Section 9

Recommended Plan Development

9.1 West Side Wastewater Treatment Plant

9.1.1 Recommended Plan

Based on the analysis presented in Sections 7 and 8, moving forward with a new upgraded and expanded wastewater treatment plant (WWTP) at the West Side plant site with the capacity to pass a peak flow of 200 million gallons per day (mgd), provides the most cost-effective, holistic approach to wet weather management while providing a facility that is robust and resilient to future conditions.

In general, the recommended facility for the West Side WWTP consists of a new headworks facility, capable of treating a peak flow of 200 mgd, constructed on the parcel north of the existing fence line. Flow would be redirected from the two existing influent structures via 72-inch pipes to the new headworks facility. Septage would be introduced upstream of the new headworks. Options will be evaluated during design to include flow metering, for billing purposes, of received septage. Four new multi-rake screens with one-inch bar spacing would be provided (three operating with one standby at peak flow) ahead of the influent pumps for pump protection. Under average flow conditions, only one screen would be operational. Two screenings washer compactors would be provided discharging to a roll-off container at grade. Screened influent would pass to a trench-style wet well. Seven identical centrifugal pumps (six operating with one standby at peak flow) would be provided. During design, alternative pump schemes will be reviewed to optimize pumping efficiency under average flow conditions which could result in providing smaller “jockey” pumps to operate during average and low flow conditions. Pump motors would be set at an elevation to protect them from flooding at the 100-year plus three feet elevation. Influent flow would be pumped to approximately elevation 40.0 to allow gravity flow through the entire plant under average conditions. Influent flow measurement would be accomplished by magnetic flow meters installed on the pump discharge. Pumped flow would first flow through a set of fines screens with ¼-inch bar spacing. Five fine screens would be provided (four operating with one standby at peak flow). Again, only one screen would be required under average flow condition. Flow and level elements would be used to automatically bring screens online or offline using electrically actuated gates. Screenings washer compactors would be provided, to reduce odor, volume and weight of the screenings removed from the site. Screened flow would then pass to five, stacked tray grit removal systems. The number of units online would be determined by influent flow measurement. Each stacked tray would be provided with two grit pumps, one operating with one standby. Collected grit would be pumped to a grit classifier or washer to wash and concentrate grit before being conveyed to a roll-off container at grade. The stacked tray grit removal system requires a constant flow of plant water to keep grit fluidized for pumping. This new headworks facility would be a major improvement over the plant’s current preliminary treatment. By significantly increasing grit and screening removal, operation and maintenance of downstream equipment would be improved dramatically.

Screened and degritted influent flow would then be conveyed to dual-use primary filtration facility in the northwest corner of the site. The facility would include 11 trains/rotating units each with 24 disks per train. Under average day conditions six units would be in service operating at 1.3 gallons per minute per square foot (gpm/sf). Under wet weather flow all 11 units would be in operation and loaded at a hydraulic loading rate of 4.9 gpm/sf. When flow exceeds 58 mgd (the hydraulic capacity of the secondary treatment system), the portion of primary effluent flow over 58 mgd would bypass the secondary treatment system and be conveyed directly to the ultraviolet (UV) disinfection system. Flow in the pipe to the secondary treatment system would be measured using an inline magnetic flow meter to ensure it does not exceed 58 mgd. The bypassed wet weather flow would be calculated as the difference between the secondary treatment flow measurement and the raw influent flow measurement, while accounting for any sidestreams introduced.

Despite cloth media filtration being a proven technology for tertiary treatment for over 20 years, the use of cloth media disk filtration for primary treatment is relatively new. It is recommended that the technology be piloted at an early stage of preliminary design. The purpose of the pilot study will be to confirm the primary filtration system's design criteria to be used in the final design (e.g. hydraulic and solids loading rates), assess five day biochemical oxygen demand (BOD_5) and total suspended solids (TSS) removal efficiencies to finalize primary effluent loads to be used in the design of the biological nutrient removal (BNR) process, establish primary effluent UV transmittance to be used for the UV disinfection system design criteria, assess backwash volumes and frequencies, and characterize primary solids for sludge management systems' design criteria.

Primary effluent up to 58 mgd would flow to the upgraded bioreactors. Each of the six existing bioreactors would be reconfigured to operate as a four-stage BNR system with integrated fixed film activated sludge (IFAS) to increase the capacity of the existing bioreactors to achieve nitrogen removal year-round under design year flow and load conditions. A new blower building would be provided with four new blowers (the type of blower will be determined during preliminary design). In addition, a supplemental carbon storage and feed system would be provided to ensure adequate denitrification performance under all conditions and a new magnesium hydroxide storage and feed system would be provided to maintain adequate alkalinity in the BNR system. New instrumentation and controls would be incorporated to enable efficient operation of the BNR system and blower operation. The three existing final settling tanks would be upgraded with all new mechanical equipment including sludge and scum collection equipment, return active sludge (RAS) and waste activated sludge (WAS) pumping, and scum pumping.

Secondary effluent would be conveyed to the UV disinfection system where it would recombine with any wet weather flow which bypassed secondary system. The UV system would consist of six channels, each with six UV modules. All six channels would be in service at peak wet weather flow while at average day conditions, only two channels would be in service. Immediately upstream or downstream of the UV system, a Parshall flume would measure the final effluent flow rate. This flow measurement along with level measurement elements would automatically control the operation of the UV channels and modules to ensure proper disinfection. Under normal flow and receiving water conditions, the effluent from disinfection would be discharged by gravity through the existing effluent outfall pipe. Under extreme tide events, effluent pumping would be provided to enable passing of flow through the plant during a 100-year flood event. Seven effluent pumps capable of pumping the full 200 mgd would be provided with one pump as a standby.

Primary solids would be pumped from the primary filters to new gravity thickeners and WAS from the secondary clarifiers would be pumped to intermediate WAS storage tanks within the new Solids Handling Facility. From the storage tanks, WAS would be pumped to one of three rotary drum thickeners on the main level of the facility. Thickened primary sludge would be pumped from the gravity thickeners and thickened waste activated sludge would flow by gravity into a second set of holding tanks for co-storage. Both WAS and thickened sludge storage tanks would be primarily below grade and shall be intermittently mixed with air supplied by low pressure air blower systems. Combined thickened sludge will be stored prior to being off-loaded to sludge hauling tanker trucks for further treatment and disposal off-site. The Solids Handling Facility will house the thickener units, low pressure air blowers, polymer system and electrical room on the main level, with the finished floor elevation at or above the 100-yr flood elevation plus three feet. The main level of the facility would partially cover the sludge storage tanks below, while providing sufficient access for inspection and maintenance from outside of the building. A loading dock with roll up door would be provided for equipment removal. The loading dock area would also serve as the tanker truck loading area and polymer fill station. The lower level of the Solids Handling Facility will include the sludge storage tanks, WAS feed pumping for the rotary drum thickeners (RDTs), thickened sludge pumps for the gravity thickeners, a wash water booster pump system (if required), and the truck loading pumps. Although not included in this recommended plan, the solids facility would be designed to accommodate pumping thickened biosolids to a new off-site stabilization facility in the future if so desired.

It is expected that two odor control systems would be provided. The first would collect and treat odorous air from the headworks facility and the primary treatment facility. A biofilter is proposed for this air stream. The second system would collect off-gases from the gravity thickeners, sludge holding tanks and rotary drum thickeners. It is assumed that this air stream would be treated through a chemical scrubber. A more detailed analysis of the odor control systems will be conducted during preliminary design.

A new control building would be constructed with dedicated space for Water Pollution Control Authority (WPCA) staff, operators, laboratory, locker rooms, and a maintenance shop. Additionally, a public entrance would be provided to accommodate customer billing. This public area would also include informational displays to provide an educational opportunity for customers and the community.

All new buildings and facilities would be designed with energy efficiency in mind. All new equipment will be equipped with high efficiency motors. Opportunities for renewable energy assets, including heat pumps, solar arrays, and wind turbines will be further assessed during preliminary design. In addition, the use of green infrastructure on-site for stormwater control will be incorporated.

A schematic of the proposed treatment facility is presented in **Figure 9.1-1** and the site plan is presented in **Figure 9.1-2**. **Table 9.1-1** presents a summary of the design criteria for the new facility.

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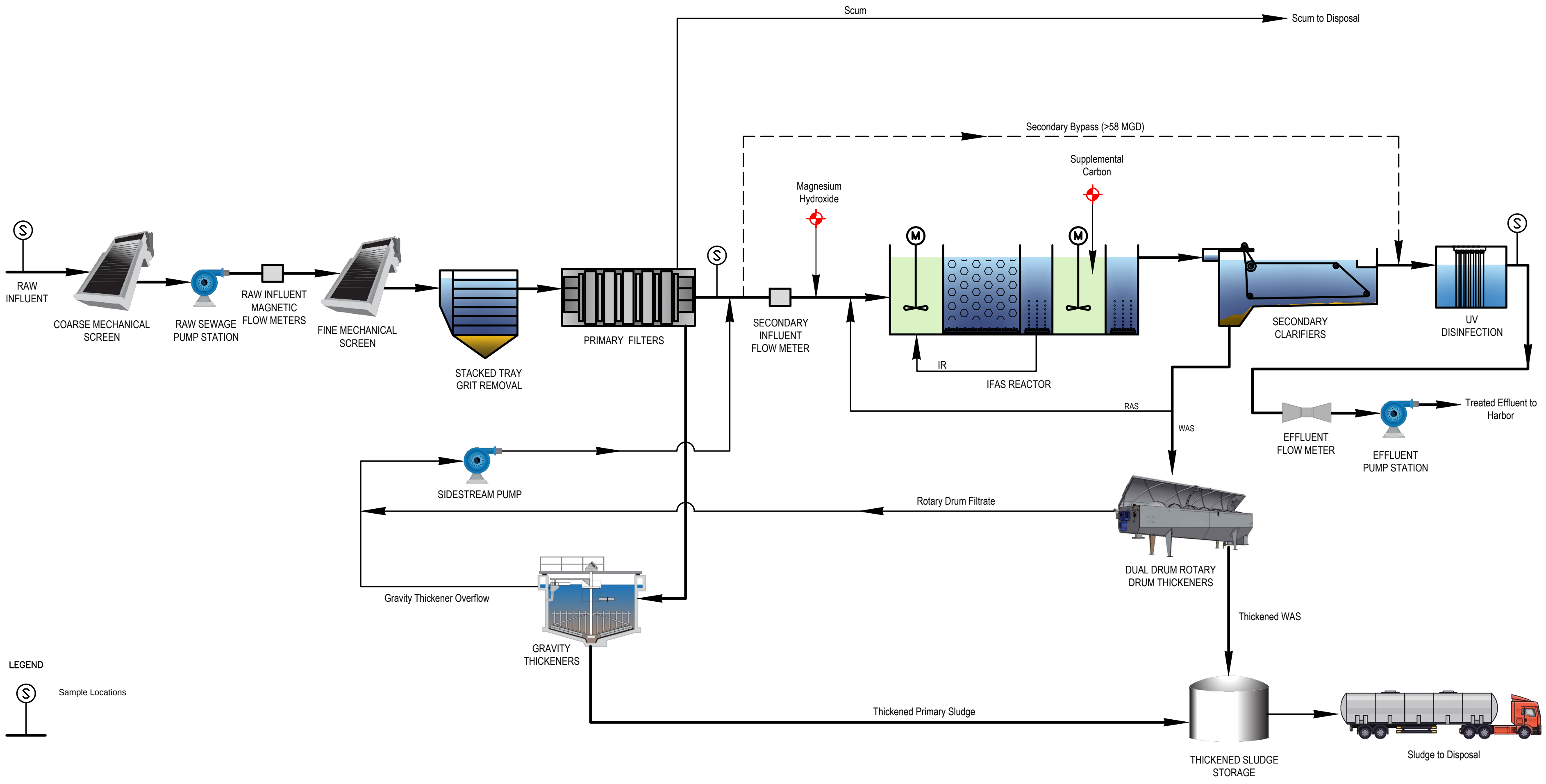

Figure 9.1-1
West Side Recommended Plan
Process Flow Diagram

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DRAFT

West Side WWTP
209 Bostwick Ave, Bridgeport CT

Scale: 1" = 150'

Feet
0 75 150

N

Figure 9.1-2
Recommended Plan - Alternative W-200C

Water Pollution Control Authority, City of Bridgeport
Wastewater Facilities Pan

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Table 9.1-1
West Side WWTP Recommended Plan Design Criteria

Flow	
Average Design Flow	30 mgd
Peak Design Flow	200 mgd
Secondary System Design Flow	58 mgd
Influent Coarse Screens	
Number	4 (3 operating, 1 standby)
Type	Multi-rake
Opening	1-inch
Influent Pumps	
Number	7 (6 operating, 1 standby)
Type	Centrifugal
Capacity, each	33.3 mgd
Approximate HP	500
Influent Fine Screen	
Number	5 (4 operating, 1 standby)
Type	Multi-rake
Opening	1/4 inch
Screenings Washer Compactor	
Number	4
Type	Washer/compactor with grinder
Capacity, each	200-300 ft^3/hr
Grit Removal	
Number	5 (5 operating at peak flow)
Type	Stacked Tray
Capacity, each	40 mgd
Plant Water	80 gpm/unit
Grit Pumps	
Number	10 (5 operating at peak flow)
Capacity, each	400 gpm
Approximate HP	TBD
Grit Classifier	
Number	5 (5 operating at peak flow)
Type	Grit Slurry Washer
Capacity, each	550 gpm
Plant Water	47 gpm/unit
Primary Filtration	
Number of Trains	11 (11 operating at peak flow)
Disks per Train	24
Capacity per Train	18.2 mgd
Hydraulic Loading Rate	4.89 gpm/ft^2
Backwash Pumps	
Number	11
Capacity, each	790 gpm
Approximate HP	20

Table 9.1-1

West Side WWTP Recommended Plan Design Criteria

Primary Sludge Pumps	
Number	11
Capacity, each	790 gpm
Approximate HP	20
Integrated Fixed Film Activated Sludge	
Number of Trains	6
Pre-Anoxic Zone Volume, each train	0.27 MG
Dimensions	36.7 ft x 60 ft x 16.4 ft
Mixers per zone	1 - 5.7 HP
IFAS Media Zone (Aeration) Volume, each train	0.41 MG
Dimensions	28.6 ft x 60 ft x 15.9 ft
Aeration Type	medium/coarse bubble
Fill of Biofilm Carriers	50%
DeOxygenated Zone Volume, each train	0.11 MG
Dimensions	16.0 ft x 60 ft x 15.6 ft
Aeration Type	medium/coarse bubble
Internal Recycle Pump, type	Submersible
Number	12 total (2 per train)
Capacity	8,785 gpm
Motor HP	12.6
Average IR Rate	200%-300%
Post Anoxic Zone Volume, each train	0.11 MG
Dimensions	16.0 ft x 60 ft x 15.6 ft
Mixers per zone	2 - 1.7 HP
Re-aeration Zone Volume, each train	0.11 MG
Dimensions	16.0 ft x 60 ft x 15.6 ft
Aeration Type	medium/coarse bubble
Secondary Clarifiers	
Number	3
Dimensions	325 ft x 50 ft x 11 ft
RAS Pumps	
Number	6
Type	Vertical, non-clog, centrifugal
Capacity, each	4,600 gpm
Approximate HP	100
WAS Pumps	
Number	4 (3 duty, 1 standby)
Type	Horizontal, non-clog, single stage, centrifugal
Capacity, each	1,740 gpm
Approximate HP	40

Table 9.1-1

West Side WWTP Recommended Plan Design Criteria

Disinfection	
Number of Channels	6
Number of UV Modules per Channel	6
Channel Width	5 ft
Channel Depth	8 ft
UV Transmittance %	50
UV Dose	45 mJ/cm^2
Effluent Pumps	
Number	7 (6 operating, 1 standby)
Type	Submersible Axial Flow
Capacity, each	33.3 mgd
Approximate HP	225
Gravity Thickeners	
Number	2
Volume, each	183,500 gal
Diameter	50 ft
Depth	12.5 ft
Rotary Drum Thickener	
Number	3 (2 Duty, 1 Standby)
Capacity, each	500 gpm
Thickener Feed Pumps	
Number	3 (2 Duty, 1 Standby)
Capacity, each	600 gpm
Truck Fill Pumps	
Number	2 (1 Duty, 1 Standby)
Capacity, each	250 gpm
WAS Storage	
Number of tanks	2
Dimensions	50-ft x 22-ft x 32-ft
Capacity, each	174,000 gal
Thickened Sludge Storage	
Number	2
Dimensions	50-ft x 50-ft x 32-ft
Capacity, each	598,000 gal

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9.1.2 BioWin Modeling

A whole plant process model was developed using Biowin process modeling software (Version 6.1.7.2226, EnviroSim Associates, Ltd.). The calibration of the West Side WWTP model using a two-week sampling program was challenging, largely attributed to the WWTP's current WAS wasting approximation strategy. IWA-stop criteria were achieved for all parameters, with the exception of WAS, solids retention time (SRT), effluent ammonia, and effluent total nitrogen (TN). This model was used to predict plant performance against a longer dataset (validation, one-year) of plant operating data. For a detailed discussion of the calibration and validation procedure, see **Appendix K**.

The calibrated BioWin model developed for the West Side WWTP was reconfigured to match the recommended alternative of this Facilities Plan. The existing conditions model and the reconfigured model is shown in **Figures 9.1-3** and **Figure 9.1-4** respectively.

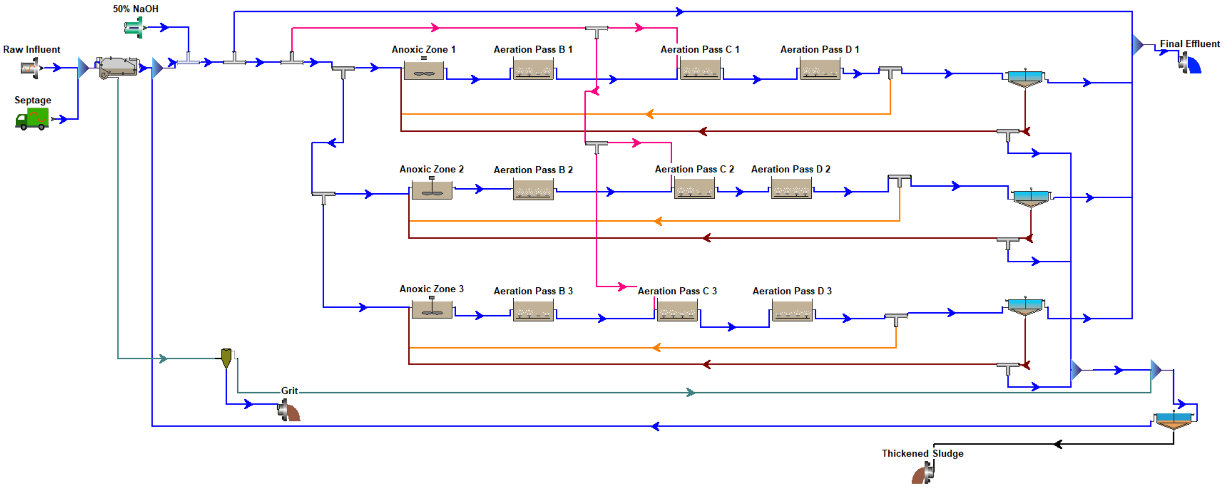


Figure 9.1-3
Existing Conditions Biowin Model

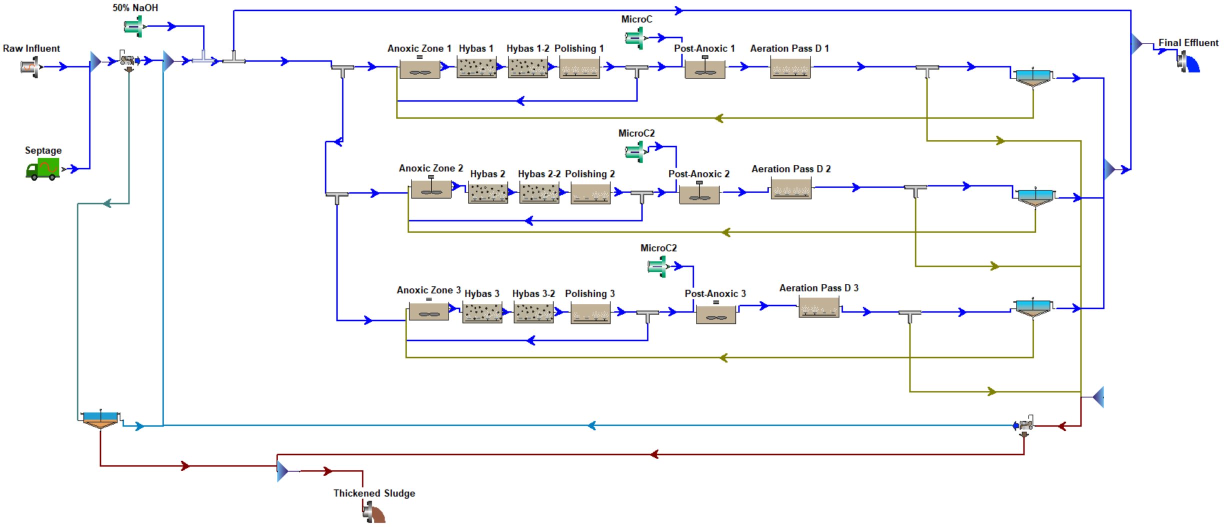


Figure 9.1-4
Upgraded West Side WWTP Biowin Model

For the design condition, a dynamic model influent itinerary was developed based on historical data. As part of future work, the dynamic model should be 'offset' so that the maximum month and maximum day loading occurs at different periods throughout the year. As part of this effort, the trend in flow and loading was assumed to match the validation year. Methods for developing this dynamic inventory are further detailed in Appendix K. Two loading scenarios were evaluated:

- **Condition A: BNR + Conventional Treatment:** the secondary system will be designed to achieve effluent National Pollutant Discharge Elimination System (NPDES) limits (e.g. BOD_5 and TSS) in addition to the effluent TN load (1,041 lbs/day) under all flow and load conditions associated with the WWTP's projected 25.8 mgd design year (2050) capacity.

- **Condition B: Conventional Treatment**: the secondary system will be designed to achieve effluent NPDES limits (e.g. BOD_5 and TSS) under all flow and load conditions associated with the WWTP's permitted flow capacity of 30 mgd. The secondary system may not be able to achieve the effluent nitrogen permit limits under all these flow and load conditions, but these influent conditions are not expected to be reached until after 2050.

Two criteria were targeted for Condition A. The first is meeting effluent nitrogen limit of 1,041 lbs/day based on annual average loading and the second is achieving monthly average effluent BOD_5 and TSS concentrations (<30 mg/L). Initial modeling of Condition A flow and loading conditions resulted in a maximum mixed liquor suspended solids (MLSS) concentration of 5,000 mg/L which exceeds the secondary clarifier capacity (2,500 mg/L). To rectify the high observed MLSS levels, the wasting rate was increased and the dissolved oxygen (DO) setpoint was adjusted from 2.0 mg/L to a seasonal high of 4.0 mg/L. Two models were run under these conditions with, and without supplemental carbon addition to the post-anoxic zones.

Condition B flows and loading conditions were modeled and assessed for effluent BOD_5 and TSS values. Similar to the initial modeling of Condition A, Condition B flow and loading conditions resulted in MLSS concentrations exceeding secondary clarifier capacity. Subsequent modeling increased wasting rates to lower MLSS concentrations. One model was run without supplemental carbon addition to the post-anoxic zones.

The model predicted effluent total nitrogen load (and concentration) for the two Condition A scenarios are presented in **Table 9.1-2**, along with effluent total nitrogen.

Table 9.1-2 Monthly Summary of Model Predicted Effluent Total Nitrogen Loads (and concentrations) for the Upgraded West Side WWTP Configuration at Design Year Flows and Loads, Condition A

Month	Effluent TN, lbs/day (mg/L)	
	Condition A (25.8 mgd)	
	No Carbon addition	150 gallons/day Carbon Addition to Post-Anoxic Zone
January	632 (2.5)	544 (2.2)
February	528 (2.2)	483 (2.0)
March	475 (2.2)	397 (1.8)
April	557 (2.5)	421 (1.9)
May	582 (2.4)	531 (2.2)
June	703 (3.5)	438 (2.1)
July	1,212 (5.6)	829 (3.8)
August	1,493 (8.2)	983 (5.4)
September	2,002 (12.2)	1438 (8.8)
October	1,362 (7.3)	873 (4.7)
November	860 (4.5)	504 (2.6)
December	843 (3.2)	772 (3.0)
Annual Average	**938 (4.7)**	**664 (3.4)**

The average effluent TN loads are less than the permitted 1,041 lbs/day for each scenario.

The greatest monthly average Condition A effluent TN without carbon was 12.2 mg/L, in September. This deviation of effluent TN is attributed to high effluent nitrate, as shown in **Figure 9.1-5**. Although the model predicts that endogenous decay in the post anoxic zone is sufficient to achieve the effluent TN loading limit, supplemental carbon addition would be beneficial from July through November to drive denitrification and remove recalcitrant effluent nitrate, to reduce overall effluent TN, as shown in **Figure 9.1-6.** Modeled effluent TN in September with carbon addition was 8.8 mg/L. It is recommended that supplemental carbon storage and feed facilities are available to offset any process upset that could occur throughout the year to lower the annual average effluent TN load.

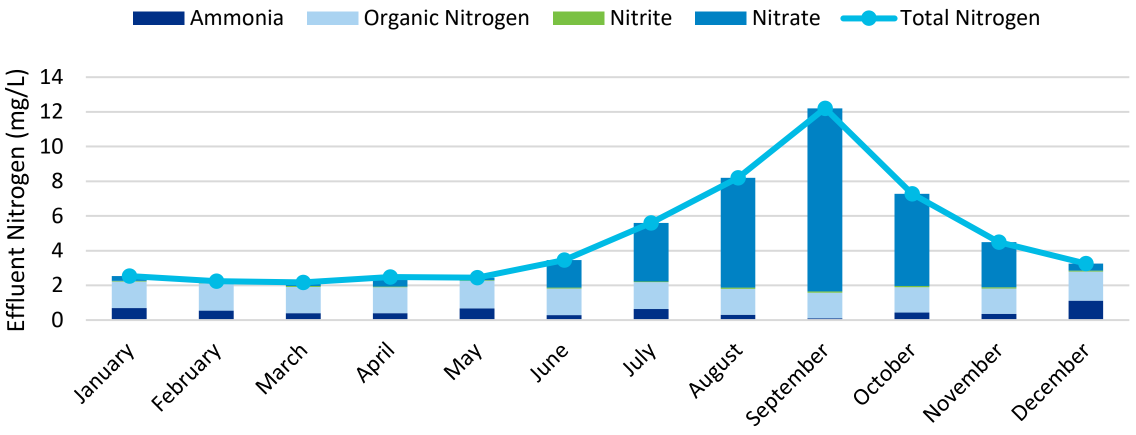


Figure 9.1-5
Condition A (no carbon addition) Monthly Average Effluent Nitrogen Species

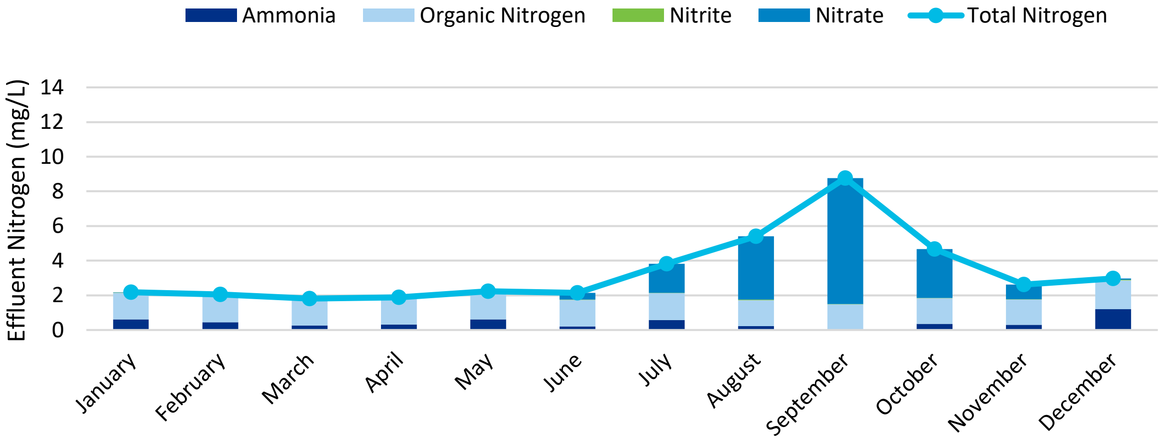


Figure 9.1-6
Condition B (150 gallons/day carbon addition to post anoxic zone) Monthly Average Effluent Nitrogen Species

The modeled predicted monthly average, effluent TSS and BOD_5 concentrations for each of the three scenarios is presented in **Table 9.1-3**.

Table 9.1-3 Monthly Summary of Model Predicted Effluent BOD_5 and TSS at the Upgraded West Side WWTP at Design Year Flows and Loads

Month	Condition A (25.8 mgd)				Condition B (30 mgd)	
	No Carbon addition		150 gallons/day Carbon Addition to Post-Anoxic Zone		No Carbon addition	
	BOD_5 (mg/L)	TSS (mg/L)	BOD_5 (mg/L)	TSS (mg/L)	BOD_5 (mg/L)	TSS (mg/L)
January	16.5	11.9	20.9	11.9	9.5	13.3
February	11.1	10.6	14.4	10.7	8.1	13.0
March	8.4	9.7	11.6	9.8	7.5	11.5
April	12.4	10.7	17.3	10.7	8.5	11.6
May	16.9	11.5	21.5	11.6	9.2	12.6
June	8.5	9.0	12.9	9.0	7.0	9.4
July	12.2	10.2	16.7	10.3	8.2	10.2
August	5.2	7.0	7.7	7.0	5.4	7.6
September	3.3	5.7	5.1	5.7	4.1	6.4
October	9.1	8.4	12.5	8.4	6.2	8.2
November	7.5	7.8	12.0	7.8	5.7	8.5
December	22.7	13.8	28.1	13.9	10.5	14.3
Annual Average	**11.2**	**9.7**	**15.1**	**9.7**	**7.5**	**10.5**

As presented in Table 9.1-3, the model significantly predicts less than 30 mg/L monthly average effluent BOD_5 and TSS throughout the year under each condition. The difference in monthly average effluent BOD_5 concentrations for Condition A with and without carbon addition show that carbon addition should only be used when needed for nitrogen removal, because dosing carbon increases effluent BOD_5.

The developed process model predicts a mixed liquor suspended solids ranging from a low of approximately 600 mg/L to a high of approximately 3,400 mg/L for Condition A (with or without carbon addition) and from a low of approximately 300 mg/L to a high of approximately 2,900 mg/L for Condition B. The maximum mixed liquor predicted for Conditions A and B exceeds the capacity of the secondary clarifiers (2,500 mg/L). Future modeling should use a BioWin controller to limit the high MLSS that are predicted to occur seasonally, during summer months.

Despite model predictions that indicate very low MLSS that can occur during summer months, it is unlikely that the plant would operate with such thin MLSS. The modeled MLSS may be too low for effective settling as sludge that is too thin doesn’t flocculate as well as a thicker sludge. Generally, the minimum recommended MLSS is 1,200 mg/L although this value changes from plant to plant. Due to the West Side WWTP’s history of operating at very high MLSS, methods to enhance sludge settleability at model predicted very low MLSS should be considered in the design. This would likely be seasonal operation of the aeration tanks and taking tanks offline during period of low loading, decrease system wasting, or bypassing a portion of primary influent around the new primary filters to increase loading to the secondary system.

9.1.3 Hydraulic Modeling and Plant Hydraulic Capacity

CDM Smith developed a hydraulic model for the West Side WWTP for the preferred alternative. From this model a hydraulic profile was created for the peak flow condition of 200 mgd discharging against a 100-year flood. The hydraulic profile is shown in **Figure 9.1-7**. The model and profile were computed using Visual Hydraulics, Version 4.2 by Innovative Hydraulics.

Table 9.1-4 lists the unit processes and identifies the number of units in service for the peak flow hydraulic profile calculations.

Table 9.1-4 Unit Process Peak Flows

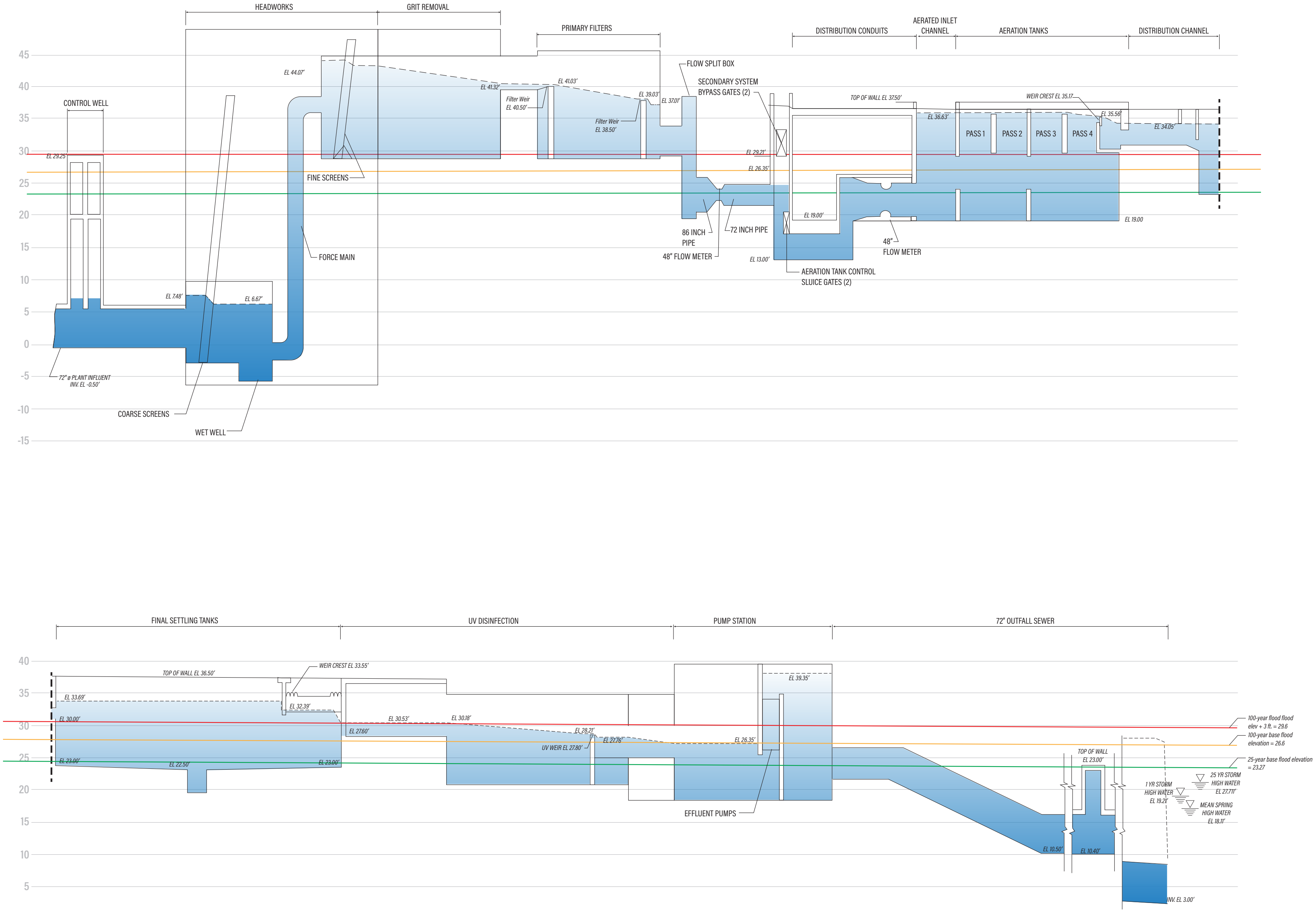
Design Element	Peak Hour (mgd)	RAS (mgd)	Internal Recycle (mgd)	Total (mgd)	Units In-Service	Peak Flow per Unit (mgd)
Coarse Screens	200	-	-	200	3 of 4	66.7
Influent Pumps	200	-	-	200	6 of 7	33.3
Fine Screens	200	-	-	200	4 of 5	50
Grit Units	200	-	-	200	5 of 5	40
Primary Filters	200	-	-	200	11 of 11	18.2
Aeration Basins	58	14.5	90.1	162.6	6 of 6	27.1
Secondary Clarifiers	58	14.5	-	72.5	3 of 3	24.2
UV Channels	200	-	-	200	6 of 6	33.3
Effluent Pumps	200	-	-	200	6 of 7	33.3

The existing WWTP does not have an effluent pumping station, but to accommodate higher flows and discharge against a 100-year flood, effluent pumping may be required during these extreme conditions. When pumping is not needed, the plant will discharge by gravity.

Modeled hydraulic head change between the influent pump station and the effluent pump station represents the net head gain that would be required by the influent pump station. At 200 mgd, the net head gain needed at the influent pump station is 37.4 ft. The modeled hydraulic head change between the effluent pump station and the discharge elevation (29.6 feet in Bridgeport datum) is 13 feet.

Additional assumptions used in the hydraulic model are listed below. Any changes made to these during the design phase may require modifications to this model and may alter the proposed hydraulic grade line.

- Conveyance between some treatment units was excluded from the model, with the assumption that these conveyance elements would not result in more than two feet of total additional headloss in the hydraulic profile. As design of the plant is finalized, this assumption will be re-evaluated and adjusted as necessary. All conveyance lengths greater than 100 feet in were included in the model.
- The effluent pipe from the primary filters to the aeration tanks was modeled as primarily 72-inch diameter with a short span of 48-inch diameter pipe to accommodate a flow meter. The flow meter was modeled as a buried, magnetic flow meter.



CDM Smith

Figure 9.1-7
West Side WWTP Recommended Plan
Hydraulic Profile

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- The existing 72-inch diameter outfall was maintained.
- Headloss through screens was approximated at 50% and 40% blinding for coarse and fine, respectively.
- Headlosses for screens, grit chambers, cloth filters, IFAS and UV treatment are all based on estimates that will be refined as designs are finalized.
- An effluent Parshall flume will be included upstream of the effluent pump station. Because headlosses from this structure are expected to be small at average day flows, they are not explicitly included in the current hydraulic model or profile. 200 mgd through a 12-foot Parshall flume results in approximately three feet of headloss. To discharge at this peak flow, the effluent pump station would provide the necessary headgain to discharge all flow through the outfall.
- The headgain represented in the hydraulic model pump stations are net head gains. Headloss from influent flow metering was not included in the hydraulic model as it was assumed the loss would be accounted for in the influent pump headgain and would not have impact on the upstream or downstream hydraulic grade line.
- This profile was developed using the existing outfall configuration.

9.1.4 Maintenance of Plant Operation (MOPO) during Construction

In order to maintain continuous plant operations during construction, a phased construction sequence similar to that described herein shall be required at the West Side WWTP. Specific constraints and steps are outlined and are intended to suggest a sequence for specific activities. Unless specifically noted below, the construction activities shall not, under any circumstances reduce the treatment capability of the plant, reduce the ability to hydraulically convey dry or wet weathers flows through the plant or negatively impact effluent quality. The treatment capability of the plant refers to all portions of wastewater treatment including screenings, grit removal, influent pumping, primary treatment, secondary treatment, disinfection, sludge thickening and laboratory capabilities.

The West Side WWTP currently receives an average daily flow of 22.1 mgd with a minimum day flow of 14.6 mgd, and a wet weather peak hour flow of 81.2 mgd. However, the peak rating of the existing facility is 90 mgd with an average rating of 30 mgd. All temporary bypass piping and pumping facilities proposed for the work herein shall maintain existing process hydraulic capacity.

As presented below, the sequence of construction is particularly complex given the limited plant site. Some existing facilities will require demolition to make way for new treatment units that will need to be constructed, tested, started-up and successfully brought on-line before the next phase of construction can commence. This results in an extended construction duration.

9.1.4.1 Preliminary Sequence

This is a partial outline only which details the specific order of constructing new and upgrading existing facilities. It does not cover sequences necessary for actual construction methods. Some of the tasks as described below may overlap one another in performance of the work. Numerical identification of the tasks within each construction phase does not necessarily conform to the actual order of construction. This plan is depicted in the MOPO figures, **Figure 9.1-8A** through **Figure 9.1-8I**. The sequence was developed around a peak flow of 200 mgd, specifically plant alternative W-200C. This plan will be further developed in the design phase for inclusion in the bid documents.

Phase 1

1. Perform general site preparation and clearing of land to the north and west of the plant
    a. In preparation for future phases of construction, clear and prep the land to the north and west of the site.
    b. The land to the north and northwest will be used for construction of new facilities.
    c. The land to the west will be used as a staging area by the contractor.
2. Demolish the existing building foundation of the former sludge building.
    a. Demolition of this structure will allow for construction of facilities in Phase 2.
    b. Relocate the existing RDT to another location on site for use or remove from operation and temporarily store until new solids handling building is constructed.
    c. Demolition of the structure will remove sludge storage from the WWTP. Sludge will need to be directly removed from gravity thickeners, a practice previously used by the contract operator, until new solids handling facilities are constructed in later phases.

Phase 2

1. Construct the new headworks facility consisting of the following processes. All will be rated for a peak wet weather flow of 200 mgd.
    a. Coarse screening
    b. Influent pumping
    c. Fine screening
    d. Grit removal
    e. Screenings and grit washing and storage facilities

West Side WWTP
209 Bostwick Ave, Bridgeport CT

PHASE 1: Site Preparation and Demolition of Former Sludge Building

Scale: 1" = 150'

0 75 150 Feet

N

Figure 9.1-8A
West Side WWTP MOPO Sequence - Phase 1

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West Side WWTP
209 Bostwick Ave, Bridgeport CT

PHASE 2: Construct New Headworks Facilities and Primary Treatment Facility

Scale: 1" = 150'

Feet
0 75 150

N

CDM Smith

Figure 9.1-8B
West Side WWTP MOPO Sequence - Phase 2

Water Pollution Control Authority, City of Bridgeport
Facilities Plan

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West Side WWTP

209 Bostwick Ave, Bridgeport CT

PHASE 3: Demolish Existing Headworks Facilities, Influent Pumping Station, and Primary Settling Tanks

Scale: 1" = 150'

0 75 150 Feet

N

Figure 9.1-8C
West Side WWTP MOPO Sequence - Phase 3

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West Side WWTP
209 Bostwick Ave, Bridgeport CT

PHASE 4: Construct New Solids Handling Building, Gravity Thickeners, and UV Disinfection System

Scale: 1" = 150'

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Figure 9.1-8D
West Side WWTP MOPO Sequence - Phase 4

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Remove Temporary Piping to Chlorine Contact Tanks

Demolish Chlorine Contact Tanks

Demolish Gravity Thickeners

West Side WWTP
209 Bostwick Ave, Bridgeport CT

PHASE 5: Demolish Existing Gravity Thickeners and Chlorine Contact Tanks

Scale: 1" = 150'

Feet
0 75 150

N

Figure 9.1-8E
West Side WWTP MOPO Sequence - Phase 5

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West Side WWTP
209 Bostwick Ave, Bridgeport CT

PHASE 6: Construct New Effluent Pumping Station, Blower Building, and Control Building

Scale: 1" = 150'

CDM Smith

Figure 9.1-8F
West Side WWTP MOPO Sequence - Phase 6

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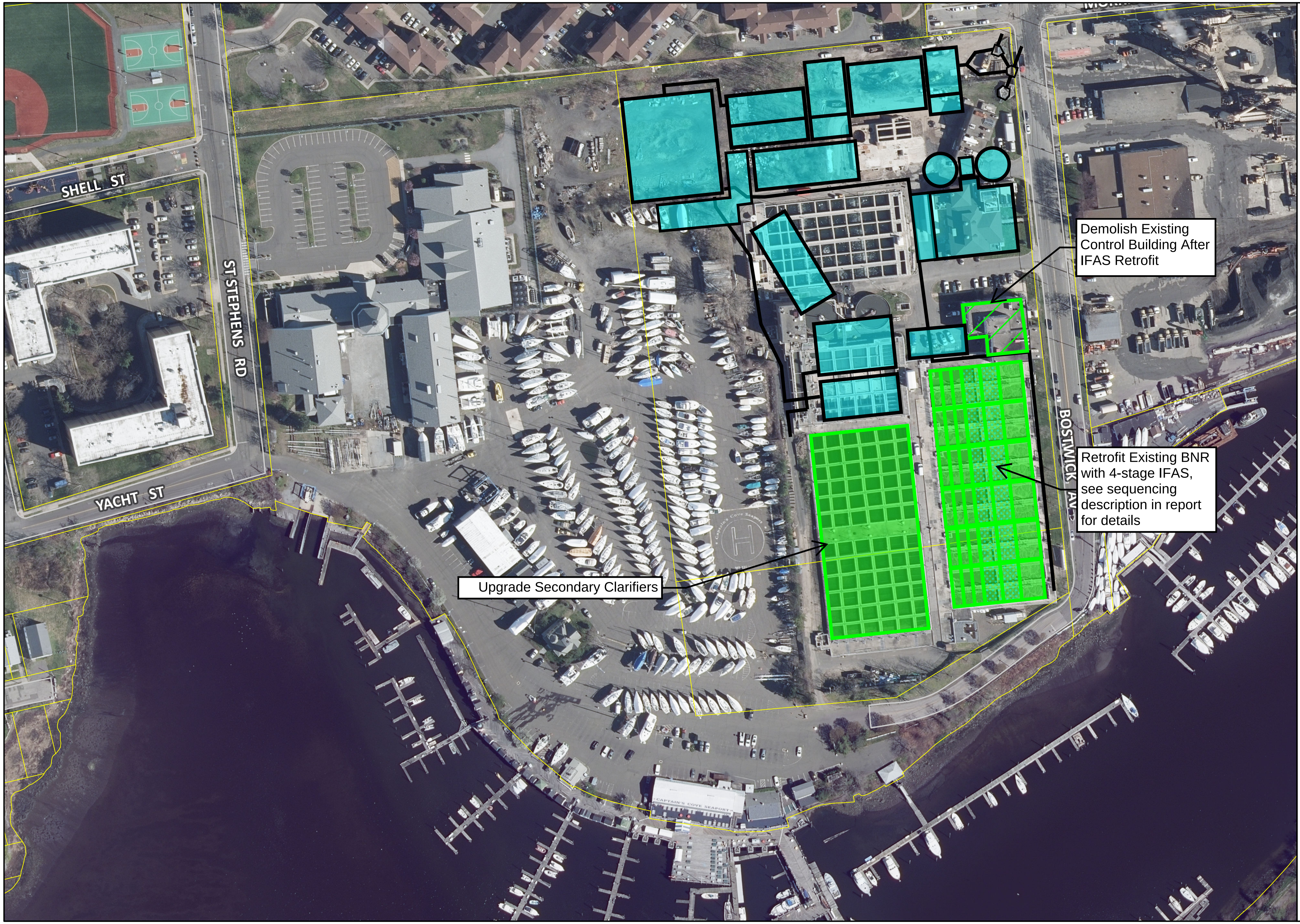

Demolish Existing Control Building After IFAS Retrofit

Retrofit Existing BNR with 4-stage IFAS, see sequencing description in report for details

Upgrade Secondary Clarifiers

West Side WWTP
209 Bostwick Ave, Bridgeport CT

PHASE 7: Retrofit IFAS into Existing BNR basins, Upgrade Secondary Clarifiers, and Demolish Existing Control Building

Scale: 1" = 150'

CDM Smith

Figure 9.1-8G
West Side WWTP MOPO Sequence - Phase 7

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West Side WWTP
209 Bostwick Ave, Bridgeport CT

PHASE 8: Complete Final Miscellaneous Improvements and Site Restoration

Scale: 1" = 150'

CDM Smith

Figure 9.1-8H
West Side WWTP MOPO Sequence - Phase 8

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West Side WWTP
209 Bostwick Ave, Bridgeport CT

Construction Complete

Figure 9.1-8I
West Side WWTP MOPO Sequence - Construction Complete

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2. Install new piping from existing sewer vaults and manholes to coarse screening. Plug pipe until headworks startup.
3. Install new piping from grit removal to new primary treatment facilities.
4. Construct the new dual use primary cloth filters, rated for a peak wet weather flow of 200 mgd.
    a. Primary cloth filters will treat both dry and wet weather flow.
    b. The Step Feed channel needs to be hydraulically connected to the existing Aeration Tank Influent channel.
    c. New dry weather primary effluent (filter effluent) piping to the existing aeration tanks to be installed. Primary Effluent pipe should be connected to the existing Step Feed Channel. Temporary piping should direct primary effluent from the Step Feed Channel to the existing Aeration Tank Influent Channel. Step Feed Channel should be plugged to stop primary effluent to flow through the channel.
    d. New temporary wet weather piping from filter effluent to existing disinfection influent channel.
    e. Install temporary sludge piping from new primary sludge pumps to existing gravity thickeners.
5. Construct new electrical distribution and backup power systems to support new headworks and primary treatment facilities.
6. Construct odor control for headworks and primary filters.

Phase 3

1. Once Phase 2 is complete and all new facilities are tested and functional, demolish the following existing facilities to allow for construction of new facilities in subsequent phases:
    a. Existing screen building
    b. Existing influent pumping station building
    c. Existing primary tanks
    d. Primary sludge pumps associated with primary tanks

Phase 4

1. Once Phase 3 demolition is complete, construct the following new facilities:
    a. New solids handling building with sludge storage
    b. New gravity thickeners

    c. New UV system to treat both wet weather and dry weather up to 200 mgd
    d. Odor control for new sludge handling building

2. Install new sludge piping from primary and WAS pump galleries to solids handling building.
3. Install new wet weather piping from primary filters to UV influent channel.
4. Construct effluent chamber for UV and effluent pumping station (constructed in Phase 6) and install new piping to connect into existing outfall pipe.
5. After UV system is tested and operational, redirect secondary effluent flow to UV facility and close off temporary wet weather piping from primary filters to the chlorine contact tanks.

Phase 5

1. Once Phase 4 is complete and all new facilities are tested and functional, demolish the following existing facilities to allow for construction of new facilities in subsequent phases:
    a. Existing gravity thickeners
    b. Existing chlorine contact tanks
2. Remove existing temporary piping from primary filters to chlorine contact tanks

Phase 6

1. Once Phase 5 demolition is complete, construct the following new facilities:
    a. New effluent pumping station and channels or piping to connect to effluent chamber
    b. New control building and visitors center
    c. New blower building, (including magnesium hydroxide storage, magnesium hydroxide feed systems, and supplemental carbon feed systems)
        i. Buried stainless steel aeration pipe header to be routed along Eastern length of bioreactors (along step feed channel).
        ii. Header shall include aeration piping to each of the 6 BNR basins that end with a manual butterfly valve for isolation.
        iii. Supplemental carbon storage tanks will be installed outside of the blower building.

Phase 7

1. Once Phase 6 upgrades are complete including the new blower building, retrofit existing aeration tanks with four-stage IFAS system and perform secondary upgrades.

    a. Bioreactors 5 and 6 will be taken offline first. Construct temporary bulkhead on influent channel after Bioreactor 4 to isolate Bioreactors 5 and 6.

    b. When Bioreactors 5 and 6 are taken offline, Secondary Clarifier 3 will be taken offline (along with RAS Pumps 5 and 6). Secondary system mechanical upgrades within Secondary Clarifier 3 can occur while Bioreactors 5 and 6 are being retrofitted to the IFAS configuration. Existing RAS Pumps 5 and 6 can be removed, and new pump and piping (both RAS and WAS) to be installed.

    c. Bioreactor internal walls will be demolished, and new walls will be constructed. A new effluent trough will be constructed along the full width of the newly configured Bioreactors, sloped to existing effluent gates.

    d. New influent gates to be installed along the width of the bioreactors adjacent to the Step Feed Channel.

    e. IFAS equipment can be installed along with diffuser drop legs to each aerated zone. Aeration piping for each bioreactor will connect to the butterfly isolation valve along the newly installed aeration header. When all improvements have been completed, 50% of the primary effluent can be directed through the step feed channel to feed Bioreactors 5 and 6 from the Eastern side of the bioreactors.

    f. Bioreactors 3 and 4 are to be taken offline next. Construct temporary bulkhead in influent channel after Bioreactor 2 to isolate Bioreactors 3 and 4. Construct temporary bulkhead after Bioreactor 4 in the Step Feed Channel. Temporary piping is to be used to feed primary effluent to Bioreactors 5 and 6 through the step feed channel.

    g. When Bioreactors 3 and 4 are taken offline, Secondary Clarifier 2 will be taken offline (along with RAS Pumps 3 and 4). Secondary system mechanical upgrades within Secondary Clarifier 2 can occur while Bioreactors 3 and 4 are being retrofitted to the IFAS configuration. RAS Pumps 3 and 4 can be removed and new pumps and piping (both RAS and WAS will be installed).

    h. Bioreactor internal walls will be demolished, and new walls will be constructed. A new effluent trough will be constructed along the full width of the newly configured Bioreactors, sloped to existing effluent gates.

    i. New influent gates to be installed along the width of the bioreactors adjacent to the Step Feed Channel.

    j. IFAS equipment can be installed along with diffuser drop legs to each aerated zone. Aeration piping for each bioreactor will connect to the butterfly isolation valve along the newly installed aeration header.

k. When all improvements have been completed, construct temporary bulkhead in Step Feed channel after Bioreactor 2. Remove bulkhead after Bioreactor 4. The length of temporary primary effluent piping may be shortened to introduce all primary effluent flow to the step feed channel and feed Bioreactors 3-6.

l. Bioreactors 1 and 2 are to be taken offline next. Install permanent bulkhead in the influent channel upstream of Bioreactor 1, which will completely remove that existing influent channel from service.

m. When Bioreactors 1 and 2 are taken offline, Secondary Clarifier 1 will be taken offline (along with RAS Pumps 1 and 2). Secondary system mechanical upgrades within Secondary Clarifier 1 can occur while Bioreactors 1 and 2 are being retrofitted to the IFAS configuration. RAS Pumps 1 and 2 can be removed and new pumps and piping (both RAS and WAS) will be installed.

n. Bioreactor internal walls will be demolished, and new walls will be constructed. A new effluent trough will be constructed along the full width of the newly configured Bioreactors 1 and 2, sloped to existing effluent gates.

o. New influent gates to be installed along the width of the bioreactors adjacent to the Step Feed Channel.

p. IFAS equipment can be installed along with diffuser drop legs to each aerated zone. Aeration piping for each bioreactor will connect to the butterfly isolation valve along the newly installed aeration header.

q. When all improvements have been completed, the bulkhead from the step feed channel will be removed and primary effluent will flow to each of the 6 IFAS basins. All temporary piping can be removed.

2. Once IFAS retrofit is complete, demolish the existing control and blower building.

Phase 8

1. Perform miscellaneous final improvements.
2. After all construction is complete, perform final landscaping and site paving.

9.1.4.2 Auxiliary Operations

The following systems will be maintained during construction throughout all phases as described below.

Effluent Pipe and Outfall

Discharge from the WWTP to the harbor shall be uninterrupted and maintained at all times. Bypass pumping may be necessary to perform any rehabilitation, cleaning or lining of the existing outfall.

Electrical

Electric power and lighting service shall be uninterrupted in all areas that remain in operation except as otherwise specified. The existing electrical distribution system shall remain in service until the new utility transformers, switchgear, standby power equipment and distribution network around the site has been installed, tested, accepted and made ready for operation. Temporary service to existing motor control centers (MCCs), panelboards, site lighting and other facilities requiring power may be required until replaced by new facilities.

Instrumentation and Control

Existing instrumentation and controls shall remain fully functional until control is switched to the new supervisory control and data acquisition (SCADA) system. Each SCADA control panel and vendor panel residing directly on the network, shall be installed prior to the installation of the plant wide fiber optic network cable. Once the network cable has been pulled and terminated at each patch panel, the operator workstations (OWS) shall be located in the control room. Then, the OWSs are placed onto the network and the SCADA system shall be viewable at each SCADA control panel human machine interface (HMI) and control room OWS.

Plant Water

Demolish and replace the plant water system. Provide a temporary plant water system with pumping capacity and pressure rating equal to the existing system and connect to the existing plant water distribution system until the new plant water system is installed, tested and made ready for operation.

Site Drainage

On-site storm drains shall be kept in operation at all times. Drains to be abandoned, removed, and/or replaced shall be kept in operation until new storm drains or temporary provisions for collecting storm run-off have been installed, tested, accepted and put into service. Sediment and erosion control measures shall be implemented.

Existing plumbing systems such as roof and floor drains, sump pumps, sanitary facilities, potable and protected water etc., shall be kept in operation at all times. Systems to be removed or replaced shall be kept in operation until new systems have been tested, accepted and authorized for use. If sewers or drains must be taken out of service to facilitate construction operations, alternative provisions shall be made to collect wastewater or drainage and dispose of them. Wastewater shall be discharged within the treatment plant headworks.

9.1.5 Ancillary Facilities

The improvements to the West Side WWTP will be all encompassing and will impact all aspects of the plant processes, infrastructure, and site. Ancillary work is required to support the new processes and the improvements to the existing processes to remain.

9.1.5.1 Civil/Site Design

The recommended improvements to the West Side WWTP will impact the entire site along with the vacant parcel to the north of the current WWTP. A significant amount of civil and site work will be required to develop the open parcels and to make the modifications within the current footprint.

The WWTP improvements include the construction of many new process facilities that will need to tie into each other and also into existing infrastructure. This work will require the installation of multiple new runs of piping, ranging from 4-in sludge and water piping to 72-in or larger to convey the peak main process flows of 200 mgd, the 58 mgd dry weather flow, and the 142 mgd wet weather flow. The majority of this piping will be ductile iron, however other materials such as copper, polyvinyl chloride (PVC), and high-density polyethylene (HDPE) may be utilized. Additionally, the largest diameter piping may be steel or prestressed concrete cylinder pipe (PCCP). Based on the historical drawings and site geotechnical information available, its anticipated that large diameter yard piping (greater than 12-inch or 24-inch) will be pile supported to prevent settling and to better connect to the structures and buildings that will also be pile supported.

The construction of various new facilities on the existing plant site and the northern vacant parcel will necessitate new access roads around the site for internal movement, deliveries of chemicals, fuels and septage, removal of screenings, grit, and solids, and access to the new control and administration building. The various site plans in Section 7 show preliminary concepts for new access roads, with continued access to the east side of the site from Bostwick Ave., and also potential access from Bostwick Ave. from the south by the final settling tanks depending on the ultimate orientation of the new control and administration building.

The civil/site work will also include miscellaneous grading and drainage improvements around both new structures and facilities and around the existing facilities. Green infrastructure will be included, when practical, as part of the grading and drainage improvements. Green infrastructure includes rain gardens, right-of-way bioswales, and other potential stormwater infrastructure. Landscaping will include lawn/unpaved open areas where feasible, along with trees and other plantings for visual aesthetics and partial screening of the WWTP from public view. A conceptual site plan of the recommended West Side WWTP improvements is shown in **Figure 9.1-9**.

Based on site history and limited available geotechnical and subsurface information, it is assumed that a majority if not all the soil excavated at the site will require some form of off-site disposal. A summary of subsurface investigations performed as a part of this report and known conditions is included in Section 4. Depending on the level of contamination encountered during design and construction, which will vary across the site, the excavated soil will require disposal at either an unlined landfill, lined landfill, commercial landfill, or at a Resource Conservation and Recovery Act (RCRA) regulated landfill for the most hazardous material. A comprehensive subsurface study, consisting of extensive sampling and lab analysis, will be performed during design to characterize the existing soil and to provide estimates of the volumes of soil that will require disposal at the various classes of disposal sites.

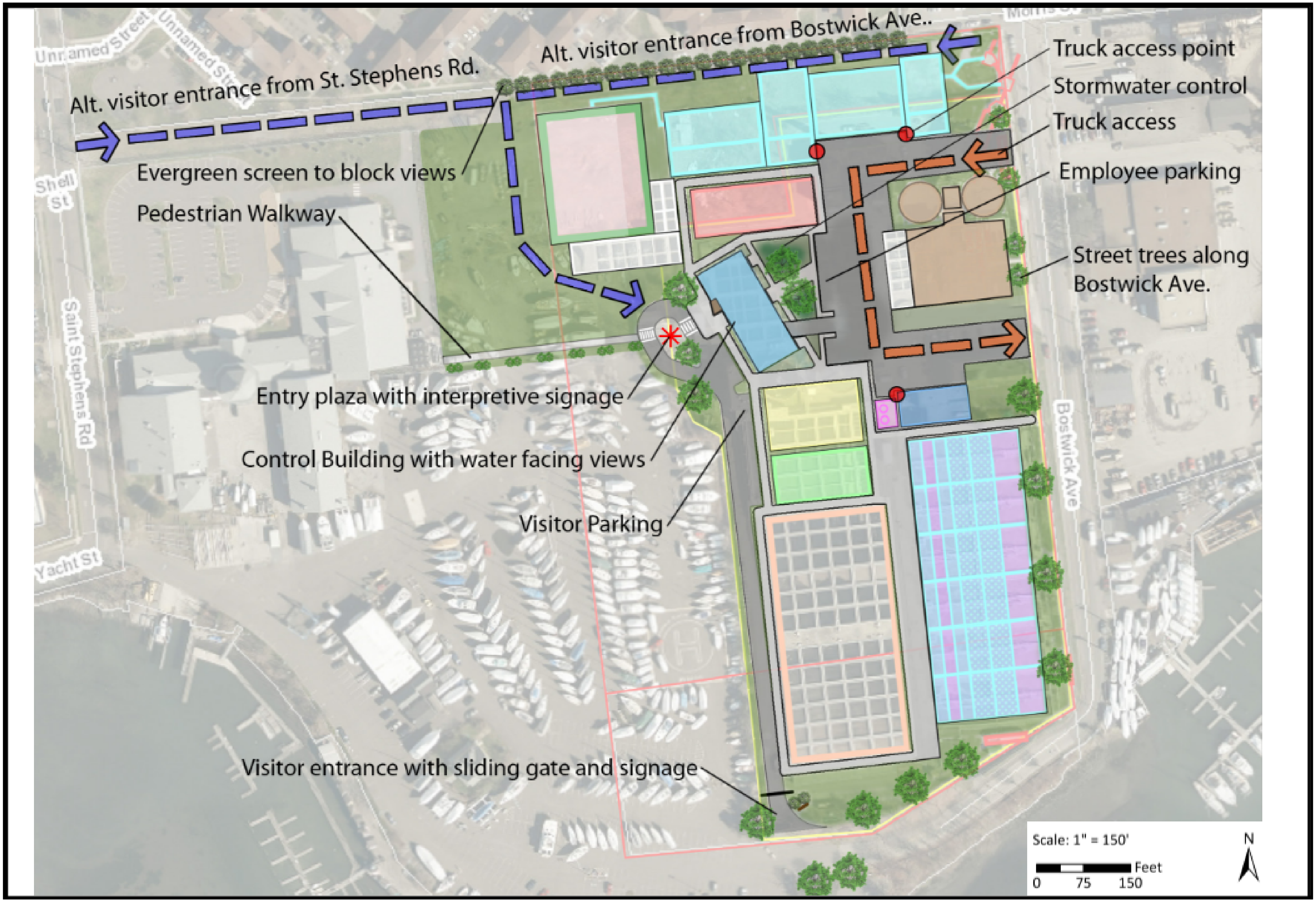

Figure 9.1-9
200 mgd West Side WWTP
Conceptual Site Plan

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9.1.5.2 Electrical Distribution and Standby Power

The improvements at the WWTP will increase the total electrical power demand and require a new power distribution system to replace the existing aging system, including new generators for emergency backup power. The new electrical distribution and standby system is anticipated to include the following:

- New 13.8 kV main power utility feed to the site
- 13.8 kV double ended main electrical switchgear
- Two diesel engine, 13.8 kV emergency power standby generators
- Three 13.8 kV to 480 V double ended unit substations
- Double ended MCCs within each major facility for feeding of process equipment
- System of concrete encased buried electrical duct banks around the site for distribution

In addition to the main power distribution, the electrical design will also include:

- New telephone and internet services to the site
- Closed circuit television (CCTV), site and building access, and building/site security systems
- Grounding and lightning protection
- Building and site lighting
- Fire alarm systems within facilities along with power requirements for a fire pump

9.1.5.3 Instrumentation and Control

The existing instrumentation and control system at the West Side WWTP is antiquated and very limited in system and process monitoring and control. A completely new SCADA system for process monitoring and control will be installed to replace the existing system and to tie together all the existing and the new process facilities and equipment to be installed. The new state of the art instrumentation and control system is anticipated to include the following:

- New central control/monitoring room in a new administration and control building.
- New self-healing fiber optic communication ring around the site.
- New building/process specific programmable logic controller (PLC) control panels with local operator interface terminals (OITs).
- New instruments and elements throughout the plant.
- Networking of equipment and systems to facilitate efficient transfer of data and information.

- SCADA system for process monitoring and control.
- Integration of vendor supplied control panels into the SCADA system. Many of the treatment processes will be provided with control panels fabricated and programmed by the manufacturer.
- Capabilities to communicate with remote sites in the future.
- WiFi through the new administration/control building.
- System flexibility to allow for future upgrades to accommodate technological advancements and innovations.
- Revised plantwide instrument and loop numbering scheme to facilitate system wide equipment and instrument identification and potential integration into asset management systems.

9.1.5.4 HVAC, Plumbing and Fire Protection

Building mechanical services (HVAC and plumbing) will be included in the new facilities and also replaced in all the existing facilities. The HVAC system will be designed in accordance with the latest building and fire protection codes to provide the required ventilation to address occupancy levels, area classifications, and limit hazardous conditions. Air conditioning will be provided where needed for equipment protection (e.g. electrical and computer server rooms) and for staff comfort.

A new City water service will be provided to the site from the street. City water will be routed within the site to the new and existing facilities where potable water sources are needed for wash down, eyewash and emergency showers, equipment operation, or staff usage. Fire protection will be provided in new and existing facilities where required. Coordination with the Fire Department will be performed during design to confirm compliance with local requirements. If required to provide adequate firefighting pressure around the site, a fire pump system will be installed. The design will be coordinated with the electrical design to ensure uninterrupted service.

9.1.5.5 Plant Water

A number of the new and existing processes will require plant/service water for operation, cleaning, flushing, wash down, etc. A new plant effluent water pumping and distribution system will be provided for the site to supply these needs. The pumping system will draw disinfected final effluent water and a new piping system will distribute it to the facilities and processes that require it. The location of the pumping system will be determined in final design when building/structure designs and their orientation on the site are more defined but a likely location could be within the effluent pumping station building.

9.1.5.6 Administration and Control Facilities

A new administration and control building will be provided at the West Side WWTP. The single facility will house the main monitoring and control facilities for the plant and serve as the central location for the WPCA administration staff. Additionally, the building will also serve as a public visitor center for public education, public engagement, and customer service. The facility is anticipated to include:

- Central monitoring and control room
- Plant supervisor offices
- WPCA staff offices
- Locker room facilities
- Conference, meeting, and break rooms
- Laboratory for process control
- Maintenance shop
- Visitor center lobby with customer service and bill pay

Conceptual floor plans of a new West Side WWTP administration and control building is shown in **Figure 9.1-10**.

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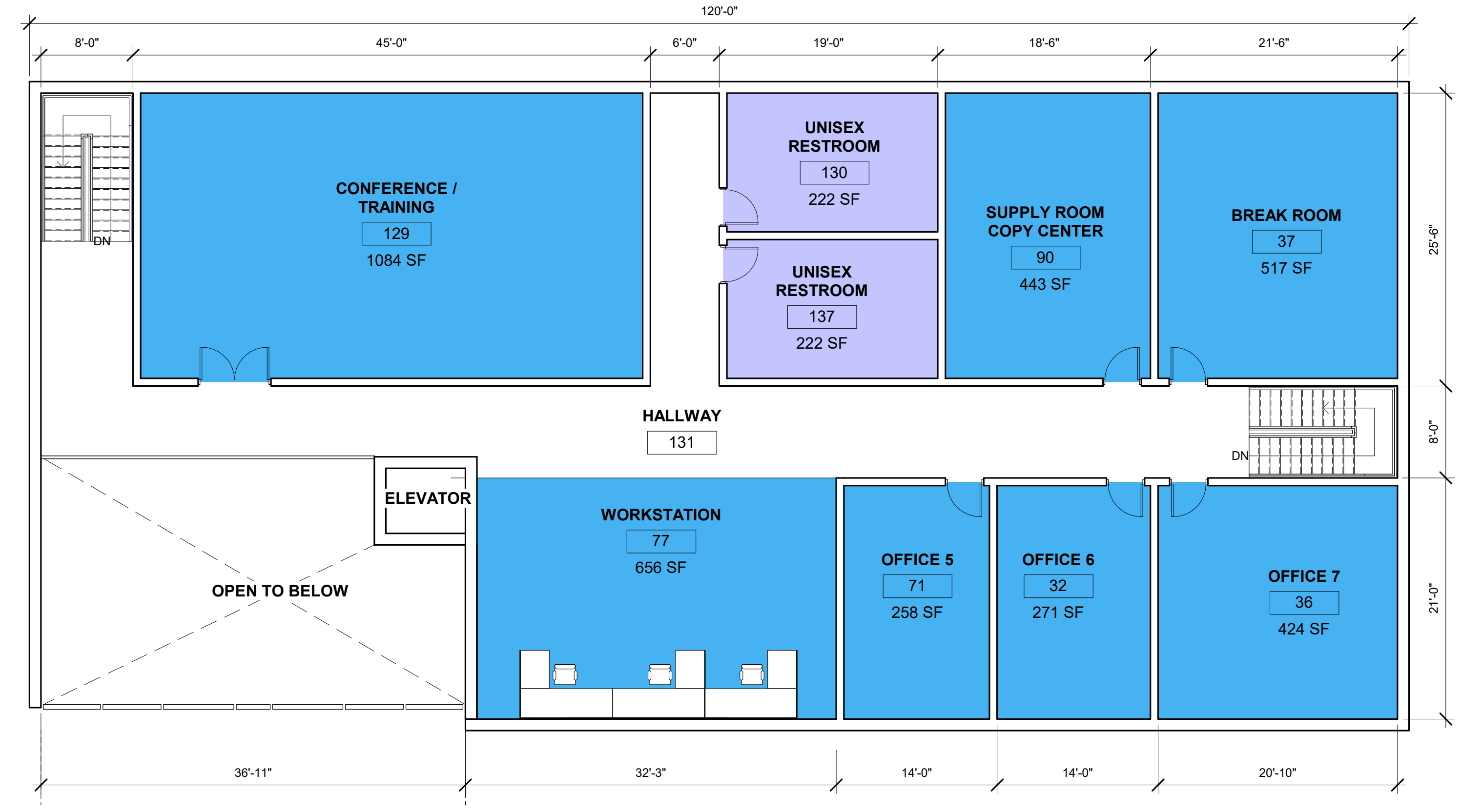
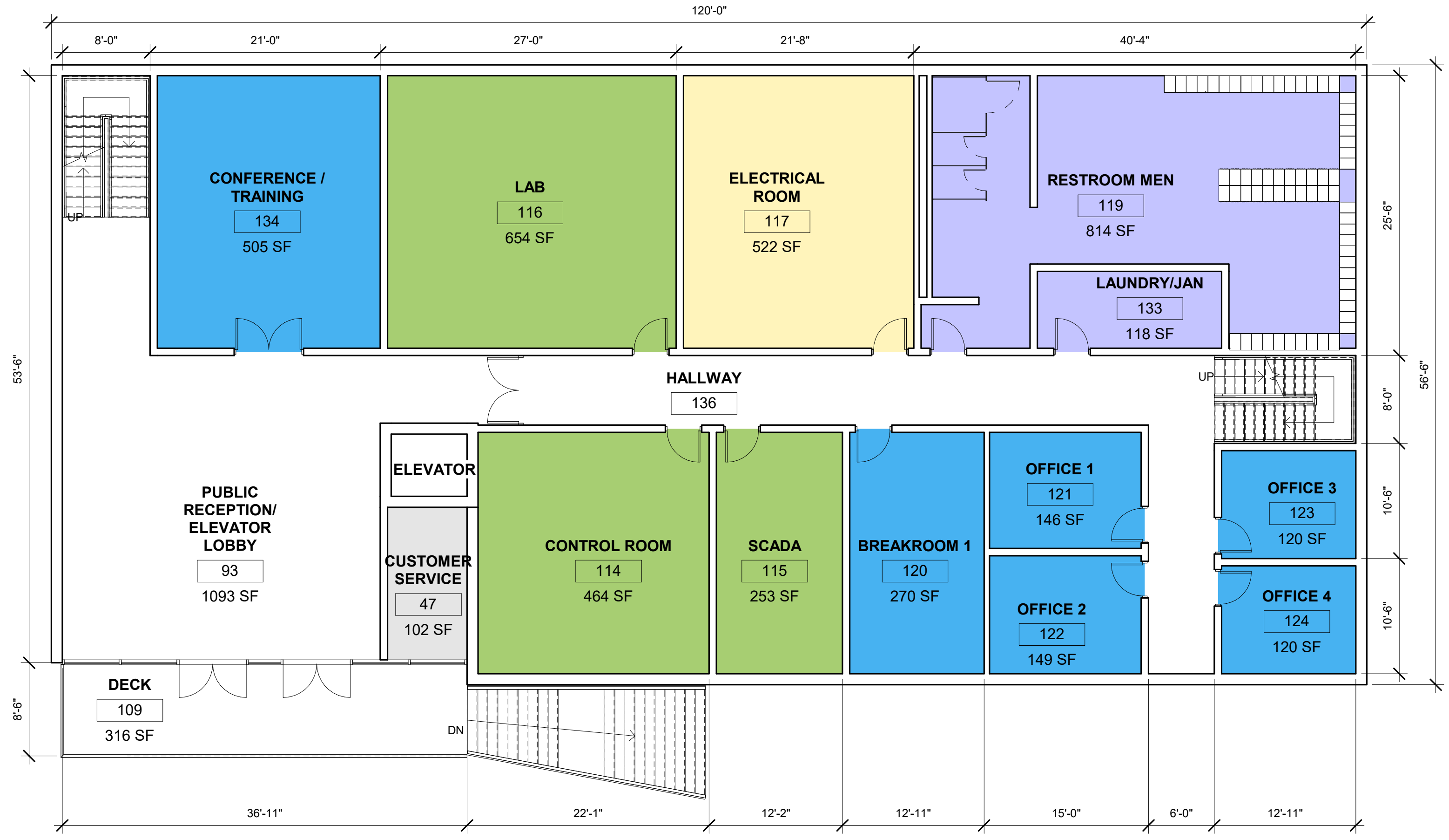
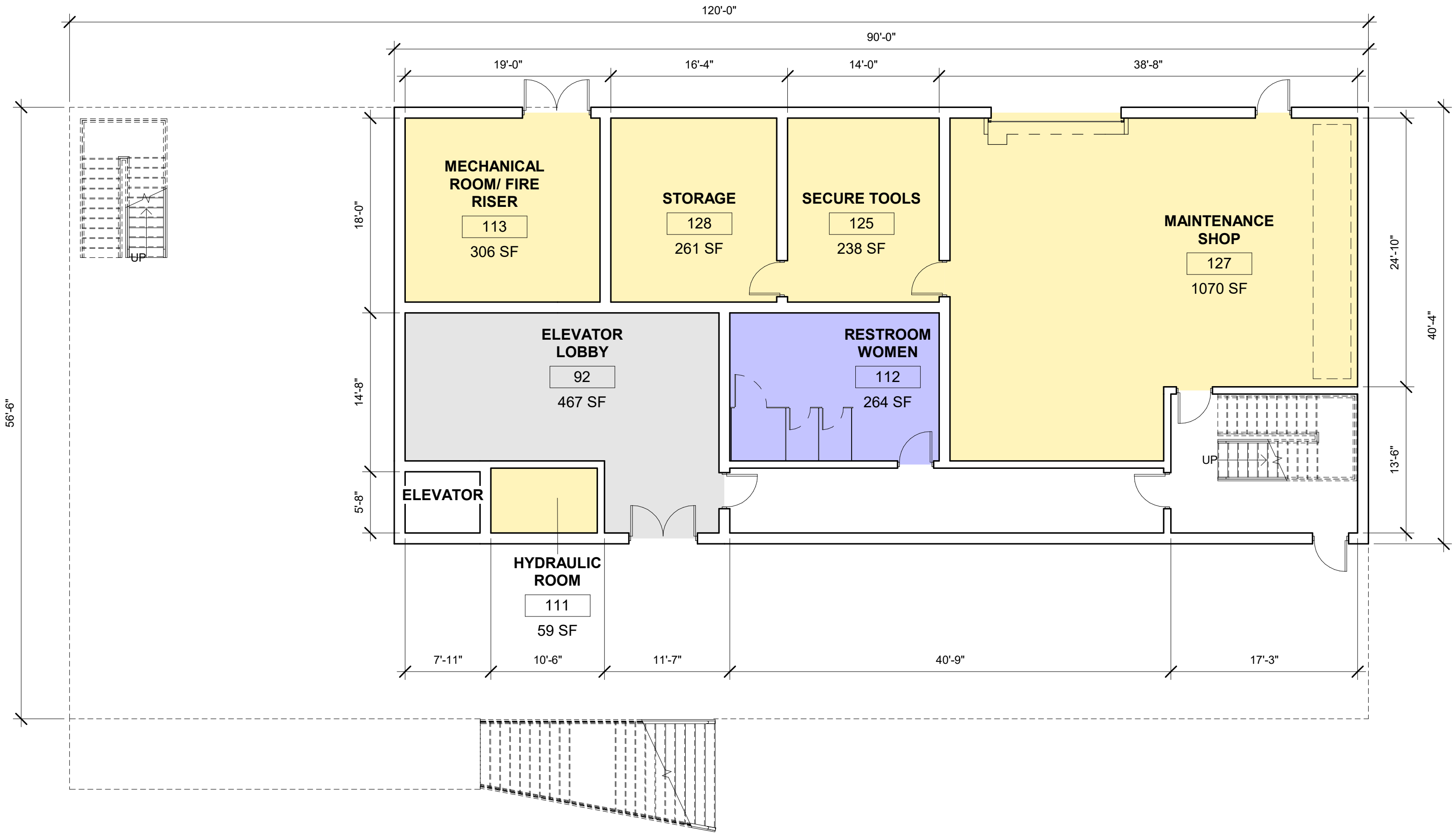


3 THIRD FLOOR PLAN



2 SECOND FLOOR PLAN



1 FIRST FLOOR PLAN

Figure 9.1-10
West Side WWTP
Control Building Concept

Water Pollution Control Authority, City of Bridgeport
Facilities Plan

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9.2 East Side Wastewater Treatment Plant

9.2.1 Recommended Plan

Based on the analysis presented in Sections 7 and 8, moving forward with a new upgraded and expanded WWTP at the East Side site with the capacity to pass a peak flow of 80 mgd, provides the most cost-effective, holistic approach to wet weather management while providing a facility that is robust and resilient under future conditions.

In general, the recommended facility consists of a new headworks facility, capable of treating a peak flow of 80 mgd, constructed to the north of the existing headworks. Flow would be redirected from the two existing influent structures via a 54-inch pipe to the new headworks facility. Three new multi-rake screens with 1-inch bar spacing would be provided (two operating with one standby at peak flow) ahead of the influent pumps for pump protection. Under average flow conditions, only one screen would be operational. Two screenings washer compactors would be provided discharging to a roll-off container at grade. Screened influent would pass to a trench-style wet well. Six identical centrifugal pumps (five operating with one standby at peak flow) would be provided. During design, alternative pump schemes will be reviewed to optimize pumping efficiency under average flow conditions which could result in providing smaller “jockey” pumps to operate during average and low flow conditions. Pump motors would be set at an elevation to protect them from flooding at the 100-year plus three feet elevation. Influent flow would be pumped to an approximate elevation of 41.0 to allow gravity flow through the entire plant under average conditions. Influent flow measurement would be accomplished by magnetic flowmeters installed on the pump discharge. Pumped flow would first flow through a set of fine screens with ¼-inch bar spacing. Three fine screens would be provided (two operating with one standby at peak flow). Again, only one screen would be required under average flow condition. Flow and level elements would be used to automatically bring screens online or offline using electrically actuated gates. Screenings washer compactors would be provided, to reduce odor, volume and weight of the screenings removed from the site. Screened flow would then pass to two stacked tray grit removal systems. The number of units online would be determined by influent flow measurement. Each stacked tray would be provided with two grit pumps, one operating with one standby. Collected grit would be pumped to a grit classifier or washer to wash and concentrate grit before being conveyed to a roll-off container at grade. The stacked tray grit removal system requires a constant flow of plant water to keep grit fluidized for pumping. This new headworks facility would be a major improvement over the plant’s current preliminary treatment. By significantly increasing grit and screening removal, operation and maintenance of downstream equipment would be improved dramatically.

Screened and degritted influent flow would then be conveyed to dual-use primary filtration units (cloth media disk filters). Five trains/rotating units would be provided with 24 disks per train. Under average day conditions two units would be in service operating at 1.3 gallons per minute per square foot (gpm/sf). Under wet weather flow all five units would be in operation and loaded at a hydraulic loading rate of 4.3 gpm/sf. When flow exceeds 24 mgd (the hydraulic capacity of the secondary treatment system), the portion of primary effluent flow over 24 mgd would bypass the secondary treatment system and be conveyed directly to UV disinfection. Flow to the secondary treatment system would be measured using the existing Parshall flume to ensure it does not exceed 24 mgd. The bypassed wet weather flow rate would be calculated by taking the difference in the secondary treatment flow measurement from the influent flow measurement, accounting for any sidestream flow.

Information from the pilot study performed at the West Side WWTP will be used to refine the design criteria of the primary cloth disk filtration system, assess BOD_5 and TSS removal efficiencies to finalize primary effluent loads to be used in the design of the BNR process, establish primary effluent UV transmittance to be used for the UV disinfection system design criteria, assess backwash volumes and frequencies, and characterize primary solids for sludge management systems' design criteria.

Primary effluent up to 24 mgd would flow through the new anoxic zones (converted primary clarifiers). Each of the six existing bioreactors would be reconfigured to operate as traditional 4-stage Bardenpho process to achieve nitrogen removal year-round under design year flow and load conditions. A new blower building would be provided with four new blowers (the type of blower will be determined during preliminary design). In addition, a supplemental carbon storage and feed system would be provided to ensure adequate nitrogen removal under all conditions. New instrumentation and controls would be incorporated to enable efficient operation of the BNR system and blower operation. The three existing final settling tanks would be upgraded with all new mechanical equipment including sludge and scum collection equipment, RAS and WAS pumping, and scum pumping.

Secondary effluent would be conveyed to the UV disinfection system where it would recombine with any wet weather flow which bypassed secondary system. The UV system would consist of three channels, each with six UV modules. All three channels would be in service at peak wet weather flow while at average day conditions, only one channel would be in service. Immediately upstream or downstream of the UV system, a Parshall flume would measure the final effluent flow rate. This flow measurement along with level measurement elements would automatically control the operation of the UV channels and modules to ensure proper disinfection. Under normal flow and receiving water conditions, the effluent from disinfection would be discharged by gravity through the effluent pipe. Under extreme tide events, effluent pumping would be provided to enable passing of flow through the plant during a 100-year flood event. Six effluent pumps capable of pumping the full 80 mgd would be provided with one pump as a standby.

Primary solids would be pumped from the primary filters to the existing gravity thickeners and waste activated sludge would be pumped from the secondary clarifiers to intermediate WAS storage tanks within the new Solids Handling Facility. It is intended that the existing gravity thickeners would be fully rehabilitated and the existing pumping systems replaced with new units (with appropriate redundancy). From the storage tanks, WAS would be pumped to one of two rotary drum thickeners on the main level of the facility. Thickened primary sludge would be pumped from the gravity thickeners and thickened waste activated sludge would flow by gravity into a second set of holding tanks for co-storage. Both WAS and thickened sludge storage tanks would be primarily below grade and shall be intermittently mixed with air supplied by low pressure air blower systems. Combined thickened sludge will be stored prior to being off-loaded to sludge hauling tanker trucks for further treatment and disposal. It is intended that the Solids Handling Facility will include thickener units, low pressure air blowers, polymer system and electrical room on the main level, with the finished floor elevation above the 100-yr flood elevation plus three feet. The main level of the facility would partially cover the sludge storage tanks below, while providing sufficient access for inspection and maintenance from outside of the building envelope. A loading dock with roll-up door would be provided for equipment removal. The loading dock area would also serve as a tanker truck loading area in addition to a polymer fill station. The lower level of the Solids Handling Facility will include sludge storage tanks, WAS feed pumping for the RDTs, a wash water booster pump system (if required), and the truck loading pumps. Although not included in this recommended plan, the solids facility would be designed to accommodate pumping biosolids to a new off-site stabilization facility in the future if so desired.

At this point, it is expected that one odor control system would be provided. This system would collect and treat air from the headworks facility and the primary treatment facility and off-gases from the gravity thickeners, sludge holding tanks and rotary drum thickeners. A biofilter is proposed for this air stream. A more detailed analysis of the odor control system will be conducted during preliminary design.

A new control building would be constructed with dedicated space for operations, laboratory, locker rooms, and a maintenance shop.

A schematic of the proposed treatment facility is presented in **Figure 9.2-1** and the site plan is presented in **Figure 9.2-2**. **Table 9.2-1** presents a summary of the design criteria for the new facility.

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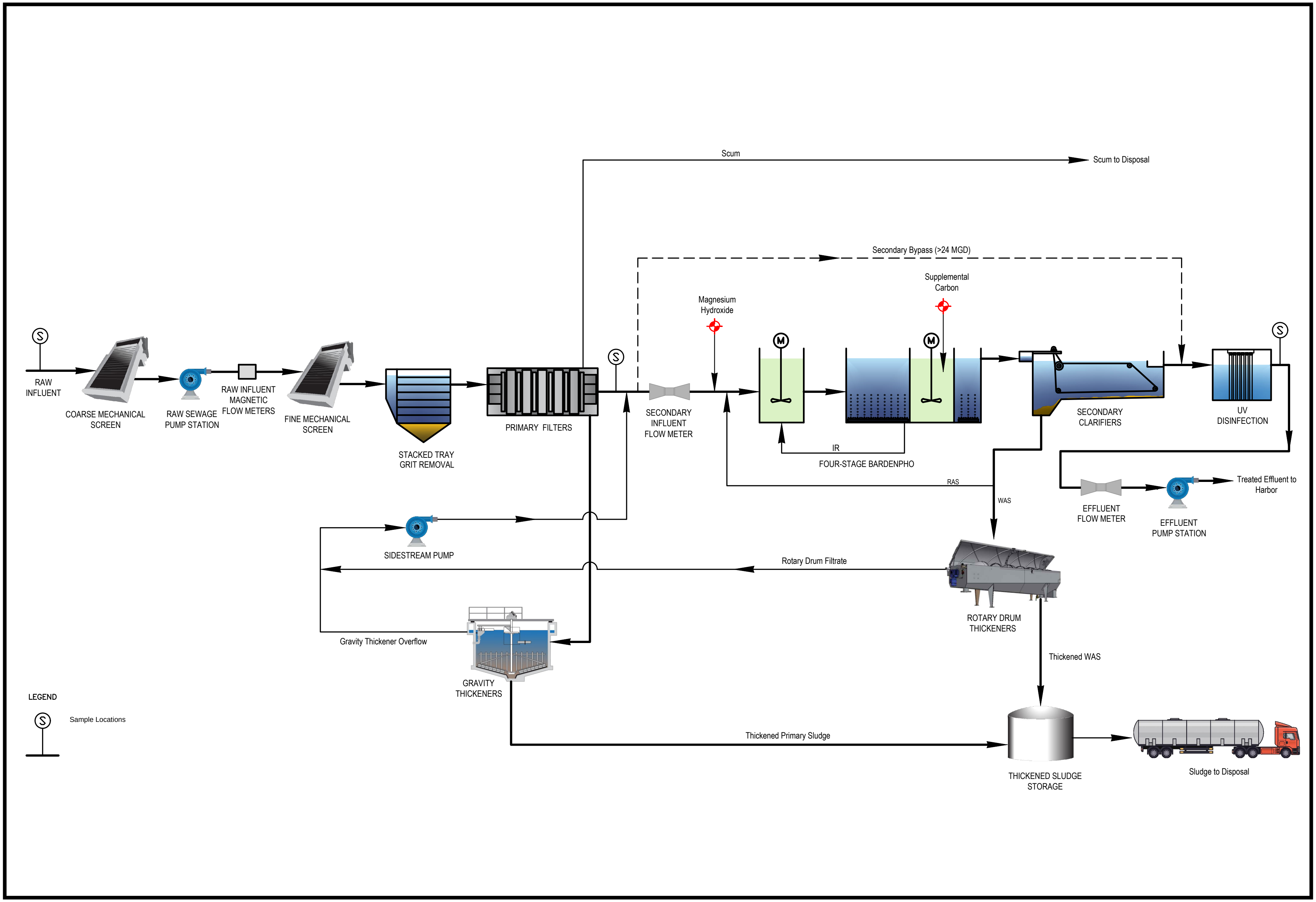

Figure 9.2-1
East Side Recommended Plan
Process Flow Diagram

Water Pollution Control Authority, City of Bridgeport
Facilities Plan

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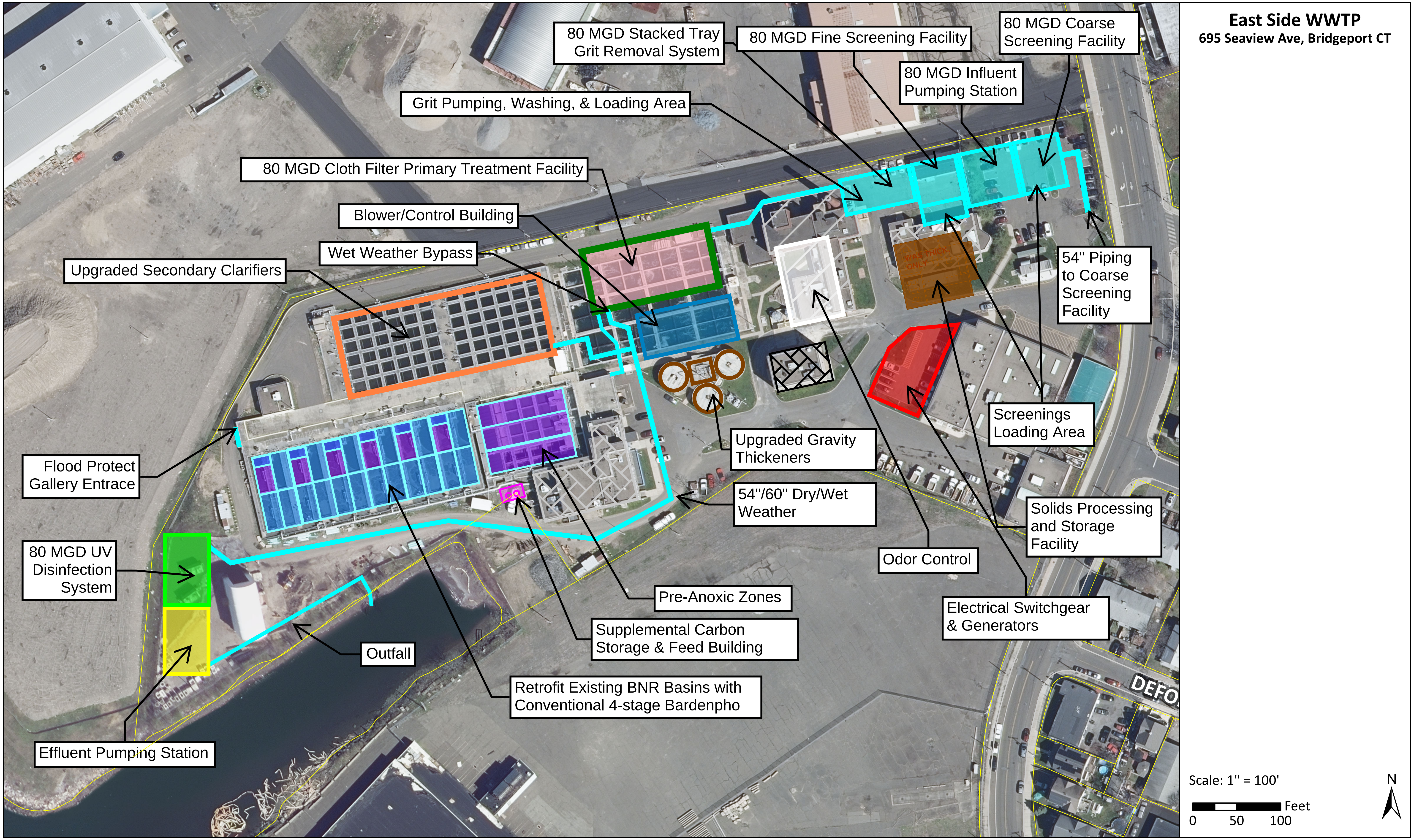

Figure 9.2-2
Recommended Plan - Alternative E-80D

CDM Smith

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Table 9.2-1

East Side WWTP Recommended Plan Design Criteria

Flow	
Average Design Flow	10 mgd
Peak Design Flow	80 mgd
Secondary System Design Flow	24 mgd
Influent Coarse Screens	
Number	3 (2 operating, 1 standby)
Type	Multi-rake
Opening	1-inch
Influent Pumps	
Number	6 (5 operating, 1 standby)
Type	Centrifugal
Capacity, each	16 mgd
Approximate HP	150
Influent Fine Screen	
Number	3 (2 operating, 1 standby)
Type	Multi-rake
Opening	1/4 inch
Screenings Washer Compactor	
Number	4
Type	Washer/compactor with grinder
Capacity, each	200-300 ft^3/hr
Grit Removal	
Number	2 (2 operating at peak flow)
Type	Stacked Tray
Capacity, each	40 mgd
Plant Water	80 gpm/unit
Grit Pumps	
Number	4 (2 operating at peak flow)
Capacity, each	400 gpm
Approximate HP	TBD
Grit Classifier	
Number	2 (2 operating at peak flow)
Type	Grit Slurry Washer
Capacity, each	550 gpm
Plant Water	47 gpm/unit
Primary Filtration	
Number of Trains	5 (5 operating at peak flow)
Disks per Train	24
Capacity per Train	16 mgd
Hydraulic Loading Rate	4.29 gpm/ft^2

Table 9.2-1

East Side WWTP Recommended Plan Design Criteria

Backwash Pumps	
Number	5
Capacity, each	790 gpm
Approximate HP	20
Primary Sludge Pumps	
Number	5
Capacity, each	790 gpm
Approximate HP	20
Four-Stage Bardenpho Activated Sludge	
Number of Trains	3
Pre-Anoxic Zone Volume, each train	0.21 MG
Dimensions	99 ft x 26 ft x 10.7 ft
Mixers per zone	2 - 5 HP
Aerobic Zone Volume, each train	0.26 MG
Number of Stages, each train	3
Dimensions per stage	43 ft x 20 ft x 13.8 ft
Aeration Type	Fine bubble disk diffusers
Internal Recycle Pump, type	Submersible
Number	6 total (2 per train)
Capacity	4,630 gpm
Motor HP	3
Average IR Rate	400%
Post Anoxic Zone Volume, each train	0.07 MG
Dimensions	34.4 ft x 20 ft x 13.8 ft
Mixers per zone	2 - 1 HP
Re-aeration Zone Volume, each train	0.02 MG
Dimensions	8.4 ft x 20 ft x 13.8 ft
Aeration Type	Fine bubble disk diffusers
Secondary Clarifiers	
Number	3
Dimensions	240 ft x 28 ft x 10.25 ft
RAS Pumps	
Number	3
Type	Vertical, non-clog, centrifugal
Capacity, each	3,600 gpm
Approximate HP	65
WAS Pumps	
Number	4 (3 duty, 1 standby)
Type	Horizontal, non-clog, single stage, centrifugal
Capacity, each	600 gpm
Approximate HP	5

Table 9.2-1

East Side WWTP Recommended Plan Design Criteria

Disinfection	
Number of Channels	3
Number of UV Modules per Channel	6
Channel Width	5 ft
Channel Depth	8 ft
UV Transmittance %	50
UV Dose	45 mJ/cm^2
Effluent Pumps	
Number	6 (5 operating, 1 standby)
Type	Submersible Axial Flow
Capacity, each	16 mgd
Approximate HP	100
Gravity Thickeners - Existing	
Number	3 (2 operating, 1 standby)
Volume, each	52,900 gal
Diameter	30 ft
Depth	10 ft
Rotary Drum Thickener	
Number	2 (1 Duty, 1 Standby)
Capacity, each	250 gpm
Thickener Feed Pumps	
Number	2 (1 Duty, 1 Standby)
Capacity, each	250 gpm
Truck Fill Pumps	
Number	2 (1 Duty, 1 Standby)
Capacity, each	250 gpm
WAS Storage	
Number of tanks	2
Dimensions	25-ft x 14-ft x 12-ft
Capacity, each	31,000 gal
Thickened Sludge Storage	
Number	2
Dimensions	25-ft x 25-ft x 24-ft
Capacity, each	112,000 gal

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9.2.2 BioWin Modeling

A whole plant process model of the East Side WWTP was developed using Biowin process modeling software (Version 6.1.7.2226, EnviroSim Associates, Ltd.). The model was calibrated using a two-week period of intensive sampling and validated against one year of historic plant data. For a detailed discussion of the calibration and validation procedure, see **Appendix L.**

The calibrated BioWin model developed for the East Side WWTP was reconfigured to match the recommended alternative identified in Section 7 of this Facilities Plan. The existing conditions model and the reconfigured model is shown in **Figures 9.2-3** and **Figure 9.2-4** respectively.

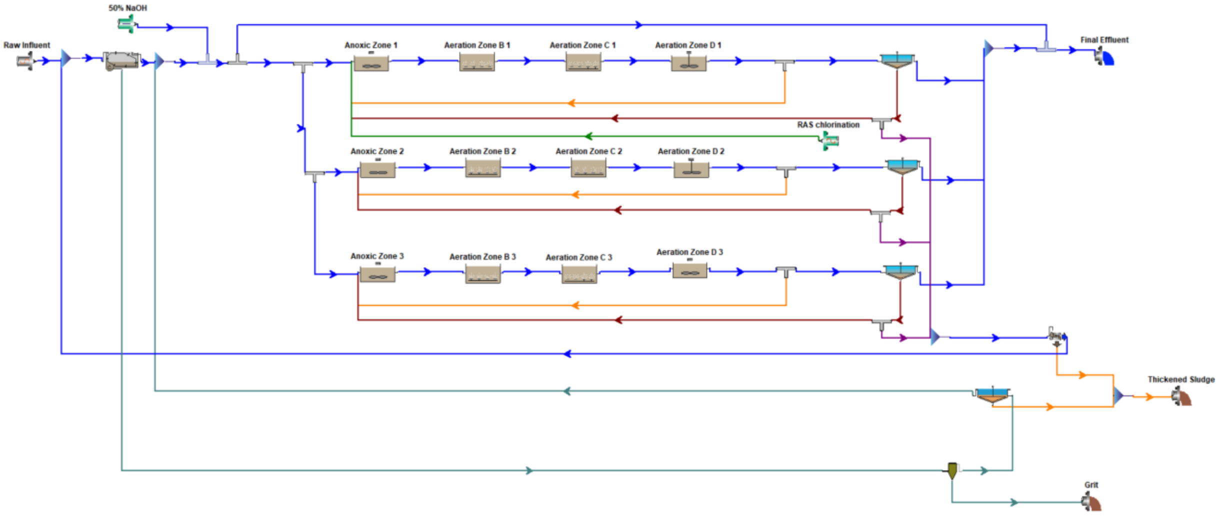

Figure 9.2-3
Existing Conditions Biowin Model

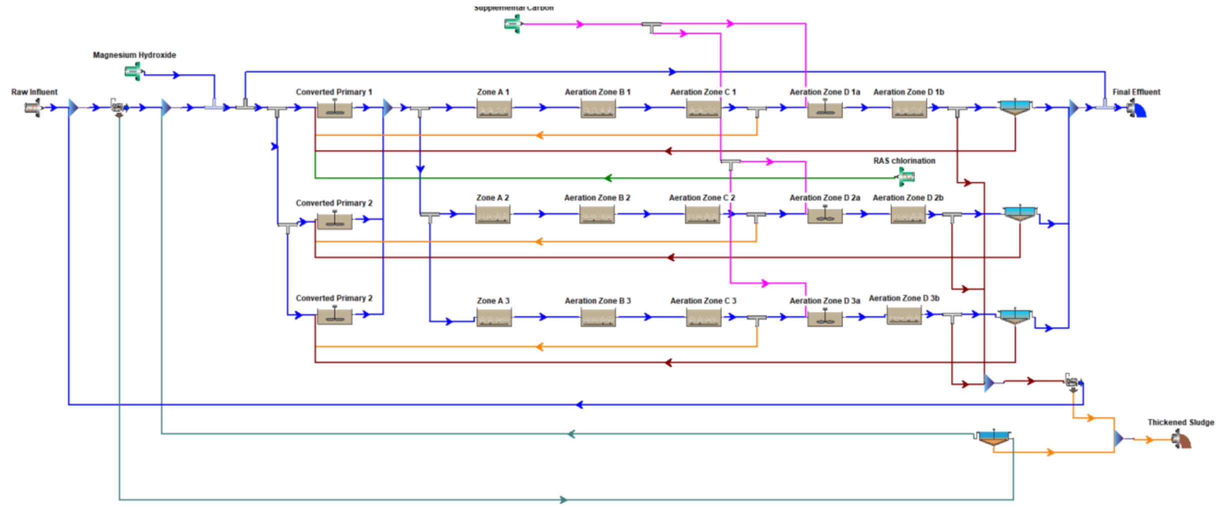

Figure 9.2-4
Recommended Upgraded East Side WWTP Biowin Model

For the design condition, a one-year dynamic model influent itinerary was developed based on a one-year historical dataset (2019). As part of future work, the dynamic model should be 'offset' so that the maximum month and maximum day loading occurs at different periods throughout the year. As part of the Facilities Planning effort, the variation in flow and loading was consistent with the time-period used during the model's validation year. Bypass volume was assumed to equal the bypass volume and frequency from the validation year. Methods for developing this dynamic inventory are further detailed in Appendix L. Two loading scenarios were evaluated:

- **Condition A: BNR + Conventional Treatment:** the secondary system will be designed to achieve effluent NPDES limits (e.g. BOD_5 and TSS) in addition to the effluent TN load (362 lbs/day) under all flow and load conditions associated with the WWTP's projected 6.4 design capacity.
- **Condition B: Conventional Treatment:** the secondary system will be designed to achieve effluent NPDES limits (e.g. BOD_5 and TSS) under all flow and load conditions associated with the WWTP's permitted flow capacity of 10 mgd. The secondary system may not be able to achieve the effluent nitrogen permit limits under all these flow and load conditions, however this flow and load is not expected until well after 2050.
- The modeled effluent total nitrogen for the two Condition A scenarios are presented in Table 9.1-2, along with effluent total nitrogen.

Condition A also included the evaluation of a supplemental carbon feed system to minimize the total mass of nitrogen in the treated wastewater. The model predicted effluent total nitrogen load (and concentration) for the two Condition A scenarios is presented in **Table 9.2-2**.

Table 9.2-2 Summary of Model Predicted Effluent Total Nitrogen Loads (and concentrations) for the Recommended East Side WWTP Configuration at Design Year Flows and Loads

Month	Effluent TN, lbs/day, (mg/L)	
	Condition A (6.4 mgd)	
	No Carbon addition	50 gallons/day Carbon Addition to Post-Anoxic Zone
January	290 (3.7)	280 (3.6)
February	250 (3.7)	220 (3.3)
March	220 (3.6)	200 (3.3)
April	250 (4.0)	220 (3.4)
May	230 (3.9)	200 (3.3)
June	200 (5.0)	110(2.7)
July	280 (6.0)	150 (3.3)
August	250 (6.8)	110 (3.0)
September	300 (9.3)	78 (2.4)
October	280 (6.7)	160 (3.8)
November	220 (5.0)	150 (3.3)
December	300 (4.3)	280 (4.0)
Annual Average	280 (5.2)	180 (3.3)

Comparing results of Condition 1A (without carbon) to Condition 1B (with carbon addition) shows that carbon addition through summer and early fall months (June-October) can drive denitrification and reduce effluent total nitrogen. Despite this improvement in effluent TN loading using carbon, the upgraded East Side WWTP configuration is predicted to achieve the annual average effluent total nitrogen goal by more nearly 100 lbs/day without carbon addition. Although the model predicts that endogenous decay in the post-anoxic zone is sufficient to meet the annual average nitrogen load limit, and that supplemental carbon is not required, this system could be included in the design as a contingency, or could be deferred.

The modeled predicted monthly average, effluent TSS and BOD_5 concentrations for each of the three scenarios is presented in **Table 9.2-3**.

Table 9.2-3 Monthly Summary of Model Predicted Effluent BOD_5 and TSS at the Upgraded East Side WWTP at Design Year Flows and Loads

Month	Condition A (6.4 mgd)				Condition B (10 mgd)	
	No Carbon addition		50 gallons/day Carbon Addition to Post-Anoxic Zone		No Carbon addition	
	BOD_5 (mg/L)	TSS (mg/L)	BOD_5 (mg/L)	TSS (mg/L)	BOD_5 (mg/L)	TSS (mg/L)
January	4.7	7.6	4.7	7.6	7.0	13
February	3.0	6.4	3.0	6.4	5.2	12
March	2.8	5.7	2.8	5.7	4.9	11
April	3.2	5.9	3.3	5.9	5.1	10
May	3.0	5.4	3.1	5.4	4.9	9.7
June	2.2	3.4	2.3	3.4	3.4	6.3
July	4.4	4.4	4.6	4.5	5.3	7.2
August	2.6	3.2	2.8	3.2	3.6	5.6
September	2.0	2.6	2.4	2.7	3.0	4.7
October	5.4	4.9	5.5	4.9	7.0	7.5
November	2.4	3.8	2.5	3.8	3.9	7.0
December	3.9	6.5	3.9	6.5	6.2	12
Annual Average	*3.3*	*5.0*	*3.4*	*5.0*	*5.0*	*8.8*

Regardless of supplemental carbon addition, the model predicts negligible difference in effluent BOD_5 or TSS for Condition A. Both constituents are well under the NPDES permit limit of 30 mg/L for every month in the model year and the annual average. Condition B has significantly higher effluent BOD_5 and TSS than Condition A due to the higher clarifier loading associated with the higher MLSS for Condition B.

The developed process model predicts a mixed liquor suspended solids ranging from a low of approximately 600 mg/L to a high of approximately 2,300 mg/L for Condition A (with or without carbon addition) and from a low of approximately 600 mg/L to a high of approximately 3,100 mg/L for Condition B. The maximum mixed liquor predicted for Condition B is above the capacity of the secondary clarifiers (2,500 mg/L).

In order to maintain an MLSS below the capacity of the secondary clarifiers, the post-anoxic zone would need to have swing zone flexibility to increase the aerobic volume of the aeration tanks allowing the target solids retention time to be met with a lower MLSS. This refinement of the proposed design would also require the installation of a second internal recycle to pull the nitrate recycle suction from different points along the length of the train.

The modeled MLSS may be too low for effective settling as sludge that is too thin doesn't flocculate as well as a thicker sludge. Generally, the minimum recommended MLSS is 1,200 mg/L although this value changes from plant to plant. Due to the East Side WWTP's history of operating at very high MLSS, methods to enhance sludge settleability at model predicted very low MLSS should be considered in the design. This could be seasonal operation of the aeration tanks and taking tanks offline during period of low loading, or bypass of some primary influent around the new primary filters to increase loading to the secondary system. There may be other methods to enhance secondary clarifier performance which can be evaluated during detailed design.

9.2.3 Hydraulic Modeling and Plant Hydraulic Capacity

CDM Smith developed a hydraulic model for the East Side WWTP for the leading alternative. From this model a hydraulic profile was created for the peak flow condition of 80 mgd discharging against a 100-year flood. The hydraulic profile is shown in **Figure 9.2-5**. The model and profile were computed using Visual Hydraulics, Version 4.2 by Innovative Hydraulics.

Table 9.2-4 lists the unit processes and identifies the number of units in service for the peak flow hydraulic profile calculations.

Table 9.2-4 Unit Process Peak Flows

Design Element	Peak Hour (mgd)	RAS (mgd)	Internal Recycle (mgd)	Total (mgd)	Units In-Service	Peak Flow per Unit (mgd)
Coarse Screens	80	-	-	80	2 of 3	40.0
Influent Pumps	80	-	-	80	5 of 6	16.0
Fine Screens	80	-	-	80	2 of 3	40.0
Grit Units	80	-	-	80	2 of 2	40.0
Primary Filters	80	-	-	80	5 of 5	16.0
Pre-Anoxic Tanks	24	6	30**	60	3 of 3	20.0
Aeration Basins	24	6	30**	60	6 of 6	10.0
Secondary Clarifiers	24	6	-	30	3 of 3	10.0
UV Channels	80	-	-	80	4 of 4	20.0
Effluent Pumps	80	-	-	80	5 of 6	16.0

** Internal recycle between from aeration basins to pre-anoxic tanks

The existing WWTP does not have an effluent pumping station, but to accommodate higher flows and discharge against a 100-year flood, effluent pumping may be required during these extremes. When pumping is not needed, the plant will discharge by gravity.

Modeled hydraulic head change between the influent pump station and the effluent pump station represents the net head gain that would be required by the influent pump station. At 80 mgd, the net head gain needed at the influent pump station is 32.4 feet. The modeled hydraulic head change between the effluent pump station and the discharge elevation (30.6 feet in Bridgeport datum) is 9 feet.

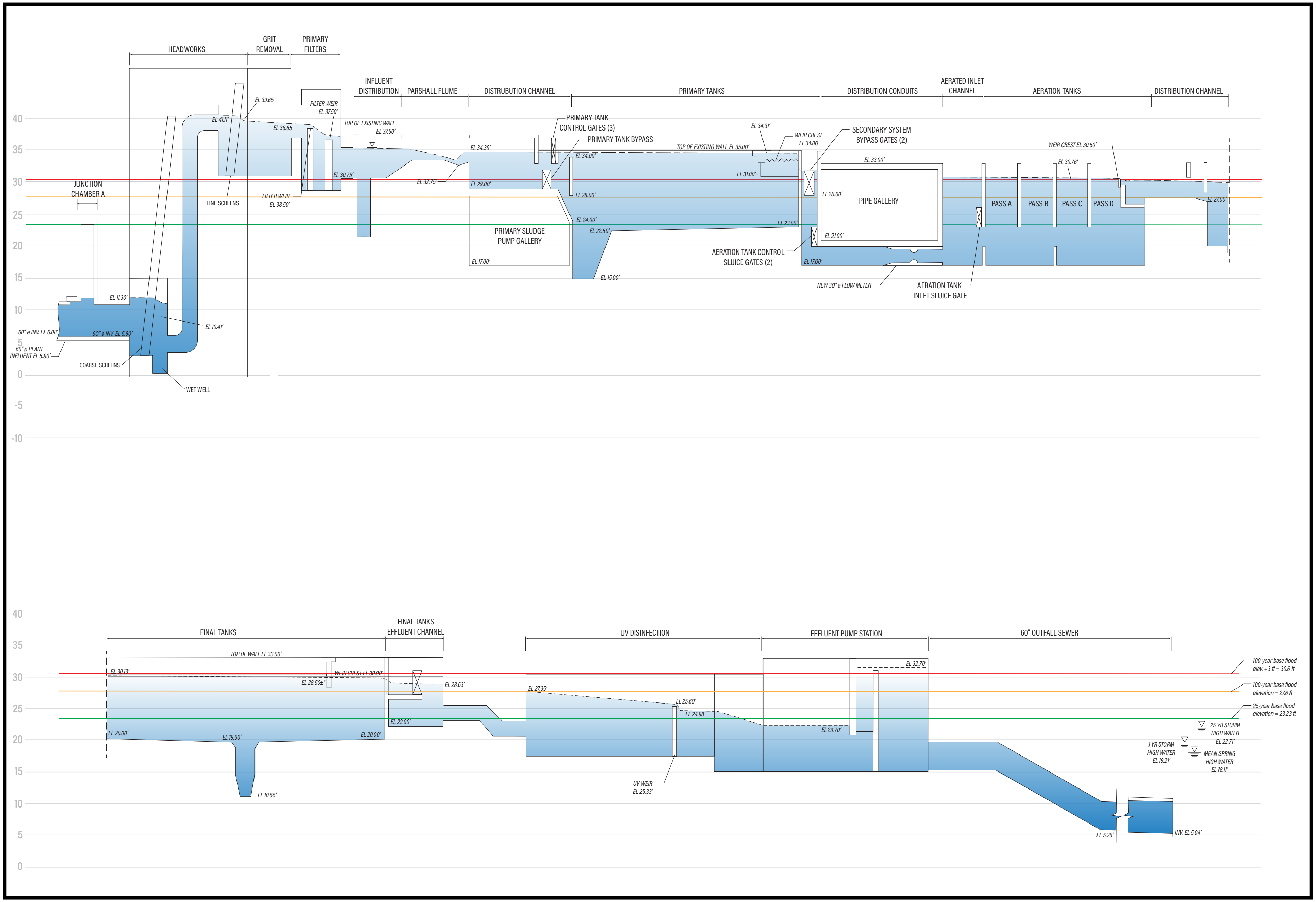

Figure 9.2-5
East Side WWTP Recommended Plan
Hydraulic Profile

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Additional assumptions used in the hydraulic model are listed below. Any changes made to these during the design phase may require modifications to this model and may alter the proposed hydraulic grade line.

- Conveyance between some treatment units was excluded from the model, with the assumption that these conveyance elements would not result in more than two feet of total headloss in the hydraulic profile. As design of the plant is finalized, this assumption will be re-evaluated and adjusted as necessary. All conveyance lengths greater than 100 feet were included in the model.
- The conveyance from the primary filters to the pre-anoxic tanks was modeled as primarily 42-inch diameter pipe before transitioning to channel flow including the existing 5-foot Parshall flume.
- The existing 60-inch diameter outfall was maintained.
- Headloss through screens was approximated at 50% and 40% blinding for coarse and fine, respectively.
- Headlosses for screens, grit chambers, cloth filters, and UV treatment are all based on estimates that will be refined as designs are finalized.
- An effluent Parshall flume will be included upstream of the effluent pump station. While headlosses from this structure are expected to be small, they are not explicitly included in the current hydraulic model or profile.
- The headgain represented in the hydraulic model pump stations is a net head gain. Headloss from influent flow metering was not included in the hydraulic model as it was assumed the loss would be accounted for in the influent pump headgain and would not have impact on the upstream or downstream hydraulic grade line.
- This hydraulic model was developed using the existing outfall configuration. Any changes to the outfall configuration would require a re-evaluation of required head at the effluent pump station.

9.2.4 MOPO

In order to maintain continuous plant operations during construction, a phased construction sequence similar to that described herein shall be required at the East Side WWTP. Specific constraints and steps are outlined and are intended to suggest a sequence for specific activities. Unless specifically noted below, the construction activities shall not, under any circumstances reduce the treatment capability of the plant, reduce the ability to hydraulically convey dry or wet weathers flows through the plant or reduce effluent quality. The treatment capability of the plant refers to all portions of wastewater treatment including screenings, grit removal, influent pumping, primary treatment, secondary treatment, disinfection, sludge thickening and laboratory capabilities.

The East Side WWTP currently receives an average daily flow of 5.7 mgd with a minimum day flow of 3.3 mgd, and a wet weather peak hour flow of 28.2 mgd. However, the peak rating of the existing facility is 40 mgd with an average rating of 10 mgd. All temporary bypass piping and pumping facilities proposed for the work herein shall maintain existing process hydraulic capacity.

9.2.4.1 Preliminary Sequence

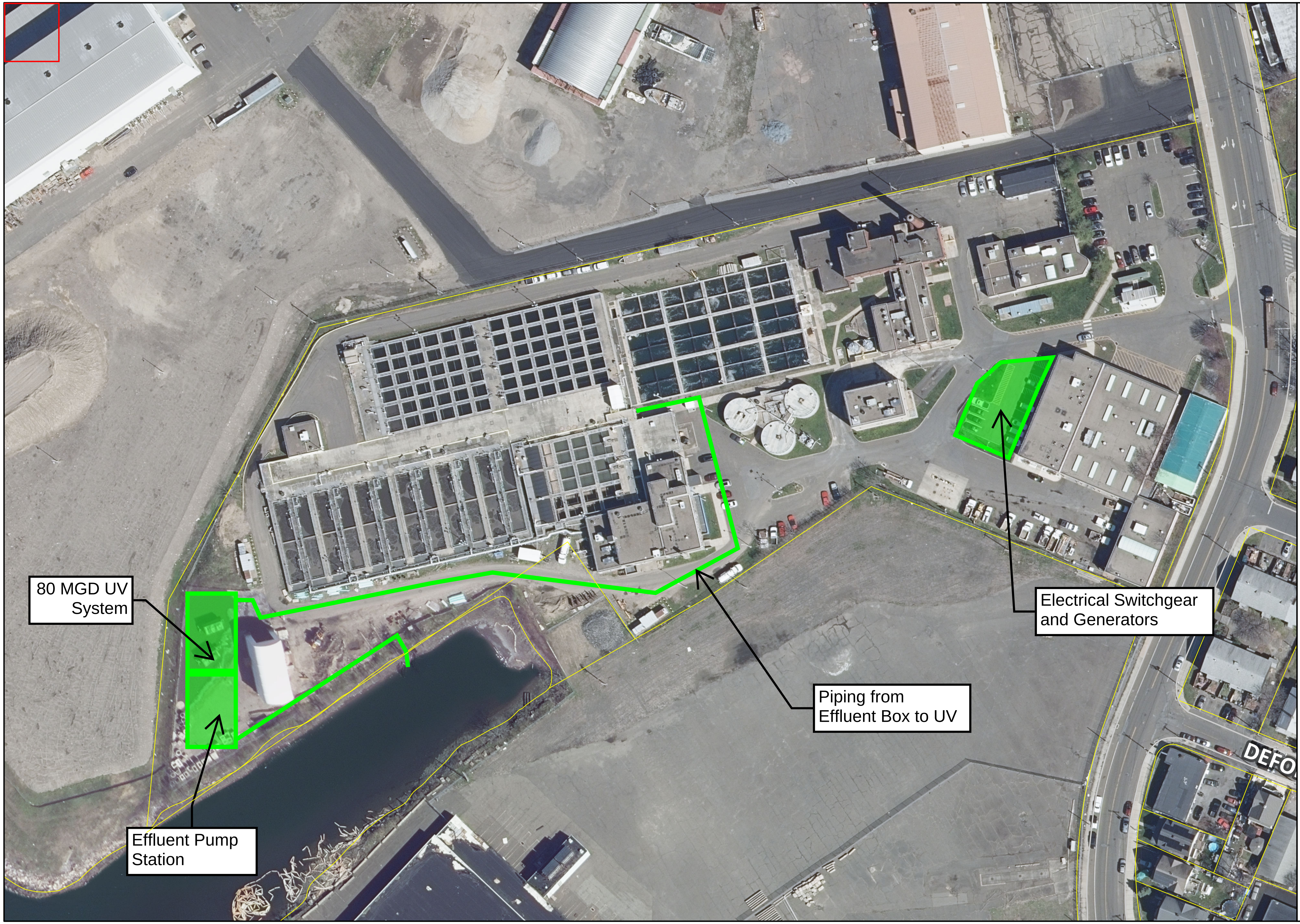
This is a partial outline only which details the specific order of constructing new and upgrading existing facilities. It does not cover sequences necessary for actual construction methods. Some of the tasks as described below may overlap one another in performance of the work. Numerical identification of the tasks within each construction phase does not necessarily conform to the actual order of construction. This plan is depicted in the MOPO figures, **Figure 9.2-6A** through **Figure 9.2-6H**. The sequence was developed around a peak flow of 80 mgd, specifically plant alternative E-80D. This plan will be further developed in the design phase for inclusion in the bid documents.

Phase 1

1. Perform general site preparation.
2. Construct new electrical switchgear and generators in preparation for future stages.
3. Construct new UV disinfection and effluent pump station.
4. Install piping from existing effluent box to new UV disinfection. Install and new piping from effluent pumping station to existing or new outfall.

Phase 2

1. Begin construction of the new headworks facility consisting of the following processes. All will be rated for a peak wet weather flow of 80 mgd.
    a. Coarse screening
    b. Influent pumping
    c. Fine screening
    d. Grit removal
    e. Screenings and grit washing and storage facilities
2. Install new piping from existing sewer vaults and manholes to coarse screening. Plug pipe until headworks startup.
3. Demolish the existing chlorine contact tanks



East Side WWTP
695 Seaview Ave, Bridgeport CT

**PHASE 1:
Site Preparation and Construct New Electrical Switchgear, Generators, UV Disinfection System, Effluent Pump Station, and Connecting Piping**

Scale: 1" = 100'

Figure 9.2-6A
East Side WWTP MOPO Sequence - Phase 1

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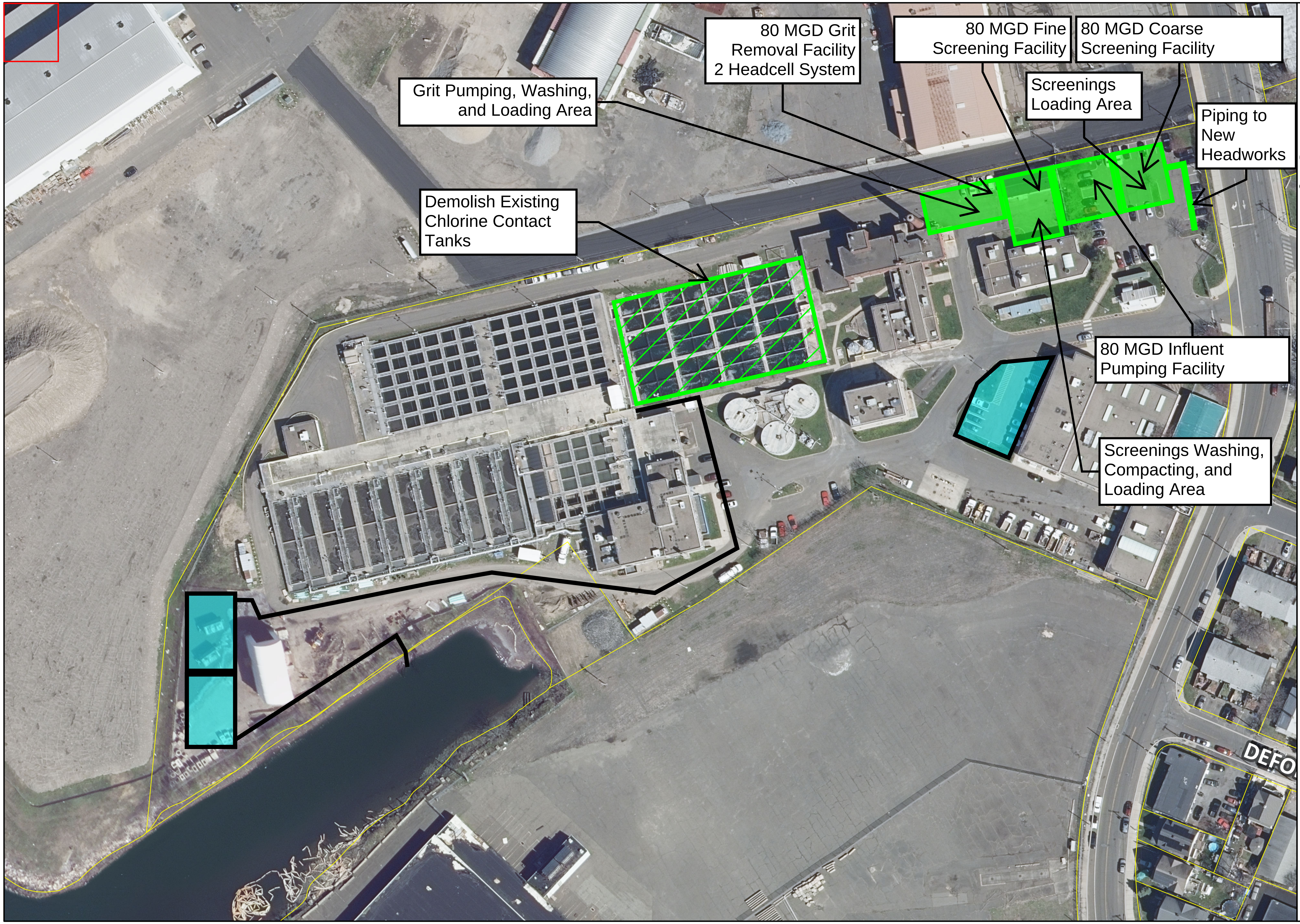

East Side WWTP
695 Seaview Ave, Bridgeport CT

PHASE 2:
Demolish Existing Chlorine Contact Tanks and Begin Constructing New Headworks Facilities

Figure 9.2-6B
East Side WWTP MOPO Sequence - Phase 2

Water Pollution Control Authority, City of Bridgeport
Facilities Plan

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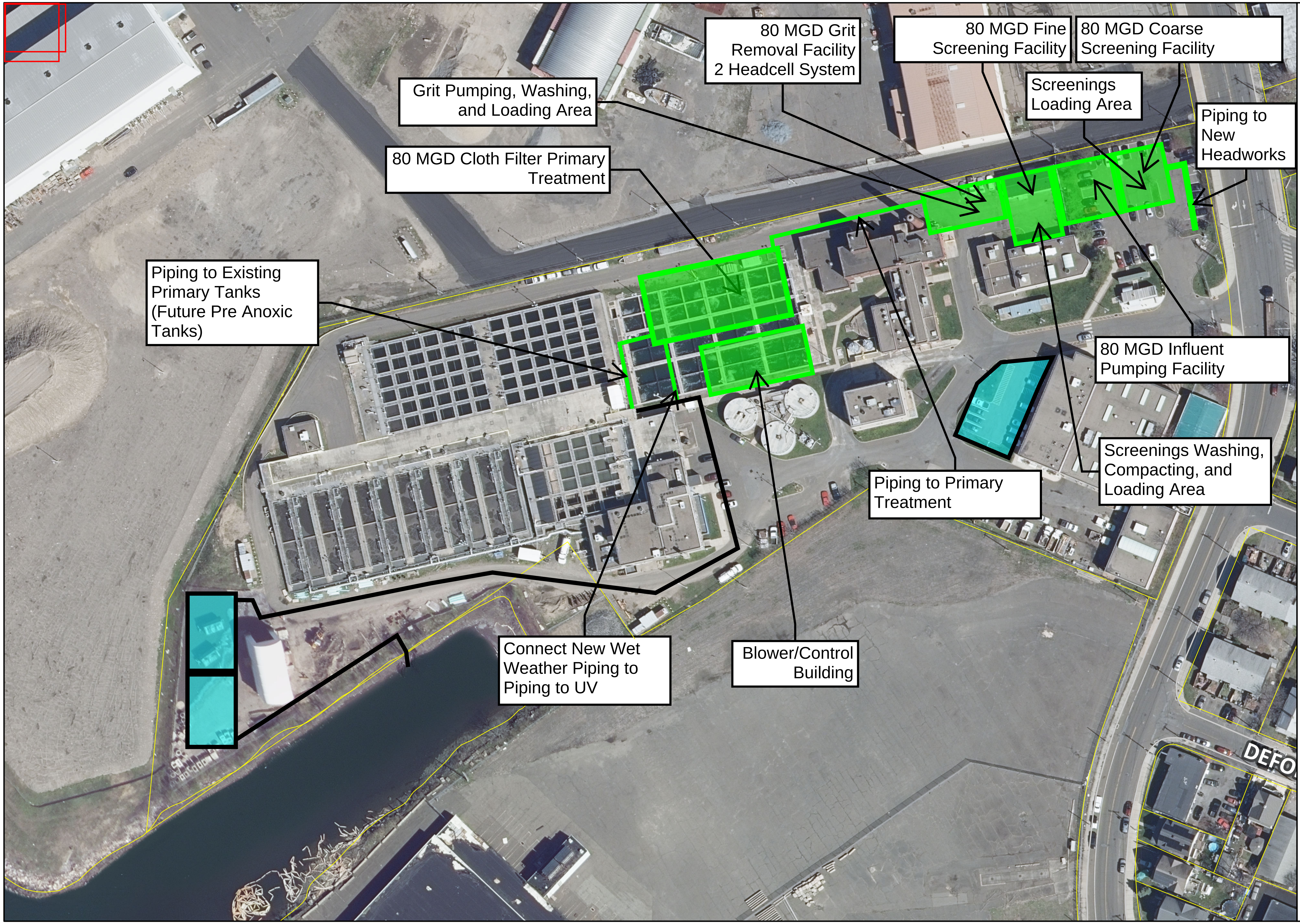

East Side WWTP
695 Seaview Ave, Bridgeport CT

PHASE 3: Finish Constructing New Headworks Facilities and Construct New Primary Treatment Facility, and Blower/Control Building

Scale: 1" = 100'

Figure 9.2-6C
East Side WWTP MOPO Sequence - Phase 3

CDM Smith

Water Pollution Control Authority, City of Bridgeport
Facilities Plan

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East Side WWTP
695 Seaview Ave, Bridgeport CT

PHASE 4: Demolish Existing Headworks Facilities and Upgrade Existing Gravity Thickeners.

Figure 9.2-6D
East Side WWTP MOPO Sequence - Phase 4

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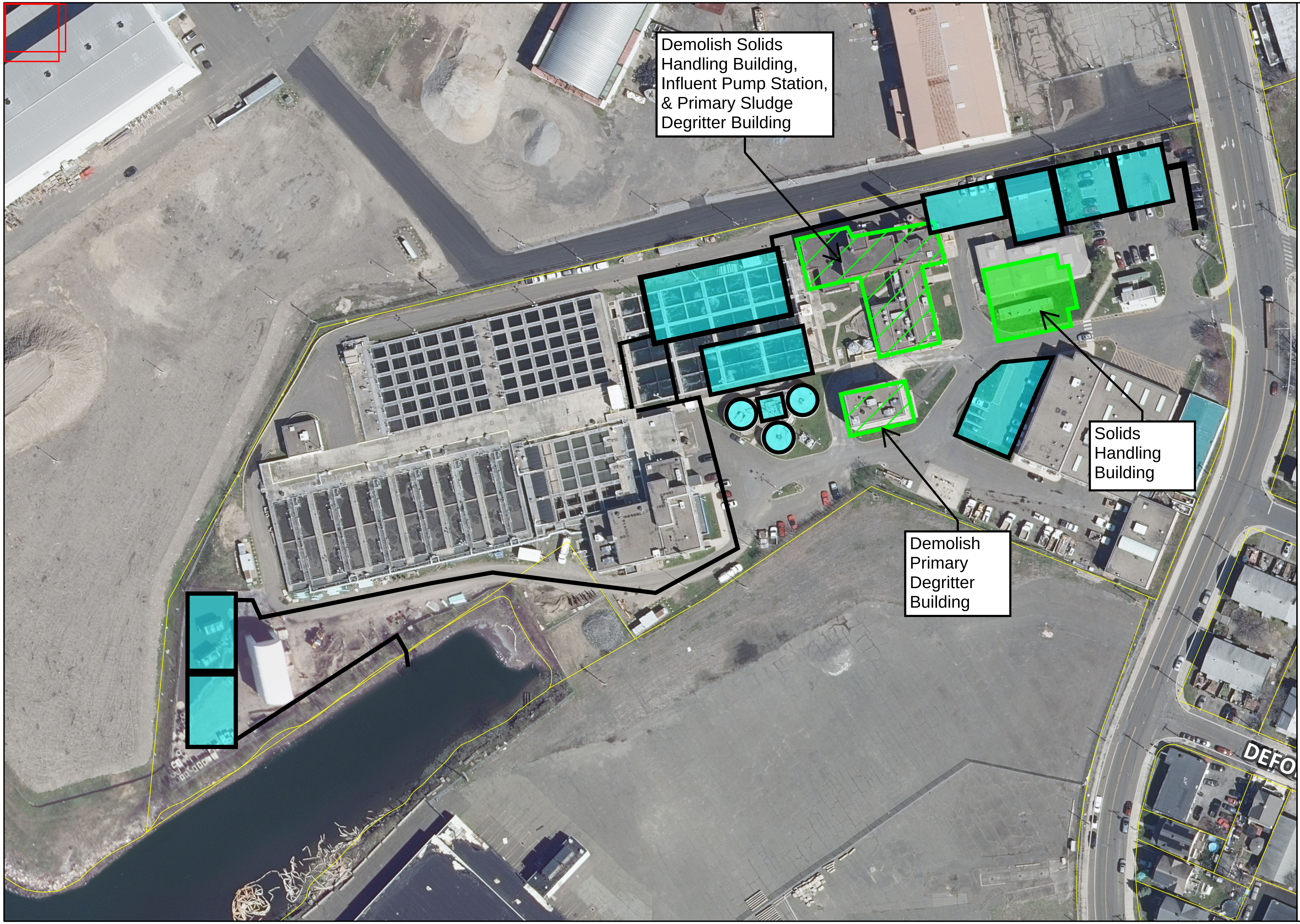

East Side WWTP
695 Seaview Ave, Bridgeport CT

PHASE 5: Construct New Solids Handling Building and Demolish Existing Solids Handling Building, Influent Pump Station, and Primary Degritter Buildings.

Scale: 1" = 100'

CDM Smith

Figure 9.2-6E
East Side WWTP MOPO Sequence - Phase 5

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East Side WWTP
695 Seaview Ave, Bridgeport CT

PHASE 6: Construct Odor Control Building, Convert Existing Primary Tanks to Pre-Anoxic Zones, Retrofit BNR basins with 4-Sage Conventional Activated Sludge, and Upgrade Secondary Clarifiers

Scale: 1" = 100'

Feet
0 50 100

N

Figure 9.2-6F
East Side WWTP MOPO Sequence - Phase 6

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East Side WWTP
695 Seaview Ave, Bridgeport CT

PHASE 7: Demolish Existing Blower and Control Building, Complete Final Miscellaneous Improvements and Site Restoration

Figure 9.2-6G
East Side WWTP MOPO Sequence - Phase 7

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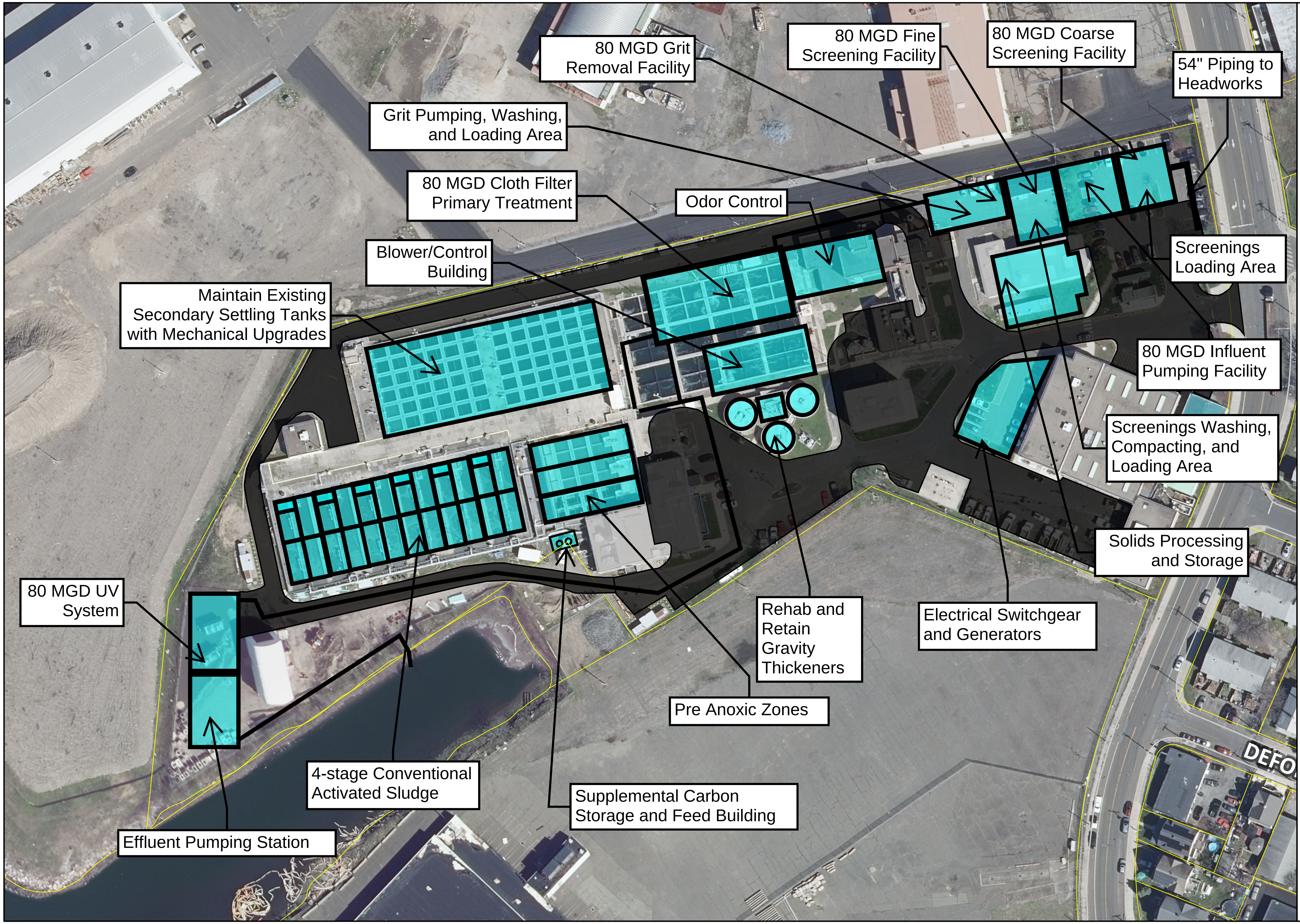

East Side WWTP
695 Seaview Ave, Bridgeport CT

Construction Complete

Scale: 1" = 100'

Feet
0 50 100

N

Figure 9.2-6H
East Side WWTP MOPO Sequence - Construction Complete

Water Pollution Control Authority, City of Bridgeport
Facilities Plan

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Phase 3

1. Finish construction of the new headworks facility started in Phase 2.
2. Construct the new dual use primary cloth filters, rated for a peak wet weather flow of 80 mgd.
    a. Primary cloth filters will treat both dry and wet weather flow
    b. Install new dry weather primary effluent (filter effluent) piping to the existing primary. Primary Effluent pipe should be connected to the box upstream of the existing Parshall flume.
    c. Install new wet weather piping from filter effluent to existing effluent box to UV disinfection.
3. Install sludge piping from new primary sludge pumps to existing gravity thickeners. Construct piping from new headworks to primary filters.
4. Construct new control and blower building.

Phase 4

1. Once Phase 3 is complete and all new facilities are tested and functional, demolish the following existing facilities to allow for construction of new facilities in subsequent phases:
    a. Existing headworks building
2. Rehabilitate and retain existing gravity thickeners by taking one tank offline at a time and performing upgrades until all are complete.

Phase 5

1. Construct new solids handling building.
2. Once solids handling building is complete, demolish the following existing facilities:
    a. Existing solids handling and influent pump building
    b. Existing primary degritter building.

Phase 6

1. Perform conversion of primary tanks to pre-anoxic tanks.
2. Retrofit existing bioreactors with 4-stage conventional activated sludge process.
    a. Bioreactors 5 and 6 will be taken offline first. Isolate Bioreactors 5 and 6 using existing influent gates.
    b. When Bioreactors 5 and 6 are taken offline, Secondary Clarifier 3 will be taken offline (along with RAS Pumps 5 and 6). Secondary system mechanical upgrades within Secondary Clarifier 3 can occur while Bioreactors 5 and 6 are being

retrofitted to the new configuration. Existing RAS Pumps 5 and 6 can be removed, and new pump and piping (both RAS and WAS) can be installed.

   c. Bioreactors 3 and 4 are to be taken offline next following the same procedure as Bioreactors 5 and 6. Secondary Clarifier 2 upgrades can occur simultaneously.
   d. Bioreactors 1 and 2 are to be taken offline next following the same procedure as Bioreactors 5 and 6. Secondary Clarifier 1 upgrades can occur simultaneously.

3. Construct new odor control system.

Phase 7

1. Once Phase 6 upgrades are complete, demolish the existing blower and control building.
2. Perform miscellaneous final improvements.
3. After all construction is complete, perform final site landscaping and paving.

9.2.4.2 Auxiliary Operations

The following systems will be maintained during construction throughout all phases as described below.

Effluent Pipe and Outfall

Discharge from the WWTP to the harbor shall be uninterrupted and maintained at all times. Bypass pumping may be necessary to perform any rehabilitation or replacement of the existing outfall.

Electrical

Electric power and lighting service shall be uninterrupted in all areas that remain in operation except as otherwise specified. The existing electrical distribution system shall remain in service until the new utility transformers, switchgear, standby power equipment and distribution network around the site has been installed, tested, accepted and made ready for operation. Temporary service to existing MCCs, panelboards, site lighting and other facilities requiring power may be required until replaced by new facilities.

Instrumentation and Control

Existing instrumentation and controls shall remain fully functional until control is switched to the new SCADA system. Each SCADA control panel and vendor panel residing directly on the network, shall be installed prior to the installation of the plant wide fiber optic network cable. Once the network cable has been pulled and terminated at each patch panel, the OWSs shall be located in the control room. Then, the OWSs are placed onto the network and the SCADA system shall be viewable at each SCADA control panel HMI and control room OWS.

Plant Water

Demolish and replace the plant water system. Provide a temporary plant water system with pumping capacity and pressure rating equal to the existing system and connect to the existing plant water distribution system until the new plant water system is installed, tested and made ready for operation.

Site Drainage

On-site storm drains shall be kept in operation at all times. Drains to be abandoned, removed, and/or replaced shall be kept in operation until new storm drains or temporary provisions for collecting storm run-off have been installed, tested, accepted and put into service. Sediment and erosion control measures shall be implemented.

Existing plumbing systems such as roof and floor drains, sump pumps, sanitary facilities, potable and protected water etc., shall be kept in operation at all times. Systems to be removed or replaced shall be kept in operation until new systems have been tested, accepted and authorized for use. If sewers or drains must be taken out of service to facilitate construction operations, alternative provisions shall be made to collect wastewater or drainage and dispose of them. Wastewater shall be discharged within the treatment plant headworks.

9.2.5 Ancillary Facilities

The improvements to the East Side WWTP will be all encompassing and will impact all aspects of the plant processes, infrastructure, and site. Ancillary work is required to support the new processes and the improvements to the existing processes to remain.

9.2.5.1 Civil/Site Design

The recommended improvements to the East Side WWTP will impact the entire site and a significant amount of civil and site work will be required to make the modifications within the current footprint.

The WWTP improvements include the construction of many new process facilities that will need to tie into each other and also into existing infrastructure. This work will require the installation of multiple new runs of piping, ranging from 4-inch sludge and water piping to 48-inch or larger to convey the peak main process flows of 80 mgd, the 24 mgd dry weather flow, and the 56 mgd wet weather flow. The majority of this piping will be ductile iron, however other materials such as copper, PVC, and HDPE may be utilized. Additionally, the largest diameter piping may be steel or prestressed concrete cylinder pipe. Based on the historical drawings and site geotechnical information available, its anticipated that large diameter yard piping (greater than 12-inch or 24-inch) will be pile supported to prevent settling and to better connect to the structures and buildings that will also be pile supported.

The construction of various new facilities on the existing plant site and the northern open parcel will necessitate new access roads around the site for internal movement, deliveries of chemicals, fuels and septage, removal of screenings, grit, and solids, and access to the new control and administration building. The various site plans in Section 7 show preliminary concepts for new access roads, with continued access to the east side of the site from Seaview Ave.

The civil/site work will also include miscellaneous grading and drainage improvements around the new structures and facilities and also around the existing facilities. Green infrastructure will be included as feasible as part of the grading and drainage improvements including items such as rain gardens and other potential stormwater infrastructure. Landscaping will include lawn/unpaved open areas where feasible, along with trees and other plantings for visual aesthetics and also for partial screening of the WWTP from public view. A conceptual site plan of the recommended East Side WWTP improvements is shown in **Figure 9.2-7**.

Based on site history and limited available geotechnical and subsurface information, it's assumed that a majority if not all the soil excavated at the site will require some form of off-site disposal. A summary of subsurface investigations performed as a part of this report and known conditions is included in Section 4. Depending on the level of contamination encountered during design and construction, which will vary across the site, the excavated soil will require disposal at either an unlined landfill, lined landfill, commercial landfill, or potentially at a RCRA regulated landfill for the most hazardous material. A comprehensive subsurface study, consisting of extensive sampling and lab analysis, will be performed during design to characterize the existing soil and to provide estimates of the volumes of soil that will require disposal at the various classes of disposal sites.

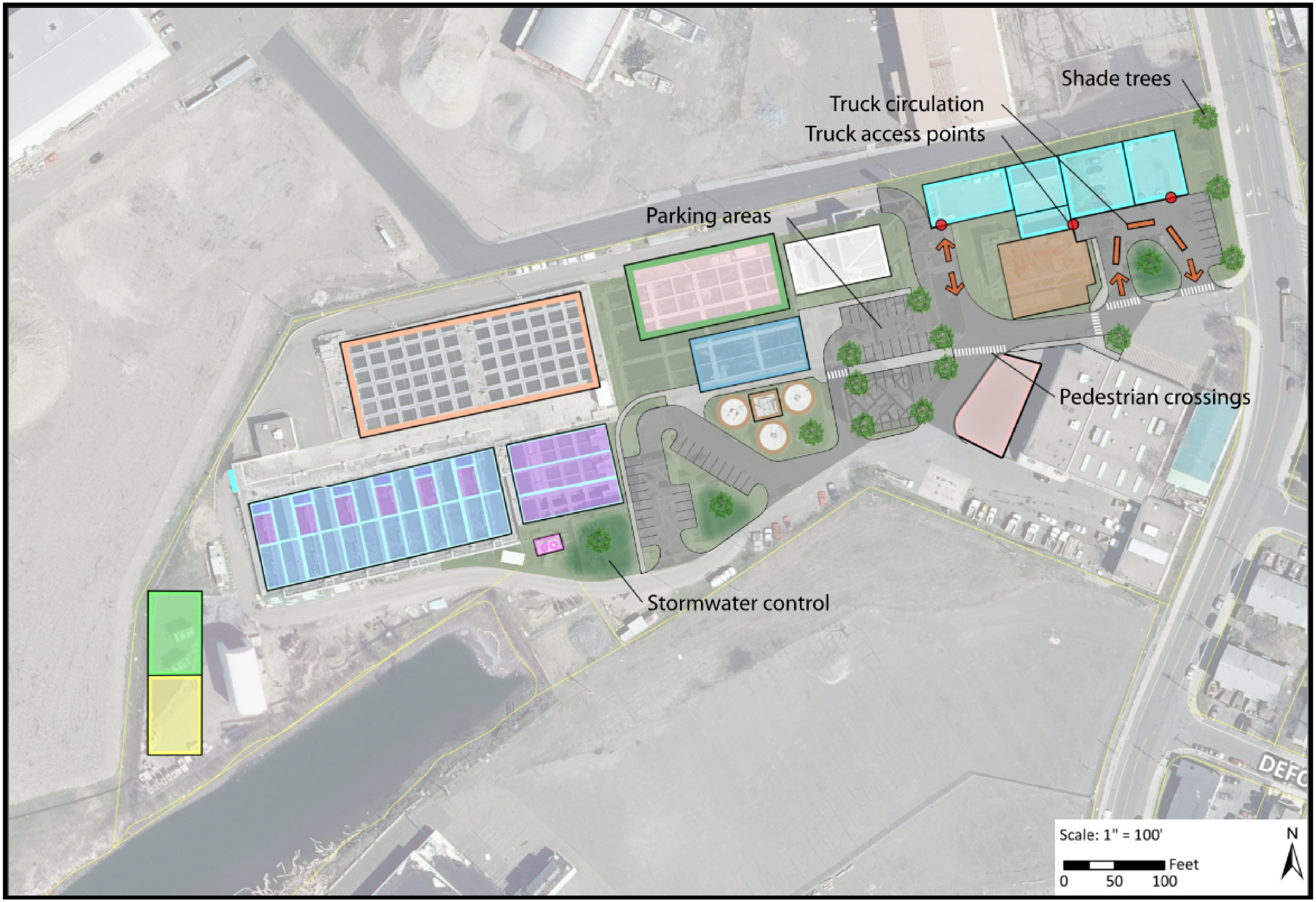
9.2.5.2 Electrical Distribution and Standby Power

The improvements at the WWTP will increase the total electrical power demand and require a new power distribution system to replace the existing aging system, including new generators for emergency backup power. The new electrical distribution and standby system is anticipated to include the following:

- New 13.8 kV main power utility feed to the site
- 13.8 kV double ended main electrical switchgear
- One to two diesel engine, 13.8 kV emergency power standby generators
- Two to three 13.8 kV to 480 V double ended unit substations
- Double ended MCCs within each major facility for feeding of process equipment
- System of concrete encased buried electrical duct banks around the site for distribution.

In addition to the main power distribution, the electrical design will also include:

- New telephone and internet services to the site
- CCTV, site and building access, and building/site security systems
- Grounding and lightning protection
- Building and site lighting
- Fire alarm systems within facilities along with power requirements for a fire pump



CDM Smith

Figure 9.2-7
80 mgd East Side WWTP
Conceptual Site Plan

Water Pollution Control Authority, City of Bridgeport
Facilities Plan

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9.2.5.3 Instrumentation and Control

The existing instrumentation and control system at the East Side WWTP is antiquated and very limited in system and process monitoring and control. A completely new SCADA system for process monitoring and control will be installed to replace the existing system and to tie together all the existing and the new process facilities and equipment to be installed. The new state of the art instrumentation and control system is anticipated to include the following:

- New central control/monitoring room in a new administration and control building.
- New self-healing fiber optic communication ring around the site.
- New building/process specific PLC control panels with localOITs.
- New instruments and elements throughout the plant.
- Networking of equipment and systems to facilitate efficient transfer of data and information.
- SCADA system for process monitoring and control.
- Integration of vendor supplied control panels into the SCADA system. Many of the treatment process will be provided with control panels fabricated and programmed by the manufacturer.
- Capabilities to communicate with remote sites in the future.
- WiFi through the new administration/control building.
- System flexibility to allow for future upgrades to accommodate technological advancements and innovations.
- Revised plantwide instrument and loop numbering scheme to facilitate system wide equipment and instrument identification and potential integration into asset management systems.

9.2.5.4 HVAC and Plumbing

Building mechanical services (HVAC and plumbing) will be included in the new facilities and also replaced in all the existing facilities. The HVAC system will be designed in accordance with the latest building and fire protection codes to provide the required ventilation to address occupancy levels, area classifications, and limit hazardous conditions. Air conditioning will be provided where needed for equipment protection (e.g. electrical and computer server rooms) and for staff comfort.

9.2.5.5 Plant Utilities

A new City water service will be provided to the site from the street. City water will be routed within the site to the new and existing facilities where potable water sources are needed for wash down, eyewash and emergency showers, equipment operation, or staff usage. Fire protection will be provided in new and existing facilities where required. Coordination with the Fire Department will be performed during design to confirm compliance with local requirements. If required to provide adequate firefighting pressure around the site, a fire pump system will be installed. The design will be coordinated with the electrical design to ensure uninterrupted service.

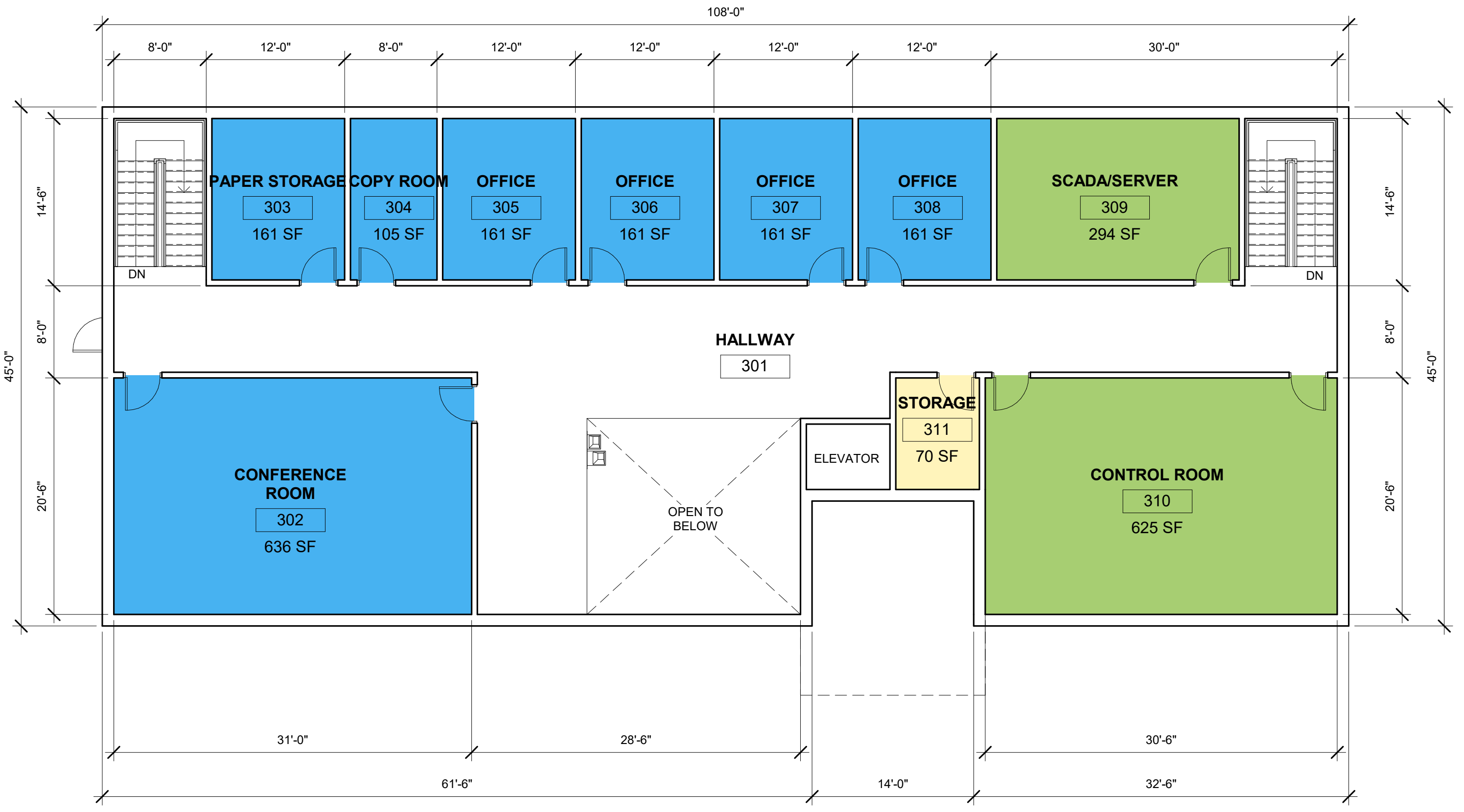
A number of the new and existing processes will require plant/service water for operation, cleaning, flushing, wash down, etc. A new plant effluent water pumping and distribution system will be provided for the site to supply these needs. The pumping system will draw disinfected final effluent water and a new piping system will distribute it to the facilities and processes that require it. The location of the pumping system will be determined in final design when building/structure designs and their orientation on the site are more defined, but a likely location will be within the new effluent pumping station.

9.2.5.6 Administration and Control Facilities

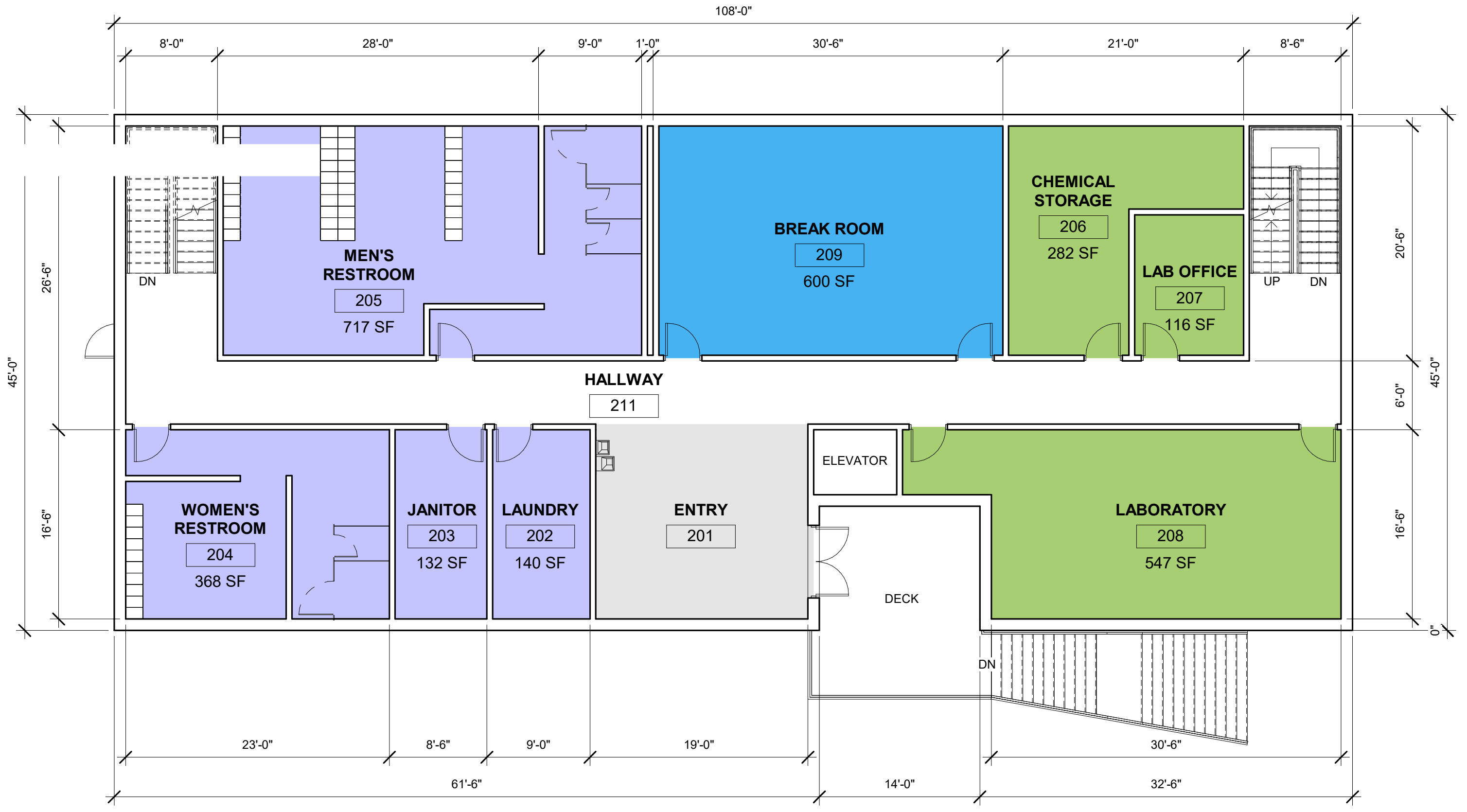
A new administration and control building will be provided at the East Side WWTP. The single facility will house the main monitoring and control facilities for the plant. With a proposed location near the BNR process, the administration and control building may also house the new blowers for the aeration tanks. The facility is anticipated to include:

- Central monitoring and control room
- Plant supervisor offices
- Locker room facilities
- Conference, meeting, and break rooms
- Laboratory for analysis of sample from both WWTPs
- Maintenance shop
- BNR system blower room (in basement)

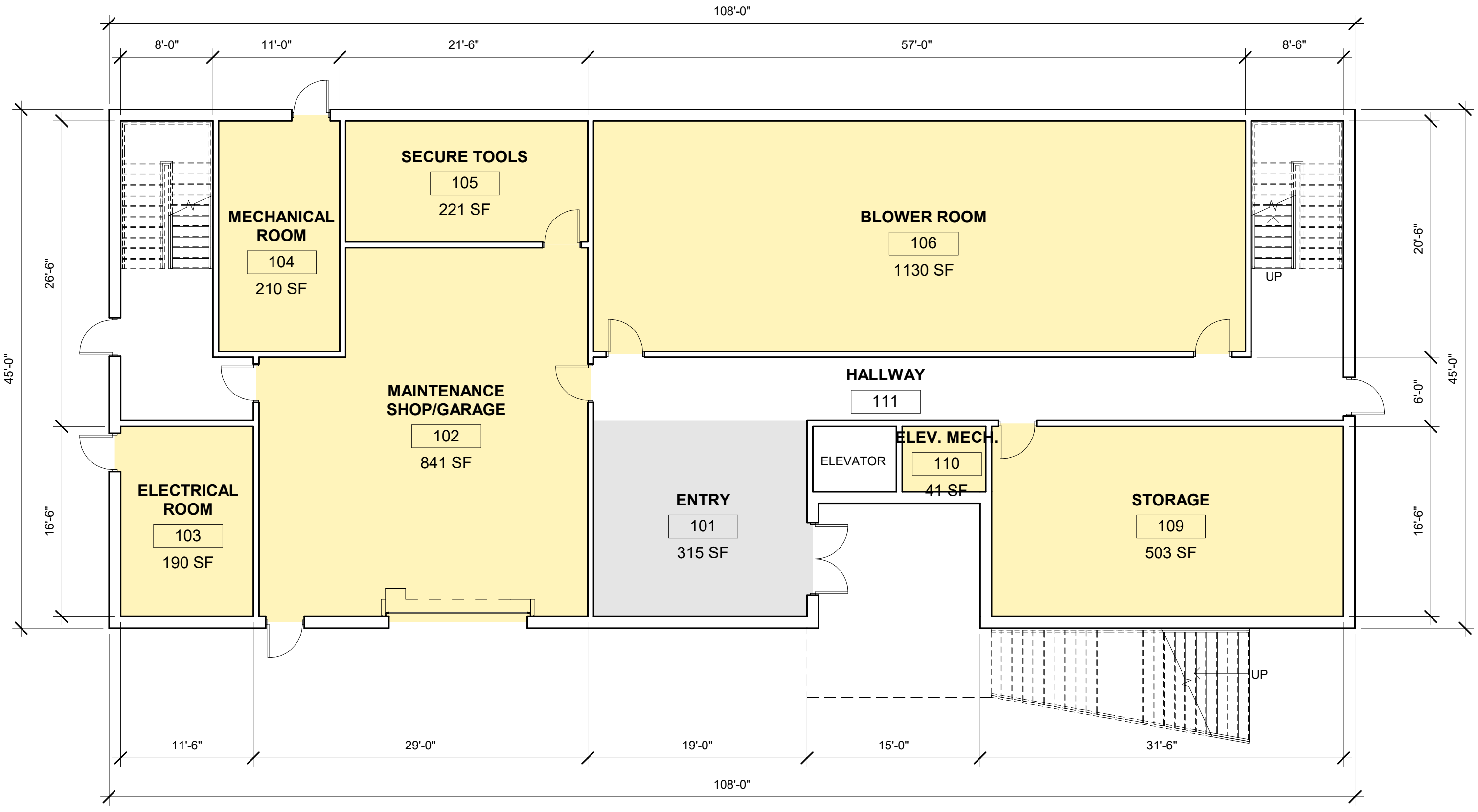
Conceptual floor plans of a new West Side WWTP administration and control building is shown in **Figure 9.2-8**.



3 THIRD FLOOR PLAN



2 SECOND FLOOR PLAN



1 FIRST FLOOR PLAN

CDM Smith

Figure 9.2-8
East Side WWTP
Control Building Concept

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9.3 Plant Staffing Considerations and Contract Operations

To determine future staffing needs at the WWTPs, CDM Smith performed a staffing estimation using the New England Interstate Water Pollution Control Commission's (NEIWPCC) "Northeast Guide for Estimating Staffing at Publicly and Privately Owned Wastewater Treatment Plants". This guide was produced using data from over 50 WWTPs in the northeast to develop charts with estimated staffing requirements for specific unit processes and maintenance activities at a range of plant capacities. CDM Smith made the following assumptions in this estimation:

- The 24/7 plant charts were used since the existing plants are staffed in multiple shifts, around the clock.
- One staff works 1,500 hours a year. This is the standard value for the guide which assumes the following:
  - 5-day work week
  - 29 days of time off (includes vacation, sick leave, and holidays)
  - 6.5 hours of work per day
- Collection system maintenance was not included.
- Administrative staff was not included.
- The design average flows were used:
  - West Side WWTP – 30 mgd
  - East Side WWTP – 10 mgd

Using the recommended plan and processes for each WWTP, the estimated staffing requirement for West Side and East Side WWTPs was 36 and 20 full time employees, respectively, for a total of 56 full time employees. Each plant and utility are different, and some plants may need more or less staff to address their specific circumstances and personnel capabilities. However, CDM Smith feels that these values are appropriate for the WPCA's WWTPs. The charts used to perform the estimations are included in **Appendix M**.

Currently the WWTP operations are contracted to a third party. Under the existing agreement, the contract operator is required to have 88 full time operations and maintenance employees. Current employment is detailed in monthly operating reports (MORs). As of December 2019, the existing breakdown of employees includes 88 staff for the treatment plants and collection system, as shown in **Table 9.3-1**.

Table 9.3-1 Contract Operator Staffing

Employee Designation	Number of Employees
West Side WWTP Operations	22
East Side WWTP Operations	20
Maintenance[1]	16
Collection System	30
Total Maintenance and Operation	**88**
Management	9
Customer Service	4
Total Employees	**103**

[1] Maintenance staff is assumed to be for WWTPs

The staffing breakdown from December 2019 meets the requirements under the existing agreement. Additionally, the 58 employees dedicated to the WWTPs, exceeds the benchmark determined by CDM Smith through NEIWPCC's guidance.

9.4 Energy Efficiency, Renewable Energy, and Sustainability

9.4.1 Energy Efficiency

As part of the overall facilities planning process, an energy efficiency study was completed for both the West and East Side WWTPs. This report developed an energy balance at both plants, identified energy efficiency opportunities, and provided guidance on potential sources of funding. The complete energy efficiency technical memorandum is included as **Appendix N** to this Facilities Plan.

Aeration accounts for approximately half of the total plant energy usage at both facilities. The secondary treatment system is expected to be completely upgraded at both plants, including new blowers, air piping and air diffusion equipment as well as the addition of new instrumentation and controls to optimize oxygen feed which will help minimize the airflow requirements of the system, and thus energy required to meet this need. After aeration, plant wide pumping was identified as the next largest energy consumer. The influent pump stations will be replaced at both plants with more efficient right-sized units, and nearly all the process pumps throughout the WWTPs were also identified for replacement. Replacement of aging pumps with automated, more efficient pumping systems with variable frequency drives (VFDs) represent a substantial potential energy savings. In addition to aeration and pumping systems, most of the WWTP processes are outdated and inefficient. There are many opportunities to increase the energy efficiency of both plants during the design phase.

EnergizeCT is a rate payer funded program that provides financial incentives for the installation of energy efficient equipment and systems, and is administered through the local utility, United Illuminating (UI). The grant funding available includes prescriptive rebates for specific lighting and HVAC improvements. In addition, UI offers financial assistance through the Custom Incentive program, which provides funding for any project that can be shown to provide energy savings and meets the program's technical requirements.

Through the program's grants, funding can be provided for up to 40% of the total project cost and 75% of the incremental project costs. Projects eligible for this funding include building system upgrades, pumping equipment upgrades, treatment system equipment and controls, and equipment replacement, as well as instrumentation and SCADA system improvements. Similar wastewater treatment facility upgrade projects in Connecticut and within UI territory have received significant funding through these programs and it is anticipated that portions of the proposed equipment and system improvements at both the East and West Side plants will be eligible. In order to qualify for the funding, the application documentation must be submitted to UI prior to initiating construction. Typically, the applications are completed during the design phase of the project as equipment selection and sizing is finalized.

The complete results of the energy efficiency study and additional guidance on the application process, including the application forms can be found in Appendix N.

9.4.2 Alternative Energy Systems

Two alternative energy systems were considered for possible implementation as part of the West Side and East Side WWTP upgrades. The implementation of these renewable energy features will be evaluated further as the projects move forward into preliminary design.

9.4.2.1 Solar Photovoltaics (PV)

Solar PV technology has been around for many years, though this technology and other renewable energy sources have seen renewed public interest in recent years. There are two general categories of PV power systems currently on the market. The first is a stand-alone system in which the PV panels are the primary source of power and a battery provides the energy storage for use when the PV power is not available. Stand-alone systems are generally used in remote and inaccessible locations such as water storage tanks, weather stations and communication stations.

The second type of PV power system is the grid-connected system in which the utility is the primary source of power and the PV panels act as a secondary source. A grid-connected system would be the power system potentially considered for the West Side and/or East Side WWTP. In this case, the PV power source operates in parallel with the utility offsetting the power drawn from the utility during the daylight hours. The grid-connected system output can be single-phase AC 120V or 3-phase AC 480V 60 Hz. If installed at the West Side or East Side WWTPs, the 480V solar PV supply would likely be connected into the electrical distribution system via transformers and disconnects.

Potential solar energy generation varies from site to site and is largely dependent upon the latitude of the location, which determines the angle of inclination of the sun. Additionally, the potential solar energy generation varies based on the time of day, time of year (due to changing inclination of the sun) and weather conditions. Solar insolation, a value used to consider the variability of the available solar energy, is typically measured as an average kWh/day/m^2 or kWh/day/ft^2.

Solar collectors, especially solar PV panels, experience dramatically reduced output if shaded at any point during the day. The only exceptions are up to 90 minutes after sunrise in the morning and before sunset in the evening. The most common features that cause shading are trees, other buildings, and telecommunications or HVAC systems, as well as inclement weather. Due to limited site footprints at both sites, PV, if implemented at either site, would be added to the rooftops of new buildings. Upon preliminary analysis, it does not appear that either sites are prone to shading; however, a formal evaluation should be executed before final design of any solar PV system. The applicability of adding a grid-connected PV system will be considered further during preliminary design of any newly proposed buildings at the West Side and East Side WWTPs.

9.4.2.2 Wind Power

Wind technology has been used for hundreds of years as a source of mechanical energy and, more recently, to generate electricity. Wind power has recently grown as a source of renewable energy, primarily due to technological advancements which have gradually reduced costs. The basic concept behind wind energy is that wind turbines convert the kinetic energy of wind into mechanical or electrical energy. The wind moves over the blades creating lift and causes them to rotate. The blades are connected to a low-speed shaft attached to a gearbox that then spins a high-speed shaft connected to a turbine generator. This generator converts the energy into electrical current. Generators presently available cover a wide range of voltages, depending upon the size and manufacturer of the wind turbine.

The most commonly used type of wind turbines today are the horizontal-axis wind turbines (blades spin perpendicular to the ground). The horizontal-axis wind turbines are composed of a rotor (including the blades and hub) and a protective enclosure referred to as a “nacelle” (mounted on top of a tower). The nacelle houses the shafts, gear box, and generator. This type of turbine can be further categorized into three categories based on size; small, medium and large. Small wind turbines are generally 7.5 to 100 kW with an 18 to 37-meter-tall tower. Medium wind turbines are 250 to 1000 kW with a 35 to 50-meter-tall tower. Large wind turbines are 1500 kW or more and with a 50 to 80-meter-tall tower. Small wind turbines would likely be considered for implementation at the West Side and/or East Side WWTP.

Like PV power, the energy generated from wind varies by location. The best locations for wind turbines are located in either offshore or mountaintop areas, which tend to have higher continuous average wind speeds. Large wind turbines (50 and 70-meter) typically require mean wind speeds of six to seven meters per second (m/s) to be considered a viable source of power. Smaller wind turbines (30-meter), however, typically only require mean wind speeds of five to six m/s to be considered a viable source of power.

Additional review of average wind speeds at both WWTP sites would need to be completed in order to determine the efficacy of installing wind turbines. Further investigation is recommended by either consulting a qualified meteorologist or by installing a meter tower on site. Onsite measurements recommended to be collected include wind speeds, direction, and frequencies over a minimum duration of one year. The feasibility of wind turbines at both WWTP sites will be considered during preliminary design. Site constraints, including nearby residential at the West Side WWTP may make the East Side WWTP the more promising option, pending additional evaluation.

9.4.3 Other Sustainable Measures

Several other sustainability measures were considered for possible implementation as part of the West Side and East Side WWTP upgrades. These will be evaluated further as the projects progresses to preliminary design.

9.4.3.1 Green Roofs

Green roofs are an example of an effective stormwater management. Green roofs are roofs covered by plants, a growing medium and several protective layers over the existing roof, including a drainage system, root barrier, and water proofing. The benefits of green roofs include extended roof life, increased insulation resulting in reduced heating and cooling costs and decreased stormwater runoff. There are two types of green roofs: extensive and intensive. Extensive roofs have low growing plants such as herbs, grasses, sedum or succulents with shallow root systems. They require no irrigation and can withstand harsh conditions. The growing medium is between two to six inches deep and weighs 13 to 35 pounds per square foot when wet. Intensive roofs have larger plants, such as annuals, perennials, shrubs and trees. They require weekly maintenance and consistent irrigation. The growing medium is six inches or more and weighs 35 to 70 pounds per square foot when wet. Intensive roofs are usually valued for their aesthetic appeal and accessibility to the public.

Extensive roofs are the preferred green roof for industrial buildings and retrofits. Because wastewater treatment facilities do not need green roofs for recreational or aesthetic purposes, extensive roofs are best suited for these facilities. Green roofs will be considered further in preliminary design as an alternative to traditional stormwater retention methods for newly proposed buildings at the West Side and East Side WWTPs.

9.4.3.2 Bioretention

Bioretention is a low impact design technique that filters and infiltrates stormwater runoff from impervious areas. An area of soil and vegetation collects stormwater runoff from impervious areas and allows it to infiltrate. An example of a bioretention system is a rain garden designed to hold up to six inches of water for several days that includes a mix of herbaceous and woody species planted in a soil mixture that optimizes percolation and pollutant removal. Tree pits or bioswales along sidewalks are potential applications of bioretention in more urban environments. In these systems, pavement slopes to a depressed, soiled area with a planted tree or vegetation. Drainage pipes and catch basins can also be reconfigured to convey flows to these systems.

Bioretention reduces the volume and peak flow rate of stormwater runoff. Disadvantages include potential clogging of the ponding area if regular maintenance is not conducted. Bioretention, bioswales, and other green stormwater management techniques will be incorporated into the design of West Side and East Side WWTP upgrades to the greatest extent possible.

9.4.3.3 Wastewater Reuse

Reuse of treated municipal wastewater effluent is an important consideration to achieve a sustainable wastewater treatment process. Wastewater reuse opportunities exist for both the West Side and East Side WWTPs for process water, as well as options for the supply of reclaimed water to other end users, are summarized below.

The WPCA currently reuses a portion of the treated effluent (plant water) for some process uses that only require non-potable water quality. The plant water system was determined to be past its useful life and in need of replacement. As part of the treatment plant upgrade, the plant water system will be replaced to provide non-potable water to various uses around the plant site, including washdown stations in the sludge processing area and around process tanks, motive water as necessary for chemical systems for odor control and/or disinfection, process water required for flushing and/or fluidization and pump seal water. Depending on the extent of improvements, other uses that could be considered on-site include, toilet flushing, irrigation for landscaping, and a potential water feature on the site. Onsite uses of plant water will be evaluated further at the time of preliminary design.

There may be opportunities for non-potable use off site as well, particularly at the West Side WWTP. The adjacent aquaculture school, boat yard, asphalt plant, and the Wheelabrator waste to energy facility are in close proximity to the West Side WWTP. These entities could potentially have requirements for non-potable water, and the WPCA could charge for providing this non-potable water for reuse. It is possible that additional treatment, perhaps membrane filtration, would be required to meet reuse standards. Offsite reuse of plant water will also be evaluated further at the time of preliminary design.

9.5 Program Costs

9.5.1 Introduction

Section 6 presents the initial development and screening of the various unit processes for the West Side and East Side WWTP improvements considered as part of this study and discusses their general advantages and disadvantages. Section 7 provides a more detailed assessment of various treatment trains and various treatment plant capacities to assess non-economic and economic aspects of the various alternatives. Section 7 also summarizes the scenarios and associated costs, and presents the recommended plans for the two plants. Sections 6 and 7 also discuss the related combined sewer overflow (CSO) Long-Term Control Plan (LTCP) collection system work that is required to reach the proposed peak flows of the two plants during the 1-year storm. Finally, Sections 6 and 7 presented alternatives, a preliminary economic and non-economic evaluation of the alternatives, and the recommended plans for each plant.

9.5.2 WWTP Costs

For the West Side and East Side WWTPs, conceptual site layouts were developed, building and structure sizes were estimated, and vendor quotes were obtained for major process equipment in order to develop Opinions of Probable Construction Cost (OPCC) for the WWTP improvements. The OPCCs include expected labor, material and equipment costs, contractor's overhead and profit, a 25 percent design development 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. It is anticipated that the midpoint of construction for the West Side WWTP will be third quarter of 2024 (4 years) and the midpoint of construction for the East Side WWTP will be the third quarter of 2028 (8 years).

9.5.2.1 West Side WWTP

The recommended plan for the West Side WWTP is scenario W-200C as described in Section 7 and Section 9.1.

The total project cost for this scenario inclusive of design and construction phase engineering services, project contingency, land acquisitions, easement, rights-of-way, and project escalation to third quarter 2024 is $383,000,00 as summarized in **Table 9.5-1**.

Table 9.5-1 West Side WWTP Total Project Costs

	Escalated Cost
Site Work & Yard Piping	$34,100,000
Demolition	$9,400,000
Headworks	$97,100,000
Primary Treatment	$63,900,000
BNR	$45,000,000
Final settling	$9,400,000
Disinfection	$22,300,000
Effluent Pumping Station	$16,700,000
Solids Processing	$41,200,000
Odor Control	$7,900,000
Site Electrical	21,900,000
Control Building	$14,100,000
Total Project Cost	**$383,000,000**

9.5.2.2 East Side WWTP

The recommended plan for the East Side WWTP is scenario W-80D as described in Section 7 and Section 9.2.

The total project cost for this scenario inclusive of design and construction phase engineering services, project contingency, land acquisitions, easement, rights-of-way, and project escalation to third quarter 2028 is $215,000,00 as summarized in **Table 9.5-2**.

Table 9.5-2 East Side WWTP Total Project Costs

	Escalated Cost
Site Work & Yard Piping	$29,400,000
Demolition	$7,900,000
Headworks	$49,300,000
Primary Treatment	$33,900,000
BNR	$7,900,000
Final settling	$7,500,000
Disinfection	$13,400,000
Effluent Pumping Station	$13,200,000
Solids Processing	$21,100,000
Odor Control	$4,500,000
Site Electrical	$19,200,000
Control Building	$7,700,000
Total Project Cost	**$215,000,000**

9.5.3 Collection System Costs

As presented and evaluated in Sections 6 and 7, increasing the capacity of the two plants allows for a reduction of work in the collection system to address the CSOs, and vice versa, maintaining the existing capacity at the plants requires increased collection system work to address CSO.

Approximately $60 million (2020 dollars) in improvements are planned for the West Side WWTP collection system. This includes Ash Creek, Ellsworth, and West Side conveyance improvements as described in Sections 6 and 7. The Ash Creek and Ellsworth CSO solutions are expected to be constructed prior to the completion of the WWTP work (both West Side and East Side WWTPs). Following the completion of the WWTP work, a comprehensive flow metering program should be conducted to assess the impacts to the two collection systems resulting from the increased plant capacities. At that point the LTCP would be revisited and reevaluated to define the scope of the future conveyance work in the East Side collection system as well the required CSO projects to reach a 1-year control level system-wide.

While the eventual LTCP collection system scope of work and costs required to compliment the WWTP work will be revisited after the work at the WWTPs is completed, it is still beneficial to upgrade the plants to their ultimate peak flows as part of the initial treatment plant work versus in the future when the collection system work is implemented.

Although additional collection system improvements are required to fully address the CSO Consent Order, collection system CSO reductions, and individual regulator control for the 1-Year, 24-Hour storm, the current interceptors will still be able to deliver a peak 200 mgd flow to the West Side WWTP and a peak 80 mgd flow to the East Side WWTP. This allows the WPCA to start treating more CSO flow and reducing system overflows as soon as the upgraded plants are brought online, which provides immediate benefit from operating the higher capacity plants.

9.5.4 Summary

The total program costs for the upgrades of the West Side and East Side WWTP improvements are presented in **Table 9.5-3**.

Table 9.5-3 Total WWTP Program Costs

	Program Cost
West Side WWTP Improvements	$383,000,000
East Side WWTP Improvements	$215,000,000
Total Program Cost	**$598,000,000**

Note: 1. WWTP costs escalated to planned midpoints of construction (2025 and 2028)

9.5.4.1 Grant Eligibility

As discussed in Section 7, the design and construction of WWTP improvements are eligible for grant/loan funding through Connecticut's Clean Water Fund (CWF). General improvements to address deficiencies 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 two guidance documents for the nitrogen and CSO funding so that a clear and consistent methodology is used in determining CWF grant percentages, *Clean Water Fund Memorandum 4 (CWFM-4)* for BNR related construction costs and *Clean Water Fund Memorandum 2015-002 (2015-002) for* CSO related costs.

Utilizing the DEEP guidance documents and applying the various component eligibility criteria to the conceptual level component costs yields a blended project grant eligibility for the recommended West Side and East Side WWTPs of at least approximately 30 percent. **Table 9.5-4** below presents a breakdown of total projects costs in terms of potential grant value and the associated share that the WPCA would be responsible for.

Table 9.5-4 Grant Eligibility

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

Note: 1. WWTP costs escalated to midpoints of construction (2025 and 2028)

It needs to be stressed that these grant percentages and amounts and approximations of the WPCA's contribution of the total WWTP costs are approximations based on conceptual level OPCC's, estimates of design fees and contingencies, and estimates of the project schedules and project cost escalation periods. The final grant percentages will be determined during final design when the WPCA coordinates with CT DEEP and develops the grant application based on the detailed OPCC and breakdown of component costs to be developed at that stage.

As noted in Section 8, 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 (as presented) is projected to keep sewer rates below EPA's 2 percent high burden, but only if CWF 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. **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.**

9.6 Program Schedule

As outlined in Section 1, the WWTP Administrative Order requires the submission of the Facilities Plan Report on or before November 30, 2020. This report complies with that requirement. The Administrative Order goes on to require 100 percent design plans and specifications be submitted for the WWTP upgrades on or before May 31, 2022. Construction of the upgrades shall commence no later than August 2023, and construction shall be completed no later than August 2026. Based on the information presented in this report, 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 WPCA's limited resources 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 WWTP commence first, followed by the construction at the East Side WWTP.

Second, because of current difficulties securing state revolving fund (SRF) funding for design, it appears that the design start will be delayed. A December 2020 start date was previously 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, as explained herein, we believe a minimum 42-month (likely 50 months) construction schedule will be necessary. This will be further assessed as the design progresses.

Based on these factors, a revised schedule is presented in **Table 9.6-1 and Figure 9.6-1**. 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 submittal approvals by the CT DEEP.

Table 9.6-1 Implementation Schedule

	Administrative Order	Proposed Date
Submit Facilities Plan	30-Nov-20	30-Nov-20
Submit Design Scope and Budget - West Side WWTP		15-Jan-21
CT DEEP Approval of Facilities Plan		31-Jan-21
CT DEEP Design Scope and Budget Approval - West Side WWTP		28-Feb-21
West Side WWTP Upgrade and Expansion		
Commence Design		1-Mar-21
Complete Design	31-May-22	30-Nov-22
CT DEEP Approval to Advertise		30-Jan-23
Advertise for Bids for Construction		15-Feb-23
Accept Bids for Construction		1-May-23
Commence Construction	15-Aug-23	1-Jun-23
Complete Construction	15-Aug-26	31-Aug-27
East Side WWTP Upgrade and Expansion		
Submit Design Scope and Budget - East Side WWTP		30-Sep-23
CT DEEP Design Scope and Budget Approval - East Side WWTP		30-Nov-23
Commence Design		1-Jan-24
Complete Design		30-Nov-25
CT DEEP Approval to Advertise		1-Mar-26
Advertise for Bids for Construction		15-Mar-26
Accept Bids for Construction		1-Jun-26
Commence Construction	15-Aug-23	1-Jul-26
Complete Construction	15-Aug-26	30-Nov-29

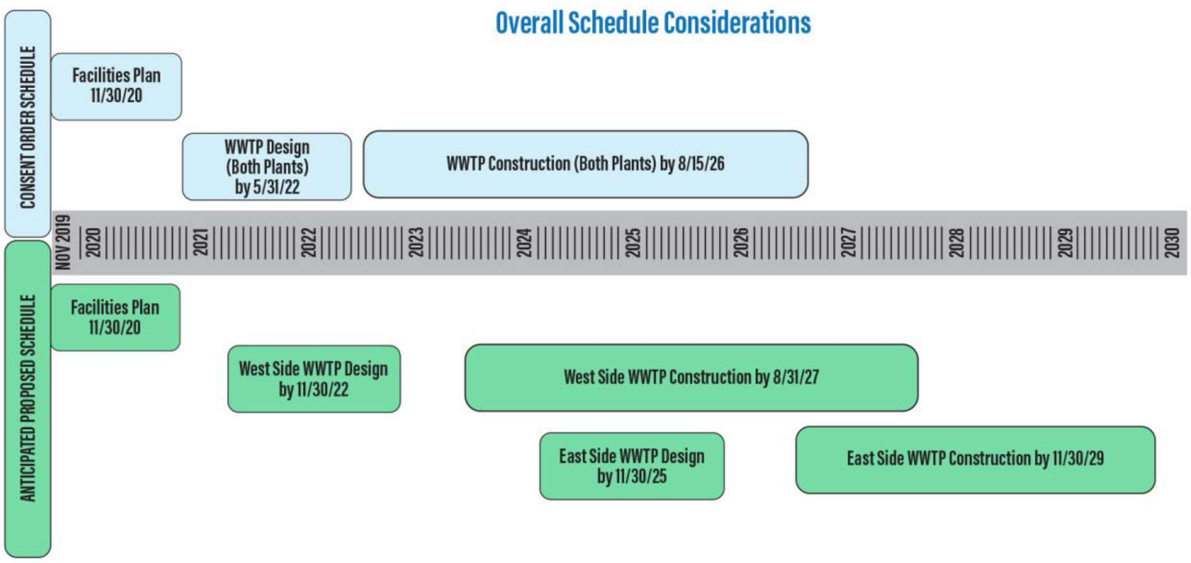

Figure 9.6-1 Proposed Program Schedule

The CSO reduction provided by the proposed revised implementation schedule versus the current CSO consent order schedule is presented in **Figure 9.6-2.** 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 city wide in the 1-Year, 24-Hour storm is approximately halved upon construction of the East Side WWTP upgrade, 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.

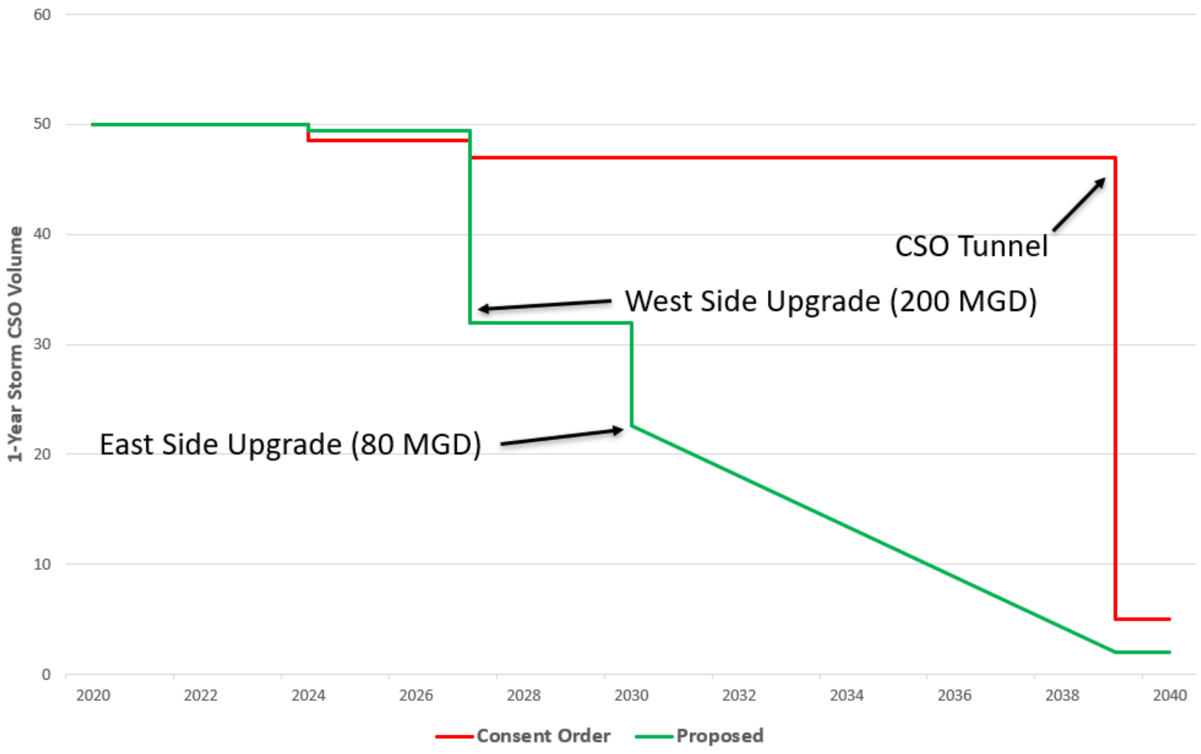

Figure 9.6-2

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

9.7 Environmental Review and Permitting Requirements

9.7.1 Environmental Review and Permitting Requirements

A preliminary review was completed to identify likely permits and approvals that may be required for the recommended projects. A listing of these potential permits and approvals is presented below.

- NPDES Permit modification for increasing WWTP capacities and relocation of East Side WWTP discharge outfall, if necessary.
- US Army Corps Wetlands Permits, if necessary. Delineation of wetlands should be completed during design to determine whether Army Corps permits are required.

- Any necessary CT DEEP OLISP or Coastal Zone approvals.
- CT DEEP Flood Management Certification Approval.
- Connecticut Environmental Policy Act Approval.
- General Permit for the Discharge of Stormwater Associated with Construction Activities.
- General Permit for Contaminated Soil and/or Sediment Management (Staging and Transfer)
- Conformance with NEIWPCC TR-16 and Executive Order 13690.
- Local City of Bridgeport Building Permits.
- Local City of Bridgeport Floodplain Development Permits.
- Fire Marshall Approval.
- Local City of Bridgeport Planning & Zoning Commission Approvals, including Inland Wetlands and Watercourses Regulations and coastal site plan review.
- CT DEEP sole source approval for certain process equipment, described in Section 9.8.1.

9.8 Design Considerations

The following sections summarize various items presented in this Facilities Plan that require further evaluation or supplemental consideration in design.

9.8.1 Sole Source Equipment

To abide by Connecticut bidding laws and CT DEEP requirements, all equipment and materials must be competitively bid by listing two manufacturer names and the qualifier “or equal” in specifications. CT DEEP provides an exception to this requirement if one of three cases can be met.

1. Sole sourcing to match existing equipment
2. Sole sourcing of equipment with no equal available
3. Sole sourcing of physically different major equipment through pre-selection

All three cases granting an exception require written approval from CT DEEP prior to bidding. CDM Smith has identified the major process areas/equipment from the recommended plans which will likely require sole sourcing during design along with the anticipated process to obtain approval. As the design phases progress, additional equipment or materials may be identified that also requires sole source approval.

9.8.1.1 Primary Cloth Media Disk Filtration

The cloth media disk filters selected in the recommend plan for both plants is a unique technology for the primary treatment process that does not have a current “or equal”. To obtain this sole source approval, an engineering evaluation would be performed to show that an “or equal" does not exist. The engineering evaluation would also demonstrate the economic and non-economic benefits of using this technology. Following the engineering evaluation, a sole source request letter would be sent to CT DEEP for review and approval. With CT DEEP approval of the sole source, the selected cloth media disk filtration design would allow the design engineers to incorporate the specific design requirements of the selected system into the overall project design, along with a fixed cost from the manufacturer.

9.8.1.2 IFAS System

For the West Side WWTP recommended plan, IFAS has been selected as the most preferable means to facilitate the selected BNR process. IFAS system design and plastic biofilm carrier media is available from multiple manufacturers; however, each has specific design requirements which impact the existing BNR basin configuration, required modifications, and aeration system design. In order to complete a final, detailed design, a sole source of the IFAS system would be obtained through a pre-selection process. In this process, manufacturers would competitively bid on the IFAS system design which would result in a formal contract and scope with the winning supplier, along with fixed cost proposal to be used in the bid form. With CT DEEP approval of the pre-selection, the selected IFAS system design would allow the design engineers to incorporate the specific design requirements of the selected IFAS system into the overall project design.

9.8.1.3 UV Disinfection

UV disinfection equipment is available from multiple suppliers; however, each has specific and varying design requirements which impact the number, size, configuration, and structural design of the UV channels and the UV facility overall, the electrical distribution system, and the plant's hydraulic profile, potentially affecting the design of the effluent pumping station as well. To provide a complete design, sole source of the UV equipment would be obtained through a pre-selection process. In this process, manufacturers would competitively bid on the UV equipment resulting in a formal contract and scope with the winning supplier, along with an equipment cost to be carried in the bid form. With CT DEEP approval of the pre-selection, the selected UV equipment would allow the engineer to incorporate the specific sizing and other design specific requirements of this equipment into the overall disinfection design.

9.8.1.4 Rotary Drum Thickener

For the West Side WWTP recommend plan, two new RDTs are recommended to supplement the existing RDT that was recently installed in 2020. It would be advantageous to the WWTP to have three identical units for uniformity of operation and equipment maintenance and repair but procuring the RDTs through the standard open bid process could result in getting two units from a different manufacturer. Sole source of the two new RDTs, along with the potential pre-negotiation of equipment pricing, will be sought by sending a request letter to CT DEEP describing the advantages of providing new units identical to the existing RDT.

9.8.2 Pilot Study

The majority of the processes and equipment that will be implemented and installed as part of the recommended plans for the two plants will be items that are common to wastewater treatment. They have been utilized successfully at other treatment plants similar in the size to the West Side and East Side WWTPs and will have performances that can be reliably determined and calculated with a comfortable level of confidence.

There will be however be processes where examples and successful references for comparable installations are limited, where actual performance of the process at the West Side and East Side WWTPs will be dependent on actual operating conditions and specific wastewater characteristic, and where the process's actual performance could have impacts on the design and specification of other related equipment and processes. For these reasons, it would be advantageous to pilot study a certain system or piece of equipment to confirm it will perform and operate successfully at the plant, to confirm it's sizing and site specific design criteria, and to ascertain how it will perform so that other related systems could be designed, sized, and specified accordingly.

As discussed in the report, it is recommended that the following processes be piloted:

- Cloth media disk filter primary filtration

Other systems and equipment may warrant pilot study as the project progresses due to advances in technology, emergence of new technology, or a rising need to confirm a planned system's actual anticipated performance at the West Side or East Side WWTP.

9.8.3 Evolving Biosolids Considerations

Currently, the WPCA, through its contract operator, Inframark, thickens primary and waste activated sludge at each treatment plant site. Inframark contracts with Synagro to haul thickened sludge off-site for disposal. The current operations contract between the WPCA and Inframark states, "Should sludge quantities be plus or minus 5 percent of the base estimate of 4,850 dt/year an adjustment for cost of sludge disposal shall be made."

Because of the limited space available on either plant site and the extensive improvements required to enhance the performance and resiliency of the liquid treatment train at both plants, it is recommended that the WPCA continue to haul thickened sludge off-site for disposal. Hauling thickened sludge from each WWTP is the most cost-effective approach at this time.

It is imperative that the base estimate for sludge quantities be revised when the contract operations contract is renewed (current contract expires in December 2023) to account for the increase in biosolids production anticipated with the upgraded treatment facilities. Assuming the West Side WWTP with primary cloth disk filtration and 4-stage process with IFAS for secondary treatment, the anticipated annual average sludge quantity for the West Side plant is estimated at 8,300 dt/year in the initial year of operation. Similarly, assuming the East Side WWTP is also upgraded with primary cloth disk filtration and 4-stage activated sludge system for secondary treatment, the anticipated annual average sludge quantity for the East Side plant is estimated at 1,300 dt/year in the initial year of operation. For a total sludge production of 9,600 dt/year when both plants are upgraded.

Biosolids management across New England is in flux. In part because disposal locations are closing down or are at capacity, and in part because of recent concerns over PFAS in biosolids and looming regulations that may be imposed related to biosolids disposal. In addition, some states in New England are prohibiting the disposal of organics in landfills or incinerators and requiring digestion or composing as a means of resource recovery. Lastly, emerging technologies for biosolids management, including pyrolysis and gasification are entering the market and may prove to be more cost-effective than digestion or drying. These issues could provide opportunities for the WPCA in the future. Subsequent to the start-up and operation of the West Side and East Side WWTPs the quality and quantity of the biosolids produced from the West Side and East Side WWTPs can be better assessed. The WPCA could consider issuing a letter of interest and/or a request for proposals from third party entities to reduce the cost of biosolids management. This could take the form of a third-party design-build-operate-finance (DBOF) contract. The vendor would be responsible for the siting, design, construction and operation of a biosolids management facility in the vicinity of one of the WWTPs. Alternatively, the WPCA could provide the site for the system. Critical to this endeavor is ensuring that any Contract with a third party is appropriately protective of the WPCA's interests.