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KITSAP COUNTY

MANCHESTER GENERAL SEWER PLAN UPDATE

January 2025

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ECOLOGY DRAFT

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Acronyms & Abbreviations

2014 Plan	2014 Manchester Sewer Facilities Strategy Plan
A	
AACE	Association for the Advancement of Cost Engineering International
AAF	Average Annual Flow
ADA	Americans with Disabilities Act
AFD	Adjustable Frequency Drive
AKART	All Known, Available, and Reasonable Methods of Prevention, Control, and Treatment
ANSI	American National Standards Institute
ASIL	Acceptable Sourcce Impact Levels
ATS	Automatic Transfer Switch
B	
BOD	Biological Oxygen Demand
C	
C&C	Collection and Conveyance
CARA	Critical Aquifer Recharge Areas
CCTV	Closed-Circuit Television
CFR	Code of Federal REgulations
CIP	Capital Improvement Plan
CMOM	Capacity Management Operations and Maintenance
CMMS	Computerized Maintenance Management System
CMU	Concrete Masonry Unit
CoF	Consequence of Failure
County	Kitsap County
CPU	Central Processing Unit
CT	Current Transformer
CWA	Clean Water Act
D	
DCD	Kitsap County Department of Community Development
DHI	Danish Hydraulic Institute
DMR	Discharge Monitoring Report
DNR	Department of Natural Resources
DO	Dissolved Oxygen
DOH	Washington State Department of Health
E	
Ecology	Washington State Department of Ecology
EPA	Environmental Protection Agency
ERU	Equivalent Residential Unit
ESA	Endangered Species Act

F	
FOG	Fats, Oils, and Grease
FRP	Fiberglass Reinforced Plastic
FTE	Full Time Equivalent
FWPCA	Federal Water Pollution Control Act
G	
GBT	Gravity Belt Thickener
GIS	Geographic Information System
GMA	Growth Management Act
gpcpd	Gallons per Capita per Day
gpd/sf	Gallons per Day per Square Foot
gpm	Gallons per Minute
H	
HP	Horsepower
HPA	Hydraulic Project Approval
HVAC	Heating, Vehtilation, and Air Conditioning
I	
I&I	Infiltration and Inflow
I/O	Input/Output
IBC	International Building Code
IFC	International Fire Code
IMC	International Machine Code
K	
KCCP	Kitsap County Comprehensive Plan
KPDH	Kitsap Department of Public Health
kV	Kilovolt
kVA	Kilovolt Ampere
L	
LAMIRD	Limited Area of More Intensive Rural Development
LEL	Lower Explosive Limit
LF	Linear Feet
LIT	Level Indicating Transmitter
LUV	Land Use Vision
M	
MCC	Motor Control Center
mg/L	Milligrams per Liter
MGD	Million Gallons per Day
mL	Milliliter
ML	Mixed Liquor
MLE	Modified Ludzack-Ettinger
MLSS	Mixed Liquor Suspended Solids
MMDWF	Maximum Month Dry Weather Flow

MMWWF	Maximum Month Wet Weather Flow
MVC	Manchester Village Commercial
MVLR	Manchester Village Low Residential
MVR	Manchester Village Residential
N	
NASSCO	National Association of Sewer Service Companies
NEC	National Electrical Code
NFPA	National Fire Protection Association
NHPA	National Historic Preservation Act
NOAA	National Oceanic and Atmospheric Administration
NOC	Nitoce of Construction
NPDES	National Pollutant Discharge Elimination System
NSR	New Source Review
O	
O&M	Operations and Maintenance
OCI	Overall Condition Index
OFM	Office of Financial Management
OIT	Operator Interface Terminal
OPPC	Opinion of Probable Project Costs
Orange Book	Criteria for Sewage Works Design (Ecology)
ORP	Oxygen Reduction Potential
OSHA	Occupational Safety and health Administration
P	
PDF	Peak Day Flow
PHF	Peak Hour Flow
PIC	Pollution Identification and Correction
Plan	General Sewer Plan Update
PLC	Programmable Logic Controller
PLE	Plant Effluent
POTW	Publicly Owned Treatment Works
ppcd	Pounds per Capita per Day
ppd	Pounds per Day
PSCAA	Puget Sound Clean Air Agency
PSD	Prevention of Significant Deterioration
PSE	Puget Sound Energy
psi	Pounds per Square Inch
PSNGP	Puget Sound Nutrient General Permit
PSRC	Puget Sound Regional Council
PVC	Polyvinyl Chloride
Q	
QCC	Quality Control Corps.

R	
RAS	Return Activated Sludge
RCW	Revised Code of Washington
S	
SCADA	Supervisory Control and Data Acquisition
SEPA	Washington State Environmental Policy Act
SERP	Washington State Environmental Review Process
SF	Square Feet
SHPO	State Historic Preservation Officer
SIU	Significant Industrial User
SOP	Standard Operating Procedure
SSO	Sanitary Sewer Overflow
T	
TAC	Toxic Air Contaminants
TAZ	Traffic Analysis Zones
TIN	Total Inorganic Nitrogen
TKN	Total Kjeldahl Nitrogen
TSS	Total Suspended Solids
TWAS	Thickened Waste Activated Sludge
U	
UBC	Uniform Building Code
UFC	Uniform Fire Code
UGA	Urban Growth Area
ULID	Utility Local Improvement District
UOS	Unstable Old Landslides
UPC	Uniform Plumbing Code
UPS	Uninterruptible Power Supply
URS	Unstable Recent Slides
USACE	United States Army Corps of Engineers
UV	Ultraviolet
V	
VAC	Volts of Alternating Current
VFD	Variable Frequency Drive
VHF	Very High Frequency
W	
WAC	Washington Administrative Code
WAS	Waste Activated Sludge
WRIA	Water Resources Infrastructure Act
WWTP	Wastewater Treatment Plant

Executive Summary

ES.1 Introduction

Since the 1950s, Kitsap County (County) has worked to protect aquifers, surface water, and the Puget Sound by providing wastewater collection, treatment, and discharge. This Manchester General Sewer Plan Update (Plan) provides a road map for the Manchester service area's long-term wastewater infrastructure needs for the next 20 years. Planning the wastewater infrastructure needs of a dynamic and fast-growing region is challenging. Expanding populations in the County will require sewer service and the County will be responsible for appropriately collecting, conveying, and treating increasing wastewater flows. Infrastructure design and implementation will be strategically planned to maximize limited fiscal resources. Federal, state, and local regulations all contribute to a need to be on the cutting edge of emerging technologies and require the utility to continually think ahead. Planning at this level involves weighing a complicated array of interconnected—and often conflicting—factors and variables. This Plan provides a framework for the County to continue to manage growth within the context of a countywide wastewater service network and achieve the overall goal of providing sewerage service to protect public health and the quality of Kitsap and the Puget Sound's water resources.

The State of Washington adopted the Growth Management Act (GMA) with the intent of creating a consistent and unified growth planning process. The GMA requires that the County create and enact a Comprehensive Plan to provide a 20-year blueprint for local policy, planning and capital facility investment. A Comprehensive Plan is used as a guide for local governments through the establishment of vision statements, goals, objectives, policies, and implementing actions. This Plan constitutes the sewer capital facilities element of the Kitsap County Comprehensive Plan (KCCP). At the time of adoption, this Sewer Plan is consistent with the other elements of the KCCP.

This Plan is based on planning horizons of a six-year period (2023 to 2028), and a 20-year period (2029 to 2042). An updated KCCP is currently in progress and will cover a 20-year planning period from 2024 to 2044. Therefore, the recommendations and conclusions presented in this Sewer Plan have been reviewed to confirm alignment with the 2044 planning horizon of the KCCP.

This Plan is also aligned with the County's Water as a Resource policy, adopted in 2009 and reaffirmed in 2016. One of the aims of Water as a Resource policy is to reduce water pollution. Implementation of the projects presented in this Plan are a direct expression of the County's guiding principle to view water as a valuable resource worthy of protection and careful stewardship.

This Plan meets the Washington State Department of Ecology (Ecology) regulations for general sewer plans contained in the Washington Administrative Code (WAC) 173-240-050.

Organization of the Plan

The Plan is organized into twelve sections that cover the Manchester wastewater system:

- **Section 1: Introduction** provides an overview of the Manchester service area, ownership of the system, and contents of the Plan.
- **Section 2: Service Area Characterization** reviews the physical and administrative characteristics of the Manchester wastewater collection basin.

- **Section 3: Population, Load, and Flow Projections** estimates the current sewer system population, analyzes the impact of projected population growth, and estimates future wastewater flows and loads within the Manchester service area.
- **Section 4: Regulatory Requirements** identifies relevant federal, state, and local regulatory requirements that affect planning and operations of the wastewater system.
- **Section 5: Collection and Conveyance Existing Conditions** evaluates existing conditions of the system's gravity sewers, pump stations, and force mains based on site visits, video inspections of pipes, and discussion with County staff.
- **Section 6: Existing Conditions – Wastewater Treatment Plant** evaluates existing conditions of the Manchester Wastewater Treatment Plant (WWTP) facilities, processes, and equipment based on site visits, discussion with plant operators, historical plant performance, and modeling of the plant processes.
- **Section 7: Collection and Conveyance System Analysis** discusses the modeling completed as a part of the 2014 Manchester Sewer Facilities Strategy Plan (2014 Plan) (BHC Consultants, 2014)
- **Section 8: Wastewater Treatment System Analysis** analyzes improvements needed to maintain and upgrade the Manchester WWTP based on condition deficiencies, capacity inadequacies, and regulatory requirements.
- **Section 9: Recycled Water** evaluates opportunities for recycled water reuse so that water treated at the Manchester WWTP can be used for beneficial purposes instead of discharged to the Puget Sound.
- **Section 10: Operations and Maintenance** documents the County's management structure, details the wastewater system operations and maintenance (O&M) practices, and makes suggestions to improve utility operation practices.
- **Section 11: Capital Improvement Plan** provides a 20-year plan for implementing capital improvement plan (CIP) projects that improve the operation of the collection and conveyance (C&C) system and Manchester WWTP.
- **Section 12: Financial Strategy** identifies financial approaches to fund the CIP.

General Sewer Plan Requirements

This Plan meets the Ecology regulations for general sewer plans contained in WAC 173-240-050.

Table ES summarizes the requirements and the sections in the 2024 Plan where the requirements are addressed.

Table ES-1 | WAC 173-240-050 Requirements

Section	Section Description	Location in Plan
3.a	The purpose and need for the proposed plan.	Section 1.2
3.b	A discussion of who will own, operate, and maintain the systems.	Section 1.5
3.c	The existing and proposed service boundaries.	Figure 2-1

Section	Section Description	Location in Plan
3.d.i	Boundaries. The boundary lines of the municipality or special district to be sewered, including a vicinity map;	Figure 2-1
3.d.ii	Existing sewers. The location, size, slope, capacity, direction of flow of all existing trunk sewers, and the boundaries of the areas served by each;	Section 5 and Section 6
3.d.iii	Proposed sewers. The location, size, slope, capacity, direction of flow of all proposed trunk sewers, and the boundaries of the areas to be served by each;	Section 11
3.d.iv	Existing and proposed pump stations and force mains. The location of all existing and proposed pumping stations and force mains, designated to distinguish between those existing and proposed;	Section 5and Section 11
3.d.v	Topography and elevations. Topography showing pertinent ground elevations and surface drainage must be included, as well as proposed and existing streets;	Figure 2-2
3.d.vi	Streams, lakes, and other bodies of water. The location and direction of flow of major streams, the high and low elevations of water surfaces at sewer outlets, and controlled overflows, if any. All existing and potential discharge locations should be noted;	Figure 2-4
3.d.vii	Water systems. The location of wells or other sources of water supply, water storage reservoirs and treatment plants, and water transmission facilities.	Figure 2-5
3.e	The population trend as indicated by available records, and the estimated future population for the stated design period. Briefly describe the method used to determine future population trends and the concurrence of any applicable local or regional planning agencies.	Section 3
3.f	Any existing domestic or industrial wastewater facilities within twenty miles of the general plan area and within the same topographical drainage basin containing the general plan area.	Figure 1-1
3.g	A discussion of any infiltration and inflow (I&I) problems and a discussion of actions that will alleviate these problems in the future.	Section 3.4.3
3.h	A statement regarding provisions for treatment and discussion of the adequacy of the treatment.	Section 6
3.i	List of all establishments producing industrial wastewater, the quantity of wastewater and periods of production, and the character of the industrial wastewater insofar as it may affect the sewer system or treatment plant. Consideration must be given to future industrial expansion.	Section 4
3.j	Discussion of the location of all existing private and public wells, or other sources of water supply, and distribution structures as they are related to both existing and proposed domestic wastewater treatment facilities.	Figure 2-5
3.k	Discussion of the various alternatives evaluated, and a determination of the alternative chosen, if applicable.	Section 7and Section 8
3.l	A discussion, including a table, that shows the cost per service in terms of both debt service and O&M costs, of all facilities (existing and proposed) during the planning period.	Section 10, Section 11, and Section 12
3.m	A statement regarding compliance with any adopted water quality management plan under the Federal Water Pollution Control Act (FWPCA) as amended.	Section 4
3.n	A statement regarding compliance with the State Environmental Policy Act (SEPA) and the National Environmental Policy Act, if applicable.	Section 4

ES.2 Service Area Characterization

The County provides sewer service within the Manchester basin. The Manchester basin map is shown in **Figure ES-1**. The sewer service area, also referred to as the Manchester Basin in this plan, is approximately

1.8 square miles and is bounded to the east by the Puget Sound, to the south by SE Mile Hill Drive, to the north near E Montana Street, to the northeast by California Avenue East, and to the southeast by SE Nebraska Street. For analysis purposes the basin is divided into 12 existing 'mini-basins' as shown in **Figure ES-1**, and 10 hypothetical future mini-basins basins in unsewered areas. Mini-basins are defined as the area from which the collection system drains to a specified discharge point.

The County has established Urban Growth Area (UGA) boundaries, land use designations, and zoning in accordance with the GMA. Urban level services, including sewer service, are not allowed outside of the UGA with limited exceptions, one of which is within a Limited Area of More Intensive Rural Development (LAMIRD). In these areas, sewers are allowed for the development of necessary public facilities and public services. Manchester is recognized as a Type 1 LAMIRD under these regulations.

The County owns and maintains the sewer collection system that provides service primarily along the Puget Sound, with a small portion of the system extending inland in the middle of the LAMIRD. The system includes approximately 64,000 feet of gravity pipe, and approximately 16,200 feet of sewer force mains in the Manchester collection system. All sewer flows within the basin are conveyed and treated at the Manchester WWTP.

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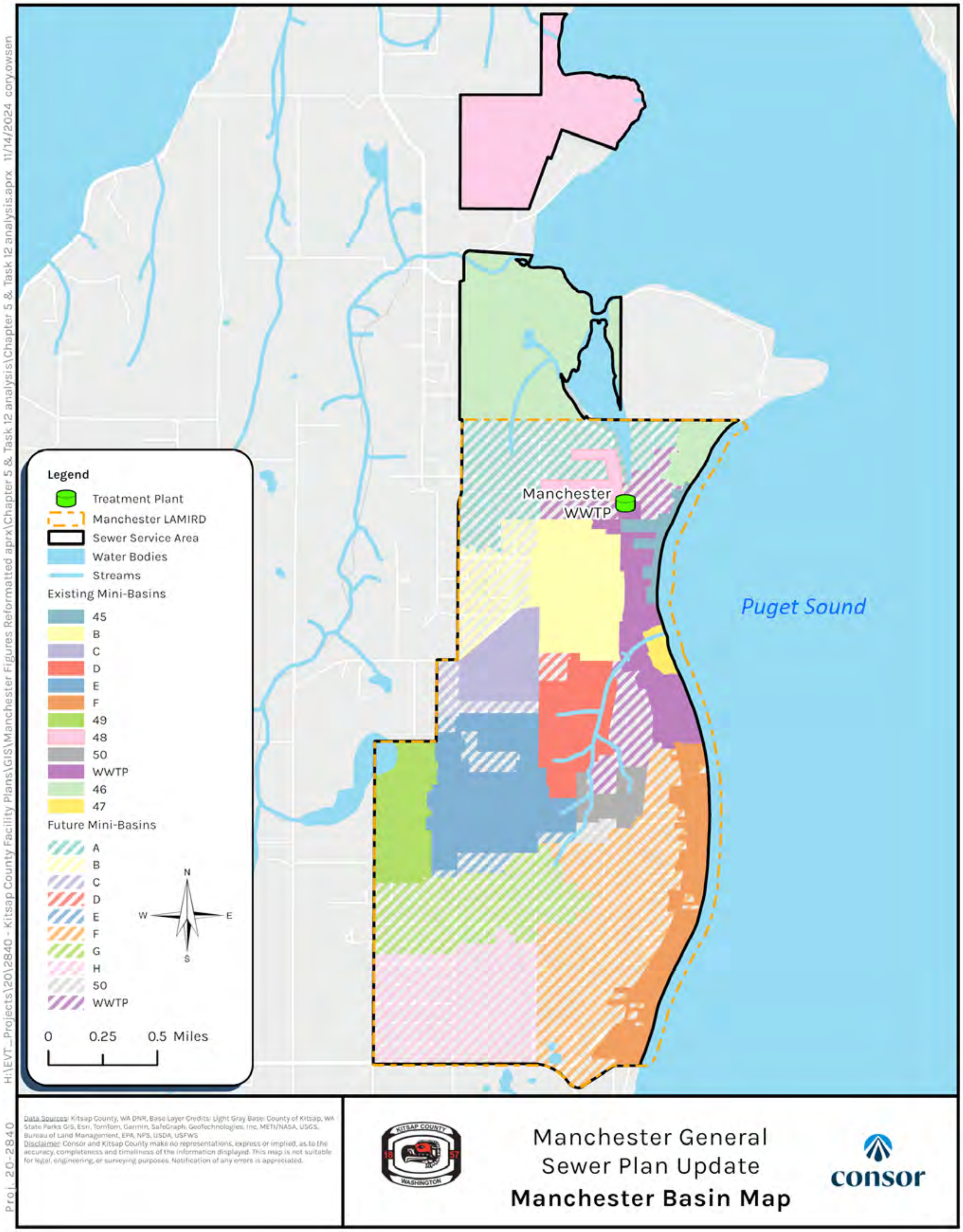
Figure ES-1 | Manchester Basin Map



ES.3 Population, Flow, and Load Projections

Current population and population growth are critical factors when considering required capacity and potential upgrades to the sewer system since sewer flows and population are closely linked.

The current sewered population in the Manchester basin was estimated based on an average of 2.5 people per equivalent residential unit (ERU). An ERU is a system specific unit of measure used to estimate wastewater volumes in the system based on the flow produced by an average single-family household.

Growth is presumed to occur within the LAMIRD according to the land use designations and zoning in the 2016 KCCP, which the County is in the process of updating. This plan, at the time of writing, is in alignment with the County's 2024 KCCP effort and is able to support the growth strategies described therein. The sewered population from the 2014 Plan was selected as the basis for the Manchester WWTP flow and load projections to provide a conservative estimate. Based on the estimated sewered population and population growth rate, the current and projected population for the sewer areas in Manchester basin are summarized in **Table ES-2**. Additionally, the Kitsap County Department of Community Development (DCD) prepared population projections as part of their update to the KCCP. These were compared to and are consistent with the projections presented in this Plan.

Table ES-2 | Manchester WWTP Current and Projected Sewered Population

Year	Sewered Population
2020	2,613
2028	3,399
2042	4,774
2044	4,971*

Note:
*Extrapolated from 2042 population

Wastewater flows and loadings heavily influence WWTP facility design. Consequently, data related to wastewater characteristics and projected flows and loadings affect the selection of key criteria used to select project alternatives for further consideration. The current flows and loads were evaluated using Discharge Monitoring Reports (DMRs) from January 2018 through June 2020. The projected flows and loads were estimated based on the current flows and anticipated population growth rate. The current and projected flows and loads for the Manchester WWTP over the planning horizon is presented in **Table ES-3** and **Table ES-4**. Consistent with Ecology guidelines, flows are developed for average annual flow (AAF), maximum month wet weather flow (MMWWF), maximum month dry weather flow (MMDWF), peak day flow (PDF), and peak hour flow (PHF). Loads are developed for biological oxygen demand (BOD), total suspended solids (TSS), and total Kjeldahl nitrogen (TKN).

Table ES-3 | Manchester WWTP Current and Projected Flows

Flow Event	2020	2028	2042
AAF (MGD)	0.19	0.24	0.34
MMWWF (MGD)	0.31	0.40	0.57
MMDWF (MGD)	0.20	0.26	0.37
PDF (MGD)	0.71	0.93	1.30
PHF (MGD)	1.00	1.30	1.84

MGD = million gallons per day

Table ES-4 | Manchester WWTP Current and Projected Loads

Parameter	2020			2028			2042		
	AAF	MMWWF	MMDWF	AAF	MMWWF	MMDWF	AAF	MMWWF	MMDWF
BOD (ppd)	356	423	473	462	549	615	650	772	864
TSS (ppd)	373	462	554	485	601	720	682	844	1,012
TKN (ppd)	69.3	77.4	113	90.1	101	147	127	141	207

ppd= pounds per day

ES.4 Regulatory Requirements

Collection, conveyance, and treatment facilities operation, design, and construction are regulated through federal, state, County, and local regulations. The regulations are detailed in **Section 4**.

The current Manchester WWTP National Pollutant Discharge Elimination System (NPDES) Permit, No. WA0023701, went into effect in 2018 and was set to expire in 2023, but has been administratively continued, and remains in effect as of the date of this Plan. The permit includes limits on plant capacity and treated effluent discharge, solids disposal requirements, monitoring requirements, recordkeeping and reporting criteria, and O&M requirements.

In addition, Ecology recently issued the first Puget Sound Nutrient General Permit (PSNGP), effective as of Jan. 1, 2022. The Manchester WWTP is classified as a small total inorganic nitrogen (TIN) load plant and is required to implement nutrient monitoring and reporting, develop a nutrient optimization plan, prepare and submit an all known and reasonable methods of prevention, control, and treatment (AKART). Ensuring compliance with the new PSNGP and developing options for anticipated future nutrient permit requirements is a key focus of the Manchester WWTP condition assessment and alternative analysis.

ES.5 Collection and Conveyance Existing Conditions

The Manchester C&C system is comprised of sewer assets owned by the County within the Manchester LAMIRD and upstream of the Manchester WWTP. The Manchester C&C system with sewered mini-basins is shown in **Figure ES-2**. A detailed review of the existing C&C system is provided in **Section 5**.

The sewage flows are routed through pump stations to the Manchester WWTP. Effluent from the WWTP is conveyed via a 12-inch diameter gravity main to Rich Passage where it discharges. The Manchester basin currently contains 12 sewered mini-basins; one for each of the seven pump stations, one for the Manchester WWTP, and four others for regions served by gravity sewers. Additionally, there are over 100 individual pump stations within the Manchester Basin, the majority of which are located along the coastline.

There is approximately 64,000 feet of gravity pipe in the Manchester collection system, all of which is county owned. There are approximately 16,200 feet of sewer force mains in the collection system that convey wastewater to downstream gravity conveyance piping and directly to the Manchester WWTP.

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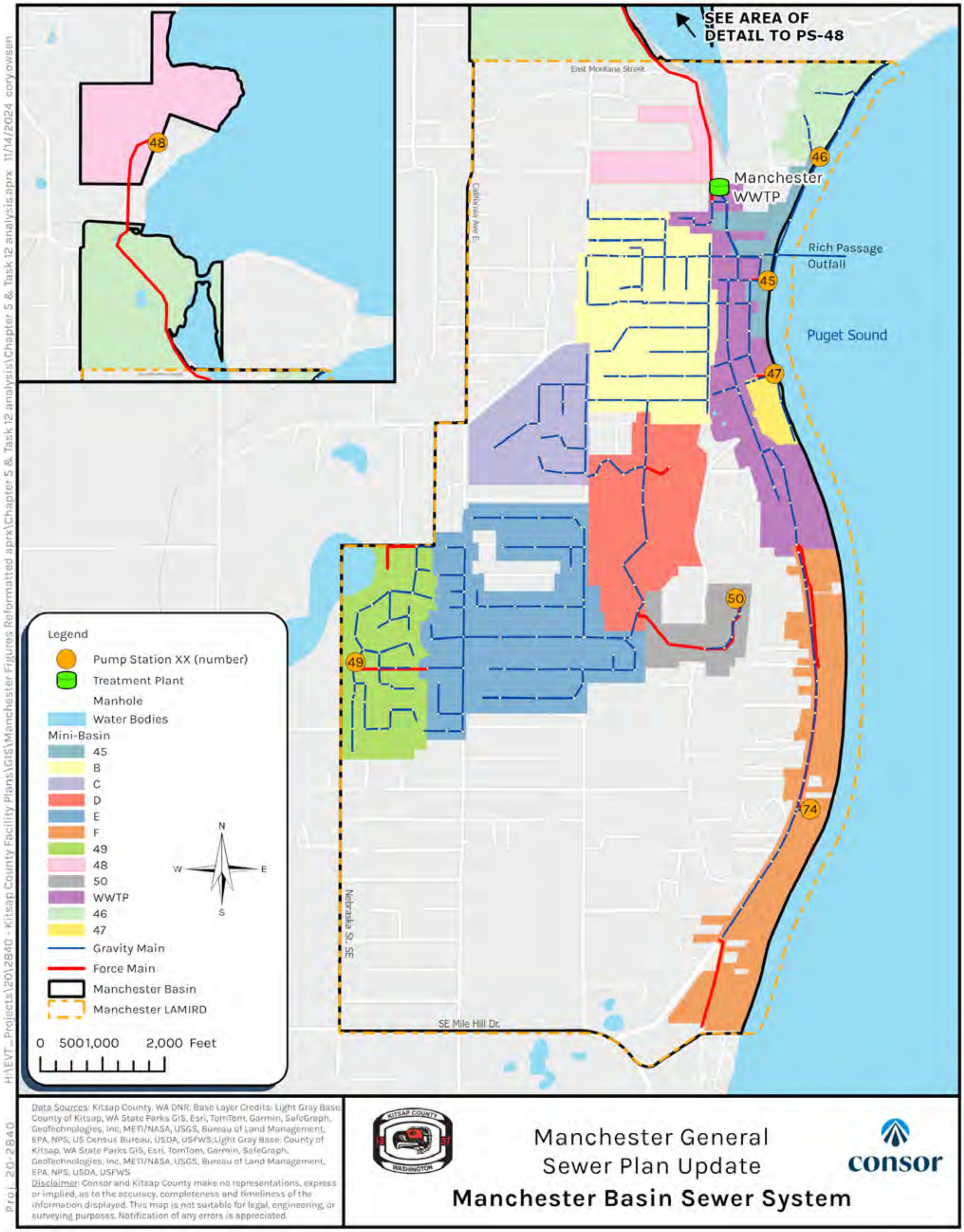
Figure ES-2 | Manchester Basin Sewer System



There are seven pump stations within the Manchester sewer system: PS-45, 46, 47, 48, 49, 50, and 74. The firm capacity ranges from 150 gallons per minute (gpm) at PS-50 to 669 gpm at PS-48. Additionally, there is a plant influent pump station at the WWTP that is discussed in the Wastewater Treatment Facilities sections. The County classifies their pump stations as Critical, Regional, Relay, or Satellite pump stations based on how many mini-basins (or upstream pump stations) discharge into the pump station. **Table ES-5** shows the classification and number of pump stations in the Manchester basin. Most of the pump stations in the system have a capacity of about 200 gpm.

Table ES-5 | Pump Station Type Consequence of Failure Definitions

Pump Station Type (from County)	Tributary Pump Stations	Number of Pump Stations in Manchester Basin
Satellite	0	6
Relay	1	0
Regional	2-3	1
Critical	4+	0

The County has conducted pipeline condition assessments through video observation with the ability to examine the entire conveyance system in a 5-year cycle. This process entails inspecting pipes via closed circuit television (CCTV), storing the video in a database, reviewing the video, and assigning an overall condition index (OCI) score based on the observations. The OCI score ranges from 0 to 100 with higher numbers indicating better condition.

The criteria that are scored for the OCI score are:

- Obstruction or Intrusion
- Worn Surface
- Belly or Sag in Pipe
- Crack or Fracture
- Break or Failure
- Lining or Repair Failure
- Joint Separation or Offset

The lengths of pipe in each OCI range are summarized in **Table ES-6**. Overall, the system is in good condition and with only one segment of pipe rated as moderate or severe condition.

Table ES-6 | Summary of Pipes OCI Scores

OCI Range	Length (ft)	Percentage of Total
0-20	-	0%
20-40	-	0%
40-60	-	0%
60-80	225	<1%
80-99	7,369	12%
100	63,955	94%

ES.6 Wastewater Treatment Facilities Existing Conditions

The Manchester WWTP was originally constructed in 1969 and after a series of upgrades was converted to a conventional activated sludge treatment system in 1998 with a plant capacity of 0.46 MGD. The

Manchester WWTP site plan is shown in **Figure ES-3**. The plant is located at the corner of Beach Drive E and E Caraway Road. There is a small amount of undeveloped area on the County owned property, which is bounded on the east and south sides by residential homes.

The plant has an influent pump station, headworks, two aeration basins, two secondary clarifiers, ultraviolet (UV) disinfection, and sludge storage and thickening. Treated effluent is discharged to the Rich Passage of the Puget Sound in accordance with the NPDES Permit. Biosolids are thickened using a gravity belt thickener (GBT) and hauled to the Central Kitsap WWTP for treatment.

An evaluation of Manchester WWTP was conducted that consisted of a site review of equipment, facilities, and processes, as well as discussions with WWTP staff to understand operational issues. Overall unit process "asset health" scores were developed to synthesize the likelihood of failure (condition) and consequence of failure (criticality) doe different components of the WWTP. Each criterion is rated on a 1 to 5 scale where higher numbers indicate worse condition and high criticality, then the scores are multiplied together to get the overall asset health score (potential range from 1 to 25). Secondary treatment and power distribution components scored higher than 10, which indicates these systems are generally in poor condition and require upgrades and/or rehabilitation to continue effective and reliable operation. The Civil component is in good condition and scored below 5. The rest of the unit processes, including Influent Pumping, Preliminary Treatment, Disinfection and Effluent, Solids Treatment and Support Systems all scored between 5 and 10, indicating moderate upgrades may be necessary.

A Visual Hydraulics© model was created to determine the hydraulic capacity and a Biowin© biological process model was used to evaluate the biological capacity of the existing WWTP unit processes. Model results indicated that all unit processes generally have sufficient hydraulic and biological capacity to handle existing and future flow and loads to meet current permit requirements, except for some portions of the secondary treatment piping that will need to be replaced with larger pipe.

Figure ES-3 | Existing Manchester WWTP Site Plan

ES.7 Collection and Conveyance System Analysis

A C&C system hydraulic analysis was not performed as a part this Plan. **Appendix H** is Chapter 5 from the 2014 Plan by BHC and includes a summary of the analysis performed at that time. Suggested improvements and the C&C CIP items, less those implemented between 2014 and 2024, are taken from the 2014 Plan. The collection and conveyance modeling and analysis completed as part of the 2014 plan was deemed adequate by the County for the development of this plan.

ES.8 Wastewater Treatment System Analysis

The results from the WWTP Existing Conditions analysis were used to identify processes that require improvement and define feasible alternatives for WWTP improvements for the 6-year and 20-year planning horizons. Minor maintenance, repairs, and direct replacements identified in the condition assessment are briefly discussed but not subject to a full alternatives analysis.

Influent Pumping and Preliminary Treatment

The influent pump station is in good condition and the pumps were replaced in 2015, so no improvements are needed. The preliminary treatment processes were constructed in 1998 and are generally in fair condition, but equipment will need replacement as it reaches the end of its expected service life. Recommended improvements include:

- Plan for mechanical equipment replacement at the end of the expected service life.
- Add a level sensor to the Parshall flume to provide flow monitoring.

Secondary Treatment

The secondary treatment system was constructed in 1998 and the condition of equipment varies with some components in good condition and others in poor condition. Additionally, some portions of the system will reach capacity limitations within the planning period. Recommended improvements include:

- Replace the mixed liquor (ML) pipes to and from the aeration basins with larger pipes to increase hydraulic capacity
- Replace the existing jet aeration system with a new system including new blowers and fine bubble diffusers and add dissolved oxygen (DO) and ammonia/nitrate probes to improve process control.
- General maintenance on the secondary clarifiers.
- As flows approach 2042 conditions, clarifier capacity should be evaluated.

Disinfection

The UV equipment was installed in 1998 and is an older, basic model that is reaching the end of its expected lifespan. Additional control and monitoring capabilities beyond what the current basic controller can offer is desired by the plant staff and will improve energy efficiency. Recommended improvements include:

- Replace the UV system with the upgraded Trojan UV3000Plus system.

Solids Treatment

The solids treatment processes were constructed in 1998 and are generally in good condition, with only minor upgrades and repairs needed. Recommended improvements include:

- Maintenance of the heating, ventilation, and air conditioning (HVAC) system in the GBT room to fix ventilation, address corrosion, and repair sensors.
- Replace sludge tank blowers in the next 12 to 15 years.
- Replace waste activated sludge (WAS) and thickened waste activated sludge (TWAS) storage tank lower explosive limit (LEL) sensors.

Odor Control

The odor control system is only partially operational and does not have adequate monitoring and control. Recommended improvements include:

- Replace the existing chemical scrubber with an activated carbon scrubber.

Non-Potable Water, Process Water, and Power Distribution Systems

Plant support systems are in good or fair condition and will require replacement as equipment reaches the end of its expected service life. Recommended improvements include:

- Equipment related to these systems will require in-kind replacements as they reach the end of their expected service life.

ES.9 Recycled Water

Recycling treated wastewater can provide numerous benefits, including conservation of limited groundwater resources, reduction of effluent discharge to the Puget Sound, and replenishment of streams and fish habitat. Use of recycled water to replace the use of potable water for non-potable purposes, such as irrigation, toilet flushing, reduces the stress on area groundwater and supports sustainable management of that limited resource. A review of potential uses of recycled water in the Manchester service area was conducted. The County coordinated with water providers and other potential stakeholders to determine if there are opportunities for irrigation of turf and landscaped areas or other recycled water uses in the vicinity of the Manchester WWTP. Entities contacted were:

- Manchester Water District: District staff indicated that there may be potential opportunities, though limited, to use recycled wastewater for irrigation uses in proximity to the Manchester WWTP.
- Environmental Protection Agency (EPA) Region 10 Manchester Environmental Laboratory: The Sustainability Coordinator for Region 10 noted that, although the site is not currently irrigated, they have no plans to modify. No other practical or sizeable uses for recycled water were identified.
- Kitsap County Parks Department: A discussion was held with County Parks Department staff, and it was determined that there are no sites where recycled water use would be cost-effective.
- United States Manchester Naval Fuel Depot: In communication with the facility's Deputy Director, it was determined that the non-potable uses of water at the facility are not likely sizeable enough

to warrant consideration for conversion to recycled water. All other water used at the facility is minimal.

- National Oceanic and Atmospheric Administration (NOAA) Northwest Fisheries Research Station: No successful connections with staff were made by the time this Plan was prepared. Further discussion with the facility is required to identify recycled water applications.

Based on locations of irrigable areas and relatively small amount of water consumption, there are no sites where recycled water use would be cost-effective.

ES.10 Operations and Maintenance

Section 10 includes a summary of the O&M programs for the C&C system, and the Manchester WWTP. A review of state and federal requirements that impact the County's O&M program are also included in Section 10.

The Sewer Utility Division consists of four main work groups: Utilities O&M (WWTPs and pump stations), Field Operations (collection system piping), Engineering and Administration, and Construction Management. A total of 72 staff work in the Sewer Utility Division and oversee O&M across each of the County's four wastewater systems. O&M activities include regular inspection of pump stations, cleaning and inspection of pipes, preventative maintenance of WWTP equipment, ongoing records management for all components of the system, and review and updates to the WWTPs O&M manual.

A staffing analysis was conducted for the C&C system and Manchester WWTP and determined that staffing levels and certifications are appropriate and adequate for current operations. No additional staff is expected to be required though the 20-year planning period.

Conclusions and recommendations based on a review of the County O&M practices are:

- Train and certify CCTV operators in National Association of Sewer Service Companies (NASSCO) assessment to improve the consistency of sewer inspecting rating.
- Review spare parts inventories and assess the need for additional spare parts due to supply chain challenges.
- Institute an annual valve exercising and maintenance program.
- Develop a training program to accelerate employees into Operator Certification Group III and prepare for anticipated Puget Sound Nutrient Reduction Goals and facility upgrades.
- Institute an Arc-Flash Analysis and Protection program to identify deficiencies that can be mitigated through coordinated CIP projects.

ES.11 Capital Improvement Plan

The CIP projects were developed to remedy existing system deficiencies, address regulatory requirements, and provide adequate capacity for projected flows and loads. CIP projects to address immediate needs are presented in a 6-year planning horizon (from 2023 to 2028) and future CIP projects are included in the 20-year planning horizon (from 2029 to 2042). A planning level cost opinion of CIP project implementation is provided. It is assumed that minor projects will be completed with O&M budget, therefore they are not included in the CIP. CIP projects for the 6-year and 20-year planning horizons are presented in Table ES-7,

Table ES-8, **Table ES-9**, and **Table ES-10**. The preliminary timeline to complete these improvements is included in **Section 11**.

Table ES-7 | 6-Year Manchester Collection and Conveyance Capital Improvement Projects

CIP No.	Item	Total Project Cost
CIP-M-CC-DEV-1[1]	Gravity Pipeline and Force Main from PS-A1 in Basin A (Beach Drive)	$0
	Total	**$0**

Note:
1. Project expected to be paid for by developers or through creation of a ULID.

Table ES-8 | 20-Year Manchester Collection and Conveyance Capital Improvement Projects

CIP No.	Item	Total Project Cost
CIP-M-CC-OM-2	Manchester WWTP Influent Pump Station Rehabilitation	$1,030,000
CIP-M-CC-OM-4	Pump Station 48 ,49 and 50 Rehabilitation	$6,200,000
CIP-M-CC-DEV-5[1]	Gravity Pipeline Expansion in Basin A	$0
CIP-M-CC-DEV-6[1]	Gravity Pipeline Expansion in Basin B	$0
CIP-M-CC-DEV-7[1]	Gravity Pipeline Expansion in Basin C	$0
CIP-M-CC-DEV-8[1]	Gravity Pipeline Expansion in Basin D	$0
CIP-M-CC-DEV-9[1]	Gravity Pipeline Expansion in Basin E	$0
CIP-M-CC-DEV-10[1]	Gravity Pipeline Expansion in Basin F	$0
CIP-M-CC-DEV-11[1]	Gravity Pipeline Expansion in Basin G	$0
CIP-M-CC-DEV-12[1]	Gravity Pipeline Expansion in Basin H	$0
CIP-M-CC-DEV-13[1]	Gravity Pipeline Expansion in Basin 50	$0
CIP-M-CC-DEV-14[1]	Gravity Pipeline Expansion in Basin WWTP	$0
CIP-M-CC-DEV-15[1]	Pump Station PS-A1	$0
CIP-M-CC-OM-16	20 Year Annual Pipe Replacement	$14,000,000
	Total	**$21,230,000**

Note:
1. Project expected to be paid for by developers or through creation of a ULID.

Table ES-9 | 6-Year Manchester WWTP Capital Improvement Projects

CIP No.	Item	Total Project Cost
CIP-M-WWTP-CAP-2	Upsize 10-inch Diameter ML Pipe and 12-inch Diameter Plant Effluent Pipes	$200,000
	Total	**$200,000**

Table ES-10 | 20-Year Manchester WWTP Capital Improvement Projects

CIP No.	Item	Total Project Cost
CIP-M-WWTP-REG-1[1]	Aeration System Optimization	$1,100,000
CIP-M-WWTP-OB-3[1]	Replace Plant Automatic Transfer Switch	$200,000
CIP-M-WWTP-OB-4[1]	Replace Odor Control System	$600,000
CIP-M-WWTP-OB-5[1]	Replace UV System	$1,100,000
CIP-M-WWTP-OB-6	Replace Clarifier Drives	$500,000

CIP No.	Item	Total Project Cost
CIP-M-WWTP-OB-7	Replace Electrical Service, Main Power Distribution, and MCC	$400,000
CIP-M-WWTP-OB-8	Replace Fine Screen	$800,000
CIP-M-WWTP-OB-9	Replace Grit Chamber, Pump, Cyclone, and Classifier	$700,000
CIP-M-WWTP-OB-10	Replace Thickening Equipment	$700,000
CIP-M-WWTP-OB-11	Replace Sludge Tank Blowers and Sludge Pumps	$400,000
CIP-M-WWTP-REG-12[2]	Biological Nutrient Removal	$1,930,000
CIP-M-WWTP-REG-13[2]	Enhanced Biological Nutrient Removal	$2,020,000
	Total	**$10,450,000**

Notes:
1. If funding becomes available, this project should be considered in the 6-year CIP.
2. Future nutrient requirements and timing are unknown. Based on the current permit cycle for the PSNGP, it is assumed that effluent TIN restrictions to values below 10 milligrams per liter (mg/L) will not be implemented until 2031 at the earliest.

ES. 12 Financial Strategy

Section 12 consists of the financial analysis performed by FCS group to develop a funding plan ("revenue requirement") for the County's sewer utility for the 2024 to 2042 planning horizon. The revenue requirement was identified based on operating and maintenance expenditures, fiscal policies, and the capital funding needs identified in Section 12.

The County sewer system has four basins, each with a treatment plant and corresponding collection system: Central Kitsap, Manchester, Suquamish, and Kingston. While a General Sewer Plan has been developed separately for each basin (this focus of this document is the Manchester basin), the County does not separate its sewer utility financial information by basin. As such, the information included in Section 12 refers to the County sewer utility as a whole, unless explicitly stated otherwise. The result of the analysis indicates that a Countywide rate adjustment of 6.31 percent for 2025 and 6 percent per year through the remaining forecast period would be sufficient to support the capital program.

SECTION 1

Introduction

1.1 Introduction

The Manchester service area is in Kitsap County (County), Washington on the west side of the Puget Sound. This General Sewer Plan Update (Plan) provides the County with a 20-year plan (2023 to 2042) for the Manchester basin sewer collection, conveyance, and wastewater treatment plant (WWTP) infrastructure. The Central Kitsap, Suquamish, and Kingston basins sewer systems are covered under separate Plans.

A Manchester basin vicinity map is shown in **Figure 1-1**. The current sewer service area is limited to the Manchester Limited Area of More Intensive Rural Development (LAMIRD) boundaries. There is no urban growth area (UGA) immediately adjacent to the LAMIRD. The total LAMIRD area is approximately 1.8 square miles. Manchester is primarily residential; an Environmental Protection Agency (EPA) lab and Naval Depot Station make up a large percentage of the commercial area.

The County owns, operates, and maintains the sewer facilities in the Manchester area. The system consists of approximately 64,000 feet of gravity pipe, 16,000 feet of force main pipe, seven pump stations (PS) and the Manchester WWTP.

The current sewered population in the basin was estimated by an analysis of sewer permits, indicating there are 1,045 equivalent residential units (ERUs) yielding a population of 2,613 people. The sewered population is expected to grow to 3,399 in 2028 and 4,774 in 2042.

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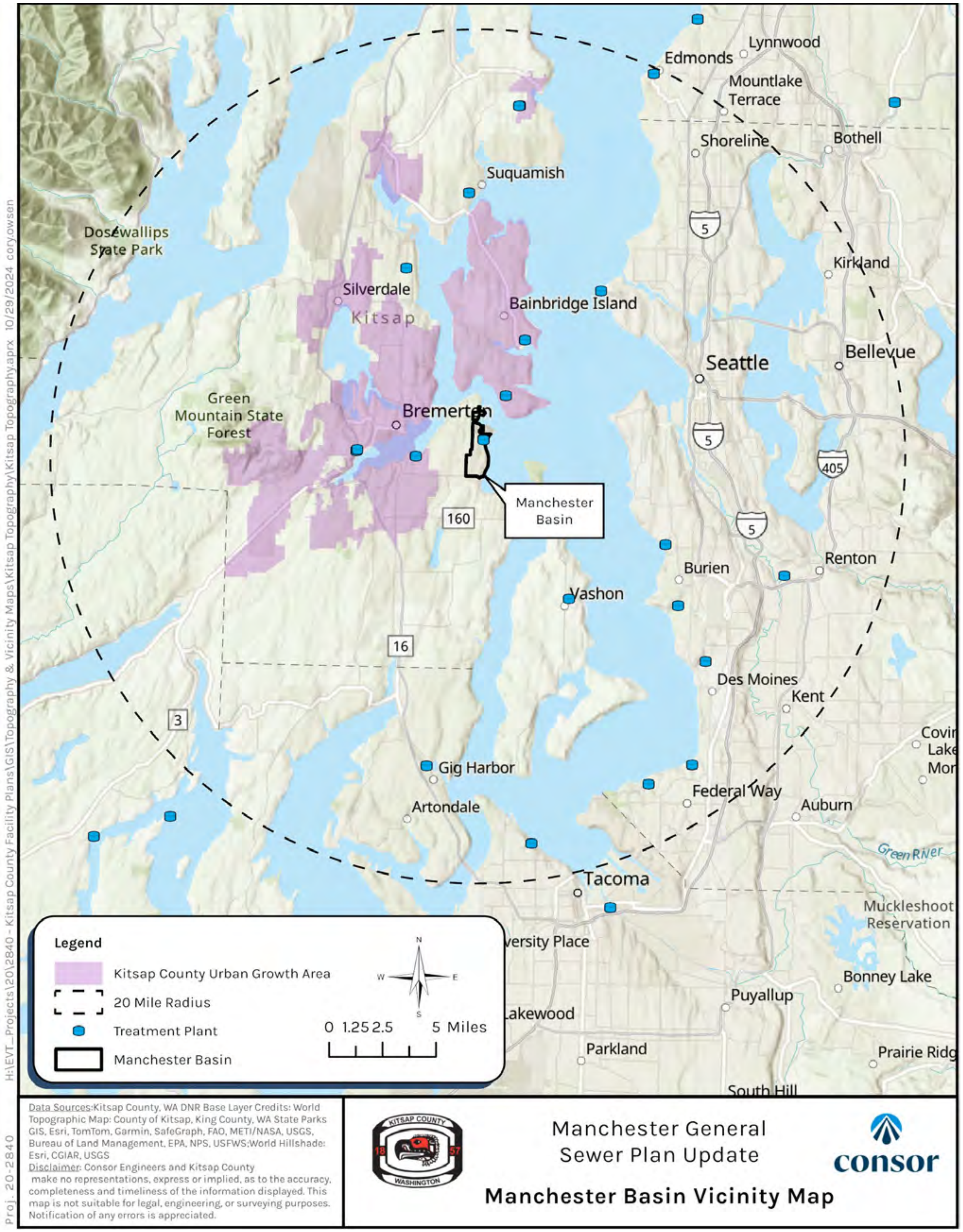
Figure 1-1 | Manchester Basin Vicinity Map



1.2 Purpose and Scope

This Plan evaluates the expected changes in the Manchester sewer service area, reports the existing condition of the collection system and WWTP, analyzes potential improvements to the system, and includes recommended and phased capital improvements that will provide service to the growing community over the planning horizon. The Plan was prepared to provide the County, the public, and regulatory agencies with information on the County's plans for maintaining, upgrading, and expanding the system. The Plan provides the roadmap for the County to continue to provide high quality service to its customers while protecting environmental quality. The Plan complies with the Washington State Department of Ecology (Ecology) regulations for general sewer plan (Washington Administrative Code [WAC] 173-240-050).

This Plan is based on planning horizons of a six-year period, 2023 to 2028, and a 20-year period, 2029 to 2042. The Plan lays out a strategy to provide wastewater services that accommodate population growth, comply with environmental regulations and permits, assess existing conditions, and maintain collection/conveyance system and treatment plant reliability and longevity. The population projections are in line with those developed by the Kitsap County Department of Community Development (DCD) over the 2044 planning horizon, which corresponds to the most recent Kitsap County Comprehensive Plan (KCCP) update. The recommendations presented here were made with consideration of the benefits of long-term investments that will continue to serve the community beyond the 20-year planning horizon.

Consor was contracted by the County in April 2020 and January 2024 to prepare the Plan and worked with the County to develop the Scope of Work.

1.3 Background

The County owns and operates the Manchester wastewater system that consists of a collection and conveyance (C&C) system, seven pump stations, and the Manchester WWTP with an outfall in the Rich Passage in the Puget Sound. The Manchester sewer system was first established in 1969 by Sewer District 3 and was financed and built by a Utility Local Improvement District (ULID). Ownership of the system was transferred to the County in 1976. The County continues to own, operate, and maintain the sewer facilities. PS-45, PS-46, and PS-47 were upgraded in 2017, and PS-74 was constructed in 2018 to support expansion of the sewer system and new development.

The system now serves approximately 1.8 square miles of residential and commercial customers within the LAMIRD boundary. While there is industry in Manchester, there is no industrial sewage discharged into the sewer system. The Manchester Naval Fuel Depot has a separate treatment plant for their industrial water and only sends domestic sewage from the land-based and ship facilities to the sewer system. The sewer system is separate from the stormwater system and consists of gravity sewers, pump stations, and individual pump stations. Some properties within the service area have on-site septic systems that are not connected to the collection system.

The ManchesterWWTP was originally constructed in 1969 and upgraded in 1991 and 1998. The liquids treatment processes in the WWTP include influent pump station, headworks with screening and grit removal, two aeration basins, two secondary clarifiers and ultraviolet (UV) disinfection. Sludge removed from the secondary clarifiers is thickened with a gravity belt thickener (GBT) and transported to the County's Central Kitsap WWTP for further treatment and disposal. The County operates the Manchester WWTP under National Pollutant Discharge Elimination System (NPDES) Permit WA-002370-1 that was most recently renewed on March 1, 2018. The NPDES Permit expired on February 28, 2023. The County has submitted the permit renewal application. The current permit was administratively continued and remains in effect as of this writing.

The County has prepared several sewerage planning documents since the 1960s. The last plan for the Manchester area was Manchester Sewer Facilities Strategy Plan (2014 Plan) (BHC Consultants, 2014). Since then, the Manchester area, and the County as a whole, has grown substantially. With this growth, the need for a renewed evaluation of sewer service to the entire County became increasingly apparent. This Plan presents the findings and recommendations for the Manchester basin sewer facilities.

1.4 General Sewer Plan Requirements

The Federal Water Pollution Control Act (FWPCA) established the requirement for a Water Quality Management Plan. Resultantly, Revised Code of Washington (RCW) 90.71 established the need for a Puget Sound Water Quality Management Plan. The stated objective of this plan is to protect and restore Puget Sound through effective coordination among governments and private interests, and through use of an adaptive management approach.

This Plan is prepared for the County to fulfill the requirements of Chapter 173-240-050 of the WAC, Chapter 90.48 of the RCW, and RCW 36.70A (Growth Management Act). The Plan provides the County with a comprehensive guide for managing and operating the sewer system and coordinating expansions and upgrades to the infrastructure through buildout. The Plan serves as a guide for policy development and decision-making processes for the County. The WAC requirements are outlined in **Table 1-1**.

Table 1-1 | General Sewer Plan Requirements per WAC 173-240-050

WAC Reference Paragraph	Description of Requirement	Location in Document
3a	Purpose and need for proposed plan	Section 1.2
3b	Who owns, operates, and maintains system	Section 1.5
3c	Existing and proposed service boundaries	Figure 2-1
3d	Layout map showing boundaries; existing sewers; proposed sewers; existing and proposed pump stations and force mains; topography and elevations; streams, lakes, and other water bodies; water systems	Figure 2-1, Figure 2-2, Figure 2-4, Figure 2-5, Section 5, Section 6, Section 7, and Section 11
3e	Population trends	Section 3
3f	Existing domestic and/or industrial wastewater facilities within 20 miles	Figure 1-1
3g	Infiltration and inflow (I&I) problems	Section 3.4.3
3h	Treatment systems and adequacy of such treatment	Section 6
3i	Identify industrial water sources	Section 4
3j	Discussion of public and private wells	Figure 2-5
3k	Discussion of alternatives	Section 7 and Section 8
3l	Define construction cost and O&M costs	Section 10, Section 11, and Section 12
3m	Compliance with water quality management plan	Section 4
3n	SEPA compliance	Section 4

1.5 Ownership and Management

The sewer system was first established in 1969 by Sewer District 3 and was financed and built by a ULID. Ownership of the system was transferred to the County in 1976. The County continues to own, operate and maintain the sewer facilities in Manchester.

The County's Sewer Utility Division (Utility) under the Department of Public Works is solely funded through fees from sewer ratepayers. The Utility does not receive funds from County tax revenue and cannot provide any financial assistance to other public works divisions or County departments. These revenues must provide for future capital improvements and cover the maintenance, operation, and replacement of sewer systems.

The operations and maintenance (O&M) of both the sewer collection system and the County’s four WWTPs is provided by the Utility. The Utility consists of four main work groups:

- Utilities O&M (Plant and Pump Station).
- Field Operations (Collections System).
- Engineering and Administration.
- Construction Management.

The Utilities Operation Group is responsible for running the WWTPs and laboratory. The Utilities Maintenance Group is responsible for maintaining the equipment associated with WWTPs and pump stations. The Field Operations Group is responsible to maintain, repair, replace, clean, and inspect the sewer utilities collection systems. The Engineering Group manages the design of capital work. The Administration Group manages the geographic information system (GIS) database and provides review efforts for Developer proposed projects. The Construction Management Group manages the delivery of capital work.

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SECTION 2

Service Area Characterization

2.1 Introduction

The Manchester wastewater system study area characteristics including geography, topography, water resources, general soil conditions, critical areas, endangered species habitats, the water supply system, and zoning designations are described in Section 2.

2.2 Growth Management Act

The State of Washington adopted the Growth Management Act (GMA) with the intent of concentrating most new development and population growth within the urban areas of the more populous and rapidly growing counties. State and local governments are required to define a UGA boundary within which urban services like sewers are provided, and any new parcels created outside that boundary must be at a very low density with sufficient acreage to support on-site sewage disposal systems conforming to Washington State Department of Health (DOH) regulations.

The following exceptions to the prohibitions of sewers outside the UGA are recognized under state law (per RCW 36.70A.110(4), RCW 36.70A.070(5)(d), and WAC 365-196-320(1)(c)):

- Public schools outside the UGA can be served by sewers but are not required to be served.
- Areas of existing development outside the UGA where sufficient on-site sewage disposal systems have failed as to create a "severe public health hazard" can be served by sewers.
- Areas can be defined as a LAMIRD, within which the development of necessary public facilities and public services, such as sewer, is allowed.

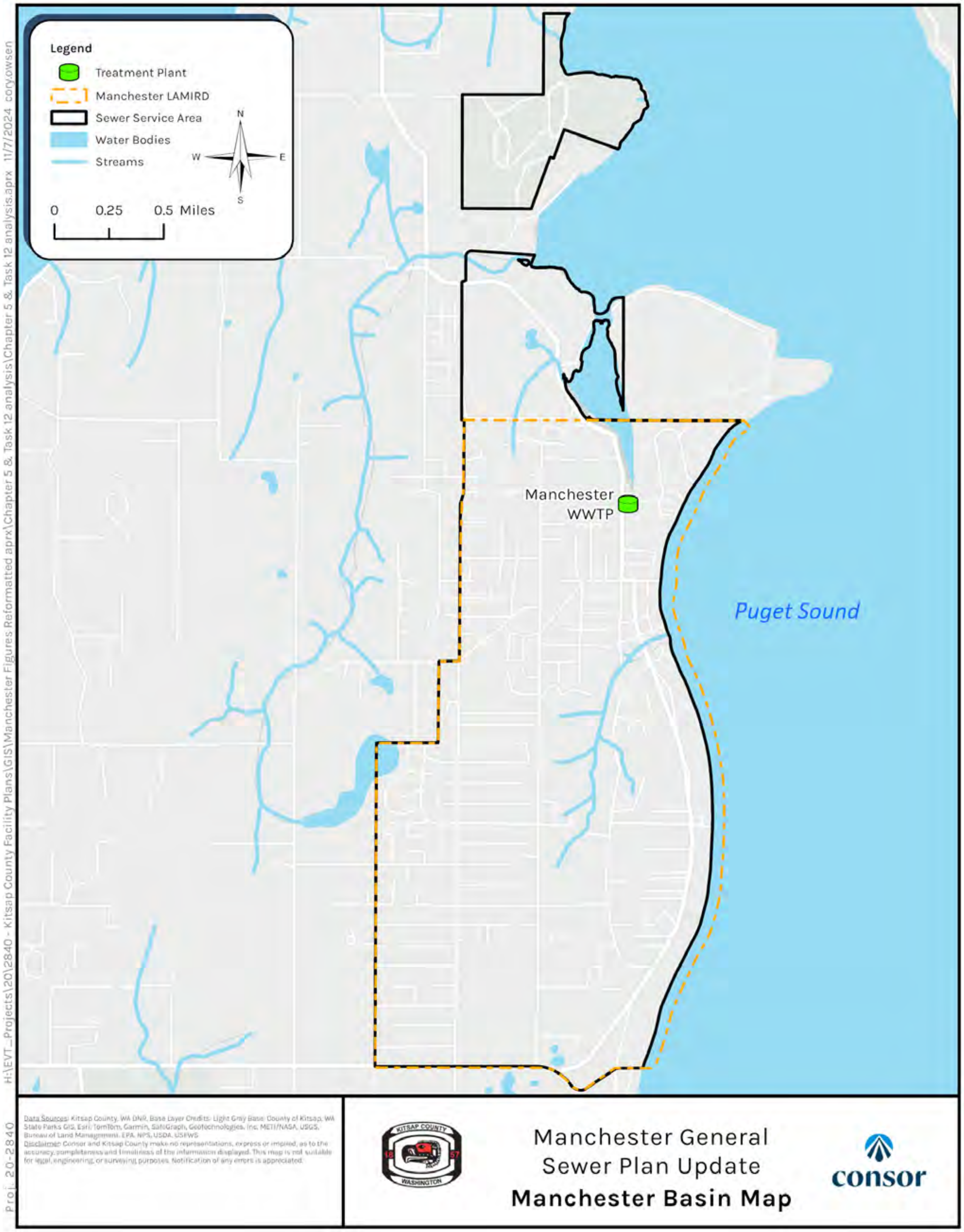
Sewers provided in these cases can be satellite systems limited to serving just the qualified and defined parcels, or a sewer extension can be 'tight-lined' to convey wastewater from the qualified and defined parcels into the UGA for connection to an existing sewer system.

Because these services and urban development are not otherwise allowed in rural areas, specific criteria must be met to establish the logical boundary of a LAMIRD and limit new patterns of low-density sprawl. Manchester is recognized as a Type 1 LAMIRD under these regulations. Therefore, it is highly unlikely that the boundary and the zoning within Manchester will change within the planning horizon for this Plan.

2.3 Service Area

The current sewer service area is limited to the Manchester LAMIRD boundaries. There is no UGA immediately adjacent to the LAMIRD. The total LAMIRD area is approximately 1.8 square miles and is bounded to the east by the Puget Sound and the south by Southeast Mile Hill Drive. The LAMIRD extends to just north of E Montana Street in the north and to California Avenue E in the northeast and SE Nebraska Street in the southeast. The LAMIRD boundaries are presented in Figure 2-1.

Figure 2-1 | Manchester Basin Map



2.3.1 Topography

The topography of Manchester generally slopes downhill from west to east approximately 5 to 10 percent. The eastern side of the LAMIRD is bound by the Puget Sound, and the high point elevation on the west side is approximately 350 feet. Basin topography is shown in **Figure 2-2**.

2.3.2 Water Resources

Immediately west of Manchester, Beaver Creek flows north and discharges into Clam Bay. Beaver Creek appears on Ecology's Category 5 Water Quality Assessment list [303(d)] for impaired water bodies. Also, Puget Sound, immediately east of downtown Manchester, appears on the Category 5 DOE listing.

The Kitsap Department of Public Health (KPDH) developed the Pollution Identification and Correction (PIC) program to prioritize and address fecal pollution problem areas in the County. Problem areas are thoroughly assessed for land uses and ranked by water quality data and public accessibility. Water quality monitoring and door-to-door PIC inspections are conducted in high priority areas, such as Yukon Harbor, to identify and correct fecal pollution sources. PIC inspectors provide free technical assistance to guide property owners through the process of correcting identified pollution sources. The inspection is designed to help property owners and residents prevent fecal pollution and get the great life possible from their septic investment. Through these site visits, KPDH has identified and repaired several failing septic systems. Sewers are the preferred method of wastewater collection in Manchester, since it minimizes the risk of public health issues associated with ageing septic systems.

2.3.3 Puget Sound Water Quality Management Plan

The FWPCA established the requirement for a Water Quality Management Plan. Resultantly, RCW 90.71 established the need for a Puget Sound Water Quality Management Plan. The stated objective of this plan is to protect and restore Puget Sound through effective coordination among governments and private interests, and through use of an adaptive management approach. This Plan is consistent with the intended goals of the Water Quality Management Plan.

2.3.4 Geology

The primary soil type in the Manchester WWTP area is McKenna gravelly loam. This soil is poorly drained and has a depth to compact glacial till ranging from 30 to 40 inches. Permeability of this soil is slow above the compact glacial till and very slow in the compact glacial till. This soil is found on uplands in low lying depressions and along drainageways and formed in glacial till.

The secondary soil type in the Manchester WWTP area is Kapowsin variant gravelly clay loam. This soil is moderately well drained and has a depth to hardpan of 20 to 35 inches. The permeability of this soil is moderately slow above the hardpan and very slow through the hardpan. This soil is found on terraces and formed in thin lacustrine sediment over glacial till.

The soils distribution in the Manchester basin is shown in **Figure 2-3**.

2.3.5 Critical Areas

Critical areas are located throughout the Manchester Basin, as shown on **Figure 2-4**. The critical areas consist of wetlands which were identified from the Department of Natural Resources (DNR) 2000 Hydrology data set, the National Wetlands Inventory data set, and survey delineated wetlands from the County's parcel maps.

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Figure 2-2 | Manchester Topography Map

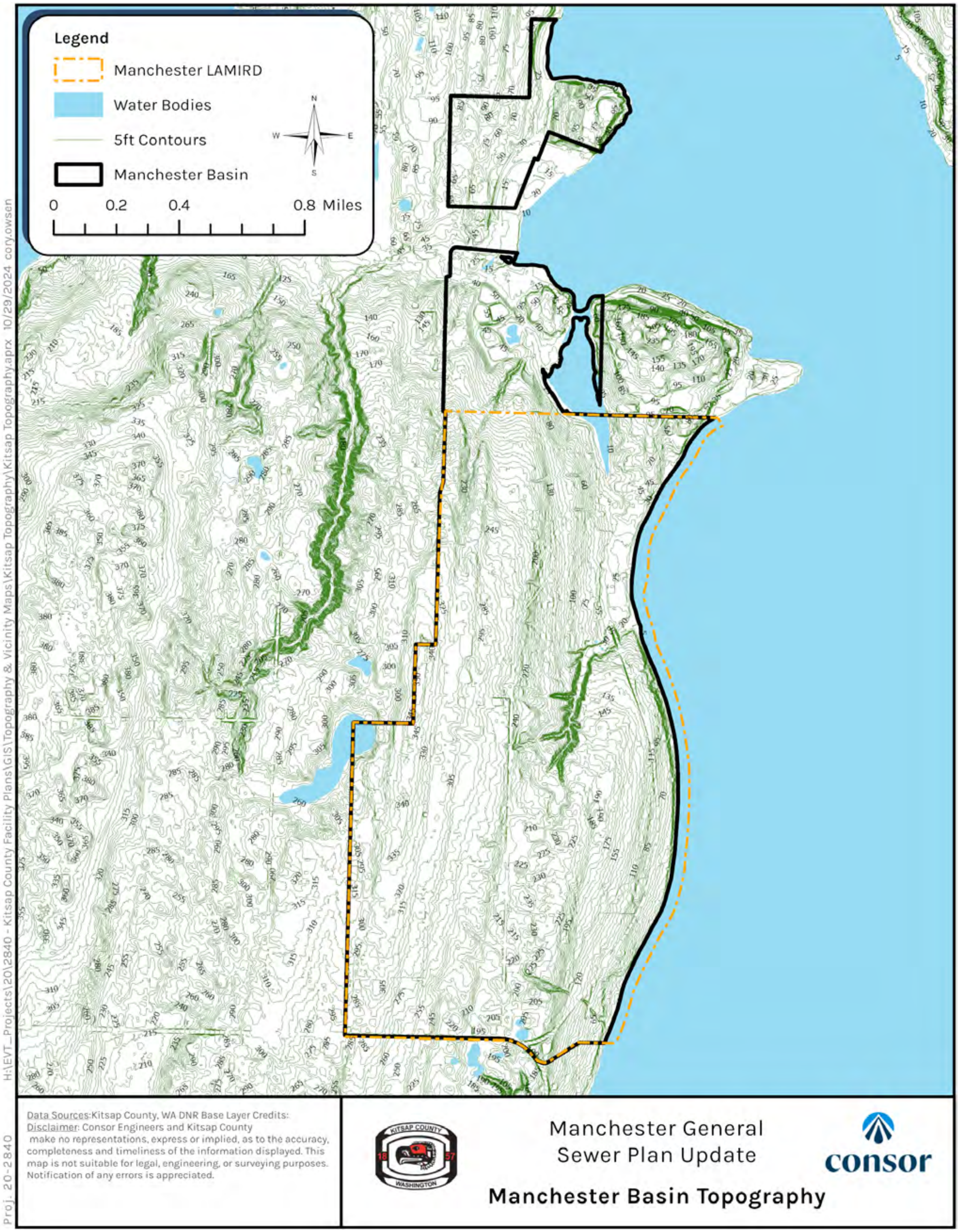


Figure 2-3 | Manchester Soils Distribution

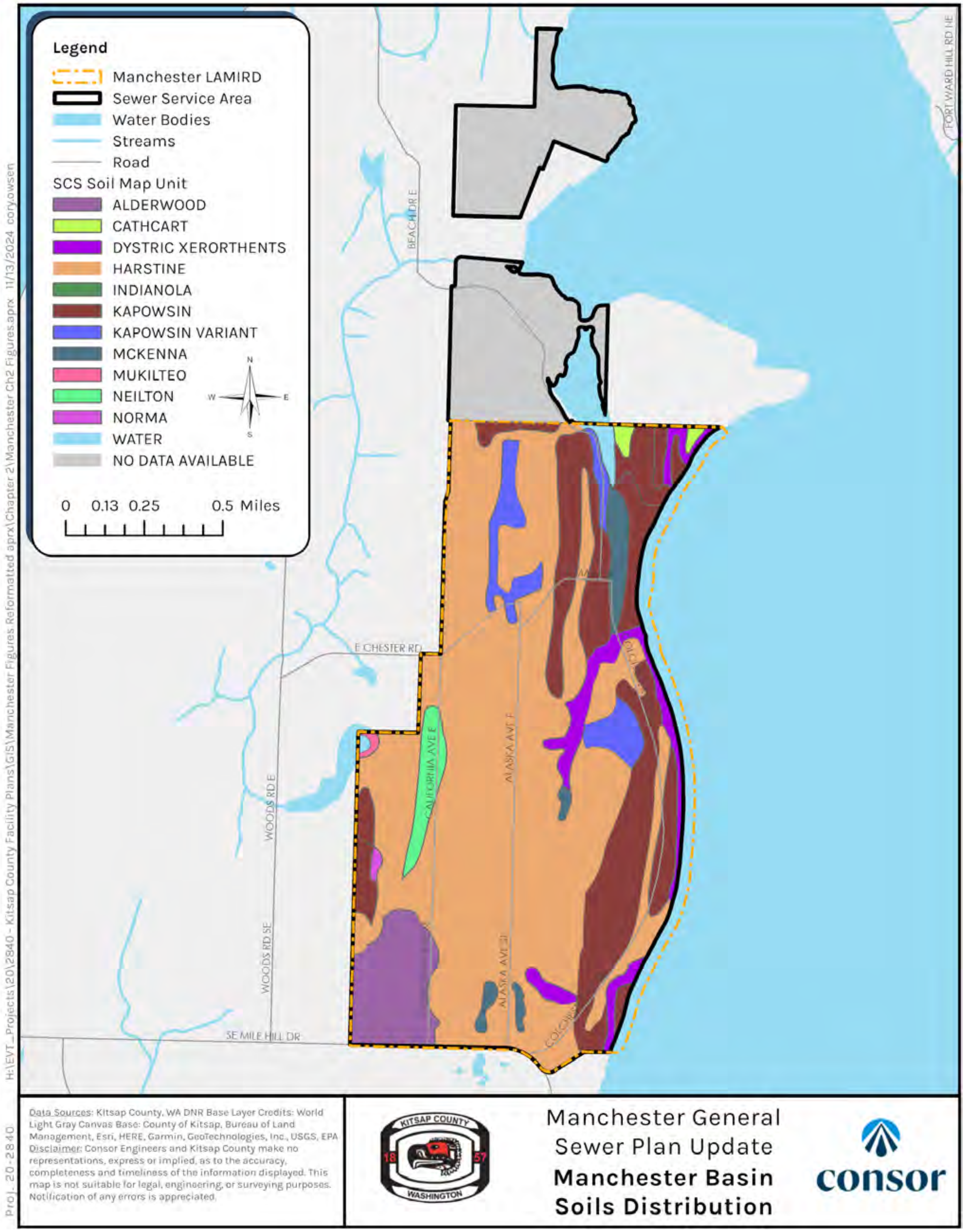
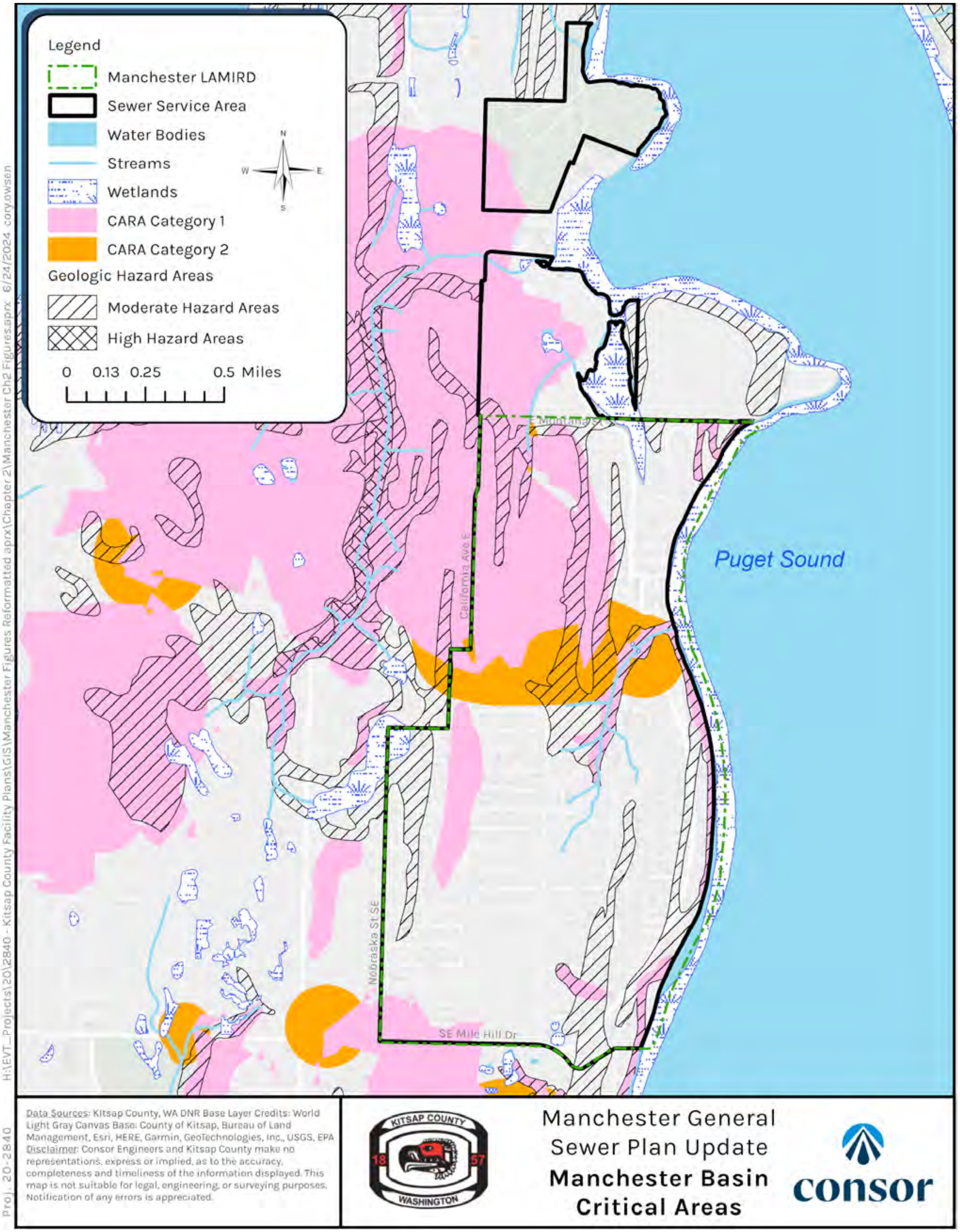


Figure 2-4 | Manchester Critical Areas



The Critical Aquifer Recharge Areas (CARA) shown on the map are separated into Category 1 and Category 2 areas. Category 1 is defined as areas where the potential for certain land use activities to adversely affect groundwater is high. Category 2 is defined as areas that provide recharge effects to aquifers that are current or potentially will become potable water supplies and are vulnerable to contamination based on the type of land use activity.

Geologic hazard areas are shown on the map and are categorized as areas of high concern and high hazard areas. High hazard areas are defined as areas with slopes greater than 30 percent and mapped by the Coastal Zone Atlas or Quaternary Geology and Stratigraphy of the County as unstable (U), unstable old landslides (UOS), or unstable recent slides (URS). Areas of concern are classified similar to the high hazard areas but with slopes between 15 percent and 30 percent and also include areas that are classified as highly erodible or potentially highly erodible, and seismic areas subject to liquefaction.

2.3.6 Endangered Species Habitat

The Manchester WWTP discharges to the Puget Sound to east. While the Washington Department of Fish and Wildlife does not list any endangered species for the sewer service area or the area of the WWTP outfall, it does denote priority habitat and species in these areas. The shoreline in this area is an estuarine and marine wetland which provides habitat for many species, including the surf smelt. Other species inhabiting the area near the outfall include the Pacific Geoduck and the Pacific Herring, which is a state candidate for listing as endangered, threatened, or sensitive.

2.4 Water Supply System

The Manchester LAMIRD is served by the Manchester Water District that receives water from 11 different deep-aquifer wells. Well #1, Well #2, Well #10, and Well #11 are located within the LAMIRD. The Manchester Water District has five reservoirs with approximately 3.2 million gallons of storage located throughout the water district. The Cedar reservoir and the California Reservoir are located within the LAMIRD. The Manchester LAMIRD contains one booster station located at the Cedar Reservoir. The Manchester Water District distribution system contains more than 32 miles of water main and has capacity to serve 4,494 ERUs throughout the water district service area. The system also server more than 360 public and private fire hydrants. A map of the Manchester water system within the Manchester sewer service area is shown in Figure 2-5.

2.5 Land Use and Zoning

The Manchester boundary and zoning are established in the *Kitsap County Comprehensive Plan 2016-2036, June 2016 with revisions through April 2020*. Manchester contains two residential zoning designations, and one commercial designation. The Manchester Village Residential (MVR) zone includes the densest parcel platting patterns. The Manchester Village Low Residential (MVLR) zone includes a variety of platting densities and incentivizes the use of clustering to encourage an increase in the establishment of open space. The Manchester Village Commercial (MVC) zone has been applied to areas where historic commercial development occurred and where future development is acceptable. The zoning in Manchester LAMIRD is shown in Figure 2-6.

Figure 2-5 | Manchester Water System

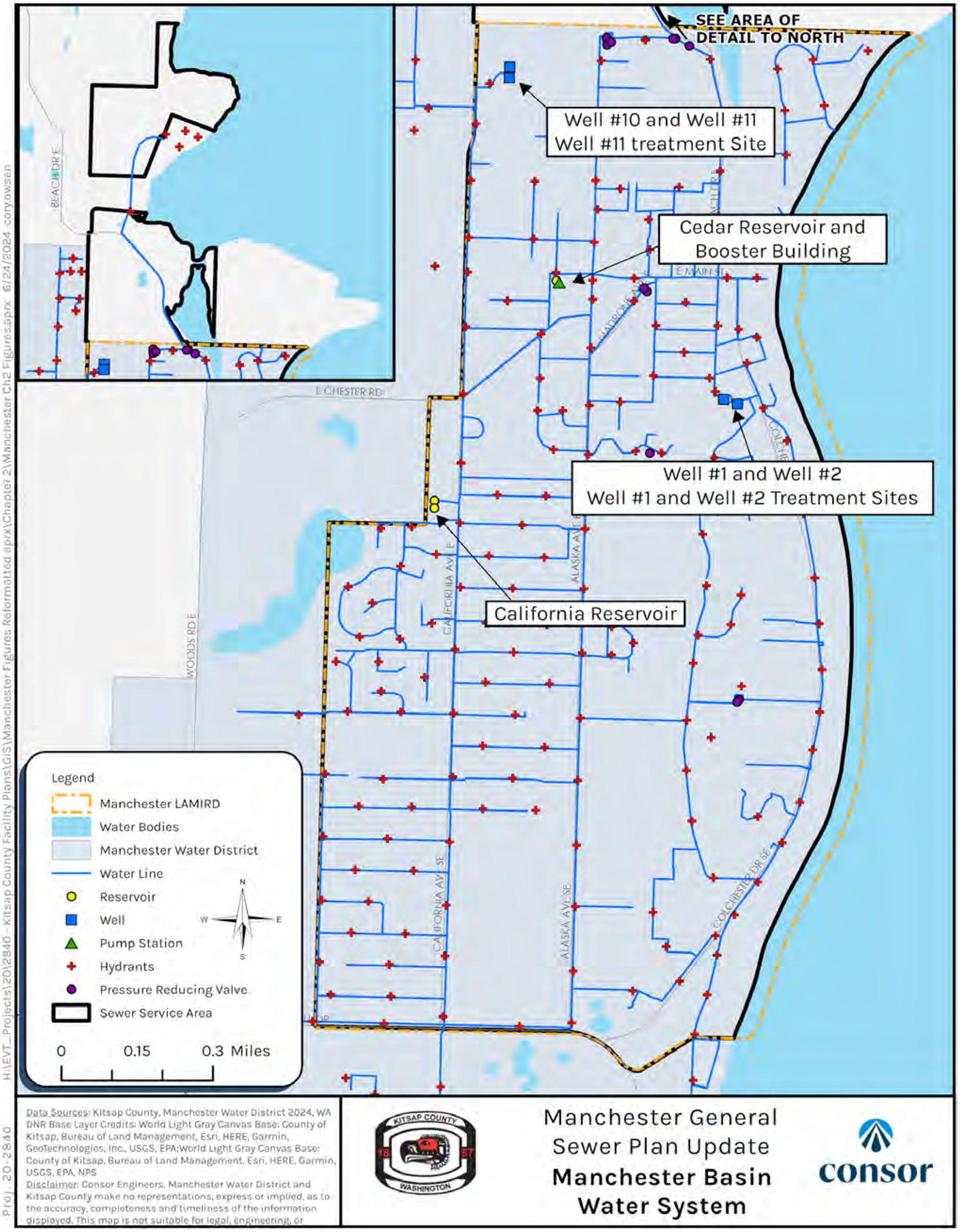
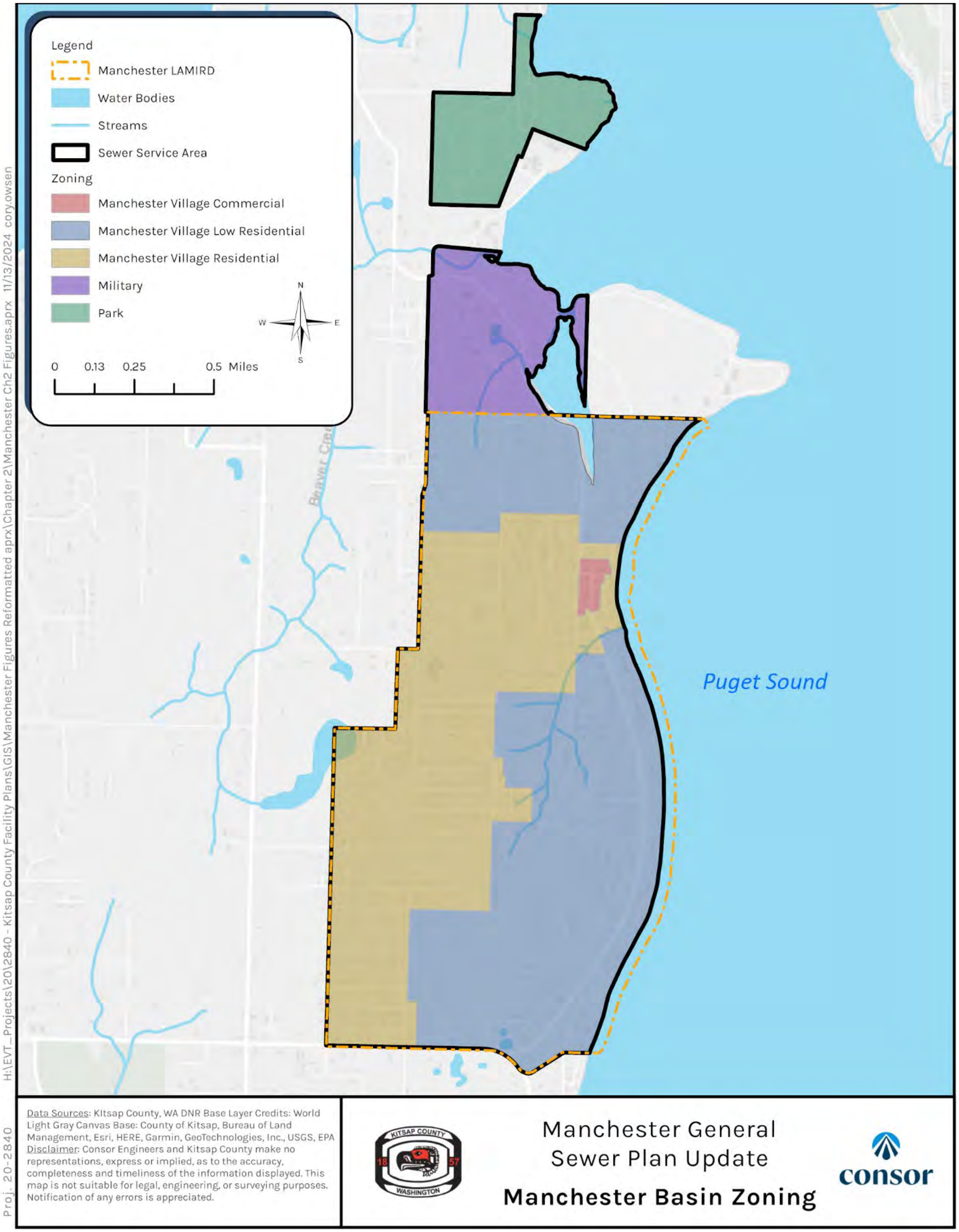


Figure 2-6 | Manchester Zoning



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SECTION 3

Population, Flow, and Load Projections

3.1 Introduction

The existing and projected populations and the methodology of determining the most appropriate sewered population and its growth rate to project future flows and loads for the Manchester WWTP are described in Section 3.

The projections consider existing and future customers within the Manchester Basin in year 2028 (the 6-year projection) and year 2042 (the 20-year projection). With these population projections, future flows will be estimated using the hydraulic model to determine sewer system deficiencies and capital improvement projects for the 6-year and 20-year planning horizons to improve and expand the Manchester WWTP.

3.2 Definitions

Evaluation Period: The flows and loads analyzed are based on discharge monitoring reports (DMRs) from January 2018 through June 2020.

Wet Weather Season: The wet weather season is November 1 through April 30 of the following year.

Dry Weather Season: The dry weather season is May 1 through October 31.

Average Annual Flow (AAF): The average daily flow for the calendar year.

Maximum Month Wet Weather Flow (MMWWF): The largest volume of flow during a continuous 30-day period in wet weather season, expressed as a daily average.

Maximum Month Dry Weather Flow (MMDWF): The largest volume of flow during a continuous 30-day period in dry weather season, expressed as a daily average.

Peak Day Flow (PDF): The largest volume of flow during a one-day period, expressed as a daily average.

Peak Hour Flow (PHF): The largest flow rate during a one-hour period, over the metered time period.

3.3 Population Projections

3.3.1 General

The population forecasts for the sewer service areas were provided by the Puget Sound Regional Council (PSRC). The PSRC is a leading source of data and forecasting for regional and local planning in the Puget Sound area and develops policies and coordinates decisions related to regional growth and transportation and economic planning within Kitsap, King, Pierce, and Snohomish counties.

The PSRC's population projections are based on their Land Use Vision (LUV) forecast. The LUV dataset reflects the VISION 2040 Regional growth strategy, local policies, and each county's adopted growth targets. The LUV dataset projects population growth for the Central Puget Sound region in five-year increments from 2020 through 2040. The PSRC's Regional Macroeconomic Forecast is apportioned to cities and unincorporated areas using the VISION 2040 Regional Growth Strategy and local growth targets to create annual control totals. The PSRC's land use model, UrbanSim, then uses the annual control totals to determine projected growth on developable land. These results can then be reported for varying geographies like UGAs, LAMIRDs, Census Tracts, or Traffic Analysis Zones (TAZ).

The projections used for this basis of planning are based on projected growth for the portions of TAZs within the Manchester sewer service areas.

The PSRC projections for residential population are separated into household population and group quarters population. Household population includes both single-family and multi-family units. Group quarters are places where people live or stay in a group living arrangement such as group homes, nursing facilities, federal and state prisons, or military quarters.

As a reference, the 2019 population developed by the Washington State Office of Financial Management (OFM) was also obtained. The OFM 2019 number falls between the PSRC projection in year 2014 and 2020, and therefore is considered a valid data point in this analysis. The detailed projections for the Manchester basin are discussed in the following sections.

Population targets from the 2016 KCCP were compared with population projections received from the PSRC in five-year increments from 2020 to 2040. The targets included in the KCCP are broken down by City or UGA and areas outside of those categories are included in the broad categories of "Unincorporated UGA" and "Rural Non-UGA". The PRSC data was available at a higher resolution which was needed for the Plan because the sewer service area for the Manchester basin is outside of the UGA boundary. The overall projections are similar to the KCCP, which gives confidence that the facility planning effort will dovetail with the overall County planning efforts described in the KCCP. The PSRC data is somewhat more conservative, which is preferrable for wastewater facility planning.

3.3.2 Residential

The OFM estimate of the residential population in the Manchester basin was 4,977 for the year 2019. The 2042 projection for population for the Manchester basin is 7,828 yielding a 57 percent increase from 2019 to 2042. The PSRC population projections for the period 2014 through 2040 in five-year increments and the 2019 OFM estimate of population and the extrapolated population in 2042 are shown in **Table 3-1**.

Table 3-1 | Manchester Service Area Population Projections and Estimates

Year	Household	Group Quarters	Total[5]
2014[1]	4,672	6	4,678
2019[2]	4,977	-	4,977
2020[1]	5,603	7	5,610
2025[1]	6,496	7	6,503
2028[3]	6,890	7	6,897
2030[1]	7,153	7	7,160
2035[1]	7,453	8	7,461

Year	Household	Group Quarters	Total[5]
2040[1]	7,715	8	7,723
2042[4]	7,820	8	7,828

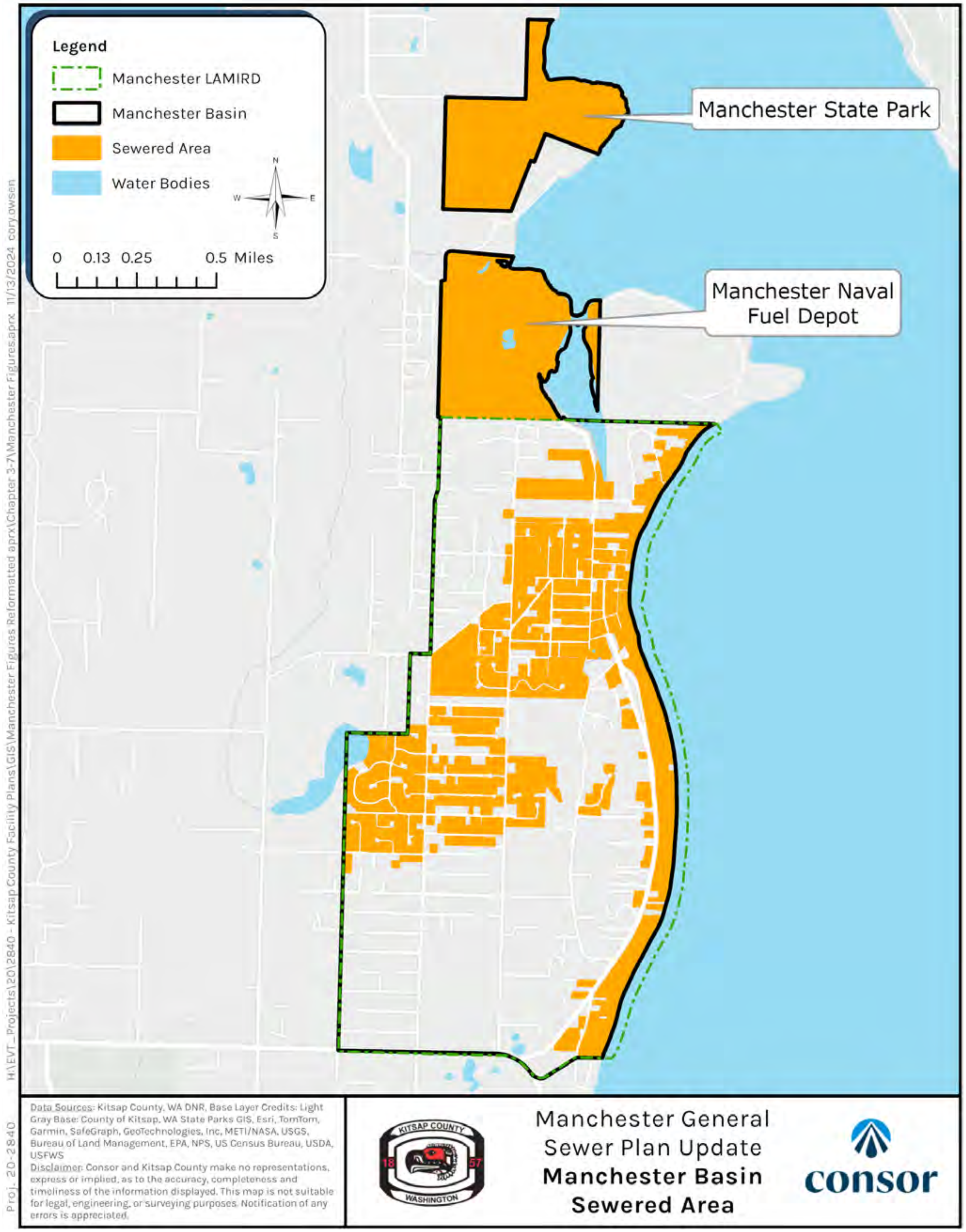
Notes

1. PSRC Projections
2. OFM estimates, group quarters population is not reported separately
3. PSRC projections, interpolated between 2025 and 2030
4. PSRC projections, extrapolated based on yearly growth between 2035 and 2040
5. The total sewered population was computed using a different methodology which is described in the subsequent section

3.3.3 Current Sewered Population

The current sewer system in the Manchester basin serves the northern portion of the LAMIRD while the population estimates and projections, presented above, represent the entire LAMIRD. The current sewered population was estimated by an analysis of sewer permits using the ERUs and assuming 2.5 people per unit. The County's sewer permit data, provided in 2020, indicated there are 1,045 ERUs in the LAMIRD yielding a current sewered population of 2,613.The Manchester basin sewered area as of 2024 is shown in **Figure 3-1**.

Figure 3-1 | Manchester Basin Sewered Area



3.3.4 Sewered Population Growth Rate and Projections

Two data sources are reviewed to determine the most appropriate sewered population growth rate as the basis for the WWTP flow and load projection:

- Estimated total population projection as presented in **Table 3-1**, based on the PSRC and OFM information. This projection shows a 57 percent growth between 2019 and 2042 within the entire LAMIRD, which averages out to be an annual growth rate of 2.0 percent.
- Estimated sewered population projection as presented in **Table 3-2**, based on extrapolated growth from the 2014 Plan. This extrapolated growth projection shows an 80 percent growth between 2019 and 2042 within the sewered population projections, which averages out to be an annual growth rate of 2.6 percent.

Table 3-2 | 2014 Manchester Sewer Facilities Strategy Plan Projected Sewered Population

Year	Projected Sewered Population
2009	2,335
2019	3,488
2030	4,757
Build-out	8,333

The higher growth rate from the 2014 Plan was selected as the basis for the Manchester WWTP flow and load projections to provide a more conservative estimate considering that growth within the sewered population should be higher than the overall LAMIRD growth rate.

Based on the estimated sewered population in **Section 3.3.3** and using the population growth rate from the 2014 Plan, the projected sewered population in 2028 and 2042 for the Manchester Basin is shown on **Table 3-3**. The 2044 population projection is also presented here and aligns with those developed by the Kitsap County DCD over the 2044 planning horizon, which corresponds to the County Comprehensive Plan update.

Table 3-3 | Manchester Projected Sewered Population

Year	Projected Sewered Population
2020	2,613
2028	3,399
2042	4,774
2044	4,971*

Note:
*Extrapolated from 2042 population

3.4 Wastewater Flows

Influent flow to the Manchester WWTP is made up of primarily residential domestic wastewater and a small amount of light commercial and minor industrial wastewater. Additionally, the plant treats domestic wastewater from the Manchester State Park, wastewater from the EPA/Ecology Accreditation laboratory, and the sewage from the Manchester Naval Fuel Depot. The latter consists of domestic sewage from onshore facilities and gray water from ships that dock at the Naval Fuel Depot. Non-domestic wastewater from the EPA/Ecology laboratory is pretreated for pH adjustment prior to discharge into the PS-48. The laboratory waste stream is collected into separate mixing tanks equipped with mechanical mixer, pH meter and metering pump to add either sodium hydroxide or sulfuric acid to the mixing tanks. The average volume of laboratory waste generated is approximately 5,000 gallons per week. The plant historical flow and loads record has captured these institutional non-domestic sources. Due to the small percentage of these wastewater streams in the total plant flow, it is assumed these wastewater streams will follow the same growth rate as the residential population growth.

3.4.1 Current Wastewater Treatment Plant Flow

Daily influent flow data were evaluated using DMR reports from January 2018 through June 2020 (the evaluation period) and are shown in **Figure 3-2**. Peak daily flows occurred during the wet weather winter months. Average daily flows are visibly lower during the dry weather months.

Figure 3-2 | Daily Flowrates

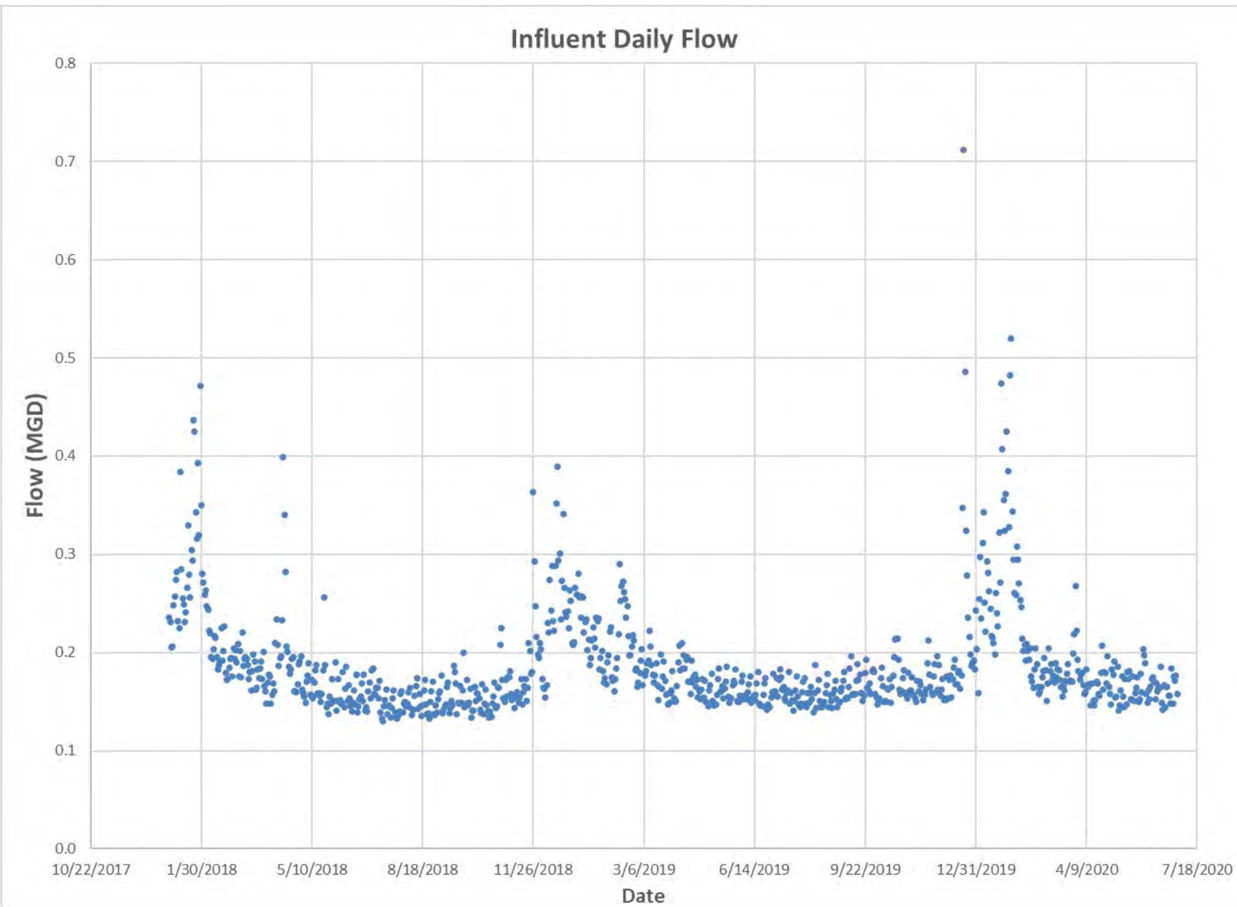
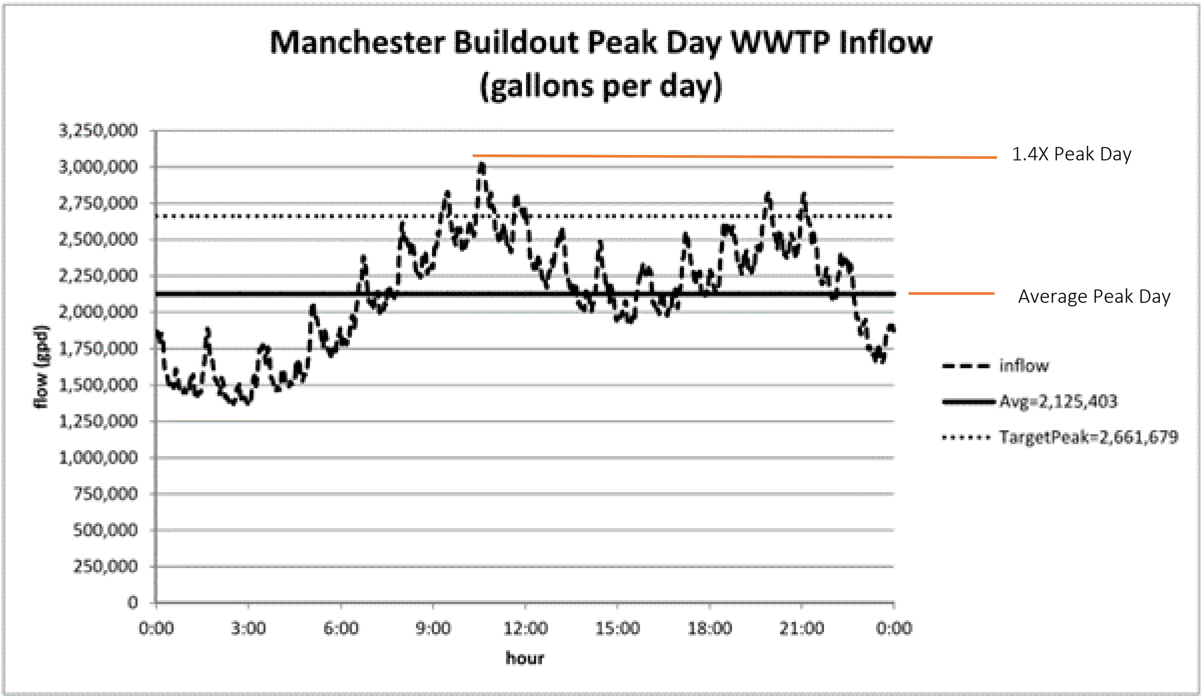


Table 3-4 summarizes the current (2020) AAF, MMWWF, MMDWF, PDF, and PHF from the plant DMR data and corresponding peaking factors and per capita values based on the estimated current sewered population of 2,613. The per capita flow values are in the normal range of most plants. Hourly flow data are not available for Manchester WWTP, so PHF was calculated using the peak day diurnal curve in Appendix C of the 2014 Plan as shown on **Figure 3-3**. From the diurnal curve, the ratio of PHF to PDF of 1.4 was applied to the observed PDF to project the PHF. The peaking factor PHF/AAF shown on **Table 3-4** is calculated by dividing the estimated PHF flow by the 2019 AAF flow.

Figure 3-3 | Manchester WWTP Peak Day Diurnal Curve



Source: 2014 Plan

Table 3-4 | 2020 Influent Flows at Manchester WWTP

Flow Event	Current Flow (MGD)	Peaking Factor	Per Capita Flow (gpcpd)
AAF	0.19	1.0	71
MMWWF	0.31	1.7	119
MMDWF	0.20	1.1	77
PDF	0.71	3.8	272
PHF	1.0	5.4	381

Notes:
MGD = million gallons per day
gpcpd = gallons per capita per day

3.4.2 Wastewater Treatment Plant Flow Projection

Table 3-5 summarizes the projected flows in year 2028 (6-year projection) and year 2042 (20-year projection), based on the 2019 flows and anticipated growth rate.

Table 3-5 | Projected Influent Flows at Manchester WWTP

Flow Event	2028	2042
Projected Sewered Population	3,399	4,774
AAF (MGD)	0.24	0.34
MMWWF (MGD)	0.40	0.57
MMDWF (MGD)	0.26	0.37
PDF (MGD)	0.93	1.30
PHF (MGD)	1.30	1.84

3.4.3 Infiltration and Inflow

Infiltration and inflow (I&I) is water that enters the sewer system that is sometimes caused by stormwater runoff or high groundwater. Inflow is runoff entering the sewer directly, typically from storm sewer connections, basement sump pumps, roof drains and submerged manholes. Infiltration occurs as groundwater leaks into the sewer system through cracked or broken pipes and manholes, or through loose joints and connections.

Evaluating I&I is important in determining the PDF and PHF through the system. The PDF and PHF can vary significantly due to changes in groundwater tables, intensity of rainfall, duration of rainfall, and when the peak of the rain event occurs during the day.

The EPA publication 'Infiltration/Inflow – I/I Analysis and Project Certification' dated May 1985 was reissued by Ecology as Ecology Publication No. 97-03. This publication established the following thresholds for possibly excessive I&I:

- If average dry weather flow is less than 120 gpcpd, infiltration is non-excessive.
- If average wet weather flow is less than 275 gpcpd, inflow is non-excessive.

The average dry weather and wet weather flows are summarized in **Table 3-6** in gpcpd and MGD. The average dry weather flows indicate that infiltration is non-excessive. The average wet weather flows indicate that inflow is non-excessive.

Table 3-6 | EPA/DOE Excessive I&I Criteria

Parameter	Value
Population	2,613
Average Dry Weather Flow (MGD)	0.221
Average Dry Weather Flow (gpcpd)	85
Average Dry Weather Dates[1]	1/16/2021 – 1/23/2021
Average Wet Weather Flow[2] (MGD)	0.608
Average Wet Weather Flow (gpcpd)	233

Notes:

1. Dry weather flows are the average flow on days where little or no rainfall has occurred in a season of high groundwater.
2. Wet weather flows are the average of the highest daily flow each year from 2018-2021.

3.5 Wastewater Loads

3.5.1 Current Wastewater Loads

Wastewater loads to a treatment plant are used to evaluate different treatment alternatives and to determine the required treatment capacities. Current biological oxygen demand (BOD), total suspended solids (TSS), and total Kjeldahl nitrogen (TKN) daily mass loads were derived from the 2018-2020 DMR evaluation period data as well as monthly influent nitrogen data collected by plant staff. These daily mass loads were divided by the projected 2020 sewered population of 2,613 to calculate per capita plant loads. These 2020 total and per capita loads for BOD, TSS, and TKN during annual average, wet weather, and dry weather flows are shown in **Table 3-7**. The load per capita values are typical of WWTPs.

Table 3-7 | 2020 Manchester WWTP Influent BOD, TSS, and TKN Loads

Population	Parameter	Annual Average		Max Month Wet Weather		Max Month Dry Weather	
		Load (ppd)	Load Per Capita (ppcd)	Load (ppd)	Load Per Capita (ppcd)	Load (ppd)	Load Per Capita (ppcd)
2,613	BOD	356	0.136	423	0.162	473	0.181
2,613	TSS	373	0.143	462	0.177	554	0.212
2,613	TKN	69.3	0.027	77.4	0.030	113	0.043

Notes:
ppd = pounds per day
ppcd = pounds per capita per day

3.5.2 Influent Wastewater Loads Projection

Per capita loading factors were multiplied by projected populations in 2028 and 2042 to project future plant BOD, TSS and TKN loading during average, wet weather, and dry weather conditions. Loading projections for 2028 and 2042 are shown in **Table 3-8** and **Table 3-9**.

Table 3-8 | 2028 (6-Year) Manchester WWTP Influent BOD, TSS, and TKN Loading Projections

Population	Parameter	Annual Average		Max Month Wet Weather		Max Month Dry Weather	
		Load (ppd)	Load Per Capita (ppcd)	Load (ppd)	Load Per Capita (ppcd)	Load (ppd)	Load Per Capita (ppcd)
3,399	BOD	462	0.136	549	0.162	615	0.181
3,399	TSS	485	0.143	601	0.177	720	0.212
3,399	TKN	90.1	0.027	101	0.030	147	0.043

Table 3-9 | 2042 (20-Year) Manchester WWTP Influent BOD, TSS, and TKN Loading Projections

Population	Parameter	Annual Average		Max Month Wet Weather		Max Month Dry Weather	
		Load (ppd)	Load Per Capita (ppcd)	Load (ppd)	Load Per Capita (ppcd)	Load (ppd)	Load Per Capita (ppcd)
4,774	BOD	650	0.136	772	0.162	864	0.181
4,774	TSS	682	0.143	844	0.177	1,012	0.212
4,774	TKN	127	0.027	141	0.030	207	0.043

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SECTION 4

Regulatory Requirements

The operation and construction of wastewater facilities are regulated through federal, state, and local regulations. Federal, state, County, and local government regulatory requirements applicable to the Manchester WWTP are described in this section.

4.1 Federal Rules and Regulations

4.1.1 Federal Water Pollution Control Act (Clean Water Act)

The FWPCA, also known as the Clean Water Act (CWA), is a comprehensive framework for the regulating the discharge of pollutants into waters of the United States. The EPA has delegated the administration of the NPDES permit program in Washington State to Ecology. NPDES permitting is discussed in further detail below, as are Pretreatment regulations and Biosolids Management.

4.1.2 U.S. Army Corps of Engineers

The United States Army Corps of Engineers (USACE) has jurisdiction over waterways and wetlands of the United States. Modifications to the treatment plant outfall or development or construction in wetland areas may require a permit from the USACE. Permitting is reviewed by Federal, State, and local agencies as well as Tribal entities. Permits are contingent on certification from Ecology that the project is consistent with the State of Washington Coastal Zone Management Plan.

4.1.3 Endangered Species Act

The National Marine Fisheries Service is directed under Section 4(d) of the Endangered Species Act (ESA) to issue regulations conserving species listed as threatened. The Section 4(d) rules apply to ocean and inland areas as well as any entity subject to United States jurisdiction. Species in the basin listed as threatened under Section 4(d) are listed in **Section 2.3.6**.

Section 9 of the ESA prevents "taking" or harm of threatened species and identifies some activities with a high risk of take. These activities include urban development in riparian areas and areas susceptible to erosion destruction or alteration of habitats, and violations of discharge permits.

4.1.4 Capacity Management Operations and Maintenance Programs

Capacity Management Operations and Maintenance (CMOM) is an anticipated regulation from the EPA related to control of sanitary sewer overflows (SSO) from sewer C&C systems or treatment facilities, which are prohibited under the Federal CWA. The EPA has prepared a draft rule titled "Sanitary Sewer Overflow Control Rule" which is intended to eliminate preventable SSOs through requiring owners and operators of sewer systems to develop and implement CMOM programs.

4.1.5 Puget Sound Water Quality Management Plan

The FWPCA established the requirement for a Water Quality Management Plan. Resultantly RCW section 90.71 established the need for a Puget Sound Water Quality Management Plan. The stated objective of this plan is to protect and restore Puget Sound through effective coordination among governments and private interests, and through use of an adaptive management approach.

4.1.6 EPA Plant Reliability Criteria

The Manchester WWTP is required to meet the Reliability Class I standards, as defined in EPA's Technical Bulletin "Design Criteria for Mechanical, Electrical, and Fluid System Component Reliability," EPA 430-99-74-001. A summary of plant reliability criteria and requirements and current deficiencies at Manchester WWTP are discussed in **Section 6** of this Plan.

4.1.7 National Historic Preservation Act

The National Historic Preservation Act (NHPA) established processes to assess, designate, and protect historic and cultural resources. It also established the National Register of Historic Places and the State Historic Preservation Officer (SHPO) to administer state historic preservation program and coordinate with federal agencies on their proposed actions, also known as undertakings. Section 106 of the NHPA requires coordination between federal, state, local, and tribal entities to review the impacts of any undertakings on historical properties listed or eligible for listing on the National Register.

4.2 State Rules and Regulations

4.2.1 Department of Ecology

The approval of this Plan is per Ecology. Requirements for sewer plans are listed in RCW 90.48.110 and WAC 173-240. Ecology administers numerous regulations published in the WAC which are briefly described below.

4.2.1.1 Water Quality Regulations

Ecology's water quality standards for surface waters of the State are published in WAC 173-201A which also contains the anti-degradation policy. The anti-degradation policy has goals which include restoring and maintaining the highest possible quality of the surface waters of Washington and to ensure that all human activities that are like to contribute to a lowering of water quality, at a minimum, apply all known, available, and reasonable methods of prevention, control, and treatment (AKART).

Ecology established water quality criteria for marine environments under WAC 173, 201A. Under this section, standards are set for "public health and public enjoyment of the waters and the propagation and protection of fish, shellfish, and wildlife." Within this section, water quality criteria are established for aquatic life uses, shellfish harvesting, recreation use, and miscellaneous uses. Under aquatic life uses, target levels for temperature, dissolved oxygen (DO), and bacteria, turbidity, and pH were established with different quality thresholds based on the importance of the environment and the species present. Mixing zone regulations for WWTP outfalls are also specified in this regulation.

4.2.1.2 NPDES Regulations

Ecology has been delegated authority from the EPA to enforce the CWA to regulate the discharge of treated effluent from WWTPs through the NPDES program. Washington's NPDES Permit requirements are included in WAC 173- 220, whose purpose is to "establish a state individual permit program, applicable to the discharge of pollutants and other wastes and materials to the surface waters of the state, operating under state law as a part of the NPDES created by Section 402 of the Federal Water Pollution Control Act

(FWPCA)." NPDES Permit limits must comply with Washington water quality standards and biosolids management regulations included in WAC 173- 201A and WAC 173-308, respectively.

The County's Manchester WWTP NPDES Permit #WA0023701 was renewed on March 1, 2018, allowing the discharge of treated effluent to Rich Passage, Puget Sound. A copy of the WWTP's NPDES Permit is included in **Appendix A**. The NPDES Permit expired on February 28, 2023. The County submitted the permit renewal application six months before the expiration date per the Permit requirement. The current permit was administratively continued and remains in effect.

4.2.1.3 Pretreatment Regulations and Industrial Users

Manchester WWTP is required in Special Condition S6 of the NPDES permit to enforce the discharge prohibitions, identify and report existing, new, and proposed industrial users, and conduct industrial user survey.

According to 40 Code of Federal Regulations (CFR) Part 403 (General Pretreatment Regulations for Existing and New Sources of Pollution) all "significant industrial users" (SIUs), which are industrial users that discharged an average of 25,000 gpd or more to the Publicly Owned Treatment Works (POTW) or makes up 5 percent or more of the average dry weather hydraulic or organic (BOD or TSS) capacity of the POTW, are required to be part of the Pretreatment Program.

The National Pretreatment Program is charged with controlling toxic, conventional, and non-conventional pollutants from non-domestic sources that discharge into sewer systems, as described in CWA Section 307(a). Ecology has been given authority by the EPA to regulate the Pretreatment Program in Washington and is required to comply with the federal provisions of the National Pretreatment Program. The Pretreatment Program requires all large POTW that have a designed treatment capacity of more than 5 MGD to establish local Pretreatment Program.

Manchester WWTP, with design flows less than 5 MGD, is only required to develop a formal Pretreatment Program if the nature or volume of the industrial influent are contributing to treatment process upsets, violations of NPDES Permit Limits or other circumstances that warrant the development of a program to eliminate those occurrences per 40 CFR 403.8 (a).

Since the majority of wastewater in the Manchester basin is from domestic sewer, and no industrial or commercial discharges have been found to impact the plant performance, a Pretreatment Program is not required for Manchester WWTP.

The County conducted an Industrial User Survey in 2017. The survey is included in **Appendix B**. There is no SIU identified within the Manchester service area.

4.2.1.4 Biosolids Management

The facility is required in Special Condition S7 of the NPDES permit to store and handle all residual solids in accordance with the requirements of applicable state water quality standards. The final use and disposal of sewage sludge from this facility is regulated by the EPA under 40 CFR 503, and by Ecology under RCW chapter 70.95, WAC 173-308, Biosolids Management, and WAC 173-350, Solid Waste Handling Standards. Washington state law requires that biosolids be put to beneficial reuse unless specifically permitted otherwise. The regulations also address the monitoring, record keeping, and reporting requirements.

The current Special Condition S7 of the Manchester WWTP NPDES permit only requires the County to handle and dispose of all solid waste material in such a manner as to prevent its entry into state ground or surface water. Biosolids from the Manchester WWTP are sent to the Central Kitsap WWTP, also owned by the county, for disposal; therefore, no biosolids management plan is required.

4.2.1.5 Puget Sound Nutrient General Permit

In response to areas of the Puget Sound not meeting the water quality criteria for DO, Ecology initiated the Puget Sound Nutrient Source Reduction Project to investigate the causes and extent of DO deficits. As part of the analysis, Ecology, along with several academic partners, developed a Salish Sea Model and determined the source of these exceedances of the water quality standard was the discharge of excess nutrients, especially nitrogen.

Ecology has implemented the Puget Sound Nutrient General Permit (PSNGP) for WWTPs to address the largest source of excess nutrients going into Puget Sound. They issued the first PSNGP effective as of January 1, 2022 and expiring on December 31, 2026. This PSNGP applies to the 58 publicly owned domestic WWTPs discharging into Washington waters of the Salish Sea. The WWTPs are categorized as 'Dominant (D) TIN loads', 'Moderate (M) TIN loads', or 'Small (S) loads' based on their percentage of TIN load currently discharged. The dominant or moderate TIN load plants have a facility specific action level and are required to implement nutrient monitoring and reporting, develop a nutrient optimization plan, conduct a nutrient reduction evaluation, and comply with action level exceedance corrective actions if nutrient discharge limits are exceeded. Small TIN load plants do not have a facility specific action level but are also required to implement nutrient monitoring and reporting, develop a nutrient optimization plan, and conduct AKART analysis. Manchester WWTP is classified as a small TIN load plant.

Ecology is working collaboratively with Puget Sound stakeholders through the Puget Sound Nutrient Source Reduction Project and Puget Sound Nutrient Forum to find solutions for reducing other human sources of excess nutrients.

4.2.1.5.1 Monitoring and Reporting Requirements

The PSNGP requires nutrient monitoring, recording, and reporting so nutrient loading can be calculated and tracked. The requirements under this permit will supplement the information collected under Manchester WWTP's NPDES permit and are limited to analyses necessary to track nutrients in the influent and effluent. The monitoring schedule is based on the classification of the WWTP. The dominant TIN load treatment plants are required to monitor the influent and effluent two times per week, one time per quarter, or one time per month, depending on the parameter. The moderate TIN load treatment plants are required to monitor the influent and effluent nutrient concentrations one time per week, one time per quarter or one time per month, depending on the parameter. The small TIN load treatment plants are required to monitor the influent and effluent nutrients one time per quarter, or once or twice a month depending on the parameter.

The influent and effluent sampling requirements for small TIN load plants including Manchester WWTP are shown in **Table 4-1** and **Table 4-2**.

Table 4-1 | Influent Nutrient Sampling Requirement for Manchester WWTP

Parameter	Units	Minimum Sampling Frequency
BOD	mg/L	2/month
Total Ammonia	mg/L as N	2/month
Nitrate plus Nitrite Nitrogen	mg/L as N	1/month
TKN	mg/L as N	1/month

Table 4-2 | Effluent Nutrient Sampling Requirement for Manchester WWTP

Parameter	Units	Minimum Sampling Frequency
Flow	MGD	2/month
BOD	mg/L	2/month
Total Organic Carbon	mg/L	1/quarter
Total Ammonia	mg/L as N	2/month
Nitrate plus Nitrite Nitrogen	mg/L as N	2/month
TKN	mg/L as N	1/month
TIN	mg/L as N	2/month
TIN	Lbs/day	2/month
Average Monthly TIN	Lbs	1/month
Annual TIN, year to date	Lbs	1/month

Note:
mg/L: Milligrams per Liter
TIN: Total Inorganic Nitrogen

4.2.1.5.2 Nitrogen Optimization Plan

An annual Nitrogen Optimization Plan is a required submittal for all permittees and would be submitted electronically as a permit submittal. The purpose of the Nitrogen Optimization Plan is to provide a framework for developing, implementing, and documenting nitrogen optimization strategies. The permit provided detailed requirements of the Nitrogen Optimization Plan components, which vary slightly depending on the TIN load categories.

4.2.1.5.3 All Known and Reasonable Treatment Analysis

Small TIN Load WWTPs are required to prepare and submit an AKART analysis by December 31, 2025. Permittees that maintain an annual TIN average less than 10 mg/L and do not document an increase in load through their DMRs do not have to submit this analysis. The AKART analysis requirements are detailed in the final permit and supporting documents. The AKART analysis must include wastewater characterization, treatment technology analysis, economic evaluation, environmental justice review, alternative selection, and implementation timelines.

4.2.1.6 Clean Water Act Section 303(d) list

Ecology conducts the water quality assessment based on Federal laws, state water quality standards, and Water Quality Assessment Policy 1-11 to track water qualities in the rivers, lakes, and marine waters in the state. The water quality assessment compares water data to requirements detailed in Policy 1-11. The assessed waters are placed into categories that describe the status of water quality, before being submitted to the EPA for approval of the category 5 listings, also called the 303(d) list. The water quality assessment divides water bodies into the following impairment categories:

- Category 1: Meets tested standards for clean waters
- Category 2: Waters of concern
- Category 3: Insufficient data
- Category 4: Impaired waters that do not require a TMDL
- Category 5: Polluted waters that require a water improvement project

4.2.1.7 Infiltration and Inflow

Ecology can require reductions in I&I in situations where diluted influent affect the 85 percent BOD removal and the suspended solids minimum removal limit. State and Federal regulations also require that recipients of loan or grant money demonstrate that their sewer collections systems are not subject to excessive I&I.

4.2.1.8 Engineering Design Criteria

Ecology's "Criteria for Sewage Works Design," also known as the Orange Book, identifies engineering criteria for design, construction, and operation of public sanitary sewer systems and wastewater treatment facilities.

4.2.2 Recycled Water Use

Recycled water is regulated by Ecology and the DOH, according to WAC 173-219. Ecology and DOH are both required to review recycled water proposals to determine if proposed treatment methods and uses will protect public health and the environment while not affecting existing water rights. The regulation also provides criteria to determine the lead agency based on the type of facility recycling the water. Requirements from both the lead and non-lead agency must be met as a condition of permitting. Recycled water from the Manchester WWTP would be regulated with Ecology as the lead agency under WAC 173-219-050 as the source water is effluent from a facility permitted by DOE.

4.2.3 State Environmental Policy Act

The Washington State Environmental Policy Act (SEPA) is intended to help state and local agencies identify environmental impacts likely to result from a range of projects or decisions. Construction of public facilities such as sewer lines or WWTPs or adopting regulations or policies such as comprehensive plans often trigger a SEPA review.

4.2.4 State Environmental Review Process

The Washington State Environmental Review Process (SERP) is regulated according to WAC 173-98-720 and states all recipients of funding for water pollution control facility projects must comply with the SERP. SERP includes all provisions of SEPA. Mitigation measures identified in documents developed through the SERP become conditions of funding.

4.2.5 Puget Sound Clean Air Agency

The Puget Sound Clean Air Agency (PSCAA) has jurisdiction in the County and is responsible for regulating and permitting air emissions in the Puget Sound Region. Construction projects are often subject to regulation under PSCAA's Notice of Construction (NOC) Program. Projects that fall under the NOC program must not be subject to provisions of the Prevention of Significant Deterioration (PSD) or the New Source Review (NSR) programs, administered by Ecology. Determination of the regulatory pathway is dependent on the potential change in emissions resulting from the project and two categorizations: the source is either characterized as a major or non-major source and emissions from the project categorized as either significant or less than significant. Acceptable Source Impact Levels (ASIL) are defined in WAC 173-460 and regardless of regulatory pathway, toxic air contaminants (TAC) emission increases must be compared to ASILs. Point sources such as waste gas burners, open tanks, and scrubber vents must be evaluated.

4.2.6 Washington State Department of Fish and Wildlife

The Washington State Department of Fish and Wildlife administers the State Hydraulic Code (WAC 220-660) which establishes regulations for the construction of hydraulic projects or work that will impact any salt or fresh waters of the state. It also sets forth procedures for obtaining Hydraulic Project Approval (HPA). Modification to the treatment plant outfall would likely require HPA.

4.3 Kitsap County and Local Government Requirements

The Manchester WWTP treats sewage from unincorporated Kitsap County.

4.3.1 Kitsap County Codes

County Code Chapter 13.12 contains regulations governing public sewer systems. This chapter describes licensing and permitting of sewers, the locations of sewers and connections, and prohibited discharges and disposal of prohibited wastes. Specifications for sewers as well as standards for excavation and trenching are also included in Chapter 13.12.

County Code Chapter 18 contains the basic requirements that apply to the SEPA process and describes the sections of the SEPA that have been adopted by the County. Contents of Chapter 18 include, but are not limited to, designation of responsible officials and lead agency, exemptions and threshold determinations, an environmental checklist for applicants, rules for preparing environmental impact statements, rules for commenting on environmental documents under SEPA, rules governing public notices and hearings, and rules describing agency compliance with SEPA.

County Code Chapter 19 contains the County's Critical Areas Ordinance which identifies and protects critical areas as required by the GMA. Critical areas include but are not limited to wetlands, fish and wildlife habitat conservation areas, and geologically hazardous areas. Chapter 19 outlines purposes and objectives for each critical area category and describes development standards, review procedures, and designation statuses.

County Code Chapter 22 contains the County's Shoreline Master Program which guides future development of the shorelines in the county consistent with the Shoreline Management Act. Chapter 22 describes shoreline jurisdiction and environment designations, goals and policies for the program, regulations, permit review and enforcement, and shoreline use and modification standards. This chapter also contains a section describing requirements for reports for critical areas including wetlands, habitats, geotechnical, and hydrogeological. This section addresses when reports are required, the qualifications of those preparing the reports, and timelines and schedules for the reports.

4.3.2 Growth Management Act

The GMA is a State, County, and City planning requirement which influences City and County plans for future growth. The GMA requires fast-growing cities and counties to develop a comprehensive plan to manage population growth. The GMA established a series of 13 goals under RCW 36.70A.020 as well as a 14th goal (RCW 36.70A.480) which adds the goals and policies from the Shoreline Management Act to those of the GMA. The County is subject to the full requirements of the GMA which requires planning for utilities including sewer service. This includes providing a capital facilities element in Comprehensive Land Use plans as well forecasting future needs for these facilities, proposed locations, and capacities of new or expanded facilities, and plans to fund these facilities into the future. The 2016 KCCP was prepared to satisfy the GMA requirements and describes the planned growth within the sewer service areas as well as plans to maintain and expand services within the sewer service area.

The GMA generally prohibits sewer service outside of designated UGAs. One exception to this prohibition is for areas defined as a LAMIRD. Because sewer service and urban development are not otherwise allowed in rural areas, specific criteria must be met to establish the logical boundary of a LAMIRD and limit new patterns of low-density sprawl. Manchester is recognized as a Type 1 LAMIRD under these regulations.

Based on the requirements of the GMA, the County is required to review, and if necessary, revise its Comprehensive Plan by June 30, 2024, and every eight years thereafter. As part of this review and revision, the County plans to revise its population and employment growth projections, which currently are projected to 2036, out to the year 2044. This revision is planned to begin in 2022, thus revised growth projections were not available at the time of this sewer plan update.

4.3.3 Water as a Resource Policy

The County's Water as a Resource policy directs the County to treat water as a resource and not a waste stream. The policy focuses on improving water in the County through 6 main guiding principles. While the guiding principles largely focus on controlling stormwater, guiding principle concerning conserving groundwater resources impacts the sewer system through use of recycled water or non-potable water for appropriate uses. The policy also contains guiding principles aimed at continual refinement of management tools. In addition to guiding principles, the policy directs the County to consider water as a resource when developing, re-developing, retrofitting, refurbishing, maintaining, and operating public assets. The policy also directs the County to consider water as a resource when developing or revising codes and regulations.

SECTION 5

Collection and Conveyance Existing Conditions

5.1 Introduction

The Manchester C&C system is comprised of sewer assets owned by the County within the Manchester LAMIRD. It is comprised of gravity sewers, seven pump stations and force mains, and a number of individual grinder pump stations. Sewage is treated at the Manchester WWTP and discharged into Puget Sound. Manchester's existing sewer system is shown in **Figure 5-1**.

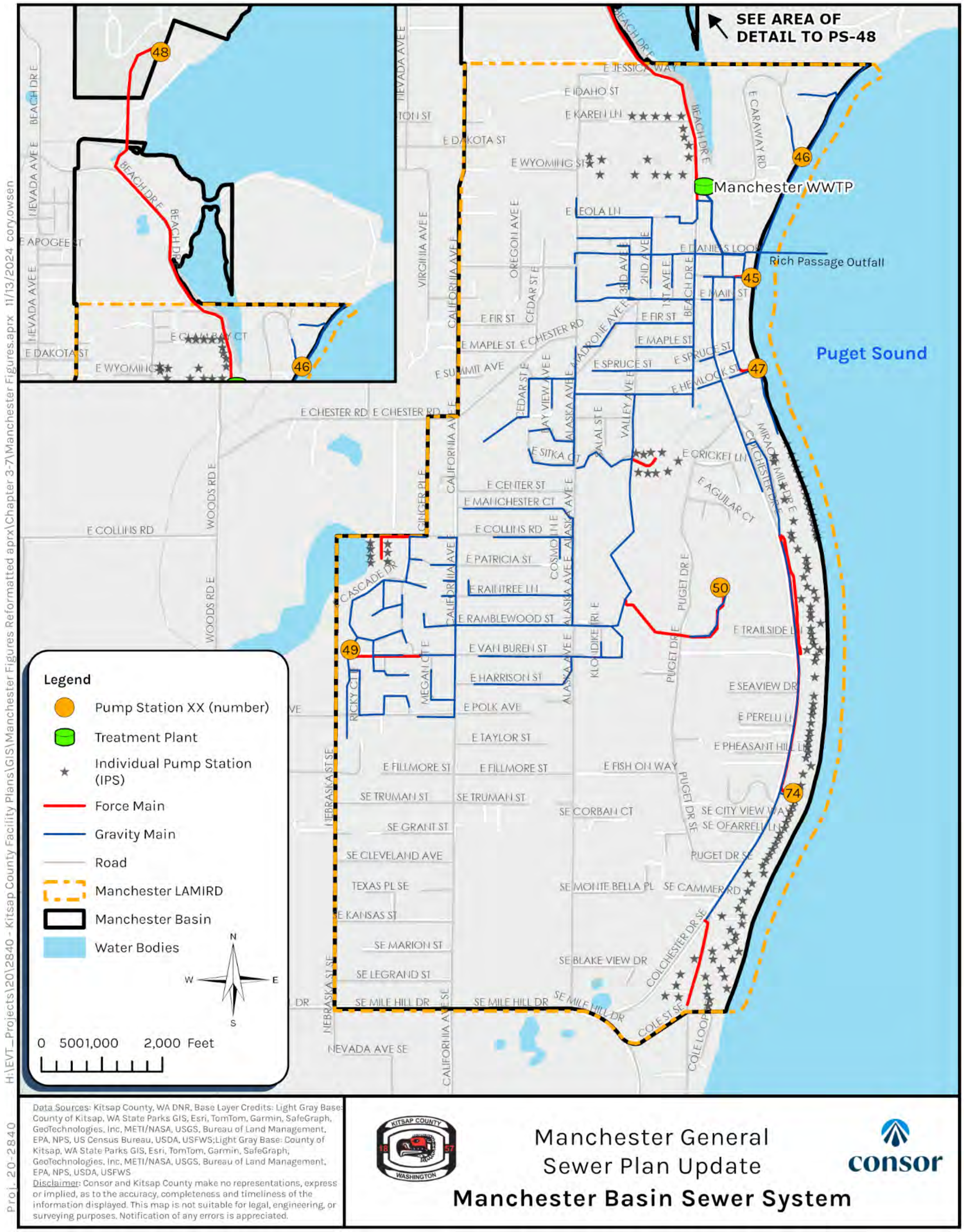
The sewer system was first established in 1969 by Sewer District 3 and was financed and built by a ULID. Ownership of the system was transferred to the County in 1976. The County continues to own, operate, and maintain the sewer facilities in Manchester.

5.2 Service Areas and Sewer Basins

The Manchester basin C&C system is shown in **Figure 5-1**. The existing conveyance system provides service primarily to the northern portion of the LAMIRD with a small portion of the system served in the southern portion, routed through PS-74 and individual pump stations.

At the level of single pump stations, service areas are delineated as 'mini-basins', defined as the area from which the collection system drains to a specified discharge point. Delineations of mini-basins are based on existing sewer service and topography. The remaining gravity systems are sectioned into four separate sewered mini-basins. The remaining unsewered areas of the LAMIRD are served by privately owned septic systems and are delineated into 10 unsewered mini-basins. A map of all mini-basins is included as **Figure 5-2**.

Figure 5-1 | Manchester Basin Sewer System



5.2.1 Flow Routing

There are approximately 64,000 feet of gravity pipe, 16,200 feet of force mains, and seven operating sewer pump stations within Manchester's sewage collection system. The existing sewer system is presented in **Figure 5-2**.

The service area's flows are routed through pump stations 45, 46, 47, 48, 49, 50, and 74. Flows from the central part of the LAMIRD flow north by gravity directly to the Manchester WWTP. Flows from several housing developments are directed east to PS-50 before being pumped to the main trunk going north to the Manchester WWTP. On the west portion of the service area, flows are routed west through PS-49. All county owned conveyance infrastructure in the southern portion of the service area is located about 500 feet inland and parallel to Puget Sound. A number of individual pump stations along the coast and PS-74 route flows from the SE portion of the system north to the Manchester WWTP. PS-46 serves the Navy Fuel Depot and a coastal region in the northeast of the LAMIRD. Both PS-46 and PS-47 are tributary to PS-45. All three are situated directly along the waterfront, and pump flows from waterfront properties in a western direction to the treatment plant. Additionally, PS-48 is located approximately one mile north of the Manchester LAMIRD boundary, and serves the EPA Laboratory, sending flows to a gravity manhole near the Manchester WWTP.

The Manchester basin currently contains 12 sewered mini-basins, one for each of the seven pump stations, one for the Manchester WWTP, and four others for regions served by gravity sewers. Since the modeling was completed as a part of the 2014 Sewer Facilities Strategy Plan, the sewered area of Basin F has been expanded to include newly built individual pump stations and the 2018 Manchester Yukon Harbor ULID Sewer Extension. **Figure 5-2** shows a schematic of the Manchester sewer conveyance and pump stations. The existing sewered and unsewered basins are shown in **Figure 5-3**.

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Figure 5-2 | Manchester Sewer System Schematic

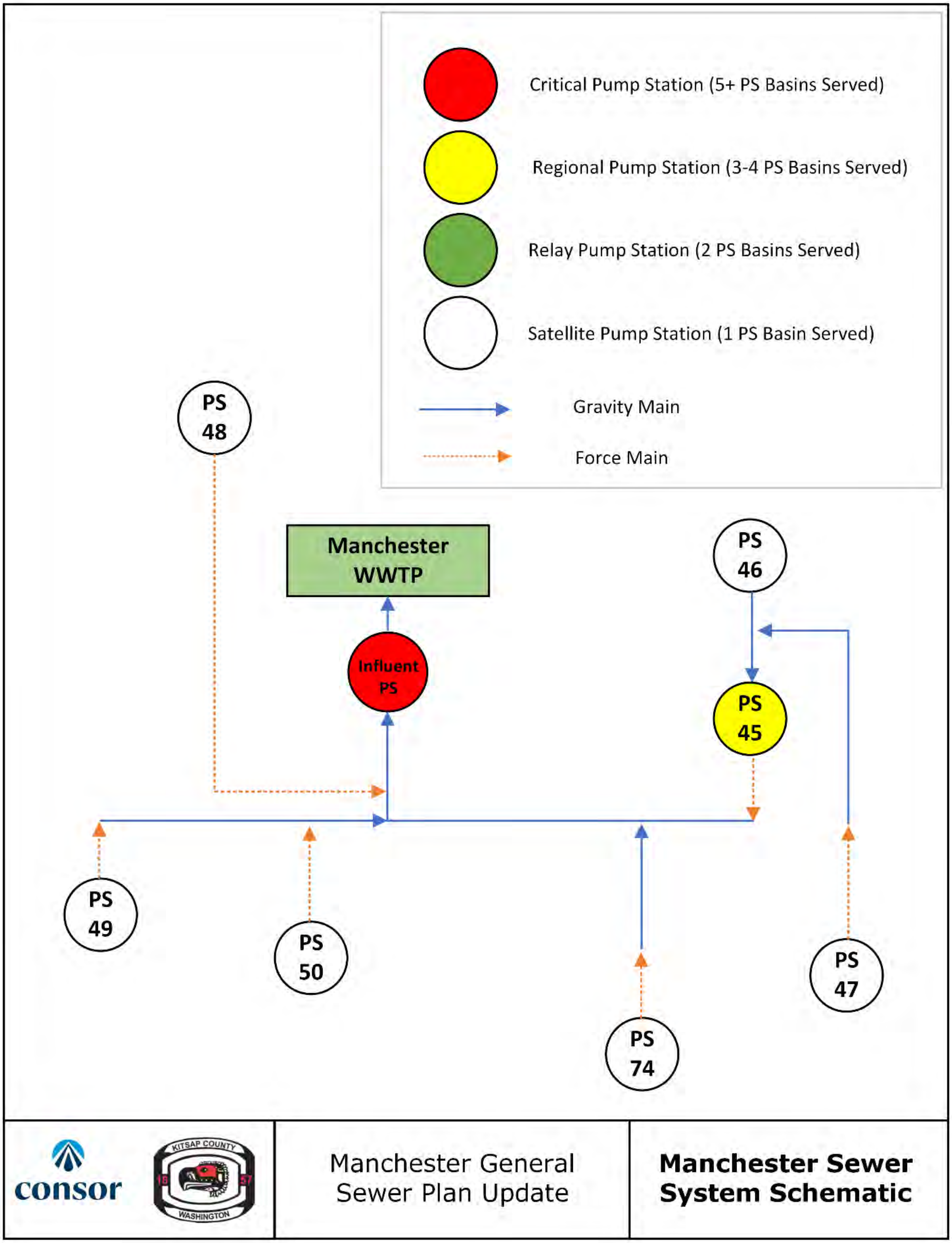
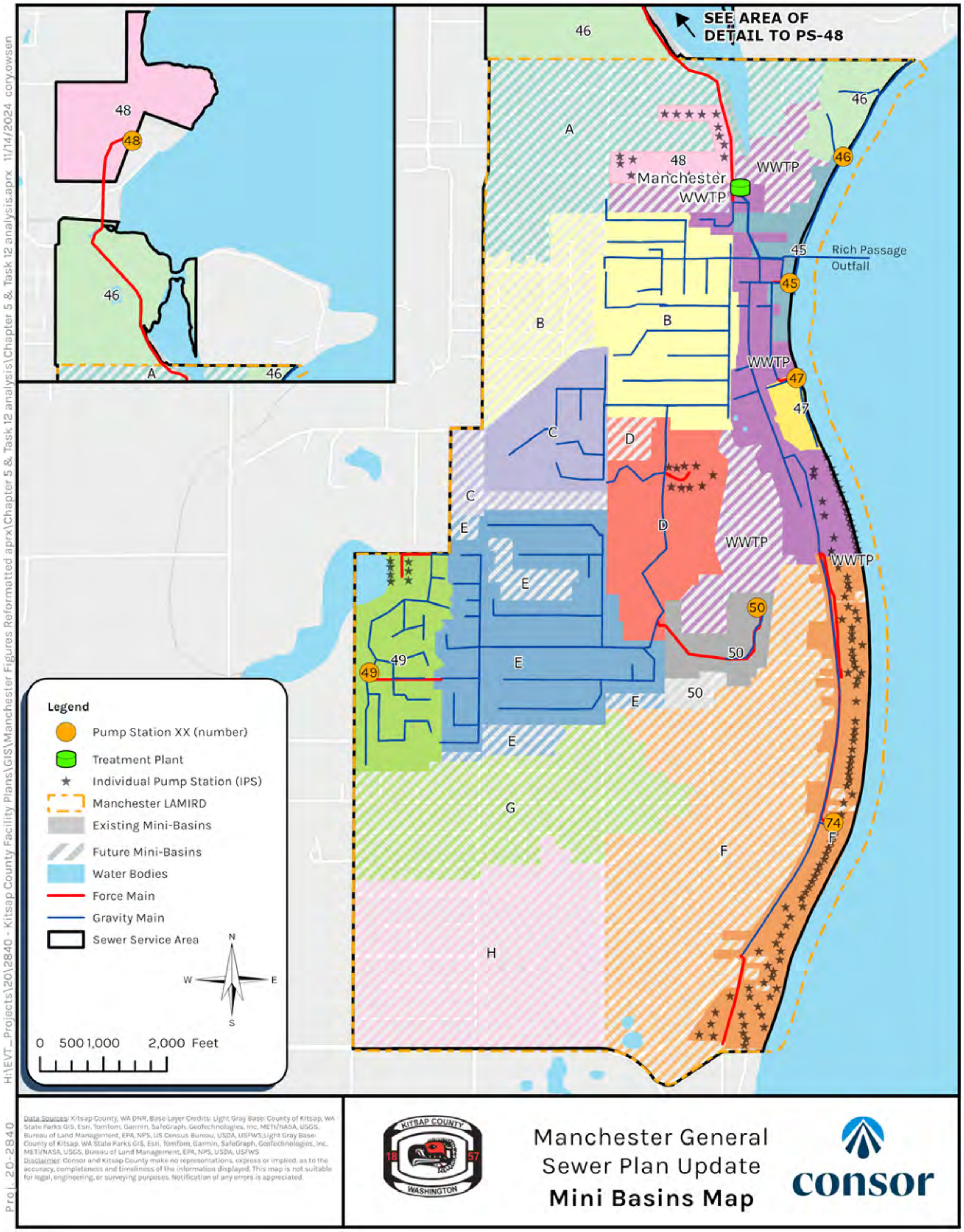


Figure 5-3 | Manchester Mini-Basins



5.2.2 Gravity Sewer

The Manchester sewer system was first constructed in 1969 to serve the Manchester area. The majority of the initial gravity system was constructed of asbestos cement piping but recent installations typically have been polyvinyl chloride (PVC) piping. The County currently maintains approximately 64,000 feet of gravity pipe in the Manchester Sewer System summarized in **Table 5-1**. Pipe lengths are calculated based on GIS data downloaded on the county website in March 2024 An updated total length was also provided by the County's sewer asset count in March 2024. The north end of the system has approximately 4,000 feet of sewer pipe constructed along the beach. Beachline sewers can pose maintenance problems due to beach dynamics and typically have high replacement costs due to difficult construction and permitting.

Table 5-1 | Gravity Sewer Pipe Inventory

Pipe Diameter (in)	Total Length (ft)
6	1,660
8	49,460
10	3,560
12	3,340
14	160
15	3,060
18	1,340
Total Gravity (2024 GIS)	**62,580**
Total Gravity (2024 Sewer Asset Count)	**63,955**

5.2.3 Force Mains

The collection system in Manchester has approximately 16,200 feet of force main pipe. Pipe lengths are approximated from GIS data downloaded on the county website in March 2024. An updated total length was also provided by the County's sewer asset count in March 2024. The force main pipe diameters and lengths are summarized in **Table 5-2** below for each pump station and for the Colchester and Yukon Harbor force mains which serve IPSs. Force main locations are shown in **Figure 5-1** and **Figure 5-3**.

Table 5-2 | Force Main Summary

Pump Station Location	Force Main Diameter (in)	Total Length (ft)
PS-45 - East Daniels Loop Road	4	220
PS-46 - Caraway Street	-	0
PS-47 - East Hemlock Street	4	230
PS-48 - EPA Region 10 Site	6	6,970
PS-49 - 6975 East Van Buren Street	6	820
PS-50 - East Commons Court	4	1,770
PS-74 - Yukon Harbor	6	190
	8	4,230
Colchester Individual Pump Station	2	1,380
Yukon Harbor FM	3	1,000
Privately Owned FM	various	870
Total Force Main Including Private (2024 GIS)		**17,680**
Total Force Main Including Private (2024 Sewer Asset Count)		**16,208**

5.2.4 Individual Pump Stations

There are over 100 individual pump stations within the Manchester basin which are shown on the map in **Figure 5-3**. These systems consist of a relatively small pump basin where the customer's waste stream is masticated and pumped through a small diameter force main to a gravity sewer or force main. The majority of individual pump stations within the Manchester LAMIRD are located along the southeast coastline of the LAMIRD and then pump into the sewer main in Colchester Drive SE.

5.2.5 Odor Control

There are no odor control facilities in the Manchester basin C&C system. There is odor control at the WWTP that is discussing in **Section 6.3.3.8**.

5.2.6 Pump Stations

The collection system includes seven pump stations. PS-45, PS-46, and PS-47 (Daniels, Caraway and Hemlock, respectively) were constructed directly on the beach. These pump stations were upgraded/ replaced in 2017 to move them upland away from the shoreline. PS-48 (EPA Lab) serves the EPA Region 10 Manchester Environmental Laboratory and the National Oceanic and Atmospheric Administration's (NOAA's) Manchester Research Station, Northwest Fisheries Science Center which are located a few miles north of the Manchester LAMIRD. PS-49 (Megan Heights) serves a neighborhood at the central west side of Manchester. PS-50 (Blackstone) was constructed to serve a development in the central portion of the LAMIRD. A summary of each pump station follows, and **Table 5-3** is a summary of the capacity and horsepower at each pump station. There are no pump station overflows to the waters of the State.

- PS-45 (Daniels) – PS-45 is a beachline pump station at the east side of Daniels Street. The pump station pumps directly west approximately 250 lineal feet and discharges into a gravity manhole at the intersection of Daniels and Denniston. PS-46 and PS-47 are tributary to PS-45. PS-45 is equipped with dual Flygt submersible pumps and an on-site emergency generator.
- PS-46 (Caraway) – PS-46 is a beachline pump station at the east end of E Caraway Road. The pump station pumps nearly vertical (approximately 20 feet) and discharges to an adjacent manhole. PS-46 is equipped with dual Flygt submersible pumps and an on-site emergency generator. There are no other pump stations tributary to PS-46.
- PS-47 (Hemlock) – PS-47 is a beachline pump station located at the east end of Hemlock Street and pumps directly west into a gravity manhole at the intersection of Nubling Avenue and Hemlock Street. PS-47 is equipped with dual Flygt submersible pumps and an on-site emergency generator.
- PS-48 (EPA Lab) – PS-48 is located on the EPA Laboratory, Region 10 site. The lab is approximately one mile north of Manchester LAMIRD limits, located on Puget Sound next to the Naval Depot Station. The pump station pumps south to a gravity discharge manhole near the Manchester WWTP. The station is equipped with two Hydromatic pumps (one duty, one standby) and an on-site emergency generator that is owned by the EPA Laboratory.
- PS-49 (Megan Heights) – PS-49 serves the Megan Heights neighborhood in the central west portion of Manchester. The pump station serves approximately 150 single family residences. The station is equipped with two submersible PACO pumps and an on-site emergency generator.

- PS-50 (Blackstone) – PS-50 is a newer pump station that was built to serve the Blackstone Development in central Manchester. Approximately 17 households are served by the pump station. It was originally estimated that approximately 25 single family residences could flow to the pump station at full development.

- PS-74 (Yukon Harbor) – PS-74 was constructed in 2018 and serves approximately 93 homes along Colchester Drive SE, along the south coast of Manchester. The majority of homes served by PS-74 utilize individual pump stations. The station is equipped with dual submersible Flygt pumps that are 23 horsepower (HP) each, and there is room in the pump station to add a third pump when the basin develops. The station is also equipped with an on-site emergency generator.

- Individual Pump Stations – A number of houses in Manchester are also served by individual pump stations, which pump only localized sewage (1-8 houses) into a common private force main.

Each pump station has two pumps to meet the Ecology's requirement for redundancy and remote telemetry that monitors pump run time and links the data to the Central Kitsap WWTP Supervisory Control and Data Acquisition (SCADA) system. All of the pump stations have float alarm signals which are connected to the telemetry system. The pump stations are all served with 3-phase power. Locations of the pump stations are shown on **Figure 5-1** and **Figure 5-3**.

Table 5-3 | Pump Station Summary

Pump Station	Location	Year Built/ Upgraded	Firm Capacity (gpm)	Static Head (ft)	Total Dynamic Head (ft)	No. of Pumps	Pump HP	Mini-Basin Served	Generator
45	East Daniels Loop Road and beach	2017	200	5	21	2	3.7	45	Present
46	Caraway Street and beach	2017	200	5	23	2	2.8	46	Present
47	East Hemlock Street and beach	2017	200	5	16	2	2.8	47	Present
48	EPA Region 10 Site	1979	669	21	69	2	10	48	Present, Owned by EPA Laboratory
49	6975 East Van Buren Street	1979	200	69	92	2	10	49	Present, Updated 2019
50	East Commons Court	2008	150	25	58	2	5	50	None, holding tank
74	Yukon Harbor	2018	379	88	139	2	23	F	Present

Note:
gpm = gallons per minute

5.3 Pump Station Condition Assessments

The County is concurrently developing Plans for their other sewer basins (Central Kitsap, Kingston, and Suquamish). Those planning documents include discussions of pump station condition assessments. No Pump Station Condition Assessments were completed for the Manchester basin, however. All of the stations are considered by County staff as being in good condition and several have been recently updated. Therefore, no condition assessment is necessary.

5.4 Pipeline Condition Assessments

The County has historically conducted pipeline condition assessments through video observation. This process entails inspecting pipes via closed circuit television (CCTV), storing the video in a database, reviewing the video, and assigning an overall condition index (OCI) score based on the observations. The results of these assessments are stored in the County's asset management database software, Cartegraph, since 2017. The County is on a five-year inspection cycle with about 20 percent of the pipes inspected each year. As of this writing, 100 percent of the collection system has been inspected and an evaluation has been stored in Cartegraph.

The County uses consistent scoring criterion when reviewing pipeline inspection videos with several criteria, which is summarized in **Table 5-4**. Each criterion has a defined score corresponding to the severity of the observed issue, if any. Lower scores indicate more severe issues based on this scoring methodology. Note that "Roots" and "I&I" have a weighting of zero which excludes these criteria from the OCI. The County captures information so that it can be filtered and viewed in Cartegraph, but other categories describe the actual pipe conditions. For example, a pipe with roots present would also be scored under the obstruction or intrusion category. The OCI is calculated by this equation:

$$OCI = \frac{\sum_{pipe}(Category\ Value\ x\ Calculation\ Weight)}{\sum_{pipe} Calculation\ Weight}$$

Table 5-4 | OCI Criteria and Weighting

Category	Value	Description	Calculation Weight
Roots	0	Blockage	0
	30	Heavy	
	50	Medium	
	80	Light	
	100	None	
I & I	40	Gushing or Spurting	0
	60	Running or Trickling	
	80	Weeping or Dripping	
	90	Stain, Possible I&I	
	100	None	
Obstruction or Intrusion	0	Severe or Impassable	1
	60	Moderate	
	80	Minor	
	100	None	

Category	Value	Description	Calculation Weight
Worn Surface	40	Severe	1
	60	Moderate	
	80	Minor	
	100	None	
Belly or Sag	40	Severe (>30%)	1
	60	Moderate (10 to 30%)	
	80	Minor (<10%)	
	100	None	
Cracks or Fractures	40	Severe Cracking	3
	60	Moderate Cracking	
	80	Minor Cracking	
	100	None	
Break or Failure	0	Collapse	5
	15	Hole Void Visible	
	30	Hole Soil Visible	
	100	None	
Lining or Repair Failure	40	Severe	1
	60	Moderate	
	80	Minor	
	100	None	
Joint Separation or Offset	40	Severe (> 1.5 Pipe Thickness)	2
	60	Moderate (1 to 1.5 Pipe Thickness)	
	80	Minor (< Pipe Wall Thickness)	
	100	None	

The County provided OCI scores for approximately 11,100 feet of pipe in the Manchester basin. This data is included as **Appendix C**. Because only pipes with noted deficiencies were input into Cartegraph, it is assumed that inspected but unscored pipes have an OCI of 100. Discussions with County staff indicate that the pipes inspected and documented in Cartegraph are representative of the entire system. For planning purposes, the lengths of pipe in each OCI range have been extrapolated and are summarized in **Table 5-5**. The rankings of all County-owned pipelines in the Manchester basin have an OCI score higher than 60; therefore, there will be no prioritizations nor projected annual costs for pipeline replacement in the CIP for this basin.

Table 5-5 | Percentage of Pipes in OCI Condition Ranges

OCI Range	Length (ft)	Percentage of Total
0-20	-	0%
20-40	-	0%
40-60	-	0%
60-80	225	<1%
80-99	7,369	12%
100	63,955	88%

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SECTION 6

Wastewater Treatment Facilities Existing Conditions

6.1 Introduction

A description of the existing WWTP field evaluation and condition assessment, the capacity analysis of the plant facilities and processes, and an evaluation of each process to identify any deficiencies is presented in Section 6. Recommendations are provided to address challenges impacting facility operations along with maintenance upgrades necessary to continue meeting NPDES Permit requirements.

6.2 Existing Wastewater Treatment Plant Description

The original Manchester WWTP was constructed in 1969 with primary treatment only and had a capacity of treating 0.16 MGD. In 1985, upgrades to secondary treatment began in accordance with the Clean Water Act. Phase 1 of the upgrade was completed in 1991 and provided 0.23 MGD of treatment with primary clarification, Sequencing Batch Reactor (SBR) aeration basins, and a chlorine contact basin. The sludge digester operation was converted to sludge storage in 1991. The most recent major treatment plant update, Phase 2, occurred in 1998 when plant capacity was increased to 0.46 MGD and upgraded to a conventional activated sludge treatment system. This upgrade replaced the influent pumping station, added headworks, retrofitted the aeration basins to create an anaerobic selector, added two secondary clarifiers, added UV disinfection to replace the chlorine contact basin, added additional sludge storage and thickening, and replaced the sludge loading facility. Treated effluent is discharged to the Rich Passage of the Puget Sound in accordance with the NPDES Permit. Biosolids are thickened using a GBT and hauled to the Central Kitsap WWTP for treatment. The Manchester WWTP site plan is shown in Figure 6-1.

Manchester WWTP is one of the highest performing WWTPs in Washington state and has constantly met all effluent limits since it was commissioned. Figure 6-2 shows the process schematic of the current Manchester WWTP.

Figure 6-1 | Existing Manchester WWTP Site Plan

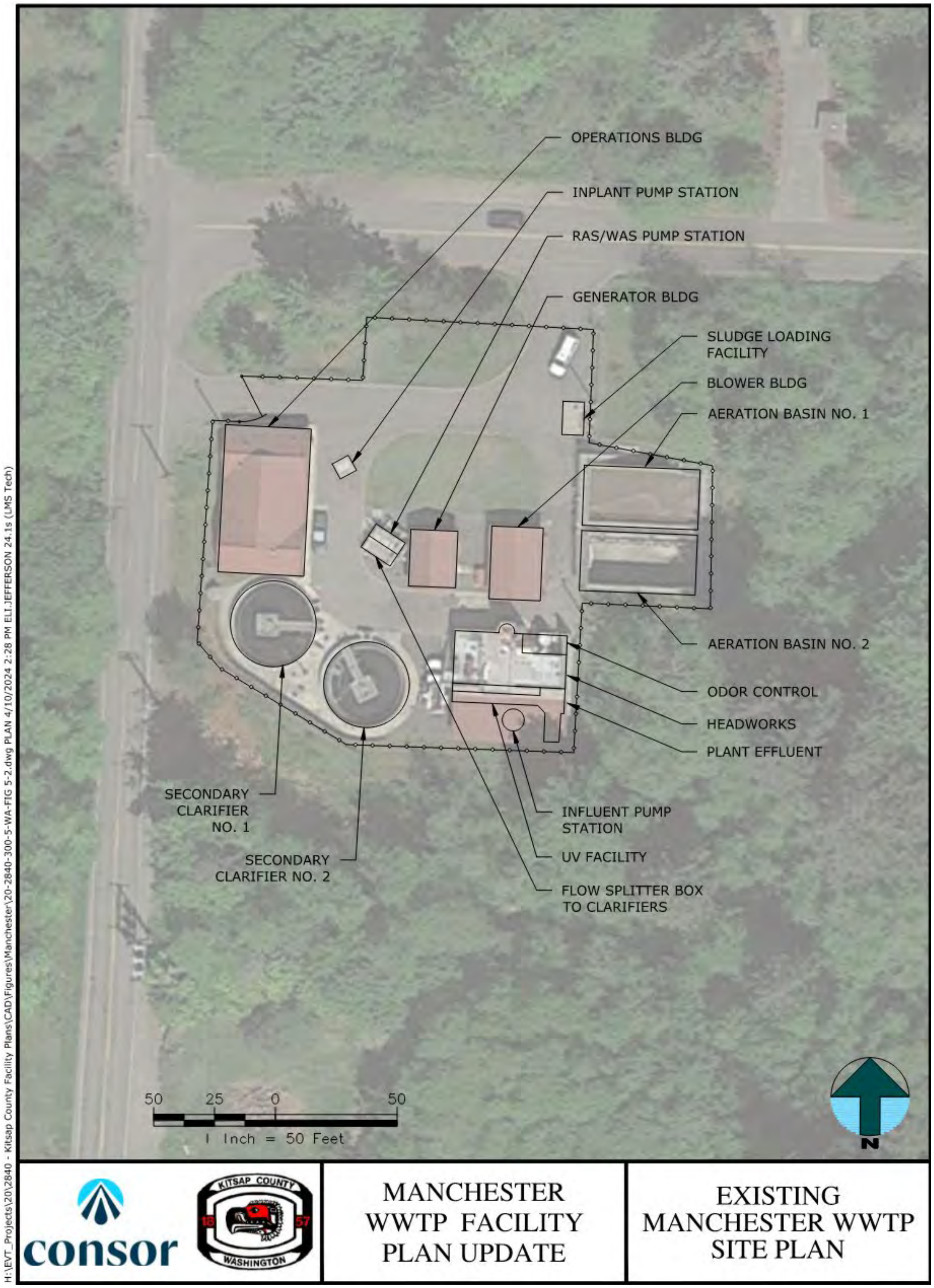
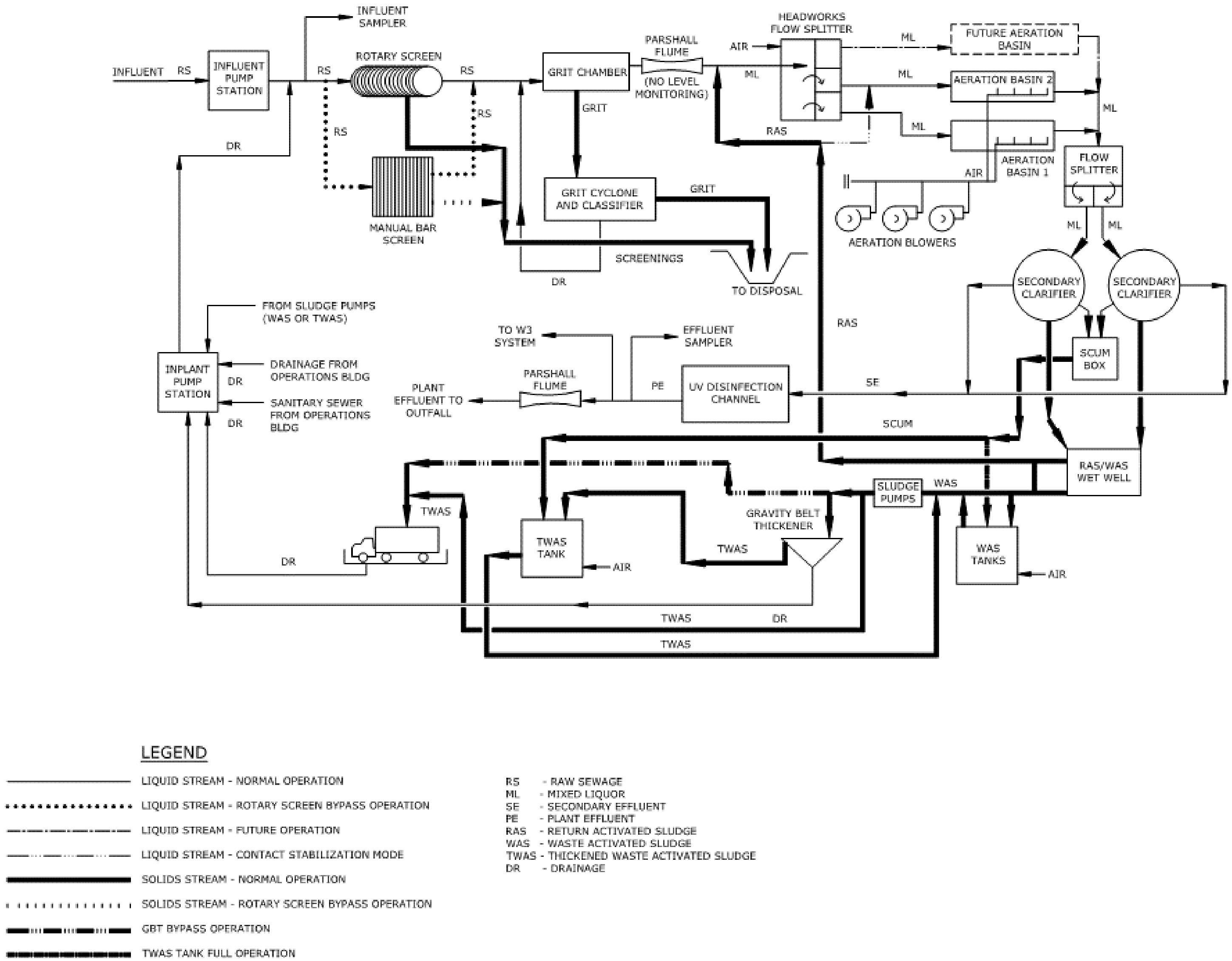


Figure 6-2 | Existing Manchester WWTP Schematic



6.3 Wastewater Treatment Plant Condition Assessment

The Murraysmith [now Consor] team visited the Manchester WWTP on September 14, 2020 to observe and document existing plant conditions and to have discussions with plant staff regarding operational and plant performance challenges. The group investigated facilities and unit processes for the liquid streams and solids streams by walking through each process to ascertain equipment condition and manufacturing information. Plant electrical equipment and structures were observed. Plant staff provided information on the daily operations of the plant, as well as past and current operational challenges. The information gathered from the assessment was used to develop a list of recommendations for maintaining plant operations and performance. The major equipment information, photos and field notes are summarized in **Appendix D**.

6.3.1 Condition Summary Tables

To better organize the results of the assessments at the Manchester WWTP, major processes were grouped as presented in **Table 6-1**.

Table 6-1 | WWTP Process Group Definitions

Process	Components
Civil	Site, site security, roadways, sidewalks, fencing
Preliminary Treatment	Screens and grit removal and associated equipment and piping
Secondary Treatment	Aeration basins and associated equipment and piping
Disinfection and Effluent	UV system and effluent Parshall flume
Solids Treatment	GBT, Waste Activated Sludge (WAS) storage tank, Thickened Waste Activated Sludge (TWAS) storage tank, and associated equipment and piping
Support Systems	Odor control and plant water system
Power Distribution	Electrical services, transfer switches, standby generator, motor control centers and control panels

These processes were further broken down into several categories when appropriate. While no two processes are identical, the processes are anatomically similar and can be characterized by a standardized set of component groupings. These component groupings are consistent with County Asset Functional Class Levels and are presented in **Table 6-2** along with definitions. Note that the Asset Functional Class Level has nine groups: Civil, Structural, Piping Systems, Pump Systems, Valve System or Assemblies, Equipment, Support Systems, Instrumentation, Power Distribution. However, for the WWTP conditions assessments, the components are narrowed down to four groups, which are more directly applicable to the wastewater treatment processes. Civil, Power Distribution and Support Systems are treated as processes; Piping and Valves are grouped together; Pumps are grouped with Equipment.

Table 6-2 | Component Group Definitions

Component Grouping	Definitions
Equipment	Mechanical equipment such as screens, pumps, and blowers. Equipment and motors are treated as one asset unless the motor is 25 HP or larger.
Instrumentation	Electrical and measuring devices such as flowmeters, transmitters, and indicators.
Structural	Concrete structures such as buildings, basins, and tanks.
Piping	A system of pipes and valves used to convey fluids such as influent, effluent, chemical, air and sludge.

6.3.2 Treatment Plant Process Asset Health Score

To better inform the County's prioritization of future asset upgrades and replacements, an overall treatment plant process "Asset Health" score was developed that synthesizes each process's existing likelihood of failure (condition) and consequence of failure (CoF).

Individual condition scores for equipment, instrumentation and piping systems consider each system's physical integrity and their current ability to perform as designed. For structural components, individual condition ratings generally apply to the physical integrity of these assets in the face of material degradation due to environmental forces such as corrosion, weathering, settling, and flooding. General observations and historical accounts from County O&M staff were also used to inform the condition ratings for all treatment plant process components in an effort to incorporate conditions not observed by Murraysmith [now Consor] staff during the site visits. Examples of this historical information from O&M staff include, but are not limited to, challenges associated with equipment operation, lack of redundancy and lack of automation. Individual condition ratings range from 1 to 5, with a score of 1 representing the best condition and a score of 5 representing the worst. **Table 6-3** presents the definition of the condition scores. It is important to note that condition scores are not simply reflections of age as dissimilar environmental and operational factors among the Manchester WWTP necessitate differing rates of condition degradation. Although age/obsolescence is not accounted for in the condition assessment, it will be a consideration for development of the 20-year CIP so that replacement of aging infrastructure is accounted for and can be budgeted.

Table 6-3 | Component Condition Scores Definitions

Condition Rating	Definition
1	Very Good, well maintained, expected to remain reliable for more than 90% of the expected life.
2	Good, some degradation but performance and reliability are not significantly affected. Performance and reliability expected to remain satisfactory for 50-90% of the expected life.
3	Fair, performance and reliability are still acceptable, but some rehabilitation or replacement will be needed in the 50% +/- of the expected life.
4	Poor, performance and/or reliability has significantly decreased, maintenance rehabilitation or replacement needed to restore performance or reliability to acceptable levels. Failure (no longer functions) is likely in 10-50% of the expected life if not rehabilitated or replaced.
5	Very poor, performance and/or reliability has significantly decreased, and failure is probable within 10% of the expected life if rehabilitation or replacement is not performed.

Individual CoF ratings for process components are based on a consideration of the effects of failure of each component within the context of the local process. Individual CoF ratings range from 1 to 5, with a score of 1 representing the lowest consequence and 5 representing the highest. **Table 6-4** presents the definition of the CoF scores.

Table 6-4 | Component Consequence of Failure Definitions

CoF Rating	Definition
1	Not Managed. Failure would not affect the treatment plant operation.
2	Not Critical. Could marginally reduce the treatment performance
3	Important (Critical but redundant). The treatment plant performance is significantly impacted without a currently installed redundant component.
4	Critical. The treatment plant performance is significantly impacted upon failure.
5	Highly Critical. Failure will cause an immediate loss of hydraulic throughput.

To fully develop an overall treatment plant process score, the individual condition and CoF scores of each process were considered within the larger context of the Manchester WWTP. To accomplish this, an overall treatment plant process CoF score (from a plant-wide perspective) is applied to an overall condition score for each unit process. The definition of the overall unit process CoF scores are the same as the definition of the component CoF scores.

Overall condition scores for each process are weighted by component CoF and are defined as the quotient of the sum of the products of individual component condition and CoF scores and the sum of individual component CoF scores. This scoring is represented symbolically as follows:

$$Overall\ Condition\ Score = \frac{\sum_{Components}(Condition\ Score\ \times CoF\ Score)}{\sum Individual\ CoF\ \ Scores}$$

This overall condition score is then scaled by the process CoF score to obtain the overall treatment plant process score:

$$Asset\ Health\ Score = Overall\ Condition\ Score\ \times Unit\ Process\ CoF\ Score$$

The results of the analysis described in the preceding paragraphs are summarized in **Table 6-5** and detailed in **Table 6-6**. The Asset Health Score will be used to rank the projects in the CIP.

Table 6-5 | Treatment Plant Process Asset Health Summary

Unit Process	Unit Process CoF Score	Overall Condition Score	Asset Health Score
Civil	1	2.0	2.0
Influent Pumping	3	2.4	7.2
Preliminary Treatment	3	2.4	7.2
Secondary Treatment	5	2.9	14.5
Disinfection and Effluent	3	3.1	9.3
Solids Treatment	3	2.0	6.0
Support Systems	3	3.2	9.6
Power Distribution	5	2.6	13.0

Table 6-6 | Treatment Plant Process Condition Assessments

Unit Process[1]	Asset Health Score	Process Component	Condition	CoF	Year Installed/Upgraded	Notes	Recommendations
Civil	2.0	Overall	2.0	1.0		➢ The fence is in good condition ➢ The site has well maintained landscaping, providing clear visibility of the site from the road	➢ Consider adding an automatically opening gate, intrusion alarms, and video surveillance
Influent Pumping	7.2	Overall	2.4	3.0	2015, 1998	➢ The influent pumps are 6 years old and are expected to meet the typical lifespan of 25-30 years.	➢ None
		Equipment	2.0	3.0			
		Instrumentation	2.0	2.0			
		Structural	3.0	4.0			
		Piping	NA	NA			
Preliminary Treatment	7.2	Overall	2.4	3.0		➢ The grit trap has moderate corrosion on the motor flange connection ➢ The grit cyclone and classifier feed box has severe corrosion ➢ The channel aeration blower has some minor surface corrosion ➢ No level sensor at the influent Parshall flume	➢ General maintenance practice to mitigate corrosion ➢ Consider replacing grit classifier feed box ➢ Add level sensor at Parshall flume to resume flow monitoring function
		Equipment	2.9	2.5	1998		
		Instrumentation	NA	NA	1998		
		Structural	2.0	2.7	1998		
		Piping	NA	NA			
Secondary Treatment	14.5	Overall	2.9	5.0		➢ Manual process control is difficult ➢ Jet aeration cannot be optimized because of a lack of control and efficiency in the system ➢ The drive of Secondary Clarifier No. 1 has some minor corrosion ➢ The weir caulking is showing wear ➢ The clarifiers have potential capacity issues ➢ Some minor discoloration around the hatches	➢ General maintenance practice to mitigate corrosion ➢ Upgrade jet aeration system and process ➢ Replace blowers with AFDs ➢ Add WAS flow meter and control valve
		Equipment	3.8	3.0	1998, 1991		
		Instrumentation	NA	NA			
		Structural	2.0	3.2	1998, 1991		
		Piping	3.0	4.0	1991		
Disinfection and Effluent	9.3	Overall	3.1	3.0		➢ Plant staff are cleaning the lamps manually ➢ The basic controller of the UV system cannot turn on or off the bank based on the flow signal	➢ Replace entire UV system for improved control in the next 2 to 10 years
		Equipment	3.3	3.3	1998		
		Instrumentation	3.0	3.5	1998		
		Structural	3.0	2.0	1998		
		Piping	NA	NA			
Solids Treatment	6.0	Overall	2.0	3.0		➢ LEL sensors in the WAS and TWAS storage tanks did not function and have been removed ➢ Frequent ragging of the WAS tanks diffusers if the sludge tank blower air is turned off ➢ The belt ploughs, magnetic flowmeter, and sludge feed piping and fittings are showing moderate corrosion ➢ The GBT room had a very strong odor, indicating that the heating, ventilation, and air conditioning (HVAC) system may be underperforming	➢ Replace LEL sensors ➢ Evaluate ventilation in GBT room to minimize corrosion. Keep a spare flowmeter ➢ Monitor the TWAS tank exterior hairline crack ➢ Install fire alarm system at GBT room
		Equipment	2.2	3.0	2000, 1998		
		Instrumentation	2.6	2.5	2009, 1998		
		Structural	1.7	3.7	1998		
		Piping	1.7	3.0	1998		
Support Systems	9.6	Overall	3.2	3.0		➢ The odor control system is only partially operational; pH is not monitored or adjusted and ORP is not monitored ➢ The in-plant pump station pumps have reached their expected lifespan and will likely need to be replaced soon ➢ The floor of the W2 system was very wet ➢ P-901 of the W3 system looks to be in poor condition with some corrosion on the piping, and a smaller discharge pipe than on P-902; the floor near the W3 system was very wet (potentially coming from the W2 system); the automatic strainer, piping and some valves showed significant corrosion. Per the plant operator, the automatic strainer is currently not in use and the W3 flow meter is not working	➢ Repair or replace the odor control system to restore automatic operation and full functionality ➢ Inspect and consider replacing the in-plant pumps ➢ General maintenance practice to mitigate corrosion of W2 and W3 system ➢ Replace existing automatic strainer and flow meter
		Equipment	3.5	2.1	1998		
		Instrumentation	5.0	1.0			
		Structural	2.3	2.0	1998		
		Piping	2.8	1.3	1998		
Power Distribution	13.0	Overall	2.6	5.0		➢ The ventilation of the electrical room in the Operations Building appears to be inadequate for the space ➢ The ATS although in good condition, is obsolete and parts are not readily available by the manufacturer, as well as the AFD's ➢ Some controllers are obsolete and non-operational ➢ Some panels show signs of rust and corrosion and chemical entrance ➢ A large junction box in influent pump station wetwell area appears to be located in a hazardous location and not installed properly	➢ Consider additional cooling for electrical room in the Operations Building ➢ Complete arc flash study ➢ Establish replacement plan for obsolete ATS, AFDs and controllers ➢ Clean and coat rusted areas ➢ Re-evaluate installation of TJB-WP1 to bring it up to current NFPA standards ➢ Plan to replace most of the electrical components in the next 12-15 years
		Equipment	3.1	3.3	2018, 1998, 1997, 1991		
		Instrumentation	NA	NA			
		Structural	2.0	3.0	1998		
		Piping	NA	NA			

Note:
1. See **Table 6-1** for major equipment included in each unit process

6.3.3 Evaluation of Components

The following sections describe in more detail the current treatment plant components. Following the description of each major process component is an outline of the observations made by the Murraysmith [now Consor] team and a list of recommended improvements. At the end of the section, **Table 6-19** summarizes the major unit process condition, capacity, and recommendations.

6.3.3.1 Civil

The Manchester WWTP is secured by a uniform chain link fence with barbed wire. Site access is through a manual gate. There is no video surveillance onsite.

Observation: The fence is in good condition, and the site has well maintained landscaping, providing clear visibility of the site from the road.

Recommendation: The County may want to consider adding an automatically opening gate, intrusion alarms and video surveillance.

6.3.3.2 Influent Pumping

Flow enters the plant through the influent pump station, which is in the same area as the UV facility. Three influent pumps (2 duty, 1 standby) lift raw sewage into the headworks where sewage then flows by gravity through the remainder of the treatment processes. The influent pump station was replaced in 1998 during the plant retrofit. The three influent pumps were replaced in 2015 with Flygt submersible pumps with adjustable frequency drive (AFD) pumps. The influent pumps are controlled to maintain a constant sewage depth level in the wetwell, which is monitored by an ultrasonic level sensor and backup floats.

Observation: The influent pumps were installed in 2015. Due to ongoing operations, the influent pump station structure was not drained or accessed for inspection during the site visit. The structure exterior looks to be in good condition based on visual inspection only. Plant staff reported that the Flygt pumps work well, with little downtime, and no maintenance concerns. The influent pumps are 6 years old and are expected to meet the typical lifespan of 25-30 years. The pumps are estimated to have approximately 50-90 percent of their expected serviceable life remaining (13-27 years).

Recommendation: None.

6.3.3.3 Preliminary Treatment

The headworks facility is a two-story above grade concrete structure that was constructed in 1998. Headworks consists of influent composite sampling, a rotary screen, manual bar screen, Parshall flume, grit removal, aerated channel, and flow splitter. Raw sewage is pumped from the influent pump station to the headworks structure. Plant drainage from the in-plant pump station combines with the raw sewage forcemain prior to entering the headworks structure.

Raw sewage enters the headworks into a channel where an automatic sampler takes composite influent samples. This influent channel splits to two channels; one with a rotary screen and one with a manual bar screen. Raw sewage normally flows through a channel with a ¼-inch rotary screen. A separate channel with a 1-inch manual bar screen bypasses the rotary screen. Both screen channels can be isolated with manual gates for inspection and maintenance. After screening, raw sewage enters a vortex-type grit chamber. The grit removal system can be isolated with manual gates, and the plant can continue operating with flow bypassing directly from the influent screens to the headworks flow splitter. Degritted wastewater passes through a 12-inch Parshall flume which is not currently monitored for influent flow rate. After the Parshall flume, wastewater flows through a headworks aerated channel aerated by coarse bubble diffusers for mixing return activated sludge (RAS) with raw sewage. RAS enters the headworks upstream of the aerated channel which is part of the headworks flow splitter. The headworks aerated channel is aerated by one channel aeration blower located on the lower level of the headworks building and can be isolated but not bypassed. Mixed liquor (ML) exits the headworks aerated channel to a flow splitter box, where it exits by two separate 12-inch diameter pipes, one to each aeration basin. The headworks channels are not coated.

Influent screenings removed by the rotary screen are washed, compacted, and then discharged into a dumpster for offsite disposal. Grit collected at the bottom of the grit chamber is transferred by one grit pump to a grit cyclone and 12-inch inclined screw grit classifier where the grit is washed and then discharged into the same dumpster as the influent screenings. The influent screenings and grit are disposed as solid waste.

Observations and recommendations for each major headworks process component are outlined below.

6.3.3.3.1 Influent Rotary Fine Screen

Observation: The ¼-inch rotary screen was installed in 1998. The rotary screen is in fair condition with no visible exterior corrosion, performance issues, or maintenance concerns reported by plant staff. The screening chute and dumpster are both in good condition with no visible corrosion or leaks. Plant staff reported no issues with the rotary screen. The influent rotary screen is 23 years old with no noted performance issues or significant visible degradation; therefore, it is expected to exceed its typically expected lifespan of 25-30 years. It is expected that the equipment may have half of its anticipated serviceable life remaining (12-15 years) but will likely require rehabilitation to maintain performance during this period, prior to replacement.

Recommendations: The corroded areas of the fine screen should be cleaned and coated to prevent further degradation of the equipment.

6.3.3.3.2 Influent Manual Screen

Observation: The 1-inch manual bar screen was not observed in the channel. The plant staff reported no issues with the manual screen.

Recommendation: None.

6.3.3.3.3 Grit Removal

Observation: The grit chamber was installed in 1998. The exterior concrete structure and cover plates appear to be in very good condition with no visible exterior corrosion. The grit trap equipment is in fair condition with moderate corrosion on the motor flange connection.

The grit cyclone and classifier were installed in 1998. They are located on the headworks upper level. This equipment is in fair condition with the feed box showing severe corrosion. Rust has eaten through the body of the feed box. This corrosion will not cause leaking from the equipment but allows odors to escape the equipment and will eventually cause the equipment to leak and malfunction. It was noted that at the Kingston WWTP, the same grit classifier is used, and the feedbox has been replaced with a custom fabrication.

The grit pump was installed in 1998. The grit pump and piping appear to be in fair condition with no visible exterior corrosion. Plant staff reported that the grit removal system is operating well, with no outstanding performance or maintenance issues.

The grit equipment is 23 years old with no noted performance issues or significant visible degradation; therefore, it is expected to exceed its typically expected lifespan of 25-30 years. It is estimated that the equipment may have half of its expected serviceable life remaining (12-15 years).

Recommendations: Add a level sensor at the Parshall flume to resume flow monitoring function. The corroded area on the grit chamber should be scraped, cleaned, and repainted to mitigate further corrosion. The grit classifier feedbox should be replaced.

6.3.3.3.4 Aerated Channel and Flow Splitter

Observation: The aeration channel and flow splitter were installed in 1998 with the rest of the headworks facility. The exterior of the channel and flow splitter are in good condition. The channel and splitter interior and coarse bubble diffusers could not be inspected during the site visit. Plant staff noted that the aeration channel can only be emptied by stopping RAS and influent pumping, storing influent in the wetwell, and allowing the aerated channel to empty into the aeration basins. During the summer months, the wetwell may provide a maximum of two hours of storage volume during the lowest flow period of the day, which will allow quick inspection and diffuser repair. Plant staff reported no operational or performance issues with the aerated channel and flow splitter; therefore, the inability to drain the isolation chamber without shutting down the influent pump station does not appear to be an issue.

Recommendation: None.

6.3.3.3.5 Aerated Channel Blower

Observation: The channel aeration blower was installed in 1998 and is in fair condition with some minor surface corrosion. The aeration channel blower is 23 years old with no noted performance issues or significant visible degradation; therefore, it is expected to exceed its typically expected lifespan of 25-30 years. It is estimated that the equipment may have half of its expected serviceable life remaining (12-15 years).

Recommendations: Clean and coat the corroded areas of the blower to prevent further degradation.

6.3.3.4 Primary Treatment

There is no primary treatment at the Manchester WWTP. Effluent from the headworks flows directly to the aeration basins.

6.3.3.5 Secondary Treatment

Headworks effluent is split into two aeration basins. The aeration basins provide secondary treatment by an activated sludge biological process. The aeration basins were originally constructed in 1991 as SBRs and have a volume of 16,840 cubic feet each. The basins were retrofitted in 1998 with relocated ML feed point into a baffled chamber in each aeration basin to create an anaerobic selector, but the anaerobic selectors did not function properly and were subsequently removed. The aeration basin decanters were replaced with a weir box in each aeration basin in 1998.

Air is supplied to the aeration basins by three constant-speed, 15-HP positive displacement blowers (two duty, one standby) in the adjacent Blower Building. Basin aeration is accomplished by a jet mixing system which includes one 15-HP submersible mixing pump in each aeration basin with piping and nozzles. The piping manifold injects air into a stream of ML, and nozzles mix the basin to integrate the aerated stream and maintain a desired DO level in the basin. The blowers and jet aeration system were installed in 1991.

From the aeration basins, flow is conveyed to a flow splitter located with the RAS/WAS pump station wetwell structure. The flow splitter evenly divides the flow to the secondary clarifiers. The secondary clarifiers were constructed in 1998, are circular 35-foot diameter structures with 13-foot side wall depth, with a total surface area of 1,925 square feet (SF). The clarifiers each have a central drive unit, center column and feed well, spiral rake arm, scum scraper, scum box, scum pit, effluent weirs, and inboard launder. Process water is sprayed onto the surface of the secondary clarifiers along the walkway to reduce foaming. ML separates in the clarifier, and the active biomass settles to the bottom of the clarifier while treated secondary effluent flows over the v-notch effluent weir.

Settled sludge flows by gravity from the bottom of each secondary clarifier through a 6-inch diameter pipe to the RAS/WAS wetwell. The RAS/WAS wetwell is divided with one RAS pump on each side. Each clarifier drains sludge to one side of the wetwell. Each RAS pump is dedicated to a clarifier, and the wetwell is divided so they cannot operate interchangeably. There is no installed spare RAS pump, but the plant keeps a shelf spare. Manual valves can be operated to return RAS to the headworks either upstream or downstream of the headworks splitter box, or waste sludge to the WAS tanks in operations building. RAS pumping is automatic and controlled to be flow-proportionate to effluent flow by the RAS flow meter but pumping to the WAS tank is not metered and is manually controlled. A portion of the activated sludge is removed from the system as WAS each morning, Monday through Friday. The volume wasted is calculated based on mean cell residence time (MCRT) and TSS concentration. WAS is not metered so the volume wasted is calculated by the level change in the WAS tanks.

The secondary clarifiers are equipped with a scum scraping mechanism that removes scum from the surface of the clarifiers. The scum is pushed into a scum trough that drains into a common scum pump station adjacent to the clarifiers. From the scum wetwell, a submersible scum pump normally pumps scum into the TWAS tank and can also pump scum into the WAS tanks if the TWAS tank is full or out of service. The scum pump must be turned on manually and will turn off based on a low-level switch in the scum wetwell.

Observations and recommendations for each major process component are outlined below.

6.3.3.5.1 Aeration Basins

Observation: The aeration basins concrete structures, walkways, and effluent weirs all appear to be in good condition. The aeration basins currently have sufficient capacity to be operated one at a time, and operation is alternated once per year. During the site visit on September 14, 2020, the north aeration basin (Aeration Basin No. 1) was empty, and the south aeration basin (Aeration Basin No. 2) was operating.

Recommendation: None.

6.3.3.5.2 Aeration Blowers

Observation: The blowers were installed in 1991 and appear to be in fair condition. They are currently operated on a time basis, typically 4 hours on and 2 hours off, or 3 hours on and 3 hours off. DO is not continuously monitored but is manually measured every morning with a portable DO probe, and in the summer is also measured in the afternoon. DO concentration in the basins is usually above the target concentration 1.0 mg/L.

Staff reported that the blowers function properly and do not require excess maintenance; however, the process control without automation is difficult. The blowers are 30 years old. It is estimated that the equipment may have about 2 to 10 years of remaining life.

Recommendation: Replace the blowers with variable speed blowers with continuous DO monitoring in the basin to allow easier and more reliable process control. The automated process aeration control is necessary to meet the future nitrogen removal permit requirements. This will also help save energy.

6.3.3.5.3 Jet Aeration System

Observation: The jet aeration system was installed in 1991 and is in poor condition. Murraysmith [now Consor] staff observed the jet aeration system in the empty north aeration basin on September 14, 2020. Staff reported that the system does not have maintenance issues, but aeration cannot be optimized because of a lack of control and efficiency in the system.

The jet aeration system and pumps are 30 years old and have nearly reached the end of their typically expected lifespan of 25-30 years. It is estimated that the equipment may have 10-50 percent of its expected serviceable life remaining (2-10 years).

Recommendation: Along with replacing the aeration basin blowers, the County should consider replacing the jet system with fine bubble diffusers and adding continuous DO monitoring, similar to the aeration basins at the Central Kitsap WWTP. This will allow for more efficient and better controlled aeration in the basins and enhanced operational capabilities that are necessary to meet nutrient removal permit requirements.

6.3.3.5.4 Flow Splitter

Observation: The flow splitter was constructed in 1991. The flow splitter could not be drained for observation but appears to be in good condition. Plant staff reported that the flow splitter provides an even split between secondary clarifiers.

Recommendation: None.

6.3.3.5.5 Secondary Clarifiers

Observation: The secondary clarifiers were constructed in 1998. The concrete structures and walkways are in very good condition. The scraper drives are in fair condition, with some minor corrosion appearing on the drive of Secondary Clarifier No. 1. Both clarifiers were in operation, but visible center column, scraper, and weir components appeared to be in good condition. The weir caulking is showing wear.

Plant staff reported that the clarifiers do not have performance or maintenance issues, but there are potential capacity issues. In the winter, both clarifiers are operated to meet plant capacity requirements, with high volumes of I&I causing occasional overloaded flow to the clarifiers in the winter.

The clarifier drive equipment is 23 years old with no noted performance issues or significant visible degradation; therefore, it is expected to exceed its typically expected lifespan of 25-30 years. It is estimated that the equipment may have half of its expected serviceable life remaining (12-15 years).

Recommendations: Clean and coat the corroded areas on the clarifier drive be to prevent further degradation. Replace secondary clarifier weir caulking during clarifier downtime. Scrape and paint corroded areas on the clarifier drives.

6.3.3.5.6 RAS/WAS Pumping

Observation: The RAS/WAS pump station and wetwell were constructed in 1998. Pump station concrete, hatches, and handrail appear to be in good condition. The wetwell was in operation during the site visit and could not be drained for inspection, but the hatches were opened, and the exposed concrete was in good condition with some minor discoloration around the hatches. There are two RAS pumps which were replaced in 2020 with variable speed Flygt submersible sewage pumps. The exposed piping, valves, and flow meters appear to be in good condition. The RAS flowmeters were replaced with new meters in approximately 2010.

Plant staff reported no performance or maintenance issues with operating the RAS pumping system.

Recommendation: Add WAS flow meter and control valve improve sludge wasting control.

6.3.3.5.7 Scum Pump and Wetwell

Observation: The scum wetwell, pump, and piping were constructed in 1998. The wetwell concrete and hatch are in good condition. The wetwell was opened and observed but not drained. The submersible pump rail system, scum piping, and float appear to be in good condition. The scum pump appeared to be in fair condition. Plant staff reported no performance or maintenance issues with the scum pumping system.

The scum pump is 23 years old with no noted performance issues or significant visible degradation; therefore, it is expected to exceed the typical expected lifespan of 25-30 years. It is estimated that the equipment may have half of its expected serviceable life remaining (12-15 years).

Recommendation: None.

6.3.3.6 Disinfection and Effluent

Secondary effluent is discharged to the UV disinfection channel located under cover south of the headworks building. The UV facility was constructed in 1998. Flow enters the UV disinfection channel with two banks of UV lamps that alternate in lead/lag operation. One of the two banks is usually energized to handle the normal flows. The second bank is brought online to deliver the required UV dose during high flows. The UV system is a Trojan UV3000B system configured in two banks equipped with 42 low pressure bulbs each. The UV channel level is controlled by fixed level control finger weirs. There are high-level and low-level switches downstream of UV bank and upstream of the level control weirs If the channel level drops below the set point, the UV system will generate a low-level alarm to alter the operator to manually shut down the system to prevent the lamp overheating. There is space in the existing channel for a third, future bank of UV lamps.

Following UV disinfection, effluent flow is measured with a 6-inch Parshall flume equipped with an open channel ultrasonic level sensor. Between the UV channel and the flume, there is a withdrawal point for plant water system. An automatic composite flow sampler collects sample before the Parshall flume. Following metering, the effluent flows into the effluent manhole where it then flows by gravity to the outfall.

Observations and recommendations for each major process component are outlined below.

6.3.3.6.1 UV Disinfection System

Observation: The concrete channel, grating, Parshall flume, and UV equipment were constructed in 1998. The channels, grating and flume are in good condition. Plant staff are not using the dip tank to clean the

UV lamps but are cleaning the lamps manually. The Trojan UV-3000B system was installed in 1998. This model has the basic controller which can only automatically alternate the lead and lag UV banks, monitor the bank run time, bank on/off status, a common alarm and UV intensity. The basic controller can turn on but cannot turn off the bank based on the flow signal from the Parshall flume. Plant staff reported no performance or maintenance issues with the UV system.

Recommendation: The Trojan UV-3000B system is an old model using the low-pressure high output open channel technology by the manufacturer. Although there are no performance or maintenance issues observed, more control and monitoring capabilities beyond what the current basic controller can offer, e.g., tracking the individual lamp status and the UV transmittance, are desired by the plant staff. The basic controller can be replaced with the touch smart controller and a new UV transmittance probe can be installed to meet most of the monitoring requirements, except the individual lamp failure status. If the individual lamp failure status needs to be monitored, the entire Trojan 3000B UV system needs to be upgraded. The Trojan UV-3000B system life is typically 20 to 25 years, therefore the UV system at Manchester WWTP is reaching the end of its life and its condition is rated as poor and has about 2-10 years of remaining life. It is recommended to upgrade the entire UV system to provide those monitoring capabilities.

6.3.3.6.2 Parshall Flume and Effluent Sampling

Observation: The Parshall flume was constructed in 1998 and is in fair condition. The automatic sampler appears to be new and is in good condition. Plant staff reported no issues with effluent monitoring and sampling.

Recommendation: None.

6.3.3.6.3 Outfall

The plant effluent (PLE) is discharged to an outfall that discharges into the Rich Passage in the Puget Sound by gravity. The outfall consists of a 12-inch diameter cast-iron pipe that terminates with a 2-foot length of 12-inch diameter vertical riser, a 90-degree bend, and a 6-inch diameter eccentric reducer nozzle. The diffuser nozzle was installed in 1998 on the original outfall piping installed in 1966. The discharge port is located at a depth of approximately 700 feet offshore and 35 feet below MLLW. The outfall was last inspected in 2019 and had some exterior marine growth but was free of obstructions at that time.

Observation: The outfall components were not observed.

Recommendation: None.

6.3.3.7 Solids Treatment

Sludge is thickened and stored at the Manchester WWTP and then transported to the Central Kitsap WWTP for further treatment and ultimate disposal under the County's Class B biosolids program. The Operations Building and solids handling processes were constructed in 1998. Sludge collected from the secondary clarifiers flows by gravity to the RAS/WAS pump station wetwell where there are two RAS pumps (one duty; one standby) which pump both the RAS and WAS to their respective locations.

RAS is returned to the headworks. WAS is pumped to the Operations Building where it is stored in two below-grade 20,000-gallon aerated WAS tanks. The WAS tanks are equipped with coarse bubble diffusers to mix and aerate the sludge and prevent septic conditions. WAS pumped to the WAS tank is not metered. Plant staff estimate the WAS quantity to be wasted on a daily basis to maintain a target aeration basin

MCRT of 8 to 10 days and manually waste the target WAS volume based on water level in the WAS tank. Sludge is currently wasted at the rate of approximately 4,000-6,000 gallons per day, so each WAS tank provides 3-5 days of storage. One WAS tank is in service at a time to minimize septic conditions in the tanks.

From the WAS tanks, sludge is pumped by one of the two sludge pumps to the GBT. The GBT was installed in 1998. WAS can bypass the GBT system and be pumped directly from the WAS tanks to tanker trucks if necessary. GBT is only run one day a week when the plant does not collect composite samples. GBT drainage flows to the in-plant pump station for discharge to the headworks. It has a 200 gpm capacity and is run to thicken sludge to 5.0 percent to 5.5 percent solids concentration. Operators have found that sludge thicker than 5.5 percent is difficult to pump. The GBT has one polymer mixing and dilution system to enhance sludge thickening in the GBT. The polymer dilution system dilutes neat polymer from delivered drums and injects the dilute polymer into the influent sludge stream entering the GBT.

TWAS is stored in a 14,000-gallon aerated below grade TWAS tank in the Operations Building. The TWAS tank accepts thickened sludge from the GBT and scum from the secondary clarifiers. TWAS from the Manchester WWTP is transported by tanker trucks to the Central Kitsap WWTP for further processing. The tank is equipped with coarse bubble diffusers to mix and aerate the sludge and minimize septic conditions.

Two 15-HP variable speed, progressive cavity sludge pumps in the operations building are used to feed WAS from the WAS tanks to the GBT, and TWAS from the TWAS tanks to the solids loading station. Piping is configured so the pumps can pump TWAS back through the GBT or WAS directly to the tanker truck loading station. Three 15-HP positive displacement blowers provide continuous aeration to the WAS and TWAS tanks. The blowers were installed in 1998. Headspace air from the GBT room and WAS and TWAS tanks is sent to the odor control scrubber near the headworks building.

Observations and recommendations for each major process component are outlined below.

6.3.3.7.1 WAS Storage Tanks

Observation: The tank interiors could not be observed, but the tank exterior surfaces appear (top outside portion and exposed exterior wall inside the Operations Building lower level) appear to be in good condition. Tank level indicating transmitters (LITs) also appeared to be in good condition.

Plant staff did not report operational or performance issues with the WAS storage tanks, however they noted that the lower explosive limit (LEL) sensors in the tanks did not function and have been removed. Staff reported frequent ragging of the WAS tanks diffusers, which occurs if the sludge tank blower air is turned off. When staff observe reduced mixing in a WAS tank, the tank is emptied and sprayed down with a firehose, and the diffusers are replaced with a backup set of cleaned diffusers. A set of standby diffusers is kept onsite to accommodate this process as it happens several times per year.

Recommendation: Install new LEL sensors and monitors.

6.3.3.7.2 Gravity Belt Thickener

Observation: The GBT was installed in 1998 and appears to be in good condition. The belt ploughs are showing moderate corrosion but should be easily replaceable. It was observed that the magnetic flowmeter that monitors sludge flow to the GBT is showing a moderate level of exterior corrosion. The sludge feed piping and fittings are also showing moderate corrosion, but no leaks were noted. It was observed that the GBT room had a very strong odor and operation staff confirmed this is common, indicating that the HVAC system may be underperforming. This may contribute to a more corrosive environment in the room.

The GBT is 23 years old with no noted performance issues or significant visible degradation; therefore, it is expected to exceed the typical expected lifespan of 25-30 years. It is estimated that the equipment may have 50-90 percent of its expected serviceable life remaining (13-27 years).

Recommendations: Clean and repaint areas of GBT where paint is chipped or missing to prevent further corrosion. Test and rebalance HVAC system in the GBT room to achieve the required air changes. Keep a shelf spare flowmeter.

6.3.3.7.3 GBT Polymer System

Observation: The polymer system is a Polyblend system that was installed in 1998 and appears to be in fair condition. Plant staff reported no operational issues with the GBT thickening polymer system. The polymer system is 23 years old and it is expected to meet or exceed the typical expected lifespan of 25-30 years. It is expected that the equipment may have 50-90 percent of its expected serviceable life remaining (13-27 years).

Recommendation: None.

6.3.3.7.4 TWAS Storage Tank

Observation: The TWAS tank was constructed in 1998. The tank interior could not be observed. A small portion of the exterior is visible on the lower level of the Operations Building. It shows one long hairline crack, several feet long that runs vertically from the LIT penetration. Otherwise, the exterior of the tank is in good condition.

Plant staff reported no maintenance or operational issues with the TWAS storage tank, however they noted that the LEL sensors in the tanks did not function and have been removed. Staff reported frequent ragging of the TWAS tank diffusers when the sludge tank blower air is turned off. When staff observe reduced mixing in the TWAS tank, the tank is emptied to the sludge truck and sprayed down with a firehose. The diffusers are replaced with a backup set of clean diffusers. A set of standby diffusers are kept onsite to accommodate this process as it happens several times per year.

Recommendation: Monitor the tank exterior hairline crack. Install new LEL sensors and monitors.

6.3.3.7.5 Sludge Tank Blowers

Observation: The sludge tank blowers were installed in 1998 and appear to be in fair condition. Plant staff reported no maintenance or operational issues with the blowers. The blowers and low-pressure stainless-steel air piping appear to be in good condition.

The sludge tank blowers are 23 years old with no noted performance issues or significant visible degradation; therefore, they are expected to exceed the typical expected lifespan of 25-30 years. It is expected that the equipment may have approximately 50 percent of its expected serviceable life remaining (12-15 years).

Recommendation: None.

6.3.3.7.6 Sludge Pumps

Observation: The sludge pumps, piping and valves in the Operations Building were installed in 1998 and appear to be in good condition. The plant staff reported no performance or maintenance issues with the sludge pumps.

The sludge pumps are 23 years old with no noted performance issues or significant visible degradation; therefore, they are expected to exceed the typical expected lifespan of 25-30 years. It is expected that the equipment may have 50-90 percent of its expected serviceable life remaining (13-27 years).

Recommendation: None.

6.3.3.7.7 Truck Loading

Observation: The truck loading station appears to be in good condition and plant staff reported no operational or maintenance issues with the truck loading station.

Recommendation: None.

6.3.3.8 Support Systems (Odor Control and Plant Water and Drainage Systems)

Manchester WWTP's odor control system was constructed in 1998 and consists of a fiberglass centrifugal fan and a multi-stage chemical scrubber vessel. Foul air is pulled from the headworks building, WAS and TWAS tanks, and GBT room into the odor control scrubber, where it is treated then released to atmosphere. The odor control scrubber was originally designed to dose both sodium hypochlorite and sodium hydroxide to the scrubbant sump at different stages based on the scrubbant pH and oxidation reduction potential (ORP). The sodium hydroxide system has been removed and the pH and ORP sensors are not functioning. Sodium hypochlorite is currently dosed at a constant rate to the system.

The chemical room housing the sodium hypochlorite system is within the Headworks Building. It includes a 500-gallon storage tank, secondary containment, and a diaphragm chemical feed pump. The feed pump is currently set up to deliver hypochlorite to the scrubbant sump at a constant rate of approximately 1 gallon per day.

The Manchester WWTP diverts various sources of plant drainage to the in-plant pump station. The in-plant pump station was retrofitted from the original influent wetwell in 1998. It collects drainage from the operations facility bathroom and sump, GBT, and truck loading area. The sludge pumps can also pump to the in-plant pump station wetwell. The in-plant pump station pumps return flow to headworks. There are two 5-HP in-plant pump station pumps, one duty and one standby, that operate automatically on level floats.

The Manchester WWTP has a W2 nonpotable water system to supply water for polymer dilution, seal water for the sludge pumps, makeup water for the odor control system, and interior hose bibs. The W2 system was installed in 1998, is supplied by the potable water system, and consists of an air gap tank, two pumps, and a hydropneumatic tank.

The W3 water system consists of two pumps operating in lead/lag and an automatic strainer. The system normally operates automatically, drawing water from PLE between the UV system and the effluent Parshall flume and pumping it in a circulation loop to provide plant water on demand to various plant processes. The W3 system provides PLE to plant processes including the GBT, rotary screen, grit classifier, secondary clarifier spraydown, and exterior hose bibs.

6.3.3.8.1 Odor Control

Observation: The odor control system is only partially operational. pH in the system is not monitored or adjusted, ORP is not monitored, and sodium hypochlorite is dosed at a constant rate set by the operator.

The equipment appears to be in fair condition. The plant does not receive a significant number of odor complaints.

As noted in **Appendix E** *Condition Assessment Red Flag Findings and Mitigation Recommendations* (Murraysmith [now Consor], October 2020), operator safety in the hypochlorite room is a concern. Strong chlorine odor was observed in the hypochlorite room. To address these concerns, the plant staff have investigated and discovered that the light switch was connected to the light and the room exhaust fan. They have been separated to allow the exhaust fan to run continuously for improved ventilation. An emergency eye wash bottle has also been placed in the chemical room.

Recommendations: Repair the odor control system to restore automatic operation and full functionality.

6.3.3.8.2 In-plant Pump Station

Observation: The in-plant pump station pumps were installed in 1998. The condition of the wetwell and pumps was not observed. The plant staff reported that the pumps are original and work well but have reached their expected lifespan and will likely need to be replaced soon.

Recommendation: Inspect and consider replacing the pumps.

6.3.3.8.3 W2 System

Observation: All components of the W2 system were installed in 1998 and appear to be in good condition, although the floor was very wet around the area of the equipment. The water source was not apparent and could be from an overflow event from the W2 air gap tank. Plant staff did not report performance or maintenance issues with the system.

Recommendation: Observe equipment for overflow and leakage.

6.3.3.8.4 W3 System

Observation: The W3 system has two pumps installed at different times, of different make and model. Plant operators report that P-901 was installed approximately in 2014 and P-902 was installed approximately in 2017. P-901 looks to be in poor condition with some corrosion on the piping, and a smaller discharge pipe than on P-902, which is in fair condition. The floor near the W3 system was very wet, although this leakage is potentially coming from the W2 system. The automatic strainer, piping and some valves showed significant corrosion and are in fair condition. Per the plant operator, the automatic strainer is currently not in use and the W3 flow meter is not working.

Recommendations: The automatic strainer and flow meter should be repaired. It is recommended that the corroded areas of the automatic strainer, piping and valves be cleaned and coated to prevent further degradation. Some of the W3 piping and valves may need to be replaced to resume normal functionality.

6.3.3.9 Power Distribution

6.3.3.9.1 Utility Service Entrance

The utility service entrance is owned and provided by Puget Sound Energy (PSE). Electrical power service to the facility is provided from a 12,470-volt, 3-phase distribution line running underground to a 300 kilovolt amperes (kVA) three phase pad-mounted transformer located in the west central area of the facility property just south of the Operations Building. The utility-owned three phase transformer steps the 12.47-kilovolt (kV) transmission primary voltage down to 480-volt secondary utilization voltage for the facility.

The utility service entrance secondary conductors continue underground from the pad-mounted transformer to the utility current transformer (CT) enclosure and then onto the main circuit breaker located inside the Operations Building. The utility revenue metering equipment and CT enclosure are located outside of the Operations Building on the west wall of the electrical room. The utility transformer, service conductors, and power metering equipment are owned and maintained by PSE.

Observation: The utility service entrance equipment (transformer, service conductors, power metering equipment, etc.) was installed in 1998 and is in fair condition. The equipment is expected to exceed the typical expected lifespan of 25-30 years. It is expected that the equipment may have approximately 50 percent of its expected serviceable life remaining (12-15 years).

Recommendation: None.

6.3.3.9.2 Main Power Distribution

The facility is served by a 480-volt, 3-phase, 3-wire electrical power distribution system. The main service and distribution equipment were installed in mid-1998 and are in the main electrical room in the Operations Building. The facility power distribution system consists of the utility service entrance, standby generator, main circuit breaker, automatic transfer switch (ATS), metering, a motor control center (MCC), various 480-volt power panels, 480: 120/208 volts of alternating current (VAC) distribution transformers and 120/208 VAC lighting and power panels.

Observation: The main power distribution system including the service entrance rated 800 ampere main circuit breaker, distribution transformers, power panels and MCC, although installed in 1998, are in fair condition. The equipment is expected to exceed the typical expected lifespan of 25-30 years. It is expected that the equipment may have 50 percent of its expected serviceable life remaining (12-15 years).

No arc flash labeling was observed on any of the electrical equipment in this facility.

The electrical room in the Operations Building was warm and it was noted that a fan was placed in front of the MCC gear and used for cooling purposes. No issues from the plant staff were mentioned but the ventilation in the room appears to be inadequate for the space.

Recommendations: A complete arc flash study for the electrical infrastructure should be performed to comply with Occupational Safety and Health Administration (OSHA) standard 1910.269 made mandatory and put into effect on July 10, 2014. Additional cooling for the electrical room is recommended as it houses equipment (e.g., ATS, AFDs, and programmable logic controllers (PLCs)) that contain critical electronics more susceptible to higher temperatures.

6.3.3.9.3 Generator and Automatic Transfer Switch

Standby emergency power is supplied by a 350-kW diesel engine-generator. It is a non-enclosed generator located in the Generator Building. The standby generator was installed in 1998 and has an 800-ampere circuit breaker and is fueled by an external diesel fuel storage tank on the east side of the Generator Building.

The 3-pole, 800-ampere, 480-volt, 3-phase, 3-wire ATS is located on the south wall in the main electrical room in the Operations Building. It is fed from the 800-ampere service entrance main breaker (normal side) and standby generator via an 600A fused disconnect (emergency side). The ATS load side connects to MCC-01 800-ampere main breaker.

Observation: The generator and ATS were installed in 1998 and are in fair condition. The equipment is expected to exceed the typical expected lifespan of 25-30 years. It is expected that the equipment may have approximately 50 percent of its expected serviceable life remaining (12-15 years). The ATS and generator are sized to provide enough back-up power for all essential functions for the facility to continue operation in the event of a prolonged power outage.

The ATS is obsolete and parts are not readily available by the manufacturer.

The Cummins standby generator engine was last serviced in 2019 according to labeling on the installed filters.

Recommendation: Replace the obsolete ATS. In addition, proper personnel should be trained on the manual use of the transfer switch and any equipment (e.g., equipment handle) needed should be readily available if the unit fails.

6.3.3.9.4 Motor Control Centers

There is one MCC in the plant, MCC-01. It has an 800-ampere main breaker and is fed from the ATS. The MCC was installed in 1998. **Table 6-7** below shows the MCC, its location, model, and rating.

Table 6-7 | MCC Locations, Models, and Rating

MCC	Location	Model	Rating [Amps]
01	Operations Building Electrical Room	Allen-Bradley Centerline Bulletin 2100	800

Observation: The MCC is in fair condition. The equipment is expected to exceed the typical expected lifespan of 25-30 years. It is expected that the equipment may have approximately 50 percent of its expected serviceable life remaining (12-15 years).

Most of the components in the MCCs individual buckets are consistent with industry standard and are readily available or could be replaced with similar manufactures' devices.

The AFDs (1336S series) installed in MCC-01 for RAS pumps are in fair condition, however they are obsolete and no longer supported. The current replacement model is Powerflex 753 or 755 from the same manufacturer.

Recommendation: Replace the obsolete AFDs. A newer model is available, and a similar manufacturers' AFD could be used, depending on physical space and options.

6.3.3.9.5 Control Panels

The facility control system consists of control panels located throughout the facility with the main plant controller located in the office area of the Operations Building and the main remote input/output (I/O) rack located in the Operations Building electrical room. The control panels are comprised of industry standard equipment including PLCs, operator interface terminals (OITs), uninterruptable power supply (UPS), small digital readouts, and typical components including circuit breakers, relays, wiring, fuses, terminals, indicator lights, selector switches, etc. **Table 6-8** below shows the panels, their location, PLC and central processing unit (CPU) models. Local pushbutton, selector switch, and or indication stations are not listed.

Table 6-8 | Panel Locations and Models

Panel	Location	PLC Model	CPU Model	OIT
Plant Control Panel (PCP) Plant Main Control Panel	Operations Building Electrical Room	Allen-Bradley Compactlogix	1769-L33ER	N/A
SBR Remote I/O Panel	Blower Building	Allen-Bradley Compactlogix	1769 Remote I/O	N/A
LP-225 Influent PS Control Panel	Headworks Building Electrical Room	Allen-Bradley Compactlogix	1769 Remote I/O	N/A
FP-201 Rotary Screen Control Panel	Headworks Area	GE Fanuc Micro 90	Micro 90	N/A
LP-205 Grit Collection Control Panel	Headworks Area	N/A	N/A	N/A
SBR Motor Panel	Blower Building	N/A	N/A	N/A
SBR Ctrl Panel (modified)	Blower Building	N/A	N/A	N/A
LP-TLP Truck Loading Panel	Sludge Loading Area	N/A	N/A	N/A
LP-TCP Thickener Control Panel	Operations Building Thickener Room	See observation and recommendation	N/A	N/A
LP-GBT Gravity Belt Control Panel	Operations Building Thickener Room	See observation and recommendation	N/A	N/A
FP-700 Odor Ctrl Sys Panel	Odor Control Area	N/A	N/A	N/A
FP-715 Blowdown Sump Control Panel	Odor Control Area	N/A	N/A	N/A
FP-905 Auto Strainer	Operations Building Lower Level	N/A	N/A	N/A
FP-915 Sump Control Panel	Operations Building Lower Level	N/A	N/A	N/A
FP-930 W-2M Control Panel	Operations Building Lower Level	N/A	N/A	N/A
AFD-101 thru 103 Inf. PS Control Panels	Headworks Building Electrical Room	N/A	N/A	N/A
AFD-611 Sludge Truck Drive Panel	Operations Building Lower Level	N/A	N/A	N/A
AFD-612 Thickener Drive Panel	Operations Building Lower Level	N/A	N/A	N/A

Observation: Overall, most of the control panels installed appear to be operating adequately and are in fair condition. Components installed are consistent with industry standard and are readily available or could be replaced with similar manufactures' devices. The exception to this is the PLC system equipment, as each brand of PLC requires special programming.

The main PLC system for the facility with equipment located in the PCP, LP-225 and SBR Remote I/O panels was upgraded by Quality Controls Corp. (QCC) in 2018 as part of a facility PLC replacement project.

The communication between the main and remote I/O panels is achieved via an ethernet link. The connection to SCADA is also via an ethernet link.

The PLC and level controller in Panel FP-201 are functioning and in fair condition, however they are obsolete. The panel also shows signs of rust and corrosion where the conduits enter the panel.

Panel LP-205 Grit Collection Control Panel shows signs of rust and corrosion where the conduits enter the panel.

Panels LP-GBT and LP-TLP interiors were not accessed and the installation of a controller (e.g., PLC) was not verified. It is likely one or both panels contain PLCs.

Panel FP-700 Odor Control Panel has two chemical controllers that are in poor condition, one chemical controller that is non-operational, and all are now obsolete. The staff has indicated that this equipment package has not operated correctly throughout its history. It is no longer used to control the sodium hypochlorite pump. This pump is now connected to a receptacle and operated manually with a dosing setpoint on the pump.

Panel FP-715 Odor Control Blowdown Sump Panel shows signs of chemical entrance. Chemical residue was found on the inside bottom of the panel and rust was observed on a few terminals.

The adjustable speed drive panels (AFD-101 thru 103) for the influent pumps, (AFD-611 and AFD-612) for the thickener and sludge truck pumps are in fair condition, however the AFD's are obsolete and the model is no longer supported.

Although not a control panel, a large junction box (TJB-WP1) containing connections and equipment for the influent pumps, float switches, and local pushbutton controls appear to be lin a hazardous location and does not comply with proper installation per National Fire Protection Association (NFPA) 70 (NEC) article 500. The junction box, according to NFPA 820, falls within the wetwell Class 1 Division 2 area classification boundary envelope of 36 inches horizontally and 18 inches vertically, due to the pump conduits routed to the wetwell being open below the enclosure, extending the area classification. It may also be classified as a Class 1 Division 1 area depending on the conduit containing the float cables, as this conduit enters the enclosure directly from the wetwell and there is no observed seal-off.

Recommendations: Verify back-up copies of all PLC and OIT programs have been created, and if not, have them created and stored in a safe place as soon as possible. Spare parts for the PLC system including a CPU, Power supply, communication module, and a minimum of one spare I/O module per type should be stored by the County in case of a failure.

Although the level controller in Panel FP-201 is obsolete, there is a direct replacement for this unit and therefore no recommendations for it are made at this time. The obsolete PLC in the panel should have its program backed-up and a migration/replacement plan should be developed and executed as soon as possible.

Although the rusted area in panels FP-201 and FP-205 do not affect functionality, it is recommended that the areas be cleaned and coated to prevent further degradation of the enclosure.

Verify whether there is a PLC in the LP-GBT or LP-TLP panel. If a PLC exists, verify if it is still supported and if a back-up of its program has been saved. Given the apparent age of these panels, if a PLC exists it is likely outdated so we recommend a migration/replacement plan should be developed and executed as soon as possible.

Panel FP-700 should be re-evaluated regarding its control function and modified and or replaced to operate the odor control system as originally designed. Panel FP-715 should be thoroughly cleaned and inspected. The source of chemical infiltration should be identified and corrected.

A replacement plan for the obsolete AFDs in the influent and thickening AFD panels should be established in the event of a failure. A newer model is available, and a similar manufacturer's AFD could be used, depending on physical space and options.

The junction box (TJB-WP1) and its installation should be re-evaluated and be brought up to current NFPA 70 (NEC) and NFPA 820 standards.

6.3.3.10 SCADA System

SCADA system condition assessment and evaluation have been conducted as part of the County-wide SCADA master plan project. See **Appendix F** *Kitsap County Sewer Utility SCADA Master Plan Technical Memoranda* (Murraysmith [now Consor]/HDR, 2021) for details.

6.4 Code Review

Code requirements for the Manchester WWTP are summarized in **Section 6.4.1**. **Section 6.4.2** includes discussion of general code requirements that would be triggered should major upgrades be completed at the WWTP. Code requirements summarized in this report include:

- Washington State Building Code including the following adopted codes. The 2021 versions of the codes went into effect March 15, 2024 and are expected to be updated in approximately 2027.
  - International Building Code (IBC)
  - International Machine Code (IMC)
  - International Fire Code (IFC)
  - National Electrical Code (NEC 70)
  - NFPA 820
  - NFPA 24
  - Uniform Plumbing Code (UPC)
- Americans with Disabilities Act (ADA)
- Code of Federal Regulations (CFR)

6.4.1 Summary of Existing Buildings and Use

The Manchester WWTP Site Plan is shown in **Figure 6-1**. There are three main buildings onsite, which are the Operations Building, the Blower Building, and the Generator Building.

6.4.1.1 Operations Building

The Operations Building, located north of the secondary clarifiers, is a multipurpose building with the following functions:

- Administrative office space and control room
- Laboratory working space
- Garage/shop
- Bathroom, shower and lockers

- Dewatering room with GBT, associated polymer system and piping
- Solids handling including aerated WAS and TWAS tanks, sludge tank blowers, sludge transfer pumps, and W2 and W3 systems.
- Electrical room

The Operations Building is a two-story building with one story below grade. It has two roll up doors, one for the GBT room and one for the garage/shop, and three man-doors. The Operations Building was constructed in 1998.

- Floor Area:
  - B (Office/Control Room) Approximately 630 SF (Allowable 8,000 SF).
  - S-2 (GBT and Solids Handling) Approximately 1,360 SF (Allowable 12,000 SF). GBT room is approximately 500 SF and solids handling area in basement is approximately 860 SF.
  - S-3 (Garage/Shop) Approximately 440 SF (Allowable 8,000 SF).
- Height: 21 feet (Allowable 2 stories, 40 feet).
- Construction Type: 1994 Uniform Building Code (UBC) and Uniform Fire Code (UFC) Type V-N, constructed of non-combustible, non-fire rated materials. The building is constructed of a concrete slab, reinforced concrete walls below grade, load-bearing concrete masonry unit (CMU) walls, and wood truss roof framing covered with standing seam metal roofing.
- Occupancy Group:
  - Office/Control Room - Group B per UBC 1994, where Section 304.1 defines Group B as occupancies consisting of business functions.
  - GBT Room and Solids Handling room in Basement – Group S-2 per UBC 1994, where Section 311.1 defines Group S-2 as occupancies consisting of low-hazard storage functions.
  - Garage/Shop – Group S-3 per UBC 1994, where Section 311.1 defines Group S-3 as occupancies consisting of repair garage functions.
- Calculated Occupancy Load:
  - B (Office/Control Room) - 6 persons per IBC Table 1004.1.2 - occupant load factor of 100 gross for business areas.
  - S-2 (GBT Room) - 5 persons per IBC Table 1004.1.2 - occupant load factor of 100 gross for industrial areas.
  - S-2 (Solids Handling in basement) – 8 persons per IBC Table 1004.1.2 - occupant load factor of 100 gross for industrial areas.
  - S-3 (Garage/Shop) - 4 persons per IBC Table 1004.1.2 - occupant load factor of 100 gross for industrial areas.

- **Fire Sprinklers**: Not required per IBC Section 903. Fire detection and portable fire extinguishers required per NFPA 820, see Section 5.4.2.3.
- **Safety features**: Tepid eyewash/shower station required where the eyes or body of any person may be exposed to injurious corrosive materials per 29 CFR 1910.151 and the American National Standards Institute (ANSI) Z358.1.

6.4.1.2 Generator Building

The Generator Building, located west of the aeration basins and Blower Building, is a one story, above grade building. The building has one man-door. The Generator Building was constructed in 1998.

- **Floor Area**: Approximately 280 SF (Allowable 12,000 SF).
- **Height**: 16 feet (Allowable 2 stories, 40 feet).
- **Construction Type**: 1994 UBC and UFC Type V-N constructed of non-combustible, non-fire rated materials. The building is constructed of a concrete slab with footings, load-bearing CMU walls, and wood truss roof framing covered with sheet metal roofing.
- **Occupancy Group**: Group S-2 per UBC 1994, where Section 311.1 defines Group S-2 as occupancies consisting of low-hazard storage functions.
- **Calculated Occupancy Load**: 2 persons per IBC Table 1004.1.2 - occupant load factor of 100 gross for industrial areas.
- **Fire Sprinklers**: Not required per IBC Section 903.

6.4.1.3 Blower Building

The Blower Building, located west of the aeration basins, is a one story, above grade building. The building has one man-door (double door). The Blower Building was constructed in 1991.

- **Floor Area**: Approximately 400 SF.
- **Height**: 13 feet.
- **Construction Type**: same as Generator Building.
- **Occupancy Group**: same as Generator Building.
- **Calculated Occupancy Load**: 2 persons per IBC Table 1004.1.2 - occupant load factor of 100 gross for industrial areas.
- **Fire Sprinklers**: Not required per IBC Section 903.

6.4.2 General Code Requirements

6.4.2.1 Accessibility

Any new building anticipating personnel occupancy is required to comply with the accessibility requirements of Chapter 11 of the IBC. In general, this means that the building shall have an accessible parking stall and accessible path of travel from the accessible stall to the Operations Building entrance.

Doors shall have lever hardware and accessible rooms shall meet the design and dimensional requirements of Chapter 11. Per the IBC, accessibility is not required for mechanical and process spaces as described in Section 1103.2.9 Equipment spaces.

Existing buildings are governed by the Existing Building Code Section 305. Generally, any portions of the building that are altered, should comply as if it is a new building, including accessibility. But the entire building does not necessarily need to be upgraded. For example, if the alternation of the existing space does not include the toilet/locker area, then that area would not have to be upgraded to meet the accessibility requirement in the IBC.

Although the Operations Building at Manchester WWTP does not comply with the latest IBC code on the accessibility requirement, it is grandfathered in from the code when it was constructed. If the building is to be upgraded or modified, it will need to meet the current accessibility requirements.

6.4.2.2 Means of Egress

The Washington State Building Code mandates in Chapter 10 that in all buildings the means of exit discharge shall meet the following requirements:

- **Illumination Required**: Means of exit discharge shall be illuminated at all times by not less than 1-foot-candle (11 lux) at the walking surface per IBC 1008.2.
- **Egress Sizing**: The minimum width of each door opening shall be a minimum width of 32 inches and height of 80 inches, as well as sufficient for the occupant load thereof per IBC 1010.1.1.

6.4.2.3 National Fire Protection Association 820

NFPA 820 provides requirements for ventilation, electrical classification, materials of construction, and fire protection measures for the collection systems (Table 4.2.2), liquid stream treatment process (Table 6.2.2), and the solid stream treatment process (Table 6.2.2). Applicable locations have been summarized in **Table 6-9** below.

Table 6-9 | NFPA 820 Requirements Pertinent to the Manchester WWTP

Location	Fire and Explosion Hazard	Ventilation	Extent of Classified Area	NEC Area Electrical Classification (All Class I, Group D)	Materials of Construction	Fire Protection Measures
Influent Wetwell	Possible ignition of flammable gases and floating flammable liquids	No Ventilation	Entire space (wetwell)	Division 1	Noncombustible, limited combustible, or low flame spread index material	Not required
Coarse and Fine Screen Facilities	Possible ignition of flammable gases and floating flammable liquids	Continuously ventilated in the channel	within 10 ft envelop around equipment and channel	Division 2	Noncombustible, limited combustible, or low flame spread index material	Portable Fire Extinguisher and hydrant protection in accordance with NFPA 820 7.2.4.
Grit Removal Tanks	Possible ignition of flammable gases and floating flammable liquids	Continuously ventilated in the channel	within 10 ft envelop around equipment and channel	Division 2	Noncombustible, limited combustible, or low flame spread index material	Portable Fire Extinguisher and hydrant protection in accordance with NFPA 820 7.2.4
Aeration Basins	N/A	No ventilation, not enclosed	Interior of the tank from the min water surface to the top of the tank. Envelope includes 0.46 m (18 in) above the top of the tank and extending 0.46 m beyond the exterior wall; envelope 0.46 m above grade extending 3 m (10 ft) horizontal from the exterior tank walls	Division 2	Noncombustible, limited combustible, or low flame spread index material	Hydrant protection in accordance with NFPA 820 7.2.4
Secondary Clarifiers	N/A	No ventilation, not enclosed	Interior of the tank from the min water surface to the top of the tank. Envelope includes 0.46 m (18 in) above the top of the tank and extending 0.46 m beyond the exterior wall; envelope 0.46 m above grade extending 3 m (10 ft) horizontal from the exterior tank walls	Division 2	Not required	Hydrant protection in accordance with NFPA 820 7.2.4
UV Disinfection Unit	N/A	No ventilation	N/A	Unclassified	Not required	Hydrant protection in accordance with NFPA 820 7.2.4
Scum pumping area – secondary clarifiers scum pump station	Buildup of vapors from flammable or combustible liquids	No ventilation	Entire enclosed scum wetwell	Division 1	Noncombustible	Portable Fire Extinguisher and hydrant protection in accordance with NFPA 820 7.2.4
Sludge storage wetwells, pits, and holding tanks (RAS pumping station)	Possible generation of methane gas in explosive concentrations; carryover of floating flammable liquids	No ventilation	Enclosed – entire space. Wetwell is not enclosed in building	Division 1	Noncombustible	Not required
Sludge storage wetwells, pits, and holding tanks (WAS and TWAS tanks)	Possible generation of methane gas in explosive concentrations; carryover of floating flammable liquids	Continuously ventilated at 12 air changes per hour	Enclosed – entire space	Division 2	Noncombustible, limited combustible, or low flame spread index material	Portable Fire Extinguisher and hydrant protection in accordance with NFPA 820 7.2.4. Combustible gas detection system.
Dewatering Room with GBT	Accumulation of methane gas	Continuously ventilated at 6 air changes per hour	Entire room	Unclassified	Noncombustible, limited combustible, or low flame spread index material	Portable Fire Extinguisher, hydrant protection in accordance with NFPA 820 7.2.4, and fire alarm system.
Odor control and ventilation systems serving classified areas	Leakage and ignition of flammable gases and vapors	Not enclosed, open to the atmosphere	Areas within 0.9 m (3 ft) of leakage sources such as fans, dampers, flexible connections, flanges, pressurized unwelded ductwork, and odor-control vessels	Division 2	Noncombustible, limited combustible, or low flame spread index material	Portable Fire Extinguisher

6.4.2.4 NFPA 24

Fire suppression hydrants shall be installed in accordance with NFPA 24. Chapter 7 of NFPA 24 references the local jurisdiction for hydrant spacing requirements. The County fire code mandates hydrants to be located between 50 and 150 feet of the buildings to be protected. At the Manchester WWTP the nearest hydrant is directly across Beach Drive from the plant, approximately 60 feet from the Operations Building, 150 feet from the headworks, and 170 feet from the Blower Building. Section C.4.1.3 of NFPA 24 generally recommends a minimum residual pressure of 20 pounds per square inch (psi) should be maintained at hydrants when delivering fire flow.

6.4.3 Summary of Code Requirements

No code violation has been observed at the Manchester WWTP. Although the Operations Building at Manchester WWTP does not comply with the latest IBC code on the accessibility requirement, such as the accessible parking stall, path from the accessible stall to the entrance, ADA bathroom, etc., it is grandfathered in from the code when it was constructed. If the building is to be upgraded or modified, it will need to meet the current accessibility requirements. It is recommended to install the fire alarm system in the GBT room and make sure functional fire extinguishers are available at all the locations listed in Table 6-9.

The following conditions require additional comprehensive analysis, beyond the scope of this review:

- HVAC compliance
- Seismic anchoring

6.5 Existing Wastewater Treatment Plant Performance

The performance of the existing WWTP in terms of NPDES permit compliance, EPA's reliability requirement, and future nutrient removal requirement is documented below.

6.5.1 Compliance to NPDES Permit

The County's Manchester WWTP NPDES Permit #WA0023701 was most recently renewed on March 1, 2018, allowing the discharge of treated effluent to Rich Passage, Puget Sound. A copy of the WWTP's NPDES Permit is included in Appendix A. The NPDES Permit expired on February 28, 2023. The County has submitted the permit renewal application. The current permit was administratively continued and remains in effect as of this writing.

Table 6-10 is a summary of waste discharge limitations for the Manchester WWTP Outfall 001 to Puget Sound as contained in Section S1 of the NPDES Permit.

Table 6-10 | Outfall 001 NPDES Waste Discharge Limits[1]

Effluent Limits: Outfall 001				
Parameter	**Average Monthly**		**Average Weekly**	
BOD	30	mg/L	45	mg/L
	115	ppd	173	ppd
	85% removal of influent BOD			
TSS	30	mg/L	45	mg/L
	115	ppd	173	ppd
	85% removal of influent TSS			
Parameter	**Daily Minimum**		**Daily Maximum**	
pH	6.0		9.0	
Parameter	**Monthly Geometric Mean**		**Weekly Geometric Mean**	
Fecal Coliform Bacteria	200/100 mL		400/100 mL	

Notes:
1. From current Manchester WWTP NPDES Permit # WA0023701
mL=milliliter

The plant design criteria listed in Section S4 of the current permit set the upper limits for the influent flow, BOD and TSS loads, as following.

- Maximum month design flow is 0.46 MGD
- Influent BOD loading for maximum month is 832 ppd
- Influent TSS loading for maximum month is 832 ppd

The County is required to submit a plan and a schedule for continuing to maintain capacity to Ecology when:

1. The actual flow or waste load reaches 85 percent of any one of the above design criteria for three consecutive months.

2. The projected plant flow or loading would reach design capacity within five years.

Figure 6-3 through **Figure 6-6** show the 7-day and the 30-day rolling average concentrations and loads for both effluent BOD and TSS between January 2018 and June 2020. The corresponding NPDES permit limits are shown for comparison. These figures indicate Manchester WWTP has not exceeded the permit effluent BOD and TSS limits during this time period. In addition, the plant has not exceeded pH or Fecal Coliform limits during this same time period based upon review of the monthly DMRs.

Figure 6-3 | 7-day Rolling Average Effluent BOD and TSS Concentrations

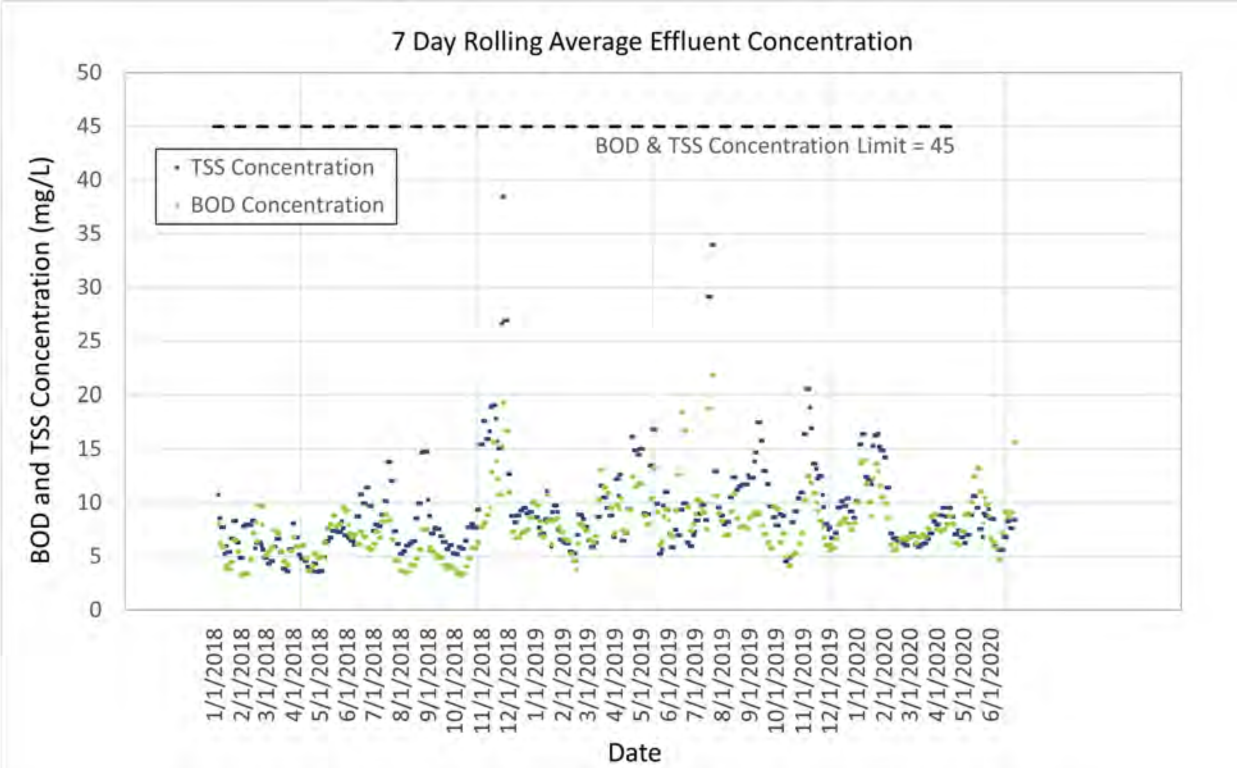


Figure 6-4 | 30-day Rolling Average Effluent BOD and TSS Concentrations

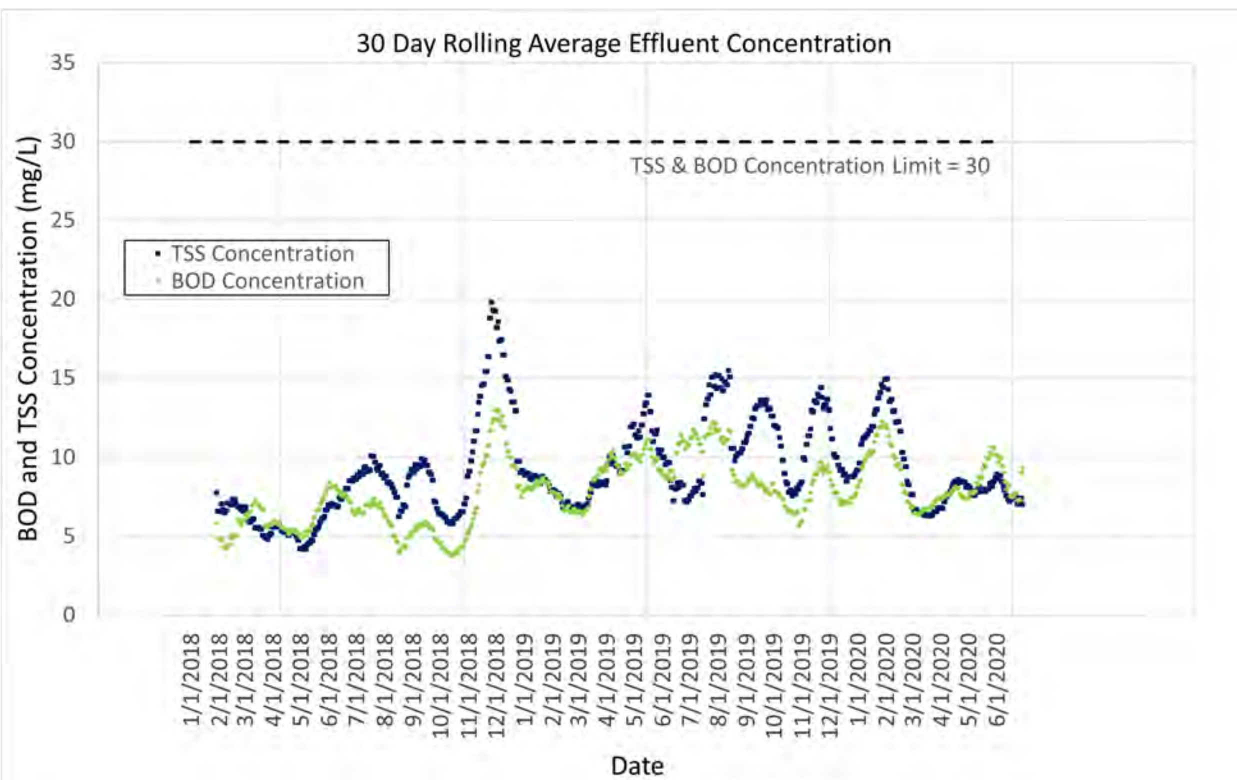


Figure 6-5 | 7-day Rolling Average Effluent BOD and TSS Loads

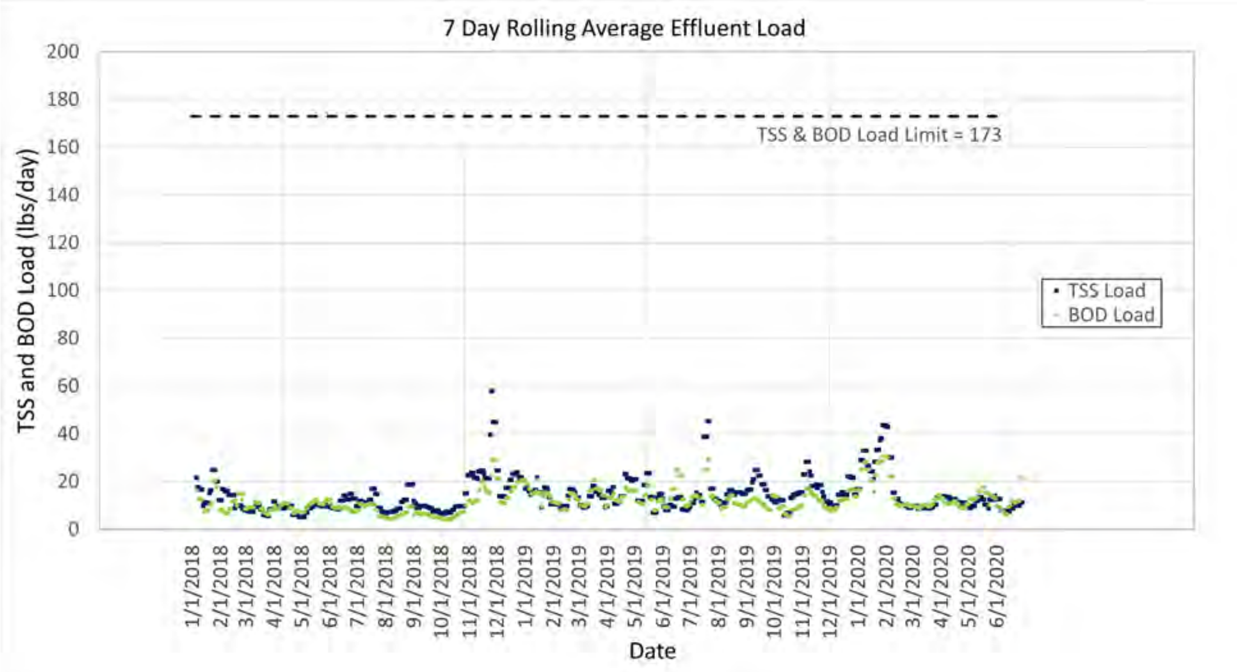


Figure 6-6 | 30-day Rolling Average Effluent BOD and TSS Loads

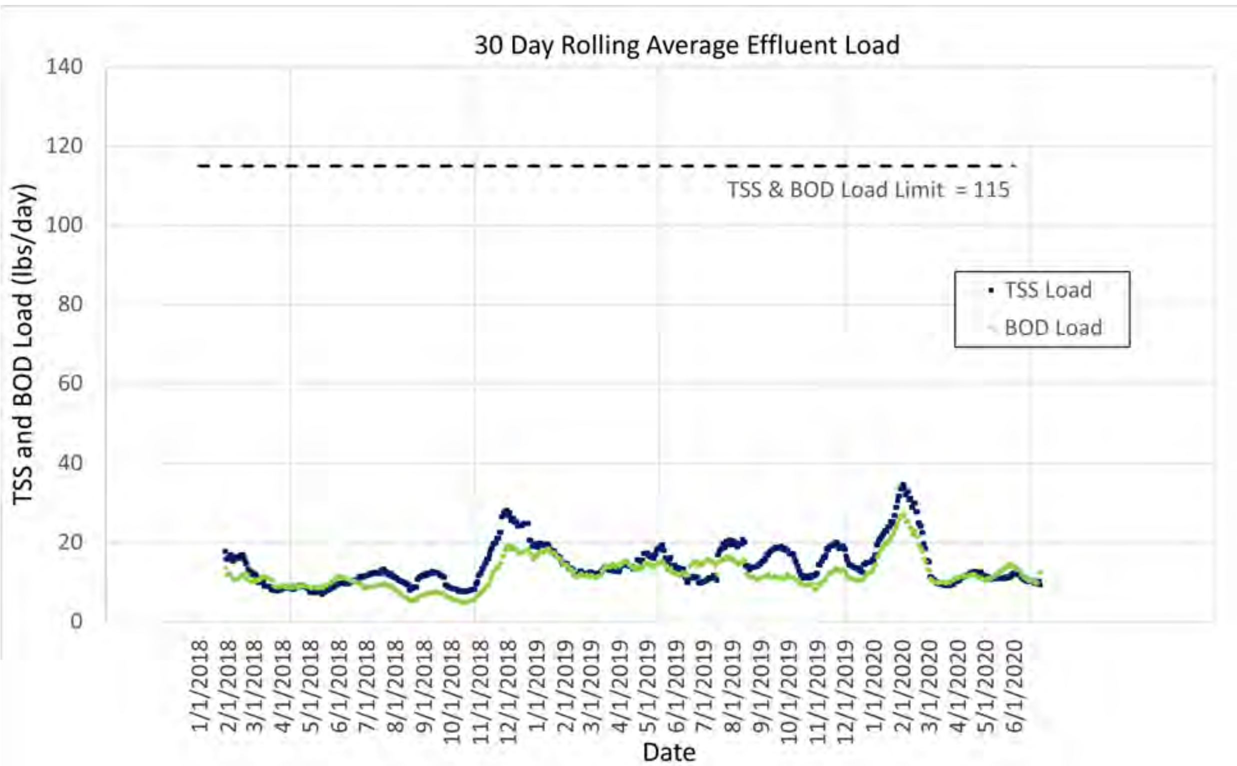


Figure 6-7 and **Figure 6-8** show the plant 30-day rolling average influent flow and BOD and TSS loads to compare with the design criteria in the permit. Both influent flow and loads are well below 85 percent of the designed values.

Figure 6-7 | 30-day Rolling Average Influent Flow

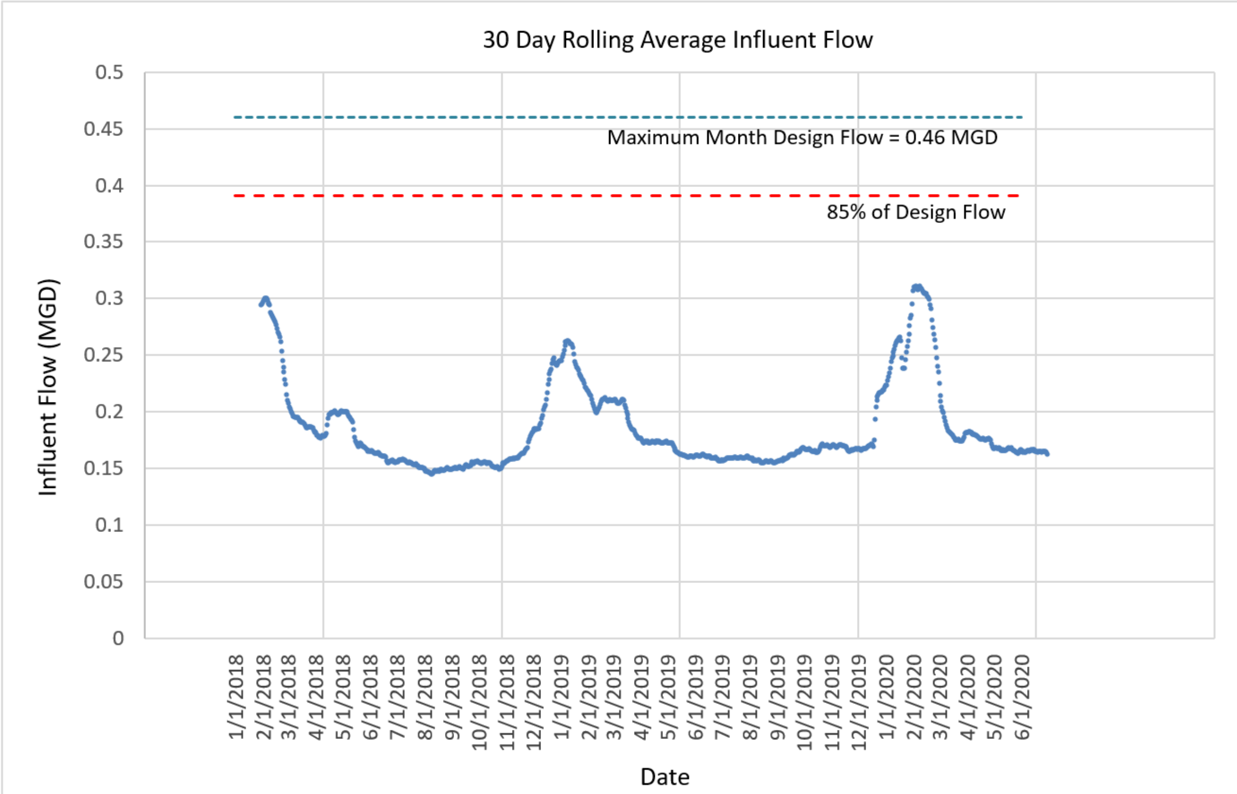
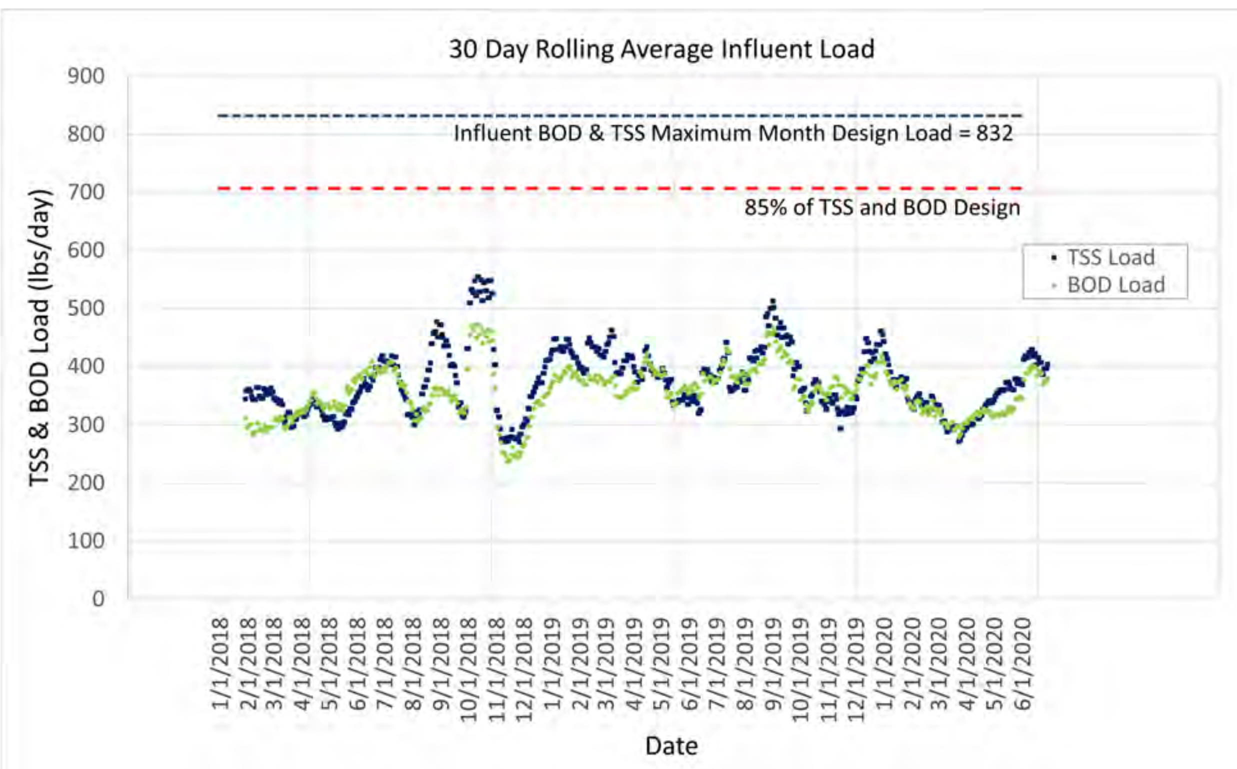


Figure 6-8 | 30-day Rolling Average Influent BOD and TSS Loads



6.5.2 EPA Plant Reliability Criteria

The Manchester WWTP is required to meet the Reliability Class I standards, as defined in EPA's Technical Bulletin "Design Criteria for Mechanical, Electrical, and Fluid System Component Reliability," EPA 430-99-74-001. **Table 6-11** includes a summary of the reliability criteria and requirements to be considered as part of the Alternatives Evaluation and Recommended Plan.

Table 6-11 | EPA Class I Reliability Criteria

Treatment Unit Process	Reliability Class I Requirements	Current Deficiencies
Influent Screening	A backup bar screen designed for mechanical or manual cleaning shall be provided. Facilities with only two bar screens shall have at least one bar screen designed to permit manual cleaning.	None. A manual screen is provided to back up the mechanical screen.
Pumps (Liquids, Solids & Chemical Feed)	A backup pump shall be provided for each set of pumps performing the same function. The capacity of the pumps shall be such that, with any one pump out of service, the remaining pumps will have the capacity to handle the peak flow.	None. Backup is provided to influent pumps, RAS pumps and sludge pumps.
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.	None. One of two secondary clarifiers will be able to handle 75% of the total flow.
Aeration Basin	A backup basin will not be required; however, at least two equal-volume basins shall be provided.	None. Two aeration basins are provided.
Aeration Blowers and/or Mechanical Aerators	There shall be a sufficient number of blowers or mechanical aerators to enable the design oxygen transfer to be maintained with the largest-capacity-unit out of service. It is permissible for the backup unit to be an uninstalled unit, provided that the installed units can be easily removed and replaced. However, at least two units shall be installed.	None. Aeration blowers are designed to provide design airflow with one backup.
Air Diffuser Systems	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.	None. Two grids of diffusers are provided in each aeration basin. Isolation of any will not impair the oxygen transfer capability of the system
Disinfection	The units should be sufficient in number and size so that, with the largest-flow-capacity unit out of service, the remaining units should have a design flow capacity of at least 50 percent of the total design flow.	None. The UV channel has two banks. One of two UV banks will be able to handle more than 50% of the total design flow.
Sludge Holding Tanks	Holding tanks are permissible as an alternative to component or system backup capabilities for components downstream of the tank provided the volume of the holding tank shall be based on the expected time necessary to perform maintenance and/or repair and the capacity of sludge treatment processes downstream can handle the combined flow from the storage tanks and the working sludge treatment system	None. WAS holding tanks and TWAS holding tank are provided to back up the GBT and sludge pump.

Treatment Unit Process	Reliability Class I Requirements	Current Deficiencies
Sludge Disposal	An alternative method of sludge disposal shall be provided for each sludge treatment unit process without installed backup.	None. If GBT is down, WAS storage tanks could store sludge for approximately a week. Or un-thickened sludge could be trucked to Central Kitsap WWTP.
Electrical Power Supply	Two separate and independent power sources, either from two separate utility substations or from a single substation and an on-site generator. The backup power supply shall be sufficient to operate all vital components during peak wastewater flow conditions, including critical lighting and ventilation.	None. An on-site generator is provided.

6.5.3 Preliminary Nutrient Loading at Manchester WWTP

Although the small TIN load plants do not have a facility specific action level in the first PSNGP, the proposed action level TIN load limits that Ecology presented in the Preliminary Draft Nutrient General Permit for Manchester WWTP provide a useful basis for evaluating performance and may be relevant again in the future. The load limits are shown in **Table 6-12**.

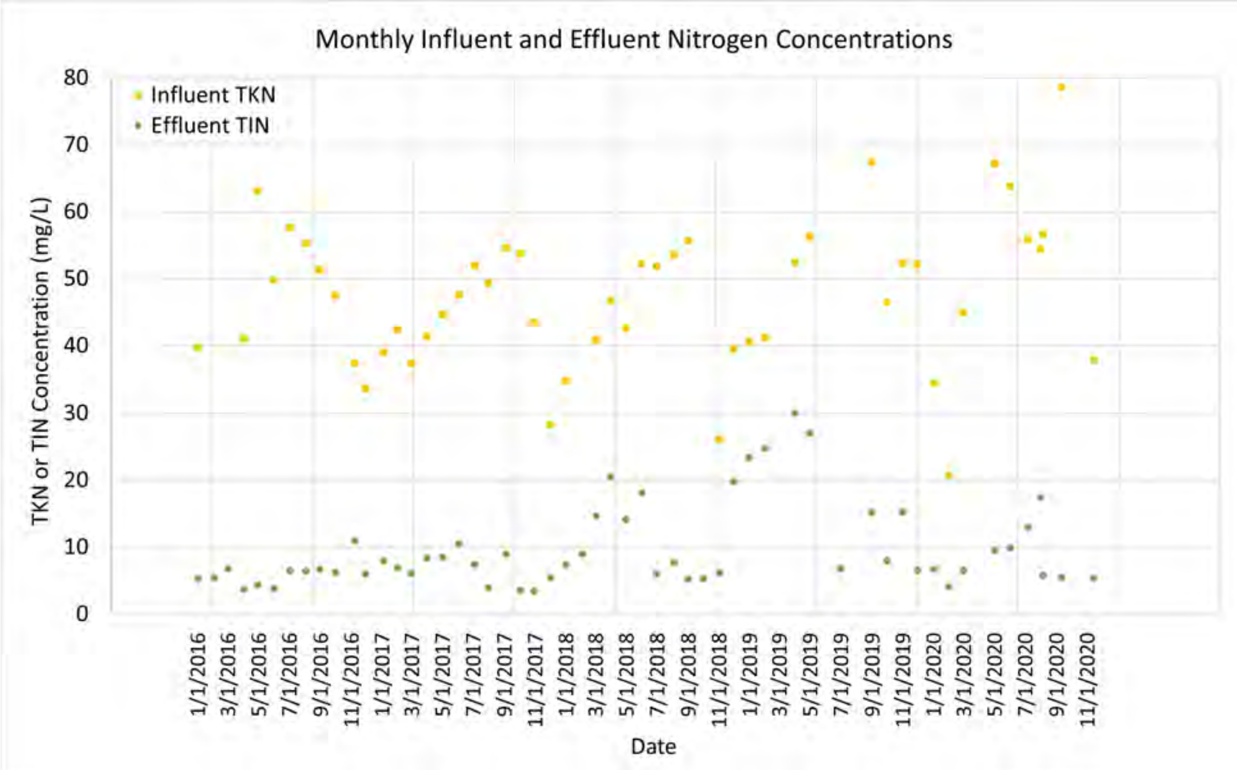
Table 6-12 | Manchester WWTP Preliminary Draft Nutrient General Permit Load Limits

Action Level	TIN Load Limit (lbs-N/year)	Maximum Average Annual Concentration[1] (mg/L)
Baseline (AL_0)	8,570	14.8
Secondary Threshold (AL_1)	8,999	15.6

Note:
lbs-N/year: pounds of nitrogen per year
1. Maximum Average Annual Concentration is the load limit divided by the current AAF

Since 2016, Manchester WWTP staff have been conducting monthly testing of the influent and effluent for nitrogen species, shown in **Figure 6-9**. Average influent TKN concentration was 48.5 mg/L, while effluent TIN concentrations ranged from 3.4 to 30.0 mg/L, with an average concentration of 9.6 mg/L.

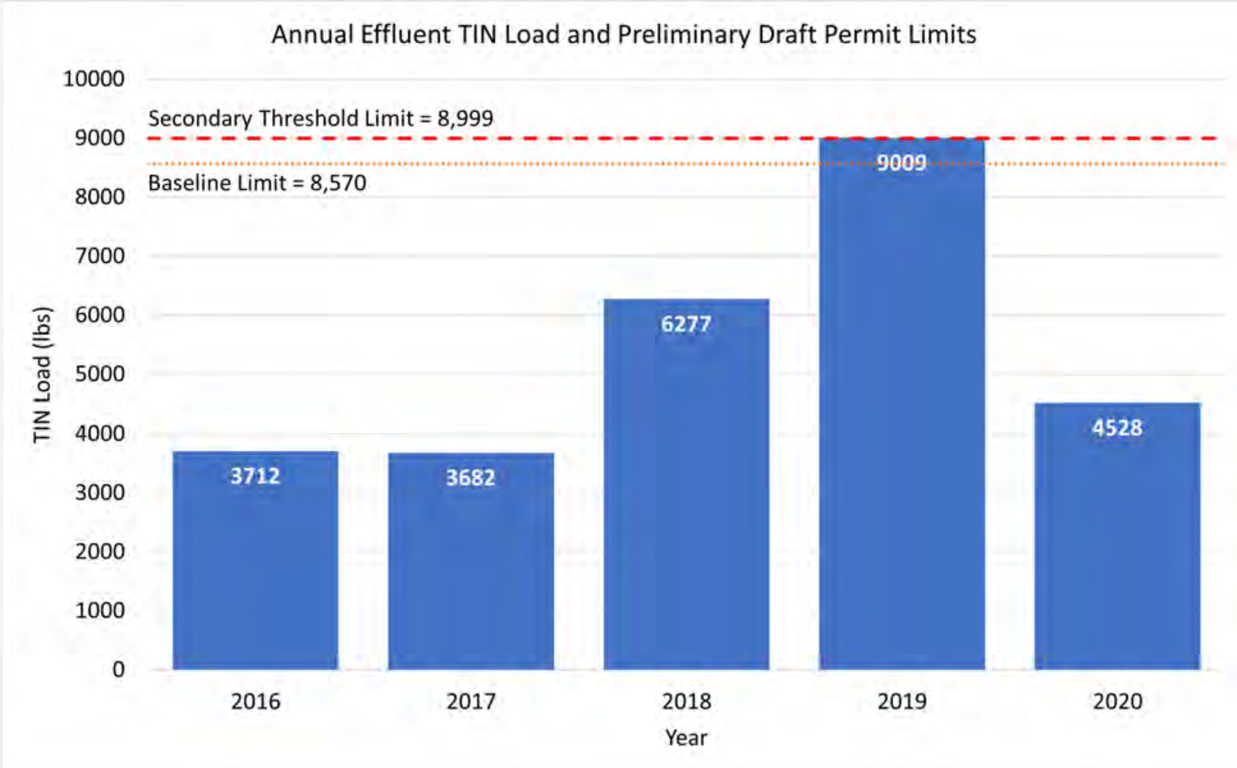
Figure 6-9 | Manchester WWTP Influent and Effluent Nitrogen Concentrations



The preliminary nutrient data was used in conjunction with effluent flow data to estimate annual TIN loading for comparison with the preliminary permit TIN load action levels in **Figure 6-10**. In a few instances, monthly data was not collected, and the effluent TIN concentration was interpolated to estimate the load for that month. In 2019, the estimated TIN load of 9,009 pounds slightly exceeded the secondary threshold due to high Nitrate + Nitrite effluent concentration in the first five months of the year. In all other years, the TIN load was well below the load limits.

It may be feasible to further reduce TIN loading to the Puget Sound by implementing a recycled water program to divert effluent from the outfall. Manchester WWTP does not currently produce effluent that meets reuse requirements nor is there a recycled water permit for the plant. The potential for a water reuse program is discussed in **Section 9**.

Figure 6-10 | Manchester Annual Effluent TIN Loads



The data indicates that Manchester WWTP has the capacity to meet the originally proposed load limits and may be able to consistently achieve low TIN loading if load limits are implemented in the future.

6.6 Existing Wastewater Treatment Plant Capacity Evaluation

This section of the Plan documents the capacity of the existing WWTP. Capacity at the treatment plant consists of equipment capacity, hydraulic capacity, and process capacity. The Manchester WWTP is required to treat the design flow and waste loads according to the NPDES permit, as well as hydraulically pass the PHF rate without being flooded. Current and projected flows were developed in **Section 3** and are shown in **Table 6-13**, below.

Table 6-13 | Existing and Projected Manchester WWTP Flows (MGD)

Flow Description	Current Flows (Years 2018-2020)	Projected Flows 2028	Projected Flows 2042
AAF	0.19	0.24	0.34
MMWWF	0.31	0.40	0.57
MMDWF	0.20	0.26	0.37
PDF	0.71	0.93	1.30
PHF	1.0	1.30	1.84

The last major treatment upgrade to the Manchester WWTP was in 1998 for a PHF of 1.40 MGD.

6.6.1 Mechanical Equipment Capacity

Based on the manufacturer's data and the 1998 design criteria, the capacity of each major unit process is listed in **Table 6-14**.

Table 6-14 | Design Capacity of Unit Processes at Manchester WWTP

System	Data
Influent Pump	
Quantity	3
Capacity, each	641 gpm
Mechanical Fine Screen	
Quantity	1
Capacity, each	2.1 MGD
Grit Chamber	
Type	Vortex
Quantity	1
Diameter	7 feet
Capacity, each	2.1 MGD
Aeration Basin	
Quantity	2
Volume, each	125,963 gallons (16,840 cubic feet)
Average Sidewater Depth	15.25 feet
Secondary Clarifier	
Quantity	2
Surface overflow rate at 1.4 MGD	730 gal/d/ ft^2
Diameter	35 feet
Depth	13 feet
UV System	
Type	Low Pressure
Quantity	2 banks in 1 channel; 42 lamps per bank
Dosage	33 milliwatt sec/sq cm
Capacity	1.40 MGD with two banks in service
WAS Storage Tank	
Quantity	2
Volume, each	20,000 gallons
TWAS Storage Tank	
Quantity	1
Volume, each	14,000 gallons
Gravity Belt Thickener	
Quantity	1
Size	1-meter belt
Capacity	200 gpm

Notes:
Gal/d/ft^2 - gallons per day per foot squared
Sec/sq cm = seconds per square centimeter

6.6.2 WWTP Liquid Stream Hydraulic Capacity

6.6.2.1 Hydraulic Capacity Analysis

To evaluate the hydraulic capacity of the existing WWTP, the treatment plant was modelled using Visual Hydraulics© based on the design and record drawings.

The hydraulic capacity was evaluated for flows up to the 2042 PHF of 1.84 MGD to identify how the existing plant hydraulics can be expected to perform during future flowrates. The model was run under two different flow scenarios, 2042 PHF and 2042 AAF. Under both scenarios two aeration basins are put into service since no redundant aeration basin is required per Ecology's reliability requirement. Under 2042 PHF scenario two sub-scenarios were modeled to simulate operation with one or two secondary clarifiers in service, since a redundant secondary clarifier is required per EPA's reliability requirement. As part of the analysis, hydraulic limitations were identified when the water level reached within 12-inches of freeboard below the top of a containment structure. The hydraulic profile at the projected 2042 AAF and PHF is shown in **Figure 6-11** below. The RAS flowrate recycle fraction (RAS/Influent) was assumed to match the average design of 0.18 MGD/0.34 MGD for the AAF and was assumed to be 0.50 of the MMWWF for flows at or higher than the MMWWF. A detailed summary of the input parameters used in the Visual Hydraulics Model is included as **Appendix G**.

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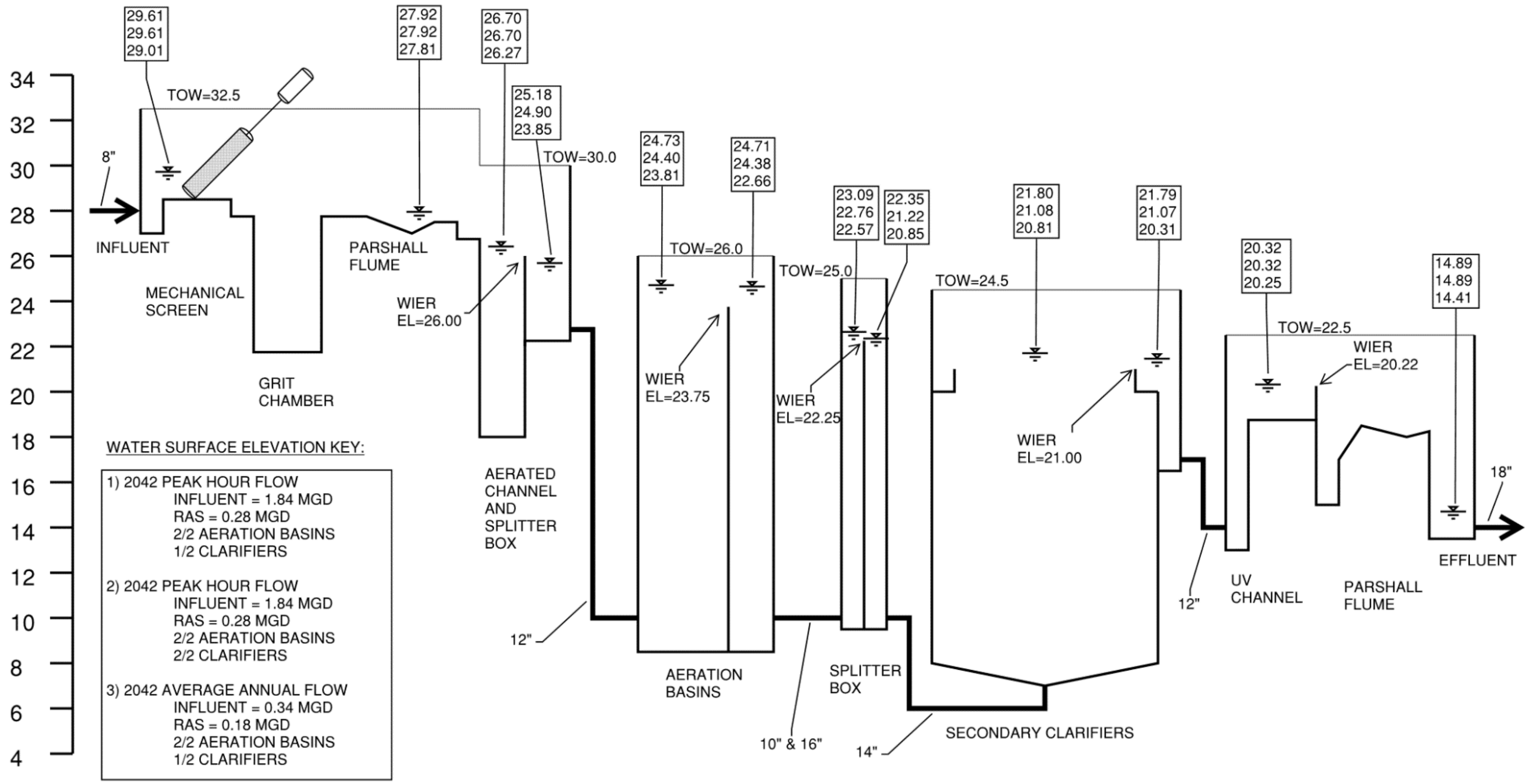
Figure 6-11 | Manchester WWTP Hydraulic Profile



NOTES:

1. ELEVATIONS BASED OFF OF NAVD 29 AS REPORTED IN THE 1996 RECORD DRAWINGS

6.6.2.2 Influent Pump Station Hydraulic Capacity

The influent pump station has three submersible pumps, each rated for 641 gpm at 39.9 feet of head. Hydraulic calculations for the influent pumps pumping to the headworks indicate that the firm capacity with two pumps running is approximately 1,300 gpm (1.87 MGD), which slightly above the estimated 2042 PHF of 1.84 MGD. The 8-inch diameter influent piping between pump station and headworks is appropriately sized for that peak flow as well. The current influent pump station has sufficient capacity to handle the estimated flow in the next 20 years.

6.6.2.3 Headworks Facility Hydraulic Capacity

The maximum flow capacity for the mechanical fine screen is unknown. However, it is very similar to the fine screen at Kingston WWTP, which has a 2.1 MGD maximum rated flow capacity, so it is assumed that the screen at Manchester has a similar capacity of 2.1 MGD which is greater than the 2042 PHF. The model indicates that remainder of the headworks has hydraulic capacity in excess of the 2042 PHF.

6.6.2.4 Secondary Treatment Hydraulic Capacity

From the Headworks Building, screened sewage is piped through two parallel 12-inch diameter ML pipes to the two aeration basins. Effluent from each aeration basin is collected in a 10-inch ML pipe then combines into a common 10-inch diameter pipe before transitioning to a 16-inch diameter ML pipe that feeds a splitter box. The 10-inch diameter pipes are from 1990 construction. The 16-inch diameter pipe was installed in 1996. ML from the splitter box is then diverted via two 14-inch diameter ML pipes to two secondary clarifiers. Effluent from the secondary clarifiers is collected in a common 12-inch diameter PLE pipe that connects to the UV channel. The original hydraulic profile from the 1996 plans shows a PLE pipe diameter of 14-inches diameter, however, the record drawings of the yard piping show a 12-inch diameter pipe, therefore 12-inch diameter PLE pipe was used for this analysis.

At high flowrates, the 10-inch diameter aeration basin effluent ML pipes have undesirably high flow velocities and therefore high headloss, which causes water to back up into the effluent weir boxes and into the aeration basins. The model indicates that the aeration basin effluent weirs begin to become submerged at 1.3 MGD and are submerged approximately 8-inches under the PHF scenario with both clarifiers operating. These 10-inch diameter pipes are the original pipes installed in 1990 and were not replaced as part of the 1998 plant upgrades, which generally used 12- or 14-inch diameter pipes for ML and PLE. Submerged effluent weir at aeration basins during the rare PHF condition should not be a big concern since it does not impact the flow distribution or process performance. Replacing the 10-inch diameter ML pipe with a larger pipe is not urgent but is suggested if other work is performed in the vicinity.

Ecology design criteria require the secondary clarifiers to have sufficient capacity to pass 75 percent of the design flow when the largest basin is out of service. Thus, with the 2042 peak flow estimated to be 1.84 MGD, a single clarifier must be capable of conveying 1.38 MGD. With one clarifier in operation, the 12-inch diameter PLE pipe causes high headloss, water back up into the clarifier effluent launder, and the clarifier weir becomes submerged at 1.2 MGD. At 1.38 MGD, the clarifier weir crest is approximately 5 inches below the water surface. With both clarifiers in operation, the effluent weir begins to become submerged at 1.4 MGD. When the secondary clarifier effluent weir becomes submerged there is potential for short-circuiting and solids washout. Enlarging the existing effluent pipe or adding a third secondary clarifier should be considered to avoid submerging the secondary clarifier effluent weir during a peak flow event.

6.6.2.5 UV Channels and Effluent Basin Hydraulic Capacity

Following the clarifiers, effluent flows through a UV disinfection channel and a Parshall flume, then to the effluent manhole. All these components have hydraulic capacity that exceeds the 2042 PHF of 1.84 MGD. The outfall piping downstream of the effluent manhole and the outfall structure were not modeled, because the design capacity of the existing outfall piping is higher than the projected 2042 PHF.

The existing UV disinfection system has two UV banks with a total rated capacity of 1.40 MGD. The existing channel has room for one additional UV bank, which would increase the total capacity to greater than 1.84 MGD.

6.6.2.6 Summary

The hydraulic analysis indicates that the influent pump station, headworks, UV channel, and effluent basin have sufficient capacity to convey flows throughout the entire 20-year planning horizon. At all flows throughout the 2042 planning period hydraulic flow through the plant is maintained and the freeboard of the structures never exceeds the 12-inch threshold. Space is available in the UV channel for an additional UV bank to treat the 2042 peak flow. The modeled hydraulic deficiencies are that with all the units in service, the aeration basin and secondary clarifier effluent weirs will be submerged before and during the 2042 PHF due to their relatively small effluent piping; and when a single clarifier needs to handle 75 percent of PHF per the Ecology's reliability criteria the clarifier effluent weir will also become submerged. These deficiencies may impact the secondary clarifier performance but will not cause any overflow.

6.6.3 Secondary Process Treatment Capacity

6.6.3.1 BioWin™ Model Development

The existing aeration basins and secondary clarifiers were modeled using BioWin™ software to determine the existing secondary process treatment capacity. The aeration basins, secondary clarifiers, and WAS storage tanks were sized in the model based on record drawings as summarized in early sections. The WAS storage tanks were modelled as one tank for simplicity. The process model was evaluated under both current and future AAF, MMWWF, and MMDWF conditions.

6.6.3.2 Influent Wastewater Characterization

Following the sampling plan developed by Murraysmith [now Consor], County staff collected three wastewater characterization of influent and effluent composite samples in September 2020 including one on a weekend. The results of the wastewater characterization (**Table 6-15**) were included to develop the influent characteristics for the process model.

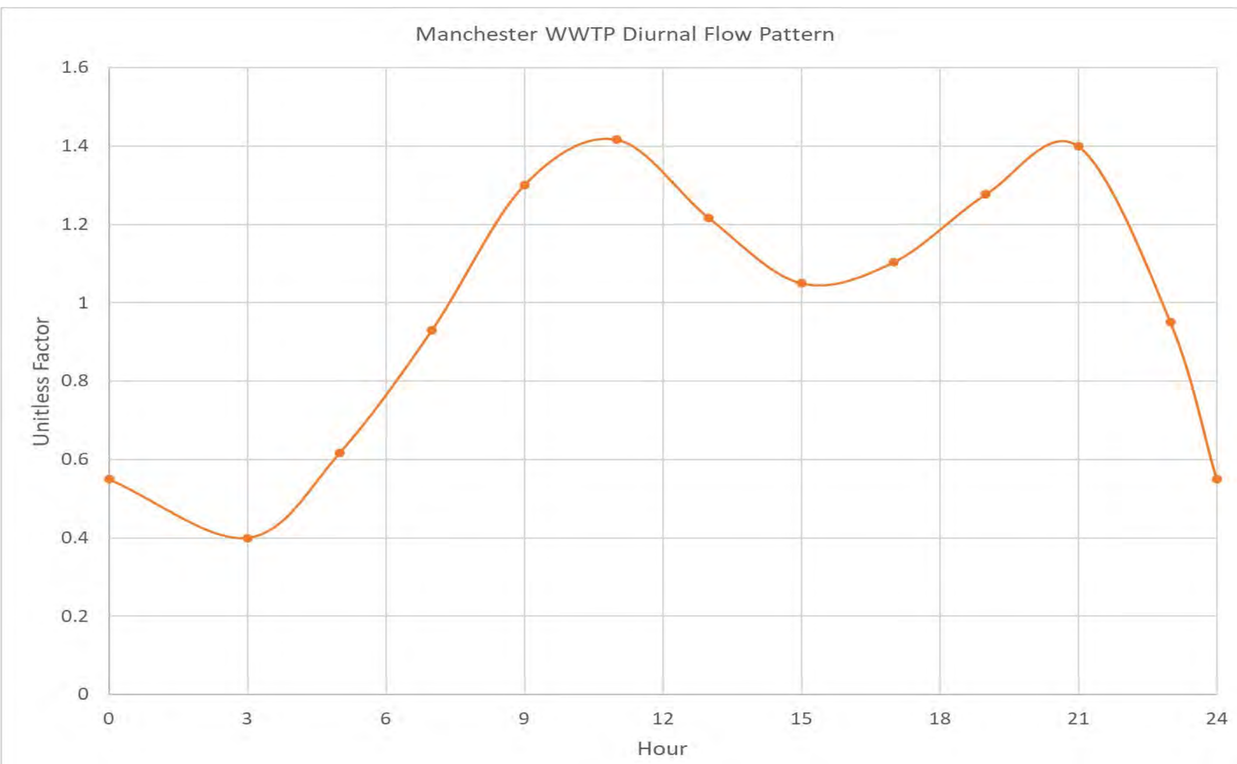
Table 6-15 | Average Influent Wastewater Characteristics

Parameter	Average Influent Concentration, mg/L	Average Effluent Concentration, mg/L
Total Chemical Oxygen Demand (COD)	719	42
Filtered COD	199	39
Flocculated and Filtered COD	108	Not Determined
Carbonaceous Biochemical Oxygen Demand (CBOD)	272	Not Determined
Filtered CBOD	60	Not Determined
TSS	330	6

Parameter	Average Influent Concentration, mg/L	Average Effluent Concentration, mg/L
Volatile Suspended Solids (VSS)	305	5
NH_3-N	40	4
NO_3-N & NO_2-N	0	3
TKN	56	6
Total Phosphorus (TP)	7	4
Orthophosphate (Ortho-P)	4	4
Alkalinity	235	107
Calcium (Ca)	23	Not Determined
Magnesium (Mg)	10	Not Determined
pH	7.96	7.02
DO	0.2	7

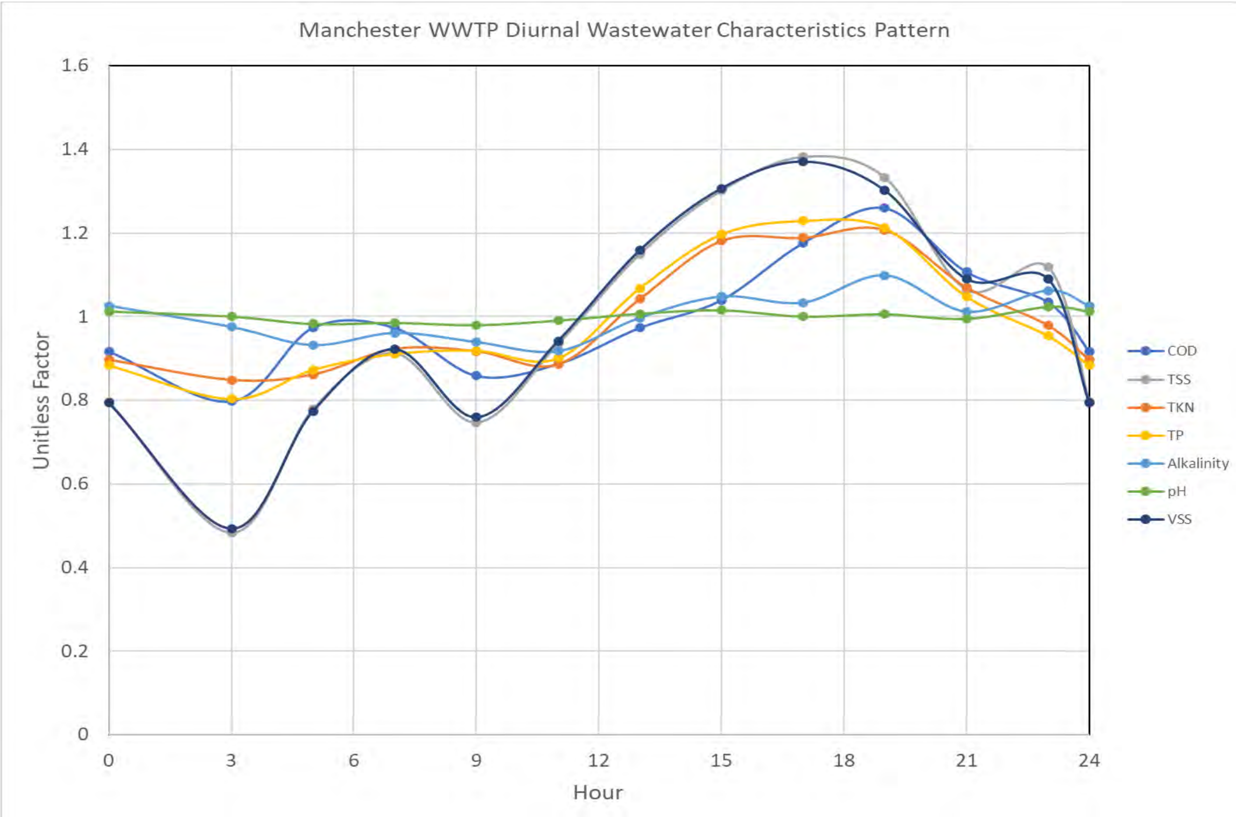
Since no hourly influent flow is recorded, the diurnal flow data from Appendix C of the 2014 Plan (BHC Consultants, October 2014) was used to simulate diurnal influent flow patterns. The diurnal influent flow pattern is shown on **Figure 6-12.** In addition, diurnal influent wastewater sampling for COD, TSS, VSS, TKN, TP, Ortho-P, Alkalinity, and pH was performed at Central Kitsap WWTP on October 21, 2020 and were used as the basis of Manchester WWTP diurnal influent concentration pattern as shown on **Figure 6-13**. Both diurnal flow and concentration information was used in the process model dynamic simulations.

Figure 6-12 | Manchester WWTP Influent Diurnal Flow Pattern



Source: 2014 Plan

Figure 6-13 | Manchester WWTP Influent Diurnal Wastewater Characteristics Pattern



Source: Central Kitsap WWTP Wastewater Sampling Results, 2020

6.6.3.3 Treatment Requirements

Although Manchester WWTP is currently only required to meet the BOD and TSS removal requirement and effluent BOD and TSS concentration and load limits, and effluent pH and fecal coliform limits, the nutrient removal requirement will be applied soon. As part of the capacity evaluation for the existing plant, besides trying to meet the current permit requirements for BOD and TSS of 30 mg/L on a monthly average basis, the plant was also evaluated for meeting a potential TIN concentration of 10 mg/L. It is anticipated the Nutrient General Permit will become more stringent with potential effluent TIN limit of 3 to 10 mg/L in the future. Potential alternatives to achieve as low as 3 mg/L will be discussed in the following section.

6.6.3.4 Aeration Basin Capacity

The results of various simulations at AAF, MMWWF and MMDWF in 2020, 2028 and 2042 are shown in **Table 6-16.**

Under current 2020 flow and loads, one aeration basin with the current operational procedure can meet all the treatment requirements on BOD, TSS and annual TIN load as discussed. Although the mixed liquor suspended solids (MLSS) will get as high as 3,700 mg/L during maximum month condition when 8 days of SRT is maintained to promote nitrification, the secondary clarifier settleability analysis (state point analysis in BioWin™) indicates this high MLSS will not deteriorate the secondary clarifier performance. This is supported by historical operational data that shows that the MLSS reached 5,000 mg/L and the effluent TSS was less than 10 mg/L.

As flow and loads increase over time, a second aeration basin will likely be required in the next six to eight years to maintain the same level of nitrification and denitrification to meet the same TIN cap. With two aeration basins in operation, the plant will have sufficient capacity to treat the projected TSS and BOD loads to meet the current NPDES permit limits and remove the projected nitrogen load to meet the potential TIN action level in the next 20 years. More detailed analysis on optimizing the oxidation ditches to meet more stringent nitrogen requirement will be discussed in **Section 9**.

The alkalinity values used in the process model were based on the three samples collected in September 2020 at the Manchester WWTP as part of the influent wastewater characterization sampling. For all MMDWF simulations, the process model indicated the plant cannot meet the pH permit requirements without supplemental alkalinity addition. In addition, nitrogen removal performance was impacted due to the low pH. Considering the historical effluent pH levels have not been low, it is likely because the plant did not accomplish the same level of nitrification as modeled, or the influent alkalinity during the maximum month dry weather is higher than the sampling data. Nonetheless, additional alkalinity measurements should be collected at the plant to determine if supplemental alkalinity addition will be required to optimize nitrogen removal.

Table 6-16 | BioWin™ Process Model Simulation Results

Parameter	2020			2028			2042		
	AAF	MMWWF	MMDWF	AAF	MMWWF	MMDWF	AAF	MMWWF	MMDWF
Flow, MGD	0.19	0.31	0.2	0.24	0.4	0.26	0.34	0.57	0.37
Temperature, °C	15	10	21	15	10	21	15	10	21
Influent Alkalinity, mg/L	235	235	400	235	235	400	235	235	400
No of AB Trains	1	1	1	2	2	2	2	2	2
DO Cycle, hrs	6 (4 ON/ 2 OFF)	6 (4 ON/ 2 OFF)	6 (3 ON/ 3 OFF)	6 (4 ON/ 2 OFF)	6 (4 ON/ 2 OFF)	6 (3 ON/ 3 OFF)	6 (3 ON/ 3 OFF)	6 (4 ON/ 2 OFF)	6 (3 ON/ 3 OFF)
Target DO during ON, mg/L	2	2	1	2	2	1	2	2	1
SRT, days	8	8	8	10	10	10	8	8	8
MLSS, mg/l	2,800	3,400	3,700	2,200	2,700	2,900	2,600	3,000	3,400
Effluent TSS, mg/l	1.6	2.7	1.7	2.0	3.6	2.3	3.0	5.4	3.3
Effluent BOD, mg/l	1.3	1.7	1.3	1.3	1.8	1.2	1.6	2.5	1.6
Effluent Ammonia, mg/l	7.3	3.8	4	1	2	2	4	4	3.5
Effluent Nitrate and Nitrite, mg/l	3	2.5	5	5.8	4	3.5	2.75	3	5
Effluent TIN, mg/L	10.3	8.5	9.0	6.8	6.0	5.5	6.8	7.0	8.5
Annual Effluent TIN Load, ppd	17.0			13.5			20		
Effluent pH	6.2	6.6	6.6	6.3	6.6	6.7	6.3	6.6	6.7
Effluent Alkalinity, mg/L	40	140	87	50	180	130	150	110	130
WAS Solids, ppd	370	480	490	461	561	613	677	813	891
WAS Tank Storage Capacity, days	7	6	6	6	5	4	3	3	3
Thickened Biosolids, % Solids	5.9	5.9	5.8	5.9	5.9	5.9	5.9	5.8	5.9
Thickened Biosolids, ppd	280	345	372	370	450	491	544	655	713
TWAS Storage Tank Storage Capacity, days	24	20	18	19	15	14	13	10	9

Note:

1. Conditions that may require supplemental alkalinity addition

6.6.3.5 Secondary Clarifier Capacity

Secondary clarifier capacity is mainly assessed based on the surface overflow rate. The typical secondary clarifier surface overflow rate under average flows is 400 to 700 gallons per day per square foot (gpd/sf). The typical secondary clarifier surface overflow rate under peak flows is 800 to 1,600 gpd/sf.

Ecology design criteria requires the secondary clarifiers to have sufficient capacity to pass 75 percent of the design flow when the largest unit is out of service. **Table 6-17** summarizes the surface overflow rate under various operating conditions. It appears one secondary clarifier will be able to treat average flows through 2042. Both clarifiers will be required to handle the peak flows for a reliable performance. Two clarifiers meet Ecology's redundancy requirement, however the surface overflow rate in 2042 PHF condition will be on the upper end of the range. As flows approach 2042 conditions, clarifier performance should be evaluated, and the County may want to consider an additional secondary clarifier.

Table 6-17 | Secondary Clarifier Surface Overflow Rate

Parameter	AAF	MMWWF	PHF	75% of PHF	AAF	MMWWF	PHF	75% of PHF
Design Year	2028	2028	2028	2028	2042	2042	2042	2042
Flow, MGD	0.24	0.4	1.3	1.0	0.34	0.57	1.84	1.4
No. of Secondary Clarifiers in service	1	1	2	1	1	1	2	1
Surface Overflow Rate, gpd/sf	249	416	676	1,013	353	592	946	1,420

6.6.4 Solids Stream Capacity

The following sections discuss the capacity of each major component in the solids handling system.

6.6.4.1 WAS Tanks Storage Capacity

Sludge is currently wasted to the two 20,000 gallon WAS tanks at a rate of 4,000-6,000 gallons per day. At 6,000 gallons per day of wasting, WAS tanks currently have over six days of storage capacity. At 2042 Maximum Month flows, the storage duration of the WAS tanks is reduced to three days based on BioWin™ model results presented in **Table 6-10**. The WAS tank storage duration could potentially be extended by slowing down the RAS pump speed and hence feeding a higher concentration of sludge to the WAS tanks. The TWAS storage could also be further utilized prior to building additional WAS storage. Otherwise, the GBT will need to be run more frequently, i.e., every three days, to empty WAS tanks.

6.6.5 Gravity Belt Thickener Loading Rate

According to the design drawings for the Manchester WWTP Improvements constructed in 1998, the GBT is designed for a hydraulic loading rate of 200 gpm. Once per week the GBT is run for 4 to 5 hours to empty the full WAS tanks. **Table 6-18** summarizes the projected WAS production by the process model and the anticipated GBT operating hours each week when run at 200 gpm. The GBT has sufficient capacity to meet existing and future flow and loads.

Table 6-18 | Projected GBT Operation

Parameter	AAF	MMDWF	AAF	MMDWF	AAF	MMDWF
Design Year	2020	2020	2028	2028	2042	2042
WAS Solids, ppd	370	490	461	613	677	891
Assumed WAS Conc., mg/L	8,000	8,000	8,000	8,000	8,000	8,000
WAS Flow, gpd	5,500	7,300	6,900	9,200	10,100	13,400
GBT Operating Hours (no. of hrs per week)	3.2	4.3	4.0	5.4	5.9	7.8

6.6.5.1 TWAS Tank Storage Capacity

Sludge from the WAS tanks is thickened one day per week and sent to the 14,000-gallon TWAS tank. WAS concentration can range from 5,000 mg/L to 9,000 mg/L. The GBT is currently operated to produce TWAS ranging from 5.0 percent to 5.9 percent solids. Based on the current TWAS quantity, the TWAS storage tank can provide approximately 24 days of capacity. Based on the 2042 TWAS projection in BioWin™ model, the TWAS storage capacity is approximately 9 days. Therefore, TWAS storage capacity is not a limiting factor at the Manchester WWTP.

6.7 Summary of Deficiencies and Recommendations

Table 6-19 provides a summary of the main findings for each unit process based on the condition assessment, code review, hydraulic analysis and treatment capacity analysis described above.

Table 6-19 | Overall Unit Process Capacity and Deficiencies

Unit Process	Physical Condition[1]	Capacity	Recommendation
Influent Pumping			
Influent Pumps	Good	1.87 MGD, firm	None
Preliminary Treatment			
Fine Screen	Fair	2.1 MGD, peak	General maintenance practice to mitigate corrosion Plan equipment replacement in the next 12-15 years
Grit Removal	Fair	2.1 MGD, peak	General maintenance practice to mitigate corrosion Plan equipment replacement in the next 12-15 years
Grit Pump and Classifier	Fair	220 gpm	Consider replacing grit classifier feedbox General maintenance practice to mitigate corrosion Plan equipment replacement in the next 12-15 years
Parshall Flume, Aerated Channel and Flow Splitter	Good	10.4 MGD, peak	Add level sensor to resume flow monitoring function
Aerated Channel Blower	Fair	100 standard cubic feet per minute (scfm) @ 3.5 psig	General maintenance practice to mitigate corrosion Plan equipment replacement in the next 12-15 years
Secondary Treatment			
Aeration Basins	Good	Over 0.6 MGD, maximum month	Upgrade jet aeration and blower system to improve aeration control Upgrade process to improve nutrient removal
Aeration Blowers	Poor	500 scfm, firm	Replace blowers with AFDs as part of aeration basin upgrade
Aeration basin ML piping	Poor	The 10-inch diameter ML piping between aeration basins and the flow splitter to clarifiers is a hydraulic constraint	Consider enlarging the 10-inch ML pipe
Flow splitter to clarifiers	Good	1.7 MGD	None
Secondary Clarifiers	Fair	over 1.84 MGD, peak. Surface overflow is high, and weir is submerged when a single clarifier needs to handle 75 percent of design PHF.	Consider adding a third clarifier as flow approaches 2042 flow General maintenance practice to mitigate corrosion Plan equipment replacement in the next 12-15 years
Secondary Clarifiers Effluent Piping	Unknown	The 12-inch diameter PLE piping between secondary clarifiers and UV channel is a hydraulic constraint	Consider enlarging the 12-inch PLE pipe
RAS and WAS Pump Station	Good	275 gpm, firm	Add WAS flow meter and control valve
Disinfection and Effluent			
UV System	Poor	1.4 MGD, peak	Replace entire system for improved control in the next 2 to 10 years
Effluent Parshall flume	Good	2.5 MGD, peak	None
Solids Treatment			
Gravity Belt Thickener	Good	200 gpm	Evaluate ventilation in GBT room to minimize corrosion Install fire alarm system at GBT room Keep a spare flowmeter
WAS Storage Tanks	Good	40,000 gallons. WAS tanks' capacity could be a limiting factor in 2042	System control to draw higher concentration WAS if needed Replace LEL sensor
TWAS Storage Tank	Good	14,000 gallons	Replace LEL sensor Monitor the tank exterior hairline crack
Sludge Tank Blowers	Fair	400 scfm, firm	Plan equipment replacement in the next 12-15 years
Support System			
Odor Control	Poor	N/A. The chemical dosing and system automation do not work	Repair or replace the odor control system to restore automatic operation and full functionality
In-plant pump station	Unknown	N/A	Inspect and consider replacing the pumps
W2 Water	Fair	N/A	Plan equipment replacement in the next 12-15 years
W3 Water	Fair to Poor	N/A	Replace existing automatic strainer and flow meter General maintenance practice to mitigate corrosion

Unit Process	Physical Condition[1]	Capacity	Recommendation
Power Distribution			
Electrical Service	Fair	N/A	Plan equipment replacement in the next 12-15 years Complete arc flash study Establish replacement plan for obsolete equipment
Generator	Fair	Generator has the capacity to fully power the plant during power outages	None
MCCs	Fair	N/A	Establish replacement plan for obsolete equipment
Control Panels	Fair	N/A	Clean and coat rusted area Re-evaluate junction box TJB-WP1 installation to bring it up to current NFPA standards Housekeeping recommendations per Section 6.3.3.9
Buildings			
Operations Building	Good	N/A	Consider additional cooling for electrical room
Generator Building	Good	N/A	None
Blower Building	Good	N/A	None

Notes:
1. Component condition rating based on Table 6-3

SECTION 7

Collection and Conveyance System Analysis

7.1 Introduction

A C&C system analysis was not performed as part of this Plan. The capital improvement plan (CIP) is based on the modeling analysis as part of the 2014 Plan. The full modeling chapter from the 2014 plan is included as Appendix H, and is summarized below. The County was the lead modeler for the Manchester LAMIRD C&C system modeling in 2014. Due to minimal growth in the LAMIRD since the model was developed, the County directed Consor to use the results from the 2014 County analysis.

7.2 Summary of 2014 Evaluation and Modeling

Modeling was performed during the 2014 Plan to evaluate existing pump stations and conveyance facilities under the current (as of 2014) and projected population and related flow scenarios. Recommended system improvements and sizing of future pump stations and force mains were based on system deficiencies found during the 2014 modeling analysis and on system needs identified by County staff at that time.

The MIKE Urban 2009 hydraulic model developed by the Danish Hydraulic Institute (DHI) was selected for use in modeling the conveyance system. Model flow loading was based on parcel-level population/sewer user data. The “Sewer Permits” data set from the County GIS was utilized to define and distribute flow in the model, with an average assumed flow of 85 gallons per day per person.

Results of the existing conditions model run indicated no areas where problems could occur during a period of PDF. Future conditions were represented conceptually by loading the model with sewage flows predicted to be generated by future populations.

The future flow loading on the existing facilities was estimated from unsewered areas of the LAMIRD, meaning that build-out modeled areas include all currently unsewered areas of the Manchester LAMIRD. The future mini-basins were delineated based on topography, as either an area that could flow strictly by gravity to an existing pump station, or to an area where a new pump station is required to convey flow into the existing system. For the latter, a hypothetical pump station was located at a topographical low point in the basin. The representation of future pump stations is not intended to establish the exact location of future facilities, rather, they are provided to approximate the future system requirements on a more global level.

These build-out sewer expansions are included as projects in the CIP, to be built as necessary if growth in the area occurs.

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SECTION 8

Wastewater Treatment System Analysis

The Manchester WWTP liquid stream improvement alternatives considered for plant improvements for the 6-year and 20-year planning horizons are described in this Section. Projected increases in flow and loading to the WWTP, aging equipment and the new PSNGP are the primary drivers for the improvements to allow the plant to consistently achieve the required effluent quality. The evaluation takes into consideration deficiencies, upgrades required, the expected treatment performance, capital and life cycle costs.

The results of the condition assessment, capacity analysis, regulatory requirements, and projected flows and loadings, were used to identify processes that require improvement and define feasible alternatives for WWTP improvements. Minor maintenance, repairs, and direct replacements identified in the condition assessment **Table 6-19** are discussed briefly herein, but are not subject to a full alternatives analysis. These items as well as the preferred alternatives identified in this section will be included in the CIP in **Section 11**.

8.1 Overview of Improvements

Preliminary treatment components at Manchester WWTP include the fine screen, grit removal, grit pump and classifier, Parshall flume, aerated channel and flow splitter, and aerated channel blower. These components are generally in good or fair condition and have sufficient capacity, so no upgrades are required, and further analysis of alternative processes is not considered in this section. Manchester WWTP does not have any primary treatment processes.

Secondary treatment components at Manchester WWTP include two aeration basins, an aeration system, two secondary clarifiers, and other associated support systems. The aeration system is in poor condition and was identified in the condition assessment, **Section 6**, as one of three primary processes requiring improvement. The PSNGP has introduced new secondary treatment requirements and further changes the permit system are expected. Therefore, the capacity of the secondary treatment system will be examined more closely in this section.

Four alternatives were developed to address the deficiencies in secondary treatment, each of which is designated with a code identifying the location and alternative number as SEC (secondary treatment)-#. The optimization and improvements will occur to the aeration basins and Blower Building.

- **Alternative SEC-1 Blower Upgrade** represents continued use of the existing jet aeration system within the existing aeration basins, installing DO probes, and replacing the existing blowers with new blowers with variable frequency drive (VFD) so that jet aeration operation could be adjusted based on DO and on/off cycle time.

- **Alternative SEC-2 Aeration System Optimization** replaces the existing jet aeration system with a new system including new blowers and fine bubble diffusers and adds DO and ammonia/nitrate probes to improve process control.

- **Alternative SEC-3 Biological Nutrient Removal – MLE** converts existing aeration basins to a Modified Ludzack-Ettinger (MLE) process which requires the improvements identified in SEC-2 and the addition of baffle walls in the aeration basins to create anoxic and aerobic zones, new mixers, and ML recycle pumps.

- **Alternative SEC-4 Biological Nutrient Removal – Bardenpho with Third Basin** includes a third aeration basin as part of the Bardenpho biological nitrogen removal process. The existing two aeration basins will be converted to include anoxic and aerobic zones, similar to SEC-3.

The secondary clarifiers are in fair condition and require some general maintenance. A third clarifier is recommended as flow approaches 2042 flow. Other components are in good condition.

The UV disinfection system condition is in poor condition and was identified in the condition assessment, **Section 6**, as one of three primary processes requiring improvement. The process was reviewed, and two alternatives were identified and analyzed to select a preferred alternative to address the observed problems.

Each alternative is designated with a code identifying the location and alternative number as DIS (disinfection)-#. Optimization and improvements will occur in the UV Facility.

- **Alternative DIS-1 Trojan UV3000B and Controller** replaces the existing Trojan UV3000B with a new version of the same system.

- **Alternative DIS-2 Trojan UV3000Plus and Controller** replaces the existing system with the upgraded Trojan 3000plus system which allows for greater operational control and monitoring.

No other UV manufacturers were considered in this analysis because the existing UV system is by Trojan. Replacing the existing UV system with Trojan system will require none to minimal modification to the existing UV channel.

Solids treatment at Manchester WWTP is provided by a GBT and includes WAS and TWAS tanks as well as blowers for the tanks. Some maintenance is needed in the GBT room to fix ventilation, address corrosion, and repair sensors. The sludge tank blowers are in fair condition and it is recommended to be replaced in the next 12 to 15 years. Other components are in good condition and have sufficient capacity, so further analysis of alternative processes is not considered in this section.

The odor control system at Manchester WWTP is provided by a chemical scrubber. The system is in poor condition and was identified in the condition assessment, **Section 6**, as one of three primary processes requiring improvement. The process was reviewed and three alternatives were identified and analyzed to select a preferred alternative to address the observed problems.

Each alternative is designated with a code identifying the location and alternative number as OC (odor control)-#. The optimization and improvements will occur in the odor control area, located north of Headworks Building.

- **Alternative OC-1 Chemical Scrubber** replaces the existing chemical scrubber with a new, similar chemical scrubber.

- **Alternative OC-2 Activated Carbon** replaces the existing chemical scrubber with an activated carbon scrubber.

- **Alternative OC-3 Engineered Biofilter** replaces the existing chemical scrubber with an engineered biofilter package.

The non-portable water, process water, and power distribution systems are in fair or good condition and have sufficient capacity, so no upgrades are required. Some equipment related to these systems will require in-kind replacements, but analysis of alternative processes is not considered in this section.

Figure 8-1 shows the site plan of WWTP with the unit processes requiring improvements identified. **Table 8-1** provides a summary of the alternatives.

Figure 8-1 | Overview of Improvement Alternatives at the Manchester WWTP

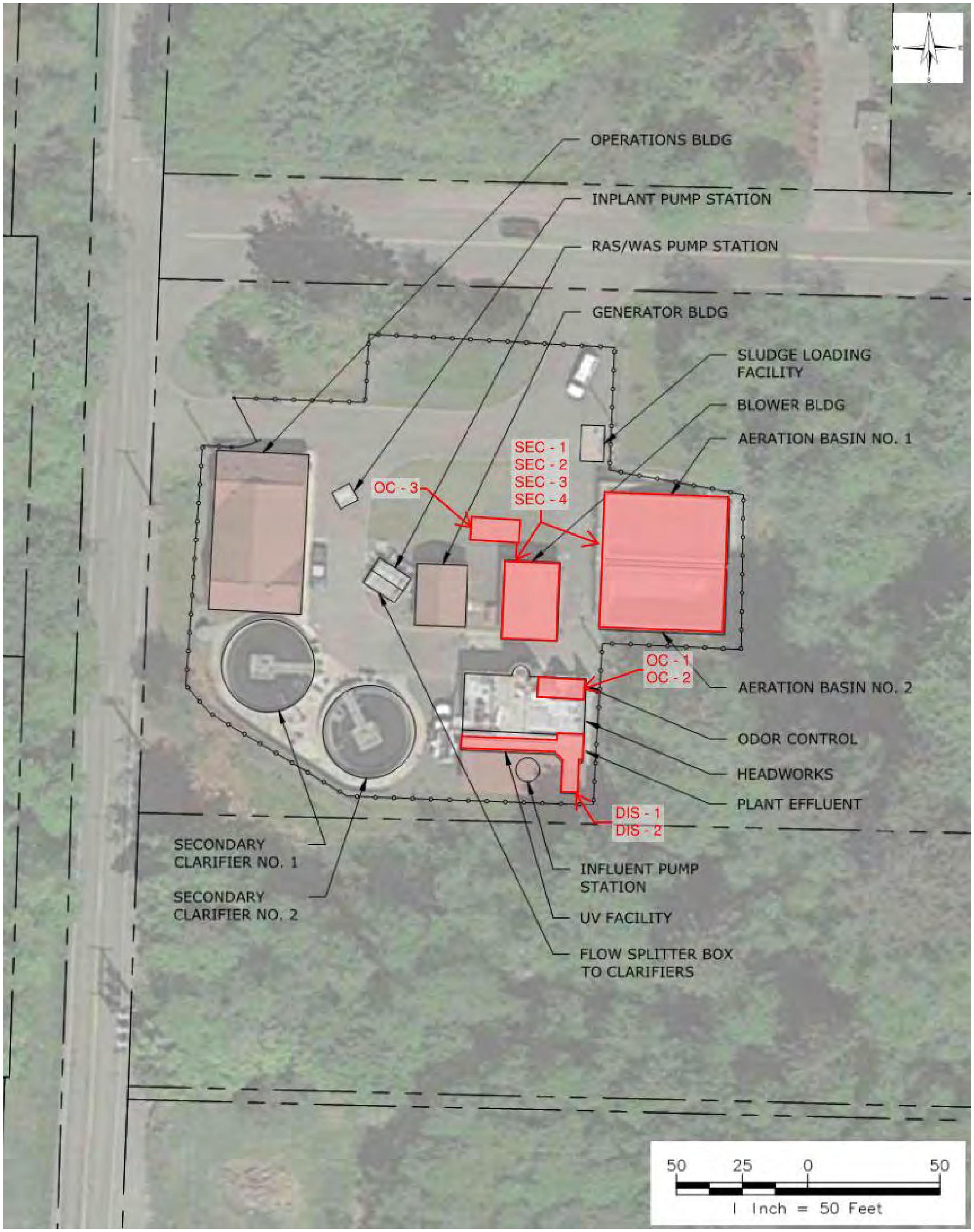


Table 8-1 | Treatment Improvement Alternatives Summary

Alternative Number	Alternative Name	Alternative Description	Deficiency Addressed
SEC-1	Blower Upgrade	Replace aeration blowers. Install DO probes. Continue the use of existing aeration basins with Jet Aeration systems.	Secondary Treatment – aging blower and blower control
SEC-2	Aeration System Optimization	Replace Jet Aeration with aeration blowers and fine bubble diffusers. Install DO and ammonia, nitrate and nitrite probes. Improve aeration control based on DO and ammonia monitoring for nitrogen removal optimization.	Secondary Treatment – aeration system & nitrogen removal optimization
SEC-3	Biological Nutrient Removal – MLE	In addition to the aeration system optimization, convert the existing aeration basins into a MLE process with submersible mixers, aeration diffusers and ML recycle pumps; add baffle walls to promote plug flow. The goal is to reliably achieve less than 10 mg/L of effluent TIN	Secondary Treatment – aeration basin, aeration system & nitrogen removal
SEC-4	Biological Nutrient Removal – Bardenpho with Third Basin	Add a new basin. Configure aeration basins into a Bardenpho process to achieve a less than 3 mg/L effluent TIN goal	Secondary Treatment – aeration basin, aeration system & nitrogen removal
DIS-1	UV Disinfection – Trojan UV3000B and Controller	Replace the existing Trojan UV 3000B with a new unit; replace the basic controller with the touch smart controller; install a UV transmittance probe	Disinfection
DIS-2	UV Disinfection – Trojan UV3000Plus and Controller	Replace the existing Trojan UV 3000B with an upgrade version – Trojan UV 3000Plus with touch smart controller and UV transmittance probe	Disinfection
OC-1	Chemical Scrubber	Replace the existing chemical scrubber with a new chemical scrubber	Odor Control
OC-2	Activated Carbon	Replace the existing chemical scrubber with an activated carbon system	Odor Control
OC-3	Engineered Biofilter	Replace the existing chemical scrubber with an engineered biofilter	Odor Control

8.2 Opinion of Probable Project Costs

Class 5 opinions of probable project costs (OPPC) for the 20-year planning period were developed for each alternative. The Class 5 OPPCs were prepared in accordance with the guidelines of the Association for the Advancement of Cost Engineering International (AACE) for planning-level evaluations with a range of -50 percent to +100 percent, based on the *AACE International Recommended Practice No. 18R-97 Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries – TCM Framework: 7.3 – Cost Estimating and Budgeting.*

The OPPCs were developed using RSMeans Heavy Construction Cost Data, recent County project bid tabs, County input, industry experience, and local contractor and supplier costs. All costs were developed based on the preliminary concepts and layouts of the system components in 2022 dollars should be escalated with the future Consumer Cost Index for use in project budgeting. The OPPC includes both construction and project costs. The construction costs include construction work and materials plus markups for mobilization, general contractor markups, overhead, and profit, taxes, and a construction contingency of 30 percent. The project costs account for a markup of 25 percent for engineering, legal, and administration costs associated with project delivery.

The O&M costs and the 20-year net present values were also developed based on the following assumptions:

- Labor cost: $60/hour
- Electricity Cost: $0.10/kWh
- Discount rate: 3 percent
- Inflation rate from 2023 to 2024: 12 percent
- Inflation rate from 2025 to 2026: 8 percent
- Long term inflation: 5 percent

8.3 Secondary Treatment Improvement Alternatives

8.3.1 Existing Condition Description

The aeration basins provide secondary treatment by a conventional activated sludge process. Basin aeration is accomplished by a jet mixing system which includes one submersible sludge mixing pump in each aeration basin with piping and nozzles. Air is supplied to supplement the jet aeration system by three positive displacement blowers (two duty, one standby) in the adjacent Blower Building.

According to the assessment in **Section 6**, the secondary treatment structures are in good condition and will last for at least another 50 years. The two aeration basins currently have sufficient capacity to be operated one at a time, and operation is alternated once per year. The blowers are currently operated on a time basis and function properly. However, the process control without automation is difficult. The jet aeration system including the blowers is old and in poor condition. Therefore, upgrading the aeration system to provide automatic aeration control and improve aeration efficiency is one of the main goals of all four secondary treatment alternatives described below.

8.3.2 Nitrogen Removal Criteria

Ecology issued the PSNGP on December 1, 2021. The permit is effective on January 1, 2022 and expires on December 31, 2026. Manchester WWTP is categorized as a small TIN load plant. Though the permit does not specify an action level of TIN load for small TIN load plants, an AKART analysis is required for permittees who cannot maintain an annual average TIN of less than 10 mg/L. Thus, staying below the existing TIN load and achieving an annual average TIN of 10 mg/L through optimization is the goal for the first three alternatives.

Future nutrient limits beyond the 2026 expiration of the PSNGP have not been determined, but Ecology has indicated the target for future permits will likely be between 3 and 10 mg/L, and the permit requires a “Nutrient Reduction Evaluation” which includes consideration of technologies capable of achieving 3 mg/L seasonally for Dominant and Moderate load WWTPs. Although it is unlikely that 3 mg/L TIN will be required for small TIN load plants such as the Manchester WWTP, in case the regulation will become more stringent overtime, a potential to meet 3 mg/L TIN in 2042 is evaluated in the fourth alternative to bracket the upper end of capital and operation requirement.

Corresponding to the anticipated evolvement of the permit, the following four secondary treatment alternatives were developed to achieve an increasingly stringent nitrogen removal goals, with increasing complexity and costs.

8.3.3 SEC-1 Blower Upgrade

For SEC-1, the blower system will be replaced and automatically controlled. The blowers are currently operated four hours on and two hours off, or three hours on and three hours off and DO concentration is manually measured. To achieve the process control automation, the existing three blowers will be replaced with three blowers with VFDs. DO probes will be used in each aeration basin to continuously monitor DO concentration and fine-tune the blower operation schedule. The aeration on/off time can be adjusted by changing SCADA set points. The new blowers will be more reliable and more energy efficient. The automatic aeration control based on DO will provide the operator better process control for nitrogen removal optimization. Although it will not significantly improve the effluent water quality, reliable equipment and better process control will help the plant stay in compliance with the current regulations. According to **Table 6-16** in **Section 6.6.3**, this alternative has a potential to achieve 10 mg/L of effluent TIN if operated properly. The BioWin™ process model simulation results are also summarized in **Table 8-2** below.

8.3.4 SEC-2 Aeration System Upgrade

For SEC-2 the blowers and DO monitoring will be updated as described in SEC-1. Additionally, the existing jet aeration system will be removed and replaced with fine bubble diffusers. Fine bubble diffusers are a proven technology, with several decades of aeration application, including successful use at Central Kitsap WWTP for many years. Online ammonia and nitrate probes will be installed so that aeration system could be controlled based on real-time ammonia level. Replacing the entire jet aeration system with a newer and more efficient aeration system and improving automatic aeration control using online analyzers will further save energy, optimize nutrient removal and make O&M easier. SEC-2 will allow the Manchester WWTP to achieve an annual average TIN level of 10 mg/L in the next 20-year horizon, according to **Table 6-16** in **Section 6.6.3** and **Table 8-2** below.

Table 8-2 | SEC-1 and SEC-2 Process Model Simulation Results

Parameter	2028			2042		
	AAF	MMWWF	MMDWF[1]	AAF	MMWWF	MMDWF[1]
Flow, MGD	0.24	0.4	0.26	0.34	0.57	0.37
Temperature, °C	15	10	21	15	10	21
Influent Alkalinity, mg/L	235	235	300	235	235	300
No. of Aeration Basin	2	2	2	2	2	2
DO Cycle, hrs	6 (4 ON/2 OFF	6 (4 ON/2 OFF	6 (3 ON/3 OFF	6 (3 ON/3 OFF	6 (4 ON/2 OFF	6 (3 ON/3 OFF
DO Target during ON cycle, mg/L	2	2	1	2	2	1
Total SRT, days	10	10	10	8	8	8
MLSS, mg/L	2,200	2,700	2,900	2,600	3,000	3,400
Effluent TSS, mg/L	2.0	3. 6	2.3	3.0	5.4	3.3
Effluent BOD, mg/L	1.3	1.8	1.2	1.6	2.5	1.6
Effluent Ammonia, mg/L	1	2	2	4	4	3.5
Effluent Nitrate and Nitrite, mg/L	5.8	4	3.5	2.8	3	5
Effluent TIN, mg/L	6.8	6	5.5	6.8	7	8.5

Parameter	2028			2042		
	AAF	MMWWF	MMDWF[1]	AAF	MMWWF	MMDWF[1]
Effluent pH	6.3	6.6	6.7	6.3	6.6	6.7
Annual Effluent TIN Load, ppd	13.5			20		

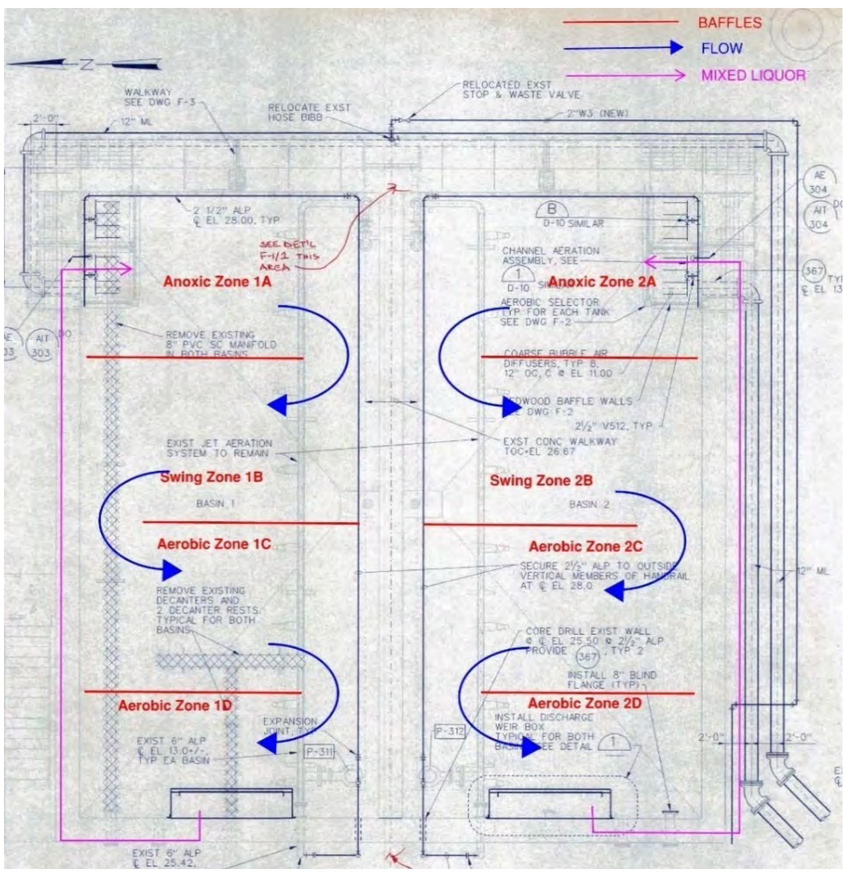
Note:

1. Conditions that may require supplemental alkalinity addition

8.3.5 SEC-3 Biological Nutrient Removal – MLE

For SEC-3 the blowers, DO monitoring, and aeration diffusers will be updated as described in SEC-2. Additionally, each of the existing aeration basins will be evenly divided into four zones with one anoxic zone, one swing zone, and two aerobic zones. The swing zone can be used as either an anoxic zone or an aerobic zone during different seasons to achieve optimum nitrogen removal. The ML will be circulated back to the head of the aeration basins to promote denitrification. Baffles will be installed to promote plug flow and to create distinct cells for MLE operation, a common process to increase nitrogen removal. Each aerated zone will have one DO probe. Each basin will also have one ammonia/nitrate probe. The proposed modification to the aeration basins is shown in **Figure 8-2**.

Figure 8-2 | Aeration Basin Modifications in SEC-3



A process model was developed using BioWin™ Modeling Software to assist the design of this alternative. The model simulated performance of MLE system for the 6- and 20-year planning horizons at AAF), MMWWF, and MMDWF. The model simulation results are summarized in **Table 8-3**.

Table 8-3 | SEC-3 Process Model Simulation Results

Parameter	2028			2042		
	AAF	MMWWF	MMDWF[1]	AAF	MMWWF	MMDWF*
Flow, MGD	0.24	0.4	0.26	0.34	0.57	0.37
Temperature, °C	15	10	21	15	10	21
Influent Alkalinity, mg/L	235	235	300	235	235	300
No. of Aeration Basin Trains	2	2	2	2	2	2
No of Anoxic Zones, per train	2	1	2	2	1	2
No of Aerobic Zones, per train	2	3	2	2	3	2
Target DO in Aerobic Zone, mg/L	2	2	1	2	2	1
ML Recirculation Rate	300%	300%	400%	300%	300%	400%
Total SRT, days	10	10	10	8	8	8
Aerobic SRT, days	5	7.5	5	4	6	4
MLSS, mg/L	2,300	2,600	2,900	2,700	3,100	3,500
Effluent TSS, mg/L	3.6	3. 6	2.3	3.0	5.4	3.3
Effluent BOD, mg/L	2.3	2.0	1.7	2.3	2.8	2.2
Effluent Ammonia, mg/L	1.2	0.9	0.4	2.3	1.6	0.7
Effluent Nitrate and Nitrite, mg/L	3.5	3.0	4.9	3.3	2.3	4.6
Effluent TIN, mg/L	4.8	3.9	5.3	5.6	3.8	5.3
Effluent pH	6.7	6.8	6.7	6.7	6.8	6.7
Effluent Alkalinity, mg/L	118	154	118	123	159	120
Annual Effluent TIN Load, ppd	10			16		

Note:

1. Conditions that may require supplemental alkalinity addition

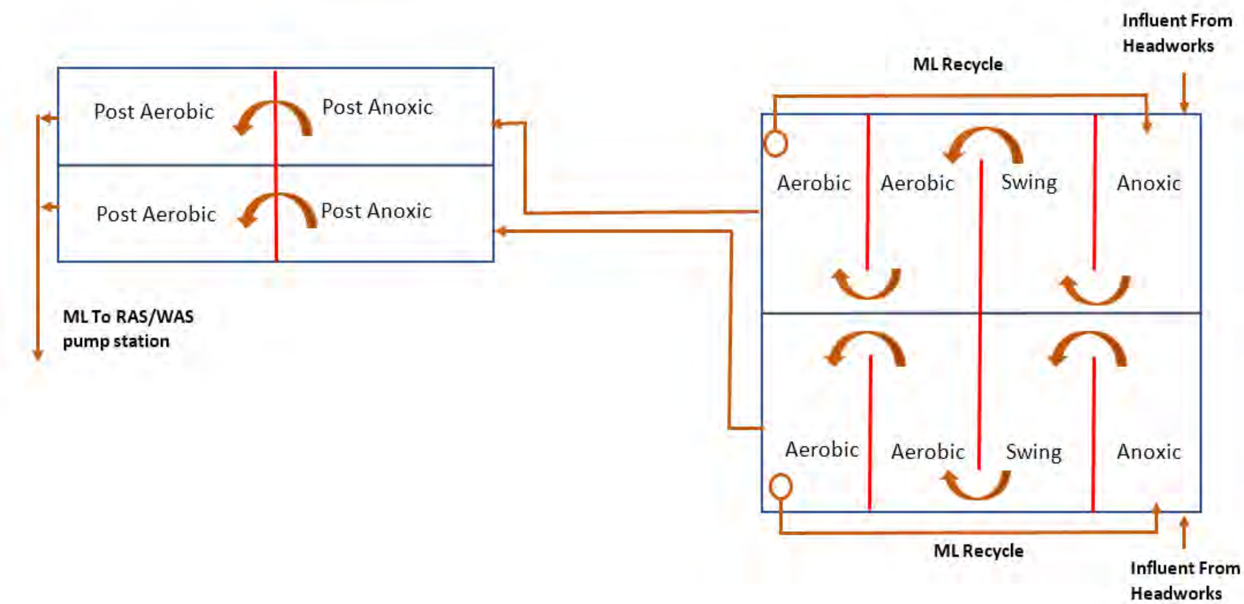
The process model predicts that alternative SEC-3 will meet the target effluent TIN concentration of 10 mg/L (even a lower target of 7 mg/L) under the projected 2028 and 2042 flows and loads conditions.

8.3.6 SEC-4 Biological Nutrient Removal – Bardenpho with Third Basin

Alternative SEC-4 recommends upgrading the secondary treatment process to the Bardenpho process in order to lower TIN below 3 mg/L during MMDWF. To achieve this, the existing aeration basins will be upgraded as described in SEC-3. The blowers, DO and ammonia monitoring, and aeration diffusers will be updated as described in SEC-1 and SEC-2. Additionally, a new aeration basin will be constructed to provide the post-anoxic and post-aerobic zones downstream. **Figure 8-3** shows the proposed location of the new basin at the Manchester WWTP. **Figure 8-4** shows a schematic of this Bardenpho process to be accomplished in the existing and new aeration basin.

Figure 8-3 | Proposed Location of New Aeration Basin in SEC-4

Figure 8-4 | Schematic of Bardenpho with Third Basin in SEC-4



The BioWin™ process model simulation results are summarized in **Table 8-4** and the model results show that under 2042 MMDWF condition, SEC-4 can achieve an effluent TIN less than 3 mg/L.

Table 8-4 | SEC-4 Process Model Simulation Results

Parameter	2042 MMDWF[1]
Flow, MGD	0.37
Temperature, °C	21
Influent Alkalinity, mg/L	300
No. of Aeration Basin Trains	2
Volume of Anoxic Zone, per train, gallons	63,000
Volume of Aerobic Zone, per train, gallons	189,000
Volume of Post-anoxic Zone, per train, gallons	60,000
Volume of Post-aerobic Zone, per train, gallons	60,000
Target DO, mg/L	2, except Swing zone = 1
ML Recirculation Rate	300%
Total SRT, days	26
MLSS, mg/l	2,700
Effluent TSS, mg/L	3.2
Effluent BOD, mg/L	1.8
Effluent Ammonia, mg/L	0.29
Effluent Nitrate and Nitrite, mg/L	2.67
Effluent TIN, mg/L	2.96
Effluent pH	6.8
Effluent Alkalinity, mg/L	125

Note:
1. Conditions that may require supplemental alkalinity addition

8.3.7 Secondary Treatment Cost Analysis

Class 5 OPPCs for the secondary treatment alternatives were developed as described in **Section 8.2** and are summarized in **Table 8-5**. The total project cost for SEC-1 is lower than the other alternatives due to fewer changes, however the annual O&M costs are higher than SEC-2. SEC-3 and SEC-4 require much higher capital and O&M costs.

Table 8-5 | Secondary Treatment Alternatives Cost Estimate

Alternative Number	Alternative Name	Project Cost	O&M 20-year Net Present Cost	Total 20-year Net Present Cost
SEC-1	Blower Upgrade	$266,000	$1,466,000	$1,732,000
SEC-2	Aeration System Optimization	$961,000	$1,039,000	$1,999,000
SEC-3	Biological Nutrient Removal - MLE	$1,772,000	$2,093,000	$3,864,000
SEC-4	Biological Nutrient Removal – Bardenpho with Third Basin	$3,593,000	$2,229,000	$5,822,000

8.4 UV Disinfection Alternatives

8.4.1 Existing Condition Description

The existing UV system is a two-bank Trojan UV3000B installed in 1998 and is nearing the end of the typical design life. This model has a basic controller which can automatically alternate the lead and lag UV banks and monitor the bank run time, bank on/off status, a common alarm, and UV intensity. However, the basic controller cannot turn off the bank based on the flow signal. Plant staff cleans the UV lamps manually. It is recommended to replace the entire UV system with a new system that has additional monitoring and control capabilities, and cleaning capabilities.

8.4.2 DIS-1 UV Disinfection – Trojan UV3000B and Controller

For DIS-1, the existing Trojan UV3000B system will be removed and replaced with a new UV3000B system (**Figure 8-5**), the basic controller will be replaced with a touch smart controller, and a new UV transmittance probe will be installed. This alternative will be able to monitor and control several operational parameters requested by operators including tracking bank lamp life, switching banks/bringing them on and off, tracking and alarming on UV intensity, and monitoring UV transmittance. However, the UV3000B unit can only be controlled based on flowrate, not UV dose, and the touch smart controller of UV3000B does not monitor the individual lamp on/off status.

A new UV3000B system designed for the 2042 peak flow condition has two banks in a lead/lag operation with a total 80 lamps. The new UV banks can be placed in the existing UV channel without any modification to the UV channel.

Figure 8-5 | DIS-1 Trojan UV3000B System

8.4.3 DIS-2 UV Disinfection – Trojan UV3000Plus and Controller

For DIS-2, the existing Trojan UV3000B system will be replaced with an upgraded model, the Trojan UV3000Plus (**Figure 8-6**). This alternative will provide all the monitoring control functionality of alternative DIS-1 and will provide flow rate adjustable intensity and additional monitoring capability including individual lamp failure status. It has a knob to adjust intensity and has an option of automatic cleaning system. With the touch smart controller, the system will be able to monitor the individual lamp status and dose pacing.

Under the 2042 peak flow design condition, two banks will be installed in the existing channel with three UV modules per bank, equating to 36 lamps. The new UV banks can be placed in the existing UV channel with minor modifications to the baffles to adjust the channel width.

Figure 8-6 | DIS-2 Trojan UV3000Plus System

The comparison of the existing basic controller, touch smart controller for UV 3000B and touch smart controller for UV 3000Plus are summarized in **Table 8-6**.

Table 8-6 | UV System Controller Capability Comparison

Capabilities	Current: Basic Controller for UV 3000B	DIS-1: Touch Smart Controller for UV 3000B	DIS-2: Touch Smart Controller for UV 3000Plus
Configuration			
Max. # of Channels	1	2	2
Max. Modules/bank	20	20	32
Max. Banks/channel	3	3	3
Control			
Flow Pacing	Yes	Yes	No
Dose Pacing	No	No	Yes
Individual Lamp Status	No	No	Yes
Lead Bank Rotation	Automatic	Automatic or Manual	Automatic or Manual
Redundant Bank Logic	No	Yes	Yes
Multiple Lamp Failure	No	No	Yes
Module Failure Alarm	No	No	Yes
Bank Communication Alarm	No	No	Yes
USB Data Logging	No	Yes	Yes
Remote Control Capabilities			
Force System On/Off	No	Yes	No
Turn On Additional Bank (if available)	No	Yes	No
Remote Monitoring Capabilities			
SCADA	No	Yes	Yes
Bank Status	Yes	Yes	Yes
Common Alarm	Yes	Major, Minor	Critical, Major, Minor
Low UV Intensity Alarm	No	Yes	Yes
Bank UV Intensity Alarm	No	Yes	Yes
Average UV Intensity	No	Yes	No

8.4.4 UV Disinfection Cost Analysis

Class 5 OPPCs for the UV disinfection alternatives were developed as described in **Section 8.2** and are summarized in **Table 8-7**. The total project cost for the UV3000B system is lower than the UV3000Plus system because the equipment is less expensive, however the annual operating costs are higher, so over the 20-year lifecycle the UV3000Plus system will cost approximately $23,000 less.

Table 8-7 | UV Disinfection Alternatives Cost Estimate

Alternative Number	Alternative Name	Project Cost	O&M 20-year Net Present Cost	Total 20-year Net Present Cost
DIS-1	UV Disinfection – Trojan UV3000B	$ 692,000	$ 470,000	$1,162,000
DIS-2	UV Disinfection – Trojan UV3000Plus	$ 934,000	$ 205,000	$1,139,000

8.5 Odor Control Alternatives

8.5.1 Existing Condition Description

The existing odor control system consists of a fiberglass reinforced plastic (FRP) three-stage scrubber with integral scrubbant sump, a FRP centrifugal fan, two chemical recirculation pumps, three chemical feed pumps, and an electrical control panel with pH and ORP sensor and controllers. Sodium hypochlorite and sodium hydroxide were originally designed to be dosed to the scrubbant sump. Foul air is pulled from the Headworks Building, WAS and TWAS tanks, and GBT room into the chemical scrubber. The system is only partially operational now. The sodium hydroxide system has been removed and the pH and ORP sensors are not functioning. Sodium hypochlorite is currently dosed to the system at a constant rate set by the operator.

Since the existing odor control system is over 24 years old and the condition is beyond repairable, the following odor control alternatives are evaluated to replace it in order to restore automatic operation and full functionality.

8.5.2 Odor Control Design Criteria

The new odor control system will treat the same sources as the existing one. The estimated air flow rate of each source and the total flow to be treated are summarized in **Table 8-8**.

Table 8-8 | Estimated Total Air Flow Rate Treated by Odor Control Unit

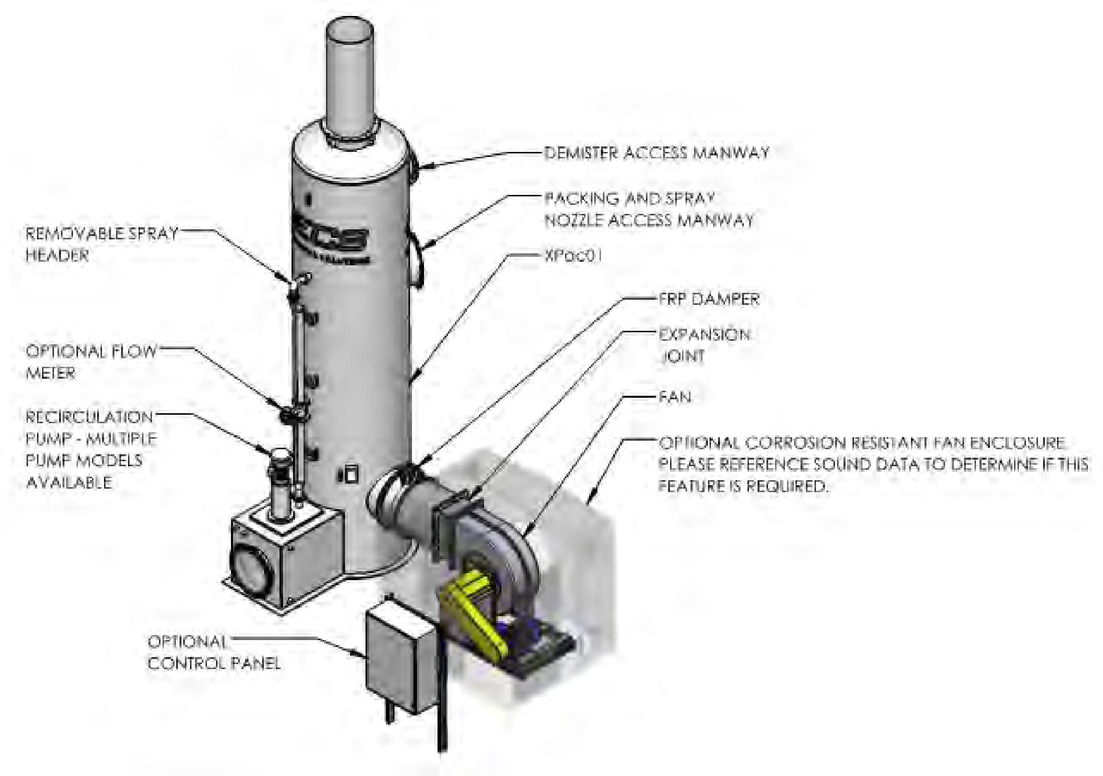
	Quantity	Area (ft^2)	Headspace (ft)	Headspace Volume (ft^3)	ACH[1] (#)	Process Air (cfm)	Ventilation Air Flow (cfm)
Screen channel	1	90	3	270	12	-	54
Manual screen channel	1	70	3	210	12	-	42
Grit channel	1	180	3	540	12	-	108
Parshall flume	1	64	4	256	12	-	51
Aerated channel	1	48	3.5	168	12	100	134
WAS tank	2	540	5	2,700	12	400	940
TWAS tank	1	196	5	980	12	200	396
GBT Room	1	384	12	4,608	6	-	461
Total Air Flow Rate with 10% factor of safety							**2,404**
Odor Control System Capacity							**2,500**

Note:
1. ACH: Air Change per Hour

8.5.3 OC-1 Chemical Scrubber

For OC-1, the existing chemical scrubber is removed and replaced with a new chemical scrubber system. A chemical scrubber uses an oxidizing liquid such as sodium hypochlorite to absorb and oxidize odor causing sulfur compounds, which eliminates odor in the exhaust air. The new chemical scrubber system consists of the FRP scrubber vessel, recirculation pump, fan, ductwork, pH/ORP monitoring, conductivity monitoring, and a control panel. The existing blowdown pump needs to be replaced with a new one. In addition, it provides a fan enclosure that reduces the sound noise. The operation, configuration and footprint are similar to those of the current system. The new system can be installed at the same location. Chemical scrubbers have high removal efficiency, a small footprint, and the plant staff is familiar with the operation of this technology. However, delivery and handling of hazardous chemicals is required, and the O&M costs are relatively high due to chemical use. **Figure 8-7** shows the three-dimensional model of a new chemical scrubber system.

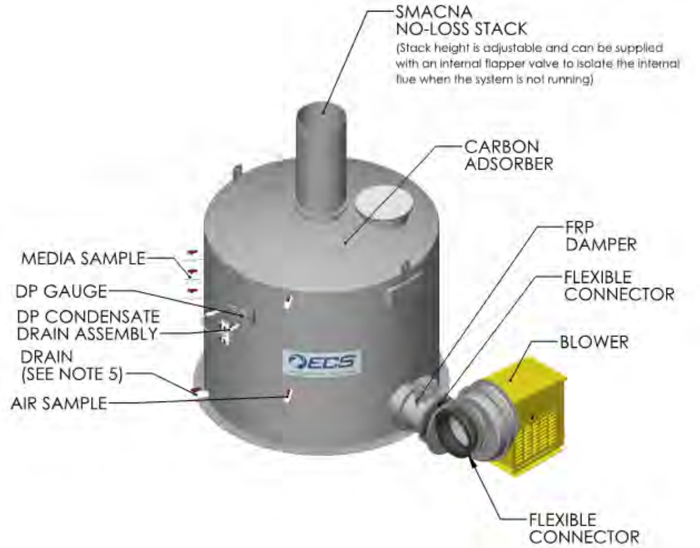
Figure 8-7 | OC-1 New Chemical Scrubber System



8.5.4 OC-2 Activated Carbon

For OC-2, the existing chemical scrubber will be removed and replaced with a new activated carbon system. Activated carbon removes odor by adsorption of odor causing compounds to the carbon media and is commonly used for removing relatively low odor levels in airstreams. Carbon adsorption can also provide for removal of a wide range of other odorous contaminants, such as organic compounds that are not as effectively removed by standard chemical scrubbers designed for hydrogen sulfide removal. No chemicals or additives are required. The proposed activated carbon system includes an FRP carbon adsorption vessel, a FRP blower, a motor starter, a sound absorbing enclosure, a pre-filter, and an epoxy coated steel skid. Regeneration of the carbon is time consuming and difficult, so it is usually replaced with new carbon which results in a higher operating cost. **Figure 8-8** shows the three-dimensional models of the activated carbon system. With ductwork modifications, the activated carbon system can fit in the location of the existing odor control system.

Figure 8-8 | OC-2 Activated Carbon System



8.5.5 OC-3 Engineered Biofilter

For OC-3, the existing chemical scrubber will be removed and replaced with a new engineered biofilter system.

Biofilters utilize the growing microorganisms in media to oxidize odor and remove a wide range of odorous constituents. The media within the biofilter varies from wet compost, soil, wood chips used in the earth berm or concrete biofilters to the inert, proprietary materials used in the engineered biofilter systems. For efficient odor removal, the biofilter media must be moist and maintain a neutral pH, so process water is required. The drain from biofilter will likely be acidic and should be collected and routed back to the plant for treatment. The advantages of biofilters are that they can provide effective treatment for a wide variety of odor causing compounds, and once constructed, they are easy to maintain and do not typically require chemical addition. However, they have a larger footprint than other odor control technologies. The conventional sand or organic media biofilters will require large footprints and cannot fit within the Manchester WWTP site. A package engineered biofilter can operate at a much higher loading rate and therefore provides a more compact footprint, which will fit within the Manchester WWTP site.

Figure 8-9 shows a package engineered biofilter system. The system has a footprint of 20-feet long by 10-feet wide. This is too large to be located in the existing odor control area but could be constructed to the north of the blower building in the area identified on the 1996 plans as reserved for a future aeration basin.

Figure 8-9 | OC-3 Engineered Biofilter

8.5.6 Odor Control Cost Analysis

Class 5 OPPCs for the odor control alternatives were developed as described in **Section 8.2** and are summarized in **Table 8-9**. Alternative OC-2 has the lowest project and net present costs.

Table 8-9 | Odor Control Alternatives Cost Estimate

Alternative Number	Alternative Name	Project Cost	O&M 20-year Net Present Cost	Total 20-year Net Present Cost
OC-1	Chemical Scrubber	$ 1,081,000	$ 759,000	$1,840,000
OC-2	Activated Carbon	$ 521,000	$ 526,000	$1,046,000
OC-3	Engineered Biofilter	$ 1,189,000	$ 525,000	$1,714,000

8.6 Recommendations

This section provides a recommendation for each process based on the performance and cost analysis of alternatives which includes both capital costs and long-term O&M costs.

8.6.1 Secondary Treatment

All four secondary treatment alternatives represent a progressive approach of improving nitrogen removal by upgrading equipment, instrumentation, improving process control, and changing treatment processes. SEC-1 requires the least capital investment and provides marginal improvement on nitrogen optimization. SEC-4 requires the highest capital investment and results in the largest nitrogen reduction.

According to the current PSGNP, Manchester WWTP needs to evaluate and implement operational strategies for maximizing nitrogen removal from the existing treatment plant. The County should document the actions taken and quantify results. The County will also need to prepare and submit an AKART analysis by the end of the permit cycle to evaluate reasonable treatment alternatives capable of reducing TIN. Implementing SEC-1 will be able to meet the nitrogen optimization plan requirement in this permit cycle as there is no numerical action level defined for Manchester. Implementing SEC-2 will be able to meet more stringent nitrogen removal requirements, i.e. annual average TIN of 10 mg/L, which is anticipated in the future permit cycles. SEC-3 and SEC-4 should be considered in AKART analyses but are not the recommended alternatives, considering the current nitrogen removal requirement described in current regulations.

Alternative SEC-2 is recommended to provide process control flexibility, improved nitrogen removal to meet the current and future regulation with moderate costs.

8.6.2 Disinfection

Alternative DIS-2 is recommended as the disinfection alternative because it provides greater functionality and efficiency. Although the capital cost is higher, the 20-year net present value is less than DIS-1, and the increased efficiency and reduced maintenance makes this alternative more favorable.

8.6.3 Odor Control

Alternative OC-2 is recommended as the odor control alternative as activated carbon system has the lowest project cost and net present value, easy O&M because of no chemical handling and less mechanical equipment, and a footprint that fits in the existing odor control area. The chemical scrubber in alternative OC-1 requires more complex equipment, instrumentation, and higher O&M due to the chemical handling. The biofilter in alternative OC-3 has a large footprint and will occupy the space reserved for the third aeration basin.

Table 8-10 summarizes the recommended alternatives and the reason why they are recommended.

Table 8-10 | Recommended Alternatives for the Manchester WWTP

Recommended Alternative	Alternative Name	Project Cost	Benefit
SEC-2	Aeration System Optimization	$961,000	➢ Replace aging equipment ➢ Save energy ➢ Improve process control ➢ Allow the plant to meet current permit and to achieve 10 mg/L effluent TIN if required in the future permit
DIS-2	UV Disinfection – Trojan UV3000Plus	$ 934,000	➢ Replace aging equipment ➢ Improve process control and equipment monitoring ➢ Reduce O&M effort
OC-2	Activated Carbon Odor Control	$ 521,000	➢ Replace faulty equipment to restore functionality ➢ Reduce O&M effort ➢ Lower costs and small footprint

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SECTION 9

Recycled Water

Recycled water provides multiple potential benefits from wastewater management, water supply, and environmental enhancement perspectives. Because of these benefits, the County identified recycled water as a key strategy in its *Water as a Resource* policy, adopted in 2009 and reaffirmed in 2016, which aims to conserve groundwater resources, restore the natural hydrologic flow in local streams and creeks, and reduce water pollution. In short, implementation of recycled water efforts would be a direct expression of the County's guiding principle to preserve water as a resource rather than treating it as a waste stream. This section summarizes the County's assessment to date of the potential for developing a recycled water program involving the Manchester WWTP.

9.1 Recycled Water Regulatory Framework

Wastewater that is reused for beneficial purposes in a municipal context must meet certain regulatory and water quality requirements. In Washington, recycled water (also referred to as reclaimed water) is defined in WAC 173-219 as: "water derived in any part from a wastewater with a domestic wastewater component that has been adequately and reliably treated to meet the requirements of WAC 173-219, so that it can be used for beneficial purposes." As such, recycled water is no longer considered a wastewater once it is put to use.

WAC 173-219 defines the requirements and constraints pertaining to the use of recycled water for a wide range of purposes. Recycled water permits are issued by Ecology and DOH. Ecology is generally the lead permitting agency, with the primary exception being when the source water is generated by an on-site sewage system with a design flow of less than or equal to 100,000 gpd.

There are three classes of recycled water defined in WAC 173-219: Class B, Class A, and Class A+. These are defined by varying degrees of treatment and water quality, and are each applicable for various uses, as summarized below.

- Class B (meets oxidation and disinfection requirements) recycled water can be used for some construction and industrial purposes, and certain irrigation uses where access to the general public is restricted.
- Class A (meets Class B requirements, plus coagulation and filtration, or use of membrane filtration) recycled water can be used for a wide range of commercial uses (such as toilet/urinal flushing and street sweeping) and irrigation of areas that have open access to the public. This can also be used for groundwater recharge, assuming additional requirements are met, such as nitrogen limits.
- Class A+ (meets Class A requirements, plus additional needs to be health protective, as defined on a case-by-case basis) is required for direct potable reuse (i.e., drinking or direct ingestion).

The public access restriction requirements for Class B are typically difficult to meet for a municipal entity like the County, whereas Class A does not require access restriction, so Class A has a wider range of potential uses. Therefore, it is water of this quality that is considered in this Plan when evaluating potential reuse opportunities. While opportunities for use of lower quality water may exist, they are anticipated to be few in number with very limited benefit being received, based upon the experience of other Puget Sound utilities.

9.2 Benefits and Potential Uses

Recycled water can provide numerous benefits, including those summarized below.

- **Conserve limited groundwater resources**. Water use in the Manchester area is sourced from groundwater pumped primarily from the sea-level aquifer. This is a limited resource, with aquifer levels susceptible to decline as local water demand increases. In addition, saltwater intrusion can occur if groundwater levels are withdrawn below certain thresholds. Use of recycled water to replace the use of potable water for nonpotable purposes, especially during peak use times (i.e., summer irrigation season), reduces the stress on area groundwater and supports sustainable management of that limited resource.

- **Reduce marine water discharge**. Recycled water is being increasingly explored around Puget Sound as a means to reduce wastewater discharge (and therefore reduce nitrogen loading) to marine waters and comply with more restrictive wastewater discharge permit requirements, such as those established by the recently enacted PSNGP. Such actions serve to protect and improve marine water quality, which in turn improves fish and shellfish habitat by reducing the overpopulation of phytoplankton and zooplankton and avoiding development of algal blooms.

- **Restore and replenish streams and fish habitats**. Recycled water can be used to directly augment streams and wetlands and can be used to indirectly influence them through recharge of groundwater that supports such features.

Though it recognizes benefits such as the above, the County has not previously identified any cost-effective applications of recycled water if it were to be produced by the Manchester WWTP. As part of development of this Plan, a cursory review of potential uses of recycled water in the Manchester area was conducted. A summary of this review is provided below, organized by use type. No other potential uses were researched, since the ones described below are typically the most cost-effective applications and represent the core elements of a recycled water program involving treatment facilities similar in size and locale to that of the Manchester WWTP.

9.2.1 Irrigation

A common use of recycled water is for irrigation of turf and landscaped areas. The County coordinated with water providers and other potential stakeholders to determine if there were any such opportunities for this type of recycled water use in the vicinity of the Manchester WWTP. Entities contacted were:

- **Manchester Water District**. The district is the drinking water purveyor serving the area where the Manchester WWTP is located. District staff indicated that there may be potential, though limited, opportunities for irrigation uses in proximity to the Manchester WWTP. The two largest open spaces located near the WWTP that receive District water for irrigation are Qa'Qad Park and the Port of Manchester. Irrigation use at each of these sites increases dramatically during summer month. Peak month water usage is approximately 96,000 gallons and 36,000 gallons for the park and the Port, respectively. Together, these uses represent approximately 4,500 gallons per day of non-potable water use that could potentially be replaced with recycled water. Other irrigation uses exist throughout the District's service area, but at locations that are further away from the WWTP and which typically represent smaller amounts of water use.

- **EPA Region 10 Manchester Environmental Laboratory**. The property upon which this facility is located has a sizeable undeveloped portion of land. However, in communication with the facility's Sustainability Coordinator in March 2023, it was determined that this site is not currently irrigated, nor are there any plans to modify it to include irrigation in the future. From this discussion, it was also determined that there are no other practical or sizeable uses for recycled water at this facility.

- **Kitsap County Parks Department.** A discussion was held with County Parks Department staff in January 2022, regarding the possibility of irrigation of other turf/landscaped areas managed by the County. It was determined that, based on locations of other irrigable areas and their relatively small amount of associated water consumption, there are no sites where recycled water use would be cost-effective.

9.2.2 Aquifer Recharge and Streamflow Augmentation

The general concept of using recycled water for managed aquifer recharge was considered as part of a watershed planning effort facilitated by Ecology for Water Resource Inventory Area (WRIA) 15, as directed by the Streamflow Restoration Act (RCW 90.94). This activity is documented in the *WRIA 15 Watershed Restoration and Enhancement Plan* (March 1, 2022). The evaluation identifies geographic locations that appear promising for both shallow aquifer infiltration and enhancement of stream baseflows, which in turn may provide water to offset to consumptive impacts of new permit-exempt domestic groundwater withdrawals. The lack of such locations in the near vicinity of the Manchester WWTP, coupled with the small discharge volume of the plant, yielded identification of no proposed recycled water infiltration projects associated with the plant.

9.2.3 Other Uses

The County also coordinated with additional potential stakeholders to determine if there were other opportunities for the use of recycled water use in the vicinity of the Manchester WWTP. Entities contacted were:

- **US Manchester Naval Fuel Depot.** The County communicated in March 2023 with the Deputy Director of this facility, which is located in proximity to the Manchester WWTP and contains multiple large storage tanks that utilize water for periodic cleaning. It was determined that the non-potable uses of water at the facility are not likely sizeable enough to warrant consideration for conversion to recycled water. Though the fuel and chemical storage tanks are large, they are only flushed up to two times per year, using less that 10,000 gallons of year in total for this purpose. All other water use at the facility is minimal.

- **NOAA Northwest Fisheries Research Station.** This facility, which receives non-potable water supply from the Manchester Naval Fuel Depot site, uses water for various fish rearing and research purposes. While use of recycled water in the facility's processes is a possibility, further discussion with the facility would be required to better understand the potential quantities of water involved and associated water quality requirements, which may be more stringent than Class A recycled water standards.

9.3 Future Steps

As the County continues future planning associated with recycled water at Manchester WWTP and its other treatment plants, key implementation considerations that will be taken into account, beyond technical feasibility, costs, and water quantity/quality benefits, include those described briefly below. These items will be explored in greater depth as the County advances in its planning process.

- **Regulatory Requirements**. One of the more rapidly changing elements that will shape future recycled water programs are water quality requirements related to currently unregulated chemicals. In particular, the water industry's current focus on per- and polyfluoroalkyl substances (PFAS) will likely yield State or federal drinking water limits that are lower than the State Action Levels established for five PFAS compounds in 2021. This may lead to certain additional forms of treatment being required to produce recycled water suitable for purposes such as groundwater recharge or streamflow augmentation.

- **Funding**. The capital investment to implement reuse can be significant and is greater than what can be realistically recouped through recycled water rates. Most utilities seek low-interest loans or grant money from the State or federal government to support reuse implementation. At the State level, this includes funding through the Centennial Clean Water Fund, while at the federal level this can include funding through the WaterSMART Title XVI program.

- **Stakeholder and Public Outreach**. The County has had extensive coordination with the Suquamish Tribe during development of a proposed recycled water project at the Kingston Treatment Plant (which the County also owns and operates). Continued collaboration with the Tribe, along with general public involvement, is critical to the success of recycled water efforts, largely in relation to the above two topics of water quality and funding. The public will want assurance that proposed reuse practices are protective of public and environmental health. In addition, the full range of benefits must be articulated so that the community can truly assess costs versus benefits, and understand how investment in reuse relates or compares to other priorities the County is facing.

- **Implementation Policies and Procedures**. Recycled water programs require much more than the upfront capital infrastructure. County policies will be needed to establish when, where, and how recycled water can be used and what the applicable rates are for customers who would use the resource. Depending on the extent of infrastructure that would be needed for a recycled water project at the Manchester WWTP, development standards may be required, including maintenance procedures specific to purple pipe distribution systems, water quality monitoring/reporting, and backflow prevention.

SECTION 10

Operations and Maintenance

10.1 Introduction

The County's Manchester sewer C&C system, WWTP O&M program, and review of State and Federal requirements that impact the County's O&M program are summarized in this section. Current department organization and staffing is presented, and future staffing needs are also discussed. Comments, observations, and recommendations to improve the efficiency and effectiveness of the County's O&M program are provided at the end of this section. Key O&M elements that have the potential to impact the CIP are carried forward and further discussed in the following sections.

10.2 Utility Management and Structure

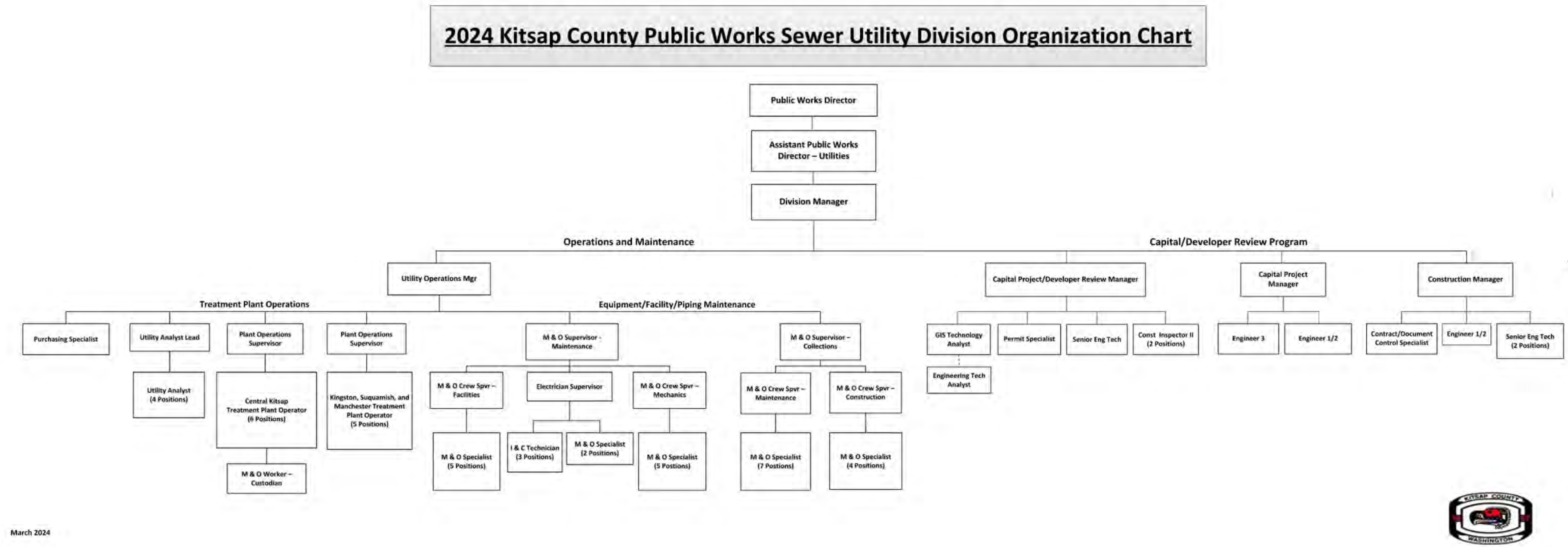
The County is managed by a three-person Board of County Commissioners, who are elected officials that represent one of three geographical districts. The Kitsap County Department of Public Works is responsible for management of County roads, recycling and solid waste, sewer, and stormwater, with separate Divisions for each. The Sewer Utility Division is responsible for O&M of both the sewer collection system and the County's four WWTPs. The organizational chart for the Sewer Utility Division is shown as **Figure 10-1**.

The Sewer Utility is led by the Sewer Utility Senior O&M Manager, who reports to the Public Works Assistant Director. A total of 72 staff currently work in the Sewer Utility Division. The Sewer Utility Division consists of four main work groups: Utilities (Plant and Pump Station) O&M, Field (Collection) Operations, Engineering and Administration, and Construction Management.

The Utilities (Plant and Pump Station) O&M group is led by the Utilities Operations Manager. The O&M of the plants and pump stations is run by the Sewer Utility O&M Supervisor who oversees two Maintenance Crew Supervisors, each with a five-person crew, and an Electrical Supervisor with a 5-person crew. The four WWTPs are managed by the two Plant Operations Supervisors: Outlying Plant Supervisor and Central Kitsap WWTP Supervisor. The three smaller WWTPs, including Manchester, each have a lead operator and share two additional operators who work on all plants as needed. Central Kitsap WWTP is run with six plant operators, and one worker. The County cross-trains operations staff so that they can fill in for other staff during absences or emergencies.

The Field (Collection) Operations group is responsible to maintain, repair, replace, clean, and inspect the sewer utilities collection systems. It is managed by the Sewer Collections O&M Supervisor who oversees two O&M Crew Supervisors. Engineering efforts are managed by both the Sewer Utility Engineering and Construction Management Groups. The Construction Management Group manages the delivery of capital work while the Engineering Group manages the design, both groups consult the Facilities and Conveyance operation groups for project specific challenges that will impact day to day or future operations. The Administration portion of the Engineering Group manages the GIS database utilized by the Operations groups and provides review efforts for Developer proposed projects.

Figure 10-1 | Kitsap County Public Works Sewer Utility Organizational Chart



10.3 Operations and Maintenance Requirements

10.3.1 Regulatory Compliance

Ecology has the authority to permit WWTPs through the NPDES program, which includes Manchester WWTP. Ecology has issued NPDES Permit WA0023701 to the County for Manchester WWTP, which includes operator certification and O&M requirements for both the WWTP and the collection system.

10.3.2 Operations and Maintenance Program

As required by the NPDES permit, the County has instituted an O&M program which consists of maintenance records for all major mechanical and electrical components for the WWTP, collection system, pump stations, and any other major facilities. The County uses a computerized maintenance management system (CMMS) to schedule and record all maintenance activities for plants and pump stations. The system identifies the frequency and type of maintenance recommended by the manufacturer and records the frequency and types of maintenance performed. The CMMS is available to all relevant County staff for review, update, and inspection. The County also uses a GIS system to inventory and record all maintenance and inspections of the conveyance pipe systems and is also used to populate downloadable asset layers accessible to the public.

10.3.3 Operations and Maintenance Manual

The Manchester WWTP O&M Manual provides basic information for the plant in accordance with the NPDES permit, WAC 173-240-080, and Ecology's *Criteria for Sewage Works Design* (Orange Book). It describes the treatment process in sufficient detail to familiarize personnel with both the normal operation of the plant as well as the alternate methods of operation that are available. In addition, it provides an overview of all miscellaneous components and management systems in use at the plant. The intent of the manual is to assist operators and other personnel with learning the overall operation of the plant, to serve as a basic reference for operating any of the system's components and provide emergency response and safety guidelines.

Pump station specific O&M information is located on the County's Electronic O&M website. This includes information on critical pieces of equipment such as pumps, electrical, instrumentation, controls equipment, valves, and odor control systems. Newer stations have more complete O&M data than older stations.

10.4 Supervisory Control and Data Acquisition

The County employs a SCADA system to monitor and record the status of the pump stations and treatment plants. The SCADA system uses Aveva (previously known as Wonderware) software. The County recently completed a Sewer Utility SCADA Master Plan that evaluated the existing SCADA system, identified operational needs, determined preferred hardware and software, and presented recommended improvement projects. The Sewer Utility SCADA Master Plan is included as **Appendix F**. All the County pump stations are connected to the SCADA system, and new pump stations include force main pressure monitoring to provide greater remote insight into operating conditions.

The pump stations and treatment plants have a number of alarms that are linked to the County SCADA system that alert staff if a problem is occurring via either very high frequency (VHF) licensed radio network or 4G cellular network. These alarms include high wet well level alarms, intrusion alarms, pump fail alarms, and others. The alarm functionality at pump stations designated as 'critical' is checked weekly to ensure they are operational.

10.5 Collection System Operations and Maintenance Activities

10.5.1 Collection System Overview

The Manchester basin C&C system provides service primarily to the northern portion of the Manchester LAMIRD with a small portion of the system served in the southern portion, routed through PS-74 and numerous individual pump stations. **Figure 10-2** presents an overview of the Manchester basin sewer system.

10.5.2 Pump Stations

County crews visit and inspect each pump station regularly to check on equipment, test alarms, and perform maintenance as needed. The inspection and testing frequency is determined by the criticality of the pump station and is completed as shown in **Table 10-1**. Criticality is determined by how many drainage basins (or upstream pump stations) discharge to the pump stations. A schematic of the conveyance system showing the pump station criticality is shown in **Figure 10-3**. Physical location of a pump station in relation to a water body or location that is difficult to access, may drive a higher criticality definition independent of number of contributing basins. Generator load exercise is completed with the pump station load at all critical stations and regional stations with loads greater than 200 kW. Stations with loads less than 200 kW are exercised with mobile load banks. Stations will be checked if alarms are indicated.

Table 10-1 | Pump Station Inspection & Testing Frequency

Pump Station Type[1]	Threshold for Designation	Inspection Frequency	Alarm Check Frequency	Generator Load Exercise[2]
Critical	5+ Basins Served, or if specifically identified	1 x per week	bi-weekly	Annually
Regional	3-4 Basins Served	1x per week	Bi-weekly	Annually
Relay	2 Basins Served	1 x per week	Bi-weekly	Annually
Satellite	1 Basin Served	1x per week	Bi-weekly	Annually

Notes:

1. Certain pump stations may serve fewer basins, yet the selection of type is driven by location.
2. Generators are run monthly, however load tested annually.

10.5.3 Sanitary Sewers

Gravity sanitary sewer pipes and manholes are regularly cleaned to clear them of debris, settled solids, and grease buildup and inspected with video equipment to evaluate pipe condition and identify any condition issues. Sewer cleaning and inspection are vital to maintaining a well working sewer collection system. Over time, deterioration, solids build-up, and blockages can cause collapse and other pre-mature failures. Proactive maintenance through cleaning and inspection keeps the sewer collection system working efficiently and avoids many serious service disruptions from occurring.

The County performs pipe cleaning/jetting and CCTV inspection in-house. Reasons for inspection include routinely scheduled inspections, warranty inspections, new construction inspections and other special project inspection. The system is jetted prior to inspections to improve visibility by removing grease, roots by foaming, sand, grit, and debris, helping reduce blockages and odor issues.

Figure 10-2 | Manchester Basin Sewer System

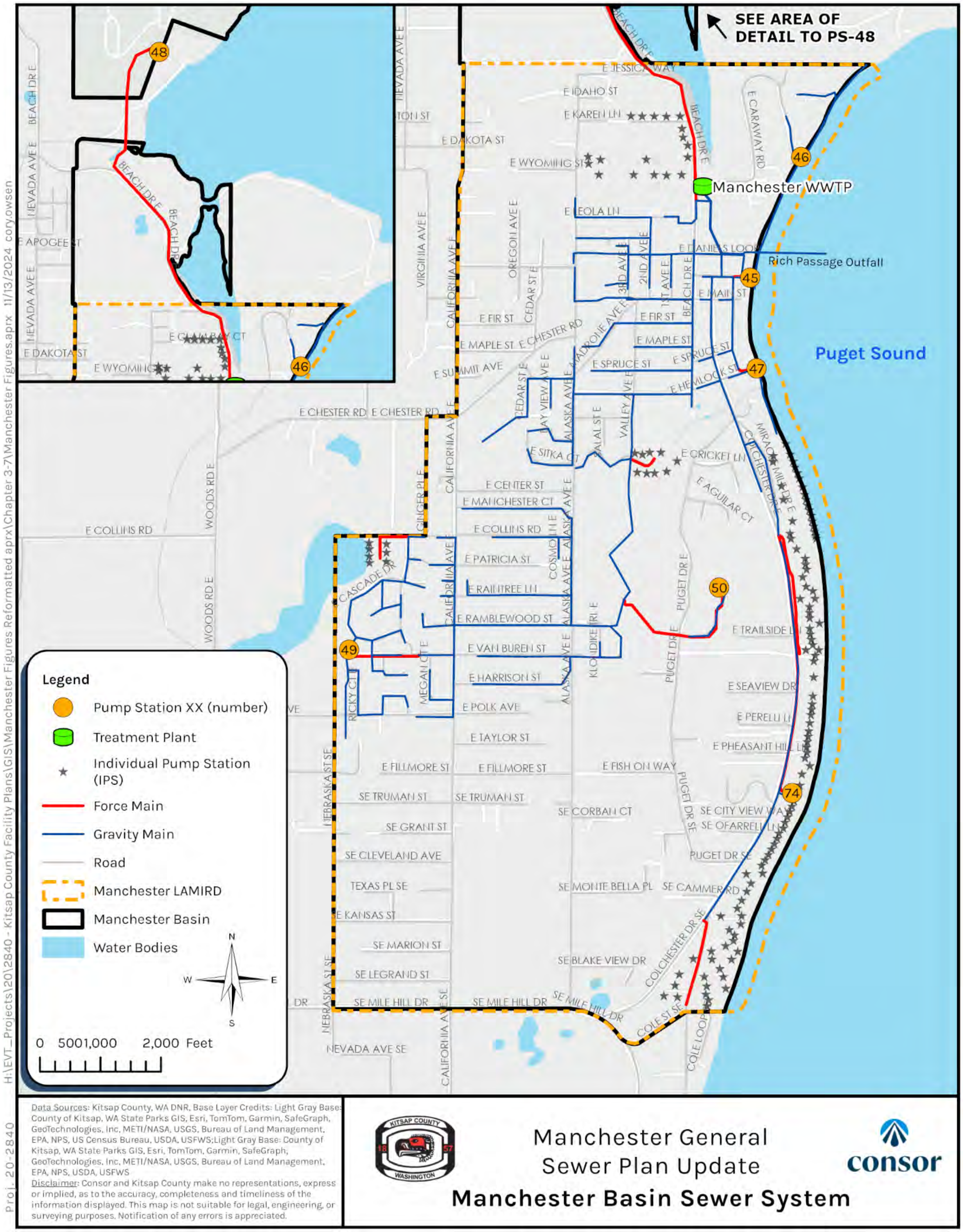
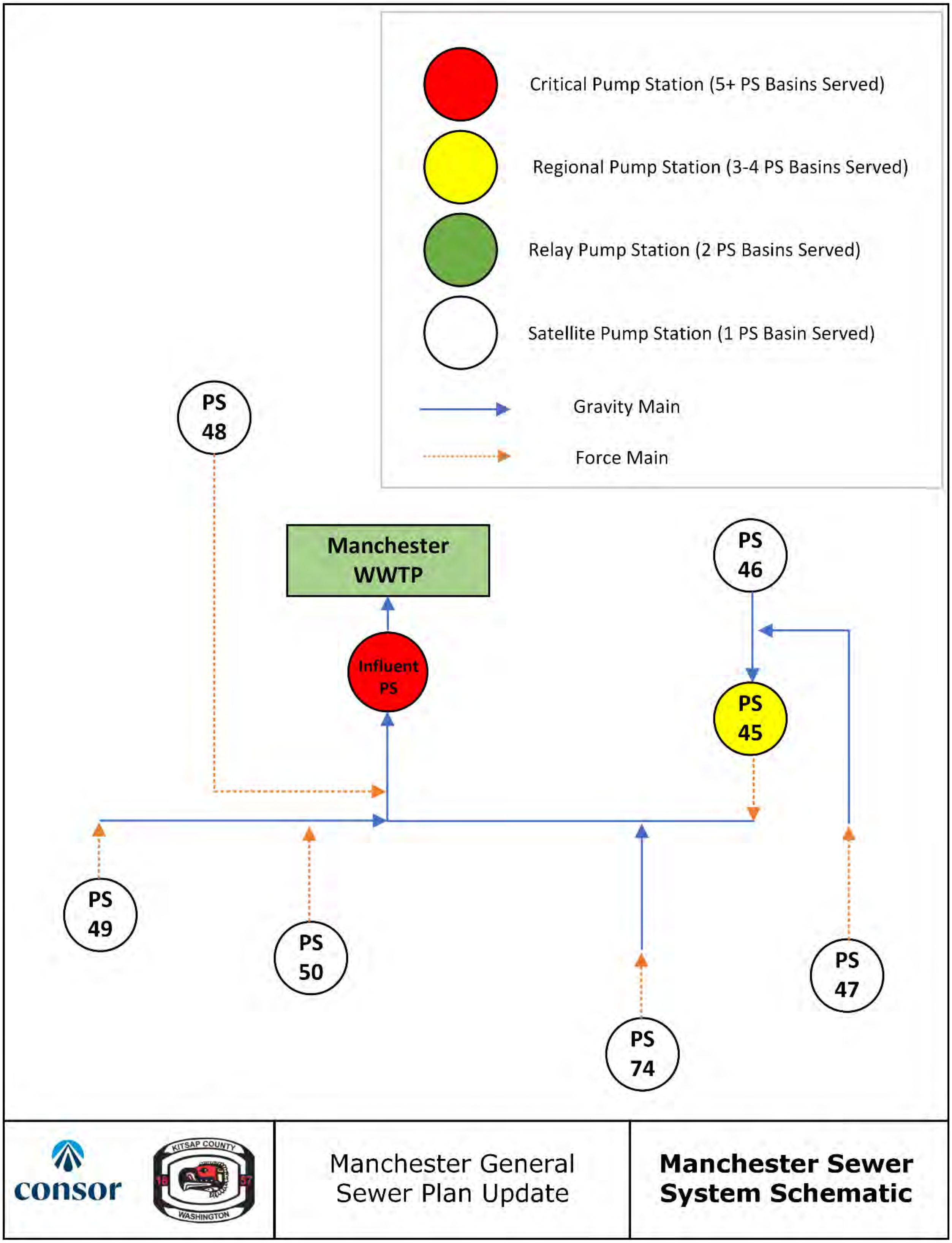


Figure 10-3 | Manchester Conveyance System Flow Schematic



The County process consists of inspecting pipe via CCTV, storing the video in a database, reviewing the video, and assigning an OCI score based on the observations. Pipe condition is evaluated based on operator experience and flagged for further investigation if needed. The County does not currently use a condition rating system such as the National Association of Sewer Service Companies (NASSCO) standards to evaluate and record observed conditions. It is recommended that the County consider having CCTV operators trained and certified in NASCCO assessment to improve the consistency of sewer inspecting rating.

The results of these assessments have been stored in their asset management database software Cartegraph since 2017. The County has a target metric to complete inspection of all pipes in the system on a five-year cycle (approximately 20 percent of the pipes inspected each year). According to Standard Operating Procedure (SOP), in addition to CCTV every five years, flushing is performed annually unless identified as a hot spot and frequency is then location dependent. At the time of this writing, all of the pipes have been inspected and an evaluation has been stored in Cartegraph.

The force mains and siphons are cleaned when needed. The County's force mains are designed to achieve scouring velocities that self-clean under normal system operation. If pipe conditions allow, pigging is performed annually. Destructive testing is only performed when lines are suspected of failure.

The Manchester WWTP outfall is inspected by divers following the procedures required by the NPDES permit.

10.5.4 Pretreatment Program

The County is required by the NPDES permit to enact a pretreatment program to ensure all commercial and industrial customers comply with the pretreatment regulations in 40 CFP Part 403 through 471. The program is required to take continuous and routine measures to identify all existing, new, and proposed significant industrial users. The County does not have any significant industrial users within the Manchester service area. Refer to **Section 4** for more information.

10.5.5 Odor and Corrosion Control Program

The County has several calcium nitrate (Bioxide™) solution dosing systems in the collection system to remove and prevent formation of hydrogen sulfide. The systems are located upstream of areas where odor complaints are common. These systems are set to dose automatically and are not connected to SCADA. Operators visit each system regularly to check on operation and refill on-site solution containers.

The County also utilizes hypochlorite dosing, charcoal filters, and organic biofilters at specific stations. Uses are prescribed based upon individual pump station characteristics.

10.5.6 Fats, Oils, and Grease Program

County Code 13.12.160 prohibits discharge of pollutants that will cause obstructions in the County sewer system. Businesses producing fats, oils, and grease (FOG) are required to have and maintain a grease removal system. Depending on the type and size of business, this may be a small grease trap maintained by employees or a large oil/water interceptor that is pumped out regularly by a permitted waste hauler. The County accepts hauled FOG waste at the Central Kitsap WWTP and is currently designing a dedicated FOG receiving station to improve ease of disposal for FOG haulers.

The County is considering implementing code through the use of inspection, enforcement, or other financial penalties to ensure FOG compliance.

10.6 WWTP Operations and Maintenance Activities

10.6.1 Preventative Maintenance

The County maintains the Manchester WWTP to keep critical components in good operating condition. This includes inspecting machinery, cleaning tanks, and maintaining equipment. Maintenance is performed in accordance with the manufacturer's recommendations during the warranty period for equipment and maintenance intervals are adjusted based on operator experience after the warranty period expires. Spare parts for all equipment are tracked in the CMMS with critical spare parts identified. Key parts are kept on hand in instances where the part cannot be readily obtained from local suppliers.

It is recommended that the County develop a valve exercise program to minimize issues with infrequently used valves seizing as they age. Additionally, the County should consider reviewing spare parts inventories and assessing the need for additional spare parts due to supply chain challenges.

10.6.2 Laboratory Operation and Accreditation

The County maintains an accredited laboratory at the Central Kitsap WWTP (W660-21A) to provide analysis of a broad range of water quality parameters including those for reporting or permit monitoring data. The laboratory at the Manchester WWTP is not certified, so samples required for reporting purposes are analyzed at the Central Kitsap WWTP lab. The County must maintain accreditation in accordance with WAC 173-50. Ecology's *Procedural Manual for the Environmental Laboratory Accreditation Program* provides details on requirements, fees, recommended practices, proficiency testing, and audit procedures.

In addition to completing water quality testing, the laboratory is responsible for recalibrating and maintaining process probes and mobile testing instruments.

10.7 Sewer Collection System Staffing Needs

The County operates and maintains all four basins as a single utility, and all sewer collection staff work in all the basins. A comparison of County sewer collection operations staff with similar utilities in the area is shown in **Table 10-2**. The County numbers reflect all County owned sewer C&C facilities from all County basins. The County has slightly more staff per mile of pipe, and fewer staff per pump station than the average of the other utilities.

Table 10-2 | Sewer System Staffing Comparison

Agency	Personnel (FTE)	Miles of Pipe	Personnel per Mile of Pipe	No. of Pump Stations	Personnel per Pump Station
Kitsap County	18	215[1]	0.09	64[2]	0.3
City of Bellevue	25	520	0.05	36	0.7
City of Enumclaw	4	142	0.03	7	0.6
City of Kent	13	211	0.06	7	1.8
City of Kirkland	24	123	0.19	6	4.0
City of Lacey	14	236	0.06	48	0.3
City of Port Orchard	6.5	75	0.09	21	0.3
Silver Lake Water and Sewer District	33	207	0.16	22	1.5
West Sound Utility District	15	45	0.33	12	1.3

Agency	Personnel (FTE)	Miles of Pipe	Personnel per Mile of Pipe	No. of Pump Stations	Personnel per Pump Station
Alderwood Water and Wastewater District	11	440	0.03	12	0.9
Average			**0.11**		**1.25**

Notes:
1. Total miles of gravity sewer pipe and force main pipe in Central Kitsap, Kingston, Manchester, Suquamish, and Navy Yard City, provided by the County's sewer asset count in 2024.
2. Number of pump stations in Central Kitsap, Kingston, Manchester, Suquamish, and Navy Yard City.

10.8 WWTP Staffing Needs

Manchester WWTP is classified by Ecology as a Class II facility, therefore, the operator in responsible charge must have a Group II operator certification. Additionally, a Group I operator must be in charge during all regularly scheduled shifts. Manchester WWTP shares the operators with the other three WWTPs. Operator certification of all four WWTPs is shown in **Table 10-3**. In addition to the plant operators, there are 5 laboratory staff who are required to obtain an operator certification within two years of being hired.

Table 10-3 | Operator Certifications

Operations Certification	Number of Staff
Operator in Training	0
Group I	4
Group II	5
Group III	3
Group IV	4
TOTAL	**16**

Current staffing at Manchester WWTP facility consists of one Lead Plant Operator specifically assigned to Manchester and one Plant Operations Supervisor and two Rover Plant Operators who oversee operations at Suquamish WWTP, Manchester WWTP and Kingston WWTP. Thus, the total full time equivalent (FTE) for Manchester is approximately 2.0, with 1.0 FTE by the Lead Plant Operator and 1/3 FTE each by the Plant Operations Supervisor and Rover Plant Operators. During off hours, critical SCADA alarms from the plant are configured to ring through to an on-call operator. Maintenance at Manchester WWTP is conducted by the Sewer Utility O&M group which is shared across all of the County's WWTPs and C&C systems.

As flows and loads increase at the facility and as improvements are undertaken, staffing levels may change. **Table 10-4** identifies potential staffing needs at existing and future planning horizon based on *Estimating Staffing for Municipal Wastewater Treatment Facilities* (EPA, 1973) and *The Northeast Guide for Estimating Staffing at Publicly and Privately-Owned Wastewater Treatment Plants* (New England Interstate Water Pollution Control Commission, Nov 2008). These estimates include supervisory, administrative, clerical, laboratory, yard work, site maintenance, and unit process O&M. All methods assume 1,500 working hours per employee after holidays, time off, training, etc. These estimates are intended to be guidelines only; specific staffing levels must be determined by the County and reviewed regularly to adequately operate and maintain the facility.

Table 10-4 | Manchester WWTP Staffing Comparison and Projection

Condition	AAF (MGD)	Current Staffing	EPA Method Staffing[1]	Northeast Guide Method Staffing
Staff at 2020 *(additional staff needed)*	0.19	2.00	1.02 *(0)*	2.86 *(0.86)*
Staff at 2042[2] *(additional staff needed)*	0.34	-	0.98 *(0)*	2.07 *(0.07)*

Notes:

1. The minimum plant capacity covered in the EPA Method is 0.5 MGD, therefore a flow of 0.5 MGD was used as the basis for staffing determinations.
2. Staff required in 2042 is lower for both methods due to the replacement of aging equipment and improved automation and controls as recommended in the CIP.

Based on both the EPA and Northeast Guide methods, the County's current approach of having one dedicated staff person for Manchester with one additional FTE of shared support staff appears to be appropriate and adequate for current operations. There is a deficiency in staff using the Northeast Guide method. It is expected that if some additional effort is required it can be covered with assistance from other operating staff on an as-needed basis. There is little expected increase in flows and improvements at the plant are expected to improve staff efficiency, so no additional staff is expected to be required though the 20-year planning period. It is recommended that the County continue executing the Sewer Utility Plant Operator Qualification Program and additional external classroom training to accelerate employees into Operator Certification Group III and prepare for anticipated Puget Sound Nutrient Reduction Goals and facility upgrades.

10.9 Conclusions and Recommendations

Conclusions and recommendations based on a review of the County O&M practices are:

- Consider having CCTV operators trained and certified in NASCCO assessment to improve the consistency of sewer inspecting rating.
- Consider reviewing spare parts inventories and assessing the need for additional spare parts due to supply chain challenges.
- Institute and annual valve exercise and maintenance program.
- Consider developing additional classroom training to accelerate employees into Operator Certification Group III and prepare for anticipated Puget Sound Nutrient Reduction Goals and facility upgrades.
- Institute an Arc Flash Analysis and Protection program to identify deficiencies that can be mitigated through coordinated CIP projects.

SECTION 11

Capital Improvement Plan

11.1 Introduction

This section identifies CIP projects and O&M projects for the Manchester collection system and WWTP. These improvements are required to remedy deficiencies identified in Section 5, Section 6, Section 7, Section 8, and the *Condition Assessment Red Flag Findings and Mitigation Recommendations* (Murraysmith [now Consor], October 2020) included as Appendix I.

11.2 Capital Improvement Plan Criteria

CIPs are presented on a 6-year basis from 2023 to 2028 for immediate needs; and, for the 20-year planning horizon (from 2029 to 2042) for improvements that are anticipated but not pressing. A planning level cost opinion and a preliminary timeline of CIP project implementation is provided. It is assumed that minor projects will be completed with O&M budget and are listed separately. The methodologies for funding the CIP projects will be discussed in Section 12.

The necessary conveyance system improvements were described in Section 7 and in Appendix H based on the evaluation as a part of the 2014 Plan. The Asset Health Scores discussed in Section 6 were used to identify the most critical projects at the Manchester WWTP based on asset condition and the CoF. The WWTP CIP projects were prioritized based on the Asset Health Scores and factors including the extent and type of deficiency, customer impact, environmental impacts, and capital and O&M costs.

In conjunction with the facility planning effort, the County has been working on a series of SCADA Master Plan technical memoranda which include project identification, estimates, and capital improvement planning in Technical Memorandum No. 5. SCADA system improvements are not incorporated into this CIP because they are generally implemented across the entire sewer division, and not specifically to process improvements at the Manchester WWTP. SCADA improvements were also included in a separate CIP.

Drivers of Improvements are considered for five categories:

1. Capacity: An asset no longer has sufficient capacity when it cannot or is modeled in the future to not be able to meet the equipment, hydraulic, or process capacity requirements, as detailed in Section 6 for the WWTP and 2014 Plan for the C&C system. For the WWTP, the proposed firm capacity is determined through hydraulic and hydrologic model simulations considering increased population for the 2042 planning horizon. Capacity driven improvements are assigned the maximum asset health score of 25 as these projects are considered the most critical. Capacities are defined as follows:

    a. An equipment/treatment process no longer meets the equipment, hydraulic, or process capacity requirements, discussed in detail in Section 6.6.

2. O&M: County staff indicate the asset requires excessive maintenance, using valuable time and money. O&M issues are primarily driven by condition. The project goal will be to improve reliability and reduce maintenance call outs.

3. Obsolescence: The asset is reaching the end of its service life. Life expectancy of piping, structures, and mechanical/electrical equipment varies depending on the treatment processes and is discussed in **Section 6**. For the collection system, life expectancy of pipes are 100 years, structures are 50 years, and mechanical/electrical equipment is 25 years.

4. Developer: A new development in the County necessitates new or upgraded infrastructure that would not be needed by the existing customers and would be funded and constructed by a developer.

5. Regulatory: Regulatory projects will address facilities that are currently out of compliance or expected to become incompliant with existing, pending, or anticipated regulations set by the State and Federal agencies, such as Ecology or the EPA.

Projects for the County's sewer systems are identified with a code that identifies the basin, system, driver of improvements, and a project number using the following identifiers (note that basin identifiers are used as Plans for the three other service areas are being completed concurrent to this Plan):

- Project Category:
  - Capital Improvement Plan = CIP
  - Operations and Maintenance = O&M
- Basin Abbreviations:
  - Central = CK
  - Kingston = K
  - Suquamish = S
  - Manchester = M
- System:
  - Collection and Conveyance = CC
  - Wastewater Treatment Plant = WWTP
- Driver:
  - Capacity = CAP
  - Op and Maintenance = OM
  - Obsolescence = OB
  - Developer = DEV
  - Regulatory = REG

For the C&C system CIP projects, costs and item descriptions are based on the estimates from the 2014 Plan and updated for 2024 dollars based on current ENR values.

For the WWTP CIP projects, AACE International Class 5 opinions of probable project costs with an anticipated accuracy range of -50 percent to +100 percent were developed using RSMeans Heavy Construction Cost Data, recent County project bid tabs, County input, industry experience, and local contractor and supplier costs. The total project costs include construction costs for work and materials plus markups for mobilization, general contractor markups, overhead and profit, taxes, and a construction contingency of 50 percent plus an additional markup of 50 percent for engineering, legal, administration, and construction management costs associated with project delivery. The OPPCs were developed in 2023 dollars.

There is a five-year moratorium on pavement excavation and trenching following the completion of a new road or road overlay. This requirement restricts all road trenching except in the event of an emergency repair or if all trenching is outside of the paved area. Projects should be coordinated with road paving projects to avoid this moratorium and reduce paving costs.

11.3 Manchester Collection and Conveyance System Improvements

The C&C system includes pump stations, force mains, and gravity sewers. Proposed CIP projects address identified deficiencies for these assets. Projects are frequently combined for efficient project delivery. The projects components are broken down into pump stations, which include force mains, and pipeline projects, which include gravity sewers.

11.3.1 Recently Completed and Ongoing Manchester Collection and Conveyance CIP

There are no known capital projects currently under construction in the Manchester C&C system at the time of this writing.

11.3.2 6-Year Collection and Conveyance CIP (2023 to 2028)

Each of the projects identified for the Manchester C&C system 6-year CIP are summarized in **Table 11-1**. The location of the 6-year CIPs are shown in **Figure 11-1**. The conveyance system deficiencies in the existing sewer system were evaluated in the 2014 Plan. New gravity sewers to ultimately expand the service area and a force main replacement will be built in conjunction with a road paving and stormwater improvement project along Alaska Avenue, including the reaches in Basins G and H that may not be connected to the sewer system until a later date when the remainder of the system is constructed. See OPPCs for individual projects in **Appendix I** for more detail.

11.3.2.1 CIP-M-CC-DEV-1 – Gravity Pipeline and Force Main from PS-A1 in Basin A (Beach Drive)

Project will be built in conjunction with the road paving and stormwater improvement project along Beach Drive (Transportation Improvement Program #28). This project involves installing 840 linear feet (LF) of gravity pipeline in Basin A in Beach Drive between Jessica Way and proposed PS-A1, including new manholes and side sewer connections. This project also includes the installation of approximately 980 LF of force main from proposed PS-A1. Development in this area or septic conversion will trigger the need for this project. It is assumed that this project would be funded by development and/or the creation of a ULID. See **Table 11-1** for project details.

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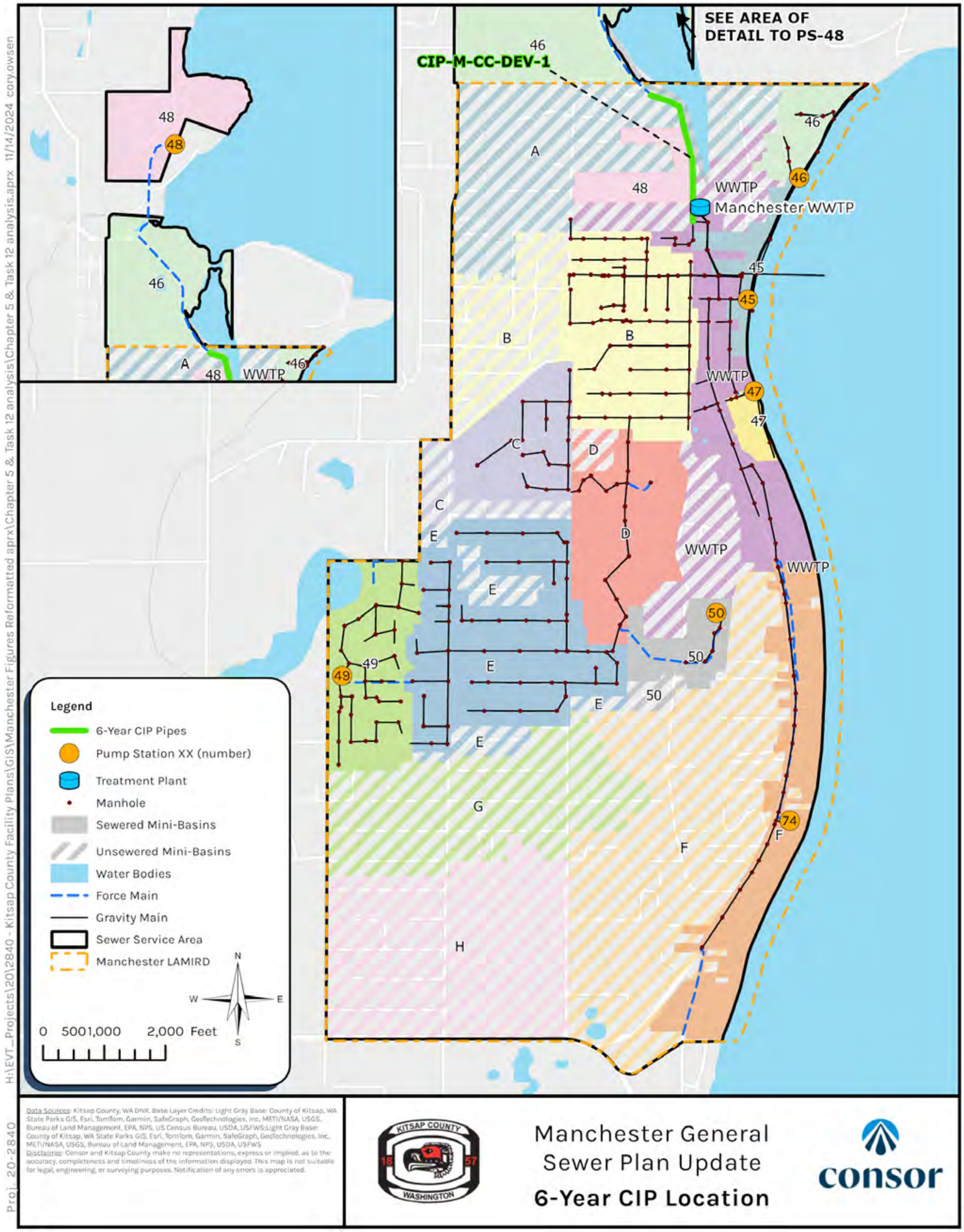
Table 11-1 | 6-Year Manchester Collection and Conveyance Capital Improvement Projects

CIP No.	Asset Health Score[4]	Item	Replacement[1]	Upgrade[2]	Capacity Increase[3]	Total Project Cost[5]	Project Description
CIP-M-CC-DEV-1	n/a	Gravity Pipeline and Force Main from PS-A1 in Basin A (Beach Drive)			X	$0	➢ Install approximately 840 LF of gravity pipeline in Basin A in Beach Drive between Jessica Way and proposed PS-A1 ➢ Install Approximately 980 LF of force main from PS-A1 ➢ Project expected to be paid for by developers or through creation of a ULID. Estimated project cost is $1,200,000.
					Total	$0	

Notes:

1. Replacement projects will construct a new facility.
2. Upgrade projects will replace components of the facility.
3. Capacity Increase projects will increase hydraulic capacity.
4. Asset health score is not applicable for these projects that are identified in 2014 Plan.
5. Cost estimates completed by Consor as a part of this plan. Details are included in **Appendix I**.
6. Cost for CIP-M-CC-OM-2 based on 2014 Plan and adjusted based on inflation and Consor's assessment of the likely costs for completed items and additional access road.

Figure 11-1 | 6-year Collection and Conveyance CIP (2023-2028)



11.3.3 20-Year Manchester Collection and Conveyance CIP (2029 to 2042)

Each of the projects identified for the Manchester C&C system 20-year CIP are summarized in **Table 11-2**. The conveyance system deficiencies in the existing sewer system were evaluated for project build-out conditions in 2014 Plan. The required facilities improvements are described below; all project timelines are subject to adjustment and are subject to availability of funds. The location of the 20-year CIPs are shown in **Figure 11-2**. See OPPCs for individual projects in **Appendix I** for more detail.

11.3.3.1 CIP-M-CC-OM-2 – Manchester WWTP Influent Pump Station Rehabilitation

Improvements including three new pumps and new mechanical components including discharge piping were made to this pump station in 2015, but some rehabilitation is still required to improve outdated equipment. These improvements include structural retrofitting of the existing wet well (based on the Raven Lining System). This retrofit would require dewatering wells for 21 days to stop groundwater intrusion for lining system application. The pump station also needs new electrical, instrumental, and control equipment, a new wet well hatch with fall prevention net, as well as new wet well level controls. Additionally, the wet well is currently inaccessible for a Vacuum Truck to clean top grease and ragging, so a gravel access road approximately 300 ft long would need to be constructed along the East side of the property. See **Table 11-1** for project details.

11.3.3.2 CIP-M-CC-OM-4 – Pump Station 48, 49, and 50 Rehabilitation

Pump Stations (PS) 48, 49, and 50 are expected to reach the end of their design lives and are projected for rehabilitation by 2033. Rehabilitation for each PS will include new mechanical components and two new pumps. The new pump stations will also require new electrical, instrumentation, and control equipment, new equipment canopy/ shelters, new flow meter vaults, and new generator sets with weather/ acoustical enclosures. See **Table 11-2** for project details.

11.3.3.3 CIP-M-CC-DEV-5 – Gravity Pipeline Expansion in Basin A

This project expands sewer service into unsewered regions of Basin A. The new sewer extension would add approximately 9,550 LF of gravity sewer pipes, and include side sewer connections, and manholes. Development in this area or septic conversion will trigger the need for this project. It is assumed that this project would befunded by development and/or the creation of a ULID. See **Table 11-2** for project details.

11.3.3.4 CIP-M-CC-DEV-6 – Gravity Pipeline Expansion in Basin B

This project expands sewer service into unsewered regions of Basin B. The new sewer extension would add approximately 6,410 LF of gravity sewer pipes, and include sewer connections, and manholes. Development in this area or septic conversion will trigger the need for this project. It is assumed that this project would be funded by development and/or the creation of a ULID. See **Table 11-2** for project details.

11.3.3.5 CIP-M-CC-DEV-7 – Gravity Pipeline Expansion in Basin C

This project expands sewer service into unsewered regions of Basin C. The new sewer extension would add approximately 2,280 LF of gravity sewer pipes, and include side sewer connections, and manholes. Development in this area or septic conversion will trigger the need for this project. It is assumed that this project would be funded by development and/or the creation of a ULID. See **Table 11-2** for project details.

11.3.3.6 CIP-M-CC-DEV-8 – Gravity Pipeline Expansion in Basin D

This project expands sewer service into unsewered regions of Basin D. The new sewer extension would add approximately 720 LF of gravity sewer pipes, and include side sewer connections, and manholes. Development in this area or septic conversion will trigger the need for this project. It is assumed that this project would be funded by development and/or the creation of a ULID. See **Table 11-2** for project details.

11.3.3.7 CIP-M-CC-DEV-9 – Gravity Pipeline Expansion in Basin E

This project expands sewer service into unsewered regions of Basin E. The new sewer extension would add approximately 3,210 LF of gravity sewer pipes, and include side sewer connections, and manholes. Development in this area or septic conversion will trigger the need for this project. It is assumed that this project would be funded by development and/or the creation of a ULID. See **Table 11-2** for project details.

11.3.3.8 CIP-M-CC-DEV-10 – Gravity Pipeline Expansion in Basin F

This project expands sewer service into unsewered regions of Basin F. The new sewer extension would add approximately 7,540 LF of gravity sewer pipes, and include side sewer connections, and manholes. Development in this area or septic conversion will trigger the need for this project. It is assumed that this project would be funded by development and/or the creation of a ULID. See **Table 11-2** for project details.

11.3.3.9 CIP-M-CC-DEV-11 – Gravity Pipeline Expansion in Basin G

This project expands sewer service into unsewered regions of Basin G. The new sewer extension would add approximately 9,790 LF of gravity sewer pipes, and include sewer connections, and manholes. Development in this area or septic conversion will trigger the need for this project. It is assumed that this project would be funded by development and/or the creation of a ULID. See **Table 11-2** for project details.

11.3.3.10 CIP-M-CC-DEV-12 – Gravity Pipeline Expansion in Basin H

This project expands sewer service into unsewered regions of Basin H. The new sewer extension would add approximately 11,390 LF of gravity sewer pipes, and include side sewer connections, and manholes. Development in this area or septic conversion will trigger the need for this project. It is assumed that this project would be funded by development and/or the creation of a ULID. See **Table 11-2** for project details.

11.3.3.11 CIP-M-CC-DEV-13 – Gravity Pipeline Expansion in Basin 50

This project expands sewer service into unsewered regions of Basin 50. The new sewer extension would add approximately 480 LF of gravity sewer pipes, and include side sewer connections, and manholes. Development in this area or septic conversion will trigger the need for this project. It is assumed that this project would be funded by development and/or the creation of a ULID. See **Table 11-2** for project details.

11.3.3.12 CIP-M-CC-DEV-14 – Gravity Pipeline Expansion in Basin WWTP

This project expands sewer service into unsewered regions of Basin WWTP. The new sewer extension would add approximately 5,310 LF of gravity sewer pipes, and include side sewer connections, and manholes. Development in this area or septic conversion will trigger the need for this project. It is assumed that this project would be funded by development and/or the creation of a ULID. See **Table 11-2** for project details.

11.3.3.13 CIP-M-CC-DEV-15 – Pump Station PS-A1

Located north of the Manchester WWTP, and near Little Clam Bay, this is a theoretical pump station that would allow for future development in Basin A. It is located at a topographic low point and routed directly to the nearest gravity sewer manhole. The representation of this future pump station is not intended to establish the exact location of future facilities, rather, it is provided to approximate the future system requirements on a more global level. More specific location and hydraulic information must be developed during the final design process for this pump station. Development in this area or septic conversion will trigger the need for this project. It is assumed that this project would be funded by development and/or the creation of a ULID. See **Table 11-2** for project details.

11.3.3.14 CIP-M-CC-OM-16 – 20 – Year Annual Pipe Replacement

This project will be an annual program to replace aging and deficient pipes not identified in other capital improvement projects. These pipes may include deficiencies related to root intrusion, high rates of I&I, deflected joints, cracked pipes, insufficient slopes, and high rates of O&M call outs. It assumes that half of one percent of the pipe in the Manchester basin would be replaced each year. See **Table 11-2** for project details.

Table 11-2 | 20-Year Manchester Collection and Conveyance Capital Improvement Projects

CIP No	Asset Health Score[4]	Project Name	Replacement[1]	Upgrade[2]	Expansion[3]	Total Project Cost[5]	Project Description
CIP-M-CC-OM-2	n/a	Manchester WWTP Influent Pump Station Rehabilitation		X		$1,030,000	➢ Retrofit existing wet well (based on Raven Lining System) ➢ Replace electrical, instrumentation, and control equipment ➢ Install new wet well hatch with fall prevention net ➢ Install new wet well level controls ➢ Install wet well access road to allow Vacuum Truck to clean top grease and ragging.
CIP-M-CC-OM-4	n/a	PS- 48 ,49 and 50 Rehabilitation		X		$6,200,000	➢ Rehabilitate PS-48, 49, and 50, which are projected to reach the end of their design lives before 2033. ➢ Replace mechanical components ➢ Replace pumps ➢ Replace electrical, instrumentation, and control equipment ➢ Install new equipment canopy/ shelters ➢ Install new flow meter vaults ➢ Install new generator sets with weather/ acoustical enclosures.
CIP-M-CC-DEV-5	n/a	Gravity Pipeline Expansion in Basin A			X	$0	➢ Install approximately 9,550 LF of gravity sewer in Basin A to expand sewer service to currently unsewered areas. ➢ Project will include installation of new gravity sewer pipe, manholes, and side sewer connections ➢ Project expected to be paid for by developers or through creation of a ULID. Estimated project cost is $11,800,000.
CIP-M-CC-DEV-6	n/a	Gravity Pipeline Expansion in Basin B			X	$0	➢ Install approximately 6,410 LF of gravity sewer in Basin B to expand sewer service to currently unsewered areas. ➢ Project will include installation of new gravity sewer pipe, manholes, and side sewer connections ➢ Project expected to be paid for by developers or through creation of a ULID. Estimated project cost is $8,300,000.
CIP-M-CC-DEV-7	n/a	Gravity Pipeline Expansion in Basin C			X	$0	➢ Install approximately 2,280 LF of gravity sewer in Basin C to expand sewer service to currently unsewered areas. ➢ Project will include installation of new gravity sewer pipe, manholes, and side sewer connections

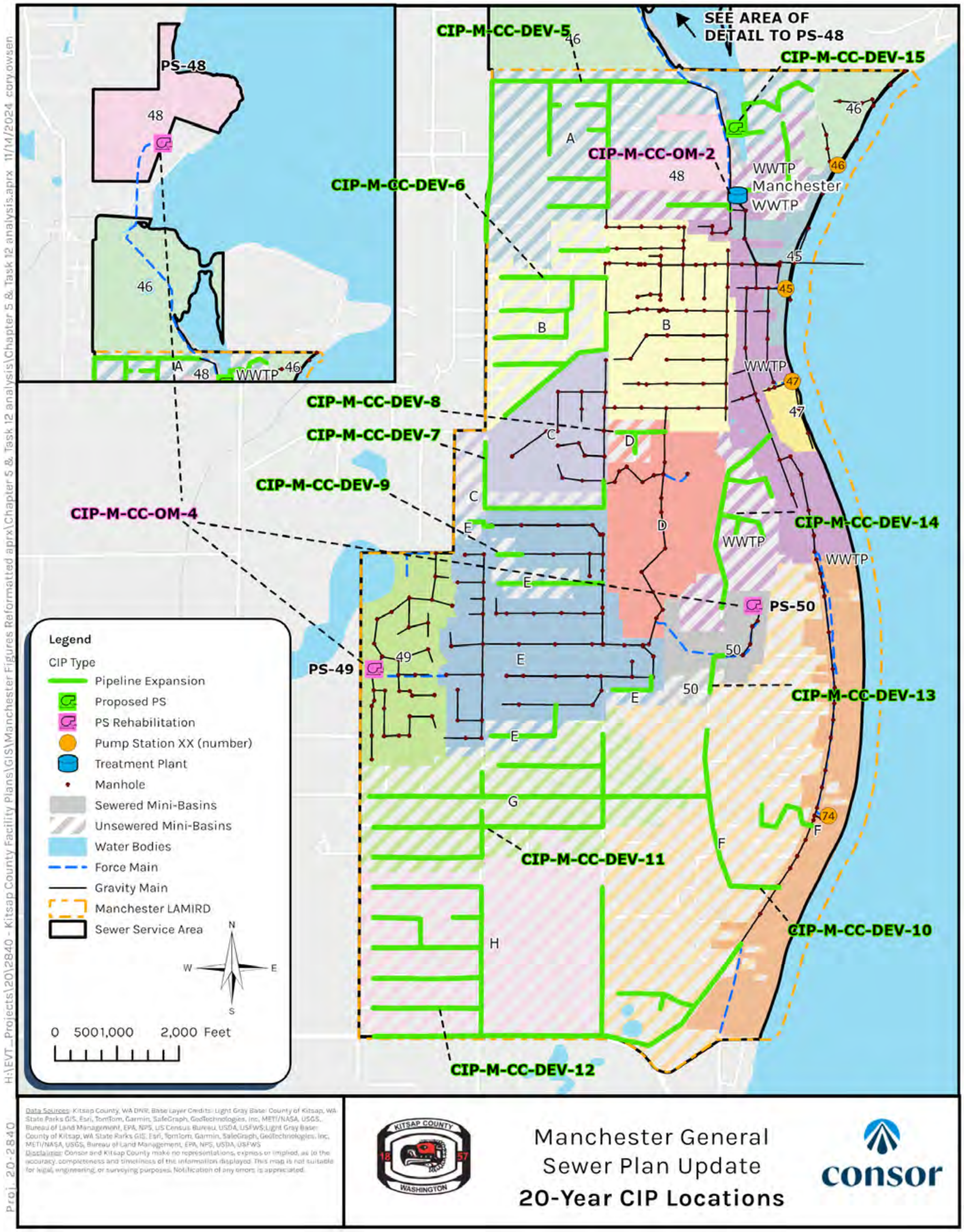
CIP No	Asset Health Score[4]	Project Name	Replacement[1]	Upgrade[2]	Expansion[3]	Total Project Cost[5]	Project Description
							➢ Project expected to be paid for by developers or through creation of a ULID. Estimated project cost is $3,300,000.
CIP-M-CC-DEV-8	n/a	Gravity Pipeline Expansion in Basin D			X	$0	➢ Install approximately 720 LF of gravity sewer in Basin D to expand sewer service to currently unsewered areas. ➢ Project will include installation of new gravity sewer pipe, manholes, and side sewer connections ➢ Project expected to be paid for by developers or through creation of a ULID. Estimated project cost is $1,400,000.
CIP-M-CC-DEV-9	n/a	Gravity Pipeline Expansion in Basin E			X	$0	➢ Install approximately 3,210 LF of gravity sewer in Basin E to expand sewer service to currently unsewered areas. ➢ Project will include installation of new gravity sewer pipe, manholes, and side sewer connections ➢ Project expected to be paid for by developers or through creation of a ULID. Estimated project cost is $4,300,000.
CIP-M-CC-DEV-10	n/a	Gravity Pipeline Expansion in Basin F			X	$0	➢ Install approximately 7,540 LF of gravity sewer in Basin F to expand sewer service to currently unsewered areas. ➢ Project will include installation of new gravity sewer pipe, manholes, and side sewer connections ➢ Project expected to be paid for by developers or through creation of a ULID. Estimated project cost is $9,500,000.
CIP-M-CC-DEV-11	n/a	Gravity Pipeline Expansion in Basin G			X	$0	➢ Install approximately 9,790 LF of gravity sewer in Basin G to expand sewer service to currently unsewered areas. ➢ Project will include installation of new gravity sewer pipe, manholes, and side sewer connections ➢ Project expected to be paid for by developers or through creation of a ULID. Estimated project cost is $12,300,000.
CIP-M-CC-DEV-12	n/a	Gravity Pipeline Expansion in Basin H			X	$0	➢ Install approximately 11,390 LF of gravity sewer in Basin H to expand sewer service to currently unsewered areas. ➢ Project will include installation of new gravity sewer pipe, manholes, and side sewer connections ➢ Project expected to be paid for by developers or through creation of a ULID. Estimated project cost is $14,000,000.

CIP No	Asset Health Score[4]	Project Name	Replacement[1]	Upgrade[2]	Expansion[3]	Total Project Cost[5]	Project Description
CIP-M-CC-DEV-13	n/a	Gravity Pipeline Expansion in Basin 50			X	$0	➢ Install approximately 480 LF of gravity sewer in Basin 50 to expand sewer service to currently unsewered areas. ➢ Project will include installation of new gravity sewer pipe, manholes, and side sewer connections ➢ Project expected to be paid for by developers or through creation of a ULID. Estimated project cost is $1,200,000.
CIP-M-CC-DEV-14	n/a	Gravity Pipeline Expansion in Basin WWTP			X	$0	➢ Install approximately 5.310 LF of gravity sewer in Basin WWTP to expand sewer service to currently unsewered areas. ➢ Project will include installation of new gravity sewer pipe, manholes, and side sewer connections ➢ Project expected to be paid for by developers or through creation of a ULID. Estimated project cost is $7,000,000.
CIP-M-CC-DEV-15	n/a	Pump Station PS-A1			X	$0	➢ Theoretical pump station that would allow for future development in Basin A. ➢ More specific location and hydraulic information must be developed during the final design process for this pump station. ➢ Project expected to be paid for by developers or through creation of a ULID. Estimated project cost is $1,800,000.
CIP-M-CC-OM-16	n/a	20 – Year Annual Pipe Replacement	X			$14,000,000	➢ Annual program to replace aging and deficient pipes not identified in other capital improvement projects ➢ Assumes that half of one percent of the pipe in the Manchester basin would be replaced each year
Total						**$21,230,000**	

Notes:

1. Replacement projects will construct a new facility.
2. Upgrade projects will replace components of the facility.
3. Capacity Increase projects will increase hydraulic capacity.
4. Asset health score is not applicable for these projects that are identified in 2014 Plan.
5. Cost estimates completed by Consor as a part of this plan. Details are included in **Appendix I**.

Figure 11-2 | 20-year Collection and Conveyance CIP (2029-2042)



11.4 Manchester WWTP Improvements

The Manchester WWTP has a conventional activated sludge process that works well and can continue to provide treatment through the 20-year planning period. Much of the plant was installed or upgraded in 1998, so additional repairs, replacements, and improvements will be required for continued operation. Additionally, implementation of the PSGNP has added additional TIN removal optimization requirements, which will require some upgrades to the secondary treatment process.

11.4.1 Manchester WWTP Alternatives Analysis

The alternatives analysis in Section 8 evaluated different treatment technologies for key processes and recommended aeration system optimization, UV disinfection system upgrades, and a new activated carbon odor control system. In addition, several minor maintenance, repairs, and direct replacements are identified in Section 6 and will be required to keep the WWTP operating reliably over the next 20 years. The urgency of each of these projects has been assessed to develop a project list of short-term CIP projects that should be addressed in the next 6-years and a long-term project list for those CIP projects that are not urgent but will need to be executed later in the 20-year planning period. The remaining projects that can be completed by the plant staff are categorized as O&M projects. These project lists, project descriptions, and costs are presented in the sections that follow.

11.4.2 Recently Completed and Ongoing Manchester WWTP CIP

There are no known current capital projects at the Manchester WWTP at the time of this writing.

11.4.3 6-Year Manchester WWTP CIP (2023 to 2028)

Each of the projects identified for the Manchester WWTP 6-year CIP are described below and summarized in **Table 11-3** Table ES-9 | 6-Year Manchester WWTP Capital Improvement Projects **.** See OPPCs for individual projects in Appendix I for more detail.

11.4.3.1 CIP-M-WWTP-CAP-2 - Upsize 10-inch Diameter ML Pipes and 12-inch Diameter Secondary Clarifier Effluent Pipes

The 12-inch diameter ML pipes that convey screened sewage to the secondary clarifiers and the 10-inch diameter secondary clarifier effluent pipes that convey clarifier effluent to the UV channel are expected to cause weir submergence at flows of 1.3 and 1.2 MGD, respectively. This is a non-critical but undesirable hydraulic capacity issue. PHFs developed in Section 3 are expected to be 1.30 MGD in 2028. This project will replace both pipes with larger pipes to reduce headloss and prevent weir submergence at high flows. Plant operators should observe the aeration basin and secondary clarifier weirs during high flow events to evaluate submergence problems and time the project accordingly.

Table 11-3 | 6-Year Manchester WWTP Capital Improvement Projects

CIP No.	Asset Health Score	Item	Replacement[1]	Upgrade[2]	Capacity	Total Project Cost	Project Description
CIP-M-WWTP-CAP-2	14.5	Upsize 10-inch Diameter ML Pipe and 12-inch Diameter Secondary Clarifier Effluent Pipes			X	$200,000	➢ Replace existing ML and secondary clarifier effluent pipes with larger pipes to increase hydraulic capacity
					TOTAL	**$200,000**	

Notes:

1. Replacement projects will construct a new facility.
2. Upgrade projects will replace components of the facility.
3. Capacity increase projects will increase hydraulic capacity.

11.4.4 20-Year Manchester WWTP CIP (2029 to 2042)

Each of the projects for the 20-year CIP are described below and summarized in **Table 11-4**. See OPPCs for individual projects in **Appendix I** for more detail.

11.4.4.1 CIP-M-WWTP-REG-1 - Aeration System Optimization

The existing jet aeration system is nearing the end of its expected lifespan and does not provide sufficient process control to allow operators to optimize the plant for nitrogen removal to consistently achieve an effluent TIN below 10 mg/L. Various alternatives for the aeration system were analyzed in **Section 8** and it was determined that the existing jet aeration system should be replaced with a fine bubble diffuser system, the blowers replaced with variable speed blowers, and DO, ammonia, and nitrate probes installed. These improvements will improve control, allow for greater optimization and consistent reduction of TIN to below 10 mg/L, save energy, and reduce O&M requirements.

*If funding becomes available, this project should be considered in the 6-year CIP.

11.4.4.2 CIP-M-WWTP-OB-3 - Replace Plant Automatic Transfer Switch

The ATS is obsolete and spare parts are no longer available for this critical emergency equipment. This project will replace the ATS with a current model to ensure that it is functional if/when needed.

*If funding becomes available, this project should be considered in the 6-year CIP.

11.4.4.3 CIP-M-WWTP-OB-4 - Replace Odor Control System

The odor control system is only partially operational. Various alternatives for replacement were analyzed in **Section 8** and an activated carbon system was selected as the preferred alternative. A new activated carbon system will be installed in place of the existing system to provide odor control at low cost and low O&M requirement.

*If funding becomes available, this project should be considered in the 6-year CIP.

11.4.4.4 CIP-M-WWTP-OB-5 - Replace UV System

The existing UV system is approaching the end of its expected lifespan. Various alternatives for replacement were analyzed in **Section 8** and replacement with the Trojan UV3000Plus was selected as the preferred alternative. Replacing the UV system with this upgraded model will provide a system with advanced monitoring and control functionality which will reduce operating costs and O&M requirements.

*If funding becomes available, this project should be considered in the 6-year CIP.

11.4.4.5 CIP-M-WWTP-OB-6 - Replace Clarifier Drives

The secondary clarifier drives and collection mechanisms are expected to reach the end of their service life within the 20-year planning horizon. This project will replace the drives, collection mechanisms, walkway and platform, and weirs with new equipment.

11.4.4.6 CIP-M-WWTP-OB-7 - Replace Electrical Service, Main Power Distribution, and MCC

The primary plant electrical equipment, including the utility service entrance, main power distribution and MCC, are expected to reach the end of their service life within the 20-year planning horizon. This project will replace these major electrical components with new equipment.

11.4.4.7 CIP-M-WWTP-OB-8 - Replace Fine Screen

The influent rotary fine screen is in fair condition but is expected to reach the end of its service life within the 20-year planning horizon. This project will replace the screen with a new mechanical screen.

11.4.4.8 CIP-M-WWTP-OB-9 - Replace Grit Chamber, Pump, Cyclone, and Classifier

The grit separation and removal system is expected to reach the end of its service life within the 20-year planning horizon. This project will replace the grit chamber mechanical unit, grit pump, cyclone and classifier with new equipment.

11.4.4.9 CIP-M-WWTP-OB-10 - Replace Thickening Equipment

The GBT and associated polymer system are expected to reach the end of their service life within the 20-year planning horizon. This project will replace the GBT with new thickening equipment and modify and replace the polymer system as needed to support the new thickener.

11.4.4.10 CIP-M-WWTP-OB-11 - Replace Sludge Tank Blowers and Sludge Pumps

The sludge tank blowers and sludge pumps are expected to reach the end of their service life within the 20-year planning horizon. This project will replace the blowers and pumps with new equipment.

11.4.4.11 CIP-M-WWTP-REG-12 - Biological Nutrient Removal

The existing aeration basins at Manchester WWTP have sufficient capacity to consistently reduce TIN to below 10 mg/L throughout the planning period. The plant can meet the TIN limits in the current PSNGP, but the permit expires December 31, 2026 and future limits may be lower. It is assumed that effluent TIN restrictions to values below 10 mg/L will not be implemented until 2031 at the earliest. If effluent TIN requirements become more restrictive, this project will add baffle walls in the basins to implement the MLE process which is expected to reduce effluent TIN to approximately 5 mg/L.

11.4.4.12 CIP-M-WWTP-REG-13 - Enhanced Biological Nutrient Removal

If TIN requirements in future permits become more restrictive and must be further reduced below the levels achievable using the MLE process (above), an additional aeration basin will be constructed so that the Bardenpho process can be implemented. This project is expected to reduce effluent TIN to approximately 3 mg/L.

Table 11-4 | 20-Year Manchester WWTP Capital Improvement Projects

CIP No.	Asset Health Score	Item	Replacement[1]	Upgrade[2]	Capacity Increase[3]	Total Project Cost	Project Description
CIP-M-WWTP-REG-1[6]	14.5	Aeration System Optimization		X		$1,100,000	➢ Project will improve TIN monitoring and control so effluent TIN can be consistently reduced to below 10 mg/L ➢ Replace jet aeration system with fine bubble diffusers ➢ Replace existing blowers with variable speed blowers ➢ Install DO and ammonia and nitrogen monitoring probes
CIP-M-WWTP-OB-3[6]	13.0	Replace Plant ATS		X		$200,000	➢ Replace obsolete ATS
CIP-M-WWTP-OB-4[6]	9.6	Replace Odor Control System		X		$600,000	➢ Replace odor control system with activated carbon filter
CIP-M-WWTP-OB-5[6]	9.3	Replace UV System		X		$1,100,000	➢ Replace obsolete UV system with new, more advanced model to reduce operating costs and O&M requirements
CIP-M-WWTP-OB-6[4]	14.5	Replace Clarifier Drives		X		$500,000	➢ Replace clarifier drives, collection mechanisms, walkways, platforms, and weirs
CIP-M-WWTP-OB-7[4]	13.0	Replace WWTP Electrical Service, Main Power Distribution, and MCC		X		$400,000	➢ Replace electrical service, main power distribution, and MCC
CIP-M-WWTP-OB-8	7.2	Replace Fine Screen		X		$800,000	➢ Replace fine screen with new fine screen
CIP-M-WWTP-OB-9	7.2	Replace Grit Chamber, Pump, Cyclone, and Classifier		X		$700,000	➢ Replace grit chamber, grit pump, cyclone, and classifier
CIP-M-WWTP-OB-10	6.0	Replace Thickening Equipment		X		$700,000	➢ Replace existing GBT with new sludge thickening system
CIP-M-WWTP-OB-11	6.0	Replace Sludge Tank Blowers and Sludge Pumps		X		$400,000	➢ Replace sludge tank blowers and pumps

CIP No.	Asset Health Score	Item	Replacement[1]	Upgrade[2]	Capacity Increase[3]	Total Project Cost	Project Description
CIP-M-WWTP-REG-12[4,5]	14.5	Biological Nutrient Removal		X		$1,930,000	➢ Convert the existing aeration basins to a biological nutrient removal system by adding baffles to implement the MLE process. ➢ Project is expected to reduce effluent TIN to approximately 5 mg/L
CIP-M-WWTP-REG-13[4,5]	14.5	Enhanced Biological Nutrient Removal		X		$2,020,000	➢ A new aeration basin will be constructed to convert the secondary treatment system to the Bardenpho process and will provide post-anoxic and post-aerobic zones downstream of the existing aeration basins. ➢ Project can be implemented if needed after or in conjunction with CIP-M-WWTP-CAP-13 to further reduce effluent TIN to approximately 3 mg/L.
					TOTAL	$10,450,000	

Notes:

1. Replacement projects will construct a new facility.
2. Upgrade projects will replace components of the facility.
3. Capacity increase projects will increase hydraulic capacity.
4. Asset health scores for the WWTP are grouped by process. This project has a high asset health score because of other health deficiencies in the process, but the specific equipment addressed by the project is not in urgent need of improvement.
5. Future nutrient requirements and timing are unknown. Based on the current permit cycle for the PSNGP, it is assumed that effluent TIN restrictions to values below 10 mg/L will not be implemented until 2031 at the earliest.
6. If funding becomes available, this project should be considered in the 6-year CIP.

11.4.5 Manchester WWTP O&M Projects

Each of the O&M projects are summarized in **Table 11-5**. Costs and drivers of improvements are not included for O&M projects since these are relatively minor projects implemented by County staff and not included in the CIP budget.

Table 11-5 | WWTP O&M Projects

O&M Project No	Asset Health Score	Item	Project Description
O&M-M-WWTP-1	7.2	Influent Flow Sensor	➢ Install a level sensor on the influent Parshall flume to collect and record influent flow data.
O&M-M-WWTP-2	7.2	Replace Influent Channel Blower	➢ Replace the influent channel blower with a new blower
O&M-M-WWTP-3	7.2	Grit Classifier Feedbox and Grit Mixer Flange Replacement	➢ Replace the grit classifier feedbox and mixer mounting flange with a custom fabricated box similar to the one installed at Kingston WWTP
O&M-M-WWTP-4	14.5	Clarifier Rehabilitation	➢ Clean and recoat corroded areas of the secondary clarifiers ➢ Re-caulk and repaint the weirs
O&M-M-WWTP-5	9.6	Replace In-plant Pump Station Pumps	➢ Replace the in-plant pumps with new pumps
O&M-M-WWTP-6	6.0	Replace Scum Pumps	➢ Replace the scum pumps with new pumps
O&M-M-WWTP-7	6.0	Install WAS Flow Meter and Control Valve	➢ Install a flow meter and control valve on the WAS pipe so that sludge wasting can be controlled with greater accuracy and less effort
O&M-M-WWTP-8	9.6	Replace GBT Fire Alarm and WAS/TWAS LEL Sensors	➢ Repair the WAS/TWAS LEL sensors and replace the GBT room fire alarm system to improve safety.
O&M-M-WWTP-9	9.6	Rebalance GBT Room HVAC and Repaint GBT Room Mechanical Equipment	➢ Test and rebalance the GBT room HVAC system to provide better ventilation. ➢ Testing may determine that new equipment is required. ➢ Once the HVAC system is functioning better, equipment should be cleaned and repainted where paint is chipped or missing to prevent further corrosion.
O&M-M-WWTP-10	9.6	Replace W3 Flow Meter and Strainer	➢ Replace the broken W3 flow meter ➢ Replace the corroded W3 strainer
O&M-M-WWTP-11	9.6	Replace Not-potable Water System	➢ Replace the non-potable pumps, air-gap tank, hydro-pneumatic tank, and control panel
O&M-M-WWTP-12	13.0	Install Additional Electrical Room Cooling	➢ Evaluate the HVAC system in the electrical room ➢ Install additional cooling capacity
O&M-M-WWTP-13	13.0	Control Panel Housekeeping, Spare Parts Inventory, and Replacement Plan	➢ Clean and coat rusted electrical panels ➢ Verify back-up copies of all PLC and OIT programs ➢ Obtain and manage spare parts for the PLC ➢ Replace obsolete controllers and AFDs

O&M Project No	Asset Health Score	Item	Project Description
O&M-M-WWTP-14	13.0	Complete WWTP Arc-Flash Study	➢ Complete arc-flash study and install signage as needed ➢ May be combined with similar projects at other WWTPs

11.5 Wastewater System 20-Year CIP

The 20-Year CIP is summarized in **Table 11-6** along with the consultant proposed spend plan over the 20-year planning horizon.

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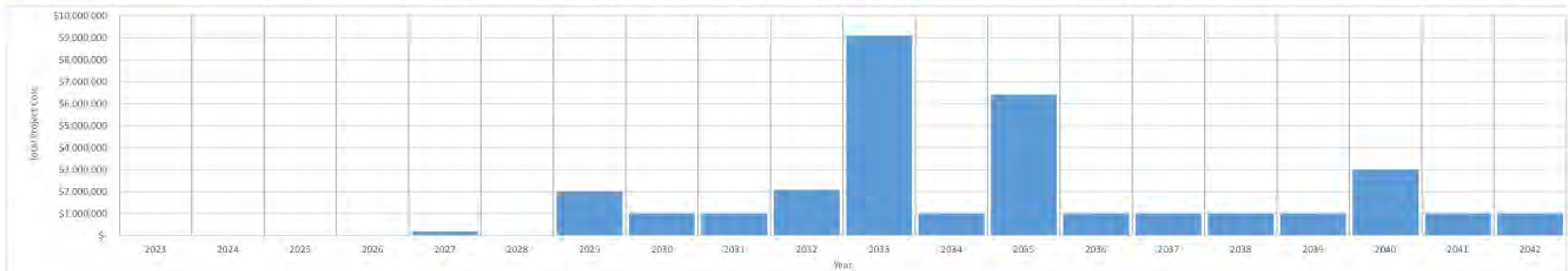
Table 11-6 | Recommended CIP Summary

Manchester WWTP CIP Plan

consor

6 or 20 Year CIP	CIP No.	Asset Health Score	Project Name	Total Project Cost	6-Year CIP 2023	2024	2025	2026	2027	2028
6	CIP-M-WWTP-CAP-2	14.5	Upsize 10" Diameter Mixed Liquor Pipe and 12" Diameter Plant Effluent Pipes	$ 200,000					$ 200,000	
20	CIP-M-CC-OM-16	20	Annual Pipe Replacement	$ 14,000,000						
20	CIP-M-CC-OM-2	N/A	Manchester WWTP Influent Pump Station Rehabilitation	$ 1,030,000						
20	CIP-M-WWTP-OB-5	9.3	Replace UV System*	$ 1,100,000						
20	CIP-M-WWTP-REG-1	14.5	Aeration System Optimization*	$ 1,100,000						
20	CIP-M-WWTP-OB-3	13	Replace Plant Automatic Transfer Switch*	$ 200,000						
20	CIP-M-CC-OM-4	N/A	Rehabilitate Pump Station 48, 49, and 50	$ 6,200,000						
20	CIP-M-WWTP-OB-4	9.6	Replace Odor Control System*	$ 600,000						
20	CIP-M-WWTP-OB-6	14.5	Replace Clarifier Drives	$ 500,000						
20	CIP-M-WWTP-OB-7	13	Replace WWTP Electrical Service, Main Power Distribution, and MCC	$ 400,000						
20	CIP-M-WWTP-OB-8	7.2	Replace Fine Screen	$ 800,000						
20	CIP-M-WWTP-OB-9	7.2	Replace Grit Chamber, Pump, Cyclone, and Classifier	$ 700,000						
20	CIP-M-WWTP-OB-10	6	Replace Thickening Equipment	$ 700,000						
20	CIP-M-WWTP-OB-11	6	Replace Sludge Tank Blowers and Sludge Pumps	$ 400,000						
20	CIP-M-WWTP-REG-12	14.5	Biological Nutrient Removal	$ 1,930,000						
20	CIP-M-WWTP-REG-13	14.5	Enhanced Biological Nutrient Removal	$ 2,020,000						
			Total Project Cost (2023)	$ 31,880,000	$ -	$ -	$ -	$ -	$ 200,000	$ -
			Assumed Inflation Rate			12%	8%	8%	5%	5%
			Inflation Multiplier		1	1.12	1.21	1.31	1.37	1.44
			Future Value Cost		$ -	$ -	$ -	$ -	$ 274,337	$ -

CIP No.	20-Year CIP 2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
CIP-M-WWTP-CAP-2														
CIP-M-CC-OM-16	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000
CIP-M-CC-OM-2	$ 1,030,000													
CIP-M-WWTP-OB-5				$ 1,100,000										
CIP-M-WWTP-REG-1					$ 1,100,000									
CIP-M-WWTP-OB-3					$ 200,000									
CIP-M-CC-OM-4					$ 6,200,000									
CIP-M-WWTP-OB-4					$ 600,000									
CIP-M-WWTP-OB-6							$ 500,000							
CIP-M-WWTP-OB-7							$ 400,000							
CIP-M-WWTP-OB-8							$ 800,000							
CIP-M-WWTP-OB-9							$ 700,000							
CIP-M-WWTP-OB-10							$ 700,000							
CIP-M-WWTP-OB-11							$ 400,000							
CIP-M-WWTP-REG-12							$ 1,930,000							
CIP-M-WWTP-REG-13												$ 2,020,000		
Total Project Cost (2023)	$ 2,030,000	$ 1,000,000	$ 1,000,000	$ 2,100,000	$ 9,100,000	$ 1,000,000	$ 6,430,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 3,020,000	$ 1,000,000	$ 1,000,000
Assumed Inflation Rate	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Inflation Multiplier	1.51	1.59	1.67	1.75	1.84	1.93	2.03	2.13	2.23	2.35	2.46	2.59	2.72	2.85
Future Value Cost	$ 3,069,937	$ 1,587,898	$ 1,667,293	$ 3,676,382	$ 16,727,538	$ 1,930,101	$ 13,031,074	$ 2,127,936	$ 2,234,333	$ 2,346,049	$ 2,463,352	$ 7,811,288	$ 2,715,845	$ 2,851,638



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SECTION 12

Financial Strategy

12.1 Introduction

This chapter documents the Sewer Financial Plan, which shows how the investments in the CIP can be funded by the County sewer utility.

This Sewer Financial Plan was written by FCS, a Bowman company, under subcontract with Consor, the County's consulting engineers who have prepared the other required elements of this Plan.

12.1.1 Four Basins, One Financial Entity

The County sewer system has four basins, each with a treatment plant and a corresponding collection system: Central Kitsap, Manchester, Suquamish, and Kingston. The capital planning has been performed separately for each basin. However, the County does not separate its sewer utility financial information by basin, so all information shown in this Sewer Financial Plan document—unless explicitly stated otherwise—refers to the County sewer utility as a whole.

This sewer financial plan document has been written so it can be included with each of the Wastewater Facilities and Sewer Plan documents: Central Kitsap, Manchester, Suquamish, and Kingston. At the end of this chapter, a table showing the allocation of costs and revenues across the four basins is included, so that the Plan documents will each contain the required elements needed for submission to Ecology.

12.1.2 Sequence of Topics

After reviewing the historical performance of the sewer utility, we describe the methodology and key assumptions underlying the financial forecast. The key assumptions address the assumed fiscal policies, economic assumptions, and data sources. This section also summarizes the CIP, expressing total project costs in both constant 2023 dollars and future inflated dollars.

After the key assumptions and data sources, this chapter then shows the results of the revenue requirement forecast. This is a two-step process. First, the capital funding strategy describes how the capital costs can be financed over time, using both debt and non-debt sources. The debt issues lead to annual debt service costs. The second step is the annual forecast, which incorporates the debt service and other annual costs into a forecast that is balanced against projected revenues. The forecast is tested assuming existing rates. If either the projected cash balances are insufficient or the required bonded debt service coverage is not achieved, then rates are adjusted until the forecast is balanced. In this forecast, the forecast can be balanced with overall rate increases of 6.31% in 2025 (already adopted by the County) and 6% per year from 2026 through 2042.

This document then shows the implications of these rate increases on several metrics and policy targets: reserve fund balances, rate-funded capital investment, bonded debt service coverage, outstanding debt as a percentage of total assets, annual debt service as a percentage of total revenue ("debt service load"), and the average single-family bill as a percentage of median household income.

The next section of this document allocates the forecast results to the four basins. Finally, **Appendix J** contains a list of loan and grant programs administered by State agencies.

12.2 Financial History

This section is a summary of historical financial performance as reported on the County sewer utility income statements.

Table 12-1 shows comparative financial statements for the six-year period 2018 through 2023. These statements summarize the revenues, expenses, and ending reserves for each year.

Table 12-1 | Sewer Utility Income Statement Summary

Kitsap County Sanitary Sewer Statement of Revenue, Expenses, and Changes in Fund Net Position	2018	2019	2020	2021	2022	2023
Operating Revenues						
Charges For services	$ 29,148,750	$ 22,655,426	$ 22,463,052	$ 29,309,413	$ 29,874,573	$ 33,131,359
Miscellaneous	8,186	1	1,830	(952)	29,607	26,281
Total Operating Revenue	29,156,936	22,655,427	22,464,882	29,308,461	29,904,180	33,157,640
Operating Expenses						
Personnel services	6,300,329	6,279,287	5,685,451	4,687,211	7,096,959	7,204,619
Contractual services	2,457,856	1,139,373	2,005,189	3,274,795	1,526,763	1,677,788
Utilities	1,730,524	1,572,611	1,629,789	1,658,245	1,829,897	2,031,543
Repair and maintenance	363,500	206,538	124,609	276,907	67,014	383,963
Other supplies and expenses	822,068	2,411,869	2,904,338	24,091	3,522,734	3,624,846
Insurance claims and other benefits	23,206	41,016	48,593	36,905	55,869	71,221
Depreciation	8,067,911	8,229,732	7,938,653	7,936,876	7,798,372	7,564,530
Amortization	-	-	-	-	18,185	43,554
Total Operating Expense	19,765,394	19,880,426	20,336,622	17,895,030	21,915,793	22,602,064
Operating Income (loss)	9,391,542	2,775,001	2,128,260	11,413,431	7,988,387	10,555,576
Nonoperating Revenues (Expense)						
Interest and investment revenue	557,566	992,414	501,061	(108,225)	(514,379)	1,599,427
Grant Revenue	-	-	-	-	12,077,611	1,617,967
Miscellaneous revenue	7,995,466	974,624	-	-	-	11,521
Interest expense	(2,332,621)	(2,574,476)	(1,774,693)	(1,663,145)	(1,534,251)	(1,592,572)
Miscellaneous expense	(2,362)	-	-	-	-	-
Total Nonoperating Revenue (Expense)	6,218,049	(607,438)	(1,273,632)	(1,771,370)	10,028,981	1,636,343
Income (loss) Before Contributions & Transfers	15,609,591	2,167,563	854,628	9,642,061	18,017,368	12,191,919
Capital contributions	1,746,374	1,079,087	3,304,592	358,850	8,815	3,378,392
Transfers in	133,903	2,116,097	-	-	-	-
Transfer out	(167,214)	(364,731)	(139,181)	(47,868)	(47,940)	(78,250)
Transfer to Fiscal Agent	-	(2,066,310)	-	-	-	-
Change in Net Position	17,322,654	2,931,706	4,020,039	9,953,043	17,978,243	15,492,061
Net Position - Beginning	92,589,114	109,914,129	104,363,824	108,683,150	118,636,193	136,614,438
Prior period adjustment	-	(8,482,011)	299,286	-	-	-
Net Position - Ending	109,911,768	104,363,824	108,683,149	118,636,193	136,614,436	152,106,499

Following are some observations about the sewer utility's historical financial performance:

- "Charges for services" revenue varies from year to year, with the total ranging from $22.4 million to $33.1 million over the past six years. While population growth and retail rate increases account for a general upward trend over time, the "up and down" variability from year to year is largely driven by changes in capital cost sharing from contract customers.

The three primary contract customers are the City of Poulsbo, U.S. Navy Keyport, and Bangor. All three contract customers pay for ongoing service at the commercial rate. Poulsbo and U.S. Navy Keyport have separate cost-sharing agreements for capital costs. In the County's accounting system, capital cost-sharing is included in the "charges for services" revenue category.

- In 2018, the County received $7,995,466 in miscellaneous revenue, with a smaller amount ($974,625) received the following year. The County's annual report showed this revenue in the "operating grants and contributions" category. While we did not determine the source, it is clearly a non-recurring revenue.
- Total operating expenses have increased over time, with an average increase of 2.3% per year. There was a temporary decrease from 2020 to 2021 followed by a rebound in 2022. This pattern may have been influenced by the COVID-19 pandemic.
- The County received approximately $13.7 million in grants over the last two years with the majority ($12.1 million) being accounted for in 2022.
- The financial statements suggest that the County utility has been drawing down its balance of outstanding debt through the six-year period, since interest expense decreased from $2.3 million in 2018 to $1.6 million in 2023.
- In the annual report, the term "net position" refers to the utility's total assets minus total liabilities. (It is analogous to "owner's equity" in private sector financial statements.) The Kitsap County sewer utility's net position has increased by $59.5 million (64%) from the beginning of 2018 to the end of 2023. This equates to an average increase of 8.6% per year during the period.

12.3 Methodology and Assumptions

12.3.1 Revenue Requirement Forecast Methodology

The revenue requirement forecast identifies the total revenue needed to fully fund the utility on a stand-alone basis considering current and future financial obligations. For this analysis, the resulting rate increases are assumed to be applied "across-the-board" to all customer classes; no rate design changes are proposed in this financial plan.

Table 12-2 shows that the forecast is a two-step process. The first step is the capital funding strategy, shown in the left column. We begin with the total capital program provided by Consor as part of the General Sewer Plan Updates for each of the County's four wastewater basins. We then subtract all of the non-debt funding sources. The remainder is the amount of borrowing needed. The number at the bottom of the first column—the debt needed to fund the remainder of the capital program—determines the amount of new debt service, which is an annual cost.

The second step is the annual forecast, shown in the column to the right. The fiscal policy targets include the minimum reserve balances that must be maintained in the forecast. To that number we add each year's projected operating costs, existing and new debt service, and the amount of current rate funding used for capital expenditures. After deducting non-retail revenue, we now know how much money is needed each year from rates.

Table 12-2 | Revenue Requirement Overview

	Capital Funding Strategy
	Total Capital Projects
-	Grants
-	Wholesale Contributions
-	Newcomer Fees
-	Rate-Funded Capital
-	Cash Reserves
=	Debt Funding (Loans or Bonds)

	Annual Forecast
	Fiscal Policy Targets
+	Operating Costs
+	Existing & New Debt Service
+	Rate-Funded Capital
=	Revenue Requirement
-	Offset Revenues
=	Revenue Required from Retail Rates

The rate revenue requirement is next compared with the revenue projected to be generated by current rates. In addition, we test the current rates against required "debt service coverage," which is an important fiscal policy explained below. If the current rates are insufficient—either because they do not generate enough cash or because the debt service coverage target is not met—then the forecast rates are adjusted to the degree necessary to balance the cash flow requirements and ensure that the coverage target is achieved.

12.3.2 Fiscal Policies

The fiscal policies that affect a rate forecast include the target operating reserve, minimum capital reserve, minimum operating and capital cash, debt service coverage, rate-funded capital reinvestment. Each type of policy is discussed below.

12.3.2.1 Target Operating Reserve

"Reserves" are another word for fund balance. An operating reserve is a liquidity cushion; it protects the utility from the risk of short-term variation in the timing of revenues or expenses.

For operating reserves, we often characterize the target with both a minimum and a maximum. For any given year, if the forecast shows an ending fund balance below the minimum, then rates need to be raised higher to replenish the reserve. If the forecast shows the ending balance above the maximum, then the excess cash is re-characterized as a capital reserve.

The most common operating reserve target for sewer utilities is between 45 days and 60 days (12%-16%) of annual operating expenses. However, Kitsap County sewer rates include a volume charge for non-residential and contract customers, which introduces more revenue variability. We therefore suggest a larger cushion—an operating reserve target of 90 days (25%) of annual operating expenses.

Recommended Policy: Achieve a year-end operating fund balance of <u>90 days (25%)</u> of total annual operating expenses. <u>Results</u>: For 2024, this amount is forecasted to be about $4.1 million; it increases throughout the forecast period as operating costs increase with inflation.

12.3.2.2 Minimum Capital Reserve

The capital fund balance fluctuates naturally because it serves two functions. First, capital reserves are a capital funding tool, the means by which a utility saves up in advance of major capital projects and avoids overreliance on debt. Utilities tend to go through waves of capital investment, so the reserve balance tends to grow over time and then drop suddenly after a large capital project.

There is also a second function of a capital reserve. It also serves as a risk reserve just like the operating reserve, giving the utility the flexibility to respond to unanticipated needs. Such needs could include a capital cost overrun, or an unexpected failure of a major asset. It could be an unexpected regulatory requirement or simply an opportunity-driven capital improvement. A cash cushion gives the utility flexibility to address unforeseen capital needs in a logical way.

That cash cushion is achieved by having a minimum capital fund balance in the projections. In other words, when we forecast capital spending and the fund balance naturally goes up and down, we only allow it to go down so far—only as far as the target minimum—not all the way to zero.

The target minimum capital fund balance could be defined as a certain percentage of the average CIP, or as the projected replacement cost of specified high-value assets. However, a simple and common way to set a target minimum capital reserve is to define it as 1% of the original cost of fixed assets in the system. This minimum naturally increases over time since future capital investment leads to a growing inventory of assets. That is the approach we recommend in this financial plan.

Recommended Policy: Achieve a year-end minimum capital balance target of 1% of the original cost of plant-in-service. Results: This equates to roughly $2.9 million for year-end 2024 and increases to $9.0 million in 2042 as capital is constructed.

12.3.2.3 Minimum Operating and Capital Cash

In recent years, bond rating agencies have focused on the combined operating and capital cash balance. A favorable indicator is when a utility maintains a combined year-end cash reserve of at least 180 days (50%) of annual operating expenses. That is the policy target we recommend here.

Recommended Policy: Maintain a minimum year-end operating and capital balance of 180 days (50%) of annual operating expenses. Results: This equates to roughly $8.2 million for year-end 2024 and increases thereafter. In this forecast, the 180-day target is achieved in all years.

12.3.2.4 Debt Management

The sewer utility currently has three revenue bonds, two Public Works Trust Fund (PWTF) loans, and four Department of Ecology (DOE) state loans. Additionally, the County is in the process of selling additional revenue bonds and securing another DOE loan. In 2024, debt service is about $5.2 million. With existing debt and the new debt arrangements already underway, debt service will rise above $7 million per year for 2027-2040, dropping off after 2040. In addition, to address the capital needs identified in this plan, additional revenue bonds are forecasted to be issued in future years. Each bond issue is assumed to have a 20-year term, issuance cost of 1%, and an interest rate of 5%.

12.3.2.4.1 Debt Service Coverage

Debt service coverage is a requirement typically associated with revenue bonds and some state loans. It is also a useful benchmark to measure the riskiness of a utility's capital funding plans. Coverage is best understood as a factor applied to annual debt service. A typical requirement in selling revenue bonds is that bonded debt service coverage must be at least 1.25 throughout the life of the bonds. That means the County agrees to collect enough revenue each year to meet operating expenses and not only pay debt service but also an additional 25% above bonded debt service. This cushion makes bondholders more confident that debt service will be paid on time. The extra revenue can be used for capital expenditures, to build reserves, or for debt service on subordinate debt.

While the County's contractual minimum coverage is 1.25, achieving coverage greater than the minimum is a positive signal that bond rating agencies notice, and it can result in more favorable terms for future borrowing. For that reason, many utilities set a policy target higher than 1.25.

Recommended Policy: Set rates to achieve bonded debt service coverage of at least 1.50. Results: The utility is forecasted to achieve this policy in all years except 2032 and 2034, when coverage decreases to 1.38 and 1.49. That is still safely above the legal minimum of 1.25.

12.3.2.5 Rate-Funded Capital Investment

To avoid overreliance on debt, it is useful to have a target for the amount of capital investment that is funded by rates ("pay-as-you-go"). A common benchmark is to aim for rate-funded capital of at least 100% of original cost depreciation by the end of the forecast period. We recommend that approach.

Recommended Policy: Rate revenue should fund 100% of original cost depreciation expense by the end of the forecast period. Annual depreciation is $7.5 million in 2023, growing to $19.8 million by 2042. Results: In this forecast, rate-funded capital at 100% of depreciation is first achieved in 2039 and continues through the remainder of the forecast.

Table 12-3 provides a summary of the recommended fiscal policies for the sewer utility.

Table 12-3 | Summary of Fiscal Policies

Policy	Recommended Target
Operating Reserve	90 days (25%) of annual O&M expenses (initially, $4.1 million)
Minimum Capital Reserve	1% of original cost of plant-in-service (initially, $2.9 million)
Minimum Operating & Capital Cash	180 days (50%) of annual O&M expenses (initially, $8.2 million).
Debt Service Coverage	A policy target of at least 1.50 for bonded debt, which is higher than the contractual minimum of 1.25
Rate-Funded (Pay-as-You-Go) Capital Reinvestment	Rate-funded capital should equal 100% of original cost depreciation by the end of the study period ($19.8 million per year by 2042)

12.3.3 Key Assumptions and Data Sources

12.3.3.1 Economic & Inflation Factors

The operating expenditure forecast relies primarily on the County's 2024 adopted budget. The line items in the budget are then adjusted each year by one of the following factors:

- General Cost Inflation – After conversations with staff, we assumed 4% in 2024 followed by 3% per year thereafter.
- Construction Cost Inflation – Unless otherwise mentioned, all project costs were given in 2023 dollars, then escalated for construction inflation of 8% in 2024, 4% per year thereafter.
- Labor Cost Inflation – Assumed at 10% for 2025 to reflect the County's compensation study adjustments, followed by 3% per year based on the Employment Cost Indices for wages.

- Benefits Cost Inflation – Assumed at 5% per year, based on the Employment Cost Indices for benefits.
- Taxes – The State excise tax rate is 3.852%, the State Business and Occupation (B&O) tax rate is 1.75%. The State excise tax applies to rate revenue allocated to the collection system. The B&O tax applies to rate revenue allocated to treatment and transmission, as well as to system development charges and other miscellaneous fees.
- Fund Earnings – Assumed to be 4% in 2024 and decreasing one percentage point per year until 2027 and then remaining at 1% for the forecast period. Based on market conditions as well as historical Local Government Investment Pool (LGIP) returns.
- Customer Growth – Conservatively assumed to be 0.5% per year, based on discussion with staff. The assumed growth rate in sewered population varies for each of the County's four service areas, which are projected to be between 0.6%/yr and 4.8%/yr. Therefore, a 0.5%/year customer base growth rate represents a conservative estimate for the purposes of financial planning in the event assumed sewered population growth rates are not realized.
- Operating Budget Execution Factor – 95% in 2024 followed by 90% for all other years, based on discussions with staff and historical data on actual vs. budgeted spending.

12.3.3.2 Fund Balances

The County manages both an operating and capital fund related to the sewer utility. For the purpose of showing funds restricted for debt service repayment, the forecast contains a third category: debt reserves. These funds are assumed to come from the operating fund. **Table 12-4** shows the updated allocated cash balance for 2024 between operating, capital, and debt purposes for the financial modeling. It also shows the projected beginning fund balance for 2024, the beginning of the forecast period.

Table 12-4 | Cash Balances

Description	2024 Beginning Cash Balances
Operating Fund	$11,560,996
Capital Fund	$369,483
Debt Reserves	$6,827,376
Total Fund Balance	**$18,784,376**

While the capital fund reserves are below the initial target of $2.9 million for 2024 beginning balance, the operating fund balance more than covers the difference. In our forecast, any excess operating reserves are re-categorized as available for capital purposes.

12.3.3.3 Existing Debt

As stated previously, current outstanding debt for the sewer utility includes three revenue bonds, two Public Works Trust Fund (PWTF) loans, and four Ecology loans. Annual debt service payments are about $5.2 million in 2024. The County has opted to time the bonded debt service payments to smooth out year-to-year fluctuations in total debt service. The 2015 bond is retired in 2027 while the 2010C QECB loan is retired in 2028. Starting in 2028, the 2010B refunding bond starts to require principal payments. The two outstanding PWTF loans are fully repaid in 2031 and 2041. Two of the DOE loans are fully repaid in 2025 while the others are repaid gradually through 2038.

12.3.3.4 Near-Term Future Debt Obligations

Although not currently making payments on them, the County has begun the process of obtaining two additional debt issues. The first is a 20-year revenue bond which assumes repayment starting in 2025. The bond proceeds (including a bond premium) are assumed to be $32.5 million, requiring annual payments of $2.5 million once principal repayment begins in 2027.

The second loan in process is a $3.78 million DOE loan for the Capital Facility Plans update. Remaining draws on this loan are assumed to occur in 2024. Repayment starts in 2025, with annual payments of about $200,000 per year.

As of the time of writing, the County has also applied for other low-cost loans from State agencies. These additional loans will be described later in this document, under "Capital Funding Strategy."

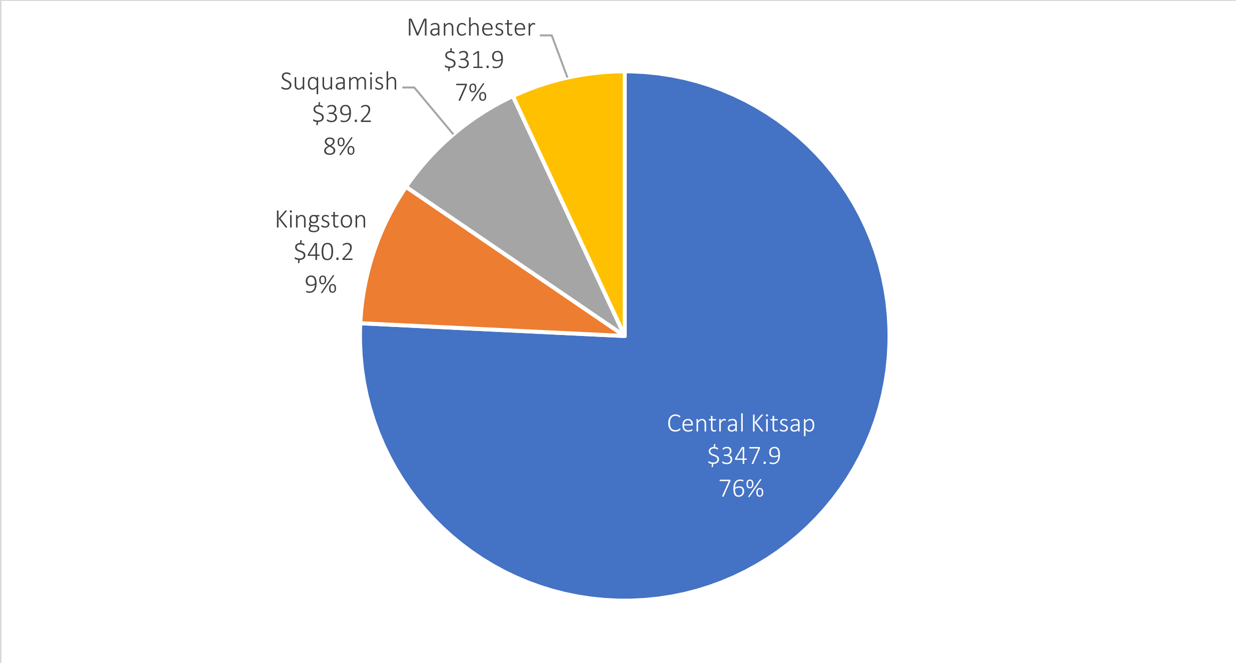
12.3.3.5 Capital Expenditure Forecast

12.3.3.5.1 Capital Projects Before Escalation

Capital project costs and timing were developed by Consor with County staff input. The resulting 2024-2042 capital improvement plan (CIP) shows estimated spending of about $459.2 million in 2023 dollars. Total capital costs in 2023 dollars by basin is shown in **Figure 12-1**. Central Kitsap is the largest treatment plant, and the Kitsap basin has 76% of the capital requirements.

The largest project in the early part of the CIP is the Solids and Liquid Hauled Waste Upgrades at the Central Kitsap treatment plant. Design for this project is currently underway, and its construction schedule is assumed to continue through 2028. (For convenience, it is sometimes referred to as the "digester project," even though it actually includes other elements besides new digesters.) Its total remaining cost (in escalated dollars) is assumed to be $140 million, and it dominates the early years of the forecast—much of the borrowing and resulting rate increases in the next few years are focused on financing the digester project. Because of the size of the project and the fact that its engineering is well advanced, its cost estimate is given in escalated dollars — no further inflation factor is applied to the $140 million cost. For the other projects, however, **Figure 12-1** shows cost estimates in 2023 dollars.

Figure 12-1 | Unescalated Capital Spending (Millions) 2024-2042



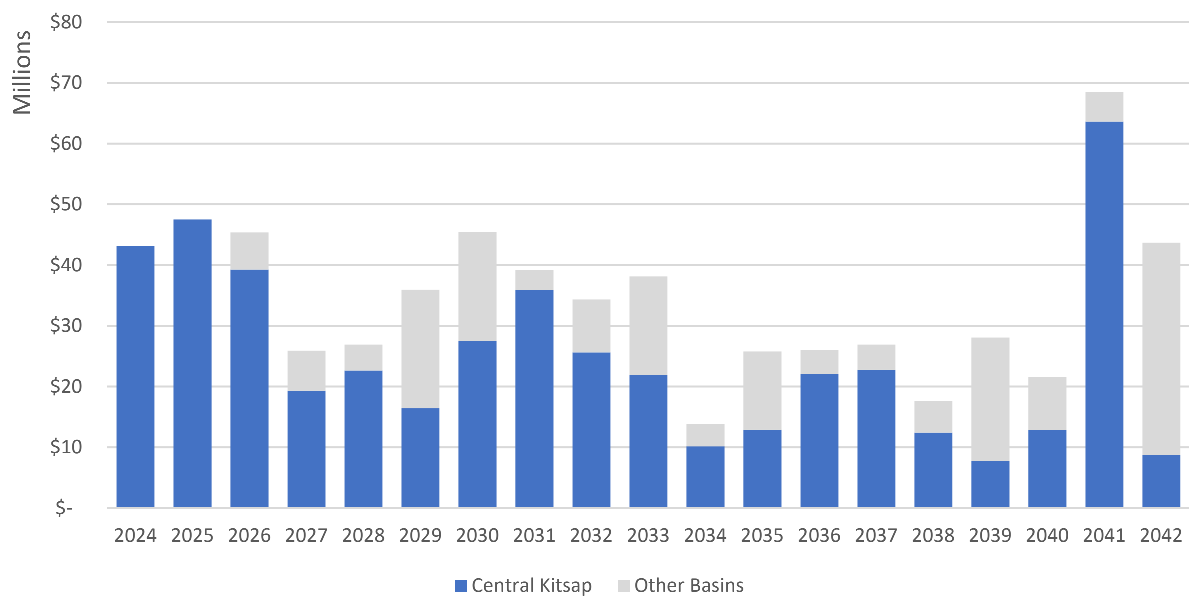
12.3.3.5.2 Projected Capital Expenditures after Cost Escalation

Figure 12-2 shows the year-by-year funding needs after applying the assumed inflation factors.

The digester project has expenditures extending from 2024 through 2028. After 2028, many of the identified capital projects are focused on the collection systems—the pipes and pumps that deliver wastewater to the four treatment plants. The 2029-2040 projects include needed improvements in the Kingston, Suquamish and Manchester basins in addition to the Central Kitsap basin.

In 2041, the CIP shows a major project ($50.3 million, in escalated dollars) to construct Aeration Basins 5 and 6 at the Central Kitsap plant, based on assumed requirements from the State. In 2042, a major upgrade (Class A Reclaimed Water Improvements, costing $29.9 million in escalated dollars) is shown for the Kingston plant. For these 2041 and 2042 projects, the nature of the regulatory requirements from the State are uncertain, but these estimates serve as a placeholder to flag the need for additional major investments in future years.

Figure 12-2 | Capital Expenditure Forecast 2024-2042 (escalated dollars) – Central Kitsap vs All Other Basins



The dark part of each column represents the Central Kitsap basin capital cost needs. The total escalated cost of capital improvements for the Central Kitsap basin is $472.6 million, about 72% of the total $654 million in escalated capital needs for the County.

12.4 County-Wide Revenue Requirement Results

The County currently has an adopted sewer rate increase for 6.31% in 2025. Following the adopted rate increase, the forecast shows that 6.0% annual rate increases would be necessary to continue to cover operations as well as fund the capital plan through a mix of cash funding and debt financing.

12.4.1 Capital Funding Strategy

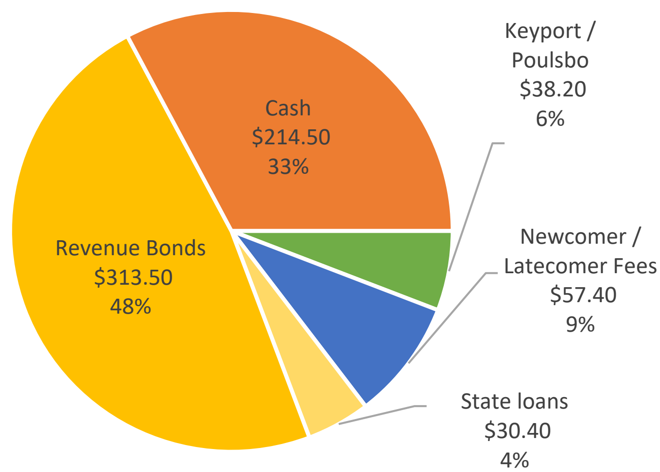
Over the full 19-year period from 2024 through 2042, the capital expenditure forecast (including inflation) contains $654 million of projects. In the capital funding strategy, our task is to identify where that $654 million will come from.

Figure 12-3 shows the forecasted sources of funding for this capital program.

- First is the capital cost sharing from U.S. Navy Keyport and Poulsbo. County staff provided estimates for 2024-2029, totaling $28.1 million for the 6-year period. We assumed that the cost share for 2029 ($778,000) continues in future years, so the total through 2042 is $38.2 million.
- Second, any available Newcomer or Latecomer revenue is applied to the capital program. The forecast assumes about $3,000,000 per year in revenue assuming no changes to the charge, or a total of $57.4 million.
- Next, we assume the low-interest loans that the County is currently pursuing from both Public Works and Department of Ecology. The assumed total is $30.4 million.

- The remaining capital funding need is balanced with a mix of cash vs. revenue bond debt. Each type of funding works to complement the other to fill the remaining funding gap. This includes:
  - Revenue bonds: issued in two-year cycles as needed, to cover capital costs for the year of issuance and the following year. Total debt proceeds are $313.5 million (48% of the total) through 2042. Except for the 2024/25 bond issue, we assumed 20-year bonds at 5% interest.
  - Cash funding: The covers the remaining $214.5 million (33% of the total). It is generated by the rate increases needed to repay revenue bonds and fund the remaining capital needs.

Figure 12-3 | Capital Funding Sources 2024 – 2042



12.4.1.1 Planned Low Interest Loans

The County has applied for low-interest State loans in the short term. The forecast assumes that the County receives the maximum $10 million in both 2025 and 2026 from the Public Works Trust Fund as well as an additional $9.85 million from the Department of Ecology. The total forecasted debt service on these loans is $1.8 million dollars.

12.4.1.2 Planned Revenue Bond Debt Issues

The first bond issue is currently in process as of 2024, but funding may not be available until 2025. After the first revenue bond debt issuance, additional issues are forecasted every two years as needed through 2041. **Table 12-5** shows the timing and magnitude of the bonded debt proceeds assumed in the financial plan, along with the annual debt service associated with each issue.

Table 12-5 | Planned Revenue Bond Issues in the Financial Plan

Year	Net Proceeds	Annual Debt Service
2024/2025	$32.5 million*	$2.5 million*
2026	$22 million	$1.9 million
2028	$42 million	$3.7 million
2030	$70 million	$5.9 million
2032	$58 million	$4.9 million
2034	$19 million	$1.6 million

Year	Net Proceeds	Annual Debt Service
2036	$25 million	$2.1 million
2039	$5 million	$0.4 million
2041	$40 million	$3.4 million
Total	**$313.5 million**	**$26.5 million**

Note:
*2024/2025 issue includes approximately $2.5m premium. Debt service is planned to have two years of interest-only payments in 2025 and 2026

12.4.1.3 Potential Grants and Other Low Cost State Loans

Due to the reliance on revenue bond funding for the capital program, the County should continue to pursue additional low-cost State loans. Grants and state loans provide two benefits. The first is the cost savings compared to the assumed alternative of issuing revenue bonds. In addition, by reducing its reliance on revenue bonds, the County improves its bonded debt service coverage calculation.

The following document is a helpful summary of the funding, eligibility, and contact details for water and sewer infrastructure assistance programs (both grants and low-cost loans) in Washington State: http://www.infrafunding.wa.gov/resources.html. This summary is updated each year by the Department of Commerce. The most recent version (September 17, 2024) is included as **Appendix J** to this report.

12.4.2 Annual Forecast

Figure 12-4 graphically represents the annual forecast through 2042. Total operating revenues are about $31.0 million in 2024 and $90.4 million in 2042. These figures exclude revenue restricted to capital purposes—debt proceeds, capital cost sharing from contract customers, or newcomer charges.

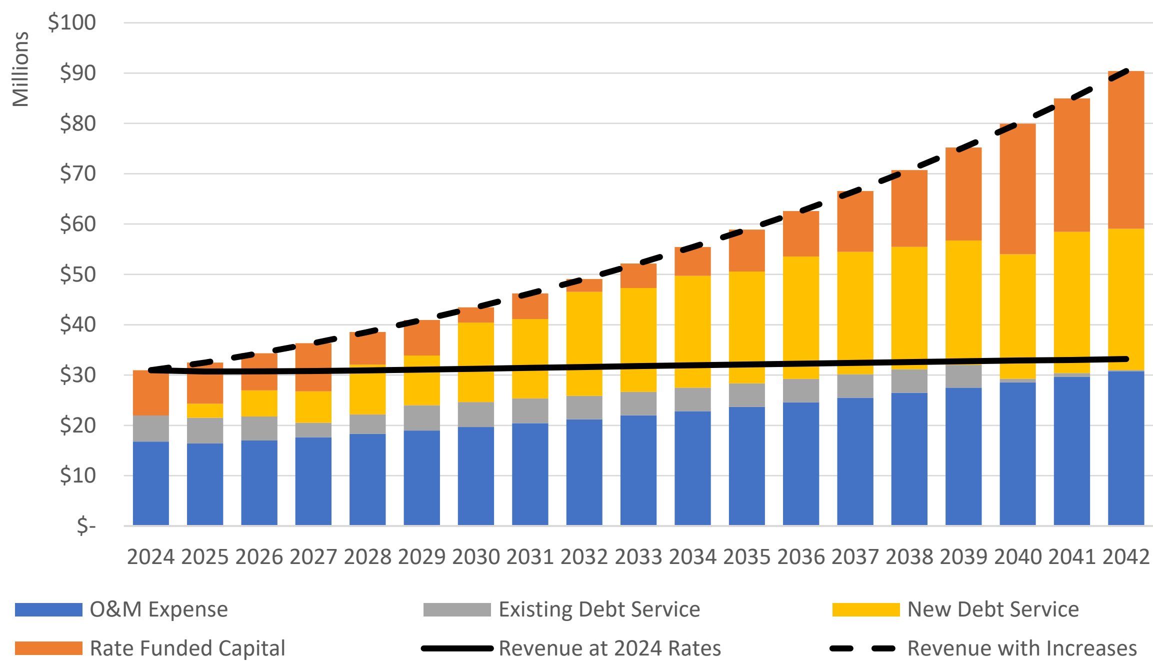
The stacked columns represent the costs of the utility, such as operating expenses, existing debt service, new debt service, and annual cash funding used for capital projects. The solid black line represents revenue at existing rates and the dashed line shows forecasted revenue with rate increases.

Below are further observations about these variables.

- Solid line: Revenue at existing rates.
  - Revenue is projected to increase with customer growth, even without future rate adjustments.
- Dashed line: Revenues with rate increases.
  - After the recommended rate increases, revenue is expected to grow to $90.4 million by 2042.
- Blue bar: Operating expenses.
  - Operating expenses increase with the annual cost escalation assumptions described earlier.
- Grey bar: Existing debt service.
  - Annual payments of about $5.2 million in 2024, declining to $214,000 by 2042.
- Yellow bar: New debt service.
  - New debt service begins in 2025. By 2042, it is about $28.1 million per year.

- Orange bar: Rate revenue available for capital projects.
  - This amount fluctuates year to year as the debt issues impact the difference between revenue collected and total other obligations.

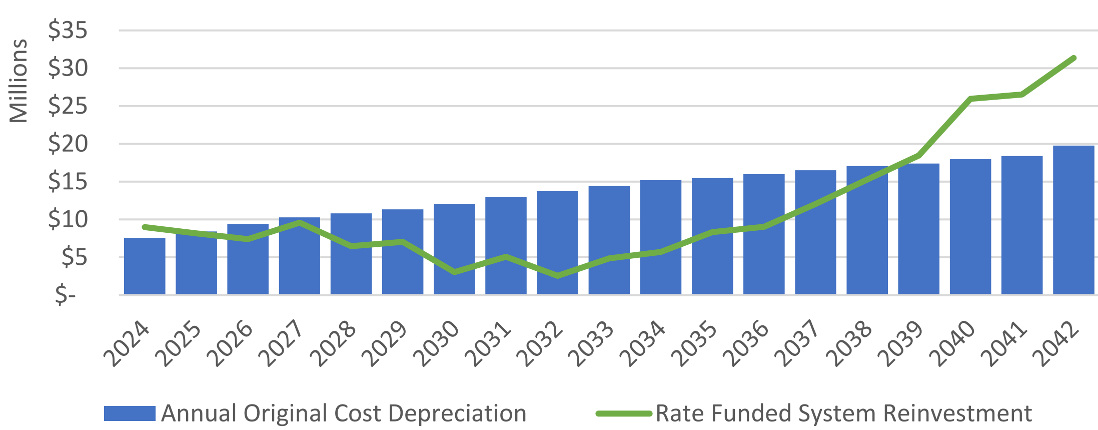
Figure 12-4 | Revenue Requirement Forecast



12.4.2.1 Rate-Funded Capital Investment

The green line in **Figure 12-5** shows the sewer utility's projected annual level of rate-funded capital investment in relation to annual depreciation.

Figure 12-5 | Annual Rate-Funded System Reinvestment



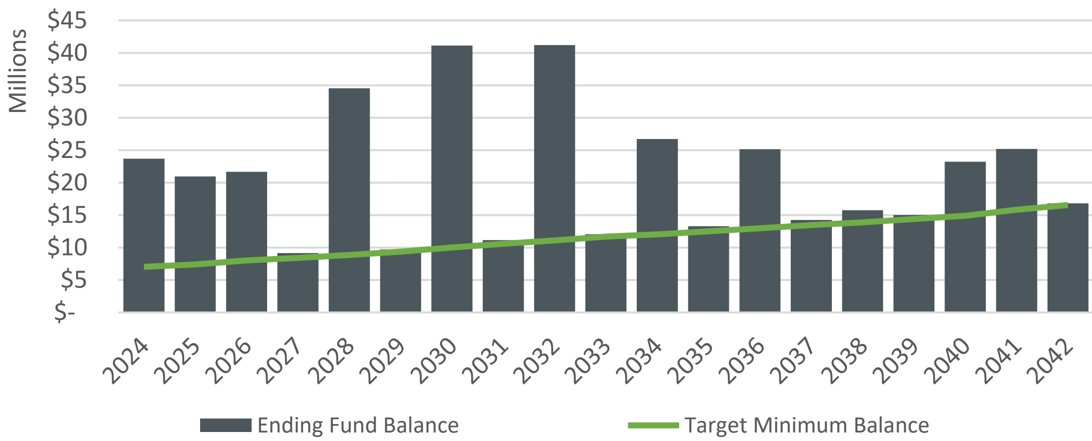
Over the forecast period, annual depreciation cost increases as the County completes capital projects. The blue line represents the same amount as the light green bar in **Figure 12-4**. Over this period, rate-funded system reinvestment reaches a low of 9% of annual depreciation in 2032. This coincides with the lowest bonded debt coverage (1.38) in the forecast. Beginning in 2039, rate-funded capital is projected to achieve the assumed policy target of at least 100% of annual depreciation cost.

12.4.2.2 Operating and Capital Reserve Level

The recommended minimum operating fund balance is 90 days of total annual operating expenses, and the recommended minimum capital fund balance is 1% of the original cost of assets. The sum of these two targets represents the combined minimum reserve balance—about $7.0 million in 2024. It grows to $16.6 million in 2042 as operating costs increase and the County adds assets to the system.

Figure 12-6 shows projected unrestricted fund balances through 2042 in relation to the reserve target (the green line). The utility is projected to achieve the reserve target each year.

Figure 12-6 | Operating and Capital Reserve Forecast

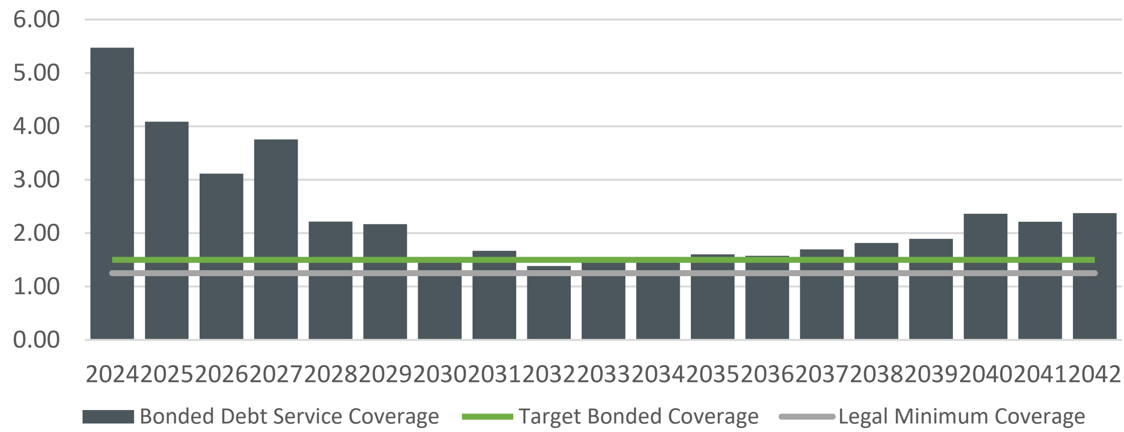


12.4.2.3 Bonded Debt Service Coverage

The legal minimum for revenue bond debt service coverage is 1.25 in each year in which bonds are outstanding. To enhance creditworthiness, many utilities set a policy target that is higher than the legal minimum. In this forecast, assumed a policy goal of at least 1.50 for bonded debt service coverage. However, we allowed exceptions to keep planned rate increases from going above 6% per year.

Figure 12-7 shows projected bonded debt service coverage through 2042 in relation to the assumed policy target of 1.50 and the legal minimum of 1.25. The utility is projected to achieve the policy target each year except for 2032 and 2034, when coverage drops to 1.38 and 1.49. The forecast stays above the legal minimum of 1.25 throughout the forecast period.

Figure 12-7 | Projected Bonded Debt Service Coverage in Relation to Target and Legal Minimum



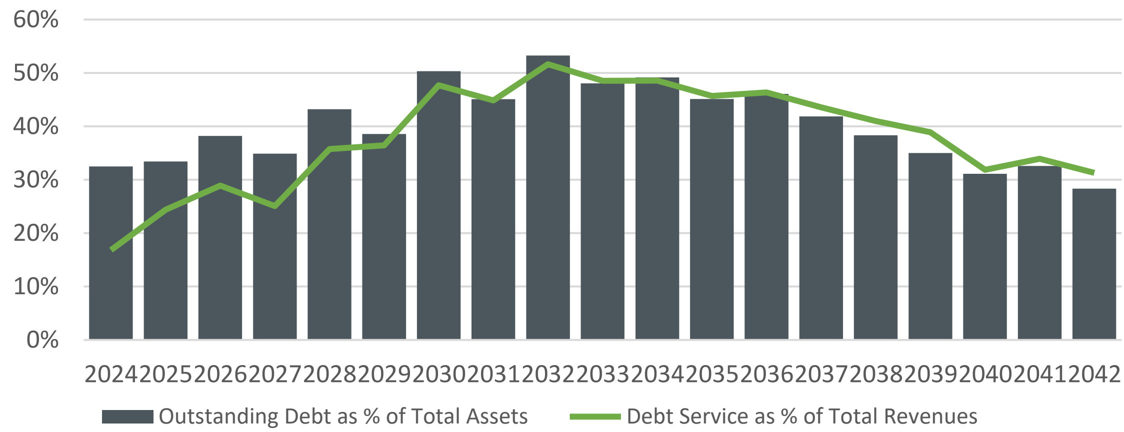
12.4.2.4 Analysis of Outstanding Debt and Debt Service Load

Because the County will need to borrow heavily to fund this CIP, two other debt-related metrics are relevant: the level of outstanding debt in relation to total assets ("debt-to-total assets ratio"), and the projected debt service as a percentage of total revenues ("debt service load"). Debt is a useful component in the capital funding toolbox, but it should not be overused. The cumulative effect of a series of borrowing decisions can be assessed by looking at these two metrics.

Figure 12-8 shows the projected debt-to-total assets ratio and the debt service load throughout the 2024-2042 forecast period. There is not a formal policy target to compare with, but we are aiming to keep both metrics below 50%. In this forecast, both metrics stay at or below 50% except in 2032, when outstanding debt is 53% of total assets and debt service is 52% of total revenue.

Based on these results, we observe that this forecast relies heavily on debt during the next 19 years, and we do not suggest greater borrowing. The significance of this finding comes from the fact that there is a tradeoff between rate increases and the level of borrowing. Higher rate increases allow more "pay-as-you-go" rate-funded capital funding (in lieu of debt), while higher levels of borrowing allow the rate impact to be pushed into future years. In this forecast, the recommended rate increases—6% per year after 2025—should not be ameliorated by more borrowing.

Figure 12-8 | Projected Debt-to-Total Assets Ratio and Debt Service as % of Total Revenue



12.4.2.5 Affordability

Since the inception of the Clean Water Act, the US Environmental Protection Agency (EPA) has provided some guidance on how to measure financial burdens. Called the residential indicator (RI), the EPA measure is the annual residential cost of utility service divided by the median household income (MHI) of the relevant service area. An RI of 2.0% or higher indicates a "high burden" according to the EPA standard for sewer utilities.

The median household income for Kitsap County is estimated to be $103,593 as of 2024. This is based on a survey from the Census Bureau 2023 American Community Survey plus one year of inflation.

Table 12-6 presents an average single-family sewer bill with projected annual rate increases for the forecast period, tested against the affordability threshold. We assumed that median household income increases at the same rate as general inflation, which after 2023 is 3.0% per year. Applying the 2.0% test, Kitsap County's sewer rates are forecasted to remain within the EPA affordability range through 2042. Note that the median income benchmark does not measure the impact on low-income households; the forecasted rates could be a significant burden on households at the lowest income levels.

Table 12-6 | Affordability Table

Year	Inflation	Median HH Income	Projected Monthly Bill	Projected Annual Bill	% of Median HH Income
2023		$99,609	$92.24	$1,107	1.11%
2024	4.00%	$103,593	$98.06	$1,177	1.14%
2025	3.00%	$106,701	$104.25	$1,251	1.17%
2026	3.00%	$109,902	$110.51	$1,326	1.21%
2027	3.00%	$113,199	$117.14	$1,406	1.24%
2028	3.00%	$116,595	$124.17	$1,490	1.28%
2029	3.00%	$120,093	$131.62	$1,579	1.32%
2030	3.00%	$123,696	$139.52	$1,674	1.35%
2031	3.00%	$127,407	$147.89	$1,775	1.39%
2032	3.00%	$131,229	$156.76	$1,881	1.43%
2033	3.00%	$135,166	$166.17	$1,994	1.48%

Year	Inflation	Median HH Income	Projected Monthly Bill	Projected Annual Bill	% of Median HH Income
2034	3.00%	$139,221	$176.14	$2,114	1.52%
2035	3.00%	$143,397	$186.71	$2,241	1.56%
2036	3.00%	$147,699	$197.91	$2,375	1.61%
2037	3.00%	$152,130	$209.78	$2,517	1.65%
2038	3.00%	$156,694	$222.37	$2,668	1.70%
2039	3.00%	$161,395	$235.71	$2,829	1.75%
2040	3.00%	$166,237	$249.85	$2,998	1.80%
2041	3.00%	$171,224	$264.84	$3,178	1.86%
2042	3.00%	$176,361	$280.73	$3,369	1.91%

12.5 Basin-Specific Revenue Requirement Forecasts

While the previous section discussed the overall financial obligations of the County's sewer utility, this section focuses on the obligations as allocated to individual basins. Because the County provides system-wide rates rather than area-specific rates, all customers share the same level of support for funding the Countywide sewer utility. The capital planning is performed for individual basins, but the funding of capital projects—including all debt obligations—and the subsequent rate changes are applied to the County sewer utility as a whole, not for individual basins.

However, this financial plan is one chapter within a set of larger General Sewer Plan Updates documents, and those documents are specific to each basin. In order to meet the Department of Ecology requirements for the planning documents, this section provides information about costs and revenues as they are allocated for each of the four basins: Central Kitsap, Manchester, Suquamish, and Kingston.

12.5.1 Allocating Costs Across Basins

As part of the financial forecast, the County provided an estimated number of Residential Billing Equivalents served by each basin. A Residential Billing Equivalent is used as a metric to estimate the proportion of revenue each basin generates and is based on how much a non-single family residential customer pays compared to a residential customer. For example, based on the County's current billing structure, a multi-family customer bill is approximately 80% of a single-family bill and would be treated as 0.8 Residential Billing Equivalent. Of the approximately 28,000 equivalents, the Central Kitsap area serves the vast majority of customers, representing 89.5% of the revenue. Accordingly, we allocated 89.5% of the overall costs to the Central Kitsap Basin. The same approach is taken to the other basins—the cost of O&M, capital, debt service, and required reserves are allocated in proportion to each basin's share of the system-wide total Residential Billing Equivalents. The Residential Billing Equivalents and resulting allocation percentages are shown in **Table 12-7**.

Table 12-7 | Allocation to Basins

Basin	Residential Billing Equivalents	Percentage
Central Kitsap	25,011	89.46%
Manchester	1,026	3.67%
Suquamish	970	3.47%
Kingston	950	3.40%
Total	**27,957**	**100%**

12.5.2 Results by Basin

The allocation of the revenue requirement to individual basins is shown in **Table 12-8**. For simplicity in presentation, we show the allocated revenue requirement only for the years 2025 and 2030, but the same percentage allocations can be applied to any of the forecast years.

Table 12-8 | Projected Revenue Requirement by Basin – 2025 and 2030

	Total	Central Kitsap	Manchester	Suquamish	Kingston
Allocation Percentage		89.46%	3.67%	3.47%	3.40%
2025					
Revenues					
Rate Revenue after Rate Increases	$30,005,499	$26,843,636	$1,101,178	$1,041,075	$1,019,610
Non-Rate Revenue	2,479,539	2,218,255	90,997	86,030	84,257
Total Revenue	**$32,485,038**	**$29,061,255**	**$1,192,175**	**$1,127,105**	**1,103,866**
Requirements					
Cash Operating Expenses	$16,403,199	$14,674,694	$601,985	$569,128	$557,393
Existing Debt Service	5,114,100	4,575,196	187,683	177,440	173,781
New Debt Service	2,802,218	2,506,931	102,839	97,226	95,221
Rate Revenue Available for Capital	8,165,521	7,305,070	299,668	283,312	277,471
Total Requirements	**$32,485,038**	**$29,061,891**	**$1,192,175**	**$1,127,105**	**$1,103,866**
2030					
Revenues					
Rate Revenue after Rate Increases	$41,168,068	$36,829,937	$1,510,836	$1,428,373	$1,398,922
Non-Rate Revenue	2,291,740	2,050,245	84,105	79,515	77,875
Total Revenue	**$43,459,808**	**$38,880,182**	**$1,594,941**	**$1,507,888**	**$1,476,797**
Requirements					
Cash Operating Expenses	$19,681,630	$17,607,656	$722,300	$682,877	$668,797
Existing Debt Service	4,946,317	4,425,094	181,526	171,618	168,080
New Debt Service	15,786,416	14,122,905	579,349	547,728	536,434
Rate Revenue Available for Capital	3,045,444	2,274,527	111,765	105,665	103,486
Total Requirements	**$43,459,808**	**$38,880,182**	**$1,594,941**	**$1,507,888**	**$1,476,797**

The sewer rate increases needed to support the above revenue requirements are the same for all four basins: 6.31% in 2025 and 6% per year through the remaining forecast period. Similarly, the projected debt service coverage is the same for all basins, as are the assumed policies for cash reserves. While the CIP is differentiated by basin, the debt obligations that are needed to fund the capital projects are all incurred at the countywide level, and all financial obligations apply to the County sewer utility as a whole, not to individual basins.