 100 feet by 45 feet deep, with 15 feet of the tank below surrounding grade, to accommodate about 3.0 MG of storage. Site selection was based on the following parameters, under the assumption that the City would need to buy the property for the equalization basin:

- Open space 2-5 acres minimum, and relatively level.
- The property should be close to the existing gravity sewer.
- Tank should be positioned to accommodate most sewer line branches.
- Site should be uphill from the treatment plant.
- Gravity conveyance from the storage tank would be beneficial but not required.
- Property is zoned non-residential (exclusive farm use, commercial, or industrial).

Due to topographical limitations near the treatment facility and the sewer line branch layout, only one possible site was identified for the location of the storage vessel. This site is shown in Figure 10-8.

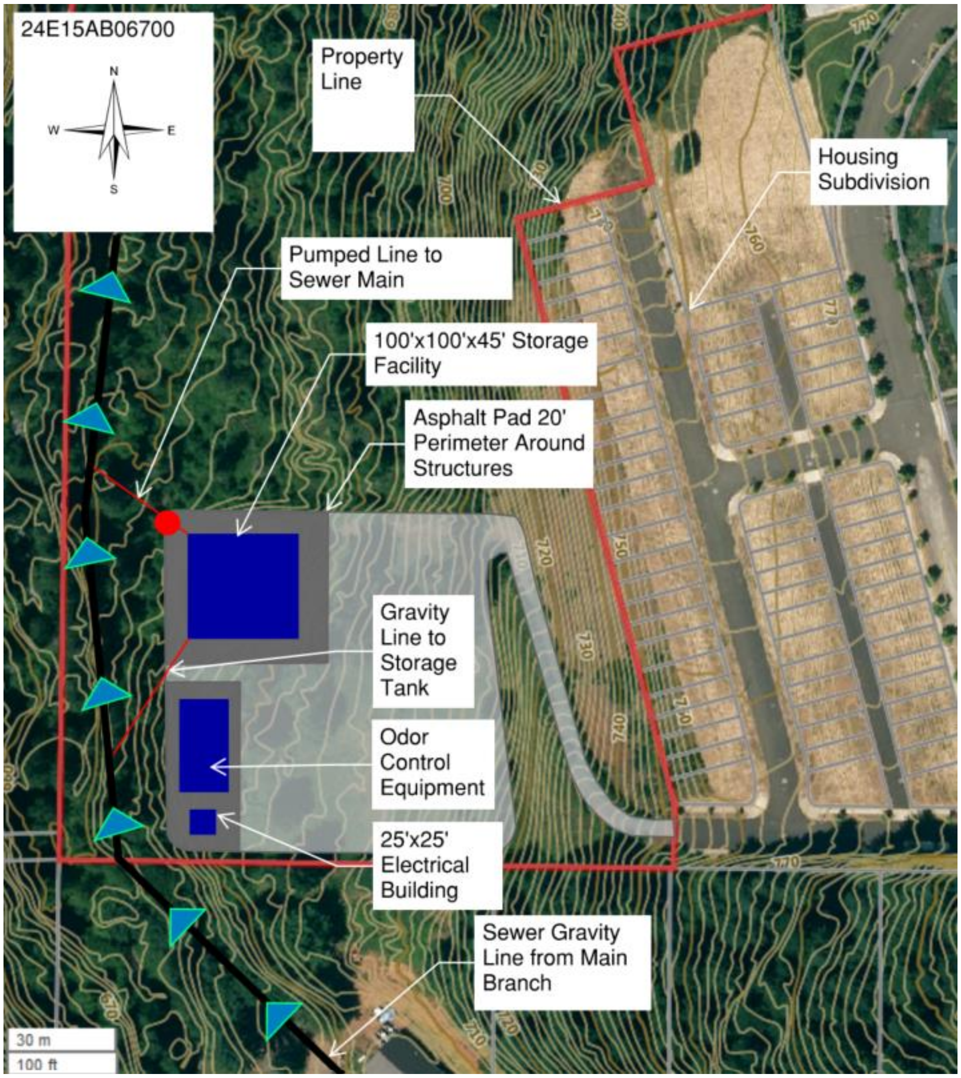
Figure 10-8: Collection System Equalization Basin Site Location



This tax lot is 16.61 acres with a Market Total Value of approximately $1.4 million. Although this lot is large, due to topographical limitations and the necessity for the tank to be close to the main sewer line, there is only one location that the tank could be placed on the lot. Wastewater would be conveyed to the tank by gravity, but a pump station would be required for pumping wastewater back to the interceptor towards the treatment plant. The proposed location of the tank on the lot is shown in Figure 10-9.

The site is in General Industrial Zone (I-3). Wastewater utilities are not an outright permitted use for this zone; therefore, it would require a Conditional Use Permit for land use approval.

Figure 10-9: Collection System Storage Tank Location



10.2.5.3 Required Treatment Plant Upgrades

The existing treatment plant capacity would be sufficient to treat the dampened wastewater volumes; however, there are plant elements that require upgrading to replace failing equipment and provide required redundancy. Those elements are:

- Headworks Screens: Two automatic coarse screens and one manually cleaned bar screen like the headworks described for Alternative 1.
- Tertiary Filtration – Ultrafiltration using membranes to meet effluent waste load requirements similar to the effluent filtration described for Alternative 1.
- UV Disinfection – One additional diversion pump station and two new closed-vessel UV similar to the units described for Alternative 1.
- Solids Processing (discussed in Section 9.2.6).

- Electrical Service – The existing facility is currently operating near the electrical service capacity, which will require an upgrade.

In addition to treatment plant upgrades, the storage tank concept would require the following mechanical elements:

- New electrical service
- Pump Station to return the stored wastewater to the interceptor
- Odor Control System consisting of a chemical odor control tower system

10.2.5.4 Alternative 5 Discussion

In theory a storage system prior to the treatment plant would offer the facility a large buffer in treatment capacity, there are several significant limitations in this collection system concept.

Because the projected MMWWF would be within the plant's existing capacity, the option to shave peak volumes could manage the peaks and minimize the amount of treatment plant upgrades required. However, as noted in Section 10.2.5.3, the number and cost of treatment plant upgrades required is significant.

Due to the general hilly topography of the region, particularly close to the treatment plant, Kennedy Jenks was able to identify only one suitable location that was both appropriately zoned and flat enough to reasonably facilitate this alternative. As shown in Figure 10-9, this parcel still has significant elevation change and would require extensive grading.

The proposed parcel is also adjacent to a housing development, and odor control would be required. This would increase the operations and material cost substantially as weekly maintenance would be required for chemical-based odor control systems.

Environmental permitting would require assessment of natural resources and sensitive species, which may be present at this location on the edge of developed City. The tank and associated equipment are not an outright allowed use in the General Industrial Zone; therefore, a Conditional Use Permit (CUP) Process would be followed. Environmental and Land Use permitting for this site is estimated to require 2 to 5 years to complete. The CUP could require architectural and landscape screening improvements, as this location is adjacent to a neighborhood. It is possible that the location adjacent to the residential zone would not be allowed due to public opposition, therefore, there is permitting risk for this Alternative.

Treatment plant improvements are significant and pose a significant element of capital cost for this alternative.

The Engineer's Estimate of Probable Cost to construct Alternative 5 is $62M.

10.3 Initial Liquid Process Concept Screening of Five Alternatives

As described in Section 5, an Initial Concept-Level Screening approach is applied in order to identify economic, regulatory, implementation, and resiliency challenges to assess the viability of liquid process treatment solutions. The outcome of this screening is presented in Table 10-2. In this table, the colored boxes indicate whether the concept is able to meet (green), likely to meet (yellow), or unable to meet (red) the criteria, which are defined in Table 5-3.

Table 10-2: Application of Screening Criteria for Initial Liquids Treatment Concepts

Initial Liquid Process Concept ➔ Criteria 🡻	Alt. 1 CAS	Alt. 2 MBR	Alt. 3 Hybrid MBR/CAS	Alt. 4 Regional Treatment Plant	Alt. 5 Collection System Storage
ECONOMIC	~	✓	~	✘	~
CURRENT REGULATORY RISK	~	~	~	✓	~
FUTURE REGULATORY RISK	~	~	~	✓	✘
IMPLEMENTATION	✓	✓	✓	~	✘
RESILIENCY	~	✓	~	✓	~

Concepts that are unable to meet one or more of the criteria are deemed non-viable / unfeasible and are eliminated from further consideration. Based on the screening of initial concepts, the 2026 Plan Amendment includes four viable wastewater treatment (liquid process) alternatives, summarized in the following section:

- ✓ **Alternative 1: CAS**
- ✓ **Alternative 2: MBR**
- ✓ **Alternative 3: Hybrid MBR/CAS**
- ✓ **Alternative 4: Regional Treatment Plant**

These four liquid process treatment approaches are relatively comparable in terms of their ability to meet each of the criteria. However, none of the proposed liquid process alternatives on the existing plant site address concerns about the dilution ratio at the outfall to Tickle Creek or assure enough storage to accommodate flows into the plant when demand of recycled water for irrigation is low. A lower dilution ratio for high-quality effluent at the outfall to Tickle Creek will reduce the required storage during the permitted discharge months. Constructing an additional outfall to the Sandy River will eliminate the need for storage during the dry season.

Alternative 4, the **Regional Treatment Plant concept**, meets all non-financial criteria. Costs to construct the pump station and forcemain are less than the cost to construct full treatment plant upgrades. However, the connection charge costs will increase the total capital cost to a level greater than lowest cost treatment alternative. The City has met with Gresham and understands there are potential wholesale rates and negotiated connection charges. There may be an opportunity to reduce SDCs from the amount assumed in this report and significantly reduce the capital costs for Alternative 4.

This alternative has the least uncertainty with respect to infrastructure construction schedule and permitting requirements. It also reduces the risk associated with potential future discharge regulations because it eliminates the City's requirement for an NPDES Permit and spreads future compliance costs over a large group of ratepayers.

Alternative 5, the **Collection System Storage concept**, would likely meet current regulatory requirements by providing additional storage to reduce the peak flows into the WWTP, resolving the issues that arise when high flow events force the plant to operate above the available capacity. However, storing more water doesn't resolve the treatment issue and would be unable to alleviate capacity concerns as growth occurs in the City and wastewater flows increase. As a result, the future regulatory risk of implementing this alternative is unacceptable. There are also significant challenges related to implementing a raw water storage facility, which would require a large amount of space for new infrastructure, including a raw water pump station and tank, in addition to challenging ongoing maintenance requirements to address odor issues and regular cleaning of facilities. For these reasons, this alternative was removed from further consideration.

10.3.1 Complete Liquids Alternatives Assumptions

The complete alternatives discussed in this section include several items not specifically stated in the alternative descriptions, but necessary for plant improvements. Each alternative includes all of the required scope items, however, the magnitude of the capital cost may vary, so they were estimated for each alternative. The following items are included in each alternative:

- Site Work & Yard Piping – This includes all process and utility piping within the plant site.
- Electrical/I&C – This includes electrical and instrumentation ductbanks, conduit, wiring, installation of equipment, control systems such as PLCs, programming, and SCADA.
- Recycled Water Pump Upgrades – This item applies to the three treatment alternatives, and not to the Regional Treatment Plant alternative.
- Utility Upgrade Allowance – The utility requirements for the plant upgrades vary somewhat and estimating them is an effort beyond the scope of this report. This analysis assigned an allowance for the utility upgrades to include electrical, water, and natural gas. This allowance was applied uniformly to all treatment and regional treatment plant alternatives.
- Equalization Basin - The current project to increase equalization basin capacity is being completed under a separate near-term project. The equalization basin will retain its aeration capacity and existing pumps will convey wastewater back to the aeration basins.

10.3.2 Alternative 1 – Conventional Activated Sludge

10.3.2.1 WWTP Upgrades for Alternative 1

10.3.2.1.1 *Influent Screening*

Automatically cleaned fine screens will screen large floatable materials, rags, and other objects from the influent wastewater at the plant headworks. Two rotary basket screens with ¼-inch spacing, rated at 6.8 MGD each, will remove floatables, rinse and dewater the screenings, and convey them to a covered waste bin to be hauled away for landfill disposal. A manually cleaned bar screen will be installed in a third channel in the headworks for redundancy if one of the automatic screens is out of service. The existing rotary drum screen will be decommissioned.

The basket style headworks screen has several benefits, including an integral rinsing and dewatering stage. The screens selected will use plant water to rinse screenings to minimize odors. In addition, the screen units will be installed with a fulcrum mount that will allow operators to remove the screen end from the wastewater stream for easy inspection and service without a significant disassembly effort. The spray system will be equipped with a cold weather package to prevent freezing. Design parameters for the headworks screens are summarized in Table 10-3.

Table 10-3: Influent Screen Design Parameters

Design Parameter	Automatic Screen No. 1	Automatic Screen No. 2	Manual Screen
Bar Spacing (in)	0.25	0.25	0.75
Peak Capacity (MGD)	6.8	6.8	6.8

The headworks screens will be installed in a cast in place concrete structure with three channels. Headworks equipment may be installed inside an enclosed building for weather protection but will require ventilation to de-classify the area. As a cost-saving measure, the headworks may be covered but with open sides, which has the added advantage of improving access around the screens for portable lifting equipment. The two automatic screens will serve as primary duty and standby screens. A third manually cleaned bar screen will screen floatable materials if one or both automatic screens are out of service and will also come into operation if the automatic screens cannot accommodate peak flowrates.

10.3.2.1.2 *Grit Removal*

The existing vortex grit removal unit will be maintained. The unit was rehabilitated within the last five years and is expected to continue to be operable, if maintained, through 2040. The unit has a capacity of 7 MGD and will serve the City during MMWWF and PWF scenarios. Grit may pass through during the PDAF and PIF scenarios; however, these conditions occur for a duration of 24 hours or less.

The grit pump will be maintained; however, a new grit classifier will replace the existing unit, that has reached the end of its useful life. Grit will dump into a landfill-bound container for disposal.

10.3.2.1.3 *Aeration Basins*

The existing two-train aeration basin secondary treatment system was recently updated. Improvements included new internal walls to encourage plug flow and new fine bubble diffusers to improve aeration efficiency. The updates have improved aeration efficiency and provided operators significantly better control over dissolved oxygen within the selector channels and aeration zones, which allows the plant to operate both aeration basins using only one of four blowers during normal loading.

To treat projected 2040 waste loads, Kennedy Jenks determined that four new aeration trains will be required for a total of six aeration trains. If designed and operated similarly to the existing aeration trains, one new blower per train will be required to treat the projected peak wasteload with one of the existing blowers offline. The biomass contained in the six aeration train process will be sufficient to reduce ammonia concentrations below conventional detection limits, and reduce the total nitrogen concentration to between 0.5 and 2 mg/L.

A preliminary BioWin process model was prepared for Alternative 1 to verify aeration basin sizes. Detailed results of process modeling are provided in Appendix B.4. Since the BioWin model was prepared, the City has added sodium hydroxide to control pH and help restore alkalinity during nitrification. The Aeration Basin Design Parameters for the planning window to 2040 are summarized in Table 10-4.

Table 10-4: Aeration Basin Design Parameters

Design Parameter	Total Capacity	Capacity with One Unit out of Service
Number of Aeration Trains	6	5
Swing Zone 1 Volume	112,400 gallons	93,650 gallons
Swing Zone 2 Volume	112,400 gallons	93,650 gallons
Aerobic Zone Volume	2,099,000 gallons	1,742,900 gallons
Total Aeration Basin Volume	**2,323,800 gallons**	**1,930,200 gallons**
Air Required at MMWWF (firm capacity)	4,880 scfm	4,880 scfm
Blowers		
Centrifugal Blower 1	1,350 scfm	1,350 scfm
Centrifugal Blower 2	1,350 scfm	1,350 scfm
Centrifugal Blower 3	1,350 scfm	1,350 scfm
Rotary Lobe Blower 1	1,199 scfm	1,199 scfm
New Blower	2,000 scfm	------- scfm
Total Blower Capacity	**7,249 scfm**	**5,249 scfm**

scfm – Standard Cubic Feet Per Minute

Construction of four new aeration basins on the size-limited site will reduce the footprint of the equalization basin and the corresponding volume by approximately 1 million gallons, which is important to the existing plant operational strategy. The basin is currently being upgraded to increase storage volume, solidifying the City's desire to maintain this basin to relieve the plant when peak volumes arrive at the plant. This makes Alternative 1 less desirable.

10.3.2.1.4 *Secondary Clarifiers*

The two existing 54-foot diameter secondary clarifiers were recently rehabilitated, and it is assumed they will remain functional through the 2040 planning window with maintenance. The peak capacity of the two clarifiers will not accommodate the peak design flowrates; therefore, one additional 70-foot diameter secondary clarifier will enable the updated treatment process to meet the peak loading requirements. To accommodate the new clarifier, the existing Aerated Sludge Stabilization Basin will be demolished, and the new clarifier constructed in its place. Clarifier surface loading rates at design flowrates are summarized in Table 10-5.

Table 10-5: Secondary Clarifier Surface Loading Rates

Design Condition	Design Flowrate (MGD)	Surface Loading Rate (gpd/sf)			Design Limit
		One 54-ft Clarifier	Two 54-ft Clarifiers	Two 54-ft Clarifiers + One 70-ft Clarifier	
AAF	2.2	960	480	260	800
MMWWF	3.6	1,570	790	430	800
PIF	12.2	5,330	2,670	1,450	1,600(1)

gpd/sf = gallons per day per square foot
(1) Maximum surface loading rate for activated sludge with anoxic selectors.

10.3.2.1.5 *Tertiary Filtration*

Secondary effluent will be conveyed to tertiary treatment through a set of ultrafiltration modules for polishing. The tertiary filters are comprised of a set of membrane filters with an average pore size of 0.01 microns, which can remove activated sludge floc that has carried over from the clarifiers, plus most pathogenic bacteria, and some viruses. Filters are periodically backwashed automatically, and the backwash is returned to the plant influent for treatment.

An existing effluent submersible diversion pump station will be used to convey wastewater to one set of new tertiary filters. The existing pumps will be upgraded to increase capacity to half of the projected PIF. An additional submersible pump station will be constructed to divert wastewater to the second set of filters.

The existing smaller disc filters will be demolished, and the ultrafiltration units will be located under the cover of the existing filtration and disinfection shed.

The proposed configuration to treat projected 2040 flowrates is summarized in Table 10-6.

Table 10-6: Tertiary Filter Modules Required

Design Condition	Design Flowrate (MGD)	Flux Rate (gpd/sf)		
		Filter Unit, Each	Filter Unit, Each with One Offline	Design Limit
AAF	2.2	5.0	4.3	12
MMWWF	3.6	8.1	7.0	26.3
PIF	12.2	27.6	23.7	34.5

gpd/sf = gallons per day per square foot

10.3.2.1.6 *Ultraviolet Disinfection*

Disinfection during the wet weather discharge season will be accomplished primarily using UV light/radiation, which renders pathogens inert. The existing Trojan open channel UV disinfection system is obsolete, no longer supported by the manufacturer, and replacement lamps are only available from third party manufacturers. Lamps are difficult to source, and costs continue to escalate. Work is underway to upgrade the existing open-channel UV unit with more modern equipment, capable of treating 7 MGD.

An additional Evoqua closed-vessel UV unit will provide 3.5 MGD of disinfection capacity, bringing the plant's total disinfection capacity to 14 MGD; however, the firm capacity is 7 MGD. Therefore, two more closed vessel UV units will be required to meet firm capacity requirements for disinfection. The City transitioned to UV disinfection year-round. A summary of the UV units is provided in Table 10-7.

Table 10-7: UV Disinfection Equipment Summary

UV Unit	Manufacturer	Type	Capacity	Status
1	Trojan	Open Channel	7 MGD	Existing
2	Evoqua	Closed Vessel	3.5 MGD	Existing
3	Evoqua	Closed Vessel	3.5 MGD	Proposed
4	Evoqua	Closed Vessel	3.5 MGD	Proposed
5	Evoqua	Closed Vessel	3.5 MGD	Proposed

10.3.2.1.7 *Sodium Hypochlorite Residual*

In addition to UV disinfection, during the non-discharge season, effluent is recycled to Iseli Nursery and requires a free chlorine residual for use as recycled water. The existing sodium hypochlorite system is adequate to provide the required residual up to 7 MGD, which is greater than the effluent pumping capacity of the current pump expansion project. The City is currently improving the UV disinfection system to disinfect irrigation water, therefore, no improvements are currently proposed to the sodium hypochlorite system.

10.3.2.2 Alternative 1 Discussion

Alternative 1 represents an expansion of the existing plant with minor changes, but not a significant change in the process. The Operator Certification Level will not change; therefore, the existing treatment plant staff will be qualified with no update. The footprint of four new aeration trains and one new clarifier will be the largest of the treatment alternatives considered. A site plan showing all components of Alternative 1 is provided in Figure 10-2. A summary of process area capacities is provided in Table 10-8.

Table 10-8: Alternative 1 Process Area Capacity Summary

Process Area	Total Capacity (MGD)	Firm Capacity[2] (MGD)
Fine Screens	20.4	13.6
Aeration Basins	12.2	12.2
Secondary Clarifiers	12.2	12.2[1]
Tertiary Filtration	12.2	12.2
UV Disinfection	21	14

[1] Meets stated loading rate guidelines for short term peak flowrate with anoxic selector.
[2] Largest unit out of service.

To enable the third clarifier to function with equivalent hydraulics, all aeration basins will convey mixed liquor to a distribution pump station, which will distribute mixed liquor to the three clarifiers proportionally. This pump-forward approach is unusual but required for this arrangement.

The third clarifier will be constructed in the existing sludge stabilization basin; therefore, a new sludge storage/stabilization basin will be required, thus, a new sludge stabilization basin will be required.

Adding two of the four new aeration trains will require a portion of the existing storage pond to be filled. This will reduce storage volume by as much as half of the current volume, before the anticipated improvements to the storage pond, which is undesirable to operations staff.

The Engineer’s Estimate of Probable Cost to construct the liquids processing portion of Alternative 1, including new interconnecting yard piping and electrical and instrumentation allowance, is $61.0M as outlined in Table 10-9.

Table 10-9: Liquid Stream Alternative 1 Engineer's Estimate of Probable Cost (2024)

Process Area	Total Cost by Area
Site Work & Yard Piping	$3.5M
Electrical/I&C	$8.6M
Headworks	$2.2M
Aeration Basins	$14.4M
Secondary Clarifiers	$5.4M
Tertiary Filtration	$18.0M
UV Disinfection	$2.7M
Recycled Water	$1.2
Utility Upgrade Allowance	$5.0M
Total Cost	**$61.0M**

The cost for Alternative 1 is the highest of the onsite treatment alternatives, thus, would likely be less preferred.

10.3.3 Alternative 2 – MBR

10.3.3.1 WWTP Upgrades for Alternative 2

10.3.3.1.1 *Influent Screening*

Three automatically cleaned basket fine screens will replace the single existing rotary drum screen. The proposed screens are each rated at 6.8 MGD capacity with 2-mm spacings in the screens. The screens will be configured for operation with two duty screens and one on standby to accommodate peak flows. The MBR membranes require greater grit removal to prevent damage to the filters. Consequently, the manual bar screen will not be needed. The screens will reside in a prefabricated concrete structure with three channels where each screen will be fulcrum mounted to remove floatables, rags, and other debris. The design parameters are summarized in Table 10-10.

Table 10-10: Influent Screen Design Parameters

Design Parameter	Automatic Screen No. 1	Automatic Screen No. 2	Automatic Screen No. 3
Bar Spacing (mm)	2	2	2
Peak Capacity (MGD)	6.8	6.8	6.8

10.3.3.1.2 *Grit Removal*

Similar to Alternative 1, the existing vortex grit removal unit will be reused in these proposed upgrades, and the grit classifier will be replaced to capture and dispose of grit.

10.3.3.1.3 *Aeration Basins*

To treat project 2040 waste loads, four packaged MBR tanks split between two process basins will be needed. Half of the existing aeration basin will be converted and improved to hold anoxic, pre-aeration, and MBR tanks. The other half of the basin can serve as additional storage for anoxic treatment or be equipped to expand the MBR system for additional treatment capacity. If designed and operated similarly to the existing aeration trains, one new blower will be required to treat the projected peak wasteload with one of the existing blowers offline. An additional equipment room next to the basin will house the scour blowers for each of the MBR tanks, as well as the RAS, WAS, and permeate pumps to convey flows within the tank, to tertiary liquids treatment, and to solids processing.

Two process basins will be sufficient to reduce ammonia concentrations below conventional detection limits, and reduce the total nitrogen concentration to approximately 2 mg/L. The secondary clarifiers will no longer be needed following the MBR-equipped aeration basin. Both clarifiers could be decommissioned, or one could serve as additional anoxic volume. The pH control system installed in 2022 will enable operators to maintain sufficient alkalinity for pH control.

A preliminary BioWin process model was prepared for Alternative 2 to verify aeration basin sizes. Results of process modeling are provided in Appendix B.4. The Aeration Basin Design Parameters for the planning window to 2040 are summarized in Table 10-11.

Table 10-11: Aeration Basin Design Parameters

Design Parameter	Total Capacity	Capacity with One Unit out of Service
Number of Aeration Trains	2	1
Swing Zone Volume	12,000 gallons	6,000 gallons
Aerobic Zone Volume	366,600 gallons	183,300 gallons
Anoxic Volume	146,600 gallons	73,300 gallons
Total Aeration Basin Volume	**525,200 gal**	**262,600 gal**
Air Required at MMWWF	4,410 scfm	4,410 scfm
Blowers		
Centrifugal Blower 1	1,350 scfm	1,350 scfm
Centrifugal Blower 2	1,350 scfm	1,350 scfm
Centrifugal Blower 3	1,350 scfm	1,350 scfm
Rotary Lobe Blower 1	1,199 scfm	1,199 scfm
New Blower	2,180 scfm	------ scfm
Total Blower Capacity	**7,429 scfm**	**5,249 scfm**

10.3.3.1.3.1 Additional Process Updates for Groundwater Injection

For groundwater injection as the discharge alternative, an effluent limit for Nitrate-N is anticipated to be between 5 and 10 mg/L, therefore, some process additions/changes may be required for groundwater injection. Those changes and their added costs will be explored as part of the Groundwater Injection Feasibility Study if required.

10.3.3.1.4 *Membrane Filters*

Each set of MBR cassettes can treat an average flowrate of 2.7 MGD and a PIF of 3.1 MGD. The plant will require a total of 20 MBR cassettes, housed between four tanks across two process trains. The MBR cassettes are best distributed between all four tanks with space left in each basin for treatment and possible future addition of cassettes. The proposed configuration to treat projected 2040 flowrates is summarized in Table 10-12.

Table 10-12: MBR Design Flux Rate Summary

Design Condition	Design Flowrate (MGD)	Flux Rate (gpd/sf)		
		Per MBR Train	Per MBR Train with One Offline	Design Limit
AAF	2.2	4.0	5.3	12
MMWWF	3.6	6.5	8.7	19.6
PIF	12.2	14.7	22.1	22.2

gpd/sf = gallons per day per square foot

10.3.3.1.5 *UV Disinfection*

Similar to Alternative 1, three additional closed vessel UV units will be required to meet firm capacity requirements for disinfection. A summary of the UV units is provided in Table 10-7.

10.3.3.1.6 *Sodium Hypochlorite Residual*

Similar to Alternative 1, the existing sodium hypochlorite system is adequate to provide the required residual required up to 7 MGD. No improvements are proposed to this system.

10.3.3.2 Alternative 2 Discussion

Alternative 2 represents an expansion of the existing plant with minor changes, but not a significant change in the process. The Operator Certification Level will increase to Level 4, which will require the plant's current Operators to update their training and certification. The footprint of the MBR plant is the smallest of the alternatives under consideration. A summary of the process areas is provided in Table 10-13. A site plan showing all components of Alternative 2 is provided in Figure 10-4.

Table 10-13: Alternative 2 Process Area Capacity Summary

Process Area	Total Capacity (MGD)	Firm Capacity[2] (MGD)
Fine Screens	20.4	13.7
Aeration Basins	12.2	12.2
Membrane Filters	12.2	12.2[1]
UV Disinfection	21	14

[1] Allowed for 2 consecutive hours.
[2] Largest unit out of service.

One of the existing clarifiers and the remaining half of the aeration basin tanks that are no longer needed with the installation of the MBRs can be reused for complete anoxic treatment. The other secondary clarifier can store sludge for additional solids handling capacity. The ASSB will remain online for aerated sludge storage.

The Engineer's Estimate of Probable Cost to construct the liquids processing portion of Alternative 2 is $45.4M as outlined in Table 10-14.

Table 10-14: Liquid Stream Alternative 2 Engineer's Estimate of Probable Cost

Process Area	Total Cost by Area
Site Work & Yard Piping	$3.0M
Electrical/I&C	$6.2M
Headworks	$2.8M
MBR Trains & Equipment	$25.4M
UV Disinfection	$3.0M
Utility Upgrade Allowance	$5.0M
Total Cost	**$45.4M**

The cost for Alternative 2 is the lowest of the treatment alternatives that can be completely contained on the treatment plant site and preserve 100% of the existing storage basin.

10.3.4 Alternative 3 – CAS/MBR Hybrid

10.3.4.1 WWTP Upgrades for Alternative 3

10.3.4.1.1 *Influent Screening*

Automatically cleaned basket fine screens will screen large floatable materials, rags, and other objects from the influent wastewater at the plant headworks. Three rotary basket fine screens rated at 6.8 MGD each will remove floatables, rinse and dewater the screenings, and convey them to a covered waste bin and will be hauled away for landfill disposal.

Because the plan includes MBR trains, the minimum bar spacing will be 2 mm and must include full redundancy to protect membranes. The screens will be configured for operation with two duty screens and one on standby to accommodate peak flows, similar to Alternative 2. Design parameters for the headworks screens are summarized in Table 10-15.

Table 10-15: Influent Screen Design Parameters

Design Parameter	Automatic Screen No. 1	Automatic Screen No. 2	Automatic Screen No. 3
Bar Spacing	2 mm	2 mm	2 mm
Peak Capacity	6.8 MGD	6.8 MGD	6.8 MGD

The headworks screens will be installed in a cast in place concrete structure with three channels. The headworks will be covered but will have open sides.

10.3.4.1.2 *Grit Removal*

Grit removal will be the same as Alternative 1. The existing vortex grit removal unit will be reused in these proposed upgrades and the grit classifier will be replaced to capture and dispose of grit.

10.3.4.1.3 *Aeration Basins*

The existing, two-train, aeration basin secondary treatment system will be upgraded and neighbored by a two-train MBR system. The aeration basins and MBR process basins will share the influent flows into the plant to accommodate peak flows and seasonal operation.

The MBR process basins will be sized to convey peak flowrates if one aeration basin must be taken offline. The MBR tanks will have their own blowers to provide scour air for the MBR cassettes and will use the existing blowers for process aeration. If designed and operated similarly to the existing aeration trains, no new process aeration blowers will be required to treat the projected peak waste loadings. The process basins are sized to treat ammonia levels to below detection limits.

An additional equipment room will be constructed next to the MBR basins to house the scour blowers, RAS, WAS, and permeate pumps for the MBR. The existing RAS, WAS, and internal recycle pumps will be used to convey flows for the existing aeration basin and secondary clarifiers. The Aeration Basin Design Parameters for the planning window to 2040 are summarized in Table 10-16.

Table 10-16: Alternative 3 Aeration Basin Design Parameters

Design Parameter	Total Capacity	Capacity with One Unit out of Service
Number of Aeration Trains	2	1
Swing Zone 1 Volume	37,500 gallons	18,750 gallons
Swing Zone 2 Volume	37,500 gallons	18,750 gallons
Aerobic Zone Volume	712,200 gallons	356,100 gallons
Total Aeration Basin Volume	**787,200 gal**	**393,600 gal**
Air Required at MMWWF	3,385 scfm	3,385 scfm
Blowers		
Centrifugal Blower 1	1,350 scfm	---- scfm
Centrifugal Blower 2	1,350 scfm	1,350 scfm
Centrifugal Blower 3	1,350 scfm	1,350 scfm
Rotary Lobe Blower 1	1,199 scfm	1,199 scfm
Total Blower Capacity	**5,249 scfm**	**3,899 scfm**

10.3.4.1.4 *Membrane Filters*

Each MBR cassette is capable of treating an average flowrate of 2.7 MGD and a PIF of 3.1 MGD and will be able to handle half of the influent flows during split-plant operation. The WWTP will require a total of 20 MBR cassettes, housed between 4 tanks in two process trains. The proposed MBR configuration that will accompany the above aeration basin to treat projected 2040 flowrates is summarized in Table 10-17.

Table 10-17: MBR Design Flux Rate Summary

Design Condition	Design Flowrate (MGD)	Flux Rate (gpd/sf)		
		Per MBR Tank	Per MBR Tank with One Offline	Design Limit
AAF	1.1	2.0	2.7	12
MMWWF	1.8	3.3	4.4	19.6
PIF	6.1	11.1	14.8	22.2

gpd/sf = gallons per day per square foot

10.3.4.1.5 *Tertiary Filtration*

Secondary clarifier effluent will be conveyed to tertiary treatment through a set of ultrafiltration modules for polishing. Similar to Alternative 1, the tertiary filters have an average pore size of 0.01 microns and are periodically backwashed automatically.

The existing smaller disc filters will be demolished, and the ultrafiltration units can be located under the cover of the existing filtration and disinfection shed if sufficient space is available.

The proposed configuration to treat projected 2040 flowrates is summarized in Table 10-18.

Table 10-18: Tertiary Filter Modules Required

Design Condition	Design Flowrate (MGD)	Flux Rate (gpd/sf)		
		Filter Unit, Each	Filter Unit, Each with One Offline	Design Limit
AAF	1.1	3.6	4.8	12
MMWWF	1.8	5.9	7.9	26.3
PIF	6.1	20.1	26.8	34.5

gpd/sf = gallons per day per square foot

10.3.4.1.6 *UV Disinfection*

Two additional closed vessel UV units will also be included in Alternative 3 to meet firm capacity requirements for disinfection. A summary of the UV units is provided in Table 10-7.

10.3.4.1.7 *Sodium Hypochlorite Residual*

Similar to Alternative 1, the existing sodium hypochlorite system is adequate to provide the required residual required up to 7 MGD. No improvements are proposed to this system.

10.3.4.2 Alternative 3 Discussion

Alternative 3 represents preserving the existing plant and the addition of new parallel MBR trains. The Operator Certification Level will increase to Level 4, which will require the plant's current Operators to update their training and certification. The footprint of the hybrid plant is between Alternatives 1 and 2. A site plan showing all components of Alternative 3 is provided in Figure 10-6. A summary of process area capacities is provided in Table 10-19.

Table 10-19: Alternative 3 Process Area Capacity Summary

Process Area	Total Capacity (MGD)	Firm Capacity[2] (MGD)
Fine Screens	20.4	13.7
Aeration Basins	12.2	12.2
Membrane Filters	12.2[1]	9.3[1,3]
Tertiary Filtration	7.0	5.3[3]
UV Disinfection	21	14

[1] Allowed for 2 consecutive hours.
[2] Largest unit out of service.
[3] Both CAS and MBR processes to be online for firm capacity to meet 12.2 MGD PIF.

The hybrid plant configuration will require both CAS and MBR trains to be online during wet weather to provide sufficient filtration capacity. With both processes online, the biological process is fully supported, and tertiary filtration capacity is provided with the largest unit out of service. The processes will require careful observation and control to adjust the MLSS concentration and SRT to optimize performance of each process.

The existing secondary clarifiers will remain online to support the conventional activated sludge portion of the plant. With reduced flows to the clarifiers, the surface loading rates will be lowered to optimize solids settling and prevent overflow of sludge and scum to the subsequent processes. The ASSB will continue to be utilized for aerated sludge storage.

The Engineer's Estimate of Probable Cost to construct the liquid's processing portion of Alternative 3 is $58.2M as summarized in Table 10-20.

Table 10-20: Liquid Stream Alternative 3 Engineer's Estimate of Probable Cost (2024)

Process Area	Total Cost by Area
Site Work & Yard Piping	$3.3M
Electrical/I&C	$12.4M
Headworks	$2.8M
MBR/CAS Treatment	$19.7M
UV Disinfection	$3.0M
Tertiary Filtration	$10.3M
Recycled Water	$1.7M
Utility Upgrade Allowance	$5.0
Total Cost	**$58.2M**

The cost for Alternative 3 is the highest of the treatment alternatives that can be completely contained on the treatment plant site, without encroaching on the existing storage basin. .

10.3.5 Alternative 4 – Regional Treatment Plant

Preliminary evaluation of Alternative 4 is based on a 14-mile, 30-inch ductile iron forcemain and pump station to transport influent wastewater to the City of Gresham Wastewater Treatment Plant. Based on initial discussions with the City of Gresham, it appears feasible that the Gresham WWTP has sufficient treatment capacity and a reliable point of discharge to avoid any permit compliance issues. Gresham is also open to negotiating with the City of Sandy to establish an agreement for appropriate connection charges to send flows to Gresham. The connection costs for the screening-level evaluation of this alternative are based on the full 2024 residential rates for connection to the Gresham wastewater system (highest cost), or the rate associated with purchasing only capacity in the WWTP (e.g., not using the existing Gresham collection system, which has a lower cost).

10.3.6 Screening Phase Cost Estimates for Complete Treatment Alternatives

The alternatives; cost estimates were developed based on capital construction costs for the liquid and solid treatment recommendations. Alternative 4 would require a new raw wastewater pump station, but no other plant improvements.

A summary table of Alt 1-4 costs is provided in Table 10-21.

Table 10-21: Cost Estimates Complete Screening Phase Wastewater Treatment Alternatives (2024)

	Alternative 1 (CAS/Sandy River)	Alternative 2 (MBR/Sandy River)	Alternative 3 (Hybrid/Sandy River)	Alternative 4 (City of Gresham)
Liquids Process	$61.0M	$47.1M	$58.2M	*N/A*
Solids Process	$8.1M	$8.1M	$8.1M	*N/A*
Sandy River Pump Station**/Outfall**	$49.4M	$49.4M	$49.4M	*N/A*
Sandy to Gresham Pump Station	*N/A*	*N/A*	*N/A*	$19.0M
Sandy to Gresham Force Main	*N/A*	*N/A*	*N/A*	$64.0M
Total Construction Cost	**$125.5M**	**$111.6m**	**$122.7M**	**$83.0M**
Connection Charge	**N/A**	**N/A**	**N/A**	**$25M-$59M**
Program Management	$5.0M	$4.5M	$4.3M	$3.3M
Const. Mgmt. & Inspection	$7.5M	$6.7M	$7.4M	$5.0M
Management Reserve	$12.6M	$11.2M	$12.3M	$8.3M
Soft Costs **(Finance, Legal)**	$3.8M	$3.3M	$3.7M	$2.5M
Program Overhead Cost	**$28.9M**	**$25.7M**	**$28.2M**	**$19.1M**
TOTAL PROJECT COST	**$154M**	**$137M**	**$151M**	**$127M-161M**

10.4 Beneficial Projects for Future Consideration

The City may consider additional projects that can be attached to selected wastewater projects that could further benefit the community and the City. These projects include:

- **Hydro Power Opportunities** – The proposed Sandy River Outfall will pump over the ridge between the Tickle Creek and Sandy River basins. A portion of the energy required to pump over this ridge can be recovered and returned to the grid through use of a turbine inside the outfall pipe. Feasibility of this opportunity should be studied as part of the Sandy River Outfall project preliminary design. Energy Trust of Oregon has incentive programs to fund studies and support construction of energy saving and generating projects.

- **Streamflow Augmentation** – Treatment Alternatives 1, 2, or 3, will produce extremely high-quality effluent that may achieve pollutant concentrations below detection limits during the summer season. The City may consider, as part of its NPDES permit renewal strategy, to have consultation with state and federal agencies regarding stream flow augmentation. Such a program could allow beneficial use of very high-quality effluent to augment declining stream flow in Tickle Creek and benefit aquatic populations. The City conducted the Tickle Creek Reuse Study to assess the feasibility of utilizing recycled water as a source of flow augmentation for Tickle Creek during the dry season. The results of this study are included in Appendix E.

- **Groundwater Recharge** – The potential is there to beneficially discharge high quality effluent to groundwater and mitigate some of the issues related to the Sandy-Boring

GRA. This could benefit the City, provide a discharge alternative to meet the dilution requirements in Tickle Creek, and support restoration of groundwater in the GRA. This option would primarily apply to Alternative 2, which can reliably meet anticipated effluent requirements. Field investigation and testing will be required to determine the infiltration rates, number of wells, and well design. At that time, estimated costs would be updated based on a validated discharge strategy.

10.5 Liquid Process Alternatives Screening

As described in Section 5, the Alternatives Screening (Liquid Process) approach is applied to the three alternatives evaluation in Section 10.3. The screening criteria and scoring guidance, previously defined in Table 5-3 are applied to compare and rank the three treatment alternatives. The outcomes of the alternatives screening are presented in Table 10-22 and discussed below.

Table 10-22: Application of Screening Criteria for Liquid Process Alternatives

Criteria	Sub-Criteria	Alt 1: CAS	Alt 2: MBR	Alt 3: Hybrid MBR/CAS	Alt 4: Regional Treat Plant
ECONOMIC	Financial Implementability	1	4	2	1
	Annual Cost Effectiveness	4	3	2	3
PERMIT COMPLIANCE RISK	Near Term Regulatory Risk	2	2	2	4
	Future Regulatory Risk	1	1	1	4
OPERATIONAL CONSIDERATIONS	Operational Complexity	3	2	2	4
	Operational Impacts During Construction	2	4	2	4
	Operational Staffing	3	2	2	4
IMPLEMENTATION	Construction Schedule	2	4	3	4
RESILIENCY	Compliance	1	3	2	4
	Vulnerability	4	4	4	4
Total Weighted Score:		**2.15**	**3.10**	**2.25**	**3.30**

Score	Legend:
4	Fully Meets Criteria
3	Mostly Meets Criteria
2	Somewhat Meets Criteria
1	Does Not Meets Criteria

Alternative 1: CAS scored lowest overall. The CAS process has the highest construction cost due to the amount of concrete, new pumps, and need for a separate effluent filtration step. The implementation schedule is also longer feasible due to time needed to construct the basins and challenges associated with operational impacts during construction because the current solids process would need to be interrupted to make the process upgrades. This alternative would also require changing the way the process works while keeping it online, requiring pumping to the clarifiers rather than using gravity. There is also a greater regulatory risk as an upset in the clarifiers could result in losing solids, which would upset the downstream ultrafiltration process, requiring additional cleaning cycles that are more intense than normal operations. Additionally, in the worst case, a solids release without an additional barrier like a submerged membrane could create an upset condition resulting in a permit violation.

Alternative 2: MBR scored the second highest overall. A package plant has the benefit of a smaller footprint, lowest cost, and the ability to construct and startup without disrupting current operations. The submerged membrane performs better as a physical barrier to the sludge, removing toxics and ammonia from the treated effluent. An MBR facility would require higher certification for operators, but due to built-in automation, the existing number of staff may be able to operate the plant as are currently overseeing operations. Overall, a single MBR solution would provide improved operation, compliance, and resiliency.

Alternative 3: Hybrid MBR/CAS scored third, blending the benefits and limitations of Alternatives 1 and 2. Having two systems is more complex to operate, and would require the most staff along with higher certified staff for the MBR. Since half the flow would go to the MBR and half to the CAS, the upset challenges associated with Alternative 1 are not as significant and there will be better removal of toxics and ammonia in the portion treated by the MBR. The cost to construct two new treatment components is less than the CAS alternative but still 10% more than the MBR alternative.

Alternative 4: Regional Treatment Plant scored the highest overall. Pumping sewage to Gresham, with sufficient treatment and discharge capacity, reduces the risk of permit violation and minimizes operational complexity. The added cost of connection charges could be negotiated if the City were to become a wholesale customer with Gresham.

10.6 Preliminary Alternative Evaluation

The City pursued options that were determined to be feasible in three phases:

1. Screening Phase: The first draft of the Facility Plan Amendment was submitted in 2024, presenting the treatment/discharge, offline storage, and regional treatment alternatives. The City considered the capital and long-term economics of alternatives that would meet NPDES permit requirements and pursued two alternatives. The City met on several occasions with the City of Gresham to discuss partnering to treat Sandy's wastewater. Simultaneously, the City further reviewed the Sandy River outfall alternative.

2. Investigation Phase: In 2025 The City investigated the possibility of conveying wastewater to Gresham and negotiating an agreement. Ultimately, this alternative was not feasible, and the City returned to treatment and discharge alternatives. The Sandy River outfall was determined to be economically infeasible.

3. Reassessment Phase: After it became clear neither Gresham nor Sandy River were economically feasible, and it became clear the State was moving toward more openness to water reuse, the groundwater recharge option was developed.

10.6.1 Screening Phase: Initial Recommended Complete Treatment Alternative

Table 10-23 summarizes the screening outcomes for the four complete process alternatives, including solids treatment. This screening identifies Alternative 2 as the preferred alternative. Alternative 2 provides optimum balance of cost, overall permit compliance, ease of operation, completion schedule, and resiliency. The MBR treatment process provides the highest quality effluent and provides a path to using all of the discharge alternatives, providing the City with the most flexibility and resilience. The capital cost for Sandy River Outfall contributes to the high cost of this alternative. If a groundwater injection discharge alternative can be negotiated, this could provide a lower cost option, however, further investigation, including well testing, is required to verify feasibility.

Table 10-23: Screening Phase: Ranking of Complete Alternatives

Option	Complete Alternative Capital Costs	Annual Operating Power Costs	Ranking
Alt 1: CAS	$117.3M	$1.6M/yr	4
Alt 2: MBR	$104.6M	$1.4M/yr	1
Alt 3: Hybrid MBR/CAS	$115.7M	$1.4M/yr	3
Alt 4: Regional Treatment Plant	$108M - 142.3M	$0.5M/yr	2

10.6.2 Screening Phase Preferred Alternative: Treatment at Gresham WWTP

Based on initial screening phase analysis, the highest ranked alternative for long-term service for the City of Sandy was to convey and treat wastewater to the Gresham WWTP. When this was preliminarily identified as the preferred alternative, the City executed a Memorandum of Understanding (MOU) with the City of Gresham to define the activities that Sandy would undertake, with input from and review by the City of Gresham, to demonstrate the viability of this approach and provide information needed to advance the required capital improvements and intergovernmental agreements (IGAs). These activities include:

- Gresham WWTP Capacity Evaluation
- Sandy Forcemain/Pipeline Preliminary Engineering Routing Study
- Gresham Collection System Evaluation Study
- Draft IGA Language

10.6.3 Screening Phase Backup Alternative 1: MBR Expansion at Jarl Road WWTP with Sandy River Outfall

Based on initial screening phase analysis, If the City cannot successfully negotiate with the City of Gresham to provide long-term service at the Gresham WWTP, the preliminary preferred alternative would be to implement the MBR expansion described under Alternative 2 and build a new outfall to the Sandy River. The Sandy River outfall would significantly increase the cost of this alternative due to the size of the pump station and the distance required to traverse to the Sandy River. In addition to the improvements described in Section 10.3.3, this alternative includes the elements described below.

10.6.3.1 Recommended Electrical Service Requirements

To implement the recommended liquid process upgrades in Alternative 2, the electrical service and standby power generator will require a significant increase in service size to serve the upgraded WWTP. Proposed improvements are expected to more than triple the electrical demand and exceed the existing service capacity of 2,000 Amperes. Table 10-24 provides an outline of these electrical load requirements.

Table 10-24: Alternative 2 Electrical Load Summary

Utility	Estimated Demand (Amperes)
Current Demand Load	4,800
New Items Demand Load	1,900
Total Expected Loads	6,700
25% Spare Capacity	1,700
Total Loads	**8,400**

10.7 Investigation Phase: Analysis of Gresham vs. Sandy River Alternative

In late 2024, Sandy City Council authorized staff and the Sandy Clean Water Program team to conduct additional investigation of the regional alternative in order to determine the viability of this alternative. This investigation included:

- Development of an Intergovernmental Agreement (IGA) with Gresham
- Route evaluation and conceptual design of a conveyance system from Sandy to the Gresham WWTP
- Capacity analysis of the Gresham WWTP to determine the available capacity and impact of accepting flow from Sandy
- Analysis of potential opportunities to utilize capacity in the Gresham collection system

The results of this analysis are described in detail in Appendix D, which includes a Summary of Regional Treatment Investigations Technical Memorandum, a Conceptual Design Report for conveyance alternatives from Jarl Road WWTP to the City of Gresham WWTP, and a Capacity Assessment of the Gresham WWTP. Findings of these analyses are summarized below, followed by an updated comparison of the capital costs of the two alternatives.

10.7.1 Pipeline Hydraulics and Route Evaluation

The Sandy to Gresham Wastewater Conveyance Conceptual Design Report (Stantec, January 2026) established projected future flowrates to be used in sizing the conveyance system, investigated system hydraulics to determine the optimum combination of pumped and gravity conveyance, established recommended force main sizing/configuration and gravity pipeline sizing, and determined the preliminary pump station configuration and location. The Conceptual Design Report also identified a preferred alignment for conveyance from Sandy to the Gresham WWTP, in parallel with an independent investigation of alternatives to discharge wastewater from the City of Sandy upstream in the existing Gresham collection system.

The Conceptual Design Report established projected peak flowrates to account for growth beyond that included in the 2040 projections in the Facility Plan Amendment. Projections were established using a combination of projected increases from the 2019 Facility Plan and reductions in peak flowrate used in the 2025 Facility Plan Amendment. Based on this analysis, the conveyance system was sized to accommodate average daily flowrates ranging from 2 to 4 MGD and peak instantaneous flowrates ranging from 12 to 17 MGD.

Analysis of the system hydraulics determined that a constant downhill slope can be established approximately 10 miles from the City's WWTP, therefore wastewater is assumed to be pumped for a portion of the alignment and then flow by gravity for the remaining 5.5 miles to the Gresham WWTP. The City of Gresham prefers that wastewater be introduced to the Gresham system upstream of the Gresham WWTP to allow for mixing of wastewater from Sandy and Gresham, therefore wastewater from Sandy was assumed to be introduced near the intersection of NE 201st Avenue and Sandy Boulevard or farther upstream in the system.

Due to the wide range of flowrates anticipated, it is recommended that the force main system is comprised of dual 24-inch pipelines with a pump station at the Jarl Road WWTP consisting of four 6-MGD pumps with variable frequency drives. This pump station and force main configuration provides the ability to manage the wide range of flowrates anticipated and also provides flexibility to perform maintenance of the system to maintain reliable performance and reduce the risk of system failures that would jeopardize the City's ability to convey wastewater to the Gresham WWTP.

The analysis investigated several options for introducing wastewater upstream in the City of Gresham's collection system to increase use of existing available capacity or allow Sandy to contribute to required upsizing in Gresham's collection system. Four upstream connection points were considered, of which only one was deemed feasible. This alternative includes introducing wastewater from the City of Sandy to a point near NW Burnside Road and SE 202nd Avenue upstream of the existing Burnside Diversion structure in the City of Gresham's system. Some upsizing of pipes in the City of Gresham collection system is required to accommodate wastewater from the City of Sandy regardless of the point of connection, however connecting near the Burnside Diversion has a lower total capital cost than connecting close to the Gresham WWTP, therefore this is the recommended conveyance alternative. The connection point and conceptual force main and gravity pipeline alignments are shown in Figure 10-10, Figure 10-11, and Figure 10-12.

Figure 10-10: Connection Point in Gresham Collection System

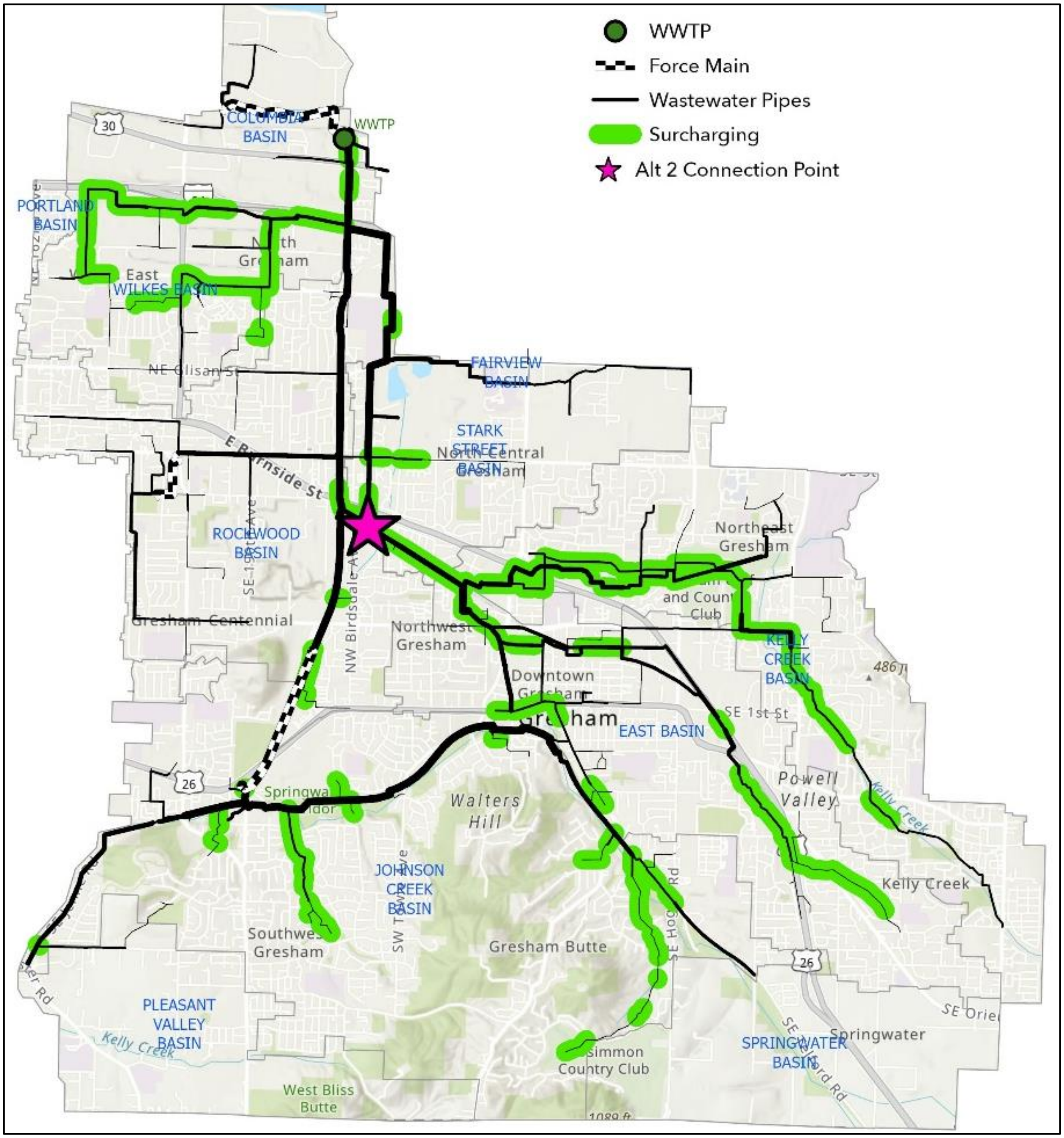


Figure 10-11: Force Main Alignment from Jarl Road WWTP to Gravity Transition at Gradin Community Sports Park

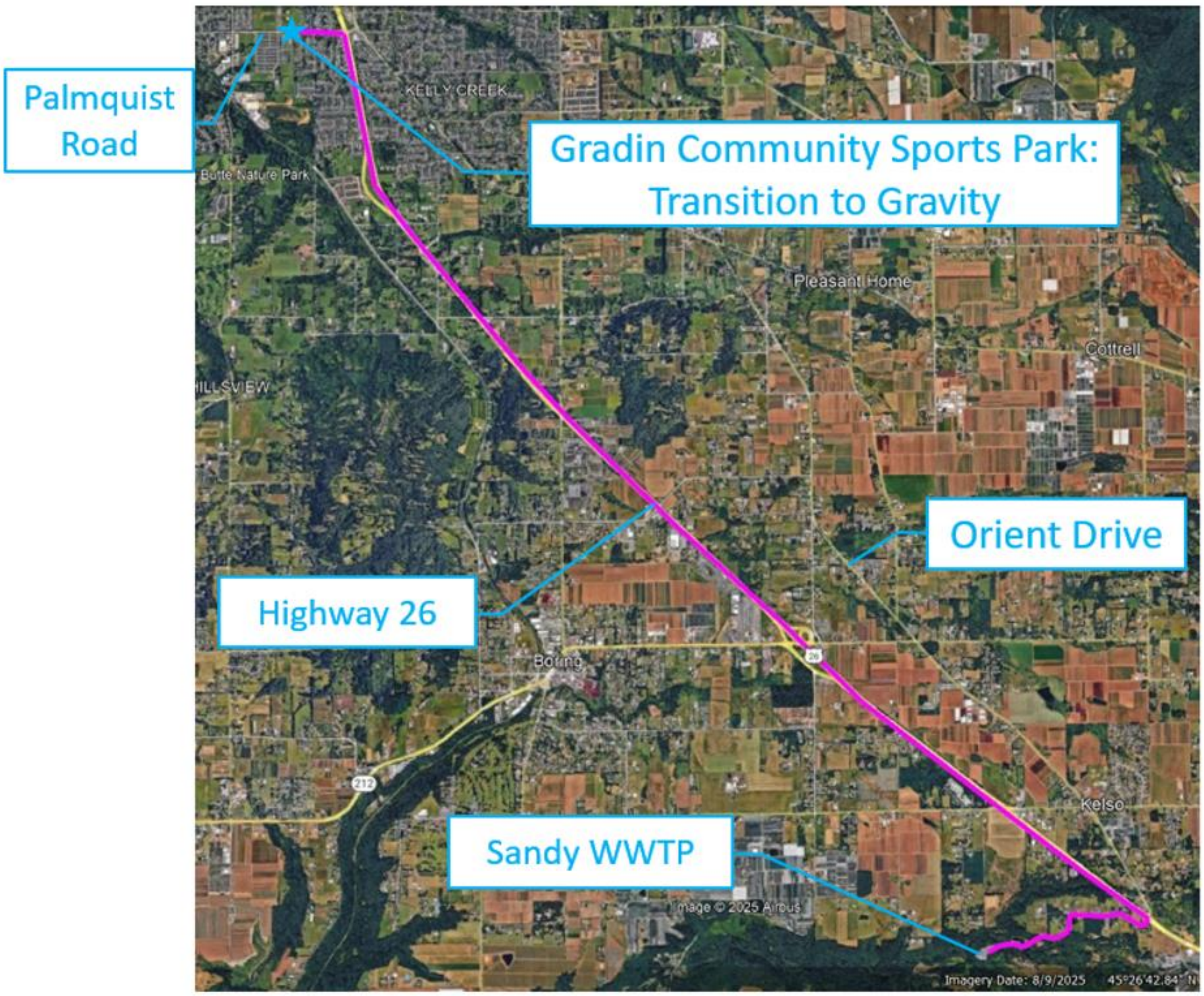
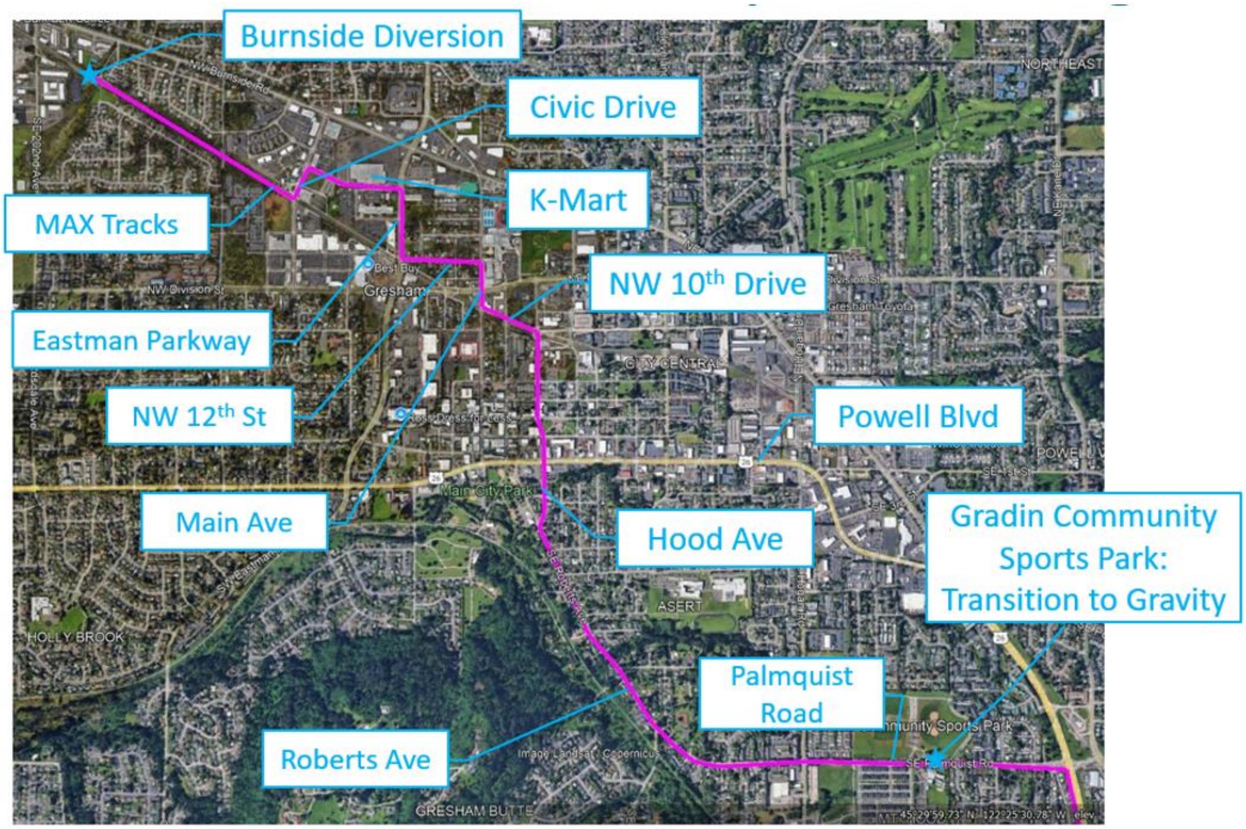


Figure 10-12: Gravity Sewer Alignment from Gradin Community Sports Park to Burnside Diversion



10.7.2 Gresham WWTP Capacity Analysis

The Program team prepared a Gresham WWTP Capacity Evaluation to determine the ability of the Gresham WWTP to accept existing and projected future flows from the City of Sandy. The objective of this analysis was to evaluate and document the impacts of Sandy's wastewater volume and load on the Gresham WWTP. The evaluation used a biological process model and hydraulic model to estimate available capacity to treat anticipated influent wastewater volume and loading for existing customers alone and with the additional contribution from the City of Sandy.

The Gresham WWTP is comprised of an "upper plant" and "lower plant" that provide biological treatment of liquid stream wastewater, and solids handling facilities that treat combined solids from the upper and lower plant processes. The plant historically has been operated to remove BOD and TSS, but it is currently being upgraded to provide nitrification for removal of ammonia-nitrogen. Gresham is also in the process of upgrading solids dewatering to replace the existing belt filter presses with centrifuge dewatering. A summary of the recommended improvements to accommodate Sandy wastewater at the Gresham WWTP are presented in Table 10-25.

Table 10-25: Summary of Process Capacity Results

Scenario	2040 Gresham Only	2040 Gresham + Sandy	Recommendation
Upper Plant			
Primary Clarification	**OK**	**OK**	No improvements needed
Primary Sludge Pumping	**OK**	**OK**	No improvements needed
Bioreactor Capacity	**OK**	**INVESTMENT REQUIRED**	Additional bioreactor may be required.[1]
Blower Capacity	**OK**	**OK**	No improvements needed
Secondary Clarification	**OK**	**OK (WITH ADDITIONAL BIOREACTOR)**	Additional clarifier may be required.[2]
RAS Pumping	**OK**	**OK**	No improvements needed
Lower Plant			
Primary Clarification	**OK (ALL IN SERVICE)**	**OK (ALL IN SERVICE)**	Peak Hour SOR exceeded when OOS
Primary Sludge Pumping	**OK**	**OK**	No improvements needed
Bioreactor Capacity	**OK**	**OK**	No improvements needed
Blower Capacity	**OK**	**OK**	No improvements needed
Secondary Clarification	**OK**	**OK (ALL IN SERVICE)**	Peak Hour SOR exceeded when OOS
RAS Pumping	**OK**	**OK**	No improvements needed
Solids Handling			
Gravity Belt Thickeners	**OK**	**OK (+25HR/WK RUNTIME)**	Additional runtime may be required
Anaerobic Digesters	**INVESTEMENT REQUIRED**	**INVESTMENT REQUIRED**	Additional digester may be required
New Centrifuges	**OK**	**OK (+4HR/D RUNTIME)**	Additional runtime may be required

Notes:
1. Assumes full nitrification occurs in the Upper Plant. Alternative operating strategies may be considered.
2. Secondary clarifier SOR and SLR were exceeded. If an additional bioreactor is installed, or the bioreactors are operated at a lower SRT, the clarifier SLR is expected to operate within the SLR capacity. The peak SOR conditions were also exceeded with one unit out of service, but are met with all units in service under peak hour condition.

Evaluation of hydraulic capacity using the Hades model determined that adding projected flow from the City of Sandy does not produce any bottlenecks, overflows, or increase hydraulic grade beyond the maximum design hydraulic grade through the wastewater treatment plant.

The outfall pipe and diffusers were designed with a hydraulic capacity of 75 MGD, however this capacity was recently reduced to 58 MGD when end caps were installed on 8 of the 18 diffusers to improve mixing. As peak flowrates increase to the 61 MGD projected in year 2040, some of the capped ports will need to be re-opened to provide sufficient hydraulic capacity.

Findings based on the process and hydraulic capacity analysis for Gresham flows alone and for combined Gresham and Sandy flows are shown Table 10-26 and Table 10-27.

Table 10-26: Capital Improvement Recommendations by 2040 – Gresham Only

Asset	Quantity/Sizing
Digester 3	One Digester, with volume approximately 1 MG.

Table 10-27: Capital improvement Recommendations by 2040 – Gresham + Sandy Flows

Asset	Quantity/Sizing
Upper Plant - Aeration Basin 5	Add one Bioreactor with volume similar to Aeration Basin 4, or confirm ability to achieve nitrification at lower SRT with full-scale operation
Digester 3	One Digester, with volume approximately 1 MG
Dewatering Units	Extend run time of new dewatering centrifuges by 4 hr/day
Outfall Diffusers	Re-open existing diffuser ports to increase peak hydraulic capacity

The Capacity Assessment confirmed that the Gresham WWTP generally has capacity to treat anticipated wastewater volume and load from the City of Sandy. The known limitation in solids handling capacity (anticipated for service to the City of Gresham only) is amplified with the additional wastewater volume from the City of Sandy and some of the outfall diffuser ports that were previously closed would need to be reopened to accommodate higher peak flows. The new dewatering centrifuges being planned for installation in the near future have sufficient capacity if daily run times are extended beyond those current planned.

In addition, with the new operating mode to achieve nitrification, the Upper Plant capacity is limited with the addition of Sandy's wastewater. While blower capacity is sufficient, the treatment volume may not be adequate to handle the additional loading through the end of the planning period. It may be possible to address this limitation with changes to the performance objectives or operational strategy, or it may be necessary to construct an additional aeration basin to provide sufficient capacity for 2040 conditions. The ability of the treatment process to handle additional wastewater volume and loading will need to be confirmed following startup of the nitrification improvements.

10.7.3 Investigation Phase Alternative Costs

Updated capital cost estimates were developed to reflect the recommended pump station, force main, and gravity pipeline improvements developed as part of the Conceptual Design. The estimated cost of conveying flow from the Sandy WWTP to a new Sandy River outfall was also updated to reflect similar assumptions as in the Sandy to Gresham conveyance system (e.g., construction of a transition structure to transition from pressurized to gravity conveyance, use of a fully-enclosed pump station) and to escalate costs to 2025 values. The Sandy to Gresham estimate was also amended to include property and easement acquisition, which is estimated at $4 million based on 20 acres of total area with an estimated cost of $200,000/acre). An updated comparison of Alternative Costs is presented in Table 10-28.

Table 10-28: Comparison of Alternative Project Costs (2025)

	Sandy River Alternative	Sandy to Gresham Alternative
Project Element	**Project Subtotal ($ Million)**	**Project Subtotal ($ Million)**
WWTP Improvements	65.1	*N/A*
Sandy River Discharge	66.2	*N/A*
Sandy to Gresham Pump Station	*N/A*	20.8
Sandy to Gresham Force Main	*N/A*	84.3
Sandy to Gresham Gravity Main[1]	*N/A*	24.3
Direct Construction Cost	**131**	**129**
Program Management	5.3	5.2
Const. Management & Inspection	7.9	7.8
Management Reserve	13	13
Soft Costs (Finance, Legal, etc.)	3.9	3.9
Total Construction Cost	**161**	**158**
Connection Fee (Low)	*N/A*	18
Connection Fee (High)	*N/A*	29
PROJECT TOTAL (LOW)	**161**	**177**
PROJECT TOTAL (HIGH)	**161**	**188**

1. Includes $1M for upsizing existing City of Gresham pipes required before 2040

Modeling of the City of Gresham's collection system shows that Sandy's discharge may trigger the need for increases in capacity in some existing pipes in Gresham's system beyond the planning horizon of this Facility Plan Amendment. If such upsizing is required, Sandy could be responsible for contributing proportionally to the cost of the collection system capacity expansion. These improvements are generally required after 2040 and would total approximately $4M (in 2025 dollars).

10.7.4 Investigation Phase Operation and Maintenance Costs

The two alternatives shown in Table 10-28 have different Operation and Maintenance costs associated with them. Table 10-29 provides a summary of anticipated operating costs including utilities and equipment replacement.

Table 10-29: Operation and Maintenance Costs for 2024 through 2040

Total Operating Costs for 2024 through 2026	Sandy River Alternative ($ Million)	Sandy to Gresham Alternative ($ Million)
Personnel	14.1	NA
Materials & Equipment	5.5	NA
Services	27.1	NA
Pump Station Power Cost	2.7	2.7
Pump Maintenance	0.6	0.6
User Fees	*NA*	82.3
TOTAL 2024-2040 COST	**50**	**86**

Both alternatives convey wastewater or effluent a substantial distance. Similar pump motor sizes are required to convey the volumes against static and dynamic head conditions. As a result, power requirements and pump maintenance requirements are similar. The significant differences between the two alternatives are treatment expenses for the Sandy River Alternative, and User Fees for the Sandy-to-Gresham Alternative.

As User Fees represent the major cost increase if the City were to select the Gresham Alternative, making this alternative competitive with the Sandy River Alternative would require the City to negotiate a 43% reduction in the User Rates.

10.8 Reassessment Phase: Updated Analysis of Discharge Alternatives

The investigation analysis reflected in Section 10.7 indicates that conveyance of raw wastewater to the City of Gresham provides the most secure long-term solution for wastewater management in Sandy, however Table 10-28 indicates that neither discharge to the City of Gresham or discharge to the Sandy River are financially viable for Sandy.

Simultaneously, legislation adopted in Oregon (2025 HB 2169 and DEQ 33-2025) moves the water and wastewater industry toward a new state policy encouraging expansion of water reuse strategies.

Given these developments, the City is pursuing new discharge alternatives that would allow the City to maintain treatment at the Jarl Road WWTP using discharge to groundwater during times when direct discharge to Tickle Creek is prohibited and reuse demand is not sufficient to use all treated effluent. Groundwater discharge could be achieved using one of two potential discharge strategies:

1. Obtaining a new NPDES for a “Functionally Equivalent” discharge to Tickle Creek under the modified Three Basin Rule, or

2. Obtaining a permit for injection of highly treated effluent directly to groundwater

These strategies would allow highly treated effluent from Sandy to continue to be used to benefit the local surface and groundwater resources, maintaining this valuable resource in the community while minimizing the financial impact on Sandy’s ratepayers relative to other alternatives. They would also allow the City to maintain the existing and highly successful beneficial reuse program that currently provides recycled water to a local nursery partner.

Neither of these strategies have been employed for municipal discharges in Oregon, however they both allow the recommended liquid stream treatment improvements (upgrading the existing plant to MBR treatment) to proceed while the City identifies a preferred discharge location, confirms the associated water quality requirements, designs and constructs the additional advanced treatment process(es) required to meet final water quality requirements, and secures the required discharge permit.

The following sections provided by the Sandy Clean Water Program team describe these new discharge options, outline the associated potential treatment requirements, identify the range of potential cost for treatment and discharge improvements, and summarize next steps.

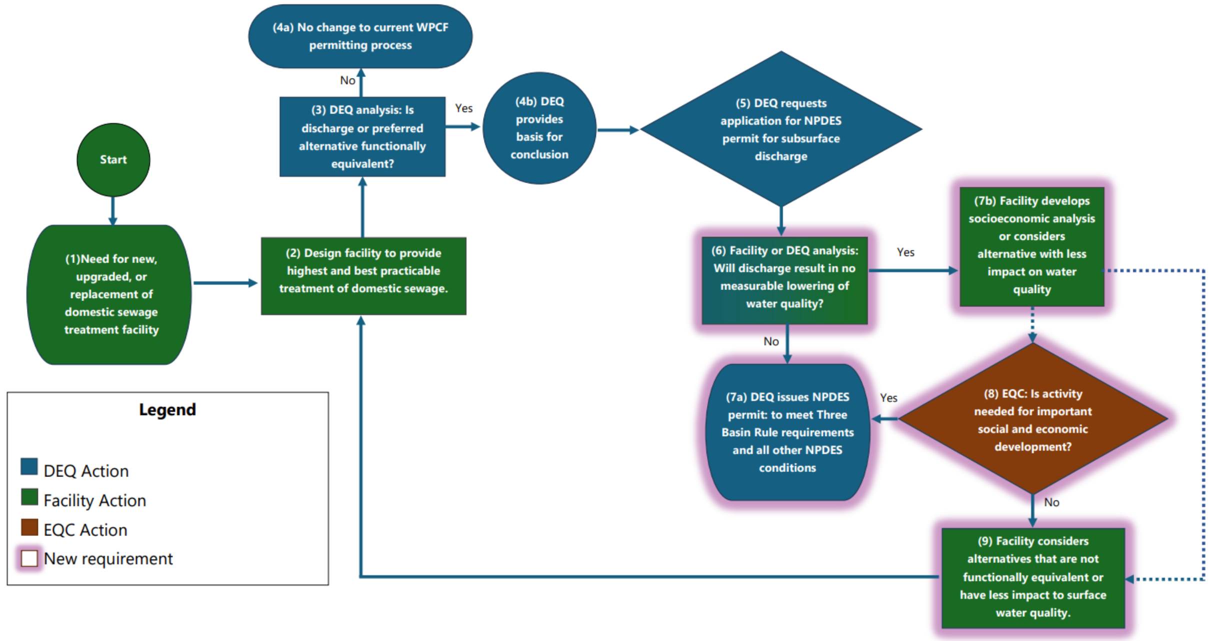
10.8.1 "Functionally Equivalent" Tickle Creek Discharge

Changes to the Three Basin Rule were adopted by the Environmental Quality Commission (EQC) in December 2025. These changes allow new NPDES permits for discharges that are "functionally equivalent" to direct discharge. Functionally equivalent discharges are defined by the following characteristics:

- Are discharged into the ground (e.g., through a highly permeable subsurface layer) but eventually enter surface water,
- Meet groundwater quality protection requirements in OAR chapter 340 division 40, and
- Result in "no measurable lowering of water quality" in surface water including
    - Insignificant temperature increases (as defined in the temperature criteria in chapter 240 division 41 parts 0028(11) and (12))
    - Up to 0.1 mg/l decrease in dissolved oxygen from upstream to downstream end of stream reach as long as there are no adverse effects on aquatic life, and
    - For other constituents, use no more than 1.0% of assimilative capacity per discharge and no more than 2.5% cumulatively

DEQ has developed a process for determining whether a new discharge has the potential to be functionally equivalent to a surface water discharge. The decision matrix for assessing a functionally equivalent discharge is shown in Figure 10-13.

Figure 10-13: Three Basin Rule Decision Matrix



Source: Three Basin Rule 2025 Technical Support Document, Oregon Department of Environmental Quality, August 2025

The new Section 8(d) of OAR 340-041-0350 adds that DEQ may issue a new NPDES permit for a discharge provided: “(A) the permit includes necessary conditions to comply with groundwater quality protection rules in ORE chapter 340 division 040;” and “(B) The discharge will result in no measurable lowering of water quality unless the facility demonstrates and the Commission concurs that the action is necessary to accommodate important economic or social development” (emphasis added).

These changes could provide a pathway for the City of Sandy to discharge to Tickle Creek or other surface waters through subsurface infiltration, with a location along Tickle Creek (potentially in close proximity to the WWTP or the existing reuse customer) or to a larger stream such as Deep Creek. Analysis would be required to demonstrate that the discharge would not measurably lower water quality or negatively impact aquatic life (e.g., salmonid spawning), however this discharge approach would take advantage of both some natural filtration as effluent flows through soil and mixes with groundwater before the water reaches the surface waterbody. If the discharge still has the potential to cause a measurable impact, action by the Environmental Quality Commission based on socioeconomic considerations would be necessary to allow the discharge to be permitted by DEQ.

10.8.2 Direct Injection to Groundwater

Discharge to groundwater in Oregon is regulated under groundwater rules in OAR chapter 340 division 40. Groundwater is protected from activities that could impair existing or potential beneficial uses, with minimum standards set at those necessary to protect drinking water supply under the Safe Drinking Water Act. The numerical groundwater reference levels included in OAR 340-020-0020 establish minimum standards for water discharged to groundwater, with higher standards possible to protect the background water quality of the receiving aquifer or to address pollutant parameters for which numerical limits for groundwater have not been established. Current groundwater quality reference levels are shown in Table 10-30 for reference and to establish the minimum water quality standards for aquifer injection.

Table 10-30: OAR 340-040-0020 Numerical Groundwater Quality Reference Levels

Table 1 – Inorganic Contaminants[1]	
Contaminant	**Reference Level (mg/L)**
Arsenic	0.05
Barium	1.0
Cadmium	0.01
Chromium	0.05
Fluoride	4.0
Lead	0.05
Mercury	0.002
Nitrate-N	10.0
Selenium	0.01
Silver	0.05
Table 2 – Organic Contaminants[1]	
Contaminant	**Reference Level (mg/L)**
Benzene	0.005
Carbon Tetrachloride	0.005
p-Dichloribenzene	0.075
1,2-Dichloroethane	0.005
1,1-Dichloroethylene	0.007
1,1,1-Trichloroethane	0.002
Trichlorethylene	0.005
Total Trihalomethanes	0.100
Vinyl Chloride	0.002
2,4-D	0.100
Endrin	0.0002
Lindane	0.004
Methoxychlor	0.100
Toxaphene	0.005
2,4,5-TP Silvex	0.010
Table 3 – Miscellaneous Contaminants[1]	
Contaminant	**Reference Level (mg/L)[2]**
Chloride	250
Color	15 Color Units
Copper	1.0
Foaming agents	0.5
Iron	0.3
Manganese	0.05
Odor	3 Threshold odor number
pH	6.5 – 8.5
Sulfate	250
Total dissolved solids	500
Zinc	5.0

1. All guidance levels except total dissolved solids are for total (unfiltered) concentrations unless the Department specifies otherwise.
2. Unless otherwise specified, except pH

The organic contaminants regulated in groundwater discharge are typically not associated with municipal wastewater, so the inorganic and miscellaneous components – specifically nitrate and metals – are of primary concern for groundwater discharge. It is likely that background water quality in the aquifers in and around Sandy have lower historical nitrate concentrations and will require consistent denitrification. In addition, treatment to remove contaminants of emerging concern (CECs) or per- and polyfluoroalkyl substances (PFAS) may be required for discharge to groundwater during the planning horizon of this document.

If the City elects to pursue groundwater injection, a field investigation and feasibility study will be required to determine the well design and number of wells required for the design flowrate. It is anticipated the wells would be near Iseli Nursery and could be served from the recycled water pipeline from the WWTF to the Nursery. Additional piping and equipment may be required; however, the requirements and costs will be determined after the feasibility study. At that time, the City will have sufficient information to select between the two discharge alternatives.

10.8.3 Potential Treatment Improvements

The anticipated water quality requirements for groundwater discharge point to the need for three potential modifications to the recommended secondary treatment improvements at the Sandy WWTP. These include the following:

1. **Design of the planned MBR process to include total nitrogen removal**. The treatment processes presented earlier in this chapter were developed to remove ammonia-nitrogen, not to remove nitrate-nitrogen. While some nitrate removal is achieved, modifications to the activated sludge process would be needed to maximize nitrate removal. These improvements should be included for any type of groundwater discharge.

2. **Effluent polishing using Granular Activated Carbon (GAC) filtration**. Granular activated carbon is an absorptive treatment technology used to remove dissolved organic contaminants and select inorganic contaminants. GAC is frequently used for effluent polishing to remove PFAS or other trace organic compounds.

3. **Effluent polishing using Reverse Osmosis**. Reverse osmosis (RO) is an advanced filtration process that removes dissolved compounds that pass through the membrane filters in the MBR system. Similar to GAC, RO membranes can remove dissolved organic compounds including PFAS and contaminants of emerging concern (CACs), and can also remove dissolved metals. The need for RO treatment would be determined based on background groundwater quality and the level of treatment required to protect existing conditions.

The nitrogen removal upgrades would be applied to the entire treatment stream, while advanced polishing steps would be sized for the effluent volume anticipated to be directed to the groundwater discharge. For purposes of evaluating this alternative, effluent polishing systems are sized to treat the maximum month wet weather flowrate of 3.6 MGD. This is anticipated to meet discharge requirements for shoulder season (spring/fall) discharge, with the EQ basin used to store flow in excess of 3.6 MGD when discharge to Tickle Creek is prohibited. During the winter discharge period, discharge between Tickle Creek and the groundwater system would be balanced to meet dilution requirements and mass load limits.

10.8.3.1 MBR Improvements

The process simulations conducted for the MBR alternative (Alternative 2 described in Section 10.2.2) resulted in effluent nitrate-nitrogen concentrations of 4.7 – 7.2 mg/L (see Table B.11), which is lower than the groundwater reference level, and can be achieved with biological processes designed for complete denitrification (5 to 10 mg/L or lower). Adding a post-anoxic zone with the potential for supplemental carbon addition would allow the facility to maximize nitrogen removal but would increase the required basin volume. The precise size and configuration of the aeration basin volume would be determined based on specific groundwater quality requirements, however for planning purposes based on typical process configurations for complete denitrification, a 20% increase in basin volume is assumed.

10.8.3.2 Granular Activated Carbon System

Granular activated carbon is a medium that provides high absorption capacity for soluble contaminants. GAC system size is determined based on empty bed contact time (EBCT), which typically ranges from 10-20 minutes for wastewater polishing and micropollutant removal. GAC systems are designed using multiple fixed-bed contactors, with the size and configuration of contactors determined to optimize operational simplicity, firm capacity, footprint, and cost. Assuming a 20-minute EBCT, a GAC polishing system for 3.6 MGD of flow would require 5,560 cubic feet of GAC bed volume. This volume can be achieved using five 12-foot diameter beds with a bed depth of 12.3 feet. The GAC vessels would be housed in a building including a carbon loading/unloading area, backwash equipment (if required for the system), and possibly a control area, resulting in a total building footprint of 4,000 – 5,000 sf. MBR effluent would need to be pumped to the GAC system, and polished effluent would flow by gravity to the UV disinfection system. An example GAC system installed inside a building is shown in Figure 10-14.

Figure 10-14: Typical GAC Treatment System

Photo courtesy of Wigan Water Technologies

10.8.3.3 Reverse Osmosis Improvements

RO membranes are effective in removing both organic and inorganic compounds from drinking water and wastewater, removing dissolved compounds that pass through the membrane filters in the MBR system. The system operates by applying high pressure to the treated effluent, forcing water through semi-permeable membranes that reject dissolved salts, nutrients, trace organic compounds, pathogens, and other residual contaminants such as PFAS.

The RO process is arranged in parallel membrane skids with multiple pressure vessels, allowing for redundancy, operational flexibility, and maintenance without full system shutdown. Treated water (permeate) is conveyed to post-treatment processes such as disinfection, while a concentrated reject stream containing salts and residual contaminants (brine) requires further treatment or disposal. The physical footprint of an RO system treating 3.6 MGD would likely require 10,000 to 12,000 sf of space for the RO membrane racks, cleaning systems, chemical dosing systems, and control equipment. TA typical RO package system is shown in Figure 10-15.

Figure 10-15: Typical RO Treatment System

Photo courtesy of Endress+Hauser

Managing brine produced by RO systems can be a significant challenge. This brine stream can equate to 10-20% of the total volume of flow through the RO system, or up to 720,000 gallons per day for a system treating 3.6 MGD of MBR effluent. Since RO systems are typically used for drinking water treatment or in arid areas, brine streams are often directed to the local wastewater treatment system or to large evaporation ponds. Since neither of these are options for Sandy, the brine would likely need to be stored and sent to a larger treatment facility or further treated using crystallization to reduce the volume of the reject stream. Either of these options could carry high capital and O&M costs. Because of the challenges associated with brine management, RO treatment would likely only be used if there are wastewater constituents that cannot be removed by precipitation, filtration, and adsorption.

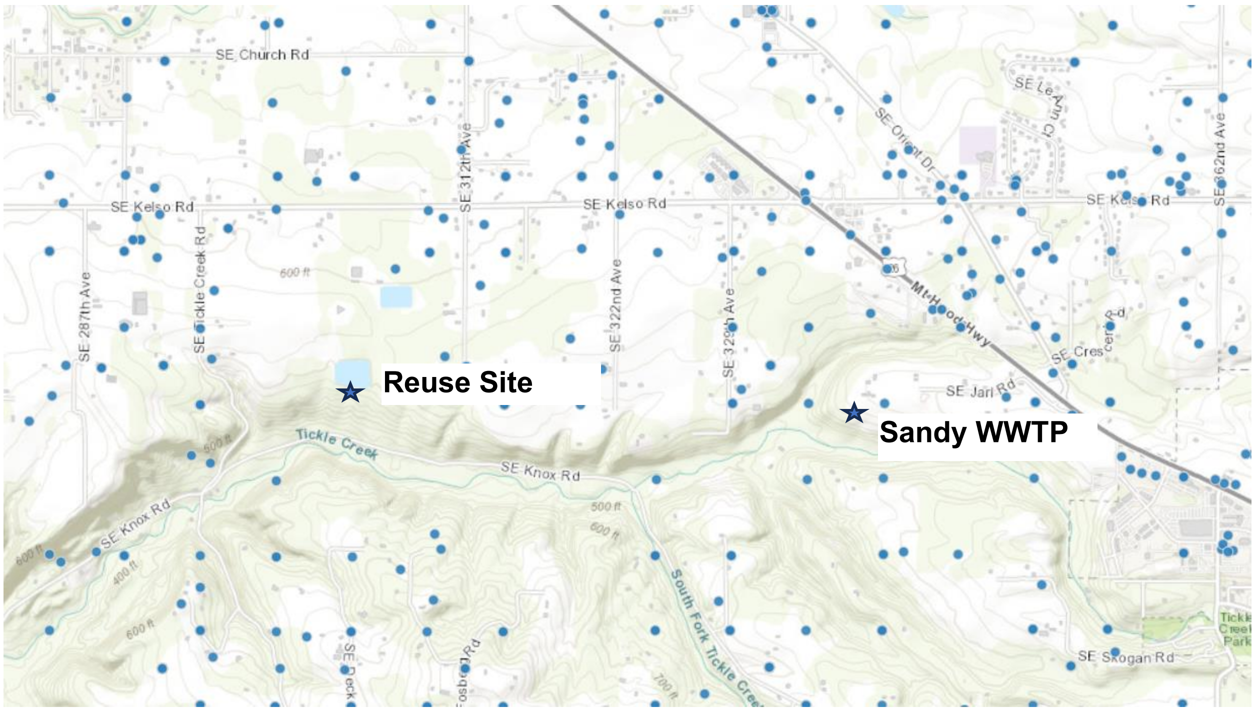
10.8.4 Potential Discharge Improvements

The ideal location for a functionally equivalent discharge or groundwater injection would be near the existing reuse site. This location is relatively close to the wastewater treatment plant (1.8-mile pipeline distance), though the site (as measured from the location of the existing recycled water storage pond) is within approximately 1,800 feet of existing private water wells. Figure 10-16 shows the locations of known drinking water wells in the vicinity of the wastewater treatment plant and reuse sites.

Improvements in the vicinity of the nursery site could include a relatively shallow infiltration system serving as a functionally equivalent discharge, or a deep injection well to introduce groundwater to an aquifer that is not hydraulically connected to Tickle Creek. Some private wells in the nearby area have completed depths of more than 350 feet, so it is assumed that aquifer injection will require injection wells of at least 1,000 feet, and that redundant wells would be required.

If the nursery site is not suitable for injection or infiltration, additional sites farther from the treatment plant will need to be investigated. The estimated cost of extending the effluent line to the final groundwater injection site is $3.5 - $5 million per mile depending on the terrain, depth, and cost of easements.

Figure 10-16: Water Well Locations Near Sandy WWTP



Source: State of Oregon GEOHub Data Water Wells

10.8.5 Range of Anticipated Capital Costs

Anticipated costs of the treatment and discharge improvements associated with the groundwater discharge alternative are shown in Table 10-31. These costs are based on typical industry costs for GAC or RO treatment systems sized to treat 3.6 MGD. The GAC expansion cost also includes an allowance for chemical storage and metering pumps to provide precipitation of metals if needed (and effective for metals of concern). In addition, all alternatives include:

- A new in-plant pump station sized for the full plant flow to pump to the GAC or RO system
- A new effluent pump station for groundwater discharge
- An allowance for miscellaneous treatment plant improvements not directly accounted for in the unit process cost estimates

Table 10-31: Estimated Cost of Groundwater Discharge Improvements (2026)

Project Element	GAC Treatment Project Subtotal ($Millions)	RO Treatment Project Subtotal ($Millions)
Base Liquids Upgrades[1]	50.8	50.8
Base Solids Upgrades[2]	8.8	8.8
Recycled Water Pipeline[3]	NA	NA
MBR expansion[4]	1.1	1.1
Carbon addition (storage tank, metering pumps)	1.2	1.2
Pumping to GAC or RO	5.8	5.8
GAC system	14.0	*NA*
Allowance for metals precipitation	1.2	*NA*
RO system	*NA*	21.0
Allowance for Brine Management	*NA*	5.0
Misc. WWTP improvements	2.0	2.0
Effluent PS Upgrade[3]	4.1	4.1
Effluent Pipeline	10.9	10.9
Functionally Equivalent discharge system	5.0	5.0
Direct injection well	4.0	4.0
Construction Subtotal	**109**	**120**
Program Management	4.4	4.8
Const. Management & Inspection	6.5	7.2
Management Reserve	11	12
Soft Costs (Finance, Legal, etc.)	3.3	3.6
Total Project Cost	**134**	**147**

1. Alternative 2 liquid stream improvement costs, escalated to 2026
2. Alternative 2 solids improvement costs, escalated to 2026
3. Assumed to be covered in Effluent Pipeline cost
4. Based on estimated process basin expansion; final cost to be based on effluent standards and updated process model
5. Included because precise location, configuration, and hydraulic requirements not established. Existing effluent pump station could be sufficient.

10.8.6 Implementation of WWTP Improvements

One advantage of the groundwater discharge alternatives compared with the regional alternative is that base expansion (upgrading the existing treatment plant to MBR with complete denitrification) serves as a first step toward either a functionally equivalent discharge under the Three Basin Rule or a discharge directly to groundwater. Implementing the MBR expansion in the near term also provides a significant reduction in effluent load, easing compliance with the existing mass load requirements for discharge to Tickle Creek. The MBR expansion will allow the City to meet mass load limitations through the planning horizon, though effluent discharge will still be constrained by dilution and seasonal limitations

In parallel with implementing the MBR upgrade, the City can pursue the hydrogeologic and water quality investigations needed to determine the likely effluent standards for groundwater discharge, and coordinate with applicable regulatory agencies to confirm the permitting process and complete permit applications.

Estimated costs by phase using this approach are shown in Table 10-32.

Table 10-32: Phased Cost of Groundwater Discharge Improvements (2024)

Project Element	Phase 1: MBR Expansion *Project Subtotal ($Millions)*	Phase 2: Effluent Polishing and Groundwater Discharge *Project Subtotal ($Millions)*	All Phases *Project Subtotal ($Millions)*
Base Liquids Upgrades	50.8		
Base Solids Upgrades	8.8		
Nursery Pipeline Replacement	N/A		
MBR expansion	1.1		
Carbon addition (storage tank, metering pumps)	1.2		
Pumping to GAC or RO		5.8	
Advanced Polishing System[1]		15-26	
Misc WWTP improvements		2.0	
Effluent PS Upgrade		3.0	
Effluent Pipeline		8.0	
Effluent Discharge System		4.0	
Construction Subtotal	**62**	**47 – 58**	**109 – 120**
Program Management	2.5	1.9 – 2.3	
Const. Management & Inspection	3.7	2.8 – 3.5	
Management Reserve	6.2	4.7 – 5.8	
Soft Costs (Finance, Legal, etc.)	1.9	1.4 – 1.7	
Total Project Cost	**76**	**58 – 71**	**134 – 147**

1. Represents cost of GAC + Metals Precipitation (low end) or RO + Brine Management (high end)

10.8.6.1 Operation and Maintenance Costs

Planning level O&M Costs for the MBR expansion with effluent polishing begin with MBR treatment plant operating costs plus pumping to the groundwater injection site and assumed the effluent will inject by gravity without a second pumping step. The estimated cost for 2024 through 2040 operational costs is $50M. The additional cost associated with operation of the polishing step depends on the technology selected, however, polishing with GAC is estimated to increase the O&M cost by 10%, resulting in an O&M cost for 2024 through 2040 of $55M.

10.9 Final Recommended Wastewater Management Strategy

It is recommended that the City of Sandy proceed with design and construction of an MBR expansion at the existing treatment plant. This improvement serves as a foundation for the City's long-term discharge strategy and allows the City to expand treatment capacity and continue to meet effluent quality requirements while the new long-term discharge is implemented.

The recommended discharge strategy leverages the existing Tickle Creek outfall and successful beneficial reuse program, adding a new groundwater discharge option that will be used when

- Discharge to Tickle Creek is prohibited and effluent flow exceeds reuse demands,
- Effluent discharge does not meet dilution criteria, or
- Mass load limitations for discharge to Tickle Creek have been reached.

The City will continue with the feasibility study needed to identify the most suitable area for groundwater discharge and conduct groundwater sampling and pilot studies needed to confirm the groundwater injection feasibility and water quality requirements. Concurrently, the City will work with DEQ and Water Resources to determine the most suitable permitting pathway for this discharge. If the effluent polishing requirements, groundwater injection feasibility, or permitting requirements result in this discharge option being less favorable than construction of a new outfall to the Sandy River, the City can proceed with implementing a new Sandy River discharge.

Section 11: Recommended Capital Improvement Plan Update

2019 PLAN | SECTION 11 SUMMARY

- Includes an overview of the recommended Capital Improvement Program (CIP) for the City's wastewater system, providing
  - A Recommended Plan overview,
  - Summary of required O&M upgrades at the City's existing WWTP,
  - Phased Implementation Plan with estimated costs; and
  - Preliminary Financial Plan.

11.1 Introduction

The recommended wastewater collection, treatment, and discharge alternatives are summarized in this section. Costs were prepared by all of the Consultants currently working on wastewater systems for the City and are summarized in this CIP section for the City's convenience. Generally, these areas include:

- Collection System Repairs
- Initial upgrade to MBR treatment at the Jarl Road WWTP
- Construction of final effluent polishing, pumping, and distribution for a new groundwater discharge to supplement the existing commercial reuse and Tickle Creek discharge

11.2 Recommended Plan Overview

11.2.1 Collection System Rehabilitation Program

The *Draft TM – 2024 Wastewater Collection System Update* (Stantec 2024a), included in Appendix A.2, identifies ongoing and upcoming activities , and provides an updated CIP for collection system activities that are included in this 2026 Plan Amendment (Table 11-1 and Table 11-2).

Table 11-1: Status of 2019 Facility Plan Recommended Collection System Improvements

Designation	Project Name	Project Description	Status	Ongoing Project
Capacity	Sandy Bluff	Additional pumping capacity, mechanical and electrical upgrades	Ongoing	Northside PS Upgrades; PS Capacity Evaluation
Capacity	Jacoby/ Timberline Trails	Additional pumping capacity	Ongoing	PS Capacity Evaluation
Capacity	Marcy Street	Additional pumping capacity, mechanical and electrical upgrades	Ongoing	PS Capacity Evaluation

Capacity	Meinig Avenue	Additional pumping capacity, mechanical and electrical upgrades	Ongoing	PS Capacity Evaluation
Capacity	Snowberry Pump Station	Additional pumping capacity	Ongoing	PS Capacity Evaluation
Capacity	Sandy Bluff	FM Upgrades	Ongoing	PS Capacity Evaluation
Capacity	Jacoby/ Timberline Trails	FM Upgrades	Ongoing	PS Capacity Evaluation
Capacity	Sandy Heights – Dubarko Rd	Gravity upgrade	Monitor	Evaluate need based on Model Recalibration
Capacity	Dubarko Road at Tupper Rd	Gravity upgrade	Monitor	Evaluate need based on Model Recalibration
I&I	Sandy Bluff	Gravity upgrade	Monitor	Evaluate need based on Model Recalibration
I&I	Site-specific	Flow monitoring	Ongoing	Flow Monitoring and Model Recalibration
I&I	33% of System	Condition Assessment (CCTV)	Ongoing	CCTV and Grade 4/5 Defects
I&I	System-wide	Smoke testing	Completed	N/A
I&I	Basin 2	Rehabilitation (piping and laterals)	Completed	N/A
I&I	Basin 8	Rehabilitation (piping and laterals)	Completed	N/A
I&I	Basins 5, 6, 7, 10	Rehabilitation (piping and laterals)	Basins 6 & 7 Completed	Basin 5 MHs as part of Manhole Grouting Contract
I&I	System-wide	Stormwater Disconnects	Completed	N/A
I&I	System-wide	$200k/yr ongoing I&I	Ongoing	CCTV and Grade 4/5 Defects
I&I	System-wide	Collection system repair and replacement program	Ongoing	CCTV and Grade 4/5 Defects
I&I (New)	Manhole Grouting	Focused grouting of manholes in Basins 5, 6, and 7 and throughout the City as identified by City staff	Ongoing	Manhole Grouting
I&I (New)	Basins 3, 9, 10	Rehabilitation (non-plastic pipe, laterals, manholes)	New	Basins 3, 9, 10 Rehabilitation

Source: Draft TM –2024 Wastewater Collection System Update (Stantec, 2024a)

Table 11-2: Collection System Recommended Projects

Project Name	Project Description	CIP Cost Estimate (2024 dollars)	Year(s) of Completion
Northside Pump Station Upgrades	Upgrade pump station to provide firm pumping capacity of 1,200 gpm	$450,000	2025
Pump Station Capacity Evaluation	Revisit the need for capacity upgrades at the Jacoby/Timberline Trails, Marcy Street, Meinig Avenue, and Snowberry pump stations	$150,000	2026
Flow Monitoring and Model Recalibration	Collect additional flow monitoring to collect data reflecting recent rehabilitation efforts, and recalibrate model reflecting current conditions	$200,000	2026
CCTV Inspection	Complete CCTV inspection of remaining collection system	$400,000 ($200,000 per year)	2024-2025
Citywide Manhole Grouting	Focused grouting of manholes in Basins 5, 6, and 7 and throughout the City as identified by City staff	$400,000	2023-2025
Grade 4/5 Defect Repairs	Repair Grade 4 and Grade 5 defects identified through CCTV inspection	1,200,000 ($300,000 per year)	2024-2028
Basins 3, 9, 10 Rehabilitation	Provide design and construction of comprehensive sewer rehabilitation in Basins 3, 9, and 10 based on results of CCTV inspection	$10,000,000	2026-2030
Pump Station Condition and Capacity Upgrades	Provide design and construction of pump station capacity and condition upgrades following completion of pump station capacity assessment	$2,000,000	2026-2030
	Total	**$14.8M**	

Source: Draft TM –2024 Wastewater Collection System Update (Stantec, 2024a)

11.2.2 Near-Term Improvements

The City has recently completed or is currently completing several near-term projects to increase reliability and bridge the treatment plant's capability to the major treatment plant improvements. The City is pursuing several treatment plant upgrade projects that are on the 10-year horizon and beginning to construct those improvements:

- Upgrading UV Disinfection – New in-channel UV treatment which will be capable of providing year-round UV disinfection, including to irrigation, to limit the risk of releasing chlorinated effluent to Tickle Creek.

- Expanding Existing Equalization Basin – The City has added approximately 0.8 MG of storage volume to the storage pond to help the City manage additional wet weather peaks within the plant so the basin can be used both to limit solids loading on the secondary clarifiers and to store peak wet weather flow.

- Blower 4 has been replaced and the City is considering additional process control improvements to provide Operators better aeration control.

- Expanding the effluent pump station – Construction is underway to expand the effluent pump station and provide improved flow monitoring both at the WWTP and at the discharge at the nursery to aid in detecting leaks in the effluent irrigation pipeline.

There are additional projects being considered for the 10-year horizon, however, these are considered maintenance improvements and do not fall under capital projects.

11.2.3 Complete Wastewater Treatment Improvements

Wastewater treatment system upgrades to provide secure, long-term treatment and discharge of wastewater from the City of Sandy include upgrading the existing WWTP to provide MBR treatment, identifying and securing easements for a new groundwater discharge location and effluent conveyance pipeline, and constructing the new effluent discharge system as well as effluent polishing systems to provide the appropriate advanced treatment for the selected groundwater discharge. The potential cost of effluent polishing and conveyance varies widely based on the location selected and the associated water quality of the underlying aquifer, and the timeframe for completing these final projects also varies depending on the time needed to determine effluent water quality requirements and obtain easements and construction permits.

The expected cost to construct the recommended alternative (in 2026 dollars) is summarized in Table 11-3. Costs are presented for the initial Phase 1 expansion consisting of treatment plant improvements only (MBR expansion with complete nitrification/denitrification), followed by a Phase 2 expansion including additional effluent polishing and the final groundwater discharge system.

Table 11-3: Engineer's Estimate of Probable Construction Cost – Groundwater Treatment Improvements (2026)

Process Area	Total Cost by Area	Year(s) of Completion
Phase 1 Upgrades		
Liquids Upgrades	$53.2M	2031
Solids Upgrades	$8.8M	2031
Construction Subtotal	**$62M**	
Program Management	$2.5M	
Const. Management & Inspection	$3,7M	
Management Reserve	$6.2M	
Soft Costs (Finance, Legal, etc.)	$1.9M	
Phase 1 Total Project Cost	**$76M**	
Phase 2 Upgrades		
Effluent Polishing Improvements	$23 - $34 M	TBD
Effluent Conveyance and Groundwater Discharge	$24 M	TBD
Construction Subtotal	**$47 - $58M**	
Program Management	$1.9-$2.3M	
Const. Management & Inspection	$2.8-$3.5M	
Management Reserve	$4.7-$5.8M	
Soft Costs (Finance, Legal, etc.)	$1.4-$1.7M	
Phase 2 Total Project Cost	**$58 - $71M**	

11.2.4 20-year CIP

A complete 20-year CIP is summarized in Table 11-4. This CIP includes the costs associated with the Collection System Rehabilitation Program and Recommended Wastewater Treatment Alternative, and the Sandy River Outfall, as well as program management, construction management and inspection, City administrative and legal costs, and a 10% management reserve to account for unanticipated expenses. The CIP also includes a range representing the estimated connection fee for securing capacity at the Gresham WWTP.

Table 11-4: 20-Year Wastewater Capital Improvement Plan Summary

Project Element	CIP Cost Estimate (2026 dollars)	Year(s) of Completion
Collection System Rehabilitation Program		
Northside Pump Station Upgrades	$0.49M	2026
Pump Station Capacity Evaluation	$0.17M	2027
Flow Monitoring and Model Recalibration	$0.22M	2028
Citywide Manhole Grouting	$0.44M	2029
Basins 3, 9, 10 Rehabilitation	$10.8M	2030
Pump Station Condition and Capacity Upgrades	$2.2M	2031
Collection System Total Cost	**$14.3M**	
Initial WWTP Upgrade	$62M	2033
Effluent Polishing Improvements	$23-$34M	TBD
Effluent Conveyance and Groundwater Discharge	$24M	TBD
Treatment and Discharge Construction Cost	**$109-$120M**	
Program Management	$4.4-$4.8M	
Construction Management & Inspection	$6.5-$7.2M	
Management Reserve	$11-$12M	
City Administrative Costs	$3.3-$3.6M	
Treatment and Discharge Total Cost	**$134-$147M**	
Total 20-Year CIP	**$148-$162M**	

Ongoing annual inspection tasks that were not included in the 20-Year CIP are summarized in Table 11-5.

Table 11-5: Ongoing Annual Inspection Tasks

Task	Anticipated Duration	Annual Cost Estimate (2024 dollars)	Cumulative Cost (2024 dollars)
CCTV Inspection	2024-2025	$0.2M	$0.4M
Grade 4/5 Defect Repairs	2024-2028	$0.3M	$1.2M
Total		**$0.5M**	**$1.6M**

11.2.5 Preliminary Funding Plan

The City has secured funding through several sources, primarily in the form of low-interest loans. Sources of funding plan are summarized in Table 11-6.

Table 11-6: Summary of Funding Sources

Funding Source	Type of Funding	Total Available Funds
Clean Water State Revolving Loan Fund (CWSRF)	Loan	$46M
Water Infrastructure Finance Innovation Act (WIFIA)	Loan	$56M
American Rescue Plan Act (ARPA)	Grant	$7M(1)
US Environmental Protection Agency (EPA) Grant	Grant	$1M (funding allocated)
	TOTAL	**$111M**

(1) Grant total is $14.7M, and is partially expended.

The funding available for the project represents the maximum debt the City can incur to support the project. The City has increased monthly sewer rates to fund the debt service associated with this funding, and further increases are not financially viable. The City has two other CWSRF loans that are nearly exhausted and have not been considered in this total. Based on the 20-year CIP proposed in Table 11-4, the City will need to secure at least $37M in grant funding through legislative appropriations or other means in order to proceed with the project. The City could also elect to defer solids handling improvements and continue to dispose of dewatered solids in a landfill, reducing the direct construction cost by $8.8M.

11.2.6 Next Steps

Following adoption of this Amendment by City Council, the Amendment will be reviewed and approved by DEQ and EPA for conformance with the Consent Decree requirements. The City will proceed with beginning the MBR upgrades to the WWTP, identifying an appropriate groundwater discharge site, and negotiating a new discharge permit. The City will also continue to seek additional funding to make the project affordable to ratepayers in Sandy.

Section 12: References

12.1 New References Since 2019 Plan

Barney & Worth, In and Globalwise, Inc. (B&W/Globalwise), 2020. City of Sandy WSFP Detailed Discharge Alternatives Evaluation Market Potential for Sandy's Recycled Water. Prepared for the City of Sandy. May 2020.

Leeway Engineering Solutions (Leeway), 2024a. 2023 Sandy Collection System Capacity, Management, Operations and Maintenance Implementation Report. Prepared for the City of Sandy.

Leeway, 2024b. 2024 Sandy CMOM Strategic Plan. Prepared for the City of Sandy.

Leeway, 2023. Sandy Wastewater Collection System Model Predicted Flows for 2023 and 2040. Table and assumptions prepared for Kennedy Jenks. November 17, 2023.

West Yost, 2023. Sandy Wastewater Preliminary Evaluation of Sandy Wastewater Treatment Capacity. Prepared for the City of Sandy. September 2023.

West Yost, 2021a. Sandy Wastewater Treatment Plant Condition Assessment Improvements Project. Prepared for the City of Sandy and Leeway Engineering Solutions. March 2021.

West Yost, 2021b. Preliminary Design Evaluation Report Sandy WWTP Condition Assessment Improvements Project.

Murraysmith, 2021. Detailed Discharge Alternatives Evaluation (DDAE) Final Report. June.

Murraysmith, 2020. Preliminary Design Report Sandy WWTP Immediate Needs Upgrade Project.

Murraysmith, 2019. City of Sandy Wastewater System Facilities Plan. Herein referred to as the 2019 Plan

Oregon DEQ, 1996. Making Wet-weather and Peak Flow Projections for Sewage Treatment in Western Oregon.

Parametrix, 2022. Draft Summary Letter Report - City of Sandy NPDES Permitting Support Subsurface Infiltration Feasibility Study. Prepared for the City of Sandy and Leeway Engineering Solutions. November 2022.

Stantec, 2024a. Draft TM – 2024 Wastewater Collection System Update. Prepared for the City of Sandy. May 3, 2024.

Stantec, 2024b. Near-Term Plant Improvements at the WWTP.

Stantec, 2024c. Sandy River Effluent Pump Station Forcemain and Outfall Draft, May 2024

Waterdude Solutions, 2022. Wastewater Treatment Facilities - Spare Parts and Repair, Replace, Refurbishment Prioritization Report. August.

EPA, 2024a. Final PFAS National Primary Drinking Water Regulation.

EPA 2024b. Interim Guidance on the Destruction and Disposal of Perfluoroalkyl and Polyfluoroalkyl Substances and Materials Containing Perfluoroalkyl and Polyfluoroalkyl Substances— Version 2, EPA. 8 April 2024.

EPA 2024c. Joint Principles for Preventing and Managing PFAS in Biosolids.

Letowsky, Karen. “Biosolids, PFAS and Oregon Agriculture.” *Oregon Environmental Council*, 22 February 2024.

Bamdad, H.; Papari, S.; Moreside, E.; Berruti, F. High-Temperature Pyrolysis for Elimination of Per- and Polyfluoroalkyl Substances (PFAS) from Biosolids. *Processes* 2022, *10*, 2187. https://doi.org/10.3390/pr10112187

City of Sandy. 2015A. Sandy Market Analysis Update. Accessed 5/3/2018 via internet at https://evogov.s3.amazonaws.com/media/88/media/22983.pdf

City of Sandy. 2018. Biosolids Management Plan.

U.S. Census Bureau QuickFacts: Sandy city, Oregon. 2019. https://www.census.gov/quickfacts/fact/table/sandycityoregon/HSD310217#HSD31021

Stantec, January 2026, Sandy to Gresham Wastewater Conveyance Conceptual Design Report.

Appendix A

Ongoing Wastewater System Project Updates

Appendix A.1

Sandy River Effluent Pump Station Draft Conceptual Design Report,
Stantec, May 3, 2024

APPENDIX A.1

Sandy River Effluent Pump Station

Draft Conceptual Design Report

Reference: Sandy Clean Waters Program

Prepared for:
City of Sandy
Jenny Coker, PE – Public Works Director

Prepared by:
Adam Odell

Reviewed by:
Dick Talley
Heather Stephens

Submitted:

May 3, 2024

Revisions

Revision History

Date	Version	Description	Author(s)	Reviewer(s)	Date of Reviewer(s)
5/3/2024	1.0	Draft Report	Adam Odell	Heather Stephens Dick Talley	April 29. 2024

Contents

List of Tables

List of Figures

Appendices

List of Abbreviations and Acronyms

A	amps
CM&I	Construction Management and Inspection
ft	feet
ft/s	feet per second
I/I	Inflow and Infiltration
ESDC	Engineering Services During Construction
mgd	million gallons per day
OPCC	Opinion of Probable Construction Cost
PHF	Peak Hour Flow
psi	pounds per square inch
SCWP	Sandy Clean Waters Program
SUP	Sandy Utilities Program
TDH	Total Dynamic Head
V	volts
WWTP	Wastewater Treatment Plant

1.0 Introduction and Background

The City of Sandy (City) currently discharges wastewater effluent to Tickle Creek in the winter (wet weather). and provides filtered water to a local nursery for beneficial reuse in the summer (dry weather). These means of effluent discharge and reuse are constrained by the Three Basin Rule prohibiting increases in mass load discharge to Tickle Creek, declining flows in Tickle Creek, and limited demand for effluent during the spring and fall shoulder seasons. To address these challenges, the City's recent Wastewater System Facilities Plan (Murraysmith, 2019) determined that a new outfall to the Sandy River is needed to provide a reliable long-term discharge solution. A subsequent Detailed Discharge Alternatives Evaluation Report (Murraysmith, 2021) evaluated options for locating a new outfall to the Sandy River and determined that the Ten Eyck Road and Revenue Bridge site has the most favorable hydrologic and geomorphologic conditions and limited fisheries impacts compared with other potential sites.

The recommended approach in the 2019 Wastewater System Facilities Plan was for the City to construct a satellite wastewater treatment plant and convey flow from this plant to the new Sandy River outfall. This recommendation was deemed unaffordable, and the City has elected to maintain treatment at the existing wastewater treatment plant (WWTP). A Facility Plan Amendment is being prepared to document new flow projections reflecting the reduction in inflow and infiltration (I/I) achieved through recent pipeline rehabilitation efforts, and to evaluate alternatives for providing improvements required to maintain treatment at the existing WWTP. This Conceptual Design Report documents the effluent pumping requirements to convey treated effluent from the existing WWTP site to the proposed Ten Eyck Road discharge location.

The driving criteria for the new effluent pipeline and outfall is the peak hour flow (PHF) projected to occur during a 1 in 5 year winter storm. The 2040 PHF was projected to be 14.3 million gallons per day (mgd) according to the 2019 Facility Plan, however the City has undergone an aggressive program to reduce I/I and has reduced overall flowrates to the WWTP. The City's collection system model was recently calibrated to reflect the observed reduction in I/I, resulting in a year 2040 peak hour flow has been reduced to 12.2 mgd.

The purpose of this memorandum is to identify a new pipeline alignment between the existing WWTP and the proposed discharge location, provide a conceptual design of this new Sandy River Effluent Pump Station, determine the optimum location at the WWTP, and present an Opinion of Construction Cost (OPCC).

2.0 System Curve Development

For development of the system curve, the key features are the length, size, and discharge elevation of the force main. For planning purposes, a new force main was conceptualized and a proposed alignment is provided in Figure 1 and Figure 2. A profile is provided in Figure 3. This alignment combines a new route from the existing WWTP with a proposed alignment from the proposed satellite treatment facility to the Ten Eyck Road at Revenue Bridge site outfall site. This site was identified as the preferred outfall location in the Detailed Discharge Alternatives Evaluation Report.

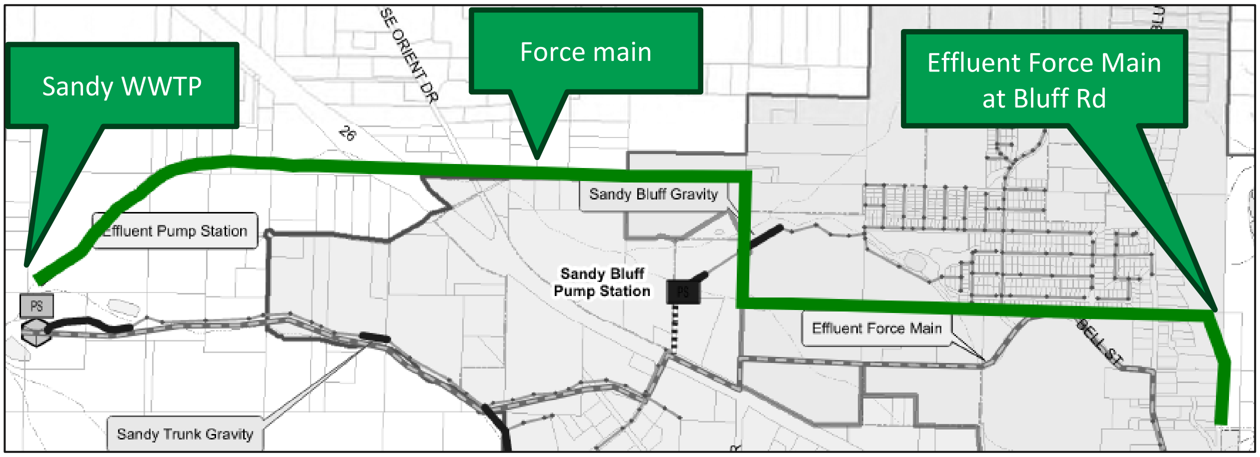


Figure 1 – Planning Level Force Main Alignment to Bluff Rd.

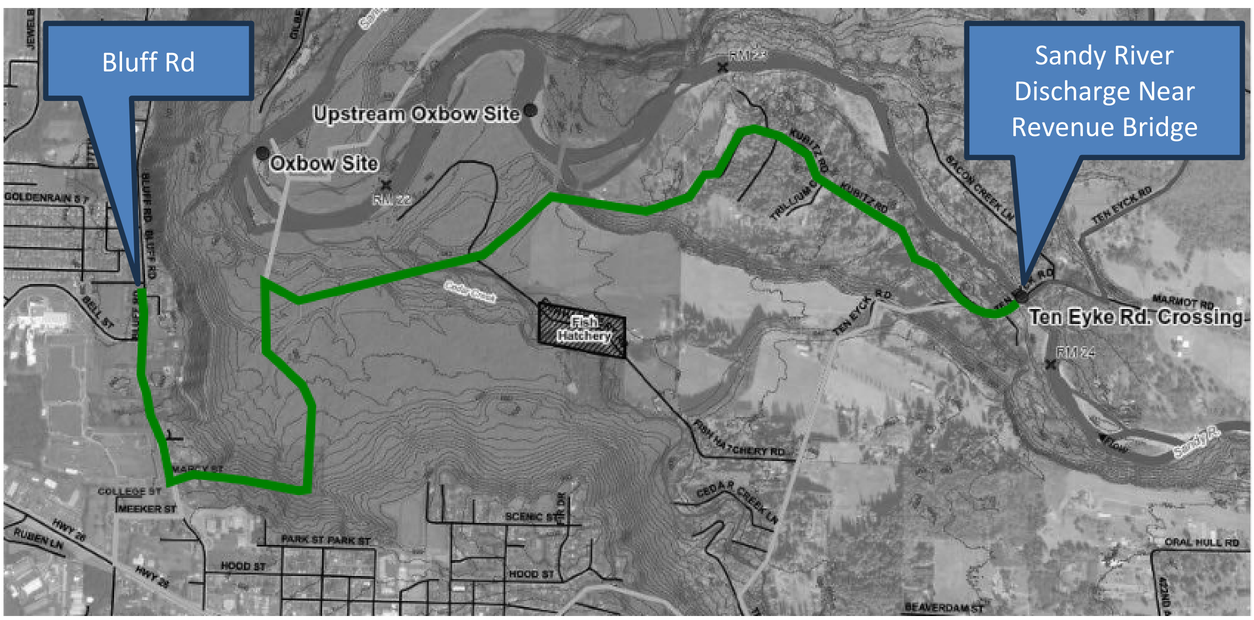


Figure 2 – Outfall Pipeline from Bluff Rd. to Discharge Near the Revenue Bridge

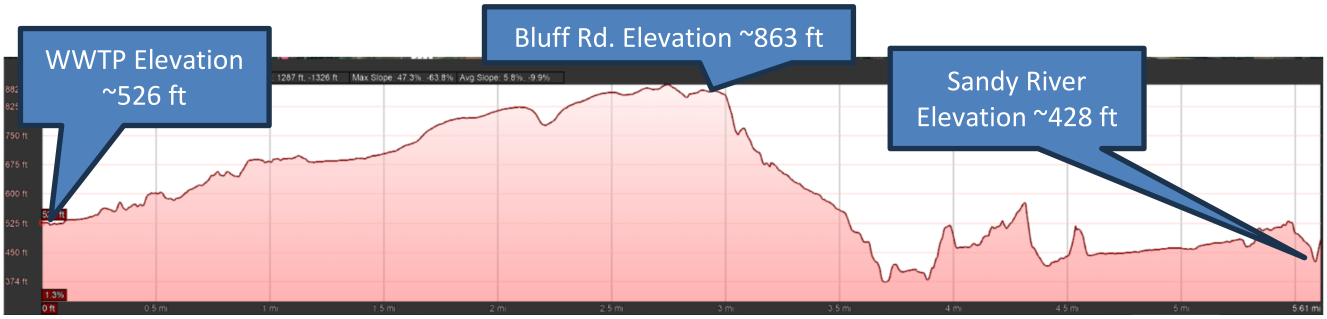


Figure 3 – Outfall Profile from the WWTP to Revenue Bridge

It is anticipated that the pumped flow from the WWTP will be a pressure main to Bluff Road. From Bluff Road to the outfall location near the Revenue Bridge, the effluent line is expected to be a gravity main. Therefore, the system curve assumed pumped or pressure flow only to Bluff Rd.

To determine force main diameter, Stantec evaluated systems curves for both a 24" and 30" diameter force main. Plotted system curves are shown in Figure 4. Because the effluent force main is a significant system asset that can't be easily expanded, the system curve was evaluated at the proposed 2040 peak flow of 12.2 mgd and a potential future flow of 16.1 mgd based on a nominal two percent annual increase in flow for the 20 years following the Facility Plan planning horizon.

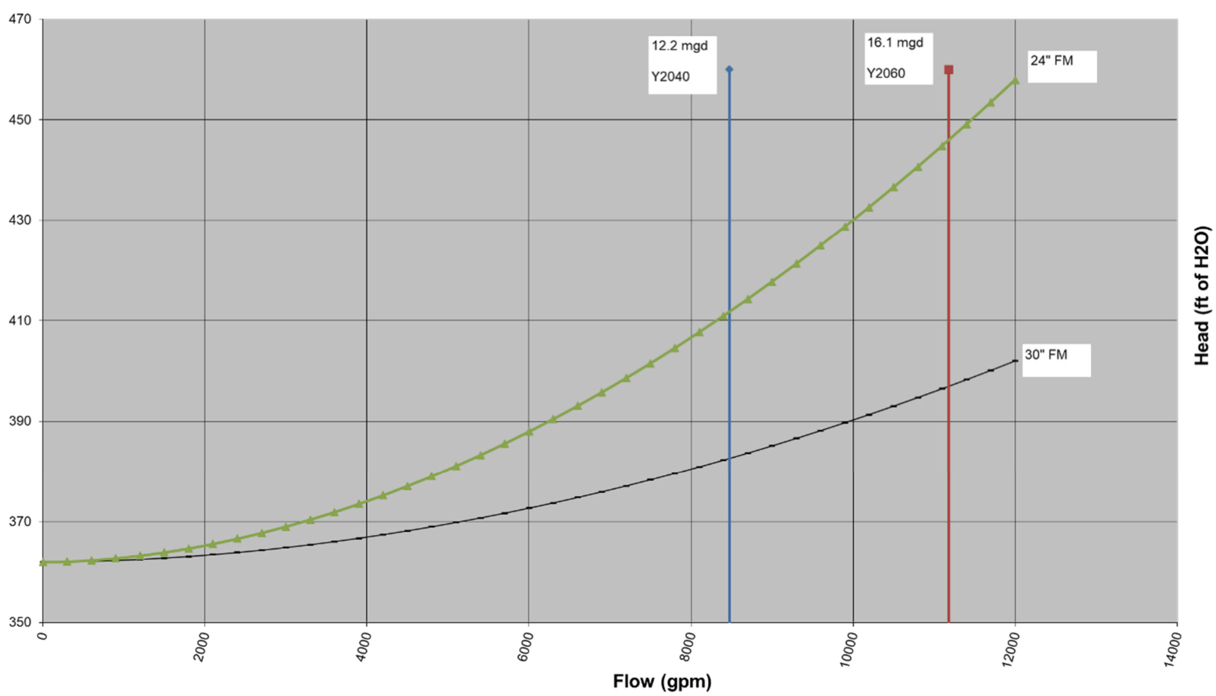


Figure 4 – Comparison of 24" FM and 30" FM System Curves

This evaluation shows that the velocity the 24-inch force main will reach 8.0 ft/s within approximately 20 years following the 2040 planning horizon, which exponentially increases friction loss, pipeline pressure, and will require excessive pumping energy. Also, because the pump station and force main is not expected to be constructed until approximately 2030, the peak velocity of 8 ft/s would be reached within 10 years of startup. By increasing the 24-inch force main to 30-inch, an 8.0 ft/s velocity would not be reached until 2083 resulting in a nominal 53-year design life or planning horizon. This reduction in headloss from the larger force main will produce energy savings over the life of the asset, as well as reduce the total installed horsepower. For planning purposes, the force main is assumed to have a 30-inch diameter.

3.0 Pump Configuration and Arrangement

The Sandy River Effluent Pump Station is sized to convey flow ranging the projected peak day flow of 12.2 mgd to the anticipated minimum flow at startup conditions of 1 mgd. The pump station configuration that best meets this criteria is a 5-pump arrangement with two small pumps and three large pumps. This configuration provides redundant capacity for the minimum startup flow and firm capacity to meet the peak pumping requirement. When minimum flows increase to 2 mgd, the smaller pumps can be replaced with larger pumps to increase the firm pumping capacity and provide service beyond 2040. The proposed pumping arrangements are show in Table 1.

Table 1: Sandy River Effluent Pump Station Pump Arrangement

	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Firm	Total
	Year 2040						
Capacity, mgd	4.1	4.1	4.1	2.0	2.0	12.2	16.3
Capacity, gpm	2847	2847	2847	1389	1389		
	Year 2060						
Capacity, mgd	4.1	4.1	4.1	4.1	4.1	16.4	20.5
Capacity, gpm	2847	2847	2847	2847	2847		

The planning level pump duty point should be the year 2060 total dynamic of 396 ft of head (171 psi) at 2847 gpm. Duty points will be further evaluated following finalization of the force main alignment and detailed design of the pump station.

The Total Dynamic Head (TDH) and flowrate in years 2040 and 2060 both result in the same motor selection of 400 hp for the larger pumps, with total installed horsepower of 200 hp. The smaller pumps in the initial pump station construction require 200 hp motors for a total installed horsepower of 1600. To achieve the desire capacity in year 2060, replacement of pumps 4 & 5 matching the duty points of pumps 1- 3 is all that is required.

4.0 Pump Station Location and Layout

A new pump station needs to receive flow from both the conventional treatment process and the new (future) membrane treatment process, should be interconnected to the existing Effluent (Irrigation) Pump Station, and ideally share a common wetwell.

The existing Irrigation Pump Station was constructed in 1998 or 1999 during a large wastewater treatment plant upgrade impacting a large portion of the treatment process. The civil site plan from the original construction drawings note a "future" disinfection basin (with pumping) just south of the existing structures (shown in Figure 5). After review of the site plan, Stantec has determined that this location still makes sense to locate a new pump station structure.

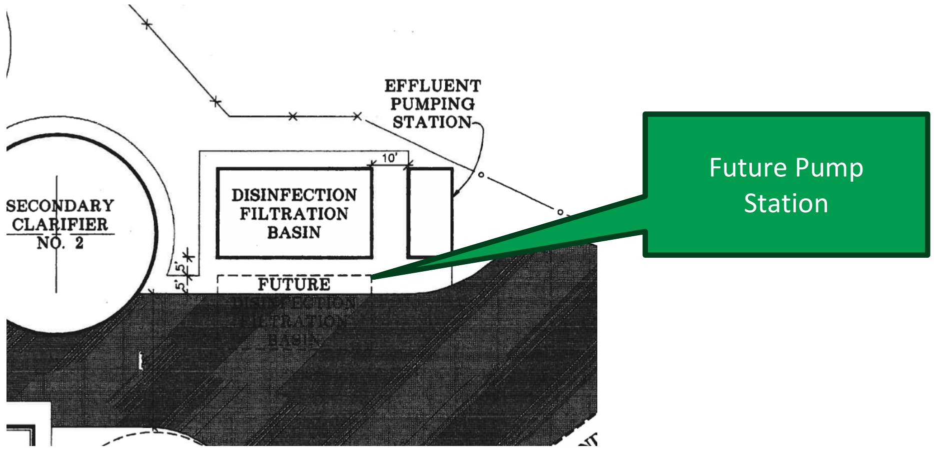


Figure 5 – Excerpt from the 1998 Asbuilt. Future and Existing Irrigation (Effluent) Pump Station

4.1 Pump Station layout

The new pump station can be placed common wall to the existing pump station as was anticipated in 1989. A conceptual pump station layout is shown in Figure 6. This pump station configuration allows the City to continue to flow by gravity or pump to the Tickle Creek outfall, pump reuse water to the nursery, or pump effluent to the new Sandy River outfall. Features of the Sandy River Pump Station include:

- A 21-ft x 26-ft wet well. The depth can be the same or shallower as the existing pump station
- An intertie between the existing metering chamber and the newly installed pumps
- The ability to access and maintain existing UV disinfection equipment
- A buried metering vault
- Expansion or replacement of the existing canopy to cover the new pump station

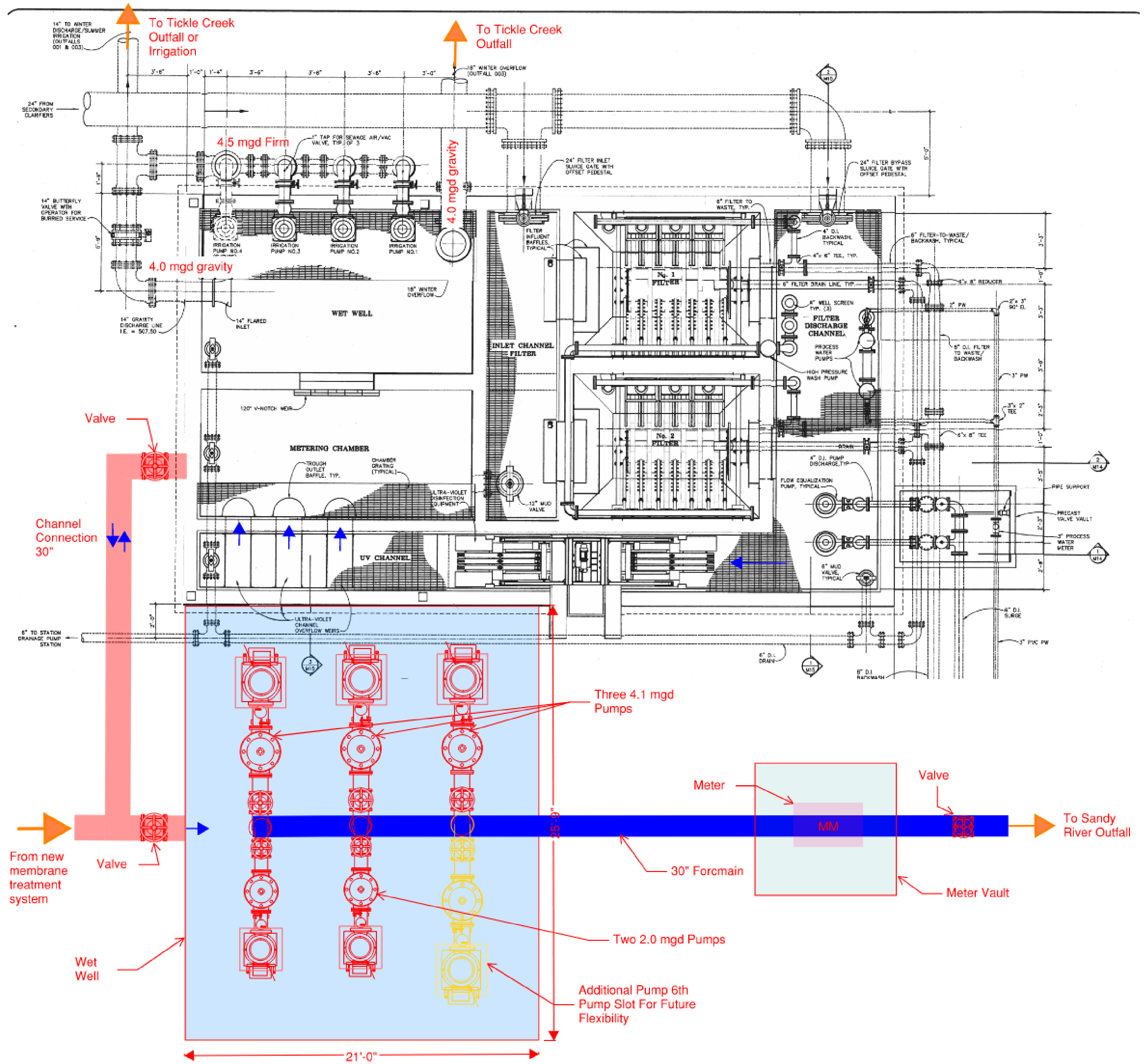


Figure 6 – Pump Station Layout

Figure 7 shows the anticipated site plan for the new pump station and a companion electrical building. The electrical building is shown east of the existing electrical building, in a location that reduces impact and access to both the new pump station, the existing pumps and disinfection equipment. The new Electrical Building is expected to be a 24-ft by 15-ft structure, fully enclosed, and sized to accommodate the Year 2060 power demand which generally includes a 2500A Bus and 480v service equipment. The interior layout is shown in Figure 8.

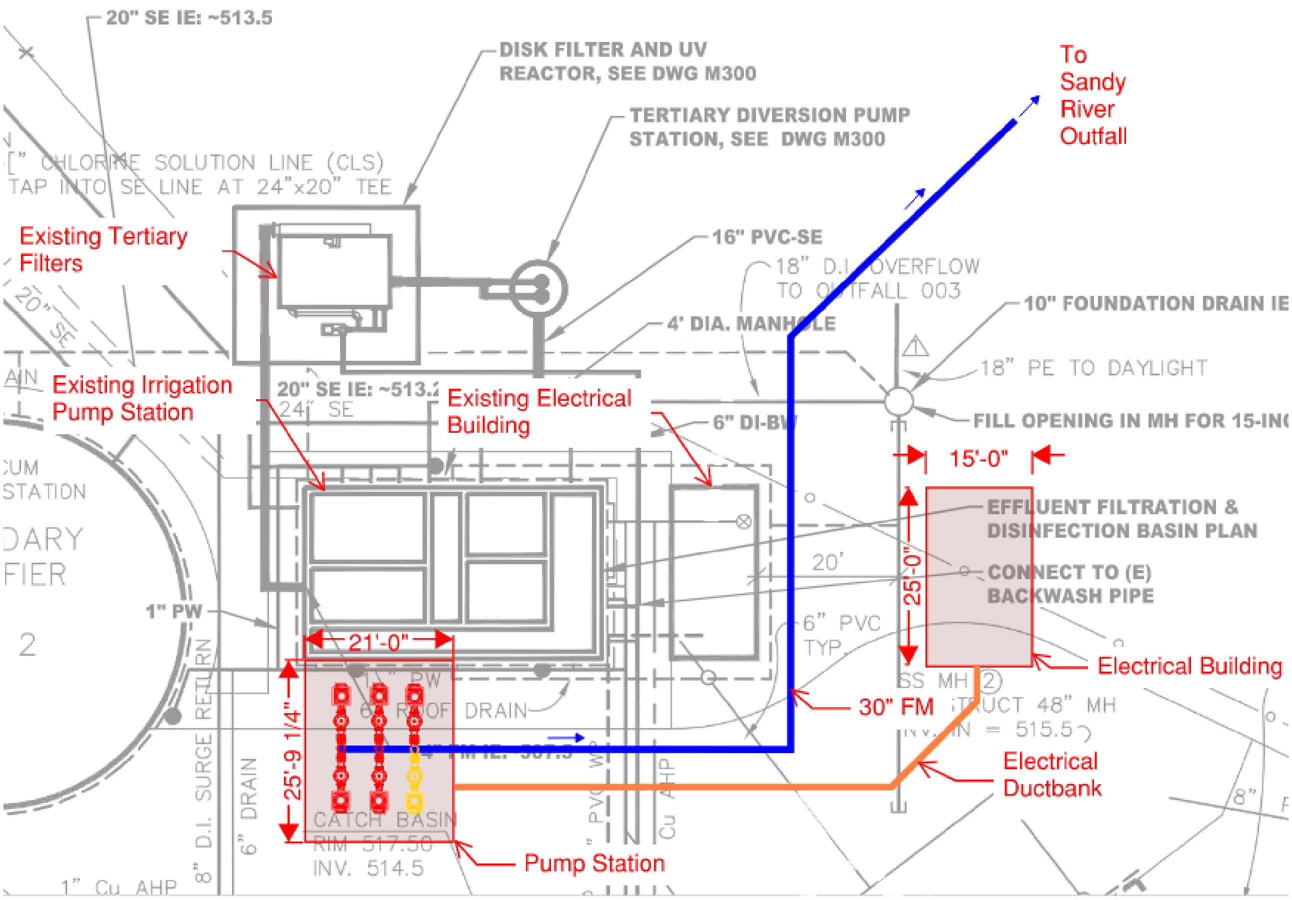


Figure 7 Civil Site Plan

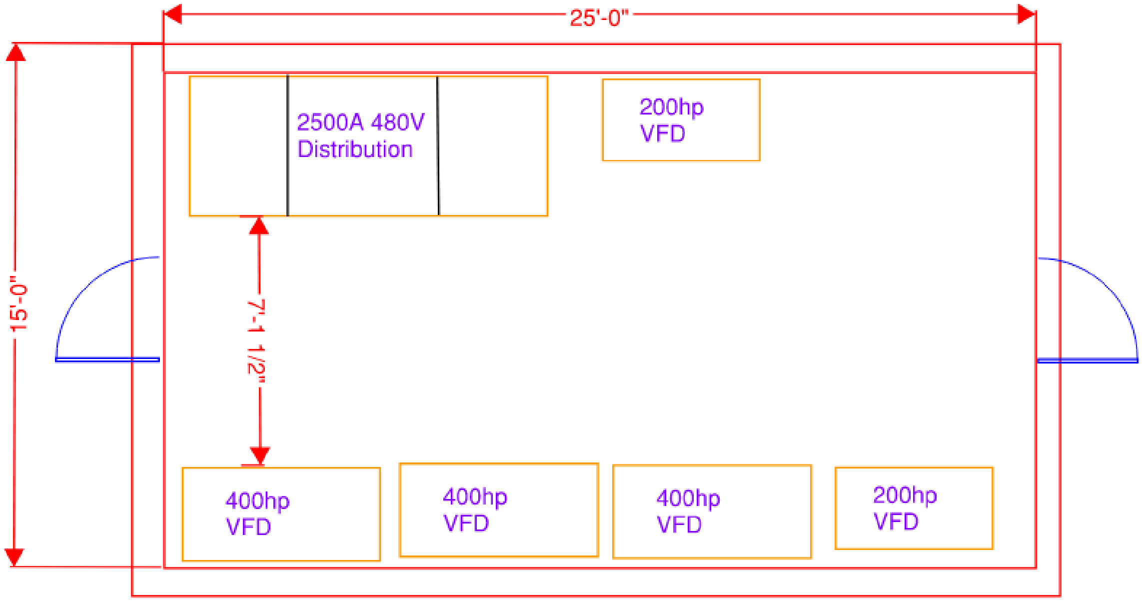


Figure 8 – Electrical Building Floor Plan

5.0 Opinion of Probable Construction Cost

Table 2 presents total project costs for the pump station and effluent pipeline. Costs include a Class 5 Opinion of Probable Construction Cost (OPCC) as well as professional services associated with design and construction. Class 5 estimates are developed based on concept-level plans and have an expected level of accuracy of -50% to +100%. Costs for the effluent pump station, electrical building, and effluent pipeline are based on pump quotations from Floway and recent similar projects. Cost estimates for the effluent force main and outfall will be updated based on final route selection.

Table 2: Estimate of Probable Construction Cost

Project Element	Cost ($Millions, 2024 dollars)
Sandy River Pump Station	$7.2
Electrical Building	$3.6
Effluent Force Main and Pipeline	$38.6
Total	**$49.4**

6.0 References

Murraysmith, 2019. *City of Sandy Wastewater System Facilities Plan*

Murraysmith, 2021. *City of Sandy Detailed Discharge Evaluation Final Report*

Appendix A.2

Technical Memorandum - 2024 Wastewater Collection System Update,
Stantec, May 3, 2024

APPENDIX A.2

TECHNICAL MEMO

Friday, May 3, 2024

FROM:	Heather Stephens - Stantec
TO:	Robert Peacock – Kennedy/Jenks
CC:	Jennifer Coker – City of Sandy, Rob Lee – Leeway Engineering Solutions
RE:	2024 Wastewater Collection System Update

1.0 Overview

The City of Sandy Wastewater System Facilities Plan (Murraysmith, October 2019) [2019 Plan] identified improvements to the collection system to provide capacity required to serve projected growth under the recommended 2019 Plan. This 2019 Plan included a combination of investigations and improvements to reduce inflow and infiltration (I&I) to the system and capacity increases to gravity interceptors, pump stations, and force mains to convey the anticipated flow to the City's wastewater treatment facility.

Since adoption of the 2019 Plan, City has undertaken significant efforts to reduce I&I in the system and has initiated capacity improvements to address needs identified in the Plan. The City has also implemented a Capacity, Management, Operation and Maintenance (CMOM) Program as a comprehensive strategy for managing the wastewater collection system, with efforts documented in the 2023 CMOM Implementation Report (Leeway Engineering Solutions, 2024) and companion 2024 CMOM Strategic Plan (Leeway Engineering Solutions, 2024). These documents define objectives and activities associated with the CMOM Program along with performance goals and schedules to meet those goals.

The purpose of this memorandum is to document improvements that have been completed since the 2019 Plan, identify ongoing and upcoming activities, and provide an updated Capital Improvements Program (CIP) for collection system activities to be included in the City's 2024 Wastewater Facilities Plan Amendment.

2.0 Collection System Investigation and Rehabilitation

Since adoption of the 2019 Plan, the City has completed system-wide smoke testing of the collection system, developed and begun implementation of a condition inspection program using closed circuit television (CCTV) inspection of sewer lines to inspect the entirety of the City's system, and implemented rehabilitation of gravity mainlines and private laterals in 4 sewer basins. Smoke testing of the entire system was completed in 2023, and the City has addressed all illicit stormwater connections identified. Additional improvements related to I&I reduction are described below.

2.1 Basins 2 and 8 Rehabilitation

The 2019 Plan identified Basins 2 and 8 as the highest priority for rehabilitation. Deficiencies in these basins were addressed through the 2021 Basins 2 and 8 Rehabilitation Project (Basins 2 and 8 Project), which rehabilitated non-plastic gravity mainlines smaller than 15 inches in diameter and private laterals. Basin 1 assets were combined into Basin 2. This project included rehabilitation using cured-in-place-pipe (CIPP), replacement using pipe bursting, and a small amount of open trench pipe replacement. In total, the project rehabilitated 21,350 linear feet (LF) of mainline pipe and 29,240 of lateral sewer pipe and provided grouting for 178 manholes. The project, shown in Figure 1, was completed in July 2022.

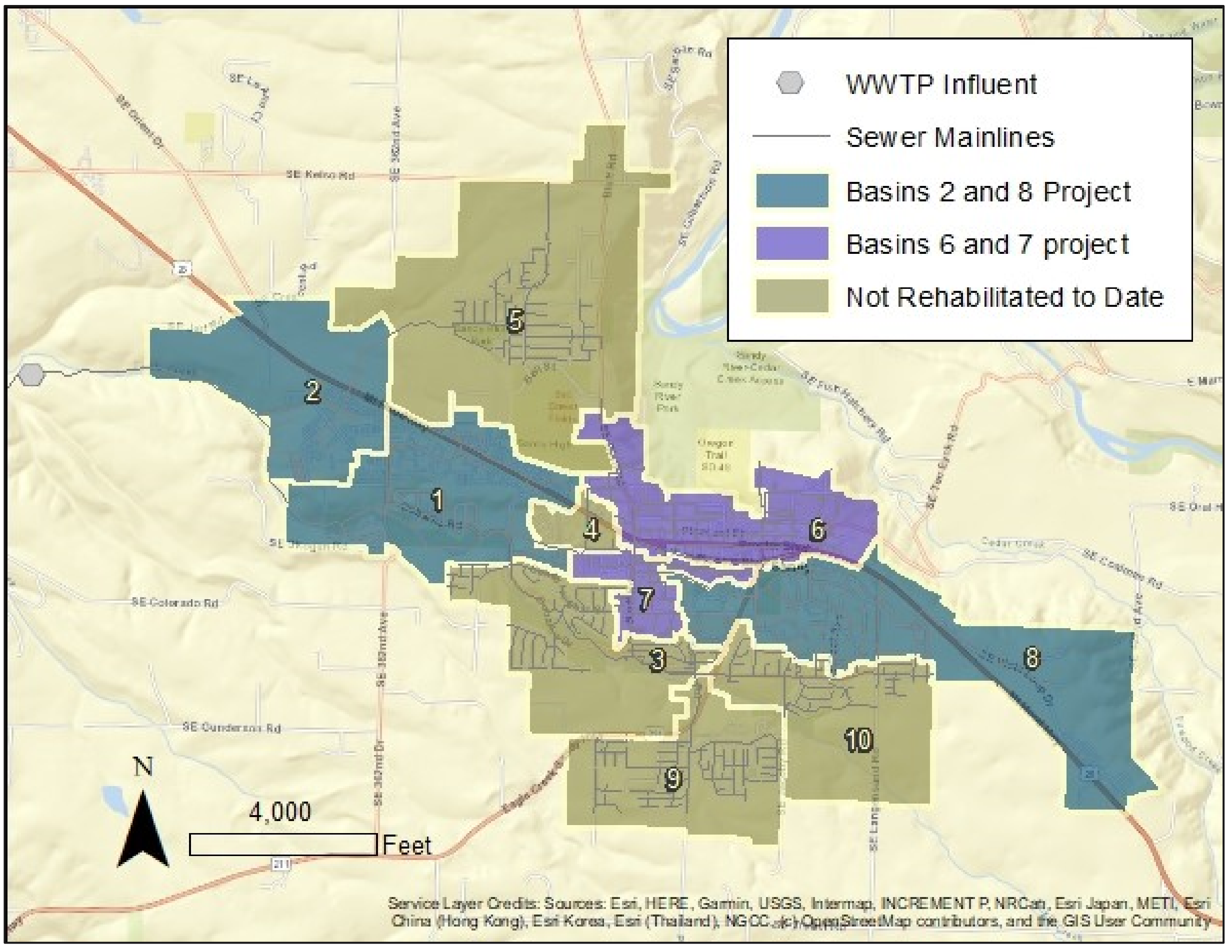


Figure 1: Collection System Rehabilitation (Source: City of Sandy Consent Decree Semi-Annual Report, January 2024)

2.2 Basins 6 and 7 Rehabilitation

The 2022 Basins 7 and 7 Rehabilitation Project (Basins 6 & 7 Project) was initiated in August 2022 and completed in August 2023. Though the project was not recommended in the CIP of the 2019 Plan, the City determined that aggressive I&I reduction was needed to maintain permit compliance and initiated this project to rehabilitate areas identified as high priority in the 2019 Plan. As with the Basins 2 and 8 project, work included rehabilitating non-plastic gravity mainline pipe smaller than 15 inches in diameter as well as public and private laterals. The project rehabilitated 24,959 LF of mainline pipe and 11,270 LF of sewer laterals using CIPP, pipe bursting, and open trench pipe replacement.

2.3 Manhole Grouting

The City has implemented a citywide Manhole Grouting program to provide grouting of high priority manholes throughout the service area. The manholes in Basins 6 and 7 were originally included in the Basins 6 and 7 rehabilitation project but work was transferred to the City's citywide Manhole Grouting Contract currently. Manhole grouting is currently underway for Basins 5, 6, and 7, and is anticipated to be completed in 2025.

3.0 Northside (Sandy Bluff) Pump Station Upgrades

The Northside Pump Station (identified in the 2019 Plan as the Sandy Bluff Pump Station) was identified as capacity deficient under conditions associated with a 5-year storm event. Although the pipes in the basin are some of the newest in the system (constructed with the past 30 years), groundwater infiltration appears to be occurring upstream of the Northside Pump Station. The ongoing Manhole Grouting Contract includes grouting of the vast majority of manholes within the Northside Pump Station service area, which is anticipated to reduce peak I/I received at the pump station.

Recent evaluation of the Northside Pump Station indicates that a firm pump station capacity of 1,180 gpm (1.7 million gallons per day [mgd]) is required to serve existing needs and allow for approved growth in the Agency Conditional Approval of City's Proposed Capacity Assurance Program Limit (April 11, 2024). A Conceptual Design Report (Stantec, 2024) evaluated alternatives for expanding the Northside Pump Station and recommended increasing the pump station capacity by removing and replacing the existing 20-horsepower (hp) pumps with new 60-hp pumps providing 1,200 gallons per minute (gpm) of capacity per pump. These pumps can be installed in the existing 84-inch diameter pump station. In addition to replacing the existing pumps, the pump station upgrade will include:

- Providing a new 200-amp electrical service
- Providing a new 100-kilowatt (kw) standby generator to replace the existing 35-kw standby generator
- Installing an ultrasonic flow meter to monitor flow trends and determine the value in adding a variable frequency drive (VFD) to the new pumps

Following completion of the recommended improvements and manhole grouting, the need for further expansion of the Northside Pump Station or the downstream force main and gravity interceptor will be reevaluated.

4.0 Upcoming Projects

Planned projects for I&I abatement and capacity management have been refined based on the results of recent sewer system rehabilitation work. These projects include flow monitoring and recalibration of the collection system model to reflect ongoing rehabilitation work and better predict the need for and timing of capacity improvements, continued condition assessment and rehabilitation, and pump station and force main capacity evaluations.

4.1 Ongoing CCTV Assessment and Defect Repair

The City will continue to conduct CCTV inspection and assessment of the remaining collection system, with a focus on Basins 3, 4, 5, 9, and 10. Significant defects (those identified as Grade 4 or Grade 5 severity) will be repaired.

The CCTV work is expected to occur over 2024-2025 with a budget of $200,000 per year. Defect repair is expected to occur over 2024-2028 with a budget of $300,000 per year.

4.2 Basins 3, 9, 10 Rehabilitation

It is recommended that the next sewer rehabilitation project focus on Basins 3, 9, and 10. These basins flow through a trunk sewer from the southeast that is projected to be under capacity at some point in the future due to increased flows from development. In order to avoid potential upsizing of the trunk, reduce the potential for overflows, and to continue to reduce I/I, these basins have been prioritized over holistic rehabilitation work in Basin 4 and 5. . Based on the type and age of pipes in these basins, it is anticipated that the rehabilitation project will address manholes and approximately 20% of the pipes in the basins (and associated laterals). The complete scope of the project will be determined based on the results of CCTV inspections described above, however a budget of $10 million is estimated over the years 2026-2030.

4.3 Flow Monitoring and Model Recalibration

The City's InfoWorks ICM hydrodynamic model was updated and calibrated in 2023 (Leeway Engineering Solutions, 2023). The wet weather flow calibration used rainfall and flow monitoring data collected from October 2022 through April 2023, and therefore did not reflect completion of the Basins 6 and 7 rehabilitation (completed in summer 2023) or the ongoing manhole grouting project. It is recommended that additional flow monitoring data be collected to determine the impact of these recent improvements, and that the model calibration be updated so the projected peak flow characteristics (volume and intensity) reflect the current system performance. This recalibrated model will be used to revisit the need for and/or timing of pump station, force main, and gravity system improvements identified in the 2019 Plan.

4.4 Pump Station Capacity Evaluation

The 2019 Plan identified the need for capacity upgrades at the Jacoby/Timberline Trails, Marcy Street, Meinig Avenue, and Snowberry pump stations. The Plan also identified the need for downstream force main and/or gravity improvements associated with the pump station capacity upgrades, including downstream of the Northside (Sandy Bluff) pump station to serve anticipated growth through 2040.

These conveyance system assets are located in Basin 6 (Marcy Street and Meinig Avenue pump stations), Basin 9 (Snowberry pump station) and Basin 10 (Jacoby/Timberline Trails pump station), all of which will be impacted by recently completed, ongoing, and planned pipeline rehabilitation and manhole grouting.

Therefore, it is recommended that these pump station capacities be revisited as part of the next model recalibration effort to confirm the need for and timing of capacity improvements identified in the 2019 Plan.

5.0 Updated Capital Improvement Plan

Improvements identified in the 2019 Plan have been completed or are being addressed through ongoing work described in the previous section. Table 1 below shows the status of projects in the 2019 Plan and new projects identified based on recent collection system improvements.

Table 1: Status of 2019 Facility Plan Recommended Collection System Improvements

Designation	Project Name	Project Description	Status	Ongoing Project
Capacity	Sandy Bluff	Additional pumping capacity, mechanical and electrical upgrades	Ongoing	Northside PS Upgrades; PS Capacity Evaluation
Capacity	Jacoby/ Timberline Trails	Additional pumping capacity	Ongoing	PS Capacity Evaluation
Capacity	Marcy Street	Additional pumping capacity, mechanical and electrical upgrades	Ongoing	PS Capacity Evaluation
Capacity	Meinig Avenue	Additional pumping capacity, mechanical and electrical upgrades	Ongoing	PS Capacity Evaluation
Capacity	Snowberry Pump Station	Additional pumping capacity	Ongoing	PS Capacity Evaluation
Capacity	Sandy Bluff	FM Upgrades	Ongoing	PS Capacity Evaluation
Capacity	Jacoby/ Timberline Trails	FM Upgrades	Ongoing	PS Capacity Evaluation
Capacity	Sandy Heights – Dubarko Road	Gravity upgrade	Monitor	Evaluate need based on Model Recalibration
Capacity	Dubarko Road at Tupper Rd	Gravity upgrade	Monitor	Evaluate need based on Model Recalibration
RDII	Sandy Bluff	Gravity upgrade	Monitor	Evaluate need based on Model Recalibration
RDII	Site-specific	Flow monitoring	Ongoing	Flow Monitoring and Model Recalibration
RDII	33% of System	Condition Assessment (CCTV)	Ongoing	CCTV and Grade 4/5 Defects
RDII	System-wide	Smoke testing	Completed	N/A
RDII	Basin 2	Rehabilitation (piping and laterals)	Completed	N/A
RDII	Basin 8	Rehabilitation (piping and laterals)	Completed	N/A
RDII	Basins 5, 6, 7, 10	Rehabilitation (piping and laterals)	Basins 6 & 7 Completed	Basin 5 MHs as part of Manhole Grouting Contract
RDII	System-wide	Stormwater Disconnects	Completed	N/A
RDII	System-wide	$200k/yr ongoing RDII	Ongoing	CCTV and Grade 4/5 Defects
RDII	System-wide	Collection system repair and replacement program	Ongoing	CCTV and Grade 4/5 Defects

Designation	Project Name	Project Description	Status	Ongoing Project
Capacity (New)	Flow Monitoring and Model Recalibration	Update model calibration based on current flow monitoring data Evaluate the need for capacity upgrades at the Jacoby/ Timberline Trails, Marcy Street, Meinig Avenue, and Snowberry pump stations	New	Flow Monitoring and Model Recalibration Pump Station Capacity Evaluation
RDII (New)	Manhole Grouting	Focused grouting of manholes in Basins 5, 6, and 7 and throughout the City as identified by City staff	Ongoing	Manhole Grouting
RDII (New)	Basins 3, 9, 10	Rehabilitation (non-plastic pipe, laterals, manholes)	New	Basins 3, 9, 10 Rehabilitation

Ongoing collection system project descriptions, timing, and estimated costs are summarized in Table 2.

Table 2: Collection System Recommended Projects

Project Name	Project Description	CIP Cost Estimate (2024 dollars)	Year(s) of Completion
Northside Pump Station Upgrades	Upgrade pump station to provide firm pumping capacity of 1,200 gpm	$450,000	2024
Pump Station Capacity Evaluation	Revisit the need for capacity upgrades at the Jacoby/Timberline Trails, Marcy Street, Meinig Avenue, and Snowberry pump stations	$150,000	2025
Flow Monitoring and Model Recalibration	Collect additional flow monitoring to collect data reflecting recent rehabilitation efforts, and recalibrate model reflecting current conditions	$200,000	2025
CCTV Inspection	Complete CCTV inspection of remaining collection system, and repair Grade 4 and Grade 5 defects	$200,000 per year	2024-2025
Citywide Manhole Grouting	Focused grouting of manholes in Basins 5, 6, and 7 and throughout the City as identified by City staff	$400,000	2023-2025
Grade 4/5 Defect Repairs	Repair Grade 4 and Grade 5 defects identified through CCTV inspection	$300,000 per year	2024-2028
Basins 3, 9, 10 Rehabilitation	Provide design and construction of comprehensive sewer rehabilitation in Basins 3, 9, and 10 based on results of CCTV inspection	$10,000,000	2026-2030
Pump Station Condition and Capacity Upgrades	Provide design and construction of pump station capacity and condition upgrades following completion of pump station capacity assessment	$2,000,000	2026-2030

6.0 References

City of Sandy, 2024. *2023 Sandy Collections System Capacity, Management, Operations and Maintenance Implementation Report*

City of Sandy, 2024. *2024 Sandy CMOM Strategic Plan*

Leeway Engineering Solutions, 2023. *Updated Collection System Hydrodynamic Model*

Murraysmith, 2019. *City of Sandy Wastewater System Facilities Plan*

Murraysmith, 2021. *City of Sandy Detailed Discharge Evaluation Final Report*

Appendix A.3

Technical Memorandum – 2024 Sandy WWTP Near-Term Upgrades,
Stantec, May 22, 2024

APPENDIX A.3

TECHNICAL MEMORANDUM

Sandy WWTP Near-Term Upgrades

May 22, 2024

Revisions

Revision History

Date	Version	Description	Author(s)	Reviewer(s)	Date of Reviewer(s)
5/17/2024	1.0	Draft Memo	Heather Stephens	Dick Talley, Adam Odell	5/22/2024

Contents

List of Tables

List of Abbreviations and Acronyms

EPS	Effluent Pump Station
gpm	gallons per minute
hp	horsepower
MCC	Motor Control Center
MG	Million Gallons
mgd	million gallons per day
MLR	Mixed Liquor Recycle
SCWP	Sandy Clean Waters Program
SRT	Solids Retention Time
TDH	Total Dynamic Head
TM	Technical Memorandum
UV	Ultraviolet
WWTP	Wastewater Treatment Plant

1.0 Introduction

The purpose of this technical memorandum (TM) is to describe near-term improvements underway at the Sandy Wastewater Treatment Plant (WWTP). These improvements are necessary to provide firm capacity, maintain reliable equipment performance, and support stable process operation until recommendations in the Facility Plan Amendment can be completed. These improvements are intended to support full approval for connecting the 760 equivalent residential units (ERUs) identified as the capacity of the existing WWTP in the Draft Capacity Evaluation Report (West Yost, 2023). Near-term projects include:

- Replacement of original ultraviolet (UV) disinfection equipment
- Expansion of the effluent pump station (EPS)
- Process improvements to optimize blower sizing and improve process control

In addition, the Sandy Clean Water Program (SCWP) team is evaluating the potential to raise the walls of the existing storage pond to increase the available storage volume.

2.0 Project Descriptions

2.1 UV Equipment Replacement

The existing WWTP has a single open channel Trojan UV 4000 unit that disinfects tertiary effluent prior to discharge to Tickle Creek during the winter discharge period. A supplemental peak flow cloth disk filter and closed vessel UV unit was added as part of the Wastewater Treatment Plant Condition Assessment Improvements Project, however the original equipment has reached the end of its useful life, and proper operation requires proprietary components that are no longer being manufactured by Trojan Technologies. The City has secured replacement parts to meet maintenance needs for several years, however complete replacement of the UV disinfection unit is required.

The UV Equipment Replacement project will replace the aged UV 4000 unit with newer UV disinfection technology and provide redundancy in the open channel UV treatment system by installing two banks of lamps. The full capacity of the UV disinfection process also includes a recently-installed 3.5 million gallon per day (mgd) medium-pressure closed vessel UV unit that was installed with a disc filter to meet design flow and redundancy requirements.

The UV system is currently under design, with anticipated award of a construction project by the end of 2024.

2.2 Effluent Pump Station Expansion

The EPS conveys treated effluent from the WWTP to Iseli Nursery for beneficial reuse during the summer when discharge to Tickle Creek is prohibited. A recent Draft Capacity Evaluation Report (West Yost, September 2023) determined that the EPS does not provide sufficient firm capacity to convey flow that could be generated during a one-in-ten year summer storm event. Evaluation of the influent flow hydrograph produced during the summer storm event determined that a combination of expanding the pump station to provide a firm capacity of 4.5 mgd and diverting 0.88 million gallons of flow to the equalization basin (using 36% of available capacity) would allow the plant to manage the design summer storm event.

The EPS was constructed in the late 1990s and includes three two-stage enclosed-impeller vertical turbine pumps manufactured by Floway. The pumps are located in a wetwell that is part of the structure containing the open channel UV and cloth disk filtration processes. There is space available in the wetwell structure for installation of a fourth pump.

The design criteria for the original EPS construction lists the pumping capacity as 1300 gallons per minute (gpm) at 125 feet of head with two pumps running. Representatives for the pump manufacturer indicate that the existing pumps can be rebuilt by replacing the pump discharge head to convert from a two-stage to three-stage pump, providing a new line shaft and bearings, replacing the stuffing box and packing, and increasing the motor size to 75 horsepower (hp). The existing motor control center (MCC) appears to have sufficient capacity to handle this load, however metering of the MCC was recommended and was initiated by the City in April 2024. Metering is ongoing through May 2024 to provide load measurements reflecting operation with the UV equipment (providing disinfection for winter flows discharged to Tickle Creek) and effluent pump station operation (providing conveyance of summer flows to Iseli Nursery).

Preliminary design of the EPS improvements is underway, with design completion anticipated in October 2024 and award of a construction contract in December 2024.

2.3 Process Improvement Projects

City and WWTP operations staff have identified a range of repair, rehabilitation and maintenance items that are needed maintain appropriate levels of aeration and mixing, and to improve the level of information available to support sound process control strategies and efficient plant operation. The SCWP team reviewed these improvements and identified those that can be implemented at this time and will serve long-term facility needs. These project elements are summarized in Table 2-1 below. The Program Team is currently evaluating whether these will be delivered as a single project or as several smaller projects.

Table 2-1. Process Improvement Project Elements

System	Need	Action Plan
Aerated Sludge Storage Basin	ASSB Blower 2 has oil leaks and experiences high belt wear, resulting in bi-weekly oil addition and frequent belt replacement.	Replace ASSB Blower 2
Aeration Process Blowers	Blower 4 was not replaced during the recent plant upgrades and has reached the end of its useful life. The blower was rebuilt approximately 5 years ago but has an air/oil seal leak and requires refurbishment or replacement. Blower 4 is needed to meet low process air requirements as the other three blowers do not have sufficient turndown to meet typical aeration demands.	Evaluate minimum aeration needs; refurbish or replace Blower 4
Aeration Mixing	The aeration mixers in Aeration zones 1, 2, 5 and 6 are approaching the end of their useful lives, are energy inefficient, and do not function reliably. Two of the mixers are currently out of service and are being replaced by plant maintenance staff. The process improvements project will replace the two remaining mixers.	Replace mixers
WAS Pumping	The existing waste activated sludge (WAS) pumps are air-operated diaphragm pumps that pump from individual sumps near the center of the aeration basins. One pump was recently replaced, but the second pump has reached the end of its useful life. The existing WAS system lacks flow metering, making it difficult to accurately control solids retention time (SRT).	Replace existing pumps with electric-driven pumps and add flow metering and SCADA programming.

System	Need	Action Plan
Flow Measurement and Monitoring	The effectiveness of the activated sludge process is dependent on the amount of nitrate returned to the anoxic zone through mixed liquor recycle (MLR) pumping. Flow monitoring along with nitrate testing will enable operators to adjust flow to optimize denitrification and alkalinity recovery.	Install two flow meters and provide SCADA programming

The total estimated construction cost of these improvements is $175,000. Including contingency and engineering, the total project cost is estimated to be approximately $360,000.

2.4 Storage Pond Expansion

The existing storage pond provides a critical function in managing peak flow at the WWTP. It is also a useful tool for plant operations to manage flow and loading to the secondary treatment process to maintain optimal process performance and optimize permit compliance during discharge to Tickle Creek. Flow can enter the storage basin through passive diversion upstream of the aeration basin, and equalization (EQ) pumps can also divert filtered effluent to the basin. Two utility pumps are used to drain the basin, directing flow back to the influent control structure or to the secondary effluent pipeline upstream of the tertiary filters. Improvements completed as part of the Wastewater Treatment Plant Condition Assessment Improvements Project added floating aerators and installed motorized valves, motorized weirs and level sensors to increase operational flexibility and support process control.

Maximizing the available capacity of the storage pond gives WWTP operations staff the greatest degree of flexibility to use the pond for both peak flow storage and process control purposes. The existing storage pond provides 2.45 million gallons (MG) of storage, with an invert elevation of 512 and top of wall elevation of 521. An overflow at elevation 520 allows flow to be passively diverted back to the aeration basins.

SCWP team has conducted a preliminary evaluation of the potential to construct a wall at the top of the existing storage pond to increase volume. Based on this preliminary evaluation, it is estimated that the depth of the pond can be increased by 36 inches, resulting in 900,000 gallons of additional storage volume. Additional investigation is underway to confirm the structural improvements needed to implement this approach and document associated mechanical improvements (e.g., extension of the overflow pipe).

Appendix B

Detailed Background of Facility Plan Alternatives Development

Appendix B.1

Sandy Wastewater Collection System Model Predicted flows for 2023 and 2040, Leeway Engineering Solutions, November 17, 2023

APPENDIX B.1

Sandy Wastewater Collection System Model
Predicted flows for 2023 and 2040

To Robert Peacock, PE, Kennedy-Jenks Consultants
From Yarrow Murphy, PE, Leeway Engineering Solutions

November 17, 2023

Tickle Creek Treatment Plant Design Values

Time Frame	2023	2040	2040	Unit
Degradation of Existing Pipes (5% increase in I/I)		Included	None	
Peak hour WWF (January 2009)	9.3	12.2	12.1	MGD
Peak Hour WWF[1] (NRCS Synthetic)	7.7	11.1	11.1	MGD
Max month wet weather (January 2009)	2.0	3.6	3.5	MGD
Average Dry Weather Flow	0.9	2.2	2.2	MGD

Assumptions	Value	Value	Unit
Population annual growth rate	2.80%	2.80%	per year
Residential Population	22,600	22,600	residents
Base wastewater peaking factor for new connections[2]	1.6	1.6	dimensionless
Wastewater demand for new population (gallons per capita per day)	92.6	92.6	gpcpd
Peaking factor for I/I assumed for new pipe to serve new population[2]	1.5	1.5	dimensionless
I/I growth rate for old and new pipes (not rehabbed)	5%	0%	per decade

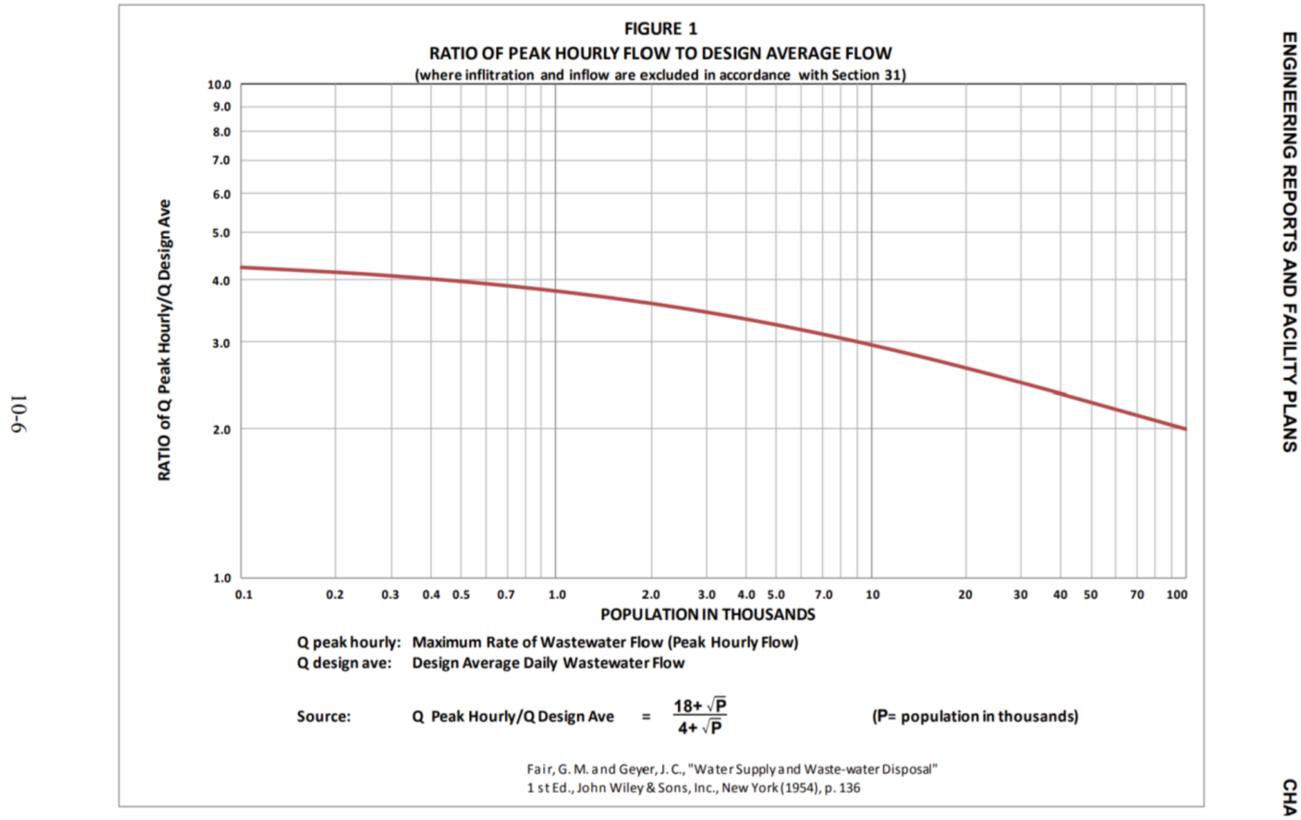
[1] The added I/I caused by pipe degradation is within the rounding error and is therefore negligible.

[2] Per 10 States Standards, population of 20,000 would have a peaking factor less than 3.0 in total. See Figure 1.

Sandy Wastewater Collection System Model

Predicted flows for 2023 and 2040

Figure 1. Reference Figure 1 from Recommended Standards for Wastewater Facilities (10 State Standards) 2014 Editior



Appendix B.2

Peak Storage Analysis for Collection System Storage, Kennedy Jenks, May 2024

APPENDIX B.2

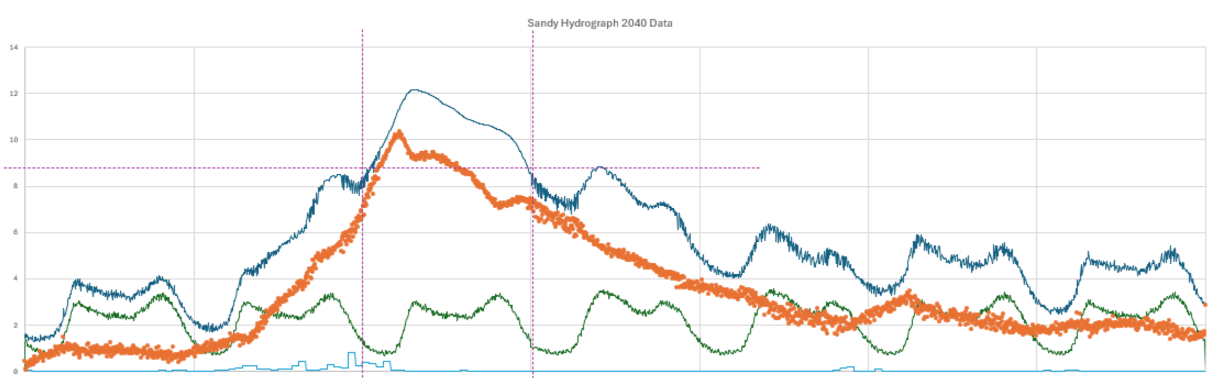
Peak Storage Analysis for Alternative 5 - Collection System Storage

Alternative 5 is a collection system storage concept that aims to divert raw wastewater from the collection system to a storage basin during peak weather events as an alternative to expanding the capacity of the WWTP. After peak conditions subside, stored wastewater will be fed back to the collection system to be treated over several days. In combination with population projection values for 2040, precipitation data, hydrograph models were used to determine the size of the required storage basin.

The projections were prepared following completion of repairs to a portion of the collection system intended to reduce rainfall induces I&I. A flow monitoring program was implemented during the winter of 2022 and 2023 to collect data that allowed calibration of the collection system model developed by Leeway Engineering Solutions (Leeway).

Leeway provided Kennedy Jenks with hydrographs of the 2040 projected influent volume, which were generated by modeling the peak hour wet weather flowrates for a storm that occurred around January 2, 2009, and peak hour wet weather flowrate (NRCS Synthetic) data from a large rainfall event. The 2040 projected volume was scaled according to population projections for the City of Sandy within the service area for the wastewater utility. The January 2009 event was chosen due to wet weather occurring in the days before the large rainfall event, which lasted about 7 hours. Due to prior wet weather, groundwater was high, and the collection system was already seeing I/I influence before the heaviest rain started on January 2nd, 2009.

The January 2009 event is shown on the chart below. The green line indicates predicted dry weather flowrate, the orange line indicates the projected peak flowrate from the January 2, 2009 storm, and the blue line indicates the total projected influent flowrate at the WWTP. The blue line shows a peak flowrate exceeding 12 MGD for approximately 1 hour, and a peak instantaneous flowrate of 12.2 MGD.



Two methods were used to determine the minimum basin size: (1) Leeway engineering's 2040 model for the January 2nd 2009 total flow, and (2) Calculations for a Worst-Case Day Max Day I/I and the 2009 precipitation data for the City of Sandy. The following table summarizes the results of minimum basin size.

Plant Capacity (MGD)	2040 Hydrograph Model (MG)	Worst-Case Max Day I/I (MG)
7	2.03	2.79

The two methods used to determine the required storage volume estimated a required minimum storage volume of 2.8 MG, which would need to then be titrated back to the collection system to be treated over several days. The rate to which the stored wastewater would be fed back to the collection system would need to be determined by the real time system flows from infiltration and direct discharge from system users. At the planning level, we will evaluate a collection system storage tank 3.0 million gallons.

Appendix B.3

Tickle Creek Discharge and Effluent Storage Analysis, Kennedy Jenks, May 2024

APPENDIX B.3

Tickle Creek Discharge Analysis and Effluent Storage Analysis

i. NPDES Permit Limits

This section includes development of treatment criteria to meet permitted mass load limits and effluent storage requirements to meet mass load and dilution limits.

a. Influent Mass Load Projections

Using historical influent BOD and TSS concentrations, corresponding population counts, and average influent flowrate, per capita mass load was calculated for both BOD_5 and TSS. The calculated load factor was then used to determine the expected influent waste loads into the year 2040 (Figure 1).

Population and flowrate future projections were based on the Sandy Wastewater Collection System Model provided to Kennedy Jenks by Leeway Engineering Solutions in the memorandum dated 2 October 2023. Sandy's annual population growth rate is 2.80%, with an expected 2040 residential population of about 22,600 residents. The 2040 Max Month Wet Weather Flow (MMWWF) is 3.6 MGD. Given this information, population and MMWWF flowrates for the city of Sandy were extrapolated between the years 2023 and 2040. The mass loads for BOD_5 and TSS MMWWF are shown as population grows in Figure A-1.

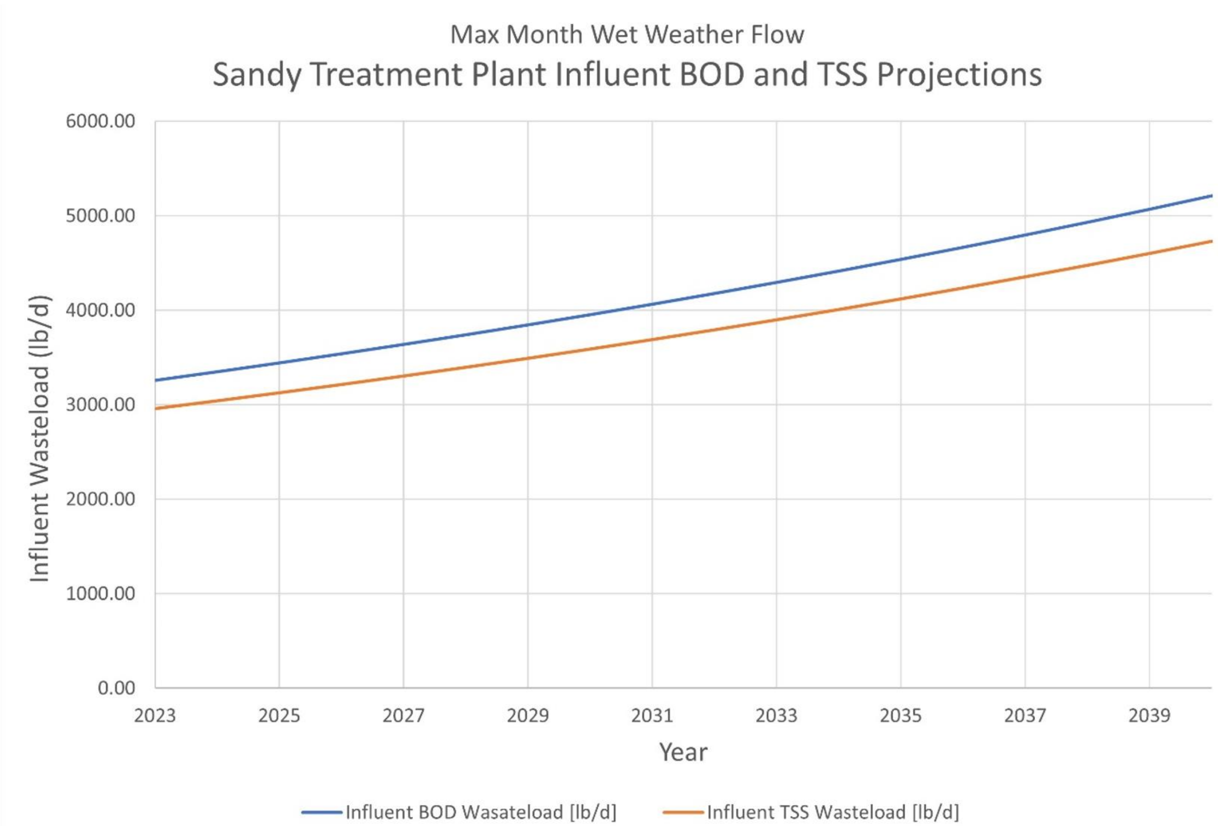


Figure B.1 –Influent BOD and TSS Projections by Year

b. Effluent Mass Load and Concentration Requirements

The BOD5 and TSS discharge limitations for outfall 001/003 from November 1 through April 30 are summarized in Table B.1

Table B.1 Concentration and Mass Load Waste Discharge Limitations

Parameter	Average Effluent Concentration Monthly	Average Effluent Concentration Weekly	Monthly Average Mass Load	Weekly Average Mass Load	Daily Maximum Mass Load
BOD	10 mg/L	15 mg/L	125 lb/d	187 lb/d	250
TSS	10 mg/L	15 mg/L	125 lb/d	187 lb/d	250

Daily mass load limit is suspended on any day the influent flowrate to the WWTP exceeds 2.5 MGD. However, the value on the days exceeding 2.5 MGD is used in weekly and monthly mass load limit calculations and could result in an exceedance of mass load limits. Therefore, the based on recent conversations with DEQ, and the potential to exceed the daily maximum limit, we have set our mass load limit to establish the effluent concentration limits at 125 lb/d for BOD and TSS. Using 125 lb/d for both limits, the design effluent concentrations for BOD and TSS are summarized in Table B.2.

Table B.2 Maximum Allowable Effluent Concentrations

Parameter	Monthly Average Mass Load	Concentration Limit(1)
BOD	125 lb/d	4.2 mg/L
TSS	125 lb/d	4.2 mg/L

(1) Calculated based on Maximum Month Flowrate of 3.6 MGD.

Based on a 2040 projected influent mass load of 5,300 lb/d, the BOD removal efficiency must be 97.6%, and the TSS removal efficiency must be 97.4%. This can be accomplished reliably through secondary treatment with ultrafiltration.

ii. Three Basin Discharge Alternatives

a. Tickle Creek Discharge

Tickle Creek flowrate, recorded throughout the discharge season, was used to develop an understanding of the Creek's seasonal discharge. This data was used in conjunction with the Plant's effluent discharge on days the stream gauge was read to calculate the dilution ratio for the wet weather seasons from May 2019 through April 2021. A summary of this information is shown in Figure B.2. It was found that on days the stream gauge was read, 15% of the calculated dilution ratios were below the permitted minimum value of 10.

Plant effluent flowrates were extrapolated 20 years using an estimated wet weather flow increase of 55% and compared against recorded creek flows. The dilution ratio was recalculated for the wet weather seasons from May 2039 through April 2041. A summary of this information is shown in Figure B.3. It is estimated that by the end of the planning period, 28% of the dilution ratios will below the permitted minimum value of 10. This aligns with the 2019 Facility Plan and indicates that discharging solely to Tickle Creek during wet weather is not a viable option in the future.

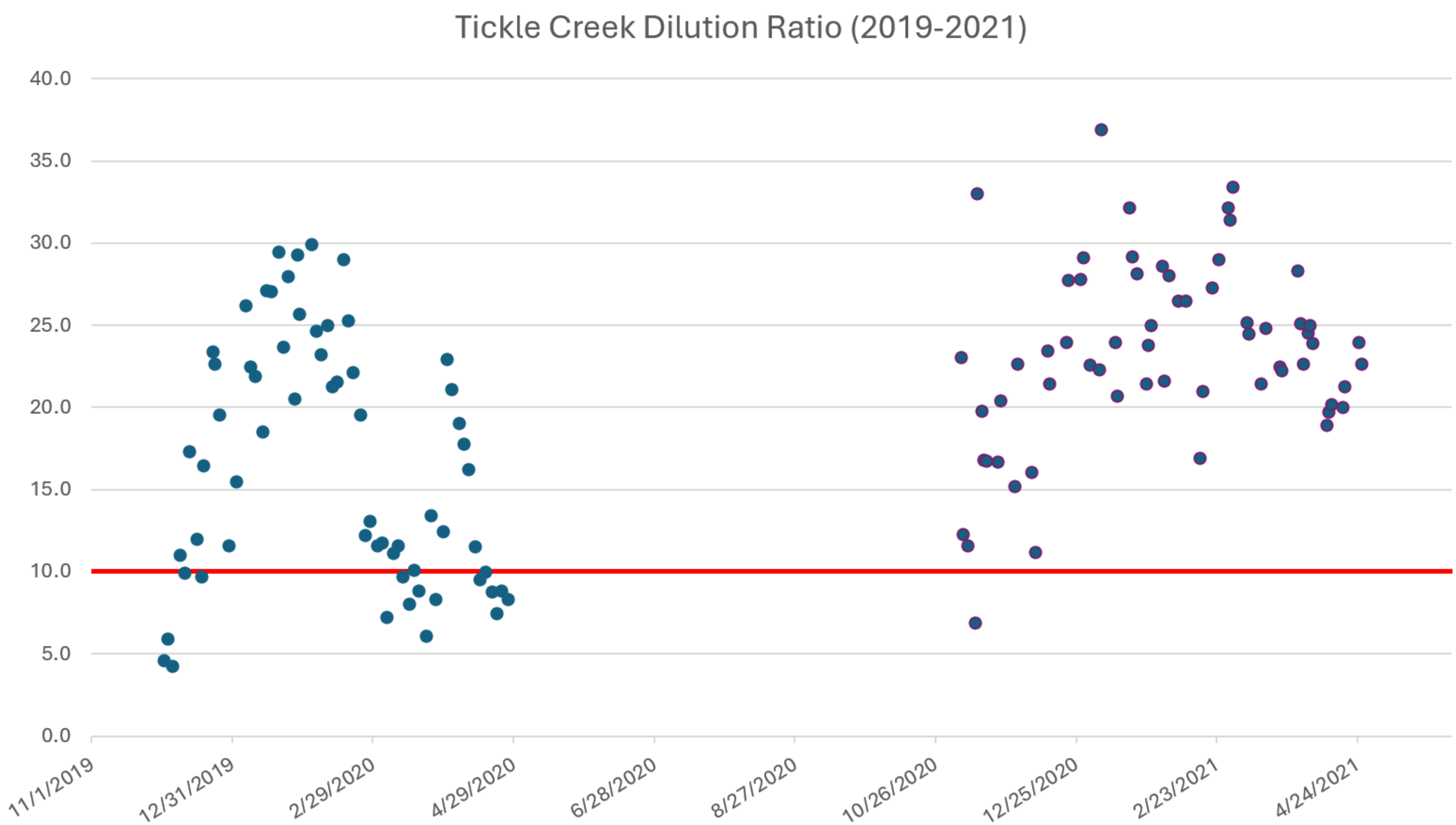


Figure B.2 Historic Tickle Creek Dilution Ratio 2019-2021

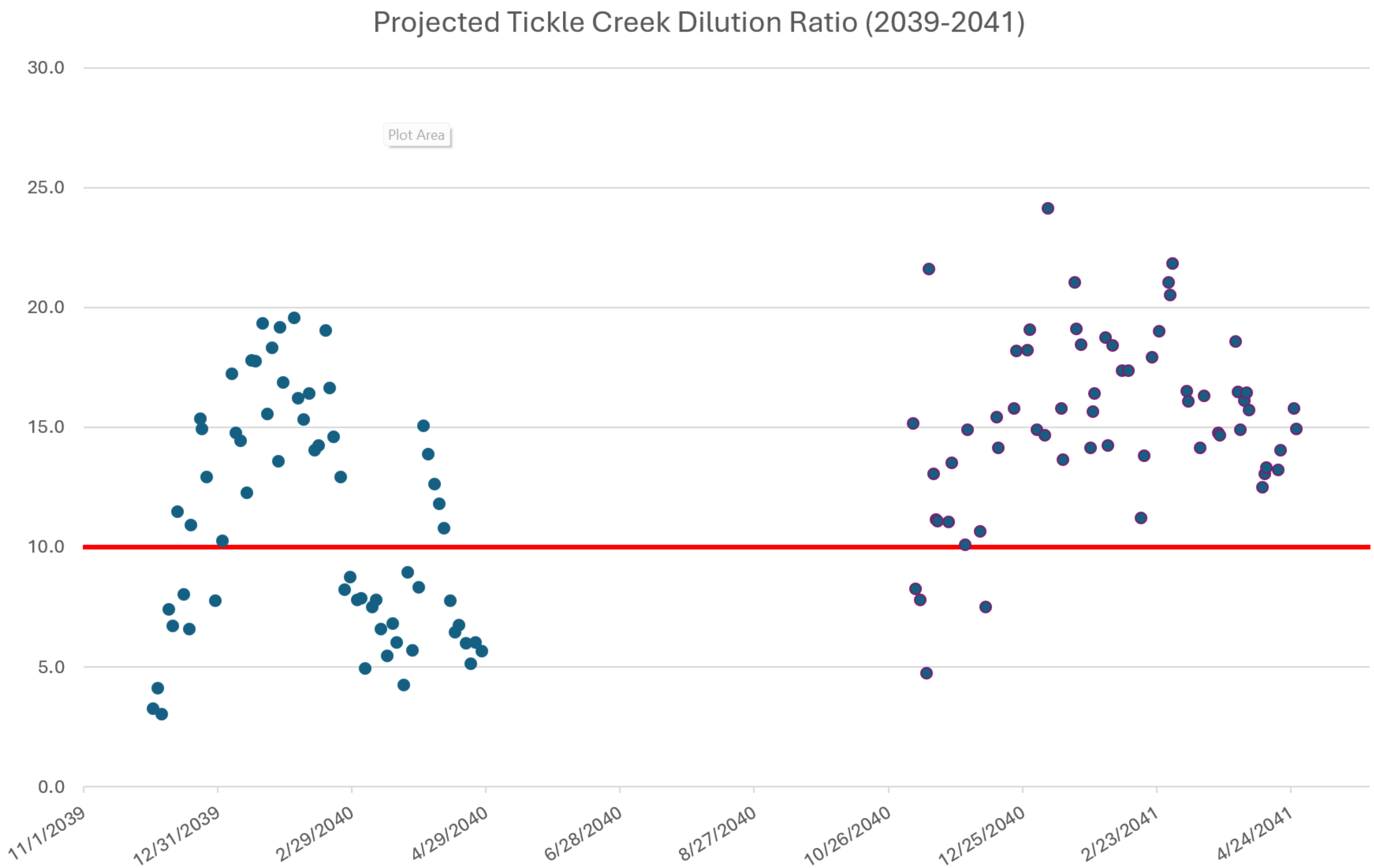


Figure B.3 Projected Tickle Creek Dilution Ratio 2039 to 2041

Allowable plant effluent flowrates were calculated based on NPDES mass load limits as well as dilution limits. The analysis indicates that, during the wet weather season from November through April, the allowable discharge to Tickle Creek was consistently limited by creek flow and the dilution criteria defined in the NPDES Permit. TSS and BOD mass limits may also be exceeded depending on the biological treatment process health and equipment function.

b. Deep Creek Discharge

Data from the United States Geological Survey (USGS) Streamstats web application was used to retrieve 2-year and 10-year low monthly flows. This data was used with information gathered from a field investigation conducted on 4 January 2023. Kennedy Jenks surveyed a representative cross section of the creek at the Knox Road bridge, and velocity tests were conducted to estimate average creek flow for that day. Rainfall data were collected for the week prior and were found to be lower than historical average rainfall for January. It was concluded that the field measured flow may be slightly lower than historical average but would provide an adequate basis for understanding flows at Deep Creek with a reasonable factor of safety.

Table B.2: Deep Creek Flow Results

Description	Value
Deep Creek 1/4/2023 Field Test Flow (MGD)	96.3
Deep Creek January 2-Year Low Flow (MGD)	69.2
Flow Multiplier (Field Flow / January 2-year Low Flow)	1.39

MGD = Million gallons per day

The flow multiplier developed in Table B.2 was combined with 2-year low flow values to estimate average Deep Creek flows by month for the wet weather season. This data was used in conjunction with the Plant’s effluent discharge flow rates to calculate the dilution ratio for the wet weather seasons from May 2019 through April 2021. A summary of this information is shown in Figure B.4. It was found that 9% of the calculated dilution ratios were below the permitted minimum value of 10.

This plant effluent data was extrapolated 20 years using an estimated wet weather flow increase of 55% and compared against recorded creek flows. The dilution ratio was recalculated for the wet weather seasons from May 2039 through April 2041. A summary of this information is shown in Figure B.5. It is estimated that by the end of the planning period, 21% of the dilution ratios will below the permitted minimum value of 10. This indicates that discharging solely to Deep Creek during wet weather is not a viable option and alternate discharge and storage options must be considered.

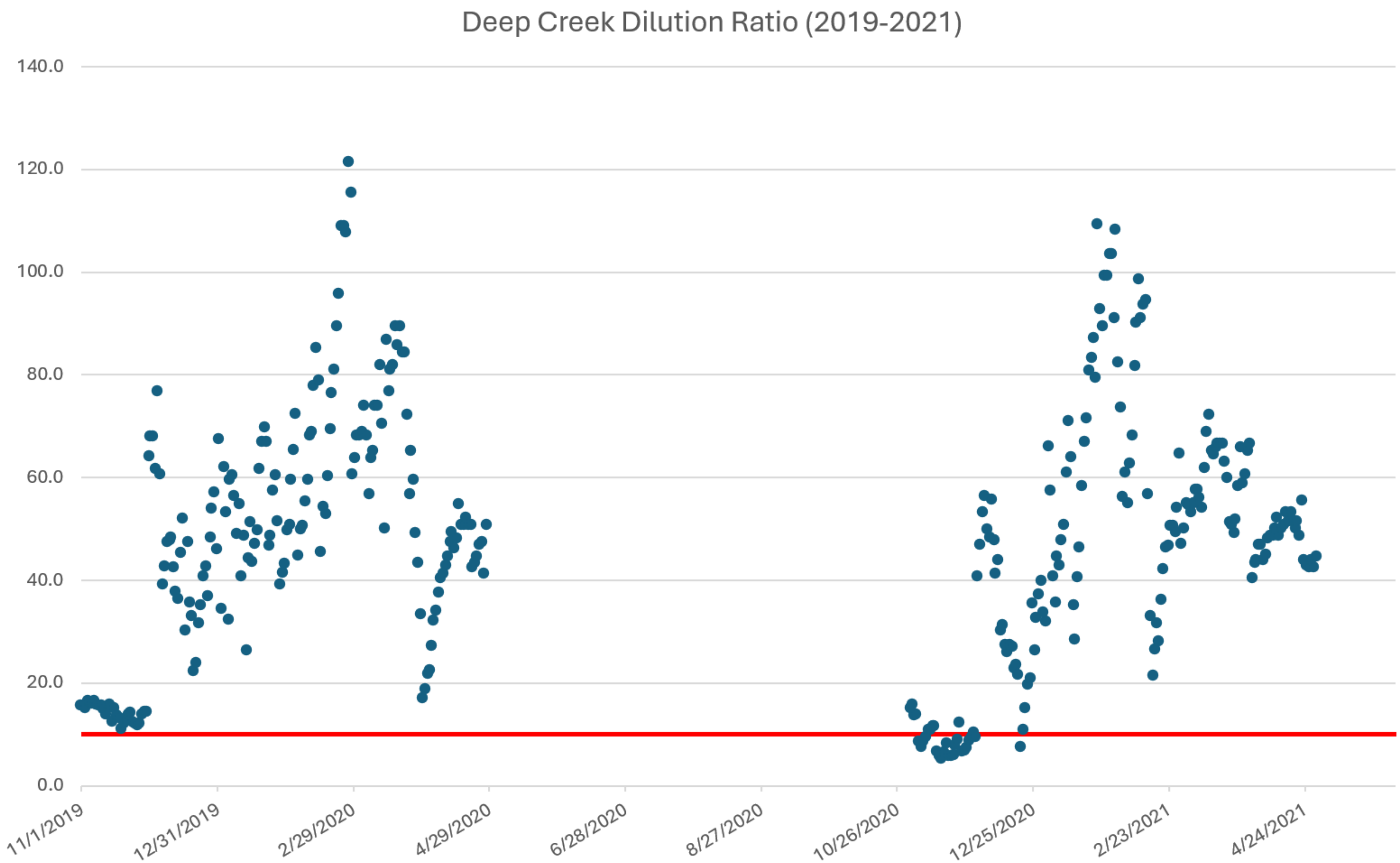


Figure B.4 Deep Creek Dilution Ratio

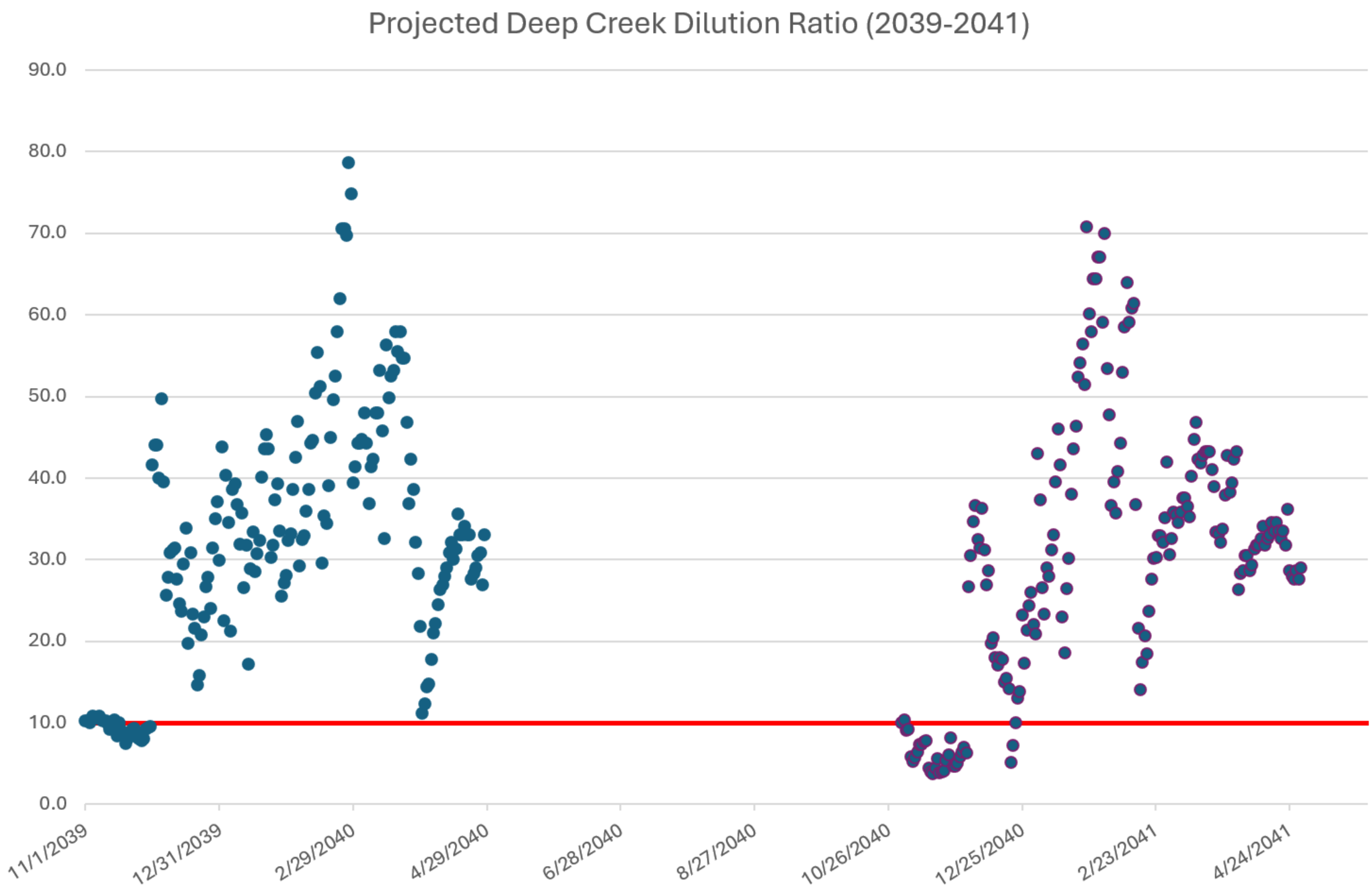


Figure B.5 Projected Deep Creek Dilution Ratio

Allowable plant effluent flowrates were calculated based on NPDES mass load limits as well as dilution limits. It was found that during the wet weather season from November through April, the allowable discharge to Deep Creek was limited by creek flow and the dilution criteria defined in the NPDES Permit in November, and mass load limits of BOD and TSS for the remaining wet weather season. The analysis revealed that current maximum 7-day average flows and peak day flows occasionally exceed the discharge limits defined in the NPDES Permit. This indicates that as plant effluent flows increase over time, discharge to Deep Creek may need to be supplemented with additional storage to attenuate peak flows.

iii. Effluent Storage

a. Current Capacity at Iseli Nursery

A summary of the existing ponds at the Iseli Nursery and their respective storage volumes are summarized below in Table B.3. It is estimated that there is approximately 21.2 MG of available storage at the Nursery.

Table B.3: Iseli Nursery Existing Pond Storage

Name	Storage (MG)
Existing Pond 1	1.8
Existing Pond 2	3.1
Existing Pond 3	14.7
Existing Pond 4	1.7
Total	**21.2**

MG = Million gallons

b. Recycled Water Storage Mass Balance

Mass Balance calculations were developed for storing recycled water at the Iseli Nursery. Historical rainfall, temperature, and humidity data was used to estimated rainfall and evaporation rates for the storage pond system. This data is shown below in Table B.4.

Table B.4: Historical Weather Data

	Average Rainfall (inches)	Average Humidity (%)	Wind Speed (mph)	Avg High Temp (°F)	Avg Low Temp (°F)
Jan	5.63	84	6.6	44	36
Feb	4.29	86	6.2	48	36
March	4.21	84	5.7	53	38
Apr	3.43	80	5.1	58	41
May	2.17	75	4.3	64	45
June	1.65	74	4	70	50
July	0.31	67	3.7	77	53
Aug	0.47	66	3.5	78	54
Sept	1.85	71	4	72	50
Oct	3.82	76	4.9	61	45
Nov	4.21	83	6	49	40
Dec	5.91	84	6.3	43	35

Notes

1. Data sourced from National Oceanic and Atmospheric Administration (NOAA) and National Weather Service (NWS) through https://www.weather-us.com/

Inflow and outflow of the storage pond system was calculated on a daily basis in order to estimate the net change of water stored and the total storage volume required throughout the year. Inflow and outflow used in the mass balance calculations are bulleted below along with other assumptions used in the calculations. Discharge to Tickle Creek is not a viable long-term solution due to limiting creek flows and associated dilution criteria. For this reason this mass balance assumes the ponds will discharge to Deep Creek and be limited by the creek's dilution criteria and mass load limits. Scenarios modeled in the calculations are listed in Table B.5.

Inflow

- WWTP Class B Recycled Water
- Rainfall

Outflow

- Nursery Usage
- Creek Discharge
- Evaporation

Model Assumptions

- Deep Creek dilution limits were used in November and December to estimate discharge from the ponds.
- Plant mass load limits were used for in January through April to estimate discharge from the ponds.
- A 27% increase in nursery water usage was assumed over the next 10 years based on conversations with the Nursery.
- A 55% increase in Plant effluent by 2043 was assumed based on flow and load projections.
- Historical rainfall, humidity, and temperature data was used to calculate precipitation and evaporation rates on a monthly basis.

Table B.5: Storage Pond Mass Balance Scenarios

Scenario	Description
1	Conventional Treatment - 2023
2	Conventional Treatment – 2033
3	Conventional Treatment – 2043
4	MBR Treatment - 2023
5	MBR Treatment - 2033
6	MBR Treatment - 2043

Notes

1. MBR = Membrane Bioreactor

Mass balance results are summarized below in Table B.6. It was found that continuing conventional treatment would not be feasible without increasing recycled water usage by the Nursery or other nearby users. Adding tertiary ultrafiltration or a membrane bioreactor (MBR) process would decrease effluent BOD and TSS concentrations and enable the Plant to discharge more flow to Deep Creek without exceeding the mass load limits defined in the NPDES Permit.

Table B.6: Storage Pond Mass Balance Result Summary

Scenario	Description	Yearly Mass Balance Feasibility (Y/N)	Maximum Storage Required (MG)	Storage Construction Feasibility (Y/N)
1	Conventional Treatment - 2023	N	59	Y
2	Conventional Treatment – 2033	N	103	N
3	Conventional Treatment – 2040	N	185	N
4	MBR Treatment - 2023	Y	43	N
5	MBR Treatment - 2033	Y	62	Y
6	MBR Treatment - 2043	Y	105	N

Appendix B.4

Sandy Facility Plan BioWin Modeling Results, Kennedy Jenks, May 2024

B.3 BioWin Model Summary

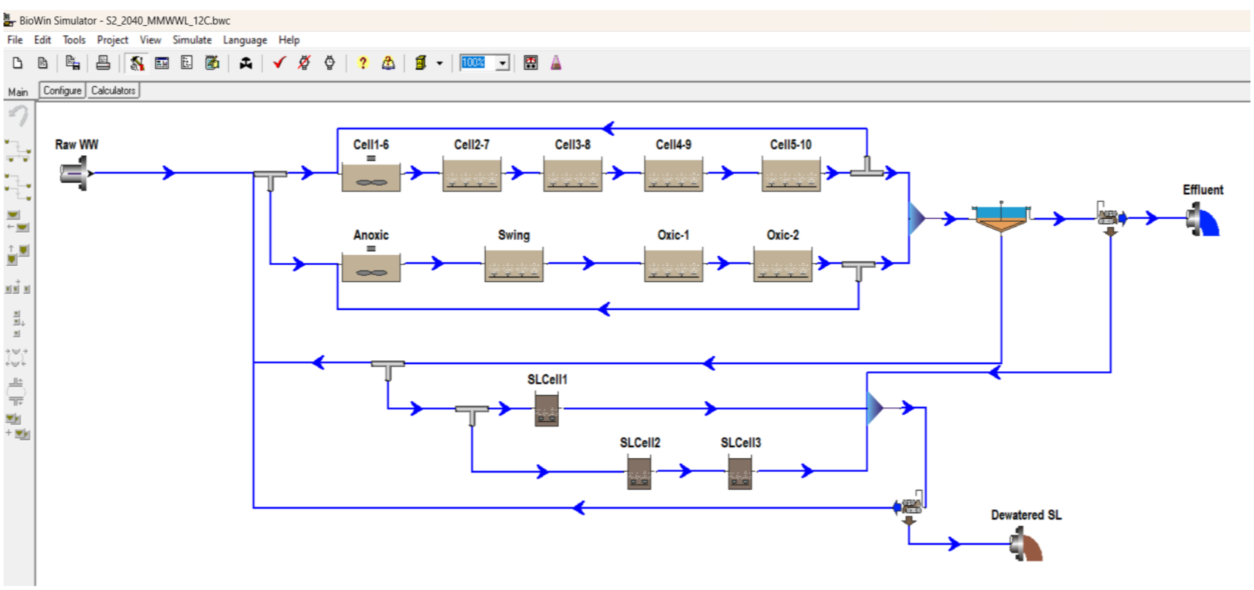
BioWin Modeling was conducted for the partial implementation of the CAS or MBR treatment concepts. The models were calibrated and validated with data collected from the plant over the previous 5 years. The results of both models are summarized in the following sections.

i. Alternative 1 – Conventional Activated Sludge (CAS) BioWin Model Summary

The concept for the initial phasing was built around the idea of duplicating the existing aeration basin to accommodate the projected flows and treat the influent loads to acceptable limits. To ensure the redundancy of the secondary treatment at the end of the design period, the 2040 projected flows were used to model the treatment capacity of the conventional activated sludge process.

The model represents the existing, two-train, aeration basin and an additional two-train aeration basin of comparable size. The new basin includes an anoxic cell, aerobic cells, and a swing cell that can be operated for either anoxic or aerobic treatment. The layout is shown in Figure B.6.

Figure B.6: BioWin Simulator Layout



The following tables B.7 and B.8 summarize the modeling results of the existing aeration basin operating in parallel with the new aeration basin for 2040 projected for average dry weather flows and maximum monthly wet weather flows. The model assumes that the flows will be split evenly between the basins.

Table B.7 Design Operating Conditions Assumed for Scenarios

Parameter	Unit	S1 MMDWL	S2 MMWWL		
		Combined	Combined	New AB	Existing AB
Process Volume					
Total Process Volume	gallons	1555500	1555500	768300	787200
Anoxic Volume	gallons	149900	149900	74900	75000
Aeration Basin Volume	gallons	1405600	1405600	693400	712200
Swing Basin Condition		Aerobic	Aerobic	-	-
# of SCs in Service	each	2	2	-	-
Total SC Area	sq.ft	4560	4560	-	-
Aerobic SRT	days	7.2	7.2	-	-
Total SRT	days	8.0	8.0	-	-
Temperature	°C	16	12		

Table B.8 Simulation Results

Parameter	Unit	S1 MMDWL			S2 MMWWL			Maximum or Target
		Combined	Existing AB	New AB	Combined	Existing AB	New AB	
Influent Condition								
Influent Flow	MGD	2.2	1.1	1.1	3.6	1.8	1.8	
BOD5	mg/L	431	-	-	263	-	-	
CBOD5	mg/L	409	-	-	250	-	-	
TSS	mg/L	408	-	-	250	-	-	
TKN	mg/L	57	-	-	35	-	-	
pH		7.0	-	-	7.0	-	-	
Alkalinity as CaCO3	mg/L	290	-	-	180	-	-	
Operating Condition								
RAS Flow	MGD	1.04	0.52	0.52	1.74	0.87	0.87	
Internal Recycle Flow	MGD	5.30	2.0	3.3	5.30	2.0	3.3	
Total HRT	hours	4.4	16.8	17.2	4.4	10.2	10.5	
Process Basin MLSS	mg/L	NA	3280	3271	NA	3233	3226	2000 to 3500
Temperature	°C	16.0	-	-	12.0	-	-	
Aeration								
DO Concentration in Aeration Basin	mg/L	NA	2.0	2.0	NA	2.0	2.0	
Airflow to Aerobic Basin	scfm	3692	1835	1857	3519	1752	1767	Current = 1,200 scfm
Total AOR	lbs/hr	378	188	190	362	180	182	
Aeration Basin OUR	mg/L/hr	NA	37	35	NA	33	32	80 or less
Aeration Basin SOTE	%	NA	29.8	29.8	NA	29.8	29.8	
Solids Production								
WAS Flow	gpm	44	-	-	44	-	-	
WAS TSS	lbs/day	5307	-	-	5234	-	-	
Secondary Clarifier								
RAS & WAS TSS	mg/L	10036	-	-	9914	-	-	6000-12000 Typical
Surface Overflow Rate	gal/sqft/d	505	-	-	827	-	-	600-800
Solids Loading Rate	lb/sq.ft/d	20	-	-	33	-	-	19.2-36
Secondary Effluent CBOD5	mg/L	10	-	-	10	-	-	
Secondary Effluent TSS	mg/L	24	-	-	24	-	-	
Tertiary Effluent								
CBOD5	mg/L	3.6	-	-	3.9	-	-	<5
TSS	mg/L	4.5	-	-	4.5	-	-	<10
NH3-N	mg/L	0.2	-	-	0.7	-	-	<<1 for Phase 1
TKN	mg/L	2.2	-	-	2.2	-	-	
NO3-N	mg/L	9.2	-	-	5.8	-	-	
TN	mg/L	11.3	-	-	8.0	-	-	
pH		6.6	-	-	6.4	-	-	6.5 to 7.5
Alkalinity as CaCO3	mg/L	101.6	-	-	65.1	-	-	80 or greater

Duplicating the aeration basin increases solids retention time to allow for additional ammonia removal to below permitted limits. Adding a third set of aeration basins would further improve the SRT and bring ammonia below detectable limits.

The required air demand was calculated for operation of one additional aeration basin and for two additional aeration basins. The oxygen required for both scenarios was calculated for high temperature conditions with minimal DO residual and an assumed standard oxygen transfer efficiency of 1.75%. The required air supply for the two sets of two-train aeration basins, Phase 1, and three sets of two-train aeration basins, Phase 2, are shown in Table B.9.

Table B.9 Calculation Results

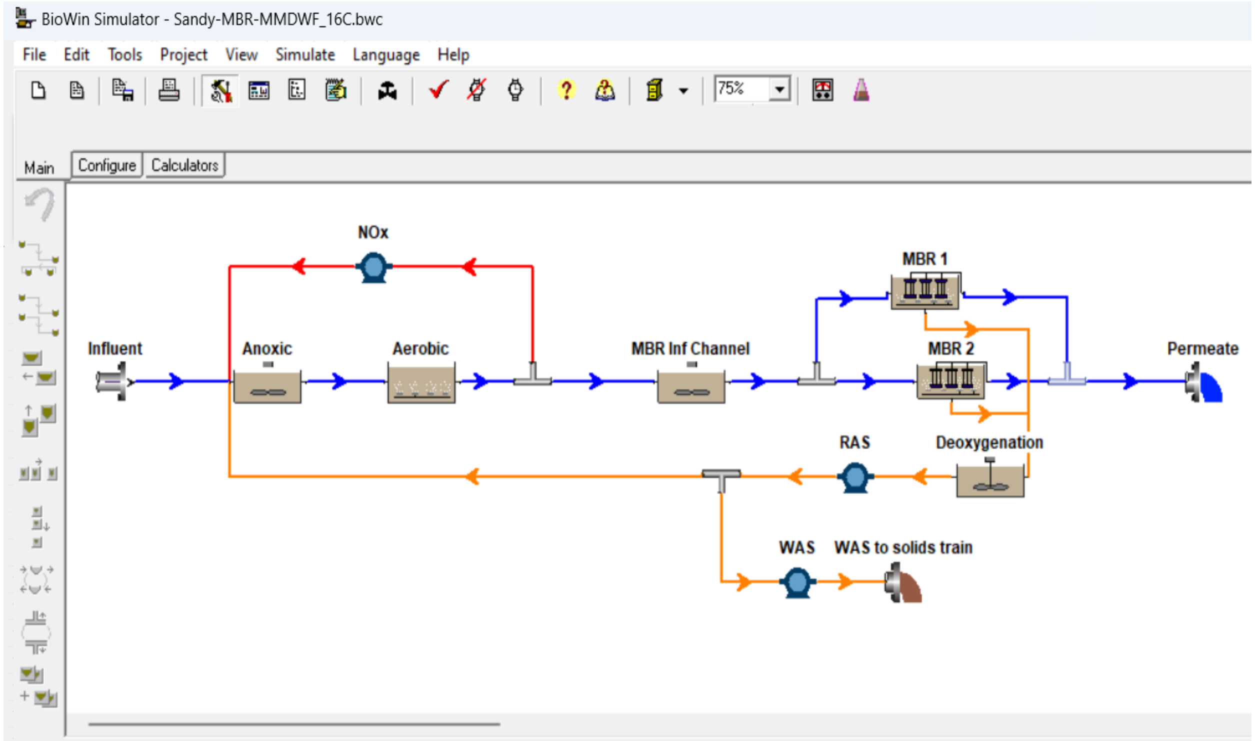
Max Air Demand from Calculations (Based on MDL)		Phase 1	Phase 2
Total Airflow to Aerobic Basin	scfm	4720	4880
Airflow per Train	scfm/train	2360	1627

ii. Alternative 2 – Membrane Bioreactor (MBR) Biowin Model Summary

The Biowin model for Alternative 2 illustrates operation during construction. The MBR tanks will be progressively incorporated into the existing footprint of the aeration basin. To keep the plant online, this will include building an additional basin to house an MBR process train to handle flows while the aeration basin is offline during construction. The BioWin modeling looked at the treatment capabilities of ZeeWeed 500 Hollow Fiber membranes and the treatment capacity that could fit within the footprint of the existing aeration basin.

Similar to Alternative 1, Alternative 2 was modeled using the 2040 projected flows and improving ammonia removal over the design period. The BioWin model results assume half of the wastewater is to be treated by the new MBR process train, and the other half by the existing aeration basin. The simulator layout for an all-MBR treatment process is shown in Figure B.7.

Figure B.7: BioWin Simulator Layout for New MBR



The results in Table B.10 AND B.11 summarize the required volumes and treatment capacity of the aeration basin and single MBR process basin operating in tandem.

Table B.10 Design Operating Conditions Assumed for Scenarios

Parameter	Unit	S1 MMDWL			S2 MMWWL		
		Combined	MBR	Existing AB	Combined	MBR	Existing AB
Total Process Volume	gallons	1,049,800	262,600	787,200	1,049,800	262,600	787,200
Anoxic Volume	gallons	148,300	73,300	75,000	148,300	73,300	75,000
Aerobic Basin Volume	gallons	895,500	183,300	712,200	895,500	183,300	712,200
MBR Influent Channel	gallons	6,000	6,000	-	6,000	6,000	-
MBR Tank Volume	gallons	49,800	49,800	-	49,800	49,800	-
De-oxygenation Channel Volume	gallons	68,100	68,100	-	68,100	68,100	-
# of Process Basin Trains Online	each	2	1	1	-	1	1
# of Membrane Tanks Online	#	2	2	-	-	2	-
# of De-oxygenation Channels	#	1	1	-	-	1	-
# of SCs in Service	each	2	-	2	-	-	2
Total SC Area	sq.ft	4,650	-	4,650	-	-	4,650
Aerobic SRT	days	7.2	7.2	7.2	7.2	7.2	7.2
Total SRT	days	-	12.0	8.0	-	12.0	8
Temperature	°C	16	16	16	12	12	12

Table B.11 MBR Simulation Results

Parameter	Unit	S1 MMDWL Combined	S1 MMDWL MBR	S1 MMDWL Existing AB	S2 MMWWL Combined	S2 MMWWL MBR	S2 MMWWL Existing AB	Maximum or Target
Influent Condition								
Influent Flow to Secondary Process	MGD	2.2	1.1	1.1	3.6	1.8	1.8	
BOD5	mg/L	431	-	-	263	-	-	
CBOD5	mg/L	409	-	-	250	-	-	
TSS	mg/L	408	-	-	250	-	-	
TKN	mg/L	57	-	-	35	-	-	
pH		7.0	-	-	7.0	-	-	
Alkalinity as CaCO3	mg/L	290	-	-	180	-	-	
Operating Condition								
RAS Flow	MGD	-	6.60	0.52	-	10.80	0.87	
Internal Recycle Flow	MGD	-	3.30	2.00	-	5.40	2.00	
Total HRT	hours	-	8.3	16.8	-	5.1	10.2	
Process Basin MLSS	mg/L	-	9,693	3,280	-	9,907	3,233	
MBR MLSS / RAS TSS	mg/L	-	11,258	10036	-	11,527	9914	< 12000
Temperature	°C	16.0			12.0			
Aeration								
DO Concentration in Aerobic Basin	mg/L	2.0	2.0	2.0	2.0	2.0	2.0	
DO Concentration in MBR	mg/L	5.4	5.4	-	5.1	5.1	-	
Airflow to Aerobic Basin	scfm	3400	1565	1835	3203	1451	1752	
Airflow to MBR	scfm/basin	1320	1320	-	1320	1320	-	
Total AOR	lbs/hr	384	196	188	373	192	180	
Aerobic Basin OUR	mg/L/hr	-	93	37	-	84	33	< 100 typical
MBR OUR	mg/L/hr	-	89	-	-	94	-	< 100 typical
Aerobic Basin SOTE	%	-	34.1	29.8	-	34.1	29.8	
MBR SOTE	%	-	6.4	-	-	6.4	-	
Solids Production								
WAS Flow	gpm	42	20	22	41	20	22	
WAS TSS	lbs/day	5299	2646	2653	5317	2700	2617	
Tertiary Effluent								
CBOD5	mg/L	2.4	1.1	3.6	2.5	1.1	3.9	<5
TSS	mg/L	2.3	0.0	4.5	2.2	0.0	4.5	<10
NH3-N	mg/L	0.2	0.2	0.2	0.7	0.8	0.7	<<1 for Phase 1
NO3-N	mg/L	7.2	3.0	11.3	4.7	1.3	8.0	
TN	mg/L	7.1	5.1	9.2	4.8	3.8	5.8	
pH		-	6.8	6.6	-	6.6	6.4	6.5 to 7.5
Alkalinity as CaCO3	mg/L	112.2	123	101.6	72.4	80	65.1	80 or greater

The required air demand was calculated for operation of one train of the existing aeration basin with one MBR process train, Phase 1, and then for two MBR process trains. The oxygen required for both scenarios was calculated for high temperature conditions with minimal DO residual and an assumed standard oxygen transfer efficiency of 1.75%. The required air does not include the scour air supplied to the MBR membranes for cleaning. Air requirements are summarized in Table B.12.

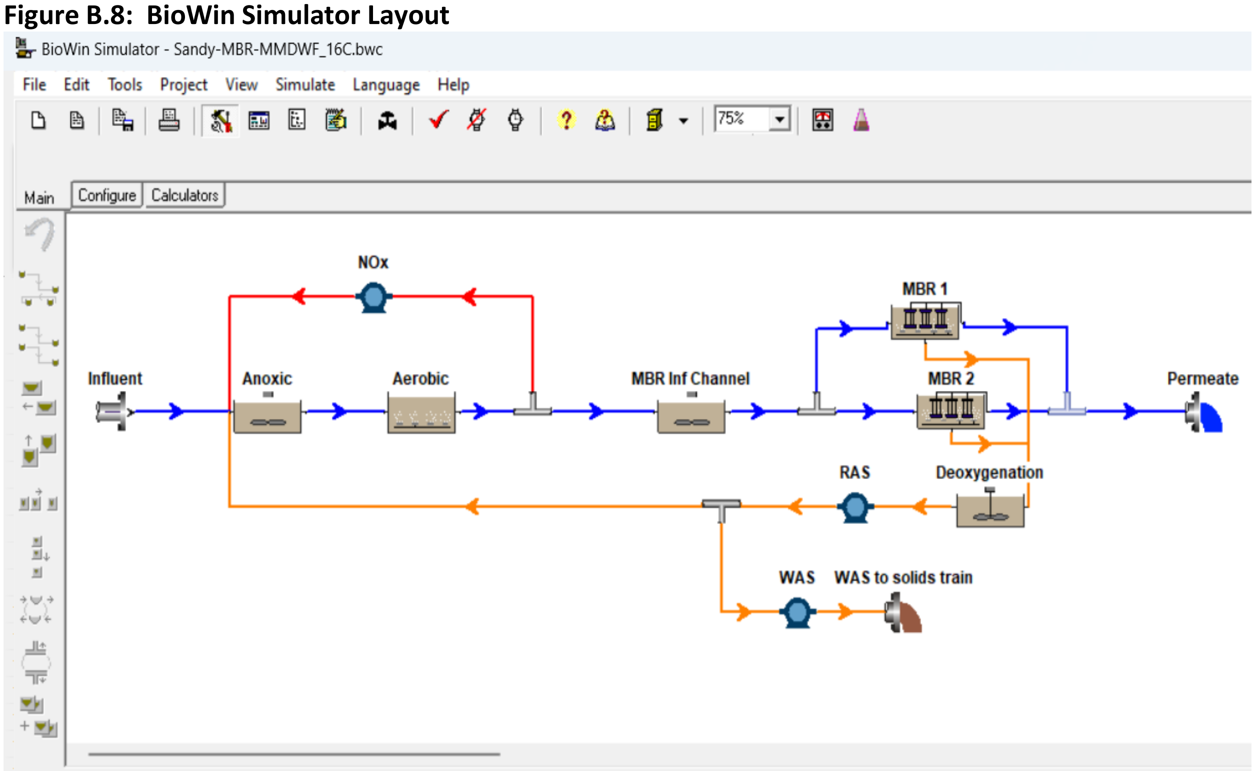
Table B.12 MBR Air Requirements

Max Air Demand from Calculations (Based on MDL)		Phase 1	Phase 2
Total Airflow to Aeration Basin	scfm	4170	4410
Airflow to New Aeration Basin	scfm	1810	4410
Airflow to Existing Aeration Basin	scfm	2360	NA

iii. Alternative 3 – Hybrid BioWin Model Summary

The results from the Alternative 1 and Alternative 2 were synthesized to create a summary for Alternative 3. The Alternative 2 operation during construction is the same for Alternative 3. Both Alternative 1 and 2 show the modeling results of the existing aeration basin for half of the 2040 projected flows and targeting effluent ammonia concentrations less than 2 mg/L. Alternative 3 also utilizes the existing aeration basin, initially alongside one MBR process basin with two MBR tanks. The BioWin layout for the single MBR process basin is shown in Figure B.8.

Figure B.8: BioWin Simulator Layout



The process sizing for Alternative 3 is summarized in Table B.13 and simulation results are summarized in Table B.14.

Table B.13 Design Operating Conditions Assumed for Scenarios

Parameter	Unit	S1 MMDWL	S2 MMWWL
		MBR	MBR
Total Process Volume	gallons	262,600	262,600
Anoxic Volume	gallons	73,300	73,300
Aerobic Basin Volume	gallons	183,300	183,300
MBR Influent Channel	gallons	6,000	6,000
MBR Tank Volume	gallons	49,800	49,800
De-oxygenation Channel Volume	gallons	68,100	68,100
# of Process Basin Trains Online	each	1	1
# of Membrane Tanks Online	#	2	2
# of De-oxygenation Channels	#	1	1
Aerobic SRT	days	7.2	7.2
Total SRT	days	12.0	12.0
Temperature	°C	16	12

Table B.14 Simulation Results

Parameter	Unit	S1 MMDWL	S2 MMWWL	Maximum or Target
		MBR	MBR	
Influent Condition				
Influent Flow to Secondary Process	MGD	1.1	1.8	
BOD5	mg/L	431	263	
CBOD5	mg/L	409	250	
TSS	mg/L	408	250	
TKN	mg/L	57	35	
pH		7	7	
Alkalinity as CaCO3	mg/L	290	180	
Operating Condition				
RAS Flow	MGD	6.60	10.80	
Internal Recycle Flow	MGD	3.30	5.40	
Total HRT	hours	8.3	5.1	
Process Basin MLSS	mg/L	9,693	9,907	
MBR MLSS / RAS TSS	mg/L	11,258	11,527	< 12000
Temperature	°C	16	12	
Aeration				
DO Concentration in Aerobic Basin	mg/L	2.0	2.0	
DO Concentration in MBR	mg/L	5.4	5.1	
Airflow to Aerobic Basin	scfm	1565	1451	
Airflow to MBR	scfm/basin	1320	1320	
Total AOR	lbs/hr	196	192	
Aerobic Basin OUR	mg/L/hr	93	84	< 100 typical
MBR OUR	mg/L/hr	89	94	< 100 typical
Aerobic Basin SOTE	%	34.1	34.1	
MBR SOTE	%	6.4	6.4	
Solids Production				
WAS Flow	gpm	20	20	
WAS TSS	lbs/day	2646	2700	
Tertiary Effluent				
CBOD5	mg/L	1.1	1.1	<5
TSS	mg/L	0.0	0.0	<10
NH3-N	mg/L	0.2	0.8	<<1 for Phase 1
NO3-N	mg/L	3.0	1.3	
TN	mg/L	5.1	3.8	
pH		6.8	6.6	6.5 to 7.5
Alkalinity as CaCO3	mg/L	123	80	80 or greater

The airflow requirements for Alternative 3 were determined by adding the airflow required for the existing aeration basin in Phase 1, and half the demand of the two MBR process basins in Phase 2, due to half of the flows going to the same number of basins. Table B.15 summarizes air flow requirements for Alternative 3.

Table B.15 Summary of Air Flow Requirements

Max Air Demand from Calculations (Based on MDL)		Phase 1	Phase 2
Total Airflow to Aeration Basin	scfm	4170	4410
Airflow to New Aeration Basin	scfm	1810	4410
Airflow to Existing Aeration Basin	scfm	2360	NA

Appendix C

Detailed Cost Estimates for Facility Plan Alternatives

APPENDIX C

COST ESTIMATES

i. Liquid Process Treatment Concept Costs

a. Liquids Alternatives Operation and Maintenance Costs

The following tables show the breakdown of annual equipment electrical costs, chemical supply and labor costs for the liquids treatment portion of the plant. The estimates below include standby, lag, equipment, but does not include the electrical loads in the annual O&M costs. The periodic use of equipment was normalized for a weekly average of annual operating hours.

ALTERNATIVE 1 OPERATION & MAINTENANCE COST						
	DESCRIPTION	HP	KVA/ KW	OPERATIN G HOURS/WK	kWh/YR	COST ($0.10/KWH)
	HEADWORKS					
	GRIT PUMP	10	8	168	69888.00	$ 6,988.80
	GRIT PADDLE DRIVE MOTOR	1	1	168	8736.00	$ 873.60
	GRIT SCREW	1	1	168	8736.00	$ 873.60
	WELL PUMP	7.5	6	168	52416.00	$ 5,241.60
	RAPTOR FINE SCREEN NO. 1	2	2	168	17472.00	$ 1,747.20
	RAPTOR FINE SCREEN NO. 2 (LAG)	2	2			
	CAS SECONDARY TREATMENT					
	INTERNAL RECIRCULATING PUMP NO. 1	40	30	168	262080.00	$ 26,208.00
	INTERNAL RECIRCULATING PUMP NO. 2	40	30	168	262080.00	$ 26,208.00
	AERATION BASIN SELECTOR ZONE MIXER NO. 1	4	3	168	26208.00	$ 2,620.80
	AERATION BASIN SELECTOR ZONE MIXER NO. 2	4	3	168	26208.00	$ 2,620.80
	AERATION BASIN SELECTOR ZONE MIXER NO. 3	4	3	168	26208.00	$ 2,620.80
	AERATION BASIN SELECTOR ZONE MIXER NO. 4	4	3	168	26208.00	$ 2,620.80
	PROCESS BLOWER NO. 1	100	75	168	655200.00	$ 65,520.00
	PROCESS BLOWER NO. 2	100	75	168	655200.00	$ 65,520.00
	PROCESS BLOWER NO. 3	100	75	168	655200.00	$ 65,520.00
	PROCESS BLOWER NO. 4	60	45	168	393120.00	$ 39,312.00
	PROCESS BLOWER NO. 5 (LAG)	100	75			
	DIFFUSERS	4	3	168	26208.00	$ 2,620.80
	SCUM PUMP	5	4	168	34944.00	$ 3,494.40
	SUMP PUMP	0.33	1	168	8736.00	$ 873.60
	GRUNDFOS UTILITY WATER PUMP NO. 1	5	4	168	34944.00	$ 3,494.40
	GRUNDFOS UTILITY WATER PUMP NO. 2 (LAG)	5	4			
	CAUSTIC SYSTEM - METERING PUMP NO. 1	0.25	1	168	8736.00	$ 873.60
	CAUSTIC SYSTEM - METERING PUMP NO. 2	0.25	1			
	NaOCl - METERING PUMP NO. 1	0.25	1	168	8736.00	$ 873.60
	NaOCl - METERING PUMP NO. 2	0.25	1			

	INSTANTANEOUS WATER HEATER NO. 1		100	168	873600.00	$	87,360.00
	INSTANTANEOUS WATER HEATER NO. 2 (LAG)		100				
	SPLITTER BOX						
	RAS	7.5	6	168	52416.00	$	5,241.60
	RAS	7.5	6	168	52416.00	$	5,241.60
	WAS	2.2	2	42	4368.00	$	436.80
	WAS	2.2	2	42	4368.00	$	436.80
	SMALL JOCKEY PUMP	5	4	112	23296.00	$	2,329.60
	Small Jockey Pump	15	12	112	69888.00	$	6,988.80
	Big Jockey Pump 1	45	34	56	99008.00	$	9,900.80
	BIG JOCKEY PUMP 2	45	34	56	99008.00	$	9,900.80
	BIG JOCKEY PUMP 3 (LAG)	45	34				
	CLARIFIERS						
	54' DIAMTER	100	75	168	655200.00	$	65,520.00
	54' DIAMTER	100	75	168		$	-
	70' DIAMETER	100	75	168	655200.00	$	65,520.00
	FILTRATION						
	EQ PUMP FROM EFFLUENT FILTRATION TO POND NO. 1	5	4	168	34944.00	$	3,494.40
	EQ PUMP FROM EFFLUENT FILTRATION TO POND NO. 2	5	4				
	FEED PUMP 1	50	38	144	284544.00	$	28,454.40
	FEED PUMP 2	50	38	144	284544.00	$	28,454.40
	FEED PUMP 3	50	38	144	284544.00	$	28,454.40
	FEED PUMP 4	50	38	144	284544.00	$	28,454.40
	FEED PUMP 5	50	38	144	284544.00	$	28,454.40
	FEED PUMP 6	50	38	144	284544.00	$	28,454.40
	FEED PUMP 7	50	38	144	284544.00	$	28,454.40
	BACKWASH PUMP	50	38	18	35568.00	$	3,556.80
	CIP	20	15	10	7800.00	$	780.00
	HEATER 1		24	40	49920.00	$	4,992.00
	HEATER 2		24	40	49920.00	$	4,992.00
	HEATER 3		24	40	49920.00	$	4,992.00
	HEATER 4		24	40	49920.00	$	4,992.00
	COMPRESSOR	15	12	2.5	1560.00	$	156.00
	DIVERSION PUMP NO. 1	15	12	168	104832.00	$	10,483.20
	DIVERSION PUMP NO. 2	15	12	168	104832.00	$	10,483.20
	PROCESS WATER PUMP NO. 1	5	4	168	34944.00	$	3,494.40
	PROCESS WATER PUMP NO. 2	5	4	168	34944.00	$	3,494.40

	DISINFECTION					
	UV SYSTEM - TROJAN		6.5	84	28392.00	$ 2,839.20
	ENCLOSED UV SYSTEM NO. 1 - EVOQUA		28	84	122304.00	$ 12,230.40
	ENCLOSED UV SYSTEM NO. 2 - EVOQUA		28	84	122304.00	$ 12,230.40
	ENCLOSED UV SYSTEM NO. 3 - EVOQUA		28			
	ENCLOSED UV SYSTEM NO. 4 - EVOQUA (LAG)					
	SODIUM HYPCHLORITE PUMP NO. 1	0.25	1	84	4368.00	$ 436.80
	SODIUM HYPCHLORITE PUMP NO. 2 (LAG)	0.25	1			
	SUBMERSIBLE PUMP PACKAGE NO. 1	15	12	168	104832.00	$ 10,483.20
	SUBMERSIBLE PUMP PACKAGE NO. 2 (LAG)	15	12			
	EFFLUENT PUMP STATION					
	IRRIGATION VERTICAL TURBINE PUMP NO. 1	100	75	84	327600.00	$ 32,760.00
	IRRIGATION VERTICAL TURBINE PUMP NO. 2	100	75	84	327600.00	$ 32,760.00
	IRRIGATION VERTICAL TURBINE PUMP NO. 3 (LAG)	100	75			
	OTHER					
	COOLANT HEATER		4	168	34944.00	$ 3,494.40
	Labor			132	6600.00	$ 343,200.00
	3 PEOPLE, 8 HRS/DAY, 5 DAYS/WK + COUPLE HOURS ON THE WKND					
	MATERIALS					
	EFFLUENT HYPOCHLORITE @ 3PPMFOR 7 MGD ($3/GAL)			74	222.00	$ 11,544.00
					Total kWh/yr	Subtotal
		Liquids O&M Cost Before Inflation			9486110	$ 1,302,672.80
	Liquids O&M Lifecycle Cost (i=3%, n=20-yrs)					$ 19,380,514.58

ALTERNATIVE 2 OPERATION & MAINTENANCE COST						
	DESCRIPTION	HP	KVA/ KW	OPERATING HOURS/WK	kWh/YR	COST ($0.10/KWH)
	HEADWORKS					
	GRIT PUMP	10	8	168	69888.00	$ 6,988.80
	GRIT PADDLE DRIVE MOTOR	1	1	168	8736.00	$ 873.60
	GRIT SCREW	1	1	168	8736.00	$ 873.60
	WELL PUMP	7.5	6	168	52416.00	$ 5,241.60
	RAPTOR FINE SCREEN NO. 1	2	2	168	17472.00	$ 1,747.20
	RAPTOR FINE SCREEN NO. 2	2	2	168	17472.00	$ 1,747.20
	RAPTOR FINE SCREEN NO. 3 (LAG)	2	2			
	SECONDARY TREATMENT					
	INTERNAL RECIRCULATING PUMP NO. 1	40	30	168	262080.00	$ 26,208.00
	INTERNAL RECIRCULATING PUMP NO. 2	40	30	168	262080.00	$ 26,208.00
	AERATION BASIN SELECTOR ZONE MIXER NO. 1	4	3	168	26208.00	$ 2,620.80
	AERATION BASIN SELECTOR ZONE MIXER NO. 2	4	3	168	26208.00	$ 2,620.80
	AERATION BASIN SELECTOR ZONE MIXER NO. 3	4	3	168	26208.00	$ 2,620.80
	AERATION BASIN SELECTOR ZONE MIXER NO. 4	4	3	168	26208.00	$ 2,620.80
	PROCESS BLOWER NO. 1	100	75	168	655200.00	$ 65,520.00
	PROCESS BLOWER NO. 2	100	75	168	655200.00	$ 65,520.00
	PROCESS BLOWER NO. 3	100	75	168	655200.00	$ 65,520.00
	PROCESS BLOWER NO. 4	60	45	168	393120.00	$ 39,312.00
	PROCESS BLOWER NO. 5 (LAG)	100	75			
	AIR COMPRESSOR NO. 1	15	12	168	104832.00	$ 10,483.20
	AIR COMPRESSOR NO. 2	15	12	168	104832.00	$ 10,483.20
	AIR COMPRESSOR NO. 3 (LAG)	15	12			
	SCUM PUMP	5	4	168	34944.00	$ 3,494.40
	SUMP PUMP	0.33	1	168	8736.00	$ 873.60
	GRUNDFOS UTILITY WATER PUMP NO. 1	5	4	168	34944.00	$ 3,494.40
	GRUNDFOS UTILITY WATER PUMP NO. 2 (LAG)	5	4			
	CAUSTIC SYSTEM - METERING PUMP NO. 1	0.25	1	168	8736.00	$ 873.60
	CAUSTIC SYSTEM - METERING PUMP NO. 2 (LAG)	0.25	1			
	NaOCl - METERING PUMP NO. 1	0.25	1	168	8736.00	$ 873.60
	NaOCl - METERING PUMP NO. 2 (LAG)	0.25	1			
	INSTANTANEOUS WATER HEATER NO. 1		100	168	873600.00	$ 87,360.00
	INSTANTANEOUS WATER HEATER NO. 2 (LAG)		100			
	MBR					
	PERMEATE PUMP NO. 1	25	19	168	165984.00	$ 16,598.40

	PERMEATE PUMP NO. 2	25	19	168	165984.00	$	16,598.40
	PERMEATE PUMP NO. 3	25	19	168	165984.00	$	16,598.40
	PERMEATE PUMP NO. 4	25	19	168	165984.00	$	16,598.40
	RAS PUMP NO. 1	35	27	168	235872.00	$	23,587.20
	RAS PUMP NO. 2	35	27	168	235872.00	$	23,587.20
	RAS PUMP NO. 3	35	27	168	235872.00	$	23,587.20
	RAS PUMP NO. 4	35	27	168	235872.00	$	23,587.20
	MEMBRANE SCOUR BLOWER NO. 1	20	15	168	131040.00	$	13,104.00
	MEMBRANE SCOUR BLOWER NO. 2	20	15	168	131040.00	$	13,104.00
	MEMBRANE SCOUR BLOWER NO. 3	20	15	168	131040.00	$	13,104.00
	MEMBRANE SCOUR BLOWER NO. 4	20	15	168	131040.00	$	13,104.00
	MOTORIZED 8" PLUG VALVE W/ ACTUATOR	10	8	168	69888.00	$	6,988.80
	WAS PUMP NO. 1	2.2	2	42	4368.00	$	436.80
	WAS PUMP NO. 2	2.2	2	42	4368.00	$	436.80
	TERTIARY PUMPING						
	EQ PUMP FROM EFFLUENT DISINFECTION TO POND NO. 1	5	4	168	34944.00	$	3,494.40
	EQ PUMP FROM EFFLUENT DISINFECTION TO POND NO. 2 (LAG)	5	4				
	DIVERSION PUMP NO. 1	15	12	168	104832.00	$	10,483.20
	DIVERSION PUMP NO. 2 (LAG)	15	12				
	PROCESS WATER PUMP NO. 1	5	4	168	34944.00	$	3,494.40
	PROCESS WATER PUMP NO. 2 (LAG)	5	4				
	DISINFECTION						
	UV SYSTEM - TROJAN		6.5	84	28392.00	$	2,839.20
	ENCLOSED UV SYSTEM NO. 1 - EVOQUA		28	84	122304.00	$	12,230.40
	ENCLOSED UV SYSTEM NO. 2 - EVOQUA		28	84	122304.00	$	12,230.40
	ENCLOSED UV SYSTEM NO. 3 - EVOQUA		28	84	122304.00	$	12,230.40
	ENCLOSED UV SYSTEM NO. 4 - EVOQUA (LAG)		28				
	SODIUM HYPCHLORITE PUMP NO. 1	0.25	1	84	4368.00	$	436.80
	SODIUM HYPCHLORITE PUMP NO. 2 (LAG)	0.25	1				
	SUBMERSIBLE PUMP PACKAGE NO. 1	15	12	84	52416.00	$	5,241.60
	SUBMERSIBLE PUMP PACKAGE NO. 2 (LAG)	15	12				
	EFFLUENT PUMP STATION						
	IRRIGATION VERTICAL TURBINE PUMP NO. 1	100	75	84	327600.00	$	32,760.00
	IRRIGATION VERTICAL TURBINE PUMP NO. 2	100	75	84	327600.00	$	32,760.00
	IRRIGATION VERTICAL TURBINE PUMP NO. 3 (LAG)	100	75				
	OTHER						

	COOLANT HEATER		4	168	34944.00	$ 3,494.40
	Labor			132	6600.00	$ 343,200.00
	3 PEOPLE, 8 HRS/DAY, 5 DAYS/WK + COUPLE HOURS ON THE WKND					
	MATERIALS					
	MBR, HYPOCHLORITE			104	3.00	$ 16,224.00
	EFFLUENT HYPOCHLORITE @ 3PPMFOR 7 MGD ($3/GAL)			74	222	$ 11,544.00
					Total kWh/yr	Subtotal
				Liquids O&M Cost Before Inflation	7875777	$ 1,157,863.20
				Liquids O&M Lifecycle Cost (i=3%, n=20-yrs)		$ 17,107,428.78

ALTERNATIVE 3 OPERATION & MAINTENANCE COST							
	DESCRIPTION	HP	KVA/ KW	OPERATING HOURS/WK	kWh/YR	COST ($0.10/KWH)	
	HEADWORKS						
	GRIT PUMP	10	8	168	69888	$	6,988.80
	GRIT PADDLE DRIVE MOTOR	1	1	168	8736	$	873.60
	GRIT SCREW	1	1	168	8736	$	873.60
	WELL PUMP	7.5	6	168	52416	$	5,241.60
	RAPTOR FINE SCREEN NO. 1	2	2	168	17472	$	1,747.20
	RAPTOR FINE SCREEN NO. 2	2	2	168	17472	$	1,747.20
	RAPTOR FINE SCREEN NO. 3 (LAG)	2	2				
	CAS						
	INTERNAL RECIRCULATING PUMP NO. 1	40	30	168	262080	$	26,208.00
	INTERNAL RECIRCULATING PUMP NO. 2	40	30	168	262080	$	26,208.00
	AERATION BASIN SELECTOR ZONE MIXER NO. 1	4	3	168	26208	$	2,620.80
	AERATION BASIN SELECTOR ZONE MIXER NO. 2	4	3	168	26208	$	2,620.80
	AERATION BASIN SELECTOR ZONE MIXER NO. 3	4	3	168	26208	$	2,620.80
	AERATION BASIN SELECTOR ZONE MIXER NO. 4	4	3	168	26208	$	2,620.80
	PROCESS BLOWER NO. 1	100	75	168	655200	$	65,520.00
	PROCESS BLOWER NO. 2	100	75	168	655200	$	65,520.00
	PROCESS BLOWER NO. 3 (LAG)	100	75				
	PROCESS BLOWER NO. 4	60	45	168	393120	$	39,312.00
	DIFFUSERS	4	3	168	26208	$	2,620.80
	SCUM PUMP	5	4	168	34944	$	3,494.40
	SUMP PUMP	0.33	1	168	8736	$	873.60
	GRUNDFOS UTILITY WATER PUMP NO. 1	5	4	168	34944	$	3,494.40
	GRUNDFOS UTILITY WATER PUMP NO. 2	5	4				
	CAUSTIC SYSTEM - METERING PUMP NO. 1	0.25	1	168	8736	$	873.60
	CAUSTIC SYSTEM - METERING PUMP NO. 2 (LAG)	0.25	1				
	NaOCl - METERING PUMP NO. 1	0.25	1	168	8736	$	873.60
	NaOCl - METERING PUMP NO. 2 (LAG)	0.25	1				
	INSTANTANEOUS WATER HEATER NO. 1		100	168	873600	$	87,360.00
	INSTANTANEOUS WATER HEATER NO. 2 (LAG)		100				
	CLARIFIERS						
	54' DIAMTER	100	75	168	655200	$	65,520.00
	54' DIAMTER	100	75	168	655200	$	65,520.00
	FILTRATION						

	EQ PUMP FROM EFFLUENT FILTRATION TO POND NO. 1	5	4	168	34944	$	3,494.40
	EQ PUMP FROM EFFLUENT FILTRATION TO POND NO. 2	5	4				
	FEED PUMP 1	50	38	144	284544	$	28,454.40
	FEED PUMP 2	50	38	144	284544	$	28,454.40
	FEED PUMP 3	50	38	144	284544	$	28,454.40
	FEED PUMP 4	50	38	144	284544	$	28,454.40
	BACKWASH PUMP	50	38	18	35568	$	3,556.80
	CIP	20	15	10	7800	$	780.00
	HEATER 1		24	40	49920	$	4,992.00
	HEATER 2		24	40	49920	$	4,992.00
	COMPRESSOR	15	12	2.5	1560	$	156.00
	DIVERSION PUMP NO. 1	15	12	168	104832	$	10,483.20
	DIVERSION PUMP NO. 2	15	12	168	104832	$	10,483.20
	PROCESS WATER PUMP NO. 1	5	4	168	34944	$	3,494.40
	PROCESS WATER PUMP NO. 2	5	4	168	34944	$	3,494.40
	DISINFECTION						
	UV SYSTEM - TROJAN	6.5	6.5	84	28392	$	2,839.20
	ENCLOSED UV SYSTEM NO. 1 - EVOQUA		28	84	122304	$	12,230.40
	ENCLOSED UV SYSTEM NO. 2 - EVOQUA		28	84	122304	$	12,230.40
	ENCLOSED UV SYSTEM NO. 3 - EVOQUA		28	84	122304	$	12,230.40
	ENCLOSED UV SYSTEM NO. 4 - EVOQUA (LAG)		28				
	SODIUM HYPCHLORITE PUMP NO. 1	0.25	1	84	4368	$	436.80
	SODIUM HYPCHLORITE PUMP NO. 2	0.25	1				
	SUBMERSIBLE PUMP PACKAGE NO. 1	15	12	84	52416	$	5,241.60
	SUBMERSIBLE PUMP PACKAGE NO. 2	15	12				
	EFFLUENT PUMP STATION						
	IRRIGATION VERTICAL TURBINE PUMP NO. 1	100	75	84	327600	$	32,760.00
	IRRIGATION VERTICAL TURBINE PUMP NO. 2	100	75	84	327600	$	32,760.00
	IRRIGATION VERTICAL TURBINE PUMP NO. 3	100	75				
	OTHER						
	COOLANT HEATER		4	168	34944	$	3,494.40
	Labor			132	6600	$	343,200.00
	3 PEOPLE, 8 HRS/DAY, 5 DAYS/WK + COUPLE HOURS ON THE WKND						

	MATERIALS					
	MBR, HYPOCHLORITE			104	3	$ 16,224.00
	EFFLUENT HYPOCHLORITE @ 3PPMFOR 7 MGD ($3/GAL)			74	222	$ 11,544.00
					Total kWh/yr	Subtotal
				Liquids O&M Cost Before Inflation	7560033	$ 1,126,288.80
				Liquids O&M Lifecycle Cost (i-3%, n=20-yrs)		$ 16,756,361.62

The table below sumamrizes the annual costs for operating either the full CAS system or MBR system for the secondary process. It includes the annual electrical costs to pump and aerate either system. The MBR O&M cost includes the cost to supply hypochlorite each year to ensure that the membranes can be cleaned on a regular basis and preserve their performance.

Treatment	Operation	Annual Cost
CAS	Pumping	$127,000
	Aeration	$302,000
MBR	Pumping	$166,000
	Aeration	$390,000
	Chemical Supply	$16,000

ii. Biosolids Treatment Concept Costs

Biosolids Concept 1 Capital Costs

Item		Cost
Solids Digestion		$4,900,000
Solids Dewatering		$2,900,000
Solids Drying		$8,400,000
Solids Storage		$900,000
Subtotals		$17,100,000
Division 1 Costs @	12%	$2,100,000
Subtotals		$19,200,000
Contractor OH&P @	8%	$1,600,000
Subtotals		$20,800,000
Estimate Contingency @	30%	$6,300,000
Subtotal		$27,100,000
Engineering, Legal, Administrative @	25%	$6,800,000
Subtotal		$33,900,000
Market Conditions Contingency	10%	$3,400,000
Subtotal		$37,300,000
Escalate to Midpt of Const. @	13%	$4,900,000
Total Estimate after Markups		$43,000,000

Biosolids Concept 1 Energy Costs

Process Description		HP	RATED KW	OPERATING HOURS/WK	kWh/YR	COST ($0.10/KWH)
Solids Dewatering						
	Screw Press 1	3	2.2371	120	13,960	$1,396
	Screw Press 2 (lag)					
Digester						
	Blower 1	125	93.2125	168	814,304	$81,430
	Blower 2	125	93.2125	168	814,304	$81,430
	Blower 3 (lag)	125	93.2125			
	Progressive Cavity Pump 1	30	22.371	168	195,433	$19,543
	Progressive Cavity Pump 2 (lag)	30	22.371			
ASSB						
	Rotary lobe blower	25	18.6425	168	162,861	$16,286
	Sludge Transfer Pump 1	10	7.457	168	65,144	$6,514
	Sludge Transfer Pump 2	10	7.457	168	65,144	$6,514
	Decant Pump 1	0.5	0.37285	168	3,257	$326
	Decant Pump 2	0.5	0.37285	168	3,257	$326
	Decant Pump 3 (lag)	0.5	0.37285			
Dryer						
	Paddle Dryer	60	44.742	120	279,190	$27,919
	Natural Gas (270 Therms/day to dry 17.2 cy/day of 18% solids to 90%)		9.136	120	57,010	$31,304 ($0.45/therm)
Sum of Energy Costs Before Inflation					2,473,865	$272,990
Solids Energy Life-Cycle Costs (i=3%, n=20-yrs)						$4,061,402

Biosolids Concept 2 Capital Costs

Item		Cost
Solids Dewatering		$ 2,900,000
Solids Drying		$ 8,400,000
Solids Storage		$ 900,000
Subtotals		$ 12,200,000
Division 1 Costs @	12%	$ 1,500,000
Subtotals		$ 13,700,000
Contractor OH&P @	8%	$ 1,100,000
Subtotals		$ 14,800,000
Estimate Contingency @	30%	$ 4,500,000
Subtotal		$ 19,300,000
Engineering, Legal, Administrative @	25%	$ 4,900,000
Subtotal		$ 24,200,000
Market Conditions Contingency	10%	$ 2,500,000
Subtotal		$ 26,700,000
Escalate to Midpt of Const. @	13%	$ 3,500,000
Total Estimate after Markups		$ 31,000,000

Biosolids Concept 2 Energy Costs

Process Description		HP	RATED KW	OPERATING HOURS/WK	kWh/YR	COST ($0.10/KWH)
Solids Dewatering						
	Screw Press 1	3	2.2371	120	13,960	$1,396
	Screw Press 2 (lag)					
ASSB						
	Rotary lobe blower	25	18.6425	168	162,861	$16,286
	Sludge Transfer Pump 1	10	7.457	168	65,144	$6,514
	Sludge Transfer Pump 2	10	7.457	168	65,144	$6,514
	Decant Pump 1	0.5	0.37285	168	3,257	$326
	Decant Pump 2	0.5	0.37285	168	3,257	$326
	Decant Pump 3 (lag)	0.5	0.37285			
Dryer						
	Paddle Dryer	60	44.742	120	279,190	$27,919
	Natural Gas (270 Therms/day to dry 17.2 cy/day of 18% solids to 90%)		9.136	120	57,010	$31,304 ($0.45/therm)
Sum of Energy Costs Before Inflation					649,823	$90,586
Solids Energy Life-Cycle Costs (i=3%, n=20-yrs)						$1,347,684

Biosolids Concept 3 Capital Costs

Item		Cost
Solids Digestion		$4,900,000
Solids Dewatering		$2,900,000
Solids Storage		$100,000
Subtotals		$7,900,000
Division 1 Costs @	12%	$1,000,000
Subtotals		$8,900,000
Contractor OH&P @	8%	$800,000
Subtotals		$9,700,000
Estimate Contingency @	30%	$3,000,000
Subtotal		$12,700,000
Engineering, Legal, Administrative @	25%	$3,200,000
Subtotal		$15,900,000
Market Conditions Contingency	10%	$1,600,000
Subtotal		$17,500,000
Escalate to Midpt of Const. @	13%	$2,300,000
Total Estimate after Markups		$20,000,000

Biosolids Concept 3 Energy Costs

Process Description		HP	RATED KW	OPERATING HOURS/WK	kWh/YR	COST ($0.10/KWH)
Solids Dewatering						
	Screw Press 1	3	2.2371	120	13,960	$1,396
	Screw Press 2 (lag)					
Digester						
	Blower 1	125	93.2125	168	814,304	$81,430
	Blower 2	125	93.2125	168	814,304	$81,430
	Blower 3 (lag)	125	93.2125			
	Progressive Cavity Pump 1	30	22.371	168	195,433	$19,543
	Progressive Cavity Pump 2 (lag)	30	22.371			
ASSB						
	Rotary lobe blower	25	18.6425	168	162,861	$16,286
	Sludge Transfer Pump 1	10	7.457	168	65,144	$6,514
	Sludge Transfer Pump 2	10	7.457	168	65,144	$6,514
	Decant Pump 1	0.5	0.37285	168	3,257	$326
	Decant Pump 2	0.5	0.37285	168	3,257	$326
	Decant Pump 3 (lag)	0.5	0.37285			
Sum of Energy Costs Before Inflation					2,137,665	$213,767
Solids Energy Life-Cycle Costs (i=3%, n=20-yrs)						$3,180,312

Biosolids Concept 4 Capital Costs

Item		Cost
Solids Dewatering		$2,900,000
Subtotals		$2,900,000
Division 1 Costs @	12%	$400,000
Subtotals		$3,300,000
Contractor OH&P @	8%	$300,000
Subtotals		$3,600,000
Estimate Contingency @	30%	$1,100,000
Subtotal		$4,700,000
Engineering, Legal, Administrative @	25%	$1,200,000
Subtotal		$5,900,000
Market Conditions Contingency	10%	$600,000
Subtotal		$6,500,000
Escalate to Midpt of Const. @	13%	$900,000
Total Estimate after Markups		$8,000,000

Biosolids Concept 4 Energy Costs

Process Description		HP	RATED KW	OPERATING HOURS/WK	kWh/YR	COST ($0.10/KWH)
Solids Dewatering						
	Screw Press 1	3	2.2371	120	13,960	$1,396
	Screw Press 2 (lag)					
ASSB						
	Rotary lobe blower	25	18.6425	168	162,861	$16,286
	Sludge Transfer Pump 1	10	7.457	168	65,144	$6,514
	Sludge Transfer Pump 2	10	7.457	168	65,144	$6,514
	Decant Pump 1	0.5	0.37285	168	3,257	$326
	Decant Pump 2	0.5	0.37285	168	3,257	$326
	Decant Pump 3 (lag)	0.5	0.37285			
Sum of Energy Costs Before Inflation					313,624	$31,362
Solids Energy Life-Cycle Costs (i=3%, n=20-yrs)						$466,593

iii. Complete Alternative-Level Cost Assumptions, Inclusions, and Exclusions

The followings general assumptions were made in the preparation of this estimate:

- Project will be publicly bid project.
- Prevailing wage requirements will apply.
- Assume there will be at least 3 qualified bids submitted.
- Assumes mat foundations for structures. No piles foundations or ground improvements are included. (Geotechnical investigations have not yet been completed)
- Assume all excess excavated material is hauled and disposed of.
- Assume all demolished material will be hauled and disposed of.
- E/I&C is included as a percentage of construction cost for each alternative.
- Various demolition will be necessary for the fine screen/headworks, secondary clarifier, UV disinfection, recycled water pumps, and dewatering building areas.
- Dewatering and shoring will occur for all below grade structural excavation areas.
- If not provided with the quote, install cost for the process equipment are assumed to be between 25% and 30% of the material cost.
- HVAC costs for buildings are assumed to be $25 per square foot.
- Plumbing costs for building are assumed to be $25 per square foot.

The following electrical, instrumentation and controls (I&C) assumptions were made in preparation of this estimate:

- Electrical and I&C were assumed to be 30% of the other project costs.

The estimate does not include the following:

- Hazardous materials (lead paint, asbestos, PCBs, etc.) removal or disposal in not included.
- Soil remediation, testing, removal, or disposal.
- Design, Construction Engineering, Construction Management or Inspection, Administration and Legal Costs

The following allowances, contingencies, and non-contract cost percentages are applied to the subtotal materials, installation, sub-contractor costs for each alternative.

- **Division 1 costs:** 12 percent is applied to the overall subtotal to reflect administration requirements.
- **Taxes:** 0 percent is applied to materials, as this job is in the state of Oregon.
- **Contractor Markup for Subcontractor:** 12 percent is applied to the overall subtotal.
- **Contractor OH&P:** 15 percent is applied to the overall subtotal.
- **Estimate Contingency:** 30 percent is applied to the overall subtotal to provide flexibility for contractors' overruns on quantities, changed site conditions, change orders, etc.
- **Bonds & Insurance:** 3 percent is applied to the overall subtotal to account for bonds and insurance for the prime contractor.
- **Market Conditions Contingency:** 5 percent is applied to the overall subtotal to account for the increase in cost relative to the competitive or lack or competitive nature of the local market
- **Escalate to Midpoint:** 12.6 percent is applied to the overall subtotal given the respective phase's midpoint (48 months).
- **Engineering, Legal, Administrative Costs:** 25 percent is applied to the overall subtotal for soft costs relative to engineering, legal and administrative services.

OPINION OF PROBABLE CONSTRUCTION COST | **KENNEDY/JENKS CONSULTANTS**

Project: Alternative 1 - Expand Existing Conventional Activated Sludge

Building, Area: N/A

Prepared By: KMC
Date Prepared: 5/24/2024
K/J Proj. No.

Estimate Type:

- [x] **Conceptual**
- [ ] **Preliminary (w/o plans)**
- [ ] **Design Development @** 10 **% Complete**
- [ ] **Construction**
- [ ] **Change Order**

Months to Midpoint of Construct 48

Spec.	Area	Item				Materials		Installation		Sub-contractor		
Section	No.	No.	Description	Qty	Units	$/Unit	Total	$/Unit	Total	$/Unit	Total	Total
	1	Site Work & Yard Piping	Site Grading	7,500	CY	$35	$262,500	$7	$50,625			$313,125
	1	Site Work & Yard Piping	Fine Grading	4,500	SY			$5	$22,500			$22,500
	1	Site Work & Yard Piping	Clear & Grub	4,500	SY			$3	$13,500			$13,500
	1	Site Work & Yard Piping	Haul and Dispose Excavated Material		CY	$25		$18				
	1	Site Work & Yard Piping	Erosion Control	1	LS	$5,000	$5,000	$2,800	$2,800			$7,800
	1	Site Work & Yard Piping	Excavation/Backfill for Manholes	11	CY			$20	$214			$214
	1	Site Work & Yard Piping	Pipeline in Paving	3,005	LF							
	1	Site Work & Yard Piping	Sawcut Paving 4" thick	6,010	LF			$3	$18,030			$18,030
	1	Site Work & Yard Piping	Remove Dispose Paving 4" Thick	1,669	SY			$15	$25,042			$25,042
	1	Site Work & Yard Piping	Trenching 5' wide x 14' deep	7,791	BCY			$15	$116,861			$116,861
	1	Site Work & Yard Piping	Pipe Bedding	556	CY	$45	$25,042	$28	$15,799			$40,840
	1	Site Work & Yard Piping	Pipe Backfill Native	6,885	CY			$28	$195,458			$195,458
	1	Site Work & Yard Piping	Haul and Dispose Excess Excavated Materials - Soil/Paveme	1,090	LCY			$25	$27,244			$27,244
	1	Site Work & Yard Piping	Rock Excavation		LCY			$48				
	1	Site Work & Yard Piping	Haul and Dispose Excess Excavated Materials - Rock		LCY			$85				
	1	Site Work & Yard Piping	Dewatering	3,005	LF			$2	$6,010			$6,010
	1	Site Work & Yard Piping	Trench Plates	30	EA	$200	$6,000	$63	$1,875			$7,875
	1	Site Work & Yard Piping	Paving Restoration over Trench	1,669	SY					$125	$208,681	$208,681
	1	Site Work & Yard Piping	Tack Coat	1,669	SY					$3	$5,008	$5,008
	1	Site Work & Yard Piping	Grind Paving 1' Each Side of Trench	6,010	SF					$2	$9,015	$9,015
	1	Site Work & Yard Piping	Pothole Utility Locate		EA					$1,500		
	1	Site Work & Yard Piping	Additional / Slower Excavation at Utilities Crossings Water	10	EA	$200	$2,000	$500	$5,000			$7,000
	1	Site Work & Yard Piping	Additional / Slower Excavation at Utilities Crossings Elec/ G	5	EA	$500	$2,500	$1,500	$7,500			$10,000
	1	Site Work & Yard Piping	Additional / Slower Excavation at Utilities Crossings - SD	5	EA	$500	$2,500	$2,500	$12,500			$15,000
	1	Site Work & Yard Piping	Trenching 3' wide x 5' deep		BCY			$11				
	1	Site Work & Yard Piping	Pipe Bedding / Backfill CDF 8"		CY	$200		$28				
	1	Site Work & Yard Piping	Fire Hydrant Line 6" Pipe		LF	$11		$8				
	1	Site Work & Yard Piping	Traffic Controls at Street Crossings/ Connections		EA					$3,000		
	1	Site Work & Yard Piping	Pavement Markings		EA	$100		$350				
	1	Site Work & Yard Piping	Pipeline in Non Pavement	2,190	LF							
	1	Site Work & Yard Piping	Trenching 5' wide x 14' deep	5,678	BCY			$15	$85,167			$85,167
	1	Site Work & Yard Piping	Pipe Bedding	406	CY	$45	$18,250	$28	$11,514			$29,764
	1	Site Work & Yard Piping	Pipe Backfill Native	5,017	CY			$28	$142,447			$142,447
	1	Site Work & Yard Piping	Haul and Dispose Excess Excavated Materials - Soil	660	LCY			$25	$16,509			$16,509
	1	Site Work & Yard Piping	Dewatering	2,190	LF			$12	$26,280			$26,280
	1	Site Work & Yard Piping	Grass /Seeding Restoration	1,217	SY					$10	$12,167	$12,167
	1	Site Work & Yard Piping	AC Pavement / Site Surfacing	5,925	SY					$35	$207,367	$207,367
	1	Site Work & Yard Piping	Base Course Under Paving (10")	5,925	SY	$23	$136,270	$3	$17,206			$153,475
	1	Site Work & Yard Piping	Storm Water Drainage - Catch Basins	6	EA	$1,269	$7,614	$352	$2,114			$9,728
	1	Site Work & Yard Piping	Excavation for SD Pipe/Catch Basins	12	CY			$9	$108			$108
	1	Site Work & Yard Piping	Backfill for SD Pipe/Catch Basins	3	CY			$14	$42			$42
	1	Site Work & Yard Piping	Landscaping Allowance	1	LS					$15,000	$15,000	$15,000
	1	Site Work & Yard Piping	Traffic Control	1	LS	$15,000	$15,000					$15,000
	1	Site Work & Yard Piping	Drain Manhole		EA	$4,703		$3,800				
	1	Site Work & Yard Piping	Connection to Exsiting SSMH		EA			$2,000				
	1	Site Work & Yard Piping	Trenching 8" PVC Sewer w/ Box		CY			$25				
	1	Site Work & Yard Piping	Haul and Dispose Excavated Material		CY			$15				

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY/JENKS CONSULTANTS**

Project: Alternative 1 - Expand Existing Conventional Activated Sludge **Prepared By:** KMC

Date Prepared: 5/24/2024

Building, Area: N/A **K/J Proj. No.**

Estimate Type: [x] **Conceptual** [ ] **Construction**

[ ] **Preliminary (w/o plans)** [ ] **Change Order** **Months to Midpoint of Construct** 48

[ ] **Design Development @** 10 **% Complete**

Spec. Section	Area No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
	1	Site Work & Yard Piping	8" PVC Sewer Pipe		LF	$30		$18				
		SUBTOTALS					$482,676		$822,344		$457,238	$1,762,257
		75% (due to solids being other 25%)					$362,007		$616,758		$342,928	$1,321,693
		ELECTRICAL/I&C										
	2	Electrical/I&C - General	Electrical Allowance	1	LS		$1,923,178		$518,141		$143,195	$2,584,513
	2	lectrical/I&C - Fine Screen Headwork	Luminaire	1	EA	$525	$525	$255	$255			$780
	2	Electrical/I&C - MBR/Aeration Basin	Luminaire	4	EA	$525	$2,100	$255	$1,018			$3,118
	2	Electrical/I&C - New Tertiary Filtratior	Luminaire	4	EA	$525	$2,100	$255	$1,018			$3,118
	2	Electrical/I&C - General	I&C Allowance	1	LS		$641,059		$172,714		$47,732	$861,504
		SUBTOTALS					$2,568,962		$693,145		$190,926	$3,453,034
		HEADWORKS										
	3	Fine Screen/Headworks	Demolish Existing Fine Screen in Existing Headworks	8	HR			$250	$2,000			$2,000
	3	Fine Screen/Headworks	Load/Haul/Dump	10	CY	$25	$250	$18	$180			$430
	3	Fine Screen/Headworks	Structural Excavation	57	BCY			$23	$1,286			$1,286
	3	Fine Screen/Headworks	Haul and Dispose Excavated Material	57	LCY	$25	$1,424	$18	$1,025			$2,449
	3	Fine Screen/Headworks	Aggregate Base under Structures (12")	57	SF	$4	$235	$1	$32			$267
	3	Fine Screen/Headworks	Manhole - 48"	2	EA	$2,330	$4,660	$2,225	$4,450			$9,110
	3	Fine Screen/Headworks	Hose Bib	1	EA	$100	$100	$250	$250			$350
	3	Fine Screen/Headworks	Pipe, 24" DI, RAW	160	LF	$197	$31,520	$51	$8,160			$39,680
	3	Fine Screen/Headworks	Pipe Fittings 24" 12.5/22.5/45 FELC	4	EA	$8,000	$32,000	$509	$2,036			$34,036
	3	Fine Screen/Headworks	Tracer Wire	160	LF	$1	$80	$1	$160			$240
	3	Fine Screen/Headworks	Pipe Marking Tape	160	LF	$0	$5	$0	$5			$10
	3	Fine Screen/Headworks	Pipe Restraints , 24"	4	EA	$482	$1,928	$318	$1,272			$3,200
	3	Fine Screen/Headworks	Pipe, 6" DI, DRAIN	110	LF	$24	$2,679	$7	$803			$3,482
	3	Fine Screen/Headworks	Pipe Fittings 6" 12.5/22.5/45 FELC	3	EA	$451	$1,239	$163	$448			$1,687
	3	Fine Screen/Headworks	Tracer Wire	110	LF	$1	$55	$1	$110			$165
	3	Fine Screen/Headworks	Pipe Marking Tape	110	LF	$0	$3	$0	$4			$7
	3	Fine Screen/Headworks	Pipe Restraints , 6"	3	EA	$41	$114	$82	$224			$338
	3	Fine Screen/Headworks	Pipe, 1" DI, PW	110	LF	$25	$2,735	$7	$759			$3,494
	3	Fine Screen/Headworks	Pipe Fittings 1" 12.5/22.5/45 FELC	3	EA	$266	$732	$131	$361			$1,093
	3	Fine Screen/Headworks	Tracer Wire	110	LF	$1	$55	$1	$110			$165
	3	Fine Screen/Headworks	Pipe Marking Tape	110	LF	$0	$3	$0	$4			$7
	3	Fine Screen/Headworks	Pipe Restraints , 1"	3	EA	$34		$66	$180			$180
	3	Fine Screen/Headworks	Pipe, 2" DI Waterline	500	LF	$25	$12,430	$7	$3,450			$15,880
	3	Fine Screen/Headworks	Pipe Fittings 2" 12.5/22.5/45 FELC	10	EA	$266	$2,663	$131	$1,311			$3,974
	3	Fine Screen/Headworks	Tracer Wire	500	LF	$1	$250	$1				$250
	3	Fine Screen/Headworks	Pipe Marking Tape	500	LF	$0	$15	$0	$16			$31
	3	Fine Screen/Headworks	Pipe Restraints , 2"	10	EA	$34	$337	$66	$656			$993
	3	Fine Screen Headworks	Foundation Prep	47	SY			$5	$233			$233
	3	Fine Screen Headworks	Slab	47	CY	$300	$14,008	$350	$16,343			$30,351
	3	Fine Screen Headworks	Walls	35	CY	$330	$11,693	$534	$18,921			$30,613
	3	Fine Screen Headworks	Stairs	5	EA	$730	$3,650	$84	$420			$4,070
	3	Fine Screen Headworks	Metal Support for Stairs Allowance	1	LS	$365	$365	$42	$42			$407
	3	Fine Screen Headworks	Handrail	20	LF	$41	$820	$18	$353			$1,173
	3	Fine Screen Headworks	Stop Gates	3	EA			$1,500	$4,500	$3,039	$9,116	$13,616

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY/JENKS CONSULTANTS**

Project: Alternative 1 - Expand Existing Conventional Activated Sludge

Building, Area: N/A

Prepared By: KMC
Date Prepared: 5/24/2024
K/J Proj. No.

Estimate Type:

- [x] **Conceptual**
- [ ] **Preliminary (w/o plans)**
- [ ] **Design Development @** 10 **% Complete**
- [ ] **Construction**
- [ ] **Change Order**

Months to Midpoint of Construct 48

Spec. Section	Area No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
	3	Fine Screen Headworks	Fine Screen Units: Basket Screens (2hp motors)	2	EA			$59,600	$119,200	$238,400	$476,800	$596,000
	3	Fine Screen Headworks	Manually Cleaned Bar Rack	1	EA			$3,039	$3,039	$6,078	$6,078	$9,116
		SUBTOTALS					$126,046		$192,343		$491,994	$810,382
		AERATION BASINS										
	4	MBR/Aeration Basins	Foundation Excavation	17,738	BCY			$23	$400,622			$400,622
	4	MBR/Aeration Basins	Haul and Dispose Excavated Material	14,191	LCY	$25	$354,769	$18	$255,433			$610,202
	4	MBR/Aeration Basins	Aggregate Base under Structures (12")	750	SF	$4	$3,090	$1	$422			$3,512
	4	MBR/Aeration Basins	Surge Basin Fill & Grading for AB Trains 3-4	3,889	LCY	$35	$136,111	$15	$58,333			$194,444
	4	MBR/Aeration Basins	Surge Basin Liner Repair	10,500	LCY	$1	$13,125	$2	$21,000			$34,125
	4	MBR/Aeration Basins	Pipe, 24", DI, ML	815	LF	$197	$160,555	$51	$41,565			$202,120
	4	MBR/Aeration Basins	Pipe Fittings 24" 12.5/22.5/45 FELC	5	EA	$8,000	$43,467	$509	$2,766			$46,232
	4	MBR/Aeration Basins	Tracer Wire	815	LF	$1	$408	$1	$815			$1,223
	4	MBR/Aeration Basins	Pipe Marking Tape	815	LF	$0	$24	$0	$26			$51
	4	MBR/Aeration Basins	Pipe Restraints , 24"	5	EA	$482	$2,619	$318	$1,728			$4,347
	4	MBR/Aeration Basins	Pipe, 16", DI	200	LF	$60	$11,914	$21	$4,261			$16,175
	4	MBR/Aeration Basins	Pipe Fittings 16" 12.5/22.5/45 FELC	6	EA	$3,133	$18,798	$335	$2,010			$20,808
	4	MBR/Aeration Basins	Tracer Wire	200	LF	$1	$100	$1	$200			$300
	4	MBR/Aeration Basins	Pipe Marking Tape	200	LF	$0	$6	$0	$6			$12
	4	MBR/Aeration Basins	Pipe Restraints , 16"	6	EA	$198	$1,188	$209	$1,251			$2,439
	4	MBR/Aeration Basins	Pipe, 10", DI	300	LF	$53	$15,852	$13	$4,010			$19,862
	4	MBR/Aeration Basins	Pipe Fittings 10" 12.5/22.5/45 FELC	8	EA	$1,113	$8,904	$212	$1,698			$10,602
	4	MBR/Aeration Basins	Tracer Wire	300	LF	$1	$150	$1	$300			$450
	4	MBR/Aeration Basins	Pipe Marking Tape	300	LF	$0	$9	$0	$10			$19
	4	MBR/Aeration Basins	Pipe Restraints , 10"	8	EA	$115	$920	$133	$1,064			$1,984
	4	MBR/Aeration Basins	Pipe, 8", DI, RAS	1,030	LF	$34	$35,216	$12	$12,516			$47,732
	4	MBR/Aeration Basins	Pipe Fittings 8" 12.5/22.5/45 FELC	18	EA	$673	$12,121	$228	$4,098			$16,219
	4	MBR/Aeration Basins	Tracer Wire	1,030	LF	$1	$515	$1	$1,030			$1,545
	4	MBR/Aeration Basins	Pipe Marking Tape	1,030	LF	$0	$31	$0	$33			$64
	4	MBR/Aeration Basins	Pipe Restraints , 8"	18	EA	$63	$1,138	$114	$2,048			$3,186
	4	MBR/Aeration Basins	Pipe, 1" DI, PW	710	LF	$25	$17,651	$7	$4,899			$22,550
	4	MBR/Aeration Basins	Pipe Fittings 1" 12.5/22.5/45 FELC	18	EA	$266	$4,726	$131	$2,327			$7,053
	4	MBR/Aeration Basins	Tracer Wire	710	LF	$1	$355	$1	$710			$1,065
	4	MBR/Aeration Basins	Pipe Marking Tape	710	LF	$0	$21	$0	$23			$44
	4	MBR/Aeration Basins	Pipe Restraints , 1"	18	EA	$34		$66	$1,164			$1,164
	4	MBR/Aeration Basins	Pipe, 6" DI, OVERFLOW	90	LF	$24	$2,192	$7	$657			$2,849
	4	MBR/Aeration Basins	Pipe Fittings 6" 12.5/22.5/45 FELC	2	EA	$451	$1,014	$163	$366			$1,380
	4	MBR/Aeration Basins	Tracer Wire	90	LF	$1	$45	$1	$90			$135
	4	MBR/Aeration Basins	Pipe Marking Tape	90	LF	$0	$3	$0	$3			$6
	4	MBR/Aeration Basins	Pipe Restraints , 6"	2	EA	$41	$93	$82	$184			$277
	4	MBR/Aeration Basins	Pipe, 1" DI, PW	110	LF	$25	$2,735	$7	$759			$3,494
	4	MBR/Aeration Basins	Pipe Fittings 1" 12.5/22.5/45 FELC	3	EA	$266	$732	$131	$361			$1,093
	4	MBR/Aeration Basins	Tracer Wire	110	LF	$1	$55	$1	$110			$165
	4	MBR/Aeration Basins	Pipe Marking Tape	110	LF	$0	$3	$0	$4			$7
	4	MBR/Aeration Basins	Pipe Restraints , 1"	3	EA	$34		$66	$180			$180
	4	MBR/Aeration Basins	Foundation Prep	1,703	SY			$5	$8,514			$8,514
	4	MBR/Aeration Basins	Slab	1,419	CY	$300	$425,722	$350	$496,676			$922,398

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY/JENKS CONSULTANTS**

Project: Alternative 1 - Expand Existing Conventional Activated Sludge

Building, Area: N/A

Prepared By: KMC
Date Prepared: 5/24/2024
K/J Proj. No.

Estimate Type:

- [x] **Conceptual**
- [ ] **Preliminary (w/o plans)**
- [ ] **Design Development @** 10 **% Complete**
- [ ] **Construction**
- [ ] **Change Order**

Months to Midpoint of Construct 48

Spec. Section	Area No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
	4	MBR/Aeration Basins	Walls	1,806	CY	$750	$1,354,708	$750	$1,354,708			$2,709,417
	4	MBR/Aeration Basins	FRP or Aluminum Grating	1,900	SF	$38	$72,200	$8	$15,200			$87,400
	4	MBR/Aeration Basins	Handrail	1,070	LF	$41	$43,870	$18	$18,867			$62,737
	4	MBR/Aeration Basins	Stairs	30	EA	$730	$21,900	$84	$2,523			$24,423
	4	MBR/Aeration Basins	Metal Support for Stairs Allowance	1	LS	$2,190	$2,190	$252	$252			$2,442
	4	MBR/Aeration Basins	Utility Pump Station									
	4	MBR/Aeration Basins	*Motorized 8" Plug Valve w/ Actuator*	*1*	*EA*	*$4,850*	*$4,850*	*$500*	*$500*			$5,350
	4	MBR/Aeration Basins	*10" SS Air Piping*	*20*	*LF*	*$90*	*$1,800*	*$88*	*$1,767*			$3,567
	4	MBR/Aeration Basins	*8" SS Air Piping*	*10*	*LF*	*$259*	*$2,590*	*$67*	*$671*			$3,261
	4	MBR/Aeration Basins	*6" SS Air Piping*	*10*	*LF*	*$200*	*$2,000*	*$55*	*$548*			$2,548
	4	MBR/Aeration Basins	*6" BFV*	*2*	*EA*	*$1,600*	*$3,200*	*$110*	*$220*			$3,420
	4	MBR/Aeration Basins	*8" BFV*	*2*	*EA*	*$2,325*	*$4,650*	*$141*	*$282*			$4,932
	4	MBR/Aeration Basins	*10" Pipe Supports*	*8*	*EA*	*$107*	*$856*	*$40*	*$323*			$1,179
	4	MBR/Aeration Basins	Recycle Pumps	*8*	*EA*	$16,040	*$128,320*					$128,320
	4	MBR/Aeration Basin	18" DI MLR Pipe	320	LF	$66	$21,216	$24	$7,777			$28,993
	4	MBR/Aeration Basin	18" Pipe Supports	16	EA	$379	$6,064	$40	$644			$6,708
	4	MBR/Aeration Basin	10" SS Air Header Pipe	370	LF	$90	$33,300	$88	$32,680			$65,980
	4	MBR/Aeration Basin	10" Pipe Supports	19	EA	$105	$1,943	$20	$362			$2,304
	4	MBR/Aeration Basin	8" DI Pipe	1,640	LF	$34	$56,072	$12	$19,928			$76,000
	4	MBR/Aeration Basin	8" Pipe Supports	82	EA	$57	$4,674	$17	$1,415			$6,089
		SUBTOTALS					$3,042,777		$2,792,940			$5,835,716
		SECONDARY CLARIFIER										
		Clarifier Splitter Box - Demo ASSB Bld	Old ASSB blower building to make room for clarifier splitter b	12,000	CF			$0.37	$4,440			$4,440
		Clarifier Splitter Box - Demo Bldg Slal	Old ASSB blower building slab	1,000	CF			$31	$30,930			$30,930
	5	Secondary Clarifier	Demolish Internals of Existing Aeration Stabilization	24	HR			$250	$6,000			$6,000
	5	Secondary Clarifier	Load/Haul/Dump	60	CY	$25	$1,500	$18	$1,080			$2,580
	5	Secondary Clarifier	Foundation Excavation	349	BCY			$23	$7,884			$7,884
	5	Secondary Clarifier	Haul and Dispose Excavated Material	279	LCY	$25	$6,981	$18	$5,027			$12,008
	5	Secondary Clarifier	Aggregate Base under Structures (12")	5,027	SF	$4	$20,709	$1	$2,830			$23,539
	5	Clarifier Splitter Box	Foundation Excavation	222	BCY			$23	$5,019			$5,019
	5	Clarifier Splitter Box	Haul and Dispose Excavated Material	278	LCY	$25	$6,944	$18	$5,000			$11,944
	5	Clarifier Splitter Box	Aggregate Base under Structures (12")	714	SF	$4	$2,942	$1	$402			$3,344
	5	Secondary Clarifier	Hose Bib	1	EA	$100	$100	$250	$250			$350
	5	Secondary Clarifier	Pipe, 20", DI	720	LF	$69	$49,601	$27	$19,707			$69,308
	5	Secondary Clarifier	Pipe Fittings 20" 12.5/22.5/45 FELC	12	EA	$5,293	$63,516	$426	$5,109			$68,625
	5	Secondary Clarifier	Tracer Wire	720	LF	$1	$360	$1	$720			$1,080
	5	Secondary Clarifier	Pipe Marking Tape	720	LF	$0	$21	$0	$23			$45
	5	Secondary Clarifier	Pipe Restraints , 20"	12	EA	$347	$4,165	$266	$3,193			$7,357
	5	Secondary Clarifier	Pipe, 8", DI	300	LF	$34	$10,257	$12	$3,645			$13,902
	5	Secondary Clarifier	Pipe Fittings 8" 12.5/22.5/45 FELC	8	EA	$673	$5,387	$228	$1,821			$7,208
	5	Secondary Clarifier	Tracer Wire	300	LF	$1	$150	$1	$300			$450
	5	Secondary Clarifier	Pipe Marking Tape	300	LF	$0	$9	$0	$10			$19
	5	Secondary Clarifier	Pipe Restraints , 8"	8	EA	$63	$506	$114	$910			$1,416
	5	Secondary Clarifier	Pipe, 6", DI, OVERFLOW	10	LF	$24	$244	$7	$73			$317
	5	Secondary Clarifier	Pipe Fittings 6" 12.5/22.5/45 FELC	2	EA	$451	$901	$163	$326			$1,227

OPINION OF PROBABLE CONSTRUCTION COST — **KENNEDY/JENKS CONSULTANTS**

Project: Alternative 1 - Expand Existing Conventional Activated Sludge

Building, Area: N/A

Prepared By: KMC
Date Prepared: 5/24/2024
K/J Proj. No.

Estimate Type:

- [x] **Conceptual**
- [ ] **Preliminary (w/o plans)**
- [ ] **Design Development @** 10 **% Complete**
- [ ] **Construction**
- [ ] **Change Order**

Months to Midpoint of Construct 48

Spec. Section	Area No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
	5	Secondary Clarifier	Tracer Wire	10	LF	$1	$5	$1	$10			$15
	5	Secondary Clarifier	Pipe Marking Tape	10	LF	$0	$0	$0	$0			$1
	5	Secondary Clarifier	Pipe Restraints , 6"	2	EA	$41	$83	$82	$163			$246
	5	Secondary Clarifier	2" DI Pipe Waterline	200	LF	$25	$4,972	$7	$1,380			$6,352
	5	Secondary Clarifier	Pipe Fittings 2" 12.5/22.5/45 FELC	8	EA	$266	$2,130	$131	$1,049			$3,179
	5	Secondary Clarifier	Tracer Wire	200	LF	$1	$100	$1				$100
	5	Secondary Clarifier	Pipe Marking Tape	200	LF	$0	$6	$0	$6			$12
	5	Secondary Clarifier	Pipe Restraints , 2"	8	EA	$34	$269	$66	$525			$794
	5	Splitter	Pipe, 6", DI, OVERFLOW	190	LF	$24	$4,627	$7	$1,387			$6,014
	5	Splitter	Pipe Fittings 6" 12.5/22.5/45 FELC	6	EA	$451	$2,704	$163	$977			$3,681
	5	Splitter	Tracer Wire	190	LF	$1	$95	$1	$190			$285
	5	Splitter	Pipe Marking Tape	190	LF	$0	$6	$0	$6			$12
	5	Splitter	Pipe Restraints , 6"	6	EA	$41	$249	$82	$489			$738
	5	Splitter	Pipe, 6", DI, WAS	10	LF	$24	$244	$7	$73			$317
	5	Splitter	Pipe Fittings 6" 12.5/22.5/45 FELC	2	EA	$451	$901	$163	$326			$1,227
	5	Splitter	Tracer Wire	10	LF	$1	$5	$1	$10			$15
	5	Splitter	Pipe Marking Tape	10	LF	$0	$0	$0	$0			$1
	5	Splitter	Pipe Restraints , 6"	2	EA	$41	$83	$82	$163			$246
	5	Splitter RAS/WAS	Pipe, 6", DI, WAS	150	LF	$24	$3,653	$7	$1,095			$4,748
	5	Splitter RAS/WAS	Pipe Fittings 6" 12.5/22.5/45 FELC	6	EA	$451	$2,704	$163	$977			$3,681
	5	Splitter RAS/WAS	Tracer Wire	150	LF	$1	$75	$1	$150			$225
	5	Splitter RAS/WAS	Pipe Marking Tape	150	LF	$0	$4	$0	$5			$9
	5	Splitter RAS/WAS	Pipe Restraints , 6"	6	EA	$41	$249	$82	$489			$738
	5	Clarifier Splitter Box	Foundation Prep	72	SY			$5	$360			$360
	5	Clarifier Splitter Box	Slab	50	CY	$300	$14,931	$350	$17,419			$32,350
	5	Clarifier Splitter Box	Walls	96	CY	$330	$31,533	$534	$51,027			$82,560
	5	Clarifier Splitter Box	Pump Wet-Well	44	CY	$330	$14,667	$350	$15,556			$30,222
	5	Clarifier Splitter Box	Top/Suspended Slab	80	CY	$1,000	$79,630	$1,000	$79,630			$159,259
	5	Secondary Clarifier	Foundation Prep	452	SY			$5	$2,262			$2,262
	5	Secondary Clarifier	Slab	226	CY	$300	$67,858	$350	$79,168			$147,027
	5	Secondary Clarifier	Walls	214	CY	$330	$70,497	$534	$114,078			$184,575
	5	Clarifier Splitter Box	Handrail	15	LF	$41	$615	$18	$264			$879
	5	Clarifier Splitter Box	Stairs	12	EA	$730	$8,760	$84	$1,008			$9,768
	5	Clarifier Splitter Box	Metal Support for Stairs Allowance	1	LS	$876	$876	$101	$101			$977
	5	Clarifier Splitter Box	Wet-well Aluminum Grate	115	SF	$46	$5,290	$8	$920			$6,210
	5	Secondary Clarifiers	Handrail	140	LF							
	5	Secondary Clarifiers	Stairs	5	EA	$730	$3,650	$84	$420			$4,070
	5	Secondary Clarifiers	Metal Support for Stairs Allowance	1	LS	$365	$365	$42	$42			$407
	5	Secondary Clarifier	Motorized Clarifier Mechanism (2 hp motor)	1	EA	$641,200	$641,200	$11,200	$11,200			$652,400
	5	Secondary Clarifier	Submersible RAS Pumps (10 hp)	2	EA	$20,970	$41,940					$41,940
	5	Secondary Clarifier	Submersible WAS Pumps (10 hp)	1	EA	$13,150	$13,150					$13,150
	5	Secondary Clarifier	Submersible Scum Pumps (5 hp)	1	EA	$20,970	$20,970					$20,970
	5	Splitter	Small Submersible Pumps	2	EA	$31,420	$62,840	$15,710	$31,420			$94,260
	5	Splitter	Large Submersible Pumps	3	EA	$77,100	$231,300	$38,550	$115,650			$346,950
		SUBTOTALS					$1,507,528		$599,323			$2,142,221

OPINION OF PROBABLE CONSTRUCTION COST — **KENNEDY/JENKS CONSULTANTS**

Project: Alternative 1 - Expand Existing Conventional Activated Sludge

Building, Area: N/A

Prepared By: KMC
Date Prepared: 5/24/2024
K/J Proj. No.

Estimate Type:

- [x] **Conceptual**
- [ ] **Preliminary (w/o plans)**
- [ ] **Design Development @** 10 **% Complete**
- [ ] **Construction**
- [ ] **Change Order**

Months to Midpoint of Construct 48

Spec. Section	Area No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
		TERTIARY FILTRATION										
	6	Existing Tertiary Filters	Demo existing 2-inch piping around Existing Tertiary Filters	8	HR			$250	$2,000			$2,000
	6	Existing Tertiary Filters	Load/Haul/Dump	30	CY	$25	$750	$18	$540			$1,290
	6	Tertiary Filtration	Foundation Excavation	237	BCY			$23	$5,345			$5,345
	6	Tertiary Filtration	Haul and Dispose Excavated Material	189	LCY	$25	$4,733	$18	$3,408			$8,141
	6	Tertiary Filtration	Aggregate Base under Structures (12")	3,408	SF	$4	$14,041	$1	$1,919			$15,960
	6	New Tertiary Filtration	Pipe, 24", DI, SE	200	LF	$197	$39,400	$51	$10,200			$49,600
	6	New Tertiary Filtration	Pipe Fittings 24" 12.5/22.5/45 FELC	1	EA	$8,000	$10,667	$509	$679			$11,345
	6	New Tertiary Filtration	Tracer Wire	200	LF	$1	$100	$1	$200			$300
	6	New Tertiary Filtration	Pipe Marking Tape	200	LF	$0	$6	$0	$6			$12
	6	New Tertiary Filtration	Pipe Restraints , 24"	1	EA	$482	$643	$318	$424			$1,067
	6	New Tertiary Filtration	Pipe, 8", DI, FILTRATE	275	LF	$34	$9,402	$12	$3,342			$12,744
	6	New Tertiary Filtration	Pipe Fittings 8" 12.5/22.5/45 FELC	6	EA	$673	$3,704	$228	$1,252			$4,956
	6	New Tertiary Filtration	Tracer Wire	275	LF	$1	$138	$1	$275			$413
	6	New Tertiary Filtration	Pipe Marking Tape	275	LF	$0	$8	$0	$9			$17
	6	New Tertiary Filtration	Pipe Restraints , 8"	6	EA	$63	$348	$114	$626			$973
	6	New Tertiary Filtration	72" Diameter Precast Wet Well x 10 ft deep - Install	1	EA	$18,000	$18,000					$18,000
	6	New Tertiary Filtration	Excavation/Backfill for Wet Well	12	CY			$20	$241			$241
	6	New Tertiary Filtration	Foundation Prep	6	SY			$5	$31			$31
	6	New Tertiary Filtration	Slab	259	CY	$300	$77,700	$350	$90,650			$168,350
	6	Tertiary Treatment	Submersible Pump Package (15hp)	2	EA	$31,420	$62,840					$62,840
	6	New Tertiary Filtration	Tertiary Filters	1	LS	$6,990,000	$6,990,000			$5,400	$5,400	$6,995,400
	6	New Tertiary Filtration	16" Above Ground DI Pipe	100	LF	$60	$5,957	$21	$2,131			$8,088
	6	New Tertiary Filtration	16" Pipe Supports	10	EA	$155		$28				
		SUBTOTALS					$7,238,436		$123,277		$5,400	$7,367,112
		UV DISINFECTION										
	7											
	7	UV Disinfection	Load/Haul/Dump	60	CY	$25	$1,500	$18	$1,080			$2,580
	7	UV Disinfection	UV Slab- Foundation Prep	37	SY			$5	$183			$183
	7	UV Disinfection	UV Channel - Piping Slab	18	CY	$300	$5,483	$350	$6,397			$11,881
	7	UV Disinfection	Closed Vessel UV Unit	3	EA	$327,129	$981,387	$11,200	$33,600			$1,014,987
		SUBTOTALS					$988,370		$41,260			$1,029,630
		RECYCLED WATER										
	8	Recycled Water Pumps	Demo 3 Existing Vertical Turbine Pumps (30 hp each)	16	HR			$250	$4,000			$4,000
	8	Recycled Water Pumps	Load/Haul/Dump	30	CY	$25	$750	$18	$540			$1,290
	8	Recycled Water Pumps	Vertical Turbine Pumps (100 hp)	3	EA	$199,500	$598,500	$2,699	$8,097			$606,597

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY/JENKS CONSULTANTS**

Project: Alternative 1 - Expand Existing Conventional Activated Sludge

Building: N/A

Prepared By: KMC
Date Prepared: 5/24/2024
K/J Proj. No.: 2276020*00

Estimate Type:

X **Conceptual** | **Construction**
Preliminary (w/o plans) | **Change Order**
Design Development @ **10% Complete**

Mos. to Midpoint 48

SUMMARY BY DIVISION

Area	ITEM DESCRIPTION		MATERIALS	INSTALLATION	SUB-CONTRACTOR	TOTAL
1	Site Work & Yard Piping		362,007	616,758	342,928	1,400,000
2	Electrical/I&C		2,568,962	693,145	190,926	3,500,000
3	Headworks		126,046	192,343	491,994	900,000
4	Aeration Basins		3,042,777	2,792,940		5,900,000
5	Secondary Clarifiers		1,507,528	599,323		2,200,000
6	Tertiary Filtration		7,238,436	123,277	5,400	7,400,000
7	UV Disinfection		988,370	41,260		1,100,000
8	Recycled Water		599,250	12,637		700,000
9	Utility Upgrade Allowance					2,450,000
	Subtotals		**16,433,375**	**5,071,682**	**1,031,248**	**25,550,000**
	Division 1 Costs @	12%	1,972,005	608,602	123,750	2,704,357
	Subtotals		**18,405,380**	**5,680,284**	**1,154,998**	**28,254,357**
	Taxes - Materials @					
	Subtotals		**18,405,380**	**5,680,284**	**1,154,998**	**28,254,357**
	Taxes - Labor @					
	Subtotals		**18,405,380**	**5,680,284**	**1,154,998**	**28,254,357**
	Contractor MU on Sub @	12%			138,600	138,600
	Subtotals		**18,405,380**	**5,680,284**	**1,293,598**	**28,392,956**
	Contractor OH&P @	8%	1,472,430	454,423		1,926,853
	Subtotals		**19,877,810**	**6,134,707**	**1,293,598**	**30,319,810**
	Estimate Contingency @	30%				9,095,943
	Subtotal					**39,415,752**
	Engineering, Legal, Administrative @	25%				9,853,938
	Subtotal					**49,269,691**
	Market Conditions Contingency	10%				4,926,969
	Subtotal					**54,196,660**
	Escalate to Midpt of Const. @	13%				6,802,158
	Total Estimate					**61,000,000**

Estimate Accuracy	
+50%	-30%

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$91,500,000	**$61,000,000**	**$42,700,000**

OPINION OF PROBABLE CONSTRUCTION COST | **KENNEDY/JENKS CONSULTANTS**

Project: Alternative 2 - Membrane Bioreactor Process
Building, Area: NA

Prepared By: KMC
Date Prepared: 5/24/2024
K/J Proj. No. 2276020*00

Estimate Type:

- [x] **Conceptual**
- [ ] **Preliminary (w/o plans)**
- [ ] **Design Development @** 10 **% Complete**
- [ ] **Construction**
- [ ] **Change Order**

Months to Midpoint of Construct 48

Spec. n	Area No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
DIVISION 2 - Site Work												
	1	Site Work & Yard Piping	Site Grading	7,500	CY	$35	$262,500	$7	$50,625			$313,125
	1	Site Work & Yard Piping	Fine Grading	4,500	SY			$5	$22,500			$22,500
	1	Site Work & Yard Piping	Clear & Grub	4,500	SY			$3	$13,500			$13,500
	1	Site Work & Yard Piping	Haul and Dispose Excavated Material		CY	$25		$18				
	1	Site Work & Yard Piping	Erosion Control	1	LS	$5,000	$5,000	$2,800	$2,800			$7,800
	1	Site Work & Yard Piping	Pipeline in Paving	2,195	LF							
	1	Site Work & Yard Piping	Sawcut Paving 4" thick	4,390	LF			$3	$13,170			$13,170
	1	Site Work & Yard Piping	Remove Dispose Paving 4" Thick	1,219	SY			$15	$18,292			$18,292
	1	Site Work & Yard Piping	Trenching 5' wide x 14' deep	5,691	BCY			$15	$85,361			$85,361
	1	Site Work & Yard Piping	Pipe Bedding	406	CY	$45	$18,292	$28	$11,540			$29,832
	1	Site Work & Yard Piping	Pipe Backfill Native	5,029	CY			$28	$142,772			$142,772
	1	Site Work & Yard Piping	Haul and Dispose Excess Excavated Materials - So	796	LCY			$25	$19,901			$19,901
	1	Site Work & Yard Piping	Rock Excavation		LCY			$48				
	1	Site Work & Yard Piping	Haul and Dispose Excess Excavated Materials - Rock		LCY			$85				
	1	Site Work & Yard Piping	Dewatering	2,195	LF			$2	$4,390			$4,390
	1	Site Work & Yard Piping	Trench Plates	30	EA	$200	$6,000	$63	$1,875			$7,875
	1	Site Work & Yard Piping	Paving Restoration over Trench	1,219	SY					$125	$152,431	$152,431
	1	Site Work & Yard Piping	Tack Coat	1,219	SY					$3	$3,658	$3,658
	1	Site Work & Yard Piping	Grind Paving 1' Each Side of Trench	4,390	SF					$2	$6,585	$6,585
	1	Site Work & Yard Piping	Pothole Utility Locate		EA					$1,500		
	1	Site Work & Yard Piping	Additional / Slower Excavation at Utilities Crossing		EA	$200		$500				
	1	Site Work & Yard Piping	Additional / Slower Excavation at Utilities Crossing		EA	$500		$1,500				
	1	Site Work & Yard Piping	Additional / Slower Excavation at Utilities Crossing		EA	$500		$2,500				
	1	Site Work & Yard Piping	Trenching 3' wide x 5' deep		BCY			$11				
	1	Site Work & Yard Piping	Pipe Bedding / Backfill CDF 8"		CY	$200		$28				
	1	Site Work & Yard Piping	Fire Hydrant Line 6" Pipe		LF	$11		$8				
	1	Site Work & Yard Piping	Traffic Controls at Street Crossings/ Connections		EA					$3,000		
	1	Site Work & Yard Piping	Pavement Markings		EA	$100		$350				
	1	Site Work & Yard Piping	Pipeline in Non Pavement	1,825	LF							
	1	Site Work & Yard Piping	Trenching 5' wide x 14' deep	4,731	BCY			$15	$70,972			$70,972
	1	Site Work & Yard Piping	Pipe Bedding	338	CY	$45	$15,208	$28	$9,595			$24,803
	1	Site Work & Yard Piping	Pipe Backfill Native	4,181	CY			$28	$118,706			$118,706
	1	Site Work & Yard Piping	Haul and Dispose Excess Excavated Materials - So	550	LCY			$25	$13,758			$13,758
	1	Site Work & Yard Piping	Dewatering	1,825	LF			$12	$21,900			$21,900
	1	Site Work & Yard Piping	Grass /Seeding Restoration	1,014	SY					$10	$10,139	$10,139
	1	Site Work & Yard Piping	AC Pavement / Site Surfacing	5,925	SY					$35	$207,367	$207,367
	1	Site Work & Yard Piping	Base Course Under Paving (10")	5,925	SY	$23	$136,270	$3	$17,206			$153,475
	1	Site Work & Yard Piping	Storm Water Drainage - Catch Basins	6	EA	$1,269	$7,614	$352	$2,114			$9,728
	1	Site Work & Yard Piping	Excavation for SD Pipe/Catch Basins	12	CY			$9	$108			$108
	1	Site Work & Yard Piping	Backfill for SD Pipe/Catch Basins	3	CY			$14				
	1	Site Work & Yard Piping	Landscaping	1	LS					$15,000	$15,000	$15,000
	1	Site Work & Yard Piping	Traffic Control	1	LS	$15,000	$15,000					$15,000
		SUBTOTALS					$465,884		$641,083		$395,180	$1,502,147
			75% (due to solids being other 25%)				$349,413		$480,813		$296,385	$1,126,610

OPINION OF PROBABLE CONSTRUCTION COST | **KENNEDY/JENKS CONSULTANTS**

Project: Alternative 2 - Membrane Bioreactor Process

Building, Area: NA

Prepared By: KMC
Date Prepared: 5/24/2024
K/J Proj. No. 2276020*00

Estimate Type:

- [x] **Conceptual**
- [ ] **Preliminary (w/o plans)**
- [ ] **Design Development @** 10 **% Complete**
- [ ] **Construction**
- [ ] **Change Order**

Months to Midpoint of Construct 48

Spec. n	Area No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
		ELECTRICAL/I&C										
	2	Electrical/I&C - General	Electrical Allowance				$595,628		$351,417		$859,292	$1,806,337
	2	ctrical/I&C - Fine Screen Headw	Luminaire	1	EA	$525	$525	$255	$255			$780
	2	ectrical/I&C - MBR/Aeration Bas	Luminaire	4	EA	$525	$2,100	$255	$1,018			$3,118
	2	Electrical/I&C - General	I&C Allowance				$198,543		$117,139		$286,431	$602,112
		SUBTOTALS					$796,796		$469,829		$1,145,723	$2,412,347
		HEADWORKS										
	3	Fine Screen/Headworks	Demolish Existing Fine Screen in Existing Headwor	8	HR			$250	$2,000			$2,000
	3	Fine Screen/Headworks	Load/Haul/Dump	10	CY	$25	$250	$18	$180			$430
	3	Fine Screen/Headworks	Structural Excavation		BCY			$23				
	3	Fine Screen/Headworks	Haul and Dispose Excavated Material	28	LCY	$25	$712	$18	$513			$1,224
	3	Fine Screen/Headworks	Aggregate Base under Structures (12")		SF	$4		$1				
	3	Fine Screen/Headworks	Manhole - 48"	2	EA	$2,330	$4,660	$2,225	$4,450			$9,110
	3	Fine Screen/Headworks	Excavation/Backfill for Manholes	11	CY			$20	$214			$214
	3	Fine Screen/Headworks	Hose Bib	1	EA	$100	$100	$250	$250			$350
	3	Fine Screen/Headworks	Pipe, 24" DI, RAW	160	LF	$197	$31,520	$51	$8,160			$39,680
	3	Fine Screen/Headworks	Pipe Fittings 24" 12.5/22.5/45 FELC	4	EA	$8,000	$32,000	$509	$2,036			$34,036
	3	Fine Screen/Headworks	Tracer Wire	160	LF	$1	$80	$1	$160			$240
	3	Fine Screen/Headworks	Pipe Marking Tape	160	LF	$0	$5	$0	$5			$10
	3	Fine Screen/Headworks	Pipe Restraints , 24"	4	EA	$482	$1,928	$318	$1,272			$3,200
	3	Fine Screen/Headworks	Pipe, 6" DI, DRAIN	110	LF	$24	$2,679	$7	$803			$3,482
	3	Fine Screen/Headworks	Pipe Fittings 6" 12.5/22.5/45 FELC	3	EA	$451	$1,239	$163	$448			$1,687
	3	Fine Screen/Headworks	Tracer Wire	110	LF	$1	$55	$1	$110			$165
	3	Fine Screen/Headworks	Pipe Marking Tape	110	LF	$0	$3	$0	$4			$7
	3	Fine Screen/Headworks	Pipe Restraints , 6"	3	EA	$41	$114	$82	$224			$338
	3	Fine Screen/Headworks	Pipe, 1" DI, PW	110	LF	$25	$2,735	$7	$759			$3,494
	3	Fine Screen/Headworks	Pipe Fittings 1" 12.5/22.5/45 FELC	3	EA	$266	$732	$131	$361			$1,093
	3	Fine Screen/Headworks	Tracer Wire	110	LF	$1	$55	$1	$110			$165
	3	Fine Screen/Headworks	Pipe Marking Tape	110	LF	$0	$3	$0	$4			$7
	3	Fine Screen/Headworks	Pipe Restraints , 1"	3	EA	$34		$66	$180			$180
	3	Fine Screen/Headworks	2" DI Pipe Waterline	500	LF	$25	$12,430	$7	$3,450			$15,880
	3	Fine Screen/Headworks	Pipe Fittings 2" 12.5/22.5/45 FELC	10	EA	$266	$2,663	$131	$1,311			$3,974
	3	Fine Screen/Headworks	Tracer Wire	500	LF	$1	$250	$1				$250
	3	Fine Screen/Headworks	Pipe Marking Tape	500	LF	$0	$15	$0	$16			$31
	3	Fine Screen/Headworks	Pipe Restraints , 2"	10	EA	$34	$337	$66	$656			$993
	3	Fine Screen Headworks	Foundation Prep	57	SY			$5	$285			$285
	3	Fine Screen Headworks	Slab	19	CY	$300	$5,694	$350	$6,644			$12,338
	3	Fine Screen Headworks	Walls	39	CY	$330	$12,976	$534	$20,997			$33,973
	3	Fine Screen Headworks	Stairs	5	EA	$730	$3,650	$84	$420			$4,070
	3	Fine Screen Headworks	Metal Support for Stairs Allowance	1	LS	$365	$365	$42	$42			$407
	3	Fine Screen Headworks	Handrail	20	LF	$41	$820	$18	$353			$1,173
	3	Fine Screen Headworks	Stop Gates	4	EA			$1,500	$6,000	$3,039	$12,155	$18,155
	3	Fine Screen Headworks	Fine Screen Units: Basket Screens (2hp motors)	3	EA			$59,600	$178,800	$238,400	$715,200	$894,000
	3	Fine Screen Headworks	Manually Cleaned Bar Rack	1	EA			$3,039	$3,039	$6,078	$6,078	$9,116

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY/JENKS CONSULTANTS**

Project: Alternative 2 - Membrane Bioreactor Process

Building, Area: NA

Prepared By: KMC
Date Prepared: 5/24/2024
K/J Proj. No. 2276020*00

Estimate Type:

- [x] **Conceptual**
- [ ] **Preliminary (w/o plans)**
- [ ] **Design Development @** 10 **% Complete**
- [ ] **Construction**
- [ ] **Change Order**

Months to Midpoint of Construct 48

Spec. n	Area No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
		SUBTOTALS					$118,069		$244,254		$733,433	$1,095,756
		MBR										
	4	MBR/Aeration Basin	Structural Excavation	4,435	BCY			$23	$100,156			$100,156
	4	MBR/Aeration Basin	Haul and Dispose Excavated Material	5,543	LCY	$25	$138,581	$18	$99,779			$238,360
	4	MBR/Aeration Basin	Aggregate Base under Structures (12")	3,832	SF	$4	$15,786	$1	$2,157			$17,943
	4	MBR/Aeration Basin	Pipe, 24", DI, PERMATE	300	LF	$197	$59,100	$51	$15,300			$74,400
	4	MBR/Aeration Basin	Pipe Fittings 24" 12.5/22.5/45 FELC	8	EA	$8,000	$60,000	$509	$3,818			$63,818
	4	MBR/Aeration Basin	Tracer Wire	300	LF	$1	$150	$1	$300			$450
	4	MBR/Aeration Basin	Pipe Marking Tape	300	LF	$0.03	$9	$0.03	$10			$19
	4	MBR/Aeration Basin	Pipe Restraints , 24"	8	EA	$482	$3,615	$318	$2,385			$6,000
	4	MBR/Aeration Basin	Pipe, 16", DI	200	LF	$60	$11,914	$21	$4,261			$16,175
	4	MBR/Aeration Basin	Pipe Fittings 16" 12.5/22.5/45 FELC	6	EA	$3,133	$18,798	$335	$2,010			$20,808
	4	MBR/Aeration Basin	Tracer Wire	200	LF	$1	$100	$1	$200			$300
	4	MBR/Aeration Basin	Pipe Marking Tape	200	LF	$0	$6	$0	$6			$12
	4	MBR/Aeration Basin	Pipe Restraints , 16"	6	EA	$198	$1,188	$209	$1,251			$2,439
	4	MBR/Aeration Basin	Pipe, 8", DI, RAS	580	LF	$34	$19,830	$12	$7,048			$26,878
	4	MBR/Aeration Basin	Pipe Fittings 8" 12.5/22.5/45 FELC	15	EA	$673	$9,764	$228	$3,301			$13,065
	4	MBR/Aeration Basin	Tracer Wire	580	LF	$1	$290	$1	$580			$870
	4	MBR/Aeration Basin	Pipe Marking Tape	580	LF	$0.03	$17	$0.03	$19			$36
	4	MBR/Aeration Basin	Pipe Restraints , 8"	15	EA	$63	$916	$114	$1,650			$2,566
	4	MBR/Aeration Basin	Pipe, 10", DI	300	LF	$53	$15,852	$13	$4,010			$19,862
	4	MBR/Aeration Basin	Pipe Fittings 10" 12.5/22.5/45 FELC	8	EA	$1,113	$8,904	$212	$1,698			$10,602
	4	MBR/Aeration Basin	Tracer Wire	300	LF	$1	$150	$1	$300			$450
	4	MBR/Aeration Basin	Pipe Marking Tape	300	LF	$0.03	$9	$0.03	$10			$19
	4	MBR/Aeration Basin	Pipe Restraints , 10"	8	EA	$115	$920	$133	$1,064			$1,984
	4	MBR/Aeration Basin	Pipe, 1" DI, AIR	710	LF	$25	$17,651	$7	$4,899			$22,550
	4	MBR/Aeration Basin	Pipe Fittings 1" 12.5/22.5/45 FELC	18	EA	$266	$4,726	$131	$2,327			$7,053
	4	MBR/Aeration Basin	Tracer Wire	710	LF	$1	$355	$1	$710			$1,065
	4	MBR/Aeration Basin	Pipe Marking Tape	710	LF	$0	$21	$0	$23			$44
	4	MBR/Aeration Basin	Pipe Restraints , 1"	18	EA	$34		$66	$1,164			$1,164
	4	MBR/Aeration Basin	Pipe, 6" DI, OVERFLOW	90	LF	$24	$2,192	$7	$657			$2,849
	4	MBR/Aeration Basin	Pipe Fittings 6" 12.5/22.5/45 FELC	4	EA	$451	$1,803	$163	$651			$2,454
	4	MBR/Aeration Basin	Tracer Wire	90	LF	$1	$45	$1	$90			$135
	4	MBR/Aeration Basin	Pipe Marking Tape	90	LF	$0	$3	$0	$3			$6
	4	MBR/Aeration Basin	Pipe Restraints , 6"	4	EA	$41	$166	$82	$326			$492
	4	MBR/Aeration Basin	Pipe, 1" DI, AIR	110	LF	$25	$2,735	$7	$759			$3,494
	4	MBR/Aeration Basin	Pipe Fittings 1" 12.5/22.5/45 FELC	4	EA	$266	$1,065	$131	$524			$1,589
	4	MBR/Aeration Basin	Tracer Wire	110	LF	$1	$55	$1	$110			$165
	4	MBR/Aeration Basin	Pipe Marking Tape	110	LF	$0	$3	$0	$4			$7
	4	MBR/Aeration Basin	Pipe Restraints , 1"	4	EA	$34		$66	$262			$262
	4	Splitter RAS/WAS	Pipe, 6", DI, WAS	150	LF	$24	$3,653	$7	$1,095			$4,748
	4	Splitter RAS/WAS	Pipe Fittings 6" 12.5/22.5/45 FELC	6	EA	$451	$2,704	$163	$977			$3,681
	4	Splitter RAS/WAS	Tracer Wire	150	LF	$1	$75	$1	$150			$225
	4	Splitter RAS/WAS	Pipe Marking Tape	150	LF	$0	$4	$0	$5			$9

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY/JENKS CONSULTANTS**

Project: Alternative 2 - Membrane Bioreactor Process

Building, Area: NA

Prepared By: KMC
Date Prepared: 5/24/2024
K/J Proj. No. 2276020*00

Estimate Type:

- [x] **Conceptual**
- [ ] **Preliminary (w/o plans)**
- [ ] **Design Development @** 10 **% Complete**
- [ ] **Construction**
- [ ] **Change Order**

Months to Midpoint of Construct 48

Spec. n	Area No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
	4	Splitter RAS/WAS	Pipe Restraints , 6"	6	EA	$41	$249	$82	$489			$738
	4	eration Basin - Preparation/MBI	Foundation Prep	900	SY			$5	$4,500			$4,500
	4	eration Basin - Preparation/MBI	Slab	750	CY	$300	$225,000	$350	$262,500			$487,500
	4	eration Basin - Preparation/MBI	Walls	1,449	CY	$330	$478,170	$534	$773,766			$1,251,936
	4	MBR Equipment Building	Foundation Prep	233	SY			$5	$1,167			$1,167
	4	MBR Equipment Building	Slab	933	CY	$300	$280,000	$350	$326,667			$606,667
	4	MBR/Aeration Basin	MBR Equipment Building (2,000 sq ft)	2,400	SF	$44	$105,600	$12	$28,800			$134,400
	4	MBR/Aeration Basins	FRP or Aluminum Grating	1,900	SF	$38	$72,200	$8	$15,200			$87,400
	4	MBR/Aeration Basins	Handrail	1,070	LF	$41	$43,870	$18	$18,867			$62,737
	4	MBR/Aeration Basins	Membrane package - cassettes, pumps, blowers	1	LS					$4,600,000	$4,600,000	$4,600,000
				1						$2,000,000	$2,000,000	$2,000,000
	4	MBR/Aeration Basins	Utility Pump Station									
	4	MBR/Aeration Basins	*Motorized 8" Plug Valve w/ Actuator*	*1*	*EA*	*$4,850*	*$4,850*	*$500*	*$500*			$5,350
	4	MBR/Aeration Basins	*10" SS Air Piping*	*20*	*LF*	*$90*	*$1,800*	*$88*	*$1,767*			$3,567
	4	MBR/Aeration Basins	*8" SS Air Piping*	*10*	*LF*	*$259*	*$2,590*	*$67*	*$671*			$3,261
	4	MBR/Aeration Basins	*6" SS Air Piping*	*10*	*LF*	*$200*	*$2,000*	*$55*	*$548*			$2,548
	4	MBR/Aeration Basins	*6" BFV*	*2*	*EA*	*$1,600*	*$3,200*	*$110*	*$220*			$3,420
	4	MBR/Aeration Basins	*8" BFV*	*2*	*EA*	*$2,325*	*$4,650*	*$141*	*$282*			$4,932
	4	MBR/Aeration Basins	*10" Pipe Supports*	*8*	*EA*	*$107*	*$856*	*$40*	*$323*			$1,179
	4	MBR/Aeration Basin	36" DI Feed Forward Pipe (in basin)	300	LF	$185	$55,500	$42	$12,451			$67,951
	4	MBR/Aeration Basin	Pipe Supports, 36"	60	EA	$909	$54,540	$80	$4,791			$59,331
	4	MBR/Aeration Basin	10" SS Air Header Piping	150	LF	$90	$13,500	$88	$13,249			$26,749
	4	MBR/Aeration Basin	10" Pipe Supports	8	EA	$379	$2,843	$40	$302			$3,144
	4	MBR/Aeration Basin	Membrane - 6" Sch 80 PVC Pipe	300	LF	$53	$15,750	$43	$12,979			$28,729
	4	MBR/Aeration Basin	Pipe Supports, 6"	30	EA	$46	$1,379	$14	$415			$1,793
	4	MBR/Aeration Basin	Allowance - Small Diameter Chemical Clean Piping	1	LS	$3,000	$3,000	$4,000	$4,000			$7,000
		SUBTOTALS					$1,774,700		$1,750,501		$6,600,000	$10,125,201
		UV Disinfection										
	5	UV Disinfection	Foundation Excavation	23	BCY			$23	$516			$516
	5	UV Disinfection	Haul and Dispose Excavated Material	18	LCY	$25	$457	$18	$329			$786
	5	UV Disinfection	Aggregate Base under Structures (12")	329	SF	$4	$1,355	$1	$185			$1,541
	5	UV Disinfection	Pipe, 24", DI, SE	200	LF	$197	$39,400	$51	$10,200			$49,600
	5	UV Disinfection	Pipe Fittings 24" 12.5/22.5/45 FELC	1	EA	$8,000	$10,667	$509	$679			$11,345
	5	UV Disinfection	Tracer Wire	200	LF	$1	$100	$1	$200			$300
	5	UV Disinfection	Pipe Marking Tape	200	LF	$0	$6	$0	$6			$12
	5	UV Disinfection	Pipe Restraints , 24"	1	EA	$482	$643	$318	$424			$1,067
	5	Tertiary Treatment	72" Diameter Precast Wet Well x 10 ft deep - Instal	1	EA	$18,000	$18,000					$18,000
	5	Tertiary Treatment	Excavation/Backfill for Wet Well	12	CY			$20	$241			$241
	5	UV Disinfection	Foundation Prep	37	SY			$5	$183			$183
	5	UV Disinfection	Slab	18	CY	$300	$5,483	$350	$6,397			$11,881
	5	UV Disinfection	Submersible Pump Package (15hp)	2	EA	$31,420	$62,840					$62,840
	5	UV Disinfection	Closed Vessel UV Unit	3	EA	$327,129	$981,387	$11,200	$33,600			$1,014,987
	5	UV Disinfection	16" Above Ground DI Pipe	100	LF	$60	$5,957	$21	$2,131			$8,088

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY/JENKS CONSULTANTS**

Project: Alternative 2 - Membrane Bioreactor Process

Building, Area: NA

Prepared By: KMC
Date Prepared: 5/24/2024
K/J Proj. No. 2276020*00

Estimate Type:

- [x] **Conceptual**
- [ ] **Preliminary (w/o plans)**
- [ ] **Design Development @** 10 **% Complete**
- [ ] **Construction**
- [ ] **Change Order**

Months to Midpoint of Construct 48

Spec. n	Area No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
	5	UV Disinfection	16" Pipe Supports	10	EA	$155		$28				
	5	UV Disinfection	10" Magnetic Flow Meters	3	EA	$2,500	$7,500	$1,400	$4,200			$11,700
		SUBTOTALS					$1,133,795		$59,291			$1,193,086
		RECYCLED WATER PUMPS										
	6	Recycled Water Pumps	Demo 3 Existing Vertical Turbine Pumps (30 hp eac	16	HR			$250	$4,000			$4,000
	6	Recycled Water Pumps	Load/Haul/Dump	30	CY	$25	$750	$18	$540			$1,290
	6	Recycled Water Pumps	Vertical Turbine Pumps (100 hp)	3	EA	$199,500	$598,500	$2,699	$8,097			$606,597
		SUBTOTALS					$599,250		$12,637			$611,887

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY/JENKS CONSULTANTS**

Project: Alternative 2 - Membrane Bioreactor Process

Prepared By: KMC

Date Prepared: 5/24/2024

Building: N/A

K/J Proj. No.:

Estimate Type: X **Conceptual** **Construction**

Preliminary (w/o plans) **Change Order**

Design Development @ **10% Complete** **Mos. to Midpoint** 48

SUMMARY BY DIVISION

Area	ITEM DESCRIPTION			MATERIALS	INSTALLATION	SUB-CONTRACTOR	TOTAL
1	Site Work & Yard Piping			349,412.92	480,812.58	296,385.00	1,200,000
2	Electrical/I&C			796,796	469,829	1,145,723	2,500,000
3	Headworks			118,069	244,254	733,433	1,100,000
4	MBR Trains and Equipment			1,774,700	1,750,501	6,600,000	10,200,000
5	UV Disinfection			1,133,795	59,291		1,200,000
6	Recycled Water			599,250	12,637		700,000
7	Utility Upgrade Allowance						2,600,000
	Subtotals			**4,772,022**	**3,017,325**	**8,775,540**	**19,500,000**
	Division 1 Costs	@	12%	572,643	362,079	1,053,065	1,987,786
	Subtotals			**5,344,665**	**3,379,404**	**9,828,605**	**21,487,786**
	Taxes - Materials	@					
	Subtotals			**5,344,665**	**3,379,404**	**9,828,605**	**21,487,786**
	Taxes - Labor	@					
	Subtotals			**5,344,665**	**3,379,404**	**9,828,605**	**21,487,786**
	Contractor MU on Sub	@	12%			1,179,433	1,179,433
	Subtotals			**5,344,665**	**3,379,404**	**11,008,038**	**22,667,219**
	Contractor OH&P	@	8%	427,573	270,352		697,926
	Subtotals			**5,772,238**	**3,649,756**	**11,008,038**	**23,365,145**
	Estimate Contingency	@	30%				7,009,543
	Subtotal						**30,374,688**
	Engineering, Legal, Administrative	@	25%				7,593,672
	Subtotal						**37,968,360**
	Market Conditions Contingency		10%				3,796,836
	Subtotal						**41,765,196**
	Escalate to Midpt of Const.	@	13%				5,241,900
	Total Estimate						**47,100,000**

Estimate Accuracy	
+50%	-30%

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$70,650,000	**$47,100,000**	**$32,970,000**

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY/JENKS CONSULTANTS**

Project: Alternative 3 - Hybrid CAS/MBR Process

Building, Area: N/A

Prepared By: KMC
Date Prepared: 5/24/2024
K/J Proj. No. 2276020*00

Estimate Type:

- [x] **Conceptual**
- [ ] **Preliminary (w/o plans)**
- [ ] **Design Development @** 10 **% Complete**
- [ ] **Construction**
- [ ] **Change Order**

Months to Midpoint of Construct 48

Spec. Section	Area No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
	1	Site Work & Yard Piping	Site Grading	7,500	CY	$35	$262,500	$7	$50,625			$313,125
	1	Site Work & Yard Piping	Fine Grading	4,500	SY			$5	$22,500			$22,500
	1	Site Work & Yard Piping	Clear & Grub	4,500	SY			$3	$13,500			$13,500
	1	Site Work & Yard Piping	Haul and Dispose Excavated Material		CY	$25		$18				
	1	Site Work & Yard Piping	Erosion Control	1	LS	$5,000	$5,000	$2,800	$2,800			$7,800
	1	Site Work & Yard Piping	Excavation/Backfill for Manholes	11	CY			$20	$214			$214
	1	Site Work & Yard Piping	Pipeline in Paving	3,005	LF							
	1	Site Work & Yard Piping	Sawcut Paving 4" thick	6,010	LF			$3	$18,030			$18,030
	1	Site Work & Yard Piping	Remove Dispose Paving 4" Thick	1,669	SY			$15	$25,042			$25,042
	1	Site Work & Yard Piping	Trenching 5' wide x 14' deep	7,791	BCY			$15	$116,861			$116,861
	1	Site Work & Yard Piping	Pipe Bedding	556	CY	$45	$25,042	$28	$15,799			$40,840
	1	Site Work & Yard Piping	Pipe Backfill Native	6,885	CY			$28	$195,458			$195,458
	1	Site Work & Yard Piping	Haul and Dispose Excess Excavated Materials - Soil/Pavement	1,090	LCY			$25	$27,244			$27,244
	1	Site Work & Yard Piping	Rock Excavation		LCY			$48				
	1	Site Work & Yard Piping	Haul and Dispose Excess Excavated Materials - Rock		LCY			$85				
	1	Site Work & Yard Piping	Dewatering	3,005	LF			$2	$6,010			$6,010
	1	Site Work & Yard Piping	Trench Plates	30	EA	$200	$6,000	$63	$1,875			$7,875
	1	Site Work & Yard Piping	Paving Restoration over Trench	1,669	SY					$125	$208,681	$208,681
	1	Site Work & Yard Piping	Tack Coat	1,669	SY					$3	$5,008	$5,008
	1	Site Work & Yard Piping	Grind Paving 1' Each Side of Trench	6,010	SF					$2	$9,015	$9,015
	1	Site Work & Yard Piping	Pothole Utility Locate		EA					$1,500		
	1	Site Work & Yard Piping	Additional / Slower Excavation at Utilities Crossings Water		EA	$200		$500				
	1	Site Work & Yard Piping	Additional / Slower Excavation at Utilities Crossings Elec/ Gas		EA	$500		$1,500				
	1	Site Work & Yard Piping	Additional / Slower Excavation at Utilities Crossings - SD		EA	$500		$2,500				
	1	Site Work & Yard Piping	Trenching 3' wide x 5' deep		BCY			$11				
	1	Site Work & Yard Piping	Pipe Bedding / Backfill CDF 8"		CY	$200		$28				
	1	Site Work & Yard Piping	Fire Hydrant Line 6" Pipe		LF	$11		$8				
	1	Site Work & Yard Piping	Traffic Controls at Street Crossings/ Connections		EA					$3,000		
	1	Site Work & Yard Piping	Pavement Markings		EA	$100		$350				
	1	Site Work & Yard Piping	Pipeline in Non Pavement	2,190	LF							
	1	Site Work & Yard Piping	Trenching 5' wide x 14' deep	5,678	BCY			$15	$85,167			$85,167
	1	Site Work & Yard Piping	Pipe Bedding	406	CY	$45	$18,250	$28	$11,514			$29,764
	1	Site Work & Yard Piping	Pipe Backfill Native	5,017	CY			$28	$142,447			$142,447
	1	Site Work & Yard Piping	Haul and Dispose Excess Excavated Materials - Soil	660	LCY			$25	$16,509			$16,509
	1	Site Work & Yard Piping	Dewatering	2,190	LF			$12	$26,280			$26,280
	1	Site Work & Yard Piping	Grass /Seeding Restoration	1,217	SY					$10	$12,167	$12,167
	1	Site Work & Yard Piping	AC Pavement / Site Surfacing	5,925	SY					$35	$207,367	$207,367
	1	Site Work & Yard Piping	Base Course Under Paving (10")	5,925	SY	$23	$136,270	$3	$17,206			$153,475
	1	Site Work & Yard Piping	Storm Water Drainage - Catch Basins	6	EA	$1,269	$7,614	$352	$2,114			$9,728
	1	Site Work & Yard Piping	Excavation for SD Pipe/Catch Basins	12	CY			$9	$108			$108
	1	Site Work & Yard Piping	Backfill for SD Pipe/Catch Basins	3	CY			$14				
	1	Site Work & Yard Piping	Landscaping	1	LS					$15,000	$15,000	$15,000
	1	Site Work & Yard Piping	Traffic Control	1	LS	$15,000	$15,000					$15,000

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY/JENKS CONSULTANTS**

Project: Alternative 3 - Hybrid CAS/MBR Process

Prepared By: KMC
Date Prepared: 5/24/2024
K/J Proj. No. 2276020*00

Building, Area: N/A

Estimate Type:

- [x] **Conceptual**
- [ ] **Preliminary (w/o plans)**
- [ ] **Design Development @** 10 **% Complete**
- [ ] **Construction**
- [ ] **Change Order**

Months to Midpoint of Construct 48

Spec. Section	Area No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
	1	Site Work & Yard Piping	Drain Manhole		EA	$4,703		$3,800				
	1	Site Work & Yard Piping	Connection to Exsiting SSMH		EA			$2,000				
	1	Site Work & Yard Piping	Trenching 8" PVC Sewer w/ Box		CY			$25				
	1	Site Work & Yard Piping	Haul and Dispose Excavated Material		CY			$15				
	1	Site Work & Yard Piping	8" PVC Sewer Pipe		LF	$30		$18				
		SUBTOTALS					$475,676		$797,302		$457,238	$1,730,215
		75% (due to solids being other 25%)					$356,757		$597,976		$342,928	$1,297,661
		ELECTRICAL/I&C										
	2	Electrical/I&C - General	Electrical Allowance				$2,427,652		$424,536		$869,006	$3,721,194
	2	ectrical/I&C - Fine Screen Headwor	Luminaire	1	EA	$525	$525	$255	$255			$780
	2	Electrical/I&C - MBR/Aeration Basin	Luminaire	4	EA	$525	$2,100	$255	$1,018			$3,118
	2	Electrical/I&C - UV Disinfection	Luminaire	4	EA	$525	$2,100	$255	$1,018			$3,118
	2	Electrical/I&C - General	I&C Allowance				$809,217		$141,512		$289,669	$1,240,398
		SUBTOTALS					$3,241,595		$568,339		$1,158,674	$4,968,608
		HEADWORKS										
	3	Fine Screen/Headworks	Demolish Existing Fine Screen in Existing Headworks	8	HR			$250	$2,000			$2,000
	3	Fine Screen/Headworks	Load/Haul/Dump	10	CY	$25	$250	$18	$180			$430
	3	Fine Screen/Headworks	Structural Excavation		BCY			$23				
	3	Fine Screen/Headworks	Haul and Dispose Excavated Material	28	LCY	$25	$712	$18	$513			$1,224
	3	Fine Screen/Headworks	Aggregate Base under Structures (12")		SF	$4		$1				
	3	Fine Screen/Headworks	Manhole - 48"	2	EA	$2,330	$4,660	$2,225	$4,450			$9,110
	3	Fine Screen/Headworks	Hose Bib	1	EA	$100	$100	$250	$250			$350
	3	Fine Screen/Headworks	Pipe, 24" DI, RAW	160	LF	$197	$31,520	$51	$8,160			$39,680
	3	Fine Screen/Headworks	Pipe Fittings 24" 12.5/22.5/45 FELC	4	EA	$8,000	$32,000	$509	$2,036			$34,036
	3	Fine Screen/Headworks	Tracer Wire	160	LF	$1	$80	$1	$160			$240
	3	Fine Screen/Headworks	Pipe Marking Tape	160	LF	$0	$5	$0	$5			$10
	3	Fine Screen/Headworks	Pipe Restraints , 24"	4	EA	$482	$1,928	$318	$1,272			$3,200
	3	Fine Screen/Headworks	Pipe, 6" DI, DRAIN	110	LF	$24	$2,679	$7	$803			$3,482
	3	Fine Screen/Headworks	Pipe Fittings 6" 12.5/22.5/45 FELC	3	EA	$451	$1,239	$163	$448			$1,687
	3	Fine Screen/Headworks	Tracer Wire	110	LF	$1	$55	$1	$110			$165
	3	Fine Screen/Headworks	Pipe Marking Tape	110	LF	$0	$3	$0	$4			$7
	3	Fine Screen/Headworks	Pipe Restraints , 6"	3	EA	$41	$114	$82	$224			$338
	3	Fine Screen/Headworks	Pipe, 1" DI, PW	110	LF	$25	$2,735	$7	$759			$3,494
	3	Fine Screen/Headworks	Pipe Fittings 1" 12.5/22.5/45 FELC	3	EA	$266	$732	$131	$361			$1,093
	3	Fine Screen/Headworks	Tracer Wire	110	LF	$1	$55	$1	$110			$165
	3	Fine Screen/Headworks	Pipe Marking Tape	110	LF	$0	$3	$0	$4			$7
	3	Fine Screen/Headworks	Pipe Restraints , 1"	3	EA	$34		$66	$180			$180
	3	Fine Screen/Headworks	Pipe, 2" DI Waterline	500	LF	$25	$12,430	$7	$3,450			$15,880
	3	Fine Screen/Headworks	Pipe Fittings 2" 12.5/22.5/45 FELC	10	EA	$266	$2,663	$131	$1,311			$3,974
	3	Fine Screen/Headworks	Tracer Wire	500	LF	$1	$250	$1				$250
	3	Fine Screen/Headworks	Pipe Marking Tape	500	LF	$0	$15	$0	$16			$31

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY/JENKS CONSULTANTS**

Project: Alternative 3 - Hybrid CAS/MBR Process

Building, Area: N/A

Prepared By: KMC
Date Prepared: 5/24/2024
K/J Proj. No. 2276020*00

Estimate Type:

- [x] **Conceptual**
- [ ] **Preliminary (w/o plans)**
- [ ] **Design Development @** 10 **% Complete**
- [ ] **Construction**
- [ ] **Change Order**

Months to Midpoint of Construct 48

Spec. Section	Area No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
	3	Fine Screen/Headworks	Pipe Restraints , 2"	10	EA	$34	$337	$66	$656			$993
	3	Fine Screen Headworks	Foundation Prep	57	SY			$5	$285			$285
	3	Fine Screen Headworks	Slab	19	CY	$300	$5,694	$350	$6,644			$12,338
	3	Fine Screen Headworks	Walls	39	CY	$330	$12,976	$534	$20,997			$33,973
	3	Fine Screen Headworks	Stairs	5	EA	$730	$3,650	$84	$420			$4,070
	3	Fine Screen Headworks	Metal Support for Stairs Allowance	1	LS	$365	$365	$42	$42			$407
	3	Fine Screen Headworks	Handrail	20	LF	$41	$820	$18	$353			$1,173
	3	Fine Screen Headworks	Stop Gates	4	EA					$3,039	$12,155	$12,155
	3	Fine Screen Headworks	Fine Screen Units: Basket Screens (2hp motors)	3	EA					$238,400	$715,200	$715,200
	3	Fine Screen Headworks	Manually Cleaned Bar Rack	1	EA					$6,078	$6,078	$6,078
		SUBTOTALS					$118,069		$56,202		$733,433	$907,703
		MBR/AERATION BASIN										
	4	MBR/Aeration Basin	Structural Excavation	887	BCY			$23	$20,031			$20,031
	4	MBR/Aeration Basin	Haul and Dispose Excavated Material	710	LCY	$25	$17,738	$18	$12,772			$30,510
	4	MBR/Aeration Basin	Aggregate Base under Structures (12")	7,663	SF	$4	$31,572	$1	$4,314			$35,886
	4	MBR/Aeration Basin	Pipe, 24", DI, PERMATE	300	LF	$197	$59,100	$51	$15,300			$74,400
	4	MBR/Aeration Basin	Pipe Fittings 24" 12.5/22.5/45 FELC	8	EA	$8,000	$60,000	$509	$3,818			$63,818
	4	MBR/Aeration Basin	Tracer Wire	300	LF	$1	$150	$1	$300			$450
	4	MBR/Aeration Basin	Pipe Marking Tape	300	LF	$0.03	$9	$0.03	$10			$19
	4	MBR/Aeration Basin	Pipe Restraints , 24"	8	EA	$482	$3,615	$318	$2,385			$6,000
	4	MBR/Aeration Basin	Pipe, 16", DI	200	LF	$60	$11,914	$21	$4,261			$16,175
	4	MBR/Aeration Basin	Pipe Fittings 16" 12.5/22.5/45 FELC	6	EA	$3,133	$18,798	$335	$2,010			$20,808
	4	MBR/Aeration Basin	Tracer Wire	200	LF	$1	$100	$1	$200			$300
	4	MBR/Aeration Basin	Pipe Marking Tape	200	LF	$0	$6	$0	$6			$12
	4	MBR/Aeration Basin	Pipe Restraints , 16"	6	EA	$198	$1,188	$209	$1,251			$2,439
	4	MBR/Aeration Basin	Pipe, 8", DI, RAS	580	LF	$34	$19,830	$12	$7,048			$26,878
	4	MBR/Aeration Basin	Pipe Fittings 8" 12.5/22.5/45 FELC	15	EA	$673	$9,764	$228	$3,301			$13,065
	4	MBR/Aeration Basin	Tracer Wire	580	LF	$1	$290	$1	$580			$870
	4	MBR/Aeration Basin	Pipe Marking Tape	580	LF	$0.03	$17	$0.03	$19			$36
	4	MBR/Aeration Basin	Pipe Restraints , 8"	15	EA	$63	$916	$114	$1,650			$2,566
	4	MBR/Aeration Basin	Pipe, 10", DI	300	LF	$53	$15,852	$13	$4,010			$19,862
	4	MBR/Aeration Basin	Pipe Fittings 10" 12.5/22.5/45 FELC	8	EA	$1,113	$8,904	$212	$1,698			$10,602
	4	MBR/Aeration Basin	Tracer Wire	300	LF	$1	$150	$1	$300			$450
	4	MBR/Aeration Basin	Pipe Marking Tape	300	LF	$0.03	$9	$0.03	$10			$19
	4	MBR/Aeration Basin	Pipe Restraints , 10"	8	EA	$115	$920	$133	$1,064			$1,984
	4	MBR/Aeration Basin	Pipe, 1" DI, AIR	710	LF	$25	$17,651	$7	$4,899			$22,550
	4	MBR/Aeration Basin	Pipe Fittings 1" 12.5/22.5/45 FELC	18	EA	$266	$4,726	$131	$2,327			$7,053
	4	MBR/Aeration Basin	Tracer Wire	710	LF	$1	$355	$1	$710			$1,065
	4	MBR/Aeration Basin	Pipe Marking Tape	710	LF	$0	$21	$0	$23			$44
	4	MBR/Aeration Basin	Pipe Restraints , 1"	18	EA	$34		$66	$1,164			$1,164
	4	MBR/Aeration Basin	Pipe, 6" DI, OVERFLOW	90	LF	$24	$2,192	$7	$657			$2,849
	4	MBR/Aeration Basin	Pipe Fittings 6" 12.5/22.5/45 FELC	4	EA	$451	$1,803	$163	$651			$2,454

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY/JENKS CONSULTANTS**

Project: Alternative 3 - Hybrid CAS/MBR Process

Building, Area: N/A

Prepared By: KMC
Date Prepared: 5/24/2024
K/J Proj. No. 2276020*00

Estimate Type:

- [x] **Conceptual**
- [ ] **Preliminary (w/o plans)**
- [ ] **Design Development @** 10 **% Complete**
- [ ] **Construction**
- [ ] **Change Order**

Months to Midpoint of Construct 48

Spec. Section	Area No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
	4	MBR/Aeration Basin	Tracer Wire	90	LF	$1	$45	$1	$90			$135
	4	MBR/Aeration Basin	Pipe Marking Tape	90	LF	$0	$3	$0	$3			$6
	4	MBR/Aeration Basin	Pipe Restraints , 6"	4	EA	$41	$166	$82	$326			$492
	4	MBR/Aeration Basin	Pipe, 1" DI, AIR	110	LF	$25	$2,735	$7	$759			$3,494
	4	MBR/Aeration Basin	Pipe Fittings 1" 12.5/22.5/45 FELC	4	EA	$266	$1,065	$131	$524			$1,589
	4	MBR/Aeration Basin	Tracer Wire	110	LF	$1	$55	$1	$110			$165
	4	MBR/Aeration Basin	Pipe Marking Tape	110	LF	$0	$3	$0	$4			$7
	4	MBR/Aeration Basin	Pipe Restraints , 1"	4	EA	$34		$66	$262			$262
	4	Splitter RAS/WAS	Pipe, 6", DI, WAS	150	LF	$24	$3,653	$7	$1,095			$4,748
	4	Splitter RAS/WAS	Pipe Fittings 6" 12.5/22.5/45 FELC	6	EA	$451	$2,704	$163	$977			$3,681
	4	Splitter RAS/WAS	Tracer Wire	150	LF	$1	$75	$1	$150			$225
	4	Splitter RAS/WAS	Pipe Marking Tape	150	LF	$0	$4	$0	$5			$9
	4	Splitter RAS/WAS	Pipe Restraints , 6"	6	EA	$41	$249	$82	$489			$738
	4	R/Aeration Basin - Preparation/MBR	Foundation Prep	900	SY			$5	$4,500			$4,500
	4	R/Aeration Basin - Preparation/MBR	Slab	750	CY	$300	$225,000	$350	$262,500			$487,500
	4	R/Aeration Basin - Preparation/MBR	Walls	1,449	CY	$330	$478,170	$534	$773,766			$1,251,936
	4	MBR Equipment Building	Foundation Prep	233	SY			$5	$1,167			$1,125
	4	MBR Equipment Building	Slab	933	CY	$300	$280,000	$350	$326,667			$585,000
	4	MBR/Aeration Basin	MBR Equipment Building (2,000 sq ft)	2,400	SF	$44	$105,600	$12	$28,800			$134,400
	4	MBR/Aeration Basins	FRP or Aluminum Grating	1,900	SF	$38	$72,200	$8	$15,200			$87,400
	4	MBR/Aeration Basins	Handrail	1,070	LF	$41	$43,870	$18	$18,867			$62,737
	4	MBR/Aeration Basins	Membrane Disk Diffusers	1	LS					$4,600,000	$4,600,000	$4,600,000
	4	MBR/Aeration Basins	Utility Pump Station									
	4	MBR/Aeration Basins	*Motorized 8" Plug Valve w/ Actuator*	*1*	*EA*	*$4,850*	*$4,850*	*$500*	*$500*			$5,350
	4	MBR/Aeration Basins	*10" SS Air Piping*	*20*	*LF*	*$90*	*$1,800*	*$88*	*$1,767*			$3,567
	4	MBR/Aeration Basins	*8" SS Air Piping*	*10*	*LF*	*$259*	*$2,590*	*$67*	*$671*			$3,261
	4	MBR/Aeration Basins	*6" SS Air Piping*	*10*	*LF*	*$200*	*$2,000*	*$55*	*$548*			$2,548
	4	MBR/Aeration Basins	*6" BFV*	*2*	*EA*	*$1,600*	*$3,200*	*$110*	*$220*			$3,420
	4	MBR/Aeration Basins	*8" BFV*	*2*	*EA*	*$2,325*	*$4,650*	*$141*	*$282*			$4,932
	4	MBR/Aeration Basins	*10" Pipe Supports*	*8*	*EA*	*$107*	*$856*	*$40*	*$323*			$1,179
	4	MBR/Aeration Basin	36" DI Feed Forward Pipe (in basin)	300	LF	$185	$55,500	$42	$12,451			$67,951
	4	MBR/Aeration Basin	Pipe Supports, 36"	60	EA	$909	$54,540	$80	$4,791			$59,331
	4	MBR/Aeration Basin	10" SS Air Header Piping	150	LF	$90	$13,500	$88	$13,249			$26,749
	4	MBR/Aeration Basin	10" Pipe Supports	8	EA	$379	$2,843	$40	$302			$3,144
	4	MBR/Aeration Basin	Membrane - 6" Sch 80 PVC Pipe	300	LF	$53	$15,750	$43	$12,979			$28,729
	4	MBR/Aeration Basin	Pipe Supports, 6"	30	EA	$46	$1,379	$14	$415			$1,793
	4	MBR/Aeration Basin	Allowance - Small Diameter Chemical Clean Piping	1	LS	$3,000	$3,000	$4,000	$4,000			$7,000
		SUBTOTALS					$1,669,642		$1,585,527		$4,600,000	$7,833,461
		UV DISINFECTION										
	5	UV Disinfection	Foundation Excavation	550	BCY			$23	$12,422			$12,422
	5	UV Disinfection	Haul and Dispose Excavated Material	440	LCY	$25	$11,000	$18	$7,920			$18,920

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY/JENKS CONSULTANTS**

Project: Alternative 3 - Hybrid CAS/MBR Process

Building, Area: N/A

Prepared By: KMC
Date Prepared: 5/24/2024
K/J Proj. No. 2276020*00

Estimate Type:

- [x] **Conceptual**
- [ ] **Preliminary (w/o plans)**
- [ ] **Design Development @** 10 **% Complete**
- [ ] **Construction**
- [ ] **Change Order**

Months to Midpoint of Construct 48

Spec. Section	Area No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
	5	UV Disinfection	Aggregate Base under Structures (12")	990	SF	$4	$4,079	$1	$557			$4,636
	5	UV Disinfection	UV In-line - Foundation Prep	37	SY			$5	$183			$183
	5	UV Disinfection	UV In-line - Slab	18	CY	$300	$5,483	$350	$6,397			$11,881
	5	UV Disinfection	Closed Vessel UV Unit	3	EA	$327,129	$981,387	$11,200	$33,600			$1,014,987
	5	UV Disinfection	16" Above Ground DI Pipe	100	LF	$60	$5,957	$21	$2,131			$8,088
	5	UV Disinfection	16" Pipe Supports	10	EA	$155		$28				
		SUBTOTALS					$1,007,906		$63,210			$1,071,116
		TERTIARY FILTRATION										
	6	Tertiary Filtration	Foundation Excavation	135	BCY			$23	$3,054			$3,054
	6	Tertiary Filtration	Haul and Dispose Excavated Material	108	LCY	$25	$2,705	$18	$1,947			$4,652
	6	Tertiary Filtration	Aggregate Base under Structures (12")	1,947	SF	$4	$8,023	$1	$1,096			$9,120
	6	New Tertiary Filtration	72" Diameter Precast Wet Well x 10 ft deep - Install	1	EA	$18,000	$18,000					$18,000
	6	New Tertiary Filtration	Excavation/Backfill for Wet Well	12	CY			$20	$241			$241
	6	New Tertiary Filtration	Foundation Prep	224	SY			$5	$1,120			$1,120
	6	New Tertiary Filtration	Slab	112	CY	$300	$33,600	$350	$39,200			$72,800
	6	Tertiary Treatment	Submersible Pump Package (15hp)	2	EA	$31,420	$62,840					$62,840
	6	New Tertiary Filtration	Tertiary Filters	1	LS	$3,994,286	$3,994,286			$2,700	$2,700	$3,996,986
		SUBTOTALS					$4,119,454		$46,659			$4,168,813
		RECYCLED WATER										
	7	Recycled Water Pumps	Vertical Turbine Pumps (100 hp)	3	EA	$199,500	$598,500	$2,699	$8,097			$606,597

OPINION OF PROBABLE CONSTRUCTION COST — **KENNEDY/JENKS CONSULTANTS**

Project: Alternative 3 - Hybrid CAS/MBR Process

Building: N/A

Prepared By: KMC
Date Prepared: 5/24/2024
K/J Proj. No.: 2276020*00

Estimate Type: X **Conceptual** | **Construction**
Preliminary (w/o plans) | **Change Order**
Design Development @ **10% Complete** | **Mos. to Midpoint** 48

SUMMARY BY DIVISION

DIV. No.	ITEM DESCRIPTION		MATERIALS	INSTALLATION	SUB-CONTRACTOR	TOTAL
1	Site Work & Yard Piping		356,756.67	597,976.22	342,928.33	1,300,000.00
2	Electrical/I&C		3,241,595	568,339	1,158,674	5,000,000
3	Headworks		118,069	56,202	907,703	1,100,000
4	MBR/CAS Treatment		1,669,642	1,585,527	4,600,000	7,900,000
5	UV Disinfection		1,007,906	63,210		1,100,000
6	Tertiary Filtration		4,119,454	46,659		4,200,000
7	Recycled Water		598,500	8,097		700,000
8	Utility Upgrade Allowance					2,450,000
	Subtotals		**11,111,923**	**2,926,009**	**7,009,305**	**23,750,000**
	Division 1 Costs @	12%	1,333,431	351,121	841,117	2,525,669
	Subtotals		**12,445,354**	**3,277,130**	**7,850,422**	**26,275,669**
	Taxes - Materials @					
	Subtotals		**12,445,354**	**3,277,130**	**7,850,422**	**26,275,669**
	Taxes - Labor @					
	Subtotals		**12,445,354**	**3,277,130**	**7,850,422**	**26,275,669**
	Contractor MU on Sub @	12%			942,051	942,051
	Subtotals		**12,445,354**	**3,277,130**	**8,792,472**	**27,217,719**
	Contractor OH&P @	8%	995,628	262,170		1,257,799
	Subtotals		**13,440,982**	**3,539,301**	**8,792,472**	**28,475,518**
	Estimate Contingency @	30%				8,542,655
	Subtotal					**37,018,173**
	Engineering, Legal, Administrative @	25%				9,254,543
	Subtotal					**46,272,717**
	Market Conditions Contingency	10%				4,627,272
	Subtotal					**50,899,988**
	Escalate to Midpt of Const. @	13%				6,616,998
	Total Estimate					**58,200,000**

Estimate Accuracy	
+50%	-30%

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$87,300,000	**$58,200,000**	**$40,740,000**

Appendix D

Regional Treatment Investigations, Stantec, 2025

APPENDIX D

TECHNICAL MEMORANDUM

Summary of Regional Treatment Investigations

December 1, 2025

Revisions

Revision History

Date	Version	Description	Author(s)	Reviewer(s)	Date of Reviewer(s)
12/1/2025	1.0	Draft Memorandum	Heather Stephens	Eric Ward	12/1/2025

Contents

List of Tables

List of Figures

Appendices

Appendix A: Sandy to Gresham Wastewater Conveyance Draft Conceptual Design Report
Appendix B: Gresham WWTP Capacity Evaluation

List of Abbreviations and Acronyms

DI	Ductile Iron
IGA	Intergovernmental Agreement
MGD	Million Gallons per Day
OOS	Out of Service
RAS	Return Activated Sludge
SLR	Solids Loading Rate
SOR	Surface Overflow Rate
TDH	Total Dynamic Head
VFD	Variable Frequency Drive
WWTP	Wastewater Treatment Plant

1.0 Purpose and Introduction

Since completion of the Draft Facility Plan Amendment in late 2024, the City of Sandy has pursued several concurrent efforts to further investigate the Regional Treatment alternative that consists of abandoning treatment at the Jarl Road Wastewater Treatment Plant (WWTP) and conveying flow from the City of Sandy to the Gresham WWTP for complete treatment and discharge. These efforts include:

- Route evaluation and conceptual design of a conveyance system from Sandy to the Gresham WWTP
- Analysis of potential opportunities to utilize capacity in the Gresham collection system
- Capacity analysis of the Gresham WWTP to determine the available capacity and impact of accepting flow from Sandy
- Development of an Intergovernmental Agreement (IGA) with Gresham

The purpose of this memorandum is to summarize these findings for inclusion in the Final Draft Facility Plan Amendment presented to the Sandy City Council for approval.

2.0 Route Evaluation and Conceptual Design

The Sandy to Gresham Wastewater Conveyance Draft Conceptual Design Report (Stantec, July 2025) included in Appendix A established projected future flows to be used in sizing the conveyance system, investigated system hydraulics to determine the optimum combination of pumped and gravity conveyance, established recommended force main sizing/configuration and gravity pipeline sizing, and determined the preliminary pump station configuration and location. This Report also identified a preferred alignment for conveyance from Sandy to the Gresham WWTP, in parallel with an independent investigation of alternatives to discharge flow from the City of Sandy upstream in the existing Gresham collection system. Key elements and recommended conceptual design features are described below.

2.1 Pipeline Hydraulics and Configuration

The alignment from a proposed pump station location near the City's existing WWTP to the Gresham WWTP has its highest point located at the intersection of SE Jarl Road and Highway 26. From this highway crossing, the profile is generally downhill but with numerous localized high points. A consistent downhill slope is not achievable until approximately 10 miles from the Sandy WWTP, so the proposed alignment consists of approximately 10 miles of force main and approximately 5.5 miles of gravity pipeline.

Due to the wide range of flows and criticality of this facility as the sole means of disposing of wastewater, three potential force main configurations were investigated:

- Dual force mains with one 24-inch diameter and one smaller force main (between 12 and 18 inch diameter depending on pump station configuration)
- Dual 24-inch diameter force mains

- Single 30-inch diameter force main

It is anticipated that the force main material will be ductile iron (DI) or high-density polyethylene (HDPE) and may require a control valve to keep the pipeline full under all operating conditions.

For the gravity pipeline, it is anticipated that a 36-inch diameter polyvinyl chloride (PVC) pipeline with a minimum design slope of 0.5% will be used.

2.2 Pump Station Configuration

Because of the wide range of flows that must be accommodated, it is recommended that a four-pump configuration be used. Modeling was conducted to examine different combinations of pump and force main sizing to investigate the total dynamic head (TDH) and velocity under a range of operating conditions. This analysis identified the following recommended system configuration:

- Dual 24-inch force mains
- Four pumps , 6 MGD each, with variable frequency drives (VFDs)
- Wet pit/dry pit configuration, trench-style wet well
- Located at the Jarl Road WWTP site

2.3 Pipeline Alignment Alternative 1: Sandy WWTP to Gresham WWTP

A preliminary alignment was developed to convey wastewater to the City of Gresham Wastewater Treatment Plant. The alignment conveys flow from the Jarl Road WWTP to the intersection of Highway 26 and Orient Drive. The City of Gresham requested that any alternative with the new pipeline ending at the Gresham WWTP will end upstream of the treatment plant at NE 201st Avenue between NE Sandy Boulevard and Interstate 84 to allow for suitable mixing of wastewater flows before reaching the treatment plant headworks.

The proposed alignment consists of approximately 9.5 miles of dual 24-inch force mains that generally follow Orient Drive from the intersection of Orient and Highway 26 to Dane Drive in Gresham. The dual force mains will transition to a 36-inch gravity pipeline near the intersection of 1st and Kane, where a foul air treatment system (assumed to include a grease and mist eliminator, exhaust fan, and activated carbon odor scrubber) will provide odor treatment at the transition point. The force main alignment for Alternative 1 is shown in Figure 1.

Downstream of the transition structure, the conveyance system will consist of approximately 5.5 miles of 36-inch gravity pipe traversing surface streets and existing sewer corridors from 1st and Kane to NE 201st Avenue upstream of Sandy Boulevard. The gravity system alignment for Alternative 1 is shown in Figure 2.

Figure 1. Alternative 1 Force Main Alignment

Figure 2. Alternative 1 Gravity Main Alignment

To handle the additional flow from the City of Sandy under full buildout conditions (year 2011), four pipes in Gresham's existing collection system between the Sandy Boulevard and the wastewater treatment plant will need to be upsized. The existing pipes have sufficient capacity to convey flow through 2040, so the capacity improvements would be required at some point between 2040 and buildout. The two upstream pipes require upsizing to serve the City of Gresham's buildout development, so the cost of this increased capacity would be shared between Gresham and Sandy. The capacity deficiency in the downstream two pipes is driven solely by buildout flow from the City of Sandy, and costs associated with the increase capacity would be borne by Sandy. The required upsizing in the existing collection system under Alternative 1 is shown in Figure 3.

Figure 3. Alternative 1 Collection System Upsizing

2.4 Pipeline Alignment Alternative 2: Sandy WWTP to Gresham Collection System

In addition, the Program team investigated several options for introducing flow farther upstream in the City of Gresham's collection system to utilize existing available capacity or contribute to additional required upsizing in Gresham's collection system to convey flow to the Gresham WWTP. Four upstream connection points were considered, of which only one was deemed feasible. This alternative includes introducing flow from the City of Sandy to a point upstream of existing diversion structures and is located near NW Burnside Road and SE 202nd Avenue. Th location of the Alternative 2 connection point and areas of surcharging are shown in Figure 4.

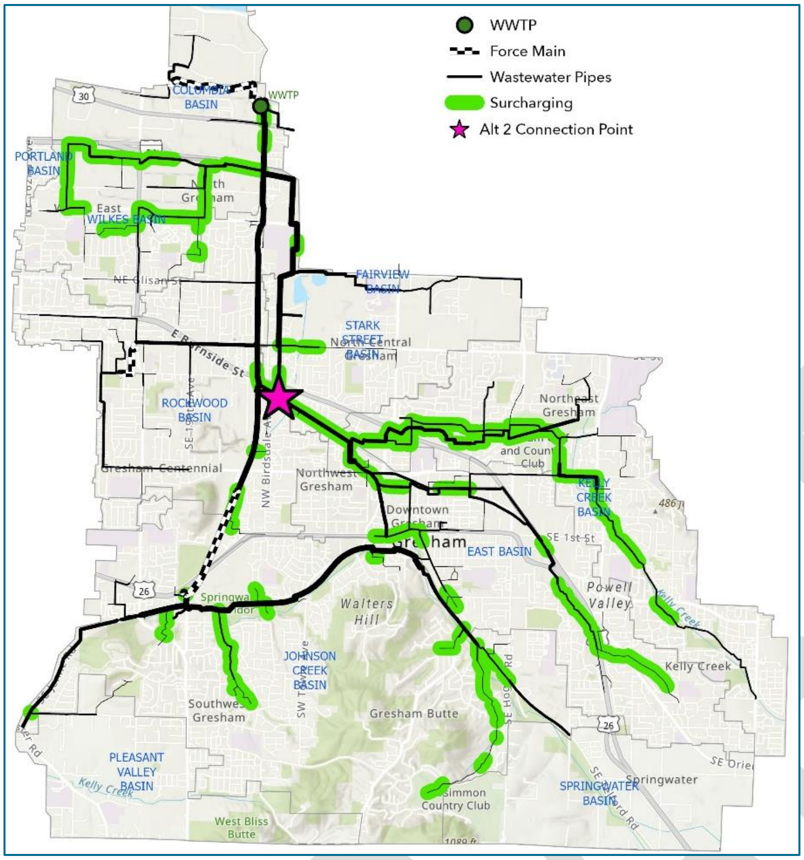


Figure 4. Alternative 2 Connection Point and Existing System Surcharging

For Alternative 2, a new force main and gravity system alignment was identified to convey flow from the Sandy WWTP to the intersection of NW Burnside Road and SE 202nd Avenue. The proposed alignment consists of approximately 8.5 miles of dual 24-inch force mains that generally follow US Highway 26 from the intersection of Orient and Highway 26 to Palmquist Road near the Gradin Community Sports Park in Gresham. The dual force mains will transition to a 36-inch gravity pipeline near the Sports Park, where a foul air treatment system will provide odor control at the transition point. The force main alignment for Alternative 2 is shown in Figure 5.

Downstream of the transition structure, the conveyance system will consist of approximately 3.5 miles of 36-inch gravity pipe traversing surface streets and existing sewer corridors from Gradin Community Sports Park to the Burnside Diversion Structure near NW Burnside Road. The gravity system alignment for Alternative 2 is shown in Figure 6.

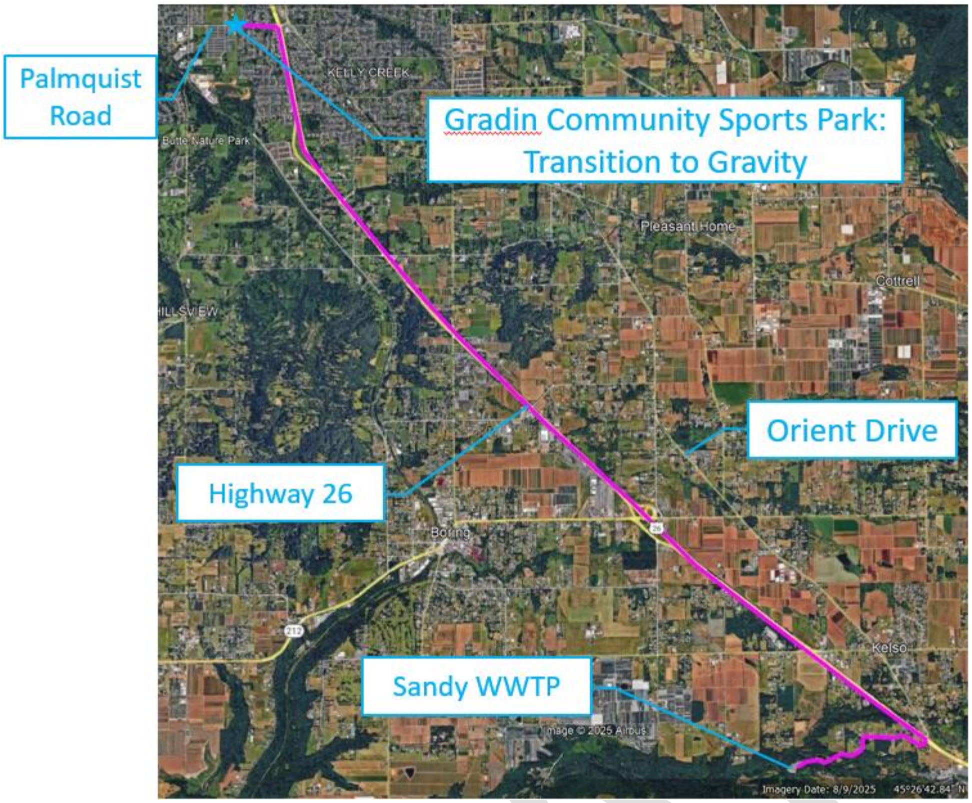


Figure 5. Alternative 2 Force Main Alignment

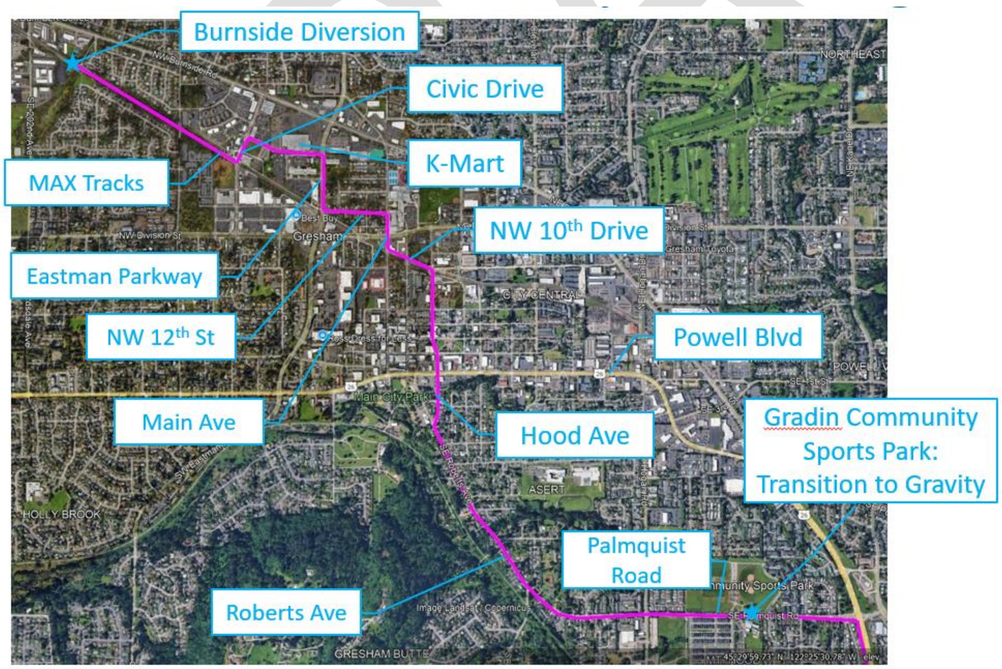


Figure 6. Alternative 2 Gravity Main Alignment

To handle the additional flow from the City of Sandy under full buildout conditions (year 2011), an additional seven pipes in Gresham's existing collection system will need to be upsized (in addition to the four pipes identified in Alternative 1). The existing pipes have sufficient capacity to convey flow through 2040, so the capacity improvements would be required at some point between 2040 and buildout. Two of the seven pipes require upsizing to serve the City of Gresham's buildout development, so the cost of this increased capacity would be shared between Gresham and Sandy. The capacity deficiency in the remaining five pipes is driven solely by buildout flow from the City of Sandy, and costs associated with the increase capacity would be borne by Sandy. The required upsizing in the existing collection system under Alternative 2 is shown in .

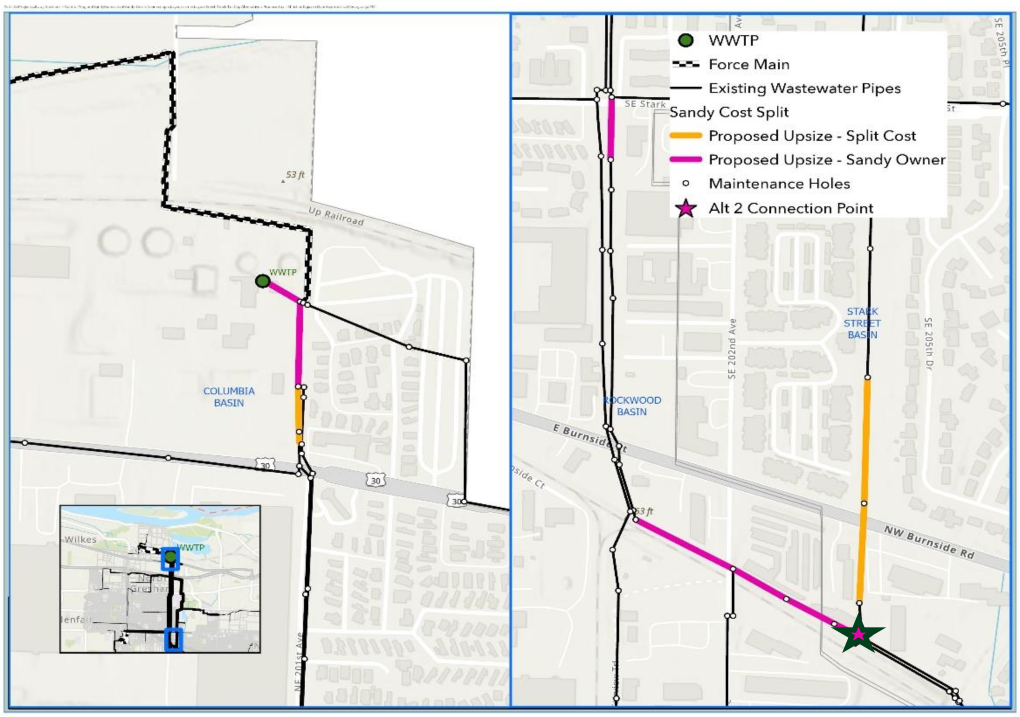


Figure 7. Alternative 2 Collection System Upsizing

3.0 Capacity Analysis of Gresham WWTP

The Program team prepared a Gresham WWTP Capacity Evaluation (Appendix B) to determine the ability of the Gresham WWTP to accept existing and projected future flow from the City of Sandy. The objective of this evaluation was to evaluate and document the impacts of Sandy's wastewater flow and load on the Gresham WWTP. The evaluation used a biological process model and hydraulic model to estimate available capacity to treat anticipated influent flow and loading for just the existing customers and with flow from the City of Sandy.

A summary of the recommended improvements to accommodate Sandy wastewater flows at the Gresham WWTP are presented in Table 1**.**

Table 1. Summary of Process Capacity Results

Scenario	2040 Gresham Only	2040 Gresham + Sandy	Recommendation
Upper Plant			
Primary Clarification	OK	OK	No improvements needed
Primary Sludge Pumping	OK	OK	No improvements needed
Bioreactor Capacity	OK	EXCEEDS CAPACITY	Additional bioreactor may be required.[1]
Blower Capacity	OK	OK	No improvements needed
Secondary Clarification	OK	OK (WITH ADDITIONAL BIOREACTOR)	Additional clarifier may be required.[2]
RAS Pumping	OK	OK	No improvements needed
Lower Plant			
Primary Clarification	OK (ALL IN SERVICE)	OK (ALL IN SERVICE)	Peak Hour SOR exceeded when OOS
Primary Sludge Pumping	OK	OK	No improvements needed
Bioreactor Capacity	OK	OK	No improvements needed
Blower Capacity	OK	OK	No improvements needed
Secondary Clarification	OK	OK (ALL IN SERVICE)	Peak Hour SOR exceeded when OOS
RAS Pumping	OK	OK	No improvements needed
Solids Handling Processes			
Gravity Belt Thickeners	OK	OK (+25HR/WK RUNTIME)	Additional runtime may be required
Anaerobic Digesters	EXCEEDS CAPACITY	EXCEEDS CAPACITY	Additional digester may be required
New Centrifuges	OK	OK (+4HR/D RUNTIME)	Additional runtime may be required

Notes:

1. *Assumes full nitrification occurs in the Upper Plant. Alternative operating strategies may be considered.*
2. *Secondary clarifier SOR and SLR were exceeded. If an additional bioreactor is installed, or the bioreactors are operated at a lower SRT, the clarifier SLR is expected to operate within the SLR capacity. The peak SOR conditions were also exceeded with one unit out of service, but are met with all units in service under peak hour condition.*

Evaluation of hydraulic capacity using the Hades model determined that adding projected flow from the City of Sandy does not produce any bottlenecks, overflows, or increase hydraulic grade beyond the maximum design hydraulic grade through the wastewater treatment plant.

The outfall pipe and diffusers were designed with a hydraulic capacity of 75 MGD, however this capacity was recently reduced to 58 MGD when end caps were installed on 8 of the 18 diffusers to improve mixing. As peak flows increase to the 61 MGD projected in year 2040, some of the capped ports will need to be re-opened to provide sufficient hydraulic capacity.

Findings based on the process and hydraulic capacity analysis for Gresham flows alone and for combined Gresham and Sandy flows are summarized in Table 2 and Table 3.

Table 2. Capital Improvement Recommendations by 2040 – Gresham Only

Asset	Quantity/Sizing
Digester 3	One Digester, with volume approximately 1 MG.
Dewatering Units	Two BFPs or Two Dewatering Centrifuges, with maximum SLR similar to existing dewatering units.

Table 3. Capital improvement Recommendations by 2040 – Gresham + Sandy Flows

Asset	Quantity/Sizing
Upper Plant - Aeration Basin 5	Add one Bioreactor with volume similar to Aeration Basin 4, or confirm ability to achieve nitrification at lower SRT with full-scale operation
Digester 3	One Digester, with volume approximately 1 MG
Dewatering Units	Extend run time of new dewatering centrifuges by 4 hr/day

Asset	Quantity/Sizing
Outfall Diffusers	Re-open existing diffuser ports to increase peak hydraulic capacity

The Capacity Assessment confirmed that the Gresham WWTP generally has capacity to treat anticipated flow and load from the City of Sandy. The known limitation in solids handling capacity (anticipated for service to the City of Gresham only) is amplified with the additional flow from the City of Gresham, and some of the outfall diffuser ports that were previously closed would need to be reopened to accommodate higher peak flows.

In addition, with the new operating mode to achieve nitrification, the Upper Plant capacity is limited with the addition of Sandy flows. While blower capacity is sufficient, the treatment volume may not be adequate to handle the additional loading. It may be possible to address this limitation with changes to the performance objectives or operational strategy, or it may be necessary to construct an additional aeration basin to provide sufficient capacity for 2040 conditions

4.0 Alternative Summaries and Cost

The following section summarizes the recommended alternative and compares the current costs of the two long-term discharge alternatives with those presented in the 2024 Draft Facility Plan Amendment.

4.1 Alternative Summary: Convey to Gresham WWTP

Of the two conveyance options evaluated, Alternative 2 connecting upstream in Gresham's conveyance system near the Burnside Diversion is the most cost-effective approach. Although this alternative results in more extensive upsizing in Gresham's system (11 pipes rather than 4 pipes), the estimated construction cost of conveyance improvements is over $20 million lower than constructing a new system to upstream of the WWTP. Furthermore, none of this additional capacity is required until after 2040 so improvements are not needed to meet current and anticipated near-term service needs.

The cost of connecting to the Gresham WWTP will be determined by the value of the existing infrastructure that will be used to serve Sandy's ratepayers, and the proportional cost of future improvements that will be needed to provide reliable long-term capacity at the treatment plant. For planning purposes, a range of potential connection fees was determined by considering:

- The City of Gresham's existing System Development Charge (SDC) methodology establishing a framework for assessing reimbursement and improvement costs in both the collection system and treatment plant, and
- The cost of capacity in the most recent agreement with the City of Wood Village, and
- The cost of purchasing capacity for current needs vs. 2040 needs.

Based on these considerations, it is recommended that the City of Sandy use a potential range of $17 to $28 million as an estimated connection fee until input is provided by the City of Gresham.

4.2 Alternative Summary: Sandy River Outfall

The estimated costs of conveying flow from the Sandy WWTP to a new Sandy River outfall was updated to reflect the addition of a transition structure where flow transitions from pressure to gravity, and use of a fully enclosed pump station. The costs were also escalated to 2025 to use the same basis as the Sandy to Gresham alternatives and were amended to include property and easement acquisition estimated at $4 million based on 20 acres of total area with an estimated cost of $200,000/acre.

4.3 Comparison of Updated Alternatives

The costs of the two alternatives were compared with costs presented to the City Council in late 2024 following preparation of the Draft Facility Plan. In order to compare the original (2024) cost estimates with the current (2025) cost estimates, the following approaches were used:

- All project summary tables include all potential project elements; elements that are not required for a given alternative are shown as Not Applicable (N/A)
- 2024 estimates were escalated to 2025 using an annual escalation rate of 4%
- Contingencies range from 20% to 40% depending on the level of detail to which the alternative was developed, and are included in the direct construction cost
- In addition to direct construction costs, project costs include the following markups:
    - Program management (4%)
    - Construction management and inspection (6%)
    - Legal, finance, and other soft costs (3%)
    - Management reserve (10%)
- Costs are escalated to the midpoint of construction based on a 4% annual escalation rate

Cost comparisons for the Sandy to Gresham alternative and the Sandy River Outfall alternative are shown in Table

Table 4. Cost Comparison: Sandy to Gresham Alternative

	2024 PLANNING ESTIMATE		2025 UPDATED ESTIMATE	
Project Element	***Project Subtotal ($ Millions)***	***Escalated to Midpoint ($ Millions)***	***Project Subtotal ($ Millions)***	***Escalated to Midpoint ($ Millions)***
WWTP Improvements	*N/A*	*N/A*	*N/A*	*N/A*
Sandy River Discharge	*N/A*	*N/A*	*N/A*	*N/A*
Sandy to Gresham Pump Station	19	22	20.8	24
Sandy to Gresham Force Main	64	75	84.3	99
Sandy to Gresham Gravity Main	*N/A*	*N/A*	23.3	27
Direct Construction Cost	**83**	**97**	**128**	**150**
Program Management	3.3	3.9	5.1	6.0
Const. Management & Inspection	5.0	6.5	7.7	9.0

Management Reserve	8	14.0	13	15
Soft Costs (Finance, Legal, etc.)	2.5	2.9	3.9	4.5
Total Construction Cost	**102**	**124**	**158**	**185**
Connection Fee (Low)	25	25	18	18
Connection Fee (High)	59	59	29	29
Gresham Upsizing Fee	*N/A*	*N/A*	4.3	4.3
PROJECT TOTAL (LOW)	**127**	**149**	**180**	**207**
PROJECT TOTAL (HIGH)	**161**	**183**	**191**	**218**

Table 5. Cost Comparison: Sandy River Outfall Alternative

	2024 PLANNING ESTIMATE		**2025 UPDATED ESTIMATE**	
Project Element	***Project Subtotal ($ Millions)***	***Escalated to Midpoint ($ Millions)***	***Project Subtotal ($ Millions)***	***Escalated to Midpoint ($ Millions)***
WWTP Improvements	63	73	65	76
Sandy River Discharge	49	57	66	77
Sandy to Gresham Pump Station	*N/A*	*N/A*	*N/A*	*N/A*
Sandy to Gresham Force Main	*N/A*	*N/A*	*N/A*	*N/A*
Sandy to Gresham Gravity Main	*N/A*	*N/A*	*N/A*	*N/A*
Direct Construction Cost	**112**	**130**	**131**	**154**
Program Management	4.5	5.2	5.2	6.1
Const. Management & Inspection	6.7	8.8	7.9	9.2
Management Reserve	11	18	13	19
Soft Costs (Finance, Legal, etc.)	3.3	3.9	3.9	4.6
Total Construction Cost	**137**	**166**	**161**	**192**
Connection Fee (Low)	*N/A*	*N/A*	*N/A*	*N/A*
Connection Fee (High)	*N/A*	*N/A*	*N/A*	*N/A*
Gresham Upsizing Fee	*N/A*	*N/A*	*N/A*	*N/A*
PROJECT TOTAL	**137**	**166**	**161**	**192**

The Sandy River Outfall alternative and the high estimated cost of the Sandy to Gresham alternative have both increased approximately 15% since late 2024, due to both escalation and a more detailed understanding of the project costs. The refined conceptual design of the conveyance from Sandy to Gresham uses a slightly longer alignment (1.5 miles longer than in the initial planning estimate) and also includes a dual force main rather than a single force main to provide greater reliability and redundancy that assures conveyance capacity is available during future inspection and repairs. The higher conveyance system cost was partially offset by the lower estimated connection fee.

5.0 Recommendations

It is recommended that the City of Sandy continue to pursue discharge to the Gresham WWTP as the preferred long-term wastewater discharge strategy. Although this alternative is slightly more expensive than the Sandy River Outfall alternative, it offer the following advantages to the City:

1. A clear pathway to future growth. The infrastructure required to implement the Sandy to Gresham alternative can be constructed on City-owned property and in public rights-of-way. The permitting requirements for these improvements are well-understood, and conventional construction techniques can be used. Construction of the Sandy River outfall requires securing extensive easements on private property and negotiating a new NPDES permit; both which have less certain outcomes and schedules.

2. Lowest impact of future regulatory uncertainty. By discharging to the City of Gresham's system, Sandy gains the advantage of contributing to a system that discharges to the Columbia River – the largest receiving stream in the region. Further, if future regulatory limits require additional treatment, costs will be shared across a much larger group of ratepayers.

3. Greatest long-term reliability. The Sandy to Gresham alternative has limited equipment that the City of Sandy would need to maintain on a long-term basis (pump station and odor control system). With the installation of dual force mains, the system would have redundancy to allow any system element to be taken out of service for inspection, maintenance, and necessary repairs.

4. Greatest stability in future costs. With the Sandy to Gresham alternative, the City has the option of purchasing smaller increments of additional capacity at the Gresham WWTP than would be feasible or cost-effective to construct at Sandy's WWTP.

Appendix A: Sandy to Gresham Wastewater Conveyance Draft Conceptual Design Report

Appendix B: Gresham WWTP Capacity Evaluation

This page intentionally left blank

Appendix E

Tickle Creek Reuse Study, Stantec, 2025

Tickle Creek Reuse Study

June 12, 2025

Revisions

Revision History

Date	Version	Description	Author(s)	Reviewer(s)	Date of Reviewer(s)
4/1/2025	1.0	Review Draft	Raj Kapur	Heather Stephens	4/14/2025
6/12/2025	2.0	Final	Heather Stephens	Raj Kapur	6/17/2025

Contents

List of Tables

List of Figures

Appendices

List of Abbreviations and Acronyms

CFS	Cubic Feet per Second
City	City of Sandy
Dry Season	May 1 to October 31
HB 2010	House Bill 2010
MGD	Million Gallons per Day
NPDES	National Pollutant Discharge Elimination System
DEQ	Oregon Department of Environmental Quality
OWRD	Oregon Water Resources Department
SCWP	Sandy Clean Waters Program
SDWRP	Sandy Drinking Water Reinvestment Program
SUP	Sandy Utilities Program
Wet Season	November 1 to April 30
WWTP	Wastewater Treatment Plant

1.0 Introduction

1.1 Purpose

Climatological changes are having a substantial impact on stream flows in many of the upper tributaries in Oregon's watersheds. Many rivers and streams are experiencing declines in flows and resulting water quality degradation especially during the dry season which are becoming more pronounced in duration and severity. These streams would benefit from a reliable source of additional flow in the form of recycled water from wastewater treatment plants (WWTPs). A reliable source of additional flow would provide sustainable baseflows and enhance water quality during the dry season. Recognizing the climatological changes and their impacts on watersheds, the Oregon legislature passed House Bill 2010 (originally introduced as House Bill 3231) that requires the Oregon Department of Environmental Quality (DEQ) and the Oregon Water Resources Department (OWRD) to undertake the following activities:

- Characterize water reuse and beneficial land application project types that are priorities to support water quality, water supply or use, and habitat or ecosystem needs in Oregon
- Identify regulatory and other impediments to expanding water reuse
- Identify environmentally protective approaches successfully employed by other states with robust water reuse programs that may be applicable in Oregon
- Identify potential regulatory changes, including but not limited to changes to internal guidance, administrative rules or statutes needed to remove impediments, and propose an implementation schedule for enacting the proposed changes; and
- Develop technical assistance, guidance, or other resources for local jurisdictions and industries to seek permitting and development of water reuse and other beneficial land application programs that achieve the objectives of this section.

House Bill 2010 requires a final report that identifies the following:

- Changes that agencies can make or have completed to internal policies, guidance, and processes
- Recommended changes that require an agency to amend administrative rules or adopt new administrative rules
- Recommended changes that would require the Legislative Assembly to create new law or amend existing law
- Programmatic needs to remove impediments to water reuse and beneficial land application expansion, and to support access to and acceleration of water reuse and beneficial land application projects
- Technical assistance resources and incentives that would support jurisdictions in evaluating and pursuing reuse and beneficial land application projects

As background, the City of Sandy (City) WWTP treats wastewater from homes and businesses in the community to provide protection of public health and the environment. During the wet season (November 1 to April 30), the National Pollutant Discharge Elimination System (NPDES) Permit for the WWTP authorizes the discharge of treated effluent into Tickle Creek, an upper watershed tributary of the Clackamas River. Recycled water for irrigation is provided to a nursery during the dry season (May to October); surface water discharge is prohibited during this period. Due to its location near Mt. Hood and associated precipitation patterns, the transition periods during the spring and early fall (i.e., May/June and September/October) are often challenging. During these periods, there may be no demand for recycled water and surface water discharge is prohibited. Under the Three Basin Rule (Oregon Administrative Rules 340-041-0350), the City is not able to pursue a longer discharge period to address these limitations. As a result of these restrictions, the City is exploring solutions that may result in the removal of the discharge from Tickle Creek, which could further exacerbate water quality conditions in this flow-depleted, upper watershed tributary. Discharge to Tickle Creek on a year-round basis would provide an environmentally beneficial and cost-effective solution.

The purpose of the study is to assess the feasibility of utilizing recycled water as a source of flow augmentation water for Tickle Creek during the dry season. This study would advance the goals and objectives of House Bill 2010 for the beneficial use of recycled water in Oregon.

1.2 Scope of Work

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

- Task 1: Establish baseline flow readings of Tickle Creek both upstream and downstream of the current outfall location and conduct stream water quality sampling to coincide with each flow measurement event.
- Task 2: Establish baseline flow readings of treated effluent from the City of Sandy WWTP including both the discharge to Tickle Creek and the recycled water provided to the nursery. This will provide an indication of the total flow available for stream augmentation. This task also includes effluent characterization for key water quality parameters.
- Task 3: Develop and document the effects on fisheries, habitat, and reliable instream flow augmentation for downstream water users on the Clackamas River through a series of workshops and summits with various stakeholders.

1.3 Deliverables

Each of the individual tasks have deliverables associated with them as summarized below:

- Task 1 deliverables consist of flow monitoring reports prepared by a licensed surveyor, and water quality reports that include field data and laboratory analytical results.
- Task 2 deliverables include a flow report from the Sandy WWTP and a summary report of current and projected augmentation flows. Additionally, this task includes a summary of effluent data for key water quality parameters.
- Task 3 deliverables include summit agendas and summary notes from each summit.

Additionally, the deliverables include draft and final summary reports.

- The draft summary report included the study results, discussion of results, conclusions, and next steps. The draft summary report also included the deliverables associated with Tasks 1, 2, and 3. The draft summary report was made available to the stakeholder group for review and comment.

- The final summary report incorporated comments and suggestions from the stakeholders on the draft summary report.

1.4 Schedule

The schedule for completing the draft and final summary reports is as follows:

- Draft Summary Report: May 7, 2025.
- Final Summary Report: June 30, 2025.

2.0 Methodology

2.1 Approach

The project consists of three primary tasks. These include Tickle Creek flow and water quality monitoring, Sandy WWTP effluent flow and water quality monitoring, and stakeholder engagement.

Each task is described below.

2.1.1 Tickle Creek Flow and Water Quality Monitoring

Tickle Creek stream flow monitoring consisted of completing a detailed topographic survey to establish stream cross-sections and collect velocity measurements. A rating curve was established by plotting recorded velocities and associated water surface elevations/depths along the observed cross-section. The rating curve was then used to determine stream flow. Cross-sections were established upstream and downstream of the Sandy WWTP discharge location; these cross-sections and corresponding velocity measurements were used to develop rating curves to calculate Tickle Creek stream flow upstream and downstream of the Sandy WWTP discharge location.

Flow and water quality monitoring were conducted six times during the study period on the dates listed in **Table 2-1.**

Table 2-1. Stream Flow and Water Quality Monitoring Events

Season	Stream Flow Monitoring Events	Water Quality Monitoring Events
Spring 2024	May 22, 2024	May 22, 2024
Summer 2024	June 25, 2024	July 26, 2024
Summer 2024	September 3, 2024	September 3, 2024
Fall 2024	November 6, 2024	November 6, 2024
Winter 2025	January 20, 2025	January 17, 2025
Winter 2025	March 5, 2025	March 5, 2025

A memorandum summarizing the flow monitoring procedures and the development of the rating curves for Tickle Creek is presented in **Appendix A**.

Except for July 26, 2024, and January 17, 2025 water quality monitoring events, the other Tickle Creek water quality monitoring events were conducted on the same day as the stream flow monitoring events. Water quality monitoring was conducted upstream and downstream of the Sandy WWTP discharge location; monitoring consisted of field monitoring and collection of grab samples for laboratory analysis. **Table 2-1** presents the water quality parameters and analytical methods.

Table 2-2. Tickle Creek Water Quality Monitoring

Parameter	Analytical Method
Field Parameters (dissolved oxygen, temperature, pH, oxidation reduction potential, electrical conductivity, turbidity)	Field Measurement
pH (laboratory)	SM 4500-H+B
Ammonia as nitrogen	SM 4500-NH3 G
Nitrite + Nitrate as nitrogen	Method 353.2
Total Kjeldahl Nitrogen	ASTM D3590
Total Phosphorus	Method 365.3
Total Aluminum	Method 200.8
Hardness	SM 2340 B
Dissolved Organic Carbon	SM 5310 B
Dissolved cations (calcium, magnesium, potassium, sodium)	Method 200.8
Dissolved anions (sulfate, chloride)	Method 300.0
Alkalinity, dissolved as CaCO3	SM 2320B
Total Metals (arsenic, barium, cadmium, chromium, copper, mercury, lead, silver selenium and zinc)	Method 200.8 & 7470A
Dissolved Metals (arsenic, barium, cadmium, chromium, copper, mercury, lead, silver, selenium and zinc)	Method 200.8 & 7470A

2.1.2 Sandy WWTP Effluent Flow and Water Quality

The City conducts daily monitoring for flow at the Sandy WWTP in accordance with the requirements of the NPDES permit. Flow monitoring is conducted prior to discharge to the surface waters or distribution for use as recycled water. Flow monitoring results are reported to DEQ monthly as part of the reporting requirements in the NPDES permit. From November 1 to April 30, the measured flow reflects the discharge to Tickle Creek. From May 1 to October 31, the measured flow represents the recycled water that is provided to a nursery for beneficial use.

Water quality monitoring was also conducted at the Sandy WWTP; water quality monitoring was conducted on the same day as the Tickle Creek water quality monitoring events. The water quality parameters and analytical methods were the same as those used for the Tickle Creek water quality monitoring (**Table 2-2**). Field data collection was not included in the Sandy WWTP water quality monitoring events. Samples used for analytical testing of WWTP effluent were provided from the effluent composite sampler.

2.1.3 Stakeholder Engagement

The City hosted two summits to discuss the purpose of the study, present study results, and seek input from various stakeholders. Summit participants included representatives from watershed councils, DEQ, OWRD, Oregon Association of Clean Water Agencies, Clackamas Water Environment Services, and City of Sandy staff and consultants.

The initial plan was to hold the first summit at the beginning of the study period to introduce the study objectives and obtain input from stakeholders on the approach, methodology, and deliverables. However, due to scheduling difficulties and staff changes, the first summit was held on January 15, 2025. The summit outlined the purpose of the study, monitoring efforts, review of initial results, and discussion of next steps. The agenda, presentation slides, meeting summary, and list of attendees from the first summit are presented in **Appendix D**.

The second summit was held on May 15, 2025. Prior to the second summit, a draft version of the summary report of the feasibility study was distributed to stakeholders. During the second summit, the complete results of the Tickle Creek and Sandy WWTP flow and water quality monitoring efforts were presented including a discussion of results, study conclusions, and how the study can be used to further advance the beneficial use of recycled water. Comments received on the draft summary report have been incorporated in the final report. The agenda, presentation slides, meeting summary, and list of attendees from the second summit are included in **Appendix E**.

3.0 Results

3.1 Tickle Creek Flow and Water Quality Data Summary

Tickle Creek flow and water quality monitoring was conducted at two locations. The upstream location was 260 feet upstream of the Sandy WWTP outfall. The downstream location was 380 feet downstream of the Sandy WWTP outfall. **Figure 3-1** shows the Sandy WWTP, the WWTP discharge location (Outfall 001), and the upstream and downstream monitoring locations.

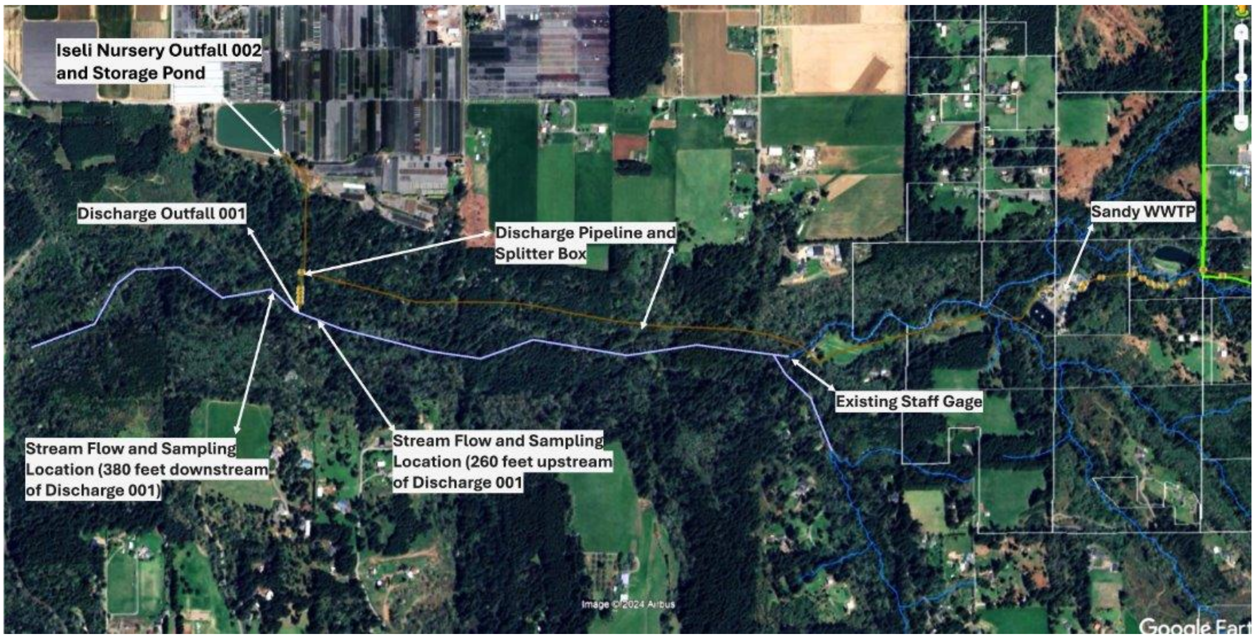


Figure 3-1. Tickle Creek Monitoring Locations

3.1.1 Tickle Creek Flow Monitoring

Flow monitoring was conducted upstream and downstream of the outfall. Between the upstream and downstream monitoring locations, there are no tributaries that enter Tickle Creek and there are no point source discharges other than the Sandy WWTP discharge. Thus, the upstream and downstream flow monitoring results should be similar when the Sandy WWTP is not discharging to Tickle Creek. The results of the upstream and downstream flow monitoring events are shown in **Figure 3-2**.

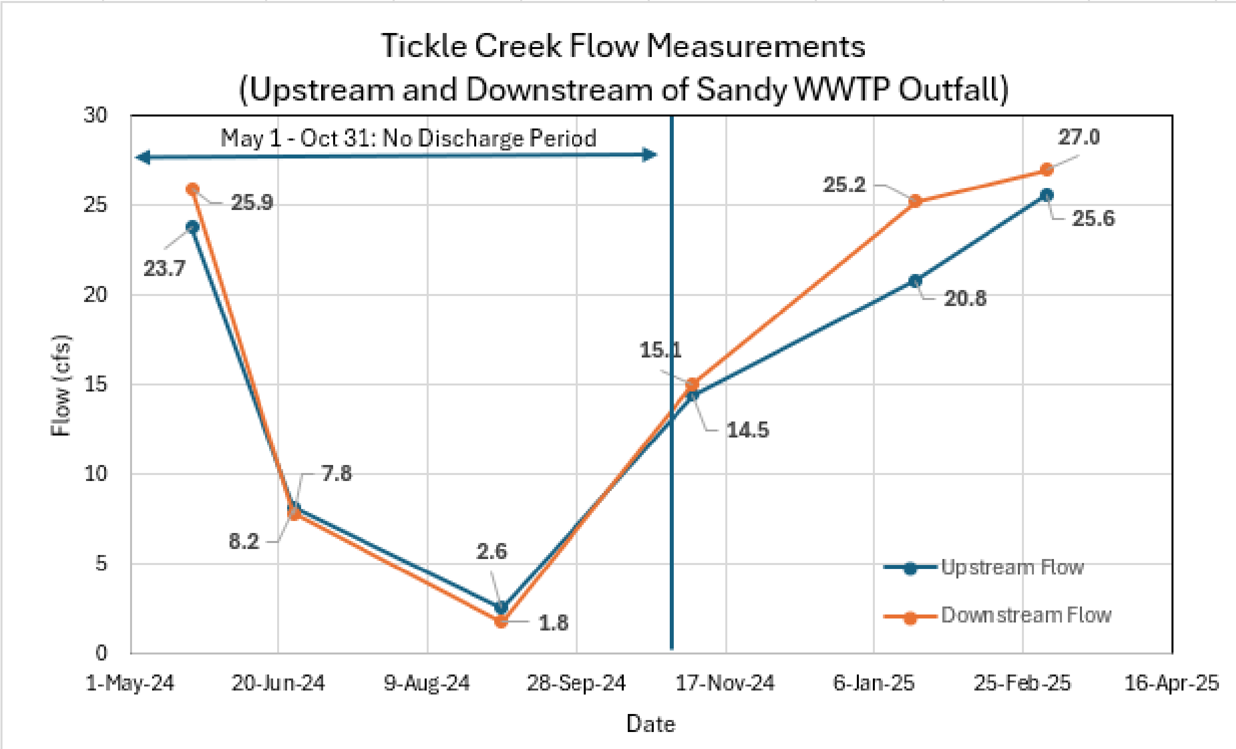


Figure 3-2. Tickle Creek Flow Measurements

Flow in Tickle Creek upstream of the Sandy WWTP outfall follows the expected seasonal pattern with flows decreasing from about 23.7 cfs in May 2024 to about 2.6 cfs in late summer. The increase in stream flow is evident with the onset of fall rains during the November 2024 monitoring event; flows continue to increase during the winter with measured flow upstream of the Sandy WWTP outfall at 20.8 cfs in January 2025 and 25.6 cfs in March 2025.

Except for the May 2024 monitoring event, upstream and downstream flow measurements are similar when the Sandy WWTP is not discharging; the minor difference in these measurements is likely due to the inherent variability associated with field stream flow measurements. The May 22, 2024, monitoring event was conducted following a precipitation event and the downstream flow in Tickle Creek was more than 2 cfs higher than the upstream flow. The Sandy WWTP had ceased discharge to Tickle Creek in accordance with the requirements of the NPDES permit. The increase in downstream flow suggests a precipitation induced gain in stream flow in this reach.
As expected, Tickle Creek flow measurements downstream of the Sandy WWTP outfall are higher than the upstream flow measurements during the fall and winter monitoring events. The increase can be attributed to the discharge from the Sandy WWTP and precipitation induced increases in the reach.

3.1.2 Tickle Creek Water Quality Monitoring

The following tables present the results of six water quality monitoring events upstream and downstream of the Sandy WWTP discharge location. Both field and laboratory data are presented in the following tables.

Table 3-1. Tickle Creek (Upstream Sample[1])

Analyte	Units	Upstream of Discharge Pt. 5/22/2024 Results	7/26/2024 Results	9/4/2024 Results	11/6/2024 Results	1/17/2025 Results	3/5/2025 Results
Alkalinity, Dissolved as CaCO3	mg/L	17.60	41.60	43.40	22.30	13.30	13.10
Aluminum	ug/L	251.00	323.00	37.90	294.00	128.00	138.00
Aluminum, Dissolved	ug/L	10.80	6.00	5.60	20.20	6.70	9.60
Ammonia as Nitrogen	mg/L				0.27		
Arsenic	ug/L	0.11	0.31	0.27	0.14	N/A	0.07
Arsenic, Dissolved	ug/L	N/A	0.21	0.26	0.10	N/A	N/A
Barium	ug/L	18.40	24.30	19.30	17.90	17.50	17.50
Barium, Dissolved	ug/L	15.40	17.70	18.20	16.50	16.00	N/A
Cadmium	ug/L	N/A	0.013	N/A	N/A	N/A	N/A
Cadmium, Dissolved	ug/L						
Calcium, Dissolved	ug/L	3810.00	6930.00	7130.00	4740.00	3590.00	3350.00
Carbon, Dissolved Organic (DOC)	mg/L	3.70	3.00	1.80	3.30	2.10	2.60
Chloride, Dissolved	mg/L	2.34	2.45	2.50	3.55	2.80	3.08
Chromium	ug/L	0.48	0.82	0.45	0.45	0.32	0.37
Chromium, Dissolved	ug/L	0.15	0.31	0.33	0.16	0.10	0.13
Copper	ug/L	0.78	1.00	0.50	0.73	0.36	0.38
Copper, Dissolved	ug/L	0.49	0.35	0.35	0.56	0.17	0.22
Hardness, Total as CaCO3	mg/L	17.50	31.40	33.60	20.90	15.40	14.60
Lead	ug/L	0.16	0.25	0.04	0.12	0.09	0.09
Lead, Dissolved	ug/L	0.02	0.01	0.01	0.02	0.01	0.01
Magnesium, Dissolved	ug/L	1750.00	3430.00	3830.00	2190.00	1570.00	1510.00
Nitrate+Nitrite as Nitrogen	mg/L	0.59	0.34	0.32	0.69	1.38	1.28
Nitrogen, Total Kjeldahl (TKN)	mg/L	0.58	0.46	0.62	1.06	0.30	0.44
pH	pH Units	7.55	7.87	7.90	7.50	7.15	7.42
Phosphorus, Total	mg/L	0.03	0.05	0.05	0.03	0.02	0.02
Potassium, Dissolved	ug/L	787.00	1300.00	1550.00	1130.00	756.00	753.00
Sulfate, Dissolved	mg/L	0.89	0.80	0.96	1.68	0.96	0.88
Zinc	ug/L	3.10	5.10	1.60	2.00	3.20	2.70
Zinc, Dissolved	ug/L	2.70	2.10	2.70	0.90	2.90	2.00

Field Measurements		5/22/2024	7/26/2024	9/4/2024	11/6/2024	1/17/2025	3/5/2025
Analyte		**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
pH	pH units	6.46	6.63	6.67	6.21	6.37	6.98
ORP	mV	88.70	16.70	-11.10	-48.10	6.40	28.00
DO	mg/L	12.26	3.25	1.15	0.61	10.99	15.14
Temp	deg C	11.20	14.20	15.00	7.80	5.10	6.60
EC	uS/cm	N/A	N/A	77.00	42.70	32.10	33.40
Turbidity	NTU	7.00	17.10	23.70	7.00	5.00	7.90

1. November laboratory samples for constituents including alkalinity, total phosphorus, nitrate+nitrite as N, and zinc showed substantially higher concentration in upstream samples than downstream samples, which was inconsistent with expected results and inconsistent with other sample dates. A mass balance analysis of the Sandy WWTP effluent and Tickle Creek monitoring data support the conclusion that Upstream and Downstream results were reversed in the November laboratory reports. Tables 3-2 and 3-3 report results based on this finding.

Table 3-2. Tickle Creek (Downstream Sample)

Analyte	Units	Downstream of Discharge Pt.					
		5/22/2024	7/26/2024	9/4/2024	11/6/2024	1/17/2025	3/5/2025
		Results	Results	Results	Results	Results	Results
Alkalinity, Dissolved as CaCO3	mg/L	17.900	42.100	43.700	33.500	24.800	17.700
Aluminum	ug/L	632.000	49.000	28.000	332.000	172.000	140.000
Aluminum, Dissolved	ug/L	13.600	5.800	6.300	17.400	7.900	9.900
Ammonia as Nitrogen	mg/L	N/A	N/A	N/A		0.025	N/A
Arsenic	ug/L	0.18	0.25	0.27	0.14	N/A	0.07
Arsenic, Dissolved	ug/L	0.10	0.24	0.28	0.10	N/A	0.06
Barium	ug/L	25.00	18.60	20.20	17.50	17.50	16.70
Barium, Dissolved	ug/L	15.80	17.90	19.40	15.50	15.60	15.50
Cadmium	ug/L						
Cadmium, Dissolved	ug/L						
Calcium, Dissolved	ug/L	3900.00	6570.00	7320.00	5190.00	4110.00	3590.00
Carbon, Dissolved Organic (DOC)	mg/L	3.80	2.90	4.30	3.30	3.50	2.40
Chloride, Dissolved	mg/L	2.46	2.48	2.66	6.09	5.10	3.95
Chromium	ug/L	0.88	0.47	0.43	0.41	0.32	0.34
Chromium, Dissolved	ug/L	0.16	0.31	0.32	0.14	0.13	0.14
Copper	ug/L	1.37	0.51	0.36	0.85	0.75	0.51
Copper, Dissolved	ug/L	0.54	0.35	0.35	0.69	0.55	0.34
Hardness, Total as CaCO3	mg/L	17.90	30.90	34.50	22.00	17.30	15.30
Lead	ug/L	0.42	0.04	0.02	0.11	0.08	0.09
Lead, Dissolved	ug/L	0.02	0.01	0.01	0.02	0.01	0.01
Magnesium, Dissolved	ug/L	1790.00	3520.00	3950.00	2200.00	1720.00	1550.00
Nitrate+Nitrite as Nitrogen	mg/L	0.56	0.36	0.35	1.05	1.82	1.37
Nitrogen, Total Kjeldahl (TKN)	mg/L	2.06	0.40	0.40	0.98	0.76	0.70
pH	pH Units	6.69	7.92	7.86	7.57	7.35	7.46
Phosphorus, Total	mg/L	0.24	0.04	0.05	0.19	0.21	0.10
Potassium, Dissolved	ug/L	876.00	1320.00	1600.00	1840.00	1590.00	1110.00
Sulfate, Dissolved	mg/L	0.98	1.02	1.01	2.86	2.15	1.40
Zinc	ug/L	5.90	1.30	1.00	5.30	6.70	4.60
Zinc, Dissolved	ug/L	1.20	0.80	0.70	4.10	5.50	3.80

Field Measurements		5/22/2024	7/26/2024	9/4/2024	11/6/2024	1/17/2025	3/5/2025
Analyte		Results	Results	Results	Results	Results	Results
pH	pH units	6.62	6.49	6.67	6.34	6.40	6.93
ORP	mV	80.90	4.90	-40.70	-16.50	26.30	32.70
DO	mg/L	15.04	3.54	1.72	0.52	11.31	16.13
Temp	deg C	11.10	14.20	14.90	8.90	5.90	6.90
EC	uS/cm	N/A	N/A	79.10	69.20	53.80	42.90
Turbidity	NTU	31.00	28.00	32.10	5.00	5.00	7.20

Both field and laboratory pH results are presented at the upstream and downstream locations. As is evident in **Table 3-1** and **Table 3-2**, the field and laboratory pH measurements are substantially different. While it is generally accepted that the field pH measurements are the appropriate technique for measuring pH, Tickle Creek field pH measurements are likely biased low. This could be due to the low ionic strength in upper watershed streams like Tickle Creek, which require the deployment of field instruments for several hours to equilibrate and accurately measure pH. Field instruments were not deployed for long periods during monitoring events and likely resulted in field pH data that are biased low. If additional field monitoring occurs in the future, the deployment period of field pH instruments will be extended to allow greater equilibration time.

3.2 Effluent Flow and Water Quality Data Summary

The following chart presents the daily effluent flow during the study period (May 1, 2024, to March 31, 2025). The chart identifies the measured effluent flow associated with the Tickle Creek flow and water quality monitoring events.

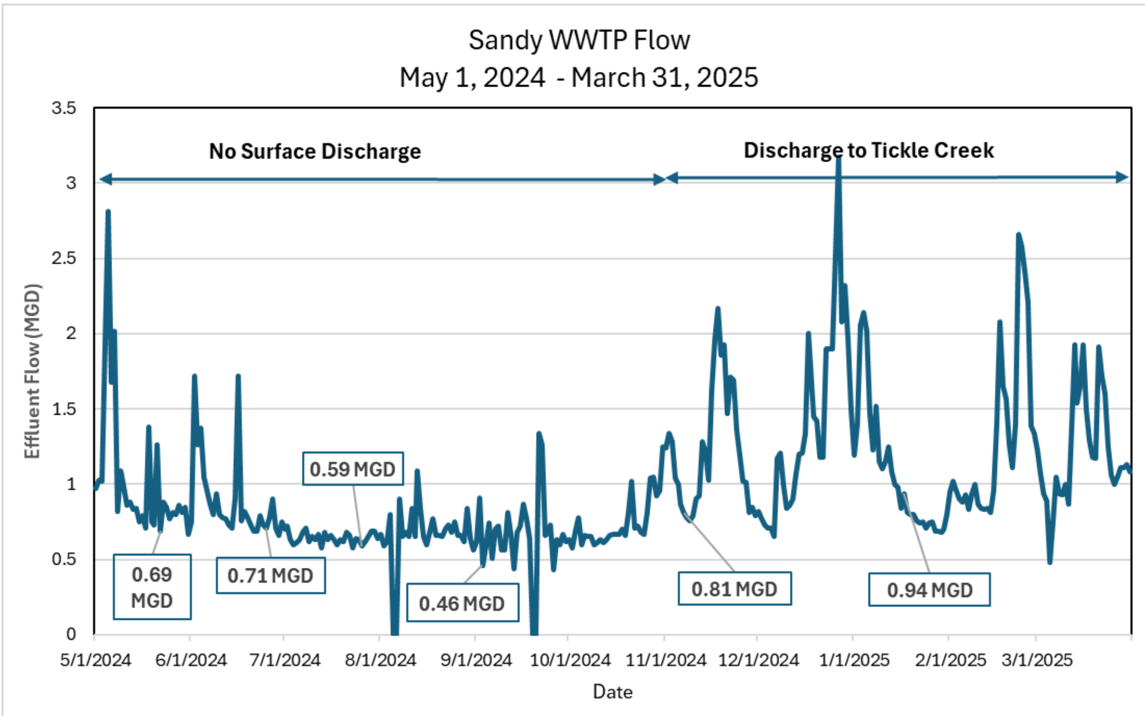


Figure 3-3. Sandy WWTP Effluent Flow (May 1, 2024 – March 31, 2025)

As previously noted, the Sandy WWTP discharges to Tickle Creek on a seasonal basis. During the wet season (November 1 to April 30), the Sandy WWTP flow reflects the discharge to Tickle Creek. During the dry season (May 1 to October 31), there is no discharge to surface waters, and the Sandy WWTP flow represents the recycled water that is provided to a nursery for beneficial use. In 2024, the average Sandy WWTP flow available for flow enhancement during the dry season is 0.77 MGD (1.2 cfs). The average Sandy WWTP flow during the July to September period, which tends to coincide with the low stream flow period, is 0.65 MGD (1.0 cfs).

The following table presents the results of the six water quality monitoring events at the Sandy WWTP. Field data were not collected at the Sandy WWTP as part of this project.

Table 3-3. Sandy WWTP Effluent Water Quality

Sandy WWTP Effluent							
		5/22/2024	7/26/2024	9/4/2024	11/6/2024	1/17/2025	3/5/2025
Analyte	Units	Results	Results	Results	Results	Results	Results
Alkalinity, Dissolved as CaCO3	mg/L	105.00	115.00	119.00	127.00	116.00	140.00
Aluminum	ug/L	10.90	14.00	20.30	6.70	8.50	10.30
Aluminum, Dissolved	ug/L	6.80	10.10	9.90	3.90	5.40	6.00
Ammonia as Nitrogen	mg/L	N/A	0.03	0.04	0.06	1.25	0.17
Arsenic	ug/L	0.09	0.11	0.15	N/A	N/A	0.10
Arsenic, Dissolved	ug/L	0.09	0.14	0.16	N/A	N/A	0.08
Barium	ug/L	5.62	6.77	6.24	6.98	7.59	7.20
Barium, Dissolved	ug/L	5.57	6.72	4.16	6.67	7.39	6.92
Cadmium	ug/L	0.014	0.011	0.020	N/A	0.015	0.008
Cadmium, Dissolved	ug/L	0.010	N/A	0.011	N/A	0.010	0.006
Calcium, Dissolved	ug/L	8860.00	10200.00	8570.00	8430.00	8150.00	8590.00
Carbon, Dissolved Organic (DOC)	mg/L	10.30	10.20	11.70	5.90	8.20	10.40
Chloride, Dissolved	mg/L	39.70	51.10	53.70	24.80	25.40	25.80
Chromium	ug/L	0.37	0.52	0.50	0.35	0.33	0.37
Chromium, Dissolved	ug/L	0.30	0.42	0.41	0.18	0.23	0.24
Copper	ug/L	4.52	3.64	6.05	2.49	4.41	3.03
Copper, Dissolved	ug/L	3.56	3.12	4.79	2.17	4.08	2.62
Hardness, Total as CaCO3	mg/L	36.20	36.70	33.10	32.20	32.70	33.80
Lead	ug/L	0.11	0.18	0.27	0.09	0.11	0.12
Lead, Dissolved	ug/L	0.09	0.16	0.13	0.05	0.08	0.10
Magnesium, Dissolved	ug/L	3340.00	2720.00	2830.00	2700.00	3010.00	3000.00
Nitrate+Nitrite as Nitrogen	mg/L	5.91	10.30	6.60	4.06	6.47	3.84
Nitrogen, Total Kjeldahl (TKN)	mg/L	2.44	1.92	2.50	2.02	2.14	1.70
pH	pH Units	7.44	7.80	7.65	7.59	7.65	7.57
Phosphorus, Total	mg/L	3.57	2.40	2.98	1.36	2.21	3.07
Potassium, Dissolved	ug/L	9810.00	12000.00	12600.00	8300.00	9570.00	9450.00
Sulfate, Dissolved	mg/L	14.30	18.10	18.50	13.10	13.20	13.40
Zinc	ug/L	45.40	41.30	62.90	36.40	45.80	39.60
Zinc, Dissolved	ug/L	45.10	41.60	60.90	36.00	45.40	39.60

Notably in the data summary, the dry season ammonia levels are very low (<0.1 mg/L) reflecting the high level of treatment (i.e., full nitrification) provided by the Sandy WWTP. Nitrite + nitrate concentrations range from 3.8 mg/L to 10.3 mg/L, which suggests that partial denitrification occurs at the WWTP. Total phosphorus levels range from 2.4 mg/L to 3.57 mg/L during the dry season and are indicative of typical levels at secondary treatment facilities. Metals concentrations are generally low and are reflective of domestic/commercial contributions and the high level of treatment provided by the WWTP. Additional discussion of upstream and downstream water quality results is provided in **Section 4.0**

3.3 Stakeholder Engagement Activities

3.3.1 Summit #1: January 15, 2025

The objective of this summit was to discuss the purpose of the project, data collection efforts, and preliminary results. The summit also sought input from the attendees on the purpose, objectives and preliminary results. Twelve people attended the kickoff summit. Summit participants included representatives from a water provider, DEQ, OWRD, Oregon Association of Clean Water Agencies, a regional wastewater utility, and City of Sandy staff and consultants. The list of attendees is included in **Appendix D**.

The City noted that it is gathering data to document the current flow and water quality conditions in Tickle Creek throughout an annual water cycle and compare both flow and water quality conditions upstream and downstream of the City's current effluent discharge location. The purpose of the data collection is to better understand current conditions in Tickle Creek and to initiate discussion and guide decisions regarding the value of instream flow augmentation provided by the effluent from the Sandy WWTP.

Comments provided by the attendees include questions about the monitoring plan and whether the plan was reviewed by DEQ. One attendee noted that a lot more data is necessary to provide support for use of WWTP effluent for flow enhancement including a continuous flow record; the attendee also noted that the upgrades to the WWTP to reduce nitrogen and phosphorus may be necessary to support use of effluent for flow enhancement. The attendees also focused on the effects of the flow enhancement on habitat – how does the use of warmer effluent for flow enhancement change habitat? What are the impacts on cold water salmonid species? One attendee noted that additional flow during the dry season would be beneficial; the attendee also noted that in-stream water rights on Deep Creek and Tickle Creek are not met every year and having additional in-stream flow would be beneficial through the end of the irrigation season.

The attendees also discussed the Three Basin Rule, which prohibits any new or expanded discharge to surface waters in the Clackamas, North Santiam, and McKenzie River basins. There was also discussion of the petition filed by Marion County on behalf of the North Santiam communities seeking an update to the Three Basin Rule. An attendee noted that changing the Three Basin Rule to allow for expanded recycled water use will require a coordinated approach with DEQ to collect data that demonstrates that adding water is beneficial and will not degrade water quality. A summary of the input from the attendees is included in **Appendix D**.

3.3.2 Summit #2: May 15, 2025

The objective of this summit was to review the Tickle Creek and Sandy WWTP flow and water quality monitoring results, discuss how the study can be used to further advance the beneficial use of recycled water, and identify future recommended activities and the next steps needed.

The presentation and meeting minutes from Summit #2 are included in **Appendix E**.

4.0 Discussion

4.1 Observations Regarding Tickle Creek Flow and Water Quality Data

Four of the six stream flow monitoring events coincided with the water quality monitoring events. The exceptions were during the summer of 2024 when stream flow monitoring was conducted on June 25th and water quality monitoring was conducted on July 26th, and in January 2025 when flow monitoring was conducted three days after the water quality monitoring.

Field measurements were conducted for temperature and dissolved oxygen during the monitoring events. **Figure 4-1** presents upstream and downstream dissolved oxygen and **Figure 4-2** presents upstream and downstream temperature data.

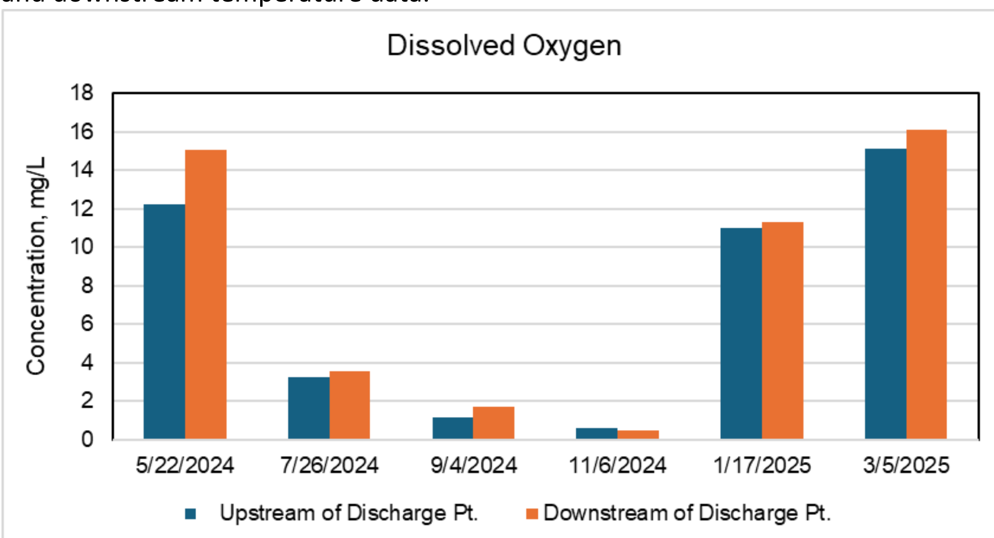


Figure 4-1. Tickle Creek Upstream and Downstream Dissolved Oxygen Data.

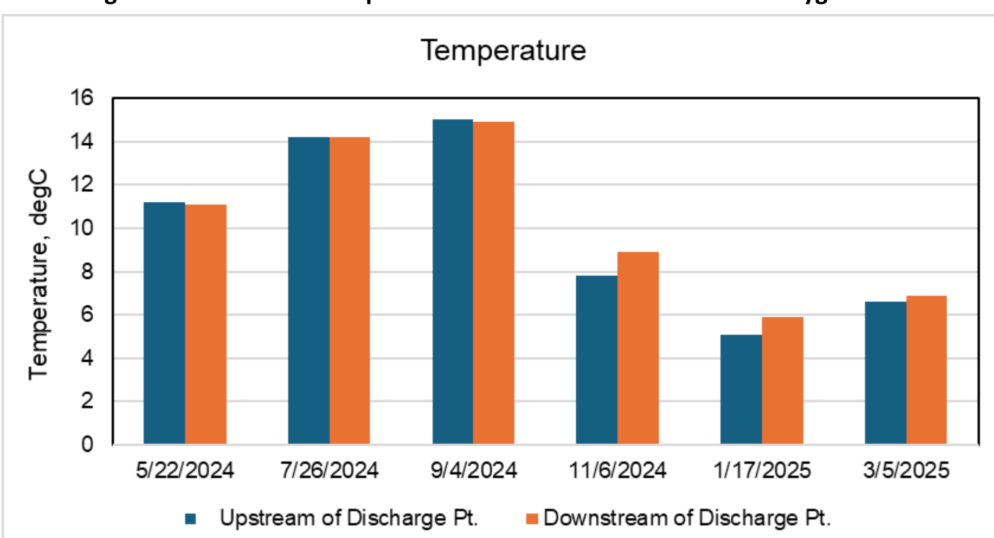
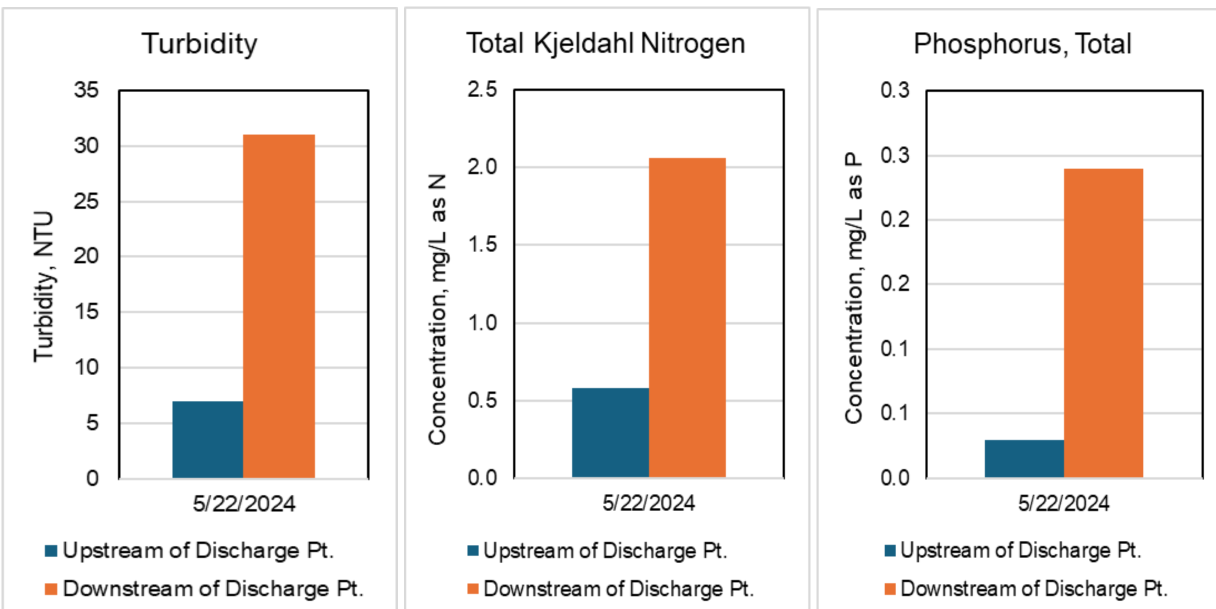


Figure 4-2. Tickle Creek Upstream and Downstream Temperature Data

As expected, these parameters show seasonal patterns with lower temperatures and higher dissolved oxygen levels during the spring (May 2024) and winter (January and March 2025) monitoring events and higher temperatures and lower dissolved oxygen levels during the summer monitoring events (July and September). Surprisingly, dissolved oxygen levels were the lowest during the November 2024 monitoring event even though stream flow was higher, and temperature was lower than during the summer monitoring events. The prolonged period of low dissolved oxygen levels is particularly concerning from a fisheries and habitat perspective.

As noted in Section 3.1, the May 22, 2024, monitoring event was conducted following a precipitation event and the downstream flow in Tickle Creek was more than 2 cfs higher than the upstream flow. The water quality data was reviewed to see if there are differences in water quality at the upstream and downstream locations. **Figure 4-3** presents upstream and downstream water quality data for turbidity, nutrients (total phosphorus and TKN), and select metals associated with the May 2024 monitoring event.



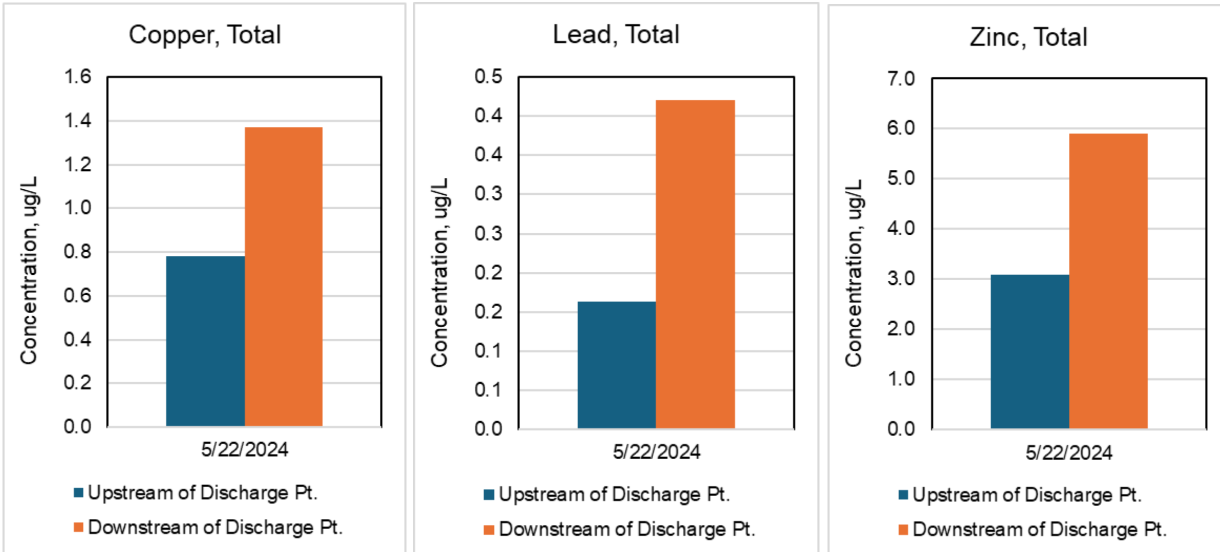
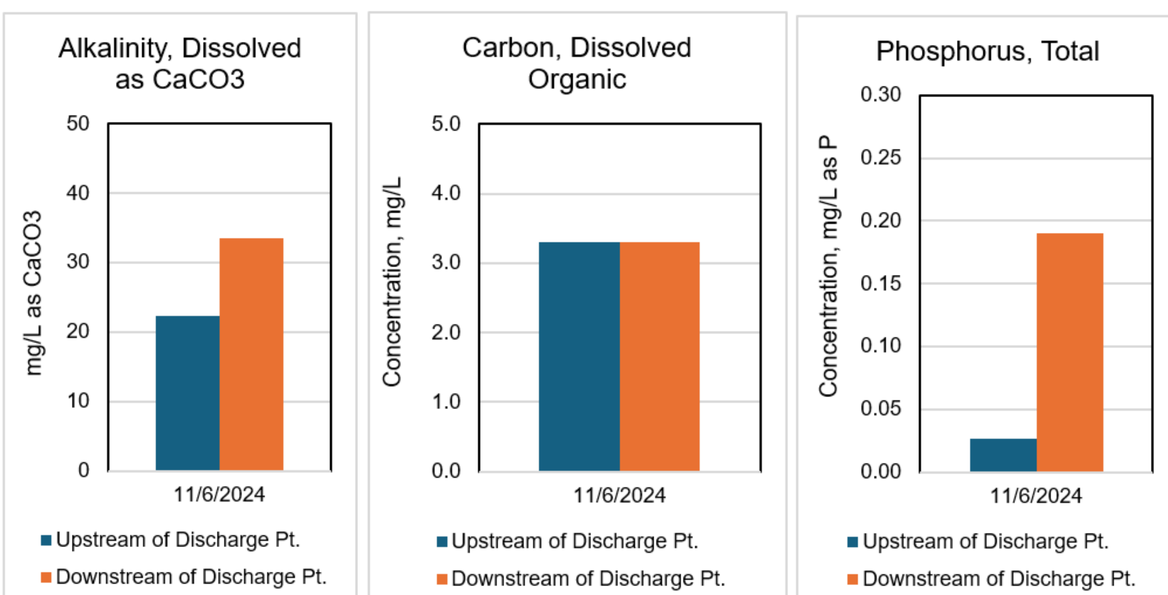


Figure 4-3. Water Quality Data from May 2024 Monitoring Event

The water quality data from the May 2024 monitoring event show that the downstream monitoring location was more turbid and had higher concentrations of nutrients (TKN and total phosphorus) and total metals (copper, lead, and zinc). Since the Sandy WWTP was not discharging to Tickle Creek during this monitoring event and there are no other point source discharges in this segment of Tickle Creek, non-point source contributions from surrounding land uses are the likely source.

The downstream flow is higher than the upstream flow once the Sandy WWTP begins discharge to Tickle Creek in November 2024. The effluent flow from the Sandy WWTP was 0.87 MGD (1.3 cfs) and accounted for about 9% of the total flow in Tickle Creek during the November 2024 monitoring event. **Figure 4-4** presents water quality data for alkalinity, dissolved organic carbon, nutrients (total phosphorus and nitrite + nitrate as N), and select metals from the November 2024 monitoring event.



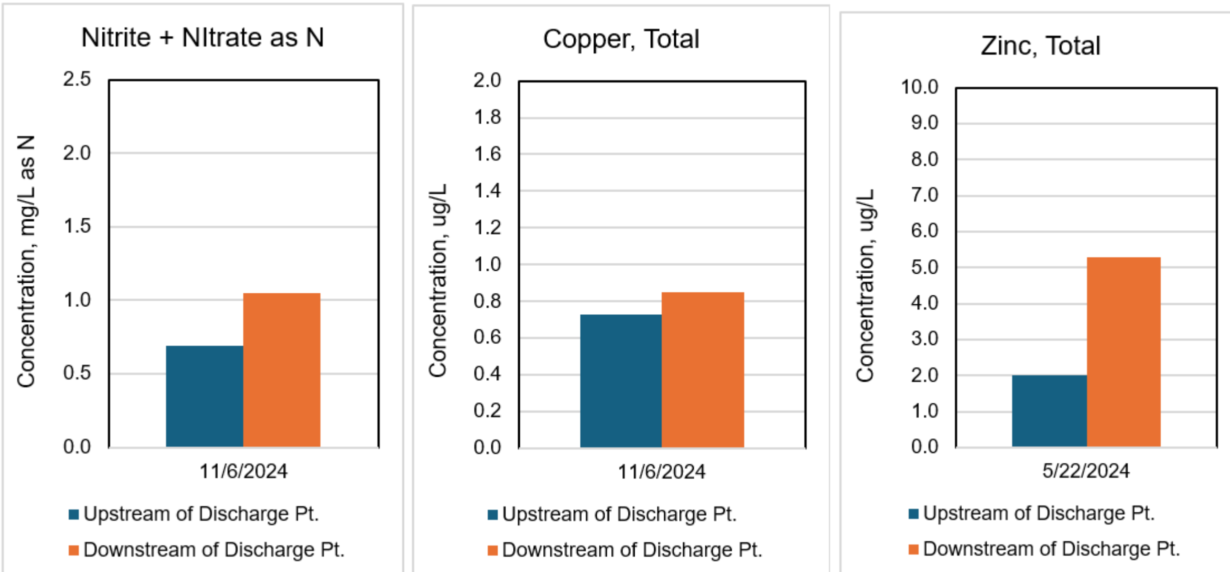


Figure 4-4. Water Quality Data from November 2024 Monitoring Event

Stream flow was not measured during the January 17, 2025, monitoring event but was measured a few days later on January 20, 2025; the measured flow upstream of the Sandy WWTP was 20.8 cfs. The Sandy WWTP was discharging to Tickle Creek during this monitoring event. A review of the January 2025 DMR shows that the effluent flow from the Sandy WWTP was 0.94 MGD (1.45 cfs). **Figure 4-5** presents water quality data for alkalinity, dissolved organic carbon, nutrients, and select metals upstream and downstream of the Sandy WWTP discharge location.

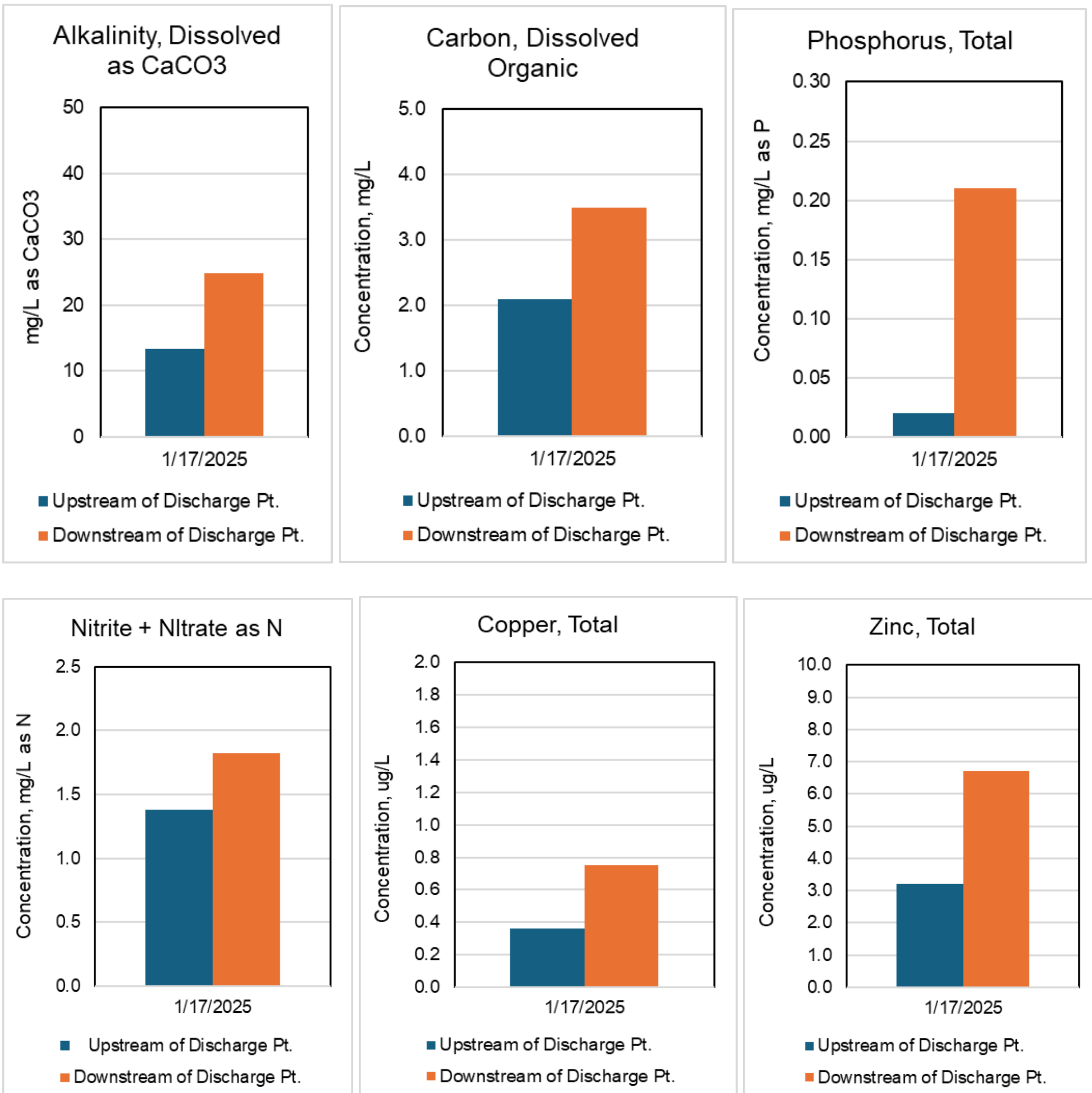


Figure 4-5. Water Quality Data from January 2025 Monitoring Event

There was no measurable precipitation between the water quality monitoring event (January 17th) and the stream flow monitoring event (January 20th); so, the stream flow measured on January 20th was used as an estimate of Tickle Creek flow during the January 17th water quality monitoring event. The discharge from the Sandy WWTP represents about 6% of the flow in Tickle Creek during this period. The downstream monitoring location has higher levels of alkalinity, dissolved organic carbon, nutrients and metals (copper and zinc). While the concentrations for these constituents are higher at the downstream location, the measurements do not exceed applicable water quality criteria.

Observations from the March 5, 2025, monitoring event were similar to the January 17, 2025, monitoring event. Both stream flow and water quality monitoring were conducted during the March 5, 2025, monitoring event. Stream flow upstream of the Sandy WWTP was 25.6 cfs. The Sandy WWTP was discharging to Tickle Creek and effluent flow from the Sandy WWTP was 0.94 MGD (1.5 cfs). **Figure 4-6** presents water quality data for alkalinity, dissolved organic carbon, nutrients, and select metals upstream and downstream of the Sandy WWTP discharge location.

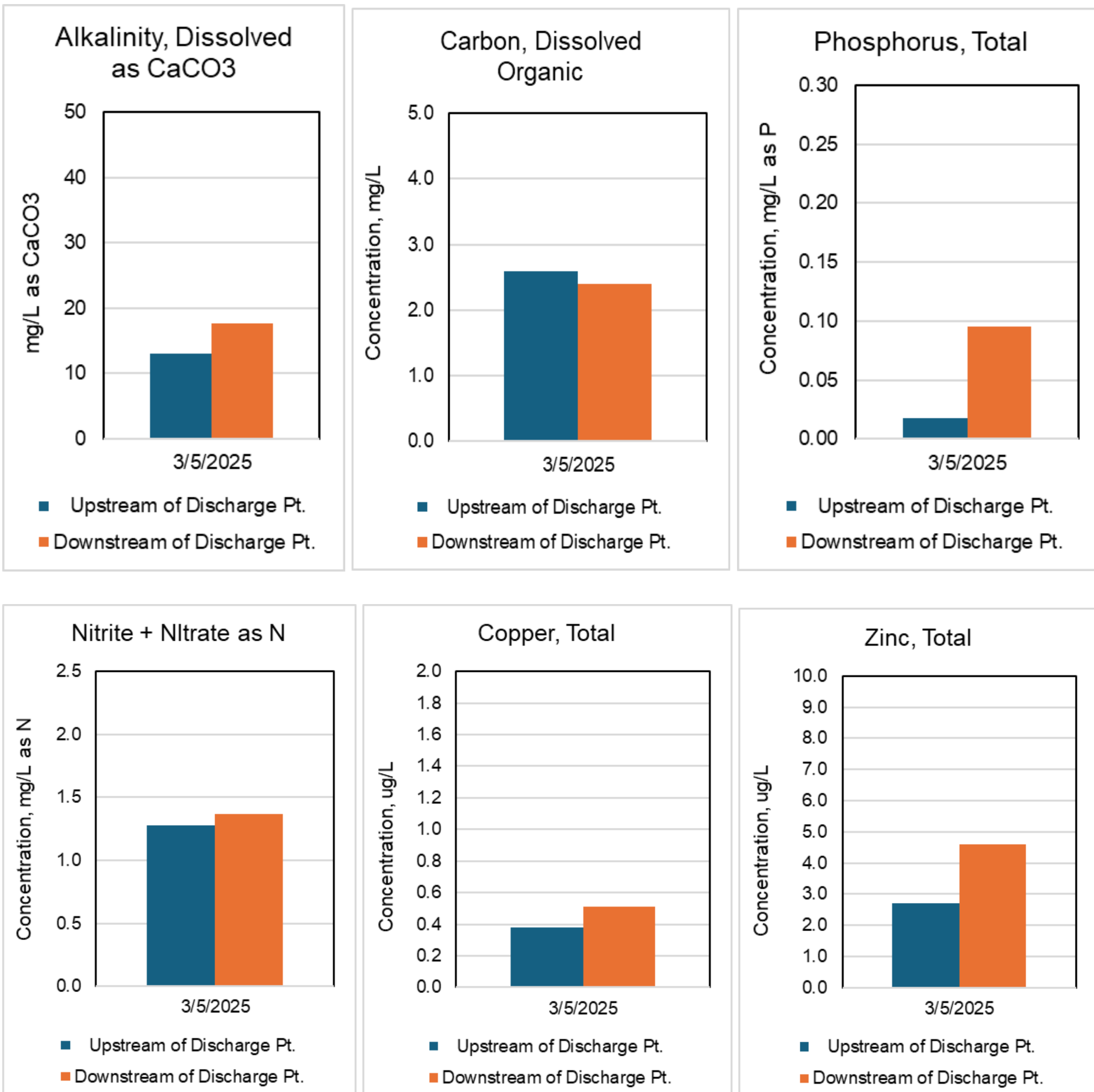


Figure 4-6. Water Quality Data from March 2025 Monitoring Event

The discharge from the Sandy WWTP represents about 5% of the flow in Tickle Creek during this period. Alkalinity, dissolved organic carbon, nitrite + nitrate as N, and copper concentrations upstream and downstream of the Sandy WWTP outfall are not substantively different; total phosphorus and zinc concentrations are higher at the downstream location. The measurements downstream of the Sandy WWTP discharge location do not exceed applicable water quality criteria.

4.2 Addition of Effluent to Tickle Creek During the Dry Season

As previously noted, the Sandy WWTP does not discharge to Tickle Creek during the dry season (May to October). To evaluate the use of Sandy WWTP effluent for flow and water quality enhancement, a mass balance evaluation was conducted using the Tickle Creek flow and water quality and the Sandy WWTP flow and water quality.

Figure 4-7 shows the measured upstream flow in Tickle Creek from the flow monitoring events and the downstream flow with the addition of the Sandy WWTP flow.

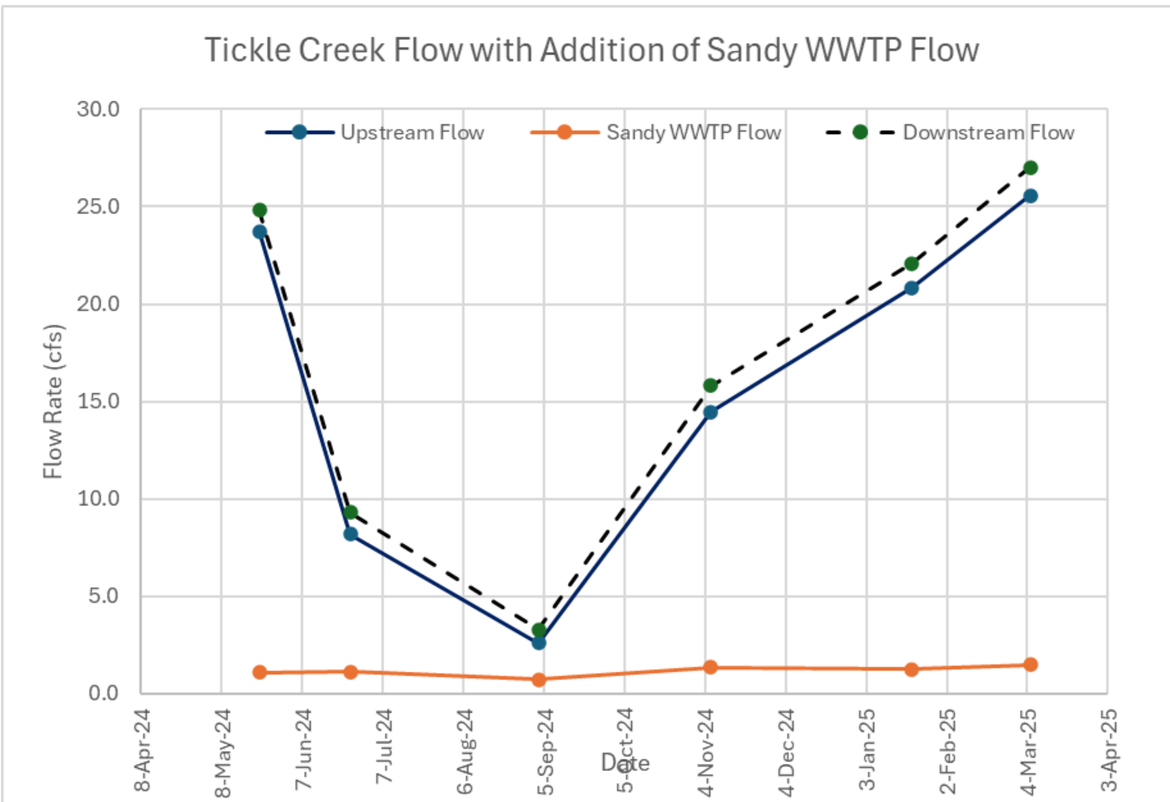


Figure 4-7. Tickle Creek Flow with Addition of Sandy WWTP Flow

Due to the precipitation driven increase in stream flow in May 2024, the percent increase in Tickle Creek flow was not substantial with the addition of Sandy WWTP effluent. The increase in Tickle Creek stream flow with the addition of Sandy WWTP effluent is substantial during the latter dry season months. The addition of Sandy WWTP flow would result in a 12% increase in stream flow during the June 2024 monitoring event and more than a 20% increase in stream flow during September 2024 monitoring event.

There were three water quality monitoring events during the dry season monitoring events (May, July and September). Note that flow data was available for the June 25, 2024, monitoring event, however, there was no corresponding water quality data collected during this flow monitoring event. Water quality data from July 26, 2024, monitoring event were used in conjunction with the June 25, 2024, flow data in the mass balance evaluation.

A weighted mass balance was performed for laboratory parameters for which both upstream Tickle Creek water quality data and Sandy WWTP water quality data were available. A mass balance was not conducted for laboratory pH because field monitoring is the accepted method for pH. A weighted-mass balance evaluation was not conducted for field parameters because field data were not available for the Sandy WWTP effluent. The following table presents the resulting water quality for the three dry season monitoring events.

Table 4-1. Tickle creek Water Quality with the Addition of Sandy WWTP Flow

		Tickle Creek Water Quality with Sandy WWTP Flow		
		5/22/2024	June/July 2024	9/4/2024
Analyte	Units	Results	Results	Results
Alkalinity, Dissolved as CaCO3	mg/L	21.36	50.29	59.79
Aluminum	ug/L	240.67	286.42	34.08
Aluminum, Dissolved	ug/L	10.63	6.49	6.53
Arsenic	ug/L	0.11	0.29	0.24
Arsenic, Dissolved	ug/L		0.20	0.24
Barium	ug/L	17.85	22.22	16.47
Barium, Dissolved	ug/L	14.98	16.40	15.16
Calcium, Dissolved	ug/L	4027	7317	7442
Carbon, Dissolved Organic (DOC)	mg/L	3.98	3.85	3.95
Chloride, Dissolved	mg/L	3.95	8.21	13.60
Chromium	ug/L	0.48	0.78	0.46
Chromium, Dissolved	ug/L	0.16	0.32	0.35
Copper	ug/L	0.94	1.31	1.70
Copper, Dissolved	ug/L	0.62	0.68	1.31
Hardness, Total as CaCO3	mg/L	18.30	32.03	33.49
Lead	ug/L	0.16	0.24	0.09
Lead, Dissolved	ug/L	0.02	0.03	0.04
Magnesium, Dissolved	ug/L	1818	3346	3613
Nitrate+Nitrite as Nitrogen	mg/L	0.82	1.52	1.68
Nitrogen, Total Kjeldahl (TKN)	mg/L	0.66	0.63	1.03
Phosphorus, Total	mg/L	0.18	0.33	0.69
Potassium, Dissolved	ug/L	1175	2567	3946
Sulfate, Dissolved	mg/L	1.47	2.85	4.76
Zinc	ug/L	4.92	9.39	14.89
Zinc, Dissolved	ug/L	4.52	6.78	15.32

5.0 Conclusion

5.1 Potential improvements associated with release of Sandy WWTP flow to Tickle Creek during the dry season

Summer flows in Tickle Creek are very low. Measurements during the 2024 dry season show that flows drop to less than 2 cfs. The additional flow from the Sandy WWTP provides a sustainable base flow in Tickle Creek, which is essential for providing habitat and ecological benefits.

The Sandy WWTP provides a high level of treatment, which includes biological treatment and filtration, and produces high quality treated water. Even with the level of treatment provided by the Sandy WWTP, the addition of treated water during the dry season would result in higher concentrations of certain constituents in Tickle Creek; these include some metals (copper and zinc), and nutrients (nitrates, phosphorus). However, the resulting Tickle Creek water quality with the addition of Sandy WWTP flow would meet applicable surface water quality criteria for metals and nitrates; note that there are no surface water quality criteria for total phosphorus.

5.2 Challenges/limitations

Treated water from the Sandy WWTP would not meet the surface water quality criteria for temperature that would apply during the dry season (18 °C). Therefore, the use of treated water from the Sandy WWTP for flow enhancement would require an approach to address temperature issues. This may include the implementation of temperature reduction strategies or temperature offset strategies such as water quality trading. Additionally, an anti-degradation evaluation may be necessary to determine whether flow augmentation will result in a lowering of water quality as defined by DEQ guidelines. This may necessitate a higher level of treatment to produce acceptable effluent quality particularly focused on nutrients and metals.

As required by HB 2010, DEQ submitted a final report in September 2024 that documents their efforts to advance the beneficial use of recycled water in Oregon. The report noted that DEQ accomplished the following:

- Stakeholder Engagement & Agency Coordination: Collaborated with municipalities as well as interstate and intrastate agencies
- County and Irrigation District Collaboration: Gathered feedback and insights from current and proposed reuse projects
- Regulatory Insights: Developed guidance for regulatory changes based on lessons learned from programs in other states
- History Review: Analyzed historic reuse initiatives to inform potential future regulatory improvements
- Rule Review: Examined current rules and identified potential changes
- Permitting Pathway: Began to develop changes to current permitting pathway

The report also identified the tasks that DEQ expects to complete by June 2025, which marks the end of the funding period for the additional resources provided by HB 2010. These include the following:

- Establishing a clear permitting pathway to support municipalities and industries pursuing water reuse projects. Guidance documentation will be developed, and regulatory documents will be updated for consistency across state agencies.
- An analysis of water reuse impacts and barriers, including cost and logistical challenges, to inform future actions.

In the September 2024 report to the legislature, DEQ also identified key tasks which will result in the completion of objectives outlined in HB 2010. These include:

- Finalizing a permitting pathway and publishing updated regulatory documents, statutes and rules.
- Specific guidance for irrigation canal reuse needs to be finalized, and completed guides for municipalities and industries need to be published.
- Creation of GIS maps to illustrate water reuse and cost barriers will also be necessary.

DEQ notes that continued efforts and sustained resources are essential to fully implement the directives of HB 2010 and support the expansion of water reuse in Oregon. While the State is looking to advance the beneficial use of recycled water, the use of recycled water for flow augmentation is not specified as an objective; so, the updates to the recycled water rules, guidance documents, and policies do not provide a pathway for Sandy to use recycled water for flow augmentation. A broader review and update to the recycled water rules and guidance documents are necessary for the use of recycled water for flow augmentation. For Sandy, this would require updates to the recycled water use rules and the Three Basin Rule – both of which prohibit the use of Sandy WWTP flow for Tickle Creek flow augmentation. The combination of updates to the Three Basin Rule and revisions to the recycled water use rules would allow effluent from Sandy and other dischargers in the area to be used to increase streamflow and improve overall stream health in the Clackamas River basin.

Appendices

Appendix A: Tickle Creek Flow Monitoring Rating Curves

Appendix B: Tickle Creek Water Quality Monitoring Results

Appendix C: Sandy WWTP Flow and Water Quality Monitoring Results

Appendix D: January 15th Summit Documents

Appendix E: May 15th Summit Documents

Appendix A: Tickle Creek Flow Monitoring Rating Curves

DAVID EVANS AND ASSOCIATES INC.

MEMORANDUM

DATE: March 17, 2025

TO: Jeff Aprati, Deputy City Manager and Interim Public Works Director
City of Sandy

FROM: Austin Wissler, P.E., CFM

SUBJECT: Tickle Creek Flow Monitoring Rating Curves

PROJECT: Tickle Creek Topographic Survey and Flow Monitoring
Project Number SNDY-0008

Introduction

David Evans and Associates, Inc. (DEA) has been retained to collect hydrologic data to establish a reliable means of determining the flow rate in Tickle Creek upstream and downstream of the City of Sandy, OR wastewater treatment plant (WWTP) discharge point to support State of Oregon permitting requirements. Data collection includes velocity and depth measurements, and topographic survey of two cross-sections. DEA developed two rating curves to assist the City of Sandy staff to estimate the flow rate in Tickle Creek by measuring the maximum depth in the channel.

The project site includes the wastewater discharge point from the City of Sandy WWTP and two established cross-sections, one approximately 260 feet upstream and one approximately 380 feet downstream of the WWTP discharge point. The project also includes taking readings during site visits from a staff gage attached to a bridge approximately 4,300 ft upstream from the WWTP discharge point, where the rating curve currently used by the City of Sandy to estimate flow in Tickle Creek was developed. See Attachment A for photos of the project site and cross-section locations.

Data Collection and Flow Rate Determination

DEA has collected streamflow observations during six site visits. Survey was completed by DEA at two flow observation cross-sections (upstream and downstream) in June 2024 to capture the cross-sectional shape and area of the channel. A Swoffer velocity probe was used to measure velocity in feet per second at 2-foot (upstream) and 1-foot (downstream) intervals along the observation cross-sections. Different measurement intervals were used because the upstream cross-section is wider than the downstream cross-section (See Attachment B). Water depths were also measured at 2-foot and 1-foot intervals during site visits. Cumulative flow was calculated by summing the individual flow from each incremental area. Attachment B shows the two surveyed cross-sections and velocity observation stations used to determine the flow rate.

A rating curve for Tickle Creek was developed for both cross-sections by plotting the calculated flows and associated maximum water depths. The draft rating curves (shown below as *Figure 1 & 2*) demonstrate the relationship between maximum water depth in the channel and flow. Processed field data and detailed results are provided in Attachment C.

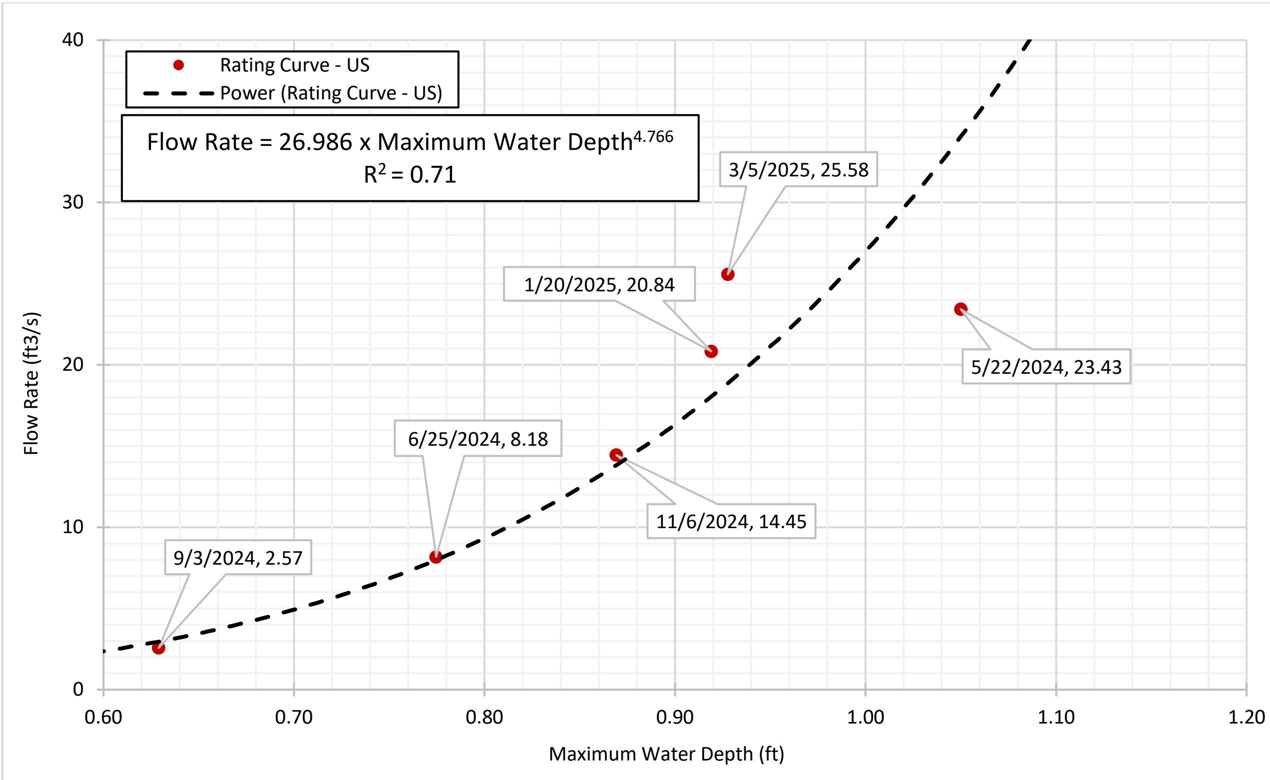


Figure 1. Tickle Creek Upstream XS Rating Curve

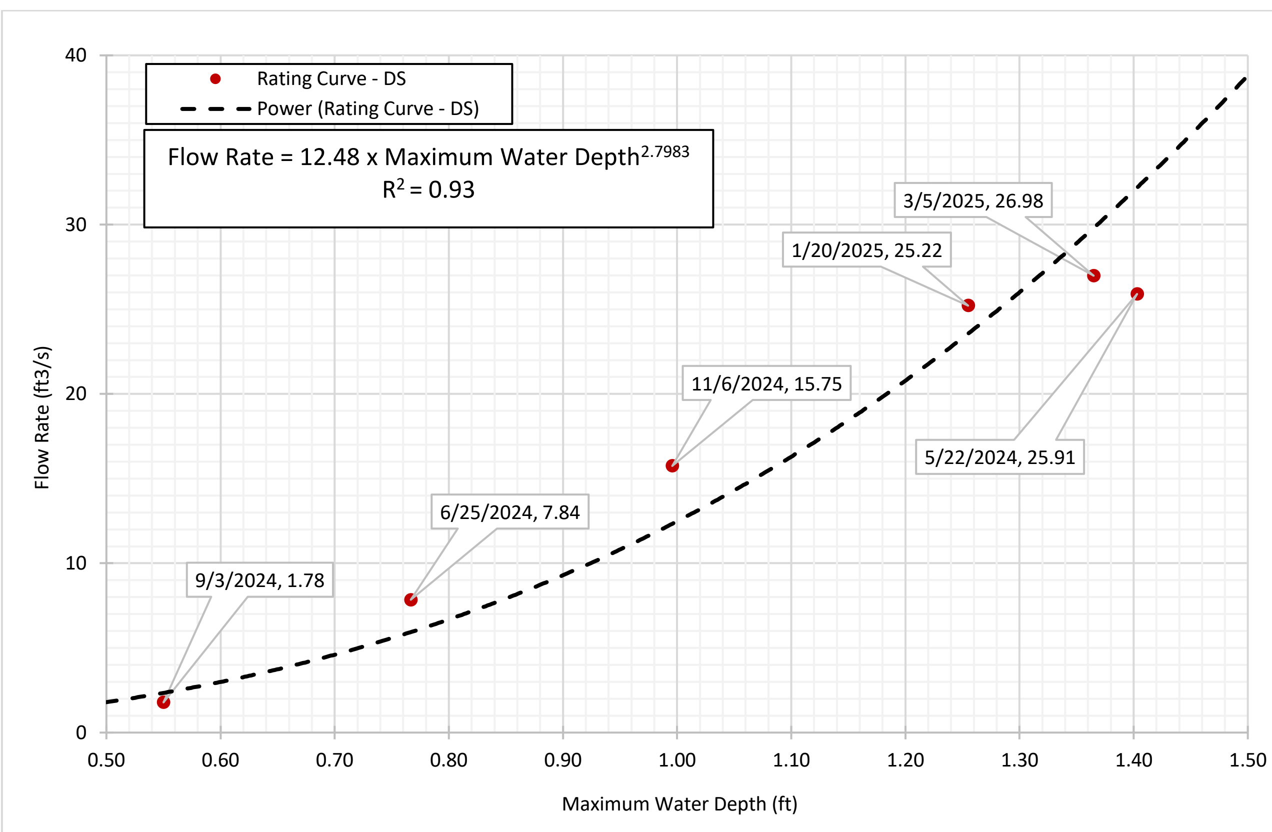


Figure 2. Tickle Creek Downstream XS Rating Curve

Rating Curves

The developed rating curves have a high goodness of fit to the observed data. The rating curve equations can be used to estimate flow by measuring the elevation of the water at the edge of the channel at the observation cross-sections and subtracting the identified thalweg elevation. The relationships were established using the elevation at the edge of the water as it can allow for a greater precision in the measurement. Simple survey equipment or construction laser levels can be used to reference the benchmark and associated elevations at each cross section. This is a more onerous process than simply measuring flow depth in the channel; however, the data collected indicates the flow rate changes rapidly with even minor changes in flow depth. This means a small error in flow depth measurement results in significant error in flow rate determination. Measuring flow depth in the stream can be challenging in higher flow and is less precise; measuring the elevation at the water's edge and subtracting the thalweg elevation provides a more precise and repeatable method.

The data collected suggests that flow in Tickle Creek reached as low as 1.78 cubic feet per second (cfs) on September 3rd, and as high as 26.98 cfs on March 5th (Table 1). Minor differences between flows measured at the upstream and downstream cross-sections are within the expected range of error based on the measurement method used to calculate flow (6 to 19%, Harmel et al., 2006). However, the method is sensitive enough to detect when wastewater is being discharged to the creek. During the November 6th field visit, the City of Sandy was discharging an estimated 2.6 cfs to the creek (P. Inman, Stantec, Personal Communication), while the observed difference in flow is 0.61 cfs between the upstream and downstream cross-section.

Flow measurements also correlate well with depth measurements taken during the time of flow data collection at an existing bridge staff gage located approximately 4,500 ft upstream from the upstream cross section, at the end of SE Colorado Road (see data below in Table 1 and Figure 3). The equations in Figure 3 can be used to estimate flow at both observation cross sections by measuring the depth at the bridge staff gage and referring to the "cheat sheet" tables included in Attachment C.

Table 1. Tickle Creek Upstream/Downstream comparison including Bridge Staff Gage height readings

Date	Flow Rate (cfs)		Bridge Staff Gage
	US	DS	Depth (ft)
5/22/2024	23.74	25.91	-[2]
6/25/2024	8.18	7.84	0.55
9/3/2024	2.57	1.78	0.40
11/6/2024[1]	14.45	15.06	0.70
1/20/2025[1]	20.84	25.22	0.72
3/5/2025	25.58	26.98	0.85

[1]Flow with WW discharging to creek
[2]Data not collected

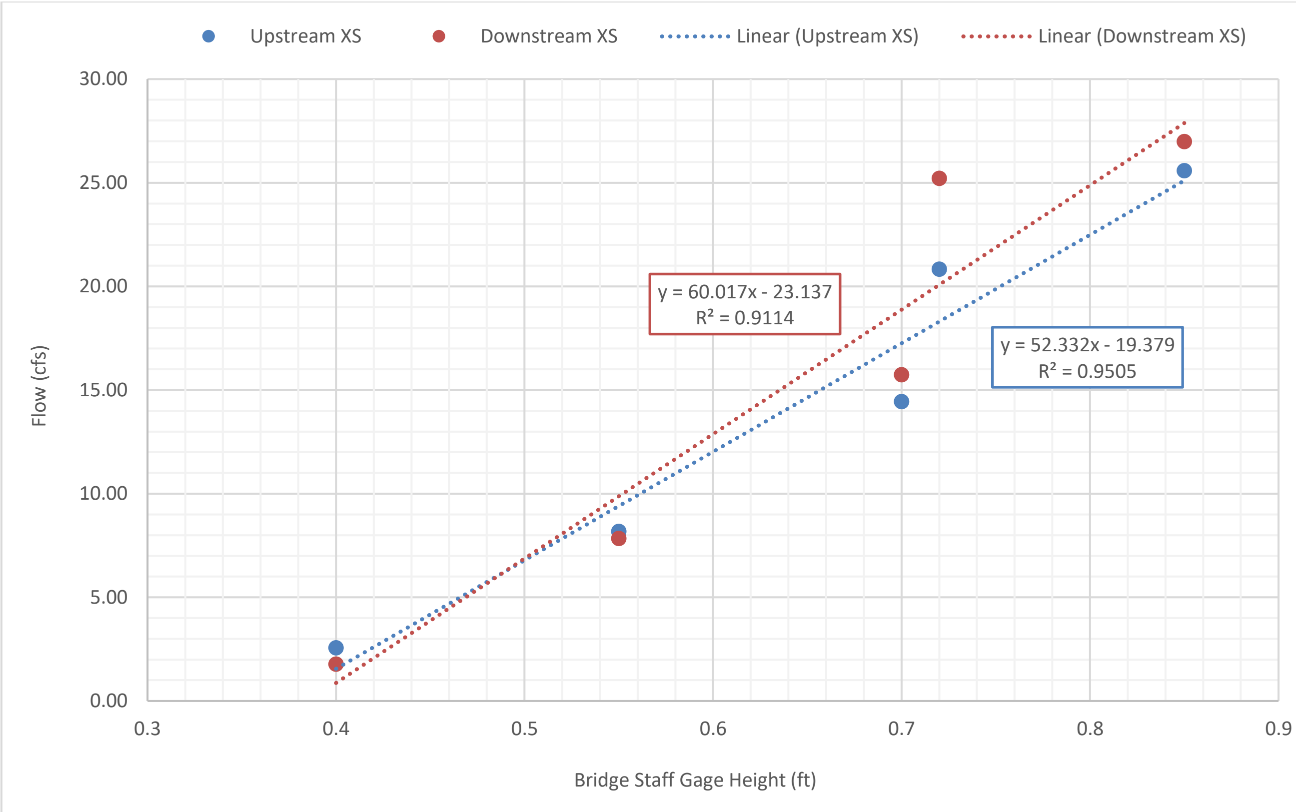


Figure 3. Flow at Tickle Creek Cross-sections (cfs) vs. Bridge Staff Gage Height (ft)

Conclusion

The developed rating curves have a high goodness of fit to the observed data. The rating curve equations can be used to estimate flow by measuring the water surface elevation at the water's edge and subtracting the identified thalweg elevation in the channel at the observation cross-sections. Flow can also be estimated by measuring depth in the channel at the bridge staff gauge on SE Colorado Road and using the attached "cheat sheets". The collected data can be used to support the City of Sandy permitting requirements for the WWTP.

References

R. D. Harmel, R. J. Cooper, R. M. Slade, R. L. Haney, & J. G. Arnold. (2006). Cumulative uncertainty in measured streamflow and water quality data for small watersheds. *Transactions of the ASABE*, *49*(3), 689–701. https://doi.org/10.13031/2013.20488

Attachments/Enclosures:

Attachment A: Site Photos
Attachment B: Tickle Creek Cross-Sections
Attachment C: Tickle Creek Data & Rating Curves

Attachment: A

Site Photos


Image 1: Tickle Creek Upstream XS (Facing East)


Image 2: Tickle Creek Upstream XS (Facing West)


Image 3: Tickle Creek Upstream Site – XS


Image 4: Data Capture – Upstream XS


Image 5: Tickle Creek Downstream XS (Facing West)


Image 6: Tickle Creek Downstream XS (Facing South)


Image 7: Data Capture – Downstream XS


Image 8: Elev. and Depth Capture – Downstream XS

Image 9: Swoffer Flow Meter – Calibration and Setup

I**mage 10:** Optical Level – Setup

Attachment: B

Tickle Creek Cross-Sections

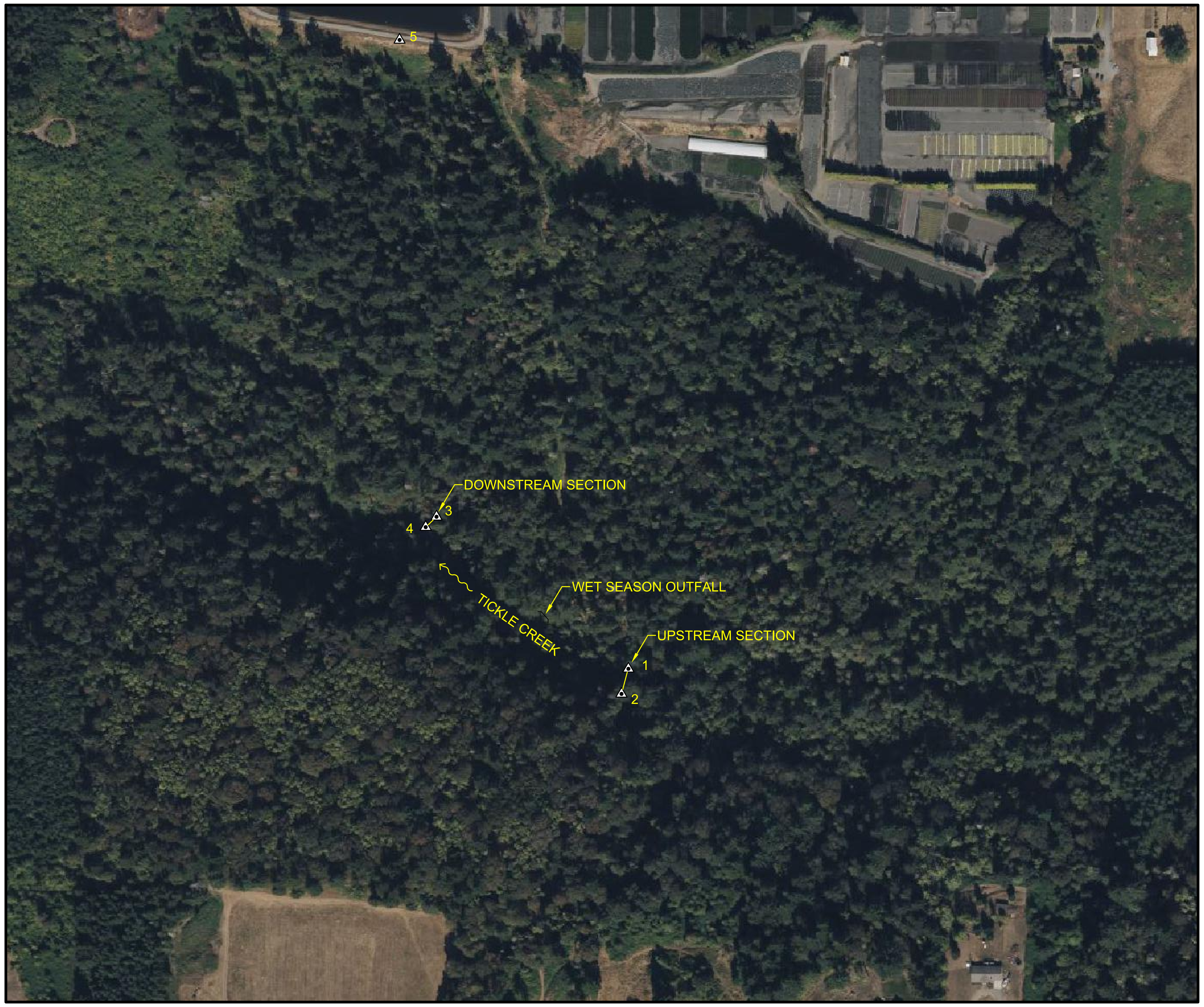
DAVID EVANS
AND ASSOCIATES INC.
2100 S River Parkway, Suite 100
Portland Oregon 97201
Phone: 503.223.6663

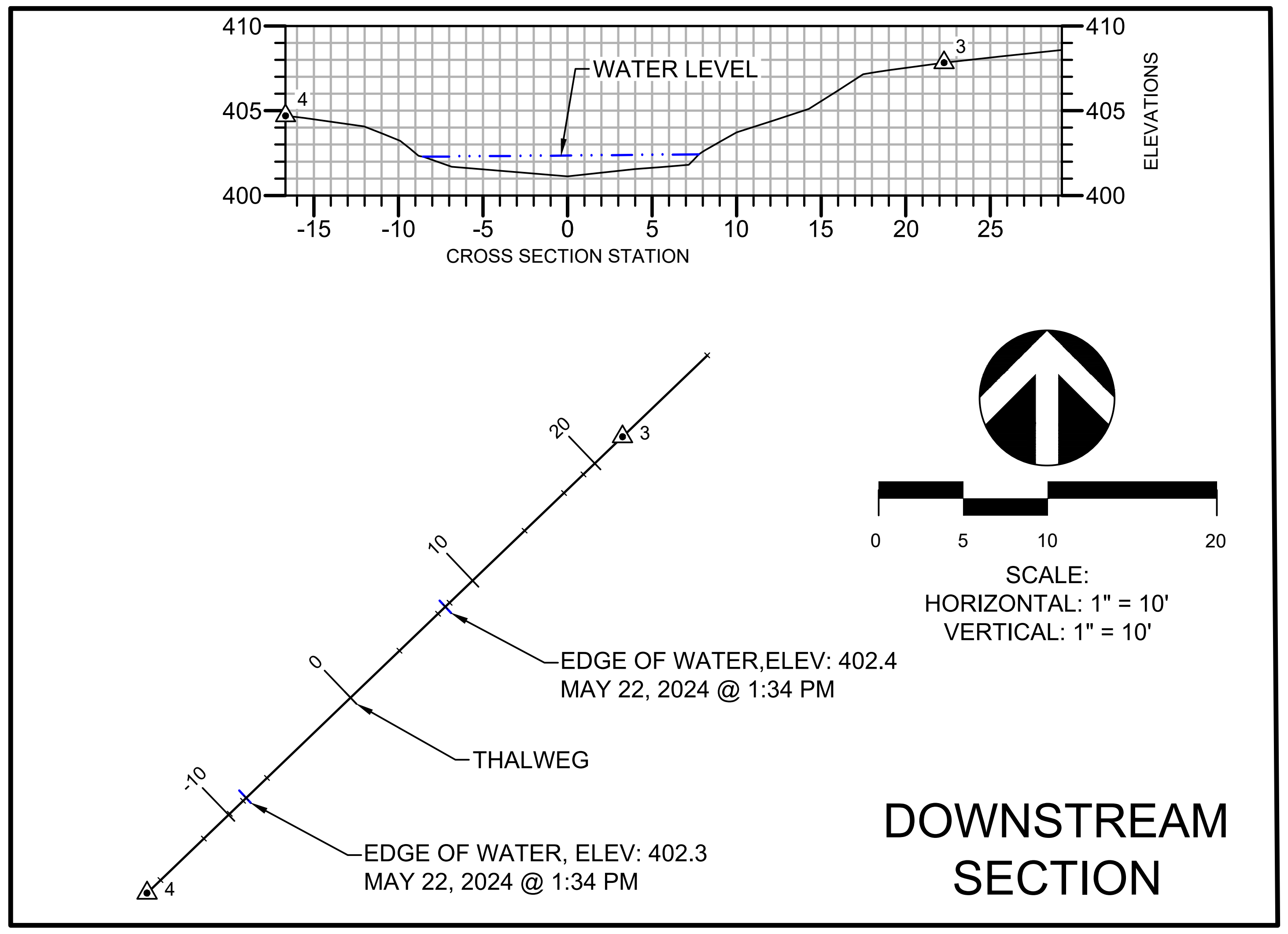
CROSS SECTIONS

FOR
CITY OF SANDY
TICKLE CREEK FLOW MONITORING SURVEY

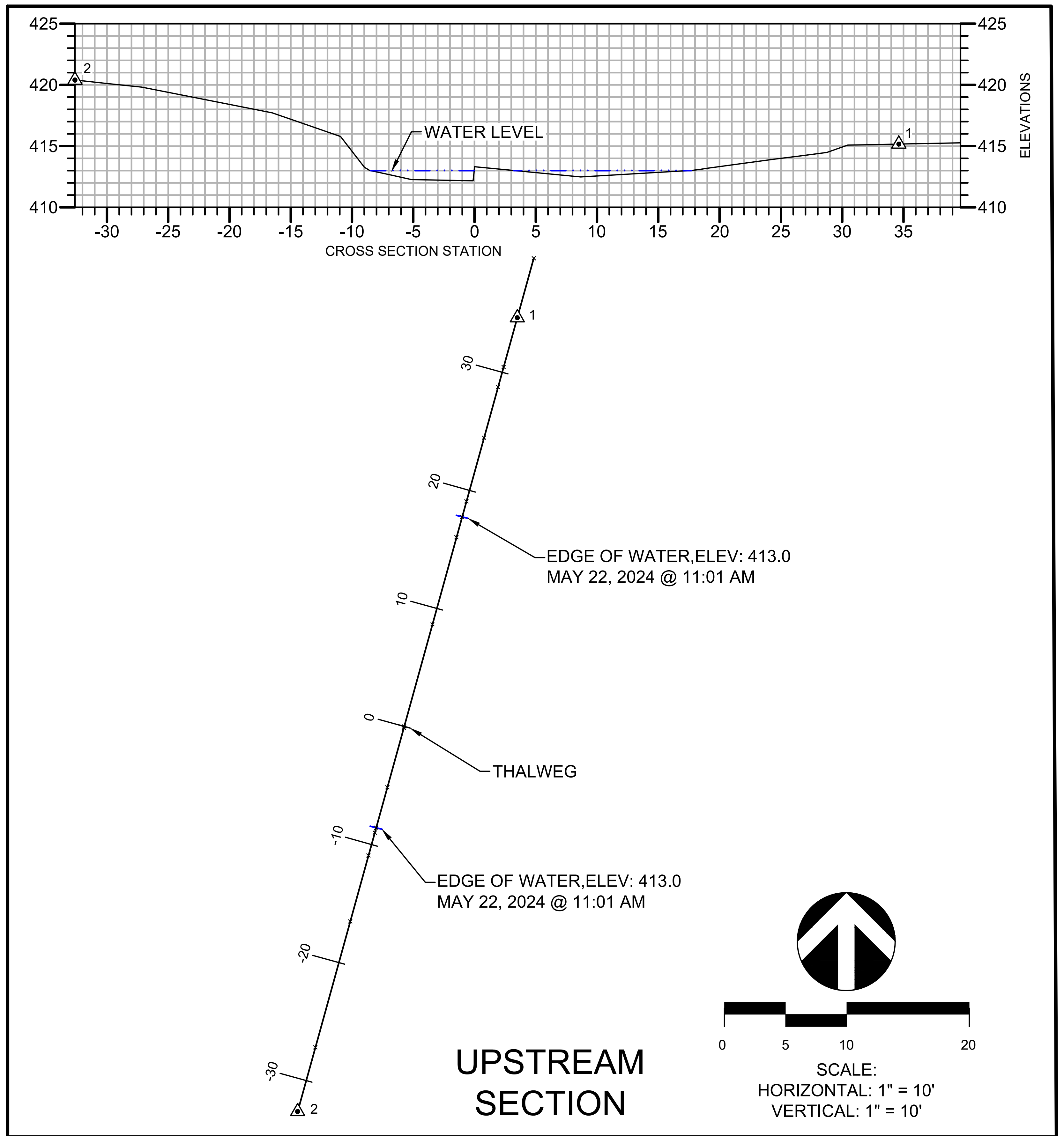
CLACKAMAS COUNTY, OREGON

SCALE: AS NOTED   MAY 28, 2024



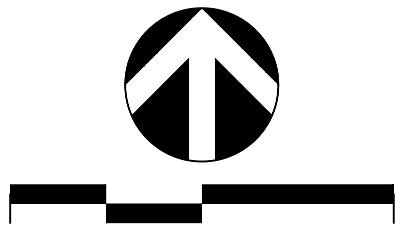


DOWNSTREAM SECTION



UPSTREAM SECTION

HORIZONTAL DATUM: NAD83(2011)
PROJECTION: OCRS PORTLAND ZONE (EPSG 6855)
VERTICAL DATUM: NAVD88
UNITS: INTERNATIONAL FEET



SCALE: 1" = 250'

CONTROL TABLE

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
1	129,704.16	431,595.35	415.16	5/8" IR W/ RPC "DEA CONTROL"
2	129,639.35	431,577.42	420.39	5/8" IR W/ RPC "DEA CONTROL"
3	130,098.13	431,097.98	407.84	5/8" IR W/ RPC "DEA CONTROL"
4	130,071.17	431,069.86	404.70	5/8" IR W/ RPC "DEA CONTROL"
5	131,333.26	431,002.16	601.98	HUB & MINI MAG

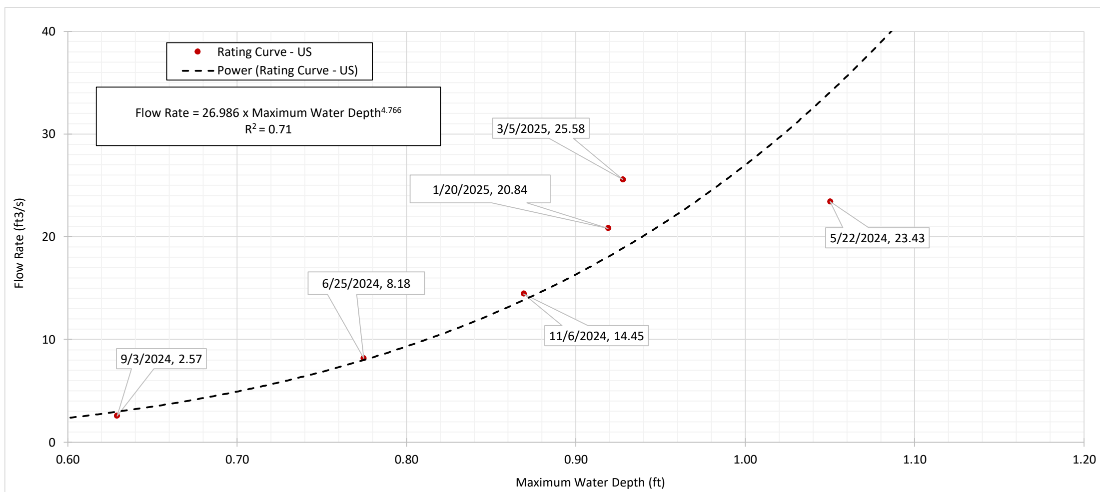
JOB NO.	SNDY0000-0008
BY:	TYMI
DRAWN:	TAS
CHECKED:	KLY
DWG FILE:	SV-BS-D-SNDY0008

Attachment: C

Tickle Creek Data & Rating Curves

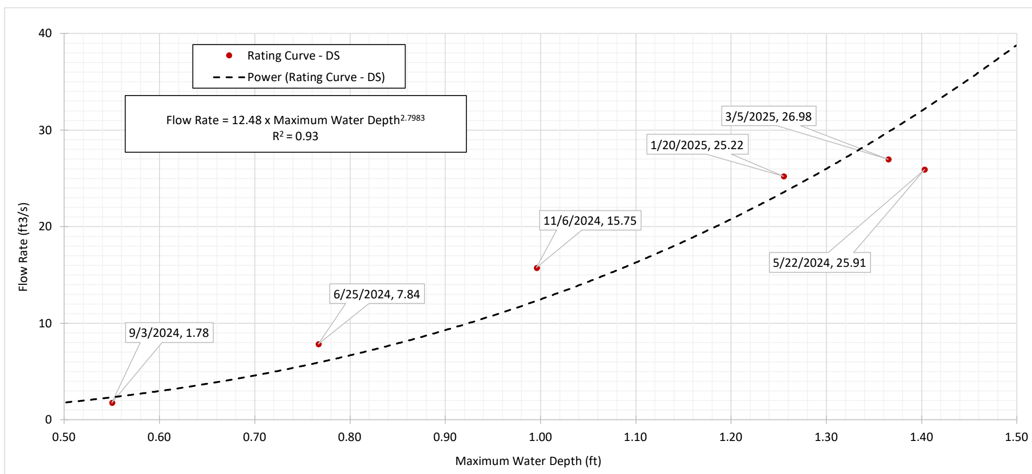
US Tickle Creek Velocity Stations (Left to Right Looking DS)			5/22/2024			6/25/2024			9/3/2024			11/6/2024			1/20/2025			3/5/2025		
Station (ft)	Width (ft)	Velocity Station	Area (ft^2)	Velocity (ft/s)	Flow Q (ft^3/s)	Area (ft^2)	Velocity (ft/s)	Flow Q (ft^3/s)	Area (ft^2)	Velocity (ft/s)	Flow Q (ft^3/s)	Area (ft^2)	Velocity (ft/s)	Flow Q (ft^3/s)	Area (ft^2)	Velocity (ft/s)	Flow Q (ft^3/s)	Area (ft^2)	Velocity (ft/s)	Flow Q (ft^3/s)
Sta 22 to 24	2	23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sta 24 to 26	2	25	0.45	0.38	0.17	0.00	0.00	0.00	-	0.00	0.00	0.28	0.27	0.08	0.78	0.28	0.22	0.91	0.59	0.53
Sta 26 to 28	2	27	1.20	1.20	1.45	0.67	0.49	0.33	0.37	0.50	0.18	1.31	1.23	1.61	1.26	1.15	1.46	1.31	1.63	2.13
Sta 28 to 30	2	29	1.60	2.41	3.86	1.03	0.68	0.70	0.66	0.56	0.37	1.50	1.27	1.90	1.57	1.77	2.79	1.65	2.18	3.60
Sta 30 to 32	2	31	1.90	2.31	4.39	1.39	1.12	1.55	1.01	0.55	0.55	1.58	1.60	2.52	1.74	2.73	4.76	1.72	2.77	4.77
Sta 32 to 34	2	33	1.85	2.52	4.66	1.39	1.27	1.77	0.91	0.53	0.48	1.60	1.09	1.74	1.66	2.80	4.64	1.68	2.50	4.20
Sta 34 to 36	2	35	1.60	2.84	4.54	1.25	1.05	1.32	0.71	0.60	0.42	1.50	2.08	3.12	1.48	2.13	3.16	1.62	2.20	3.57
Sta 36 to 38	2	37	1.60	1.52	2.43	1.18	1.26	1.48	0.79	0.55	0.43	1.34	1.29	1.72	1.33	1.62	2.16	1.48	1.30	1.92
Sta 38 to 40	2	39	1.39	0.86	1.20	0.90	0.62	0.56	0.47	0.27	0.13	1.02	1.05	1.07	0.95	0.58	0.55	1.20	2.09	2.51
Sta 40 to 42	2	41	0.99	0.34	0.34	0.62	0.33	0.21	0.24	0.00	0.00	0.70	0.78	0.54	0.67	0.87	0.58	0.90	1.27	1.14
Sta 42 to 44	2	43	0.90	0.21	0.19	0.48	0.29	0.14	0.16	0.00	0.00	0.54	0.28	0.15	0.56	0.76	0.43	0.70	1.12	0.78
Sta 44 to 46	2	45	0.85	0.15	0.12	0.31	0.44	0.13	0.00	0.00	0.00	0.40	0.00	0.00	0.35	0.28	0.10	0.60	0.38	0.23
Sta 46 to 48	2	47	0.50	0.16	0.08	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.44	0.44	0.19
Sta 48 to 50	2	49	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sta 50 to 52	2	51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sta 52 to 54	2	53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sta 54 to 56	2	55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

	5/22/2024	6/25/2024	9/3/2024	11/6/2024	1/20/2025	3/5/2025
Flow Sum (ft^3/s):	23.43	8.18	2.57	14.45	20.84	25.58
Water Surface Elevation (ft):	412.96	412.70	412.59	412.93	412.95	413.04
Max. Water Depth (ft):	1.05	0.77	0.63	0.87	0.92	0.93
Thalweg Elevation (ft):	411.91	411.92	411.96	412.06	412.04	412.17



DS Tickle Creek Velocity Stations (Left to Right Looking DS)			5/22/2024			6/25/2024			9/3/2024			11/6/2024			1/20/2025			3/5/2025		
Station (ft)	Width (ft)	Velocity Station	Area (ft^2)	Velocity (ft/s)	Flow Q (ft^3/s)	Area (ft^2)	Velocity (ft/s)	Flow Q (ft^3/s)	Area (ft^2)	Velocity (ft/s)	Flow Q (ft^3/s)	Area (ft^2)	Velocity (ft/s)	Flow Q (ft^3/s)	Area (ft^2)	Velocity (ft/s)	Flow Q (ft^3/s)	Area (ft^2)	Velocity (ft/s)	Flow Q (ft^3/s)
Sta 6 to 8	2	7	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sta 8 to 10	2	9	0.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.25	0.86	1.13	1.35	1.01	1.48
Sta 10 to 12	2	11	1.86	0.70	1.30	0.83	0.65	0.27	0.19	0.22	0.04	1.45	0.48	0.66	1.79	2.00	3.62	2.19	2.50	5.50
Sta 12 to 14	2	13	2.06	2.01	4.13	1.28	0.42	0.53	0.84	0.51	0.22	1.43	2.04	2.84	2.11	2.45	5.17	2.43	2.31	5.61
Sta 14 to 16	2	15	2.40	2.21	5.30	1.48	1.38	2.05	0.97	0.88	0.43	1.75	1.88	3.22	2.07	2.69	5.59	2.45	2.35	5.78
Sta 16 to 18	2	17	2.60	2.21	5.73	1.53	1.54	2.35	1.07	1.46	0.78	1.99	2.21	4.23	2.37	2.62	6.21	2.19	2.54	5.60
Sta 18 to 20	2	19	2.15	2.38	5.11	1.15	1.37	1.58	0.68	0.73	0.27	1.67	2.05	3.36	1.69	1.49	2.59	1.97	1.22	2.47
Sta 20 to 22	2	21	1.81	1.57	2.84	0.67	1.11	0.75	0.25	0.24	0.04	1.21	1.24	1.43	1.04	0.67	0.71	1.26	0.38	0.50
Sta 22 to 24	2	23	1.55	0.96	1.49	0.40	0.75	0.30	0.00	0.00	0.00	0.85	0.00	0.00	0.42	0.35	0.21	0.72	0.06	0.04
Sta 24 to 26	2	25	0.69	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

	5/22/2024	6/25/2024	9/3/2024	11/6/2024	1/20/2025	3/5/2025
Flow Sum (ft^3/s):	25.91	7.84	1.78	15.75	25.22	26.98
Water Surface Elevation (ft):	402.51	402.02	401.89	402.07	402.32	402.40
Max. Water Depth (ft):	1.40	0.77	0.55	1.00	1.26	1.37
Thalweg Elevation (ft):	401.11	401.24	401.34	401.08	401.09	401.04



Depth Versus Flow Tabulation "Cheat Sheet"

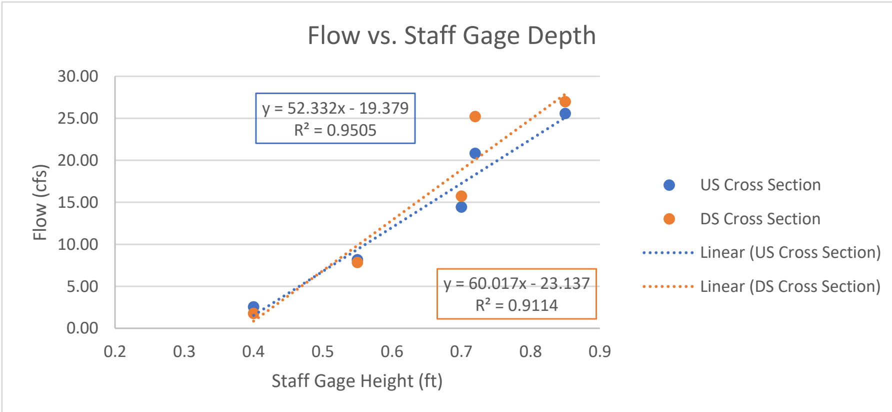
Upstream Cross Section	
Max Water Depth (ft)*	Flow (cfs)
0.1	0.0005
0.2	0.01
0.3	0.1
0.4	0.3
0.5	1.0
0.6	2.4
0.7	4.9
0.8	9.3
0.9	16.3
1	27.0
1.1	42.5
1.2	64.3
1.3	94.2
1.4	134.1
1.5	186.4
1.6	253.5
1.7	338.4
1.8	444.4
1.9	575.0
2	734.3
2.1	926.5
2.2	1156.4
2.3	1429.3
2.4	1750.8
2.5	2126.8
2.6	2563.9
2.7	3069.2
2.8	3650.0
2.9	4314.5
3	5071.1

Downstream Cross Section	
Max Water Depth (ft)*	Flow (cfs)
0.1	0.02
0.2	0.1
0.3	0.4
0.4	1.0
0.5	1.8
0.6	3.0
0.7	4.6
0.8	6.7
0.9	9.3
1	12.5
1.1	16.3
1.2	20.8
1.3	26.0
1.4	32.0
1.5	38.8
1.6	46.5
1.7	55.1
1.8	64.6
1.9	75.2
2	86.8
2.1	99.5
2.2	113.3
2.3	128.4
2.4	144.6
2.5	162.1
2.6	180.9
2.7	201.0
2.8	222.6
2.9	245.6
3	270.0

* Max water depth = WSE - Thalweg Elevation

Red-shaded cells represent flows that were not observed during the development of the rating curves and should be considered approximate.

Correlation of Measured Flows to Staff Gage Depth Measurements on SE Colorado Rd



Depth Versus Flow Tabulation "Staff Gage Cheat Sheet"

Upstream Cross Section	
Staff Gage Depth (ft)	Flow (cfs)
0.1	0.0
0.2	0.0
0.3	0.0
0.4	1.6
0.5	6.8
0.6	12.0
0.7	17.3
0.8	22.5
0.9	27.7
1	33.0
1.1	38.2
1.2	43.4
1.3	48.7
1.4	53.9
1.5	59.1
1.6	64.4
1.7	69.6
1.8	74.8
1.9	80.1
2	85.3
2.1	90.5
2.2	95.8
2.3	101.0
2.4	106.2
2.5	111.5
2.6	116.7
2.7	121.9
2.8	127.2
2.9	132.4
3	137.6

Downstream Cross Section	
Staff Gage Depth (ft)	Flow (cfs)
0.1	0.00
0.2	0.00
0.3	0.00
0.4	0.9
0.5	6.9
0.6	12.9
0.7	18.9
0.8	24.9
0.9	30.9
1	36.9
1.1	42.9
1.2	48.9
1.3	54.9
1.4	60.9
1.5	66.9
1.6	72.9
1.7	78.9
1.8	84.9
1.9	90.9
2	96.9
2.1	102.9
2.2	108.9
2.3	114.9
2.4	120.9
2.5	126.9
2.6	132.9
2.7	138.9
2.8	144.9
2.9	150.9
3	156.9

Red-shaded cells represent flows that were not observed during the development of the rating curves and should be considered approximate.

Appendix B: Tickle Creek Water Quality Monitoring Results Appendix

		Downstream of Discharge Pt.					
		5/22/2024	7/26/2024	9/4/2024	11/6/2024	1/17/2025	3/5/2025
Analyte	**Units**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
Alkalinity, Dissolved as CaCO3	mg/L	17.900	42.100	43.700	33.500	24.800	17.700
Aluminum	ug/L	632.000	49.000	28.000	332.000	172.000	140.000
Aluminum, Dissolved	ug/L	13.600	5.800	6.300	17.400	7.900	9.900
Ammonia as Nitrogen	mg/L	N/A	N/A	N/A		0.025	N/A
Arsenic	ug/L	0.18	0.25	0.27	0.14	N/A	0.07
Arsenic, Dissolved	ug/L	0.10	0.24	0.28	0.10	N/A	0.06
Barium	ug/L	25.00	18.60	20.20	17.50	17.50	16.70
Barium, Dissolved	ug/L	15.80	17.90	19.40	15.50	15.60	15.50
Cadmium	ug/L						
Cadmium, Dissolved	ug/L						
Calcium, Dissolved	ug/L	3900.00	6570.00	7320.00	5190.00	4110.00	3590.00
Carbon, Dissolved Organic (DOC)	mg/L	3.80	2.90	4.30	3.30	3.50	2.40
Chloride, Dissolved	mg/L	2.46	2.48	2.66	6.09	5.10	3.95
Chromium	ug/L	0.88	0.47	0.43	0.41	0.32	0.34
Chromium, Dissolved	ug/L	0.16	0.31	0.32	0.14	0.13	0.14
Copper	ug/L	1.37	0.51	0.36	0.85	0.75	0.51
Copper, Dissolved	ug/L	0.54	0.35	0.35	0.69	0.55	0.34
Hardness, Total as CaCO3	mg/L	17.90	30.90	34.50	22.00	17.30	15.30
Lead	ug/L	0.42	0.04	0.02	0.11	0.08	0.09
Lead, Dissolved	ug/L	0.02	0.01	0.01	0.02	0.01	0.01
Magnesium, Dissolved	ug/L	1790.00	3520.00	3950.00	2200.00	1720.00	1550.00
Nitrate+Nitrite as Nitrogen	mg/L	0.56	0.36	0.35	1.05	1.82	1.37
Nitrogen, Total Kjeldahl (TKN)	mg/L	2.06	0.40	0.40	0.98	0.76	0.70
pH	pH Units	6.69	7.92	7.86	7.57	7.35	7.46
Phosphorus, Total	mg/L	0.24	0.04	0.05	0.19	0.21	0.10
Potassium, Dissolved	ug/L	876.00	1320.00	1600.00	1840.00	1590.00	1110.00
Sulfate, Dissolved	mg/L	0.98	1.02	1.01	2.86	2.15	1.40
Zinc	ug/L	5.90	1.30	1.00	5.30	6.70	4.60
Zinc, Dissolved	ug/L	1.20	0.80	0.70	4.10	5.50	3.80

Field Measurements		5/22/2024	7/26/2024	9/4/2024	11/6/2024	1/17/2025	3/5/2025
Analyte		**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
pH	pH units	6.62	6.49	6.67	6.34	6.40	6.93
ORP	mV	80.90	4.90	-40.70	-16.50	26.30	32.70
DO	mg/L	15.04	3.54	1.72	0.52	11.31	16.13
Temp	deg C	11.10	14.20	14.90	8.90	5.90	6.90
EC	uS/cm	N/A	N/A	79.10	69.20	53.80	42.90
Turbidity	NTU	31.00	28.00	32.10	5.00	5.00	7.20

Upstream of Discharge Pt.							
		5/22/2024	7/26/2024	9/4/2024	11/6/2024	1/17/2025	3/5/2025
Analyte	**Units**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
Alkalinity, Dissolved as CaCO3	mg/L	17.60	41.60	43.40	22.30	13.30	13.10
Aluminum	ug/L	251.00	323.00	37.90	294.00	128.00	138.00
Aluminum, Dissolved	ug/L	10.80	6.00	5.60	20.20	6.70	9.60
Ammonia as Nitrogen	mg/L				0.27		
Arsenic	ug/L	0.11	0.31	0.27	0.14	N/A	0.07
Arsenic, Dissolved	ug/L	N/A	0.21	0.26	0.10	N/A	N/A
Barium	ug/L	18.40	24.30	19.30	17.90	17.50	17.50
Barium, Dissolved	ug/L	15.40	17.70	18.20	16.50	16.00	N/A
Cadmium	ug/L	N/A	0.013	N/A	N/A	N/A	N/A
Cadmium, Dissolved	ug/L						
Calcium, Dissolved	ug/L	3810.00	6930.00	7130.00	4740.00	3590.00	3350.00
Carbon, Dissolved Organic (DOC)	mg/L	3.70	3.00	1.80	3.30	2.10	2.60
Chloride, Dissolved	mg/L	2.34	2.45	2.50	3.55	2.80	3.08
Chromium	ug/L	0.48	0.82	0.45	0.45	0.32	0.37
Chromium, Dissolved	ug/L	0.15	0.31	0.33	0.16	0.10	0.13
Copper	ug/L	0.78	1.00	0.50	0.73	0.36	0.38
Copper, Dissolved	ug/L	0.49	0.35	0.35	0.56	0.17	0.22
Hardness, Total as CaCO3	mg/L	17.50	31.40	33.60	20.90	15.40	14.60
Lead	ug/L	0.16	0.25	0.04	0.12	0.09	0.09
Lead, Dissolved	ug/L	0.02	0.01	0.01	0.02	0.01	0.01
Magnesium, Dissolved	ug/L	1750.00	3430.00	3830.00	2190.00	1570.00	1510.00
Nitrate+Nitrite as Nitrogen	mg/L	0.59	0.34	0.32	0.69	1.38	1.28
Nitrogen, Total Kjeldahl (TKN)	mg/L	0.58	0.46	0.62	1.06	0.30	0.44
pH	pH Units	7.55	7.87	7.90	7.50	7.15	7.42
Phosphorus, Total	mg/L	0.03	0.05	0.05	0.03	0.02	0.02
Potassium, Dissolved	ug/L	787.00	1300.00	1550.00	1130.00	756.00	753.00
Sulfate, Dissolved	mg/L	0.89	0.80	0.96	1.68	0.96	0.88
Zinc	ug/L	3.10	5.10	1.60	2.00	3.20	2.70
Zinc, Dissolved	ug/L	2.70	2.10	2.70	0.90	2.90	2.00

Field Measurements		5/22/2024	7/26/2024	9/4/2024	11/6/2024	1/17/2025	3/5/2025
Analyte		**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
pH	pH units	6.46	6.63	6.67	6.21	6.37	6.98
ORP	mV	88.70	16.70	-11.10	-48.10	6.40	28.00
DO	mg/L	12.26	3.25	1.15	0.61	10.99	15.14
Temp	deg C	11.20	14.20	15.00	7.80	5.10	6.60
EC	uS/cm	N/A	N/A	77.00	42.70	32.10	33.40
Turbidity	NTU	7.00	17.10	23.70	7.00	5.00	7.90

Appendix C: Sandy WWTP Flow and Water Quality Monitoring Results

	Sandy WWTP Effluent					
	5/22/2024	7/26/2024	9/4/2024	11/6/2024	1/17/2025	3/5/2025
Analyte	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
Alkalinity, Dissolved as CaCO3	105.00	115.00	119.00	127.00	116.00	140.00
Aluminum	10.90	14.00	20.30	6.70	8.50	10.30
Aluminum, Dissolved	6.80	10.10	9.90	3.90	5.40	6.00
Ammonia as Nitrogen	N/A	0.03	0.04	0.06	1.25	0.17
Arsenic	0.09	0.11	0.15	N/A	N/A	0.10
Arsenic, Dissolved	0.09	0.14	0.16	N/A	N/A	0.08
Barium	5.62	6.77	6.24	6.98	7.59	7.20
Barium, Dissolved	5.57	6.72	4.16	6.67	7.39	6.92
Cadmium	0.014	0.011	0.020	N/A	0.015	0.008
Cadmium, Dissolved	0.010	N/A	0.011	N/A	0.010	0.006
Calcium, Dissolved	8860.00	10200.00	8570.00	8430.00	8150.00	8590.00
Carbon, Dissolved Organic (DOC)	10.30	10.20	11.70	5.90	8.20	10.40
Chloride, Dissolved	39.70	51.10	53.70	24.80	25.40	25.80
Chromium	0.37	0.52	0.50	0.35	0.33	0.37
Chromium, Dissolved	0.30	0.42	0.41	0.18	0.23	0.24
Copper	4.52	3.64	6.05	2.49	4.41	3.03
Copper, Dissolved	3.56	3.12	4.79	2.17	4.08	2.62
Hardness, Total as CaCO3	36.20	36.70	33.10	32.20	32.70	33.80
Lead	0.11	0.18	0.27	0.09	0.11	0.12
Lead, Dissolved	0.09	0.16	0.13	0.05	0.08	0.10
Magnesium, Dissolved	3340.00	2720.00	2830.00	2700.00	3010.00	3000.00
Nitrate+Nitrite as Nitrogen	5.91	10.30	6.60	4.06	6.47	3.84
Nitrogen, Total Kjeldahl (TKN)	2.44	1.92	2.50	2.02	2.14	1.70
pH	7.44	7.80	7.65	7.59	7.65	7.57
Phosphorus, Total	3.57	2.40	2.98	1.36	2.21	3.07
Potassium, Dissolved	9810.00	12000.00	12600.00	8300.00	9570.00	9450.00
Selenium			0.30			
Selenium, Dissolved			0.20			
Sodium, Dissolved						
Silver			0.01		0.04	0.01
Silver, Dissolved					0.03	
Sulfate, Dissolved	14.30	18.10	18.50	13.10	13.20	13.40
Zinc	45.40	41.30	62.90	36.40	45.80	39.60
Zinc, Dissolved	45.10	41.60	60.90	36.00	45.40	39.60

Appendix D: January 15th Summit Documents

Kickoff Summit

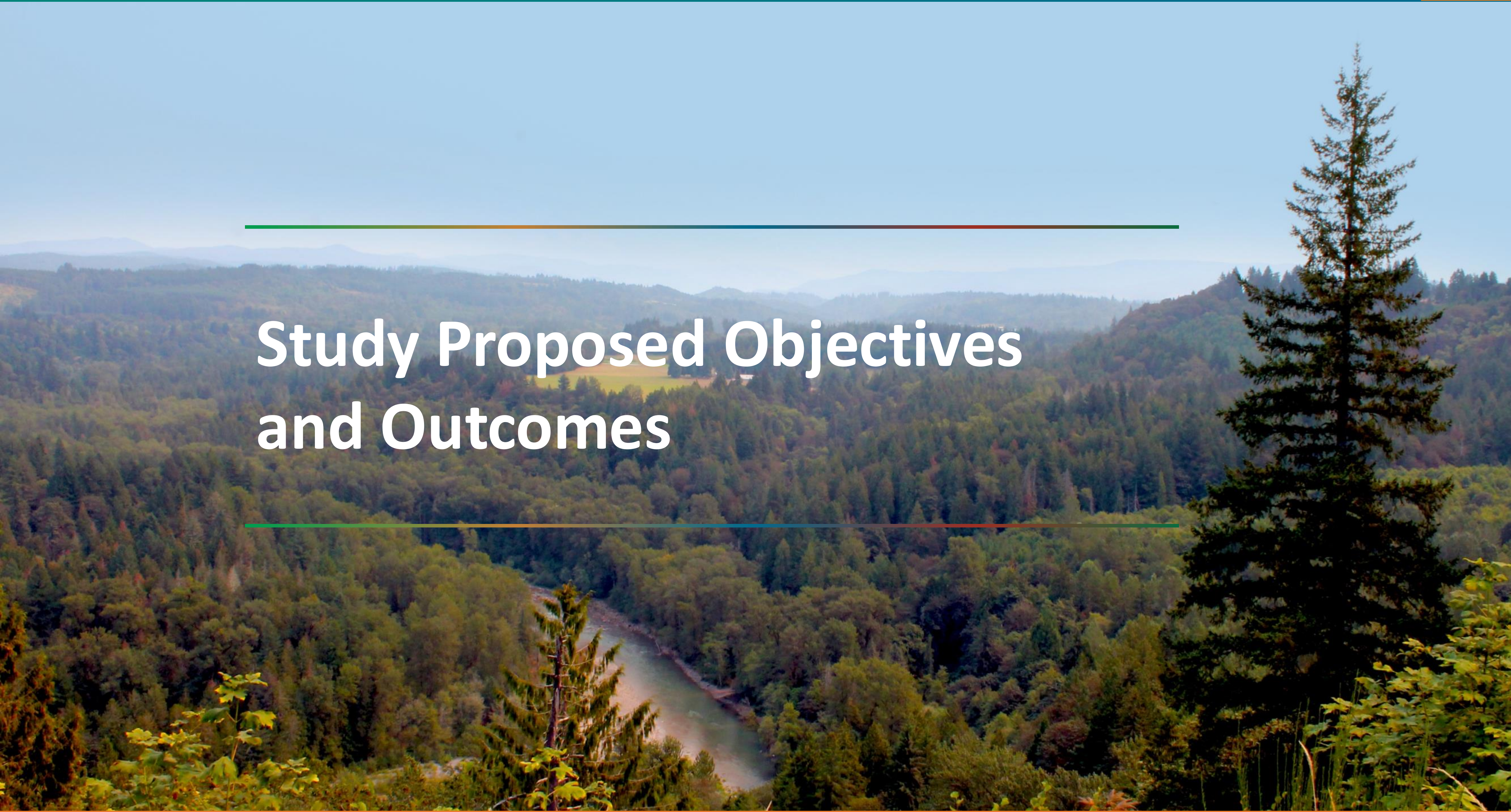
January 15, 2024

City of Sandy

Tickle Creek Reuse Study

AGENDA

1. **Welcome and Introduction**
2. **Study Proposed Objectives and Outcomes**
3. **Data Collection and Analysis Methodologies**
4. **Stakeholder Input and Suggestions**
5. **Consensus on Deliverables**
6. **Next Steps**



Study Proposed Objectives and Outcomes

Objectives

- Obtain current flow and water quality information for Tickle Creek
- Develop a better understanding of flow and water quality seasonal variation through periodic measurement and sampling events.

Outcomes

- Develop a consensus amongst stakeholders of the value that high quality effluent can provide to the Clackamas watershed
- Initiate a collective interest for watershed flow augmentation with reclaimed water and advocate for a One Water approach to managing our resources.

Background

- The City of Sandy owns and operates a wastewater treatment plant (WWTP) located on Jarl Road in Boring, Oregon.
- Treated effluent discharge is regulated by an NPDES Permit that expired in 2013. The permit has been administratively extended and DEQ is preparing a new Draft Permit based on Sandy's permit renewal application.
- From November 1 to April 30, treated effluent from the WWTP is discharged into Tickle Creek, a tributary of the Clackamas River. Recycled water for irrigation is provided to a nursery from May 1 to October 31.

SANDY DRINKING WATER

Background

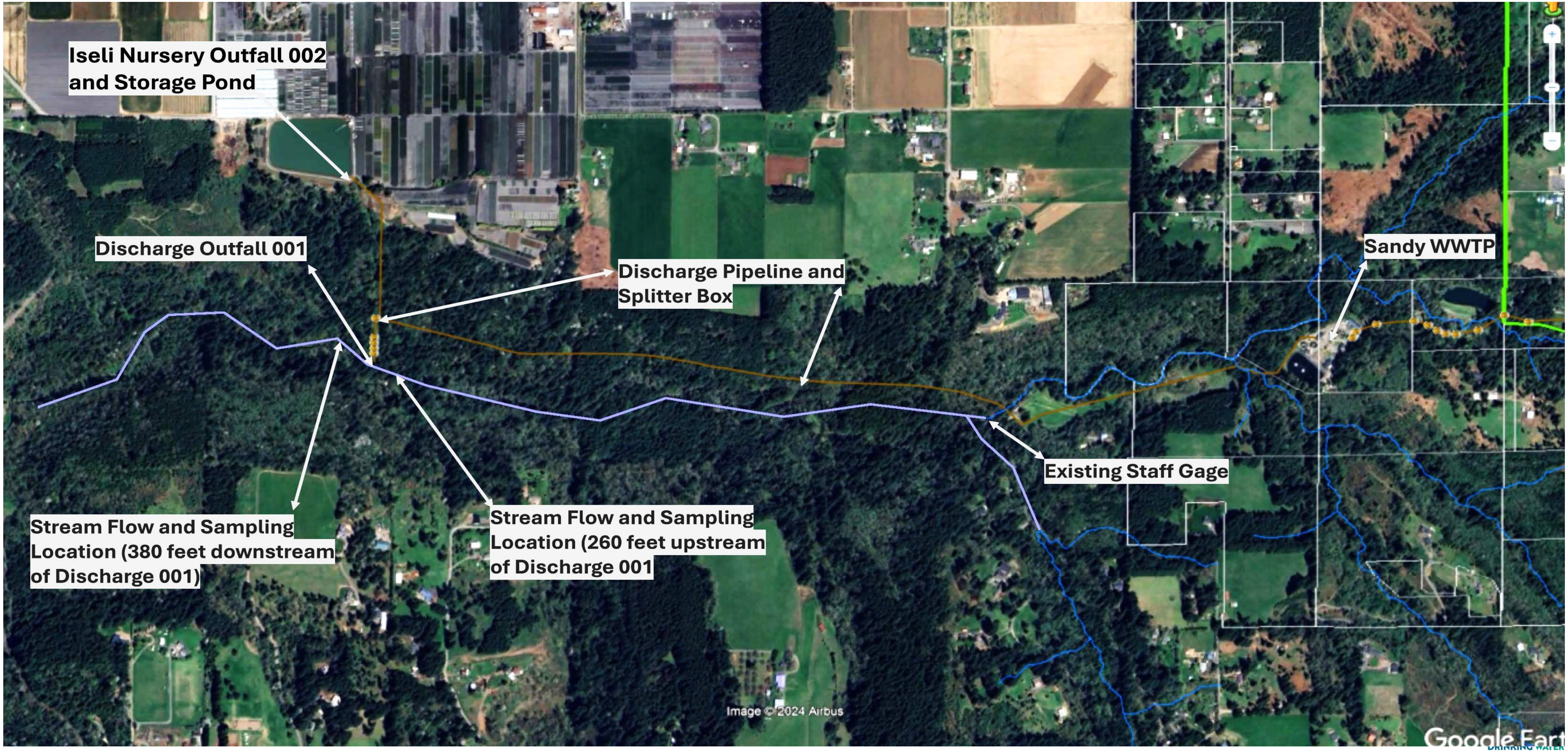
- In addition to the seasonal limitation (i.e., November 1 – April 30) for discharge to Tickle Creek, the NPDES permit further restricts the discharge based on a dilution requirement, which authorizes discharge when stream dilution is greater than or equal to 10.
- Plant capacity in NPDES permit dates back to the 1990s; however, does not reflect current conditions and anticipated growth in service area.

Background

- The NPDES permit includes concentration and mass limits for
  - BOD and TSS
  - Ammonia
  - E. coli bacteria

- The mass limits for BOD and TSS are based on the established concentration limits and an average wet weather design flow of 1.5 MGD.

Background


Iseli Nursery Outfall 002 and Storage Pond
Discharge Outfall 001
Discharge Pipeline and Splitter Box
Sandy WWTP
Existing Staff Gage
Stream Flow and Sampling Location (380 feet downstream of Discharge 001)
Stream Flow and Sampling Location (260 feet upstream of Discharge 001
Image © 2024 Airbus
Google Earth

Background

- Sandy regularly reports plant effluent data and discharge location as well as reports values for Tickle Creek flows utilizing an existing staff gage located approximately 4,300 feet upstream of the WWTP discharge point.
- Given the pending NPDES permit discussions and with knowledge that recent water quality and calibrated flow measurements of Tickle Creek are unavailable, Sandy approached the Oregon Water Conservation, Reuse and Storage Grant Program for financial assistance in completing water quality sampling and flow monitoring activities to assess the current condition of the stream

Study Objectives

1

Assess and document the current water quality/quantity of Tickle Creek to establish a baseline

2

Document quality and quantity of reclaimed water from WWTP

3

Explore value that effluent can provide to the Clackamas watershed through a One Water approach to managing our resources.

Study Approach – Flow Monitoring

- Acquire the services of a professional surveying firm to complete a detailed topographic survey to establish flow observation stream cross sections and collect velocity measurements up and down stream of the effluent discharge location.
- Establish a rating curve to calculate the measured flow of the stream.
- Flow observations will occur at six separate intervals spaced throughout the year to obtain an annual flow record throughout an entire water year.

Study Approach – Water Quality Monitoring

- Acquire the services of a professional engineering/environmental services firm to complete a periodic stream water quality sampling to coincide with each flow measurement exercise.
- Obtain water quality samples where uniform flow and mixing is observed.

Study Approach – Water Quality Monitoring

- A typical suite of water quality analysis parameters included:

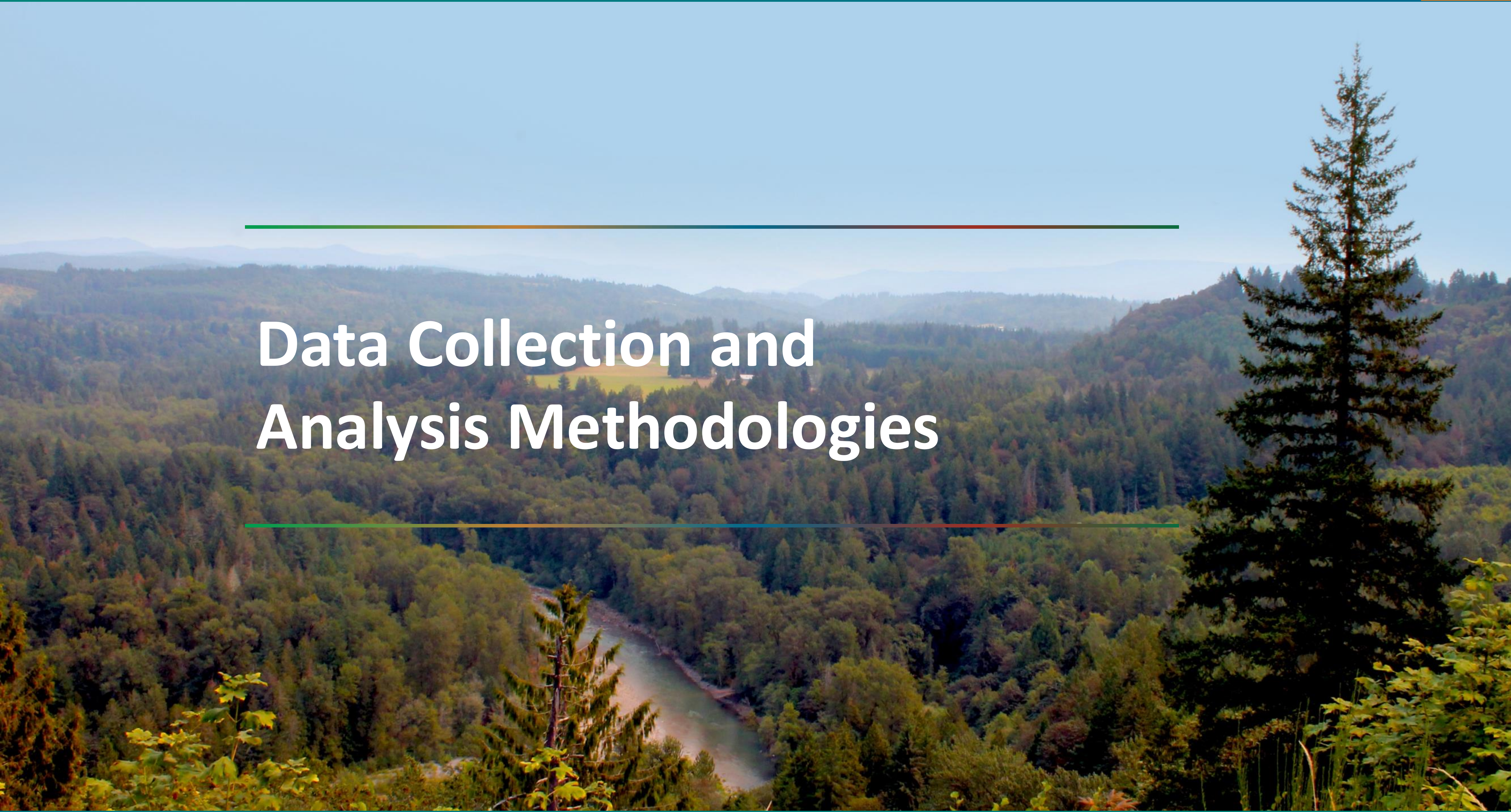
- ✓ Ammonia
- ✓ Nitrite+nitrate
- ✓ Total Kjeldahl Nitrogen
- ✓ Total Phosphorus
- ✓ Total Copper
- ✓ Dissolved Copper
- ✓ Total Aluminum
- ✓ Total Zinc
- ✓ Dissolved Zinc
- ✓ Hardness
- ✓ Dissolved Oxygen
- ✓ Dissolved Magnesium
- ✓ Dissolved Potassium
- ✓ Dissolved Sodium
- ✓ Dissolved Sulfate
- ✓ Dissolved Chloride
- ✓ Dissolved Alkalinity
- ✓ Total and Dissolved:
  - Arsenic
  - Barium
  - Cadmium
  - Chromium
  - Mercury
  - Lead
  - Silver
  - Selenium

Study Approach – WWTP Effluent Flow and Quality Monitoring

- Record daily total discharge volumes for the period of April 2024 through April 2025.
- Adjust baseline flow readings based on projected flows into the future for 2040 .
- Record daily water quality parameters for the period of April 2024 through April 2025.
- Adjust baseline water quality records based on projected flows into the future for 2040.

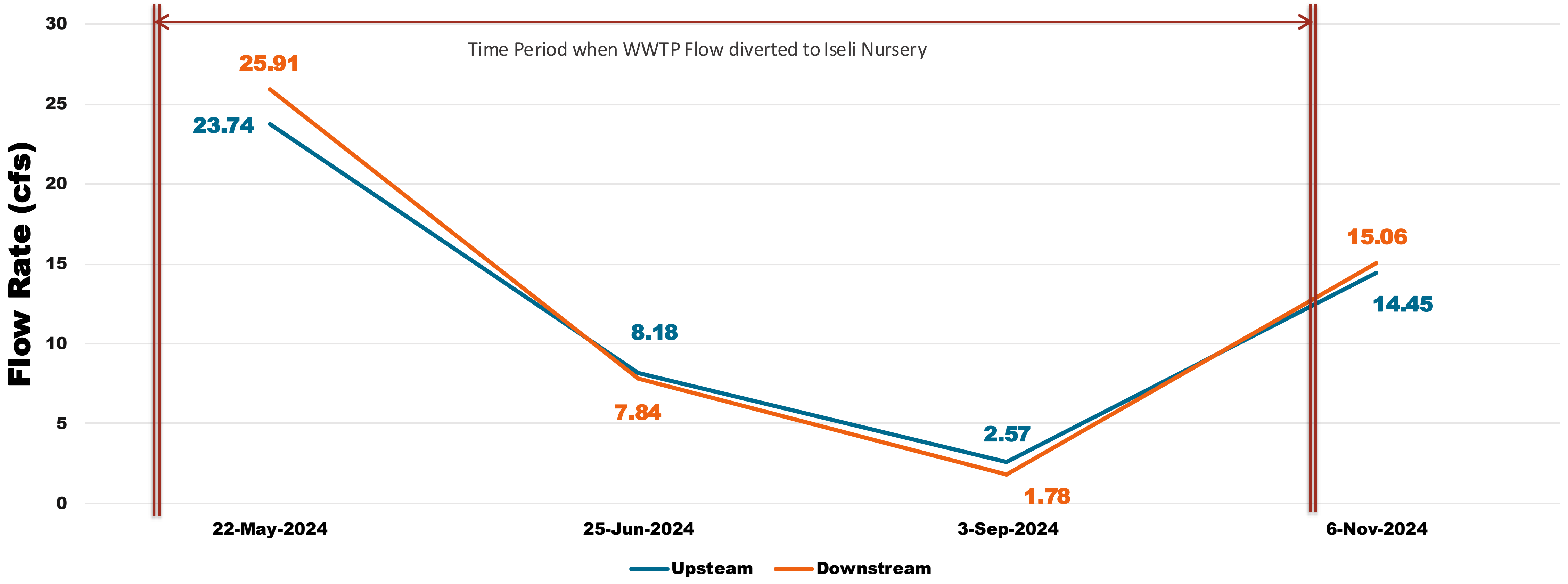
Evaluate Instream Flow Augmentation Potential and Prepare Summary Report

- Evaluate potential instream flow augmentation for downstream water users on the Clackamas River through collaboration with Clackamas River Water Users, US Fish and Wildlife, Oregon Department of Fish and Wildlife, Oregon Department of Environmental Quality and Oregon Water Resources Department.
- Prepare draft summary report prior to the third summit and submit to the panel of stakeholders. The draft format will contain the data collected, document the outcomes and decisions from Summit One and Two, and provide for a list of recommended future actions and next steps. **Draft Summary Report is due first week in April 2025.**
- Incorporate comments and suggestions from the stakeholders following the completion of Summit Three and compile a final version of the Study Summary Report. **Final Summary Report is due last week in June 2025.**



Data Collection and Analysis Methodologies

Flow Monitoring - Current



- Flow values have been provided by initial hydrograph prepared by David Evans and Associates.
- No correlation has been made versus staff gage readings on same time intervals.
- Plant was discharging to stream during November 6th
- New effluent flow meters are planned to be installed at the plant in 2025

SANDY DRINKING WATER

Surface Water Quality Sampling

Water Quality samples were obtained:

- May 22nd, 2024
- June 26th, 2024
- September 4th, 2024
- November 6th, 2024

Two additional sampling events are anticipated to be:

- January 22nd, 2025
- March 1st, 2025

Results of analytical lab data for stream samples as well as corresponding WWTP effluent samples are recorded and graphically displayed (Tickle Creek Sample Results.xlsx)

Initial Impressions

- Analytical results and stream flow readings between up and downstream samples suggests that there is an unidentified contributing source between the upstream and downstream data locations particularly in the May sampling event.

- Nutrient levels are higher as are Total metals concentrations; dissolved metals concentrations are nearly identical.

- Flows measured during this time also suggest an increase of 2 cfs between downstream and upstream measurements.

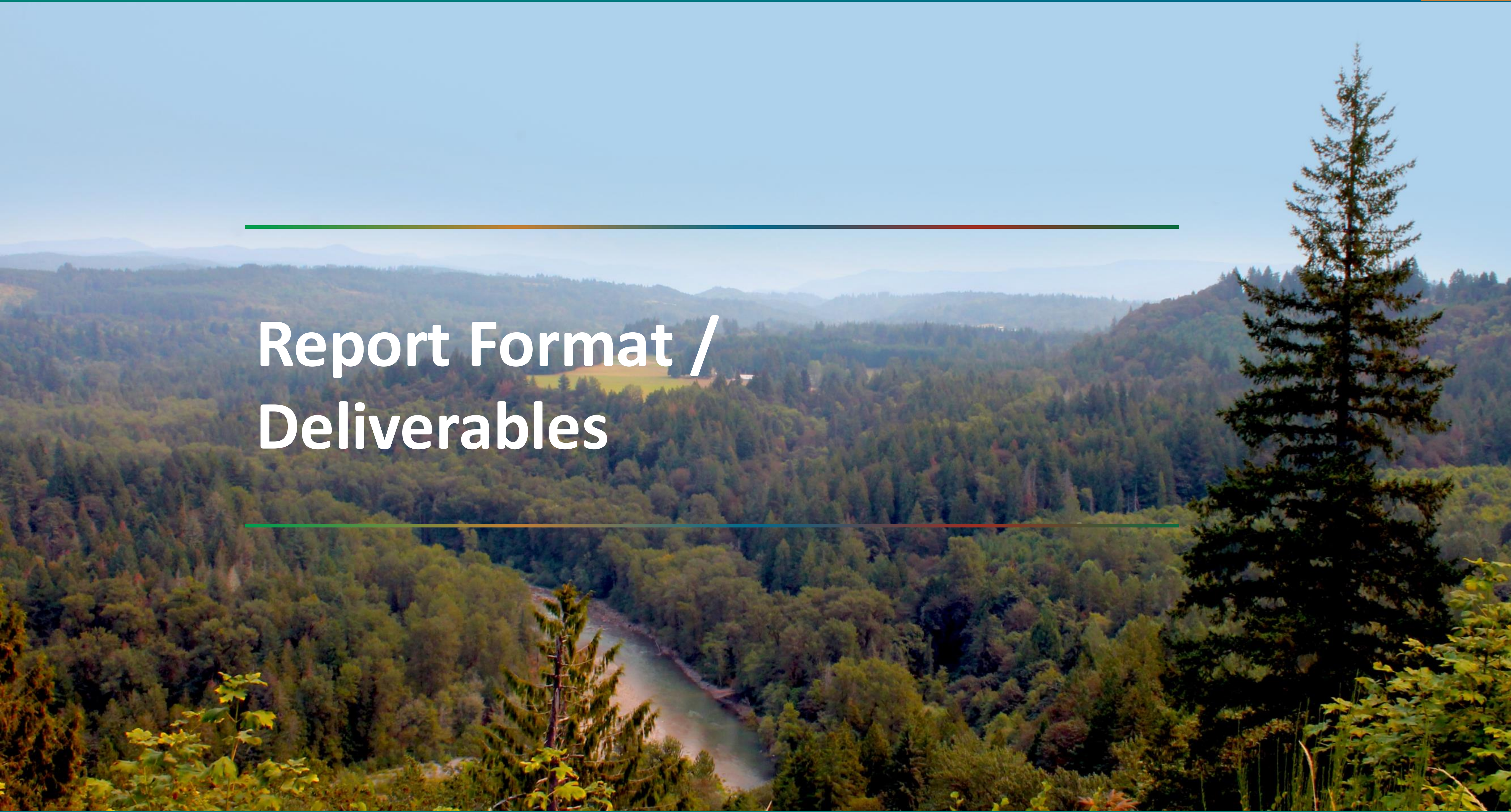
Initial Impressions

- However, the quality variations are dampened in later year events and the flow measurements are more closely aligned in the June, September and November readings.
- The data suggest a surface water source; there are agricultural activities in the immediate area and surface runoff may be contributing to the higher nutrient and total metals concentrations at the downstream location in the Spring
- Plant flows were discharged into the stream in the November event and differences in water quality up and downstream were minimal.

Stakeholder Input and Suggestions

What additional data for the report?

- Forecasted effluent water quality and flow projections from updated 2024 Facility Plan Amendment
- Correlation of Stream flows and Staff Gage Recordings, if possible.
- Additional Data Collection suggestions



Report Format / Deliverables

Proposed Table of Contents

Next Steps

Next Steps

- Prepare Draft Summary Report
- Submit to Stakeholders for Review
- Schedule Summit #2

MEETING MINUTES

Meeting Title:	Tickle Creek Reuse Study Kickoff Summit		
Purpose:	Present information to stakeholders as part of the Tickle Creek Reuse Study project.	**Date:**	January 15, 2025
Location:	Teams	**Time:**	1:00 p.m.

Attendees:

Ron Wierenga – Clackamas Water Environment Services	Rob Annear – Annear Water Resources, Consultant to CRWP	Suzi Cloutier – resident of Tickle Creek Subwatershed
Amy Landvoigt – Water Master for District 20	Jo Lewis – Geosyntec	Sarah Mattecheck – DEQ; Basin Coordinator, Clackamas Subbasin
Jerry Linder – Executive Director of Oregon Association of Clean Water Agencies	Raj Kapur – West Yost	Heather Stephens - Stantec
AJ Thorne – City of Sandy	Jeff Aprati – City of Sandy	Portia Inman - Stantec

The Sandy Clean Water Program team provided an overview of the Tickle Creek Reuse Study objectives, data collection and analysis methodologies, initial findings, and planned deliverables. A copy of the presentation is included at the end of these minutes.

The City's existing NPDES permit poses significant challenges for the City, which makes the potential for expanding beneficial reuse attractive. If there is wet weather in the fall and spring seasons when discharge to Tickle Creek is prohibited and irrigation demand is minimal, it is very difficult for the City to manage effluent. The purpose of the Tickle Creek Reuse Study is to assess the feasibility of using recycled water as a source of flow augmentation for Tickle Creek during the dry season.

Stakeholder input and suggestions are summarized below.

- Was the monitoring plan reviewed by DEQ? Will DEQ be satisfied with one year of data collection?
  - The Plan was not submitted to DEQ for review nor was it developed with the intent of receiving approval from DEQ. The purpose of this effort is primarily to get a conversation started regarding the benefits of recycled water during dry seasons as a mechanism for enhancing stream flow. This is something that is recognized in the State of Washington has not in Oregon.
  - Stakeholders agreed that a more robust dataset would be required if the City were to proceed with flow augmentation in Tickle Creek. This dataset would likely include continuous flow and temperature monitoring in Tickle Creek as well as additional data regarding effluent characteristics.

- It would be helpful to document environmental benefits if there are any that can be demonstrated. This would require evaluating current flow in the creek compared with historical records and how effluent reuse would change this under current and future conditions. If current fish species rely on Tickle Creek for resting areas and cold water refugia, would also need to demonstrate the impacts of reuse on habitat.
- From a water quantity perspective, any additional flow in Tickle Creek during the summer would be beneficial. Instream demands on both Deep Creek and Tickle Creek are not met by July every year.
- The stakeholders requested clarification regarding how the Three Basin Rule impacts potential reuse on Tickle Creek. The Rule prohibits any new discharges to surface waters, or any increase in discharge as well. This issue is being felt by other communities in the area, and DEQ is convening an Advisory Committee to look at the Three Basin Rule. ACWA will have a seat on the committee, as will Sandy.
- ACWA is working with DEQ and the legislature to get a bill to further support advancement of reuse, coordinate rules, encourage reuse, and develop internal management directives that are more encouraging of reuse. The timing of this study could be beneficial.

Appendix E: May 15th Summit Documents

Final Study Summit

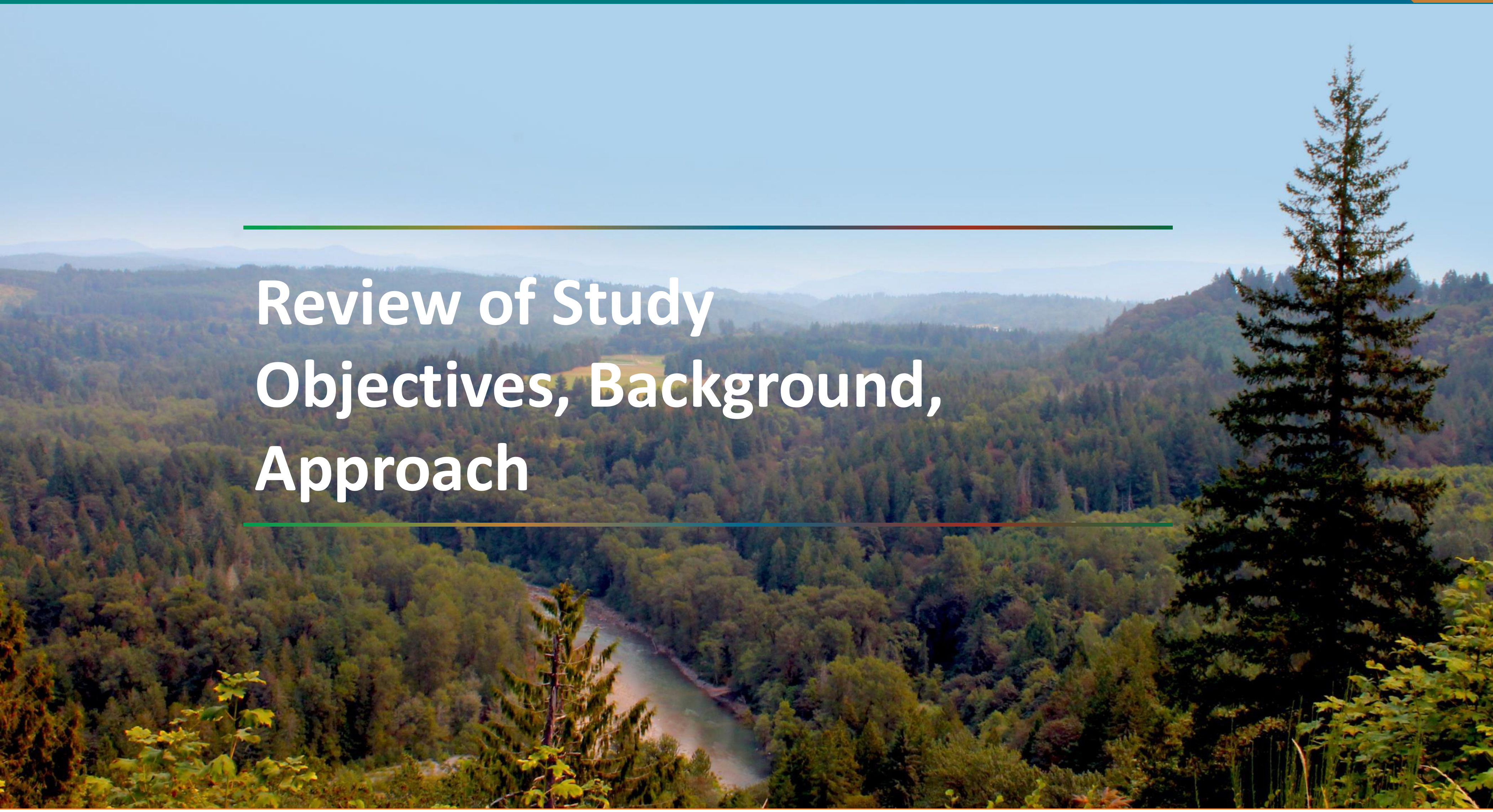
May 15, 2025

City of Sandy

Tickle Creek Reuse Study

AGENDA

1. **Welcome**
2. **Review of Study Objectives, Background, Approach**
3. **Final Data Collection & Findings**
4. **Stakeholder Input**
5. **Next Steps**



Review of Study Objectives, Background, Approach

Objectives

- Obtain current flow and water quality information for Tickle Creek
- Develop a better understanding of flow and water quality seasonal variation through periodic measurement and sampling events.

Outcomes

- Develop a consensus amongst stakeholders of the value that high quality effluent can provide to the Clackamas watershed
- Initiate a collective interest for watershed flow augmentation with reclaimed water and advocate for a One Water approach to managing our resources.

SANDY DRINKING WATER

Background

- The City of Sandy owns and operates a wastewater treatment plant (WWTP) located on Jarl Road in Boring, Oregon.
- Treated effluent discharge is regulated by an NPDES Permit that expired in 2013. The permit has been administratively extended and DEQ is preparing a new Draft Permit based on Sandy's permit renewal application.
- From November 1 to April 30, treated effluent from the WWTP is discharged into Tickle Creek, a tributary of the Clackamas River. Recycled water for irrigation is provided to a nursery from May 1 to October 31.

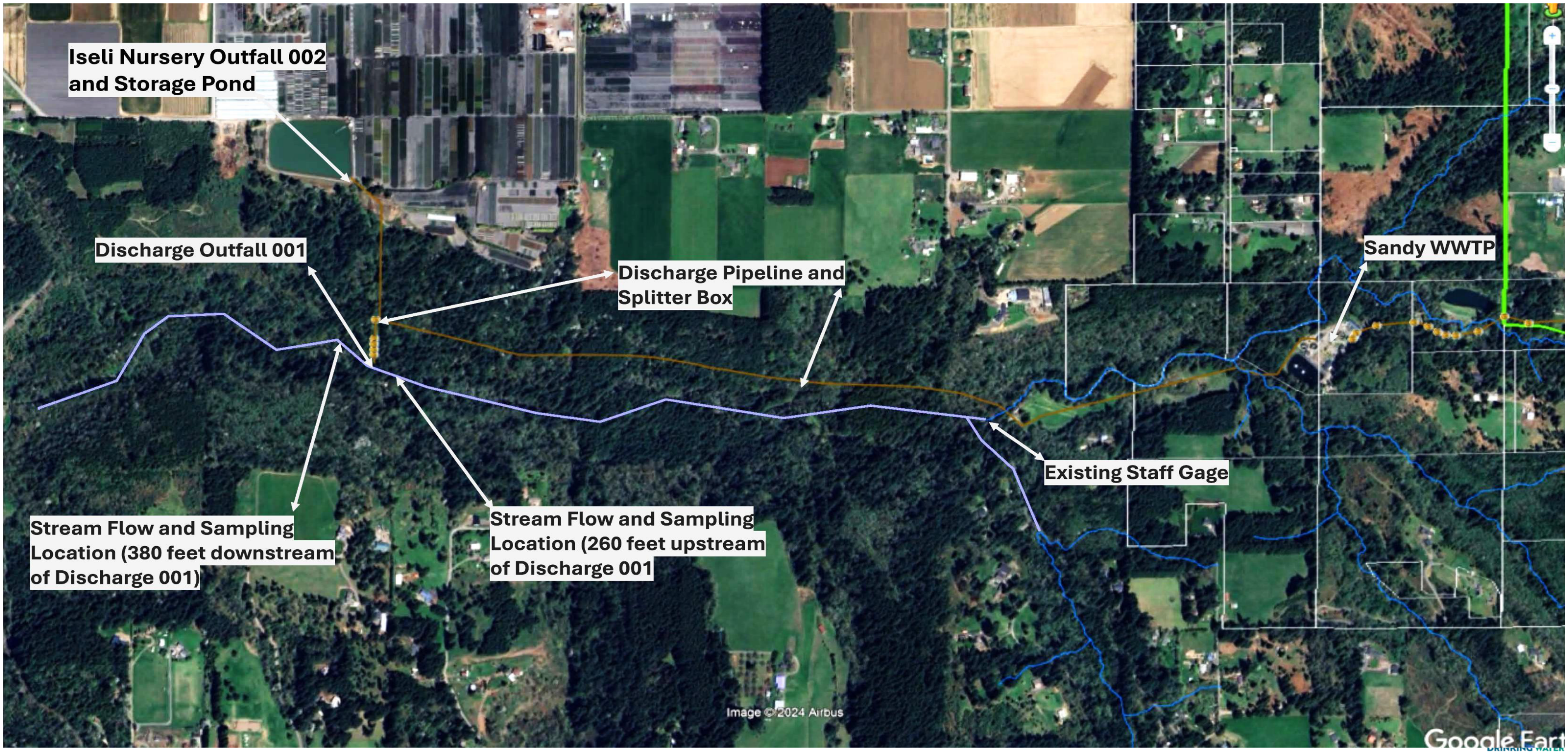
SANDY DRINKING WATER

Background

- In addition to the seasonal limitation (i.e., November 1 – April 30) for discharge to Tickle Creek, the NPDES permit further restricts the discharge based on a dilution requirement, which authorizes discharge when stream dilution is greater than or equal to 10.
- Plant capacity in NPDES permit dates back to the 1990s; however, does not reflect current conditions and anticipated growth in service area.

SANDY DRINKING WATER

Background


Iseli Nursery Outfall 002
and Storage Pond
Discharge Outfall 001
Discharge Pipeline and
Splitter Box
Sandy WWTP
Existing Staff Gage
Stream Flow and Sampling
Location (380 feet downstream
of Discharge 001)
Stream Flow and Sampling
Location (260 feet upstream
of Discharge 001
Image © 2024 Airbus

Background

- Sandy regularly reports plant effluent data and discharge location as well as reports values for Tickle Creek flows utilizing an existing staff gage located approximately 4,300 feet upstream of the WWTP discharge point.
- Given the pending NPDES permit discussions and with knowledge that recent water quality and calibrated flow measurements of Tickle Creek are unavailable, Sandy approached the Oregon Water Conservation, Reuse and Storage Grant Program for financial assistance in completing water quality sampling and flow monitoring activities to assess the current condition of the stream

SANDY DRINKING WATER

Study Objectives

1

Assess and document the current water quantity and quality in Tickle Creek to establish a baseline

2

Document quality and quantity of reclaimed water from WWTP

3

Explore value that effluent can provide to the Clackamas River watershed

Study Approach – Flow Monitoring

- Acquire the services of a professional surveying firm to complete a detailed topographic survey to establish flow observation stream cross sections and collect velocity measurements up and down stream of the effluent discharge location.
- Establish a rating curve to calculate the measured flow of the stream.
- Flow observations will occur at six separate intervals spaced throughout the year to obtain an annual flow record throughout an entire water year.

SANDY DRINKING WATER

Study Approach – Water Quality Monitoring

- Acquire the services of a professional engineering/environmental services firm to complete a periodic stream water quality sampling to coincide with each flow measurement exercise.
- Obtain water quality samples where uniform flow and mixing is observed.

Study Approach – Water Quality Monitoring

- A typical suite of water quality analysis parameters included:

✓ **Alkalinity**
✓ **Ammonia** (as N)
✓ **Dissolved Organic Carbon**
✓ **Calcium** (dissolved)
✓ **Chloride**
✓ **Hardness**
✓ **Magnesium** (dissolved)
✓ **Nitrite+Nitrate** (as N)
✓ **Total Kjeldahl Nitrogen**
✓ **Total Phosphorus**
✓ **Potassium** (dissolved)
✓ **Sulfate** (dissolved)

✓ **Total and Dissolved:**
  - **Aluminum**
  - **Arsenic**
  - **Barium**
  - **Chromium**
  - **Copper**
  - **Lead**
  - **Zinc**

✓ **pH**
✓ **ORP**
✓ **Dissolved Oxygen**
✓ **Temperature**
✓ **Conductivity**
✓ **Turbidity**

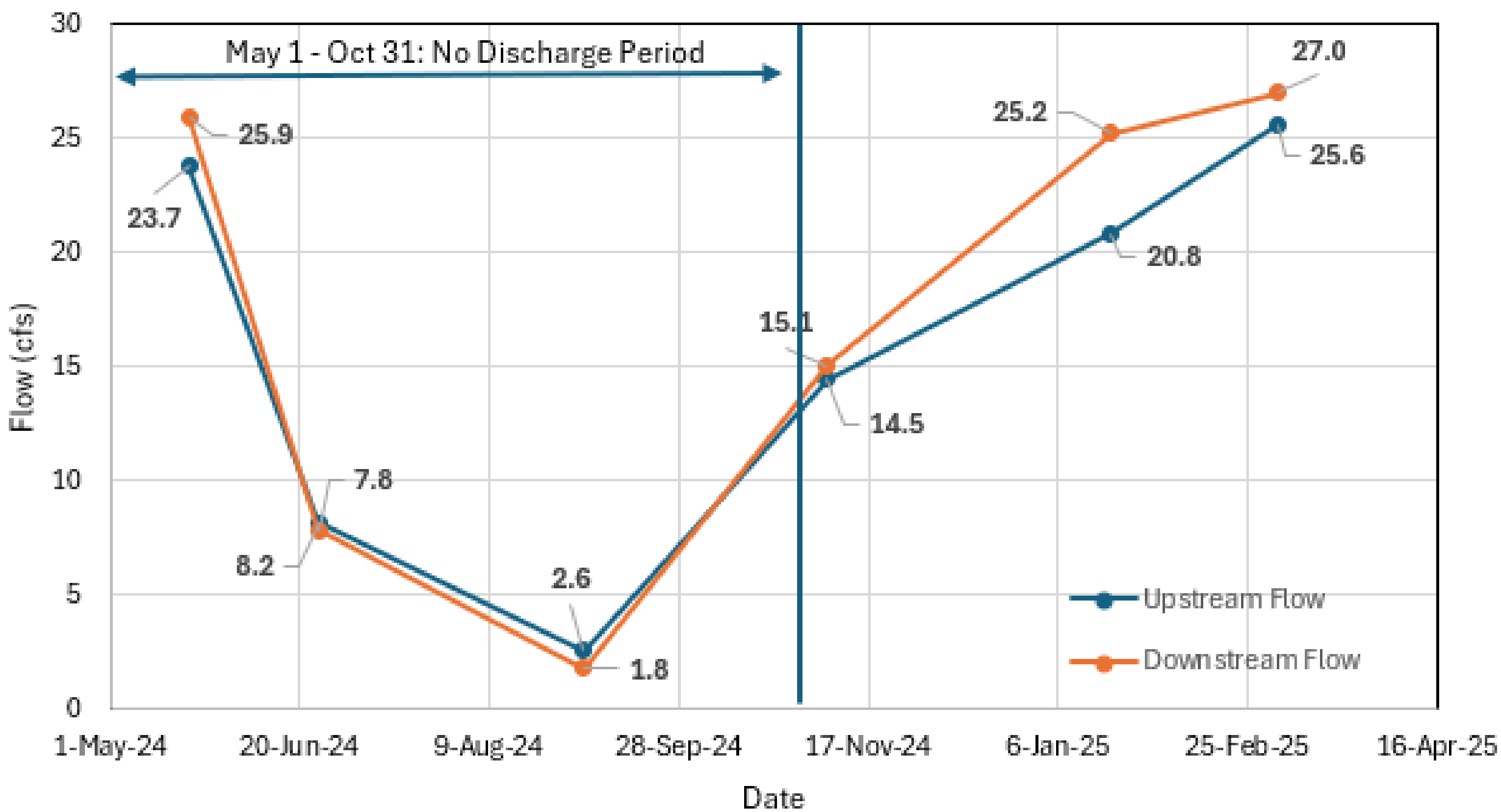
Evaluate Instream Flow Augmentation Potential and Prepare Summary Report

- Document potential impact of instream flow augmentation for downstream water users on the Clackamas River through collaboration with Clackamas River Water Users, US Fish and Wildlife, Oregon Department of Fish and Wildlife, Oregon Department of Environmental Quality and Oregon Water Resources Department.
- Prepare draft summary report and submit to the panel of stakeholders. The draft format will contain the data collected, document the outcomes and decisions from Summit One and Two, and identify potential future actions and next steps. **Draft Summary Report was provided prior to this Summit.**
- Incorporate comments and suggestions from the stakeholders following the completion of Summit Three and compile a final version of the Study Summary Report. **Final Summary Report is due last week in June 2025.**

Final Data Collection and Findings

Flow Monitoring

- Flows follow expected seasonal pattern
- Increase in downstream flow during May 2024 sampling coincided with precipitation event
- WWTP discharge average ~1 cfs during summer – January & March 2025 results indicate contributions to streamflow during winter



SANDY DRINKING WATER

Surface Water Quality Sampling

Water Quality samples were obtained:

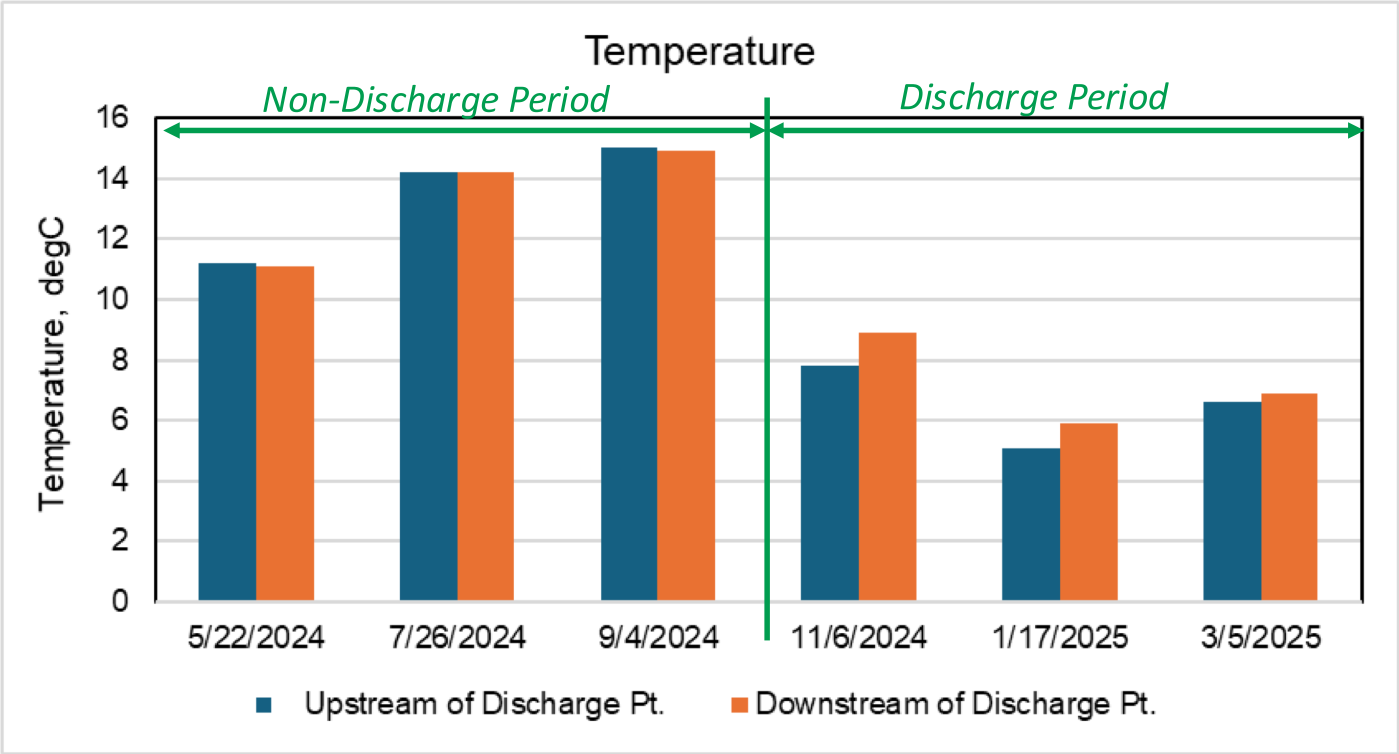
- May 22, 2024
- June 26, 2024
- September 4, 2024
- November 6, 2024
- January 17, 2025
- March 5, 2025

Water Quality sampling included 26 analytes and six field measurements

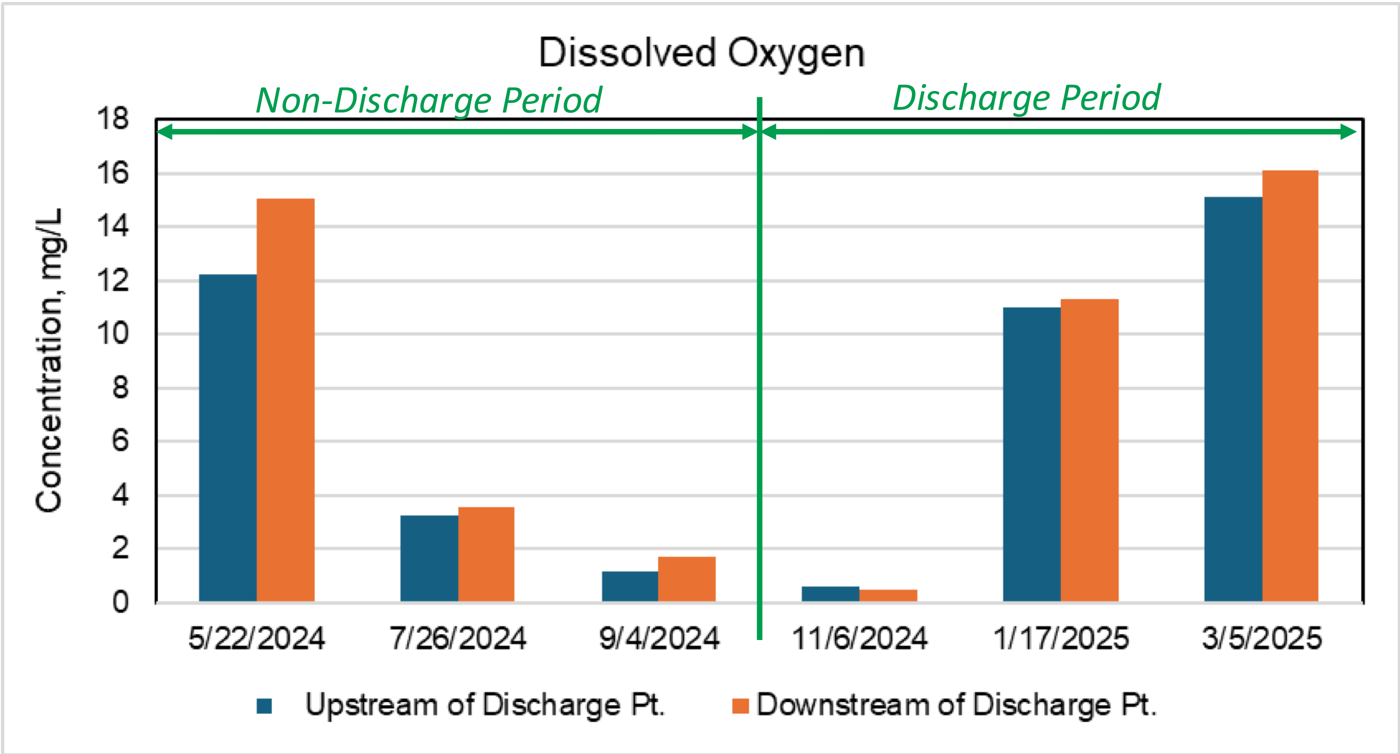
Results of analytical lab data for stream samples as well as corresponding WWTP effluent samples are recorded and graphically displayed

Tickle Creek Sample Results (1).xlsx

Upstream/Downstream Stream Sampling: Temperature



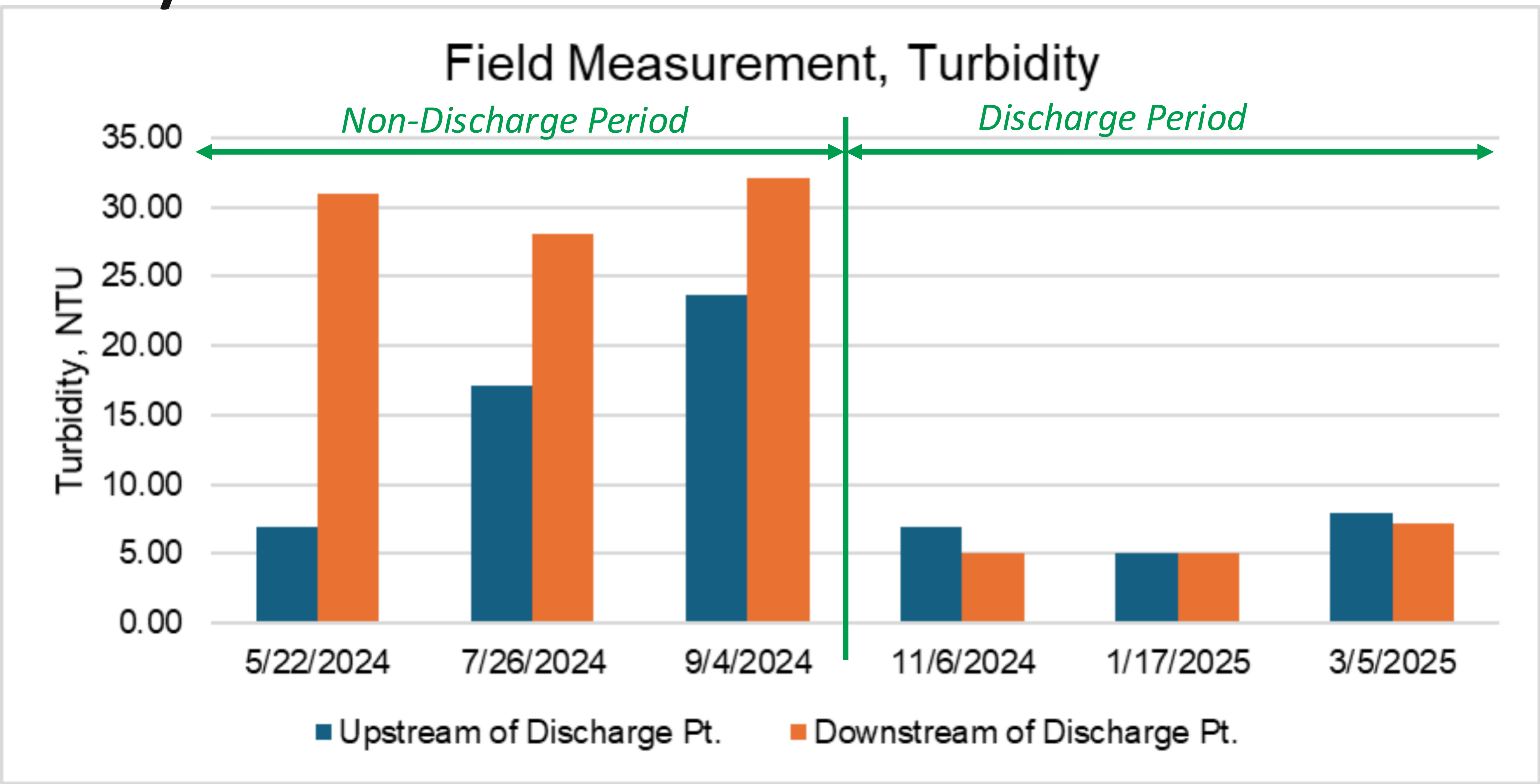
Upstream/Downstream Stream Sampling: Dissolved Oxygen



Low DO during November sampling unexpected given high streamflow and low temperature

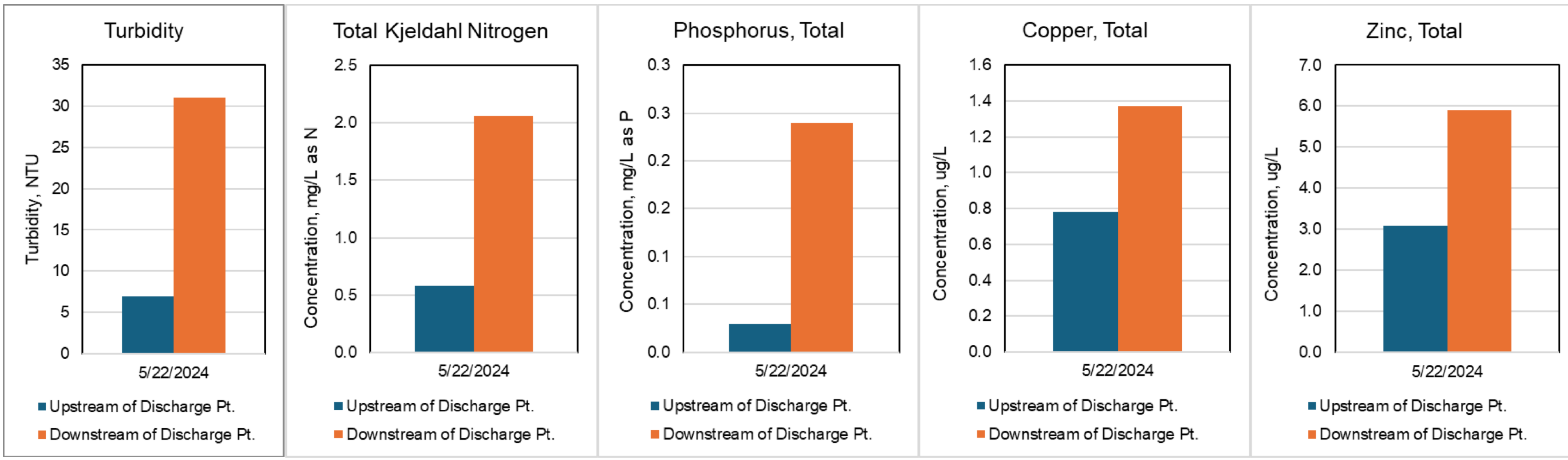
SANDY DRINKING WATER

Upstream/Downstream Stream Sampling: Turbidity



Significant increase in turbidity in May sampling event

Upstream/Downstream Stream Sampling : May 2024

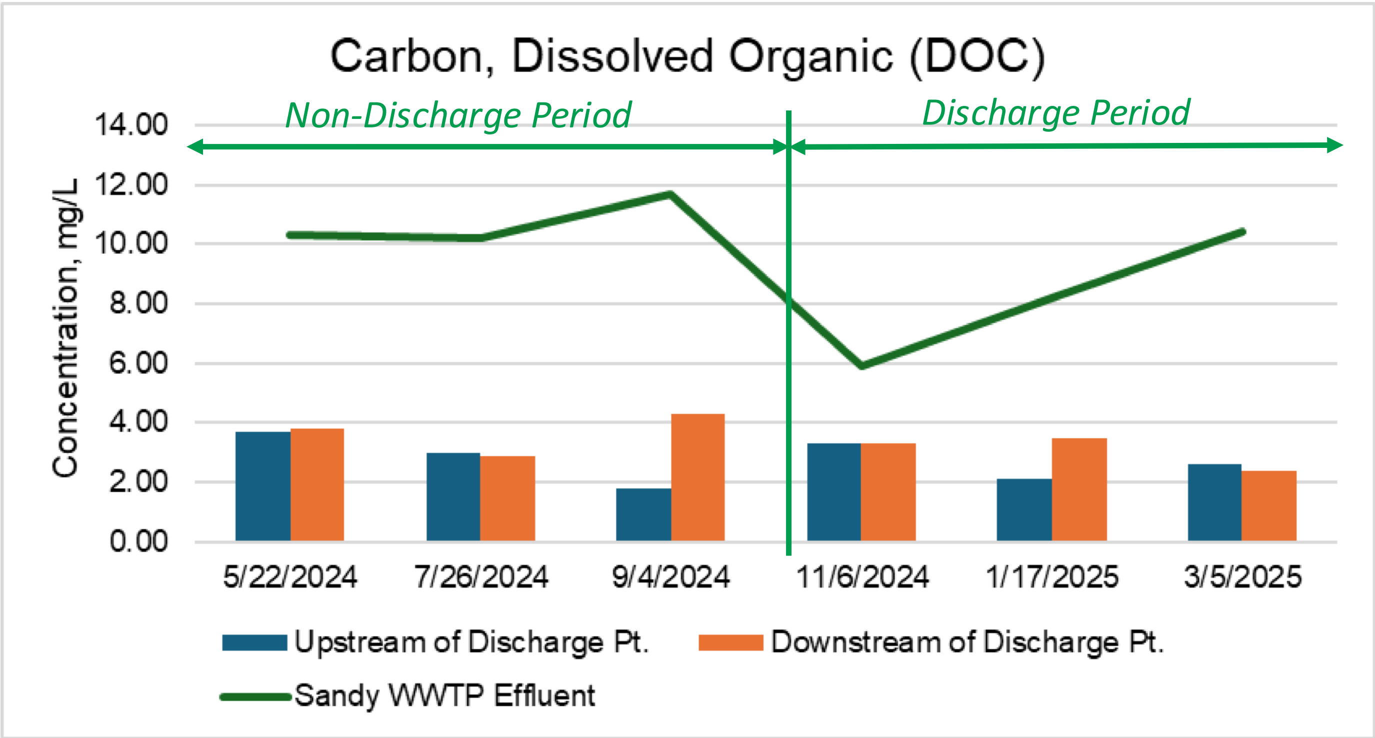


Higher downstream turbidity, nutrients and total metals observed although WWTP not discharging

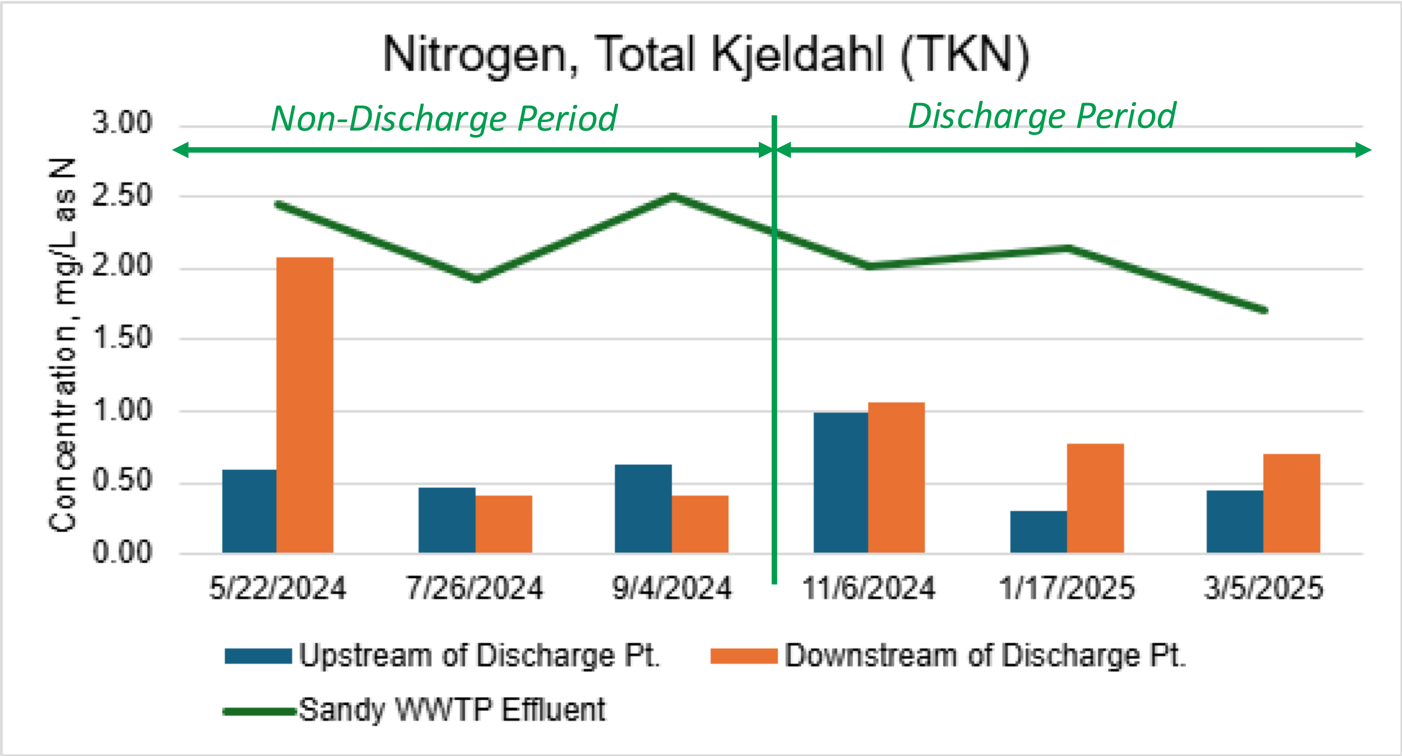
- 2.2 cfs difference in flow
- Likely that nonpoint source contributed increased loading to stream

SANDY DRINKING WATER

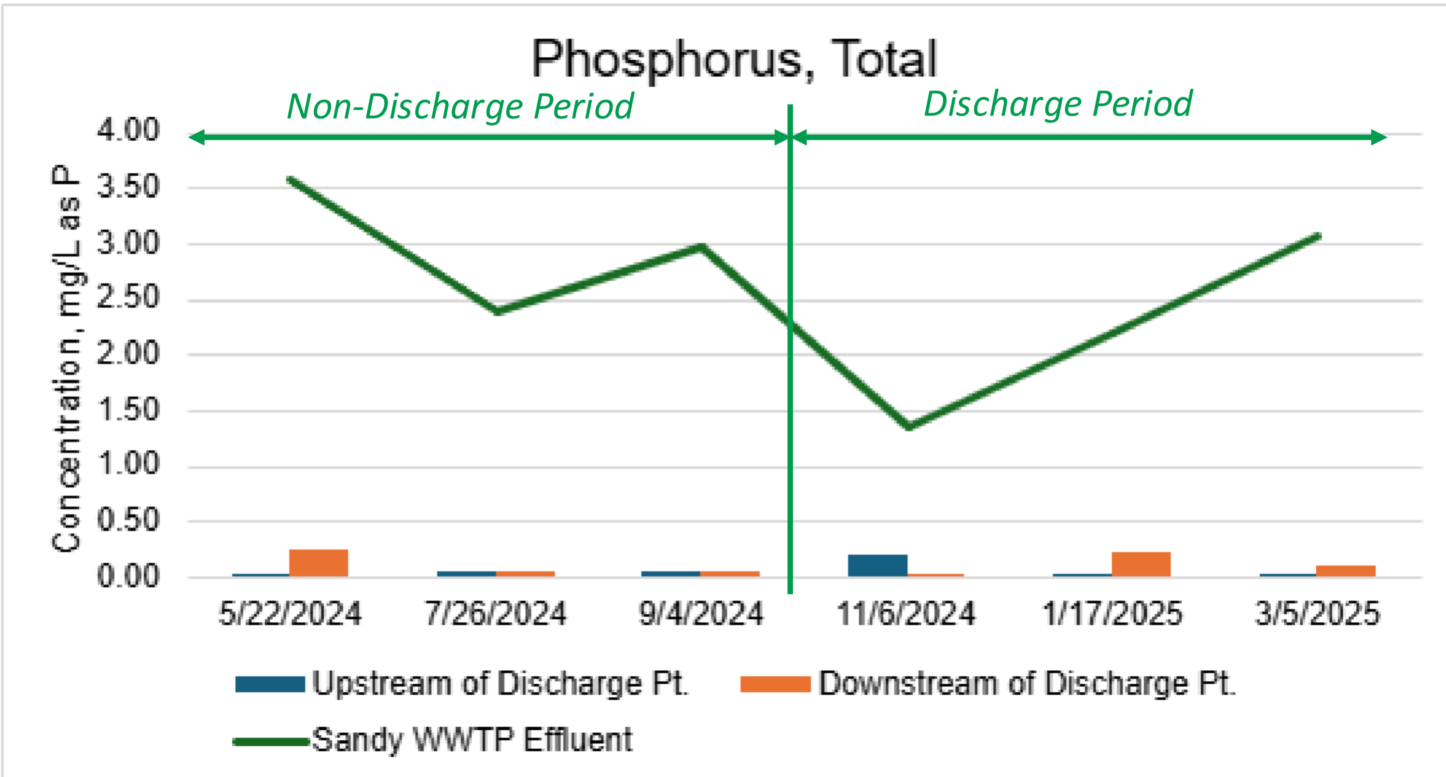
Stream and Effluent Results: DOC



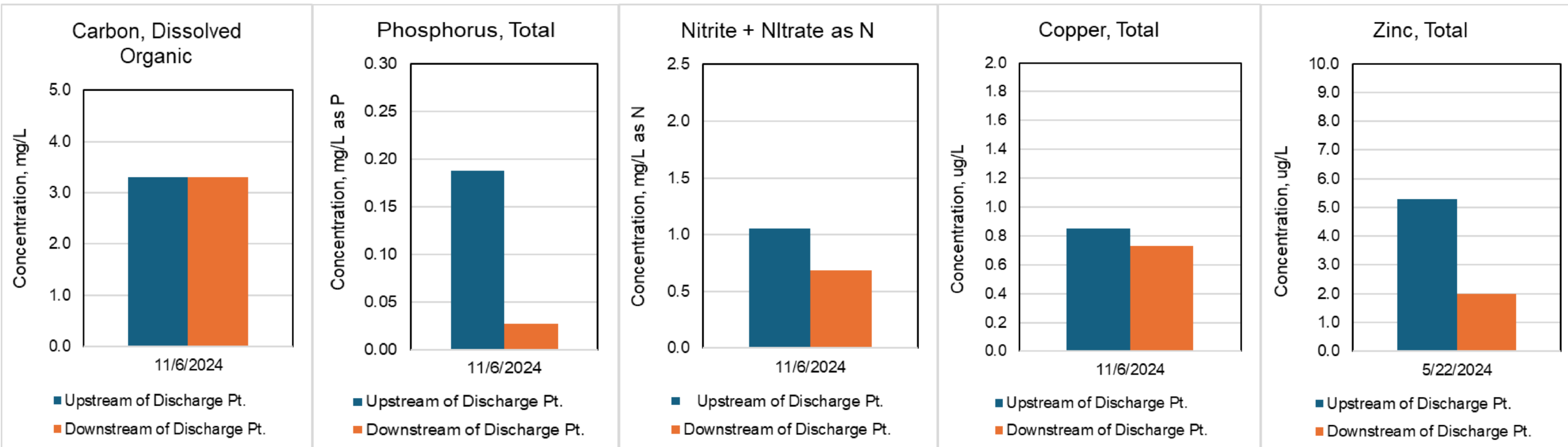
Stream and Effluent Results: TKN



Stream and Effluent Results: Total P

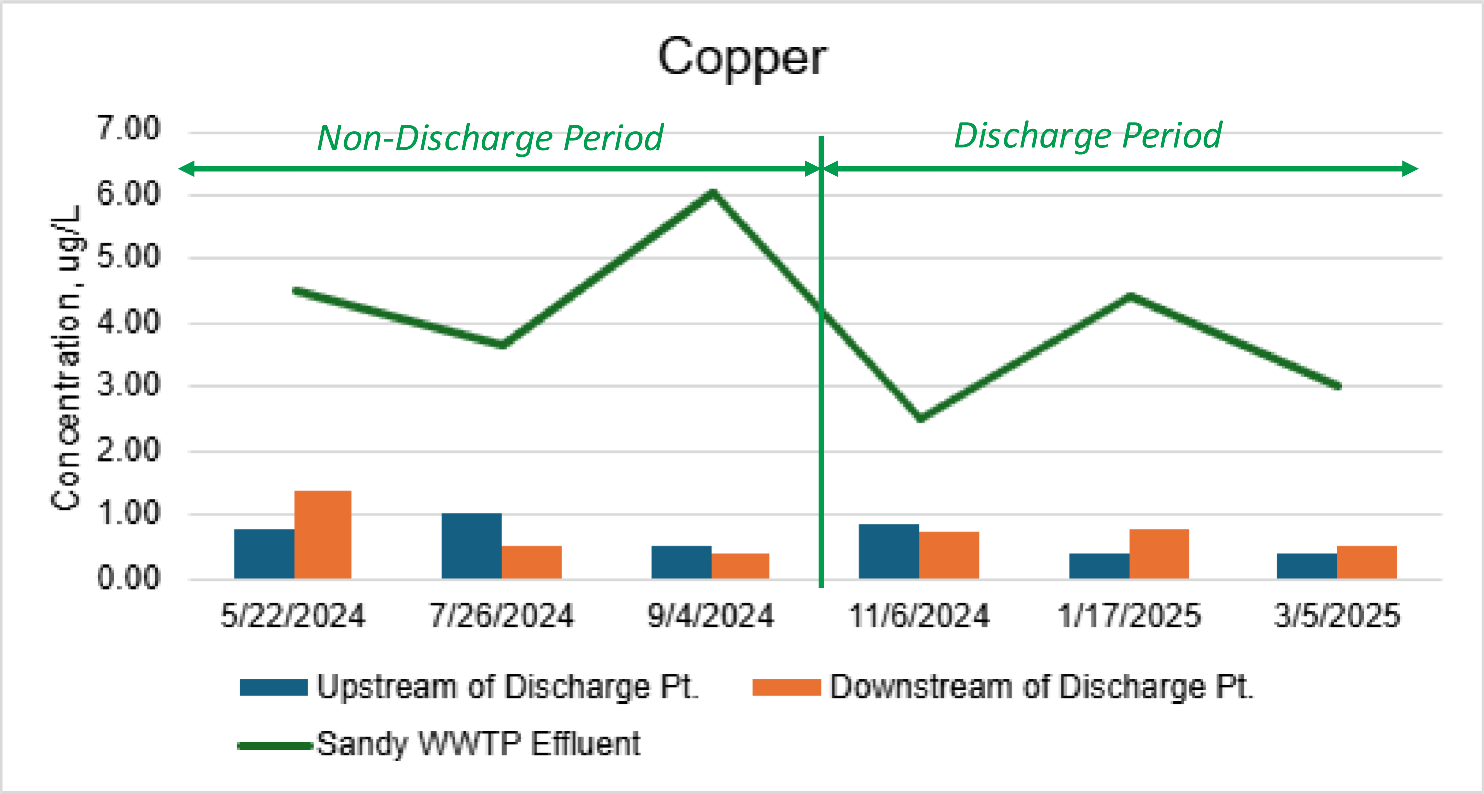


Upstream/Downstream Stream Sampling : Nov 2024

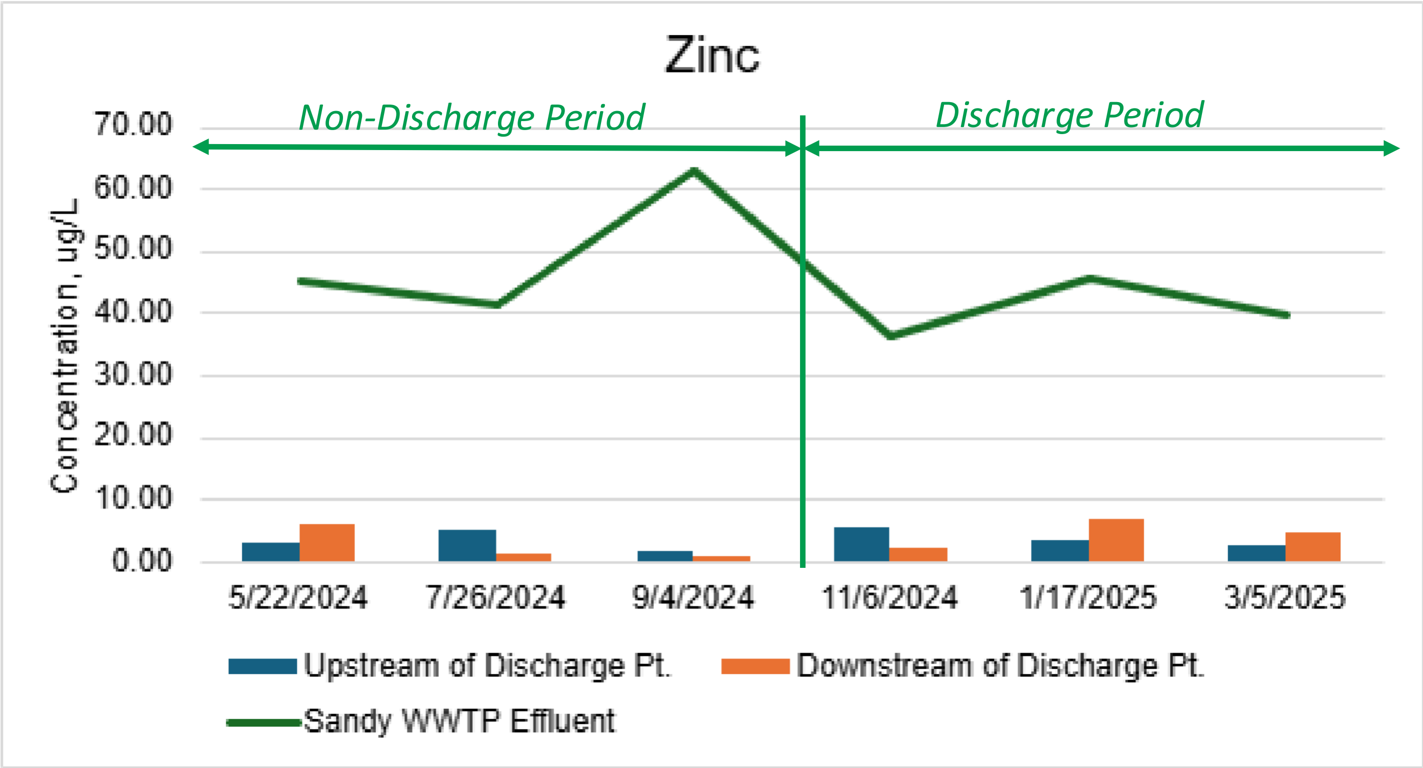


Downstream concentrations of effluent-related constituents expected to be higher during discharge period; possible error in sample labeling (supported by mass balance)

Stream and Effluent Results: Copper



Stream and Effluent Results: Zinc



Key Findings

- Analytical results and stream flow readings between up and downstream samples suggests that there is an unidentified contributing source between the upstream and downstream data locations particularly in the May 2024 sampling event.
  - Nutrient levels are higher as are Total metals concentrations; dissolved metals concentrations are nearly identical.
  - Flows measured during this time also suggest an increase of 2 cfs between downstream and upstream measurements.

SANDY DRINKING WATER

Key Findings

1

Assess and document the current water quantity and quality in Tickle Creek to establish a baseline

2

Document quality and quantity of reclaimed water from WWTP

3

Explore value that effluent can provide to the Clackamas River watershed

SANDY DRINKING WATER

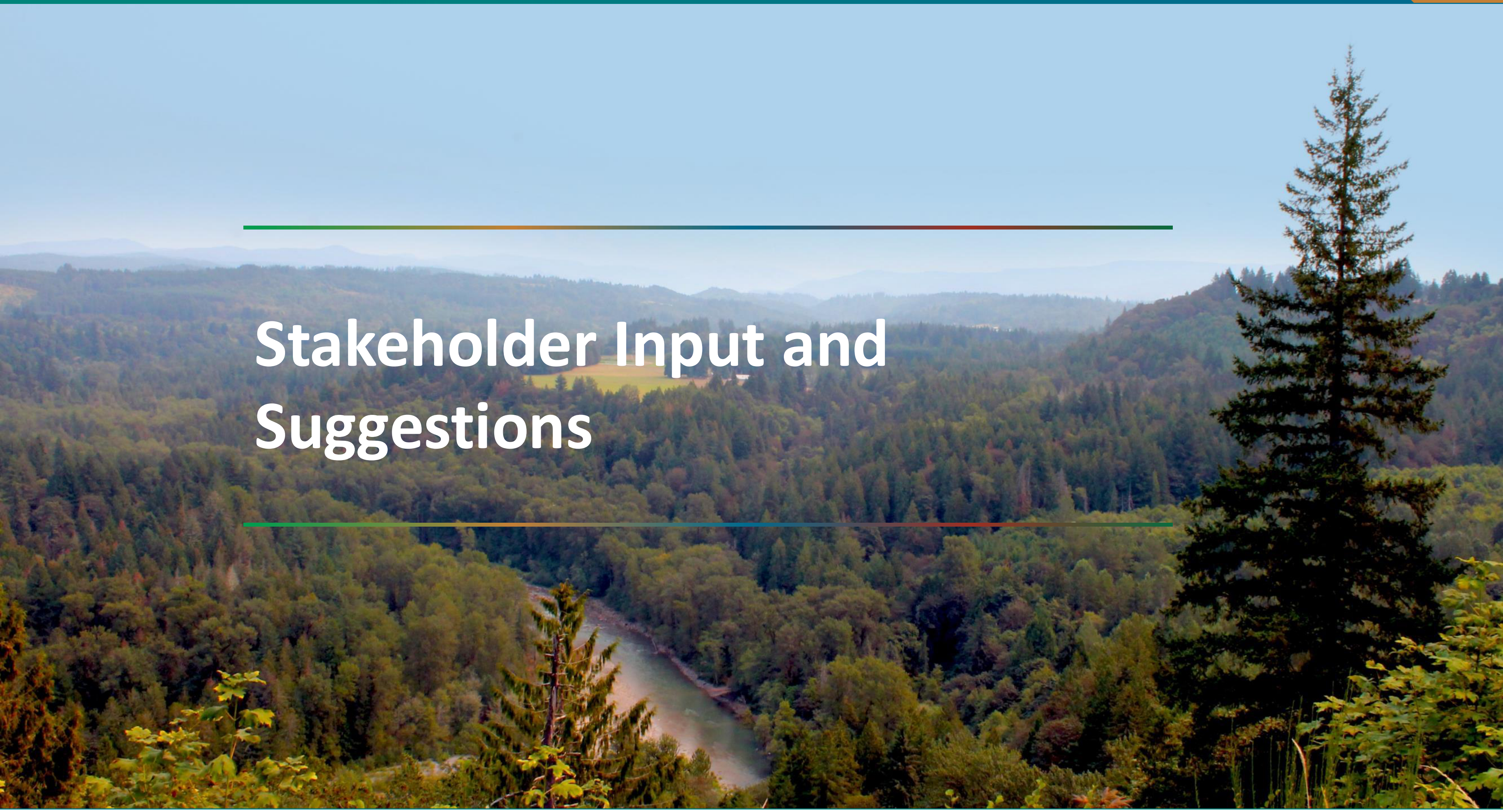
Key Findings

- Results provide baseline information regarding in-stream water quantity and quality, and the impacts of WWTP discharge
  - ✓ At time of September 2024 sampling, WWTP effluent would have increased streamflow by 21%
  - ✓ Though effluent increases concentrations of nutrients and some metals, Tickle Creek would still meet applicable surface water quality criteria

- Data during non-discharge period suggests a surface water source resulting in high nutrient and metal concentrations;

- Findings demonstrate potential benefit of recycled water for instream flow enhancement of Tickle Creek if allowed under Recycled Water Rule

SANDY DRINKING WATER



Stakeholder Input and Suggestions

MEETING MINUTES

Meeting Title:	Tickle Creek Reuse Summit		
Purpose:	Review the draft	**Date:**	May 15, 2025
Location:	Sandy Public Library – Hoyt Community Room; 38980 Proctor Blvd, Sandy, OR 97055	**Time:**	10: 00 a.m.

Attendees:

Jerry Linder	John Borden	Rick Cowlishaw
Raj Kapur	Heather Stephens	AJ Thorne
Portia Inman		

	Topic
1.	Welcome
2.	Review of Study Objectives, Background, Approach
3.	Final Data Collection and Findings
4.	Stakeholder Input
5.	Next Steps

1. **Welcome**
2. **Review of Study Objectives, Background, Approach:**
   a. **Objectives**
      i. Obtain current flow and water quality information for Tickle Creek.
      ii. Develop a better understanding of seasonal variation in flow and water quality through periodic measurement and sampling events.
   b. **Outcomes**
      i. Develop stakeholder consensus.
   c. **Background**
      i. The City of Sandy owns and operates a WWTP on Jarl Road in Boring, OR
      ii. The NPDES permit for treated effluent discharge expired in 2013; renewal is currently in process and anticipated in Fall 2025.
      iii. Discharge to Tickle Creek is limited to November 1- April 30.
      iv. The existing permit dates to the 1990s and does not reflect current operational conditions.

v. Data Collected

1. Flow and water quality data have been collected at two points: 260 feet upstream and 380 feet downstream.
2. There was a proposed alternative to discharge to the Sandy River rather than Tickle Creek. Although an application was submitted, it has not advanced. The current Facilities Plan amendment (FPA), required by the Consent Decree, identified a recommended alternative that does not include constructing a new discharge to the Sandy River.
3. Dry season (May 1 – October 30) discharge goes to Iseli Nursery; winter discharge is to Tickle Creek.
4. Average dry weather flow: 1 MGD; peak flows reach 8-9 MGD
5. I/I (inflow and infiltration) control has significantly reduced peak winter flow; influent flow reached 4.4 MGD in winter 2024.
6. I/I reduction strategies include pipe lining in high-rate I/I basins, lining private laterals, grouting leaky manholes, smoke testing, and identifying cross-connections

vi. Study Objectives

1. Assess and document stream conditions.
2. Evaluate and document water quality.
3. Explore the potential value of future discharge options.

3. **Study Findings**

a. **Water Quality Monitoring:**

i. Field samples collected where uniform flow and mixing is observed.

ii. Samples sent to a certified lab.

iii. Sampling generally occurred on the same days as flow monitoring.

iv. Standard parameter suite included:

1. **Nutrients & Organics:** Ammonia (as N), Dissolved Organic Carbon, Total Kjeldahl Nitrogen, Total Phosphorus, Nitrite + Nitrate
2. **Metals (Total & Dissolved):** Aluminum, Arsenic, Barium, Chromium, Copper, Lead, Zinc
3. **Other Parameters:** Alkalinity, Hardness, Calcium, Magnesium, Potassium, Sulfate, pH, ORP, Dissolved Oxygen, Chlorine

b. **Flow Monitoring:**

i. Seasonal patterns aligned with expectations.

ii. A May 2024 sampling event showed increased downstream flows due to precipitation.

iii. WWTP discharge averages ~1 cfs in summer.

iv. January and March 2025 data showed measurable winter contributions to streamflow (peak of ~1.8 cfs).

c. Surface Water Quality:

i. Higher dissolved oxygen observed during cooler periods and higher flows.

ii. Anomalously low dissolved oxygen was recorded in November, raising fisheries concerns.

1. EQ Basin was in use; facility was not discharging at full capacity.

d. Turbidity and Storm Events:

i. May 2024 storm event showed higher downstream turbidity, metals, and nutrients.

ii. 2.2 cfs difference between upstream and downstream flow may indicate non-point sources such as agricultural runoff.

4. **Stakeholder Input**

a. Thermal impact is a primary concern

i. With limited temperature TMDL (Total Maximum Daily Load) margin, discharging warm water into low-flow streams is a major challenge.

ii. Tickle Creek flows into Deep Creek and then Clackamas River; heat loads are cumulative and affect the entire watershed.

b. Three Basin Rule

i. The Three Basin Rule was intended to manage growth and protect water supplies.

ii. Variance options were purposely excluded, which may have been a mistake.

iii. A rule change would now be the only available path forward.

iv. City of Sandy is represented on the Advisory Committee for potential changes to the Three Basin Rule.

5. **Next Steps**

a. Finalize and submit the summary report by the end of June 2025.

b. Further discussions on Three Basin Rule and discharge strategy.