ELLIOTT WEST
Wet Weather Treatment Station

King County
Protecting Our Waters
Doing our part on rainy days

Elliott West Wet Weather Treatment Station Project

Engineering Report

FINAL / June 2025

King County Department of Natural Resources and Parks
Wastewater Treatment Division

Digitally signed by Susanna M. Leung
Date: 2025.06.26 13:16:17-07'00'

6/25/25

For comments or questions, contact:
Rowena Johnson
201 South Jackson Street, Suite 500
Seattle, WA 98104
206-477-5851
rowena.johnson@kingcounty.gov

This information is available in alternative formats on request at 206-684-1280 (voice) or 711 (TTY).

ES.1 Executive Summary

ES.1.1 Introduction

King County's (County) Wastewater Treatment Division (WTD) owns and operates the Elliott West Wet Weather Treatment Station (EWWTS), a combined sewer overflow (CSO) treatment facility located in the City of Seattle. Placed in operation in 2005, the EWWTS receives and treats combined sewage from Denny and Lake Union CSO basins encompassing the Seattle neighborhoods of South Lake Union, Eastlake, Belltown, and Uptown, and portions of Capitol Hill, Downtown, and Queen Anne. The EWWTS is located on the western edge of the service area as shown in Figure ES-1.

The EWWTS operates and discharges treated combined sewage under the County's National Pollutant Discharge Elimination System (NPDES) permit for the West Point Treatment Plant (WPTP), a County-owned regional wastewater treatment facility. Since operation began, EWWTS has substantially reduced pollution entering Elliott Bay, but not all NPDES permit effluent limits have been met. EWWTS operations also contribute to limiting the excess CSO flows at the Denny Way Regulator (DSN 027a) outfall to Elliott Bay so that it remains in compliance with the state's CSO standard of no more than one untreated CSO overflow per year on average.

Between 2020 and 2023, the County assessed potential upgrades for key EWWTS processes to comply with the anticipated NPDES permit requirements in the renewed permit, which the Washington State Department of Ecology (Ecology) was then developing. Ecology issued the renewed 2024 NPDES permit on April 29, 2024, effective June 1, 2024. The renewed permit includes more stringent effluent limits for the EWWTS than those in the previous permit. The more stringent limits are a result of the removal of the mixing zones for the EWWTS discharges, which the County's 2020-23 assessment of potential upgrades did not anticipate.

This Engineering Report describes the existing and anticipated future conditions, related CSO control needs, the evaluation and selection of the recommended upgrades to the station, and the associated basic design data. Further, this Engineering Report describes the financial analysis, regulatory approvals, and public involvement process and objectives for the EWWTS Project (Project), which consists of new and upgraded treatment facilities to treat CSOs prior to discharge through the existing outfall in Elliott Bay. Specifically, the Project will replace and upgrade the screening facility, replace the existing influent pumps with new pumps, add ballasted sedimentation technology for solids removal, replace the existing chlorine disinfection system with a new ultraviolet (UV) light disinfection system, complete electrical upgrades, and complete modifications to the operation of the Mercer Street tunnel for additional equalization and recirculation.

This Engineering Report was prepared under the requirements of the Washington Administrative Code (WAC) 173-240-060, the requirements of Ecology's Criteria for Sewage Works Design (Ecology, 2023), and the requirements of the Code of Federal Regulations (CFR) Title 40, 35.2030. A checklist is included in Appendix A that cross references the location of each required item contained within this report.

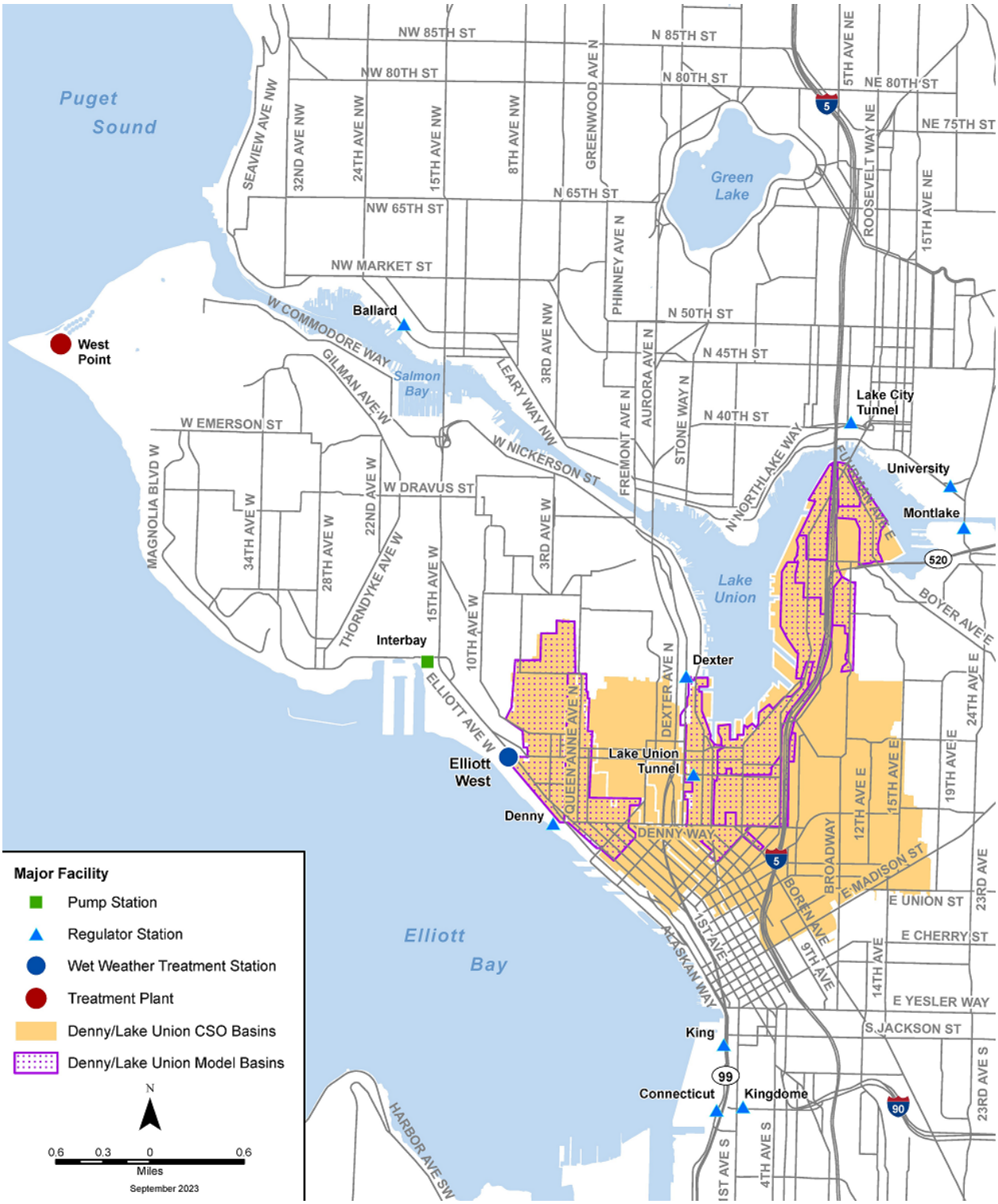


Figure ES-1. Denny Way/Lake Union Basin Area

ES.1.2 Combined Sewer Overflow Program

The County's CSO Control Program reflects more than 60 years of planning and investment in wastewater infrastructure in Seattle and the surrounding central Puget Sound metropolitan region. Regional construction of CSO control facilities began in the late 1970s. In 1988, the County received written approval for its first CSO Control Plan (*Final 1988 Combined Sewer Overflow Control Plan*, 1988) and for the systematic monitoring and measuring of CSOs. The most recent updates to this guiding document include the 2012 King County Long-Term Combined Sewer Overflow Control Plan Amendment and the 2018 CSO Control Program Update.

In 1999, the County adopted the Regional Wastewater Services Plan (RWSP), a 30-year comprehensive approach to regional wastewater services (King County, 1999). RWSP policies guide the County in controlling CSO discharges so that all 38 existing CSO locations will meet state and federal regulations by 2030. The County has made notable progress controlling CSOs in local waterways, having successfully reduced the average annual CSO discharge volume by 50 percent compared to the 1983 baseline condition (King County, 2023a).

The EWWTS receives flow from the Mercer Street Tunnel, the Denny Way diversion structure, and the Elliott Bay control structure, all of which were originally constructed as part of the larger Denny Way and Lake Union CSO control project, with the purpose of controlling City of Seattle CSO discharges into Lake Union, King County Dexter CSO discharges into Lake Union, and Denny Way CSO discharges into Elliott Bay. When flow exceeds the County's wastewater interceptor capacity during a storm event, the EWWTS system has several operational modes, including:

- Mercer Street Tunnel storage, no discharge, with stored flows returned for treatment at WPTP.
- Pumping and treatment (screening, chlorination, dechlorination), with discharge of treated flows into Elliott Bay via the Elliott West outfall approximately 3,000 feet away.
- Pumping and treatment during extreme events, with discharge of treated flows up to 250 million gallons per day (mgd) into Elliott Bay via the EWWTS outfall, and discharge of flows in excess of 250 mgd without treatment, via the Denny Way CSO outfall.

In 2013, the County entered a consent decree (CD) with Ecology and the United States Environmental Protection Agency (EPA). Both the Long-Term Control Plan (LTCP) Amendment and CD included nine CSO control projects to reduce untreated CSOs to no more than one untreated discharge per year per outfall by 2030, based on a 20-year moving average and to provide primary treatment and disinfection for any treated CSOs. The County and negotiating parties reached an agreement on the first Material Modification of the Consent Decree in 2024, and the modification was subsequently approved by King County Council, and adopted in May 2025. Although the original EWWTS Project predates the CD, stipulated penalties for EWWTS failure to comply with effluent limits are assessed under the CD.

ES.1.3 Existing Conditions

The existing design flow criteria for EWWTS are listed in Table ES-1 as obtained from the "Design Criteria Summary of Elliott West CSO Facility Design Plans (Drawing G1111)," dated 2005.

Table ES-1. Elliott West Wet Weather Station Flows

Parameter	Design[a]
Tunnel Storage Volume	8.2 MG[b]
Peak Day Flow	80 mgd
Maximum Hydraulic Capacity	250 mgd

[a] Source: Design Criteria Summary of Elliott West CSO Facility Design Plans (Drawing G1111). Includes Mercer Street Tunnel, East Portal, and EWWTS wet well volumes.

[b] Includes volume of East Portal, EWWTS wet well, and Mercer Tunnel.

MG = million gallons

Between 2015 and 2021, EWWTS discharged an average of 8.7 times per year with an average annual treated volume of 246 MG and an average duration of 10.4 hours per discharge event. Table ES-2 summarizes the performance of the EWWTS for the period between January 2015 and December 2021 (Ecology, 2024).

Table ES-2. Elliott West Wet Weather Station Performance between 2015 to 2021

Year	Annual Number of Discharge Events	Annual Discharge Volume (MG)	Annual Discharge Duration (Hours)
2015	14	251.3	105.9
2016	9	172.5	80.3
2017[a]	17	917.4	253.6
2018	7	95.6	55.3
2019	1	121.6	46.5
2020	6	69.7	40.2
2021	7	91.4	53.7

[a] Volume and duration of discharges in 2017 are higher than normal due to the flow management strategy the County used following the emergency recovery of WPTP in February 2017.

ES.1.4 Future Conditions

ES.1.4.1 Regulatory Requirements

The primary objective of the Project is to implement improvements that will result in more reliable NPDES permit compliance at the EWWTS. In developing a compliance approach for these parameters, long-term compliance strategies addressing existing/future effluent limits and climate change (Jacobs, 2021) guided the development of the Project.

The EWWTS discharge will be regulated under the County's NPDES permit WA0029181 for the WPTP. Key elements of the recently renewed NPDES permit, which was issued April 29, 2024 and expires May 31, 2029, include:

- A compliance schedule for planning, design and completion of bidding for construction of the approved modifications to the existing EWWTS.
- The mixing zone authorization was removed, and corresponding final water quality-based effluent limits were established for total residual chlorine (TRC), zinc, and copper. Interim effluent limits for TRC, zinc, and copper were also established to be in effect until the completion of the proposed Project, after which Ecology states in its response to comments that the mixing zone authorization will be reconsidered.
- Modifications to the method used to calculate solids removal. The renewed permit requires the County to calculate total suspended solids (TSS) removal (again through an annual mass-based calculation) at CSO treatment stations (including EWWTS), although now excluding storage-only events, and no longer in combination with removal at WPTP.
- More stringent monitoring requirements. Changes include requiring daily monitoring per event for influent and effluent TSS and BOD_5 in lieu of a single event-based monitoring requirement.
- The renewed 2024 NPDES permit includes the following unchanged EWWTS limits from the previous 2014 permit: annual average settleable solids of 0.3 milliliters per liter per hour (ml/L/hr), fecal coliform (monthly geometric mean/most probable number [MPN]): 400 MPN per 100 milliliters, and instantaneous pH between 6.0 and 9.0.

ES.1.4.2 System Modeling and Basis of Planning

The County maintains hydrologic and hydraulic models of its combined sewage system draining to the EWWTS (West Core model) using the MIKE URBAN simulation software by DHI. The West Core model (version 9a), including the EWWTS system, captures the furthest downstream portion of the basin. The control level was modeled under both current conditions and a potential future condition incorporating climate model forecasting. In 2020, the County verified the model's calibration and suitability for use at EWWTS by comparing modeled to observed inflow events into the existing EWWTS between 2006 and 2018 (King County, 2021). In 2024, the County updated the model's calibration of historical events to extend through 2023 and incorporates the additional flow Seattle Public Utilities (SPU) intends to convey to the Elliott Bay Interceptor (EBI) and Lake Union Tunnel from the upcoming Vine Street CSO project. Overall, it was concluded that the model is a reasonable reflection of current events and can be used to simulate inflows to EWWTS based on rainfall.

Currently the operational strategy does not attenuate peak flow sent to EWWTS during a storm event. The proposed revision to the operational methodology involves partially filling the Mercer Street Tunnel before pumping and treatment at the station starts and simultaneously utilizing the remaining volume to equalize the peak flow. By utilizing the tunnel for both storage and equalization during the peak of an event, the County's modeling concluded that a lower peak flow treatment capacity will contribute to the control at the Denny CSO overflow location. This is considered the optimal approach that results in improved water quality while maximizing the use of the existing infrastructure sustainably.

The County's West Core system model based on 46 years of data showed that maintaining a minimum of 4.1 MG of available equalization volume in the Mercer Street Tunnel at the onset and during a wet weather event would reduce the required peak instantaneous influent flow from 250 mgd to 219 mgd and increase the peak hour influent flow to 189 mgd, while providing reliable control. The County also determined that maintaining additional tunnel capacity for equalization (for a total of 5.8 MG) would allow the station to continually operate long term at the ultimate influent peak hour design flow of 219 mgd to

address potential future precipitation impacts to flows due to climate change while maintaining the same level of service.

ES.1.4.3 Influent Water Quality Characteristics

The influent characteristics expected at EWWTS are summarized in Table ES-3 (Jacobs, 2021). Future influent characteristics are expected to be similar to current conditions.

Table ES-3. Summary of Influent Characteristics to EWWTS

Parameter	Units	Average	25th Percentile	50th Percentile	95th Percentile
TSS	mg/L	121	50	105	295
BOD_5	mg/L	57[a]	40	49	115
Alkalinity	mg/L as $CaCO_3$	18 to 32	--	--	--
pH	--	7.0	--	--	--

[a] BOD removal in EWWTS treated effluent is not required by permit. However, the ballasted sedimentation treatment process provides particulate BOD removal relational to suspended solids removal.

BOD = biochemical oxygen demand

BOD_5 = 5-day biochemical oxygen demand

$CaCO_3$ = calcium carbonate

mg/L = milligrams per liter

ES.1.5 Alternative Analysis

The evaluation of alternatives to improve NPDES permit compliance at the EWWTS began in 2020. A series of workshops were held to develop criteria to narrow and eventually score alternatives. The team collaboratively brainstormed potential solutions to meet project goals. In addition, this step involved evaluating technologies for the solids removal, disinfection, and outfall systems. Based on a review of each technology's key advantages and disadvantages identified by County staff and consulting engineer subject matter experts, representative technologies for each process were selected as components that, when combined, would comprise a complete alternative. A total of 14 options were generated by the end of the brainstorming process. A workshop was held to assign a preliminary rating to each criterion for each brainstormed option. The brainstormed options were narrowed to a shortlist represented as Alternatives 1, 2, 3, and 4 in Table ES-4. Engineering details were developed for each of the shortlisted alternatives to identify advantages, challenges, and other key differentiators. Through a series of workshops, the four alternatives were scored relative to the previously developed criteria. The results of this scoring process indicated that all four alternatives were similar and adequately met project goals, with only a few points separating the highest-scoring and lowest-scoring alternatives.

The four narrowed alternatives were then further refined to improve cost-effectiveness and prioritize proven treatment technologies that are familiar to the County. This optimization step ultimately led to the development of Alternatives 5A, 5B, and 5C respectively. Following the development of Alternative 5C, Ecology issued a draft NPDES permit with reduced effluent TRC limits for EWWTS. The new TRC limits are considered challenging to achieve and present a long-term risk that a chlorine-based disinfection alternative may result in permit noncompliance. This prompted the development of Alternative 6, which is similar to Alternative 5C but instead utilizes UV disinfection to eliminate the use of chlorine for disinfection

and the need for outfall improvements to increase dilution and achieve compliance with marine water quality criteria for total residual chlorine.

Table ES-4. Summary of Alternatives Evaluated

Treatment Alternative	Capacity in mgd (Peak Hour Design/ Peak Instantaneous)	Mercer Tunnel Equalization (MG)	Pumping/ Preliminary/Solids Technology	Disinfection Technology	Outfall Improvements
Alternative 1	120/250	3	New pumps/ Bar Screens/ Retention Treatment Basin	Chemical Disinfection within RTB	Alongshore Diffuser
Alternative 2	120/250	3	New pumps/ Bar Screens/ Ballasted Sedimentation	UV	Terminal Rosette Diffuser
Alternative 3	120/250	3	New pumps/ Bar Screens/ Chemically Enhanced Primary Treatment	Chlorination/ Dechlorination	Terminal Rosette Diffuser
Alternative 4	120/250	3	New pumps/ Bar Screens/ Ballasted Sedimentation	Chlorination/ Dechlorination	Terminal Rosette Diffuser
Alternative 5A	180/180	4.4	New pumps/ Bar Screens/ Ballasted Sedimentation	Chlorination/ Dechlorination	Terminal Rosette Diffuser
Alternative 5B	180/180	4.4	Retrofitted pumps + 1 new pump/ Bar Screens/ Ballasted Sedimentation	Chlorination/ Dechlorination	Terminal Rosette Diffuser
Alternative 5C	180/210[a]	4.4	Retrofitted pumps + 1 new pump/ Bar Screens/ Ballasted Sedimentation	Chlorination/ Dechlorination	Terminal Rosette Diffuser
Alternative 6	180/210[a]	4.4	Retrofitted pumps + 1 new pump/ Bar Screens/ Ballasted Sedimentation	UV	N/A[b]

[a] A peak instantaneous condition of 210 mgd was added to account for future precipitation due to climate change.

[b] Alternative 6 relies on UV disinfection technology obviating the need for NPDES permit limits for TRC. The County's updated reasonable potential analysis (RPA) presented in Appendix F anticipates that the proposed treatment can demonstrate compliance with water quality criteria at the edge of an authorized mixing zone without the need for outfall improvements. Outfall improvements are part of the County's adaptive management strategy that can be implemented if NPDES permit compliance challenges arise due to unanticipated changing conditions.

RTB = retention treatment basin

During the second quarter of 2023, the County and Project team compared Alternative 5C and Alternative 6 in light of the then-draft NPDES language and in consideration of risk, cost, and non-cost factors. A decision workshop with the County and Project team was held in June 2023, to present and discuss the evaluation criteria and scoring, describe the differences between Alternative 5C and Alternative 6, and select the preferred alternative for design and development. The evaluation concluded that Alternative 6 can best achieve the project objectives of bringing the facility into NPDES permit compliance, mitigating risk, and managing cost to the extent possible. Thus, the Project team has selected Alternative 6 as the preferred alternative.

ES.1.6 Recommended Project

In late 2024 during preliminary design, the County updated the design capacity criteria to reflect the station's treated capacity discharged to the outfall. The design capacity incorporates the additional flow SPU intends to convey to the EBI and Lake Union Tunnel from the upcoming Vine Street CSO project. For the purpose of this design, it is assumed that the Vine Street CSO flows may be part of the capacity calculations, however, adding Vine Street CSO flows to EWWTS is contingent upon an approved Agreement with SPU regarding capital and O&M costs.

Combining 4.1 MG of equalization capacity in the Mercer Street Tunnel, the EWWTS Project will be designed to hydraulically handle a peak hour influent design flow of 189 mgd with a peak instantaneous influent design flow of 219 mgd for short duration stressed hydraulic conditions with 180 mgd and 210 mgd being discharged through the outfall, respectively. The peak hour treatment capacity of the station will be 180 mgd. The Project will include the following major elements:

- Optimize Mercer Street Tunnel operations for flow equalization by lowering the control level.
- Upgrade the existing influent pump station with six new influent pumps.
- Provide new screens and screenings handling facilities, replacing existing.
- Provide new ballasted sedimentation facilities for solids removal (Actiflo®).
- Provide additional chemical treatment for heavy metals removal.
- Provide new UV disinfection facilities replacing the chlorination/dichlorination system.
- Provide recirculated water storage (C3) and recirculation to the Mercer Street tunnel for initial flows during treatment start-up and for facility-clean up and otherwise off-spec effluent.
- Modify yard piping and conduit.
- Provide new final effluent sampling (FESAM) location on the EWWTS site.
- Provide ancillary facilities including odor control, equipment storage, electrical and power supply upgrades, geotechnical improvements, and on-site stormwater treatment and rainwater harvesting.
- Modify the existing FESAM building in Myrtle Edwards Park to decommission facilities that will no longer be required for the EWWTS facility. Repurpose the building for ancillary uses by the adjacent Denny Way Regulator Station.

The treatment process flow diagram is shown in Figures ES-2 and ES-3. Flow is pumped from the common wet well at the influent pump station to the new screens and downstream parallel Actiflo® trains. Gates allow each of the two Actiflo®/UV disinfection trains to be isolated to allow for independent startup of parallel units while discharging fully treated water.

A detailed evaluation of the EWWTS discharge compliance with applicable water quality criteria has been developed for the proposed Project. The proposed treatment improvements is designed to achieve compliance with the technology-based standards for CSO treatment facilities as specified in the 2024 NPDES permit and provide the "Nine Minimum Controls" required by special condition S11.B of the 2024 NPDES permit. Therefore, the EWWTS will meet the requirements for "all known, available and reasonable methods of prevention, control and treatment" (AKART) and will qualify for a mixing zone authorization under the requirements of WAC 173-201A-400. A mixing zone authorization will significantly reduce the EWWTS discharge's long-term risk of noncompliance with marine water quality criteria.

ES 1.7 Project Implementation

ES 1.7.1 Project Financing

The EWWTS project is included in the capital funding plan included in the adopted wholesale sewer rate forecast. Contracts with member cities and districts specify that the sewer rate must be adopted annually by June 30 for the subsequent year. A 20-year wholesale sewer rate forecast travels with the annual rate proposal and includes the project costs identified in this Engineering Report. The capital program is funded from a combination of cash funding from annual revenue and debt financing, primarily by revenue bonds. Project-specific loans are pursued through the EPA's Water Infrastructure Finance and Innovation Act (WIFIA) program, the State Revolving Fund, and other sources, though project prioritization is unaffected by success of securing these below market funding sources.

The estimated total capital project cost of the EWWTS Project based on the Advancement of Cost Engineering International (AACE) Class 3 (10 to 40 percent level of design definition) is estimated to range from $553 million (low range with -20 percent accuracy adjustment) to $898 million (high range with +30 percent accuracy adjustment), with a probable estimate of $691 million. The life cycle costs for the EWWTS Project, calculated using the WTD life cycle cost model with a 50-year project life and a 5 percent discount rate, amount to a present value operation and maintenance (O&M) cost of $32 million and a present value net cost of $22 million.

ES 1.7.2 Implementation Plan

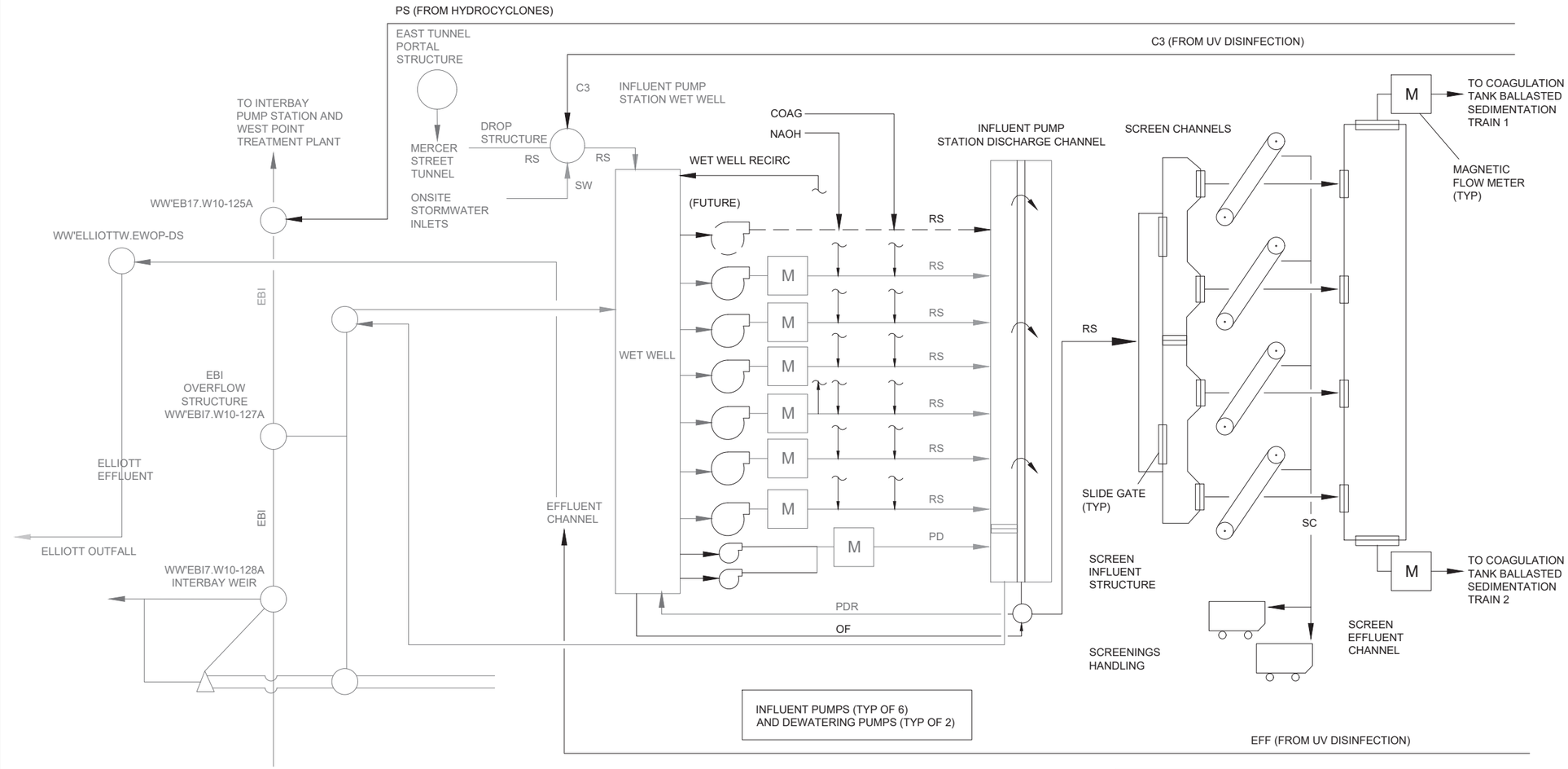
The EWWTS Project will be implemented to achieve the schedule compliance milestones as presented in Table ES-5.

Table ES-5. EWWTS Schedule Compliance Milestones

	Task	Due Date
1	Submit a draft Engineering Report to Ecology for review.	June 30, 2024 (completed)
2	Submit a final Engineering Report to Ecology for review and approval.	June 30, 2025
3	Submit for Ecology review of the 60 percent draft plans and specifications.	June 30, 2026
4	Submit the 90 percent draft plans and specifications for Ecology review.	June 30, 2027
5	Submit final plans and specifications for the facility improvement Project to Ecology for review and approval.	December 31, 2027
6	Complete bidding for construction of the approved improvement Project.	May 30, 2028

The County is implementing a collaborative delivery approach using General Contractor/Construction Management (GC/CM) contracting to better assure meeting all its milestone dates.

NOTES:
1. ODOR CONTROL FOR SCREENING, ANCILLARY SYSTEMS AND VALVES NOT SHOWN FOR CLARITY.
2. INFLUENT SAMPLING LOCATION UPSTREAM OF NAOH DOSING POINT NOT SHOWN FOR CLARITY.



FLOW STREAMS:	ABBREVIATIONS:
PD: PUMPED DRAINAGE	COAG: COAGULANT (ALUMINUMCHLOROHYDRATE)
RS: RAW SEWAGE	NAOH: SODIUM HYDROXIDE
SC: SCREENINGS	PDR: PROCESS DRAIN
EFF: EFFLUENT	SAM: SAMPLING LOCATION
PS: PRIMARY SLUDGE	EBI: ELLIOTT BAY INTERCEPTOR
SSL: SAND+SOLIDS	SAND: MICROSAND
C3: TREATED	
SW: SITE STORMWATER	
RECIRC: RECIRCULATION	
OF: OVERFLOW	

NO	REVISION DESCRIPTION	BY	APVD	DATE

Jacobs

PRELIMINARY ISSUE DRAWING
INFORMATION ONLY
60% REVIEW

MIAOMIAO ZHANG STATE OF WASHINGTON 41883 REGISTERED PROFESSIONAL ENGINEER

DESIGNED/DRAWN: Y. PAN	SCALE: NTS
DESIGN ENGINEER: M. ZHANG	WORK ORDER:
PROJECT ENGINEER: X. XXXX	PROJECT NO: XXXXXXX
LOCATION CODE: WW792	CONTRACT NO: C0XXXXCXX

King County

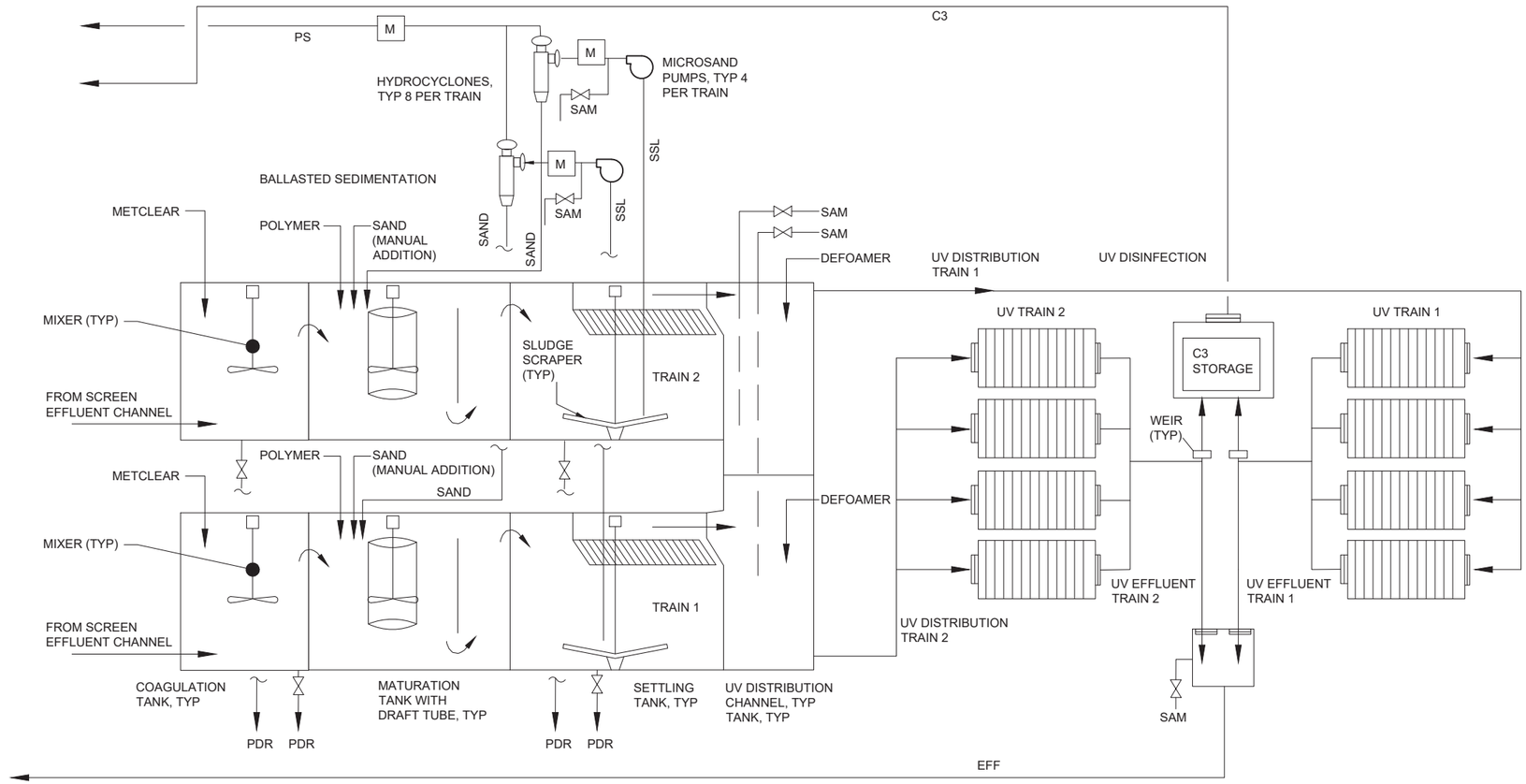
DEPARTMENT OF NATURAL RESOURCES & PARKS
WASTEWATER TREATMENT DIVISION
ELLIOTT WEST WET WEATHER TREATMENT STATION UPGRADE
CSO CONTROL FACILITY

FIGURE ES-2 PROCESS FLOW DIAGRAM AND MASS BALANCE 1

DATE:	MARCH 2026
PROJECT DWG NO:	G0051
ECMS DOC NO:	WW792-G-0051
SHT NO / TOTAL	#
REV NO:	0

BORDER FILE EDITION: KCWTD-Dsize-TB-Border
C:\pw_workdir\den003\jeg_ex-pany\d1677704\WW792-G-0051.dwg | Layout: G0051
PLOTTED: Jun 19, 2025-02:42:55pm By ypan
XREFS: EWWTS-Dsize-Border.dwg
IMAGES: Carollo logo 2023_black.jpg

NOTES:
1. SEE G-0051 FOR FLOW STREAM IDENTIFICATION AND ABBREVIATIONS.
2. UV TRAIN CONFIGURATION DIFFERS FROM THAT SHOWN ON MECHANICAL AND STRUCTURAL SHEETS AT 30%



DESIGN MASS BALANCE

FLOW STREAM	GOING TO	PEAK HOUR FLOW (MGD)	TSS CONCENTRATION (MG/L)	TSS LOADING (LBS/DAY)
RS	SCREENING	189	121	191,000
RS	BALLASTED SEDIMENTATION	189	121	191,000
UV INF	UV DISINFECTION	180	18	27,100
EFF	OUTFALL	180*	18	27,100
PS	EBI	APPROXIMATELY 9	2,200	160,000 - 165,000

* EWWTS PEAK HOUR DESIGN TREATMENT CAPACITY

NO	REVISION DESCRIPTION	BY	APVD	DATE

Jacobs

PRELIMINARY ISSUE DRAWING
INFORMATION ONLY
60% REVIEW

MIAOMIAO ZHANG — STATE OF WASHINGTON — 41883 — REGISTERED PROFESSIONAL ENGINEER

DESIGNED/DRAWN: Y. PAN	SCALE: NTS
DESIGN ENGINEER: M. ZHANG	WORK ORDER:
PROJECT ENGINEER: X. XXXX	PROJECT NO: XXXXXXX
LOCATION CODE: WW792	CONTRACT NO: C0XXXXCXX

King County

DEPARTMENT OF NATURAL RESOURCES & PARKS
WASTEWATER TREATMENT DIVISION
ELLIOTT WEST WET WEATHER TREATMENT STATION UPGRADE
CSO CONTROL FACILITY

FIGURE ES-3 PROCESS FLOW DIAGRAM AND MASS BALANCE 2

DATE:	MARCH 2026
PROJECT DWG NO:	G0052
ECMS DOC NO:	WW792-G-0052
SHT NO / TOTAL	#
REV NO:	0

Contents

Figures

Tables

Appendices

Acronyms and Abbreviations

#/yr	number per year
µg/L	micrograms per liter
µg/m^3	micrograms per cubic meter
AACE	Advancement of Cost Engineering International
Action Plan	EWWTS Equity and Social Justice Action Plan
AECM	alternative evaluation criteria matrix
AKART	all known, available and reasonable methods of prevention, control and treatment
APE	area of potential effects
AWWF	average wet weather flow
BCT	best conventional pollutant control technology
BMP	best management practice
BNSF	Burlington Northern Santa Fe
BOD	biochemical oxygen demand
BOD_5	5-day biochemical oxygen demand
CAA	Clean Air Act of 1970
$CaCO_3$	calcium carbonate
$CBOD_5$	5-day carbonaceous biochemical oxygen demand
CD	consent decree
CEPT	chemically-enhanced primary treatment
CFD	computational fluid dynamics
cfm	cubic feet per minute
CFR	Code of Federal Regulations
CM	construction management
cm	centimeter
CO	carbon monoxide
County	King County

CSO	combined sewer overflow
CWA	Clean Water Act
DAHP	Washington State Department of Archaeology and Historic Preservation
DPD	Seattle Department of Planning and Development
DPS	distinct population segment
EBI	Elliott Bay Interceptor
ECA	environmentally critical area
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
ESJ	equity and social justice
EWWTS	Elliott West Wet Weather Treatment Station
FEMA	Federal Emergency Management Agency
FESAM	final effluent sampling
FIRM	Flood Insurance Rate Maps
FMD	King County Facilities Management Division
GC/CM	General Contractor/Construction Management
GCM	global climate models
GOIA	Governor's Office of Indian Affairs
gpm	gallons per minute
GSI	Green Stormwater Infrastructure
GWWTS	Georgetown Wet Weather Treatment Station
H_2S	hydrogen sulfide
hp	horsepower
HVAC	heating, ventilation, and air conditioning
I/I	infiltration and inflow
I-5	Interstate 5
IPaC	Information for Planning and Consultation

IPS	influent pump station
IUVA	International Ultraviolet Association
KCRHA	King County Regional Homelessness Authority
kV	kilovolt
kVA	kilovolt amp
kW	kilowatt
lbs/day	pounds per day
LDW	Lower Duwamish Waterway
LED	light-emitting diode
LTCP	Long-Term Control Plan
M/WBE	Minority and Women Business Enterprises
MACC	maximum allowable construction cost
MBE	Minority-Owned Business Enterprises
MG	million gallons
mg/L	milligrams per liter
mgd	million gallons per day
MH	maintenance hole
mJ/cm^2	millijoules per square centimeter
mL	milliliter
ml/L	milliliters per liter
ml/L/hr	milliliters per liter per hour
mm	millimeter
MPN	most probable number
MS2	bacteriophage MS2
NAAQS	National Ambient Air Quality Standards
NAVD88	North American Vertical Datum of 1988
NCEI	National Centers for Environmental Information

NFPA	National Fire Protection Association
NO_2	nitrogen dioxide
NPDES	National Pollutant Discharge Elimination System
NWI	National Wetland Inventory
O&M	operations and maintenance
OCU	odor control units
PCMP	Post Construction Monitoring Plan
PGIS	pollution-generating impervious surface
PHF	peak hour flow
PHS	Priority Habitats and Species
PIF	peak instantaneous flow
PM_{10}	particulate matter less than 10 micrometers in size
$PM_{2.5}$	particulate matter less than 2.5 micrometers in size
ppb	parts per billion
ppm	parts per million
Project	EWWTS Project
PS	pump station
PSCAA	Puget Sound Clean Air Agency
RCW	Revised Code of Washington
RED	reduction equivalent dose
RP	recommended practice
RPA	reasonable potential analysis
RTB	retention treatment basin
RWSP	Regional Wastewater Services Plan
SCADA	supervisory control and data acquisition
SCP	Supplemental Compliance Plan
SCS	Small Contractor and Supplier
SEPA	State Environmental Policy Act

SERP	State Environmental Review Process
SIP	State Implementation Plan
SMC	Seattle Municipal Code
SMP	Sediment Management Plan
SMS	Sediment Management Standards
SPU	Seattle Public Utilities
SR	State Road
SRF	State Revolving Fund
SS	scrub-shrub
ST	Sound Transit
TMDL	total maximum daily load
TRC	total residual chlorine
TSS	total suspended solids
USFWS	United States Fish and Wildlife Service
UV	ultraviolet
V	volts
VFD	variable frequency drive
WAC	Washington Administrative Code
WBE	Women-Owned Business Enterprises
WDFW	Washington Department of Fish and Wildlife
WIFIA	Water Infrastructure Finance and Innovation Act
WPTP	West Point Treatment Plant
WRIA	Water Resource Inventory Area
WSE	water surface elevation
WTD	Wastewater Treatment Division
WWTS	wet weather treatment station

1. Introduction

1.1 Introduction and Purpose

King County's (County) Wastewater Treatment Division (WTD) owns and operates the Elliott West Wet Weather Treatment Station (EWWTS), a combined sewer overflow (CSO) treatment facility located in the City of Seattle. Placed in operation in 2005, the EWWTS receives and treats combined sewage from Denny Way and Lake Union basins to Elliott Bay, as shown in Figure 1-1.

The EWWTS operates and discharges treated combined sewage under the County's National Pollutant Discharge Elimination System (NPDES) permit for the West Point Treatment Plant (WPTP), a County-owned regional wastewater treatment facility. Since operation began, EWWTS has substantially reduced pollution entering Elliott Bay, but not all NPDES permit effluent limits have been met.

Between 2020 and 2023, the County assessed potential upgrades for key EWWTS processes to comply with the anticipated renewed 2024 NPDES permit requirements in the renewed permit, which Ecology was then developing. Ecology issued the renewed 2024 NPDES permit on April 29, 2024, effective June 1, 2024. The renewed 2024 permit includes more stringent effluent limits than those in the previous permit. The more stringent limits are a result of the removal of the mixing zones for the EWWTS discharges, which the County's 2020-23 assessment of potential upgrades did not anticipate. This Engineering Report describes existing and anticipated future conditions, related CSO control needs, selection of the recommended upgrades to the station, and the associated basic design data. Further, this Engineering Report describes the financial analysis, regulatory approvals, and public involvement process and objectives for the EWWTS Project (Project) as described in Section 1.5.

This Engineering Report was prepared under the requirements of the Washington Administrative Code (WAC) 173-240-060, the requirements of the Washington State Department of Ecology's (Ecology) Criteria for Sewage Works Design (Ecology, 2023), and the requirements of the Code of Federal Regulations (CFR) Title 40, 35.2030. A checklist is included in Appendix A that cross references the location of each required item contained within this report.

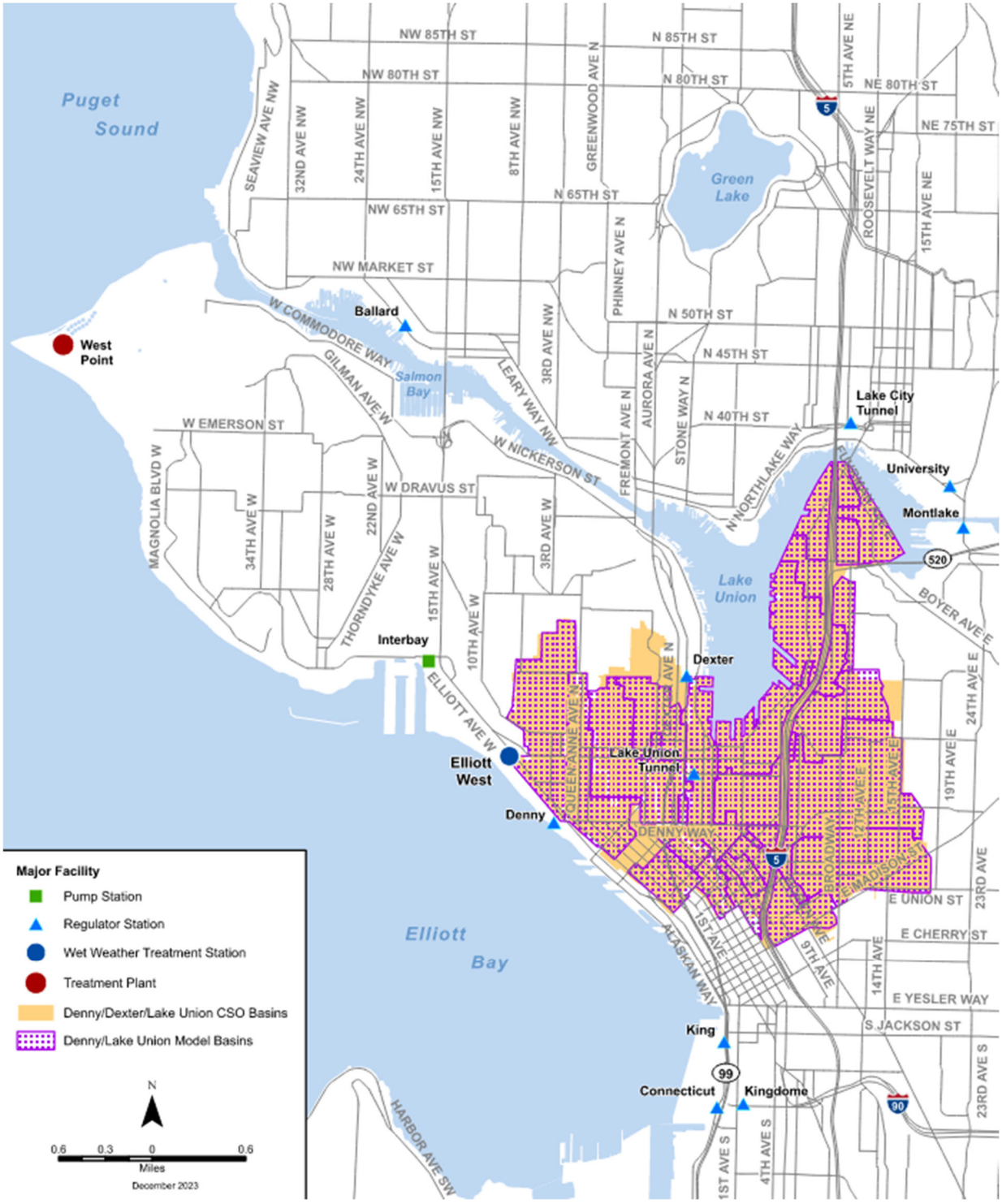


Figure 1-1. Denny Way/Lake Union Basin Area

1.2 Combined Sewer Overflow Control Requirements

Amendments to the Federal Water Pollution Control Act, also known as the Clean Water Act (CWA), were passed in 1972, in 1977, and in 1987. The purpose of this body of law is to “restore and maintain the

chemical, physical, and biological integrity of the Nation's waters" (33 USC 26 §1251[a]). On a practical level, this objective falls under two overarching aspirational goals:

- Eliminate the discharge of pollutants into the nation's waters.
- Achieve and maintain fishable and swimmable waters "whenever attainable."

In 1994, the CWA was further amended to include a CSO Control Policy, which included expectations for CSO control and definitions of what constituted CSO treatment. The first goal was met in part through the NPDES permitting program. The second goal is being addressed through a targeted approach, where pollution control programs are developed to meet specific water quality standards for individual water bodies.

The CWA requires all wastewater treatment facilities and industries that discharge effluent into surface waters to have NPDES permits. In Washington State, NPDES permits are issued by Ecology. These permits define appropriate technology controls and specify limits on the allowable quality and quantity of effluent discharged from point sources, such as treatment plants, CSOs, and industrial facilities. The CWA requirements are incorporated in the NPDES permit for the County's WPTP. The WPTP NPDES permit includes the County's CSO outfalls, and existing CSO control facilities already constructed and in operation.

CSOs were recognized by Ecology in the early 1980s as a unique category of discharge that was not adequately covered by existing federal or state regulations. In 1984, Ecology introduced legislation that required agencies with CSOs to develop plans for "the greatest reasonable reduction [of CSOs] at the earliest possible date." In January 1987, Ecology published a new regulation (Chapter 173-245 WAC) that defined the greatest reasonable reduction in CSOs as "control of each CSO such that an average of one untreated discharge may occur per year." This regulation also considers control/treatment solutions that at a minimum provide at-site treatment equal to at least primary treatment, provided that an offshore outfall is adequately submerged.

The United States Environmental Protection Agency's (EPA) 1994 CSO Control Policy was codified as the Wet Weather Water Quality Act of 2000. This policy requires implementing "nine minimum controls" for CSOs and developing long-term CSO control plans. The purpose of the nine minimum controls is to implement early actions that can improve water quality before more expensive CSO control projects in the control plan are built. The following are the nine minimum controls, implementation of which is also included in Special Condition 11 of the WPTP NPDES permit:

- Ensure proper operation and regular maintenance programs for the sewer system and CSOs.
- Maximize use of collection system for storage.
- Review and modify pretreatment requirements to assure CSO impacts are minimized.
- Maximize flow to the publicly owned treatment works for treatment.
- Prohibit CSOs during dry weather.
- Control solid and floatable materials in CSOs.
- Prevent pollution.
- Ensure the public is adequately notified of CSO occurrences and impacts.
- Monitor to effectively characterize CSO impacts and the efficacy of CSO controls.

The regulatory assessment of an average of no more than one untreated discharge per CSO outfall per year is based on a 20-year moving average as stated in the WPTP NPDES permit. The number of

untreated discharges that occurred over each of the previous 20 years is reported for each CSO site and then averaged. This moving average, along with modeled data for controlled sites, is used each year to assess compliance with the performance standard for CSOs identified as controlled.

The Federal CSO Control Policy and the Washington State regulation (Chapter 173-245 WAC) also define minimum levels of treatment for CSOs, which are generally regarded as technology standards. To ensure that protective permit limits are established for CSO treatment facility discharges, Ecology also evaluates discharge requirements necessary for compliance with the use-based water quality standards (Chapter 173-201A WAC). These water quality standards are aimed at keeping waters clean and safe for people, fish, and wildlife. Both the CWA and Washington State regulations define minimum technologies to be used to treat different wastewater streams. The federal rules define “best conventional pollutant control technology” (BCT). Washington State defines technology based CSO treatment as primary treatment.

The biological, chemical, and physical criteria used to assess a water body’s health include numeric and narrative water quality standards, including levels of bacteria, dissolved oxygen, temperature, pH, ammonia, turbidity, and measurement of a variety of other chemical compounds. The State Water Quality Standards also include the provision, where appropriate, for granting a “mixing zone,” which is defined by WAC 173-201A-020 as the “portion of a water body adjacent to an effluent outfall where mixing results in the dilution of the effluent with the receiving water.” To qualify for a mixing zone under WAC 173-201A-400, permittees must meet the requirements for AKART. To align the CSO control standards with water quality standards, the State Water Quality Standards exempt CSOs once-per-year from the numeric mixing zone size criteria (WAC 173-201A-400[11]) if the untreated CSO location is in compliance with the controlled performance standard (one untreated discharge per CSO outfall per year, based on a 20-year moving average), if the CSO discharge does not cause loss of sensitive habitat per subsection 4 of WAC 173-210A-400. Water quality-based effluent limits are applied to treated CSO discharges at the end of pipe, and a specific mixing zone may be applied under Chapter 173-201A WAC to treated CSO locations.

1.3 Combined Sewer Overflow Control Program Overview

The County’s CSO Control Program reflects more than 60 years of planning and investment in wastewater infrastructure in Seattle and the surrounding central Puget Sound metropolitan region. Regional construction of CSO control facilities began in the late 1970s. In 1988, the County received written approval for its first CSO Control Plan (*Final 1988 Combined Sewer Overflow Control Plan*, 1988) and for the systematic monitoring and measuring of CSOs. The most recent updates to this guiding document include the 2012 King County Long-term Combined Sewer Overflow Control Plan Amendment and the 2018 CSO Control Program Update.

In 1999, the County adopted the Regional Wastewater Services Plan (RWSP), a 30-year comprehensive approach to regional wastewater services (King County, 1999). RWSP policies guide the County in controlling CSO discharges so that all 38 existing CSO locations will meet state and federal regulations by 2030. The RWSP includes policies that call for regularly assessing CSO control projects, priorities, and opportunities.

CSO Control Policy CSOCP-9 addresses the cleanup of contaminated sediments near County CSO sites. That policy directs the County to implement its long-range sediment management strategy (King County, 2012a) and, where applicable, participate with partners in sharing responsibilities and costs of cleaning sites such as Superfund sites.

The County’s Post Construction Monitoring Plan (PCMP) is designed to assess, document, and report on the effectiveness of its CSO Control Program in meeting performance requirements and state water and sediment quality standards compliance. The King County PCMP was submitted to Ecology in July 2010

and was approved on September 28, 2012. The PCMP outlines the County's required process for sediment characterization by sampling or modeling, hazard assessment/site identification, cleanup actions (where necessary), and data reporting. That characterization approach was applied to all CSO and CSO treatment plant outfalls and presented in the King County Sediment Management Plan (SMP) (original in 1999) and the 2018 update sent to Ecology on November 2, 2018.

Over the last two decades, there has been a downward trend for total annual CSO volume discharged, while average annual rainfall in the County has increased (King County, 2018a). This successful trend is a direct result of the County implementing the CSO Control Program. In addition, the County reviews and updates its CSO control plan in association with regular cycles of permit review and approval by Ecology, pursuant to NPDES regulations. The most recent update to the County CSO Control Program (2018 CSO Control Program Update) reflects an evaluation of the program and LTCP implementation status. This latest review of the CSO program does not recommend changes to the previously adopted 2012 King County Long-Term Combined Sewer Overflow Control Plan Amendment. However, the 2018 update documents the investigations that the County has been doing to improve the water quality discharged from EWWTS.

The County has made notable progress controlling CSOs in local waterways, having successfully reduced the average annual CSO discharge volume from about 2.3 billion gallons in the early 1980s to about 1 billion gallons (King County, 2023a). The following are the County's general strategies for reducing or mitigating CSO effects:

- Pollution prevention through source control.
- Stormwater management.[1]
- Operational controls that transfer as much flow as possible to regional treatment plants.
- Upgrades to existing facilities.
- Construction of new CSO control facilities, which may include green stormwater infrastructure, sewer separation, conveyance, storage, and treatment.

1.3.1 Consent Decree

After the King County Council approved the 2012 LTCP, the County submitted the LTCP to Ecology and EPA for approval. EPA and Ecology approved the County's LTCP as meeting federal requirements on March 7, 2013. The approved 2012 LTCP is the County's plan to construct nine projects for control over 14 CSOs by the end of 2030. This approved version became the basis for settlement of the consent decree (CD) between the County, Ecology, and EPA that outlines the planned actions to bring the County's CSO program into compliance with the CWA. The CD was formally filed in U.S. District Court on July 3, 2013.[2]

The CD commits the County to implementation of various CSO control measures and compliance activities to achieve reliable compliance with the CWA, applicable state law and regulations, and terms and conditions of the WPTP NPDES permit, and to meet the requirements of EPA's CSO control policy. The CD commits the County to complete construction of all CSO control projects by December 31, 2030. The CD also requires the County to monitor and make adjustments to ensure CSOs remain under control.

---

[1] Note that since the combined system is located within the City of Seattle, the County does not have jurisdiction over stormwater management.

[2] United States of America and the State of Washington, Plaintiffs, v. King County, Washington, Defendant. Consent Decree. Case 2:13cv00677-JCC. Document 6, Filed July 3, 2013. Available at http://www.kingcounty.gov/environment/wastewater/CSO/ControlReq.aspx.

"Control" is defined in the WPTP NPDES permit as no more than one untreated discharge per outfall per year on a 20-year moving average.

In 2019, the County requested to initiate negotiations to modify the CD. This request was put forward due to several changed conditions upon which the CD was based (King County, 2019). These conditions included climate change considerations that have increased the size of CSO control projects necessary to achieve compliance, additional wastewater system asset management needs, rising costs and other regional financial factors, and additional regulatory compliance obligations.

The County, EPA, and Ecology (in coordination with the City of Seattle) were engaged between 2019 to 2023 in developing a modification to the CD to address these changed conditions. In association with the changed conditions, the County acknowledged in a March 4, 2022, letter to the EPA, Ecology, and the U.S. Department of Justice that it anticipated delays in meeting CD milestones for CSO control projects in the University, Montlake, Chelan, Hanford #2, Lander, King, and Kingdome basins. In 2021, the County and negotiating parties reached an agreement on the First Material Modification the Consent Decree, and the modification was subsequently approved by King County Council and was adopted in 2025.

The initial EWWTS Project predates the CD, and the improvements at EWWTS are being addressed through the WPTP NPDES permit process. Stipulated penalties for EWWTS failure to comply with effluent limits are assessed under the CD.

1.4 Project Needs

In compliance with the Washington State standards for CSO control requirements, the Revised Code of Washington (RCW) 90.48 and WAC 173-245-020, the EWWTS was completed in 2005. This was part of the Denny Way and Lake Union CSO control project, with the purpose of controlling City of Seattle CSO discharges into Lake Union, King County Dexter CSO discharges into Lake Union, and Denny Way CSO discharges into Elliott Bay.

Major components of the Denny Way and Lake Union CSO project included construction of the EWWTS and the Mercer Street Tunnel. Other structures associated with the project included the Lake Union Regulator Station, east tunnel portal, CSO outfall transition structure, dechlorination vault and miscellaneous pipelines, pipe vaults, and control, diversion, and drop structures.

Two CSO outfalls in Elliott Bay were constructed as part of the Denny Way and Lake Union CSO project. One outfall replaced the outfall structure at the Denny Way Regulator and discharges untreated CSOs from the Denny Way Regulator Station. The other outfall discharges treated CSOs from EWWTS. The Elliott West outfall extends offshore and terminates below the mean lower low water level.

Currently during most storms, the Mercer Street Tunnel system, with a volume of 8.2 million gallons (MG), is used for storage until the flows can be transferred to WPTP. The EWWTS was designed to pump, screen, and disinfect when the tunnel becomes full during larger storms. After the flow is pumped through the screening and disinfection processes, the effluent then continues through the Elliott West effluent pipeline, which carries the flow to the dechlorination vault near the Denny Way Regulator Station. After dechlorination, the treated effluent is released through the EWWTS outfall into Elliott Bay. During extreme weather events, flows in excess of 250 million gallons per day (mgd) are discharged without treatment via the Denny Way CSO outfall.

While the EWWTS has achieved a substantial reduction of discharged pollutants, operational problems were encountered, and the EWWTS faced significant challenges in consistently meeting the current NPDES effluent permit requirements. The County invested in pumping and weir modifications between

2011 and 2015 to improve performance. Continued compliance challenges are rooted in the basic configuration and performance of the EWWTS's screening, settleable and suspended solids removal in the wet well, chlorination, and dechlorination processes along with difficulties in collecting representative samples that accurately reflect the station's influent and effluent quality and treatment performance.

To overcome these challenges, the County has committed to implementing the EWWTS Project, as described in this Engineering Report, which defines a timetable for assessing upgrades to the EWWTS to an advanced wet weather treatment station that will lead to year-round and event-based permit compliance. Separately, the County has a Supplemental Compliance Plan (SCP) with Ecology to bring the Denny Way Regulator Station Overflow (027a) into control/compliance with the permitted CSO event frequency (King County, 2022). The Project assumes that the County will continue to separately plan and report on actions for achieving control/compliance at the Denny Way Regulator Station under the existing and ongoing SCP process. Recent modeling and data indicate modifications have achieved control/compliance and this EWWTS project will substantially contribute to maintaining control/compliance at the Denny Way Regulator Station Overflow (027a).

1.4.1 CSO Wet Weather Treatment and Discharge Regulatory Requirements

The EWWTS is regulated under the County's NPDES permit WA0029181 for the WPTP. The permit regulates discharges of domestic wastewater effluent from the County's WPTP, five CSO treatment facilities that provide at least primary treatment and disinfection at the site of CSO discharges (Alki, Carkeek, Elliott West, Henderson/MLK, and Georgetown), and 38 CSO outfalls that discharge untreated combined sewage during large rain events.

The previous 2014 NPDES permit requirements for EWWTS include 50 percent average annual TSS removal, annual average settleable solids of 0.3 ml/L/hr, fecal coliform (monthly geometric mean/MPN): 400 MPN per 100 milliliters, maximum daily TRC of 109 micrograms per liter (µg/L), and instantaneous pH between 6.0 and 9.0.

Key elements of the renewed 2024 NPDES permit (effective June 1, 2024) include:

- A compliance schedule for planning, design, and completion of bidding for construction of the approved modifications to the existing EWWTS.
- The mixing zone authorization was removed, and corresponding final water quality-based effluent limits were established for TRC, zinc, and copper. Interim effluent limits for TRC, zinc and copper were established to be in effect until the completion of the proposed Project, after which Ecology states the mixing zone authorization will be reconsidered. The interim limit for TRC is set equal to the previous (2014 NPDES permit) effluent limit of 109 µg/L. The interim limits for zinc and copper are set to the 95th percentile of effluent concentrations as reported by the County to Ecology. The final effluent limits for TRC, zinc and copper were set equal to the numeric criteria for acute aquatic life exposure: 13 µg/L TRC, 90 µg/L zinc (total recoverable), and 4.8 µg/L copper (total recoverable).
- Modifications to the method used to calculate solids removal. Previous permits required the County to assess compliance with TSS removal efficiency through an annual mass balance that used the combined removal efficiencies of both EWWTS and WPTP. The renewed permit requires the County to calculate TSS removal (again through an annual mass-based calculation) at CSO treatment stations (including EWWTS) no longer in combination with removal at WPTP, and excluding storage-only events. The limit is still set to 50 percent average annual total suspended solids removal.
- More stringent monitoring requirements. Changes include the permit requiring daily monitoring per event for influent and effluent TSS and BOD_5 in lieu of a single event-based monitoring requirement.

- The renewed 2024 NPDES includes the following unchanged EWWTS limits from the previous 2014 permit: annual average settleable solids of 0.3 ml/L/hr, fecal coliform (monthly geometric mean/MPN): 400 MPN per 100 milliliters, and instantaneous pH between 6.0 and 9.0.

1.5 Project Description

The EWWTS Project consists of new and upgraded treatment facilities to treat CSOs prior to discharge through the existing outfall in Elliott Bay. Specifically, the Project will replace and upgrade the screening facility, replace the existing influent pumps with new pumps, add ballasted sedimentation technology for solids removal, replace the existing chlorine disinfection system with a new ultraviolet light (UV) disinfection system, complete electrical upgrades, and complete modifications to the operation of the Mercer Street tunnel for additional equalization. The Project consists of the following main components:

- Optimize Mercer tunnel operations for flow equalization by lowering control levels.
- Upgrade the existing influent pump station with six new influent pumps.
- Provide new screens and screenings handling facilities, replacing existing.
- Provide new ballasted sedimentation facilities for solids removal.
- Provide additional chemical treatment for heavy metals removal.
- Provide new UV disinfection facilities replacing the chlorination/dichlorination system.
- Recirculated water storage and recirculation to the Mercer Street tunnel for initial flows during treatment start-up, to provide C3 water for facility-clean up and otherwise off-spec effluent.
- Modify yard piping and conduit.
- Relocate final effluent sampling location to the EWWTS site.
- Provide ancillary facilities including odor control, equipment storage, electrical and power supply upgrades, geotechnical improvements, and on-site stormwater treatment and rainwater harvesting.
- Modify the existing FESAM building in Myrtle Edwards Park to decommission facilities that will no longer be required for the EWWTS facility. Repurpose the building for ancillary use by the adjacent Denny Way Regulator Station.

The EWWTS Project will be designed to hydraulically handle a peak hour influent design flow (PHF) of 189 mgd and a peak instantaneous influent design flow (PIF) of 219 mgd for short duration stressed hydraulic conditions. The peak hour and instantaneous discharge to the outfall will be 180 mgd and 210 mgd, respectively. The peak hour treatment capacity of the station will be 180 mgd. The EWWTS Project is designed to achieve compliance with technology-based standards for CSO treatment plants and implement the “Nine Minimum Controls” as required by federal CSO control policy.

This Project is a requirement of the NPDES permit, which includes a compliance timeline for improvements completion.

1.6 Community Involvement

WTD implements the public participation program for its CSO control program within three contexts - WTD, the County in general, and the City of Seattle:

- WTD - General outreach efforts for CSO control (including control projects design and construction, program reviews, long-term control plan updates and amendments, special studies and pilot projects, and public notification of overflows) are coordinated with outreach efforts on wastewater management

and water quality in general. This coordination provides context and shows how all WTD activities work together to achieve the same goals.

- King County - Outreach is also carried out in the context of the County as a whole. The King County Community Engagement Guide and information about how community outreach implements social justice and equity principles can be found on the King County Equity and Social Justice website.
- City of Seattle - The City of Seattle is both a stakeholder and a partner in the County's CSO Control Program.

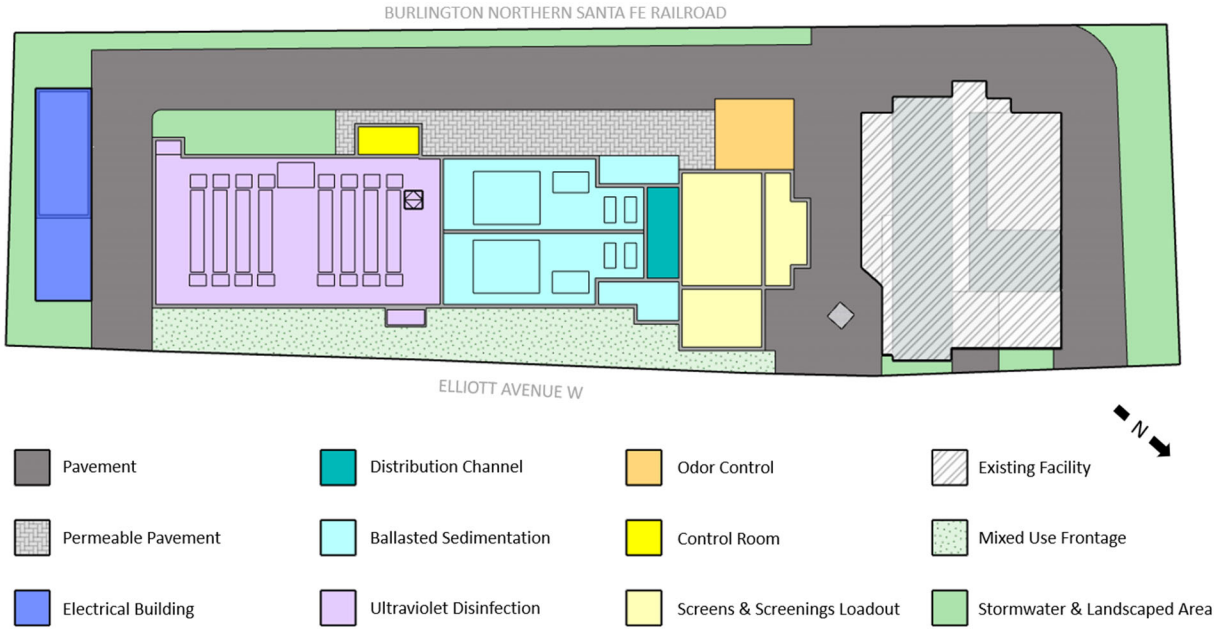


Figure 1-2. Simplified Site Plan of EWWTS

The County's combined sewer system collects combined flows from the City of Seattle's combined sewer system and conveys them to the WPTP. Both agencies have a collaborative role in each other's long-term control efforts and in their associated public and agency participation plans.

The public involvement goal during CSO control projects is to ensure that the public can be involved in specific aspects of the projects during delivery, from conceptual design and scoping through construction, when appropriate. This process is designed to ensure that community members are informed and, when possible, can participate in the design, environmental review, and permitting processes associated with each project.

Both the County and Seattle Public Utilities (SPU) own CSO outfalls within Seattle city limits. SPU manages 82 CSO outfalls and the County manages 38. Based on agreements made at the start of the regional system in 1958, both the County and SPU are responsible for CSOs and are working to control them under long-term CSO control plans (SPU 2015a, King County 2012a).

The two agencies communicate frequently and participate in cross-agency CSO control planning efforts. The County and SPU consider shared CSO control projects if the projects are deemed to be cost-effective for ratepayers, provide a better environmental outcome, or if they have the potential to minimize construction disruption to nearby communities.

2. Background Information

2.1 Introduction

This chapter presents the existing environment of the Denny Basin and EWWTS Project site. Additionally, it describes land use and demography; existing King County West Section, Denny Basin, and South Lake Union wastewater and CSO control facilities; current wastewater and combined sewer system flows and loads; industrial and commercial users; water systems; and unsewered areas.

2.2 Service Area

The EWWTS receives flows from the Denny and Lake Union CSO basins (service area) encompassing the Seattle neighborhoods of South Lake Union, Eastlake, Belltown, and Uptown, and portions of Capitol Hill, Downtown, and Queen Anne. The basin is partitioned into four subbasins: Denny Local, Central Trunk South, Lake Union Tunnel, and Lake Union Regulator Station. The CSO basins span north to the southern and eastern boundaries of Lake Union and the south half of Queen Anne Hill, and south to Madison Street. Elliott Avenue and Western Avenue generally form the western edge of the basins, while the eastern boundary generally follows 10th Avenue East and 15th Avenue East through the top of Capitol Hill. The EWWTS is located on the western edge of the basin. Figure 2-1 shows the Denny/Lake Union Service Area.

2.3 Existing Environment

This section describes the location and existing environmental setting of the Project.

2.3.1 Site Description

EWWTS is located near Elliott Bay at 601 Elliott Avenue W (parcel number 766620-2060) on the northern edge of Seattle's downtown core, as shown in Figure 2-2. The County also owns the neighboring parcel to the south at 531 Elliott Avenue W[3] (parcel number 766620-2035), which the EWWTS Project proposes to use for the upgraded facilities. The treatment station site is adjacent to multi-story offices on the north and south side, a heavily used multi-lane arterial road on the east side (Elliott Avenue West), and the Burlington Northern Santa Fe (BNSF) Railway's corridor on the west side. The area surrounding the EWWTS is mixed-use, with businesses, offices, residential, and industrial users nearby.

A future Sound Transit (ST) light rail extension project called the Ballard Link Extension, on the EWWTS's east side, is in its planning phase. As currently planned, the Ballard Link Extension project will install an elevated rail parallel to Elliott Avenue West that will pass adjacent to the EWWTS. The elevated rail will have columns and foundations within Elliott Avenue West, with some of these elements placed on County property, potentially interfering with expansion of EWWTS under the Project. The County and ST have collaborated to develop alternatives for the Project to accommodate regionally beneficial efforts and ensure the future projects are well coordinated.

[3] The King County Assessor reports the current EWWTS and neighboring parcel addresses as 601 and 531 Elliott Avenue W, respectively. However, the addresses displayed on the existing buildings are 545 and 551 Elliott Avenue W. For the purposes of this Engineering Report, 601 and 531 are used as the property addresses.

The EWWTS Project will also include modifications at the transition and dechlorination facilities, which are adjacent to the Denny Way Regulator Station. The Regulator Station is located in Myrtle Edwards Park, approximately 0.5 miles south of EWWTS at 3155 Alaskan Way. The park is an open space with vistas, public art, bike and pedestrian paths, and shoreline access along Elliott Bay.

Figure 2-1. Denny/Lake Union Service Area

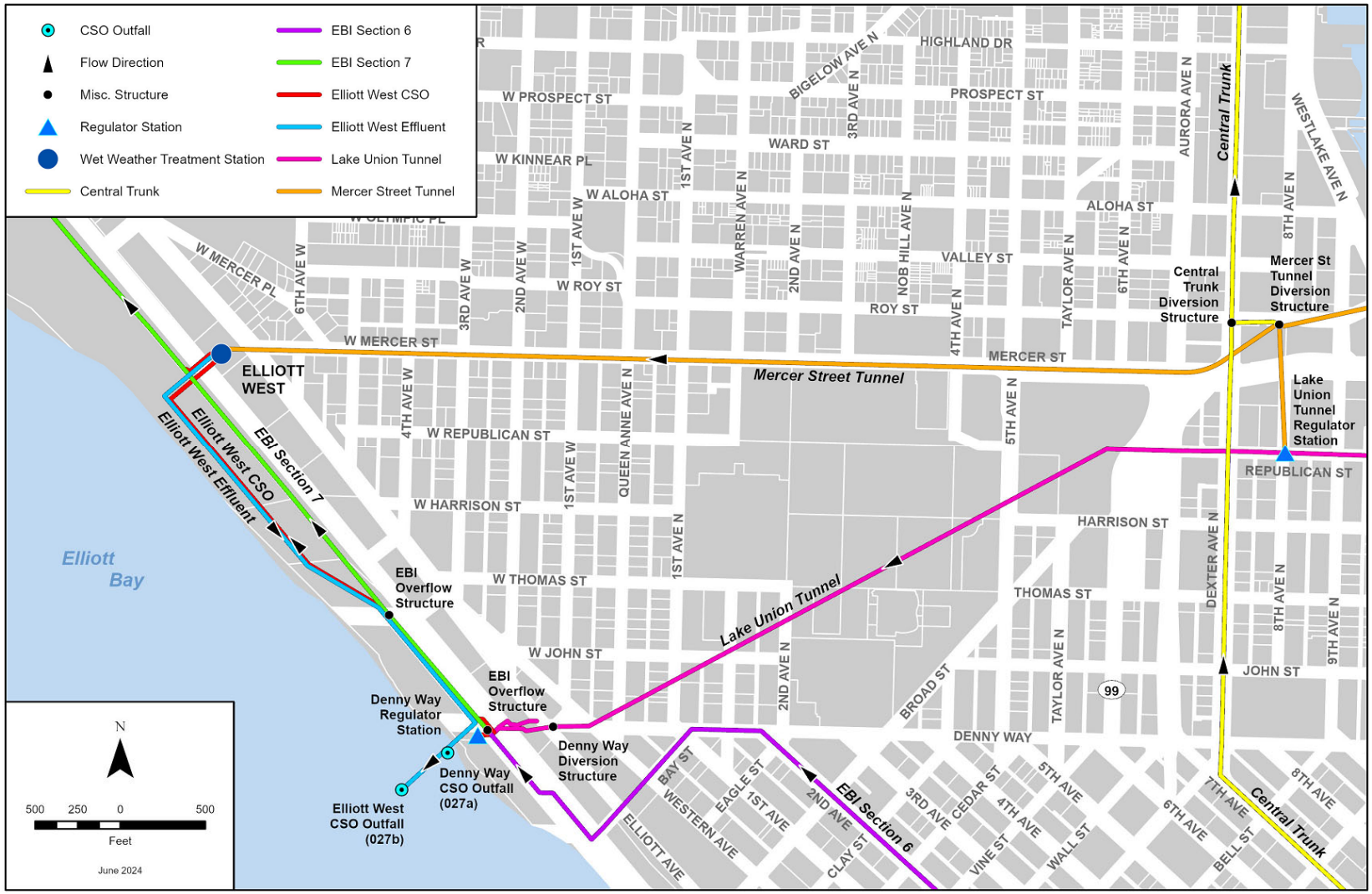


Figure 2-2. Project Site/Vicinity

2.3.2 Topography, Geology, and Soils

Elevations in the Denny/Lake Union CSO Basins range between approximately 40 and 440 feet North American Vertical Datum of 1988 (NAVD88); see Figure 2-3. The highest portions of the service area are the top of Capitol Hill to the east, and the top of Queen Anne Hill to the north. Between these two hills, the topography is relatively flat and slopes southwest toward the shores of Elliott Bay. The large variations in basin topography lead to rapid fluctuations in stormwater inflow to the CSO collection system during heavy rain events.

The surface geology of the basin is presented in Figure 2-4. The Denny/Lake Union CSO Basins are located in the Elliott Bay embayment, formed by erosion of lodgment till as a result of over-compacted glacial sediments. Glacial deposits of till, outwash, and Lawton Clay were deposited and compacted by the Puget lobe of the Cordilleran continental glacier. EWWTS subsurface conditions are based on borings drilled in July 2023. In general, the Project site is underlain by artificial fill and medium/soft sediments with some zones of dense material. Historical land use has included log storage and milling, railways, port activities, commercial, industrial, and residential development.

Groundwater level fluctuation is expected throughout the year depending on climate, tides, and other factors. Generally, the highest groundwater levels occur in late winter and early spring, and lower levels in late summer and early fall. Borings indicated groundwater depths between 9 and 16 feet below ground surface.

It is likely that contaminated soils and groundwater will be encountered during excavation work on the Project site. Prior to construction, shallow subsurface investigations and environmental data reviews will be conducted to characterize soil contaminant conditions. A review of environmental records provided by Environmental Data Resources Inc. and available site records indicate that prior to the current EWWTS being built, the 1.19-acre 601 Elliott Avenue W parcel was occupied by a lumber business from the 1930s to the 1980s. The review also notes that a leaking underground storage tank, which has since been removed from the property, caused diesel-range petroleum hydrocarbons contamination in the soil and groundwater. Previous data indicates that there are still traces of contaminated soils present. The site is listed on Ecology's contaminated sites list. The site's history raises the possibility of additional contamination, particularly from the release of petroleum hydrocarbons and chemical compounds associated with the nearby railroad tracks.

Additional environmental impacts may come from past and current land use within the vicinity of the Project. The 1.77-acre 531 Elliott Avenue W parcel was occupied by a lumber business from approximately 1905 to 1950. Meanwhile, the general area surrounding the Project site (i.e., within a quarter mile) was characterized by numerous upgradient businesses that use, store, or dispense petroleum hydrocarbons. One inactive dry cleaner has reported a suspected release of halogenated volatile organic compounds into soil and groundwater that is upgradient and within a quarter mile of the EWWTS.

During construction of the EWWTS upgrades, the soil will be screened for impacts, and if encountered, contaminated soils will be removed from the work area and transported to a permitted disposal site. Contaminated groundwater removed from work areas will be captured and treated prior to discharge in accordance with all applicable regulatory requirements. Additional mitigation and abatement measures will be followed to protect workers from hazardous materials in accordance with relevant federal, state, and local regulations.

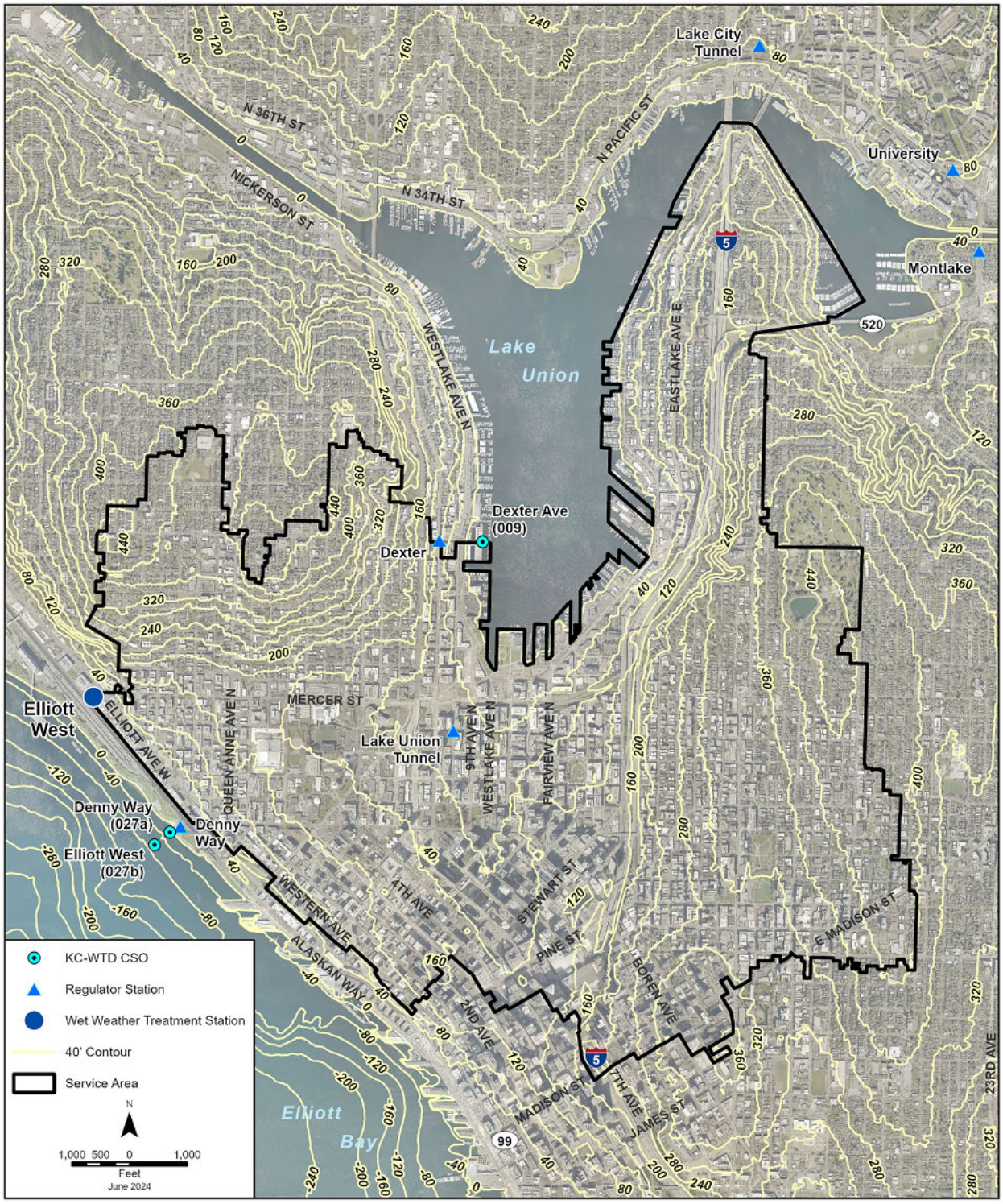


Figure 2-3. Topography

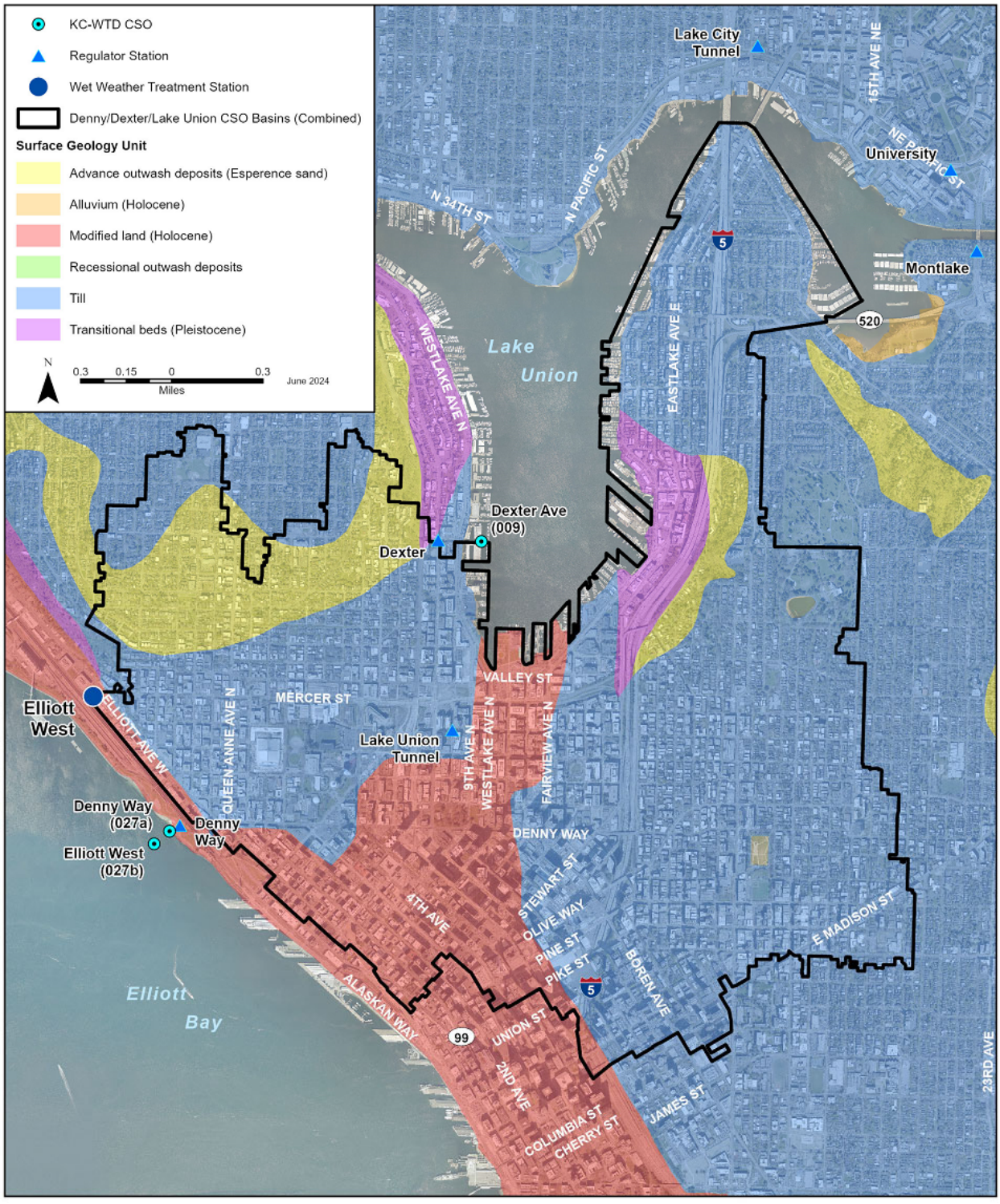


Figure 2-4. Surface Geology Units

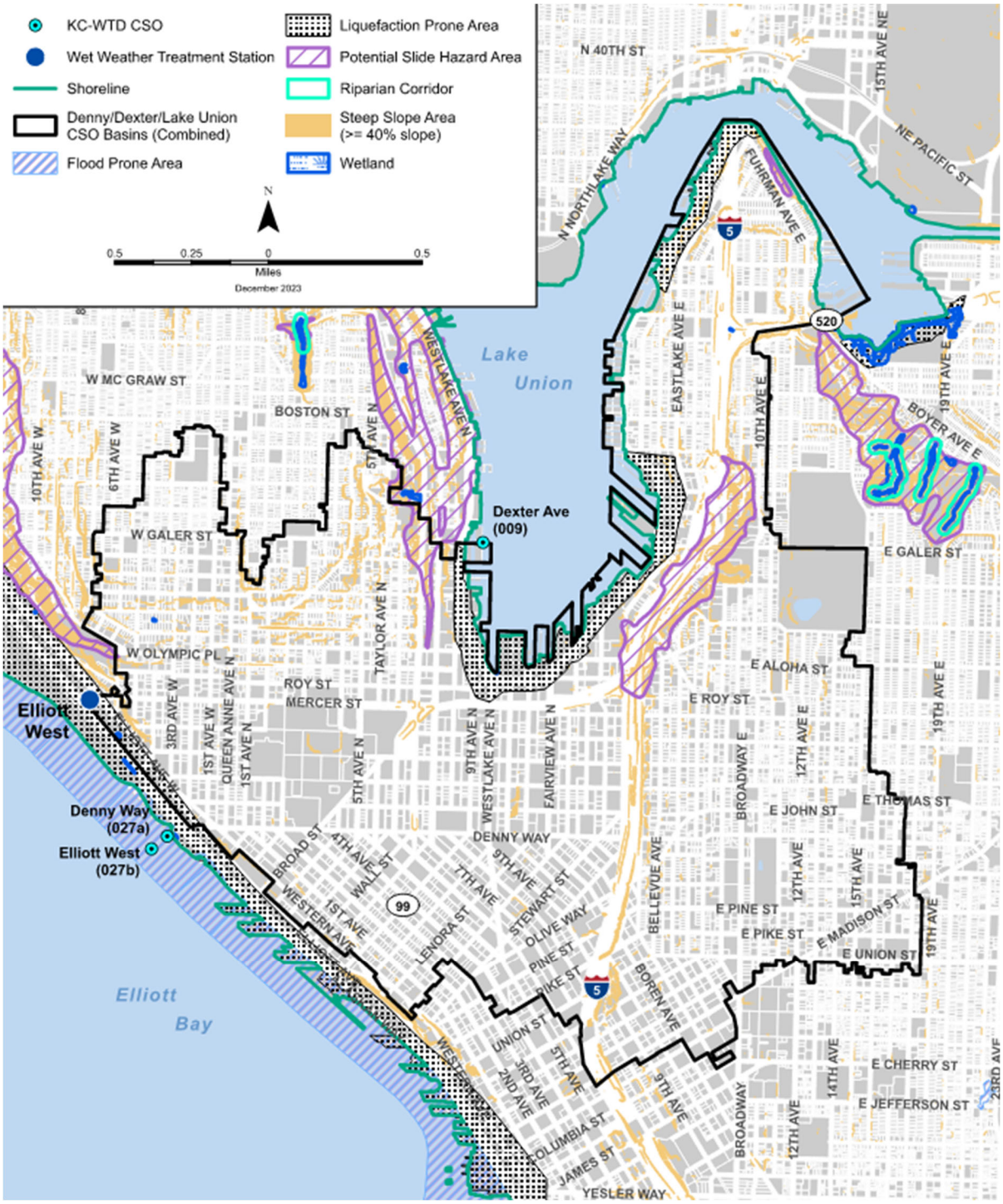


Figure 2-5. City of Seattle Sensitive Areas

Sensitive areas in the Denny/Lake Union Basin, as identified by the County, City of Seattle, and Washington State Department of Natural Resources, are shown in Figure 2-5. Areas prone to liquefaction within the Denny/Lake Union CSO Basins include the southern shoreline of Lake Union and the shoreline of Elliott Bay, including the EWWTS Project site. There are steep slope areas across Elliott Avenue West

from the Project site, along the Interstate 5 (I-5) corridor, and throughout the Queen Anne neighborhood. Areas along I-5 have also been identified as a potential slide hazard area.

Based on the nature of the development around the Project site, it is anticipated that obstructions such as logs, piles, abandoned pipes, industrial debris, and buried tanks are likely to be encountered in excavations and other subsurface work. These potential obstructions, in addition to poor soil conditions, limit the use of trenchless construction for conveyance pipelines.

2.3.3 Climate

The Puget Sound region has moderate weather with mild temperatures and few serious storms. Puget Sound's weather is largely a result of maritime influences and diverse topography. The jet stream typically supplies the area with a steady stream of cool, fresh air off the ocean. This marine flow not only contributes to the mild climate, but also stirs the air, which helps keep pollution from building up in the atmosphere.

Average annual rainfall for the Seattle area is between 38 and 39 inches. The heaviest rainfall occurs in the winter months, with November, December, and January averaging 5 to 6 inches per month. June, July, and August rainfalls each average about 1 inch per month (National Centers for Environmental Information [NCEI], 2023). Historical rainfall is measured at the nearby Seattle-Tacoma International Airport station as shown in Table 2-1.

Table 2-1. Historical Precipitation at Seattle-Tacoma International Airport, 1949 to 2022

Period	Minimum Rainfall (inches)	Maximum Rainfall (inches)	Average Rainfall (inches)
January	0.6	12.9	5.8
February	0.4	9.1	4.0
March	0.6	9.4	3.9
April	0.3	6.5	2.7
May	0.1	3.8	1.8
June	0.1	3.8	1.5
July	0	2.4	0.7
August	0	4.6	1.0
September	0	6.2	1.8
October	0.3	10.1	3.7
November	0.7	15.6	6.1
December	1.4	11.9	5.8
Annual (Year)	***23.78 (1952)***	***55.14 (1950)***	***38.75 (1948 - 2022)***

Source: National Oceanic and Atmospheric Administration National Center for Environmental Information, 2023.

2.3.4 Air Quality

Air quality in Puget Sound is regulated by the EPA, Ecology, and Puget Sound Clean Air Agency (PSCAA). Under the federal Clean Air Act of 1970 (CAA) (42 U.S. Code 7401 et seq.), the EPA established the National Ambient Air Quality Standards (NAAQS), which specify maximum concentrations for carbon monoxide (CO), particulate matter less than 10 micrometers in size (PM_{10}), particulate matter less than 2.5 micrometers in size ($PM_{2.5}$), ozone, sulfur dioxide, lead, and nitrogen dioxide (NO_2). These regulated pollutants are referred to as criteria pollutants.

The EWWTS Project site was previously located within a maintenance area under the EPA classifications for ozone, PM_{10}, and CO (Ecology, 2015). A maintenance area is an area where the NAAQS for these criteria pollutants were violated in the past but are now being met and closely monitored under a State Implementation Plan (SIP) to reach air quality standards. Maintenance areas are effective for 20 years. The Maintenance areas for ozone and CO ended in 2016, and PM_{10} ended in 2021. As the Project site is within a previous maintenance area under the EPA classifications for ozone, PM_{10}, and CO, the EWWTS Project is no longer subject to the requirements of the SIP.

In the Puget Sound area, the main sources of air pollution are internal combustion engines, wood burning stoves, road dust, industrial emissions, and wildfire smoke. According to PSCAA (2021), air quality in the County was generally good in 2021 (the year with most recently published data). The air quality index rating in the County was “good” for 84.1 percent of the year, “moderate” for 14.8 percent of the year, and “unhealthy for sensitive groups” for under 1 percent of the year. Sensitive receptors located within the Plan area jurisdictions and adjacent to the Plan area are shown in Figure 2-5. While overall air quality has improved in the last two decades, the levels for fine particles were only met in 2021 when days of wildfire smoke were excluded from the data. As such, elevated fine particle levels ($PM_{2.5}$) and wildfire smoke remain a great concern for air quality in the region, in addition to ozone levels (PSCAA 2021). Air quality in the Project area, based on monitoring data from a nearby site, is generally good.

Air quality data are collected by the PSCAA and Ecology Northwest Region at several monitoring locations in the Seattle area. Air quality data for the monitoring site nearest to the Project site was obtained from the EPA Air Data database (EPA, 2023a). The monitoring site (Seattle - 10th and Weller) used is at 10th Avenue S and S Weller Street near 1001 S Weller Street (approximately 2.8 miles southeast of the Project site) in Seattle, Washington. The latest data from the Seattle - 10th and Weller site were obtained for the gaseous pollutants: $PM_{2.5}$, NO_2, and CO. Table 2-2 shows the latest maximum concentrations (as of December 2023) for these pollutants at the Seattle - 10th and Weller site based on EPA’s database (EPA, 2023a).

Table 2-2. Air Pollutant Concentrations at 10th & Weller Monitoring Site

	Standards	Latest Maximum Concentration[a]
NO_2 (1-hour)	100 ppb	56.7 ppb
CO (1-hour)	35 ppm	1.1 ppm
CO (8-hour)	9 ppm	0.9 ppm
$PM_{2.5}$ (24-hour)	35 µg/m^3	27.5 µg/m^3

Source: EPA Air Data Air Quality Monitors, 2023a.

[a] Latest maximum concentration in 2023; date of maximum concentration varies per pollutant.

ppb = parts per billion

ppm = parts per million

µg/m^3 = micrograms per cubic meter

The maximum NO_2, CO, and $PM_{2.5}$ concentrations are 94, 96, and 20 percent below the NAAQS standards, respectively.

Emissions due to Project construction will consist of mobile equipment exhaust and fugitive dust from excavation and other earthmoving activities. The exhaust emissions will be intermittent and spread across the site and are not expected to affect the attainment status of the Project area. Once the facility is in operation, it is estimated that it will be in operation 15 to 20 times per year. During such events, one or two staff may be needed for operations on-site. In between such events, County staff will perform daily facility checks. Both operational and maintenance staff would generate a very small number of vehicle trips for these operational phase activities. The existing standby generator at the Denny Way Regulator Station is below the size threshold where an air operating permit is required. The County will work with PSCAA to comply with air quality regulations if required for the new generator as part of this Project.

The current EWWTS wet well shares a common headspace with the EBI control structure and Mercer Street Tunnel. Influent flows and pumping causes turbulence that increases the potential of odorous hydrogen sulfide (H_2S) emissions. The existing EWWTS has two independently operated odor control systems. These systems mitigate potential odors from the wet well and pump discharge channel. The odor control system consists of a network of ducting, four deep bed odor control units, and four exhaust fans.

2.3.5 Water Resources

The EWWTS is located in Water Resource Inventory Area (WRIA) 9, within the Nearshore Sub watershed. This subbasin has been identified as highly impacted by residential, commercial, and industrial development resulting in poor habitat quality. Approximately two-thirds of WRIA 9 shoreline is armored, which has disrupted natural sediment delivery and transport. The highest intensity development is located along the industrial and commercial shores of Elliott Bay (WRIA 9, 2021), including the EWWTS Project area.

While Elliott Bay is the receiving water body for the EWWTS, this Project is also designed to alleviate CSO overflows to Lake Union. Lake Union is located in the northeast portion of the Denny Basin. Lake Union is a heavily modified water body, serving as a mid-point of the migration route utilized by salmon, commercial vessels, barges, and recreational boaters between Lake Washington and the Puget Sound. The urban lake is used for commercial and recreational passages and moorage. Historically, the lake has

been a destination for both sediment and contaminants. Heavy industrial activity in the 1900s left lasting effects on Lake Union's water quality. Although large improvements have been made, elevated temperatures, dissolved oxygen deficits, metals, fecal coliform, and polycyclic aromatic hydrocarbons have been detected in water quality monitoring efforts.

Elliott Bay is a tidally influenced marine water body that is part of the Central Puget Sound Basin. Elliott Bay supports numerous uses. WAC 173-201A-612 lists the uses for Elliott Bay as follows:

- Aquatic life use: Excellent.
- Recreational use: Primary Contact.
- Harvest use: All (except shellfish harvesting is closed in Elliott Bay).
- Miscellaneous uses: Aesthetics, boating, commerce/navigation, and wildlife habitat.

Elliott Bay is on Ecology's 303(d) list of impaired and threatened water bodies as defined in the CWA, 33 U.S. Code 1251 et seq. The waterway is listed for multiple Category 5 parameters at various sites near the Project site, meaning water quality standards have been violated for these pollutants, and there is currently no total maximum daily load in place. These parameters, listed by medium, are shown in Table 2-3.

Table 2-3. Elliott Bay Category 5 303(d) Listings by Medium

Water	Sediment	Tissue
Bacteria - Fecal Coliform	Mercury	Benzo(a)anthracene
Bacteria - Enterococci	Acenaphthene	Benzo(a)pyrene
	Arsenic	Benzo(b)fluoranthene
	Cadmium	Benzo(k)fluoranthene
	Copper	Chrysene
	Dibenzofuran	Indeno(1,2,3-cd)pyrene
	Fluorene	Polychlorinated Biphenyls
	Lead	2,3,7,8-TCDD (Dioxin)
	Low Molecular Weight Polycyclic Aromatic Hydrocarbons	Methyl Mercury
	High Molecular Weight Polycyclic Aromatic Hydrocarbons	
	Phenanthrene	
	Polychlorinated Biphenyls	
	Phenol	
	Silver	
	Zinc	

Source: Ecology, 2024.

The sediments adjacent to the Denny Way Regulator Station overflow, which is in the vicinity of the EWWTS discharge, were part of a County led interim cleanup action conducted under an Agreed Order with Ecology. The cleanup action was completed in 2008. Approximately 14,000 cubic yards of sediment was dredged from nearshore areas in the immediate vicinity of the former Denny Way Regulator Station

Overflow at the shoreline. The dredge area was backfilled and armored along the shoreline with additional placement of clean sand around the perimeter of the dredge prism to address potential dredging residuals. The sediments around the EWWTS and Denny Way Regulator Station overflow outfalls are currently undergoing long-term monitoring to meet Biological Opinion requirements of the Elliott West outfall construction and confirm the effectiveness of the remedial action. Sediments around the perimeter of a cap placed in 1990 offshore of the 2008 cleanup area still exceed the sediment management standards (Chapter 173-204 WAC) and are being evaluated for additional cleanup actions by the County (King County 2018b). Sediment monitoring efforts are required for 20 years, and Year 20 monitoring is scheduled to occur in 2025.

The National Wetland Inventory (NWI) shows a 0.4-acre *Freshwater Emergent Wetland* habitat (PEM1A) mapped approximately 50 feet south of the Denny Way Regulator Station at Myrtle Edwards Park, as shown in Figure 2-5. This subclass is found only in the Estuarine and Palustrine systems that are inundated by brief periods of surface waters and a water table well below the ground surface. This palustrine emergent wetland occurs in tidal areas where salinity due to ocean-derived salts is below 0.5 parts per thousand. This wetland was not observed during the site visit to the Denny Way Regulator Station in August 2023. NWI also shows a *freshwater emergent wetland* (PEM1/SSA) or scrub-shrub (SS) measuring 0.12 acre within the railroad corridor. This wetland habitat is generally dominated by woody vegetation less than 6 meters (20 feet) tall. Other identified wetlands are located outside of the Project area.

As introduced earlier, groundwater depth is assumed to be 5 feet below grade. Most groundwater is found perched on glacial till in sand and gravels associated with glacial outfall deposits. Groundwater recharge is limited by extensive coverage of pavement and buildings. It is likely that groundwater near and around Elliott Bay varies with the tides and is located at shallow depths.

2.3.6 Cultural Resources

The Project rests within an area that the Washington State Department of Archaeology and Historic Preservation's (DAHP) predictive model designates as highly likely to contain archaeological deposits. This assessment is made according to a variety of factors including aspect, slope, and proximity to water.

A literature review of the Washington Information System for Architectural and Archaeological Records Data and other cultural and environmental documents revealed that 35 cultural resource surveys, 10 archaeological resources, 14 registered historic properties, and 2,303 historic properties had previously been recorded within 1 mile of the project area of potential effects (APE). No previously recorded archaeological sites, cemeteries, or eligible/listed National Register of Historic Places or properties are within the APE itself. Archaeological monitoring for the Project was carried out during subsurface investigations conducted in 2023, totaling 9 days of monitoring over a 1-month period. One significant cultural resource was discovered during archaeological monitoring (Stell 2023). One Seattle landmark and two historic properties are located within the Project area and are shown in Figure 2-6.

Figure 2-6. Cultural Resources

2.3.7 Endangered and Threatened Species and Habitats

The EWWTS Project site is located within the highly urbanized Seattle metropolitan area. Surrounding land uses are characterized by industrial and commercial development. The natural habitat in the Project area has been extensively altered by human activity, and little undeveloped land lies within the Project area. No threatened and endangered species are listed at the Project area and there is no suitable habitat for threatened or endangered species at or adjacent to the Project area (see Section 2.3.7.2). Nearshore areas adjacent to the Project area provide foraging and resting habitat for terrestrial species and other migratory birds and nesting habitat for migratory birds.

2.3.7.1 Habitat

The overall habitat of the proposed EWWTS Project site is developed with two areas of mixed deciduous and coniferous trees on the north and south perimeters of the EWWTS Project site. Trees bordering the north are associated with a drainage swale. Trees to the south generally measure greater than a 6-inch diameter at standard height, number more than 20 trees, and may be considered a grove per City of Seattle Tree Protection Code (Seattle Municipal Code [SMC] 25.11). The trees are adjacent to a down sloping grassy area. At the bottom of the slope there are two very small areas with creeping buttercup (Ranunculus repens), a King County Weed of Concern with a facultative wetland classification. No wetland plants were present in these two small areas during a site visit in August 2023. Ornamental shrubs and ruderal vegetation were also observed on the parcels. The surrounding area is highly developed with the exception of Kinnear Park, located approximately 456 feet north of these parcels. Kinnear Park is a City of Seattle environmentally critical area (ECA)9 - Wildlife Habitat.

The EWWTS Project site has a few blackberry bushes (*Rubus* spp.), which are classified by the County as a nonregulated Class C noxious weed, along the railway fence line. Three giant hogweed (*Heracleum mantegazzianum*, a regulated Class A noxious weed) occurrences were shown south of the proposed EWWTS location on Elliott Avenue West, with a closed status (King County, 2023b). Several poison hemlock (*Conium maculatum*) occurrences are reported, which are a regulated Class B noxious weed with a status of controlled, within Kinnear Park.

The Denny Way Regulator Station is located within Myrtle Edwards Park on the Elliott Bay shoreline. The northeast area is characterized by horsetail species, creeping buttercup, and weedy species. This area also has a layer of wood chips. The south and east vegetation includes grasses and weedy species, and to the west lawn and an area covered with wood chips. The outfall pipe runs east to west on the north side of the building and a pavilion or viewing area is on the west portion of the parcel. The east and west areas of the parcel consist of grasses, forbs, and shrubs with Elliott Bay to the west. Myrtle Edwards Park is characterized by impervious paths, grasses, trees, and shrubs. These species are generally non-native and planted for their aesthetic value for park users. The Elliott Bay shoreline is lined with hard armoring (riprap), and a small gravelly pocket beach is adjacent to the Denny Way Regulator Station parcel.

A Washington Department of Fish and Wildlife (WDFW) Priority Habitats and Species (PHS) query of the study area documents estuarine, estuarine and marine deepwater, and estuarine and marine wetlands along the Elliott Bay shoreline, and freshwater emergent wetlands within the BNSF railroad property (WDFW 2023a). Patchy kelp habitat is documented at Myrtle Edwards Park shoreline (Ecology 2023). The United States Fish and Wildlife Service (USFWS) documents a freshwater emergent wetland approximately 50 feet from the Denny Way Regulator Station (USFWS 2023). However, there was no evidence of a wetland in this area during a site visit on August 9, 2023.

The nearshore portion of the study area may support macro-algae, including kelp species. Elliott Bay provides habitat for marine aquatic species including salmonids and other fish species, marine mammals, marine benthic species, and Myrtle Edwards Park provides foraging and resting habitat for terrestrial

species including great blue heron and other migratory birds and nesting habitat for migratory birds. Marine shoreline habitat along Elliott Bay has been dramatically reduced due to shoreline armoring. This has reduced foraging areas and opportunities for migratory species within the Bay. The degradation of marine shorelines and associated ecological functions has implications not only for Chinook salmon recovery, but also for the Endangered Species Act (ESA) listed southern resident orca population. Shoreline armor, especially along feeder bluffs, disrupts sediment supply and transport, altering nearshore habitat quantity and quality. Shoreline land use ranges from recreational, commercial, and industrial waterfront in Elliott Bay, leaving limited shoreline areas for foraging and spawning.

2.3.7.2 Endangered and Threatened Species

A query of the USFWS Information for Planning and Consultation (IPaC), for ESA-listed species on or near the site, showed no known endangered or threatened species at the Project site or the Denny Regulator Station site (USFWS 2023a). Proposed Threatened North American wolverine (*Gulo gulo luscus*) and yellow-billed cuckoo (*Coccyzus americanus*) were listed for the study area. However, there is no suitable habitat for these species in the study area or in proximity to the study area. The yellow-billed cuckoo is a very rare migrant, and the last documented nesting occurrence in the County was in 1923 in Renton (WDFW 2017). The federally listed threatened Marbled Murrelet (*Brachyramphus marmoratus*) also overlaps the Elliott Bay portion of the study area, and while rare, may be present within Elliott Bay. There is no nesting habitat for marbled murrelet. Bull trout (*Salvelinus confluentus*) and designated critical habitat overlaps the Elliott Bay nearshore portion of the study area (SPU, 2015b).

The City of Seattle's Seattle Biological Evaluation (2015) was referenced for National Marine Fisheries Service-managed species that may be in the study area. The following species may occur in Elliott Bay adjacent to the study area:

- Threatened Puget Sound Chinook Salmon (*Oncorhychus tshawytscha*), nearshore designated critical habitat.
- Endangered southern resident killer whale (*Orcinus orca*) and designated critical habitat (waters of Puget Sound greater than 6.1 meters deep).
- Threatened humpback whale (*Megaptera novaeangliae*).
  - Mexico distinct population segment (DPS).
  - Endangered Central America DPS.
- Threatened eulachon (*Thaleichthys pacificus*).
- Endangered Bocaccio (*Sebastes paucispinis*) and nearshore designated critical habitat.
- Threatened canary rockfish (*S. pinniger*).
- Threatened yelloweye rockfish (*S. ruberrimus*).

A query of the WDFW PHS site shows Pacific herring, a state candidate, in the shoreline and marine areas of the study area (WDFW 2023a). Pacific sand lance, no state or federal status, may also be within the study area. Both Pacific herring and Pacific sand lance are important forage fish species for federal listed species Chinook salmon, steelhead, bull trout, and marbled murrelet.

2.3.7.3 Fish and Wildlife

The study area is within a highly urbanized landscape, which is developed with commercial, industrial, and high-density residential land uses. It lacks significant open spaces or wildlife habitat except for the shoreline of Elliott Bay. Wildlife species that may inhabit the study area are likely limited to those species

acclimated to human intrusion and development. Upland areas within the study area may provide habitat for small mammals and bird species acclimated to urban city habitats. Bird species may include American crow (*Corvus brachyrhynchos*), black-capped chickadee (*Poecile atricaphillus*), and rock pigeon (*Columba livia*), as well as various gull and songbird species. These species frequently nest, roost, and forage in highly developed urban settings. The study area is within the Pacific Flyway, a major migration route for birds. Types of small mammals which may inhabit the study area's urban open spaces and limited greenways include rabbits (*Oryctolagus* species), deer mice (*Peromyscus* spp.), Norway rat (*Rattus norvegicus*), and opossum (*Didelphis virginiana*). During the site visit the following species were observed: rabbit, black-capped chickadees, Anna's hummingbird (*Calypte anna*), rock pigeons, crows, and gull species.

Myrtle Edwards Park is located on the shoreline of Elliott Bay. Marine habitat is available for aquatic bird species such as pigeon guillemot (*Cepphus columbus*), double crested cormorant (*Phalacrocorax auritus*), and goldeneye (*Bucephala species*) and large wading birds such as great blue heron (*Ardea herodias*). The shoreline and marine aquatic habitat are used by bird species primarily for foraging and resting. The marine estuarine and deepwater habitat provides habitat for over 100 species of fish (e.g., sole, starry flounder, sculpin, perch, herring, smelt), and the pocket beach at Myrtle Edwards Park is documented herring spawning habitat (WDFW 2023). Salmonid species use Elliott Bay for migration to the Duwamish and Green Rivers. Aquatic mammals observed from Myrtle Edwards Park include harbor seal (*Phoca vitulina*), killer whale (*Orcinus orca*), and river otter (*Lontra canadensis*).

2.3.8 Public Health

CSOs are a public health concern since they carry pollutants, primarily in the form of untreated sewage and stormwater, into water bodies. The EWWTS Project will reduce the frequency of CSOs at the Denny Way CSO Outfall to an average of no more than one untreated discharge per year on a 20-year moving average.

2.4 Land Use and Demography

Current land use and population in the Denny Basin and Lake Union area are described in the following subsection. Future land use and population projections are presented in Chapter 3 of this Engineering Report. Denny Basin and Lake Union Area demography and land use are further described in the *City of Seattle Comprehensive Plan - Toward a Sustainable Seattle* (City of Seattle, 2005).

2.4.1 Land Use and Zoning

Historically, the EWWTS site has been occupied by a lumber business which operated from the 1930s to the 1980s. This was prior to development of the current CSO facility. Existing land use at the site is a public utility, which is consistent with local government zoning and comprehensive plans and policies. The site is designated within the Ballard/Interbay Northend Manufacturing and Industrial Center and is currently zoned as Industrial and Maritime (II U/85). Figure 2-7 shows the current zoning designations for the site and CSO basins.

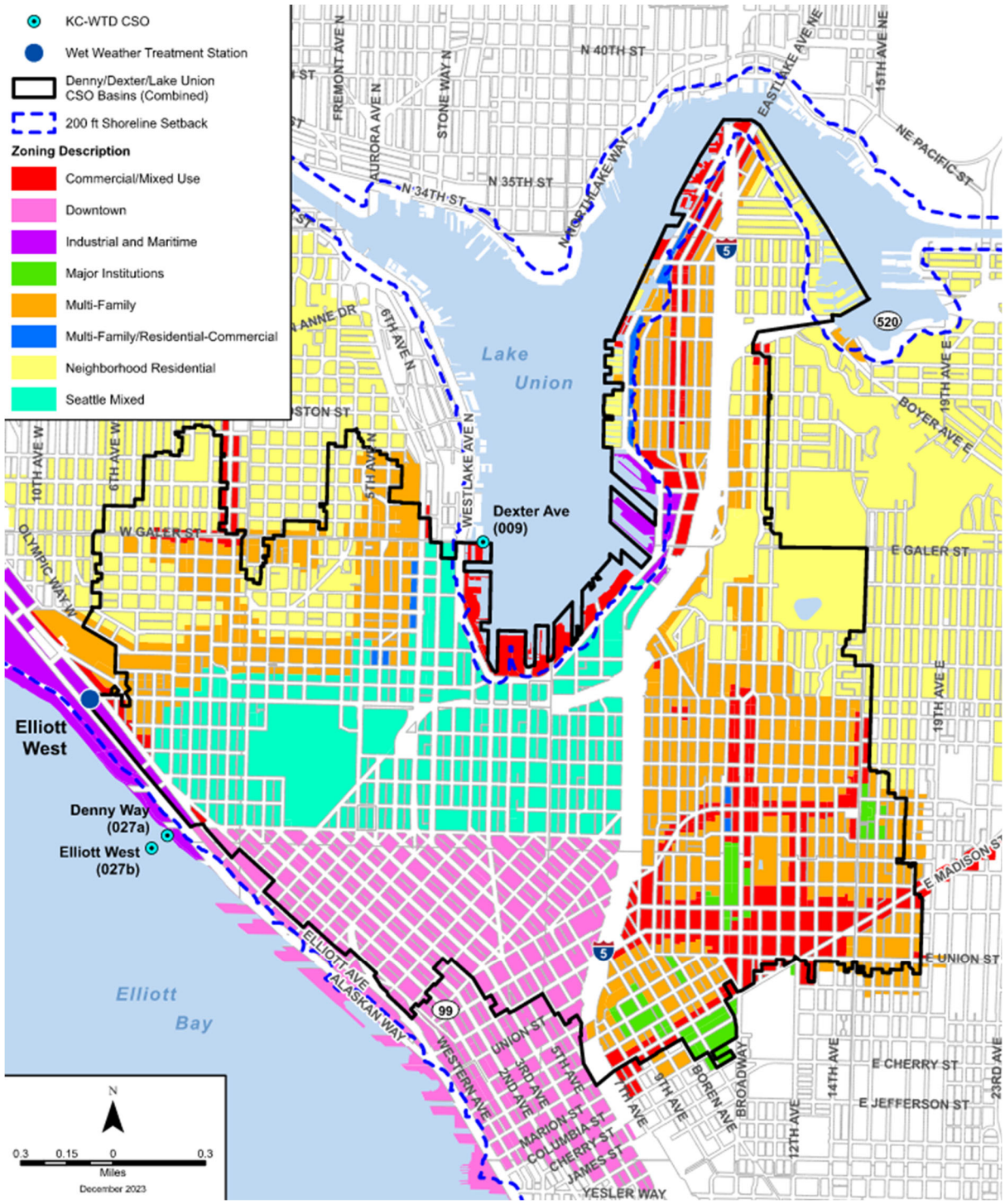


Figure 2-7. Zoning

At present, the EWWTS site is constrained by adjacent properties and assets, including multi-story offices on the north and south side, a heavily used multi-lane arterial road on the east side, and the BNSF Railway's corridor on the west side. The area surrounding the EWWTS is mixed use, with businesses, offices, residential, and industrial users nearby. The parcel to the south of the existing EWWTS facility,

owned by King County WTD, is currently occupied by the Elliott Avenue Modular Pilot Project, now known as the Bridge Shelter. The Bridge Shelter is an interim use for this property and provides temporary housing and service resources to people experiencing homelessness. The Bridge Shelter was initially established in 2020 by King County Facilities Management Division (FMD) in partnership with the King County Department of Community and Human Services at the direction of King County Executive Dow Constantine. The initial plan for the Bridge Shelter was to operate for 2 years (2020 through 2022), noting that the use of the parcel was temporary. Currently, King County has a special-use permit in place with King County Regional Homeless Authority (KCRHA) for Bridge Shelter operations.

The effluent line is located within Myrtle Edwards Park. The outfall parcel, while not having an official address, is approximately near 3155 Elliott Avenue, also within Myrtle Edwards Park. The conveyance system passes southwest out of the EWWTS site, through a railroad right-of-way, slim private railroad parcels among the rights-of-way, and continues southeast through public open space parcels for the majority of its extent.

The effluent conveyance system spans into the shoreline district where the pipes enter Myrtle Edwards Park, and within 200 feet of Elliott Bay. The pipes run through the following shoreline environments regulated under the City of Seattle's Shoreline Master Program: Urban Industrial, Urban General, Conservancy Management, and Conservancy Recreation. The outfall parcel occupies the Conservancy Recreation and Conservancy Management shoreline environments.

Land use patterns beyond the EWWTS Project site but within the basin include commercial/residential, cultural/entertainment, education/childcare, government/public service, historic property, industrial, medical/dental, miscellaneous, parks/open space, religious/cemetery, school/childcare, single family, social services, utility, and vacant uses. Figure 2-8 presents existing land use of the Denny/Lake Union CSO Basins. Table 2-4 summarizes the land use acreage for the basins.

The Project will be constructed in a heavily developed area with a full range of underlying utilities including electrical, telecommunications, natural gas, sewer, stormwater, and water. Figure 2-9 shows utilities in the Project area. During project design, existing utilities will be identified and impacts to utilities will be avoided to the extent possible. However, it is likely construction will require some utility relocations necessitating close coordination with service providers to minimize interruptions in service during construction.

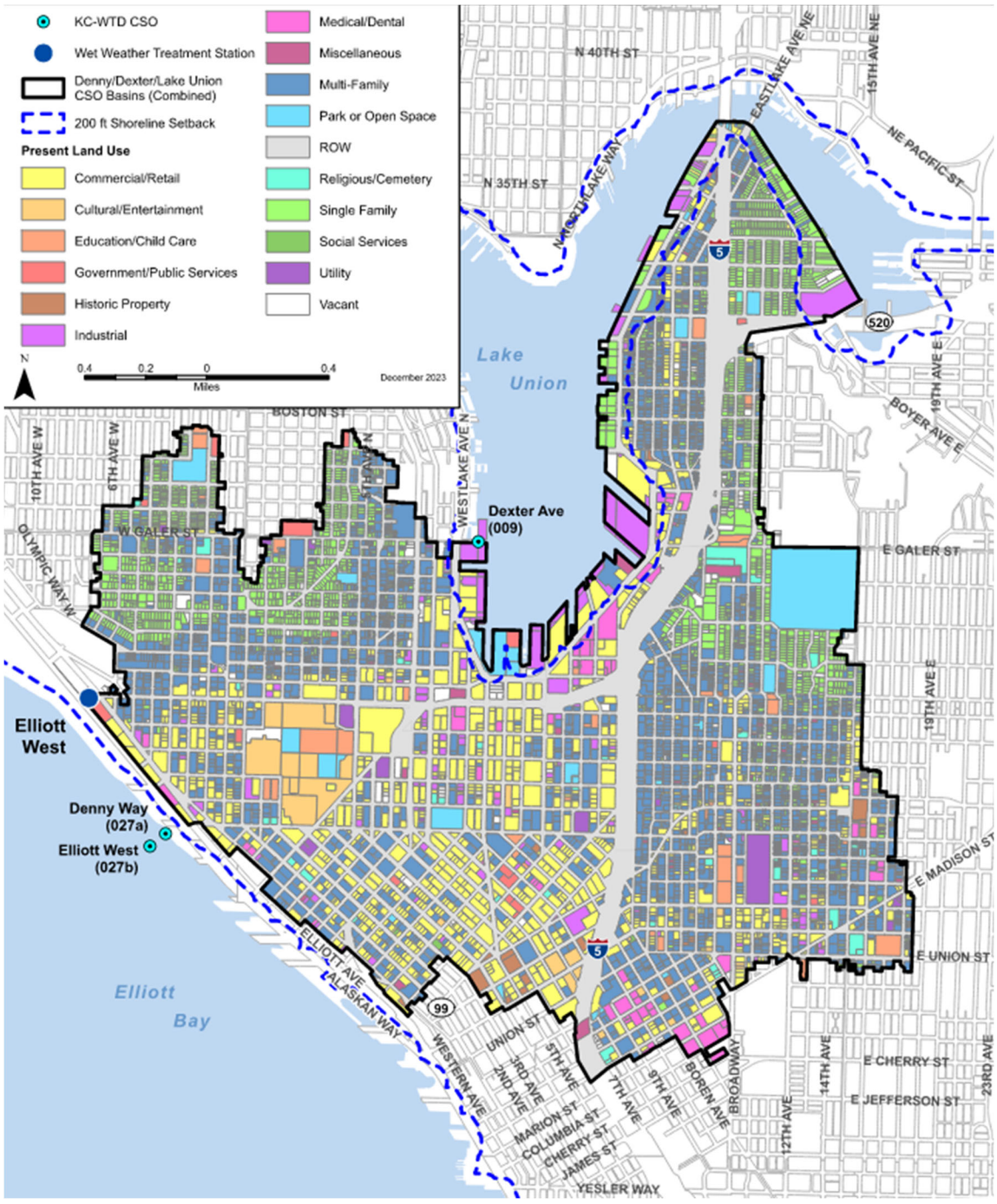


Figure 2-8. Present Land Use

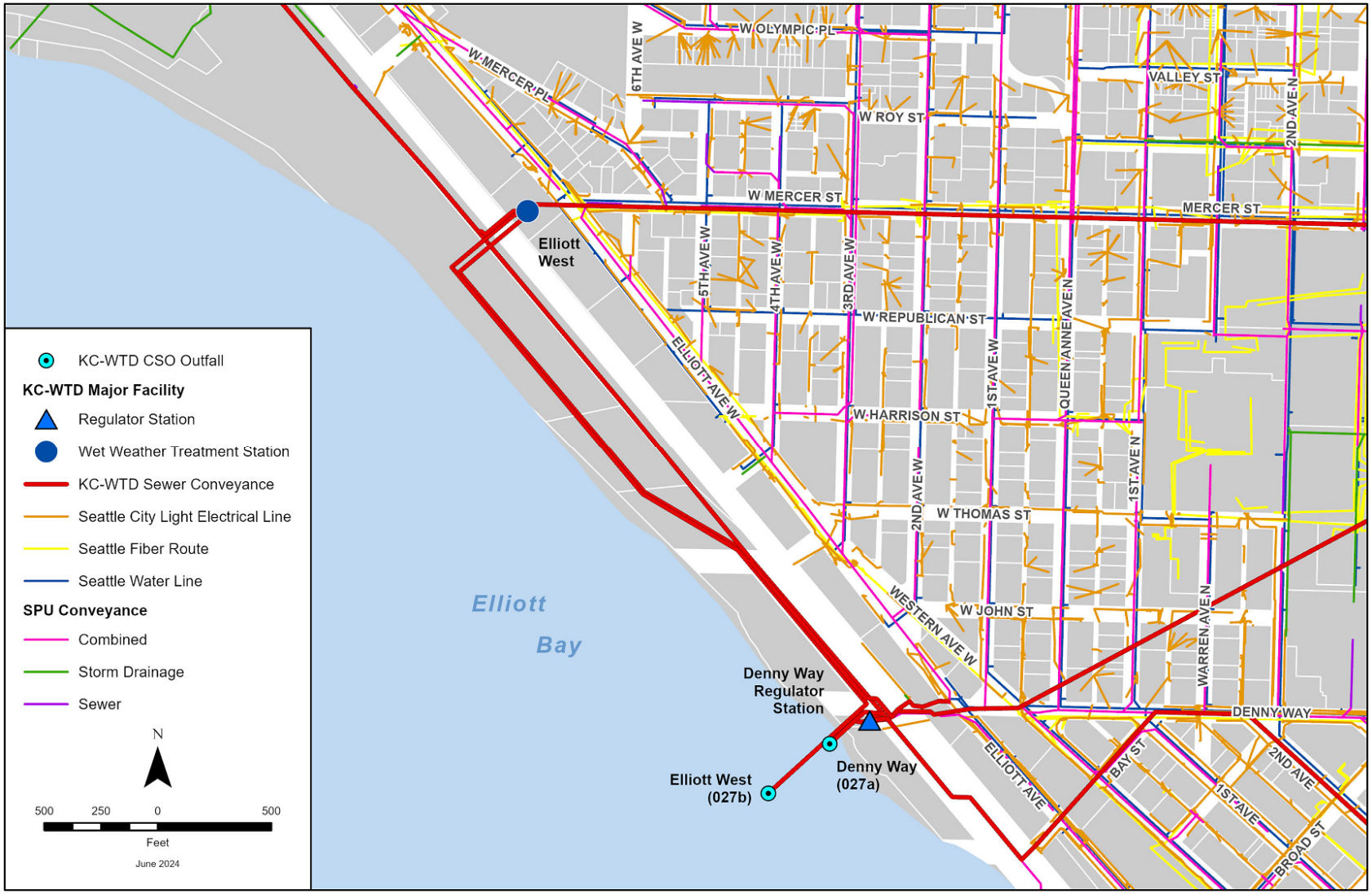


Figure 2-9. Utilities

Table 2-4. Land Use for Denny/Lake Union Basin

Land Use	Area (acres)	Percent of Total
Commercial/Retail	374	14%
Cultural/Entertainment	60	2%
Education/Childcare	40	1%
Government/Public Service	12	0%
Historic Property	12	0%
Industrial	80	3%
Medical/Dental	43	2%
Miscellaneous	13	0%
Multi-Family	603	22%
Park or Open Space	103	4%
Right-of-Way	998	36%
Religious/Cemetery	60	2%
Single Family	273	10%
Social Services	2	0%
Utility	22	1%
Vacant	40	1%
Total	**2,736**	**100**

Figure 2-10 shows the transportation network in the Denny/Lake Union area, including arterials, railroad, and multi-use trails. There are no accessibility or traffic issues at the current facility. However, recent modeling shows that multiple conflicts may occur with an expanded EWWTS, and additional support columns associated with the planned ST light rail extension project. It is likely that accessibility and traffic will be negatively impacted due to additional vehicles carrying workers and materials to and from the Project area that do not contribute to the existing flow of traffic. These traffic impacts will be temporary. However, the County and ST must coordinate on necessary revisions and alternative specific site-access analyses to mitigate site access issues.

Workers and materials are expected to travel to and from the site primarily via Elliott Avenue West and Mercer Street and then connect to State Road (SR) 99 and I-5 to go north or south from the site. Smaller amounts of traffic could use Denny Way and Western Avenue. As designed, the proposed EWWTS will generate minimal everyday vehicular traffic unless there is a treatment event, which will require greater operational presence. However, the parking, storage, and small office facilities could result in less than 10 trips per week on a sporadic basis.

Figure 2-10. Transportation

2.4.2 Service Area Population

Table 2-5 shows the estimated service area populations for the Denny Basin and Lake Union Area in the year 2020. The population projections are based on Puget Sound Regional Council data adjusted for the service area.

Table 2-5. Service Area Populations for Denny/Lake Union CSO Basins Areas

Year	Residential (Population)	Commercial (Employees)	Industrial (Employees)
2020	115,675	184,056	8,161

2.4.3 Environmental Justice

Ecology defines environmental justice as the "fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies." This section describes current environmental justice concerns in the Project vicinity. Chapter 8 provides an overview of how the Project team intends to meaningfully involve the community in the proposed Project.

To identify potential environmental justice concerns, the proportion of low-income and minority populations in the Service Area was compared to the City of Seattle census tracts as a whole.

The total minority population in the Service Area census tracts is 36 percent, which is the same percentage for the City of Seattle as a whole. Table 2-6 summarizes the "Population by Race" 2020 Census data, reported at the census tract level for the area. Figure 2-11 illustrates the percentage of minority population in each census tract within the service area.

The parcel to the south of the existing EWWTS facility, owned by WTD, is currently occupied by the Elliott Avenue Modular Pilot Project, now known as the Bridge Shelter. The Bridge Shelter is an interim use for this property and provides temporary housing and service resources to people experiencing homelessness. This project was initially established in 2020 by FMD in partnership with the King County Department of Community and Human Services at the direction of King County Executive Dow Constantine. The initial plan for the Bridge Shelter was to operate for 2 years (2020 through 2022), noting that the use of the parcel was temporary. Currently, King County has a special-use permit in place with KCRHA for Bridge Shelter operations. FMD, who owns the shelter structures, will work to move the shelter when King County WTD needs the parcel for the required regulatory work. Social Services providers will work with residents of the shelter.

In addition, the study area includes the presence of the federally recognized Muckleshoot Indian Tribe and Suquamish Tribe, who use and fish Elliott Bay under their "usual and accustomed" fishing rights.

Table 2-6. Population and Race/Ethnicity

Total Population	City of Seattle 777,801		Study Area[a] 144,776	
White	497,027	63.90%	92,333	63.78%
Black or African American	56,987	7.33%	7,366	5.09%
American Indian or Alaska Native	4,590	0.59%	874	0.60%
Asian	128,702	16.55%	29,366	20.28%
Native Hawaiian or Pacific Islander	1,896	0.24%	292	0.20%
Some Other Race	21,223	2.73%	2,078	1.44%
Two or More Races	67,376	8.66%	12,467	8.61%
Hispanic	59,435	7.64%	9,650	6.67%
Total Minority[b]	280,774	36.10%	52,443	36.22%

[a] The study area includes the Census tracts that intersect the Service Area.

[b] Total minority is calculated by adding the populations for all non-white races.

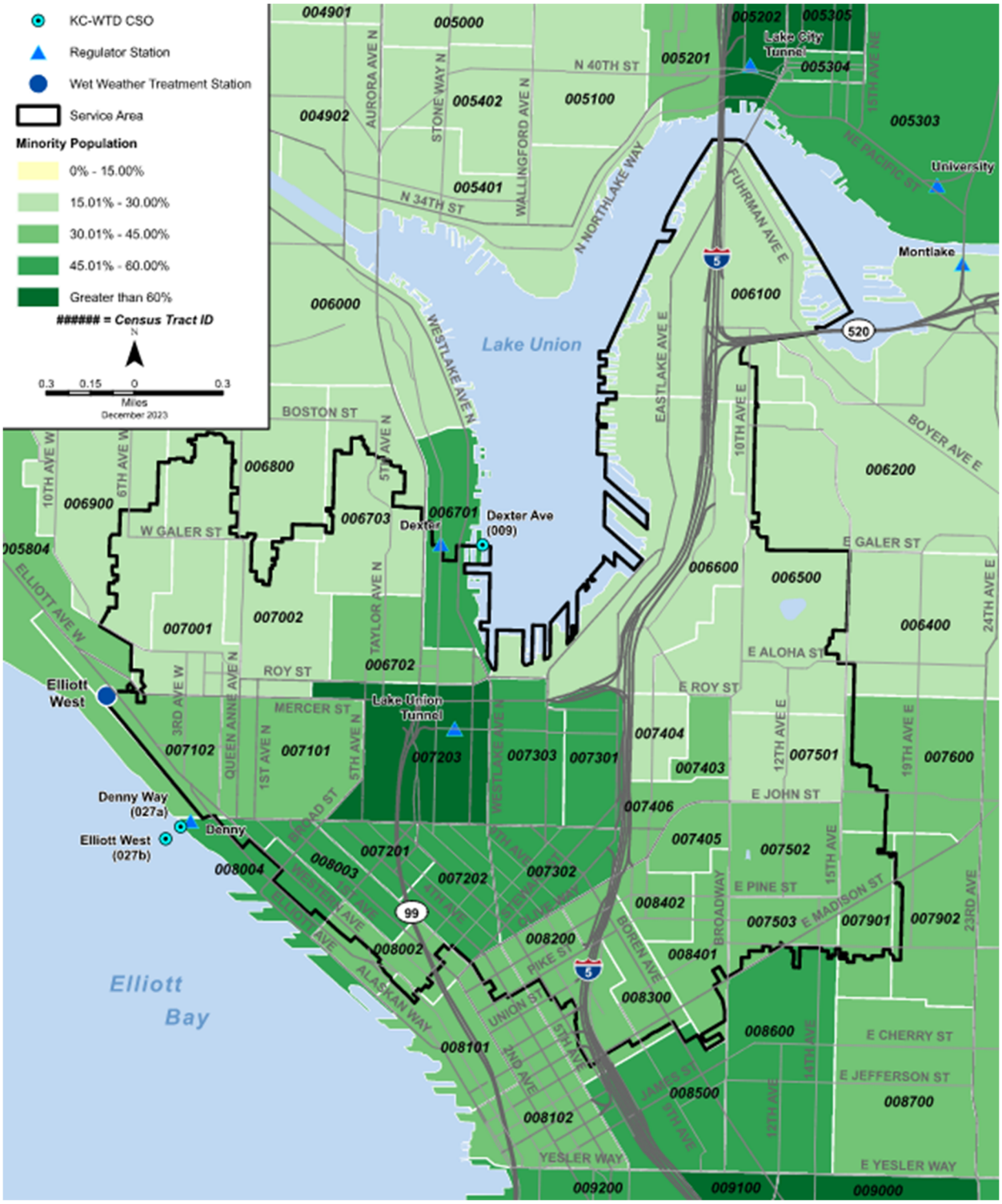


Figure 2-11. Project Area Minority Population

Table 2-7 describes the percentage of low-income residents in the study area who have a household income at or below the federal poverty level (Project area low-income population map reference). Low-income status is determined by the federal poverty threshold, which is set annually by the United

States Department of Health and Human Services. The 2022 federal poverty level for a four-person household was $27,750. To provide a threshold for this analysis, and because of the way 2020 Census median household income data is summarized, any household with an income less than twice the poverty level is considered low income at the census tract level. The 2020 American Community Survey data shows that approximately 18 percent of the population in the study area are reported as being low income, which is comparable to the City of Seattle as a whole. Figure 2-12 shows the percentage of households with median household incomes less than $25,000.

Table 2-7. Population and Poverty

Census Block (King County, WA)	Study Area[a]			
	Population	Number Below 200% Poverty Level	Percent Below 200% Poverty Level	Median Household Income[b]
Census Tract 61	5,658	827	14.6	128,904
Census Tract 64	3,626	467	12.9	167,167
Census Tract 65	4,815	615	12.8	121,546
Census Tract 66	4,334	469	10.8	132,326
Census Tract 67.01	3,411	186	5.5	153,387
Census Tract 67.02	2,922	423	14.5	114,222
Census Tract 67.03	3,085	286	9.3	103,393
Census Tract 68	3,307	167	5.0	148,164
Census Tract 69	4,859	438	9.0	150,139
Census Tract 70.01	3,547	490	13.8	58,088
Census Tract 70.02	3,534	574	16.2	69,613
Census Tract 71.01	2,768	415	15.0	112,258
Census Tract 71.02	2,538	414	16.3	96,154
Census Tract 72.01	5,202	1,667	32.0	109,335
Census Tract 72.02	3,343	313	9.4	173,264
Census Tract 72.03	2,891	454	15.7	120,000
Census Tract 73.01	2,658	668	25.1	91,232
Census Tract 73.02	4,673	687	14.7	132,978
Census Tract 73.03	2,606	385	14.8	123,095
Census Tract 74.03	2,725	462	17.0	85,260
Census Tract 74.04	3,052	467	15.3	97,794
Census Tract 74.05	2,606	686	26.3	76,250
Census Tract 74.06	2,414	625	25.9	56,801
Census Tract 75.01	4,156	1,195	28.8	68,798
Census Tract 75.02	2,359	348	14.8	101,375
Census Tract 75.03	2,275	597	26.2	64,609
Census Tract 76	4,670	910	19.5	120,103

Table 2-7. Population and Poverty

Census Block (King County, WA)	Study Area[a]			
	Population	Number Below 200% Poverty Level	Percent Below 200% Poverty Level	Median Household Income[b]
Census Tract 79.01	2,961	811	27.4	69,510
Census Tract 79.02	3,786	986	26.0	75,074
Census Tract 80.02	4,018	1,014	25.2	102,365
Census Tract 80.03	4,104	599	14.6	108,111
Census Tract 80.04	3,186	215	6.7	180,086
Census Tract 81.01	2,539	684	26.9	87,820
Census Tract 81.02	2,505	740	29.5	107,250
Census Tract 82	4,223	619	14.7	116,250
Census Tract 83	3,292	743	22.6	102,962
Census Tract 84.01	3,048	488	16.0	74,622
Census Tract 84.02	2,536	512	20.2	70,989
Census Tract 85	2,863	757	26.4	72,520
Census Tract 86	5,382	1,743	32.4	66,607
Study Area Total	138,477	25,146	18	167,167[c]
City of Seattle	713,114	133,314	19	105,391
King County	2,210,498	395,938	18	106,326
Washington State	7,478,757	1,761,862	24	82,400

Source: U.S. Census Bureau, 2023.

[a] This table includes data for all populated Census tracts that intersect the Service Area.

[b] Median household income data provided by 2021 ACS 5-year estimate for the Census tracts.

[c] Average median.

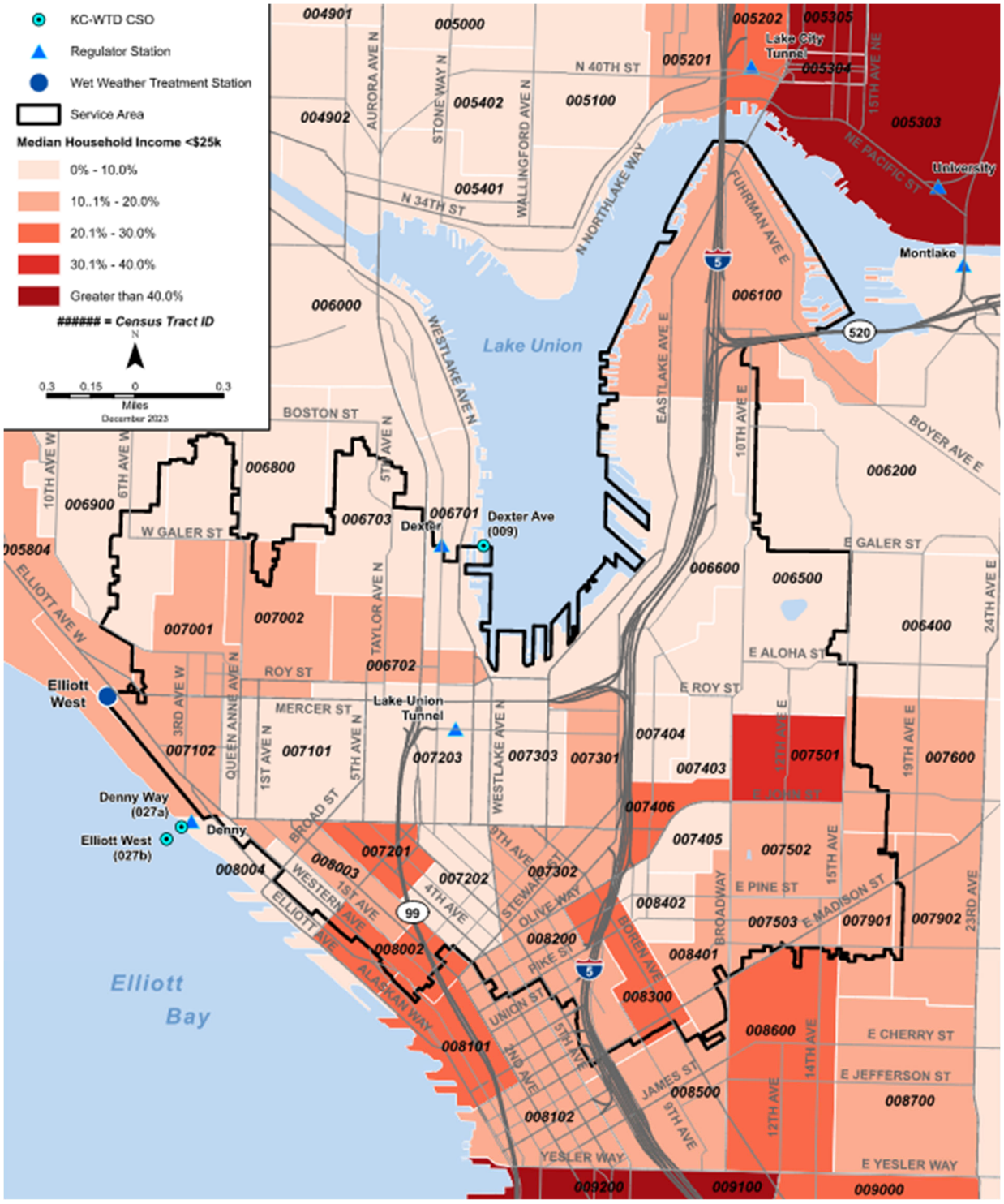


Figure 2-12. Project Area Low-Income Population

The County and City recently completed heat mapping work of each Seattle neighborhood to assess age, mobility/disability, education, unemployment, poverty, and primary languages (City of Seattle, 2023). Table 2-8 summarizes the age, education, and language findings of three neighborhoods in the Project vicinity as well as the City of Seattle overall.

Table 2-8. Age, Education, and Language in Project Vicinity

Neighborhood	Age	Education	Language
Belltown	< 18 years: 2.7% ≥ 65 years: 9.3%	High school or higher: 97.4% Bachelor's degree or higher: 75.1%	Residents speaking a language at home other than English: 30.0%
Interbay	< 18 years: 11.0% ≥ 65 years: 9.7%	High school or higher: 98.7% Bachelor's degree or higher: 72.9%	Residents speaking a language at home other than English: 16.9%
Queen Anne	< 18 years: 10.0% ≥ 65 years: 10.0%	High school or higher: 99.0% Bachelor's degree or higher: 74.4%	Residents speaking a language at home other than English: 17.4%
City of Seattle	< 18 years: 14.5% ≥ 65 years: 12.3%	High school or higher: 95.5% Bachelor's degree or higher: 65.9%	Residents speaking a language at home other than English: 22.1%

2.4.4 Tribal Treaty Fishing Rights

The Muckleshoot Indian and Suquamish Tribe hold treaty fishing rights within Elliott Bay. The treaty rights for Tribes were established in the Treaty of Point Elliott (Governor's Office of Indian Affairs [GOIA], 2023). The fishery catch allowed by Tribal treaty rights were further defined in the 1974 Boldt decision (U.S. v. Washington, 1974), which affirmed that 50 percent of the catch from an area identified as a Tribal usual and accustomed fishing and harvesting area should go to the Tribes with rights for that area as defined in the Treaty of Point Elliott. Usual and accustomed areas for different Tribes often coincide in Washington, as is the case in Elliott Bay.

2.5 Existing West Section Wastewater and Combined Sewer Overflow Treatment System

The County provides wholesale wastewater treatment services to 18 cities, 15 local sewer utilities, and one Indian tribe. The complex regional wastewater system, owned and operated by the County, includes three regional wastewater treatment plants that serve about 1.9 million people within a 424-square-mile service area. The regional service area includes most urban areas of King County and parts of south Snohomish County and northeast Pierce County.

Within the regional service area, the local agencies own and operate independent collection systems, which include pipelines and pump stations to collect and convey wastewater flows in their service area to the County's regional system for treatment and disposal. The local agencies have long-term agreements with the County for this service. The County owns and operates the major sewer interceptors and pump stations that convey sewage collected by local sewer utilities to its regional wastewater treatment plants. The County has divided the service area into two administrative sections and three treatment service areas.

The EWWTS is located within the County's West Section wastewater service area along with the West Point Treatment Plant and other associated regional facilities. Figure 2-13 shows the location of the WPTP along with the 5 wet-weather treatment facilities and 38 untreated CSO outfalls in the West Section. In addition to WPTP, the County's other secondary wastewater treatment plants include South Treatment Plant, Brightwater Treatment Plant, Vashon Treatment Plant, and Carnation Treatment Plant.

Figure 2-13. Combined System Wastewater Infrastructure

The following subsections summarize the existing West Section wastewater system, flows, and loads.

2.5.1 WPTP Summary

WPTP treats domestic, commercial, and industrial wastewater (following any required pre-treatment) and stormwater (from combined sewage flows) from the greater Seattle area before discharging the treated

effluent to central Puget Sound. The plant is located at the western tip of Discovery Park between Shilshole Bay and Elliott Bay as shown in Figure 2-13. Currently, WPTP provides secondary treatment for flows up to 300 mgd and provides primary treatment and disinfection for flows exceeding 300 mgd. The plant's hydraulic capacity is 440 mgd. The WPTP is rated as a Class IV treatment plant, according to regulations. The liquid treatment process includes screening, grit removal, primary clarification, biological treatment using high-purity oxygen-activated sludge, secondary clarification, sodium hypochlorite disinfection, and sodium bisulfite dechlorination. The disinfected effluent discharges to Puget Sound through a multiport diffuser located about 3,600 feet offshore at a depth of about 240 feet below mean lower low water.

For solids treatment, the primary and waste-activated solids are blended in a tank and co-thickened via gravity belt thickeners. The thickened sludge is anaerobically digested and dewatered by centrifuges. The WPTP produces several products including Class B biosolids, which are trucked offsite and used in agriculture and forestry, reclaimed water used for in-plant processes and irrigation, and methane that fuels the raw sewage pump engines and a power generation system.

During wet-weather operation (flows above 300 mgd and up to 440 mgd), the WPTP NPDES permit authorizes CSO-related bypasses of the secondary treatment portion at WPTP when the instantaneous flows to the treatment plant exceed 300 mgd due to precipitation. Wastewater that bypasses secondary treatment must receive solids and floatable removal, primary clarification, and disinfection, and must meet secondary effluent limits. The wet-weather treatment process consists of screening, de-gritting, primary sedimentation in clarifiers, disinfection with sodium hypochlorite in a chlorine contact channel, and dechlorination.

The County reports influent pollutant concentrations in discharge monitoring reports. Table 2-9 summarizes influent wastewater quality for the West Point Treatment Plant for the period between January 2015 and December 2021 (Ecology, 2024). Table 2-10 summarizes the flow, BOD, and TSS projections, as submitted in the County's 2019 NPDES permit application and waste load assessment analysis to Ecology reflected in the final Fact Sheet (Ecology, 2024). The population projections consider planned changes in apportionment of flows between the West Point Treatment Plant, South Treatment Plant, and Brightwater Treatment Plant.

Table 2-9. WPTP Influent Characterization Between 2015 to 2021

Parameter	Units	Average	Maximum	Minimum	95th Percentile
BOD_5 Concentration	mg/L	225	740	32	318
BOD_5 Mass	lbs/day	152,352	408,800	62,609	207,441
$cBOD_5$ Concentration	mg/L	188	485	25	277
$cBOD_5$ Mass	lbs/day	126,856	308,891	53,420	173,515
TSS Concentration	mg/L	234	530	60	325
TSS Mass	lbs/day	163,923	617,555	50,722	250,888

$cBOD_5$ = 5-day carbonaceous biochemical oxygen demand

lbs/day = pounds per day

Table 2-10. Summary of WPTP Flow, BOD, and TSS Projections by Year

Year	Residential Population and Employment[a]	Percent Increase	Average Annual Flow (mgd)[b]	Influent BOD Loading (lbs/day)	Influent TSS Loading (lbs/day)
2010	1,169,845		95	131,000	153,000
2020	1,497,461	28%	105	162,600	186,500
2030	1,617,008	8%	107	172,900	198,000
2040	1,767,463	9.3%	113	186,400	211,200
2050	1,942,242	9,9%	120	201,700	227,100
2060	2,125,714	9.4%	127	217,400	243,300
Design			215	254,000	274,000

[a] Residential Population and Employment combines the number of people living in the service area with the equivalent population impact of people that work at businesses located in the service area.

[b] Annual flow projections are based on average rainfall.

2.5.2 Conveyance System Summary

The West Section service area includes areas north and west of Lake Washington and the City of Seattle. Developments within the north Lake Washington area were constructed with separate sanitary and storm drains. Within the City of Seattle, approximately 42,000 acres or 75 percent of the total city is constructed with combined sewers. Sanitary and combined flows from Seattle are merged prior to arriving at the WPTP (King County, 2014a). In the service area, the County's responsibility begins where the City of Seattle's pipes have collected sewage from areas of greater than 1,000 acres and conveyed the sewage to the County's system.

The West Section conveyance system consists of a series of pump and regulator stations and related trunks and interceptors. Combined sewage enters the WPTP through two influent tunnels at an influent control structure. The County's supervisory control and data acquisition (SCADA) computer systems automatically monitor and control the flow. The control system minimizes surges, maximizes flow to the plant, and maximizes use of conveyance system storage to limit CSOs.

2.5.3 Biosolids Management Summary

Biosolids are nutrient-rich organic material produced by treating wastewater solids. Since 1972, the County's biosolids have been used in numerous land application, reclamation, and research projects within Washington. The County has supported important scientific research on the environmental effects of biosolids recycling that has demonstrated the value and safety of land application.

The current biosolids beneficial use program has been designed to provide reliable biosolids disposal options through the establishment of several market outlets and geographic diversity. The County launched the County's biosolids brand, Loop®, in 2012 as part of the County's 2012-2016 Biosolids Plan (King County, 2012b). The development of the Loop brand is part of a long-term strategic goal to increase public support and strengthen demand for biosolids.

The biosolids produced at the WPTP have been treated to meet Class B pathogen reduction using mesophilic anaerobic digestion, an approved process to significantly reduce pathogens under EPA 40 CFR Part 503. The digested biosolids are dewatered and then trucked offsite for 100 percent

beneficial use, either as a directly applied soil amendment or as a compost feedstock. In 2013, 115,801 wet tons of Loop biosolids were produced at WPTP, South Treatment Plant, and Brightwater Treatment Plant, all of which were recycled and used beneficially as a nutrient-rich soil amendment for forestry and agricultural applications or were used to make compost (King County, 2014a).

Upon completion of the EWWTS Project, up to 160,000 pounds per day of solids (85 percent removal efficiency) will be captured and returned to WPTP for processing into biosolids for beneficial use.

2.5.4 Water Conservation Program Summary

In accordance with RWSP policies, the Metropolitan King County Council implemented a water conservation program to provide a holistic approach to water resource management and reduce impacts to the wastewater system. Specifically, the RWSP policy calls for the County to "support regional water supply agencies and water purveyors in their public education campaign on the need and ways to conserve water through pilot projects that support homeowner water conservation, emphasizing strategies and technologies that reduce wastewater." Water conservation minimizes the loss of potable water into the wastewater stream, thus decreasing the demand for valuable freshwater from fish-bearing streams and decreasing the base flow of wastewater to treatment plants. Water conservation projects are being implemented as a form of "demand management" under the RWSP. There was a 15 percent reduction in average wet-weather flow (AWWF) over the last decade, which aligns with reduction in water use seen from 2000 to 2010. Because of this and projected future water use and conservation, the AWWF capacity needs are less than previously forecasted (King County, 2014b).

2.5.5 Infiltration and Inflow

The County created the Regional Infiltration and Inflow (I/I) Control Program in 1999 as part of the RWSP to explore the feasibility of I/I control. In response to the RWSP I/I Control Program policies, the County, working in a consensus-based approach with local sewer agencies, conducted a comprehensive 6-year, $41 million I/I control study. The study began in 2000 and culminated with the King County Executive's recommendation for a regional I/I control program. The following work was completed as part of this study:

- Defined current levels of I/I for each local agency tributary to the regional system through extensive flow monitoring and modeling program (2001-2002).
- Selected and constructed 10 pilot projects in 12 local agency jurisdictions to demonstrate the effectiveness of collection system rehabilitation projects and to test various technologies and gain cost information (2003-2004).
- Developed final draft model standards, procedures, policies, and guidelines (October 2004) for use by local agencies to reduce I/I in their systems. Completed a thorough benefit-cost analysis to determine the cost-effectiveness of I/I reduction (November 2005).
- Developed a long-term regional I/I control plan, approved by the King County Council (May 2006).
- The County worked with the local sewer agencies to conduct an I/I reduction feasibility analysis and selected three initial I/I reduction project areas (2007-2009).
- Completed the Skyway Water and Sewer District I/I reduction project. This I/I reduction project replaced side sewers serving 332 residential properties, repaired or replaced public sewer mains and manholes, and disconnected improper storm drainage connections to the sanitary sewer (2010-2012). Selected I/I reduction projects in Bellevue and Issaquah were cancelled in early 2010 due to County budget limitations.

Analysis of the effectiveness of the Skyway I/I reduction project was completed in 2014. The analysis tested the cost-effectiveness of I/I reduction and the potential to offset the need for a larger conveyance or storage facility. The results of this analysis indicated that the need for a larger conveyance or storage facility will be delayed. Flow monitoring is ongoing at the Skyway site to verify the project results.

In 2015, the County initiated discussions with the 17 cities and 17 local sewer utilities in King, Snohomish, and Pierce counties that deliver wastewater to the regional system on potential next steps for the regional I/I program. Initial planning efforts explored concepts to reduce I/I programmatically with a focus on private side sewers. Following definition and consideration of several different programs, regional best management practices for side sewers were recommended for adoption and implementation by all of the County's component agencies.

2.5.6 Wet Weather Treatment Stations

In addition to EWWTS, the County operates four other wet weather treatment stations (WWTS) in the West Section as shown in Figure 2-14:

- Alki WWTS - The Alki WWTS, located in West Seattle at the intersection of Beach Drive and Benton Place, was constructed in 1958 as a primary treatment plant to serve the 4,095-acre Alki Basin. The service area is largely residential with a projected saturation population of 43,700. Commercial activity is concentrated along portions of California Avenue and SW Alaska Street. In 1998, the County remodeled the station to operate as a near fully automated WWTS and added flow transfer components, such as the West Seattle Pump Station and the West Seattle Tunnel. In 1999, Ecology incorporated the Alki WWTS into the NPDES permit for the WPTP.

  Hydraulic capacity at Alki WWTS is 45 to 65 mgd, depending on tide level. During dry weather, all flows from the Alki basin route through the West Seattle Tunnel to the West Seattle Pump Station and ultimately to WPTP for secondary treatment. The plant operates as needed during storm events to manage flows that exceed the 7.2 MG storage capacity of the West Seattle Trunk. It provides primary treatment, chlorine disinfection, and dechlorination to flows that exceed downstream capacity before the treated wastewater is discharged into the Puget Sound. Once a storm passes and the plant stops discharging, pumps drain the remaining water from the station back to the collection system for conveyance to the WPTP. Solids removed by the primary clarifiers are also discharged to the collection system for treatment at WPTP.

- Carkeek Park WWTS - The Carkeek WWTS, located at 1201 NW Carkeek Park Road, was constructed in 1962 as a primary treatment plant to serve the Carkeek Basin. In 1994, the County constructed a pumping station and converted it to a WWTS. Ecology began regulating the station as a WWTS under the WPTP's NPDES permit beginning in January 1996. The hydraulic capacity at the Carkeek WWTS is 20 mgd.

  The Carkeek Pump Station and WWTS serve a 4,200-acre area in northwest Seattle. During dry weather, the Carkeek station operates as a pump station that conveys wastewater to WPTP. Ecology does not authorize this station to discharge into Puget Sound during dry weather. During wet-weather events when flows exceed the pumping capacity, the station provides primary treatment, chlorine disinfection, and dechlorination to flows that exceed downstream capacity. The station discharges primary-treated and disinfected effluent to Puget Sound until the flow rates at the pump station subside. Solids removed in the treatment process are returned to the Carkeek Pump Station for conveyance to the WPTP for further treatment.

- Henderson/MLK WWTS - The County completed construction of the Henderson/MLK WWTS in 2005 as part of a project to control untreated CSOs to Lake Washington from Henderson Pump Station. The station relies primarily on storage to control untreated CSOs with treatment (settling, disinfection, and dechlorination) applied to any excess combined sewage, and to discharge treated flow through the Norfolk CSO Outfall in the Lower Duwamish Waterway (LDW).

During dry weather, wastewater from the Henderson Pump Station normally flows to the South Treatment Plant in Renton for secondary treatment. During most storm events, the tunnel provides storage for up to 3.5 MG of combined sewage. Stored flow and any removed solids transfer back to either the South Treatment Plant or to the WPTP once system flows reduce after a storm.

- Georgetown WWTS - Construction of the Georgetown WWTS commenced in March 2018 and reached substantial completion in late November 2022. The new station, located at the corner of 4th Avenue and South Michigan Street in Seattle's Georgetown neighborhood, was designed to treat up to 70 mgd of combined sewage that would have otherwise been discharged directly to the LDW without treatment during storm events. The treatment station includes screening, ballasted sedimentation, solids handling, UV disinfection and ancillary facilities. The Georgetown WWTS design anticipates that the station will operate 20 times per year and discharge an average of 69 MG of primary-treated and disinfected combined sewage each year.

  Influent and effluent characterizations for the five WWTSs in the West Section can be found in the Fact Sheet for NPDES Permit WA0029181 West Point Wastewater Treatment Plant and Combined Sewer Overflow System (Ecology, 2024) and in Annual CSO Reports provided to Ecology.

2.5.7 Combined Sewer Overflow Outfalls

The County has 38 CSO outfalls, which are designed to discharge untreated sewage and stormwater during periods of heavy precipitation. The collection system, as configured in 1983, discharged more than 2.3 billion gallons per year of untreated sewage and stormwater from a total of 498 overflow events. Between 2018 and 2022, the County's CSO outfalls discharged an average of 1.13 billion gallons of untreated combined sewage to area waterways each year. This represents about a 50 percent reduction in discharge volume compared to the 1983 baseline condition (King County, 2023a).

2.6 Existing Elliott West Wet Weather Treatment Station

The Elliott West Wet Weather Treatment Station is a CSO treatment station with a maximum hydraulic capacity of 250 mgd and peak day flow of 80 mgd. The EWWTS consists of storage of combined sewer in a 6,200-foot long tunnel underneath Mercer Street, pumping equipment, a screening facility, disinfection and dechlorination, final effluent sampling and a marine outfall discharging 490 feet offshore. These treatment systems are spread between two locations. The pumping equipment, screens, and disinfection systems are located at the EWWTS at 601 Elliott Avenue W. The dechlorination structure, final effluent sampling and marine outfall is located near the Denny Way Regulator Station at Mrytle Edwards Park, approximately 0.6 miles from the EWWTS.

Placed in operation in 2005, the EWWTS controls CSOs to Lake Union and Elliott Bay. Figure 2-14 shows the location of the EWWTS and the associated structures including the dechlorination structure, Mercer Street Tunnel, Denny Way and Lake Union Regulator Station, the EBI, Lake Union Tunnel, the Elliott West, and Denny Way CSO outfalls. Figure 2-15 shows how flows are managed in the system.

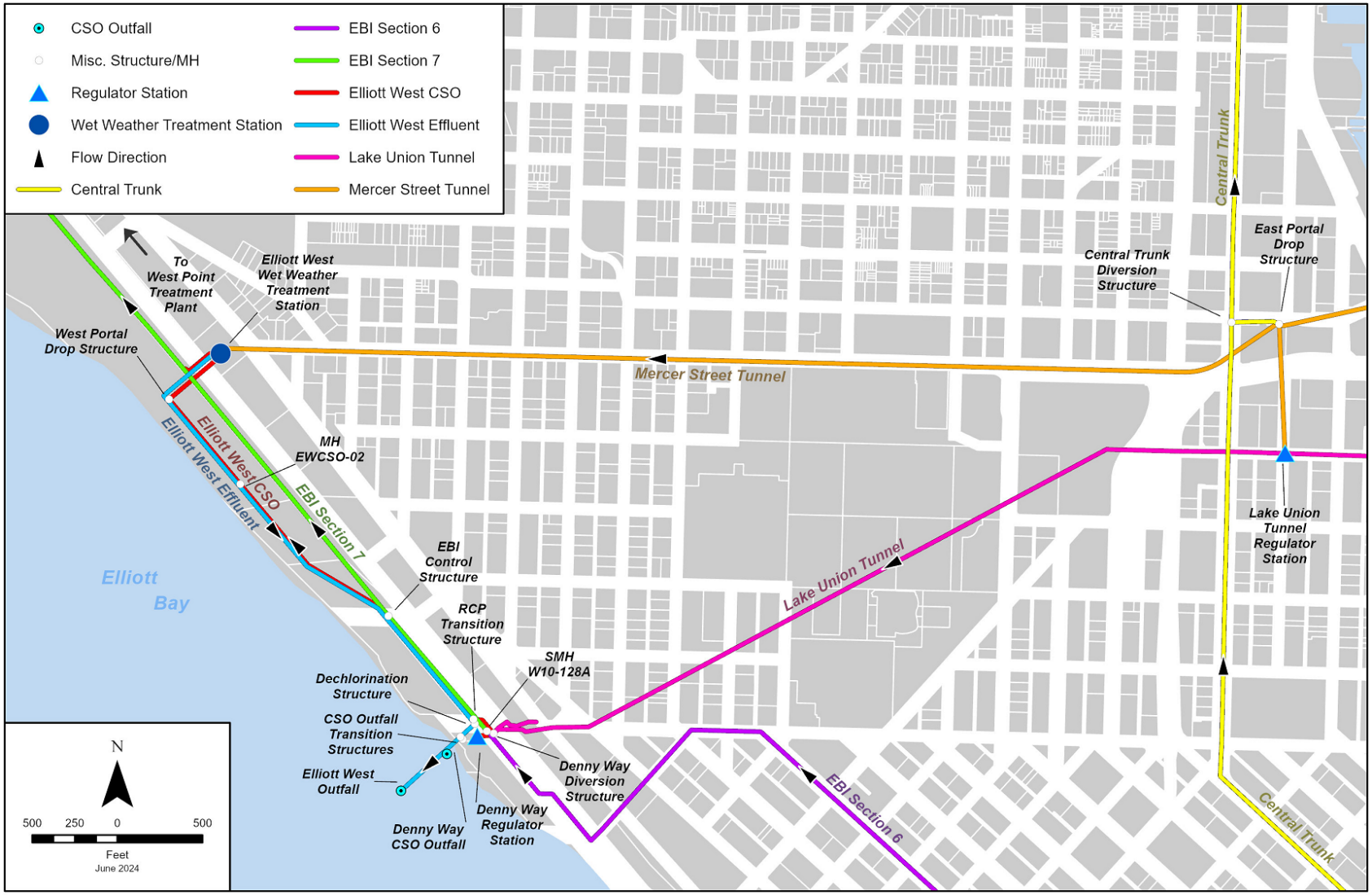


Figure 2-14. Elliott West Wet Weather Treatment Station Overall System

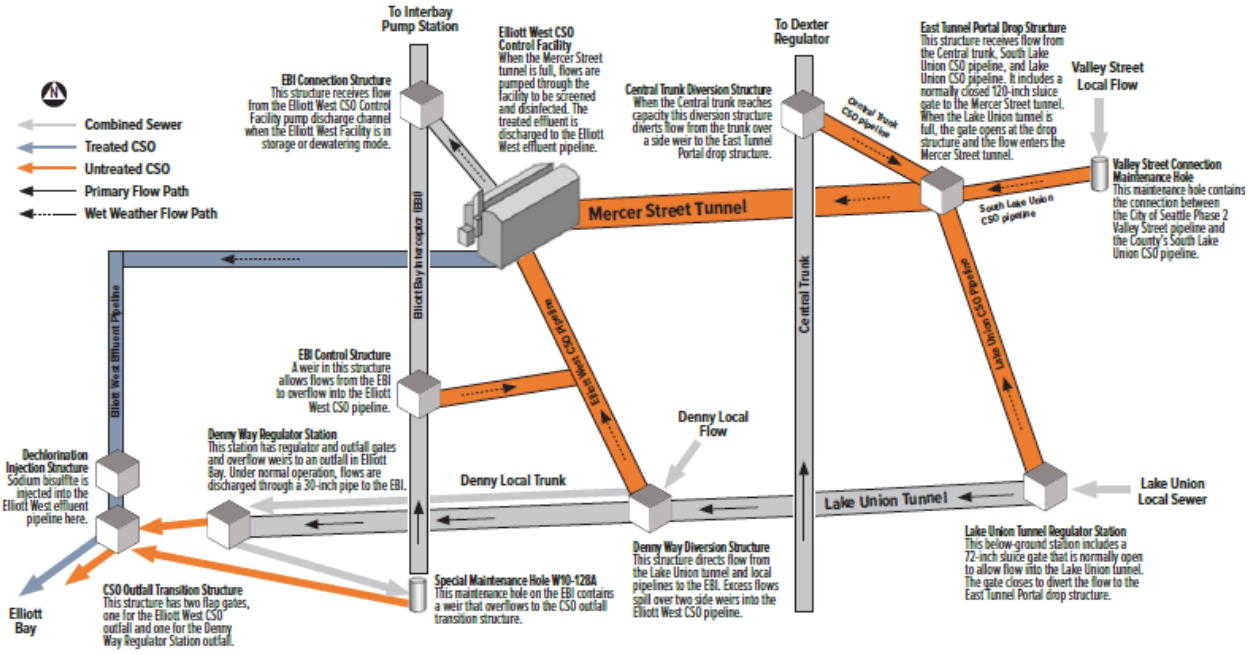


Figure 2-15. Existing Elliott West Conveyance System
Source: Elliott West Combined Sewer Overflow Control Facility Operations Manual, 2012.

2.6.1 Treatment Process

The Elliott West Wet Weather Treatment Station has several operational modes, including:

- Tunnel storage, no discharge, with stored flows returned for treatment at WPTP.
- Pumping and treatment, with discharge of treated flows into Elliott Bay via the Elliott West outfall.
- Pumping and treatment during extreme events, with discharge treated flows up to 250 mgd into Elliott Bay via the EWWTS outfall, and discharge of flows in excess of 250 mgd without treatment, via the Denny Way CSO outfall.

For most of the year, no flow is diverted into EWWTS. Flows are low enough that the existing Lake Union tunnel and conveyance facilities can handle and direct the flow to the EBI, which carries the flow to WPTP for secondary treatment. When water levels exceed established elevations, flow is diverted from these structures into the Mercer Street Tunnel for storage. As the tunnel's storage capacity approaches exceedance, the flow backs into the wet well at EWWTS. Pumping and treatment start at EWWTS when the level in the wet well reaches a set elevation. Following an extreme event, as soon as capacity is available in the EBI, the operational mode of the station goes back to tunnel storage and stored flow is dewatered back to the EBI and carried to WPTP for treatment. The major systems at the EWWTS include the following:

- Storage: The existing Mercer Street Tunnel is 6,212 feet long with a 14-foot 8-inch inner diameter. The tunnel stores 7.5 MG when completely full. Combined with the East Portal (0.3 MG), the Elliott West Wet Well (0.4 MG), a total of 8.2 MG of storage is available. An additional 1 MG of storage is available for treated effluent in the 96-inch effluent pipeline between the EWWTS and dechlorination structure.

- Pumping Systems: The pumping systems include six pumps that handle sending CSO flow through EWWTS and two dewatering pumps. The six main pumps are variable speed, single-stage, vertical, non-clog, end suction centrifugal pumps. The pumps start and stop in sequence, with the first pump coming on just before all the storage space in the Mercer Street Tunnel is used. The existing pump station was designed to convey a peak instantaneous flow of 250 mgd and is configured to allow the installation of a seventh main pump. The pumps are each rated to deliver approximately 42 mgd or 29,000 gallons per minute (gpm). The two 1.5 mgd dewatering pumps are used to dewater the wet well and tunnel during and after storms back to the EBI.
- CSO Treatment System: Flow is pumped from the downstream end of the Mercer Street Tunnel into the station at the pump discharge channel when the tunnel reaches its capacity. Sodium hypochlorite is injected close to the pipe terminations in the pump discharge channel to disinfect the flow. Next, the water flows through bar screens, then into the CSO effluent channel. Screenings blind the bar screens resulting in limited removal efficiency. The treated effluent flows through the Elliott West effluent pipeline to a dechlorination vault north of the Denny Way Regulator Station. At the dechlorination vault, the flow is injected with sodium bisulfite to neutralize residual chlorine before discharge into Elliott Bay through the Elliott West outfall.
- Odor Control System: The odor control system consists of four deep bed carbon units, two dedicated to treating odors from the CSO treatment area (pump discharge channel) at the control facility, and two dedicated to treating odors generated by the wet well and Mercer Street Tunnel headspace. The odor control unit fans pull foul air through the deep bed carbon units and discharge the scrubbed air through an exhaust stack above the control facility. The odor control units operate continuously year-round.
- Sampling and Monitoring System: Flow rate, fecal coliform, residual chlorine, pH, BOD, TSS, and settleable solids are monitored and sampled at the EWWTS to comply with Ecology and Federal regulations. Sampling and monitoring systems include composite samplers, magnetic flow meters, and chlorine and pH analyzers.

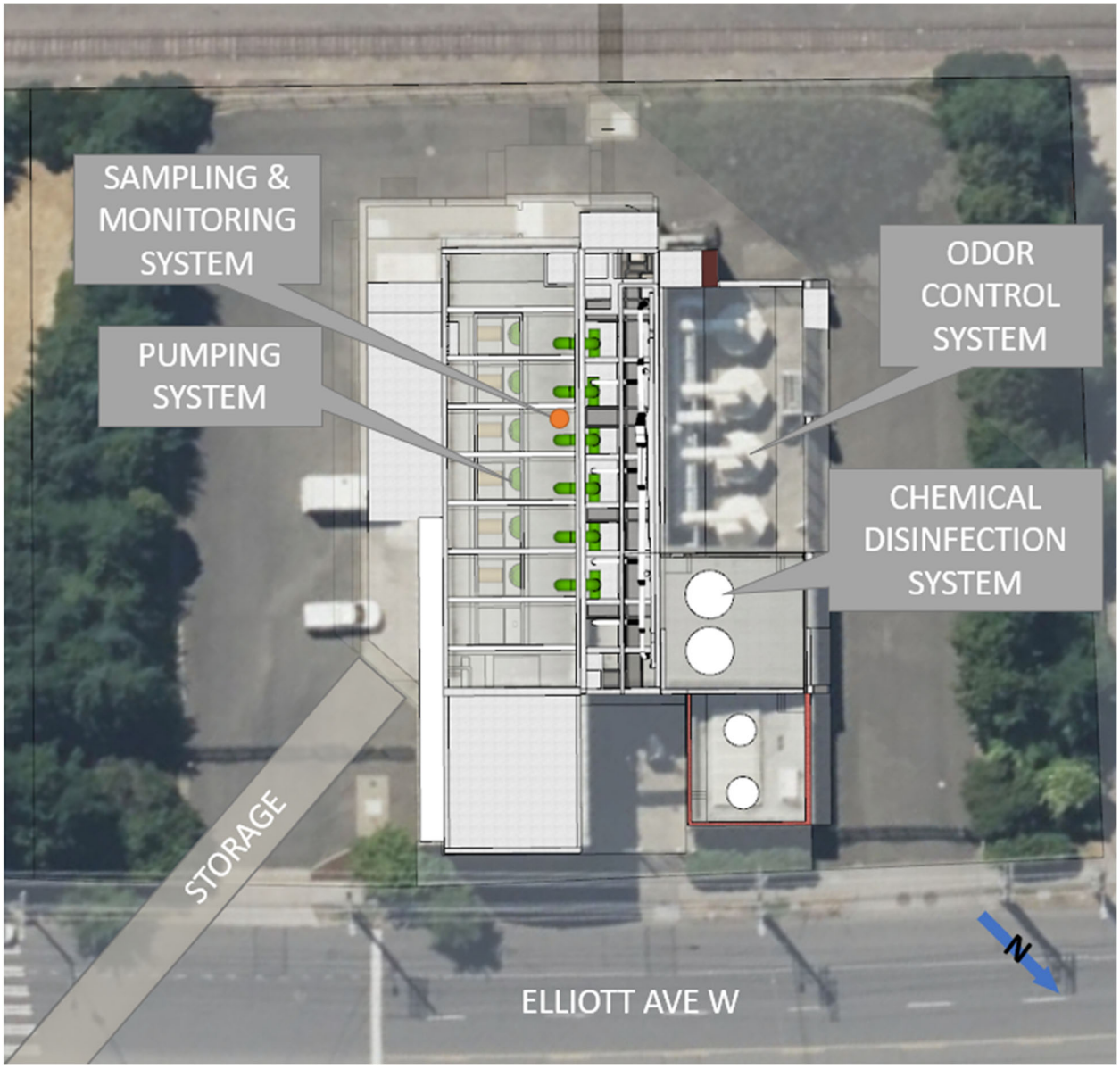


Figure 2-16. Existing Elliott West Major Systems

2.6.2 Outfall

The EWWTS discharges treated CSO flows to a 96-inch diameter outfall that extends approximately 490 feet into Elliott Bay to a depth of approximately 60 feet below mean lower low water. The outfall terminates with a 90-inch diameter open-ended pipe, which provides limited dilution. The Elliott West outfall terminus is enclosed within a pile-supported rectangular concrete discharge box structure that is 12 feet tall, 14.5 feet wide, and 26.5 feet long and is open on the offshore end.

2.6.3 Flows, Loads, and Treatment Performance

The design flow criteria for EWWTS are listed in Table 2-11 as obtained from the "Design Criteria Summary of Elliott West CSO Facility Design Plans (Drawing G1111)" dated 2005.

Table 2-11. Elliott West Wet Weather Station Flows

Parameter	Design[a]
Tunnel Storage Volume	8.2 MG[b]
Peak Day Flow	80 mgd
Maximum Hydraulic Capacity	250 mgd

[a] Source: Design Criteria Summary of Elliott West CSO Facility Design Plans (Drawing G1111). Includes Mercer Street Tunnel, East Portal, and EWWTS wet well volumes.

[b] Includes volume of East Portal, EWWTS wet well, and Mercer Tunnel.

Performance standards for the EWWTS Project design anticipated that the station would provide treatment for 90 percent of the storm events that generated more than 30 MG of combined runoff. Based on historical flow records, this standard would result in discharges of treated CSOs between 1 and 30 times per year. Discharge events were characterized as discharges either to the tunnel or to Elliott Bay and separated by at least 48 hours without discharge.

Between 2015 and 2021, EWWTS discharged an average of 8.7 times per year with an average annual volume of 246 MG and an average duration of 10.4 hours per discharge event. Table 2-12 summarizes the performance of the EWWTS for the period between January 2015 and December 2021 (Ecology, 2024). The volume and duration of discharges in 2017 were higher than normal because of the flow management strategy the County used following the emergency recovery of the WPTP in February 2017.

Table 2-12. Elliott West Wet Weather Station Performance between 2015 to 2021

Year	Annual Number of Discharge Events	Annual Discharge Volume (MG)	Annual Discharge Duration (Hours)	Annual Average Settleable Solids (ml/L)	Annual Average % TSS Removal (percent)
2015	14	251.3	105.9	2.0	57.7
2016	9	172.5	80.3	2.3	52.8
2017[a]	17	917.4	253.6	3.0	21.4
2018	7	95.6	55.3	2.6	49.4
2019	1	121.6	46.5	0.5	62
2020	6	69.7	40.2	1.7	60.9
2021	7	91.4	53.7	2.8	58.3

[a] Volume and duration of discharges in 2017 are higher than normal due to the flow management strategy the County used following the emergency recovery of WPTP in February 2017.

ml/L = milliliters per liter

2.7 Industrial Users

Table 2-13 lists the significant industrial users over whom the County has source control compliance authority within the Denny Way/Lake Union Basin. The table indicates the facility name, type of industrial operation, and the address of the facility. All dischargers are held to County local limits and other applicable standards. For certain industries, federal categorical limits also apply.

Table 2-13. Active Industrial Facilities

Facility Name	Document Number	Type of Operation	Address of Facility
Richmark Label Co.	11961-01	Printing	1110 E. Pine Street, Seattle 98122
Lake Union Drydock Co.	225-07	Shipyard	1515 Fairview Avenue E., Seattle 98102

3. Future Conditions

3.1 Introduction

This chapter presents future projections of population, land use, wastewater flows, and wastewater loads for the Denny Way/Lake Union Basin and describes how those projections were developed. The chapter also describes the future environment without the Project, and recreation and open space opportunities.

3.2 Land Use and Demography

3.2.1 Zoning

The County considers the Denny/Lake Union CSO basin serving EWWTS substantially developed. The County anticipates continued redevelopment in the area over the next 5 years. Future zoning outlined in the One Seattle 2035 Comprehensive Plan (City of Seattle, 2022) designates the Downtown, South Lake Union, and Uptown neighborhoods as urban centers, while the EWWTS site will remain zoned within the land use designation of Ballard/Interbay Northend Manufacturing and Industrial Center and as an industrial and maritime zone.

3.2.2 Population

To facilitate long-term system wide planning, the County projected service area conditions for a planning period extending from Year 2030 through Year 2050; these projections are presented in Table 3-1. The population projections are based on Puget Sound Regional Council data for the Denny Way/Lake Union Basins.

Table 3-1. Projected Sewered Populations for Study Area

Year	Residential (Population)	Commercial (Population)	Industrial (Employees)
2020	115,675	184,056	8,161
2030	147,636	221,617	7,869
2040	179,137	240,277	6,305
2050	201,673	256,038	5,547

3.2.3 Environmental Justice

The Project area is expected to remain in an area with environmental justice concerns due to the temporary presence of the Bridge Shelter. The WTD parcel, currently occupied by the Bridge Shelter, will be needed to upgrade the existing EWWTS facility to meet regulatory requirements. King County FMD will work to move the shelter before King County WTD needs the parcel for the required regulatory project work. Social Services providers will work with residents of the shelter.

Additionally, the federally recognized Muckleshoot Indian Tribe and Squamish Tribe will continue to use and fish Elliott Bay under their “usual and accustomed” fishing rights.

3.2.4 Recreation and Open Space Opportunities

Due to the relatively small size of the EWWTS Project site and its location within a highly developed commercial and multi-use area, recreation and open space opportunities are not available. Proposed modifications at the Denny Way Regulator Station in Myrtle Edwards Park are contained within the footprint of existing structures. The removal of a trailer (currently housing a generator) would provide an opportunity for site security improvements and restoration of that small space to landscape.

3.3 NPDES Permit Requirements

Discharges from the EWWTS must meet the 2024 NPDES permit effluent requirements to protect the current water quality and designated uses in Elliott Bay.

3.3.1 Technology-based Effluent Limits

Technology-based treatment requirements establish the minimum level of treatment that must be provided by the EWWTS, regardless of receiving water characteristics. These standards currently limit the discharge of conventional pollutants including TSS, settleable solids, fecal coliform bacteria, and pH. These upper-bound standards allow for establishment of both concentration and mass-based discharge limitations in the permit-based design flows. It is also anticipated that EWWTS will have an enterococci bacteria limit established in a future NPDES permit term.

3.3.2 Water Quality-based Effluent Limits

The EWWTS effluent discharge must also comply with state water quality standards, protecting listed uses for the Elliott Bay receiving water and meeting numerical criteria for marine waters. The renewed permit does not authorize a mixing zone in Elliott Bay. Based on an RPA analysis conducted as part of the 2024 renewal process, Ecology concluded there is a reasonable potential for TRC, copper and zinc to exceed the marine water quality criteria and included corresponding water quality-based effluent limits for those parameters.

3.3.3 Antidegradation Policy

The State of Washington's antidegradation rule is defined in WAC 173-201A-300. This rule may result in more restrictive limitations than would be dictated by the water quality standards to prevent further degradation of high-quality water. The fact sheet for the renewed 2024 NPDES Permit WA0029181 states that effluent from West Point and the associated CSO facilities must meet Tier I antidegradation requirements to protect existing and designated uses. Additionally, the Tier II antidegradation provisions require that any new or expanded action that has potential to degrade any water quality parameter beyond the edge of an authorized mixing zone boundary must be found by Ecology to be necessary and in the overriding public interest. The treatment upgrades proposed under this Project do not add treatment capacity, do not increase pollutant loading or concentrations, do not introduce new pollutants to the existing EWWTS facility's discharge, and would not be a new or expanded action under the antidegradation rule.

3.3.4 TMDL-based Limits

In many cases, technology-based limitations require sufficient treatment to result in compliance with water quality standards. If a water body fails to meet any water quality standards after application of

technology-based controls, the federal Clean Water Act requires a water body be placed on its 303(d) list of impaired water bodies. The Clean Water Act then requires development of a total maximum daily load (TMDL) analysis to bring impaired water bodies into compliance with water quality standards. The 303(d) listings are described in Section 2.3.5.

The EWWTS discharge does not have a reasonable potential to violate water quality criteria for the 303(d)-listed chemical parameters for water and fish tissue; therefore, water quality-based effluent limits for these parameters are not included in the 2024 NPDES permit. However, fecal coliform bacteria permit limits may place increased emphasis on the need to improve EWWTS disinfection performance. In addition, the sediment quality analysis provided in Appendix F demonstrates that the discharge is not expected to exceed marine Sediment Management Standards (SMS) or applicable marine sediment cleanup levels.

3.4 Future Wastewater Flow and Load Projections

This section describes how future wastewater flows and loads were estimated, including system modeling and basis of planning, wastewater loads, and management of flows between the EWWTS and WPTP.

3.4.1 Basis of Regulatory Planning

The primary objective of the Project is to implement improvements that will result in more reliable NPDES permit compliance at the EWWTS. In other words, the objective is to limit the number of untreated CSO discharges to one event per year on a 20-year moving average while meeting water quality and sediment management standards for treated discharges. In developing a compliance approach for these parameters, the following long-term compliance strategies *(*Jacobs, 2021) guided the development of the alternatives:

- Configuration of Facilities: Reconfiguration of influent and effluent sampling and monitoring locations to support process control and to accommodate future NPDES permit conditions.
- Existing Effluent Limits: Improvements to enhance TSS and settleable solids removal, disinfection, and pH control.
- Future Effluent Limits: Provisions needed to address potential future effluent limits and revised disinfection criteria.
- Climate Change: Required capacities under both current conditions and a potential future condition using forecasts from a climate model.

With the completion of the Project's proposed treatment improvements, the discharge from EWWTS will show compliance with the technology-based standards for CSO treatment facilities as specified in the 2024 NPDES permit and will provide the "Nine Minimum Controls" required by special condition S11.B of the 2024 NPDES permit. Therefore, the EWWTS will meet AKART requirements and will qualify for a mixing zone authorization under the requirements of WAC 173-201A-400. A mixing zone authorization will significantly reduce the EWWTS discharge's long-term risk of noncompliance with marine water quality criteria.

3.4.2 System Model Scenarios

The County maintains hydrologic and hydraulic models of its combined sewage system draining to the EWWTS (West Core model) using the MIKE URBAN simulation software by DHI. The West Core model (version 9a), including the EWWTS system, captures the furthest downstream portion of the basin. The control level was modeled under both current conditions and a potential future condition incorporating

climate model forecasting. Detailed discussion of the model methodology and results can be found in the *Alternatives Analysis Technical Memorandum* (Jacobs, 2021) and updates documented in *Design Flows for Additional Treatment at Elliott West CSO Facility* (King County, 2025).

In 2020, the County verified the model's calibration and suitability for use at EWWTS by comparing modeled to observed inflow events into the existing EWWTS between 2006 and 2018. In 2024, the County updated the model's calibration of historical events to extend through 2023 and incorporates the additional flow SPU intends to convey to the EBI and Lake Union Tunnel from the upcoming Vine Street CSO project. Overall, it was concluded that the model is a reasonable reflection of current events and can be used to simulate inflows to EWWTS based on rainfall. Additionally, the analysis concluded that the predicted and actual occurrence of overflow events was an adequate match, and that the model could be used for preliminary design capacity purposes.

Under future conditions, global climate models (GCM) indicate that rainfall intensities will increase in the Pacific Northwest, and a future rainfall time series was generated through a contract with the Climate Impacts Group at the University of Washington. This contract generated a future altered rainfall time series that the West Core model incorporated into a simulation of future conditions. The climate was simulated at the end of the current century (2070 to 2099) to quantify the changes expected in the 21st century. The resulting rainfall data was inputted and modeled as the "2085 conditions" (Mauger et al., 2018). It is assumed that the increase in flows resulting from the future rainfall time series is a reasonable approximation to the overall flow expected under this future climate change scenario. In CSO basins, the base sewage flow is typically only a few percent of the once per year flow that must be conveyed to achieve CSO control. While this base sewage flow may increase as the population and employment increase in the basin, the expected increase in the once per year flow is small. Population growth is somewhat offset by less per capita water use due to water conservation efforts such as low flow toilets and showerheads.

3.4.3 Control Methodology

Currently, the Mercer Street Tunnel (7.5 MG), the East Portal (0.3 MG), and the EWWTS wet well (0.4 MG) are filled until only 0.75 MG of the 8.2 MG of equalization capacity remains before the EWWTS pumps are called into operation. The Mercer Street Tunnel storage availability curve is included as Figure 3-1. This operational method does not attenuate peak flow sent to EWWTS during an event.

The proposed operational methodology involves decreasing the current storage volume being utilized for the Mercer Street Tunnel before the pumping and treatment at the station starts and utilizing the larger remaining volume to equalize the peak flow. By utilizing the tunnel for both storage and equalization during the peak of an event, the County concluded that a lower peak flow treatment capacity will contribute to reliable CSO control. This is considered the optimal approach that results in improved water quality while maximizing the use of the existing infrastructure sustainably.

Using this approach, the 2024 update to the County's West Core system model based on 46 years of data showed that maintaining a minimum of 4.1 MG of available equalization volume in the Mercer Street Tunnel at the onset and during a wet weather event would decrease the required peak instantaneous influent flow from 250 mgd to 219 mgd and increase the peak hour influent flow to 189 mgd, while providing reliable control as shown in Figure 3-2. The County also determined that maintaining an additional 1.7 MG of tunnel capacity for equalization (for a total of 5.8 MG) would allow the station to continually operate long term at the ultimate influent peak hour design flow of 219 mgd to address potential future precipitation impacts to flows due to climate change while maintaining the same level of service.

In this analysis, the County also noted that a seventh influent pump would need to be installed and there may need to be improvements to the ballasted sedimentation and UV systems to continually handle peak influent flows of 219 mgd instead of treating 219 mgd as a peak instantaneous influent flow.

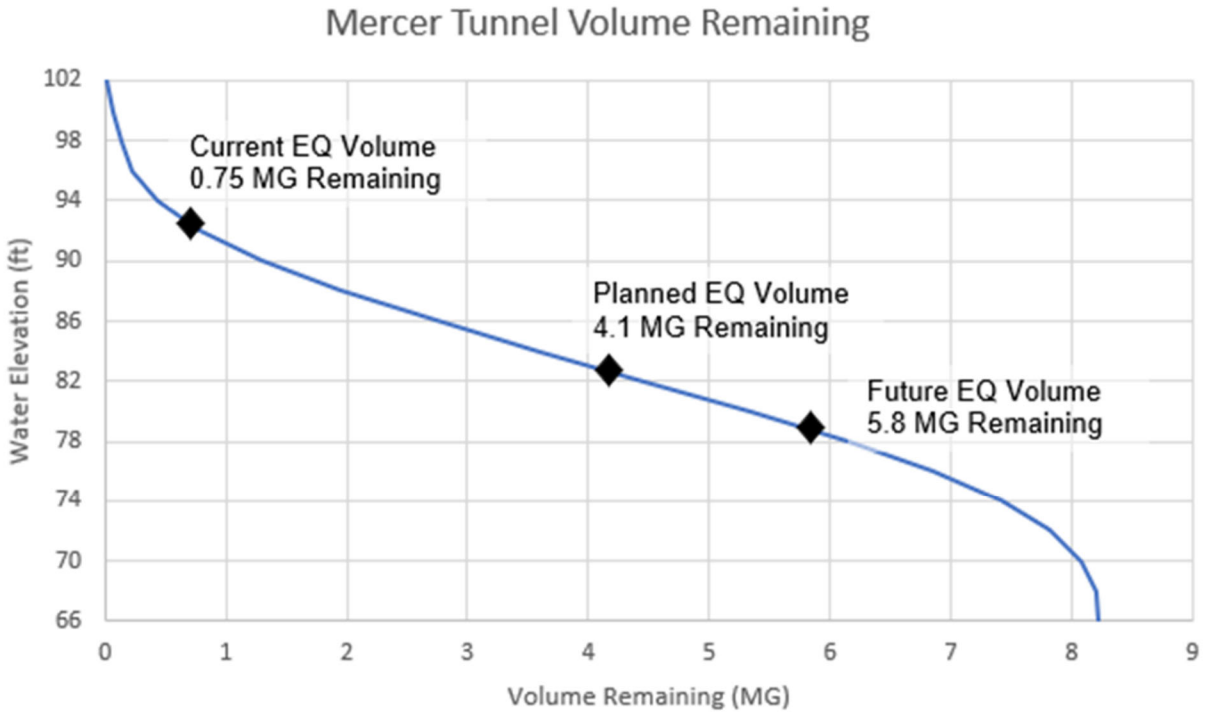


Figure 3-1. Storage Availability in the Mercer Tunnel System

An increase in equalization volume allows a smaller treatment capacity to fully treat the same number of events by providing storage for the portion of the inflow hydrograph that exceeds the treatment capacity. The flow-storage curve in Figure 3-2 shows that a peak hour influent design flow of 189 mgd is required along with 4.1 MG of equalization storage to control untreated discharges to a similar frequency as the existing EWWTS, which is better than the one untreated overflow per year standard. By selecting a PHF of 189 mgd and allowing for the ability to adjust the equalization volume over time, the EWWTS achieves two concepts: (1) EWWTS will meet the minimum level of control reliably, and (2) EWWTS will be resilient to gradual increases in rainfall intensity and duration anticipated to result from climate change.

Figures 3-3, 3-4, and 3-5 show the current, proposed and future flow strategies for EWWTS.

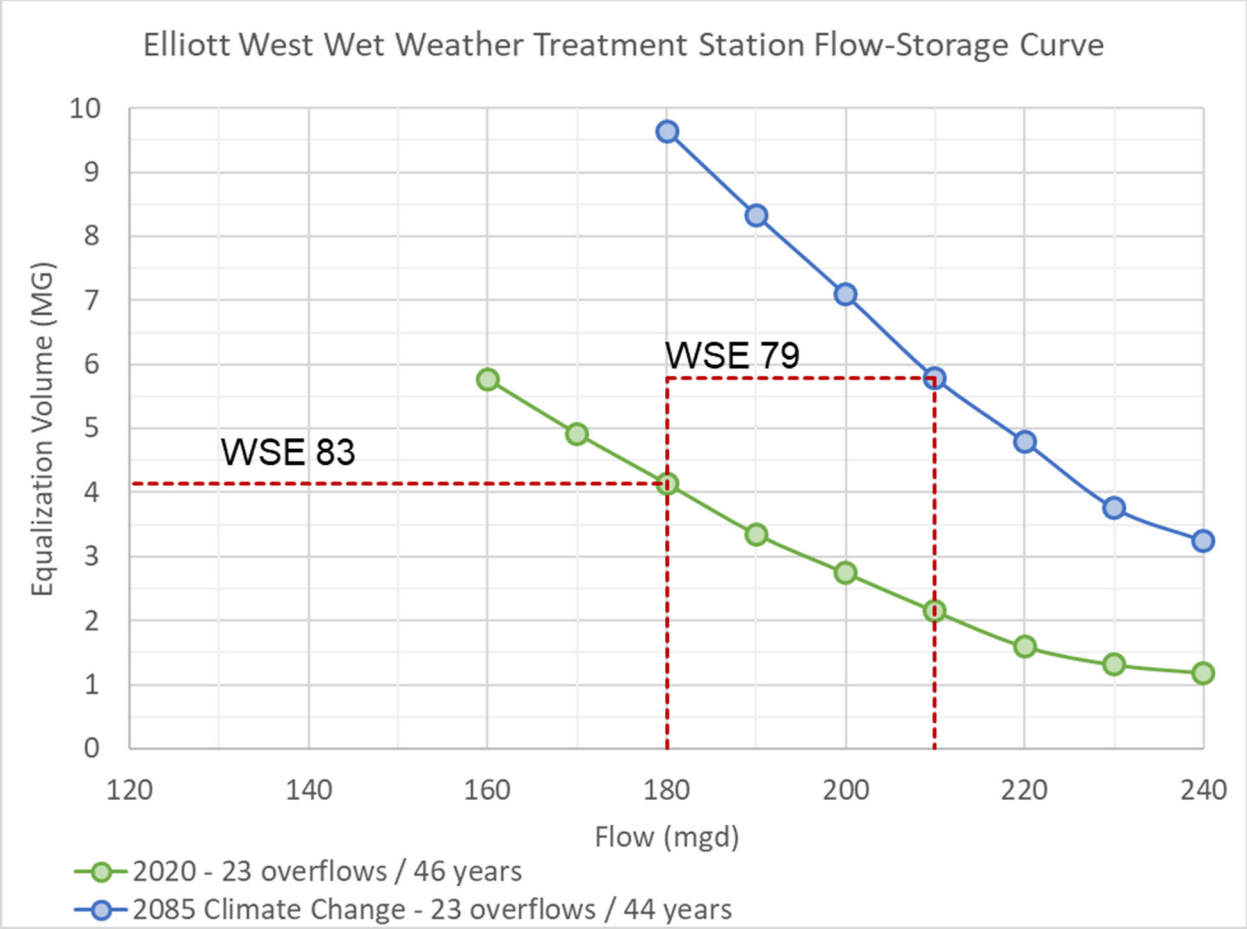


Figure 3-2. Proposed and Future EWWTS Flow-Storage Curve

Note: The operating water surface elevation (WSE) in the Mercer Street Tunnel of 79 and 83 provides an equalization volume of 5.8 and 4.1 MG respectively.

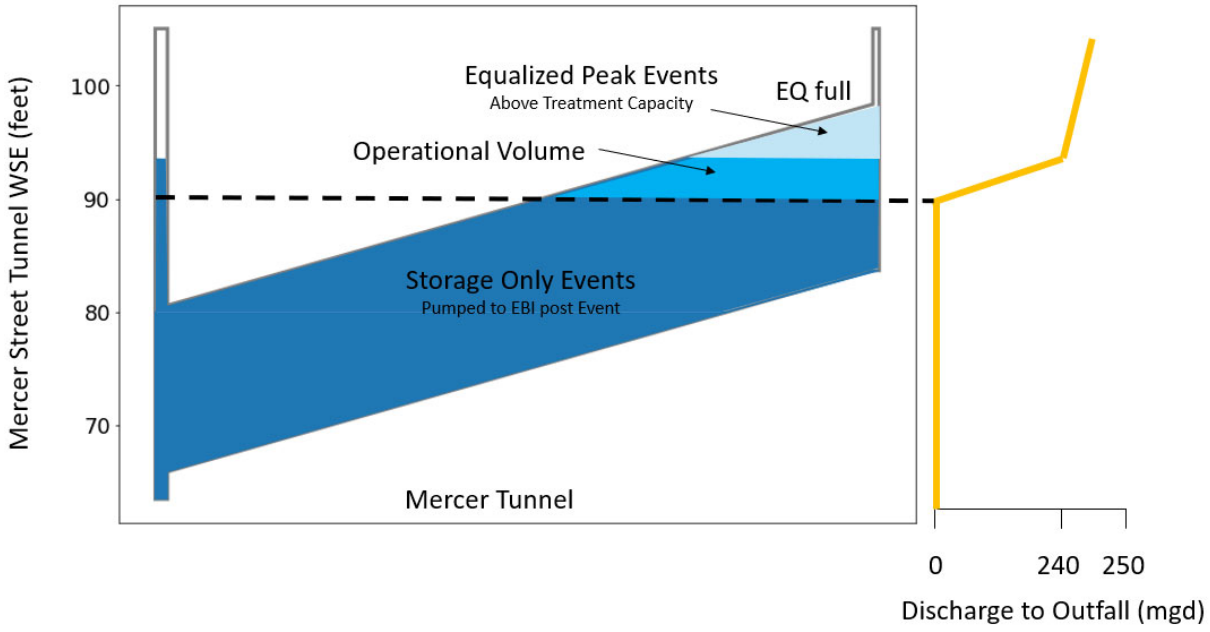


Figure 3-3 Current EWWTS Flow Strategy

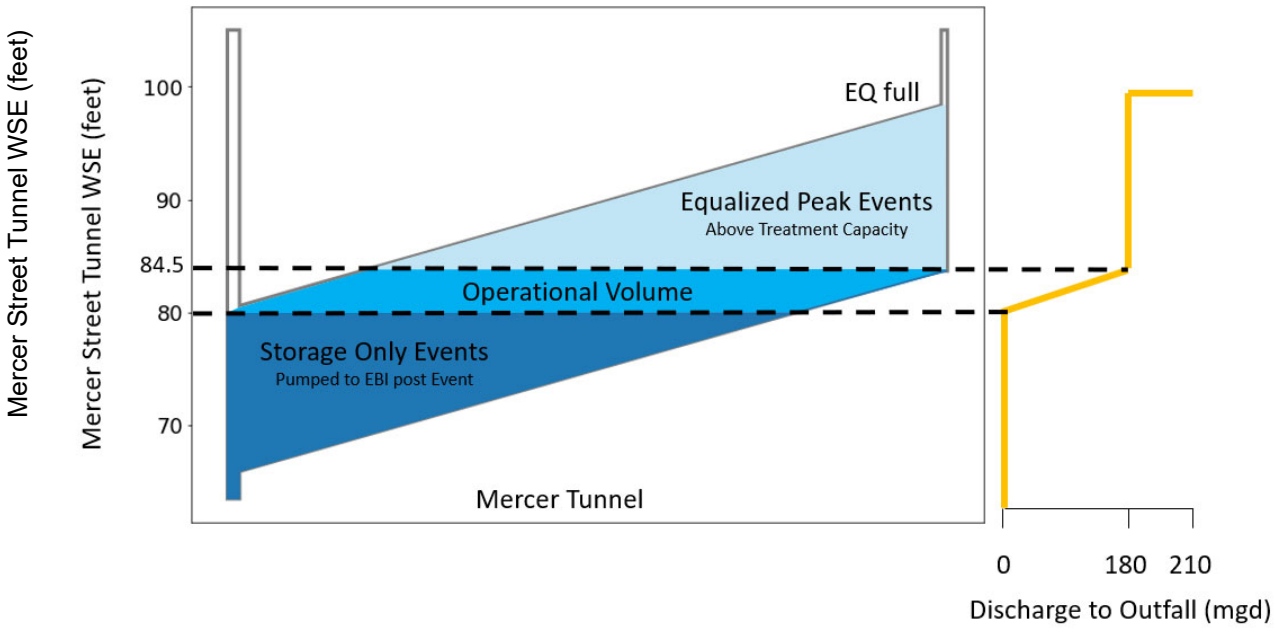


Figure 3-4. Proposed EWWTS Flow Strategy

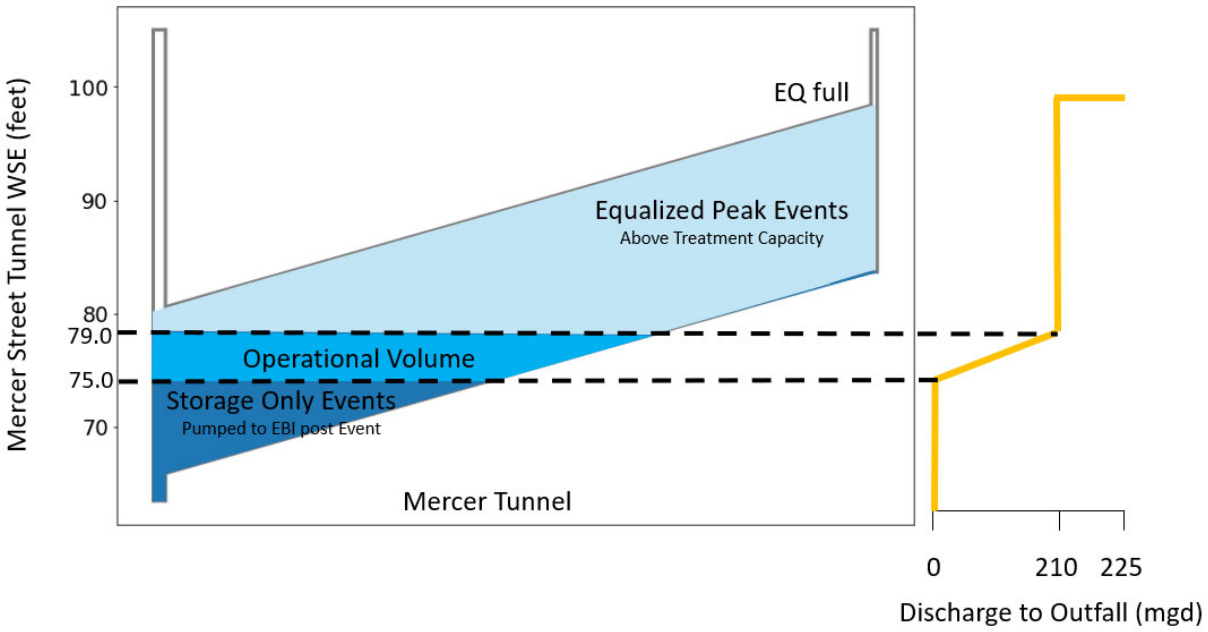


Figure 3-5. Future EWWTS Flow Strategy

3.4.4 Influent Loads

The influent characteristics expected at EWWTS are summarized in Table 3-2 (Jacobs, 2021). Future wastewater characteristics are expected to be similar to current conditions.

Table 3-2. Summary of Influent Characteristics to EWWTS

Parameter	Units	Average	25th Percentile	50th Percentile	95th Percentile
TSS	mg/L	121	50	105	295
BOD_5	mg/L	57[a]	40	49	115
Alkalinity	mg/L as $CaCO_3$	18 to 32	--	--	--
pH	--	7.0	--	--	--

[a] BOD removal in EWWTS treated effluent is not required by permit. However, the ballasted sedimentation treatment process provides particulate BOD removal relational to suspended solids removal.

3.4.5 Management of Flows between Elliott West Wet Weather Treatment Station and West Point Treatment Facilities

Stored and return flows at EWWTS will be conveyed to the WPTP after an event via the EBI and downstream County infrastructure. Return flows will consist of equalization storage of the Mercer Street Tunnel and flushing water from post-event cleaning. Flows will be pumped to the EBI as downstream capacity in the EBI becomes available. Real-time capacity information at the EBI will allow operators to begin the draining sequence. If another storm is not anticipated, the flushing sequence will start and drain

pumps operate until the liquid level in the tunnel reaches a minimum set-point. Further discussion on the draining and flushing sequence can be found in Chapter 5.

3.4.6 Flow and Load Design Conditions Summary

The model run overlaps the existing facility operation by 18 years over the period from 2006 through 2023. The model output found that a configuration of 189 mgd peak hour influent design flow and 4.1 MG equalization storage was optimal to meet the current level of operation and not exceed the one untreated event per year on a long-term average control basis. Table 3-3 presents the design flows and volumes to be used for this Project (Jacobs, 2021 and King County, 2025).

Table 3-3. Design Flow and Volumes

Description	Units	Design Condition	
		Influent	Discharge to Outfall
Peak Hour Design Flow	mgd	189	180
Peak Instantaneous Design Flow	mgd	219	210
Ultimate Peak Hour Design Flow	mgd	219	210
Peak Hour Design Treatment Capacity	mgd	180	
Solids Return Design Flow to EBI	mgd	approximately 9	
Mercer Street Tunnel Equalization Volume	MG	4.1	
5-year Recurrence Event Volume[b]	MG	113	
20-year Recurrence Event Volume[b]	MG	151	
Total Average Annual Events Volume[b]	MG	298	
Total Average Annual Events Volume (Historic)[a, b]	MG	550	

[a] Refer Appendix E for discussion on historic average annual events volume.

[b] These event volumes represent the volumes of treated discharge from EWWTS.

3.5 Future Environment without the Project

This Project is required as a condition of the renewed 2024 WPTP NPDES permit. Without the EWWTS Project, King County would not be fully compliant with the WPTP 2024 NPDES permit.

4. Alternative Analysis

4.1 Introduction

4.1.1 Previous Improvements to EWWTS

The current EWWTS improves water quality and substantially reduces the number of untreated CSO events but has not reliably achieved full NPDES permit compliance. Operational difficulties are related to screening, solids removal, how to measure and account for solids removal (sampling points, flow measurement), compliance with the settleability parameter in the permit (during discharges), post event wet well clean out, and dosing for both chlorination and dechlorination. Numerous corrective actions and improvements have been made over the years, and the County has dedicated substantial financial and staff resources, spending approximately $10 million in capital and operating funds to improve compliance with permit conditions and operability. The following summarizes the improvement projects the County has completed:

- Modified Outfall Hydraulics. Around 2010, the County removed the elastomeric duckbill flap valve from the end of the outfall, weighted some lift slabs, and constructed an additional story on the dechlorination vault to improve the hydraulic grade line from EWWTS. The removal of the elastomeric flap valve from the outfall terminus reduced head loss at the outfall.
- Improved Chlorination and Dechlorination. In 2011, the County installed a new sodium hypochlorite mixer, flowmeter, and feed systems, and replaced the sodium bisulfite feed flowmeter.
- Enhanced Sampling. In 2012, the County installed a portable sampler at the EWWTS, which collected samples from the pump discharge channel. Results indicated that solids concentrations in the pumped discharge are similar to those measured at a sample point upstream of the Mercer Street Tunnel.
- Enhanced Flushing. In 2013, the County enhanced and automated flushing of the Mercer Street Tunnel. Although staff report that additional flushing has reduced the amount of solids that accumulate in the system, solids continue to deposit in the downstream reach of the tunnel and in the EWWTS wet well.
- Changes in Solids Management. The County operations staff also implemented an operational strategy that maximizes the amount of solids conveyed to the WPTP for treatment. The dewatering pumps start at the beginning of a fill event and operate continuously until the event is complete and a single large influent pump is used to increase dewatering capacity during the initial stages of wet well drawdown. This strategy increases the scour of the wet well to deliver more solids to the WPTP.
- Changes in Pumping Control Strategy. Over the years, County staff have evaluated and implemented adjustments to the pumping control strategy to reduce the overflow frequency at EWWTS.
- Replacement of 30-inch Drain Gate. In 2023, leakage back into the EWWTS wet well was eliminated by replacing the 30-inch drain gate, which allows for full use of the 0.4 MG equalization volume.

In 2009, the *Elliott West CSO Facility Evaluation - Performance Assessment Technical Memorandum* (Tetra Tech, 2009) provided recommendations within the existing screening system that included retrofitting the screens to increase cleaning frequencies, evaluating the feasibility of retrofitting with a 12-millimeter (mm) bar spacing, and studying the addition of a screenings return flow channel. In addition, recommendations were made for operational changes to the Mercer Tunnel and influent pumps, repairs to the wet well drain gate, and capturing the CSO-derived solids returned to WPTP during dewatering of the Mercer Tunnel in the mass balance.

Despite these efforts, the current configuration of the system has not been able to consistently meet NPDES permit effluent requirements for TSS removal efficiency, settleable solids, disinfection, pH, and chlorine residual. Multiple studies suggest these performance and compliance challenges are rooted in the configuration of the EWWTS's core treatment systems.

4.1.2 Alternatives Analysis Approach

The evaluation of alternatives to achieve more reliable NPDES permit compliance at the EWWTS began in 2020. This chapter summarizes those efforts as detailed in the *Alternatives Analysis Technical Memorandum* (Jacobs, 2021) for Alternatives 1-4, 5A, and 5B, and the *Alternatives Analysis Technical Memorandum Amendment* (Jacobs, 2024) for Alternatives 5C and 6 and its associated appendices. The alternatives development and evaluation process is summarized in the following steps:

- Criteria Development: In this step, a series of workshops were held to develop criteria to narrow and eventually score alternatives. The criteria were intended to be objective and comprehensive and included specific criteria in each of the following categories: permitting/regulatory, environmental/site, technical, O&M, community, equity and social justice (ESJ), and sustainability/Envision. Section 4.2 further details the process of Criteria Development.
- Alternatives Brainstorming and Narrowing: The team collaboratively brainstormed potential solutions to meet the Project goal. In addition, this step involved evaluating technologies for the solids removal, disinfection, and outfall systems. Based on a review of each technology's key advantages and disadvantages identified by County staff and consulting engineer subject matter experts, representative technologies for each process were selected as components that, when combined, would comprise a complete alternative. A total of 14 options were generated by the end of the brainstorming process. A workshop was held to assign a preliminary rating to each criterion for each brainstormed option. As a result, the brainstormed options were narrowed to a shortlist of four alternatives (Alternatives 1, 2, 3, and 4). Section 4.3 further describes the Alternatives Brainstorming and Narrowing approach.
- Alternatives Development and Scoring: Engineering detail was developed for each of the four shortlisted alternatives (Alternatives 1-4) to identify advantages, challenges, and other key differentiators. Through a series of workshops, the four alternatives were scored relative to the previously developed criteria. The results of this scoring process indicated that all four alternatives are similar and adequately met Project goals, with only a few points separating the highest-scoring and lowest-scoring alternatives. Section 4.4 details the Alternative Development and Scoring process.
- Alternatives Optimization: The narrowed alternatives (Alternatives 1-4) were then further refined to improve cost-effectiveness and prioritize proven treatment technologies that are familiar to the County. This optimization step ultimately led to iterative development of Alternatives 5A, 5B, and 5C respectively. Following the development of Alternative 5C, Ecology issued a draft NPDES permit with reduced effluent TRC limits for EWWTS. The new TRC limits are considered challenging to achieve and present a long-term risk that a chlorine-based disinfection alternative may result in permit noncompliance. This prompted the development of Alternative 6, which utilizes UV disinfection and eliminates the use of chlorine. Section 4.6 further details the Alternative Optimization process and the key components of Alternatives 5A, 5B, 5C, and 6.
- Evaluation and Selection of Recommended Alternative: The optimized alternatives 5C and 6 were compared and evaluated. The evaluation concluded with the selection of Alternative 6 as the recommended alternative. Section 4.7 details the Evaluation and Selection process.

4.2 Criteria Development

The Project team held four workshops with the County in December 2020 to develop evaluation criteria for the Project's initial alternative evaluation criteria matrix (AECM). The criteria were developed in collaboration with various stakeholders, including representatives from long-term planning, engineering, environmental planning, permitting, O&M, construction management (CM), modeling, community engagement, and sustainability.

The AECM was initially developed around the categories of permitting/regulatory, technical, O&M, site, environmental, and sustainability, ESJ, and community. The regulatory basic design data used during the alternative selection and analysis in 2021 for Alternatives 1-4, 5A, and 5B were assumptions made by the County and design team prior to the final permit being published in 2024.

These categories were used throughout this evaluation to guide the narrowing and selection of the alternatives. Evaluation criteria were developed prior to brainstorming to facilitate and lay the groundwork for an unbiased evaluation process. There was also a focus on including criteria from a diverse discipline perspective to document these discussions and represent inclusion in the process. However, the process allowed certain criterion (such as the regulatory design criteria) the flexibility to adjust the original assumptions made with the issued draft NPDES permit.

4.3 Alternatives Brainstorming and Narrowing

4.3.1 Identification

To achieve the treatment and water quality regulatory requirements described in Chapters 1 and 3, the Project team first identified potential improvements to the EWWTS's solids removal, disinfection, and outfall systems. The technologies suitable for EWWTS were identified primarily based on their proven track record in similar CSO treatment applications, and their evaluation formed the basis of what this Project considers to be feasible alternatives.

4.3.1.1 Solids Removal Technologies

Solids removal technologies were screened according to their ability to meet the anticipated permit requirements for effluent TSS and settleable solids. The following technologies were selected for this evaluation:

- Storage - Providing temporary CSO retention and subsequent conveyance to WPTP after a wet weather event instead of adding new solids removal technology.
- Retention Treatment Basin (RTB) - RTBs provide storage during smaller storms and limited flowthrough treatment during larger storms that exceed their storage capacity. RTBs can also be designed to: 1) incorporate coagulants and flocculants to enhance solids or metals removal, and/or 2) simultaneously serve a dual function for solids settling and disinfection contact (adding chemical dose such as sodium hypochlorite).
- Chemically-Enhanced Primary Treatment (CEPT) - CEPT adds a coagulant and flocculant to the influent flow within primary treatment tanks during high-flow scenarios. These chemicals allow large, aggregated particles (floc) to gain a higher settling velocity, which increases the system's solids removal rate and treatment efficiency.

- Ballasted Sedimentation - This is similar to CEPT but is a proprietary process that includes the addition of a ballast (e.g., sand) to further enhance the settling characteristics of the floc formed. This technology is utilized in the County's new Georgetown Wet Weather Treatment Station (GWWTS) and is being considered by the County for other wet weather projects.
- Membrane Filtration - A proprietary silicon carbide membrane system coupled with a coagulant that creates a physical barrier to larger solids and pathogens.

The separated solids from these technologies are then handled separately.

4.3.1.2 Disinfection Technologies

The disinfection technologies investigated under this evaluation fall under two categories:

- Retaining Chemical Oxidizers - Oxidizers such as sodium hypochlorite (utilized currently) and peracetic acid disinfect wastewater by inactivating/destructing cellular material. This method of disinfection is followed by a second chemical such as sodium bisulfite to neutralize the residual disinfectant.
- Ultraviolet Light - UV light emitted at a germicidal wavelength to disrupt microorganisms' DNA, inactivating them without the use of chemicals.

4.3.1.3 Outfall Modifications

Five diffuser configurations (plus a sixth "no change" alternative) were identified to install on the terminus end of the existing EWWTS outfall discharging into Elliott Bay to increase dilution and associated water-quality-based effluent limits. Several diffuser configurations were evaluated as part of the first four alternatives (Alternatives 1-4) and detailed in the *Alternatives Analysis Technical Memorandum* (Jacobs, 2021). Ultimately, increased dilution from an outfall modification was found to be likely unnecessary to meet NPDES permit limits, so outfall improvements were decoupled from the EWWTS Project during the development of Alternative 6, which relies on UV disinfection technology to meet the objective of bringing the facility into TRC limit compliance and relies on solids removal and additional chemical treatment for copper limit compliance. Refer to Section 5.2.1.3 for a full discussion of permit compliance for water quality and sediments.

4.3.2 Brainstorming Process

After identifying suitable treatment technologies for the EWWTS's solids removal, disinfection, and outfall systems, the County held a workshop on January 25, 2021, to brainstorm different treatment technologies "packages" capable of meeting the Project's goals. These packages served as the initial list of options that were then short-listed during the narrowing process. More effective solids removal technologies required less extensive outfall modifications to meet the minimum required (target) dilution factors for compliance with the state water quality standards.

4.3.3 Narrowing of Alternatives

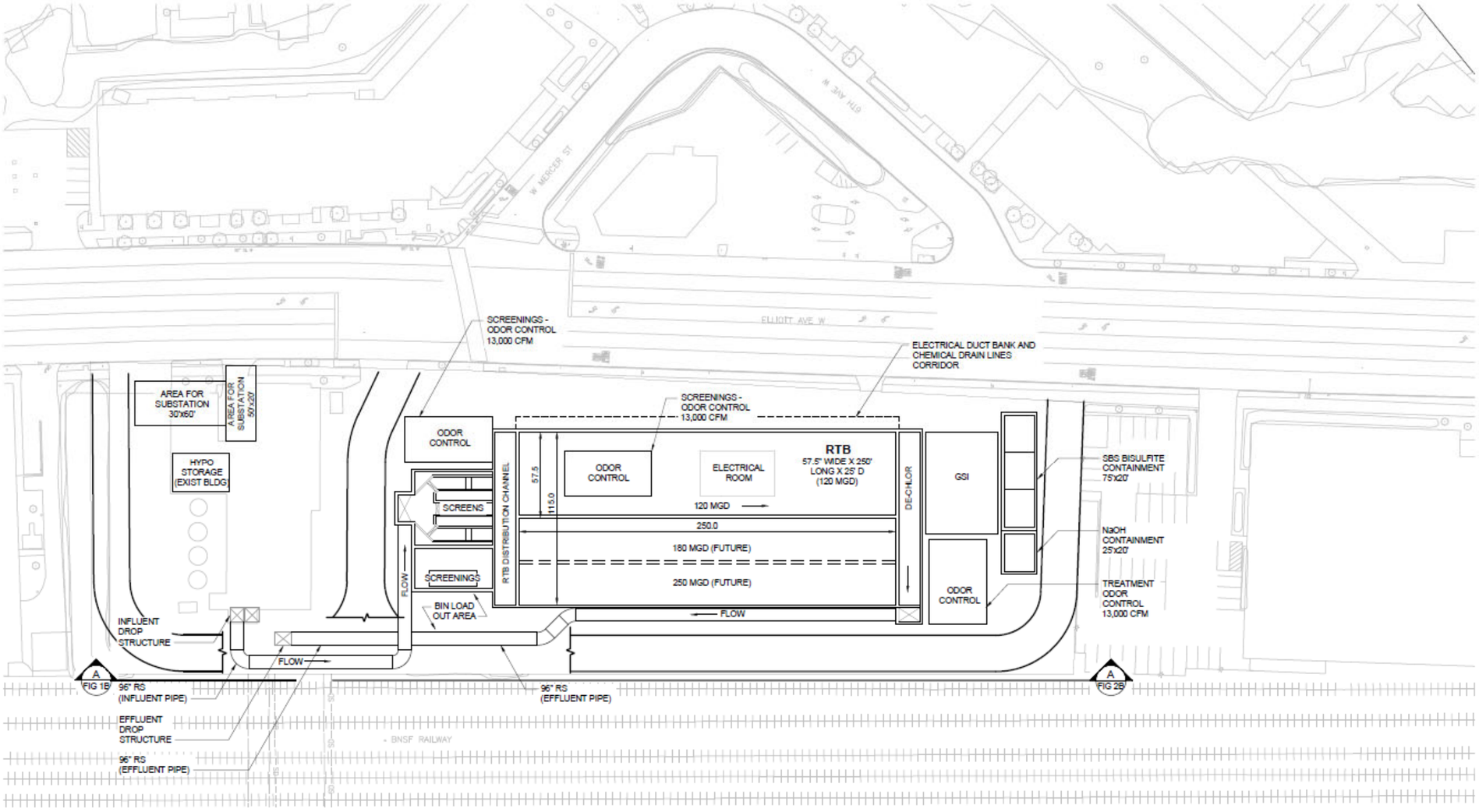
Five workshops were held to narrow the 14 potential options to a shortlist for further development. At the conclusion of these workshops, four alternatives (Alternatives 1-4) were shortlisted for further development based on an initially identified 120 mgd capacity and consideration for an ultimate future capacity of 250 mgd. These alternatives are summarized in Table 4-1 (Jacobs, 2021). Additional infrastructure beyond what is outlined in Table 4-1 would be necessary to accommodate future flows of up to 250 mgd. Figures 4-1, 4-2, 4-3, and 4-4 depict the conceptual layouts of the Alternatives 1-4.

Table 4-1. Alternatives Proposed for Development

Treatment Alternative	Capacity in mgd[a] (Current/Ultimate)	Mercer Tunnel Equalization (MG)	Screening	Solids Technology	Disinfection Technology	Outfall Improvements
Alternative 1	120/250	3	Two multi-rake screens, 60 mgd each	Two RTBs, 60 mgd each	Chemical Disinfection within RTB	Alongshore Diffuser[b]
Alternative 2	120/250	3	Two multi-rake screens, 60 mgd each	Two ballasted sedimentation trains, 60 mgd each	Four UV channels, 30 mgd each	Terminal Rosette Diffuser[b]
Alternative 3	120/250	3	Two multi-rake screens, 60 mgd each	Five CEPT tanks, 24 mgd each	On-Site Chlorination	Terminal Rosette Diffuser[b]
Alternative 4	120/250	3	Two multi-rake screens, 60 mgd each	Four ballasted sedimentation trains, 30 mgd each	Off-Site Chlorination	Terminal Rosette Diffuser[b]

[a] Alternatives 1 through 4 were developed for a peak day flow of 120 mgd (until future expansion is required) and an ultimate peak instantaneous flow of 250 mgd.

[b] More extensive outfall modifications included with initial alternatives 1 through 4 only.



ALTERNATIVE 1
RETENTION TREATMENT BASIN (RTB)
PLAN VIEW

FIGURE 1A
ALTERNATIVE 1

Figure 4-1. Alternative 1 - Retention Treatment Basin Plan View

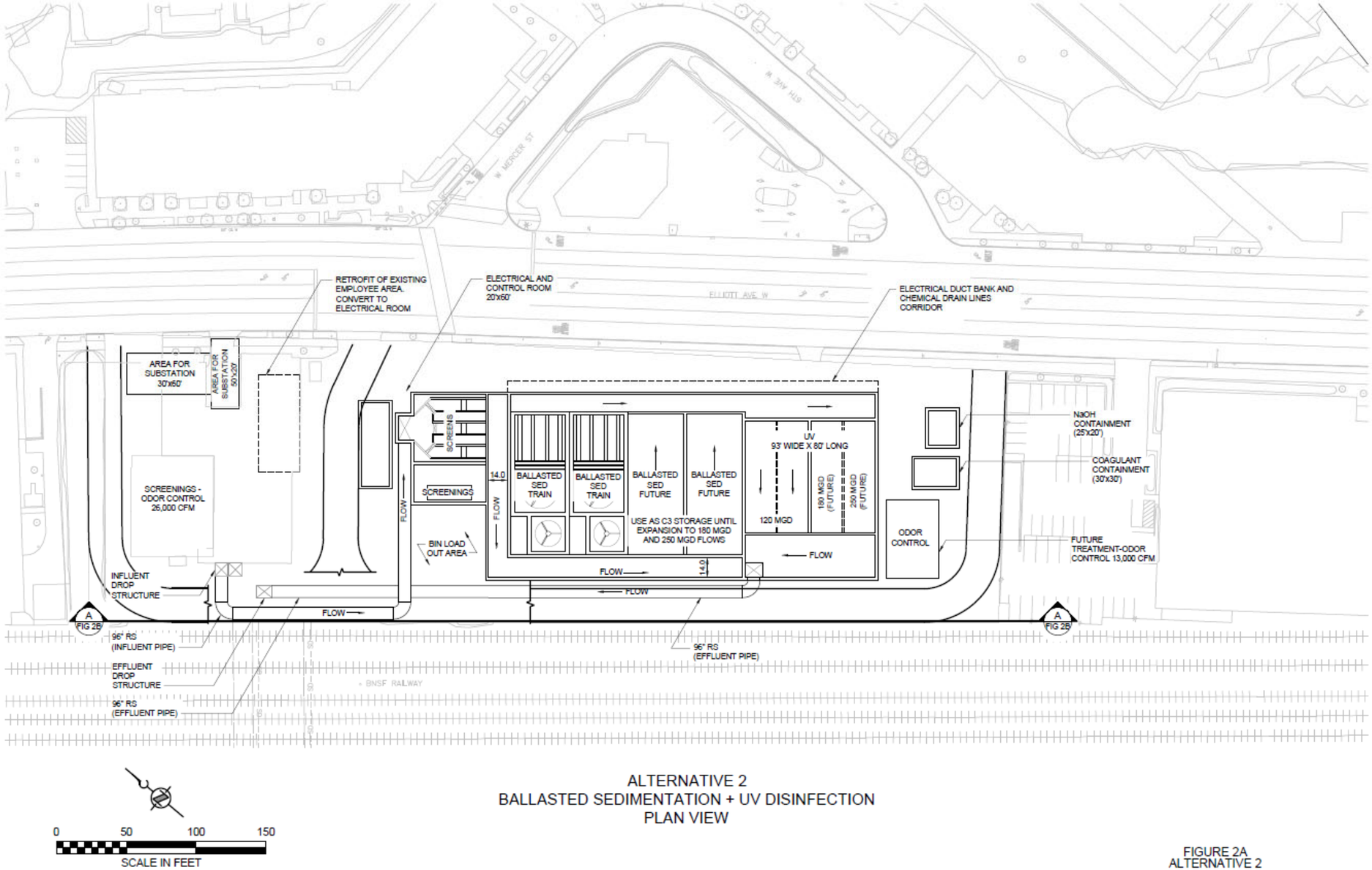
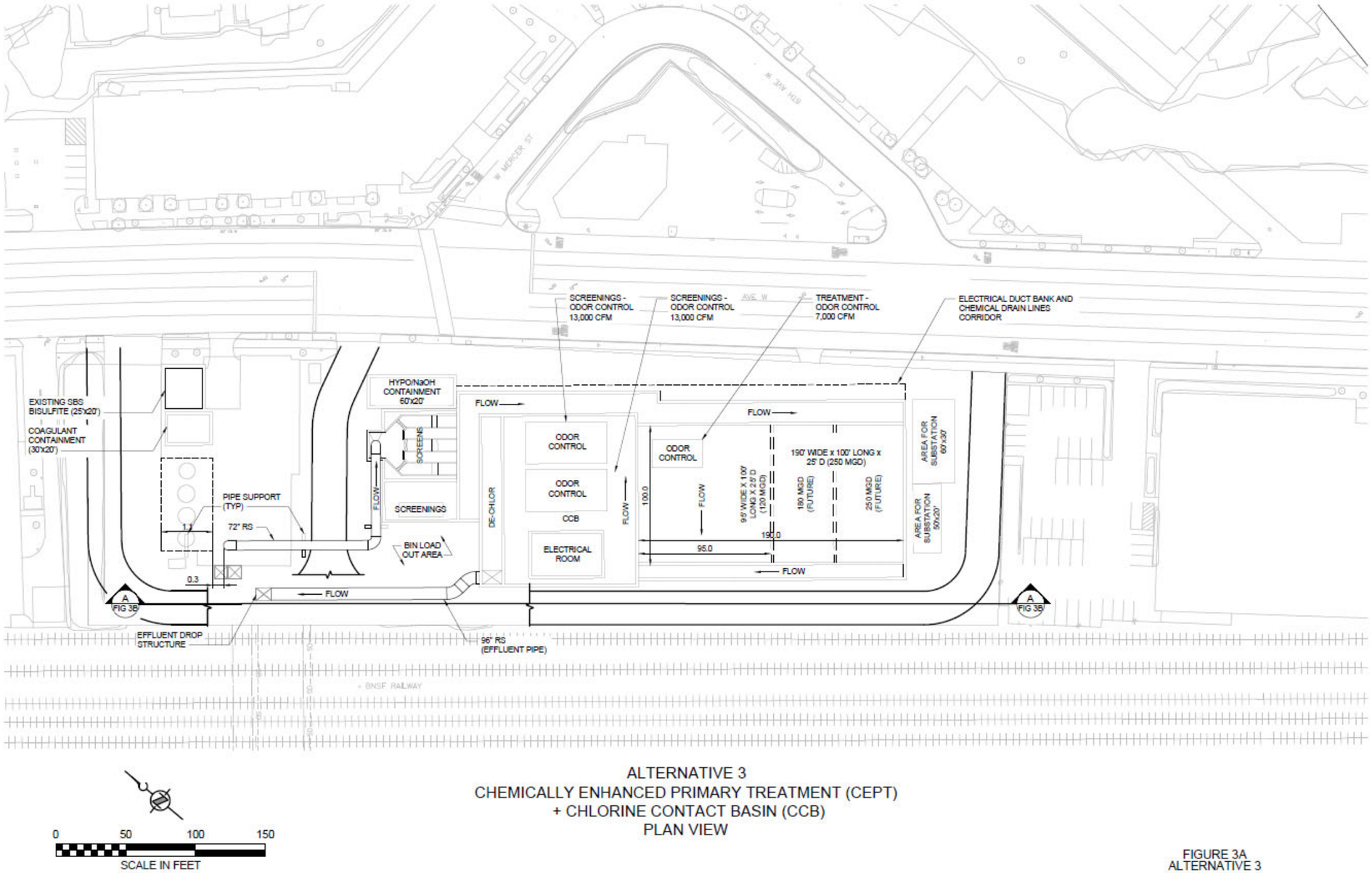


Figure 4-2. Alternative 2 - Ballasted Sedimentation + UV Disinfection Plan View



ALTERNATIVE 3
CHEMICALLY ENHANCED PRIMARY TREATMENT (CEPT)
+ CHLORINE CONTACT BASIN (CCB)
PLAN VIEW

FIGURE 3A
ALTERNATIVE 3

Figure 4-3. Alternative 3 - Chemically Enhanced Primary Treatment + Chlorine Contact Basin Plan View

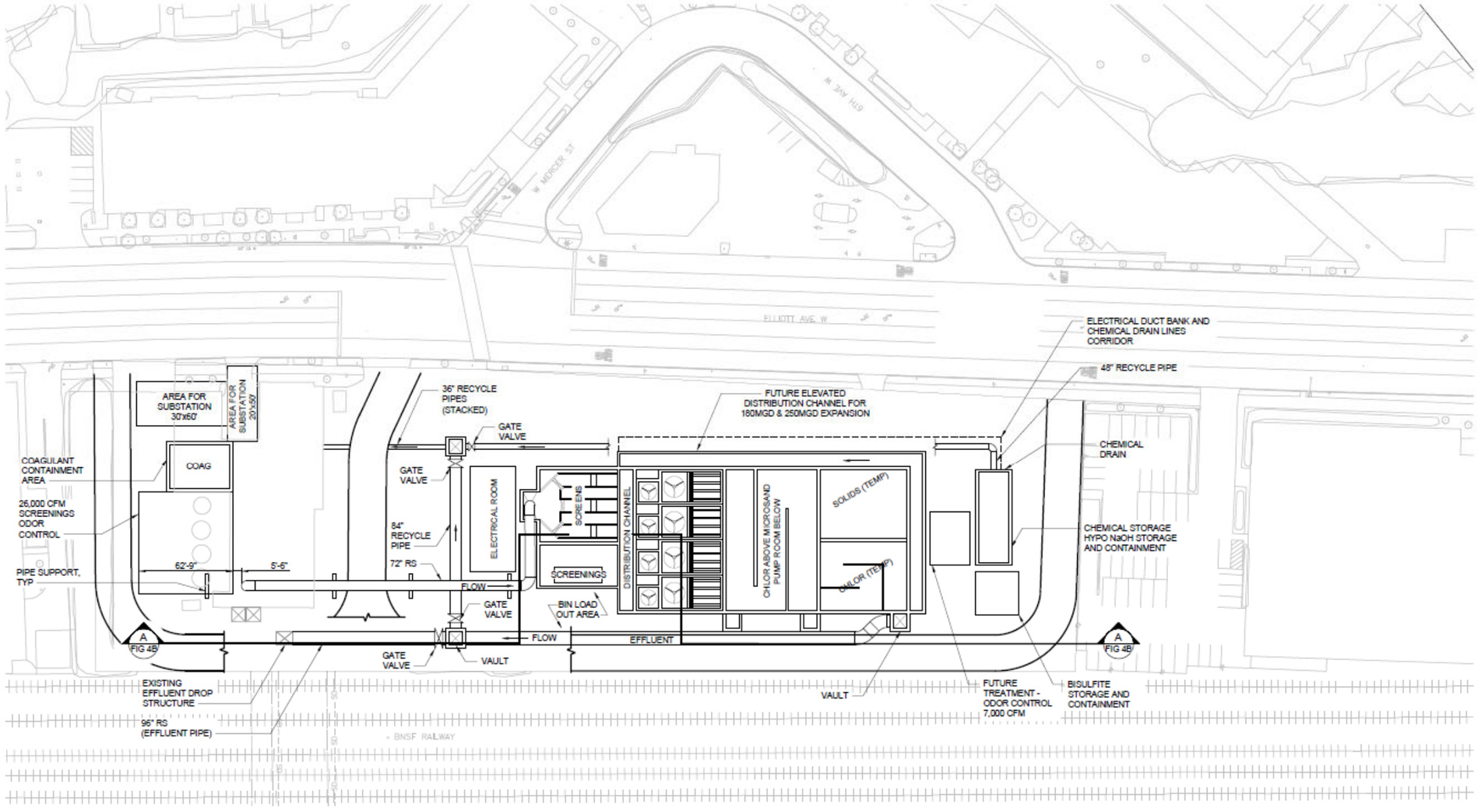


Figure 4-4. Alternative 4 - Ballasted Sedimentation + Chlorine Contact Basin Plan View

4.4 Alternatives Development and Scoring

For each of the four system alternatives (Alternatives 1-4) initially identified, layout drawings, hydraulic profiles, and cost opinions were developed. In addition, individual supporting components such as pump station, screening/screenings handling, electrical, geotechnical, and civil modifications were independently developed.

Five scoring workshops were held to evaluate, rate, and rank the four alternatives. During the first workshop, the Project team and the County worked collaboratively to translate the AECM into a numerical scale of 1, which indicates that the evaluated criteria were “hard” to satisfy, to 5, which indicates that the criteria were “easy” to satisfy. Each criterion within the AECM also received a weighted factor to reflect the relative importance of that specific category or component, and the AECM itself implemented columns to further define what “easy,” “medium,” and “hard” mean for each criterion.

The next four workshops were held to score each alternative using the updated AECM and discuss associated risks. Workshops were dedicated to discussing the main criteria categories of the AECM. Following the workshops, each alternative’s scores were summed to produce a weighted score. All alternatives scored similarly overall, with only a few points separating the highest scoring from the lowest scoring. Further details on the scoring process and the detailed scores can be found in the *Alternatives Analysis Technical Memorandum* (Jacobs, 2021).

Similar to the scoring results, the alternatives’ estimated total Project costs were relatively close, within only a 10 percent difference between the highest cost for Alternative 2, and the lowest cost for Alternative 1. This outcome further reinforces the overall competitiveness and interchangeability of the four alternatives, and they were all determined to be effective in meeting the EWWTS’s permitting needs and Project goals.

4.5 Cost Estimate

Alternatives 1 through 4 were developed for a peak instantaneous flow of 250 mgd and a peak day flow of 120 mgd (with future expansion). Combined with 3 MG equalization in the Mercer Street Tunnel, this initial modeling showed that the configuration would likely control untreated overflows to less than one event per year on average (Jacobs, 2021). Cost estimates were prepared to reflect a common initial capital cost basis associated with constructing the 120 mgd facility. The EWWTS capacity criteria were subsequently refined as part of the later alternatives development as discussed in Section 4.6.

In accordance with the King County Estimating Guidelines, the cost estimates were prepared using the AACE Recommended Practice (RP) 18R-97 (Cost Estimate Classification System - As Applied in Engineering, Procurement, and Construction for the Process Industries), which is used for projects that are primarily heavy in the manufacturing and production of chemicals, petrochemicals, and hydrocarbon processing. Table 4-2 summarizes each alternative’s opinion of probable cost for a Class 5 estimate (0 to 2 percent of design definition).

Table 4-2. Alternatives Cost Estimate

Description	Low Range (AACE: -20% to -50%)[a]	Estimate of Probable Project Cost[a]	High Range (AACE: +30% to 100%)[a]
Alternative 1	$207,000,000	$414,000,000	$828,000,000
Alternative 2	$226,000,000	$452,000,000	$905,000.000
Alternative 3	$217,000,000	$435,000,000	$870,000,000
Alternative 4	$221,000,000	$441,000,000	$882,000,000

[a.] Costs are provided in October 2021 dollars.

4.6 Alternative Optimization

Subsequent to the initial screening, the system operational methodology was further refined, and the preliminary alternatives were optimized. The optimization prioritized cost-effective technologies that were both proven to meet the NPDES permit effluent requirements and familiar to County O&M staff.

The most cost-effective cost reduction measure identified was to use the existing Mercer Street Tunnel more productively for peak flow equalization to, in turn, reduce the EWWTS's required peak instantaneous flow capacity. By decreasing the current operating storage volume being utilized for the Mercer Street Tunnel before the pumping and treatment at the station starts and utilizing the larger remaining volume to equalize the peak flow, the County concluded that the 250 mgd PIF could be lowered while providing for reliable CSO control.

A facility capacity analysis was re-performed to reduce the EWWTS's required capacity while still meeting the minimum level of control, limiting the number of untreated discharges to one event per year on a long-term average. The analysis indicated that an influent design flow of 180 mgd along with 4.4 MG of equalization storage controlled untreated discharges to a similar frequency as the existing EWWTS. This resulted in Alternatives 5A and 5B being developed around an increased peak hour treatment design flow of 180 mgd (increased from the 120 mgd peak hour flow assumed at previous alternatives) and paired with 4.4 MG of equalization volume in the Mercer Tunnel. An ultimate design flow (peak instantaneous) of 210 mgd was also added to account for future precipitation due to climate change by the year 2085 during the development of Alternatives 5C and 6.

The following two core components were selected for all alternatives as a starting point for optimization:

- Ballasted sedimentation was selected as the solids removal technology. This technology has been successfully employed at multiple wet-weather treatment facilities across the United States and employed at the County's new GWWTS. Ballasted sedimentation, combined with a polishing step using MetClear® or similar metal-sequestering polymers for additional copper removal, is expected to remove most of the copper from the effluent with strong potential for reliably demonstrating compliance with water quality criteria for copper, without the need to modify the outfall to utilize increased dilution for demonstrating compliance. Additional bench scale testing during the upcoming wet weather season is simultaneously occurring to provide data to confirm treatment assumptions.
- On-site chlorination/dechlorination was initially selected as the disinfection technology for several reasons, including the limited availability of additional electrical capacity needed to install UV at EWWTS, and the fact that this technology has proven to be effective at other CSO treatment stations in the County's regional system. Ultimately, the team re-evaluated this technology selection based on the proposed new requirements for TRC performance in the draft NPDES permit, which were issued at a later date in draft form in April 2023. Additional preliminary analyses indicated modifying the

outfall and diffuser for increased dilution would be more challenging than original planning indications. The proposed NPDES limits were a factor in the County decision to change the recommended disinfection technology from chlorination to UV.

The following sections summarize key optimization advancements with the analysis detailed in the *Alternatives Analysis Technical Memorandum* (Jacobs, 2021) for Alternatives 5A and 5B and the *Alternatives Analysis Technical Memorandum* (Jacobs, 2024) for Alternatives 5C and 6. Table 4-3 summarizes the optimized Alternatives 5A, 5B, 5C and 6.

Table 4-3. Optimized Alternatives

Treatment Alternative	Capacity in mgd (Current/Ultimate)	Mercer Tunnel Equalization (MG)[b]	Pumping/ Preliminary/Solids Technology	Disinfection Technology	Outfall Improvements
Alternative 5A	180/180	4.4	New pumps/ bar screens/ ballasted sedimentation	On-Site Chlorination	Terminal Rosette Diffuser
Alternative 5B	180/180	4.4	Retrofitted pumps + 1 new pump/ bar screens/ ballasted sedimentation	On-Site Chlorination	Terminal Rosette Diffuser
Alternative 5C	180/210[a]	4.4	Retrofitted pumps + 1 new pump/ bar screens/ ballasted sedimentation	On-Site Chlorination	Terminal Rosette Diffuser
Alternative 6	180/210[a]	4.4	Retrofitted pumps + 1 new pump/ bar screens/ ballasted sedimentation	UV	N/A[b]

[a] A peak instantaneous condition of 210 mgd was added to account for future precipitation due to climate change.

[b] Refer to Sections 4.3.1.3 and 5.2.1.3 for discussion of permit compliance. Outfall improvements were decoupled from the EWWTS Project during the development of Alternative 6.

4.6.1 Alternative 5A

Figure 4-5 depicts the conceptual layout of Alternative 5A. Key elements of this alternative include:

- Mercer Tunnel Equalization: 4.4 MG.
- Peak Hour Design Flow: 180 mgd.
- Pump Station: Six new pumps.
- Screenings: Three multi-rake bar screens (60 mgd each).
- Solids Settling: Three high-rate clarification trains (60 mgd each), with solids returned to the EBI for treatment at the WPTP.
- Disinfection: Sodium hypochlorite disinfection and sodium bisulfite dechlorination.
- Outfall Modifications: Rosette-type diffuser to increase dilution.

4.6.1.1 Hydraulic Analysis and Pump Station Evaluation

Figure 4-6 depicts the projected hydraulic profile at 180 mgd. This hydraulic profile accounts for two scenarios, one which includes 2 feet of sea level rise in Elliott Bay and one without it. The 2 feet of sea level rise falls between the most likely (50 percent probability) relative sea level rise for high (2.3 feet) and

low (1.9 feet) emission scenarios in the year 2100 estimated by University of Washington's Climate Impacts Group. New pumps are required to operate within the recommended industry standard pumping range, and installing these pumps would necessitate upgrades to the pump station structure. The existing low voltage (480-volt [V]) electrical service was sufficient to serve the upgraded station.

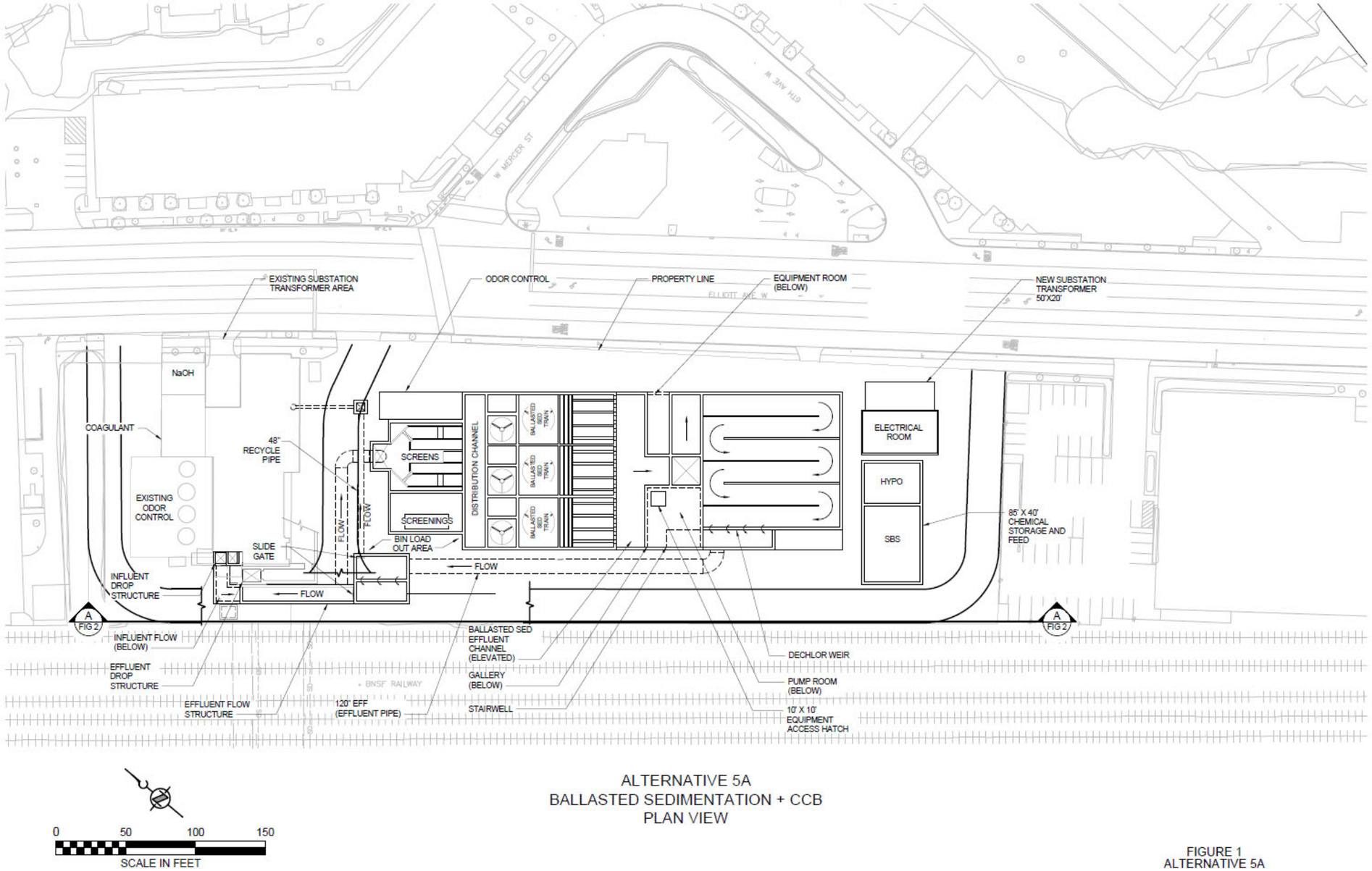


Figure 4-5. Alternative 5A Plan View

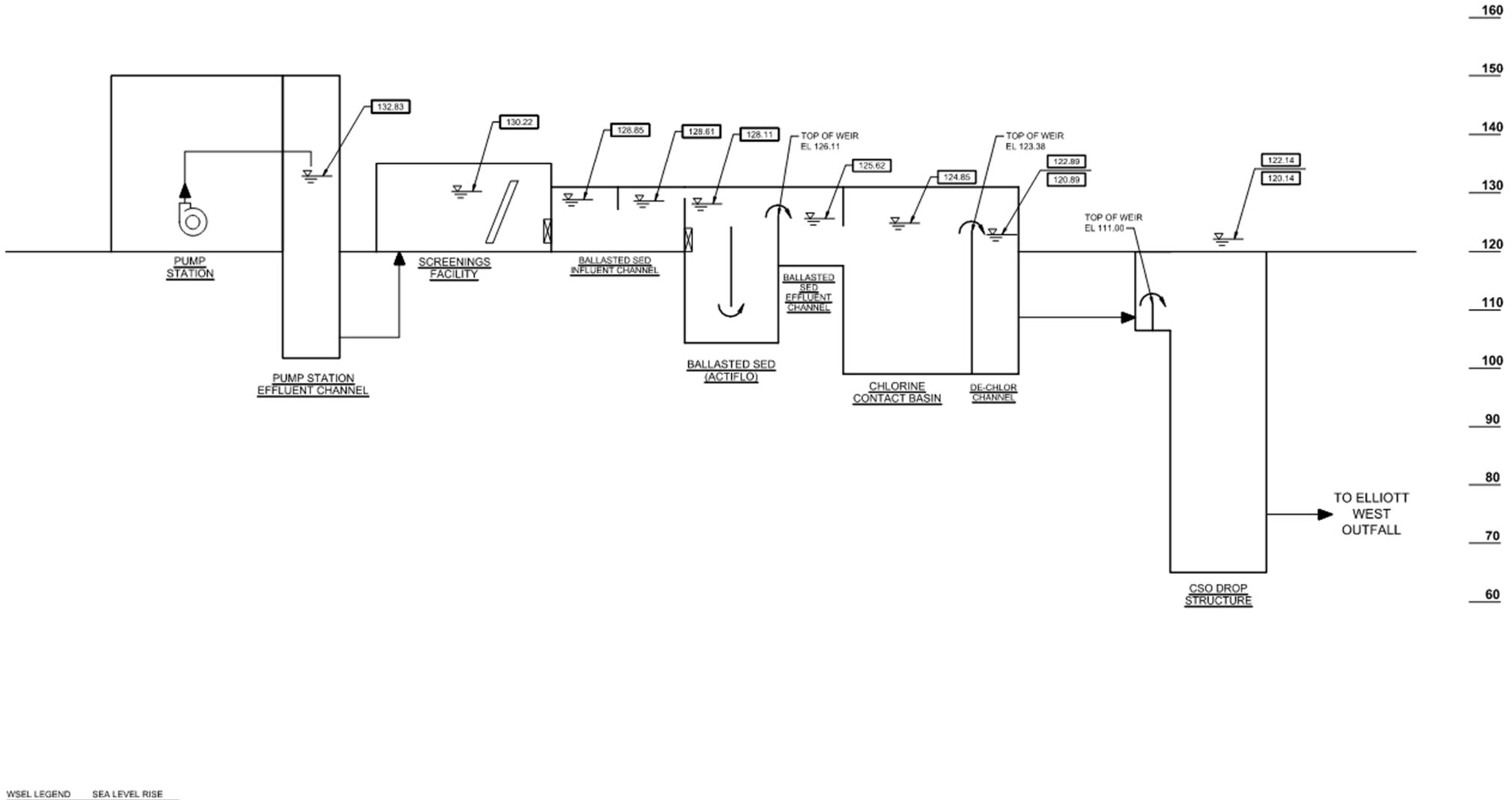


Figure 4-6. Alternative 5A Hydraulic Profile at 180 mgd

4.6.1.2 Key Modifications

The following modifications were included in the optimized Alternative 5A to meet a peak hour design flow of 180 mgd:

- Screening: A third multi-rake screen was added.
- Solids Removal: A third high-rate clarification train was added.
- Disinfection: Optimization of on-site chlorination channels were performed using computational fluid dynamics (CFD) modeling. The analysis indicated that the contact basin should be sized to provide approximately 10 minutes of contact time at 180 mgd.
- Solids Storage: The solids removed through ballasted sedimentation would be returned to the EBI for treatment at the WPTP, eliminating the need for an on-site solids storage tank.
- Chemical Storage: Revised treatment capacity criteria increased the volume of chemical storage tanks needed for disinfection.
- Electrical: A new medium voltage power supply was eliminated, based on the assumption that the existing generator power feed and transformers could accommodate additional loads and will not need replacement.
- Off-site Improvements: Providing a means to sample and monitor effluent at the EWWTS site eliminated the need for bisulfite and final effluent sample improvements in Myrtle Edwards Park. Replacement of the temporary generator at the Denny Way Regulator Station was also removed from the scope of the Project.
- Geotechnical: Refinements to the hydraulic grade line indicated that treatment basins would need to be constructed approximately 20 feet below grade, resulting in a greater amount of excavation, disposal of soils, dewatering, and associated costs.

4.6.1.3 Cost Estimate

The cost estimate was developed using the King County Estimating Guidelines and the AACE RP18R-97 Guidelines. The estimated total Project cost for the Alternative 5A is $453 million (in October 2022 dollars), representing an average savings of about $45 million, compared to the narrowed Alternatives 1 through 4. Per AACE, the expected accuracy range of the estimate is minus 20 percent to minus 50 percent on the low end, and plus 30 percent to plus 100 percent on the high end.

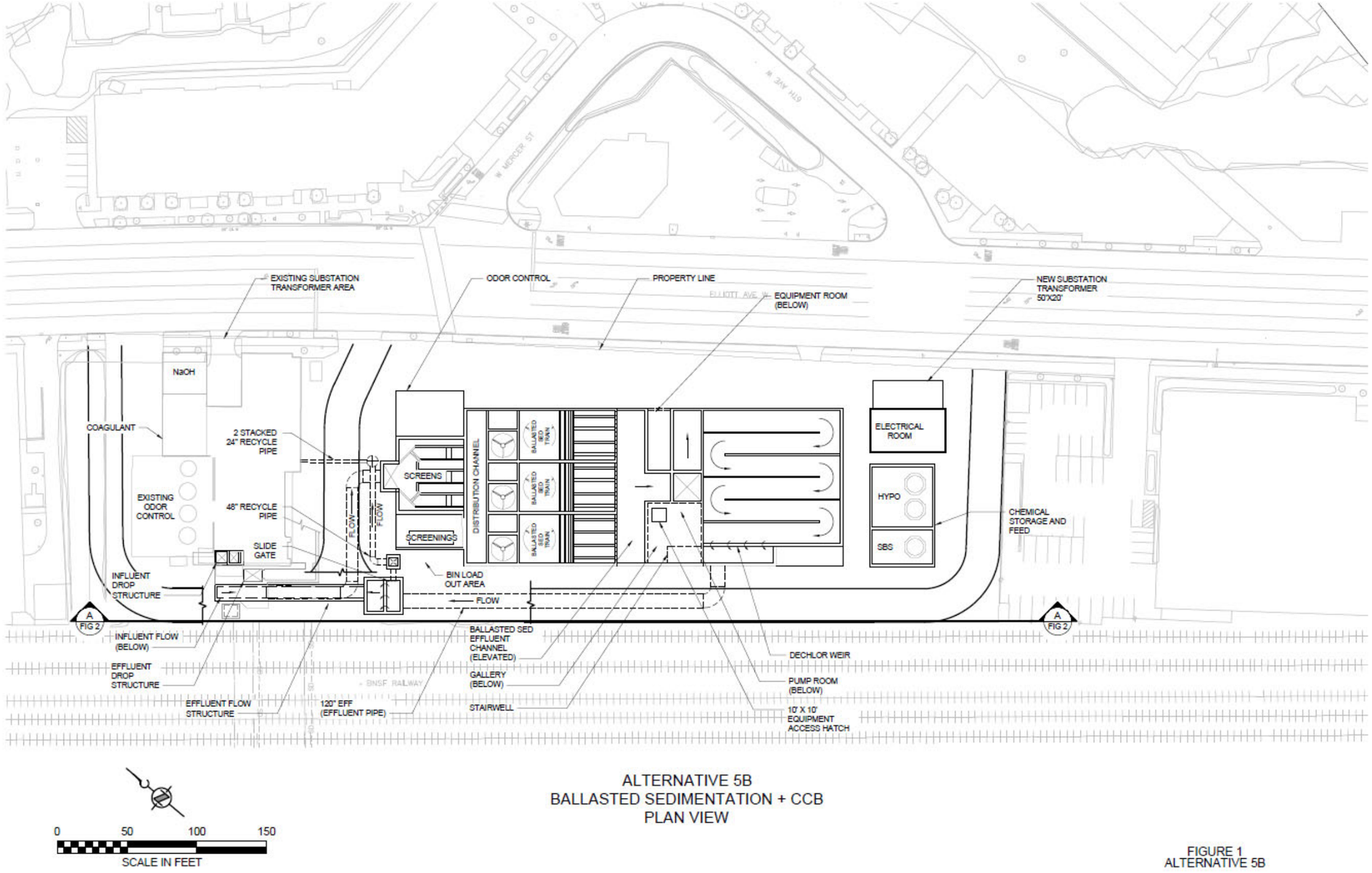


Figure 4-7. Alternative 5B Plan View

4.6.2 Alternative 5B

Alternative 5B optimized the alternative by reducing the required influent pump station modifications. Figure 4-7 depicts the conceptual layout of the alternative. Key elements of this alternative include (changes from Alternative 5A shown in **bold**):

- Mercer Tunnel Equalization: 4.4 MG.
- Peak Hour Design Flow: 180 mgd.
- **Pump Station: Six new impellers for existing pumps.**
- Screenings: Three multi-rake bar screens (60 mgd each).
- Solids Settling: Three high-rate clarification trains (60 mgd each), with solids returned to the EBI for treatment at the WPTP.
- Disinfection: Sodium hypochlorite disinfection and sodium bisulfite dechlorination.

Key optimization advancements made in the development of Alternative 5B include pump retrofits in lieu of a new pump station and updates to geotechnical considerations.

4.6.2.1 Hydraulic Analysis and Pump Station Evaluation

Figure 4-8 depicts the projected hydraulic profile. This hydraulic profile accounts for two scenarios, one which includes 2 feet of sea level rise in Elliott Bay and one without it. In lieu of fully replacing the pump station, Alternative 5B retrofits the impeller and shaft of the existing pumps and modifies the anti-siphon breakers. The retrofit allows the existing motors and variable frequency drives (VFD) to remain in use.

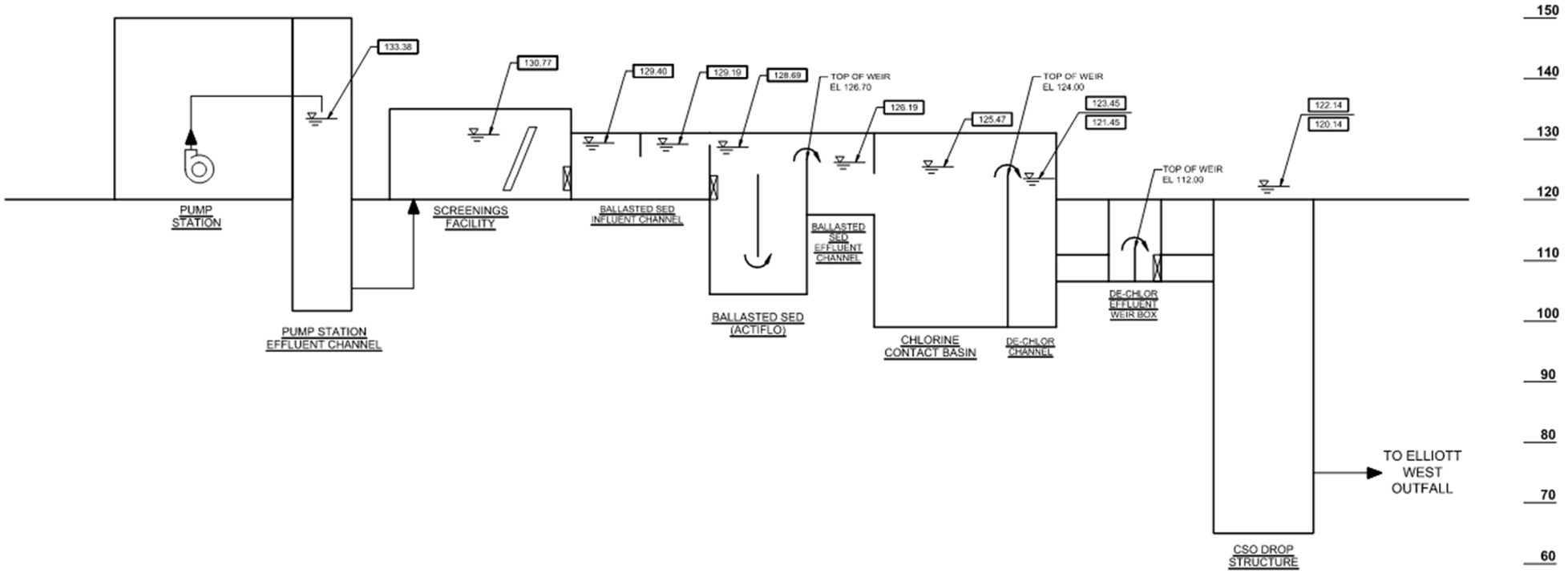


Figure 4-8. Alternative 5B Hydraulic Profile at 180 mgd

4.6.2.2 Key Modifications

The key modification made to the treatment process and overall facility under Alternative 5B included performing a conceptual level geotechnical analysis using borings drilled for the existing facility and simplified methods to evaluate seismic liquefaction potential and the risk of seismically induced lateral spreading. The results of the analysis changed the overall geotechnical and structural approach for EWWTS including:

- Shifting the EWWTS structure west to better locate between the BNSF railroad tracks to the west and the planned Ballard Link Extension light rail tracks to the east.
- Utilizing temporary sheet pile wall with a waler system and tie-back anchors.
- Assuming over-excavation of remaining liquefiable soils, backfill and eliminate piles under treatment basins.
- Increasing thickness of base slabs and selected walls to mitigate buoyancy and lateral spreading.
- Inclusion of an L-shaped precast cantilevered wall to meet BNSF requirements and preserve underground space for undefined conduits and yard piping.

4.6.2.3 Cost Estimate

Cost was developed using the King County Estimating Guidelines and the AACE RP18R-97 Guidelines. The estimated total Project cost for the Alternative 5B is $375 million (in October 2022 dollars), representing additional savings of about $68 million (approximately 18 percent cost reduction) compared to the narrowed Alternative 5A. Per AACE, the expected accuracy range of the estimate is minus 20 percent to minus 50 percent on the low end, and plus 30 percent to plus 100 percent on the high end.

4.6.3 Alternative 5C

Figure 4-9 depicts the conceptual layout of Alternative 5C. Alternative 5C further optimized the treatment process configurations to handle the 180 mgd peak hour design flow and added the peak instantaneous design flow of 210 mgd to handle future precipitation, as discussed in Section 5.1.

Key elements of this alternative include (changes from Alternative 5B shown in **bold**):

- Mercer Tunnel Equalization: 4.4 MG.
- Peak Hour Design Flow: 180 mgd.
- **Peak Instantaneous Design Flow: 210 mgd.**
- **Pump Station: Six new impellers for existing pumps, a new redundant seventh pump in the space allocated for future expansion.**
- Screenings: Three multi-rake bar screens (60 mgd each).
- Solids Settling: Two Actiflo® high-rate clarification trains (90 mgd each), with solids returned to the EBI for treatment at the WPTP.
- Disinfection: Sodium hypochlorite disinfection and sodium bisulfite dechlorination.

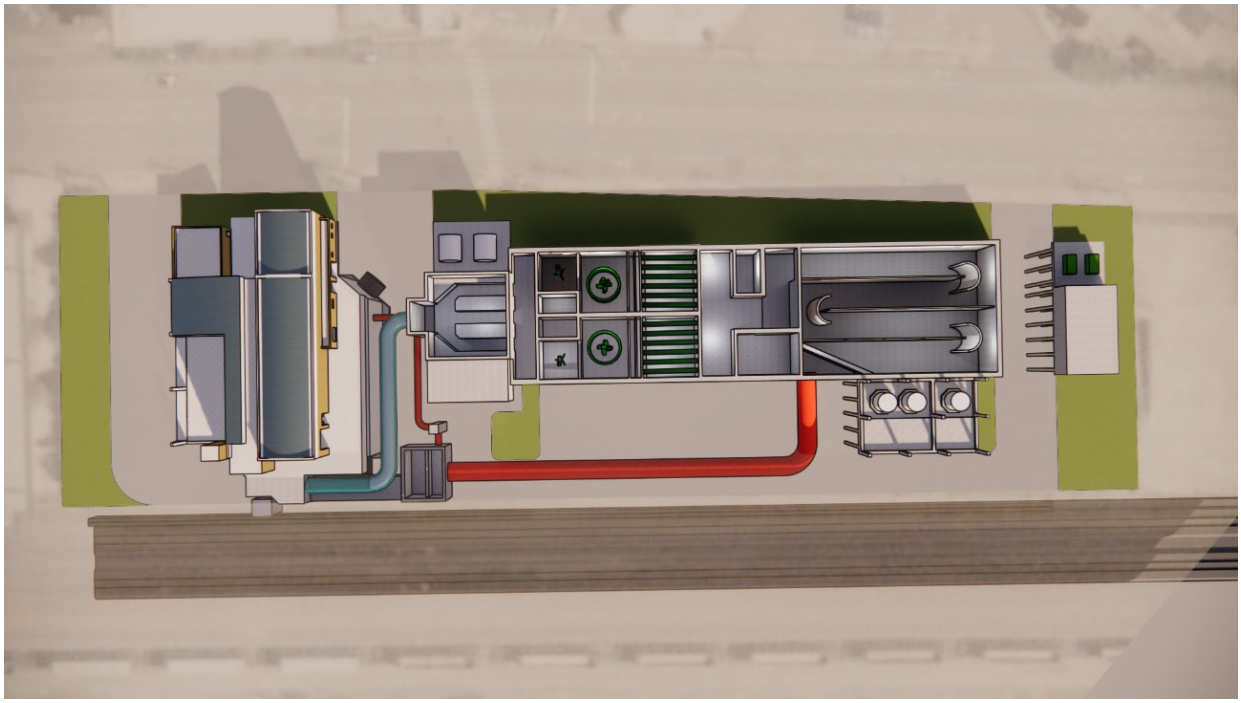


Figure 4-9. Alternative 5C Plan View

4.6.3.1 Hydraulic Analysis and Pump Station Evaluation

Figure 4-10 depicts the projected hydraulic profile. This hydraulic profile includes 2 feet of sea level rise in Elliott Bay. A new seventh pump installed in the originally designed expansion footprint will allow the facility to achieve the ultimate design flow of 210 mgd.

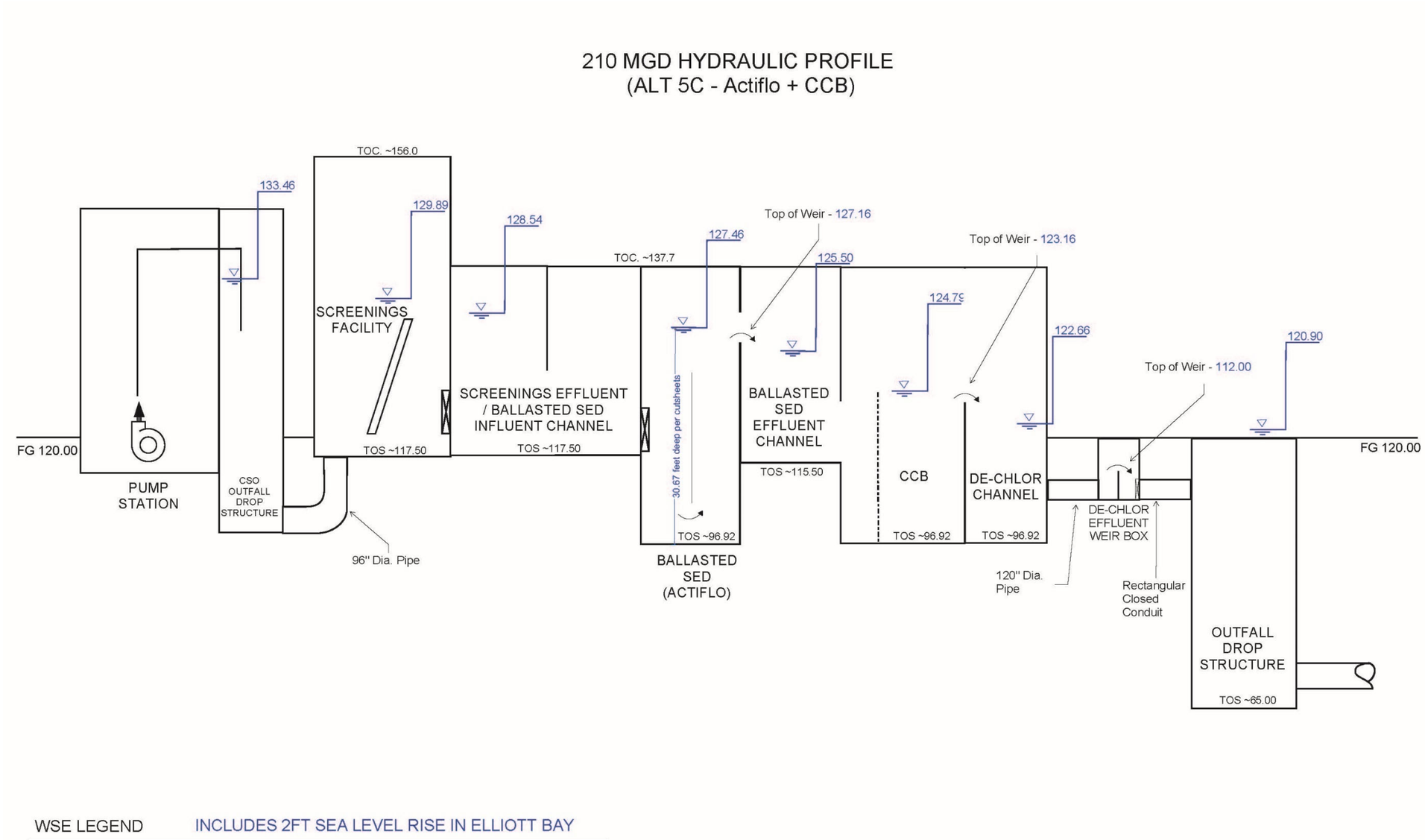


Figure 4-10. Alternative 5C Hydraulic Profile at 210 mgd

4.6.3.2 Key Modifications

The following modifications were included in Alternative 5C to meet the ultimate design flow of 210 mgd:

- Screenings: The higher hydraulic grade line increased the screenings modifications required.
- Solids Treatment: The ballasted sedimentation treatment train configuration was modified from three 60 mgd treatment trains to two 90 mgd deeper trains. The Project team obtained approval for a sole source waiver for the EWWTS Project process to use the Actiflo® system.
- Disinfection: The concrete chlorine contact basin was enlarged to handle the increased flow and adjusted to better accommodate the two ballasted sedimentation trains. Additionally, dechlorination and sampling was moved from the existing Myrtle Edwards Park to within the EWWTS facility.
- Chemical Storage: Chemical storage volumes and pumping systems were upsized, and the storage building was shifted to the western side of the site to accommodate longer, narrower treatment structure.
- Park Improvements: In Alternative 5C, the existing dechlorination structure will be retrofitted and simplified, the existing external generator replaced and potentially moved to the building interior, and mechanical equipment removed from the building.

4.6.3.3 Cost Estimate

Cost was developed using the King County Estimating Guidelines and the AACE RP18R-97 Guidelines. The estimated total Project cost for the Alternative 5C is $372 million (in October 2022 dollars). This represents a savings of approximately $3 million compared to the optimized Alternative 5B (also updated to in October 2022 dollars). The savings are mainly attributable to the change from three to two ballasted sedimentation trains. Per AACE, the expected accuracy range of the estimate is minus 20 percent to minus 50 percent on the low end, and plus 30 percent to plus 100 percent on the high end.

4.6.4 Alternative 6

Following development of Alternative 5C, Ecology issued a draft NPDES permit with reduced effluent TRC limits for EWWTS in April 2023. The team re-evaluated the disinfection technology based on the proposed new requirements for the TRC performance. Achieving the new TRC limits in combination with the pH limit performance issues, in the absence of outfall improvements for increased dilution, are considered challenging to achieve and present a long-term risk that a chlorine-based disinfection alternative may result in permit noncompliance. This prompted the development of a UV disinfection alternative to eliminate the use of chlorine.

Figure 4-11 depicts the conceptual layout of the alternative. Key elements of this alternative include (changes from Alternative 5C shown in **bold**):

- Mercer Tunnel Equalization: 4.4 MG.
- Peak Hour Design Flow: 180 mgd.
- Ultimate Peak Instantaneous Design Flow: 210 mgd.
- Pump Station: Six new impellers for existing pumps, a new seventh pump in the space allocated for future expansion.
- Screenings: Three multi-rake bar screens (60 mgd each).

- Solids Settling: Two Actiflo® high-rate clarification trains (90 mgd each), with solids returned to the EBI for treatment at the WPTP.
- **Disinfection: UV.**
- **C3 Storage: 0.75 MG.**

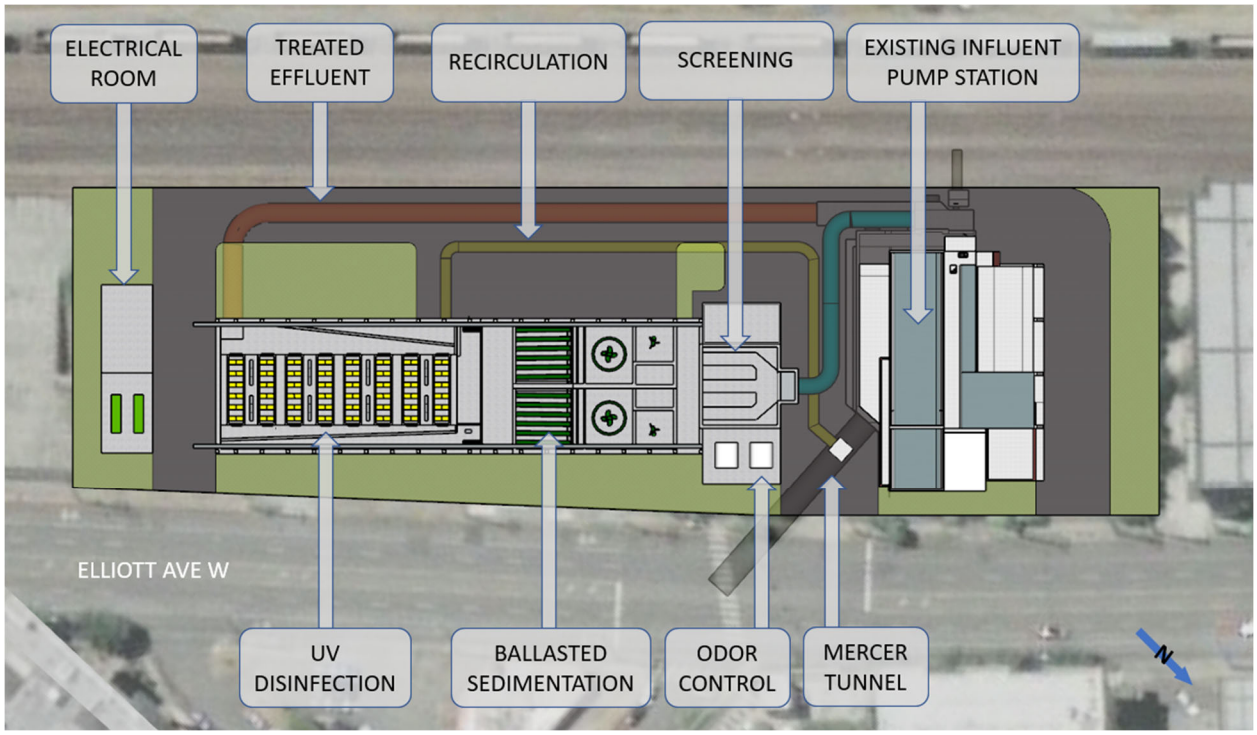


Figure 4-11. Alternative 6 Plan View

4.6.4.1 Hydraulic Analysis and Pump Station Evaluation

Figure 4-12 depicts the projected hydraulic profile for Alternative 6 at the peak instantaneous flow of 210 mgd. This hydraulic profile includes 2 feet of sea level rise in Elliott Bay.

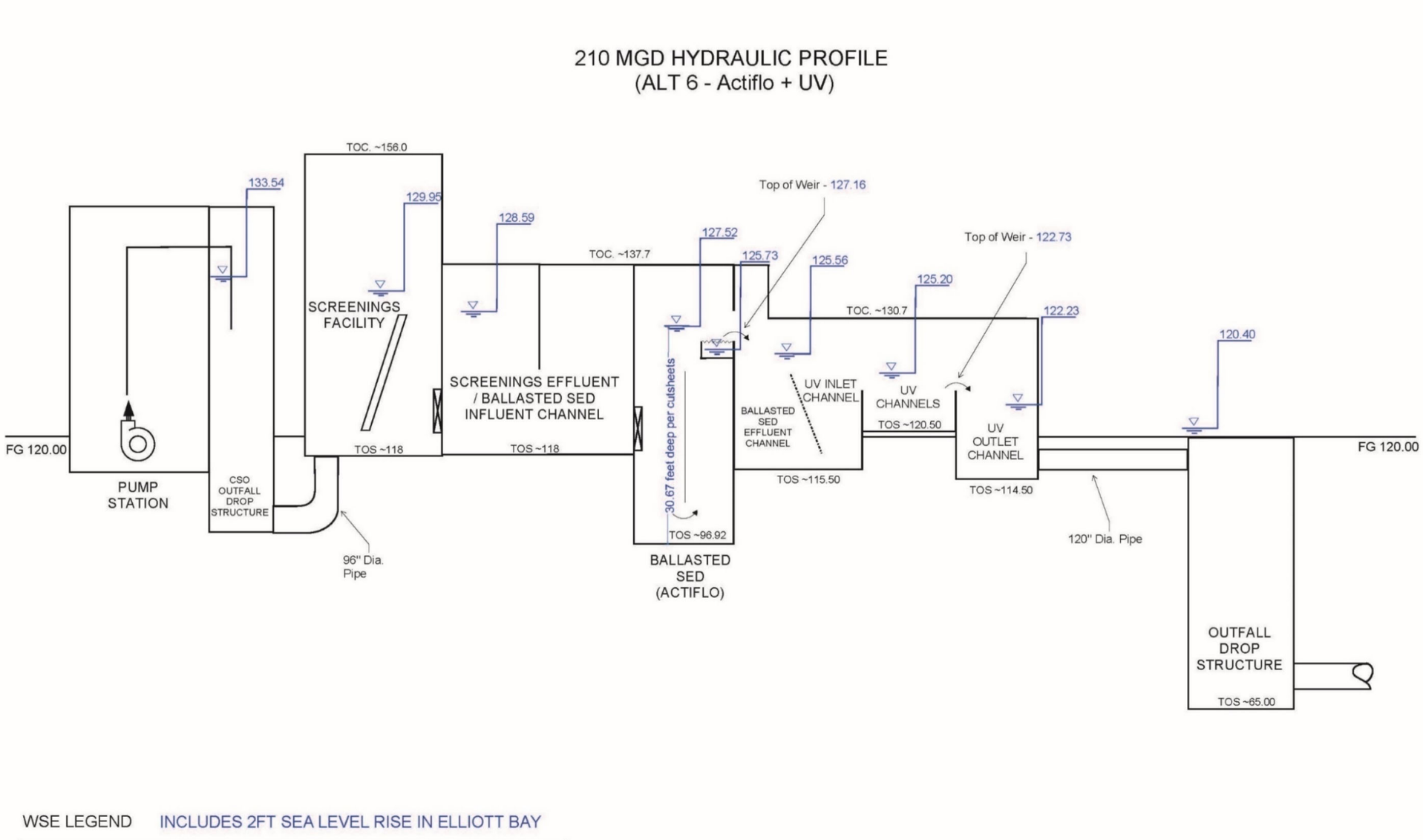


Figure 4-12. Alternative 6 Hydraulic Profile at 210 mgd

4.6.4.2 Key Modifications

The modifications made for Alternative 6 are summarized below:

- Disinfection: Replace chlorine disinfection with UV disinfection. The conceptual layout replaced the chlorine contact basin with shallower individual treatment channels, inlet baffle wall channel for flow equalization, a separate weir for noncompliant treated water, and an extended canopy over the structure. The overall structure footprint was similar to Alternative 5C.
- C3 Storage: Underneath the UV facility, a plant water (C3) storage tank was added to handle noncompliant treated water. The C3 storage will provide storage with a gravity recirculation pipe returning C3 to the Mercer Tunnel for additional treatment.
- Chemical Storage: Reduced chemical storage needs and associated geotechnical costs due to the elimination of hypochlorite and sodium bisulfite.
- Electrical: Increased power demand for UV disinfection requires a new dual feed medium voltage electrical system for Alternative 6 (2,000 kilovolt amps [kVA] larger than for Alternative 5C), which will also require increased power supply service from Seattle City Light.
- Geotechnical: Geotechnical costs for Alternative 6 were reduced from those of Alternative 5C by eliminating the chemical storage building needed for hypochlorite and sodium bisulfite and associated pile supports. However, Alternative 6 resulted in a slight increase in pile supports under the larger electrical transformer pads.
- Outfall: Alternative 6 relies on UV disinfection technology obviating the need for use of chlorine for disinfection. This eliminates the need for increased dilution at the outfall to meet NPDES permit limits for TRC, and the proposed treatment is expected to allow the discharge to demonstrate reliable compliance with other water quality criteria. To ensure the rest of the Project can be implemented without the risk of schedule delay from being tied to lengthy in-water work permitting, the outfall modifications are now considered decoupled from the EWWTS improvements.

4.6.4.3 Cost Estimate

Cost was developed using the King County Estimating Guidelines and the AACE RP18R-97 Guidelines. The estimated total Project cost for the Alternative 6 is $398 million (in October 2022 dollars), which is 7 percent higher than Alternative 5C. The majority of this increase is attributed to the change in disinfection technology and the increased electrical needs for UV disinfection. Per AACE, the expected accuracy range of the estimate is minus 20 percent to minus 50 percent on the low end, and plus 30 percent to plus 100 percent on the high end.

4.7 Evaluation and Selection of Recommended Alternative

During the second quarter of 2023, the County and Project team compared Alternative 5C and Alternative 6 in light of the draft NPDES language issued at the time and considering risk, cost, and non-cost factors. A decision workshop with the County and Project team was held on June 26, 2023, to present and discuss the evaluation criteria and scoring, describe the differences between Alternative 5C and Alternative 6, and select the preferred alternative for design and development.

The evaluation between Alternative 5C and Alternative 6 considered the following key categories:

- Technology and operation/maintenance attributes for intermittently operated facilities.
- Regulatory risks, specifically NPDES permit effluent compliance.

- Probability of schedule delay risks due to design, permitting and construction.
- Project costs.

Alternative 6 had the lowest regulatory and schedule risks, eliminates the risks related to meeting the draft TRC permit requirements, has fewer schedule and operational risks, and has a 7 percent increase in cost in the Class 5 cost estimate. However, at the Class 5 level of accuracy, the majority of the total Project cost ranges for the two alternatives overlap, meaning that the two alternatives may ultimately have comparable costs.

The evaluation concluded that Alternative 6 can best achieve the project objectives of bringing the facility into NPDES permit compliance, mitigating risk, and managing cost to the extent possible. Thus, the Project team elected Alternative 6 as the preferred alternative and proceeded with preliminary design. In addition, the team will continue bench-scale testing with metal-sequestering polymers and perform collimated beam testing to inform the performance and design of the treatment technologies. The selection of Alternative 6 acknowledged that the recommendation could be revisited if the final NPDES permit changed effluent requirements, or the bench-scale testing changed the anticipated performance or design of the solids removal process. The issuance of the renewed 2024 NPDES permit on April 29, 2024 (Ecology, 2024) has not compelled the County to revisit the decision at this time.

5. Recommended Alternative

5.1 Introduction

Chapter 5 summarizes the recommended EWWTS Project, including the design flows and loads, ability to expand, feasibility of implementation, and design life. The design elements described in this chapter are current through January 2025.

5.2 Recommended Alternative

The County selected Alternative 6 as the recommended Alternative for the EWWTS Project, as discussed in Section 4.6.5. In late 2024 during preliminary design, the County increased the design capacity criteria to reflect the station's treated capacity discharged to the outfall. The design capacity incorporates the additional flow SPU intends to convey to the EBI and Lake Union Tunnel from the upcoming Vine Street CSO project as summarized in Table 5.1. For the purpose of this design, it is assumed that the Vine Street CSO flows may be part of the capacity calculations, however, adding Vine Street CSO flows to EWWTS is contingent upon an approved Agreement with SPU regarding capital and O&M costs.

This section describes the EWWTS Project planning basis and design parameters including the water quality requirements, site layout, process descriptions and performance, treatment plant design data, flow diagram and hydraulic profile, mass balance, and O&M and staffing.

5.2.1 Project Planning Basis

The following section summarizes the overall planning basis for the proposed Project.

5.2.1.1 System Flow Equalization

The existing Mercer Street Tunnel is 6,212 feet long with a 14-foot 8-inch inner diameter, and accounting for the cunette cast in the bottom, has a storage volume of 7.5 MG when completely full. Combined with the East Portal (0.3 MG) and the EWWTS wet well (0.4 MG), a total of 8.2 MG of storage is available. The tunnel and existing facility operate in a fashion that maximizes the use of storage prior to pumping and treating flows. For the upgraded station, the operational strategy will be modified to allow the Mercer Street Tunnel to provide up to 4.1 MG of equalization volume during an event. The modified approach to flow equalization will provide the following benefits:

- Reduce short-term peak flow and the required design treatment capacity.
- Store flows during small events, thus lowering the frequency of treatment station start-up, stored flow would be routed to WPTP post-event.
- Provide storage for partially treated effluent that does not yet meet discharge requirements during facility startup for each event.
- Provide storage for partially treated effluent in the event of treatment disruption, such as temporary loss of power in UV disinfection.

5.2.1.2 Station Flow and Water Quality

Table 5-1 summarizes the modeled system flow and water quality as the preliminary design basis for the Project (Jacobs, 2021 and King County, 2025).

Table 5-1. Design Flow and Volumes

Description	Units	Design Condition	
		Influent	Discharge to Outfall
Peak Hour Design Flow	mgd	189	180
Peak Instantaneous Design Flow	mgd	219	210
Ultimate Peak Hour Design Flow	mgd	219	210
Peak Hour Design Treatment Capacity	mgd	180	
Solids Return Design Flow to EBI	mgd	approximately 9	
Mercer Tunnel Equalization Volume	MG	4.1	
C3 Storage (180 MG x 6 minutes)	MG	0.7	
Frequency of Events (Average)	#/yr	18	
Frequency of Events (Historic)[a]	#/yr	50	
Peak Event Volume[b]	MG	60	
Total Average Annual Events Volume[b]	MG	298	
Total Average Annual Events Volume (Historic)[a, b]	MG	550	
Average TSS	mg/L	121	--
Average Alkalinity	mg/L as $CaCO_3$	18 to 32	--
Average pH (Instantaneous)	--	4.0 - 8.0	--

[a] Refer to Appendix E for discussion on historic frequency of events and average annual events volume.

[b] These event volumes represent the volumes of treated discharge from EWWTS.

5.2.1.3 Discharge Standards

This section describes the discharge standards applicable to the EWWTS and the facility's compliance with these standards under the proposed project.

5.2.1.3.1 Summary of Compliance with CSO Standards

The CSO Control Policy under the CWA requires CSO systems to implement the "Nine Minimum Controls", which are summarized as:

- Ensure proper operation and regular maintenance programs for the sewer system and CSOs.
- Maximize use of collection system for storage.
- Review and modify pretreatment requirements to assure CSO impacts are minimized.

- Maximize flow to the publicly owned treatment works for treatment.
- Prohibit CSOs during dry weather.
- Control solid and floatable materials in CSOs.
- Prevent pollution.
- Ensure the public is adequately notified of CSO occurrences and impacts.
- Monitor to effectively characterize CSO impacts and the efficacy of CSO controls.

Federal rules also specifically require CSO systems to provide, at a minimum, primary clarification, solids and floatable material disposal, and disinfection for the combined sewage that is greater than the amount that can be reduced or eliminated through storage or flow reduction measures. The “at-site” treatment provided by EWWTS is allowed under WAC 173-245-020 which also defines the technology-based limits applicable to the County’s CSO treatment plants with discharges authorized under an NPDES permit. The technology-based effluent limits applicable to EWWTS are as follows:

- TSS: an annual average of at least 50% removal of the influent mass of TSS during discharge events
- Settleable Solids: no more than 0.3 mL/L/hr on an annual average basis
- Fecal Coliform Bacteria: 400/100 mL as a monthly geometric mean
- pH: Within the range between 6.0 and 9.0 standard units (daily minimum and maximum)

With the completion of the Project’s proposed treatment improvements, the discharge from EWWTS will provide the “Nine Minimum Controls” required by special condition S11.B of the 2024 NPDES permit and will reliably achieve compliance with the above technology-based effluent limits for CSO treatment facilities as specified in the 2024 NPDES permit. The proposed screening improvements, the added treatment with ballasted sedimentation, and UV disinfection are consistent with the level of CSO treatment for the authorized discharges at the County’s other CSO treatment plants, which include the GWWTS, Carkeek, Alki, and Henderson/MLK CSO treatment plants. The proposed Project’s improvements maximize the use of the available space for treatment, while affording provisions for a potential future expansion with a third solids removal treatment train (sized at 30 mgd).

5.2.1.3.2 Summary of Compliance with Water Quality Criteria and Sediment Quality Standards

With the proposed treatment improvements and resulting compliance with the standards for CSO discharges, the EWWTS will meet AKART requirements for CSO discharges and will qualify for a mixing zone authorization under the requirements of WAC 173-201A-400, as interpreted by Ecology in its response to comments #2.4 and #3.2 (NPDES permit Appendix G - Responses to Comments; Ecology, 2024). A mixing zone authorization will significantly reduce the EWWTS discharge’s long-term risk of noncompliance with marine water quality criteria. Without a mixing zone authorization, water quality criteria would likely be exceeded for copper as well as other pollutants.

A detailed evaluation of the EWWTS discharge’s compliance with applicable water quality criteria has been developed for the proposed Project, under the assumption that a mixing zone is authorized with an acute dilution factor of 2.5 applicable to the ultimate discharge design flow (210 mgd) conditions. This detailed evaluation is presented in Appendix F. It was developed as an RPA consistent with Ecology’s Permit Writer’s Manual (Ecology, 2018) and is based on: 1) the current State Surface Water Quality Standards (WAC 173-201A-240, updated January 2023), 2) anticipated revisions to the water quality standards based on EPA’s National Recommended Water Quality Standards, 3) updated effluent and background receiving water chemistry data, 4) updated dilution modeling for the proposed design flows, and 5) assumed removal of pollutants from proposed solids removal treatment improvements under this

Project. In addition, this analysis incorporated proposed draft revisions to State marine water quality criteria that are expected under an Aquatic Life Toxics Rulemaking in 2024. The updated RPA presented in Appendix F found no reasonable potential to exceed water quality criteria at the edge of an authorized mixing zone for all parameters except copper, based on expected removal rates from ballasted sedimentation. In addition, the Project's proposed additional chemical treatment with the MetClear® or similar metal-sequestering polymers is being incorporated into the design to address water quality-based criteria compliance. This additional chemical treatment for metals removal is expected to result in a determination of no reasonable potential to exceed water quality criteria for copper. This additional metals removal was not reflected in the minimum required dilution identified in the *Alternatives Analysis Technical Memorandum* (Jacobs, 2021). Key findings of the RPA and related evaluation are presented below.

Water Quality Based Effluent Limits - Copper

Ecology's RPA analysis conducted for the renewed 2024 NPDES permit (effective on June 1, 2024) found a reasonable potential for copper to exceed acute aquatic life water quality criteria for EWWTS's existing discharge and consequently established interim and final daily maximum effluent limits for copper. The County's reasonable potential determination for copper in the analysis presented in Appendix F includes an assumption for removal of particulate copper through the solids removal achieved by the proposed ballasted sedimentation process. To further reduce effluent copper concentrations, addition of a heavy metal sequestration polymer MetClear® or similar metal-sequestering polymers is proposed to precipitate soluble metals including dissolved copper. Based on the RPA presented in Appendix F, particulate copper removal rates of 85 percent and dissolved copper removal rates of 70 to 89 percent with MetClear® on the highest measured influent copper concentrations would demonstrate no reasonable potential of exceeding the acute water quality standard. The required removal rate from MetClear® (70 to 89 percent) is dependent on which calculation method is used in the reasonable potential analysis (see Appendix F). There is no data available yet from full-scale wet weather treatment facilities operating with copper removal, but bench-scale testing at EWWTS and pilot-scale testing conducted by King County (2010) support the assumption that this Project can achieve additional dissolved copper removal rates of at least 70 percent with MetClear® or similar metal-sequestering polymers.

A summary of the copper removal rates from the bench-scale testing completed to date is provided in Table 5-2, and in more detail within the Interim Bench Testing Report provided in Appendix G. This bench-scale testing will continue to support design and project planning through the 2026 to 2027 wet season and will be documented in a final comprehensive technical report in 2027 at the 90 percent design milestone. Reliable compliance with the acute copper criterion is expected with the proposed treatment if the criterion applies at the edge of an authorized acute mixing zone with a dilution factor of 2.5 (see Appendix F). Washington State Water Quality Standards for Surface Waters, Chapter 173-201A WAC, Table 240 for marine waters specify the acute water quality criterion of 4.8 µg/L is a 1-hour average dissolved concentration not to be exceeded more than once every three years on average.

Table 5-2. EWWTS Bench-Scale Testing Copper Removal Results (To Date)

Total Recoverable Copper Concentration, µg/L					Dissolved Copper Concentration, µg/L	
Event Date	Raw Wastewater	Ballasted Sedimentation Treated Wastewater	Ballasted Sedimentation + MetClear® Treated Wastewater	Total Removal of Total Recoverable Copper	Ballasted Sedimentation + MetClear® Treated Wastewater	Total Removal of Dissolved Copper
2/28/2022	26.1	10.8	(MetClear® not applied)	57%	--	--

Table 5-2. EWWTS Bench-Scale Testing Copper Removal Results (To Date)

Total Recoverable Copper Concentration, µg/L					Dissolved Copper Concentration, µg/L	
3/15/2022	87.5	4.77	2.7	97%	--	--
11/4/2023	23.7	(Not reported)	5.9	75%	--	--
12/5/2023	14.4	11.3	1.7	88%	--	--
2/29/2024	25.3	16.3	2.5	90%	0.39	98%
11/11/2024	15.6	11.0	2.0	87%	Non-Detect	100%
11/13/2024	19.1	9.9	3.9	79%	0.39	96%
12/18/2024	16.3	11.3	2.8	83%	0.65	95%
12/26/2024	13.7	13.1	5.4	60%	0.23	97%

Notes: These results reflect an optimal dose of 5 mg/L MetClear® polymer to the optimized Actiflo®-treated wastewater samples. In 2023, two different MetClear® products (2435 and 2405) were tested with only small differences in results between them.

Total recoverable copper concentrations in the existing facility's effluent monitoring dataset evaluated here (since 2016) have been variable, with a 95th percentile near 100 µg/L. Figure 5-1 shows estimated effluent concentrations that would have been discharged over the past seven years of monitoring if treatment with ballasted sedimentation and MetClear® or similar metal-sequestering polymer had been in place. These estimated effluent concentrations are calculated from paired measurements of dissolved and total recoverable copper concentrations, with the particulate phase (reduced by ballasted sedimentation) equal to the reported total recoverable concentration minus the dissolved concentration (reduced by MetClear®), consistent with calculation Method 3 presented in Appendix F's reasonable potential analysis.

Particulate copper is assumed to be removed at the same rate as TSS; this assumption is supported by testing to-date at GWWTS and will continue to be corroborated with additional bench-scale testing through 2026-2027 and later performance testing at EWWTS. Based on the available bench-scale and pilot-scale testing data, dissolved copper removal rates from MetClear® or similar metal-sequestering polymers are also expected to be able to achieve 70 percent removal or greater of the dissolved copper. Removal rates of dissolved copper from MetClear® in the four most recent bench tests are all higher than 90 percent (see Table 5-2). These removal rates would have resulted in no exceedances of the water quality criteria at the edge of an acute mixing zone across the historical monitoring period. To reflect a higher level of conservatism, a minimum removal assumption of 70 percent for dissolved copper was also applied to the dataset and shown in Figure 5-1.

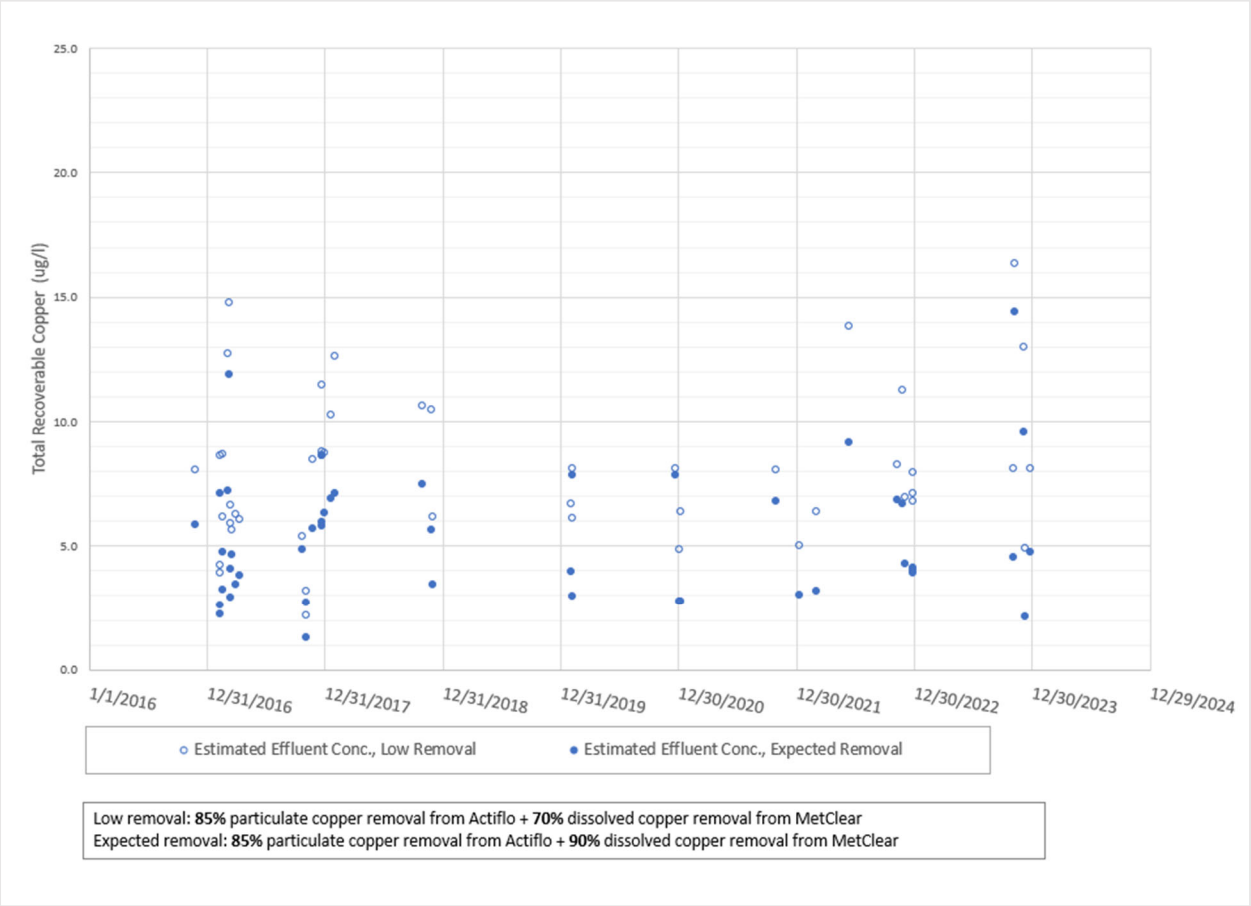


Figure 5-1. Estimated Effluent Copper Concentrations Based on Historical Monitoring Data, Reduced by Proposed Ballasted Sedimentation + MetClear® Polymer

In addition to the proposed treatment and a mixing zone, the following factors are expected to work in favor of compliance over the long-term by reducing sources of copper in the incoming wastewater. Expectations for decreasing sources of copper pollution in this basin are based on reduced sources of deposition on roadways from vehicle brakes, and reduced sources from drinking water. The Better Brakes Law (Chapter 70.285 RCW), passed by the 2010 Washington State Legislature, phases out the use of copper in vehicle brake pads to less than 0.5 percent copper by the year 2025. In addition, benefits may be seen from the increasing prevalence of electric vehicles and use of the added regenerative braking system instead of the conventional friction brakes with metal-based wearing components. Copper levels in Seattle Public Utilities drinking water are also trending downward, based on the 90th percentile concentrations reported in the Annual Drinking Water Reports since 2008. The reported 90th percentile copper concentration in SPU's drinking water in 2022 was 120 µg/L. Older household plumbing systems that corrode are the main source of copper and lead in drinking water and are gradually being replaced.

Adaptive Management

The County is committed to compliance with aquatic life criteria for marine water for the EWWTS facility and has defined an adaptive management strategy to reduce the uncertainty around compliance with copper water quality criteria. Bench testing will continue through the final design phase over the 2025--2026 and 2026-2027 wet weather seasons, with a final comprehensive set of results to be

evaluated at the 90 percent design milestone in June 2027. Once complete, this testing will finalize the design assumption for the copper removal rate from the proposed treatment. If the comprehensive testing results, or other changing conditions, indicate that effluent copper concentrations will be higher than expected and result in exceedances of the receiving water quality criteria at the edge of the authorized mixing zone, the County would initiate project planning for additional adaptive management actions. This would begin with a problem definition document to be completed within nine months of the decision. The problem definition document would establish the process and timeline for completing the adaptive management actions to ensure compliance with water quality criteria.

As part of the adaptive management strategy, the County has proactively identified a simple outfall modification concept that would increase dilution within the mixing zone. This simple outfall modification concept involves the addition of a rosette style four-port diffuser to the terminal offshore end of the existing submerged outfall pipe, similar to one of the concepts previously evaluated in the 2021 Alternatives Analysis. Preliminary dilution modeling analysis shows that this configuration provides enough dilution at the edge of the acute zone boundary to demonstrate compliance with acute aquatic life water quality criteria for copper, if effluent concentrations exceed those currently expected under the proposed treatment. The preliminary dilution analysis of the simple rosette outfall modification concept is included in Appendix F.

Water Quality Based Effluent Limits - Zinc

Ecology's RPA analysis conducted for the renewed 2024 NPDES permit (effective on June 1, 2024) found a reasonable potential for zinc to exceed acute aquatic life water quality criteria for the EWWTS's existing discharge and consequently established an interim and final daily maximum effluent limit for total recoverable zinc. The updated RPA presented in Appendix F found no reasonable potential to exceed zinc water quality criteria, based on the proposed design flows, predicted dilution factor of 2.5 assuming that the mixing zone is reauthorized, treatment with ballasted sedimentation to remove particulate-bound metals, and updated effluent and background chemistry data. Beginning in 2024, EWWTS bench-scale test data has been collected to support a removal assumption for zinc from ballasted sedimentation and MetClear® or similar metal-sequestering polymers, and will be reported in 2027 in the final bench testing report. Assuming that particulate zinc is removed at the same rate (85 percent) as TSS (the same assumption applied to copper), the discharge would not have a reasonable potential to exceed the zinc criterion at the edge of the mixing zone boundaries (refer to Appendix F) even assuming no removal of dissolved zinc from the use of MetClear® or similar metal-sequestering polymers. Therefore, a water-quality-based effluent limit for zinc after the proposed Project is not expected to be necessary, assuming the mixing zone is reauthorized. Figure 5-2 presents the estimated effluent concentrations of total recoverable zinc that would have been discharged since 2009, assuming 85 percent removal with ballasted sedimentation alone.

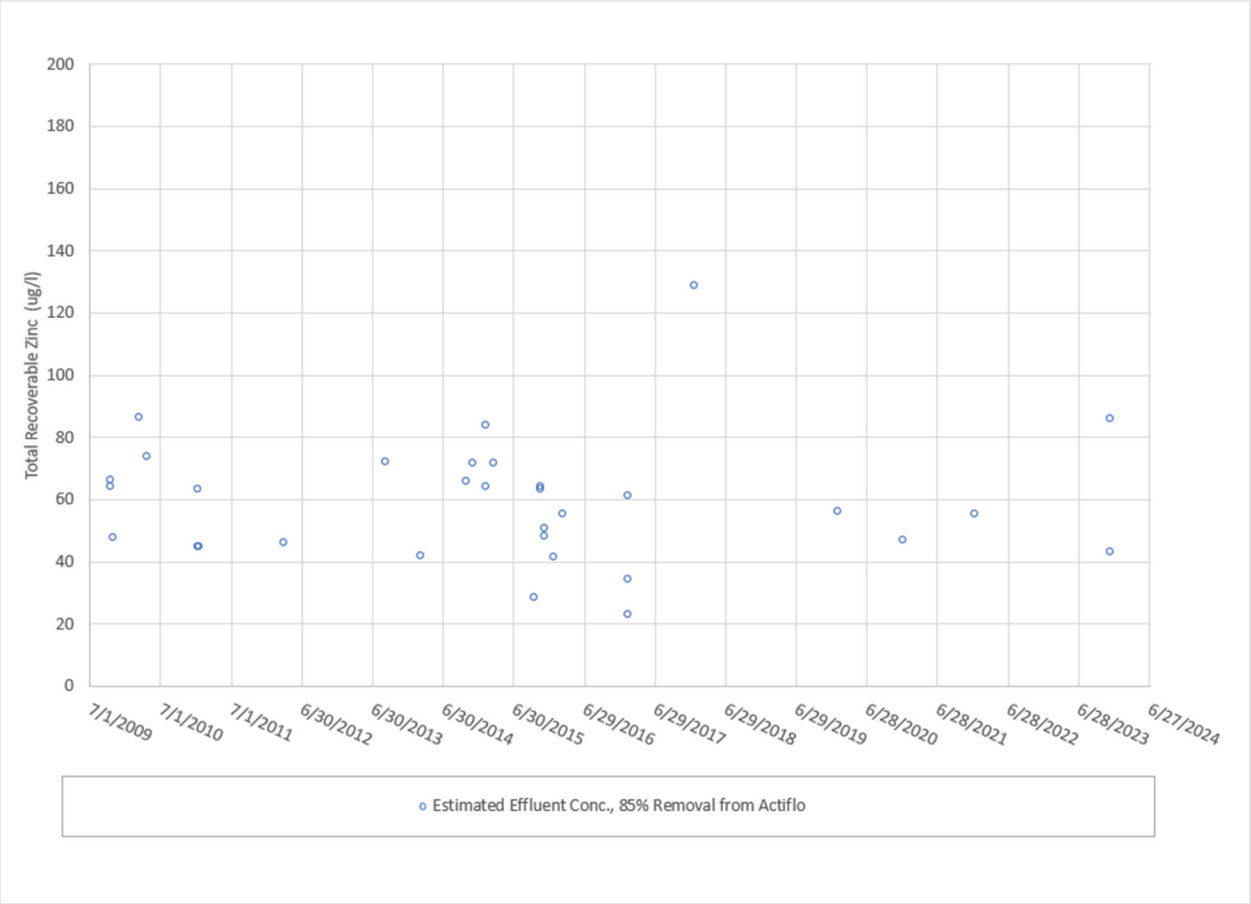


Figure 5-2. Estimated Effluent Zinc Concentrations Based on Historical Monitoring Data, Reduced by Proposed Ballasted Sedimentation

5.2.1.3.3 Sediment Standards

The County has previously completed an analysis of sediment deposition from the EWWTS outfall to determine if the observed discharges have the potential to cause exceedances of the state Sediment Management Standards (SMS). This analysis applied a simple model of existing solids deposition rates from the EWWTS facility's discharges, without considering the solids removal to be achieved by the proposed Project, and realistic tidal flow characteristics and resulting plume behavior. Under these assumptions, the model predicted a sediment deposition rate of less than 0.3 mm per year, and no potential for exceedances of SMS, sediment cleanup objectives or cleanup screening levels. The proposed Project would result in lower deposition rates than the existing facility since less solids will be discharged and have no potential for SMS exceedances. A summary of this sediment quality analysis is included in Appendix F. As described previously in Section 2.3.5, the sediments around the EWWTS and Denny Way Regulator Station overflow outfalls will continue to be monitored over the long-term to meet Biological Opinion requirements of the Elliott West outfall construction and confirm the effectiveness of the County's 2008 remedial cleanup action.

5.2.1.3.4 Anticipated Effluent Limits

Table 5-3 summarizes the previous, existing and future anticipated NPDES permit effluent limits. As the proposed Project would remove chlorine disinfection and provide UV disinfection instead, the anticipated permit limit for total residual chlorine listed here would not be applicable to the upgraded facility. Effluent limits for settleable solids, TSS, pH, and fecal coliform bacteria are assumed to continue unchanged in the future NPDES permit cycle. The interim effluent limit for TRC is set equal to the previous (2014 NPDES permit) effluent limit of 109 µg/L. The interim effluent limits for zinc and copper are set to the 95th percentile of EWWTS effluent concentrations as reported by the County to Ecology. As stated in Section S1.B of the renewed 2024 NPDES permit, the interim limits are in effect until completion of the Project. The final limits under the renewed 2024 NPDES permit for zinc (90 µg/L) and copper (4.8 µg/L) were based on the removal of the mixing zone authorization for the EWWTS discharge that is in effect until Ecology reconsiders that authorization upon completion of the proposed Project (NPDES permit Appendix G - Responses to Comments; Ecology, 2024).

The final effluent limit for total recoverable copper under the renewed 2024 NPDES permit, which is set to the receiving water standard for acute aquatic life exposure due to the removal of the mixing zone authorization, is not reliably achievable even with the proposed treatment with both ballasted sedimentation and MetClear® or similar metal-sequestering polymers. A mixing zone is expected to be necessary for the discharge to achieve reliable compliance with water quality criteria for copper as well as several other pollutants. As stated at the beginning of this section, the EWWTS will qualify for a mixing zone authorization under WAC 173-201a-400 by meeting AKART requirements for CSO discharges.

As explained in this section, the RPA presented in Appendix F indicates that solids removal from the proposed ballasted sedimentation facility alone will be sufficient to remove the reasonable potential for zinc, which provides confidence that no effluent limit will be needed if the mixing zone is reauthorized. In contrast, additional treatment with MetClear® or similar metal-sequestering polymers is necessary to remove the reasonable potential for copper at the edge of a reauthorized mixing zone and that additional treatment's performance assumption is still being finalized. The County assumes that post-Project conditions including the design parameters presented in this Engineering Report as well as effluent concentrations measured (rather than estimated, as done here) in the fully treated wastewater will be used as the basis for the discharge requirements in the future renewal of the NPDES permit, including determination of the need for numeric water quality-based effluent limits. Therefore, post-Project effluent limits for copper and zinc are not estimated here.

Table 5-3. Summary of NPDES Permit Effluent Limits

Parameter	Units	Previous 2014 Effluent Limit	Renewed 2024 Permit Effluent Limit	Anticipated Post Project Effluent Limit
Total Residual Chlorine - Maximum Daily (Interim Limit)	µg/L	N/A	109	N/A
Total Residual Chlorine - Maximum Daily (Final Limit)	µg/L	109	13	N/A
Settleable Solids - Annual Average	mL/L/hr	0.3	0.3	0.3
Total Suspended Solids - Annual Average	mass	≥50% removal of influent (mass)	≥50% removal of influent (mass)	≥50% removal of influent (mass)
pH – Daily Minimum/Maximum	standard units	6.0-9.0	6.0-9.0	6.0-9.0
Fecal Coliform Bacteria - Monthly Geometric Mean	per 100 mL	400	400	400

Table 5-3. Summary of NPDES Permit Effluent Limits

Parameter	Units	Previous 2014 Effluent Limit	Renewed 2024 Permit Effluent Limit	Anticipated Post Project Effluent Limit
Zinc, Total Recoverable - Daily Maximum (Interim Limit)	µg/L	No Limit	162.5	N/A
Zinc, Total Recoverable - Daily Maximum (Final Limit)	µg/L	No Limit	90	Not estimated
Copper, Total Recoverable - Daily Maximum (Interim Limit)	µg/L	No Limit	84.1	N/A
Copper, Total Recoverable - Daily Maximum (Final Limit)	µg/L	No Limit	4.8	Not estimated

mL = milliliter

5.2.2 Station Layout

Figure 5-3 illustrates the proposed 15 percent concept design EWWTS layout. The treatment facilities are organized as a single structure with a new screening building and canopy over the ballasted sedimentation and UV disinfection process areas. An equipment room and C3 storage are located below the UV disinfection area. The electrical building is located on the south end of the property. Drawings of the recently 30 percent baseline design are included in Appendix K.

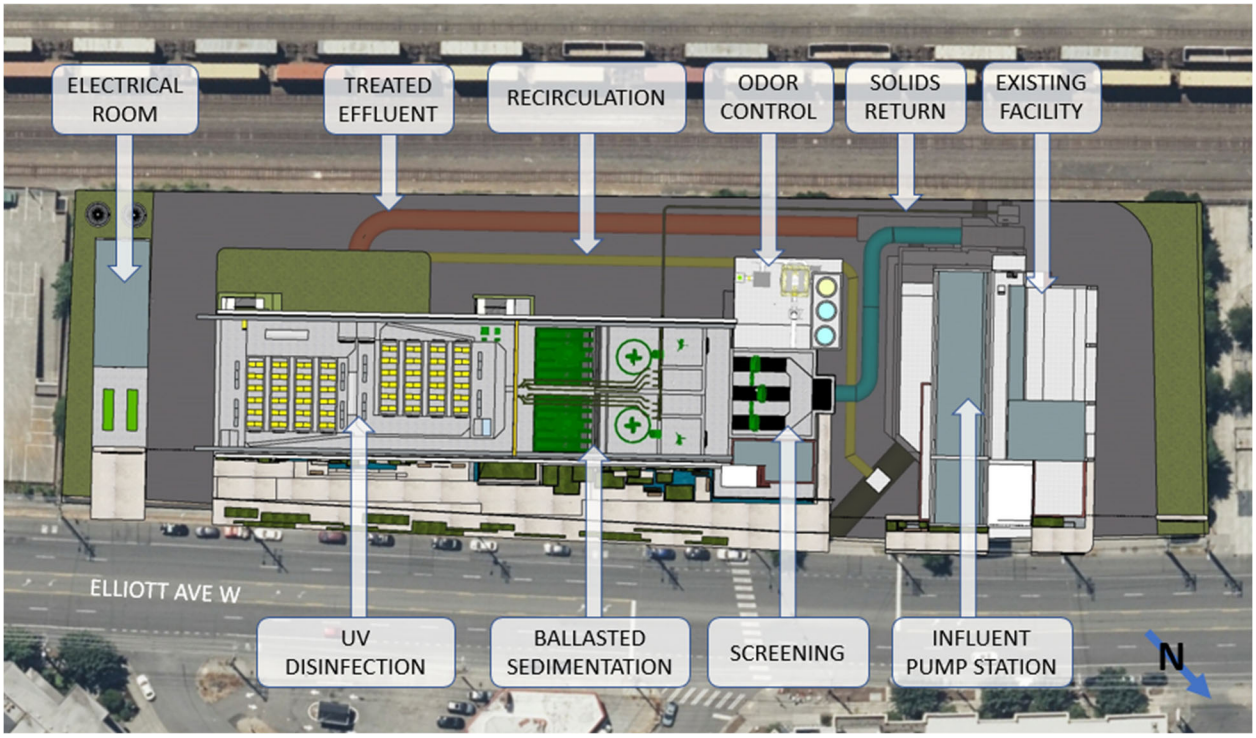
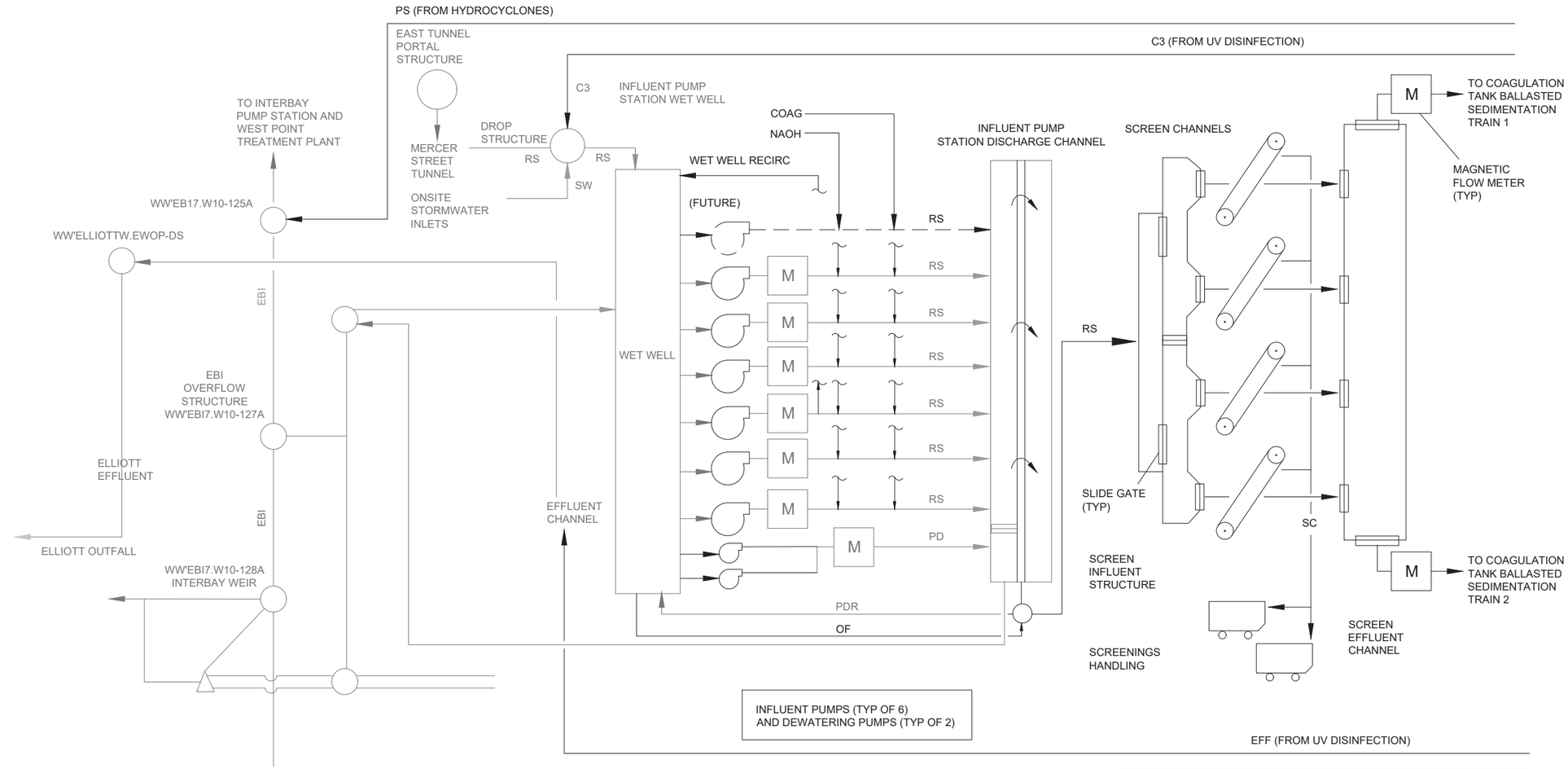


Figure 5-3. EWWTS Recommended Alternative Layout
Not shown: Canopy over process areas for clarity. In addition, the Denny Way Regulator Building Modifications located in Myrtle Edwards Park are not shown.

Figures 5-4 and 5-5 show the process flow diagram for the EWWTS system, including proposed sampling locations. Flow is pumped from the common wet well at the influent pump station to downstream parallel Actiflo® trains. As development of Alternative 6 continued, the County decided to incorporate train isolation into the Project, similar to the GWWTS approach, which allows each of the parallel Actiflo®/UV disinfection trains to be independently started up while discharging fully treated water.

NOTES:
1. ODOR CONTROL FOR SCREENING, ANCILLARY SYSTEMS AND VALVES NOT SHOWN FOR CLARITY.
2. INFLUENT SAMPLING LOCATION UPSTREAM OF NAOH DOSING POINT NOT SHOWN FOR CLARITY.



FLOW STREAMS:	ABBREVIATIONS:
PD: PUMPED DRAINAGE	COAG: COAGULANT (ALUMINUMCHLOROHYDRATE)
RS: RAW SEWAGE	NAOH: SODIUM HYDROXIDE
SC: SCREENINGS	PDR: PROCESS DRAIN
EFF: EFFLUENT	SAM: SAMPLING LOCATION
PS: PRIMARY SLUDGE	EBI: ELLIOTT BAY INTERCEPTOR
SSL: SAND+SOLIDS	SAND: MICROSAND
C3: TREATED	
SW: SITE STORMWATER	
RECIRC: RECIRCULATION	
OF: OVERFLOW	

NO	REVISION DESCRIPTION	BY	APVD	DATE

Jacobs

PRELIMINARY ISSUE DRAWING
INFORMATION ONLY
60% REVIEW

MIAOMIAO ZHANG STATE OF WASHINGTON 41883 REGISTERED PROFESSIONAL ENGINEER

DESIGNED/DRAWN: Y. PAN	SCALE: NTS
DESIGN ENGINEER: M. ZHANG	WORK ORDER:
PROJECT ENGINEER: X. XXXX	PROJECT NO: XXXXXXX
LOCATION CODE: WW792	CONTRACT NO: C0XXXXCXX

King County

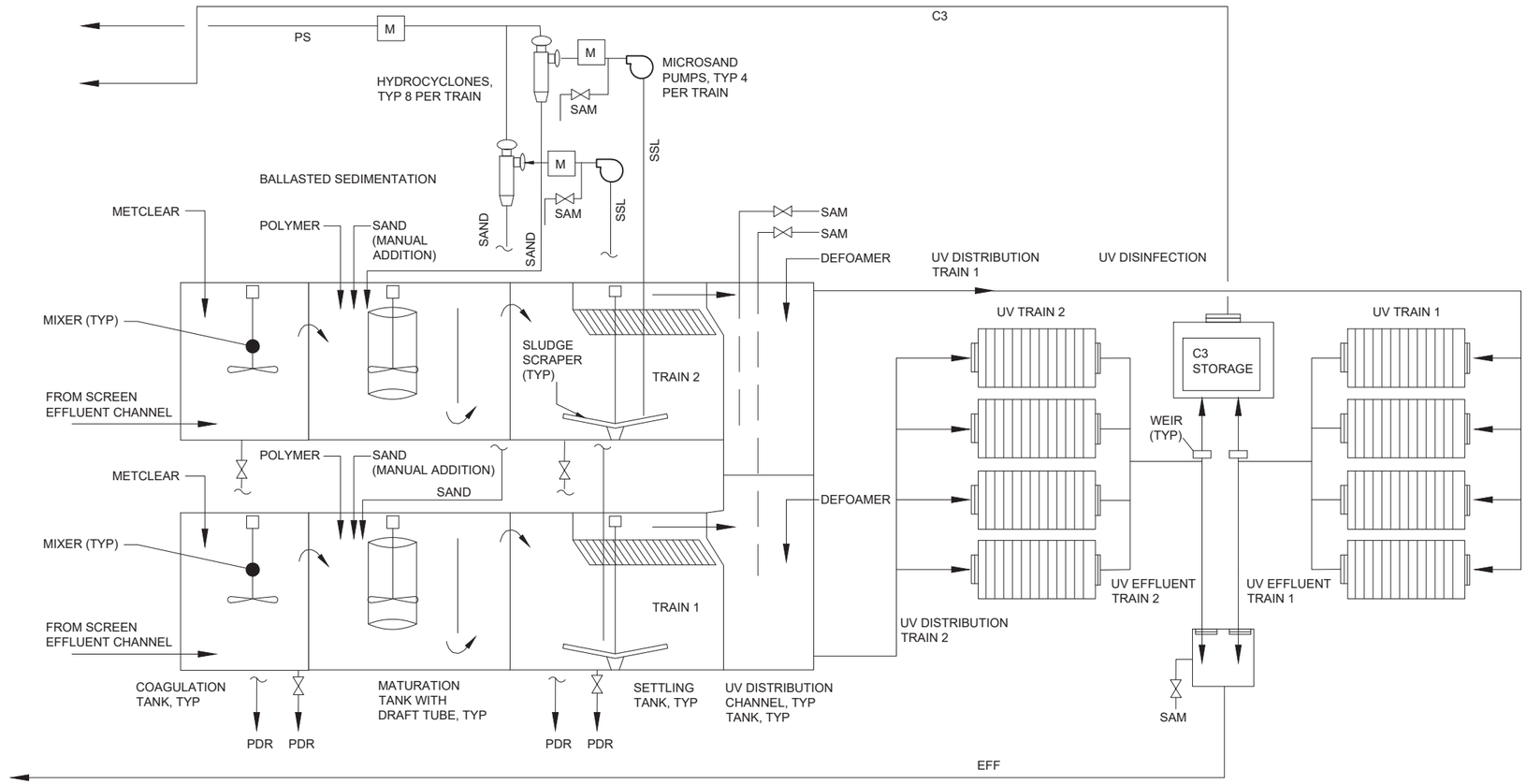
DEPARTMENT OF NATURAL RESOURCES & PARKS
WASTEWATER TREATMENT DIVISION
ELLIOTT WEST WET WEATHER TREATMENT STATION UPGRADE
CSO CONTROL FACILITY

FIGURE 5-4 PROCESS FLOW DIAGRAM AND MASS BALANCE 1

DATE:	MARCH 2026
PROJECT DWG NO:	G0051
ECMS DOC NO:	WW792-G-0051
SHT NO / TOTAL	#
REV NO:	0

BORDER FILE EDITION: KCWTD-Dsize-TB-Border
C:\pw_workdir\den003\jeg_ex-pany\d1677704\WW792-G-0051.dwg | Layout: G0051
PLOTTED: Jun 19, 2025-02:42:55pm By ypan
XREFS: EWWTS-Dsize-Border.dwg
IMAGES: Carollo logo 2023_black.jpg

NOTES:
1. SEE G-0051 FOR FLOW STREAM IDENTIFICATION AND ABBREVIATIONS.
2. UV TRAIN CONFIGURATION DIFFERS FROM THAT SHOWN ON MECHANICAL AND STRUCTURAL SHEETS AT 30%



DESIGN MASS BALANCE

FLOW STREAM	GOING TO	PEAK HOUR FLOW (MGD)	TSS CONCENTRATION (MG/L)	TSS LOADING (LBS/DAY)
RS	SCREENING	189	121	191,000
RS	BALLASTED SEDIMENTATION	189	121	191,000
UV INF	UV DISINFECTION	180	18	27,100
EFF	OUTFALL	180*	18	27,100
PS	EBI	APPROXIMATELY 9	2,200	160,000 - 165,000

* EWWTS PEAK HOUR DESIGN TREATMENT CAPACITY

NO	REVISION DESCRIPTION	BY	APVD	DATE

Jacobs

PRELIMINARY ISSUE DRAWING
INFORMATION ONLY
60% REVIEW

MIAOMIAO ZHANG — STATE OF WASHINGTON — 41883 — REGISTERED PROFESSIONAL ENGINEER

DESIGNED/DRAWN: Y. PAN	SCALE: NTS
DESIGN ENGINEER: M. ZHANG	WORK ORDER:
PROJECT ENGINEER: X. XXXX	PROJECT NO: XXXXXXX
LOCATION CODE: WW792	CONTRACT NO: C0XXXXCXX

King County

DEPARTMENT OF NATURAL RESOURCES & PARKS
WASTEWATER TREATMENT DIVISION
ELLIOTT WEST WET WEATHER TREATMENT STATION UPGRADE
CSO CONTROL FACILITY

FIGURE 5-5 PROCESS FLOW DIAGRAM AND MASS BALANCE 2

DATE:	MARCH 2026
PROJECT DWG NO:	G0052
ECMS DOC NO:	WW792-G-0052
SHT NO / TOTAL:	#
REV NO:	0

During treatment events, the station will start by engaging one treatment train (10 mgd to 94.5 mgd), and as flows increase the second train will be called into service (94.5 mgd to 189 mgd). The UV disinfection system will also be designed using a similar concept to isolate the channels into two distinct trains so that only half the influent or effluent channels need be active if CSO flow is low. Flow is controlled by a series of isolation gates and weirs for each individual train or channel, with the UV channels split evenly between each of the two trains.

In the unlikely event of an electrical power outage, effluent gates will close to prevent the discharge of effluent that has not been fully treated. Recirculation gates will, in parallel, open to allow effluent flow to recirculate back to the C3 storage tank. Once power is restored, recirculation can continue for a set time, allowing for flushing of the effluent channel and full treatment to be re-established, before the effluent gates will be opened and normal effluent discharge can resume.

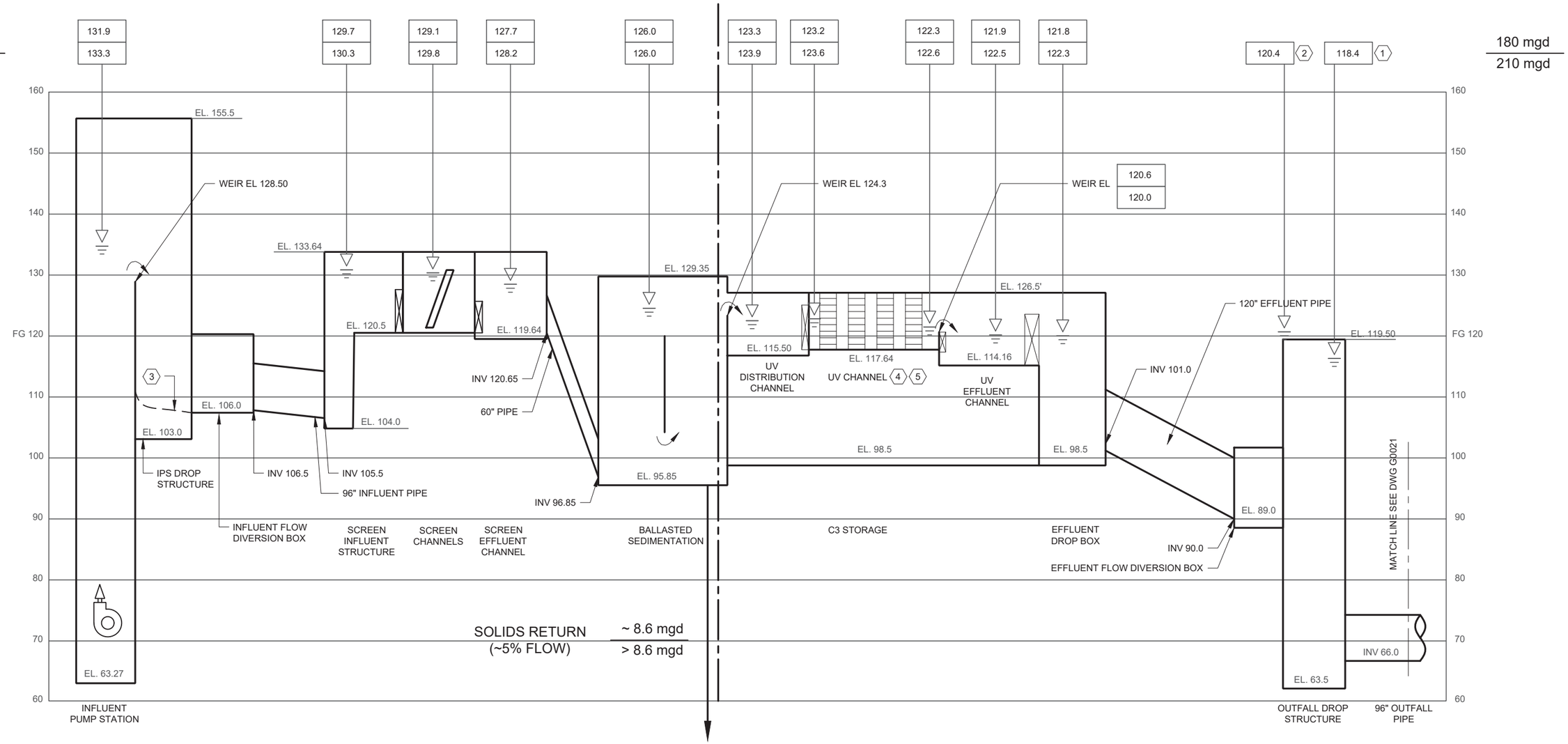
Figure 5-6 shows the updated hydraulic profile for the recommended Alternative 6 that includes train isolation. If the frequency and/or duration of rainfall events increases in the future, the equalization volume can be adjusted to provide additional storage, and the facility will be designed to preserve an ultimate influent peak hour design flow of 219 mgd. The hydraulic profile also includes a 2-foot allowance for future sea level rise in Elliott Bay.

5.2.3 Mass Balance

Table 5-4 presents the mass balance through the treatment station at design conditions, based on a TSS removal of 85 percent in the Actiflo® ballasted sedimentation process.

Table 5-4. Mass Balance

Flow Stream	Going to	Peak Hour Flow (mgd)	TSS Concentration (mg/L)	TSS Loading (lbs/day)
Raw Sewage	Screening/Ballasted Sedimentation	189	121	191,000
Effluent	UV Disinfection/Outfall	180	18	27,100
Solids	EBI	approximately 9	2,200	160,000 -165,000



LEGEND:

▽ HYDRAULIC WATER SURFACE ELEVATION

GENERAL NOTES:

1. HYDRAULIC PROFILE REPRESENTS NORMAL SYSTEM OPERATION WITH EFFLUENT DISCHARGE TO THE OUTFALL IN KING COUNTY METRO DATUM.
2. HIGH TIDE EVENT IS AT 109.6 IN KING COUNTY METRO DATUM. THIS IS BASED ON THE HIGHEST OBSERVED TIDE RECORDED IN ELLIOTT BAY ON DECEMBER 27, 2022 AT COLMAN DOCKS.

KEY NOTES:

1. WATER SURFACE ELEVATION EXPECTED BASED ON CONCURRENT HIGH TIDE EVENT AT PEAK INSTANTANEOUS FLOWRATE OF 210 MGD THROUGH THE OUTFALL.
2. WATER SURFACE ELEVATION EXPECTED BASED ON CONCURRENT HIGH TIDE EVENT AT PEAK INSTANTANEOUS FLOWRATE OF 210 MGD THROUGH THE OUTFALL WITH TWO (2) FEET OF SEA LEVEL RISE.
3. CONFIGURATION IMPROVEMENTS INCORPORATED BY FILLING EXISTING ENERGY DISSIPATION BOX AND PROVIDING CONCRETE CONTOURING TO IMPROVE FLOW CHARACTERISTICS.
4. WATER SURFACE ELEVATION WILL VARY DEPENDING ON THE UV DISINFECTION SYSTEM INSTALLED. THE MOST CONSERVATIVE UV SYSTEM HEADLOSS WAS USED AT 30%.
5. LOWERED UV DISINFECTION SYSTEM SO THAT THE MINIMUM WATER SURFACE ELEVATION REQUIRED TO OPERATE AND SEA LEVEL RISE ELEVATION AND PEAK INSTANTANEOUS FLOWRATE COINCIDE.

PEAK HOUR TREATMENT DESIGN
PEAK INSTANTANEOUS HYDRAULIC

NO	REVISION DESCRIPTION	BY	APVD	DATE

Jacobs
carollo

PRELIMINARY ISSUE DRAWING
INFORMATION ONLY
30% REVIEW

MICHAEL S. BORRERO — STATE OF WASHINGTON — REGISTERED PROFESSIONAL ENGINEER

DESIGNED/DRAWN: Y. PAN	SCALE: NTS
DESIGN ENGINEER: M. BORRERO	WORK ORDER:
PROJECT ENGINEER: X. XXXX	PROJECT NO: XXXXXXX
LOCATION CODE: WW792	CONTRACT NO: C0XXXXCXX

King County

DEPARTMENT OF NATURAL RESOURCES & PARKS
WASTEWATER TREATMENT DIVISION
ELLIOTT WEST WET WEATHER TREATMENT STATION UPGRADE
CSO CONTROL FACILITY

FIGURE 5-6 EWWTS RECOMMENDED ALTERNATIVE 6 HYDRAULIC PROFILE

DATE:	2025
PROJECT DWG NO:	G0061
ECMS DOC NO:	WW792-G-0061
SHT NO / TOTAL	#
REV NO:	0

5.2.4 Project Elements and Refinements

The following sections summarize the preliminary design basis for each of the individual Project elements as of January 2025. Unit processes were sized based on the design influent flow and load and established basic design data, including Ecology's Criteria for Sewage Works Design (Ecology, 2023a) and WTD's Engineering Design Standards for CSO Storage Systems (King County, 2013). The treatment plant basic design data and sizing information was originally prepared under the *Alternatives Analysis Technical Memorandum* (Jacobs, 2021) and updated as necessary under the *Amendment Alternatives Analysis Technical Memorandum* (Jacobs, 2023).

5.2.4.1 Influent Pump Station (IPS)

A pump station analysis concluded that to provide the peak hour influent design flow rate of 189 mgd, the six existing centrifugal pumps must be replaced with six new pumps that are more suited to operate at a lower wet well level. This was found to be the most cost-effective solution in a Business Case Evaluation completed by King County, as detailed in Appendix H. Space will be reserved in the IPS for installation of a seventh pump. The pump capacity of each of the new six pumps is 31.5 mgd at a wet well level ranging between 75.0 and 85.0 feet. The new pumps will be capable of handling the peak instantaneous influent design flow rate of 219 mgd while operating at a reduced static head. These new pumps will allow more rapid dewatering of the Mercer Street tunnel and a greater ability to remove solids from the wet well.

Each IPS pump will be equipped with a VFD to allow the pump station (PS) to follow the inflow of a particular wet-weather event, as well as to provide the required minimum startup flow for the treatment process. The IPS will be configured to provide this startup flow when the first pump is called into service as the Mercer tunnel begins to fill with combined sewage. Once the tunnel fills to approximately 3 MG, the treatment system will initiate, and pumps will be called to service as needed. After CSO events, two IPS dewatering pumps convey the remaining combined sewage from the IPS wet well to the IPS discharge channel.

Table 5-5 summarizes the preliminary basic design data for the influent pump station.

Table 5-5. Preliminary Basic Design Data for Pump Station

Parameter	Units	Basic Design Data
Influent Pumps		
Type	--	Vertical Centrifugal
No. of Units	--	6 + 0 (duty, standby) (with space provided for 7th future)
Capacity, each	mgd	31.5
Horsepower, each	hp	400
Wet Well Level (Continuous Duty)	feet	75.0 - 85.0
Total Dynamic Head	feet	60.5
Dewatering Pumps		
No. of Units	--	2 + 0 (duty, standby)
Capacity, each	mgd	1.44

hp = horsepower

5.2.4.2 Screens and Screenings Handling

The IPS will convey incoming wastewater to preliminary treatment that consists of multi-rake fine screens and screenings handling equipment in a new building. All wastewater will flow through the four multi-rake screens, with each screen rated to handle 60 mgd. In the unlikely event that the screens are blinded to require EWWTS to operate at a reduced capacity, additional equalization will be utilized in the Mercer Street Tunnel. If the reduced peak flow attenuation ability in the Mercer Street Tunnel is insufficient to buffer peak flows above the reduced EWWTS capacity, an overflow may occur at the regulators.

Each screen will discharge its screenings to a belt conveyor, which is then routed to collection bins for disposal located in the screenings handling room. Both the screening building and the screenings handling room will be enclosed for odor control. Table 5-6 summarizes the preliminary basic design data.

Table 5-6. Preliminary Basic Design Data for Screens and Screenings Handling

Parameter	Units	Basic Design Data
Number of Screen Units	--	4
Screen Capacity (each)	mgd	60
Screen Type	--	Multi-rake
Screen Clear Opening Width	inches	0.25
Number of Conveyors	--	1
Conveyor Belt Type		Trough Belt
Belt Width	inches	24
Conveyor Length	feet	80

5.2.4.3 Solids Removal

Screened combined sewage will flow to the influent distribution channel where it will be routed to one of two Actiflo® treatment trains through slide gates and 60-inch pipes. A 60-inch magnetic flow meter will be installed on each pipe to provide flow measurement to each treatment train. The process uses microsand-enhanced flocculation and lamellar plate settling to achieve high solids removal within a small footprint. Each train will be comprised of a coagulation, maturation, and settling tank. Each train will also have an independent sludge scraper. Dedicated ballast recirculation pumps and recovery equipment, coagulant, polymer, caustic metering, and MetClear® or similar metal-sequestering polymers dosing pumps will be provided for each train.

During system startup, it takes about 15 minutes for the floc to form, and for the operation to reach stabilization. A recirculation weir after disinfection in each train will be provided to divert partially treated flow and allow for the system to properly startup at the onset of an event or when any failure occurs during normal operation. The recirculated effluent will be conveyed by weir to the C3 storage tank where an open sluice gate will allow it to be conveyed by gravity back to the Mercer Tunnel.

Solids will be separated from the recirculation ballast flow by hydrocyclones and discharged back by gravity through the EBI to WPTP. Table 5-7 summarizes the preliminary basic design data.

Table 5-7. Preliminary Basic Design Data for Actiflo®

Parameter	Units	Basic Design Data
Number of Trains	--	2
Design Capacity Peak Hour, per train	mgd	94.5
Peak Instantaneous Capacity, per train	mgd	109.5
Solids Return, per train	mgd	approximately 4.5
Overall Footprint	feet x feet	99.25 x 38.75 x two trains
Side Water Depth (Coagulation Tanks at Design Capacity Peak Hour Flow)	feet	31.65
Inlet Conditions	--	Bottom entry via 60-inch pipe
Outlet Conditions	--	Lamellar Plates and Finger Weir
Design Hydraulic Loading Rate	gpm per square foot	60
Average TSS Removal	%	85%
Number of Coagulant Tank Mixer Units, per train	--	1
Coagulant Tank Mixer, each	hp	30
Number of Maturation Tank Mixer Units, per train	--	1
Maturation Tank Mixer, each	hp	75
Number of Microsand Pumps, per train	--	3 + 1 (duty, standby)
Microsand Pumps, each	hp	60
No. of Sludge Scrapers, per train	--	1
Sludge Scraper, each	hp	10
No. of Hydrocyclones, per train	--	3 + 1 (duty, standby)

5.2.4.4 Disinfection

The Actiflo® effluent will be disinfected by UV light. Pre-procurement of the UV disinfection equipment will occur during pre-design using an evaluated bid approach. In this approach, the system with the best value based on an acceptable combination of life-cycle costs and noneconomic factors will be selected. The final layout, dimensions, and configuration of the system will be designed to reflect the specific equipment needs of the selected vendor.

Three UV equipment manufacturers provided preliminary proposals for their low pressure, high intensity systems in November 2024. The current layout and design criteria are based on the system with the largest footprint needs and includes various features to integrate with the upstream and downstream portions of the treatment plant, regardless of the final vendor selected. Furthermore, allowances for head loss and footprints were made to accommodate the different ranges of potential UV vendors at this stage. Table 5-8 summarizes the preliminary basic design data based on typical combined sewer flow characteristics. The EWWTS design parameters may be adjusted as the design progresses and wet weather testing results become available.

Table 5-8. Preliminary Basic Design Data for UV System

Parameter	Units	Basic Design Data
Number of Trains	--	2
Design Capacity Peak Hour, per train	mgd	90
Peak Instantaneous Capacity, per train	mgd	105
Average Flow Rate, per train	mgd	60
Design UV Transmittance	% per 1 cm sample	50
Average UV Transmittance	% per 1 cm sample	60
Inlet TSS concentration	mg/L	30
Design Dose (MS2 RED per IUVA)	mJ/cm^2	50
Number of UV Channels	per train	4
Total Number of UV Channels	--	8
UV Channel dimension, each	feet x feet	50 x 8
UV Structure Overall Footprint	feet x feet	132 x 82
Total Number of Lamps	--	1,920
Total Power Consumption	kW	1,786

cm = centimeter

IUVA = International Ultraviolet Association

kW = kilowatt

mJ/cm^2 = millijoules per square centimeter

MS2 = bacteriophage MS2

RED = reduction equivalent dose

5.2.4.5 Denny Way Regulator Station and Dechlorination Vault

With the selection of an alternative that does not rely on chlorination and dechlorination for disinfection, the existing facilities and disinfection system can be decommissioned. This will occur near the end of construction after the expansion (solids treatment and UV disinfection) is complete and in commissioning. At the existing FESAM Building at Myrtle Edwards Park, the equipment in the sodium bisulfite room can be removed and the chemical containment sump filled in with concrete. Once complete, a new 40-kW standby generator for the control of the Denny Way Regulator Station, can be installed in the vacated room and the temporary external generator removed from the site. The existing automatic transfer switch will be reused. A restroom will be included in the original sampling room. Additionally, the County will perform site improvements to enhance operator security as well as refresh some of the landscaping adjacent to Myrtle Edwards Park.

The EWWTS point of compliance for its treated effluent will be relocated from the FESAM Building to the EWWTS site. The building has been named based on its purpose as a sampling location (final effluent sampling or FESAM). Since the sampling will be relocated to the main EWWTS site, the site name will revert to its previous designation as “Denny Way Regulator Station.” Additionally, due to this change, the existing diagonal weir in the dechlorination vault that was installed to aid in the collection of final effluent

samples can be removed. Once removed, a 90 degree bend will be installed or formed in the structure. This modification will reduce headloss between EWWTS and the outfall by 0.7 feet. See Figure 5-7 for a site plan of the proposed improvements.

Table 5-9 summarizes the preliminary basic design data.

Table 5-9. Preliminary Basic Design Data for Denny Way Regulator Station

Parameter	Units	Basic Design Data
Standby Generator	kW	40

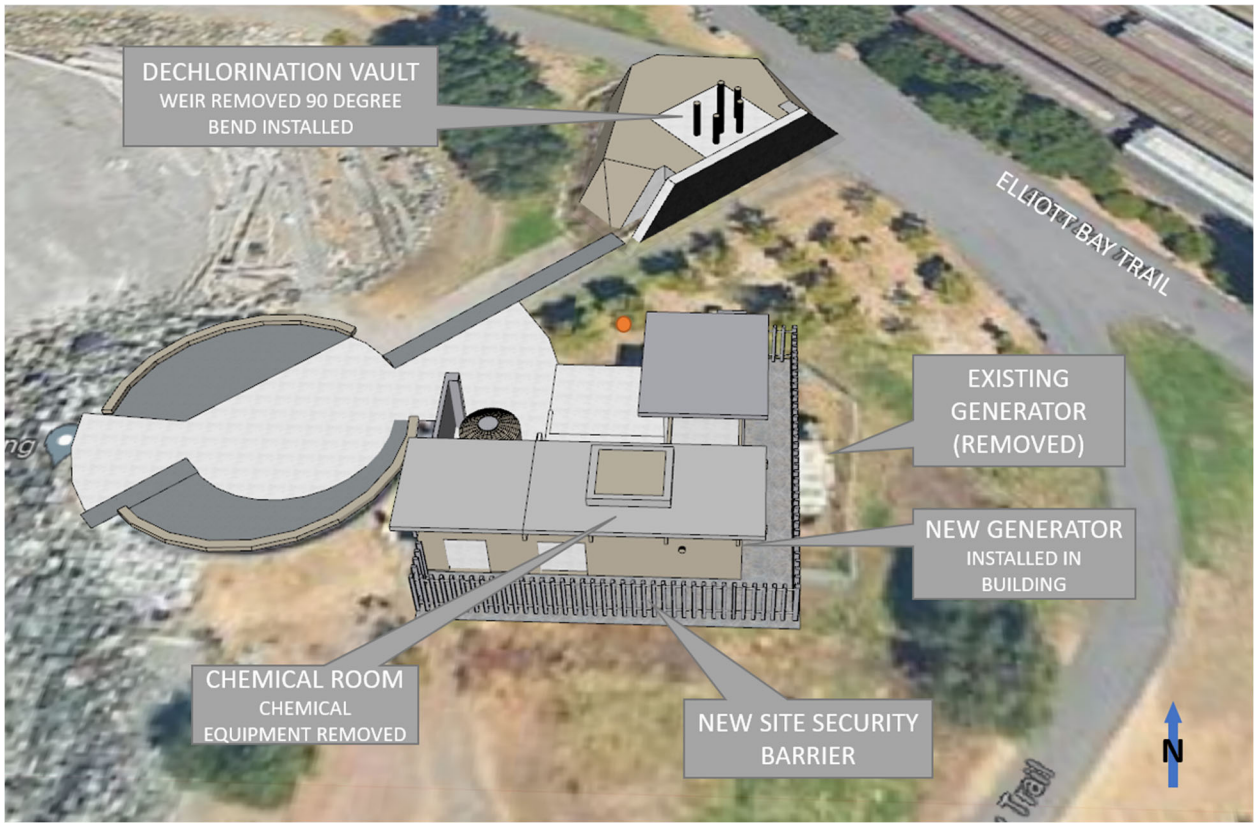


Figure 5-7. Denny Way Regulator Station Site Plan of Proposed Improvements

5.2.4.6 Support Facilities

C3 Storage

The C3 storage tank is located underneath the UV disinfection channels. It stores recirculated water, which is partially or fully treated water, to allow for gravity recirculation back to the Mercer Street Tunnel, or wetwell flushing needs following an event. The C3 storage tank will provide storage for partially treated effluent that does not yet meet discharge requirements during facility startup for each event and in the event of treatment disruption, such as temporary loss of power in UV disinfection. The C3 storage tank will provide approximately 6 minutes of storage at peak flow.

C3 recirculation weir gates located on the UV effluent channels allow recirculated water to enter the C3 storage tank during treatment system startup or power outages. A 60-inch recirculation pipe is connected to the C3 storage tank, which returns flow by gravity from the C3 storage tank to the Mercer Street Tunnel drop structure. The recirculated water returns to the Mercer Street Tunnel for further treatment.

Table 5-10 summarizes the preliminary basic design data.

Table 5-10. Preliminary Basic Design Data for C3 System

Parameter	Units	Basic Design Data
C3 Storage Tank Footprint	feet x feet	113.5 X 78.5
C3 Storage Volume	gallons	700,000
Number of C3 Pumps (for flushing)	--	2 (duty + standby)
C3 Pump, each	hp	15
Recirculation pipe diameter	inch	60

Chemical Storage

The following chemical additions will be provided for the treatment system:

- Sodium Hydroxide - Provides supplemental alkalinity.
- Coagulant - Neutralizes negative charge on fine particles.
- Polymer - Joins fine particles together into floc.
- Metclear® or similar metal-sequestering polymers - metal sequestering agent to remove copper.
- Defoamer - Adds hydrophobic oils to reduce surfactant induced foaming.

Chemical tanks and piping will be single-wall construction located inside containment areas with double-walled piping and leak detection provided at engineered low points outside containment areas. Tanker truck unloading stations, storage tanks, and chemical pump systems will conform to National Fire Protection Association (NFPA) 820, County requirements and preferences, and standards of practice. Table 5-11 summarizes the preliminary basic design data.

Table 5-11. Preliminary Basic Design Data for Chemical Storage

Parameter	Units	Basic Design Data
Sodium Hydroxide		
Number of Tanks	--	1
Tank Volume, each	gallons	3,190
Metering Pump Quantity	--	5+ 1 (duty, standby)
Coagulant (Aluminum Chlorohydrate)		
Number of Tanks	--	2
Tank Volume, each	gallons	6,750
Metering Pump Quantity	--	5 + 1 (duty, standby)
Polymer		
Number of Totes	--	3 + 1 (duty, standby)
Tote Storage, each	gallons	330
MetClear® or similar metal-sequestering polymers[1]		
Number of] Totes	--	1
Tote Storage, each	gallons	330
Metering Pump Quantity	--	1 + 1 (duty, standby)
Defoamer		
Number of totes	--	1
Total Defoamer Storage, each	gallons	330
Metering Pump Quantity	--	2 + 0 (duty, standby)

Notes: Final storage volume to be determined based on final design dosage.

Odor Control

The existing odor control system at EWWTS will remain in operation to provide foul air exhaust ventilation and treatment for the wet well and pump discharge room (former screening room). The system is separate for the wet well and pump discharge room and consists of four deep bed odor control units (OCUs), four exhaust fans and a network of ducting. The four OCUs are in the odor control yard in the station's northwest corner. Each unit is 12 feet in diameter, 3 feet deep and can handle 5,000 cubic feet per meter (cfm) airflow. One exhaust fan connects to each of the carbon OCU. These fans draw air into and through each of the OCU to treat odors. The fans are located immediately by each OCU.

The new EWWTS odor control system will be designed to provide additional foul air exhaust ventilation and treatment for the new screenings system (screening building and screenings handling room,). Exhaust air will be ventilated from these areas and routed through horizontal, dual vertical-bed, activated-carbon scrubber for treatment prior to discharge to the atmosphere. Based on the overall advantage of low maintenance, coupled with applicability for a facility that is intermittently used and has relatively low odor concentration, EWWTS will use standard virgin activated-carbon scrubbers as defined by County standards. This will provide an economical carbon option that is relatively easy to handle and

process. The horizontal flow option with dual beds is a common geometry used by the County for similar facilities, due to its ease of maintenance, and provides a middle ground between having a number of vessels (for redundancy) while keeping the footprint as low as possible (via combining at least two carbon beds into a single vessel). Following County standards, the vessel would be operated under negative pressure to reduce the risk of fugitive emissions of untreated exhaust air. Table 5-12 summarizes the preliminary basic design data.

Table 5-12. Preliminary Basic Design Data for Odor Control

Parameter	Units	Basic Design Data
Number of Units	--	1
Capacity, each	cfm	29,000
Number of Fans	--	1
Fan Horsepower, each	hp	100
Normal Inlet H_2S Loading	ppm	10
Peak Inlet H_2S Loading	ppm	30
Normal Treated Discharge H_2S Concentration	ppm	0.10
Peak Treated Discharge H_2S Concentration	ppm	0.30

Mechanical and Electrical Equipment Areas

The new EWWTS is anticipated to have higher electrical loads than the existing facility and will require construction of a new separate 26 kilovolt (kV)-480 V substation and additional transformers. A new dual utility fed electrical building will be added on the south side of the site to satisfy the increased electrical needs and loads for the UV disinfection system. The existing 150-kW generator can accommodate additional minimal loads for occupied areas. The existing generator appears to have at least a third of its capacity unutilized. The generator will be used to power life safety systems at the expanded station.

A mechanical equipment room will be located underneath the UV channels next to the C3 storage tank. The room will house mechanical support equipment for the Actiflo®, C3 pumps, and other ancillary systems.

Table 5-13. Preliminary Basic Design Data for Equipment Areas

Parameter	Units	Basic Design Data
Equipment Room beneath UV	feet x feet x feet	62 x 78.5 x 17
Electrical Building	feet x feet	30 x 53

Other Ancillary Systems

Ancillary systems include utilities (various water systems and natural gas), ventilation systems, process drainage and sampling. Instrumentation air will be provided at EWWTS should a need be identified.

Potable water (C1) systems, including hot water and fire protection water, will be provided in accordance with the City of Seattle code and standard requirements. There will be a non-potable process water (C2) system sourced from C1 (potable) water and protected by an air gap. This C2 system will provide pump seal water, wash sprays for screens during a CSO event, a backup system for the post-event flushing water (normally handled by C3 water), flushing water for chemical metering and polymer pumps, and several hose bibbs located around the facility.

Process drainage from washdown areas will be conveyed by gravity to the sanitary sewer system. Where gravity flow is not feasible, process drainage will be captured in centralized sumps and submersible pumps used to convey flows to the sanitary sewer system.

Sampling locations and equipment will be provided in accordance with County Engineering Design Standards for CSO Treatment Systems, the federal CD, and regulatory NPDES requirements.

5.2.5 Stormwater Management

Stormwater control will be provided as required in SMC 22.800 to 22.808 in the Stormwater Code Ordinance (Ordinance Number 123105), and as described in the Seattle Stormwater Code (Seattle Department of Planning and Development [DPD] Director's Rule 10-2021). The currently proposed stormwater management strategy is described below and will evolve as Project design progresses.

A portion of the EWWTS site drains to the combined sewer, and the Project will replace more than 10,000 square feet of pollution-generating impervious surface (PGIS); therefore, on-site stormwater management and peak flow control are required per the City of Seattle Stormwater Code. Water quality treatment is not required for sites draining to combined sewer. The City of Seattle Stormwater Code 2021 has been used for the current basis of design.

Stormwater infiltration at the EWWTS site is prohibited due to the potential for contamination in the area, and therefore no infiltration facilities are proposed. The preliminary treatment station site drainage design proposes to meet City of Seattle code and County goals with the following elements:

- Amend all new, replaced, and disturbed topsoil with organic matter to improve on-site management of drainage water flow and water quality.
- Implement Green Stormwater Infrastructure (GSI) best management practices (BMPs) with a combination of noninfiltrating bioretention and "grass pave" permeable pavement. One or more detention and rainwater harvesting cisterns may also be added.
- Ensure that sufficient capacity exists in the public drainage system and public combined sewer to carry existing and anticipated loads, including any flows from dewatering activities. Runoff from the site will discharge to the wet well in the EWWTS, which is connected to the Mercer Tunnel. When the tunnel is below less than half its capacity, flows will be pumped by a dewatering pump into the combined sewer system. This dewatering pump only turns on when the WPTP and the combined system have available capacity, therefore flows from the site are never creating a conveyance or treatment capacity issues downstream. No additional flow control facilities are proposed.
- Install source-control BMPs for specific pollution-generating activities as specified in the Source Control Technical Requirements Manual (SPU and DPD, 2009) to the extent necessary to prevent prohibited discharges as described in Section 22.802.020, and to prevent contaminants from coming in contact with drainage water. This requirement applies to the pollution-generating activities that are stationary or occur in one primary location and to the portion of the site being developed. Examples of installed source controls include erecting a roof or awning over the pollution-generating activity area.

5.2.6 Energy Reduction and Recovery Opportunities

Energy reduction and recovery opportunities for the EWWTS are limited because the facility is designed for intermittent use, and previous evaluations for similar facilities showed that alternative energy and heat recovery systems are economically difficult to justify without substantial grant funding.

The EWWTS Project will be using sustainable design per County policies. The County incorporates energy efficiency measures into its facilities including the use of light-emitting diode (LED) lighting, high-efficiency motors, and heating, ventilation, and air conditioning (HVAC) setpoints to minimize heating and cooling when the facility is not in use. In addition, the County incorporated and considered the following energy recovery and recovery opportunity criteria during alternatives scoring:

- Reduction or minimization of annual energy usage.
- Reduction or minimization of total lifecycle greenhouse gas emissions.
- Reduction in potable water usage.
- Reduction of urban heat island effect.
- Renewable energy production opportunity.

Solar panels will be installed on the roof over the ballasted sedimentation and UV disinfection processes. Solar power will be used in the facilities when the solar power production is less than the facility load.

5.2.7 Operations and Maintenance and Staffing

The current staffing at the West Section Offsite includes 29 staff as follows:

- One Supervisor.
- Operations: one lead and twelve operators.
- Instrumentation and Controls Maintenance: one lead and nine staff.
- Mechanical Maintenance: one lead and four staff.

The EWWTS is anticipated to require 2.5 maintenance and 0.5 operations full-time equivalent staff in addition to its current staff levels. This is expected to have a negligible impact on traffic in the area.

5.3 Design Life

The EWWTS facilities are designed to accommodate an ultimate influent peak hour design flow of 219 mgd that accounts for additional rainfall intensities due to climate change in the Year 2085 and a 2-foot allowance for future sea level rise in Elliott Bay. Peak flows within the Denny Way/Lake Union basin are not anticipated to increase over time. The station's structures are based on at least a 50-year life cycle. Primary equipment design life is estimated at an average of 25 years.

5.4 Ability to Expand

Significant changes in land use or demography are not expected in the future in the Denny Way/Lake Union basins. It is not anticipated that residential, commercial, or industrial user changes will affect the peak flow and sizing of the treatment and conveyance facilities. Hydraulic allowances have been made to for future precipitation intensities affecting peak flows. However, if the ultimate influent peak hour design flow of 219 mgd is realized and more in line with the future average flow, a seventh influent pump will need to be installed, to allow the station to operate with adequate equalization in the Mercer tunnel.

The County currently tracks CSO frequency trends on an annual basis. These compliance trends would be an indicator of when additional work is needed. Should there be an increase in flows above the current prediction or future regulatory requirements, the County could adjust the equalization volume in the

Mercer Street Tunnel and increase influent pumping. Otherwise, the County would consider other options for improvements, including adding additional ballasted sedimentation or UV disinfection, or siting new facilities.

.

6. Project Implementation

6.1 Introduction

This chapter presents the project implementation plan and financial analysis for the EWWTS Project, including project financing, estimated capital costs, O&M costs, and schedule.

6.2 Project Financing

The EWWTS project is included in the capital funding plan included in the adopted wholesale sewer rate forecast. Contracts with member cities and districts specify that the sewer rate must be adopted annually by June 30 for the subsequent year. A 20-year wholesale sewer rate forecast travels with the annual rate proposal and includes the project costs identified in this Engineering Report. The capital program is funded from a combination of cash funding from annual revenue and debt financing, primarily by revenue bonds. Project-specific loans are pursued through the EPA's WIFIA program, the State Revolving Fund, and other sources, though project prioritization is unaffected by success of securing these below market funding sources. The current and proposed 2026 sewer wholesale rate and corresponding financial and customer information are documented in the technical memorandum that accompanies the wholesale sewer rate legislation, item #9 at the following link King County - File #: 2025-B0063.[4] For additional information, the utility financial statements can be found at Annual financial statements - King County, Washington.[5]

6.3 User Charges

The two main revenue sources for WTD are from the monthly sewer rate and from the capacity charge. In 2022, the monthly sewer rate accounted for 78.1 percent of the total operating revenue of the utility, and the capacity charge accounted for 17.3 percent. Remaining revenue and debt service needs are met with special handling charges, miscellaneous operating revenues, and investment earnings. The sewer rate is set by King County Council at a level that provides the County with sufficient money, when combined with other sources of revenue, to treat wastewater, upgrade infrastructure, and service its debt obligations. The King County Council adopted a 2025 sewer rate of $58.28.

The monthly sewer rate is applied to each single-family residence ("residential customers") and to a residential customer equivalent value for each 750 cubic feet of water consumption by all other customers such as multifamily, commercial, and industrial properties. Each participant agency is billed a monthly amount based on the adopted sewer rate and the number of residential customers and residential customer equivalents reported by the agency.

The County's capacity charge has been levied since 1990 on customers who establish new connections to the sewer system. Annual capacity charge revenues averaged 17.0 percent of total operating revenue between 2017 and 2021. State law imposes some limitations on calculating capacity charges, but

[4] Available at: https://mkccleqisearch.kingcounty.gov/LegislationDetail.aspx?ID=7350098&GUID=BCC892E6-73D5-418F-B13F-8B4405B11E5B&Options=&Search= .

[5] Available at: https://kingcounty.gov/en/dept/dnrp/waste-services/wastewater-treatment/about/investing-in-clean-water/annual-financial-statements

capacity charges do not require the approval of the Washington State Utilities and Transportation Commission. The King County Council adopted a 2025 capacity charge rate of $76.09.

The County allows the capacity charge to be prepaid on a discounted basis at the customer's discretion. To provide a more stable, long-term revenue stream, the County established provisions that allow the annual updating of the discount rate based on the 15-year mortgage and 10- and 20-year Treasury bonds, with the discount rate being updated in December of each year. The resulting discount rate was 2.1 percent in 2021.

6.4 Project Costs

The capital costs associated with the Project would be financed through the resources available for capital improvements in accordance with the financial policies of the County and WTD. The actual financing mix and cost of these instruments would reflect economic and financial conditions, WTD's financial position, and the appropriateness of the Project for securing below-market-rate resources. The estimated capital project cost of the EWWTS Project based on the AACE Class 3 (10 to 40 percent level of design definition) estimate of the preliminary design is presented in Table 6-1 in 2025 dollars.

Table 6-1. Estimated Project Cost

	Low Range (AACE: -20% to -10%)	Estimate of Probable Cost[a]	High Range (AACE: +10% to +30%)
Accuracy Range	-30%		+50%
Total Direct Construction Costs	$332,000,000	$415,000,000	$540,000,000
Anticipated County Non-Construction Costs	$221,000,000	$276,000,000	$358,000,000
Total Project Costs	$553,000,000	$691,000,000	$898,000,000

Notes: Costs are rounded.

The County recently lowered the cash funding target from 40 percent to 34 percent to reduce near term impacts on rate payers. The estimated monthly increase in capital cost for ratepayers due to the proposed improvements is listed in Table 6-2. Table 6-2 also includes annual debt service using funding via bonds versus SRF low interest loans. Funding via SRF will provide over $7 million in annual savings because of the lower interest rate and no issuance costs.

Table 6-2. Monthly Increase to Rate Payers and Funding Strategies Comparison

Monthly Capital Cost to Ratepayers	Annual Debt Service (Funded via Bonds)	Annual Debt Service (Funded via SRF)
$2.40	$21,065,000	$13,293,000

The life cycle costs shown in Table 6-3 for the EWWTS Project were developed by adding the present values of the capital costs, benefits, and O&M costs using the most current WTD life cycle cost model for a 50-year project life and a 5 percent discount rate.

Table 6-3. Life Cycle Costs (2025 Dollars)

Present Value Capital Cost	Present Value O&M Costs	Present Value Net Cost
$891 million	$32 million	$922 million

The estimated monthly increase in O&M costs for ratepayers due to the proposed improvements is 7 cents per month. The rate impacts presented are an average over the next 10 years.

6.5 Implementation Plan

The EWWTS Project will be implemented to achieve the schedule compliance milestones listed in Section 15 of the NPDES permit and presented in Table 6-4.

Table 6-4. EWWTS Schedule Compliance Milestones

Task	Due Date
Submit a draft Engineering Report to Ecology for review. The Engineering Report must describe the modifications required to bring the Elliott West CSO Treatment Plant effluent into compliance with its permitted limits and identify the anticipated construction schedule necessary to complete the Project by December 31, 2031.	June 30, 2024 (completed)
Submit a final Engineering Report to Ecology for review and approval.	June 30, 2025
Submit for Ecology review of the 60 percent draft plans and specifications that provide the detailed design requirements for facility improvements, as described in the approved Engineering Report.	June 30, 2026
Submit the 90 percent draft plans and specifications for Ecology review.	June 30, 2027
Submit final plans and specifications for the facility improvement Project to Ecology for review and approval.	December 31, 2027
Complete bidding for construction of the approved improvement Project.[a]	May 30, 2028

[a] Because the Project is being implemented using a GC/CM approach, the equivalent task is a negotiated Maximum Allowable Construction Cost (MACC) which will occur at 90% design. GC/CM will complete bidding of subcontractor packages by the listed due date of May 30, 2028.

In addition, the NPDES permit requires that the Engineering Report summarize the anticipated construction schedule to complete the modifications required to bring the EWWTS into compliance (substantial completion) by December 31, 2031. While the County is committed to meeting all its milestone dates, the County acknowledges that conditions and challenges outside of WTD's control may impact the planned timeline. These may include factors such as funding approval, maintaining existing facility operations during construction, permit approvals, labor shortages, supply chain shortages, unforeseen site conditions, equipment availability, and other third -party constraints.

To proactively address these challenges, the County is implementing a collaborative delivery approach using GC/CM contracting and phased construction packages.

- **General Contractor/Construction Management (GC/CM) delivery approach**. This delivery approach selects the contractor based on qualifications and includes their expertise during design. GC/CM delivery can reduce constructability challenges and reduce risks for all parties helping to deliver the Project. The County received approval from the Washington State Capital Projects Advisory Review Board to proceed with GC/CM and selected a GC/CM for the EWWTS in 2024. The

Project team is working with the GC/CM to adaptively manage an optimized project schedule. The anticipated construction packages are summarized in Table 6-5.

Table 6-5. EWWTS Planned Construction Packages

Package	Purpose	Elements
Main Grading Package	Site and subgrade preparation for construction of station.	Demolition, shoring, excavation, and erosion control.
Main Station Package	Station construction.	Influent pump station improvements, screenings, ballasted sedimentation, UV disinfection, ancillary facilities, west/south retaining wall and site improvements. Once this package is substantially complete, the EWWTS will be capable of discharging effluent in compliance with NPDES permit limits.
Denny Way Regulator Package	Removal or optimization of physical and hydraulic infrastructure at Denny Way Regulator Station that is no longer required.	Dechlorination vault improvements, demolition of existing chemical storage, and relocation of the existing outdoor standby generator into the former dechlorination chemical room at the Denny Way Regulator Station. This package is not required to bring EWWTS effluent into compliance.

Refer to Table 6-6 for the key construction activities and milestones for each package under this streamlined approach. King County's goal is to have the construction substantially complete by December 2031 at which time effluent from EWWTS will be capable of consistently discharging effluent that complies with permit limits. Additionally, the Denny Way Regulator Package is expected to be completed by the following year or December 2032.

Table 6-6. EWWTS Key Construction Activities and Milestones

Project Milestones	NPDES Permit Milestones	Construction Timelines	Duration
• Submit Draft Engineering Report to Ecology • County selects GC/CM	June 2024		24 MONTHS
• Submit Final Engineering Report to Ecology	June 2025		
• Submit 60 percent draft plans and specification to Ecology • Tenant vacates expansion property	June 2026		18 MONTHS
• Submit 90 percent draft plans and specifications to Ecology • GC/CM Bids 90% plans to establish the MACC • Submit **Main Grading Package** for grading permit • Submit **Main Station Package** for construction permit	June 2027		
• Submit final plans and specifications to Ecology for review and approval	December 2027		
• Receive permit for **Main Grading Package** • Provide GC/CM with NTP to start grading • Receive all construction permits and Ecology approval for **Main Station Package** • Provide GC/CM NTP to start construction of **Main Station Package** • Mobilization, submittals, procure long lead items and complete bidding of subcontractor packages • Install secant piles and tiebacks and build west/south retaining wall • Install sheet piles, excavate, and install large diameter conveyance pipes • Excavate Ballasted Sedimentation and UV facilities and install geofabric base rock • Pour base slabs and wall of Ballasted Sedimentation and UV Facilities • Install temporary chemical facility and demo existing chemical storage area • Install auger cast piles for Screenings Facilities and Electrical Building • Erect structural steel beams, girders, joists, metal decking • Demo, install, test, and commission Influent Pumps 1 & 2 - Summer 2029 • Pour base slabs and walls of Screenings Facilities and Electrical Building • Install Roofing and solar system over Ballasted Sedimentation and UV facilities • Install mechanical equipment in Ballasted Sedimentation and UV facilities • Demo, install, test, and commission Influent Pumps 3 & 4 - Summer 2030 • Install bridge crane, elevator, and wall panels in Ballasted Sedimentation and UV facilities • Install roofing and skylights over the Screening Facilities and Electrical Building • Install mechanical equipment in Screening Facilities • Install electrical, low voltage mechanical, lighting, and I&C controls systems • Pave site, install landscape features, and install site security fencing • Submit **Denny Regulator Package** for permit • Demo, install, test, and commission Influent Pumps 5 & 6 - Summer 2031 • Begin system and operational testing • Achieve substantial completion • Construction complete	May 2028 December 2031	January 2028 April 2028 June 2029 June 2030 June 2031 December 2031	45 MONTHS
• Receive all permits and Ecology approvals for **Denny Regulator Package** • Contractor mobilizes at Denny Regulator Station site • Begin demolition of existing chemical system at Denny Regulator Station • Begin demolition of weir wall and sampling equipment at Dechlorination Vault (Dry Season) • Install 90 bend in Dechlorination Vault (Dry Season) • Install new stand-by generator at Denny Regulator Station • Remove existing exterior stand-by generator • Commissions Denny Regulator Station improvements • Achieves substantial completion of **Denny Regulator Package** • **Denny Regulator Package Complete**	December 2032	January 2032 December 2032	12 MONTHS

6.6 Permits and Approvals

This section provides an overview of anticipated Project permits and approvals, and Project conformance with the County's RWSP.

6.6.1 Permits

A preliminary list of anticipated federal, state, and local permits and approvals for the EWWTS Project is provided in Table 6-7.

Table 6-7. Preliminary List of Anticipated Permits and Approvals

Agency/Jurisdiction	Permit Name
EWWTS Site	
Washington Department of Ecology	NPDES Construction Stormwater General Permit
King County Industrial Waste Program	Industrial Waste Dewatering Permit
King County WTD	SEPA Documentation and Determination
City of Seattle Department of Construction and Inspections	Preliminary Application Site Visit Construction (Building) Permit Clear and Grade Permit Side Sewer Permit (for temporary dewatering)
City of Seattle Department of Transportation	Street Improvement Permit Urban Forestry Tree Removal Permit
City of Seattle Public Utilities	Side Sewer Permit (for utility in right-of-way)
Seattle City Light	New Construction Service Application Temporary Service Application
BNSF Railway	Right of Entry Permit (for survey and for construction)
Denny Way Regulator Station Site	
King County WTD	SEPA Documentation and Determination
City of Seattle Department of Construction and Inspections	Construction Addition/Alteration Permit Lot Boundary Adjustment Shoreline Exemption Permit
City of Seattle Parks & Recreation	Revocable Use Permit

SEPA = State Environmental Policy Act

6.6.2 Plan Conformance

The County's RWSP (King County, 1999) addresses wastewater management, including CSOs, and serves as the overall general sewer plan for the County. The RWSP identifies wastewater projects to be built through 2030 to protect human health and the environment, serve population growth, and meet regulatory requirements. The RWSP includes a CSO control plan, which identifies 21 CSO control projects and a goal for achieving control at each CSO location by 2030. An effort to update the RWSP is currently underway, and a draft of the updated plan is anticipated in 2027.

The approved 2012 LTCP is the County's plan and basis for settlement of the CSO consent decree between the County and Ecology that outlines the planned actions to bring the County's CSO program into compliance with the Clean Water Act. The most recent update to the County CSO Control Program (2018 CSO Control Program Update) reflects an evaluation of the program and LTCP implementation status. The 2018 update documents the investigations that the County has been doing to improve the water quality discharged from EWWTS. The EWWTS Project is included in the WTD Capital Improvement Program. The next amendment to the County's LTCP is due December 1, 2028. In addition, The County has an active supplemental compliance plan for the Denny Way Regulator Station Overflow. Updates on supplemental compliance projects are included in the CSO/CD Annual Report.

7. Environmental Analyses

This section describes environmental issues of the Project, including ESJ, SEPA requirements, State Environmental Review Process (SERP) requirements, and federal cross-cutting authorities.

7.1 State Environmental Policy Act

Compliance with SEPA (WAC 197-11) is a prerequisite for obtaining permits and approvals for a CSO control project. SEPA allows agencies to both consider and mitigate the environmental impacts of proposals as well as to provide opportunities for public participation prior to any final decision. The County, as SEPA lead agency, conducted SEPA reviews for this Project. A SEPA Environmental Checklist is included in Appendix B. The County issued a Determination of Non-Significance for the Project, included in Appendix B.

7.2 State Environmental Review Process

All projects that apply for financial assistance from the Clean Water SRF for facility planning or construction must meet the provisions of the SERP (SERP; WAC 173-98-720). SERP compliance helps to ensure that environmentally sound and cost-effective alternatives are selected, and that the public has had an opportunity to learn about and comment on the potential environmental impacts of a proposal. SERP includes all the provisions of the SEPA, chapter 43.21C RCW and SEPA rules, Chapter 197-11 WAC, and all applicable federal requirements. The County will complete SERP for the proposed Project, including preparing a SEPA submittal for Ecology that demonstrates SERP compliance.

7.3 Federal Cross-Cutting Authorities

Federal cross-cutting authorities are the requirements of federal laws and executive orders that apply to federal financial assistance programs. They may be expressly applied by a statute authorizing assistance, but more often the requirements are not cited in a specific assistance-authorizing statute. Instead, they apply broadly on their own terms to a wide range of federal financial assistance programs. All projects that apply for financial assistance from the SRF for construction must comply with cross-cutting federal authorities. The following subsections summarize how the Project would comply with the federal cross-cutting authorities. The County would prepare a report documenting compliance with all federal cross-cutting authorities after all federal approvals have been received. The following subsections describe federal cross-cutting authorities that apply to SRF-financed projects in Washington (Ecology 2016).

7.3.1 Clean Air Act

The Clean Air Act establishes a comprehensive program for improving and maintaining air quality across the United States. A review of existing air quality is summarized in Chapter 3.4 of this Engineering Report. Anticipated impacts and mitigation measures would be evaluated as a part of the SERP and SEPA review process.

7.3.2 Historic Resources

The National Historic Preservation Act requires federal agencies to evaluate the effects of federal undertakings on historical, archaeological, and cultural resources, and to consult with the State Historic Preservation Officer regarding adverse impacts to cultural resources. A review of historical, archaeological, and cultural resources near the proposed Project is summarized in Chapter 3.6 of this Engineering Report and the Cultural Resources Existing Conditions Technical Memorandum (ESA 2023).

The Archaeological and Historic Preservation Act requires agencies to identify relics, specimens, and other forms of scientific, prehistorical, historical, or archaeological data that may be lost during the construction of federally sponsored projects and to nominate for the register resources under the agency's control to ensure that these resources are not inadvertently transferred, sold, demolished, substantially altered, or allowed to deteriorate significantly. Archaeological monitoring for the Project was conducted during preliminary design efforts, including geotechnical borings on July 10 to 14, 17 to 18, and 25 to 26, 2023, totaling 9 days of monitoring over 1 month. A subsurface concrete foundation was discovered at three separate borings over 20 meters along the southern edge of the existing facility property at 601 Elliott Avenue W., just east of the center of the Area of Potential Effects boundary. This is considered an unidentified historic cultural resource. Other non-diagnostic cultural materials identified included several brick pieces less than 1 inch in length, a small concrete slab, a bent wire, and an amber glass piece. Due to the non-diagnostic nature of these materials, they cannot be assigned to a specific period and are, therefore, not considered significant cultural resources. Monitoring is further discussed in Elliott West Combined Sewer Overflow Control Facility Alternatives Evaluation Project Cultural Resources Monitoring Report (Stell, 2023).

Should significant cultural/archaeological resources be found during construction, the Project team has a plan in place to best mitigate potential loss of data. This plan has been informed by Federal Register Guideline 48 FR 44716 and will be implemented following notification to the Department of the Interior.

7.3.3 Coastal Zone Management Act

The federal Coastal Zone Management Act created a partnership between the Federal Government and coastal states and territories to allow states to weigh in on federal projects. The proposed Project area contains designated shorelines and is within the County, which is one of 15 coastal counties in Washington State. All projects occurring within these counties must meet Coastal Zone Management requirements. Coastal Zone Management Act compliance would be reviewed as a part of the SERP process.

7.3.4 Safe Drinking Water Act

Congress passed the Safe Drinking Water Act in 1974 to protect public health by regulating the United States' public drinking water supply. Wastewater construction projects must evaluate the risk of contamination to a sole-source aquifer and integrate appropriate preventive measures. Local governments can ensure that wastewater discharging to groundwater is not located near drinking water supplies. The proposed Project area is not within a sole-source aquifer, nor is the proposed Project discharging to groundwater; therefore, Safe Drinking Water Act regulations and requirements would not apply to this Project.

7.3.5 Endangered Species Act

Section 7 of the Endangered Species Act prohibits federal agency actions from jeopardizing listed species or adversely modifying designated critical habitat. The USFWS website was reviewed for the

presence of federally listed species and critical habitat areas. The proposed threatened North American wolverine (*Gulo gulo luscus*) and yellow-billed cuckoo (*Coccyzus americanus*) were listed for the study area. However, there is no suitable habitat for these species in the study area or in proximity to the study area. The yellow-billed cuckoo is a very rare migrant, and the last documented nesting occurrence in the County was in 1923 in Renton. The federally listed threatened marbled murrelet (*Brachyramphus marmoratus*) also overlaps the Elliott Bay portion of the study area, and while rare, may be present within Elliott Bay. There is no nesting habitat for marbled murrelet. The bull trout (*Salvelinus confluentus*) and designated critical habitat overlaps the Elliott Bay nearshore portion of the study area.

In addition, the WDFW's PHS on the Web app describes all species native to the state of Washington and their natural habitat. A query of the WDFW PHS site shows Pacific herring, a state candidate, in the shoreline and marine areas of the study area. Pacific sand lance, no state or federal status, may also be within the study area. Both Pacific herring and Pacific sand lance are important forage fish species for federally listed species Chinook salmon, steelhead, bull trout, and marbled murrelet.

Bald eagles were delisted several years ago, but the species remain protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. Endangered species and habitats are discussed in further detail in Chapter 2.3.7 of this Engineering Report.

7.3.6 Sustainable Fisheries Act (Essential Fish Habitat)

The EPA and National Marine Fisheries Service must be consulted on any federally funded actions that may adversely affect essential fish habitats. A Biological Opinion (National Marine Fisheries Service, 2000) was issued for construction of the original EWWTS outfall, and the County continues to monitor sediments per the Biological Opinion issued in 2000. Any biological assessment prepared for the Project in support of the Endangered Species Act consultation process would also address essential fish habitats.

7.3.7 Environmental Justice

Based on federal Executive Order 12898, any "disproportionately high and adverse human health or environmental effects" from projects funded through the SRF program on minority, tribal, or low-income populations must be identified and addressed. Based on the available data, the total minority and low -income population percentages in the geographic area likely to be directly or indirectly affected by the Project is comparable with the total minority and low-income populations of the City of Seattle as a whole. Environmental justice considerations, including Tribes and the Bridge Shelter, are further reviewed in the *Elliott West Wet Weather Treatment Station Equity and Social Justice Action Plan*) and the *EWWTS Demographics, Housing, and Environmental Justice Technical Memorandum* (ESA, 2024).

7.3.8 Wetland Protective Executive Orders

Executive Order 11990, Protection of Wetlands, and other implementing rules govern protecting wetlands. The Project is not anticipated to require construction in any designated wetland; no wetlands are located within the Project vicinity (See Section 2.3.5). Wetlands are regulated under Seattle Municipal Code Chapter 25.09. Project construction would not result in direct impacts to wetlands.

7.3.9 Farmland Protection Policy Act

The Farmland Protection Policy Act preserves the nation's farmlands. The site area is not included on the inventory of prime or unique farmlands and would not impact or convert any existing farmlands to nonagricultural uses. Therefore, the Farmland Protection Policy Act regulations and requirements would not apply to the Project.

7.3.10 Wild and Scenic Rivers Act

The Wild and Scenic Rivers Act preserves the scenic, cultural, historical, recreational, and geologic values of selected rivers. The Project site does not fall within the vicinity of any federally recognized wild and scenic rivers. Therefore, the Wild and Scenic Rivers Act regulations and requirements would not apply to the Project.

7.3.11 Floodplain Management Executive Orders

The proposed Project area is not located within a mapped Federal Emergency Management Agency (FEMA) 100- or 500-year floodplain; therefore, the regulations and requirements of Executive Order 11988 would not apply to the Project. The County also completes their own Flood Insurance Rate Maps (FIRM). The EWWTS is contained within Map Number 53033C0630G. According to the most recent FIRM Index date, August 19, 2020, the Project site is not located within a floodplain.

8. Public Involvement, Equity, and Social Justice

8.1 Introduction

This section describes the public involvement process and ESJ action plan for the EWWTS Project. The public involvement plan includes public engagement strategies to support the Project and opportunities for public comment. The ESJ action plan ensures that equity impacts and opportunities are considered in the design and implementation of the proposed Project.

8.2 Public Involvement Plan

WTD implements a program for public and regulatory agency participation in its CSO Control Program within two contexts:

- WTD: General outreach efforts for CSO control (including control project design and construction, program reviews, LTCP updates and amendments, special studies and pilot projects, and public notification of overflows) are coordinated with outreach efforts on wastewater management and water quality in general. This coordination provides context and shows how all WTD activities work together to achieve the same goals.
- King County: The King County Community Engagement Guide (King County, 2011) presents information about how community outreach implements social justice and equity principles. This information can be found on the King County Equity and Social Justice website.

Starting in 2023, the Project team has been developing the *Elliott West Wet Weather Treatment Station (EWWTS) Public Involvement Plan* for the preliminary design phase of the Project, included as Appendix I. The Public Involvement Plan is a living document and will be updated as the team works with the community and gathers more information and feedback. A Public Involvement Plan for the construction phase will be developed building off the successes and lessons learned from the design phase plan. The plan establishes principles and processes for public engagement that support design, and the needs of community members and potentially interested community organizations. It also identifies outreach approaches and describes goals that will ensure transparency, and internal and external collaboration throughout the Project. The goals of the Project's community involvement process are as follows:

- Effectively engage a diverse community about the Project, its impacts, and opportunities by increasing our investment in cross-cultural communications and equitable engagement.
- Keep the community informed, heard, and acknowledged. Share how public input influenced decisions on design.
- Build trust with agency and community partnerships.

8.2.1 Public Outreach Activities and Tools

The public involvement approach is based on equitable outreach, commitment to maintain awareness, transparency, and accessibility. Certain outreach tools are more appropriate or effective in different situations or with different groups. The following engagement tools may be used to provide coordinated communications and outreach for the EWWTS Project to reach community organizations, partner agencies, and other interested parties:

- Community briefings.
- Agency briefings.
- Digital ads and graphics.
- Ongoing listserv communications.
- Mailer/fliers/newsletters.
- Online and in-person public meetings.
- Project brochure, fact sheet, and other physical materials for distribution.
- Digital and paper surveys.
- Project website.
- Posters and traffic message boards.

A community values survey was conducted in September 2023 to gain an understanding of community priorities and the preferred methods of communication for project information and updates. Most of the 59 survey respondents indicated that they were residents near the Project area. These respondents stated that their most important community priorities were focused on public safety and a healthy environment. Protecting water quality and avoiding system failures were among the top priorities specifically related to the wastewater system. Survey respondents denoted a preference for receiving information via email updates versus community meetings and local organizations, and moving forward, want to know more about construction and how Elliott West will work after the upgrade.

A Project website was established to make information on the EWWTS Project available to the public. Technical information is available on the website to allow interested citizens opportunities to better understand the Project. A WTD community engagement staff member's contact information is also available on the webpage. A link to the Project website is provided to the public in meeting notices, press releases, newsletters, emails, and at in-person and virtual meetings. Interested parties can also subscribe for Project updates provided via text message and/or email. The online presence of the Project will be updated at least every 3 months to ensure information is up to date.

WTD will be adaptive in their approach to engaging and keeping the community informed. As the Project progresses, the tools and the engagement plan will be adjusted based on experience and community feedback.

8.3 Equity and Social Justice

WTD strives to view all projects through an equity lens. The EWWTS Equity and Social Justice Action Plan (Action Plan), included as Appendix J, was developed to ensure that equity impacts and opportunities are considered in the design and implementation of the proposed Project. Chapters 2 and 3, and the Action Plan provide context for the neighborhoods surrounding the proposed Project site.

Pro-equity systems and policies result in community conditions, also known as "determinants of equity". The determinants of equity are as follows:

- Healthy built and natural environments.
- Quality education.
- Early childhood development.
- Family-wage jobs and job training.

- Access to parks and natural resources.
- Community and public safety.
- Access to affordable, healthy local food.
- Digital equity.
- Strong, vibrant neighborhoods.
- Access to health and human services.
- Access to safe and efficient transportation.
- Affordable, safe, and quality housing.
- Economic development.
- Equitable law and justice system.
- Equity in County practices.

Determinants of equity also guide future projects and developments to increase equity and social justice. The Project team seeks to improve the determinants of equity in the Project area through project commitments that relate directly to known community values, regulatory requirements, and sustainability actions. The Action Plan outlines the following key recommendations:

1. **Engage Residents and Businesses:** Conduct regular community outreach sessions, surveys, and public meetings to ensure that the needs of nearby residents are integrated into project planning. Prioritize community feedback in design decisions and mitigation efforts where possible.
2. **Expand Public Access and Scenic Views:** Incorporate designated public spaces and viewpoints of Elliott Bay in project design or establish new accessibility enhancements at WTD-owned facilities to improve neighborhood engagement with waterfront vistas.
3. **Implement Sustainability Measures**: Integrate energy-efficient technologies, eco-friendly construction practices, and pollution-reduction strategies such as dust control, emissions minimization, and responsible waste disposal throughout construction and operation phases.
4. **Educate and Empower the Community**: Establish educational programs, informational materials, and guided site tours during design, construction, and operation. Develop interactive forums where community members can provide insights, learn about key project elements, and participate in decision-making processes.
5. **Enhance Commuter Safety and Transit Access**: Identify and incorporate pedestrian-friendly infrastructure, bike lanes, and transit-friendly features into the design. Maintain safe and accessible pathways during construction to prevent disruptions to commuters.
6. **Prioritize Neighborhood Safety**: Implement crime-prevention strategies, adequate lighting, security monitoring, and collaboration with local safety organizations to ensure the new facility strengthens, rather than disrupts, neighborhood security.

9. References

ESA. 2024. *Elliott West Wet Weather Treatment Station Demographics, Housing, and Environmental Justice Technical Memorandum.* February 22.

King County. 1999. *Regional Wastewater Services Plan*. Available at King County Regional Wastewater Services Plan - King County, Washington. King County, Department of Natural Resources and Parks, Wastewater Treatment Division, Seattle, Washington. November.

King County. 2010. *Evaluation and Testing of Chemically Enhanced Sedimentation with and without Lamella Plates for Combined Sewer Overflow Treatment.* Pilot Test Report. June.

King County. 2011. *Community Engagement Guide*. Available at CommunityEngagementGuideContinuum2011.ashx

King County. 2012a. *2012 King County Long-Term Combined Sewer Overflow Control Plan Amendment*. Available at KC_LTCSOControlPlanAmendment,Oct2012.pdf. King County, Department of Natural Resources and Parks, Wastewater Treatment Division, Combined Sewer Overflow Program, Seattle, Washington. October.

King County. 2012b. *2012 - 2016 Biosolids Plan*. Available at https://kingcounty.gov/en/dept/dnrp/waste-services/wastewater-treatment/resource-recovery/biosolids/resources. King County Department of Natural Resources and Parks, Wastewater Treatment Division. June.

King County. 2012c. *Post Construction Monitoring Plan for King County CSO Controls*.

King County. 2013. *WTD's Engineering Design Standards for CSO Storage Systems*.

King County. 2014a. *Fact Sheet for NPDES Permit WA0029181 West Point Wastewater Treatment Plant (WWTP) and Combined Sewer Overflow (CSO) System*. Available at https://apps.ecology.wa.gov/paris/DownloadDocument.aspx?id=135860. King County Department of Natural Resources and Parks, Wastewater Treatment Division. December 19.

King County. 2014b. *Regional Wastewater Services Plan (RWSP) 2013 Comprehensive Review*. Available at https://kingcounty.gov/depts/dnrp/wtd/system-planning/regional-wastewater-services-plan.aspx.

King County. 2014c. *WTD Engineering Design Standards - CSO Treatment Systems*.

King County. 2018a. *Combined Sewer Overflow Control Program; 2018 CSO Control Program Update.* King County, Department of Natural Resources and Parks, Wastewater Treatment Division, Seattle, Washington. October. Available at 2018_CSO-control-program-update-secure.ashx (kingcounty.gov)

King County. 2018b. *King County Sediment Management Plan 2018 Update*. Prepared by Anchor QEA for King County Dept of Natural Resources and Parks, Sediment Management Program.

King County. 2019. *Request to Modify King County's Combined Sewer Overflow Consent Decree*. Available at https://kingcounty.gov/~/media/services/environment/wastewater/cso/docs/Ecology_USEPA_CDModificationRequest_102819.ashx?la=en. October 28.

King County. 2021. *Design Flow for Additional Treatment at Elliott West CSO Facility*. King County, Department of Natural Resources and Parks, Wastewater Treatment Division, Seattle, Washington.

King County. 2022. *2022 Denny Avenue Regulator Station Combined Sewer Overflow (CSO) Supplemental Compliance Plan.* King County, Department of Natural Resources and Parks, Wastewater Treatment Division, Seattle, Washington.

King County. 2023a. *2022 King County CSO Control Program.* King County, Department of Natural Resources and Parks, Wastewater Treatment Division, Seattle, Washington.

King County. 2023b. GIS Center. Accessed at https://gismaps.kingcounty.gov/iMap/.

King County. 2023c. *A CFD Model Analysis of a Proposed Outfall Structure for the Elliott West Wet Weather Treatment Station (EWWTS), Seattle, Washington.* King County, Department of Natural Resources and Parks, Wastewater Treatment Division.

King County. 2025. *Design Flows for Additional Treatment at Elliott West CSO Facility.* Department of Natural Resources and Parks Wastewater Treatment Division.

National Marine Fisheries Service. 2000. *Biological Opinion; Denny Way/Lake Union CSO Control Project; WSB-00-039*. Available at https://your.kingcounty.gov/dnrp/library/wastewater/sedman/Denny/Denny_200006.pdf. Accessed February 12, 2024.

Washington State Department of Ecology (Ecology). 2015. *Air Quality Maps of Maintenance Areas*. Available at http://www.ecy.wa.gov/programs/air/other/namaps/web_map_intro.htm. Ecology. Accessed June 28, 2023.

Washington State Department of Ecology (Ecology). 2018. *Water Quality Program Permit Writer's Manual.* Publication No. 92-109. July.

Washington State Department of Ecology (Ecology). 2016.*Combined Funding Program Environmental Review Guidance*. Department of Ecology Water Quality Financial Assistance. March 2016. Available: https://fortress.wa.gov/ecy/publications/documents/1610003.pdf.

Washington State Department of Ecology (Ecology). 2023. *Criteria for Sewage Works Design (The "Orange Book")*. Publication No. 98-37 WQ. Available at https://fortress.wa.gov/ecy/publications/summarypages/9837.html. Washington State Department of Ecology, Water Quality Program. May.

Washington State Department of Ecology (Ecology). 2024a. *National Pollutant Discharge Elimination System Waste Discharge Permit No. WA0029181* and *Fact Sheet.* Issued April 29, 2024. Effective Date June 1, 2024.

Washington State Department of Ecology (Ecology). 2024b. Washington State Water Quality Assessment 303(d)/305(b) List. Accessed at: https://apps.ecology.wa.gov/ApprovedWQA/ApprovedPages/ApprovedSearch.aspx

King County Department of Natural Resources and Parks Water and Land Resources Division (King County DNR). 2017. *Science and Technical Support Section: Lake Union and Ship Canal - A History of Pollution and Work Towards a Solution*. Available at SCIYI Newsletter - January 2017L: Lake Union and the Ship Canal Article (kingcounty.gov). King County DNR. Accessed July 11, 2023.

National Center for Environmental Information (NCEI). 2023. Climate Sciences and Services Division. Available at NOAA NCEI U.S. Climate Normals Quick Access. National Oceanic and Atmospheric Administration. Accessed on July 11, 2023.

Washington State Department of Fish and Wildlife (WDFW). 2023. PHS on the Web. Available at Priority Habitats and Species: Maps | Washington Department of Fish & Wildlife Accessed July 11, 2023.

Washington State Governor's Office of Indian Affairs (GOIA). 2023. Treaty of Point Elliott, 1855. Available at Treaty of Point Elliott, 1855 | GOIA (wa.gov). Accessed July 11, 2023.

Water Resource Inventory Area 9 (WRIA 9). 2021. Green/Duwamish and Central Puget Sounds Watershed Salmon Habitat Plan 2021 Update. Making Our Watershed Fit for a King. Approved by the Watershed Ecosystem Forum February 11, 2021. Available at Salmon Habitat Plan 2021 Update - February 2021 (govlink.org). Accessed July 11, 2023.

Seattle Public Utilities (SPU). 2015a. *Seattle Public Utilities Draft Long Term Control Plan*. Available at http://www.seattle.gov/util/MyServices/DrainageSewer/Projects/SewageOverflowPrevention/LongTermControlPlan/index.htm. May 29.

Seattle Public Utilities (SPU). 2015b. *Seattle Biological Evaluation Document*. Accessed at: https://www.seattle.gov/utilities/construction-resources/standards-and-guidelines/seattle-biological-evaluation/sbe-document.

Jacobs Engineering Group, Inc. (Jacobs). 2021. *Alternatives Analysis Technical Memorandum*. Prepared for the Elliott West Wet Weather Treatment Station Project, King County, Department of Natural Resources and Parks, Wastewater Treatment Division, Seattle, Washington. Final. December.

Jacobs Engineering Group, Inc. (Jacobs). 2024. *Alternatives Analysis Technical Memorandum Amendment*. Prepared for the Elliott West Wet Weather Treatment Station Project, King County, Department of Natural Resources and Parks, Wastewater Treatment Division, Seattle, Washington.

Mauger, G. et al. (2018) *New Projections of Changing Heavy Precipitation in King County*. Available at: https://cig.uw.edu/publications/new-projections-of-changing-heavy-precipitation-in-king-county-2/ (Accessed: 6 December 2021).

Carollo Engineers, Inc. (Carollo). 2016. *Elliott West Wet Weather Treatment Station Evaluation - Existing Facility Assessment and Optimization Technical Memorandum*. Prepared for King County, Department of Natural Resources and Parks, Wastewater Treatment Division, Seattle, Washington. September.

Carollo Engineers, Inc. (Carollo). 2018. *Elliott West Wet Weather Treatment Station Computational Fluid Dynamics Modeling Technical Memorandum*. Prepared for King County, Department of Natural Resources and Parks, Wastewater Treatment Division, Seattle, Washington. October.

Carollo Engineers, Inc. (Carollo). 2019. *Elliott West Wet Weather Treatment Station 2018 Combined Sewer Overflow Long Term Control Plan Update Technical Memorandum*. Prepared for King County, Department of Natural Resources and Parks, Wastewater Treatment Division, Seattle, Washington. February.

Parametrix, Inc. (Parametrix) 2017. *Elliott West Wet Weather Treatment Station Chlorination and Dechlorination Evaluation Phase 1 Findings Technical Memorandum*. Prepared for King County, Department of Natural Resources and Parks, Wastewater Treatment Division, Seattle, Washington. November.

Kennedy/Jenks Consultants, Inc. (Kennedy/Jenks). 2013. *Hydraulic Assessment of Elliott West CSO Treatment Facilities Technical Report*. Prepared for King County, Department of Natural Resources and Parks, Wastewater Treatment Division, Seattle, Washington. September.

Tetra Tech, Inc. (Tetra Tech). 2009. *Elliott West CSO Facility Evaluation - Performance Assessment*

Technical Memorandum. Prepared for King County, Department of Natural Resources and Parks, Wastewater Treatment Division, Seattle, Washington. June.

Stell Environmental Enterprises Inc. 2023. *Draft Elliott West Combined Sewer Overflow Control Facility Alternatives Evaluation Project Cultural Resources Monitoring Report*. September 2023.

Washington Department of Fish and Wildlife (WDFW). 2023a. Geodata Services "Priority Habitats and Species." Accessed at: https://geodataservices.wdfw.wa.gov/hp/phs/.

U.S. Fish and Wildlife Service (USFWS). 2023b. National Wetland Inventory. Accessed at https://fwsprimary.wim.usgs.gov/wetlands/apps/wetlands-mapper/

U.S. Fish and Wildlife Service (USFWS). 2023a. IPaC (Information, Planning, and Conservation). Accessed at: https://ipac.ecosphere.fws.gov/.
Wiles, G. J., and K. S. Kalasz (WDFW). 2017. Status report for the Yellow-billed Cuckoo in Washington. Washington Department of Fish and Wildlife, Olympia, Washington. 32+ iv pp.
Washington Department of Fish and Wildlife (WDFW). 2023a. Geodata Services "Priority Habitats and Species." Accessed at: https://geodataservices.wdfw.wa.gov/hp/phs/.

City of Seattle. 2005. *City of Seattle Comprehensive Plan - Toward a Sustainable Seattle. As Amended*. Available at CouncilAdopted2022FullPlan.pdf (seattle.gov). City of Seattle, Department of Planning and Development, Seattle, Washington. January.

City of Seattle. *One Seattle 2035 Comprehensive Plan*. 2022. Accessed at: Seattle 2035 Comprehensive Plan - OPCD | seattle.gov

City of Seattle Department of Neighborhoods, Neighborhood Snapshot, August 2023. https://jacobsengineering.sharepoint.com/sites/CPW3X98800/Dev/KC450FacilityPlan/Forms/AllItems.aspx?newTargetListUrl=%2Fsites%2FCPW3X98800%2FDev%2FKC450FacilityPlan&viewpath=%2Fsites%2FCPW3X98800%2FDev%2FKC450FacilityPlan%2FForms%2FAllItems%2Easpx&id=%2Fsites%2FCPW3X98800%2FDev%2FKC450FacilityPlan%2FDraft%2FCoordination%2FNeighborhood%20snapshots&viewid=23afc708%2D6a35%2D40af%2Dbb7e%2D0b493ad055eb

University of Washington. 2019. Interactive Sea Level Rise Data Visualizations. Available at https://cig.uw.edu/projects/interactive-sea-level-rise-data-visualizations/. Climate Impacts Group, University of Washington, Seattle, Washington. July.