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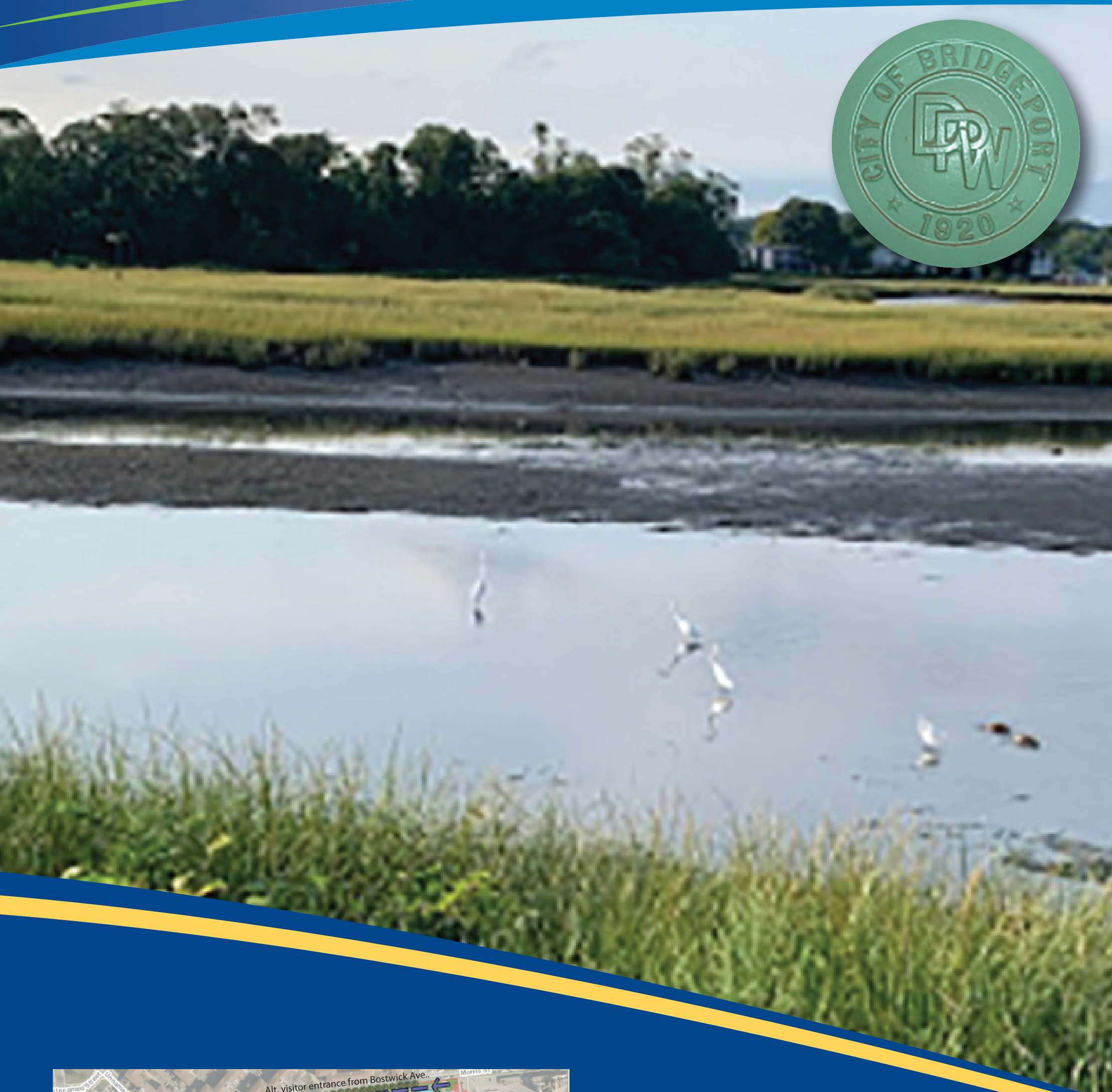
Water Pollution Control Authority (WPCA)

City of Bridgeport, CT

Facilities Plan for the West and East Side Wastewater Treatment Plants



REPORT

November 2020

CDM Smith®

WATER POLLUTION CONTROL AUTHORITY
for the City of Bridgeport
695 Seaview Avenue • Bridgeport, Connecticut 06607-1628
Telephone (203) 332-5550 • Fax (203) 576-7005

Lauren McBennett Mappa, P.E.
General Manager

November 24, 2020

Ms. Ann A. Straut
Sanitary Engineer III
Connecticut Department of Energy and Environmental Protection
Bureau of Water Protection and Land Reuse
Water Planning and Management Division
79 Elm Street
Hartford, CT 06106-5127

Subject: WPCA, City of Bridgeport
Facilities Plan for the West Side and East Side Wastewater Treatment Plants
WWTP Order Dated March 1, 2019

Dear Ms. Straut:

On behalf of the Water Pollution Control Authority, City of Bridgeport, CDM Smith Inc. has completed the attached Facilities Plan for the West Side and East Side Wastewater Treatment Plants. This report has been developed and is hereby submitted in accordance with Paragraph B.1.b of the Order for the Wastewater Treatment Plants dated March 1, 2019.

Per Paragraph B.18 of the Order, this report is being submitted in electronic format. Paper copies can be provided upon request. If any paper copies would be helpful, please let me know how many you want and where they should be sent.

The WPCA is committed to moving forward with the important projects recommended by the attached Facility Plan. However, as noted in the Facility Plan, if Clean Water Fund assistance is not available in the amounts assumed in this report, the financial capabilities of the WPCA, and the schedule for completion of the recommended projects, will need to be re-evaluated.

Please reach out to me with any questions. I can be reached directly at (203) 332-5605.

I have personally examined and am familiar with the information submitted in this document and all attachments thereto, and I certify, based on reasonable investigation, including my inquiry of those individuals responsible for obtaining the information, that the submitted information is true, accurate and complete to the best of my knowledge and belief. I understand that any false statement made in the submitted information may be punishable as a criminal offense under Section 53a-157b of the Connecticut General Statutes and any other applicable law.

Very truly yours,

Lauren McBennett Mappa, P.E.
General Manager
Water Pollution Control Authority

Attachments: Facilities Plan for the West Side and East Side Wastewater Treatment Plants

c: Joe Laliberte – CDM Smith Inc.

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List of Abbreviations

AACE	American Association of Cost Engineering
ACM	asbestos containing material
ADF	average daily flow
AO	Administrative Order
AOC	areas of concern
ATS	automatic transfer switch
BAF	biologically active filter
BEP	best efficiency point
BFP	belt filter press
Bgs	below ground surface
BNC	Bayonet Neill-Concelman
BNR	biological nutrient removal
BOD_5	Five-day Biochemical Oxygen Demand
BTF	biotrickling filter
BTI	Bridgeport-Trumbull Interceptor
ccf	100 cubic feet
cfs	cubic feet per second
CCTV	closed circuit television
C&D Plan	Conservation and Development Policies: The Plan for Connection 2013-2018
CEPT	chemically enhanced primary treatment
CFU	colony forming units
CMOM	capacity, management, operations, and maintenance
COC	constituents of concern
CSO	combined sewer overflow
CT DEEP	Connecticut Department of Energy and Environmental Protection
CT ECO	Connecticut Environmental Conditions Online
CT SWF/LF	Connecticut Solid Waste Facility/Landfill

CWF	Clean Water Fund
DAFT	dissolved air flotation thickener
DBP	disinfection by-products
DEM	digital elevation
DMR	Discharge Monitoring Report
DO	dissolved oxygen
ECAF	Environmental Conditions Assessment Form
ECHO	EPA's Enforcement and Compliance History Online
EPA	United States Environmental Protection Agency
EPA SWMM	EPA's Storm Water Management Model
ETPH	Extractable Total Petroleum Hydrocarbons
EPS	extracellular polymeric substances
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FOG	fats, oil, and grease
ft	feet
ft/s	feet per second
GBT	gravity belt thickener
GIS	geographic information system
gpcpd	gallons per capita per day
gpd	gallons per day
gpm	gallons per minute
GT	gravity thickener
GWI	groundwater infiltration
GWPC	Groundwater Protection Criteria
H_2S	hydrogen sulfide
HBM	hazardous building material
HDPE	high-density polyethylene

HGL	hydraulic grade line
HI	Hydraulic Institute
HMI	human machine interface
hp	horsepower
hr	hour
HRC	high rate clarification
HVAC	heating, ventilation, and air conditioning
I&C	instrumentation and control
IDEC	Industrial/Commercial Direct Exposure Criteria
IFAS	integrated fixed film activated sludge
IGVs	inlet guide vanes
I/I	infiltration and inflow
in	inch
IR	internal recycle
Kg	kilogram
kg/d	kilogram per day
kV	kilovolt
kVA	kilovolt-ampere
kWh	kilowatt-hour
lb	pound
lbs/day	pounds per day
LP BTF	low profile biotrickling filter
LTCP	Long-Term CSO Control Plan
LUST	leaky underground storage tank
MABR	membrane aerated biofilm reactor
MBBR	moving bed biofilm reactor
MBR	membrane bioreactor
MCC	motor control center
MDF	maximum daily flow

mg	milligram
MG	million gallon
mgd	million gallons per day
mg/L	milligram/Liter
mL	milliliter
MLE	Modified Ludzack Ettinger
MLLW	mean lower low water level
MLSS	mixed liquor suspended solids
MMF	maximum month
MOPO	maintenance of plant operations
MOR	Monthly Operating Report
MTBE	Methyl tert-butyl ether
MTBM	micro tunnel boring machine
M	microgram
NAD23	Connecticut State Plane North American Datum 1983
NAVD88	North American Vertical Datum of 1988
NCEI	National Centers for Environmental Information
NEIWPCC	New England Interstate Water Pollution Control Commission
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NGVD29	National Geodetic Vertical Datum of 1929
NMC	Nine Minimum Controls
No.	number
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
OH&P	overhead and profit
OIT	operator interface terminal
O&M	operation and maintenance
OPCC	opinion of probable construction cost

OP	ortho-Phosphate
OPM	Office of Policy and Management
ORP	oxidation-reduction potential
OWS	operator workstations
PAA	peracetic acid
PAH	polyaromatic hydrocarbons
PCBs	polychlorinated biphenyls
PCE	tetrachloroethene
PCU	Primary Control Unit
PD	positive displacement
PE	primary effluent
PF	power factor
PFA	Priority Funding Area
PLC	programmable logic controller
PMC	pollutant mobility criteria
PMSM	permanent magnetic synchronous motor
POTW	Publicly Owned Treatment Works
PPCP	prestressed concrete cylinder pipe
PSU	power supply unit
PVC	polyvinyl chloride
RAS	return activated sludge
RCP	reinforced concrete pipe
RCRA	Resource Conservation and Recovery Act
RDEC	Residential Direct Exposure Criteria
RDT	rotary drum thickener
ROV	remotely operated vehicle
rpm	revolutions per minute
RSR	Connecticut Remediation Standard Regulations
RVC	Residential Volatilization Criteria

SCADA	supervisory control and data acquisition
scfm	standard cubic feet per minute
SCS	Soil Conservation Survey
sf	square foot
SOR	surface overflow rate
SRF	State Revolving Fund
SRT	solids retention time
SVI	sludge volume index
SWD	side water depth
SWMM	Stormwater Management Model
SVOC	Semi-volatile Organic Compounds
SWPC	Surface Water Protection Criteria
TBM	tunnel boring machine
TDH	total dynamic head
TKN	total Kjeldahl nitrogen
TN	total nitrogen
TP	total phosphorus
TRC	total residual chlorine
TSS	total suspended solids
USGS	United States Geologic Survey
UST	underground storage tank
UV	ultraviolet
UVT	UV transmittance
V	volt
VC	Volatilization Criteria
VCP	Connecticut Voluntary Cleanup Program
VDVs	variable diffuser vanes
VFD	variable frequency drive
VOCs	volatile organic compounds

WAS	waste activated sludge
WET	whole effluent toxicity
WPCA	Water Pollution Control Authority
WPCF	Water Pollution Control Facility
WWTP	Wastewater Treatment Plant
XRF	X-Ray Fluorescence

Executive Summary

ES.1 Background

The Water Pollution Control Authority (WPCA), City of Bridgeport collects and treats wastewater generated in Bridgeport, the sewered portion of Trumbull, and a small number of users in both Stratford and Fairfield on the Bridgeport line. The system consists of nearly 290 miles of sewer pipe, nine pumping stations, and two wastewater treatment plants (WWTPs): the 30 million gallon per day (mgd) West Side WWTP and the 10 mgd East Side WWTP. A portion of the collection system is served by combined sewers – where wastewater and stormwater are conveyed in a common pipe to the treatment facilities. During rainfall events, when the capacity combined sewer pipes and/or treatment facilities are exceeded, a combination of wastewater and stormwater can be discharged through the 25 combined sewer overflows (CSOs) located throughout Bridgeport, or can be partially treated and discharged at the two treatment plant sites.

In July 2011, as required under an Administrative Order, the WPCA submitted a Long-Term CSO Control Plan (LTCP), to address the CSOs in Bridgeport. The LTCP provided a plan to control CSOs to the 1-year, 24-hour storm including the following actions and plans: an illicit connection elimination program, sewer separation, static weir control, storage tanks, green infrastructure, a tunnel, and a continuous water quality monitoring and modeling program. The LTCP was approved by Connecticut's Department of Energy and Environmental Protection (CT DEEP) in January 2018. The WPCA then entered into a superseding Administrative Order in June 2018 which includes milestones for implementation of recommended improvements. The cost of the proposed LTCP improvements was estimated at $385 million at the time the report was submitted, which equates to $496 million in 2020 dollars.

In March 2019, the WPCA entered into a second Administrative Order requiring the WPCA to submit a Wastewater Treatment Facilities Plan to the Commissioner of Connecticut Department of Energy and Environmental Protection (CT DEEP) on or before November 30, 2020. This Wastewater Facility Plan fulfills the requirement of the Order. The Facilities Plan presents an assessment of all critical components at both treatment plants and a long-term vision of the capital needs of the WPCA's West Side and East Side WWTPs to improve the performance and reliability of the treatment systems over a 30-year planning period through 2050. This Facilities Plan is designed to dovetail with recommendations presented in the LTCP and provide a holistic view of the collection and treatment systems to result in the most cost-effective, timely solutions to improve water quality in the receiving waters. The schedule outlined in the wastewater treatment Administrative Order is summarized in **Table ES-1.**

As presented and justified in this Facilities Plan, modifications to the Administrative Order milestones are proposed.

Table ES-1 WWTP Administrative Order Milestones

Date	Action
On or before November 30, 2020	Submit Facilities Planning Report
On or before May 31, 2022	Submit 100% design plans and specifications for WWTP upgrades
No later than August 2023	Commence construction of remedial actions
No later than August 2026	Complete construction of remedial actions

ES.2 Goals of the Wastewater Facilities Plan

The scope of the wastewater treatment improvements presents challenges in maintenance, rehabilitation, and replacement. Capital projects across both plants must be implemented while facilities are on-line, posing operational challenges. Decisions to replace aging assets with more efficient, up-to-date treatment processes must be appropriately vetted, and phased to ensure continued operation of the existing facility during construction. The improvements at the two WWTPs must move forward in a logical fashion, ensuring integration with the LTCP, while being cognizant of the WPCA's ability to afford the recommendations. In addition to complying with the requirements of the Administrative Order, the WPCA is taking this opportunity to move the utility toward a culture of Effective Utility Management where the following desired, overarching Facility Planning outcomes are achieved:

- Protect public health and safety
- Preserve (and restore) natural resources and a healthy environment through permit compliance
- Provide reliable, resilient, and high-quality service
- Contribute to economic prosperity through cost-effective treatment

Major goals that feed into the desired outcomes for the WWTP improvements include:

- Replacement of aging assets, including support systems, to meet current codes and standards
- High flow management at the WWTPs to help reduce remaining untreated CSOs, and maximize flow to secondary treatment
- Improved preliminary and primary treatment to reduce downstream operation and maintenance (O&M) costs, improve system performance and improve quality of wet weather discharges
- Improved biological nitrogen removal to optimize nitrogen credits

- Development of a long-term residuals management plan
- Providing system resiliency to account for climate change, including sea level rise.

The intent of this Facilities Plan is to help WPCA invest wisely and move towards a scheme to "build-it-better" rather than "replace-in-kind" and move the facility toward a utility of the future which is sustainable and resilient. As mentioned, improvements have been assessed and recommendations made herein to dovetail with the LTCP concepts to avoid sunk costs and missed opportunities.

ES.3 Existing Conditions

ES.3.1 Contract Operations

The WPCA currently contracts with Inframark (referred to as the "Company" in the contract) for the operations of the wastewater treatment system defined as the collection system, collection system sites, and the two treatment facilities. On October 8, 2013 the WPCA entered into a 10-year Agreement (with two 5-year renewable options) with Severn Trent Environmental Services, Inc for the operation and maintenance of the wastewater treatment system. In 2017 Severn Trent – North American changed its name to Inframark, following the separation from the parent company in the United Kingdom.

The current operations contract requires the Company to procure and provide all necessary materials, supplies, consumables, labor, etc. to continuously operate and maintain the system 24 hours per day, 7 days a week, 52 weeks per year in accordance with applicable law, the operation and maintenance (O&M) manual, and the conditions of the National Pollutant Discharge Elimination System (NPDES) permits, the General Permit for Nitrogen Discharges, the Consent Agreement and the Consent Order. The Company is responsible for payment of the following utility costs: fuel for generators, vehicles and collection system equipment, water, and telecommunications. The WPCA pays directly for electricity and natural gas costs. Residuals from the wastewater treatment system shall be processed and properly disposed of by the Company and the Company's sole cost and expense in accordance with the contract and all applicable law. A chemical allowance limit of $450,000 is included in the service fee. Chemical costs are tracked monthly and at the end of each year any unused amount will be reimbursed to WPCA. If the amount exceeds the limit WPCA will reimburse the Company for the excess chemical costs.

With respect to Total Nitrogen limits, WPCA will pay the Company 50 percent of the direct cash payment received from the CT DEEP Nitrogen Credit Exchange Program. The Company is required to pay for all nitrogen credit costs with a limit of liability in any given billing year of one million dollars.

ES.3.2 Collection System

Although the intent of the Wastewater Treatment Facilities Plan is to focus on facilities "inside the fence," the collection system tributary to the two plants was evaluated, and the collection system SWMM model used for the LTCP refined to better understand the influent flow and load implications of the ongoing work in the collection system, and more importantly, to uncover synergies which could reduce overall costs to achieve the goals of the planning process.

As presented on **Figure ES-1**, generally, the combined sewers are located in the older, southern end of the City along the coast. The separated sewers are mostly located in the northern half of the City built during the 1950s and 1960s during a period of expansion. The separated sewers are largely located in more residential areas. Generally, the Pequonnock River represents the divide between the West Side and East Side service areas. There are currently 25 active CSO outfalls in Bridgeport, 19 within the West Side WWTP service area and six within the East Side WWTP tributary area. CSO pipes discharge to several different water bodies including Ash Creek, Black Rock Harbor, Burr Creek, Bridgeport Harbor, Cedar Creek, Island Brook, Johnson's Creek, Pequonnock River and Yellow Mill Channel.

Overall, the existing collection system is old but in acceptable condition for its age. Pumping stations throughout the system have been recently upgraded and are in generally good condition. Preventative maintenance activities by the WPCA are ongoing, but problem areas include the siphons and storage conduits which need additional attention (cleaning and repair), and inflow through tide gates. Recent lining and separation projects recommended in the LTCP are helping to renew older portions of the collection system.

In reviewing the collection system model, it became evident that the collection system has the capacity to convey much more flow to the treatment facilities than the treatment facilities are able to accept. However, surprisingly, the LTCP did not assess increasing the peak flow capacity at either plant as a means to reduce or mitigate CSOs. As a part of this Facilities Plan, the capacity of the collection system to convey flow to the plant was assessed, as well as the reduction in the frequency and volume of CSOs if treatment plant flow was increased.

Under current conditions, assuming a maximum current capacity of 80 mgd (limited by influent pumps) at the West Side WWTP, estimated peak CSO discharge volumes during the 1-year, 24-hour design storm totals 44.4 million gallons (MG), with 21 of 22 CSO regulators active. Total simulated East Side CSO volume is 5.4 (MG), with 6 of 6 CSOs active, based on a maximum current capacity of 35 mgd (limited by influent pumps) at the East Side WWTP. Note, in a few instances, multiple regulators discharge to a single CSO outfall, so although a total of 28 regulators exist only 25 outfalls exist.

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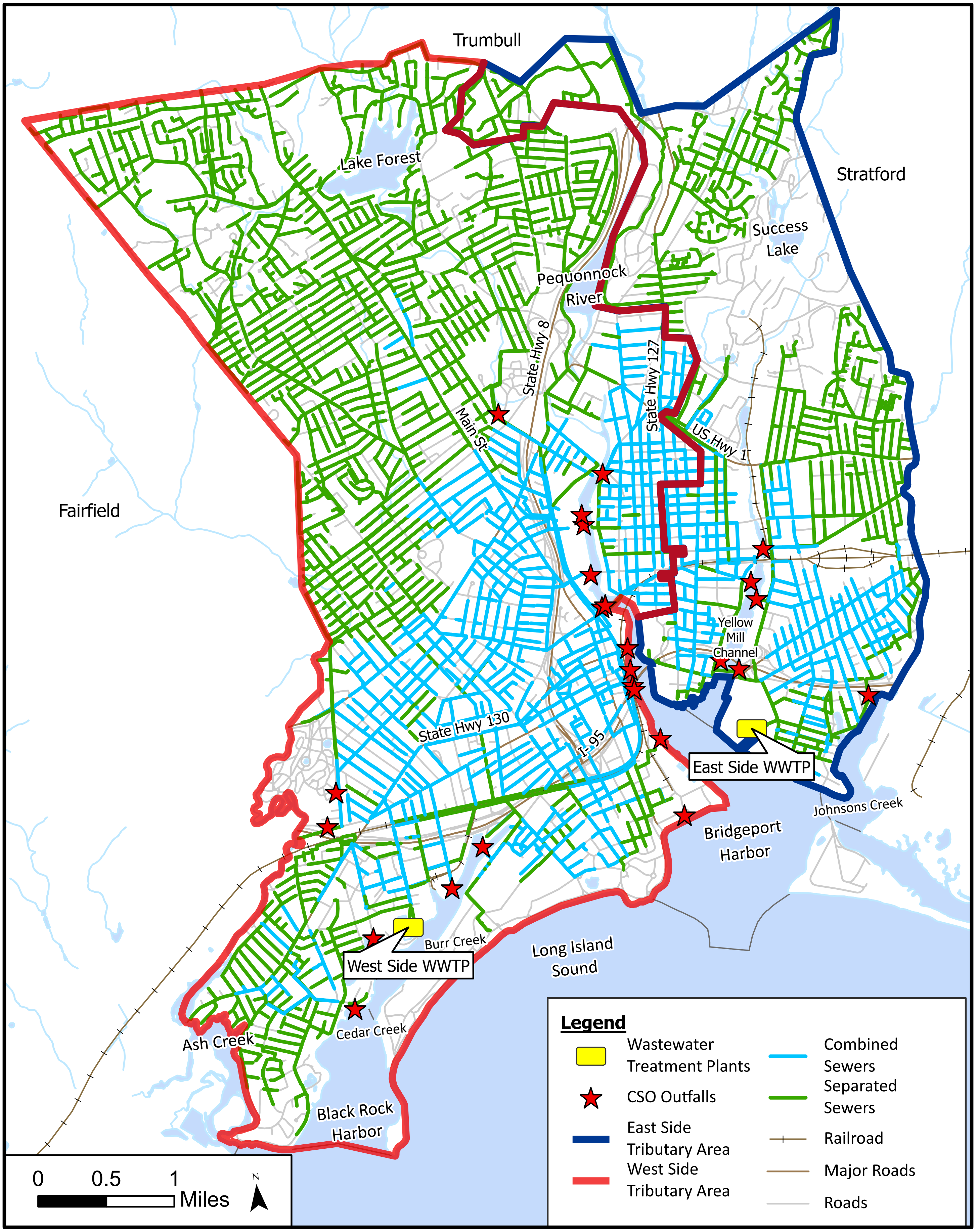

Figure ES-1
System Overview

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ES.3.3 Wastewater Treatment Plants

ES.3.3.1 West Side WWTP

The West Side WWTP is located at 205 Bostwick Avenue and discharges into Long Island Sound via Cedar Creek (Black Rock Harbor). Construction of the original interceptors began in the early 1900s. Collected wastewater was conveyed to the site on Bostwick Avenue. Over the years the original treatment plant infrastructure was upgraded, expanded, demolished, and repurposed resulting in the facility that exists on the site today. Generally, the plant consists of influent screening ahead of influent pumping, rectangular primary settling tanks, an activated sludge system modified to operate in a Modified Ludzack-Ettinger (MLE) mode for nitrogen removal, rectangular secondary clarifiers, disinfection with sodium hypochlorite and gravity thickeners and a rotary drum thickener for sludge thickening. The plant effluent is discharged through a 72-inch outfall pipe at a headwall along the north side of Cedar Creek in Black Rock Harbor near the Captain's Cove Seaport restaurant. The most recent major upgrade on-site was in the early 2000s when the activated sludge system was modified to achieve some level of interim nitrogen reduction. Dechlorination was also added in the early 2000s. No major upgrades have been completed since that time and most equipment has reached the end of its useful life. An aerial of the West Side WWTP and surrounding areas is presented in **Figure ES-2.**

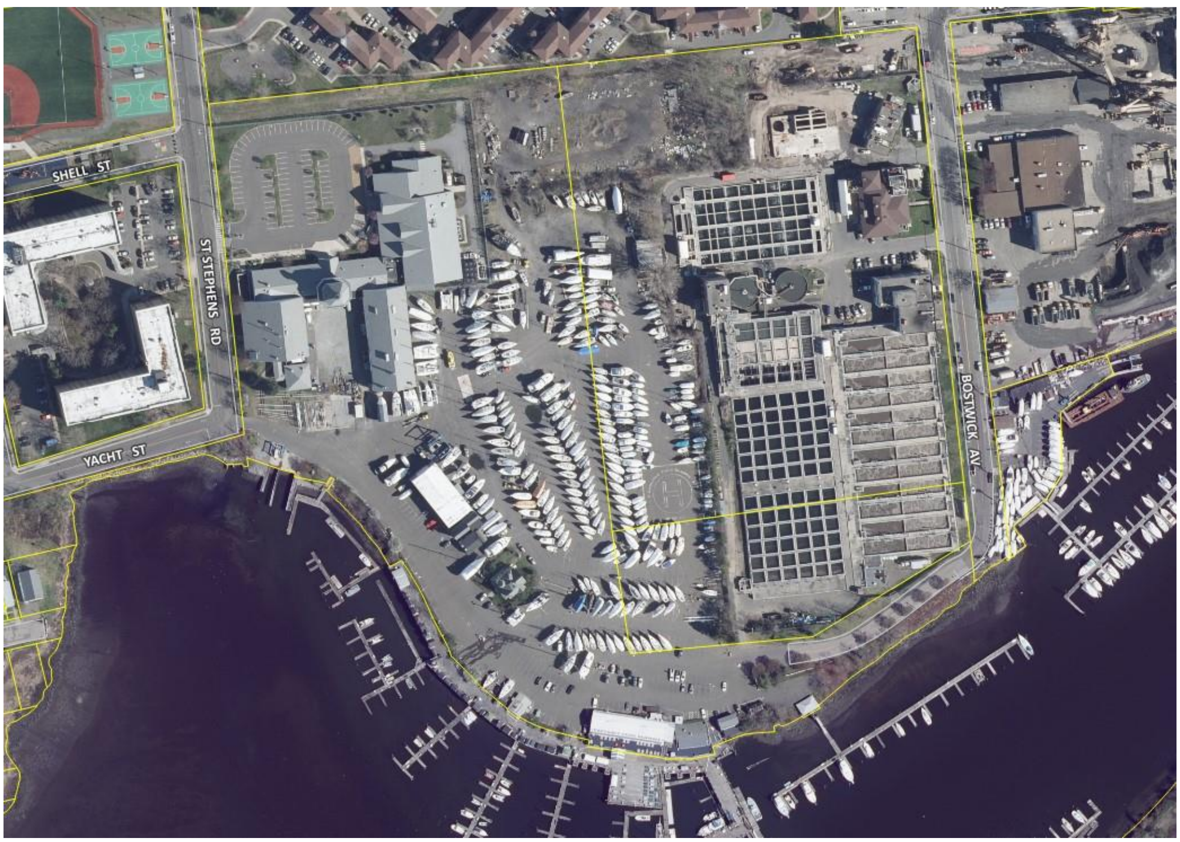

Figure ES-2
Aerial of West Side Wastewater Treatment Plant

The West Side WWTP was designed to achieve secondary effluent quality (30 milligrams per Liter (mg/L) five day biochemical oxygen demand (BOD_5) and total suspended solids (TSS)) at annual average design flow capacity of 30 mgd and a peak secondary treatment capacity of 58 mgd. All wet weather flow in excess of the secondary treatment capacity, up to the design capacity of 90 mgd, was intended to receive primary treatment before re-combining with secondary effluent prior to effluent disinfection and discharge. The most recent General Permit for Nitrogen Discharges defines the annual mass loading of total nitrogen for the West Side WWTP of 1,041 lb/day.

A review of plant data from 2017 through 2019 reveals an average influent flow of 22.1 mgd, about 25 percent less than the design flow of 30 mgd, and weak to moderate influent concentrations, typical of a combined collection system as presented in **Table ES-2**.

Table ES-2 West Side WWTP Influent Conditions (2017-2019)

	West Side WWTP
Average daily flow (mgd)	22.1
Biochemical oxygen demand (BOD_5), lb/day (mg/L)	28,000 (152)
Total suspended solids (TSS), lb/day (mg/L)	42,000 (228)
Total Kjeldahl nitrogen (TKN), lb/day (mg/L)	4,500 (24.4)
Total phosphorus (TP), lb/day (mg/L)	780 (4.2)

The West Side WWTP suffers from aging, being undersized, and inadequate treatment processes which directly and indirectly impact the ability of the treatment facility to meet permit limits. Specifically, this includes ineffective screening and no in-line grit removal, undersized primary settling tanks, a secondary treatment system that was reconfigured to impart nitrogen removal but is undersized to do so under all flow and load conditions year-round, inappropriately designed chlorine contact tanks, and the inability to effectively and efficiently remove scum and solids from the treatment system. In addition, limited operational instrumentation and controls exist making operations and control even more difficult.

During the three-year period analyzed, the plant experienced permit violations related to effluent BOD_5, TSS, fecal coliform and enterococci. In addition, during this period, the plant did not meet its waste allocation for total nitrogen removal. The average annual flow volume and final effluent quality is presented in **Table ES-3.**

Table ES-3 West Side WWTP Average Final Effluent Quality (2017-2019)

	Total Flow Treated through Secondary (MG)	BOD (mg/L)	TSS (mg/L)	TN (mg/L)
2017	6,591	6.6	15	8.5
2018	7,255	14	32	10.6
2019	7,336	8.6	17	9.1

Figure ES-3 presents the historic annual mass loading from the West Side WWTP. As presented, 2018 was a particularly challenging year due to the extreme rain events that occurred during that calendar year.

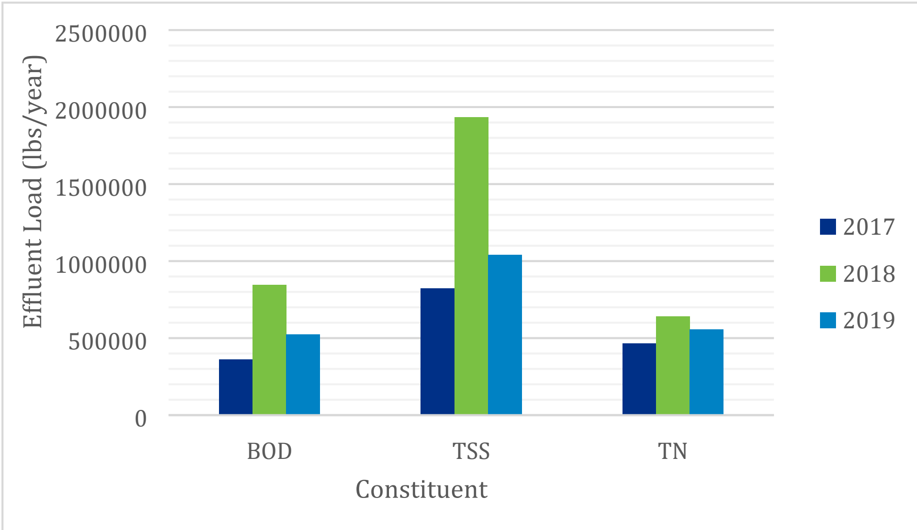

Figure ES-3
Historic Mass Loading from West Side WWTP (2017-2019)

Also, during this time period, the plant experienced between 20 and 33 secondary treatment bypass events per year, resulting in between 137 and 297 million gallons of primary treated effluent discharges from the WWTP as presented in **Table ES-4**. Plant performance suffers during these high flow events.

Table ES-4 West Side WWTP Secondary Treatment Bypass Events (2017-2019)

	Number of Bypass Events	Total Flow Bypassed (MG)
2017	20	137
2018	33	297
2019	29	235

ES.3.3.2 East Side WWTP

The East Side WWTP is located at 695 Seaview Avenue and discharges into Long Island Sound via Bridgeport Harbor. A portion of the collection system serving the East Side WWTP is also served by combined sewers. The East Side WWTP was originally designed as a primary treatment facility in the 1950s and then later between 1969 and 1971 was upgraded to secondary treatment. The East Side plant is a sister plant to the West Side plant consisting of similar unit processes: influent screening ahead of influent pumping, rectangular primary settling tanks, an activated sludge system modified to operate in an MLE mode, disinfection with sodium hypochlorite and gravity thickeners and a gravity belt thickener for sludge thickening. The plant effluent is discharge through a 60-inch outfall pipe at the shore of the Powerhouse Channel, a dead-end channel off the east side of the Pequonnock River in Bridgeport Inner Harbor. An aerial of the East Side WWTP Site is presented in **Figure ES-4**. As with the West Side plant, the East Side plant was modified for interim nitrogen reduction in the early 2000s and dechlorination added. Limited mechanical improvements have been made since that time and most equipment has reached its useful life.

Figure ES-4
Aerial of East Side Wastewater Treatment Plant

The East Side WWTP was also designed to achieve secondary effluent quality (30 mg/L BOD_5 and TSS) at annual average design flow capacity of 10 mgd and a peak secondary treatment capacity of 24 mgd. All wet weather flow in excess of the secondary treatment capacity, up to 40 mgd, was intended to receive primary treatment before recombining with secondary effluent prior to effluent disinfection. The most recent General Permit for Nitrogen Discharges defines the annual mass loading of total nitrogen for the East Side WWTP of 362 lb/day.

A review of plant data from 2017 through 2019 reveals an average influent flow of 5.7 mgd, about 43 percent less than the design flow of 10 mgd, and weak influent concentrations, typical of a combined collection system as presented in **Table ES-5**.

Table ES-5 East Side WWTP Influent Conditions (2017-2019)

	East Side WWTP
Average daily flow (mgd)	5.7
Biochemical oxygen demand (BOD_5) lb/day, (mg/L)	5,700 (120)
Total suspended solids (TSS) lb/day, (mg/L)	6,200 (131)
Total Kjeldahl nitrogen (TKN) lb/day, (mg/L)	1,200 (25.2)
Total phosphorus (TP) lb/day, (mg/L)	160 (3.4)

The East Side WWTP also suffers from aging, undersized and inadequate treatment processes, however, does a better job meeting permit limits since the influent flow is well below the design capacity. As with the West Side plant, the East Side plant suffers from ineffective screening and no in-line grit removal, aging and slightly undersized primary settling tanks, a secondary treatment system that was reconfigured to impart nitrogen removal, and inappropriately designed chlorine contact tanks. Although solids management is more effective at this facility, the East Side WWTP receives scum from the West Side plant which can overload this system. In addition, limited operational instrumentation and controls exist making operations and control even more difficult.

During the three-year period analyzed, the plant experienced a few permit violations related to effluent BOD_5, TSS, fecal coliform and enterococci. However, in general, the East Side plant does a commendable job meeting its permit limits. The plant was able to meet its waste allocation for total nitrogen removal all three years. The average annual effluent quality is presented in **Table ES-6** and annual loads presented graphically in **Figure ES-5**.

Table ES-6 East Side WWTP Average Final Effluent Quality (2017-2019)

	Total Flow Treated through Secondary (MG)	BOD (mg/L)	TSS (mg/L)	TN (mg/L)
2017	1,765	4.0	5.5	5.3
2018	2,064	4.7	6.8	5.7
2019	2,051	3.7	6.8	5.3

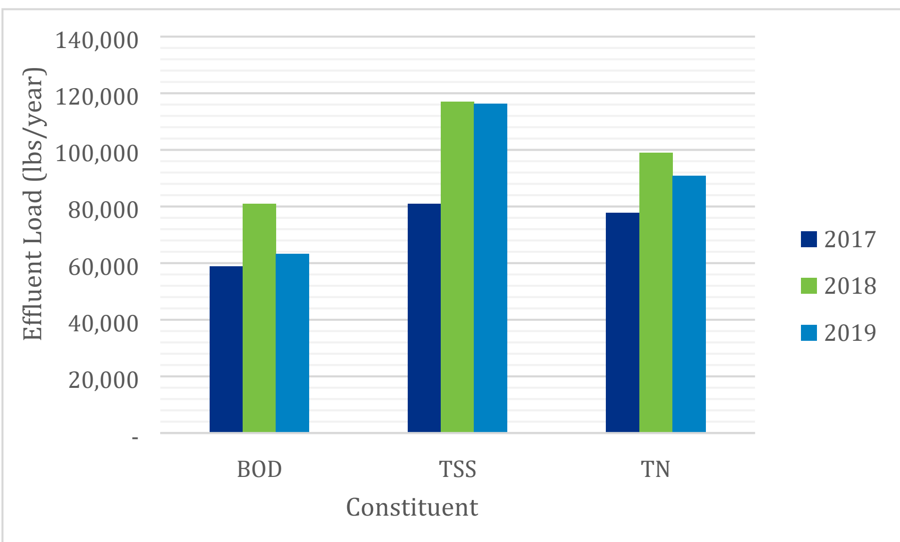

Figure ES-5
Historic Mass Loading from East Side WWTP (2017-2019)

Also, during this time period, the plant experienced 5 to 17 secondary treatment bypass events per year, resulting in between 12 and 38 million gallons of primary treated effluent discharges from the WWTP as presented in **Table ES-7**. The East Side plant does a better job managing solids through peak flow events.

Table ES-7 East Side WWTP Secondary Treatment Bypass Events (2017-2019)

	Number of Bypass Events	Total Flow Bypassed (MG)
2017	5	12
2018	17	38
2019	12	30

ES.3.4 Flood Protection

Due to the treatment plants' proximity to the Long Island Sound, tidal flooding occurs at both plant sites during intense storms and hurricanes. Tidal flooding is typically the result of several factors such as tidal fluctuation, intense rainfall (which cannot drain from the sites when tides are high) and wind driven coastal storm surge. In the case of Bridgeport, tidal floods are conveyed from Long Island Sound to the Cedar Creek and Bridgeport Harbor.

Currently the unit processes and equipment at both plants are subject to inundation during extreme flood events. In fact, under a current day 25-year flood event, the chlorine contact tank weirs are submerged at both plants, preventing flow from being discharged from the plant. In addition, numerous building openings are below the flood plain level allowing flooding of pump and piping galleries and basement levels in these buildings. Based on current CT DEEP standards, new and upgraded facilities shall be designed to pass the design flow during a 100-year flood elevation. In addition, critical processes and equipment shall be protected against a flood elevation of 100-year plus three feet, and non-critical processes and equipment protected against a flood elevation of 100-year plus two feet. The design flood elevations for both plants is presented in **Table ES-8**. These elevations were incorporated into the planning level concepts developed for this Facilities Plan.

Table ES-8 Flood Protection Criteria

	East Side Wastewater Treatment Plant	West Side Wastewater Treatment Plant
Uninterrupted Hydraulic Operation Flood Elevation (100-year flood)	27.60	26.60
Critical Process and Equipment Flood Elevation (100-year flood plus three feet)	30.60	29.60
Non-Critical Process and Equipment Flood Elevation (100-year flood plus two feet)	29.60	28.60

It is also important to understand rising sea level will result in increased frequency and duration of tidal inflow through the CSO structures, further warranting the need to repair or replace failing tide gates.

ES.4 Future Flows and Loads

ES.4.1 Average Future Flows and Loads

In order to ensure upgraded treatment facilities have the capacity to manage treatment plant flows through the design year of 2050, estimated future flows and loads were established for each plant based on existing conditions and estimated growth in the service area.

The population in Bridgeport has been essentially stagnant over the past decade with a total population of about 145,000 in 2010 per the United States Census. Per the WPCA and City of Bridgeport, the current population is 147,000 which will be used as the baseline population for 2020. Of the 147,000, 26 percent reside in the East Side WWTP's service area. Therefore, the service area population is estimated to currently be approximately 38,000 for East Side WWTP and 109,000 for the West Side WTTP.

Future population in Bridgeport was estimated to increase by about 9,150 over the next decade as noted in *Plan Bridgeport*, the Master Plan of Conservation and Development for City of Bridgeport, adopted on April 22, 2019. The same population increase used from 2020 to 2030 was used to project population to 2040 and 2050. This estimate, although conservative, will provide reserve treatment capacity.

Bridgeport currently also receives flow from neighboring towns. No additional inter-municipal sanitary flows were projected from Fairfield or Stratford, since currently only a limited number of homes along the town borders are served. Despite the lack of projected growth from Trumbull, the WPCA will plan for a future scenario in which the current daily average limit from Trumbull of 4.2 mgd is achieved. Any future growth or extension of the sanitary system which exceeds the allocation would need to be offset with corrective measures to reduce infiltration and inflow (I/I).

The Town of Monroe, located to the north of Trumbull, currently does not have a sanitary sewer system. However, per the Town's Plan of Conservation and Development, there is a desire to construct sewer along Routes 25 and 111 to provide sewer service for existing and future commercial businesses. The most logical interconnection would be with the Town of Trumbull and therefore would contribute flow to the West Side WWTP. While a connection has not yet been approved by Trumbull or Bridgeport, it was assumed that a connection would be made within the planning period.

Based on the expected growth within the service area the design year (2050) average daily influent flow and load for the two treatment facilities are presented in **Tables ES-9 and ES-10**, respectively. Also included in these tables is the expected loadings associated with the existing plant rating of 30 mgd on the West Side WWTP and 10 mgd on the East Side WWTP. In each case, the maximum flow through secondary treatment has been held constant with the existing capacity of 58 mgd on the West Side WWTP and 24 mgd on the East Side WWTP.

Table ES-9 Projected Design Year (2050) Average Influent Flow and Loads West Side WWTP

	2050	Existing Plant Rating
Average daily flow (mgd)	25.8	30.0
Biochemical oxygen demand (BOD_5), lb/day	35,000	40,000
Total suspended solids (TSS), lb/day	54,000	62,000
Total Kjeldahl nitrogen (TKN), lb/day	5,500	6,300
Total phosphorus (TP), lb/day	1,000	1,100

Table ES-10 Projected Design Year (2050) Average Influent Flow and Loads East Side WWTP

	2050	Existing Plant Rating
Average daily flow (mgd)	6.4	10
Biochemical oxygen demand (BOD_5) lb/day	6,400	10,000
Total suspended solids (TSS) lb/day	6,900	11,000
Total Kjeldahl nitrogen (TKN) lb/day	1,300	2,100
Total phosphorus (TP) lb/day	180	280

ES.4.2 Peak Plant Capacity

Given that both plants serve combined sewers in their respective service areas, peak flows are governed by rain events as well as the system capacity.

The existing West Side plant is rated for a wet weather flow of 90 mgd, however when assessing recent treatment plant influent flows supplemented by discussions with the plant operators it is apparent that for the most part, influent flow to the West Side plant is limited to about 80 mgd. This is achieved by partially closing the influent gates at the head end of the plant, to avoid flooding of the influent pumping station and/or washout of solids in the treatment system, which in turn surcharges the collection system.

As part of the Facilities Plan, the benefits of conveying more flow to the plant with the goal of reducing CSOs in the service area was investigated, since it is clear that the conveyance capacity in the collection system exceeds the treatment capacity at the plant. This is consistent with EPA's CSO Control Guidance Document which includes as one of the nine minimum controls "maximization of flows to the WWTP for treatment." The SWMM model was used to estimate the volume of CSOs at varying treatment plant capacities from 80 mgd to 200 mgd at the West Side plant during a 1-year, 24-hour frequency storm. All alternatives (apart from the validation condition) assumed a "best case" maintenance scenario for the collection system. Under these conditions, 160 mgd was able to be conveyed to the West Side WWTP during the 1-year, 24-hour design storm. Capacity alternatives exceeding this rate must be paired with the addition of upstream conveyance improvements (construction of new piping) in order to deliver higher peak flow to the West Side WWTP during the 1-year, 24-hour design storm. Note however, that higher flows could be conveyed under more extreme storm conditions. The resulting CSO volume at each West Side plant capacity is shown in **Figure ES-6**.

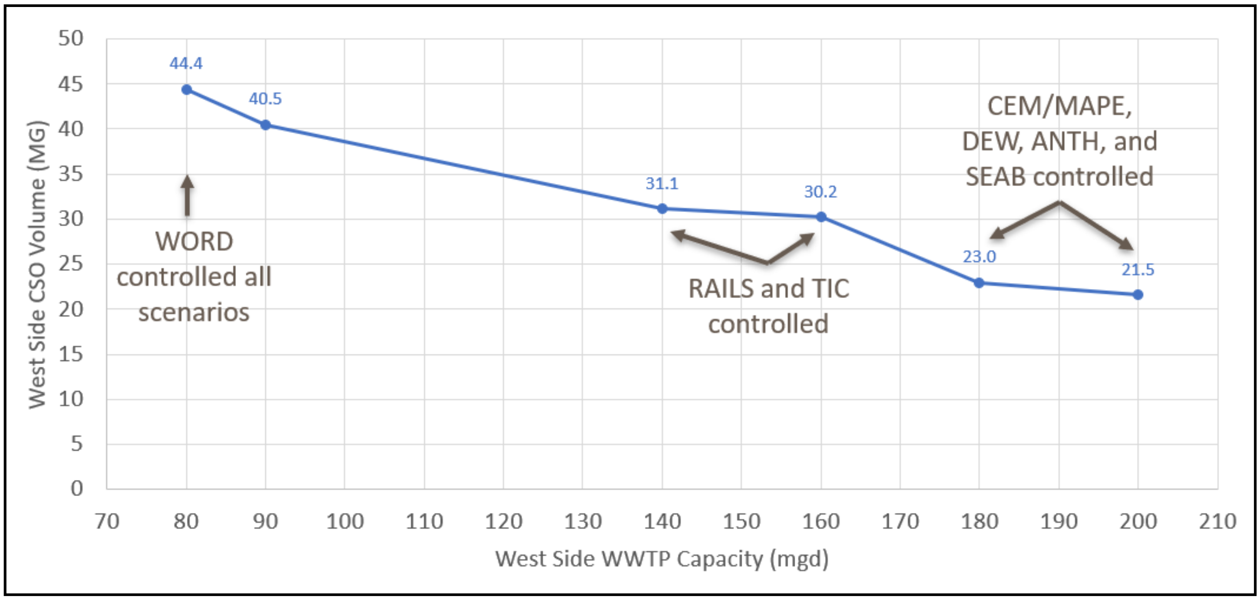

Figure ES-6
Simulated West Side WWTP Capacity vs CSO Volume during the 1-year, 24-hour Design Storm

As presented, increasing the West Side WWTP treatment capacity to 140 mgd, results in a reduction in CSO volume in a 1-year, 24-hour storm from 44.4 MG to 31.1 MG, or about a 30-percent reduction. Increasing the peak flow plant capacity to 200 mgd reduces the CSO volume by over 50-percent. More importantly, the CSOs discharging to the most sensitive receiving waters are controlled by increasing plant capacity. CSO WORD attains 1-year level of control in all modeled scenarios. CSOs RAILS and TIC achieve 1-year level of control when West Side WWTP wet weather capacity is increased to 140 mgd. CSOs CEM/MAPE, DEW, ANTH, and SEAB achieve 1-year level of control when West Side WWTP wet weather capacity is 180 mgd and higher, when paired with collection system improvements.

The existing East Side plant is rated for a wet weather flow of 40 mgd, but currently appears to be capped at 35 mgd. The benefits of conveying more flow to the East Side plant with the goal of reducing CSOs in the service area was also explored. Again, the SWMM model was used to estimate the volume of CSOs at treatment plant capacities of 35, 40, 60, and 80 mgd at a 1-year, 24-hour frequency storm. Under existing, “best case” conditions, 60 mgd was able to be conveyed to the East Side WWTP during the 1-year, 24-hour design storm. In order to convey 80 mgd to the East Side plant during the 1-year, 24-hour design storm the addition of upstream conveyance improvements (construction of new piping) is required. Note however, that higher flows could be conveyed under more extreme storm conditions. The resulting CSO volume at each East Side plant capacity is shown in **Figure ES-7**.

As presented, increasing the plant capacity to 60 mgd results in a 59% reduction in CSO volume and increasing the plant capacity to 80 mgd results in a 81% reduction in CSO volume, leaving only 1 MG left to be controlled during a 1-year, 24-hour event. Three of the six CSO regulators (DEAC, WANN, and STRAT) are controlled to the 1-year level with an 80 mgd treatment capacity.

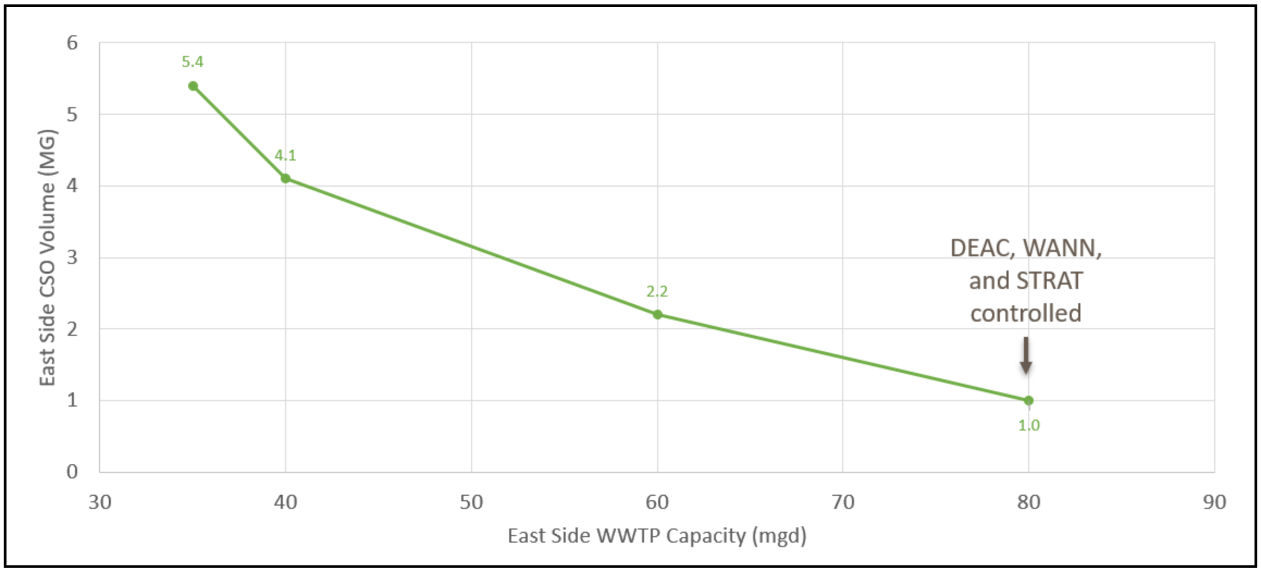

Figure ES-7
Simulated East Side WWTP Capacity vs CSO Volume during the 1-year, 24-hour Design Storm

The estimated range in cost for the collection system modifications referenced to allow for the conveyance of the 1-year, 24-hour storm event to the respective plants are presented in **Table ES-11.**

Table ES-11 Estimated Cost of Collection System Improvements to Increase Flow to WWTPs

Collection System Alternative	Estimated Project Cost $2020
ESP2: East Side WWTP to 80 mgd	$10-12 Million
WSP3: West Side WWTP to 180 mgd[1]	$20-60 Million
WSP4: West Side WWTP to 200 mgd[1]	$20-60 Million

Note: 1) WSP3 and WSP4 include the same collection system improvements, but vary in WWTP peak capacity

Based on this assessment, four different levels of wet weather treatment were considered for the West Side WWTP, and two different wet weather treatment capacities were considered for the East Side WWTP. The treatment capacities carried forward for further evaluation in this facilities plan are listed below:

- West Side WWTP: 90 mgd, 140 mgd, 180 mgd, and 200 mgd
- East Side WWTP: 40 mgd and 80 mgd

The baseline upgrades of 90 mgd at West Side WWTP and 40 mgd at East Side WWTP represent a return to the design peak capacity of the existing plants. These alternatives would be focused primarily on restoring the reliability of the treatment plants, rather than focusing on CSO reduction in the collection system. The capacities of 140, 180, and 200 mgd at the West Side WWTP, as well as 80 mgd at East Side WWTP were carried forward in the evaluation process to take advantage of the existing conveyance capacity of the collection system and strive for the maximum environmental benefit that could be provided through these treatment plant upgrades.

ES.5 Screening and Evaluation of Alternatives

ES.5.1 Screening of Alternatives

The development and preliminary screening of treatment process alternatives was based on our understanding and evaluation of the condition and needs of the existing facility and the CSO LTCP recommendations. The desire of the WPCA to treat wastewater efficiently and effectively, reduce CSOs, and increase the resilience of the system to assure the value of investment is central to the evaluation. For each unit process, the universe of alternatives was reviewed and screened to determine those most feasible options to carry forward for detailed evaluation and costing.

Concurrent to examining each of the treatment technologies, the collection and treatment systems were holistically assessed. This includes a review of the hydraulic capacity of the collection system, as discussed above, and the potential benefits of increasing wastewater treatment plant capacity to accept additional flow at the two plants, as compared to providing off-line storage in the collection system to reduce combined sewer overflows. Graphically the evaluation process is presented below in **Figure ES-8**. The initial assessment and screening of alternatives is undertaken for all treatment technologies, while concurrently considering opportunities for resource recovery, sustainable development, and community enhancement. Wastewater treatment plant concepts were finalized, and alternative scenarios built around viable treatment plant capacities. These alternatives are integrated with system recommendations developed as a part of the Long-Term Control Plan, ultimately resulting in the Recommended Plan.

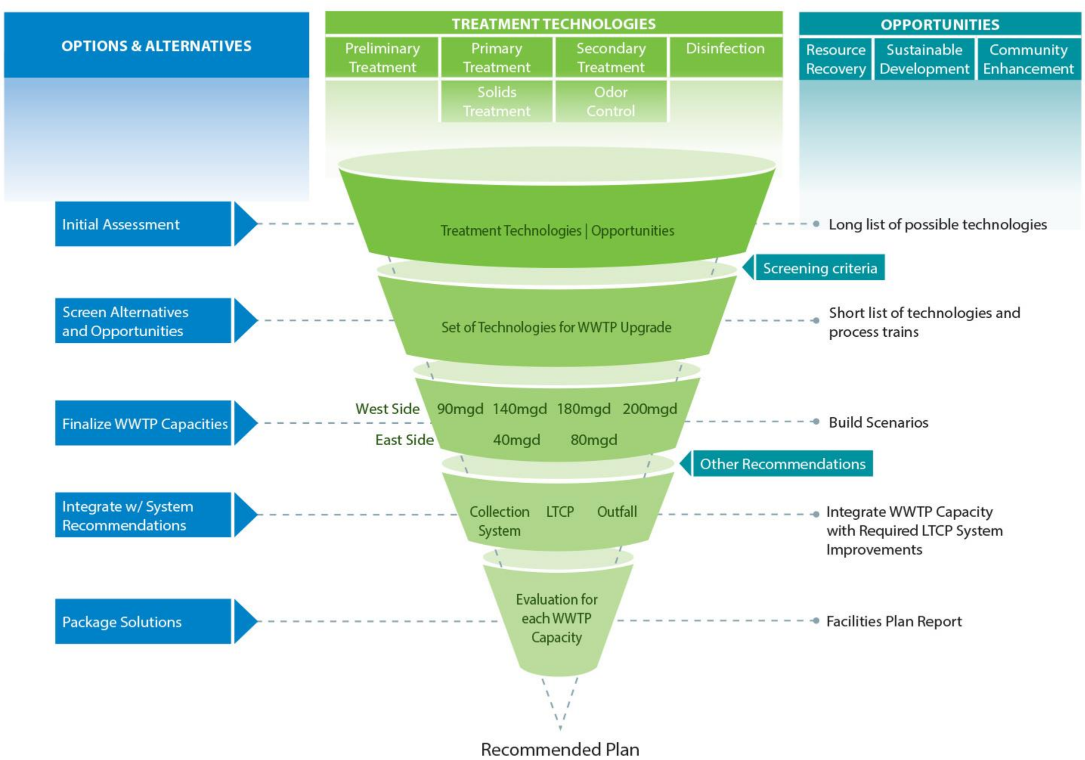

Figure ES-8
Evaluation Process

The list of technologies evaluated for each unit process as well as those alternatives carried forward from the screening process and those ultimately recommended are presented in **Figure ES-9.**

Figure ES-9
Treatment Technologies Screened and Recommended

Alternative site layouts using various combinations of treatment technologies under varying peak flow scenarios were developed. Treatment trains were developed to depict both conventional treatment technologies that can be more land intensive, and more innovative treatment technologies that result in a more compact site. Some alternatives include a separate treatment train to treat peak wet weather flows, while others provide dual-use primary treatment alternatives to be used in both dry weather and wet weather conditions. The alternatives assessed present some common features typically related to the preliminary treatment, disinfection, and residuals management, with the variation in alternatives portrayed in the varying primary and secondary treatment trains.

For the West Side WWTP four peak flow scenarios were assessed and a total of thirteen different liquid treatment trains:

- Four (4) – 90 mgd treatment train options (the current peak flow of the existing facility), Options W-90A through W-90D
- One (1) – 140 mgd treatment train option (an intermediate flow which provides a reasonable reduction in CSOs), Option W-140A
- Five (5) – 180 mgd treatment train options (doubling the current peak capacity and providing significant CSO reductions), Options W-180A through W-180E, and
- Three (3) – 200 mgd treatment train options (peak capacity analyzed), Options W-200A through W-200C

For the East Side WWTP two peak flow scenarios were assessed and a total of eight different liquid treatment trains:

- Four (4) – 40 mgd treatment train options (the current peak flow of the existing facility), Options E-40A through E-40D
- Four (4) – 80 mgd treatment train option (doubling the current peak capacity and providing significant CSO reductions), Options E-80A through E-80D

In all cases, a new headworks would be constructed to dramatically improve the removal of screenings and grit at the head end of the plant thereby improving downstream operations and maintenance and to increase the efficiency and reliability of influent pumping. Both coarse screens, ahead of the influent pumps, and fine screens subsequent to the influent pumps would be provided with screenings washer compactors to reduce the volume and weight of screenings to be disposed of and to reduce the odors associated with this material. Grit removal would be provided with the novel stacked tray grit removal system which has the smallest footprint and removes the most grit from the treatment process. Grit washer/classifier would be provided to reduce the organics in the grit removed and thus reduce odors associated with the product taken to landfill.

While alternatives using conventional primary settling tank present some distinct benefits in terms of experience in the industry, the sheer size of the process, as compared to other alternatives assessed makes this technology particularly challenging if not impossible to site within the footprint of the existing plant. As the treatment plant peak capacity is increased, conventional primary settling tanks become virtually unfeasible. Chemically enhanced primary treatment was assessed at the East Side plant within the existing primary clarifiers, however, was discounted due to its heavy reliance on chemical (coagulant and a polymer) usage for treatment of elevated flows and potential incompatibility with ultraviolet (UV) disinfection. High rate clarification is commonly used as a standalone wet weather treatment system and was investigated herein for that purpose but also as a dual-use primary treatment system, which is less common. The need for chemical and polymer addition and the mechanically intensive nature of the system made this option less favorable. Cloth media disk filtration was selected as the preferred alternative for primary treatment at all flow scenarios at both plants. In addition to having the smallest footprint of all primary treatment systems analyzed, it can function as a single, dual-use dry and wet weather process by varying the number of filter units in service, simplifying operations. In addition, it will produce a high quality primary effluent that will (1) reduce the loading on the downstream biological nutrient removal (BNR) process without chemical addition, (2) minimize loadings to the receiving water when the secondary system is bypassed, and (3) enable UV disinfection for all flows. The system can be fully enclosed facilitating maintenance, controlling odors and reducing visual impacts. Lastly, the primary sludge generated is a high-value biosolid for future energy production.

Because cloth media filters are a relatively new technology for use in primary treatment and high flow management applications, an onsite pilot study of the technology is recommended to establish design criteria to be used in preliminary design and to confirm system performance. It should be noted, the technology has been used for over two decades for tertiary treatment.

Of the secondary treatment/nutrient removal alternatives evaluated, the Integrated Fixed-Film Activated Sludge (IFAS) system is deemed most advantageous for the West Side WWTP due to a combination of site utilization and neighborhood impacts, energy efficiency, and ease of operations and maintenance. The IFAS alternative also has the lowest present worth of the alternatives evaluated. Implementation of the IFAS system includes upgrading the existing bioreactors to operate as a four-stage bardenpho system (pre-anoxic, aeration, post-anoxic, re-aeration) with internal recycle pumping and IFAS cassettes installed in the aeration zone. New aeration blowers would be provided, and all new mechanical equipment would be provided in the secondary clarifiers including sludge and scum collection equipment and return and waste activated sludge pumping. For the East Side plant, the bioreactors would be upgraded to operate in a four-stage bardenpho mode, and secondary clarifiers would be upgraded. IFAS is not required at the East Side plant to achieve the desired total nitrogen (TN) limits. In both cases, supplemental carbon storage and feed system would be provided to enhance TN removal.

Ultraviolet irradiation is the recommended alternative for disinfection at both plants, again primarily because of the space saving attribute offered by this alternative as compared to disinfection with sodium hypochlorite within a chlorine contact tank. Effluent pumping would be provided to pump the extreme flows through the plant under extreme tidal conditions. At the West Side WWTP, the existing outfall will be maintained and cleaned and lined to extend the useful life. Extension of the West Side plant outfall is a significant cost, permitting endeavor and not currently required for NPDES permit requirements so it is recommended that this project be deferred until the impacts of the improved treatment systems on water quality in the inner harbor can be assessed. At the East Side WWTP, the outfall terminus could be extended to the seawall facing Bridgeport Inner Harbor to improve dispersion of the effluent, however, this is not required to meet NPDES standards. The cost-benefit of this option will be further investigated during preliminary design.

Figure ES-10 and ES-11 present the general flow schematic of the recommended liquid treatment train for the West Side and East Side WWTPs, respectively.

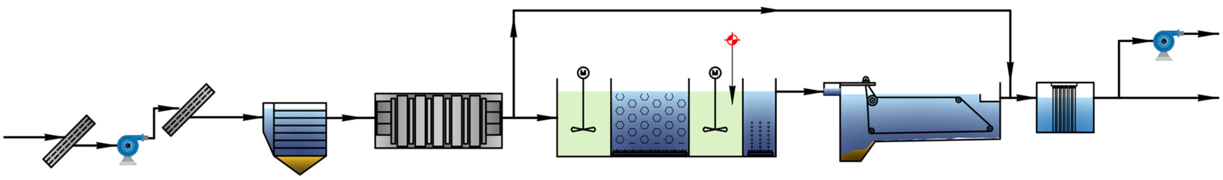

Figure ES-10
West Side WWTP Liquid Treatment Flow Schematic

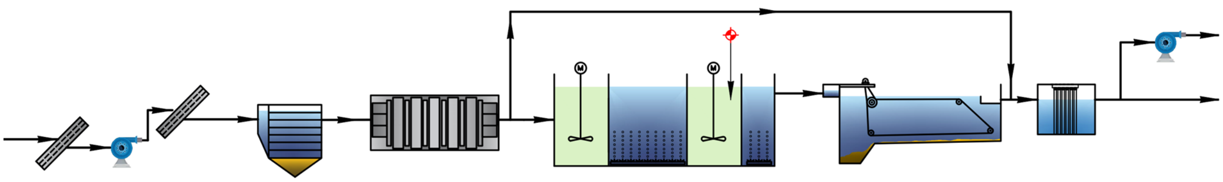

Figure ES-11
East Side WWTP Liquid Treatment Flow Schematic

With respect to biosolids management, options for thickening, dewatering and stabilization were assessed. Both plants currently thicken primary sludge in gravity thickeners. The West Side plant now thickens waste activated sludge (WAS) with a rotary drum thickener, and the East Side plant thickens WAS on a gravity belt thickener. Thickened sludge is hauled off-site for disposal. Moving forward, in the near term, it is recommended that primary sludge continue to be thickened on new (West Side WWTP) or upgraded (East Side WWTP) gravity thickeners. It is also recommended that the WAS be thickened using rotary drum thickeners. Because of the significant investment required on the liquid treatment train, and the limited space available on-site, it is recommended that biosolids continue to be hauled off-site for disposal.

New odor control systems would be provided at each facility to contain and treat odorous off-gases from the new headworks facility, primary treatment, and sludge processing. It is likely that biofilters and/or chemical scrubbers will be incorporated for this purpose, however, preferred technology will be further assessed in preliminary design.

In addition to the process improvements at both plants it is expected that a complete overhaul of the electrical system and instrumentation and controls is warranted to bring the facility up to current code and standards. New administration/maintenance/laboratory facilities will be provided at each plant. Opportunities to provide a visitors' center at the West Side plant with educational materials are being pursued.

The estimated project cost of the most favorable wastewater treatment plant upgrade and expansion options are presented in **Table ES-12.**

Table E-12 Estimated Project Cost of Most Feasible WWTP Alternatives

Item	West Side WWTP			East Side WWTP	
	W-90B Dual Use Primary Filter & IFAS	W-180D Dual Use Primary Filter & IFAS	W-200C Dual Use Primary Filter, IFAS, 200 MGD UV	E-40C Dual Use Primary Filter & 4-Stage	E-80D Dual Use Primary Filter & 4-Stage
Site Work & Yard Piping	$ 33,400,000	$ 34,000,000	$ 34,100,000	$ 27,000,000	$ 29,400,000
Demolition	$ 9,400,000	$ 9,300,000	$ 9,400,000	$ 7,800,000	$ 7,900,000
Headworks	$ 53,800,000	$ 86,900,000	$ 97,100,000	$ 38,300,000	$ 49,300,000
Primary Treatment	$ 41,900,000	$ 56,500,000	$ 63,900,000	$ 27,800,000	$ 33,900,000
BNR	$ 44,900,000	$ 44,800,000	$ 45,000,000	$ 7,800,000	$ 7,900,000
Final Settling	$ 9,400,000	$ 9,300,000	$ 9,400,000	$ 7,500,000	$ 7,500,000
Disinfection	$ 11,900,000	$ 20,300,000	$ 22,300,000	$ 8,000,000	$ 13,400,000
Effluent Pumping Station	$ 11,100,000	$ 14,800,000	$ 16,700,000	$ 8,200,000	$ 13,200,000
Solids Processing	$ 41,200,000	$ 41,100,000	$ 41,200,000	$ 21,000,000	$ 21,100,000
Odor Control	$ 7,900,000	$ 7,900,000	$ 7,900,000	$ 4,500,000	$ 4,500,000
Site Electrical	$ 18,000,000	$ 21,800,000	$ 21,900,000	$ 16,600,000	$ 19,200,000
Control Building	$ 14,100,000	$ 14,100,000	$ 14,100,000	$ 7,700,000	$ 7,700,000
Total Project Cost	**$ 297,000,000**	**$ 361,300,000**	**$ 383,000,000**	**$ 182,000,000**	**$ 215,000,000**

Notes

- Costs inclusive of all contractor overhead, profit, and contingency and engineering fees.
- Costs escalated to the midpoint of construction.
- Overall Project Contingency carried is 10%. Typical contingency ranges from 10% to 25%.

The site layouts for the most favorable treatment options for three alternative flow capacities for the West Side plant are shown on **Figure ES-12. Figure ES-13** presents the site layouts for the most favorable 40 and 80 mgd options for the West Side plant.

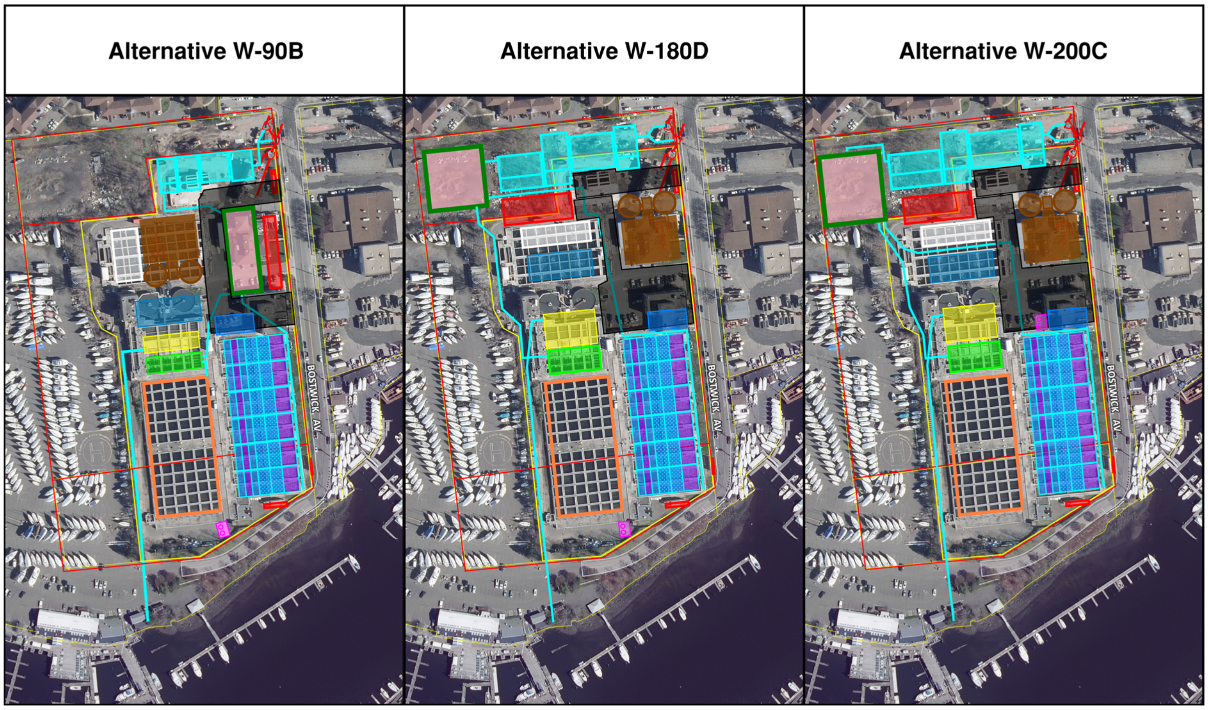

Figure ES-12
Most Favorable Treatment Options for 90, 180 and 200 mgd, West Side WWTP

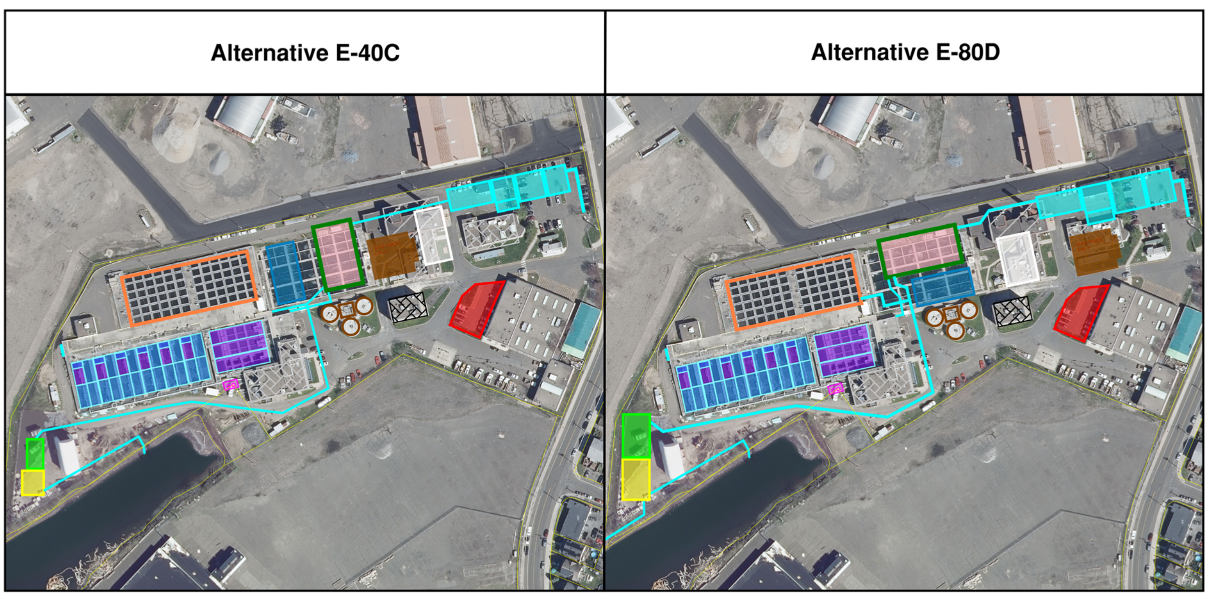

Figure ES-13
Most Favorable Treatment Options for 40 and 80 mgd, East Side WWTP

As presented, there is a clear economy of scale achieved in the treatment plant costs when capacity is increased, however, as shown, the footprint of the plant expands into some of the open space surrounding the plant, particularly on the West Side plant site. The benefits of the increased plant capacity can be assessed in terms of:

- Timing of CSO Reduction
- Reduced Cost of CSO Reduction
- Environmental Benefits associated with CSO Reduction and Improved Treatment

ES.5.2 West Side WWTP Evaluation

As presented, the West Side WWTP was designed to accept a peak flow of 90 mgd and treat 58 mgd through secondary treatment with the balance of flow receiving primary treatment and disinfection prior to discharge. Today, the plant typically can only accept between 80 to 85 mgd during storm events, so operators “choke” the influent gates to limit flow into the plant when flows are high. This then surcharges the collection system and results in increased volume of CSO discharges.

Collection system modeling has shown that today, if no improvements were made in the collection system, up to 160 mgd could be conveyed to the West Side plant during a 1-year, 24-hour storm event. Peak flows upwards of 180 to 200 mgd can be conveyed in storms greater than the 1-year, 24-hour design storm. This illustrates that higher flow capacity WWTP options will be utilized and can be effective prior to construction of collection system improvements. With conveyance system improvements, and a treatment capacity of 180 to 200 mgd, seven of the 22 CSO regulators within the West Side service area are controlled during the 1-year, 24-hour event, resulting in a reduction in CSO volume by 22.9 MG, over 50 percent. The controlled CSOs are those in close proximity to the plant that discharge into the most sensitive receiving waters: WORD, RAILS, TIC, CEM/MAPE, DEW, ANTH and SEAB. Five of these regulators are shown in **Figure ES-14**. The control of these CSOs through treatment plant expansion and collection system capacity improvements would preclude the need to construct off-site storage at the Ash Creek and Ellsworth Park sites as identified in the 2011 CSO LTCP.

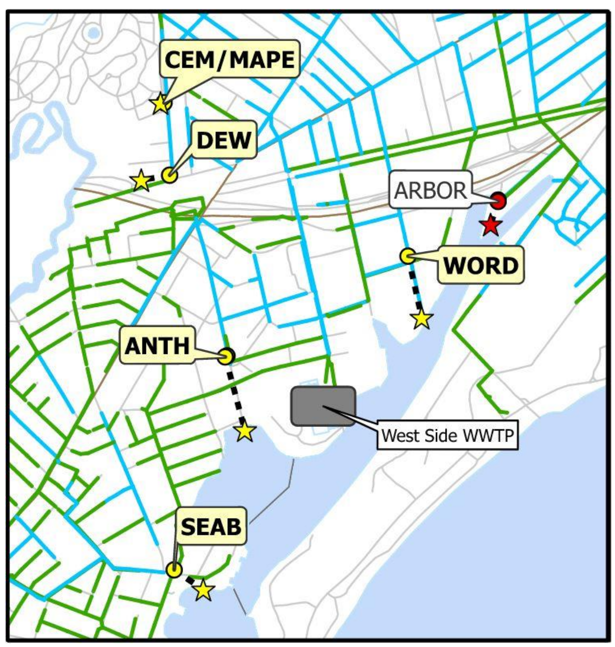

Figure ES-14
CSOs Controlled with Increased Capacity at West Side WWTP

On an annual basis, using the three years of historic data as a guide, about 55 MG reduction in CSOs would be expected at West Side in a typical year and over 80 MG in a wet year with the expanded treatment plant capacity. Much of this reduction comes through the reduction of CSOs designated ANTH and ARBOR, which are responsible for the highest volume of CSOs in a 1-year, 24-hour event.

By capturing these CSOs and sending flow to the treatment plant, the overflows which would have been discharged untreated, resulting in the discharge of trash, floatables, bacteria and solids, are instead sent through screening, grit removal, primary filtration and disinfection dramatically improving the water quality in the receiving waters.

In addition, the reduction in CSOs will be measurable immediately after the upgraded and expanded treatment facility is put into service, whether or not additional collection system improvements are implemented.

ES.5.3 East Side WWTP Evaluation

The East Side WWTP was designed to accept a peak flow of 40 mgd and treat 24 mgd through secondary treatment with the balance of flow receiving primary treatment and disinfection prior to discharge. Today, the plant typically can only accept about 35 mgd during storm events. The influent gates ahead of the pumping station are throttled to limit flow into the plant when flows are high. This then surcharges the collection system and results in combined sewer overflows.

Collection system modeling has shown that today, if no improvements were made in the collection system, up to 60 mgd could be conveyed to the East Side plant during a 1-year, 24-hour storm event. Peak flows upwards of 80 mgd can be conveyed in storms greater than the 1-year, 24-hour design storm. This illustrates that higher flow capacity WWTP options will be utilized and can be effective prior to construction of collection system improvements. With conveyance system improvements, and a treatment capacity of 80 mgd, three of the six CSOs in the East Side service area are controlled during the 1-year, 24-hour event, resulting in a reduction in CSO volume of 4.4 MG, over 80-percent, with the CSOs responsible for the highest discharges (DEAC, WANN and STRAT) being controlled.

On an annual basis, using the three years of historic data as a guide, between 13 and 15 MG reduction in CSOs would be expected at East Side representing a reduction of 35 to 45 percent in volume.

ES.5.4 Project Funding

The design and construction of WWTP improvements to address the aging infrastructure and accommodate future flows and loadings are eligible for grant/loan funding through Connecticut's Clean Water Fund (CWF). This program, administered by DEEP, has long provided financial assistance to Connecticut municipalities for projects addressing wastewater needs. Primary sources of funding for the CWF programs are state revolving fund revenue bonds and state general obligation bonds as managed by the Office of the State Treasurer, and federal capitalization grants through the Clean Water Act with annual appropriations through the U.S. Environmental Protection Agency (EPA). General improvements to address deficiencies and aging infrastructure are eligible for a 20 percent grant, nitrogen reduction facilities are eligible for a 30 percent grant, CSO reduction components are eligible for a 50 percent grant and the balance of project costs are eligible for a 2 percent 20-year loan.

DEEP has issued guidance documents for the nitrogen and CSO funding so that a clear and consistent methodology is used in determining CWF grant percentages. The guidance includes: *Clean Water Fund Memorandum 4 (CWFM-4) – Thirty percent (30%) Grant for construction costs related to BNR removal* and *Clean Water Fund Memorandum 2015-002 (CWFM-2015-002) – fifty percent (50%) Grant/Loan Eligibility for Combined Sewer Overflow and twenty percent (20%)*

Grant / Loan for General Treatment Plant Projects. Applying the various component eligibility criteria yields project grant eligibility ranging from about 21 to 23 percent for the baseline upgrade projects (i.e. no CSO capacity increase), and 30 to 40 percent for the expanded treatment capacity alternatives. To represent conservative assumptions for the financial capability analysis presented, assumed aggregate grant percentages of 21 percent (for non CSO capacity increases) and 30 percent (for alternatives with CSO capacity).

As the plant size increases, more costs are associated with CSO management and therefore provide a benefit in the reduction in the share of the cost by the WPCA. This variation in the assumed aggregate grant percentages between the higher flow and baseline flow WWTP alternatives reduces the cost differential to construct a WWTP for a higher peak flow. The fraction of the cost to be paid by the WPCA for the low and high flow alternatives becomes closer, and the high flow plant alternatives provide a significant CSO benefit not seen with the lower flow options.

Due to the estimated aggregate grant percentages presented previously**,** the anticipated costs to the WPCA of the high flow WWTP upgrade options (W-200C, E-80D) are cost competitive with the lower flow WWTP upgrade options (W-90B, E-40C). This is due to an increased fraction of CSO CWF grant percentage as described in DEEP guidance documents.

Upgrading both the West Side and East Side WWTPs to higher wet weather is expected to substantially reduce the estimated $496 million (2020 dollars) investment required in the collection system to completely control CSO in the 1-year, 24-hour storm.

ES.5 Financial Capability

Based on the technical evaluation, the most desirable options were carried forward to evaluate the financial impacts of the wastewater treatment plant upgrade and the CSO improvement program on the users and rate payers. The financial assessment detailed in the Facilities Plan used the framework developed by the EPA in *Combined Sewer Overflows — Guidance for Financial Capability Assessment and Schedule Development*, published in February 1997 and modified in November 2014. The intent is to assess the affordability of the WPCA's capital improvement programs. The first phase of the EPA financial capability assessment estimates the impact of anticipated capital improvements and operating costs on the average residential ratepayer by evaluating the household burden. The household burden is an EPA defined metric that assesses the typical residential sewer bill as a percent of a community's median household income (MHI). Under the EPA guidance process, a household burden exceeding 2 percent of MHI is deemed a high burden.

The second phase of the EPA process details financial impact indicators, which are benchmarks defined by the US EPA. These indicators evaluate ancillary factors that may influence an entity's ability to fund the proposed capital plan.

The two financing projections used in the analysis are as follows:

- The WPCA (through the City of Bridgeport) issues bonds for all capital. It is assumed that General Obligation (GO) debt will be issued with an average interest rate of 5.0 percent and a 20-year amortization period.

- State Revolving Fund (SRF) loans will be executed with a 2.0 percent interest rate for a 20-year amortization period. Many of the capital items to be financed are eligible and are assumed to receive state grants that will reduce the debt financed requirement by between 20 and 50 percent depending on the type of project.

Four distinct alternative capital plans were assessed:

- Baseline. This assumes no WWTP upgrade or LTCP spending. The baseline alternative assumes capital spending allowances for ongoing renewal and replacement of existing infrastructure. The capital spending carried in the baseline alternative is included in all other alternatives. The remainder of the expenses for the Facilities Plan ($1.4 million) is assumed to be covered through grants. The Combined Sewer Overflow Project H3 is anticipated to be 50% grant funded, 50% financed through SRF loans. The remainder of the capital spending for the baseline alternative is either cash funded or assumed financed though GO debt.

- 90/40 Consent Order Schedule. These two alternatives (with and without CWF grant and loans) follow the capital plan detailed in the existing consent order schedules and assume that the two WWTPs would be constructed to match their current capacities (90 mgd at the West Side plant and 40 mgd at the East Side plant). This analysis shows the impact of assuming full eligibility for SRF and state grants, as well as the impact of assuming all city GO debt to finance the program.

- 200/80 Staggered Schedule. In this alternative the West Side plant would be upgraded followed by the East Side plant. Additionally, the wet weather treatment capacity of both plants would be increased to provide a significant CSO reduction benefit. The West Side WWTP capacity would be increased to 200 mgd and the East Side plant capacity would be increased to 80 mgd. Collection system improvements would be included to address the Ash Creek and Ellsworth Park consent order.

Based on the Phase 1 and Phase 2 evaluations presented in the Facilities Plan, completing projects on the current Consent Order schedules will put a high burden on the sewer rate payers in Bridgeport per current EPA guidance. The City has and continues to experience economic stress as evidenced by the relatively low-income growth over the past 20 years and the very high poverty rate. The City will face a significant financial challenge implementing any significant capital program as contemplated herein. This problem is intensified if the WPCA were forced to self-fund the projects.

Staggering the design and construction of both treatment plants, with the Ash Creek and other collection system improvements, while increasing plant capacity to cost-effectively mitigate CSOs, is projected to keep sewer rates below EPA's 2 percent of MHI high burden, but only if Clean Water Fund assistance is available in the form of 2 percent loans and grant funding per the current programs. Even with such assistance, the magnitude of the required rate increases is anticipated to present major financial challenges for the WPCA and is expected to result in an average annual rate increase of 7.9 percent in the first 10 years with multiple years of double-digit rate increases. If CWF assistance is not available in the amounts assumed in this report, the financial capabilities of the WPCA, and the schedule for completion of the recommended projects, will need to be re-evaluated.

ES.6 Recommended Plan

Based on the analysis summarized above, Option W-200C and Option E-80D are carried forward as the recommended plans for WWTP upgrade and expansion. These alternatives provide cost-effective treatment systems, in conjunction with holistic, cost-effective measures to control CSOs in the City by eliminating or reducing in size the remote facilities in the system as planned in the 2011 LTCP. By increasing plant capacity, additional flow can be conveyed to each facility for treatment. This benefit occurs immediately at plant start up and doesn't require the in-system improvements identified, although these improvements would further increase the flow that can be conveyed to the treatment facility. By providing the hydraulic capacity at the plant, as system improvements are implemented the higher peak flows could be accepted. It is recommended that subsequent to the startup of the expanded treatment facilities, additional system flow monitoring be undertaken to further refine system modeling and calibration, to determine the necessity and scope of further collection system improvements to control CSOs. For the West Side and East Side WWTPs recommended plans, conceptual site layouts were developed and are presented in **Figures ES-15** and **ES-16**.

ES.6.1 Project Costs

The Opinions of Probable Construction Cost (OPCC) for the WWTP improvements were developed and include expected labor, material and equipment costs, contractor's overhead and profit, a 25 percent construction contingency, a 22 percent allowance for design and construction phase engineering services, and a 10 percent overall project contingency. Finally, a 3.0 percent per year price escalation allowance was included through the expected midpoint of construction. **Table ES-13** presents the estimated Program Costs. An assumed grant percentage of 30% is carried herein, but this will be further refined as the projects develop.

Table ES-13 Estimated Program Costs

	West Side WWTP	East Side WWTP
Total Project Cost	**$383,000,000**	**$215,000,000**
Assumed Grant Percentage	30%	30%
Total Grant Amount	$115,000,000	$64,000,000
WPCA Contribution	$268,000,000	$151,000,000

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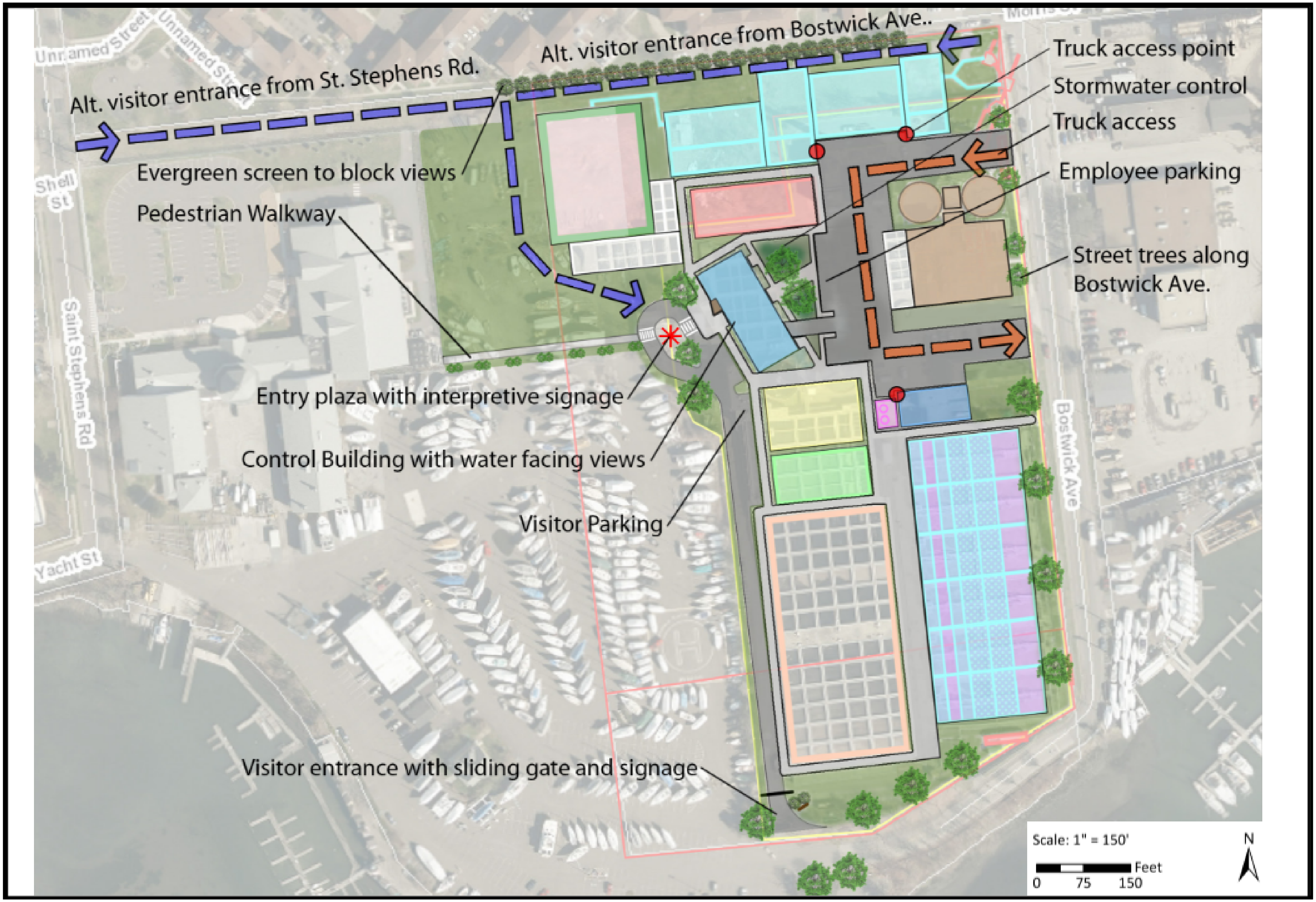

Figure ES-15
200 mgd West Side WWTP
Conceptual Site Plan

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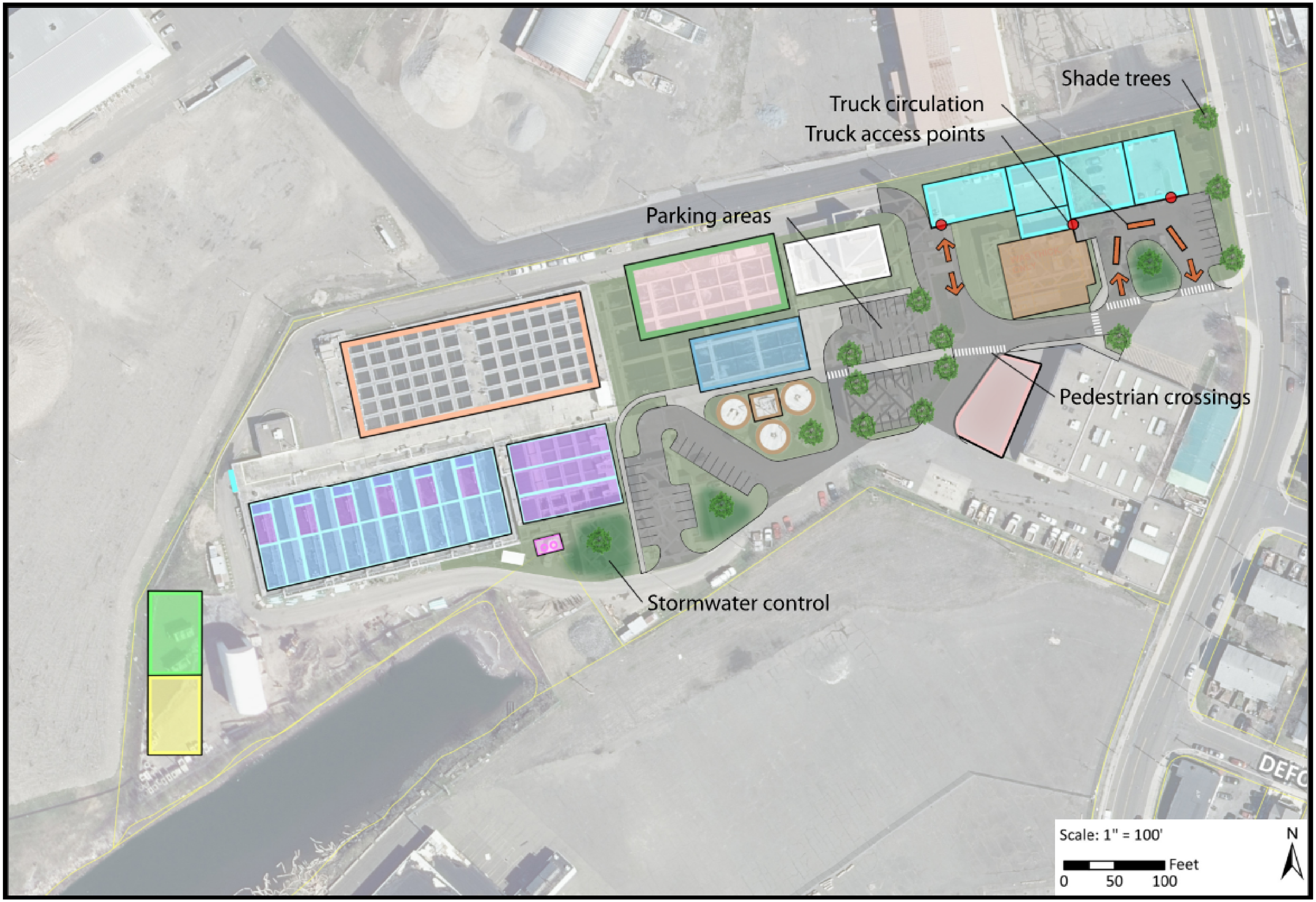

Figure ES-16
80 mgd East Side WWTP
Conceptual Site Plan

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ES.6.2 Program Schedule

As presented, the WWTP Administrative Order requires 100 percent complete design plans and specifications be submitted for both the wastewater treatment plant upgrades be submitted on or before May 31, 2022. The Administrative Order goes on to require that construction of the upgrades commence no later than August 2023, and construction shall be complete no later than August 2026. Based on the information presented in this Facilities Plan, the WPCA requests a modification to the design and construction project schedule to accommodate the significant amount of work that is necessary to mitigate current issues at both plants and the significant impacts on sewer use rates to the citizens of Bridgeport.

First, it is proposed that the design and construction of the two facilities occur sequentially, versus concurrently as presented in the Administrative Order. All previous projects, whether large or small, conducted for the WPCA occurred sequentially to enable the limited resources at the WPCA to provide adequate and timely input and review of the design documents and construction issues, and to better manage the costs incurred by the WPCA. It is proposed that the construction at the West Side plant commence first, followed by the construction at the East Side plant. The sequential construction also helps reduce the impact to rate payers.

Second, because of current difficulties securing SRF funding for design, it appears that the design start will be delayed. Previously, a December 2020 start date was anticipated.

Lastly, the Administrative Order proposed a three-year construction duration. Given the complexity of the improvements, especially regarding maintenance of plant operations during construction and the need to get certain systems up and running before others can be decommissioned and demolished to make room for new facilities, a minimum 40-month construction schedule will be necessary.

Based on these factors, a revised schedule is presented in **Figure ES-17** below. As presented, the West Side WWTP upgrade and expansion will be completed one year after the original construction date presented in the Administrative Order. The East Side WWTP will be completed by the end of 2029. Achieving these milestones will require SRF funding in addition to timely reviews and approvals of submittals by the CT DEEP.

With respect to the LTCP milestones, it is recommended that the construction of CSO reduction projects, beyond the Ash Creek and Ellsworth improvements, be delayed until the benefits of increased treatment capacity can be further assessed through collection system metering efforts.

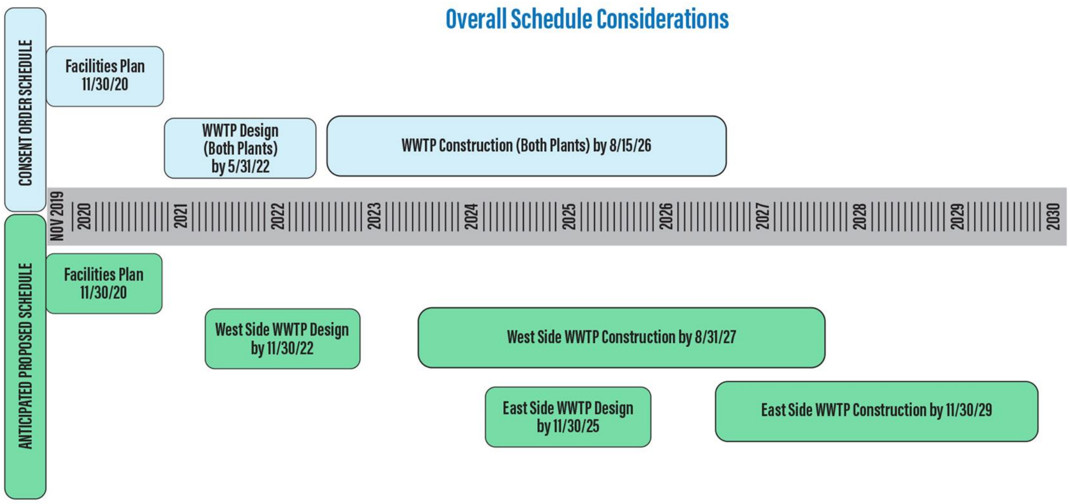

Figure ES-17
Revised Implementation Schedule

The CSO reduction provided by the proposed revised implementation schedule versus the current CSO consent order schedule is presented in **Figure ES-18.** Although construction of the West Side and East Side WWTPs is proposed to be completed sequentially rather than concurrently, the CSO benefit of upgrading both WWTPs as recommended is still substantial. CSO volume discharged in the 1-Year, 24-Hour storm is approximately halved upon completion of the West Side WWTP upgrade project, whereas in the existing CSO consent order schedule, much of the CSO benefit is not seen until the completion of the CSO storage tunnel a decade later.

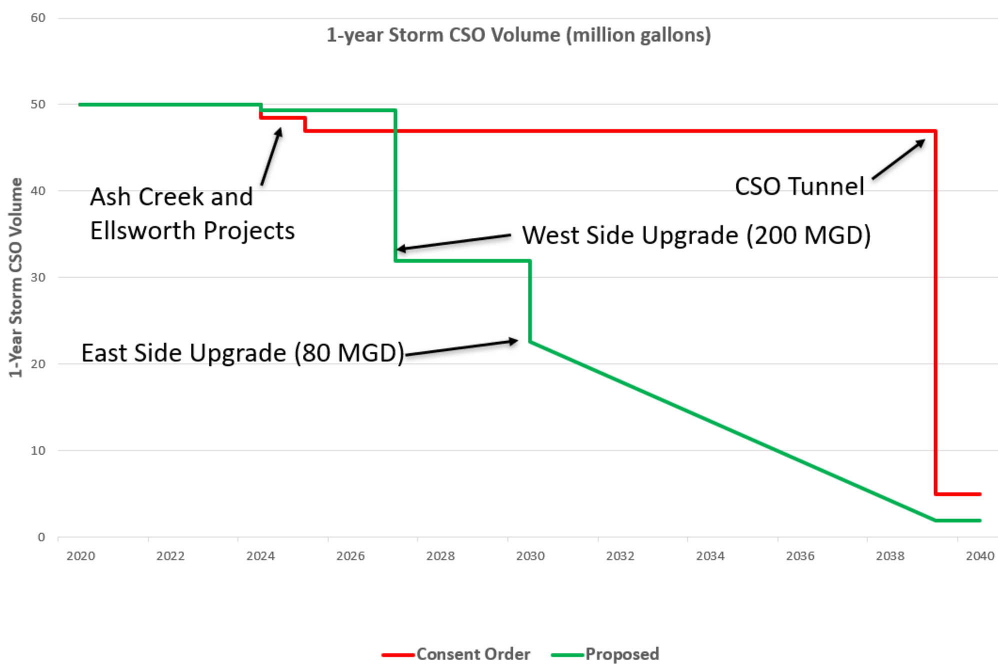

Figure ES-18
Recommended Schedule – CSO Reduction in 1-Year, 24-Hour Storm