North Hudson Sewerage Authority

Long Term Control Plan

Alternatives Development and Evaluation: River Road Wastewater Treatment Plant

New Jersey Pollutant Discharge Elimination System Permit No.: NJ0025321

Date: June 25, 2019

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SIGNATURE CERTIFICATION

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Document Name(s):	Alternatives Development and Evaluation: River Road Wastewater Treatment Plant
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Date:	June 24, 2019

Executive Summary

Under the New Jersey Pollutant Discharge Elimination System (NJPDES) permit for the River Road Wastewater Treatment Plant (WWTP), as part of the Long-Term Control Plan, the North Hudson Sewerage Authority (the Authority) must evaluate alternatives for combined sewer overflow (CSO) technologies at the River Road WWTP and its outfalls. This report presents the results of the evaluation of identified control technologies for the WNY1 and joint overflow sewer outlet (JOSO) drainage basins and the River Road WWTP. The alternatives evaluation process included identification of alternatives, preliminary screening, development of conceptual layouts, testing the alternative in the River Road Service Area InfoWorks Integrated Catchment Modelling (ICM) hydraulic collection system model (model), and cost development.

Identification of alternatives included summarizing findings of the Alternatives Analysis workshop in June 2018 and development of evaluation criteria to assign a score to each alternative and provide a parametric comparison for the different alternatives. The Authority's priorities were identified along with the goals of CSO reduction to determine categories for evaluation criteria. These categories were assigned a weighting method based on the priorities of the Authority and the overall goals of CSO reduction to develop scores for each. The evaluation criteria can be found in Appendix A .

After alternatives identification, a preliminary screening was conducted to identify anticipated constraints, site limitations, expected feasibility and functionality for all alternatives from the identification phase. This step includes identifying any aspects of the proposed alternatives that may have a major effect on cost or schedule, and some alternatives were eliminated at this stage based on previous experience or planned projects in the area. The complete Preliminary Screening memorandum can be found in Appendix B.

For alternatives that were not eliminated after preliminary screening, conceptual layouts were developed showing the required piping, footprints of proposed structures, and potential updates to existing facilities for implementation of the alternatives. For storage and conveyance alternatives at the outfalls, these layouts were simulated in the model to extract the anticipated overflows in the Typical Year expected from implementing these alternatives with the goal of reaching 4 overflows in the Typical Year. For disinfection alternatives, the available contact time was calculated either within the existing pipes or within a proposed contact basin with the goal of disinfecting the peak hourly flow within the Typical Year. In all drainage basins, disinfection in the outfall pipes is not feasible as based on analysis, there is not adequate contact time from the proposed disinfection point to the outfall for any drainage basin. For alternatives proposed at the River Road WWTP, the current layout and processes of the treatment plant were analyzed to determine what proposed structures would be required and the approximate annual amount of chemicals required for disinfection. Class 5 cost estimates were developed once the layouts were finalized and included construction, capital, O&M, and the lifecycle cost with the projected year dependent on the type of alternative.

When the analysis, modeling, and cost estimates were complete, each alternative was assigned a weighted point total and percentage based on the evaluation criteria (Appendix A). Alternatives could receive a maximum weighted point total of 152. The weighted percentage shows the percentage that the weighted point total has received of the maximum total. The ideal alternatives have a weighted percentage closer to 100%. The weighted point totals and weighted percentages for all alternatives are shown in Table ES-1 1

Table ES-1. River Road WWTP Service Area - CSO Control Alternatives Comparison

Drainage Basin	Alternatives	Weighted Point Total	Weighted Percent	Class 5 Conceptual Construction Cost Estimate
JOSO	Combined Sewer Overflow Storage Structure In Water	66	47%	$82,160,000.00
	Raise Regulator Weirs at UC1, UC2 and WNY2	105	76%	$120,000
	Replace Existing JOSO Sideflow Weirs with Bending Weirs	119	86%	$352,000
WNY1	Combined Sewer Overflow Storage Tank near WNY1 Outfall	65	47%	$60,333,000.00
	Linear Storage Tunnel at Anthony Defino Way	63	46%	$171,450,000.00
	Cloth Media Filtration[1]	-	-	$27,700,000-$86,500,000
	Compressible Media Filtration[2]	-	-	$92,000,000
Systemwide	Inflow/Infiltration Rehabilitation	107	77%	$13,788,000
	Green Infrastructure	99	71%	$42,310,000.00
River Road WWTP	ActiFLO	121	87%	$11,923,000
	CoMag	121	87%	$12,191,000
	Cloth Media Filtration	122	88%	$14,961,000
	Compressible Media Filtration	122	88%	$15,425,000

1. Alternative not scored due to potential range of costs
2. Alternative not scored due to potential range of costs; cost shown assumes max TSS concentration of 320 mg/L

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Acronyms and Abbreviations

%	percent
Authority	North Hudson Sewerage Authority
CBOD	Carbonaceous biochemical oxygen demand
CCTV	closed-circuit television
CH2M	CH2M HILL Engineers, Inc.
CMF	compressible media filtration
CSO	combined sewer overflow
CSS	combined sewer system
DEFM	Demographic and Employment Forecast Mode
EPA	U.S. Environmental Protection Agency
ES	executive summary
EWRI	Environmental & Water Resources Institute
ft^2	square foot or feet
ft^3	cubic feet
GI	Green Infrastructure
GIS	geographic information system
gpad	gallons per acre per day
gpd	gallons per day
I/I	inflow and infiltration
ICM	Integrated Catchment Modeling
idm	inch diameter-mile
ID	identification
Jacobs	Jacobs Engineering Group Inc.
JOSO	joint overflow sewer outlet
LTCP	Long-Term Control Plan
MG	million gallon(s)
mgd	million gallons per day
NJ	New Jersey
NJDEP	New Jersey Department of Environmental Protection
NJPDES	New Jersey Pollutant Discharge Elimination System
NJTPA	New Jersey Transportation Planning Authority
PS	pump station
RCP	reinforced concrete pipe

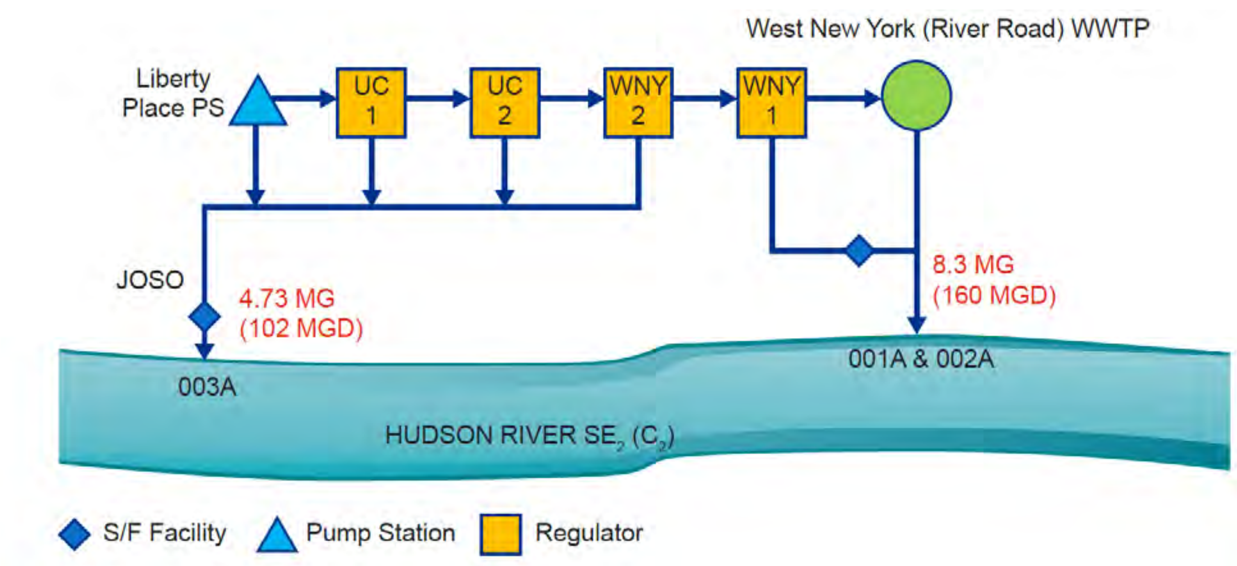
ROW	right-of-way
S/F	solids/floatables
SCADA	supervisory control and data acquisition
TAZ	Traffic Analysis Zone
TBM	tunnel boring machine
TSS	total suspended solids
U.S.	United States
USACOE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
VCP	vitrified clay pipe
WEF	Water Environment Federation
WNY	West New York
WWETCO	Wet Weather Engineering and Technology
WWF	wet-weather facility
WWPS	wastewater pump station
WWTP	wastewater treatment plant

SECTION 1

Introduction

This report evaluates the control technologies deemed as feasible for the North Hudson Sewerage Authority's (the Authority's) River Road wastewater treatment plant (WWTP) system. Control technologies include flow control (for example, storage) and treatment. Figure 1-1 depicts the system block diagrams of the River Road WWTP outfalls. This figure provides an understanding of the relative locations and configuration of the Authority's infrastructure along the Hudson River based on the WWTP service area, as well as volume of the fifth-largest overflow from the model that will be used as a target to evaluate storage and capacity alternatives. Treatment alternatives are evaluated based on the peak available contact time within the pipes where disinfection is applied or the peak flow rate within the Typical Year.

Figure 1-1. River Road WWTP Service Area



1.1 Background

The Authority owns two WWTPs and the combined sewer systems' (CSSs') tributary to these facilities. The Adams Street and River Road WWTPs are regulated by the New Jersey Department of Environmental Protection (NJDEP) under the New Jersey Pollutant Discharge Elimination System (NJPDES) permit program.

1.2 Regulatory Requirements

In October 2015, the NJDEP issued individual permits to municipalities and authorities that own and operate segments of CSSs. The NJPDES permits addressed requirements for overall water quality improvements, routine reporting and development of a CSO LTCP.

Pursuant to NJPDES Permit NJ0025321 (River Road WWTP), Part IV, Combined Sewer Management Section, Section D.3.b.ii., a System Characterization Report for the LTCPs was submitted to NJDEP on December 31, 2015. The document fulfills the requirement in Part IV, Combined Sewer Management, Section D.3.b.ii., to submit the Development and Evaluation of Alternatives by July 1, 2019. Information generated from the System Characterization Work Plan comprises this Evaluation of Alternatives, including:

- Alternatives Analysis Workshop
- Identification and Preliminary Screening of Alternatives
- Evaluation of Alternatives in Hydraulic Collection System Model
- Class 5 Cost Estimate

1.3 Purpose and Scope

The purpose of this report is to fulfill NJDEP permit requirements to evaluate a range of CSO control alternatives predicted to accomplish the requirements of the CWA. The evaluation includes a thorough review of the collection system that conveys flow to the River Road WWTP, including areas of sewage overflows to streets, and other public and private areas, to adequately address the response of the CSS to various precipitation events. In its evaluation of each potential CSO control alternative, the approved hydrologic, hydraulic and water quality models were used to simulate the existing conditions and conditions as they are expected to exist after construction and operation of the chosen alternative(s). The practical and technical feasibility of the proposed CSO control alternative(s), and water quality benefits of constructing and implementing various remedial controls include:

- Green Infrastructure
- Increased storage capacity in the collection system.
- STP expansion and/or storage at the plant including an evaluation of the capacity of the unit processes must be conducted at the STP resulting in a determination of whether there is any additional treatment and conveyance capacity within the STP
- I/I reduction to meet the definition of non-excessive infiltration and non-excessive inflow as, defined in N.J.A.C. 7:14A-1.2 in the entire collection system that conveys flows to the treatment, works to free up storage capacity or conveyance in the sewer system and/or treatment capacity at the STP, and feasibility of implementing in the entire system or portions thereof.
- Sewer separation.
- Treatment of the CSO discharge.
- CSO related bypass of the secondary treatment portion of the STP in accordance with N.J.A.C. 7:14A-11.12 Appendix C, II C.7.

The anticipated limitations and constraints, conceptual layouts, and anticipated results of implementing the alternative using the model in the River Road WWTP service area and planning level costs are described.

1.4 Future Conditions

At the time of this analysis, no capital projects are anticipated within the River Road service area. The timeline of the proposed projects may extend well after the selection of alternatives has been completed. For this reason, an analysis on the potential changes in population was conducted to determine the potential changes in volume that the CSS and alternatives will need to report. Descriptions of the analysis is provided in the following subsection.

1.4.1 Population Projections and Future Flows

In section G.4.e. of the permit, it is indicated that “the permittee shall utilize the models to simulate the existing conditions and conditions as they are expected to exist after construction and operation of the chosen alternative(s).” It has been assumed that the alternatives that are selected through the LTCP process will be constructed and implemented over a 30-year period. As such, the year 2050 has been assumed as the future baseline condition against which the alternatives have been evaluated.

Several population projections were sourced in order to select the most reasonable projection for the design basis. These are summarized below.

1.4.1.1 U.S. Census Bureau

Census data is available from the 2010 census, and population projections for 2017 are also available from the U.S. Census Bureau. This data is shown in Table 1-1, extrapolated to 2050. It is noted that while these towns underwent some growth over the past ten years, this rate of growth is unlikely to continue as the service area is already urbanized. As such census data was not used for this analysis.

Table 1-1. 2010 and 2017 Census Data

	2010	2017	Annual Increase (%)	2050 Projection
Union City	66,455	69,815	0.72	85,655
Weehawken	12,554	14,268	1.95	22,354
West New York	49,708	53,345	1.05	70,488
Total	128,717	137,428		178,497

1.4.1.2 North Jersey Transportation Authority

The North Jersey Transportation Planning Authority is a metropolitan planning organization with federal authorization. It is responsible for the 13 northern counties in New Jersey and is responsible for overseeing certain transportation related projects and studies. The NJTPA updates its regional forecasts for population, households and employment every four years.

In 2017, NJTPA completed the latest set of forecasts. Final forecasts were approved by the NJTPA Board on November 13, 2017. The NJTPA employs the Demographic and Employment Forecast Model (DEFM). According to their website:

> The DEFM uses regional and county level forecasts of employment, population and households produced from a regional econometric modeling effort and allocates these forecasts to a localized Traffic Analysis Zone (TAZ) level. It also aggregates the TAZ level information to the municipal level. The DEFM uses data elements that influence location behavior to perform this allocation analysis including:
>
> Current land use data (residential, commercial, industrial and vacant land);
> Composite zoning estimates for density;
> Highway and transit accessibility;
> Historical growth; and
> - Known project developments.

The forecasts produced by the DEFM form the basis of the final set of forecasts produced by NJTPA. The forecasts are reviewed by the NJTPA and partner agencies and adjustments are made to incorporate local knowledge to produce NJTPA's final forecasts and are used to help distribute expected population and employment growth in the NJTPA region. The forecast is summarized in Table 1-2, as can be seen forecast population growth is minimal.

1.4.1.3 New Jersey Department of Labor

Population and labor force projections on a county-wide basis have been developed by the New Jersey Department of Labor extending to 2034. To obtain an estimated population for 2050, we assumed that River Road service area population will grow at the same rate as the county as a whole. Accordingly, since the service area made up 20.3% of the county population in 2010 it would be expected to make of 20.3% of the county population in 2050. The County population estimate for 2034 was projected to 2050, this yields the estimates in **Error! Reference source not found.**.

1.4.1.4 Population Summary

As can be seen available sources of data project widely varying future populations. Given that with recent development the River Road WWTP service area is essentially built out, past trends in population growth are not likely to continue. Likewise, as one of the most densely populated areas in the state, it is unlikely the service area will follow projected population trends of the overall county. The smaller growth projected by the NJTPA still represents an optimistic buildout condition that may not be achieved. Future development, redevelopment and remodeling of existing structures will continue to introduce low flow fixtures which reduce water consumption. Accordingly, it is reasonable to project that future wastewater generation within the service area will remain similar to current wastewater generation.

1.4.2 Sea Level Rise

It is acknowledged that sea levels have been rising and are expected to continue to rise over the life of the project and beyond. In low lying areas, increased sea levels would tend to reduce the volume of combined sewage overflow. However, the regulators tributary to the River Road WWTP are located well above any projected sea level rise as such there is no need to incorporate sea level rise into the analysis.

Table 1-2. NJTPA Population Extrapolation						
County	**Municipality Code**	**Municipality Name**	**2015 Population**	**2045 Population**	**Annualized % Population Change 2015-2045**	**2050 Population Extrapolation**
Hudson	3401774630	Union City	68,390	71,954	0.20%	72,566
Hudson	3401777930	Weehawken	13,706	14,868	0.30%	15,072
Hudson	3401779610	West New York	52,236	55,219	0.20%	55,732
					Total	**143,370**

Table 1-3. Hoboken Population Extrapolation						
	Census	**Projections to July 1**				**Projected for LTCP**
County	**4/1/2010**	**2019**	**2024**	**2029**	**2034**	**2050**
Hudson	634,266	708,100	718,700	747,400	766,500	831,008
Union City	66,455					
Weehawken	12,554					
West New York	49,708					
Total	**128,717**					**168,643**

SECTION 2

Development and Evaluation of Alternatives Approach

2.1 Alternatives Analysis Concept Workshop

The Authority held a CSO Alternatives Analysis Concept Workshop on June 14 and 15, 2018. The workshop served as a brainstorming session to identify strategies and alternatives for maximizing wastewater treatment and reducing CSOs in the Authority's systems. The output from the workshop was used by the Authority and the CSO Advisory Board to further develop and evaluate CSO control alternatives (this contract) and to ultimately prepare the analysis for integration into the LTCP.

The workshop format involved reviewing the sewer systems by outfall to identify the complete list of CSO control alternatives which would be optimal strategies for CSO control, including areas of open space, and discussing current bottlenecks in the system and how to mitigate them. The mitigation strategies discussed included storage and conveyance, disinfection, green infrastructure, inflow/infiltration (I/I) solutions, and high-level storm sewers. The fifth-largest overflow from the Baseline Characterization was used to estimate the facilities required to minimize overflows to an average of four per year. The workshop results were used to compile a list of alternatives to be considered per outfall. This list was narrowed down further to identify those alternatives that would proceed to preliminary screening. The alternatives analysis workshop memorandum in Appendix C includes more information on the initial list of alternatives proposed.

2.2 Alternatives Analysis Approach

After identifying the alternatives based on information from the Alternatives Analysis Concept Workshop and the Authority's needs, a preliminary screening was conducted on each alternative to identify the overall feasibility, functionality, and anticipated constraints, as well as a preliminary layout of the expected footprint and alignment of the alternative. This screening further refined the list of alternatives and, in some cases, eliminated any alternatives that are expected to have constraints or limitations that are unable to be mitigated and therefore would not allow to meet the final permit limits. Those alternatives that did not have practical solutions to limiting constraints proceeded to evaluation. For storage and conveyance alternatives, the proposed alternatives were simulated in the River Road model under existing conditions using the Typical Year. The existing model network was edited to reflect the conceptual alignment developed in the preliminary screening for the alternatives, which proposed additional storage or increased conveyance. Model results were developed to estimate the potential number and volume of overflows in the Typical Year after implementing the alternative.

For alternatives that propose pipe disinfection, flow timeseries data from the River Road model for the Typical Year was extracted for the pipes immediately downstream of where the dosing point is proposed to the outfall pipe. Rolling averages of the velocities from the timeseries data were developed in 5-, 15-, and 60-minute intervals to determine the potential maximum contact time available in the pipeline. For alternatives that proposed a chlorine contact basin, the peak hourly flow for the Typical Year in the pipe that would be immediately upstream of the contact basin was used to determine the potential contact time. The approximate volume within the chlorine contact basin per year was also used to estimate the size of a chlorine contact basin required.

After the concept of each alternative was finalized and results were obtained from the model, Class 5 conceptual cost estimates were developed including the capital, operational, and life-cycle costs for the

CSO control alternatives. AACE International describes a class 5 cost estimate as a concept screening estimate that is developed through parametric models, judgement, or analogy to similar projects. The costs presented here represent the expected cost with a range as wide as +30-100% or as narrow as -20-50%.

SECTION 3

JOSO Basin

The following section presents the evaluation of the alternatives which passed the Preliminary Screening phase in the JOSO drainage basin. A discussion on all alternatives considered in the JOSO Basin can be found in the Preliminary Screening Memorandum in Appendix D. The following alternatives were evaluated for CSO Outfall 003A

- CSO Storage Structure in Water and divert flow to Adams Street WWTP via Pershing Road Force Main
- Raise Regulator Weirs at UC1, UC2, and/or WNY2
- Replace Existing JOSO side-flow weirs with bending weirs

3.1 Drainage Basin Overview

The JOSO drainage basin measures 205.36 acres, and the basin's overall imperviousness is 78%. The combined sewer network within this drainage basin discharges to Outfall 003A. The total length of pipe in the drainage basin is approximately 46,371 feet and most of the pipes are 12" in diameter. The majority of the surrounding sewers from JOSO basin are vitrified clay pipe (VCP). In addition to the combined sewer network, the River Road Facilities in the JOSO drainage basin are the UC1/UC2/WNY2 Regulators, the Liberty Place Pump Station and the JOSO solids/floatables facility. Each facility is shown in Figure 3-1 and additional information is provided in the following subsections.

3.1.1 JOSO Regulators

There are three side overflow weir-operated regulators that discharge excess wet weather flow into the JOSO relief sewer that combines flows from the Town of West New York, Union City and Weehawken. Two regulators are located in Union City: UC1 is located on Park Avenue just north of 43rd Street, and UC2 is located on 49th Street just west of Broadway. The third regulator, WNY2 is located in West New York on 51st Street, just west of Broadway. The JOSO relief sewer directs the excess wet weather flow to the Hudson River. All three regulators were originally constructed in the 1950s and 1960s.

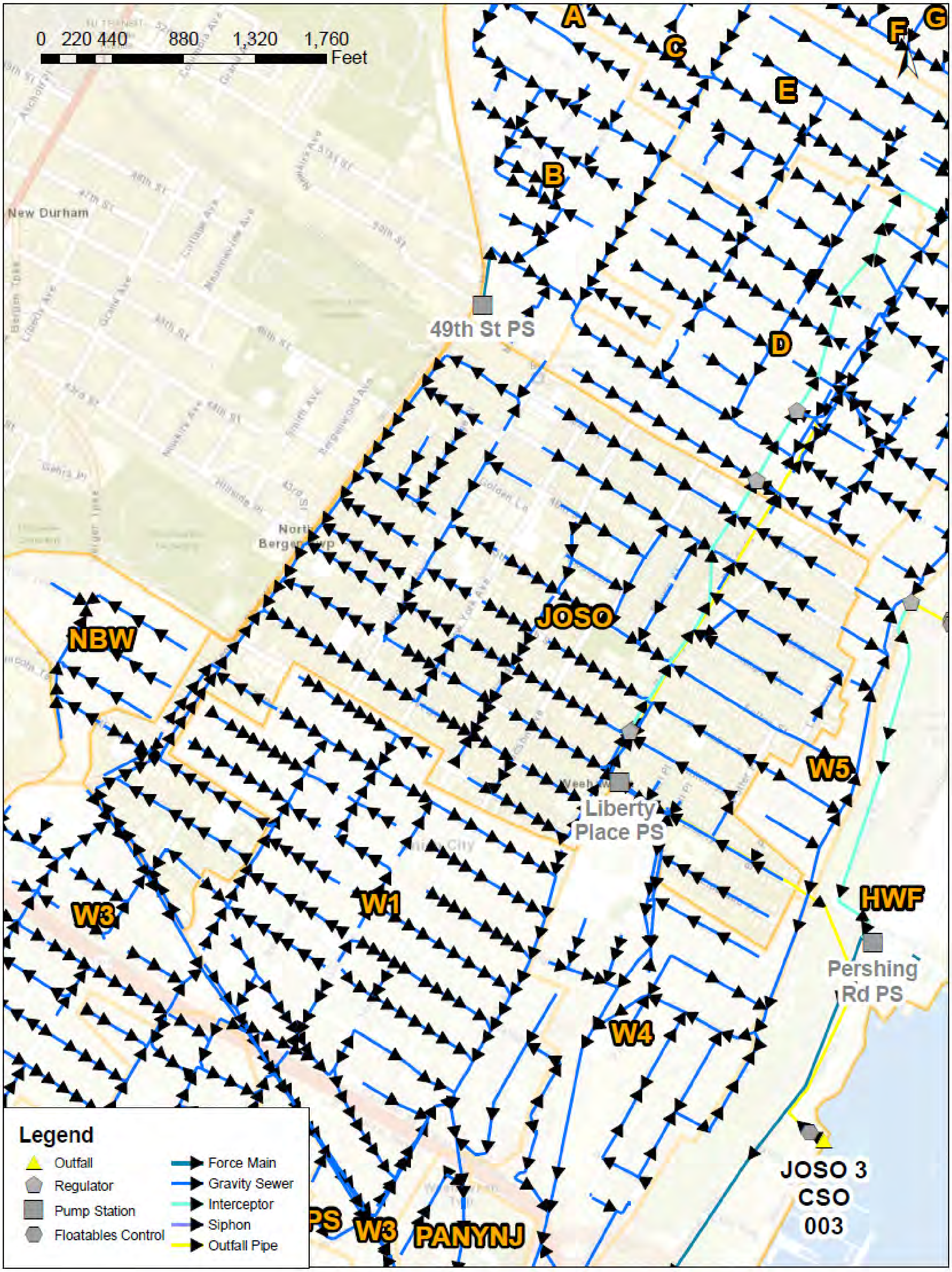
3.1.2 Liberty Place Pump Station

The Liberty Place Pump Station pumps sewage from Liberty Place, Eldorado Place and Highwood Avenue into the River Road WWTP via a force main. It receives flow from nearby residences. The pump station includes two (2) 5 hp submersible pumps and one above-grade electrical cabinet on the sidewalk. The pumps were installed in 2012 by the Authority and are the ABS Contrablock pumps with open impeller design. The pumps could not be inspected, however, they have performed well without clogging. The electrical cabinet is old but operable. There is no bar rack nor comminutor at this station. Excess wet weather flow at the Liberty Place Pump Station flows by gravity to the JOSO outfall for discharge to the Hudson River.

3.1.3 JOSO Solids/Floatables Facility

The JOSO S/F Facility treats overflows from the UC1, UC2 and WNY1 regulators. It was constructed in 2005 and is located in a subsurface facility at the end of Henry Place, upstream (west) of the JOSO outfall. The facility has a 72-inch influent RCP pipe and a 72-inch effluent RCP pipe. The facility has bar screens with 5-foot 6-inch width with a span of 15 feet. It has 48-inch Tideflex check valves and 48-inch by 54-inch sluice gates.

Figure 3-1. JOSO Drainage Basin



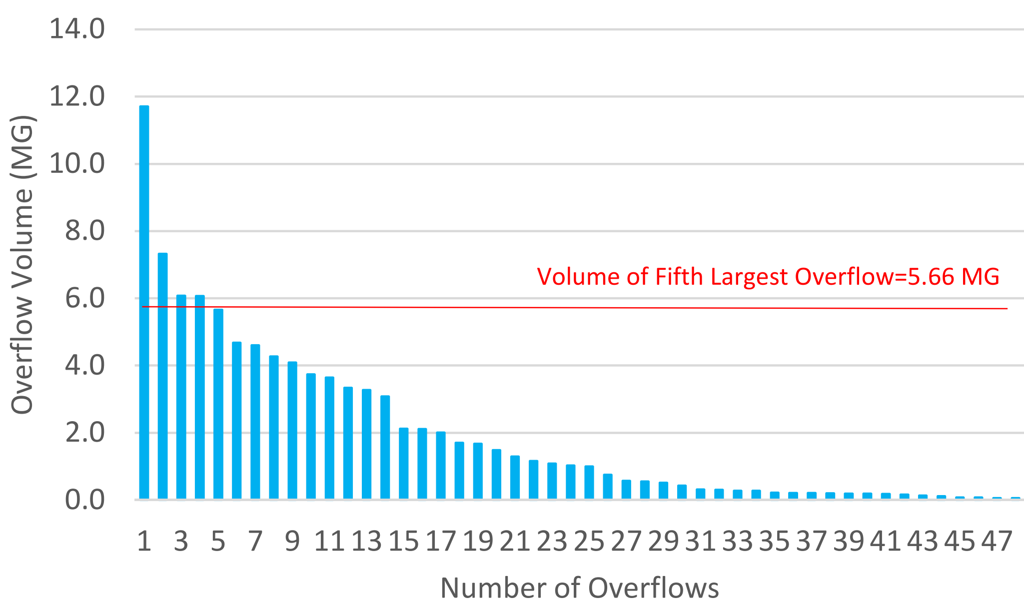
3.1.4 Outfall 003A

Outfall 003A is located at the end of Liberty Place in Weehawken. The associated regulators are UC1, UC2 and WNY2 regulators. The outfall pipe is 60-inch RCP. Drawings of the outfall pipe are not available, however from the Authority staff it is known that there is a drop structure located at the end of Liberty Place, which is included in the River Road WWTP model. The known elevation of the outfall was also included in the model. The outfall is located over 117 feet deep from the surface and was constructed from blasting the rock. The tunnel is an irregular shape and drops steeply down the Palisades to Port Imperial and end at a solids and floatables structure at the Hudson River.

3.2 Existing Conditions

Figure 3-2 shows the calculated frequency and volume of overflows based on the Typical Year. For the storage and conveyance alternatives proposed, the fifth-largest overflow is the target volume to control. For disinfection and treatment alternatives, the yearly peak flow, 15 minutes peak flow, and annual total volume for each outfall were analyzed to determine contact time and sizing of any related disinfection alternatives. The following subsections detail the proposed plan for each alternative.

Figure 3-2. JOSO Outfall-Overflow Frequency vs. Volume, Existing Condition



3.3 Alternatives

The following sections detail the alternatives that moved on from the preliminary screening to full evaluation. The alternative identification, conceptual layout, potential overflow frequency after the alternative is implemented, and conceptual cost estimate for each are described.

3.3.1 Combined Sewer Overflow Storage Structure in Water and Divert Flow to Adams Street Wastewater Treatment Plant

3.3.1.1 Identification and Preliminary Screening

A storage tank constructed in the Hudson River is proposed for the JOSO Basin for this alternative. This may include a public/private partnership with a residential development that will ultimately develop above this alternative. Based on the target volume of 4.7 million gallons (MG) and an assumed depth of 10 feet for a storage structure, an approximate area of 63,000 square feet would be required. The overall dimensions of the structure can be modified to yield a larger or smaller area by adjusting the depth of the structure.

- Anticipated Constraints and Site Limitations:
  - Foundation - If the proposed structure would include a pier, achieving the proper foundation stability would require the use of multiple piles which can require complex methods and coordination.
  - Construction in Navigable Waters and Boat Traffic - This alternative would require the use of a Cofferdam and dewatering during construction would present challenges and have significant costs
  - The proposed structure would extend beyond the current edge of all nearby existing structures with the exception of Days Point. Extending beyond the existing shoreline will require extensive permitting and would be required to meet stringent impact design criteria for boat and barge traffic so as to not disrupt currents and tides in the River. Permitting the structure as an “end of pipe” structure may allow for approval of surface water encroachments but the adjacency would need to be confirmed.
  - Sea Level Rise - This alternative being located on the shoreline presents design challenges to accommodate sea level rise. The designing of pumping system power and controls will need to meet flood damage protection criteria and sea level rise criteria which may conflict with the desire to not limit lines of sight for residents.
- Functionality and Feasibility:
  - The proposed storage structure would need to be at the water level equal with the surrounding grade to allow for a pedestrian park/development to be extended over the top of the structure. The required pumping system would also need to be enclosed in an architecturally consistent structure that does not limit lines of sight from residents. The access for structure maintenance would be from the existing lot along Henley Place
  - The proposed structure is adjacent to a new high end residential complex (Henley on Hudson). Not only will design and construction efforts need to be heavily structured and regulated, odor control measures taken after construction would be paramount. It is anticipated that the local residents along the shoreline would be difficult to gain approval as public stakeholders.

3.3.1.2 Conceptual Network Layout

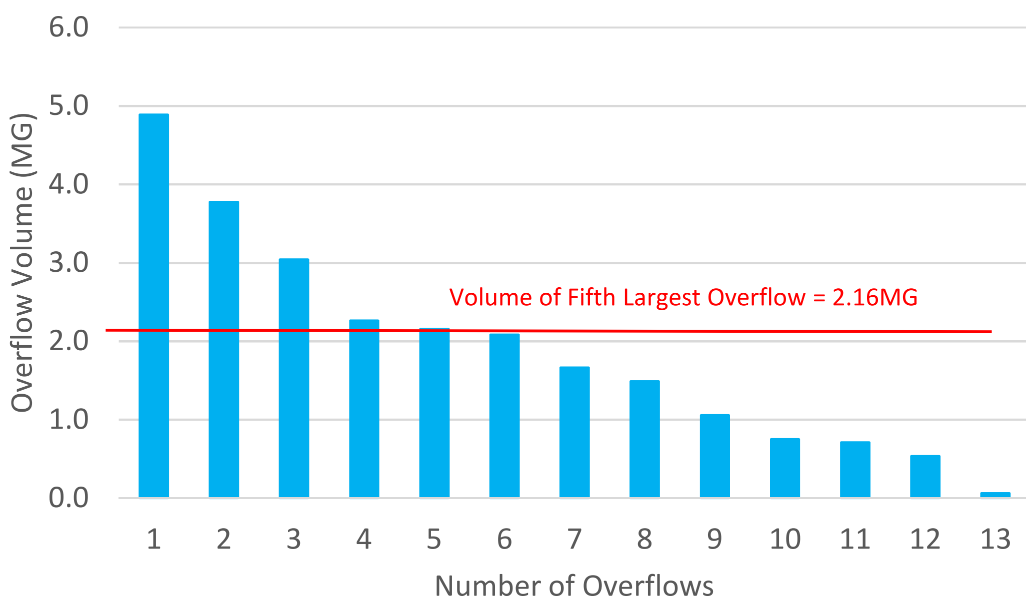
Figure 3-3 shows the required modifications to the existing network including the staging of the storage tank and required piping.

Figure 3-3. JOSO – Proposed In-Water Storage Structure

3.3.1.3 InfoWorks Integrated Catchment Modelling Modeling Results

The River Road WWTP model was used to simulate the conditions as they are expected to exist after construction and operation of this storage alternative. The model network was updated based on the conceptual GIS network. Figure 3-4 shows the plot of the Typical Year overflow volume vs. number of overflows for the JOSO outfall.

Figure 3-4. Outfall JOSO Overflow Frequency vs. Volume, CSO Storage Tank Proposed Condition



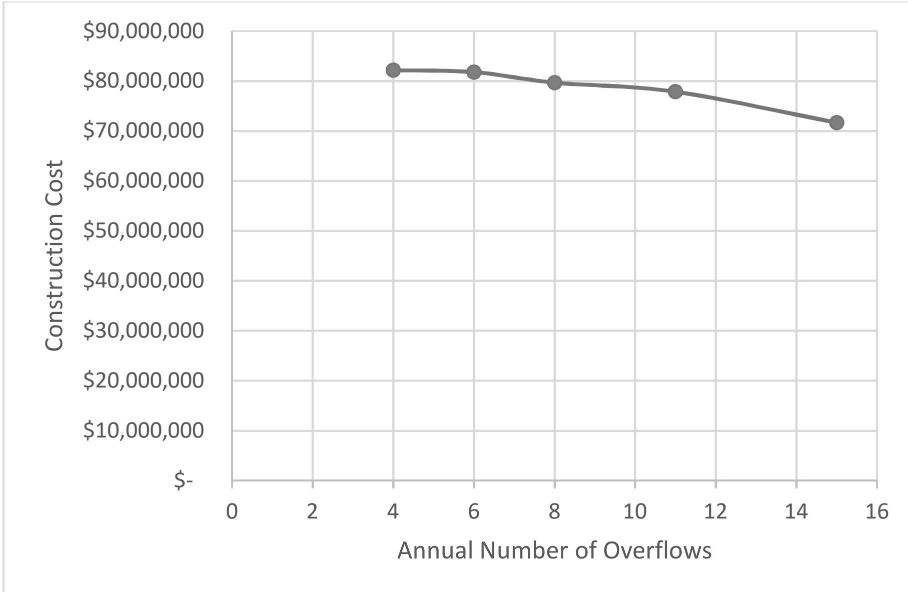
3.3.1.4 Cost

Table 3-1 lists the associated costs for this alternative.

Table 3-1. JOSO Proposed CSO Storage Tank Conceptual Cost Estimate	
Construction Cost Estimate	$82,160,000.00
Project Annual Operations and Maintenance	$76,000.00
Project Capital Cost Estimate	$108,450,000.00
Project 50 Year Present Worth Estimate	$138,010,000.00

To observe the range in costs versus number of annual overflows expected to result from smaller CSO storage volumes, Figure 3-5 shows the cost performance curve for the construction costs for annual overflow events greater than 4.

Figure 3-5. JOSO CSO Storage Cost Performance Curve



3.3.2 Raise Regulator Weirs at UC1, UC2, and WNY2

3.3.2.1 Identification and Preliminary Screening

For this alternative diverting flows from the JOSO network to the WNY1 outfall is proposed. The JOSO outfall currently has 3 regulators (UC1, UC2 and WNY2) in the network that direct wet weather flow to the JOSO relief sewer as needed. To avoid expensive, disruptive and challenging in-rock construction, an option is to raise the overflow weirs in the regulators to direct more flow to WNY1 (and less overflow to JOSO) is proposed. This could be accomplished with minimal construction and/or break in service, and without the hassles of in-rock construction.

- Anticipated Constraints and Site Limitations:
  - Capacity at River Road WWTP - Diverting additional flow to the WNY1 regulator alone may not result in CSO reduction to the desired level; the River Road WWTP needs to have sufficient capacity to treat the increased flow, otherwise, it may result in a larger or an additional WNY1 outfall with solids/floatables reduction. Since discharge from the JOSO outfall already receives solids/floatables (S/F) reduction, its mere diversion to WNY1 may not be an improvement. To ensure the desired level of CSO reduction, diverting additional flow to the WNY1 regulator should be supplemented by increased capacity at the River Road WWTP to treat additional flow.
- Functionality and Feasibility:
  - The level of CSO reduction expected would need to be verified by modeling or other theoretical means. Modeling could also help determine which regulators need their weir raised, the additional weir height necessary and any unintended consequences. No additional hiring/training is anticipated to be required for the function of this alternative. This alternative is anticipated to reduce CSOs to the desired level by improving on existing conveyance methods while avoiding challenging in-rock construction and conveying increased flow to an existing WWTP for complete treatment.
  - Managing impact on traffic and the neighborhood during construction is anticipated to be limited because these improvements would be within existing structures owned by the Authority. Relatively small capital and O&M costs are expected compared to other storage or disinfection alternatives. These improvements are also anticipated to work effectively under a

variety of flow conditions and during intermittent operation. This alternative is considered feasible.

3.3.2.2 Network Updates

The River Road Integrated Catchment Modelling (ICM) Model was adjusted to increase the weir height of UC1, UC2 and WNY2 regulators by 4-ft to reduce the outfall overflow. The existing weir heights are: 140.08-ft, 137.08-ft and 136.24-ft respectively. The proposed weir heights are: 144.08-ft, 141.08-ft and 140.24-ft respectively.

3.3.2.3 InfoWorks Modeling Results

The River Road ICM model was adjusted to decrease the time of the overflow. It was found that the overflow at JOSO decreased from 45 times to 5 times in a Typical Year. And the fifth largest overflows dropped from 4.61 MG to 0.15 MG total overflow volume. The surface flooding upstream of regulators increase from 4.84 MG to 5.59 MG. The CSO volumes and events are summarized in Table 3-2. Figure 3-6 and Figure 3-7 show the change in overflow volume and flow rate at the JOSO outfall, respectively. While these results indicate that overflows are decreased at JOSO, results show that basins WNY1 and JOSO may be hydraulically connected and reducing the overflows at JOSO will impact the overflows at WNY1. It is not recommended to consider changes in regulator weirs as a lone alternative, but can be used to optimize another alternative.

Table 3-2. JOSO Proposed Regulator Adjustment Results

	Number of Overflows		Total CSO Volume (MG)	
	Existing	With Weir Adjustment	Existing	With Weir Adjustment
JOSO	45	5	95.56	4.90

Figure 3-6. Change of Overflow Volume at JOSO, Proposed Condition

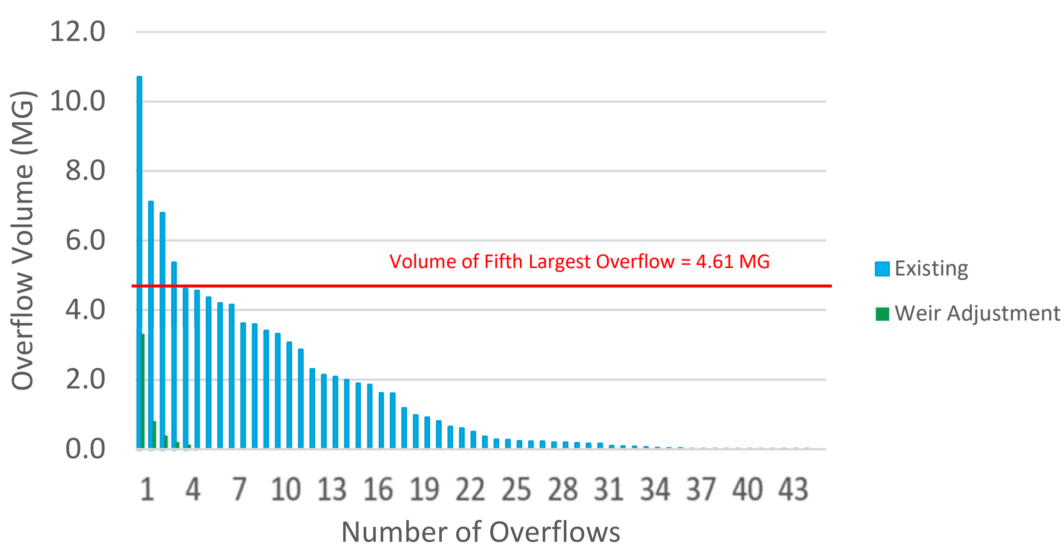
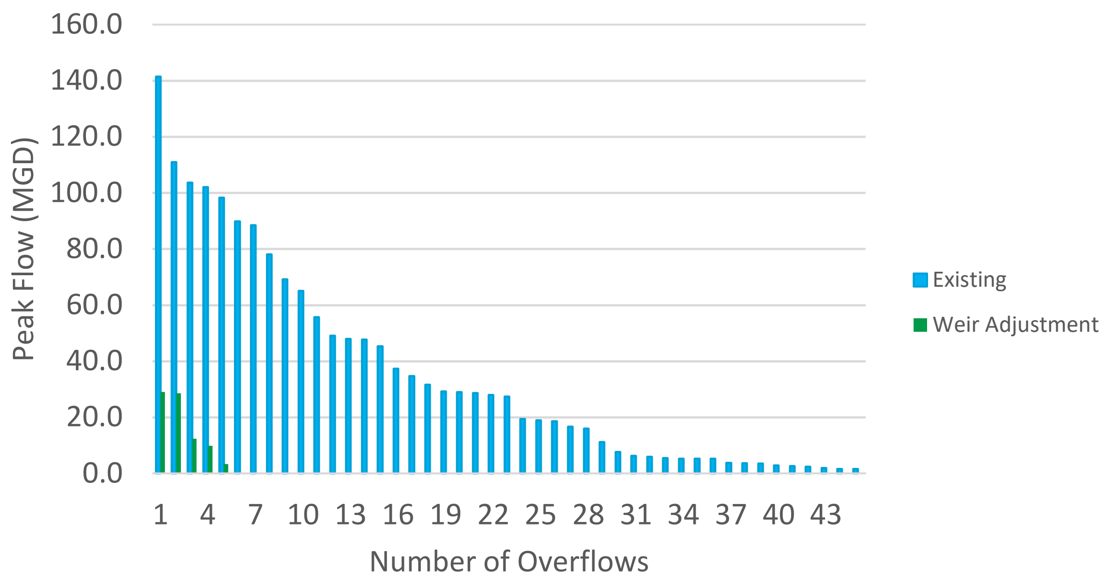


Figure 3-7. Change of Peak Flow at JOSO, Proposed Condition



3.3.2.4 Cost

Table 3-3 lists the associated costs for this alternative.

Table 3-3. JOSO Proposed CSO Storage Tank Conceptual Cost Estimate	
Construction Cost Estimate	$120,000
Project Annual Operations and Maintenance	-
Project Capital Cost Estimate	$158,400
Project 50 Year Present Worth Estimate	$194,000

3.3.3 Replace Existing Joint Overflow Sewer Outlet Sideflow Weirs with Bending Weirs

3.3.3.1 Identification and Preliminary Screening

The regulators in the River Road WWTP Service Area direct all sewage flows during dry weather to the River Road WWTP and convey excess flows during large wet weather events directly to the Hudson River. There are a total of four regulators in the River Road WWTP Service Area, which are located in series along the main WNY1 interceptor sewer, see Figure 3-8. Regulator WNY1 discharges to outfall 001A/002A and regulates CSO discharges using a mechanical float operated regulator. The other three regulators regulate CSOs using side overflow weirs that divert excess combined sewage to the Joint Overflow Sewer Outlet (JOSO) which discharges to the Hudson River.

The objective of replacing the JOSO weirs with bending weirs is to maximize storage capacity in the upstream collection system during smaller storms to reduce CSO events, while allowing flows to be diverted to the CSO outfalls during larger storms.

- Anticipated Constraints and Site Limitations:
  - Capacity at River Road WWTP - Diverting additional flow to the WNY1 regulator alone may not result in CSO reduction to the desired level. Further, if more flow is diverted from JOSO to the River Road WWTP by the bending weirs, the River Road WWTP will need to have sufficient

capacity to treat and discharge the additional flow that is diverted from JOSO. Upgrades to treatment components at the River Road WWTP may be required to provide capacity to treat this additional flow, as well as upgrades to the River Road outfall to discharge the additional flow. To ensure the desired level of CSO reduction, diverting additional flow to the WNY1 regulator should be supplemented by increased capacity at the River Road WWTP to treat additional flow.

  - Bending weirs can be prone to clogging/jamming with debris and would require periodic cleaning, thus a top-opening weir is preferable to provide easier access for cleaning. A visual inspection should be conducted every 6 months, with a thorough inspection/cleaning once per year, requiring two staff members for one day. This alternative requires replacement of the existing side overflow weirs and assumes modification of the existing access manhole to a larger rectangular hatch, which would result in temporary traffic disruption on Park Avenue, 49th Street and 51st Street, however the duration of work would be shorter than other alternatives that have been evaluated.
  - Managing impact on traffic and the neighborhood during construction is anticipated to be limited because these improvements would be within existing structures owned by the Authority. Relatively small capital and O&M costs are expected compared to other storage or disinfection alternatives.

- Functionality and Feasibility:
  - Bending weirs provide a mechanism to maximize storage capacity in the upstream collection system while minimizing potential upstream impacts associated with static weirs. This alternative also allows flexibility to consolidate flow volume at the WWTP.
  - No additional hiring/training is anticipated to be required for the function of this alternative. This alternative is anticipated to reduce CSOs to the desired level by improving on existing conveyance methods while avoiding challenging in-rock construction and conveying increased flow to an existing WWTP for complete treatment.
  - The addition of bending weirs does not require any SCADA automation or external controls for operation, thus there is minimal complexity in operation. Bending weirs are anticipated to work effectively under a variety of flow conditions and during intermittent operation. This alternative is considered feasible.

3.3.3.2 Conceptual Network Layout

There are four existing side-flow regulator weirs along the interceptor in the JOSO basin, shown on Figure 3-8. These four locations are: UC1, UC2, WNY2, and WNY1.

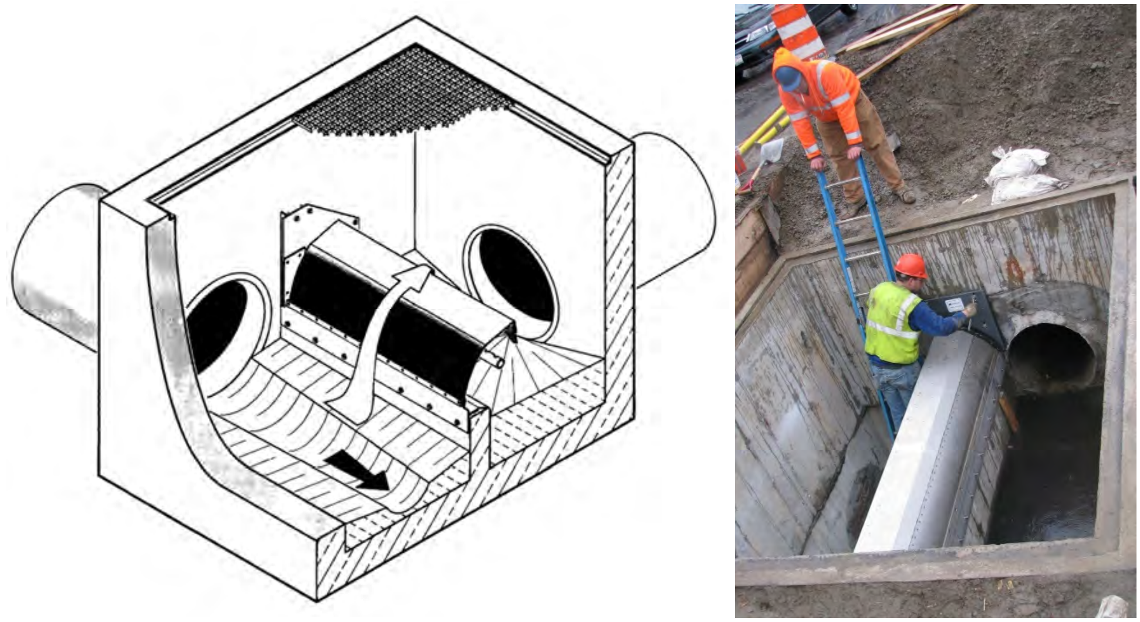
The existing regulators are side-flow weirs which are relatively close to overtopping under dry weather flow conditions. Representative photos of the side-flow weirs are shown on Figure 3-9.

Figure 3-8. Regulators in River Road Service Area

Figure 3-9. Existing Side-Flow Weirs

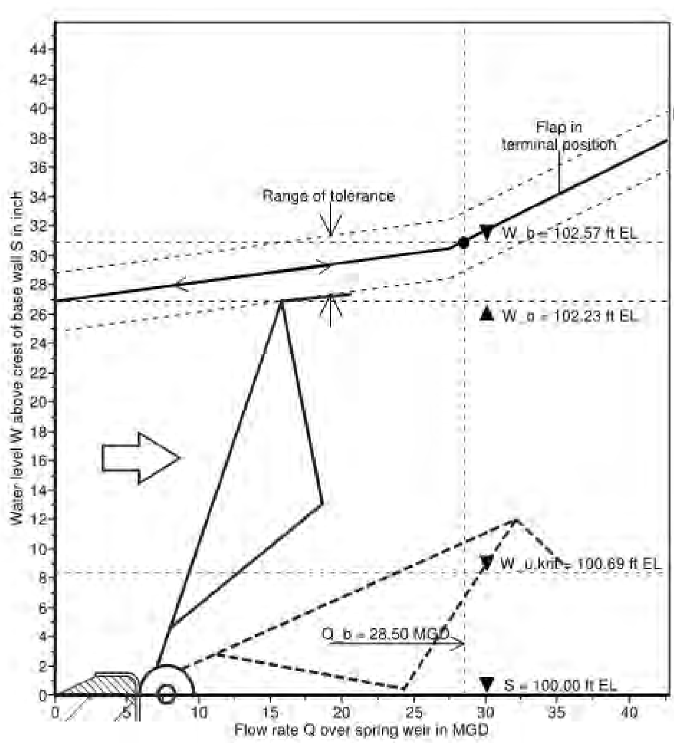
Under this alternative, the existing weirs would be replaced with bending weirs such as Hydrovex, shown on Figure 3-10.

Figure 3-10. Hydrovex Bending Weir



In conversations with the supplier of Hydrovex, based on the length of the weir and peak flow through the regulator it was found that bending weirs are not a viable alternative for Regulator WNY1, which has a peak flow of 194.7 million gallons per day (mgd) and length of 7 feet 9 inches. As such, bending weirs are only suggested for Regulators UC1, UC2 and WNY2. Figure 3-11 shows the rating curves for each of these weirs. UC2 requires two weirs in series, and WNY2 requires three weirs in series. The curves reflect the characteristics for all of the weirs at that location operating in unison.

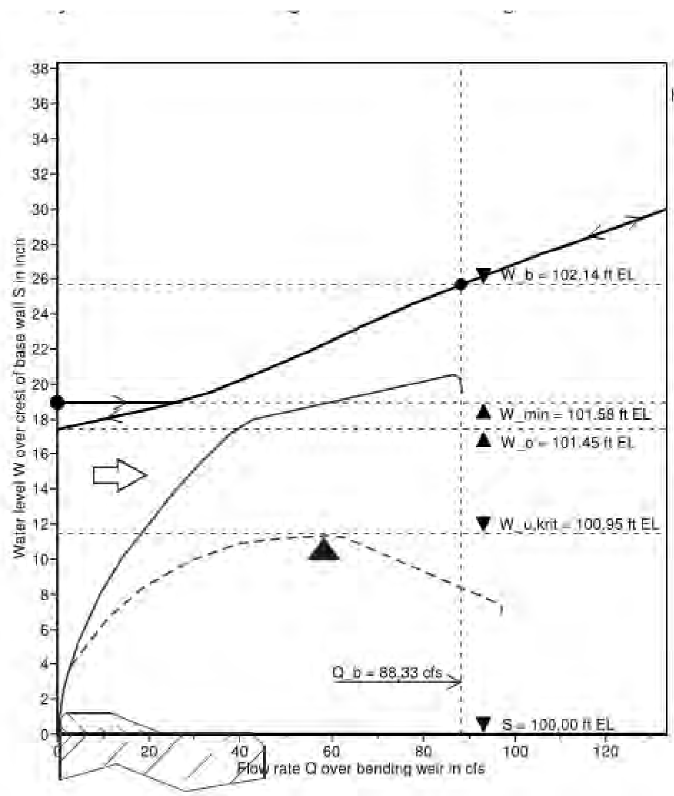
Figure 3-11. UC1 Weir Rating Curve



rating curve data

Index	W in inch	Q in MGD	W in ft EL
00	26.8	0.00	102.234
01	30.4	27.51	102.534
02	45.9	59.24	103.824

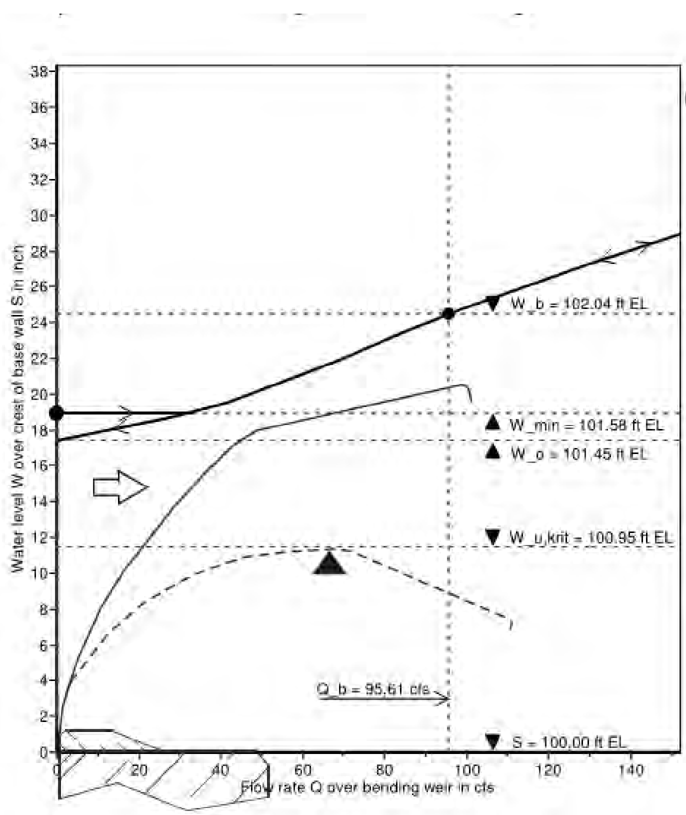
Figure 3-12. UC2 Weir Rating Curve (2 weirs in series)



rating curve data

Index	W in inch	Q in cfs	W in ft EL
00	17.4	0.00	101.451
01	18.0	11.08	101.502
02	18.7	22.17	101.556
03	19.5	33.25	101.622
04	20.7	44.33	101.724
05	21.9	55.42	101.829
06	23.3	66.50	101.942
07	24.6	77.58	102.050
08	25.7	88.67	102.142
09	27.5	106.18	102.291
10	27.9	110.84	102.323
11	29.0	121.92	102.413
12	30.0	133.00	102.499

Figure 3-13. WNY2 Weir Rating Curve (3 weirs in series)



rating curve data

Index	W in inch	Q in cfs	W in ft EL
00	17.4	0.00	101.451
01	18.0	13.81	101.502
02	18.7	27.62	101.556
03	19.5	41.42	101.622
04	20.7	55.23	101.724
05	21.9	69.04	101.829
06	23.3	82.85	101.942
07	24.6	96.65	102.050
08	25.7	110.46	102.142
09	27.5	132.28	102.291
10	27.9	138.08	102.323
11	29.0	151.89	102.413

3.3.3.3 InfoWorks Modeling Results

The River Road InfoWorks ICM model was used to simulate the impact that replacing the existing side-flow weirs with bending weirs would have on CSO volume, peak flows, and number of events, under Typical Year conditions. This alternative only generates about 0.12 mgd of storage along the interceptor, but during the typical year, shifts about 65 MG from the JOSO outfall towards River Road. Table 3-4 summarizes the results. These results are presented graphically in Figure 3-14 through Figure 3-17.

Table 3-4. Summary of Modelling Results

	Number of Overflows		**Total CSO Volume (MG)**	
	Existing	**With Bending Weirs**	**Existing**	**With Bending Weirs**
JOSO (003A)	61	24	95	28
River Road (002A)	60	60	190	254

Figure 3-14. Change in Volume at JOSO due to Bending Weirs

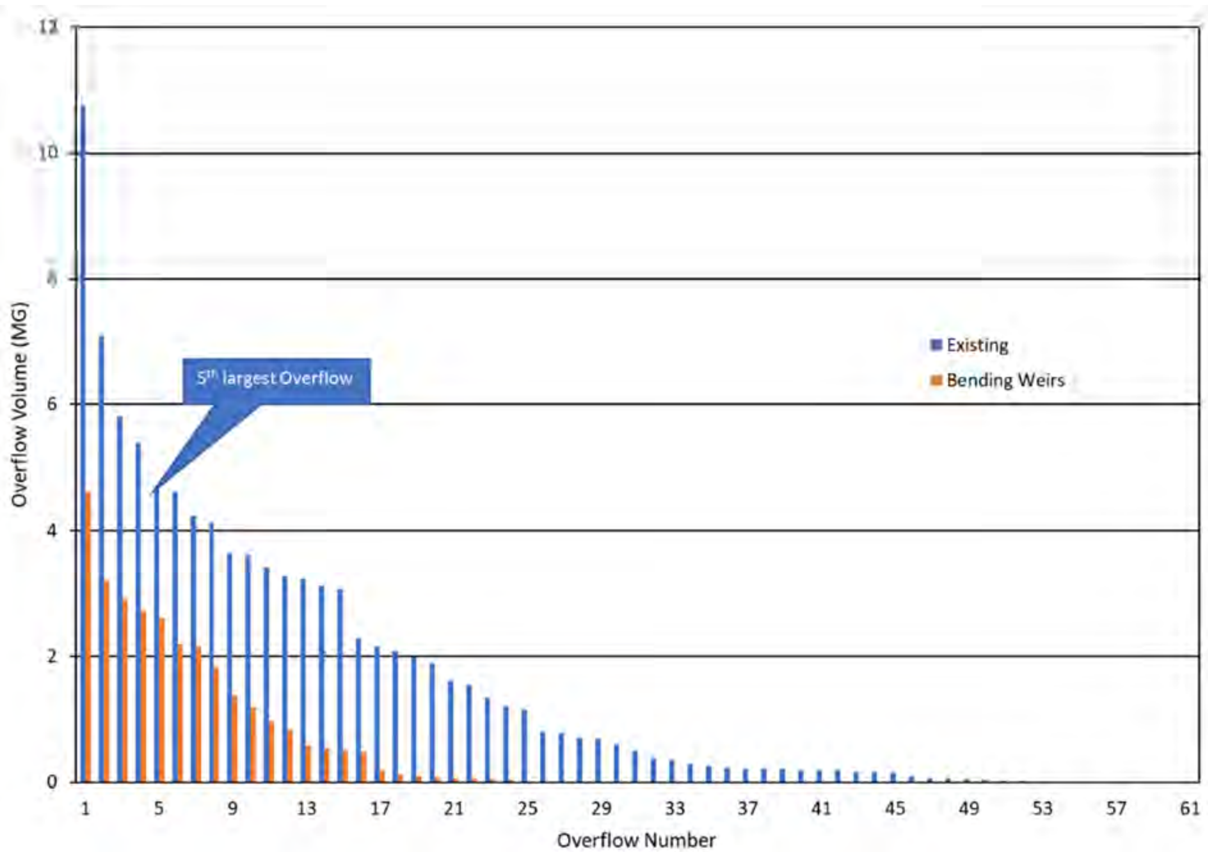


Figure 3-15. Change in Volume at River Road due to Bending Weirs

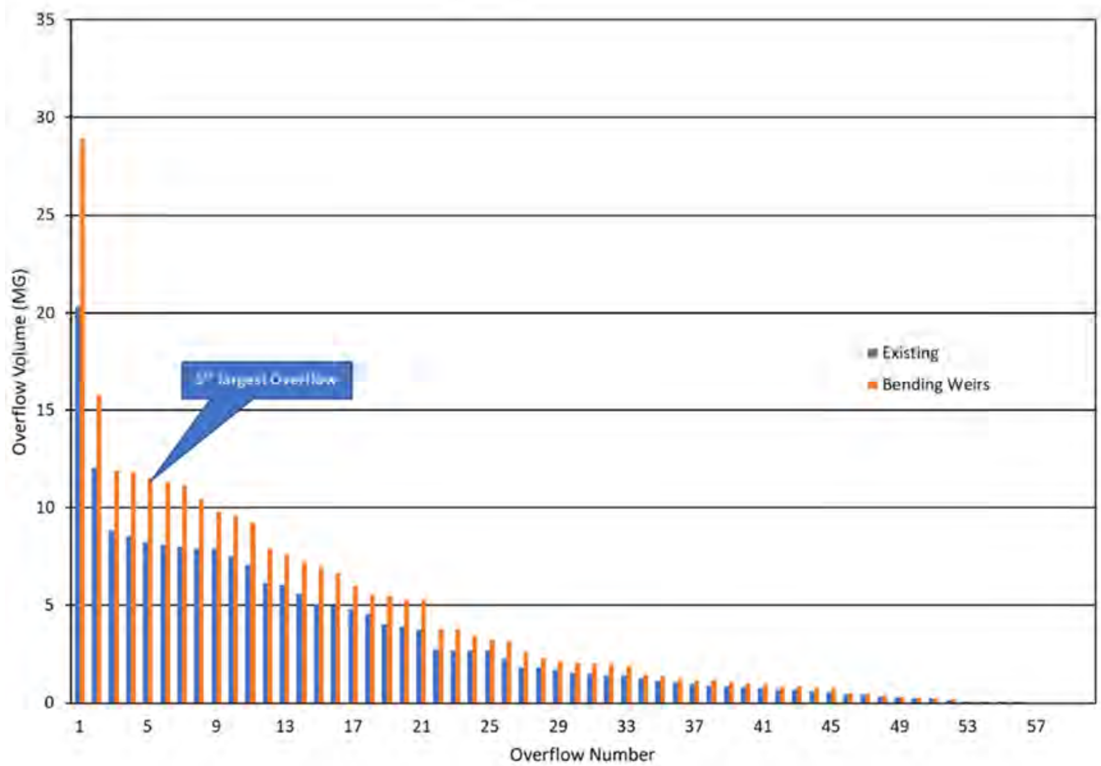


Figure 3-16. Change in Peak Flow at JOSO due to Bending Weirs

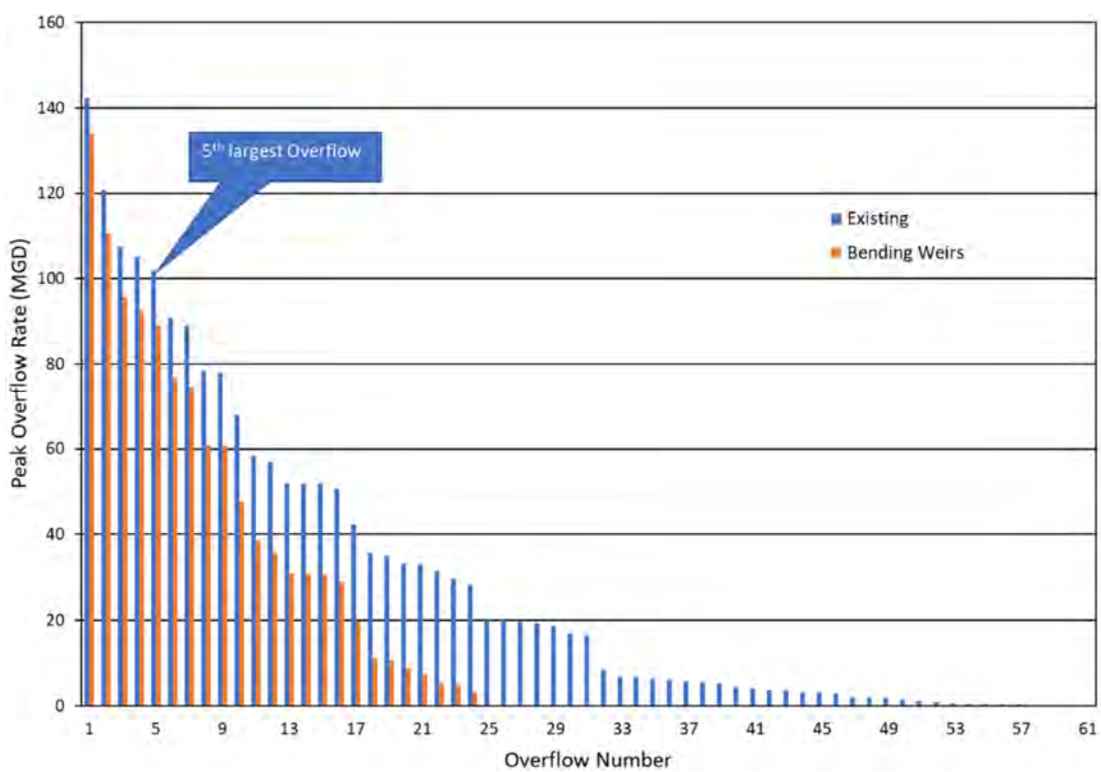
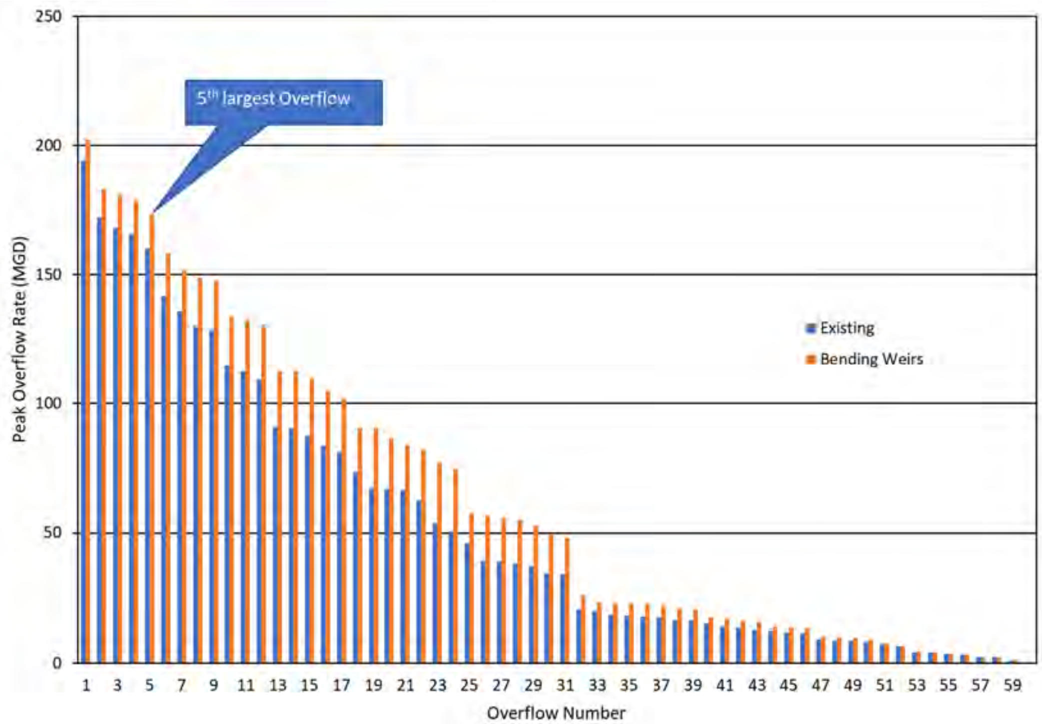


Figure 3-17. Change in Peak Flow at River Road due to Bending Weirs



3.3.3.4 Cost

Table 3-5 lists the associated costs for this alternative.

Table 3-5. JOSO Proposed Bending Weirs Conceptual Cost Estimate

Construction Cost Estimate	$352,000
Project Annual Operations and Maintenance	$3,100
Project Capital Cost Estimate	$464,000
Project 50 Year Present Worth Estimate	$544,000

3.4 JOSO Basin Alternatives Comparison

Each alternative was assigned a score based on the evaluation criteria identified in Task 1. Table 3-6 shows the weighted point total and weighted average of each alternative for the JOSO drainage basin. The full breakdown of the scoring for each alternative can be found in Appendix B.

Table 3-6. JOSO Basin Alternatives Score Comparison

Alternative	Weighted Point Total	Weighted Percent
Combined Sewer Overflow Storage Tank in Water and Divert Flow to Adams Street WWTP	84	61%
Raise Regulator Weirs at UC1, UC2, and WNY2	114	83%
Replace Existing JOSO Sideflow Weirs with Bending Weirs	119	86%

SECTION 4

WNY1 Basin

The following section presents the evaluation of the alternatives which passed the Preliminary Screening phase in the WNY1 drainage basins. A discussion on all alternatives considered in the WNY1 Basins for can be found in the Preliminary Screening Memorandum in Appendix D. The following alternatives were evaluated for CSO Outfall 002A:

- CSO Storage Tank near WNY1 outfall
- Linear Storage Tunnel along Anthony M. Defino Way
- Disinfect at WNY1 S/F Facility

4.1 Drainage Basin Overview

The WNY1 drainage basin measures 657.5 acres, and the basin's overall imperviousness is 78%. The combined sewer network within this drainage basin discharges to Outfall 002A. The total length of pipe in the drainage basin is approximately 119,572 feet and most pipes are 12-inches in diameter. In addition to the combined sewer network, the River Road WWTP facilities in the WNY1 basin are the WNY1 Regulator, the WNY1 S/F Facility. Figure 4-1 shows an overview of the facilities described in the following subsections.

4.1.1 WNY1 Regulators

The WNY1 Regulator regulates CSO discharges using mechanical floats. This regulator conveys up to 10 mgd of flow to the River Road WWTP. The WNY1 Regulator is a mechanical weir controlled regulator which is located on Anthony M. Defino Way, just east of the Intersection with John F. Kennedy Boulevard in West New York. The regulator contains a weir and a regulator float gate. The influent line is an 84-inch diameter pipe which receives all combined sewer flows originating from the River Road WWTP service area, with the exception of overflows directed to JOSO for discharge to the Hudson River. A 27-inch diameter interceptor directs flow to the River Road WWTP. The River Road WWTP outfall joins the WNY1 54-inch diameter outfall pipe prior to discharging to the Hudson River. The WNY1 Regulator was originally constructed in the 1950s and 1960s and underwent rehabilitation in 2015.

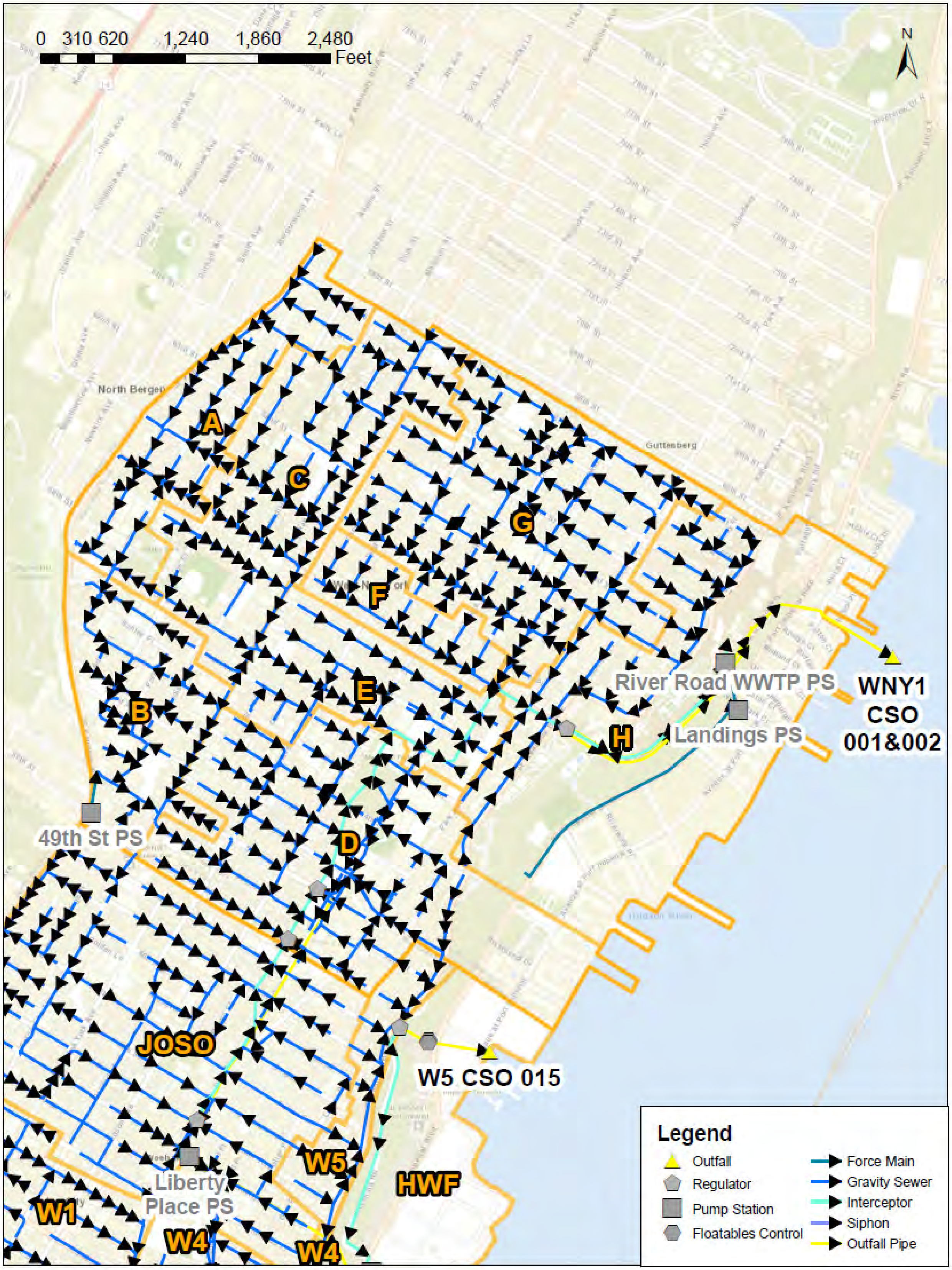
4.1.2 WNY1 Solids/Floatables Facility

The WNY1 S/F Facility treats overflows from the WNY1 regulator. It was constructed in 2009 and is located in a building adjacent (south) to the River Road WWTP. The facility has an 84-inch influent prestressed concrete cylinder pipe and a 78-inch effluent prestressed concrete cylinder pipe. The facility has 0.5-inch bar screen which is 5 feet 6 inches wide with a span of 20 feet 6 inches.

4.1.3 Outfall 002A

Outfall 002A is located at Observer Highway and River Street Regulator WNY1 discharges wet weather flows to Outfall 002A and directs dry weather flow to the River Road WWTP. CSO Outfall 002A continues down Anthony M. Defino Way where the flow is passed through the WNY1 S/F Facility. After being screened it joins the WWTP outfall (001A) to form Outfall 001A/002A which continues as a single pipe extending into the Hudson River.

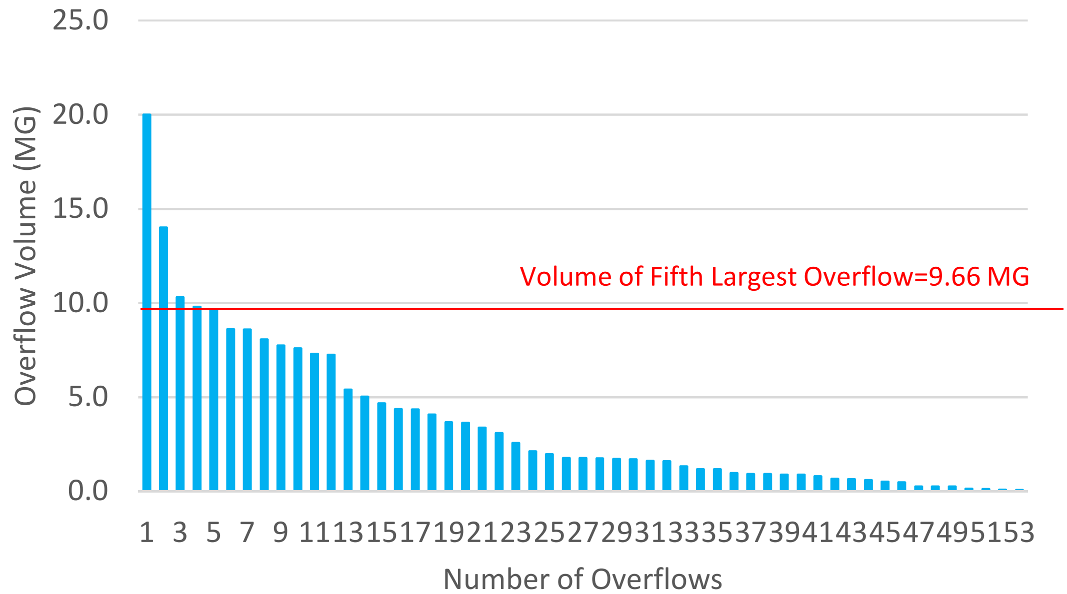
Figure 4-1. WNY1 Drainage Basin



4.2 Existing Conditions

Figure 4-2 shows the calculated frequency and volumes of overflows based on the Typical Year. For the storage and conveyance alternatives proposed, the fifth-largest overflow is the target volume to control. For disinfection and filtration alternatives, the yearly peak flow, 15 minutes peak flow, and annual total volume for each outfall were analyzed to determine contact time and sizing of any related disinfection and filtration alternatives.

Figure 4-2. WNY1 Outfall-Overflow Frequency vs. Volume, Existing Conditions



4.3 Alternatives

The following sections detail the alternatives that moved on from the preliminary screening to full evaluation. The alternative identification, conceptual layout, potential overflow frequency after the alternative is implemented, and conceptual cost estimate for each are described.

4.3.1 Combined Sewer Overflow Storage Tank Near WNY1 Outfall

4.3.1.1 Identification and Preliminary Screening

A storage alternative constructed in the water is proposed for WNY1. This may include a public/private partnership with a residential development that will ultimately develop above this alternative. Based on the target volume of 8.3 MG and an assumed depth of approximately 30 feet (height of the existing pier) the required area for a structure would be approximately 37,000 square feet. The overall dimensions of the structure can be modified to yield a larger or smaller area by adjusting the depth of the structure.

- Anticipated Constraints and Site Limitations:
  - Foundation - If the proposed structure would include a pier, achieving the proper foundation stability would require the use of multiple piles which can require complex methods and coordination.
  - Construction in Navigable Waters - This alternative would require the use of a cofferdam and dewatering during construction which would present challenges and have significant costs. Permitting the structure as an "end of pipe" structure may allow for approval of surface water encroachments, but the adjacency would need to be confirmed.
  - Sea Level Rise - This alternative being located on the shoreline presents design challenges to accommodate sea level rise. The designing of pumping system power and controls will need to meet flood damage protection criteria and sea level rise criteria which may conflict with the desire to not limit lines of sight for residents.
- Functionality and Feasibility:
  - The proposed storage structure would need to be at high water level equal with the surrounding grade to allow for a pedestrian park/development to be extended over the top of the structure. The required pumping system would also need to be enclosed in an architecturally consistent structure that does not limit lines of sight from residents. The access for structure maintenance would be from the existing lot along Fulton Court which is private property.
  - The proposed structure is adjacent to a residential complex (The Landings at Port Imperial). Not only will design and construction efforts need to be heavily structured and coordinated, odor control measures taken after construction would be paramount. It is anticipated that the local residents along the shoreline would be difficult to gain approval as public stakeholders. However, due to the proximity to the River Road WWTP and the existing outfall, incorporating a park structure or other pier as an extension of the existing pier that houses the WNY1 outfall is an option that should be tested. This alternative is considered feasible.

4.3.1.2 Conceptual Network Layout

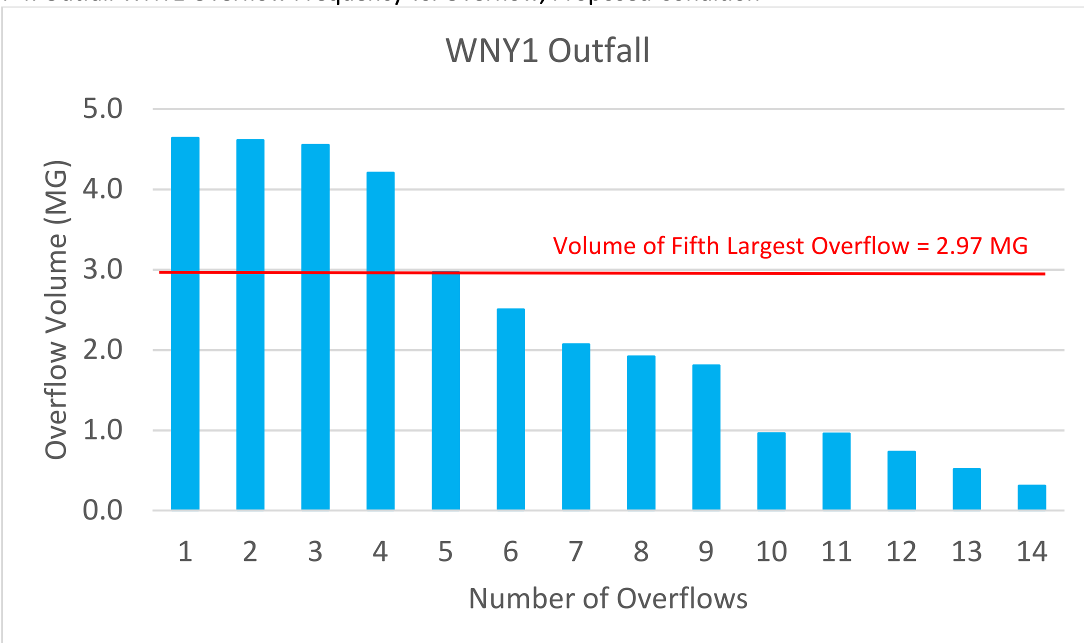
Figure 4-3 shows the required modifications to the existing network including the staging of the storage tank and required piping.

Figure 4-3. WNY1 – Proposed In-Water Storage Tank, Proposed Condition

4.3.1.3 InfoWorks Integrated Catchment Modeling Results

The River Road model was used to simulate the conditions as they are expected to exist after construction and operation of the storage alternative. The model network was updated based on the conceptual GIS network. Figure 4-4 shows the plot of the Typical Year overflow volume vs. number of overflows for Outfall 005A.

Figure 4-4. Outfall WNY1 Overflow Frequency vs. Overflow, Proposed Condition



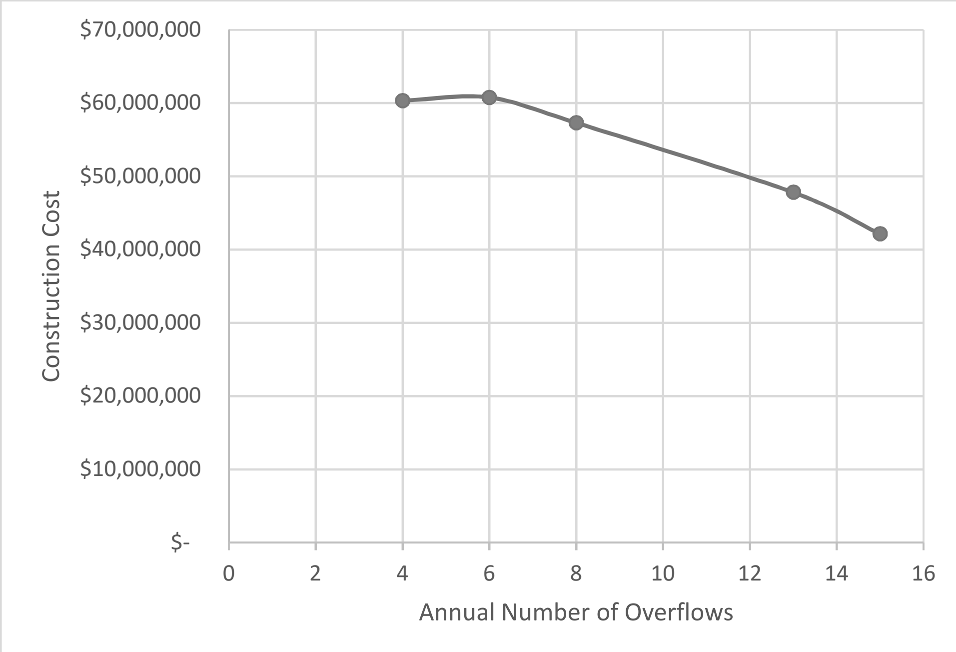
4.3.1.4 Cost

Table 4-1 lists the associated costs for this alternative.

Table 4-1. WNY1 Proposed CSO Storage Structure Conceptual Cost Estimate	
Construction Cost Estimate	$60,333,000.00
Project Annual Operations and Maintenance	$84,000.00
Project Capital Cost Estimate	$79,640,000.00
Project 50 Year Present Worth Estimate	$115,653,000.00

To observe the range in costs versus number of annual overflows expected to result from smaller CSO storage volumes, Figure 4-5 shows the cost performance curve for the construction costs for annual overflow events greater than 4.

Figure 4-5. WNY1 CSO Storage Cost Performance Curve



4.3.2 Linear Storage Tunnel at Anthony M. Defino Way

4.3.2.1 Identification and Preliminary Screening

Linear storage in the form of a tunnel between the WNY1 regulator and the outfall, along the underutilized vegetated area south of Anthony M. Defino Way and the River Road WWTP was also evaluated. Tunnels have been shown to be a feasible alternative in providing temporary CSO storage. Overflows would be captured by the tunnel during wet weather, providing CSO storage and subsequent pumping, primary treatment, disinfection and discharge to the river.

- Anticipated Constraints and Site Limitations:
  - The effectiveness of the tunnel hinges on the ability to provide the required storage within the available tunnel alignment. While the constructed tunnel does not utilize significant surface space in relation to the storage volume it provides, large areas are required for laydown and construction. The steep ground surface (upstream end approximate ground elevation of 135 feet, and at the downstream the approximate ground elevation is 50 feet, a change of 85 feet) may pose a challenge for siting the laydown area. The steep slope also requires that the receiving shaft and storage tunnel be very deep to function properly.
  - Construction would take place behind the Port Imperial monument located at the intersection of Port Imperial Boulevard and Anthony M. Defino Way. The monument will be temporarily relocated during construction.
  - Installation of a launching shaft at the downstream end of the alignment and a receiving shaft at the upstream end would be required. Filling of the tunnel would require a drop shaft such as a vortex drop structure or baffle drop structure at the upstream end to dissipate energy and emptying the tunnel would require the installation of a wet weather pumping station at the downstream end of the tunnel.
- Functionality and Feasibility:
  - A tunnel of the diameter required to capture the volume of the fifth largest storm would require a tunnel boring machine (TBM) for construction and may need to be buried up to 60 feet below

the surface to avoid utilities. Deep tunnels also require specialized equipment, personnel and training to maintain and operate.

– While some tasks could be carried out by Authority personnel, periodic tunnel inspection and various maintenance tasks would require tunnel entry. Extensive geotechnical investigations are required to determine the tunneling or mining methods to be used. Poor quality rock, excessive groundwater and other factors can increase the complexity of the construction.

– Following construction, permanent facilities are required for pumping, odor control, grit handling, screening and dewatering, these facilities add cost, energy requirements, and operational considerations. It would also require SCADA monitoring and controls to level sensors, flow monitors, and overflow detectors. Automated gates upstream of the tunnel would be required to control the diversion of flow from the plant to the tunnel.

– High rate treatment such as ActiFlo and a disinfection facility would be located downstream of the pumping station to provide treatment prior to discharge via the outfall. It is assumed that retention time in the tunnel would be about 24 hours prior to discharge, as such a 15 mgd high rate treatment facility would be appropriate to fully dewater the tunnel in less than 24 hours.

– A new outfall parallel to the existing outfall is proposed to discharge treated flows from the tunnel and to serve as an emergency overflow. A tide gate would be installed in the outfall pipe to prevent backflow from the Hudson River from entering the tunnel. Flow will leave the tunnel in one of two ways: either pumping by the WWPS to the ActiFlo unit for treatment, or through an overflow once the tunnel is overtopped. Both the treatment and the overflow will discharge to the new outfall.

4.3.2.2 Conceptual Network Layout

In order to capture the 8.3 MG volume of the fifth largest storm, a tunnel of about 2,200 feet in length with a diameter of about 26 feet would be required, as shown in Figure 4-6. This figure shows the approximate alignment of the proposed tunnel at the construction stage, including the laydown area, and launch and receiving sites.

Figure 4-7 shows the area adjacent to (east of) the River Road WWTP where the launch site, wet weather pump station, high rate treatment, and disinfection facilities would be located.

Figure 4-6. Conceptual Tunnel Layout – Construction Stage

Figure 4-7. Proposed Location of Launch site and aboveground facilities

Figure 4-8 shows the layout of the treatment facilities at the site. The drop shaft would be installed as a vortex drop structure which would dissipate energy. An example of a vortex drop structure is shown in Figure 4-9.

Figure 4-8. Conceptual Layout of Tunnel Treatment Facilities

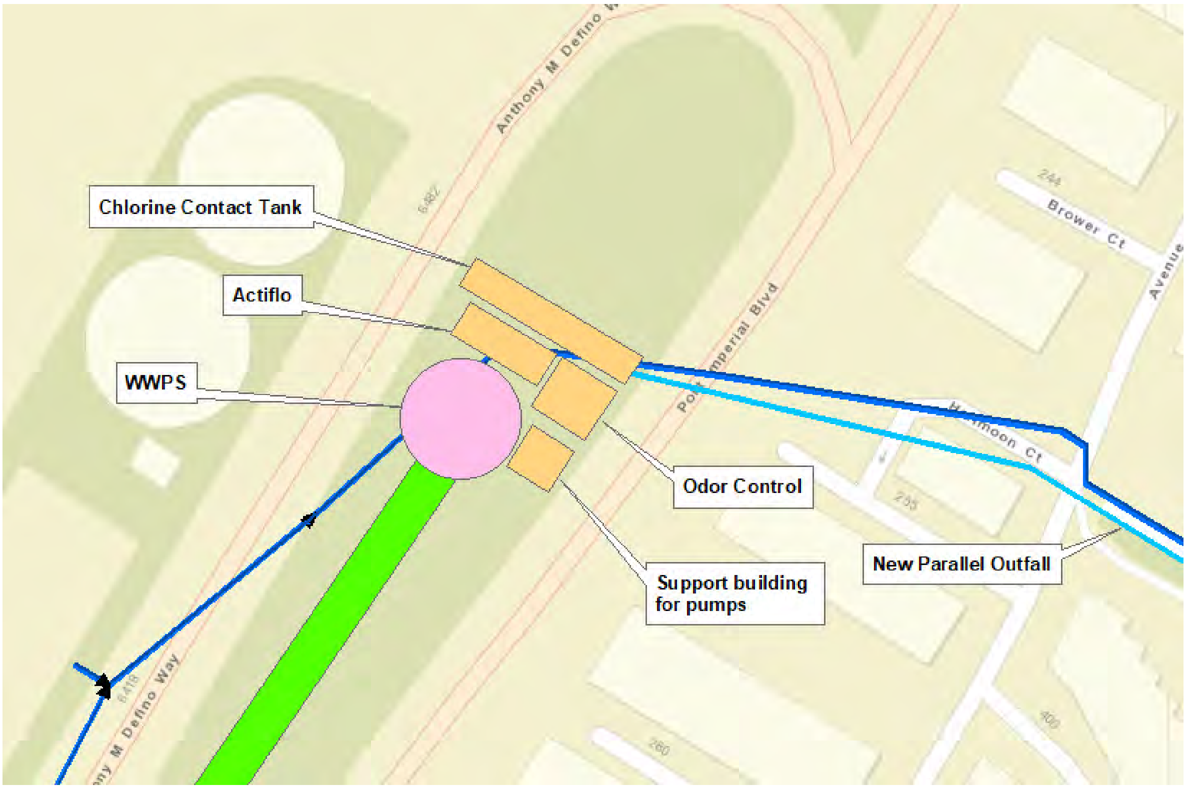
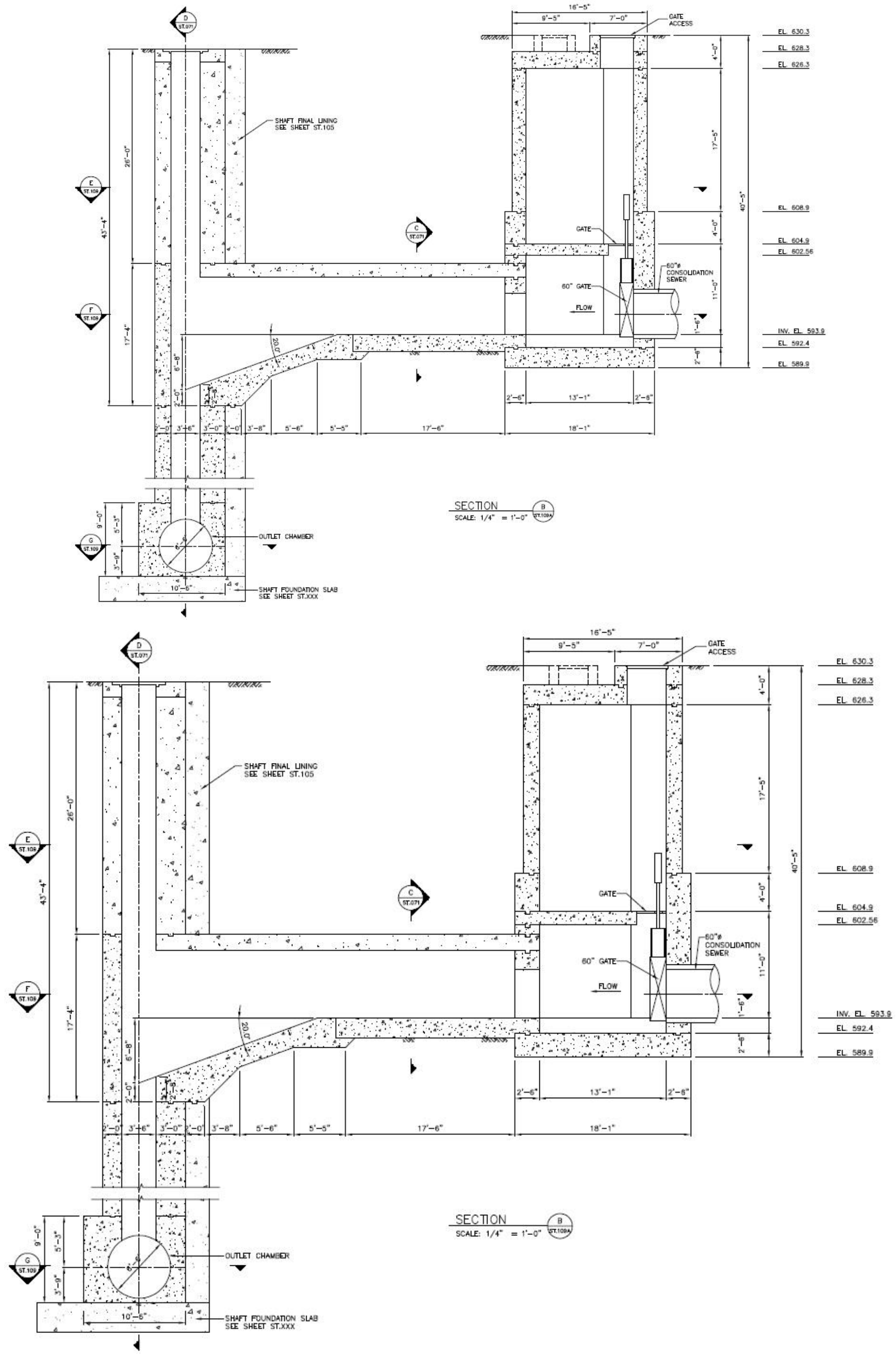


Figure 4-9. Example of Vortex Drop Structure



4.3.2.3 InfoWorks Integrated Catchment Modeling Results

The River Road InfoWorks ICM model was used to simulate the addition of a tunnel under the Typical Year conditions to determine the impacts on total CSO volume and number of overflows. It was found that with the addition of the tunnel, the number of overflow events at River Road reduced from 60 to zero, see profile below for the maximum flow condition. Figure 4-10 shows the profile of the proposed tunnel and outfall pipe. The tunnel alternative does not improve overflow events at JOSO but could be combined with weir optimization to provide improvements to JOSO. The modelling results are summarized in Table 4-2.

Figure 4-10. Modelling Results - Tunnel

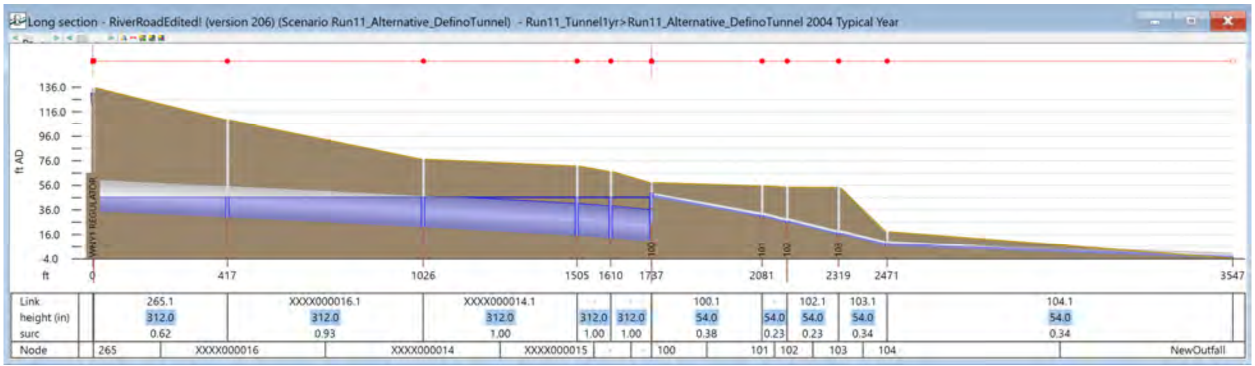


Table 4-2. Summary of Modelling Results				
	Number of Overflows		**Total CSO Volume (MG)**	
	Existing	**With Tunnel**	**Existing**	**With Tunnel**
JOSO (003A)	61	61	95	95
River Road (002A)	60	0	190	0

4.3.2.4 Cost

Table 4-3 lists the associated costs for this alternative.

Table 4-3. WNY1 Proposed CSO Tunnel Conceptual Cost Estimate	
Construction Cost Estimate	$171,450,000.00
Project Annual Operations and Maintenance	$605,000.00
Project Capital Cost Estimate	$226,314,000.00
Project 50 Year Present Worth Estimate	$241,881,000.00

4.3.3 Disinfect at WNY1 Solids/Floatables Facility

4.3.3.1 Identification and Preliminary Screening

For this alternative disinfection is proposed at the existing WNY1 S/F Facility. Outfall 002A has 60 CSO events and an annual CSO volume of 190.4 MG in a Typical Year with the largest event at 20.3 MG and a corresponding peak flow rate of 194 mgd.

- Anticipated Constraints and Site Limitations:
  - Available Space - A nominal 25-ft x 61-ft. disinfection building with 2 bulk storage tanks would need to be sited adjacent to the S/F Facility which is located against a rock cliff. A significant amount of rock blasting would be required to widen the available area to the south of the S/F Facility. A lesser amount of rock blasting would be required if a single bulk storage tank were determined to be sufficient. A disinfection building would not fit to the north of the existing S/F Facility. However, if the parking lot area could be used, it appears that there is just enough room for a single bulk storage tank facility without blocking the service roads.
  - Contact Time - The available contact time in the outfall pipeline and S/F Facility would need to be evaluated.

  - Traffic/Public Access - Construction staging could require a lane closure on Anthony M Defino Way. The project may cause similar traffic constraints to those experienced during the construction of the WNY1 S/F Facility which limits road access to the north thereby requiring all construction equipment to access the site from the road. Chemical unloading could require lane closure although this would only be required a few times per year.

- Functionality and Feasibility:
  - Chemical Dose - Available detention times in the discharge pipe to the outfall and WNY1 S/F Facility would need to be determined.
  - Chemical Storage and Feed - The annual volumes to be treated and the design storm events are sufficiently large to assume two nominal 6000 gallon bulk storage tanks for screening purposes. A single tank may be possible with peracetic acid (PAA) since it does not degrade but testing would be required to determine the required dose.
  - Due to the proximity to the WWTP and the distance from residential areas, this alternative is considered feasible.

4.3.3.2 Conceptual Network Layout

Figure 4-11 shows the proposed disinfectant path for this alternative.

Figure 4-11. WNY1 – Proposed Disinfection

4.3.3.3 Analysis

The required contact time was analyzed within the pipeline. Table 4-4 shows the possible detention time within the pipe at 5-, 15-, and 60-minute time series based on the pipe length from the WNY1 S/F facility to the outfall and the velocity within the pipe from the model. As there is not sufficient contact time in the pipe for disinfection this alternative is not considered feasible.

Table 4-4. Pipe Detention Time (minutes)

	5-min	15-min	60-min
TOTAL	1.37	1.39	1.54

4.3.4 WNY1 Outfall Cloth Media Filtration Facility

4.3.4.1 Identification and Preliminary Screening

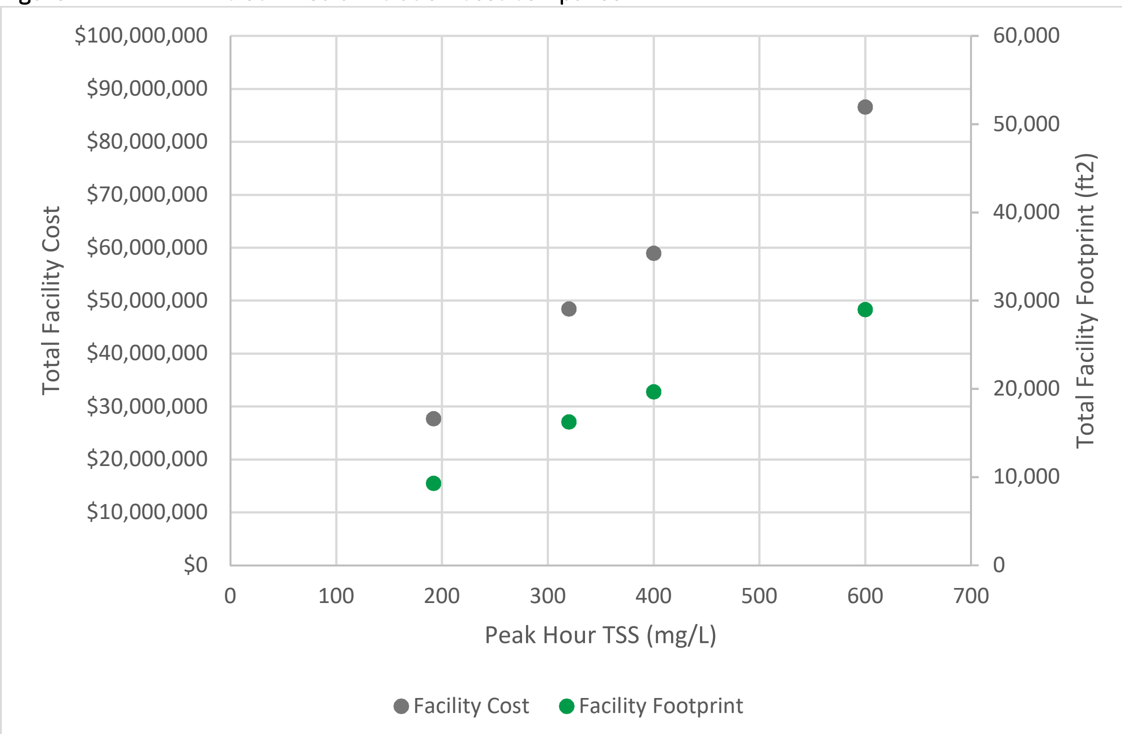
Cloth media filtration such as Aqua Prime was identified as a potential filtration method for the WNY1 outfall for this alternative. Cloth media filtration utilizes cloth woven or fiber pile construction for 10 micron TSS removal. Cloth media filtration can filter to less than 5 mg/L TSS concentration. The most common geometry and the type analyzed for this application is disc filters. Benefits to this type of implementation is the discs are vertically oriented to reduce the required footprint and have higher solids and hydraulic loading rates than other technologies. While this technology is ideal for solids removal, any application for this analysis will require disinfection to meet permit limits.

- Anticipated Constraints and Site Limitations:
  - Traffic/Public Access - Construction staging could require a lane closure on Anthony M Defino Way. The project may cause similar traffic constraints to those experienced during the construction of the WNY1 S/F Facility which limits road access to the north thereby requiring all construction equipment to access the site from the road.
- Functionality and Feasibility:
  - For design purposes at this stage, it has been assumed that the average peak TSS concentration is similar to that of the WWTP as they are within the same system. This concentration as listed in the Baseline Characterization Report is 193 mg/L.
  - Filtration technologies are often limited by the solids loading rate. If the solids loading rate is too high, the filter require frequent and excessive backwash cycles. Aqua Aerobic Systems' AquaPrime cloth media disc filters have a maximum solids loading rate (SLR) of 15 lbs/day/sf cloth area. They have a maximum hydraulic loading rate (HLR) of 6.5 gpm/sf cloth area. The influent TSS concentration at the maximum HLR and maximum SLR is 192 mg/L. Any influent TSS concentration greater than 192 mg/L at peak flows to the cloth media filtration train will be SLR limited and the overall configuration; and therefore cost may increase significantly.
  - To verify the peak TSS concentration that the system should be designed to control, it is recommended to collect hourly samples during several wet weather events immediately downstream of the location where the cloth media filtration will be implemented. Flow and TSS data is used to generate pollutographs for different storm events that plot TSS and flow versus time. The pollutograph indicates when the 'first flush' of pollutants enter the treatment facility. Often, the peak TSS concentration (first flush) occurs before the peak flow meaning a lower solids loading rate which will optimize the size of the treatment facility.

4.3.4.2 Cost

Due to the potential variation in costs described in the previous section, a cost range is presented for potential peak TSS concentrations at the WNY1 outfall. Figure 4-12 shows the variation in facility cost and footprint based on the WNY1 peak hourly flow of 189 mgd and a simultaneous peak TSS concentration ranging from 200 - 600 mg/L. Should the peak TSS concentration exceed 600 mg/L, the cost and facility footprint would increase accordingly. The cost and footprints include the influent and effluent channels, filter influent and effluent chambers, filter tanks, filter discs, valves, pumps, valve and pump gallery, and electrical building.

Figure 4-12. WNY1 – Cloth Media Filtration Cost Comparison



4.3.5 WNY1 Outfall Compressible Media Filtration

4.3.5.1 Identification and Preliminary Screening

Implementation of compressible media filtration was analyzed at the WNY1 outfall. Compressible media filtration utilizes durable synthetic balls which are compressed to create a porosity gradient resulting in the removal of large and small particles throughout the media bed. Media compression varies by vendor with Schreiber's Fuzzy Filter compressing media between two plates and WWETCO's FlexFilter compressing media using a flexible bladder. Benefits to this type of implementation are the small footprint and relatively simple operation. While this technology is ideal for solids removal, any application for this analysis will require disinfection to meet permit limits.

- Anticipated Constraints and Site Limitations:
  - The anticipated site constraints and site limitations are nearly the same as those for cloth media filtration.
- Functionality and Feasibility:
  - WWETCO's FlexFilter was used a reference for this analysis. WWETCO limits their FlexFilter to a maximum HLR of 10 gpm/sf at peak flow for CSO applications. The maximum SLR can be up to 50 lbs/day/sf. Sizing a compressible media filtration facility is an iterative process that considers

the HLR, SLR, number of cells in operation, and managing filter backwash flow. A number of options are available for managing filter backwash flow and each is evaluated to select the optimal one. Due to the number of variables in sizing a compressible media filter, the facility was sized using a maximum HLR of 10 gpm/sf and a maximum SLR of 38 lbs/day/sf. The influent TSS concentration at the maximum HLR and maximum SLR is 320 mg/L. These values are equivalent to the design HLR and SLR for WWETCO's 100 mgd compressible media (FlexFilter) CSO wet weather treatment facility in Springfield, OH and are reasonable assumptions for H1. The Springfield facility was used as a guideline for sizing and costing the H1 facility.

4.3.5.2 Cost

A compressible media filter facility for WNY1 at a peak flow TSS concentration of 320 mg/L using an HLR of 10 gpm/sf and a maximum SLR of 38 lbs/day/sf costs $92 million with a footprint of 47,727 sf. The cost and footprint includes the influent and effluent channels, filter influent and effluent chambers, filter tanks, compressible media, air compressors, and compressor and electrical building. The comparable (189 mgd at 320 mg/L TSS) cloth media filtration facility cost and footprint from Figure 4-12 is $27 million and 18,000 sf, respectively.

4.4 WNY1 Basin Alternatives Comparison

Each alternative was assigned a score based on the evaluation criteria identified in Task 1. Table 4-5 shows the weighted point total and weighted average of each alternative for the WNY1 drainage basin. The full breakdown of the scoring for each alternative can be found in Appendix B.

Table 4-5. WNY1 Basin Alternatives Score Comparison

Alternative	Weighted Point Total	Weighted Percent
Combined Sewer Overflow Storage Tank Near WNY1 Outfall	65	47%
Linear Storage Tunnel at Anthony Defino Way	63	46%

SECTION 5

Systemwide Alternatives

To supplement the alternatives identified at each drainage basin, the feasibility of reducing I/I and implementing green infrastructure were analyzed throughout each drainage basin where data is available. Reduction of I/I is necessary to reduce dry weather flows which would allow for more capacity within the collection system during wet weather events, and implementing green infrastructure can capture flow in wet weather events that would otherwise be directed into the collection system. Both strategies aim to reduce the volume and frequency of overflows at the outfalls. These strategies do not aim to control the entire target volume at each outfall, but rather aim to reduce volumes required for CSO control.

5.1 Inflow and Infiltration

5.1.1 Identification and Preliminary Screening

The Authority has reported increasing issues with dry weather flows at the River Road WWTP in recent years. This can be attributed to issues with I/I due to aging infrastructure. CCTV data that was conducted for all of the River Road WWTP drainage basins indicated the severity of aging infrastructure within the service area. The analysis categorized each pipe, with a 4 or 5 on the Pipeline Assessment Certification Program rating scale indicating that they are more susceptible to failure. Using the U.S. Environmental Protection Agency (EPA) Quick Guide for estimating I/I, the approximate infiltration rate was calculated per drainage basin using the base flow extracted from the model, which represents the approximate groundwater infiltration per basin. These results are presented in Table 5-1.

Table 5-1. River Road Service Area-Estimated I/I to Be Removed By Drainage Basin

Basin	Area (acre)	Baseflow (mgd)	Baseflow (mgd)
UC1	131.624	**1.269**	9,641.10
UC2	80.911	0.047	580.89
WNY1	511.832	**1.692**	3,305.77
WNY2	135.66	0.508	3,744.66
gpad gallons per acres per day			

The total inch diameter-miles of pipe is calculated for each drainage basin. This unit of length is divided by the baseflow extracted from the model (mgd) and converted to a rate to represent the approximate infiltration per inch diameter-mile, or gpd/idm, of groundwater infiltration. In the River Road WWTP Service area, RedZone data was collected for UC1, UC2, WNY1 and WNY2 metersheds. It was assumed that pipes with a Pipeline Assessment Certification Program score of at least 3 contributed to this infiltration. Based on these calculations, the approximate possible infiltration to be removed and that remaining are presented in Table 5-2.

Table 5-2. River Road Service Area-Estimated I/I to Be Removed

	Possible Removal by Lengths, Assuming All I/I Comes from Pipes (gpd)			Total I/I Removed by Replacing/Lining Pipes near Failure	Potential I/I Remaining after Lining Authority Pipes
	5	4	3		
UC1	158,731	345,656	202,407	706,793	562,207
UC2	9,980	19,014	6,999	35,993	11,007
WNY2	-	8,749	11,793	20,542	487,458
WNY1	50,594	127,385	60,676	238,655	1,453,345
			TOTAL	1,001,983	2,514,017

5.1.2 Cost

Table 5-3 and Table 5-4 list the associated costs for this alternative.

Table 5-3. JOSO Proposed Pipe Rehabilitation Conceptual Cost Estimate

Construction Cost Estimate	$10,131,000.00
Project Annual Operations and Maintenance	$210,000.00
Project Capital Cost Estimate	$13,370,000.00
Project 50 Year Present Worth Estimate	$21,757,000.00

Table 5-4. WNY1 Proposed Pipe Rehabilitation Conceptual Cost Estimate

Construction Cost Estimate	$3,675,000.00
Project Annual Operations and Maintenance	$78,000.00
Project Capital Cost Estimate	$4,850,000.00
Project 50 Year Present Worth Estimate	$7,936,000.00

5.2 Green Infrastructure

Green Infrastructure (GI) is one type of source control technology that can help to manage stormwater, reduce CSOs, and improve water quality. GI technologies most common in urban areas like the River Road WWTP drainage basins include bioretention, bioswales, stormwater planters, permeable pavement, subsurface infiltration/storage, and stormwater tree pits. For less constrained sites with additional space, GI technologies such as infiltration basins, ponds, and constructed wetlands can prove to be effective, as well as cost-efficient. Conversely, for more constrained sites with limited at grade opportunities, green (vegetated) roofs may be the only viable GI technology. When properly designed, constructed, and maintained, these technologies can provide significant levels of control over the course of a year through their performance in small to moderate-sized storms. For this analysis, the feasibility of bioretention practices and green roofs were analyzed.

5.2.1.1 Identification and Preliminary Screening

To estimate the potential for green infrastructure (GI) in the River Road WWTP service area, the feasibility of both right-of-way (ROW) bioretention features and green roofs were considered. The estimated capture volume represents a 1.1” capture depth across 20% of total impervious area within the River Road service area.

5.2.1.2 Functionality and Feasibility

The functionality of ROW GI placement and GI implementation through green roofs was analyzed for overall feasibility to compare the required area for the target capture to the available area within the drainage basins.

ROW GI Implementation Assumptions

- ***Drainage Area*** The drainage area managed by GI was assumed to equal 20% of existing impervious area within the River Road service area. This assumption is based on a high-level analysis of the land use within each River Road sewershed, a review of the 2013 Hoboken Green Infrastructure Strategic Plan, and general assumptions about feasible implementation levels of GI retrofits in urban areas. The impervious area managed includes 20% of all impervious area, including both buildings and roads. Portions of buildings would be captured by disconnecting and rerouting downspouts, where feasible. While 20% of the impervious area was assumed to be captured overall, in practice this would likely translate into certain blocks/drainage areas being managed at much higher percentages and certain blocks/drainage areas not being managed at all. In other words, GI retrofits would ideally be placed on those blocks/drainage areas where they have the best opportunity to capture 100% of the 1.1” storm or greater.
- ***GI Storage Volume*** Once the approximate drainage area was established, the corresponding GI area required was estimated. The average loading ratio utilized was 20:1 (ratio of impervious area to GI area). From the GI footprint, the storage volume was calculated based on the breakdown of storage in a typical bioretention feature with an average total depth of 6 feet. The total storage volume is the sum of surface ponding volume, soil volume, and stone volume.
- ***GI Siting*** The GI features would be bioretention systems located either in the sidewalk or in curb bump-outs extending into the street. The sizes of these features would vary depending on local site constraints (slope, utilities, parking considerations, etc), though a typical size would likely range from 10-20’ long and 3-6’ wide.

Based on these assumptions, the maximum storage ROW volume within the River Road service area is 4.6 MG. The storage by drainage basin is listed in Table 5-5

Table 5-5. Estimated Maximum ROW GI Storage Volume by Drainage Basin in Authority Service Area

Drainage Area ID	[1]Estimated GI Storage Volume (ft^3)
UC1	100,119
UC2	52,544
WNY1	349,324
WNY2	113,049
Total (ft^3)	**615,036**
Total (million gallons)	**4.6**

[1]Area of bioretention facilities based on 20:1 Loading Ratio of Impervious Drainage Area to GI Footprint, 3" ponding depth (80% of the bioretention area), 2.5' soil depth (20% soil porosity for storage), 3' stone depth (40% stone porosity for storage).

ft^3 cubic feet
ID identification

Further aspects of the Authority service area were examined to account for other limitations to siting GI. Specifically, the feasibility of placing GI facilities within the public ROW and on private rooftops was further explored at a planning-level.

Feasibility Analysis - Available Roadway Area for GI placement

As the public ROW is typically the primary location for GI in municipal programs, the total area of GI required was compared to potentially available area within the roads of the River Road service area. In addition to type of impervious area, other constraints were considered, including recommendations from the 2013 Hoboken Green Infrastructure Strategic Plan, proximity to existing buildings, and existing roadway width. For this analysis, the assumptions for determining feasible road area for GI implementation include:

- All roads considered public ROW
- Areas of existing buildings and areas within 7 feet of any building were not considered feasible for ROW GI implementation
- Roadways with widths less than 26 feet wide were not considered feasible for GI implementation. The minimum width of 26 feet allows for a GI feature width of 6 feet (conservatively assuming a GI feature within the cartway, i.e. a bioretention bump-out) and remaining roadway width of 20 feet. The minimum roadway width maintains travel lanes for emergency vehicle access.
- For roadways with widths of 26 feet or greater, the feasible area for GI implementation was considered the total width after subtracting 20 feet to maintain travel lanes.

With these assumptions, the total GI area required as a percentage of feasible road area is 4.6% (Table 5-6). This value indicates that there is ample feasible space in roadways for the assumed level of GI implementation in the service area. Note this is a planning-level analysis that does not consider more site-specific constraints, such as utility conflicts.

Table 5-6. GI Area and Feasible Roadway Area in the Authority Service Area

Drainage Area ID	[1]Assumed Required Right-of-Way GI Area (ft^2)	Total Roadway Area Feasible for GI Placement (ft^2)
UC1	52,694	1,168,806
UC2	27,655	653,482
WNY1	183,855	4,106,413
WNY2	59,499	1,318,698
Total (ft^2)	**323,703**	**7,247,399**
[1]Assumed GI Type is Bioretention with 20:1 Loading Ratio of Impervious Drainage Area to GI Footprint		

Feasibility Analysis – Storage Volumes on Private Rooftop Areas

Green (vegetated) roofs are a viable option for source control, especially in areas where constraints limit ground-level stormwater features like bioretention. For the urban service area, calculations assumed a 5% implementation across the service area. The estimated potential storage volume for green roofs from this assumed percentage is 0.27 million gallons (Table 5-7). This volume assumes that 5% of all rooftops, including both publicly- and privately-owned, would have an extensive green roof with 3 inches of soil depth. The assumed level of green roof implementation is relatively aggressive. To refine this analysis, it would be beneficial to consider site-level constraints to implementing green roofs, such as building structural capacity for additional loads, presence/extent of rooftop mechanical equipment, and slope.

Table 5-7. Private Rooftop Storage in the Authority Service Area

Drainage Basin ID	[1]Estimated Green Roof Storage Volume (ft^3)
UC1	6,240
UC2	3,261
WNY1	20,433
WNY2	6,734
Total (ft^3)	**36,667**
Total (million gallons)	**0.27**

[1]Rooftop area based on Hudson County Land Use GIS data. Includes both privately-owned and publicly-owned roofs. Implementation percentage of 5% applied. Storage assumes extensive green roofs (3" media depth) with 20% porosity

ft^3 cubic feet
ID identification

Recommendations for Future Analysis

Green infrastructure can reach 35% of the goal for volume reduction in the River Road WWTP service area. Further analysis to refine these estimates could include an investigation of publicly-owned parcels and their surrounding neighborhoods for the feasibility of large area disconnections (i.e. disconnecting large combined areas into more regional, larger GI facilities in public spaces). Additionally, an assessment of existing tree canopy would be useful to identify areas that could benefit from added vegetation, as well as areas where impacts to existing trees should be avoided.

5.2.2 Cost

Table 5-8 lists the associated costs for this alternative.

Table 5-8. River Road WWTP Service Area- Proposed Green Infrastructure Conceptual Cost Estimate

Cost	Amount
Construction Cost Estimate	$42,310,000.00
Project Annual Operations and Maintenance	$3,427,000.00
Project Capital Cost Estimate	$55,850,000.00
Project 50 Year Present Worth Estimate	$122,560,000.00

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5.3 Systemwide Alternatives Comparison

Table 5-9. Systemwide Basin Alternatives Score Comparison

Alternative	Weighted Point Total	Weighted Percent
Inflow/Infiltration Rehabilitation	107	77%
Green Infrastructure	99	71%

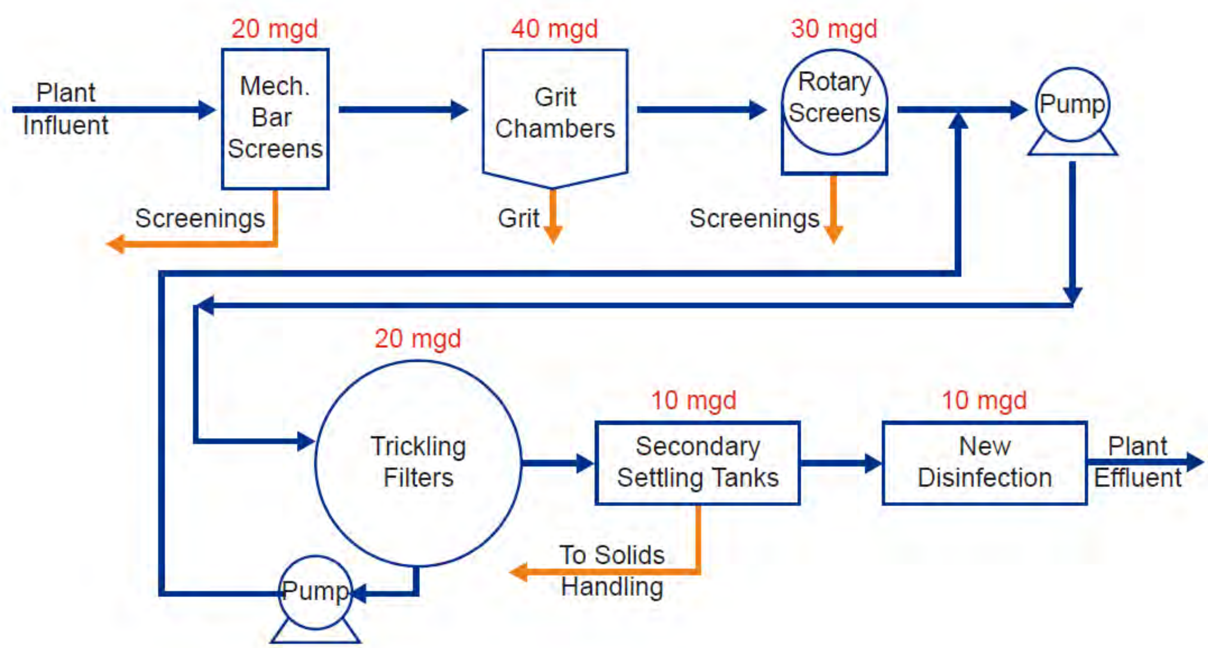
River Road Wastewater Treatment Plant

6.1 Wastewater Treatment Plant Overview

The River Road WWTP is located at 6400 Anthony M. Defino Way in West New York. The WWTP was constructed as a primary treatment plant in 1953 with a design capacity of 10 mgd and 20 mgd peak flow. In 1992, an upgrade to the plant was completed to provide secondary treatment using the trickling filter biological treatment process. The plant treats the sewage from the Town of West New York and from a section of Union City and Weehawken covering an area of approximately 1.4 square miles and three communities. The average flow to the facility has approached the plant capacity of 10 mgd in the past, but has been decreasing in recent years with aggressive I/I reduction efforts. Effluent is discharged to the Hudson River in accordance with the NJPDES permit NJ0025321.

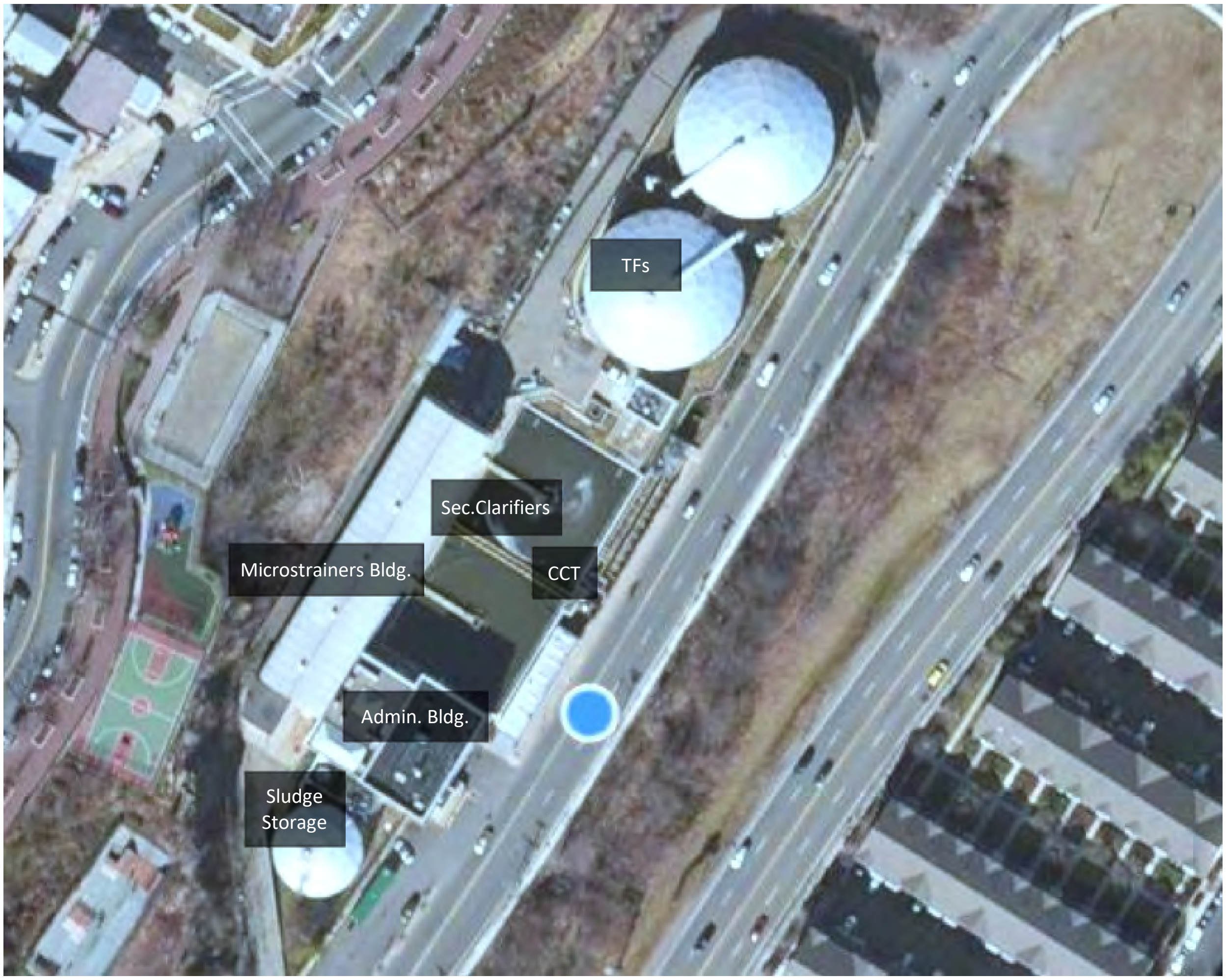
The treatment process at the plant includes preliminary treatment consisting of influent screening and grit removal using vortex type units, micro-strainers in lieu of primary clarifiers, trickling filters, secondary clarification, effluent disinfection using sodium hypochlorite and de-chlorination using sodium bisulfite, solids handling including sludge storage and sludge thickening using two belt presses and odor control. The process flow diagram for the River Road WWTP is provided on Figure 6-1. An aerial photograph of the site is provided on Figure 6-2.

Figure 6-1. River Road WWTP Process Flow Diagram



The capacities shown in the figure above indicate the hydraulic capacity of the plant, however are not necessarily representative of the biological capacity and may not reflect regular plant operations. For the purposes of this alternatives analysis, based on discussions with operating staff, it has been assumed that a maximum of 20 MGD would be conveyed through the trickling filters.

Figure 6-2. Aerial View of River Road WWTP



It is known that the treatment bottlenecks at the River Road WWTP are the capacities of the rotary screens, the secondary clarifiers and the chlorine contact chamber. In order to identify improvements at these points in the treatment train, available space was evaluated through the plant. A site visit to the WWTP was conducted on January 18, 2019 to obtain addition details on space availability and flexibility.

The preliminary treatment building houses the bar screens, grit vortex chamber, rotary strainers and intermediate pumping station. It can be seen on Figure 6-3 and Figure 6-4 that there is very limited space in this building to add additional treatment capacity.

Figure 6-3. Preliminary Treatment Building – facing northwest from southeast corner

Figure 6-4. Preliminary Treatment Building – Facing Southeast from Northwest End

The only available space in the pretreatment building is a small elevated area at the northwest end of the building adjacent to the rotary screens (shown in Figure 6-5), which is approximately 12-ft x 20-ft, and is not large enough for any of the evaluated treatment methods and their ancillary equipment, discussed further below. As such, any proposed improvements to the preliminary treatment building have not been considered further.

Figure 6-5. Open Area in Preliminary Treatment building

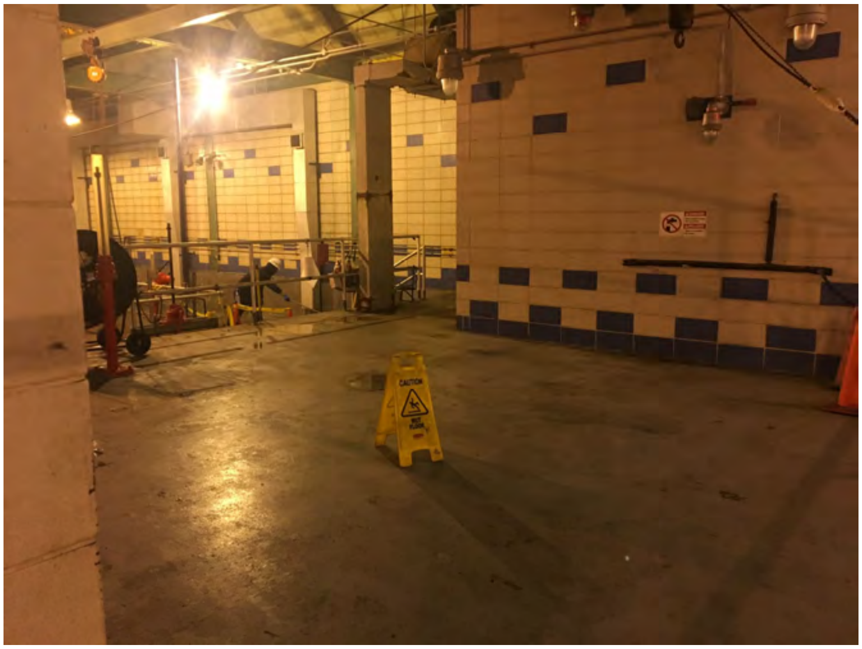
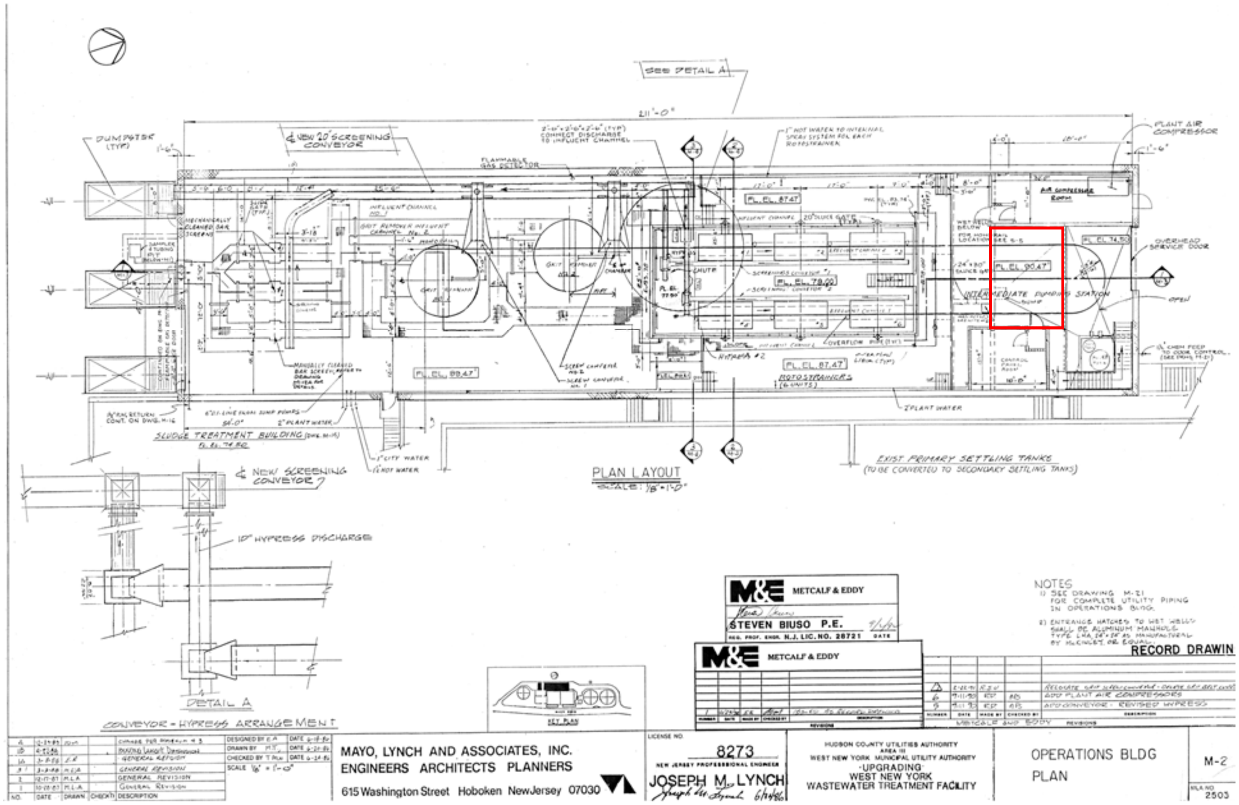


Figure 6-6. Plant Plan Drawing showing open area in preliminary treatment building



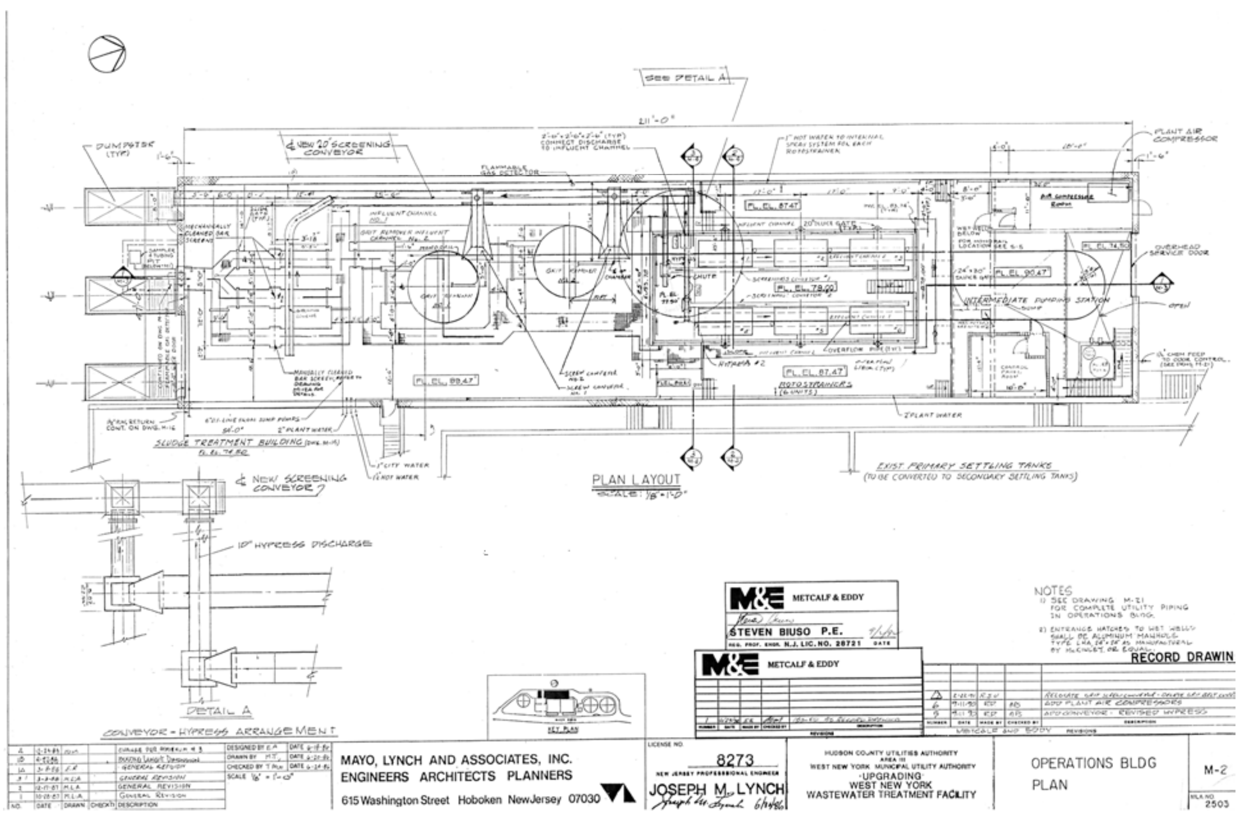
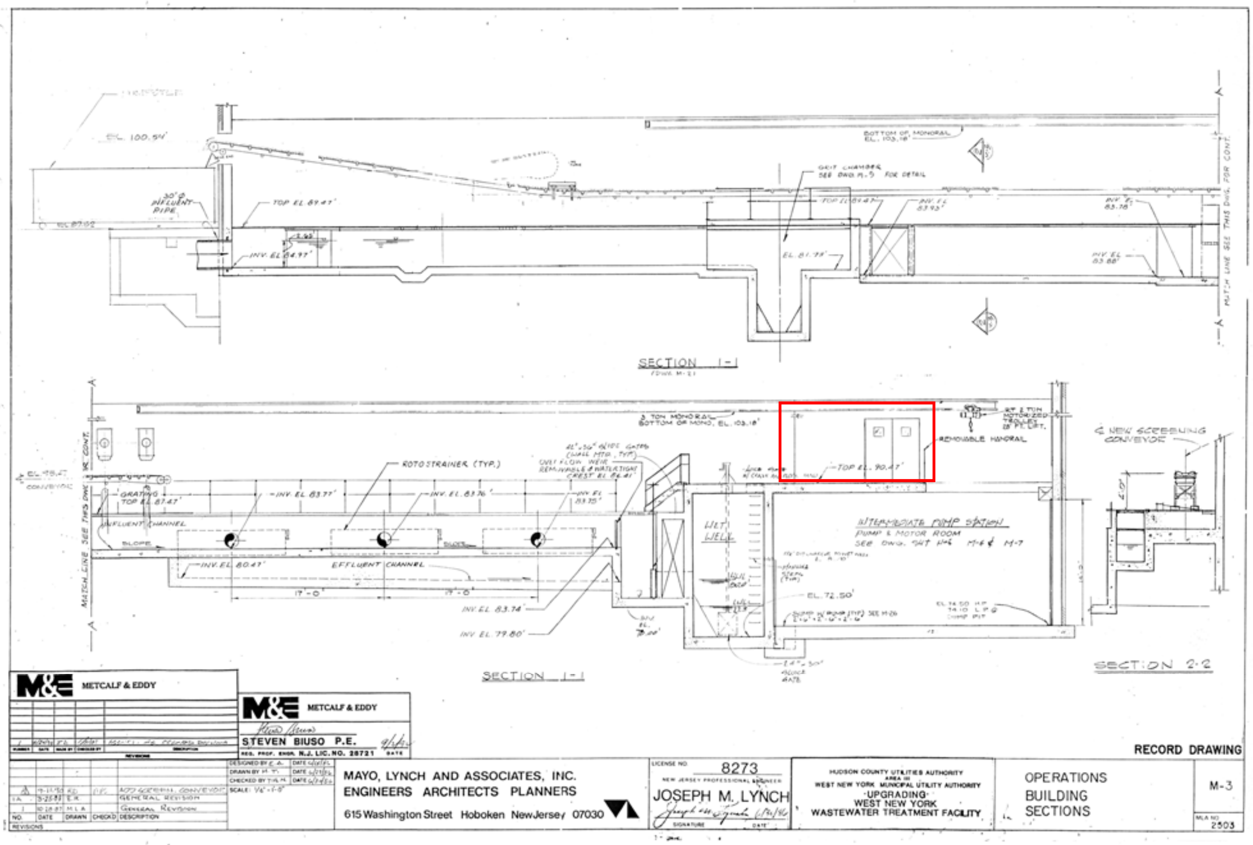
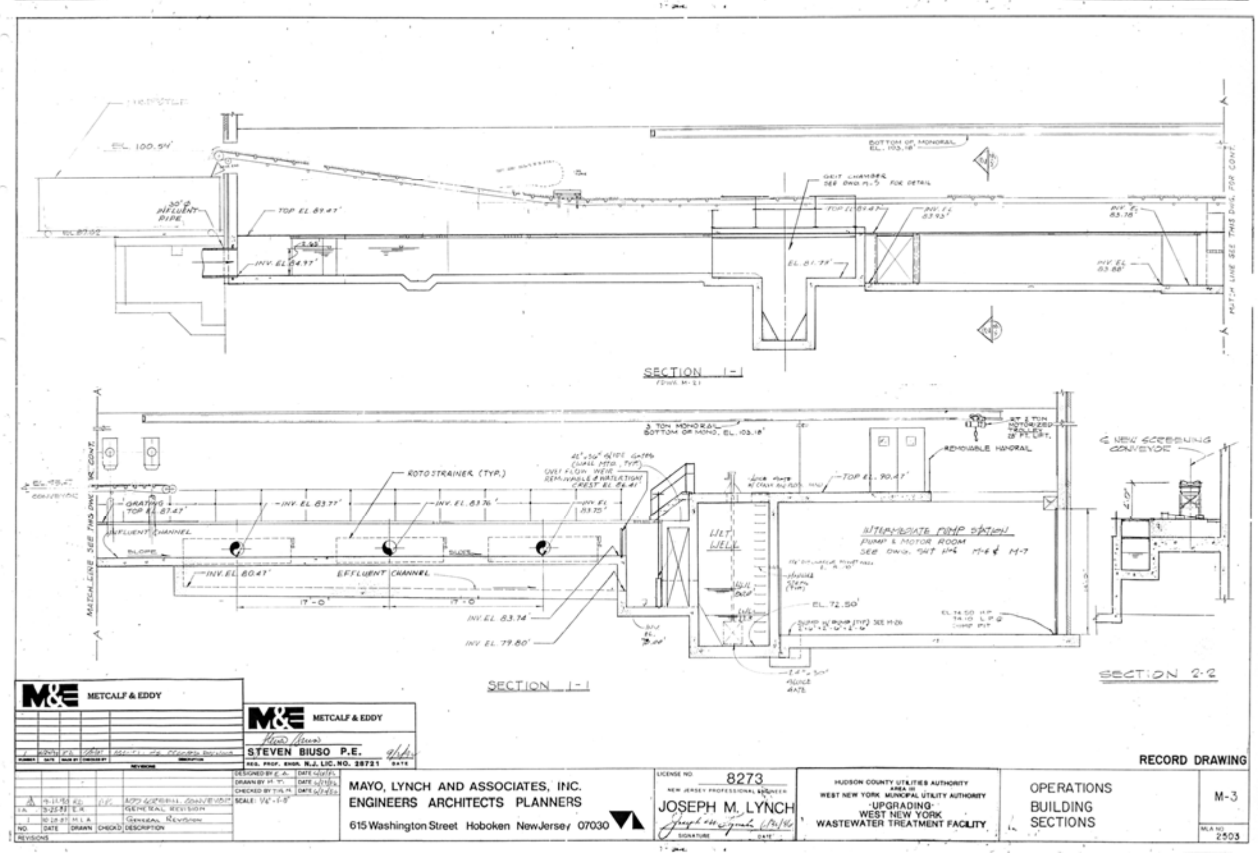


Figure 6-7. Plant Profile Drawing showing open area in preliminary treatment building





The plant has an existing bypass that conveys flow from the vortex grit chambers to the trickling filters, bypassing the rotary screens. It is proposed that the bypass be retrofitted to split flows, bypassing wet weather flow from the rotary screens and conveying it from the vortex grit chambers towards the location of the existing secondary clarifiers.

During dry weather, up to 20 mgd would continue to be conveyed through the rotary screens and trickling filters, and to a new higher capacity treatment unit located in the footprint of the existing secondary clarifiers, which would be decommissioned. During wet weather, the modified bypass would convey additional wet weather flows up to 15 mgd from the vortex grit chambers directly to the new higher capacity treatment unit located in the footprint of the decommissioned secondary clarifiers. Flows from the trickling filters and the bypass from the vortex grit chamber would be blended and conveyed to an upsized chlorine contact tank. The location of the secondary clarifiers and chlorine contact tank is shown in Figure 6-8.

Figure 6-8. Secondary Clarifiers and Chlorine Contact Tank

The proposed modification to the process flow schematic in order to increase plant capacity is shown in Figure 6-9 and the location of the proposed bypass is shown in Figure 6-10.

Figure 6-9. Proposed Modifications to Existing Plant Flow

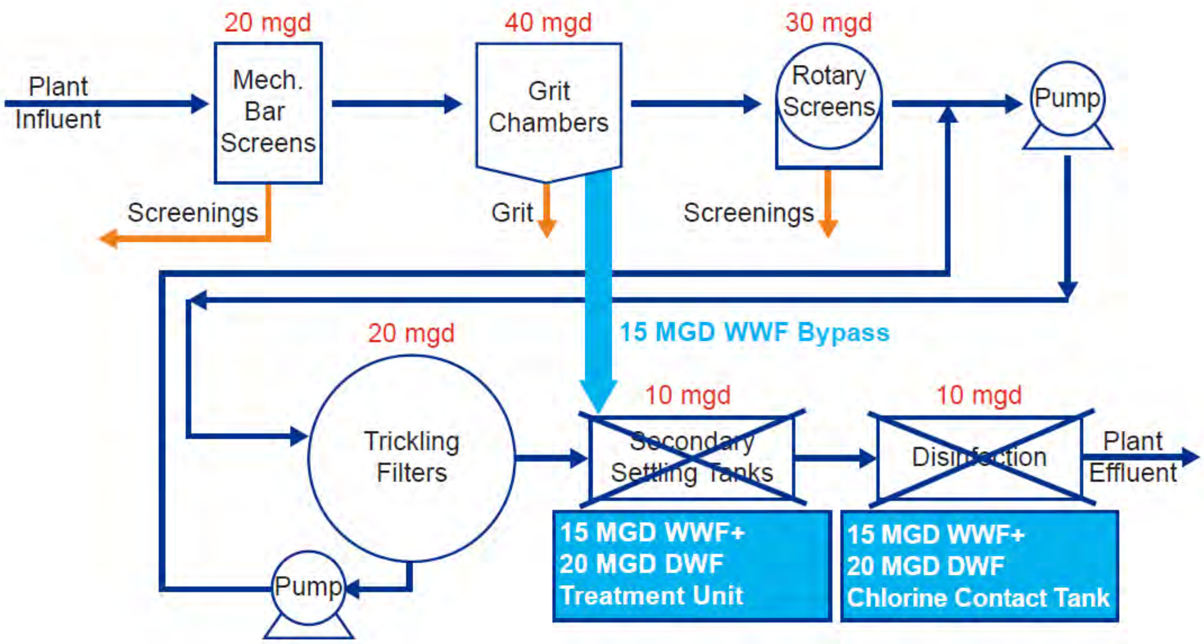
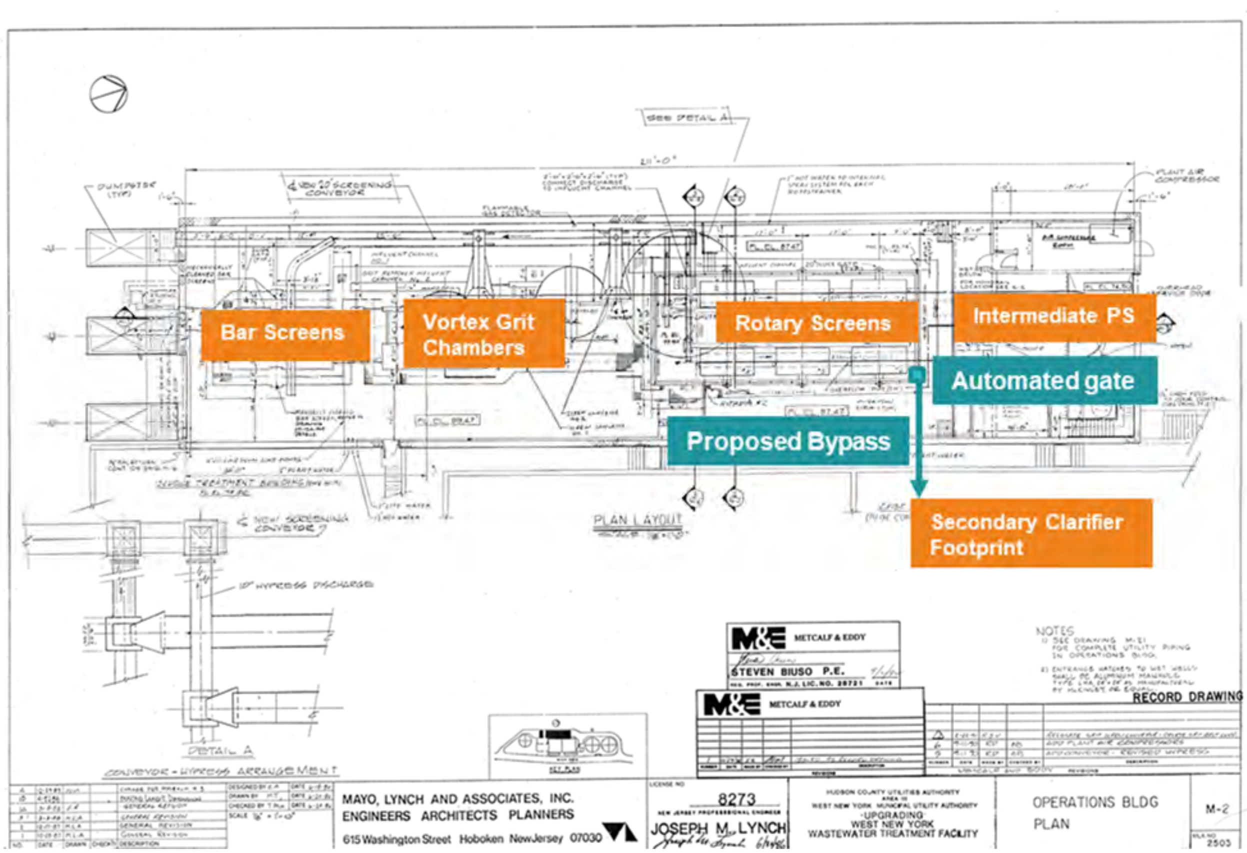


Figure 6-10. Proposed Bypass Location



It is proposed that chemical dosing of the southern secondary clarifier will be implemented to improve treatment performance by up to 50% while the northern secondary clarifier tank is decommissioned and replaced with the new treatment unit and upsized chlorine contact tank. While the southern secondary clarifier is decommissioned, the new treatment unit in the footprint of the northern clarifier will have a

20 mgd capacity which is sufficient to treat the current peak flows received at the plant. An additional treatment unit can be installed in the footprint of the southern clarifier if required.

Treatment alternatives to be located in the footprint of the secondary clarifier and chlorine contact area are thus evaluated in the next section below.

6.1.1 Construction Narrative

If making improvements at the treatment plant site, consideration will need to be given to how the new treatment unit will be installed and the secondary clarifiers decommissioned while keeping the plant in operation. The following construction sequence is proposed. It is noted that the construction sequence will be the same, regardless of the treatment alternative that is selected:

1. Retrofit bypass in preliminary treatment building so WWF (up to 15 mgd) bypasses rotary screens to flow from vortex grit chamber toward secondary clarifier. Up to 20 mgd still goes through rotary screens and trickling filters to secondary treatment.
2. Implement chemical dosing of southern secondary clarifier.
3. If required, install temporary secondary treatment unit to supplement chemical dosing.
4. Decommission northern secondary clarifier tank and replace with new treatment unit and upsized 9-foot-deep chlorine contact tank in the same footprint.
5. If required, decommission southern secondary clarifier tank and replace with treatment unit and upsized chlorine contact tank.

It is noted that this strategy is contingent upon the assumption that temporary chemical dosing of the clarifier will provide adequate secondary treatment. Alternatively, approval will be sought from NJDEP to receive approval for this intermediary treatment approach until construction has been completed.

6.1.2 Modelling Results

The River Road WWTP ICM model was adjusted to increase the capacity of the plant to 35 mgd. It was found that while there was no change to the overflows at JOSO, the River Road overflows dropped from 60 to 42 events in Typical Year and from 190.4 MG to 90.9 MG total overflow volume. The CSO volumes and events are summarized in Figure 6-11 through Figure 6-14.

Figure 6-11. Change in Volume at JOSO due to Treatment Plan Modifications

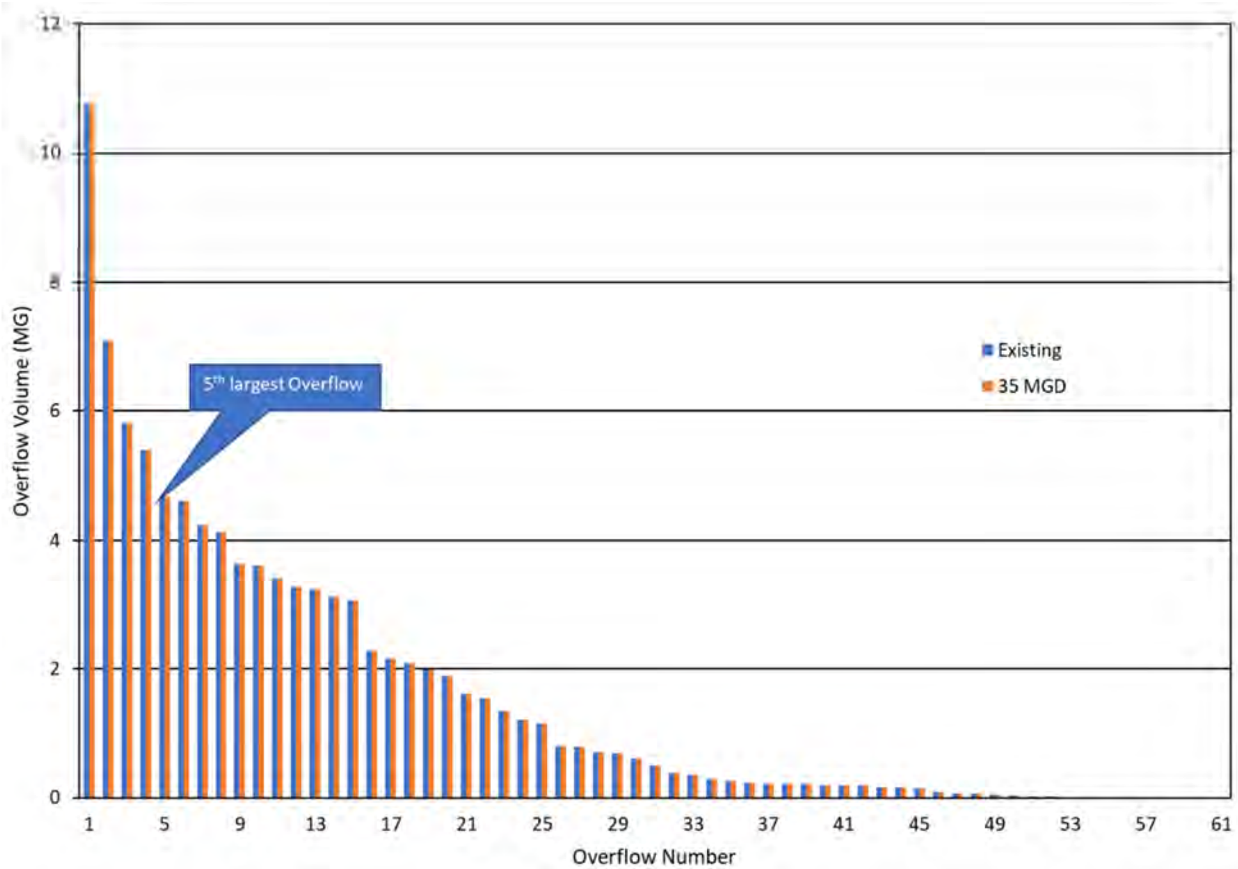


Figure 6-12. Change in Volume at River Road due to Treatment Plan Modifications

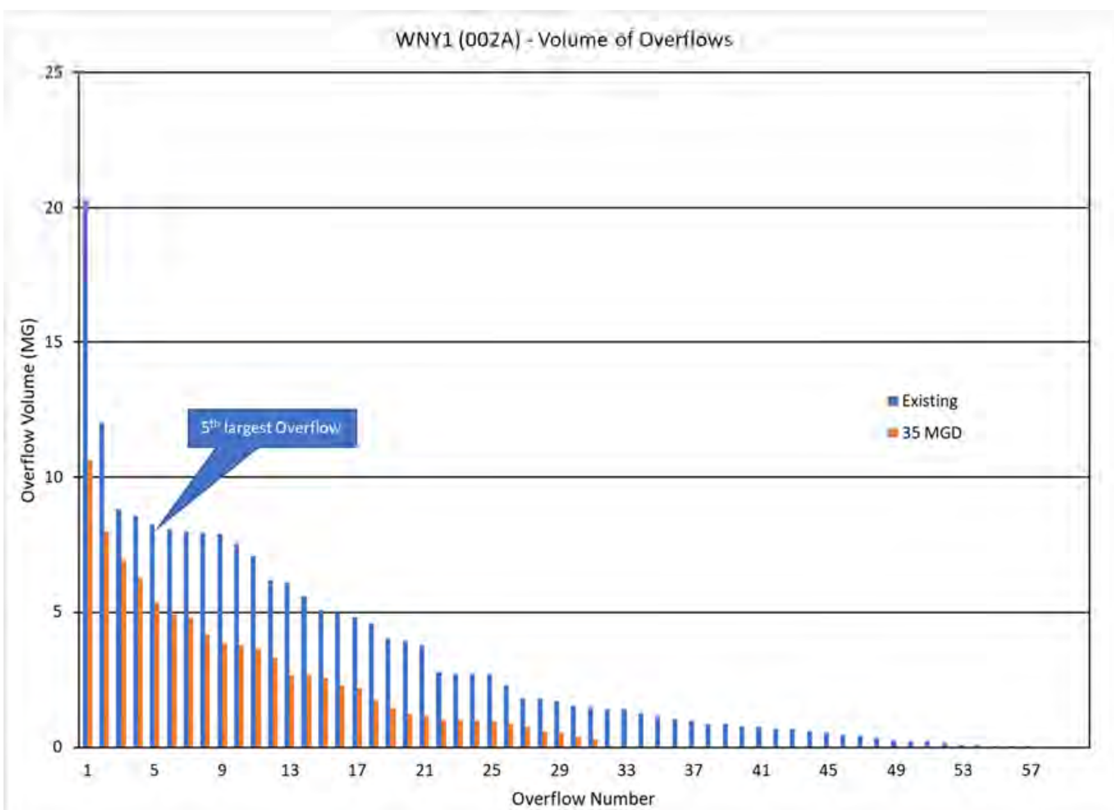


Figure 6-13. Change in Peak Flow at JOSO due to Treatment Plan Modifications

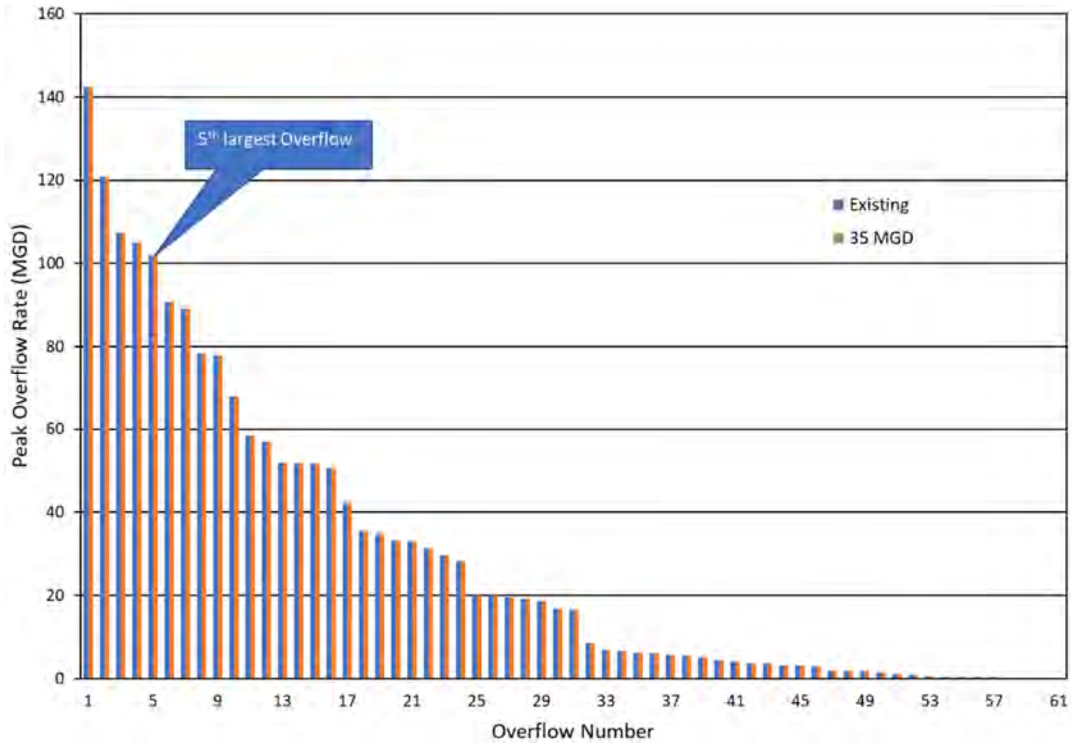
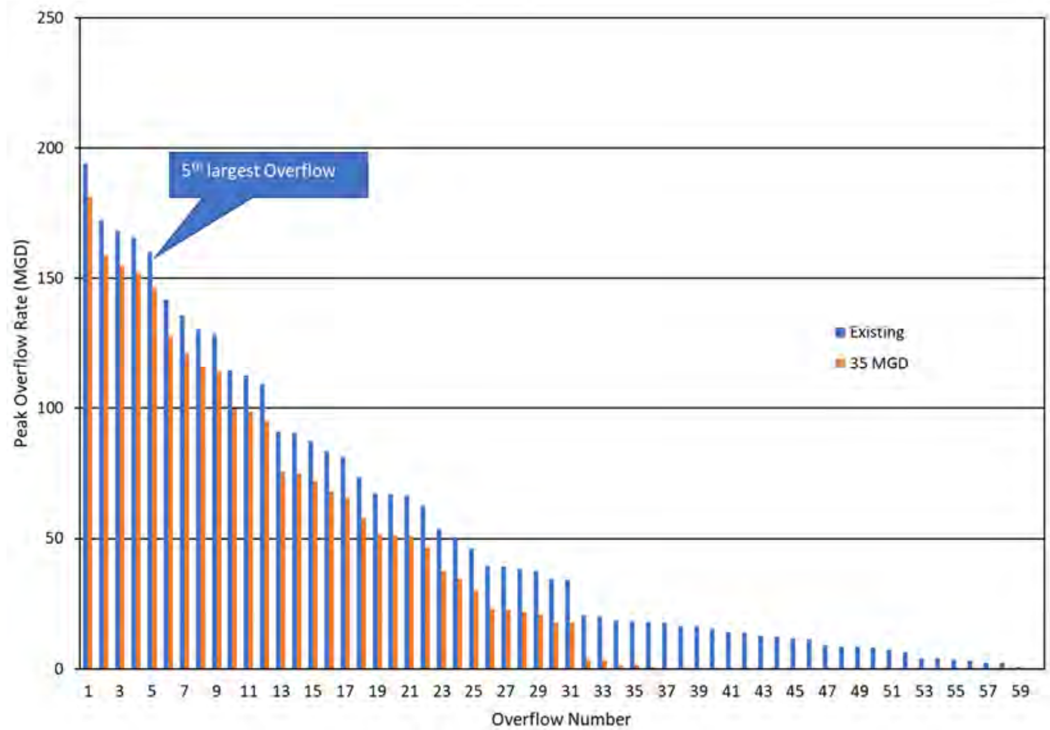


Figure 6-14. Change in Peak Flow at River Road due to Treatment Plan Modifications



6.2 Alternatives

Four treatment alternatives were evaluated as alternatives to the existing secondary clarifiers based on site limitations and feasibility of technology at the River Road WWTP.

ActiFLO
CoMag

- Cloth Media Filtration
- Compressed Media Filtration

6.2.1 ActiFLO

6.2.1.1 Identification and Preliminary Screening

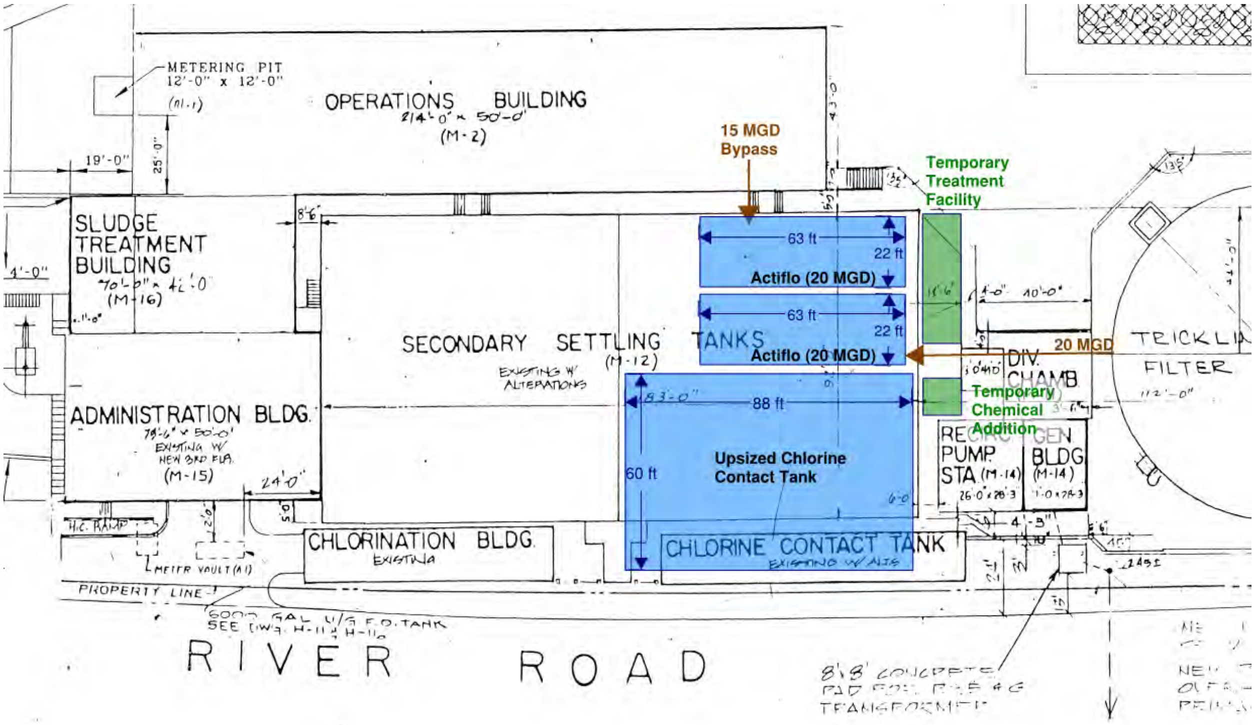
The addition of ACTIFLO® technology to bypass the strainers is considered as an alternative to increase treatment capacity to the River Road WWTP. ACTIFLO® is an established ballasted flocculation technology for CSO and wet weather treatment.

- Anticipated Constraints and Site Limitations:
  - As noted in the construction sequence, existing equipment would need to be relocated and reconfigured to accommodate the addition of the ACTIFLO® system. It is anticipated that the system may also require coarse as well as fine screening upstream to ensure that larger debris does not impact the functionality of the system. The ACTIFLO® also requires space for support systems such as a coagulant, polymer, and sand storage systems. In order to achieve a total treatment capacity of at least 35 mgd, two 20 mgd units are proposed, which would require a footprint of approximately 63 feet-3 inches by 22 feet each. Installation of an ACTIFLO facility to increase treatment capacity may also require upgrades to downstream processes such as disinfection and the outfall to treat and discharge the additional flow.
  - A significant constraint in the use of ACTIFLO® technology in end of pipe applications is the startup time, which is in the range of 15-30 minutes. However, at the WWTP the system would be in continuous operation and would be able to treat the first flush, which carries the greatest pollutant loading. As such it is recommended that the ACTIFLO system be left on all the time, and a wet weather operational procedure developed to bring additional train on-line with increasing flow. The system requires significant operation and maintenance attention and there is some complexity in determining the appropriate chemical dosage, which must be controlled by the flow rate.
- Functionality and Feasibility:
  - Performance efficiency - ActiFLO is known to provide TSS removal rates of 80-95% and fecal coliform removal rates of 85-95%. It is very effective in removing pollutants, particularly because the addition of coagulant and polymer helps to remove smaller particles.
  - Performance of the ACTIFLO® system is believed to deteriorate quickly for surface loading rates higher than 60 gallons per minute per square foot. The system is gravity fed, compatible with previously developed site layouts, and there is some flexibility in the system because the units can be added modularly. The amount of head loss must be considered in fitting it into the hydraulic grade line of the plant.
  - The system requires weekly inspections and preventive maintenance. If the system is being used intermittently, maintenance will be required to ensure that it is in working condition. These commitments would need to be agreed upon by plant staff. The ACTIFLO® system has significant operational and maintenance requirements, as well as complexity in chemical dosage, as such the Authority will need to take on the additional operational and upkeep duties.

6.2.1.2 Conceptual Network Layout

Figure 6-15 shows a conceptual layout of the ACTIFLO system.

Figure 6-15. ActiFlo Conceptual Layout



6.2.1.3 Cost

Table 6-1 lists the associated costs for this alternative.

Table 6-1. River Road WWTP ActiFLO- Conceptual Cost Estimate	
Construction Cost Estimate	$11,923,000
Project Annual Operations and Maintenance	$1,175,000
Project Capital Cost Estimate	$15,500,000
Project 50 Year Present Worth Estimate	$38,533,000

6.2.2 CoMag

6.2.2.1 Identification and Preliminary Screening

CoMag® is a ballasted settling process that could be implemented to increase treatment capacity. Modification of the current treatment works with CoMag® technology is considered as an alternative to add additional treatment capacity to the River Road WWTP.

- Anticipated Constraints and Site Limitations:
  - Existing equipment would need to be relocated and reconfigured to accommodate the addition of the CoMag® system. It is anticipated that a CoMag® system may also require coarse screening and possibly fine screening upstream to ensure that larger debris does not impact the functionality of the system. The CoMag® system also requires space for support systems such as a coagulant storage system and a feed storage system.
  - A significant constraint in the use of CoMag® technology in end of pipe applications is the startup time, which is in the range of 15-30 minutes. However, at the River Road WWTP the system would be in continuous operation and would be able to treat the first flush, which carries the greatest pollutant loading. As such it is recommended that the CoMag® system be

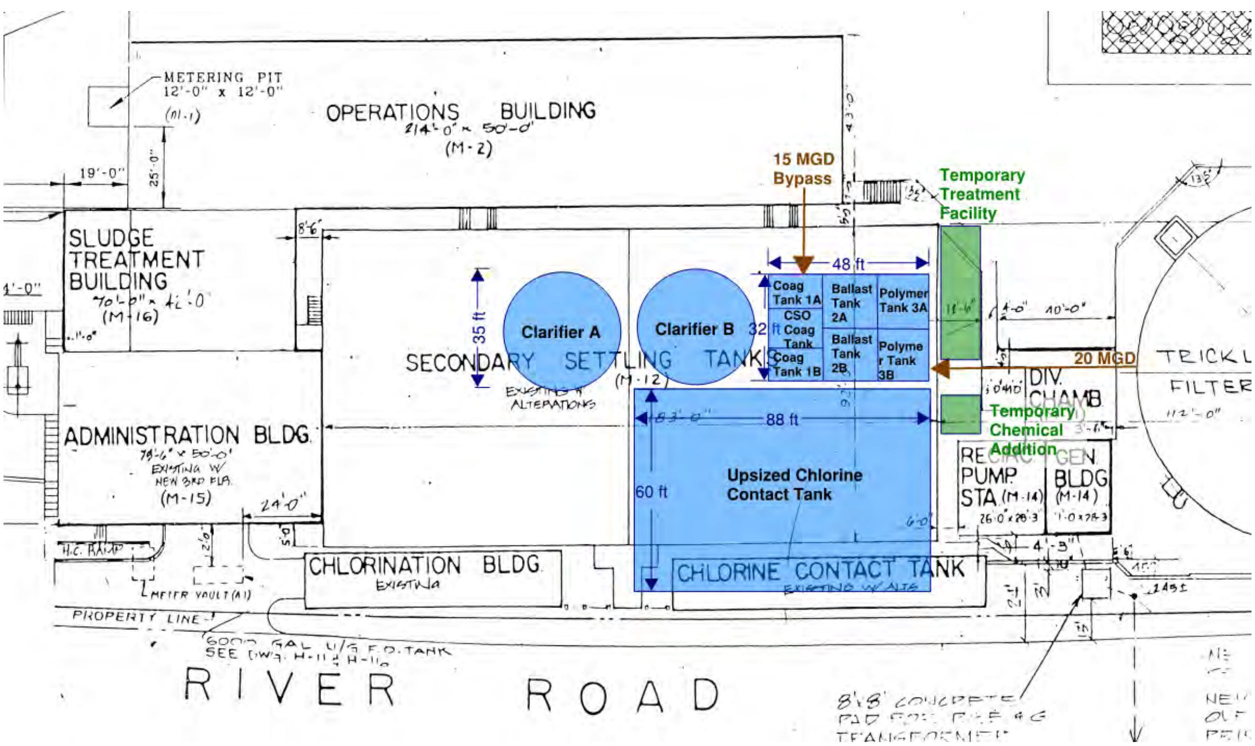
left on all the time, and a wet weather operational procedure developed to bring additional train on-line with increasing flow.

- Functionality and Feasibility:
  - Performance efficiency - the system is known to provide TSS removal rates of 75-95% and fecal coliform removal to < 200 Col/100 mL. CoMag® is not as widely used as other technologies for CSO and wet weather treatment applications as such site-specific pilot testing is recommended.
  - The amount of headloss must be considered in fitting it into the hydraulic grade line of the plant. The CoMag® system is able to provide settling rates which are faster than conventional treatments.
  - CoMag® is considered a flexible process because of its ability to treat widely fluctuating flows and loads. In addition, magnetite is denser than the sand used in other ballasted flocculation processes, readily available (iron ore commodity), fully inert, not abrasive (particle size is 40-50 microns) and magnetically retrievable (high recovery rates). Because the recovery rates of magnetite are high, the daily consumption is very low.
  - The system requires significant operation and maintenance attention and there is some complexity in determining the appropriate chemical dosage, which must be controlled by the flow rate. As such the Authority will need to take on the additional operational and upkeep duties.

6.2.2.2 Conceptual Network Layout

A conceptual layout of the CoMag system.

Figure 6-16. CoMag Conceptual Layout



6.2.2.3 Cost

Table 6-2 lists the costs associated to this alternative.

Table 6-2. River Road WWTP CoMag- Conceptual Cost Estimate	
Construction Cost Estimate	$12,191,000
Project Annual Operations and Maintenance	$409,000
Project Capital Cost Estimate	$15,849,000
Project 50 Year Present Worth Estimate	$23,860,000

6.2.3 Cloth Media Filtration

6.2.3.1 Identification and Preliminary Screening

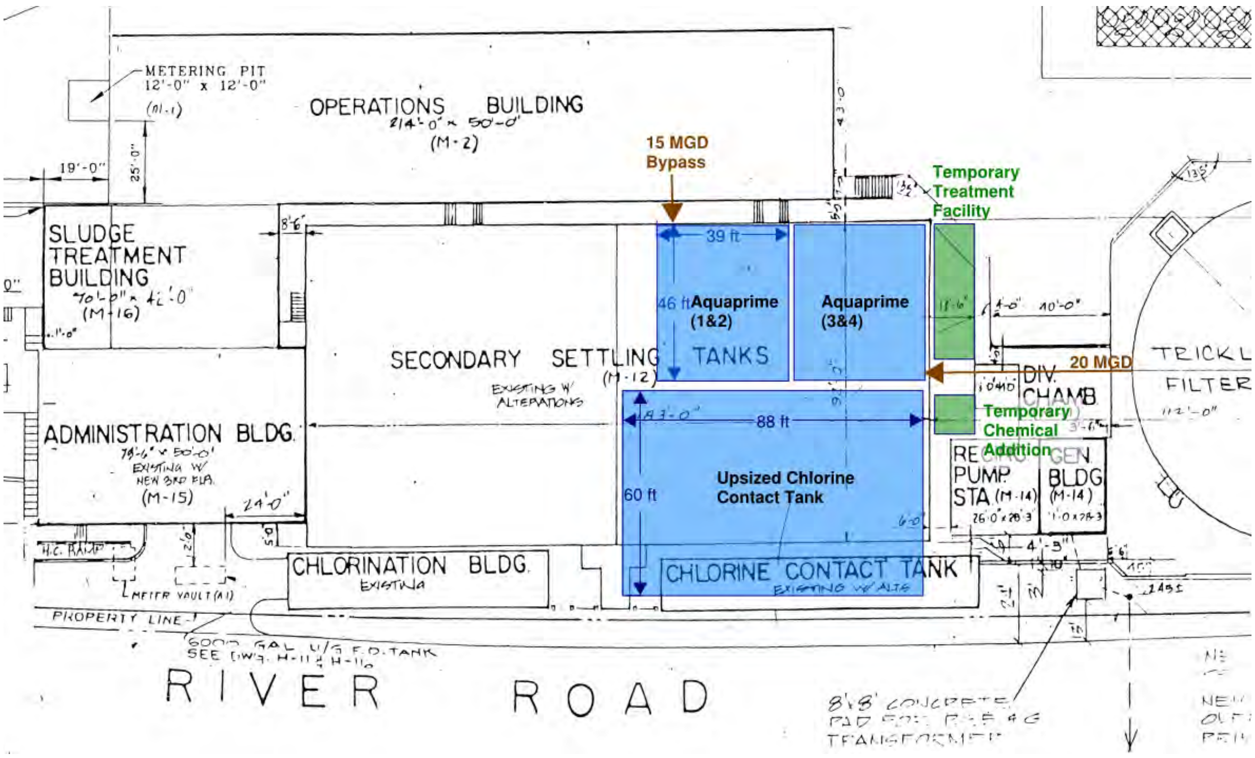
A high rate cloth media filtration system such as Aquaprime is considered as an alternative at the WWTP to increase treatment capacity and provide removal of total suspended solids (TSS). This application would require four Model 108 AquaPrime® Cloth Media Filters with 24 disks each in concrete basins.

- Anticipated Constraints and Site Limitations:
  - Existing equipment may need to be relocated and reconfigured to accommodate this system. A filtration system may also require space for support systems such as blowers and backwash pumps.
- Functionality and Feasibility:
  - Cloth media filters such as AquaPrime® for wet weather treatment is a relatively new application of an older technology that is being more widely adopted in recent years. They are gravity fed but are able to remain in filtration mode during backwashing meaning standby units are necessarily required. A significant benefit of this system is the short startup time. Performance efficiency with the AquaPrime® is about 75% to 85% TSS removal and 45% to 60% for CBOD removal. The amount of headloss required must be considered in fitting it into the hydraulic grade line of the plant.
  - Onsite piloting is required to determine the achievable effluent quality. AquaPrime has been successfully tested on filtering trickling filter effluent, however the maximum loading was only about 60 milligrams per liter (mg/L), and a pilot study is needed to confirm the treatability of higher solids wastewater, which based on historical data has an average TSS loading of about 110 mg/L and maximum of 668 mg/L.

6.2.3.2 Conceptual Network Layout

Figure 6-17 shows a conceptual layout of the Aquaprime system.

Figure 6-17. AquaPrime Conceptual Layout



6.2.3.3 Cost

Table 6-3 lists the costs associated to this alternative.

Table 6-3. River Road WWTP Cloth Media Filtration- Conceptual Cost Estimate	
Construction Cost Estimate	$14,961,000
Project Annual Operations and Maintenance	$330,000
Project Capital Cost Estimate	$19,450,000
Project 50 Year Present Worth Estimate	$25,927,000

6.2.4 Compressible Media Filtration

6.2.4.1 Identification and Preliminary Screening

Compressible media filtration (CMF) is a process that uses a synthetic, porous filter media for removal of turbidity and total suspended solids. The WWETCO FlexFilter compressible media filtration system has been considered as an alternative at the River Road WWTP to increase treatment capacity and provide removal of total suspended solids (TSS). The FlexFilter uses synthetic fiber spheres as filter media. This application would require 8 filter cells in two trains (4 cells per train) that can treat 35 mgd at an average TSS of 127 mg/L (average dry and wet TSS concentration).

- Anticipated Constraints and Site Limitations:
  - The system would fit into the footprint of one of the two 90-ft x 90-ft square clarifier structures with additional space required for the upgraded chlorine contact tank. The layout concept would include room for backwash transfer pumping and low head effluent pumping. This layout would treat the 35 mgd plus recycle and backwash return (approximately 46 mgd total). One train can be used for dry weather and one for wet weather, or both operating as a combined system. The capacity of the existing grit and trickling filter systems should be confirmed as to

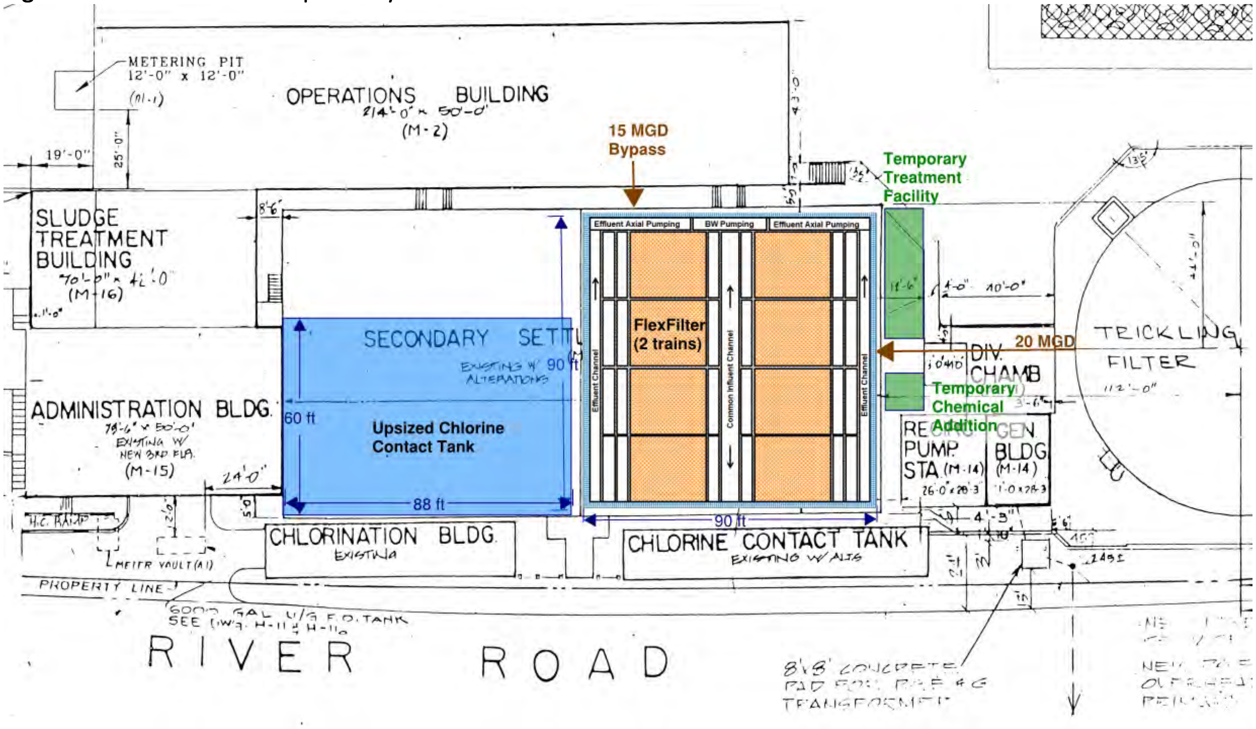
whether they can accommodate the increased flow as well as the extra flow from the backwash and grit loading.

- Functionality and Feasibility:
  - Performance of CMF is similar to other more conventional filters, however the filtration rate is more than 3 to 6 times the rate of other filters and the startup time is instantaneous. percent backwash water required is significantly less than that used in conventional filtration technologies. The manufacturer indicates that the contaminants removal efficiency of WWETCO FlexFilter in CSO application ranges from 73% to 94% for TSS removal and 16% to 69% for CBOD removal.
  - It is known from the Bayonne Municipal Utilities Authority pilot study that the FlexFilter units may experience operating issues related to the pumps and the time needed to backwash. Shorter filter run times and frequent backwashing were experienced when testing at the higher end of the filter loading rate recommended for CSO treatment. The compressed media filter is effective in removing finer and organic suspended solids. The FlexFilter utilizes low head air to accomplish the media scrubbing while lifting the backwash water to waste, thus minimizing backwash waste volumes. The influent TSS concentration to the FlexFilter is limited to less than 100 mg/L, and higher TSS concentrations increase the backwash time resulting in overall reduced performance of the units.
  - Operational and maintenance considerations include power costs for the blowers, recycle pumps, and backwash pumps as well as media change-out cost, labor for preventative and routine maintenance, and labor for post event clean-out. The FlexFilter system is relatively complex to operate due to automated valves, hydraulically operated porous plate, air injection into the beds during backwashing, and the monitoring needed for the flow and headloss conditions. The valves can be an issue during outdoor operation in freezing weather conditions. Chlorine dose of 5 mg/L to backwash is needed to control biological growth. This system is not designed for continuous backwash or continuous TSS of 300 mg/L at 35 mgd.

6.2.4.2 Conceptual Network Layout

Figure 6-18 shows a conceptual layout of the FlexFilter system.

Figure 6-18. FlexFilter Conceptual Layout



6.2.4.3 Cost

Table 6-4 lists the costs associated to this alternative.

Table 6-4. River Road WWTP Compressible Media Filtration (FlexFilter) - Conceptual Cost Estimate	
Construction Cost Estimate	$15,425,000
Project Annual Operations and Maintenance	$351,000
Project Capital Cost Estimate	$20,053,000
Project 50 Year Present Worth Estimate	$26,931,000

6.3 Alternatives Comparison

Each alternative was assigned a score based on the evaluation criteria identified in Task 1. Table 6-5 shows the weighted point total and weighted average of each alternative for the JOSO drainage basin. The full breakdown of the scoring for each alternative can be found in Appendix B.

Table 6-5. River Road WWTP Alternatives Score Comparison

Alternative	Weighted Point Total	Weighted Percent
ActiFLO	121	87%
CoMag	121	87%
Cloth Media Filtration	122	88%
Compressible Media Filtration	122	88%

Summary

The Development and Evaluation of Alternatives report can be applied to the following phase of the LTCP, Selection and Implementation of Alternatives in the River Road Service Area. Table 7-1 shows the comparison of the alternatives based on the evaluation criteria. The details of each alternative listed in the report apply under the specific conditions stated here and any deviations to the assumptions listed may result in a change in the overall result of implementation, cost and evaluation score.

Table 7-1. River Road Service Area-CSO Control Alternatives Comparison

Drainage Basin	Alternatives	Weighted Point Total	Weighted Percent	Class 5 Conceptual Construction Cost Estimate
JOSO	Combined Sewer Overflow Storage Structure In Water	66	47%	$82,160,000.00
	Raise Regulator Weirs at UC1, UC2 and WNY2	105	76%	$120,000
	Replace Existing JOSO Sideflow Weirs with Bending Weirs	119	86%	$352,000
WNY1	Combined Sewer Overflow Storage Tank near WNY1 Outfall	65	47%	$60,333,000.00
	Linear Storage Tunnel at Anthony Defino Way	63	46%	$171,450,000.00
	Cloth Media Filtration[1]	-	-	$27,700,000-$86,500,000
	Compressible Media Filtration[2]	-	-	$92,000,000
Systemwide	Inflow/Infiltration Rehabilitation	107	77%	$13,788,000
	Green Infrastructure	99	71%	$42,310,000.00
River Road WWTP	ActiFLO	121	87%	$11,923,000
	CoMag	121	87%	$12,191,000
	Cloth Media Filtration	122	88%	$14,961,000
	Compressible Media Filtration	122	88%	$15,425,000

1. Alternative not scored due to potential range of costs
2. Alternative not scored due to potential range of costs; cost shown assumes max TSS concentration of 320 mg/L

SECTION 8

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Appendix A
Evaluation Criteria

Evaluation Criteria-Disinfection/Treatment Alternatives

Category	Criteria	1	2	3	4
CSO Reduction	Bacteria Reduction	Alternative does not eliminate or reduce bacteria discharges of effluent	-	Alternative results in reduction of bacteria discharges of effluent	Alternative eliminates bacteria discharges of effluent
	Water Quality Benefits	Will not meet water quality standards in the Hudson River	-	Will meet water quality standards in the Hudson River with help of another alternative	Will meet water quality standards in the Hudson River standing alone
	Support designated uses in Hudson River (Secondary contact recreation and fishing)	Will not attribute to improved water quality to support designated uses of the Hudson River	Will attribute to improved water quality to support partial designated uses of the Hudson River	Will attribute to improved water quality to support partial designated uses of Hudson River with help of another alternative	Will support all designated uses of the Hudson River standing alone
Feasibility	Availability of validation on main technology for the alternative	Scientific basis largely unproven/untested	Limited data provided, but technology claims cannot be corroborated using conventional scientific/engineering principles	Significant data to corroborate technology claims available but lacks consensus of the scientific community	Uses well known and accepted scientific principles or the Authority already uses technology with success
	Flexibility of alternative to be adjusted or optimized with future changing flows	Alternative cannot be adjusted after initial implementation	Alternative can be adjusted with significant additional construction/cost in conjunction with adjustment to related alternative	Alternative can be adjusted with significant additional construction/cost	Alternative can be altered without significant additional construction/cost
	Flexibility of the alternative to provide effective treatment under variety of operating conditions.	Need for supplemental steps in the treatment process – compatibility with disinfection process.	-	-	Limited number of steps in the treatment process. Effective performance under a variety of operating conditions. Tolerance of the alternative to variable loading conditions (flow, pollutant load) and compatibility with influent.
	Anticipated Operations from the Authority's personnel	Capabilities and/or staff resources are not readily available and require hiring	Capabilities and/or staff partially available and require training. Some hiring may be required.	Capabilities can be accomplished with existing staff, with additional training	No additional hires/training required
	Reliability	Alternative struggles with intermittent operation. Relies on chemicals that are subject to degradation. Lack of performance history in application.	-	-	Alternative provides consistent performance while operating intermittently. Ability to operate after long idle periods.
Regulatory Compliance	Anticipated effects on project timeline through coordination with other agencies or the Authority's projects	High probability of project delay of one year or greater from interaction with agency	Moderate potential for project delay	Minor probability or project delay of one year or greater	No anticipated cause for delay of this project or other projects
	Anticipated lead time for permitting	Permit lead time > 6 months	-	-	Permit lead time < 6 months
	Requirement of USACOE Permit	USACOE permit required for construction	-	-	USACOE permit not required for construction
	Requirement of NJPDES Permit	Requires a new NJPDES permit	-	Requires revision of an existing NJPDES Permit	New NJPDES permit or revisions to existing NJPDES permit not required
Location Constraints	Anticipated Land Acquisition	Permanent acquisition of publicly or privately owned land with owner known to be strongly resistant	Temporary acquisition of land for construction purposes where owner is known to be strongly resistant	Temporary acquisition of land for construction where owner is known to be compliant	Sufficient access is likely available at low cost and resistance, or land is already owned by the Authority
	Anticipated Traffic Impacts	Significant adverse impacts on primary road	Significant adverse impacts on secondary road	Minor adverse impacts lasting more than 6 months on smaller road	Minor adverse impacts lasting less than 6 months
	Compatibility with Existing Infrastructure	Requires utility relocating for 1000 feet or counteracts previous investment	Requires utility relocating for less than 1000 feet	Localized/minor consequences-Utility relocation at spot locations	No impact/positive impact
	Anticipated Noise and Odor Impacts	Noise and odor impacts are significant or unable to be measured or mitigated	Noise and odor impacts are significant but are able to be mitigated with additional services	Noise and Odor Impacts are minor but able to be mitigated with additional services	Noise and Odor impacts are minimal or non-existent
	Physical Characteristics	Size or footprint of the alternative will significantly impact surrounding area	Size or footprint of the alternative will significantly impact surrounding area but can be mitigated	-	Size or footprint of the alternative will not impact surrounding areas
Cost	Capital (Includes New Equipment, staffing during and after wet weather events, and Design Costs and Present Worth)	Greater than $80,000,000	$50,000,000-$80,000,000	$20,000,000-$50,000,000	Less than $20,000,000
	Operations and Maintenance (Includes chemicals, labor to maintain equipment, power cost and need for staffing during and after wet weather events.	Greater than $200,000	$100,000-$200,000	$75,000-$100,000	Less than $75,000
Community Impact	Public Acceptance	Public concerns expected	Moderate public concerns anticipated	Minor public concerns anticipated	No public response anticipated
	Impact to Businesses	Permanent interruption to businesses with no mitigation	Permanent interruption with mitigation strategy	Temporary interruption with mitigation strategy	No interruption
	Quality of life after construction	Significant adverse impact on use of parks or public spaces for more than 6 months	Significant adverse impact on use of parks or public spaces for less than 6 months	Minor adverse impacts on parks or public spaces for less than 6 months	Negligible or no adverse impacts on use of parks or public spaces

Evaluation Criteria-Storage/Conveyance Alternatives

Category	Criteria	1	2	3	4
CSO Reduction	CSO Volume Reduction	Greater than 4 overflows per year	-	-	Maximum of 4 overflows per year
	Bacteria Reduction	Alternative does not eliminate or reduce bacteria discharges at outfall	-	Alternative results in reduction of bacteria discharges at outfall	Alternative eliminates bacteria discharges at outfall
	Water Quality Benefits	Will not meet water quality standards in the Hudson River	-	Will meet water quality standards in Hudson River with help of another alternative	Will meet water quality standards in the Hudson River standing alone
	Support designated uses in Hudson River (Secondary conta	Will not attribute to improved water quality to support designated uses of the Hudson River	Will attribute to improved water quality to support partial	Will attribute to improved water quality to support partial	Will support all designated uses of the Hudson River standing alone
Feasibility	Availability of validation on main technology for the alternative	Scientific basis largely unproven/untested	Limited data provided, but technology claims cannot be corroborated using conventional scientific/engineering principles	Significant data to corroborate technology claims available but lacks consensus of the scientific community	Uses well known and accepted scientific principles or the Authority already uses technology with success
	Flexibility of the alternative to be adjusted or optimized with future changing flows	Alternative cannot be adjusted after initial implementation	Alternative can be adjusted with significant additional construction/cost in conjunction with adjustment to related alternative	Alternative can be adjusted with significant additional construction/cost	Alternative can be altered without significant additional construction/cost
	Flexibility of the alternative to provide effective operation under variety of operating conditions.	Need for supplemental steps in the operation process – compatibility with disinfection process.	-	-	Limited number of steps in the storage process. Effective performance under a variety of operating conditions. Tolerance of the alternative to variable loading conditions (flow, pollutant load) and compatibility with influent.
	Anticipated Operations from the Authority's personnel	Capabilities and/or staff resources are not readily available and require hiring	Capabilities and/or staff partially available and require training. Some hiring may be required.	Capabilities can be accomplished with existing staff, with additional training	No additional hires/training required
	Reliability	Alternative struggles with intermittent operation. Lack of performance history in application.	-	-	Alternative provides consistent performance while operating intermittently. Ability to operate after long idle periods.
Regulatory Compliance	Anticipated effects on project timeline through coordination with other agencies or the Authority's projects	High probability of project delay of one year or greater	Moderate potential for project delay	Minor probability or project delay of one year or greater	No anticipated cause for delay of this project or other projects
	Anticipated lead time for permitting	Permit lead time > 6 months	-	-	Permit lead time < 6 months
	Requirement of USACOE Permit	USACOE permit required for construction	-	-	USACOE permit not required for construction
	Requirement of NJPDES Permit	Requires a new NJPDES permit	-	Requires revision of an existing NJPDES Permit	New NJPDES permit or revisions to existing NJPDES permit not required
Location Constraints	Anticipated Land Acquisition	Permanent acquisition of publicly or privately owned land with owner known to be strongly resistant	Temporary acquisition of land for construction purposes where owner is known to be strongly resistant	Temporary acquisition of land for construction where owner is known to be compliant	Sufficient access is likely available at low cost and resistance, or land is already owned by the Authority
	Anticipated Traffic Impacts	Significant adverse impacts on primary road	Significant adverse impacts on secondary road	Minor adverse impacts lasting more than 6 months on smaller road	Minor adverse impacts lasting less than 6 months
	Compatibility with Existing Infrastructure	Requires utility relocating for 1000 feet or counteracts previous investment	Requires utility relocating for less than 1000 feet	Localized/minor consequences-Utility relocation at spot locations	No impact/positive impact
	Anticipated Noise and Odor Impacts	Noise and odor impacts are significant or unable to be measured or mitigated	Noise and odor impacts are significant but are able to be mitigated with additional services	Noise and Odor Impacts are minor but able to be mitigated with additional services	Noise and Odor impacts are minimal or non-existent
	Physical Characteristics	Size or footprint of the alternative will significantly impact surrounding area	Size or footprint of the alternative will significantly impact surrounding area but can be mitigated	-	Size or footprint of the alternative will not impact surrounding areas
Cost	Capital (Includes New Equipment, staffing during and after wet weather events, and Design Costs and Present Worth)	Greater than $80,000,000	$50,000,000-$80,000,000	$20,000,000-$50,000,000	Less than $20,000,000
	Operations and Maintenance (Includes chemicals, labor to maintain equipment, power cost and need for staffing during and after wet weather events.	Greater than $200,000	$100,000-$200,000	$75,000-$100,000	Less than $75,000
Community Impact	Public Acceptance	Public concerns expected	Moderate public concerns anticipated	Minor public concerns anticipated	No public response or positive public response anticipated
	Impact to Businesses	Permanent interruption to businesses with no mitigation	Permanent interruption with mitigation strategy	Temporary interruption with mitigation strategy	No interruption
	Quality of life after construction	Significant adverse impact on use of parks or public spaces for more than 6 months	Significant adverse impact on use of parks or public spaces for less than 6 months	Minor adverse impacts on parks or public spaces for less than 6 months	Negligible or no adverse impacts on use of parks or public spaces

Appendix B
Evaluation Scores

JOSO Drainage Basin-Replace Existing Weirs with Bending Weirs

Category	Criteria	1	2	3	4
CSO Reduction	CSO Volume Reduction	Greater than 4 overflows per year	-	-	Maximum of 4 overflows per year
	Bacteria Reduction	Alternative does not eliminate or reduce bacteria discharges at outfall	-	Alternative results in reduction of bacteria discharges at outfall	Alternative eliminates bacteria discharges at outfall
	Water Quality Benefits	Will not meet water quality standards in the Hudson River	-	Will meet water quality standards in Hudson River with hel	Will meet water quality standards in the Hudson River standing alone
	Support designated uses in Hudson River (Secondary conta	Will not attribute to improved water quality to support designated uses of the Hudson River	Will attribute to improved water quality to support partial	Will attribute to improved water quality to support partial	Will support all designated uses of the Hudson River standing alone
Feasibility	Availability of validation on main technology for the alternative	Scientific basis largely unproven/untested	Limited data provided, but technology claims cannot be corroborated using conventional scientific/engineering principles	Significant data to corroborate technology claims available but lacks consensus of the scientific community	Uses well known and accepted scientific principles or the Authority already uses technology with success
	Flexibility of the alternative to be adjusted or optimized with future changing flows	Alternative cannot be adjusted after initial implementation	Alternative can be adjusted with significant additional construction/cost in conjunction with adjustment to related alternative	Alternative can be adjusted with significant additional construction/cost	Alternative can be altered without significant additional construction/cost
	Flexibility of the alternative to provide effective operation under variety of operating conditions.	Need for supplemental steps in the operation process – compatibility with disinfection process.	-	-	Limited number of steps in the storage process. Effective performance under a variety of operating conditions. Tolerance of the alternative to variable loading conditions (flow, pollutant load) and compatibility with influent.
	Anticipated Operations from the Authority's personnel	Capabilities and/or staff resources are not readily available and require hiring	Capabilities and/or staff partially available and require training. Some hiring may be required.	Capabilities can be accomplished with existing staff, with additional training	No additional hires/training required
	Reliability	Alternative struggles with intermittent operation. Lack of performance history in application.	-	-	Alternative provides consistent performance while operating intermittently. Ability to operate after long idle periods.
Regulatory Compliance	Anticipated effects on project timeline through coordination with other agencies or the Authority's projects	High probability of project delay of one year or greater	Moderate potential for project delay	Minor probability or project delay of one year or greater	No anticipated cause for delay of this project or other projects
	Anticipated lead time for permitting	Permit lead time > 6 months	-	-	Permit lead time < 6 months
	Requirement of USACOE Permit	USACOE permit required for construction	-	-	USACOE permit not required for construction
	Requirement of NJPDES Permit	Requires a new NJPDES permit	-	Requires revision of an existing NJPDES Permit	New NJPDES permit or revisions to existing NJPDES permit not required
Location Constraints	Anticipated Land Acquisition	Permanent acquisition of publicly or privately owned land with owner known to be strongly resistant	Temporary acquisition of land for construction purposes where owner is known to be strongly resistant	Temporary acquisition of land for construction where owner is known to be compliant	Sufficient access is likely available at low cost and resistance, or land is already owned by the Authority
	Anticipated Traffic Impacts	Significant adverse impacts on primary road	Significant adverse impacts on secondary road	Minor adverse impacts lasting more than 6 months on smaller road	Minor adverse impacts lasting less than 6 months
	Compatibility with Existing Infrastructure	Requires utility relocating for 1000 feet or counteracts previous investment	Requires utility relocating for less than 1000 feet	Localized/minor consequences-Utility relocation at spot locations	No impact/positive impact
	Anticipated Noise and Odor Impacts	Noise and odor impacts are significant or unable to be measured or mitigated	Noise and odor impacts are significant but are able to be mitigated with additional services	Noise and Odor Impacts are minor but able to be mitigated with additional services	Noise and Odor impacts are minimal or non-existent
	Physical Characteristics	Size or footprint of the alternative will significantly impact surrounding area	Size or footprint of the alternative will significantly impact surrounding area but can be mitigated	-	Size or footprint of the alternative will not impact surrounding areas
Cost	Capital (Includes New Equipment, staffing during and after wet weather events, and Design Costs and Present Worth)	Greater than $80,000,000	$50,000,000-$80,000,000	$20,000,000-$50,000,000	Less than $20,000,000
	Operations and Maintenance (Includes chemicals, labor to maintain equipment, power cost and need for staffing during and after wet weather events.	Greater than $200,000	$100,000-$200,000	$75,000-$100,000	Less than $75,000
Community Impact	Public Acceptance	Public concerns expected	Moderate public concerns anticipated	Minor public concerns anticipated	No public response or positive public response anticipated
	Impact to Businesses	Permanent interruption to businesses with no mitigation	Permanent interruption with mitigation strategy	Temporary interruption with mitigation strategy	No interruption
	Quality of life after construction	Significant adverse impact on use of parks or public spaces for more than 6 months	Significant adverse impact on use of parks or public spaces for less than 6 months	Minor adverse impacts on parks or public spaces for less than 6 months	Negligible or no adverse impacts on use of parks or public spaces

JOSO Drainage Basin-In-Water CSO Storage Tank and Route Flow to Adams Street WWTP

Category	Criteria	1	2	3	4
CSO Reduction	CSO Volume Reduction	Greater than 4 overflows per year	-	-	Maximum of 4 overflows per year
	Bacteria Reduction	Alternative does not eliminate or reduce bacteria discharges at outfall	-	Alternative results in reduction of bacteria discharges at outfall	Alternative eliminates bacteria discharges at outfall
	Water Quality Benefits	Will not meet water quality standards in the Hudson River	-	Will meet water quality standards in Hudson River with hel	Will meet water quality standards in the Hudson River standing alone
	Support designated uses in Hudson River (Secondary conta	Will not attribute to improved water quality to support designated uses of the Hudson River	Will attribute to improved water quality to support partial	Will attribute to improved water quality to support partial	Will support all designated uses of the Hudson River standing alone
Feasibility	Availability of validation on main technology for the alternative	Scientific basis largely unproven/untested	Limited data provided, but technology claims cannot be corroborated using conventional scientific/engineering principles	Significant data to corroborate technology claims available but lacks consensus of the scientific community	Uses well known and accepted scientific principles or the Authority already uses technology with success
	Flexibility of the alternative to be adjusted or optimized with future changing flows	Alternative cannot be adjusted after initial implementation	Alternative can be adjusted with significant additional construction/cost in conjunction with adjustment to related alternative	Alternative can be adjusted with significant additional construction/cost	Alternative can be altered without significant additional construction/cost
	Flexibility of the alternative to provide effective operation under variety of operating conditions.	Need for supplemental steps in the operation process – compatibility with disinfection process.	-	-	Limited number of steps in the storage process. Effective performance under a variety of operating conditions. Tolerance of the alternative to variable loading conditions (flow, pollutant load) and compatibility with influent.
	Anticipated Operations from the Authority's personnel	Capabilities and/or staff resources are not readily available and require hiring	Capabilities and/or staff partially available and require training. Some hiring may be required.	Capabilities can be accomplished with existing staff, with additional training	No additional hires/training required
	Reliability	Alternative struggles with intermittent operation. Lack of performance history in application.	-	Alternative provides marignal performance while operating intermittently. Ability to operate after long idle periods.	Alternative provides consistent performance while operating intermittently. Ability to operate after long idle periods.
Regulatory Compliance	Anticipated effects on project timeline through coordination with other agencies or the Authority's projects	High probability of project delay of one year or greater	Moderate potential for project delay	Minor probability or project delay of one year or greater	No anticipated cause for delay of this project or other projects
	Anticipated lead time for permitting	Permit lead time > 6 months	-	-	Permit lead time < 6 months
	Requirement of USACOE Permit	USACOE permit required for construction	-	-	USACOE permit not required for construction
	Requirement of NJPDES Permit	Requires a new NJPDES permit	-	Requires revision of an existing NJPDES Permit	New NJPDES permit or revisions to existing NJPDES permit not required
Location Constraints	Anticipated Land Acquisition	Permanent acquisition of publicly or privately owned land with owner known to be strongly resistant	Temporary acquisition of land for construction purposes where owner is known to be strongly resistant	Temporary acquisition of land for construction where owner is known to be compliant	Sufficient access is likely available at low cost and resistance, or land is already owned by the Authority
	Anticipated Traffic Impacts	Significant adverse impacts on primary road	Significant adverse impacts on secondary road	Minor adverse impacts lasting more than 6 months on smaller road	Minor adverse impacts lasting less than 6 months
	Compatibility with Existing Infrastructure	Requires utility relocating for 1000 feet or counteracts previous investment	Requires utility relocating for less than 1000 feet	Localized/minor consequences-Utility relocation at spot locations	No impact/positive impact
	Anticipated Noise and Odor Impacts	Noise and odor impacts are significant or unable to be measured or mitigated	Noise and odor impacts are significant but are able to be mitigated with additional services	Noise and Odor Impacts are minor but able to be mitigated with additional services	Noise and Odor impacts are minimal or non-existent
	Physical Characteristics	Size or footprint of the alternative will significantly impact surrounding area	Size or footprint of the alternative will significantly impact surrounding area but can be mitigated	-	Size or footprint of the alternative will not impact surrounding areas
Cost	Capital (Includes New Equipment, staffing during and after wet weather events, and Design Costs and Present Worth)	Greater than $80,000,000	$50,000,000-$80,000,000	$20,000,000-$50,000,000	Less than $20,000,000
	Operations and Maintenance (Includes chemicals, labor to maintain equipment, power cost and need for staffing during and after wet weather events.	Greater than $200,000	$100,000-$200,000	$75,000-$100,000	Less than $75,000
Community Impact	Public Acceptance	Public concerns expected	Moderate public concerns anticipated	Minor public concerns anticipated	No public response or positive public response anticipated
	Impact to Businesses	Permanent interruption to businesses with no mitigation	Permanent interruption with mitigation strategy	Temporary interruption with mitigation strategy	No interruption
	Quality of life after construction	Significant adverse impact on use of parks or public spaces for more than 6 months	Significant adverse impact on use of parks or public spaces for less than 6 months	Minor adverse impacts on parks or public spaces for less than 6 months	Negligible or no adverse impacts on use of parks or public spaces

JOSO Drainage Basin-Raise Regulator Weirs at UC1, UC2, and WNY2

Category	Criteria	1	2	3	4
CSO Reduction	CSO Volume Reduction	Greater than 4 overflows per year	-	-	Maximum of 4 overflows per year
	Bacteria Reduction	Alternative does not eliminate or reduce bacteria discharges at outfall	-	Alternative results in reduction of bacteria discharges at outfall	Alternative eliminates bacteria discharges at outfall
	Water Quality Benefits	Will not meet water quality standards in the Hudson River	-	Will meet water quality standards in Hudson River with hel	Will meet water quality standards in the Hudson River standing alone
	Support designated uses in Hudson River (Secondary conta	Will not attribute to improved water quality to support designated uses of the Hudson River	Will attribute to improved water quality to support partial	Will attribute to improved water quality to support partial	Will support all designated uses of the Hudson River standing alone
Feasibility	Availability of validation on main technology for the alternative	Scientific basis largely unproven/untested	Limited data provided, but technology claims cannot be corroborated using conventional scientific/engineering principles	Significant data to corroborate technology claims available but lacks consensus of the scientific community	Uses well known and accepted scientific principles or the Authority already uses technology with success
	Flexibility of the alternative to be adjusted or optimized with future changing flows	Alternative cannot be adjusted after initial implementation	Alternative can be adjusted with significant additional construction/cost in conjunction with adjustment to related alternative	Alternative can be adjusted with significant additional construction/cost	Alternative can be altered without significant additional construction/cost
	Flexibility of the alternative to provide effective operation under variety of operating conditions.	Need for supplemental steps in the operation process – compatibility with disinfection process.	-	-	Limited number of steps in the storage process. Effective performance under a variety of operating conditions. Tolerance of the alternative to variable loading conditions (flow, pollutant load) and compatibility with influent.
	Anticipated Operations from the Authority's personnel	Capabilities and/or staff resources are not readily available and require hiring	Capabilities and/or staff partially available and require training. Some hiring may be required.	Capabilities can be accomplished with existing staff, with additional training	No additional hires/training required
	Reliability	Alternative struggles with intermittent operation. Lack of performance history in application.	-	Alternative provides marignal performance while operating intermittently. Ability to operate after long idle periods.	Alternative provides consistent performance while operating intermittently. Ability to operate after long idle periods.
Regulatory Compliance	Anticipated effects on project timeline through coordination with other agencies or the Authority's projects	High probability of project delay of one year or greater	Moderate potential for project delay	Minor probability or project delay of one year or greater	No anticipated cause for delay of this project or other projects
	Anticipated lead time for permitting	Permit lead time > 6 months	-	-	Permit lead time < 6 months
	Requirement of USACOE Permit	USACOE permit required for construction	-	-	USACOE permit not required for construction
	Requirement of NJPDES Permit	Requires a new NJPDES permit	-	Requires revision of an existing NJPDES Permit	New NJPDES permit or revisions to existing NJPDES permit not required
Location Constraints	Anticipated Land Acquisition	Permanent acquisition of publicly or privately owned land with owner known to be strongly resistant	Temporary acquisition of land for construction purposes where owner is known to be strongly resistant	Temporary acquisition of land for construction where owner is known to be compliant	Sufficient access is likely available at low cost and resistance, or land is already owned by the Authority
	Anticipated Traffic Impacts	Significant adverse impacts on primary road	Significant adverse impacts on secondary road	Minor adverse impacts lasting more than 6 months on smaller road	Minor adverse impacts lasting less than 6 months
	Compatibility with Existing Infrastructure	Requires utility relocating for 1000 feet or counteracts previous investment	Requires utility relocating for less than 1000 feet	Localized/minor consequences-Utility relocation at spot locations	No impact/positive impact
	Anticipated Noise and Odor Impacts	Noise and odor impacts are significant or unable to be measured or mitigated	Noise and odor impacts are significant but are able to be mitigated with additional services	Noise and Odor Impacts are minor but able to be mitigated with additional services	Noise and Odor impacts are minimal or non-existent
	Physical Characteristics	Size or footprint of the alternative will significantly impact surrounding area	Size or footprint of the alternative will significantly impact surrounding area but can be mitigated	-	Size or footprint of the alternative will not impact surrounding areas
Cost	Capital (Includes New Equipment, staffing during and after wet weather events, and Design Costs and Present Worth)	Greater than $80,000,000	$50,000,000-$80,000,000	$20,000,000-$50,000,000	Less than $20,000,000
	Operations and Maintenance (Includes chemicals, labor to maintain equipment, power cost and need for staffing during and after wet weather events.	Greater than $200,000	$100,000-$200,000	$75,000-$100,000	Less than $75,000
Community Impact	Public Acceptance	Public concerns expected	Moderate public concerns anticipated	Minor public concerns anticipated	No public response or positive public response anticipated
	Impact to Businesses	Permanent interruption to businesses with no mitigation	Permanent interruption with mitigation strategy	Temporary interruption with mitigation strategy	No interruption
	Quality of life after construction	Significant adverse impact on use of parks or public spaces for more than 6 months	Significant adverse impact on use of parks or public spaces for less than 6 months	Minor adverse impacts on parks or public spaces for less than 6 months	Negligible or no adverse impacts on use of parks or public spaces

WNY1 Drainage Basin-Storage Tunnel

Category	Criteria	1	2	3	4
CSO Reduction	CSO Volume Reduction	Greater than 4 overflows per year	-	-	Maximum of 4 overflows per year
	Bacteria Reduction	Alternative does not eliminate or reduce bacteria discharges at outfall	-	Alternative results in reduction of bacteria discharges at outfall	Alternative eliminates bacteria discharges at outfall
	Water Quality Benefits	Will not meet water quality standards in the Hudson River	-	Will meet water quality standards in Hudson River with hel	Will meet water quality standards in the Hudson River standing alone
	Support designated uses in Hudson River (Secondary conta	Will not attribute to improved water quality to support designated uses of the Hudson River	Will attribute to improved water quality to support partial	Will attribute to improved water quality to support partial	Will support all designated uses of the Hudson River standing alone
Feasibility	Availability of validation on main technology for the alternative	Scientific basis largely unproven/untested	Limited data provided, but technology claims cannot be corroborated using conventional scientific/engineering principles	Significant data to corroborate technology claims available but lacks consensus of the scientific community	Uses well known and accepted scientific principles or the Authority already uses technology with success
	Flexibility of the alternative to be adjusted or optimized with future changing flows	Alternative cannot be adjusted after initial implementation	Alternative can be adjusted with significant additional construction/cost in conjunction with adjustment to related alternative	Alternative can be adjusted with significant additional construction/cost	Alternative can be altered without significant additional construction/cost
	Flexibility of the alternative to provide effective operation under variety of operating conditions.	Need for supplemental steps in the operation process – compatibility with disinfection process.	-	-	Limited number of steps in the storage process. Effective performance under a variety of operating conditions. Tolerance of the alternative to variable loading conditions (flow, pollutant load) and compatibility with influent.
	Anticipated Operations from the Authority's personnel	Capabilities and/or staff resources are not readily available and require hiring	Capabilities and/or staff partially available and require training. Some hiring may be required.	Capabilities can be accomplished with existing staff, with additional training	No additional hires/training required
	Reliability	Alternative struggles with intermittent operation. Lack of performance history in application.	-	-	Alternative provides consistent performance while operating intermittently. Ability to operate after long idle periods.
egulatory Complian	Anticipated effects on project timeline through coordination with other agencies or the Authority's projects	High probability of project delay of one year or greater	Moderate potential for project delay	Minor probability or project delay of one year or greater	No anticipated cause for delay of this project or other projects
	Anticipated lead time for permitting	Permit lead time > 6 months	-	-	Permit lead time < 6 months
	Requirement of USACOE Permit	USACOE permit required for construction	-	-	USACOE permit not required for construction
	Requirement of NJPDES Permit	Requires a new NJPDES permit	-	Requires revision of an existing NJPDES Permit	New NJPDES permit or revisions to existing NJPDES permit not required
Location Constraints	Anticipated Land Acquisition	Permanent acquisition of publicly or privately owned land with owner known to be strongly resistant	Temporary acquisition of land for construction purposes where owner is known to be strongly resistant	Temporary acquisition of land for construction where owner is known to be compliant	Sufficient access is likely available at low cost and resistance, or land is already owned by the Authority
	Anticipated Traffic Impacts	Significant adverse impacts on primary road	Significant adverse impacts on secondary road	Minor adverse impacts lasting more than 6 months on smaller road	Minor adverse impacts lasting less than 6 months
	Compatibility with Existing Infrastructure	Requires utility relocating for 1000 feet or counteracts previous investment	Requires utility relocating for less than 1000 feet	Localized/minor consequences-Utility relocation at spot locations	No impact/positive impact
	Anticipated Noise and Odor Impacts	Noise and odor impacts are significant or unable to be measured or mitigated	Noise and odor impacts are significant but are able to be mitigated with additional services	Noise and Odor Impacts are minor but able to be mitigated with additional services	Noise and Odor impacts are minimal or non-existent
	Physical Characteristics	Size or footprint of the alternative will significantly impact surrounding area	Size or footprint of the alternative will significantly impact surrounding area but can be mitigated	-	Size or footprint of the alternative will not impact surrounding areas
Cost	Capital (Includes New Equipment, staffing during and after wet weather events, and Design Costs and Present Worth)	Greater than $80,000,000	$50,000,000-$80,000,000	$20,000,000-$50,000,000	Less than $20,000,000
	Operations and Maintenance (Includes chemicals, labor to maintain equipment, power cost and need for staffing during and after wet weather events.	Greater than $200,000	$100,000-$200,000	$75,000-$100,000	Less than $75,000
Community Impact	Public Acceptance	Public concerns expected	Moderate public concerns anticipated	Minor public concerns anticipated	No public response or positive public response anticipated
	Impact to Businesses	Permanent interruption to businesses with no mitigation	Permanent interruption with mitigation strategy	Temporary interruption with mitigation strategy	No interruption
	Quality of life after construction	Significant adverse impact on use of parks or public spaces for more than 6 months	Significant adverse impact on use of parks or public spaces for less than 6 months	Minor adverse impacts on parks or public spaces for less than 6 months	Negligible or no adverse impacts on use of parks or public spaces

WNY1 Drainage Basin-In-Water CSO Storage Tank

Category	Criteria	1	2	3	4
CSO Reduction	CSO Volume Reduction	Greater than 4 overflows per year	-	-	Maximum of 4 overflows per year
	Bacteria Reduction	Alternative does not eliminate or reduce bacteria discharges at outfall	-	Alternative results in reduction of bacteria discharges at outfall	Alternative eliminates bacteria discharges at outfall
	Water Quality Benefits	Will not meet water quality standards in the Hudson River	-	Will meet water quality standards in Hudson River with hel	Will meet water quality standards in the Hudson River standing alone
	Support designated uses in Hudson River (Secondary conta	Will not attribute to improved water quality to support designated uses of the Hudson River	Will attribute to improved water quality to support partial	Will attribute to improved water quality to support partial	Will support all designated uses of the Hudson River standing alone
Feasibility	Availability of validation on main technology for the alternative	Scientific basis largely unproven/untested	Limited data provided, but technology claims cannot be corroborated using conventional scientific/engineering principles	Significant data to corroborate technology claims available but lacks consensus of the scientific community	Uses well known and accepted scientific principles or the Authority already uses technology with success
	Flexibility of the alternative to be adjusted or optimized with future changing flows	Alternative cannot be adjusted after initial implementation	Alternative can be adjusted with significant additional construction/cost in conjunction with adjustment to related alternative	Alternative can be adjusted with significant additional construction/cost	Alternative can be altered without significant additional construction/cost
	Flexibility of the alternative to provide effective operation under variety of operating conditions.	Need for supplemental steps in the operation process – compatibility with disinfection process.	-	-	Limited number of steps in the storage process. Effective performance under a variety of operating conditions. Tolerance of the alternative to variable loading conditions (flow, pollutant load) and compatibility with influent.
	Anticipated Operations from the Authority's personnel	Capabilities and/or staff resources are not readily available and require hiring	Capabilities and/or staff partially available and require training. Some hiring may be required.	Capabilities can be accomplished with existing staff, with additional training	No additional hires/training required
	Reliability	Alternative struggles with intermittent operation. Lack of performance history in application.	-	Alternative provides marginal performance while operating intermittently. Ability to operate after long idle periods.	Alternative provides consistent performance while operating intermittently. Ability to operate after long idle periods.
Regulatory Compliance	Anticipated effects on project timeline through coordination with other agencies or the Authority's projects	High probability of project delay of one year or greater	Moderate potential for project delay	Minor probability or project delay of one year or greater	No anticipated cause for delay of this project or other projects
	Anticipated lead time for permitting	Permit lead time > 6 months	-	-	Permit lead time < 6 months
	Requirement of USACOE Permit	USACOE permit required for construction	-	-	USACOE permit not required for construction
	Requirement of NJPDES Permit	Requires a new NJPDES permit	-	Requires revision of an existing NJPDES Permit	New NJPDES permit or revisions to existing NJPDES permit not required
Location Constraints	Anticipated Land Acquisition	Permanent acquisition of publicly or privately owned land with owner known to be strongly resistant	Temporary acquisition of land for construction purposes where owner is known to be strongly resistant	Temporary acquisition of land for construction where owner is known to be compliant	Sufficient access is likely available at low cost and resistance, or land is already owned by the Authority
	Anticipated Traffic Impacts	Significant adverse impacts on primary road	Significant adverse impacts on secondary road	Minor adverse impacts lasting more than 6 months on smaller road	Minor adverse impacts lasting less than 6 months
	Compatibility with Existing Infrastructure	Requires utility relocating for 1000 feet or counteracts previous investment	Requires utility relocating for less than 1000 feet	Localized/minor consequences-Utility relocation at spot locations	No impact/positive impact
	Anticipated Noise and Odor Impacts	Noise and odor impacts are significant or unable to be measured or mitigated	Noise and odor impacts are significant but are able to be mitigated with additional services	Noise and Odor Impacts are minor but able to be mitigated with additional services	Noise and Odor impacts are minimal or non-existent
	Physical Characteristics	Size or footprint of the alternative will significantly impact surrounding area	Size or footprint of the alternative will significantly impact surrounding area but can be mitigated	-	Size or footprint of the alternative will not impact surrounding areas
Cost	Capital (Includes New Equipment, staffing during and after wet weather events, and Design Costs and Present Worth)	Greater than $80,000,000	$50,000,000-$80,000,000	$20,000,000-$50,000,000	Less than $20,000,000
	Operations and Maintenance (Includes chemicals, labor to maintain equipment, power cost and need for staffing during and after wet weather events.	Greater than $200,000	$100,000-$200,000	$75,000-$100,000	Less than $75,000
Community Impact	Public Acceptance	Public concerns expected	Moderate public concerns anticipated	Minor public concerns anticipated	No public response or positive public response anticipated
	Impact to Businesses	Permanent interruption to businesses with no mitigation	Permanent interruption with mitigation strategy	Temporary interruption with mitigation strategy	No interruption
	Quality of life after construction	Significant adverse impact on use of parks or public spaces for more than 6 months	Significant adverse impact on use of parks or public spaces for less than 6 months	Minor adverse impacts on parks or public spaces for less than 6 months	Negligible or no adverse impacts on use of parks or public spaces

Category	Criteria	1	2	3	4
CSO Reduction	Bacteria Reduction	Alternative does not eliminate or reduce bacteria discharges of effluent	-	Alternative results in reduction of bacteria discharges of effluent	Alternative eliminates bacteria discharges of effluent
	Water Quality Benefits	Will not meet water quality standards in the Hudson River	-	Will meet water quality standards in the Hudson River with help of another alternative	Will meet water quality standards in the Hudson River standing alone
	Support designated uses in Hudson River (Secondary contact recreation and fishing)	Will not attribute to improved water quality to support designated uses of the Hudson River	Will attribute to improved water quality to support partial designated uses of the Hudson River	Will attribute to improved water quality to support partial designated uses of Hudson River with help of another alternative	Will support all designated uses of the Hudson River standing alone
Feasibility	Availability of validation on main technology for the alternative	Scientific basis largely unproven/untested	Limited data provided, but technology claims cannot be corroborated using conventional scientific/engineering principles	Significant data to corroborate technology claims available but lacks consensus of the scientific community	Uses well known and accepted scientific principles or the Authority already uses technology with success
	Flexibility of alternative to be adjusted or optimized with future changing flows	Alternative cannot be adjusted after initial implementation	Alternative can be adjusted with significant additional construction/cost in conjunction with adjustment to related alternative	Alternative can be adjusted with significant additional construction/cost	Alternative can be altered without significant additional construction/cost
	Flexibility of the alternative to provide effective treatment under variety of operating conditions.	Need for supplemental steps in the treatment process – compatibility with disinfection process.	-	-	Limited number of steps in the treatment process. Effective performance under a variety of operating conditions. Tolerance of the alternative to variable loading conditions (flow, pollutant load) and compatibility with influent.
	Anticipated Operations from the Authority's personnel	Capabilities and/or staff resources are not readily available and require hiring	Capabilities and/or staff partially available and require training. Some hiring may be required.	Capabilities can be accomplished with existing staff, with additional training	No additional hires/training required
	Reliability	Alternative struggles with intermittent operation. Relies on chemicals that are subject to degradation. Lack of performance history in application.	-	-	Alternative provides consistent performance while operating intermittently. Ability to operate after long idle periods.
Regulatory Compliance	Anticipated effects on project timeline through coordination with other agencies or the Authority's projects	High probability of project delay of one year or greater from interaction with agency	Moderate potential for project delay	Minor probability or project delay of one year or greater	No anticipated cause for delay of this project or other projects
	Anticipated lead time for permitting	Permit lead time > 6 months	-	-	Permit lead time < 6 months
	Requirement of USACOE Permit	USACOE permit required for construction	-	-	USACOE permit not required for construction
	Requirement of NJPDES Permit	Requires a new NJPDES permit	-	Requires revision of an existing NJPDES Permit	New NJPDES permit or revisions to existing NJPDES permit not required
Location Constraints	Anticipated Land Acquisition	Permanent acquisition of publicly or privately owned land with owner known to be strongly resistant	Temporary acquisition of land for construction purposes where owner is known to be strongly resistant	Temporary acquisition of land for construction where owner is known to be compliant	Sufficient access is likely available at low cost and resistance, or land is already owned by the Authority
	Anticipated Traffic Impacts	Significant adverse impacts on primary road	Significant adverse impacts on secondary road	Minor adverse impacts lasting more than 6 months on smaller road	Minor adverse impacts lasting less than 6 months
	Compatibility with Existing Infrastructure	Requires utility relocating for 1000 feet or counteracts previous investment	Requires utility relocating for less than 1000 feet	Localized/minor consequences-Utility relocation at spot locations	No impact/positive impact
	Anticipated Noise and Odor Impacts	Noise and odor impacts are significant or unable to be measured or mitigated	Noise and odor impacts are significant but are able to be mitigated with additional services	Noise and Odor Impacts are minor but able to be mitigated with additional services	Noise and Odor impacts are minimal or non-existent
	Physical Characteristics	Size or footprint of the alternative will significantly impact surrounding area	Size or footprint of the alternative will significantly impact surrounding area but can be mitigated	-	Size or footprint of the alternative will not impact surrounding areas
Cost	Capital (Includes New Equipment, staffing during and after wet weather events, and Design Costs and Present Worth)	Greater than $80,000,000	$50,000,000-$80,000,000	$20,000,000-$50,000,000	Less than $20,000,000
	Operations and Maintenance (Includes chemicals, labor to maintain equipment, power cost and need for staffing during and after wet weather events.	Greater than $200,000	$100,000-$200,000	$75,000-$100,000	Less than $75,000
Community Impact	Public Acceptance	Public concerns expected	Moderate public concerns anticipated	Minor public concerns anticipated	No public response anticipated
	Impact to Businesses	Permanent interruption to businesses with no mitigation	Permanent interruption with mitigation strategy	Temporary interruption with mitigation strategy	No interruption
	Quality of life after construction	Significant adverse impact on use of parks or public spaces for more than 6 months	Significant adverse impact on use of parks or public spaces for less than 6 months	Minor adverse impacts on parks or public spaces for less than 6 months	Negligible or no adverse impacts on use of parks or public spaces

River Road WWTP-ActiFlo

Category	Criteria	1	2	3	4
CSO Reduction	Bacteria Reduction	Alternative does not eliminate or reduce bacteria discharges of effluent	-	Alternative results in reduction of bacteria discharges of effluent	Alternative eliminates bacteria discharges of effluent
	Water Quality Benefits	Will not meet water quality standards in the Hudson River	-	Will meet water quality standards in the Hudson River with help of another alternative	Will meet water quality standards in the Hudson River standing alone
	Support designated uses in Hudson River (Secondary contact recreation and fishing)	Will not attribute to improved water quality to support designated uses of the Hudson River	Will attribute to improved water quality to support partial designated uses of the Hudson River	Will attribute to improved water quality to support partial designated uses of Hudson River with help of another alternative	Will support all designated uses of the Hudson River standing alone
Feasibility	Availability of validation on main technology for the alternative	Scientific basis largely unproven/untested	Limited data provided, but technology claims cannot be corroborated using conventional scientific/engineering principles	Significant data to corroborate technology claims available but lacks consensus of the scientific community	Uses well known and accepted scientific principles or the Authority already uses technology with success
	Flexibility of alternative to be adjusted or optimized with future changing flows	Alternative cannot be adjusted after initial implementation	Alternative can be adjusted with significant additional construction/cost in conjunction with adjustment to related alternative	Alternative can be adjusted with significant additional construction/cost	Alternative can be altered without significant additional construction/cost
	Flexibility of the alternative to provide effective treatment under variety of operating conditions.	Need for supplemental steps in the treatment process – compatibility with disinfection process.	-	-	Limited number of steps in the treatment process. Effective performance under a variety of operating conditions. Tolerance of the alternative to variable loading conditions (flow, pollutant load) and compatibility with influent.
	Anticipated Operations from the Authority's personnel	Capabilities and/or staff resources are not readily available and require hiring	Capabilities and/or staff partially available and require training. Some hiring may be required.	Capabilities can be accomplished with existing staff, with additional training	No additional hires/training required
	Reliability	Alternative struggles with intermittent operation. Relies on chemicals that are subject to degradation. Lack of performance history in application.	-	-	Alternative provides consistent performance while operating intermittently. Ability to operate after long idle periods.
Regulatory Compliance	Anticipated effects on project timeline through coordination with other agencies or the Authority's projects	High probability of project delay of one year or greater from interaction with agency	Moderate potential for project delay	Minor probability or project delay of one year or greater	No anticipated cause for delay of this project or other projects
	Anticipated lead time for permitting	Permit lead time > 6 months	-	-	Permit lead time < 6 months
	Requirement of USACOE Permit	USACOE permit required for construction	-	-	USACOE permit not required for construction
	Requirement of NJPDES Permit	Requires a new NJPDES permit	-	Requires revision of an existing NJPDES Permit	New NJPDES permit or revisions to existing NJPDES permit not required
Location Constraints	Anticipated Land Acquisition	Permanent acquisition of publicly or privately owned land with owner known to be strongly resistant	Temporary acquisition of land for construction purposes where owner is known to be strongly resistant	Temporary acquisition of land for construction where owner is known to be compliant	Sufficient access is likely available at low cost and resistance, or land is already owned by the Authority
	Anticipated Traffic Impacts	Significant adverse impacts on primary road	Significant adverse impacts on secondary road	Minor adverse impacts lasting more than 6 months on smaller road	Minor adverse impacts lasting less than 6 months
	Compatibility with Existing Infrastructure	Requires utility relocating for 1000 feet or counteracts previous investment	Requires utility relocating for less than 1000 feet	Localized/minor consequences-Utility relocation at spot locations	No impact/positive impact
	Anticipated Noise and Odor Impacts	Noise and odor impacts are significant or unable to be measured or mitigated	Noise and odor impacts are significant but are able to be mitigated with additional services	Noise and Odor Impacts are minor but able to be mitigated with additional services	Noise and Odor impacts are minimal or non-existent
	Physical Characteristics	Size or footprint of the alternative will significantly impact surrounding area	Size or footprint of the alternative will significantly impact surrounding area but can be mitigated	-	Size or footprint of the alternative will not impact surrounding areas
Cost	Capital (Includes New Equipment, staffing during and after wet weather events, and Design Costs and Present Worth)	Greater than $80,000,000	$50,000,000-$80,000,000	$20,000,000-$50,000,000	Less than $20,000,000
	Operations and Maintenance (Includes chemicals, labor to maintain equipment, power cost and need for staffing during and after wet weather events.	Greater than $200,000	$100,000-$200,000	$75,000-$100,000	Less than $75,000
Community Impact	Public Acceptance	Public concerns expected	Moderate public concerns anticipated	Minor public concerns anticipated	No public response anticipated
	Impact to Businesses	Permanent interruption to businesses with no mitigation	Permanent interruption with mitigation strategy	Temporary interruption with mitigation strategy	No interruption
	Quality of life after construction	Significant adverse impact on use of parks or public spaces for more than 6 months	Significant adverse impact on use of parks or public spaces for less than 6 months	Minor adverse impacts on parks or public spaces for less than 6 months	Negligible or no adverse impacts on use of parks or public spaces

Category	Criteria	1	2	3	4
CSO Reduction	Bacteria Reduction	Alternative does not eliminate or reduce bacteria discharges of effluent	-	Alternative results in reduction of bacteria discharges of effluent	Alternative eliminates bacteria discharges of effluent
	Water Quality Benefits	Will not meet water quality standards in the Hudson River	-	Will meet water quality standards in the Hudson River with help of another alternative	Will meet water quality standards in the Hudson River standing alone
	Support designated uses in Hudson River (Secondary contact recreation and fishing)	Will not attribute to improved water quality to support designated uses of the Hudson River	Will attribute to improved water quality to support partial designated uses of the Hudson River	Will attribute to improved water quality to support partial designated uses of Hudson River with help of another alternative	Will support all designated uses of the Hudson River standing alone
Feasibility	Availability of validation on main technology for the alternative	Scientific basis largely unproven/untested	Limited data provided, but technology claims cannot be corroborated using conventional scientific/engineering principles	Significant data to corroborate technology claims available but lacks consensus of the scientific community	Uses well known and accepted scientific principles or the Authority already uses technology with success
	Flexibility of alternative to be adjusted or optimized with future changing flows	Alternative cannot be adjusted after initial implementation	Alternative can be adjusted with significant additional construction/cost in conjunction with adjustment to related alternative	Alternative can be adjusted with significant additional construction/cost	Alternative can be altered without significant additional construction/cost
	Flexibility of the alternative to provide effective treatment under variety of operating conditions.	Need for supplemental steps in the treatment process – compatibility with disinfection process.	-	-	Limited number of steps in the treatment process. Effective performance under a variety of operating conditions. Tolerance of the alternative to variable loading conditions (flow, pollutant load) and compatibility with influent.
	Anticipated Operations from the Authority's personnel	Capabilities and/or staff resources are not readily available and require hiring	Capabilities and/or staff partially available and require training. Some hiring may be required.	Capabilities can be accomplished with existing staff, with additional training	No additional hires/training required
	Reliability	Alternative struggles with intermittent operation. Relies on chemicals that are subject to degradation. Lack of performance history in application.	-	-	Alternative provides consistent performance while operating intermittently. Ability to operate after long idle periods.
Regulatory Compliance	Anticipated effects on project timeline through coordination with other agencies or the Authority's projects	High probability of project delay of one year or greater from interaction with agency	Moderate potential for project delay	Minor probability or project delay of one year or greater	No anticipated cause for delay of this project or other projects
	Anticipated lead time for permitting	Permit lead time > 6 months	-	-	Permit lead time < 6 months
	Requirement of USACOE Permit	USACOE permit required for construction	-	-	USACOE permit not required for construction
	Requirement of NJPDES Permit	Requires a new NJPDES permit	-	Requires revision of an existing NJPDES Permit	New NJPDES permit or revisions to existing NJPDES permit not required
Location Constraints	Anticipated Land Acquisition	Permanent acquisition of publicly or privately owned land with owner known to be strongly resistant	Temporary acquisition of land for construction purposes where owner is known to be strongly resistant	Temporary acquisition of land for construction where owner is known to be compliant	Sufficient access is likely available at low cost and resistance, or land is already owned by the Authority
	Anticipated Traffic Impacts	Significant adverse impacts on primary road	Significant adverse impacts on secondary road	Minor adverse impacts lasting more than 6 months on smaller road	Minor adverse impacts lasting less than 6 months
	Compatibility with Existing Infrastructure	Requires utility relocating for 1000 feet or counteracts previous investment	Requires utility relocating for less than 1000 feet	Localized/minor consequences-Utility relocation at spot locations	No impact/positive impact
	Anticipated Noise and Odor Impacts	Noise and odor impacts are significant or unable to be measured or mitigated	Noise and odor impacts are significant but are able to be mitigated with additional services	Noise and Odor Impacts are minor but able to be mitigated with additional services	Noise and Odor impacts are minimal or non-existent
	Physical Characteristics	Size or footprint of the alternative will significantly impact surrounding area	Size or footprint of the alternative will significantly impact surrounding area but can be mitigated	-	Size or footprint of the alternative will not impact surrounding areas
Cost	Capital (Includes New Equipment, staffing during and after wet weather events, and Design Costs and Present Worth)	Greater than $80,000,000	$50,000,000-$80,000,000	$20,000,000-$50,000,000	Less than $20,000,000
	Operations and Maintenance (Includes chemicals, labor to maintain equipment, power cost and need for staffing during and after wet weather events.	Greater than $200,000	$100,000-$200,000	$75,000-$100,000	Less than $75,000
Community Impact	Public Acceptance	Public concerns expected	Moderate public concerns anticipated	Minor public concerns anticipated	No public response anticipated
	Impact to Businesses	Permanent interruption to businesses with no mitigation	Permanent interruption with mitigation strategy	Temporary interruption with mitigation strategy	No interruption
	Quality of life after construction	Significant adverse impact on use of parks or public spaces for more than 6 months	Significant adverse impact on use of parks or public spaces for less than 6 months	Minor adverse impacts on parks or public spaces for less than 6 months	Negligible or no adverse impacts on use of parks or public spaces

River Road WWTP-FlexFilter CMF

Category	Criteria	1	2	3	4
CSO Reduction	Bacteria Reduction	Alternative does not eliminate or reduce bacteria discharges of effluent	-	Alternative results in reduction of bacteria discharges of effluent	Alternative eliminates bacteria discharges of effluent
	Water Quality Benefits	Will not meet water quality standards in the Hudson River	-	Will meet water quality standards in the Hudson River with help of another alternative	Will meet water quality standards in the Hudson River standing alone
	Support designated uses in Hudson River (Secondary contact recreation and fishing)	Will not attribute to improved water quality to support designated uses of the Hudson River	Will attribute to improved water quality to support partial designated uses of the Hudson River	Will attribute to improved water quality to support partial designated uses of Hudson River with help of another alternative	Will support all designated uses of the Hudson River standing alone
Feasibility	Availability of validation on main technology for the alternative	Scientific basis largely unproven/untested	Limited data provided, but technology claims cannot be corroborated using conventional scientific/engineering principles	Significant data to corroborate technology claims available but lacks consensus of the scientific community	Uses well known and accepted scientific principles or the Authority already uses technology with success
	Flexibility of alternative to be adjusted or optimized with future changing flows	Alternative cannot be adjusted after initial implementation	Alternative can be adjusted with significant additional construction/cost in conjunction with adjustment to related alternative	Alternative can be adjusted with significant additional construction/cost	Alternative can be altered without significant additional construction/cost
	Flexibility of the alternative to provide effective treatment under variety of operating conditions.	Need for supplemental steps in the treatment process – compatibility with disinfection process.	-	-	Limited number of steps in the treatment process. Effective performance under a variety of operating conditions. Tolerance of the alternative to variable loading conditions (flow, pollutant load) and compatibility with influent.
	Anticipated Operations from the Authority's personnel	Capabilities and/or staff resources are not readily available and require hiring	Capabilities and/or staff partially available and require training. Some hiring may be required.	Capabilities can be accomplished with existing staff, with additional training	No additional hires/training required
	Reliability	Alternative struggles with intermittent operation. Relies on chemicals that are subject to degradation. Lack of performance history in application.	-	-	Alternative provides consistent performance while operating intermittently. Ability to operate after long idle periods.
Regulatory Compliance	Anticipated effects on project timeline through coordination with other agencies or the Authority's projects	High probability of project delay of one year or greater from interaction with agency	Moderate potential for project delay	Minor probability or project delay of one year or greater	No anticipated cause for delay of this project or other projects
	Anticipated lead time for permitting	Permit lead time > 6 months	-	-	Permit lead time < 6 months
	Requirement of USACOE Permit	USACOE permit required for construction	-	-	USACOE permit not required for construction
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	Anticipated Traffic Impacts	Significant adverse impacts on primary road	Significant adverse impacts on secondary road	Minor adverse impacts lasting more than 6 months on smaller road	Minor adverse impacts lasting less than 6 months
	Compatibility with Existing Infrastructure	Requires utility relocating for 1000 feet or counteracts previous investment	Requires utility relocating for less than 1000 feet	Localized/minor consequences-Utility relocation at spot locations	No impact/positive impact
	Anticipated Noise and Odor Impacts	Noise and odor impacts are significant or unable to be measured or mitigated	Noise and odor impacts are significant but are able to be mitigated with additional services	Noise and Odor Impacts are minor but able to be mitigated with additional services	Noise and Odor impacts are minimal or non-existent
	Physical Characteristics	Size or footprint of the alternative will significantly impact surrounding area	Size or footprint of the alternative will significantly impact surrounding area but can be mitigated	-	Size or footprint of the alternative will not impact surrounding areas
Cost	Capital (Includes New Equipment, staffing during and after wet weather events, and Design Costs and Present Worth)	Greater than $80,000,000	$50,000,000-$80,000,000	$20,000,000-$50,000,000	Less than $20,000,000
	Operations and Maintenance (Includes chemicals, labor to maintain equipment, power cost and need for staffing during and after wet weather events.	Greater than $200,000	$100,000-$200,000	$75,000-$100,000	Less than $75,000
Community Impact	Public Acceptance	Public concerns expected	Moderate public concerns anticipated	Minor public concerns anticipated	No public response anticipated
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Appendix C
Alternatives Analysis Workshop Memorandum

WORKSHOP SUMMARY

CSO Alternatives Analysis Concept Workshop

DATE: June 14-15, 2018

ATTENDEES: See attached attendance roster

PREPARED BY: CH2M HILL

PROJECT: Long Term Control Plan

ISSUED: October 5, 2018

The North Hudson Sewerage Authority (the Authority or NHSA) is developing its combined sewer overflow (CSO) Long Term Control Plan (LTCP) to comply with its permits. The Authority held a CSO Alternatives Analysis Concept Workshop on June 14 and 15, 2018. The workshop served as a brainstorming session to identify strategies and alternatives for maximizing wastewater treatment and reducing CSOs in the NHSA systems. The output from the workshop will be used by the Authority to further develop and evaluate CSO control alternatives, culminating in preparation of LTCP Evaluation of Alternatives Reports. This document describes the purpose of this summary, conceptual discussions for reducing and/or eliminating Adams Street and River Road CSOs, and action items.

Purpose of this Workshop Summary

The purpose of this summary is to document the discussions at the Authority's CSO Alternatives Analysis Concept Workshop held on June 14 and 15, 2018. The first day of the workshop focused on the Adams Street WWTP system, and the second day focused on the River Road WWTP system. Sign in sheets showing those in attendance over both days are provided in Attachment 1. The agenda detailing the schedule for discussion on each day is provided in Attachment 2. Handouts from the workshop are provided as Attachment 3.

Adams Street CSOs

Adams Street - Brief Overview of WWTP system

The Adams Street WWTP system is a combined sewer system owned and operated by the Authority. A few private developments have separate systems within the area, but they are not operated by NHSA. The Authority's "Sewer Atlas", developed using GIS, shows sewers, regulators and facilities featured on maps. NHSA has been using the maps to keep an accurate record of all sewers. The entire GIS was updated in 2015 and is continually updated. The GIS was used as the basis of the updated hydraulic collection system model. Summaries of the modeled CSO activations and volumes for the typical year for each regulator are provided in the handouts in Attachment 3.

The typical year rainfall data referenced in the table and charts showing the CSO activation frequencies and volumes in Attachment 3 was obtained from the NJ CSO Group. The typical year is based on hourly rain volumes at Newark Airport in 2004. The InfoWorks ICM collection system hydraulic/hydrologic model was calibrated and validated to six months of flow monitoring data collected in 2016. The flow monitoring data was collected from flow monitors placed upstream of each regulator. The Authority also installed Mission sensors at the elevation of the weirs within each regulator. These sensors were connected to a cellular device to indicate that a CSO is activated when the water elevation in the sewer is greater than the height of the weir. The model does not include future projections for additional flows because the Authority considers the system to be built out and does not anticipate that redevelopment will significantly increase dry weather flows. The Authority's new connection requirements are proactive and minimize peak wet weather flows into the systems.

It was noted that in Hoboken, tidal impacts can prevent the regulators from opening at high tides. On the system schematics included in the handouts, the number of days of overflow exceeds the number of events, since overflows can sometimes occur over two or more days. It was noted that overflows typically do not correlate directly with higher flows at the WWTP but when flows rise at the WWTP, CSOs are likely occurring. When severe wet weather events and high tides occur simultaneously, CSOs are pumped to river to prevent street flooding. In general, the West New York regulators (in the River Road WWTP service area) are the first to activate, and Hoboken regulators are the last to activate. The regulators then stop activating from north to south. Regulators W1, W2, W3 and W4 are operated manually. All outfalls currently have solids/floatables (S/F) controls (except W1234 - under construction) with TideFlex valve tide gates. It was suggested to show overflow volumes by storm for each outfall to determine if there are patterns in system-wide overflows or if overflows occur at some outfalls but not others at threshold-sized events.

Flushing chambers were originally provided in the upstream reaches of several drainage basins in Hoboken. These flushing chambers provide hydraulic connections between adjacent drainage basins, but the flushing chambers are no longer used by the Authority. The Authority desires to eliminate these interconnections between the drainage basins. The interconnections are included in the InfoWorks model and are assumed to be open but can be removed when changes are made to the system. The Authority has been removing these chambers when opportunities arise. The Authority is developing a drainage plan for areas H1 through H5 (a CH2M HILL/Mott MacDonald project) that will likely address this issue. The project will also investigate improving dry weather flow conveyance with new booster pump stations. It was noted that small-diameter pipes embedded in the inverts of the combined sewers were originally intended to feed the flushing chambers. The potential to repurpose these pipes for enhanced conveyance was discussed.

A brief overview of the status of the Rebuild by Design-Hudson River project was discussed. Funds from the U.S. Department of Housing and Urban Development (HUD) were given to the New Jersey Department of Environmental Protection (NJDEP) for two projects in the Meadowlands and the Hudson River. The Hudson River project has the goal of increasing flood resilience for Hoboken and Weehawken. The ongoing design is to raise flood protection to the 100-year flood elevation by integrating natural topography with new permanent and mobile barriers. During a storm with surge, the barriers will be closed, and wet weather flow will be held in the collection system. The H1 and H5 wet weather pump stations are critical to pumping out the collection system under high tide or storm surge conditions, but those pump stations will not protect parts of the H5 and H7 drainage areas. Future planning for the LTCP needs to consider the impact of the resilience program and if possible, seek to leverage the improvements where they can be coordinated to compliment the flood barrier project. Although likely a minor contributor to wet weather flows, the Authority should include in its LTCP model scenarios with the removal of areas that will be drained by the new stormwater systems outside the barrier.

The Authority's ongoing H6/H7 CSO Project is planning and designing high level storm sewers and a pump station in the H7 area alongside Hoboken's Northwest Resiliency Park project, which will have a one million gallon (MG) stormwater tank designed by Hoboken. The tank will be located under the new park. The tank will be emptied by the pump station via a force main connected to the existing Adams Street WWTP outfall. Runoff from both buildings and the street will be diverted to the stormwater tank. Planning takes into consideration Hoboken's long-term redevelopment plans for northwest Hoboken as well as the Authority's progressive requirements for new connections that would be applied in the area to limit wet weather flows in the existing combined sewers and maximize flows in the new high-level storm sewers.

It was noted that no bathing areas are located along the shoreline, but boating is popular, and a boat club is located near outfall 006A.

The intended level of CSO control was discussed. In general, the target will be 4 OF/yr. The NJ CSO group will conduct water quality modeling. CSO control may not result in a big change in attainment of water quality standards (WQS). Current data show WQS are being attained. AECOM noted that Hudson River data collected by the New York City Department of Environmental Protection shows similar findings.

Adams Street System-wide Alternatives

Green Infrastructure
Green infrastructure (GI) implementation would involve coordinating with all city departments although the different municipalities have different interests in CSO controls including GI. Hoboken is proactive but has poor infiltration and high ground water. Hoboken has a GI plan that includes Southwest Park and other GI projects and initiatives. A porous pavement project is located within the Police parking lot. The Authority may want to incorporate and quantify what Hoboken is doing into its LTCP now. But the Authority would need to coordinate with City and its various departments to determine what each will be doing and when. The Authority is constructing three GI projects in the other cities on its own. An overview of these projects is provided in Attachment 3.

GI projects done by others could be included as part of the NHSA LTCP, but the projects would have to be put into the LTCP implementation schedule and the expected performance would have to be established. If the Authority includes GI projects done by others in the LTCP, the Authority would have to partner with others on these installations to assure implementation and continual long-term operation that ensures the intended performance. This may be difficult as the technologies would need to be maintained and kept in service. One municipal administration may agree but the next may not, and instead limit/stop maintenance and/or remove a swale or porous pavement.

The Authority worked with Hoboken to implement GI at Southwest Park located in drainage area H1. The site includes the use of bioswales, rain gardens and permeable pavers. In addition, the site utilizes OPTI technology that involves automated valves with cloud-based technology to hold 70,000 gallons of runoff in storage and release it into the combined sewer system after a storm has passed. The Authority is implementing this technology at several other locations that are in planning and design stages in cooperation with developers. This is a combination of green/gray infrastructure. Because of this, agencies are viewing OPTI as more of a storage opportunity since operators/software monitor and control flows. In general, the OPTI technology allows for capture of stormwater from smaller storms that would otherwise pass through the orifices on stormwater tanks. The use of the OPTI technology may provide a factor of safety in the performance of the recommended CSO control plan.

The Authority requires a sewer connection application and significant stormwater attenuation for each sewer connection applicant. Grey infrastructure is common, however in some cases the owner looks for alternative solutions such as GI. The Authority offers credits for GI and has worked with applicants to promote green roof systems when there are challenges to installing conventional grey infrastructure. The Authority is incorporating all GI sites into the development review database to track all new developments with GI features and ensure GI maintenance. The owner is responsible for maintaining onsite GI. The Authority also noted that an inspection program for all stormwater management systems (gray and green) was recently approved by three of the four municipalities, and it is now being implemented.

The discussion noted how GI could be incorporated into the InfoWorks model. It was suggested that the model can be run with multiple control scenarios – 100% grey, 90% grey/10% green, 80% grey/20% green, etc.

Incorporating GI on private property was noted as an alternative to incorporating more GI in public spaces. Two concepts were identified for this approach: official projects are completed as part of stormwater management rules, and initiatives to have the community voluntarily contribute to stormwater control. This is a challenge for NHSA currently because opportunities are limited, and it is anticipated that developers will be the prime decision makers for applying GI. The developers will tend to look at GI in terms of cost-benefit for themselves, and their decisions will not necessarily be aligned with the Authority's LTCP goals. Individual homeowner GI initiatives with incentives may be a possible strategy to reduce wet weather flows. Agreements would be required to ensure perpetual maintenance of the GI on private property and this could be a hinderance. One suggestion was developing a menu of projects and selecting the project that captures the largest volume. Involving developers in this stage with the ability to quantify reductions in wet weather flows may be beneficial to the LTCP. This may entice developers to reduce flows and achieve LEED certifications.

It would make sense to use the model to conduct sensitivity runs of the impact of private GI on CSO volumes. If the impact on CSO volumes is minimal, it would not likely be worth the risk to commit to a level of private GI implementation.

Although the City of Hoboken is implementing various GI improvements as per its plan, the overall impact on reductions in CSO activations and volumes has yet to be quantified. A representative of AECOM indicated that in other cities, GI generally does not have a major impact on CSO volumes, perhaps on the order of 5% reduction in volume. GI may not be cost effective in terms of CSO reduction, but GI does have other community benefits that could be considered in a triple-bottom-line evaluation. NJDEP representatives noted that Rutgers did a GI study for Newark and it revealed only a minor CSO reduction if GI was implemented city-wide in all potential areas.

It was noted that the LTCP needs to be flexible to enable NHSA to make changes over time as new technologies may be introduced. An example cited was D.C. Water, George Hawkins, who has noted in presentations that when GI concepts were introduced, original grey infrastructure plans (such as tunnels) were subsequently modified to reflect reduction in the need for grey infrastructure. NJDEP indicated that the LTCP would be integrated into the NJPDES in 5-year increments aligned with milestones in the LTCP, which would provide for future flexibility.

Grey I/I Reduction

An effective approach to reduce infiltration and inflow (I/I) may be to build new stormwater systems to reduce flows in the combined sewers. However, the Authority indicated that providing separate storm drains would only pick up about 25% of the drainage, as 75% comes from private sources. The Authority noted that within its service area, I/I accounts for a significant portion of the flows at the WWTPs. The combined sewer systems may have been designed for conveying a 5-year/24-hour storm. However, some parts of Hoboken flood at high tide and then drain when the tide drops. Street flooding is not an issue in Union City, Weehawken and West New York. It was noted that the concept of sewer separation, even if feasible, does not necessarily result in water quality improvements. In some cases, such as when the CSO discharge frequency and volume is relatively low, sewer separation can degrade receiving water quality. The Authority noted that the NJDEP has indicated on the H6/H7 CSO Project that constructing new high-level storm sewers must result in the same or reduced solids discharges to surface waters, overall, between the new storm system and remaining CSOs.

The priority of reducing I/I was discussed. While I/I reductions do not contribute as much to CSO control as reducing runoff entering combined systems during wet weather, it was noted that I/I must be addressed to lower dry weather flows (DWF) in Hoboken and provide more capacity for wet weather flows. Within the River Road system, water leaks from drinking water distribution systems significantly contribute to I/I. The Authority works with United Water (Suez) to identify and reduce leaks, with noticeable benefits in the past. However, flows are rising again, and those flows may be attributable to new leaks. The Authority may be able to reduce its DWF to 7 or 8 million gallons per day (mgd) via continual focus on I/I reduction and sewer lining. Alternative evaluations should include model calculations of incremental I/I reductions to identify if appreciable benefits may be realized and compare I/I reduction to other alternatives for cost-effectiveness.

Private sources of rainfall-derived I/I from existing downspouts and sump pumps are sources of wet weather flow. The general opinion is that the opportunity to remove these sources is limited due to a number of factors, including the costs to homeowners for making changes to existing structures, the lack of separate storm sewer systems, and the density of development. New development is required to store flow from rooftops and surfaces to delay flows where the combined sewer system serves the area. New waterfront development has no combined sewers. Redevelopment in the H7 area will be required to connect storm flow to the future high-level storm sewer system being designed by the Authority's H6/H7 CSO Project.

The Authority indicated that they get some tidal inflow, but don't see high salinity at the WWTPs.

Storage at Regulators and Outfalls

Opportunities for 'system optimization' were discussed. Profiles reviewed during the meeting generally indicate that the interceptors run at capacity or surcharged conditions during the largest event of the typical year. It was suggested that similar graphics be prepared for 'the fifth largest' event to determine if in-system storage may be available for smaller storms.

Storage may be a possibility at several locations under streets, parks and parking lots (Observer Highway in H1, Stevens Park at H3/H4/HSI, under Sinatra Drive for H3/H4/HIS and H5, along waterfront at 18th Street Pump Station outfall). Alternatives to be considered could include locating storage offshore at existing/abandoned piers, or constructing a new pier, where storage (or treatment) could be located at or beneath the pier, with some potential recreation use at the surface. Permitting may be very difficult, and although the Authority was successful in permitting the W1234 S/F facility as an end-of-pipe facility in the Hudson River, the Authority should verify the feasibility of gaining regulatory approvals for end-of-pipe storage facilities that may encroach on surface waters.

Box culverts used in Elizabeth were raised as an example for discussion. In Elizabeth, a box culvert was constructed to store runoff to address flooding issues. This facility served as offline storage to capture the volume associated with storm peaks., and then to return the flow to the system when the storm recedes. For Hoboken, a box culvert may be difficult to site due to utility conflicts. It is important to note these structures were intended specifically for flood control.

Storage systems will likely require post-event flushing to remove floatables, solids and grit accumulations if no pre-treatment is constructed. In a tunnel or tank, 800 feet is typically the maximum length of scour effectiveness for a flushing gate. Odor generation and the need for odor control also can be a significant issue for the remnant solids.

Siting for storage facilities will be challenging. Property acquisition costs can be as high as $1 million for 2,500 square feet. It was noted that with above-grade storage, the need for influent pumping can increase the cost and risk. Contaminated soil handling costs could increase costs for below-grade storage.

High rate treatment at remote facilities was discussed. Challenges related to disinfection and de-chlorination of CSO discharges. Newport's facilities were mentioned as examples where high rate treatment has been used to supplement satellite storage facilities.

Increase Conveyance to WWTP and Expanded WWTP Capacity

System-wide alternatives to increase conveyance to the Adams Street WWTP were discussed. The Adams Street WWTP characteristics provided in the handout were reviewed (Attachment 3), including average and peak design flows. A consensus was that increasing wet weather flow to the WWTP may be potentially more cost-effective as opposed to in-system storage or end-of-pipe storage/treatment. The

WWTP was originally constructed in 1958, and since then has been expanded to increase hydraulic capacity and upgraded in terms of treatment processes. The annual average dry weather flow (AADF) has decreased from 20 mgd to 13 mgd. This reduction in flow was suggested to be a result of water conservation and targeting leaks in the system. The primary and secondary capacities are described in detail in the handout.

Possible updates to the WWTP processes and how they would benefit increased flows were discussed. Currently the primary clarifiers have a low overflow rate and some capacity is available to increase flow. It may be worth obtaining data on PST removals and overflow rates. One of the primary clarifiers is currently being used to store initial wet weather volumes during events as a standard procedure. The Authority is considering covering the primary clarifiers for odor control. Three trickling filters are installed and there are rare instances when all three are required for operation. It was suggested that one of the trickling filters could be replaced with a wet weather flow storage tank providing approximately 7 MG of storage. The existing sludge handling facility building was also mentioned as a potential location use for wet weather storage/treatment. However, potentially only half of this building would be readily available as the building currently houses the main electrical switch gear, which was recently upgraded. The dissolved air flotation (DAF) filters are currently the limiting factor for reaching the peak capacity of 40 mgd. The DAF filters are being replaced in an ongoing project that should enable 40 mgd peak capacity. The plant outfall may have an additional 7 to 12 mgd of storage.

It was noted that the Authority does not own any additional property adjacent to the Adams Street WWTP.

Increases in overall WWTP flow also brought up the topic of how this would affect the regulators and siphon that feed the WWTP. The siphon needs to be inspected and the construction of a parallel siphon may be necessary to enable the inspection. This would create an opportunity to increase flows to the WWTP. The suggestion of moving the W1, W2 and W3 regulators from their present locations to the top of the hill in their drainage areas was discussed. It was noted that the current manual operation of these regulators is a critical function, as failure to throttle the regulators under certain storm conditions could cause flooding that would affect the Lincoln Tunnel. Moving the regulators to the top of the hill could provide the opportunity for automation and better control of the flow as it drops in elevation. There was discussion of the significant technical challenges associated with this hydraulic control. Disinfection of the W1234 outfall may be the only viable control alternative for this outfall.

Approximately 22 MG of storage would be needed for all outfalls to reduce all overflows to four per typical year. If the Adams Street WWTP accepted typical dry weather flow, plus the additional volume from 22 MG of storage, it would take approximately three days to empty all the storage with the WWTP running at full capacity the entire time. Sidestream- treatment, blending, and/or a wet weather flow treatment facility at the WWTP would likely be required to drain 22 MG of storage in one day through the WWTP. The cost-effectiveness of this approach would need to be compared to end-of-pipe solutions.

Increasing flow through the WWTP would necessitate increasing the capacity of the effluent pump station and constructing a new WWTP outfall. The existing outfall capacity is limited and will also need to account for the H7 stormwater that will be pumped from the new Northwest Resiliency Park stormwater pump station. A new WWTP outfall could potentially be constructed from the northeast corner of the WWTP in a straight line to Weehawken Cove.

The Park Avenue siphon provides approximately 30% of the flow to the Adams Street WWTP. Pump station peak flows are as follows:

- Baldwin Ave PS: 0.65 mgd
- 5th Street PS: 5.5 mgd

- 11th Street PS: 2.5 mgd
- 18th Street PS: 5.5 mgd

The wet weather SOP calls for throttling W1 to W4, and the 5th Street and 11th Street Pump Stations as needed.

Regional Tunnel

The concept of a tunnel to capture wet weather flows from multiple regulators was discussed. It would make sense to first investigate what upgrades to flow capacity at the WWTP could be achieved and then move on to how a tunnel could be integrated. Tunneling would require land for shaft construction. Typically two to three acres is required for the mining operation at one end of the tunnel, while less area would be needed for the tunnel boring machine (TBM) removal shaft. The mining shaft is typically the downstream shaft, and a dewatering pump station would typically be located on the downstream shaft site. Acquiring access to properties during construction and for long-term operation at the shafts may be problematic in the service areas. Once constructed, the tunnel will require air shafts, which will require additional property.

Two tunnel concepts were discussed. In Weehawken, the overall concept was 'Hold, Release and Treat' for W1234 while in Hoboken the overall concept was 'Convey, Treat, Release.' The construction of a tunnel could be coordinated with resiliency work; data from geotechnical investigations by the Rebuild by Design project may be helpful in determining where and how to construct the tunnel. Additional use of the tunnel as an alternate means of conveyance to the WWTP to allow for system maintenance was discussed. It is also not ideal to have varying densities in material (combination of soft material and rock) as this may cause a tunnel boring machine to veer off course. Hard rock exists in the rock formations of the Palisades, while soft material exists along the waterfront. Deep rock tunnels minimize the settlement risk associated with shallower, soft ground tunnels.

The depths and sizes of tunnels were discussed. It was noted that a tunnel constructed within the Palisades may drain by gravity. Tunnels 100 feet below the surface and 300 feet below the surface were also suggested, noting that a tunnel at a depth of 100 feet would require one-stage pumping while a tunnel at 300 feet depth would most likely require two-stage pumping. A diameter range of eighteen to twenty feet is ideal to allow for efficient construction of the tunnel. A 2,000-foot tunnel at twenty feet in diameter can store approximately 4.7 MG. The ability to dewater the tunnel in a timely manner must also be considered to maximize capacity to accept multiple storms. Solids captured in a tunnel would have to be managed.

An example of a tunnel in another municipality was discussed for similarities. Milwaukee has had a tunnel system for 20 years. They hired a contractor to inspect the tunnel because deep tunnel inspection is specialized work and done infrequently. The tunnel itself generally requires little maintenance. The tunnel dewatering pump station maintenance can be challenging due to the depth of the pump station and the difficulty of access for personnel and equipment. Keeping the pump station dry can be another challenge, and it is usually necessary to dehumidify a pump station to keep it dry. Locating the mining shaft/dewatering pump station near the WWTP facilitates access to the facility and reduces the length of the dewatering pump station discharge force main.

It was noted that a tunnel could potentially help address surface flooding issues, if volume is available in the tunnel. If not operated properly, a tunnel could back up near surface piping.

Disinfection at Outfalls

Disinfection may be a viable option at existing facilities such as the H1 and H5 Wet Weather Pump Stations (outfalls 002A and 006A) and the 18th Street Pump Station (outfall 012A). Sufficient contact time will be needed for effective dosing systems. Disinfection may be the only viable option for W5 (outfall 015A). Peracetic acid may not be worth the chemical expense, difficulty in handling and design/construction costs to use at an outfall. It is currently used at the Adams Street WWTP to augment UV disinfection processes that are problematic due to DAF sand leaching. Peracetic acid is not widely used for CSO disinfection, so operating data on full-scale installations is limited. The Authority would prefer to not use peracetic acid. If sodium hypochlorite is used for disinfection, then dechlorination facilities would likely be required near the ends of the outfalls. It was noted that end-of-pipe treatment systems would likely require above-grade facilities to house a control room, an electrical room, chemical storage and feed equipment, etc.

Adams Street Outfall-specific Alternatives

The table provided in Attachment 4 summarizes the discussions for alternatives of specific outfalls for the Adams Street drainage area. Points were made regarding the estimated volume to control, available nearby open space for design, and key design points that may affect implementation.

River Road CSOs

River Road - Brief Overview of WWTP System

Attachment 3 is the handout provided during the workshop describing the River Road WWTP service area and providing the calculated CSO performance for the typical year. Like the Adams Street service area, the InfoWorks ICM model of the River Road service area is based on the Authority's GIS and was calibrated and validated to data collected in 2016.

There were some questions regarding the high flows calculated for Regulator WNY1. It was noted that the hydraulic profiles showed the peak hydraulic grade lines generally below the crown of the interceptor upstream of regulator WNY1 in the typical year, due to the elevation of the UC1, UC2 and UC3 weirs. The outfall downstream of Regulator WNY1 was shown to be surcharged. The regulators are located on the interceptor. Regulators UC1, UC2 and UC3 are side-overflow weirs. The top half of the interceptor has a hanging baffle to drive the flow over the weirs. At UC2 there appears to be only 4 inches of available freeboard during dry weather flow. WNY1 has a transverse weir and a gate. One of the weirs is up to 27 feet in length. The potential benefits of raising weirs to utilize the interceptor's capacity and 'maximize' flow to the WWTP should be evaluated during the planning effort.

General characteristics of the WWTP were discussed. It was noted that approximately half of the AADF may be I/I. The Authority noted the I/I is more closely connected to water main leaks as opposed to groundwater infiltration. I/I due to watermain leaks has been a challenge to eliminate but as noted earlier, the Authority proactively works with SUEZ to identify and eliminate leaks while also relining its sewers.

Overall WWTP capacity was discussed, noting that the current WWTP capacity is limited. Both clarifiers, both trickling filters and all six rotostrainers must run at all times. The two clarifiers are presently a bottleneck. The chorine contact tanks for disinfection are another bottleneck. Currently there is no space to expand at the WWTP. Expansion would be possible by excavating into the rock that abuts the facility. Space can also be made if the new treatment units are stacked.

It is currently not feasible to expand capacity within the existing unit processes described in Attachment 3, however replacements were discussed. CoMag® or Biomag® for clarifiers may enhance treatment. Replacing one clarifier with a cloth media filter or with a more efficient settling process may increase WWTP capacity. It was also suggested to replace the micro-strainers with a high-rate treatment system like Actiflo® to run at a higher rate during wet weather and lower rate during dry weather. Increasing WWTP capacity will likely necessitate increasing the capacity of the WWTP/WNY1 outfall to the Hudson River. The WWTP outfall drops from 90-inch to 54-inch diameter.

A concept of diverting some of the DWF to the Adams Street WWTP was discussed. The NHSA noted that this has been considered previously. It was also noted this could have permitting implications as the system would then be hydraulically connected. Another option discussed was constructing a tunnel connecting the Adams Street and River Road systems and equalizing flows between the two WWTPs.

This alternative would most likely require significant SCADA controls and optimization. It can be investigated to send sanitary/CSO flow to Adams Street and use River Road for stormwater treatment only.

River Road Outfall-specific Alternatives

WNY1

It was noted that the overflow volume for the largest storm in the typical year is significantly larger than the next-largest storm. Constructing approximately 2,000 feet of linear storage beneath Anthony M Defino Way between Regulator WNY1 and the WWTP was discussed. The Authority has also been investigating available lots near the River Road WWTP to locate storage and/or treatment for WNY1 overflows. A strip of land approximately 95 feet in width below the WWTP between Anthony M Defino Way and Port Imperial Blvd. was discussed as a potential site. The slope on the property is steep and it would be challenging to construct a facility cost-effectively. It was noted that this swath is owned by a developer. Creating storage here would require the flow to be pumped to the WWTP. Constructing a treatment system on the site would likely be more cost-effective than storage and pumping to the WWTP. A final alternative suggested was creating a new WWTP outfall altogether. This however would create permitting and constructability issues.

JOSO

The JOSO outfall is a box culvert taking overflows from multiple regulators above the Palisades, then dropping down to the Hudson River waterfront via a drop shaft and conveyance to the S/F facility on the waterfront. The top ten feet of the drop shaft is precast concrete, but the shaft then transitions to unlined rock. This location creates a very high-energy drop. The culvert is an irregular shape due to the surrounding rock. The available space for control alternatives along the outfall is minimal. No space is available for storage tanks and also no ideal space for linear storage through the use of a tunnel. A suggested alternative was to divert JOSO flows to either the Adams Street system or to WNY1. Diverting to WNY1 would necessitate a larger or additional outfall at WNY1.

River Road System-wide Alternatives

There was a consensus that I/I reduction and GI should be considered but may not be the most cost-effective alternatives due to the smaller size of the system and limited space available for GI. The Authority will continue to be proactive with United Water (Suez) in working to eliminate their leaks. The Authority estimates that the cost of relining sewers in the River Road service area is likely $20 to $25M. It was suggested that increased capacities and storage with diverted flow elsewhere should be considered with greater weight for this system. Bending weirs should be considered for the existing regulators to maximize flow in the system, especially where modeling indicates that sewer capacities are not maximized during wet weather. It was suggested that additional modeling runs should be conducted as well to further analyze system flows and evaluate how the timing of the peaks compares with a view towards opportunities to maximize storage and conveyance to the WWTP.

Disinfection may be considered for both outfalls, but the dosing point may need to be as far upstream as possible in the outfalls to achieve the proper contact time. An outfall disinfection system may also need a dechlorination facility. There were additional discussions on peracetic acid since it would not have a residual. It was noted that peracetic acid is five times more expensive than conventional chlorination, so even without the need for de-chlorination peracetic acid is not always cost-effective. As noted earlier, there are few full scale wet weather applications of peracetic acid with operational and performance histories. Other disinfection alternatives were discussed. The City of Newport, RI has two high rate chlorination/de-chlorination facilities. These facilities find it difficult to hit target kills because flow rates change rapidly.

Recommended Modeling Scenarios

The following modeling scenarios and evaluations were recommended for better understanding existing performance and starting evaluations of control alternatives:

For baseline conditions:

- Tabulate overflow volumes by storm, to help identify threshold rainfall characteristics for the various outfalls and assessment of system-wide overflows/year
- Plot all overflow hydrographs on common axes for selected storms based on the tabulation in the first bullet, to better characterize the relative timing of peaks and overflows and identify trends.
- Check whether storms that have the highest or 5th-largest volumes in the typical year also have the highest/5th largest peak flows
- Characterize flows through flushing chambers between drainage areas.
- Look at peak hydraulic profiles for smaller events in the typical year, to see if optimization may be effective during smaller storms

To begin control alternative evaluations:

- Include the H6/H7 CSO Project Plan
- Maximize Adams Street WWTP flows (simulate free discharge at the WWTP; may need to follow up with increased capacities of influent siphons and upstream pump stations)
- Equalization storage at Adams Street WWTP
- Maximize River Road WWTP flows (simulate free discharge at WWTP)
- Incremental I/I reduction scenarios
- Incremental GI scenarios
- Reroute H1 Housing Authority runoff to surface water
- Increase flow from 18th Street Pump Station to eliminate overflows
- Add parallel siphon to existing siphon
- Raise weirs at JOSO regulator weirs
- Add bending weirs to JOSO regulator weirs
- Relocate W1-W4 regulators
- Add sanitary pump stations in Hoboken
- Evaluate interconnections at flushing chambers
- Evaluate using flushing water lines for additional conveyance

Action Items

- ☐ CH2M to draft a meeting summary and distribute to the consultants.
- ☐ Consultants to review the draft meeting summary and return to the Authority (Fred Pocci) and the LTCP Program Manager (Bill McMillin).
- ☐ CH2M will finalize the meeting summary.
- ☐ The LTCP Program Manager will distribute the final meeting summary to all attendees.

Attachment 1
Workshop Attendance Sheets

NHSA Long Term Control Plan CSO Alternatives Analysis Workshop
Friday June 15, 2018

Sheraton Lincoln Harbor Hotel
8:00 AM – 5:00 PM

Sign in Sheet

Name	Affiliation	Email
Karen Karvazy	MM	Karen.Karvazy@hotmail.com
JOE MANNICK	NJDEP	joe.mannick@dep.nj.gov
Mike Wilson	Jacobs	mike.wilson1@jacobs.com
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Christina Lehr	Jacobs	christina.lehr@jacobs.com
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Greg Heath	AECOM	gregory.heath@aecom.com
Bill McMillan	JACOBS	william.mcmillan@JACOBS.COM
Don Conger	NHSA-Jacobs Ops	don.conger@jacobs.com
Phil Reeve	Jacobs	
Fred Pocci	NHSA	

Kevin Wynn	Mott MacDonald	
Tony Costello	Gannett Fleming	
Chris Pizarro	Ganett Fleming	
John Denning	Mott MacDonald	

NORTH SEWERAGE AUTHORITY HUDSON

NHSA Long Term Control Plan CSO Alternatives Analysis Workshop
Thursday June 14, 2018

Sheraton Lincoln Harbor Hotel
8:00 AM – 5:00 PM

Sign in Sheet

Name	Affiliation	Email
PETER LONZWECK	JACOBS	PETER.LONZWECK@JACOBS.COM
Mike Wilson	Jacobs	Mike.Wilson1@jacobs.com
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Christopher Pizarro	Gannett Fleming	cpizarro@gfnet.com
Greg Heath	AECOM	gregory.heath@aecom.com
Bill McMillin	JACOBS	WILLIAM.MCMILLIN@CH2M.COM
Christina Lehr	Jacobs	christina.lehr@jacobs.com
Brian Busseno	Jacobs	Brian.Busseno@jacobs.com

NORTH HUDSON SEWERAGE AUTHORITY

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Nancy Kempel	"	nancy.kempel@dep.nj.gov
Fred Pocci	NHSA	
Breana Whittaker	City of Newark	whittakerb@ci.newark.nj.us
Armando Alfonso	NJDEP	armando.alfonso@dep.nj.gov
Moriah Kinberg	NJ Future	mkinberg@NJFuture.org
Susan Rosenwinkel	NJDEP	susan.rosenwinkel@dep.nj.gov

Attachment 2
Workshop Agendas

MEETING AGENDA

CSO Alternatives Analysis Concept Workshop

PROJECT:	North Hudson Sewerage Authority CSO LTCP Program
MEETING DATE:	June 14 – 15, 2018
MEETING TIME:	8:00 am – 5:00 pm
LOCATION:	Sheraton Lincoln Harbor Hotel, 500 Harbor Boulevard, Weehawken, NJ 07086
INVITED ATTENDEES:	Fredric Pocci, Richard Wolff, Don Conger, Phil Reeve, Bill McMillin, Don Walker, Greg Heath, Kevin Wynn, John Dening, Karen Karvazy, Mike Wilson, Peter von Zweck, Eugene DeStefano, Tony Costello, Chris Pizarro, Joe Mannick, Susan Rosenwinkel, Nancy Kempel, Armando Alfonso, Breana Whittaker

Objectives

This meeting will be a brainstorming session to identify strategies and alternatives for maximizing wastewater treatment and reducing CSOs in the NHSA system. The output from the workshop will be used by NHSA's LTCP program to further develop and evaluate CSO control alternatives, culminating in preparation of Evaluation of Alternatives Reports. The first day of the workshop will focus on the Adams Street WWTP system, and the second day will focus on the River Road WWTP system.

Schedule for both days:

8:00 am – 9:00 am: Breakfast
9:00 am – 12:30 pm: Working Session
12:30 pm – 1:15 pm: Lunch Break
5:00 pm (or sooner): Conclude

Agenda Items

<u>Thursday, June 14, 2018</u>

1. **Welcome and Introductions**
2. **Meeting Objectives**
3. **Brief Overview of Adams Street WWTP System**
   a. System schematic/overview of tributary area
   b. CSO Activations/volumes
   c. Recent CSO/wet weather projects implemented
   d. Target level(s) of CSO control
   e. Other wet weather issues in the collection system (flooding)
   f. Overview of Adams Street WWTP
      i. Capacity
      ii. Current/projected design flows
      iii. Physical layout and constraints

4. **System-wide Alternatives**
    a. Green Infrastructure
    b. Grey I/I reduction
    c. Increase conveyance to WWTP
    d. Regional tunnel
5. **Outfall-specific alternatives**
    a. Outfalls 002A, 003A, 005A
    b. Outfalls 006A, 008A
    c. 18th Street PS Outfall 012A
    d. Outfalls 013A, 015A
6. **Summary/recap of Alternatives for Adams Street WWTP System**

<u>Friday June 15, 2018</u>

1. **Brief Overview of River Road WWTP System**
    a. System schematic/overview of tributary area
    b. CSO Activations/volumes
    c. Recent CSO/wet weather projects implemented
    d. Target level(s) of CSO control
    e. Other wet weather issues in the collection system (flooding)
    f. Overview of River Road WWTP
        i. Capacity
        ii. Current/projected design flows
        iii. Physical layout and constraints
2. **System-wide Alternatives**
    a. Green Infrastructure
    b. Grey I/I reduction
    c. Increase conveyance to WWTP
    d. Regional tunnel
3. **Outfall-specific alternatives**
    a. WNY1 Outfall 002A
    b. JOSO Outfall 003A
4. **Summary/recap of Alternatives for River Road WWTP System**
5. **Summary and Concluding Remarks**
6. **Action Items Review**

Attachment 3
Workshop Handouts

North Hudson Sewerage Authority
Long Term Control Plan
CSO Alternatives Analysis Workshop

Adams Street WWTP

NJPDES Permit: NJ0026085

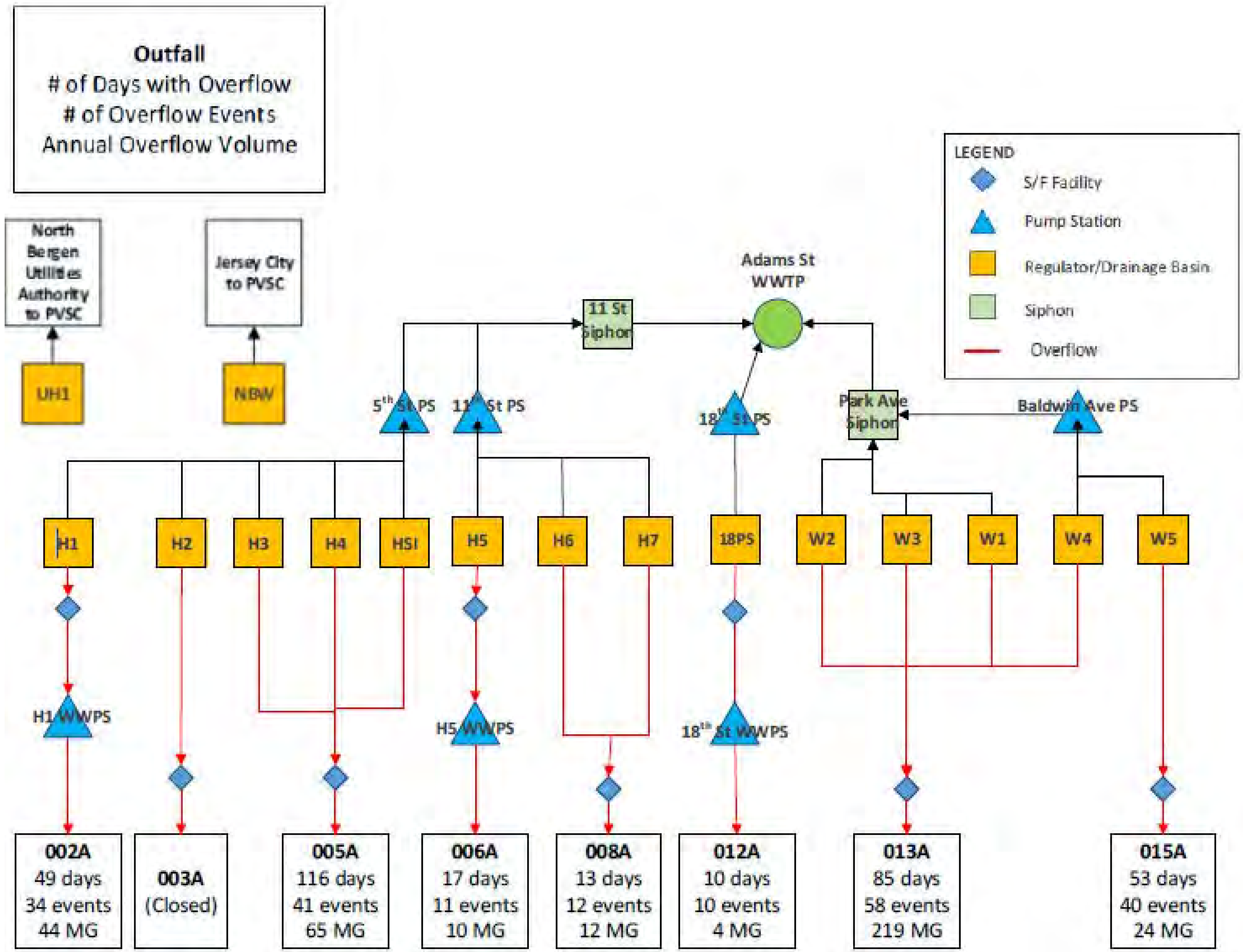
Date:June 14, 2018

North Hudson Sewerage Authority

1600 Adams Street
Hoboken, NJ 07030
(201) 963-6043

www.nhudsonsa.com

Adams Street STP Collection System Schematic Diagram



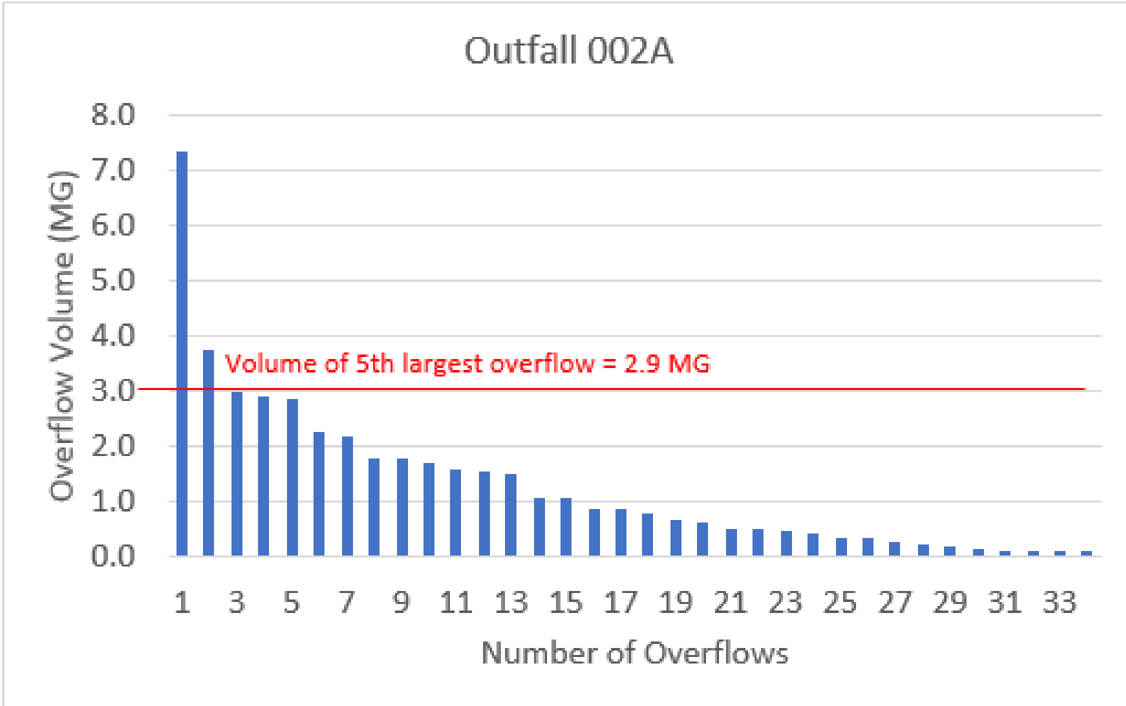
Summary Table - CSO Frequency, and Total Overflow Volume per Year

Outfall	CSO Frequency	Volume per year (MG)
002A	34	44
005A	41	65
006A	11	9.5
008A	13	12
012A	10	3.6
013A	58	219
015A	40	24
	Total volume, MG	377

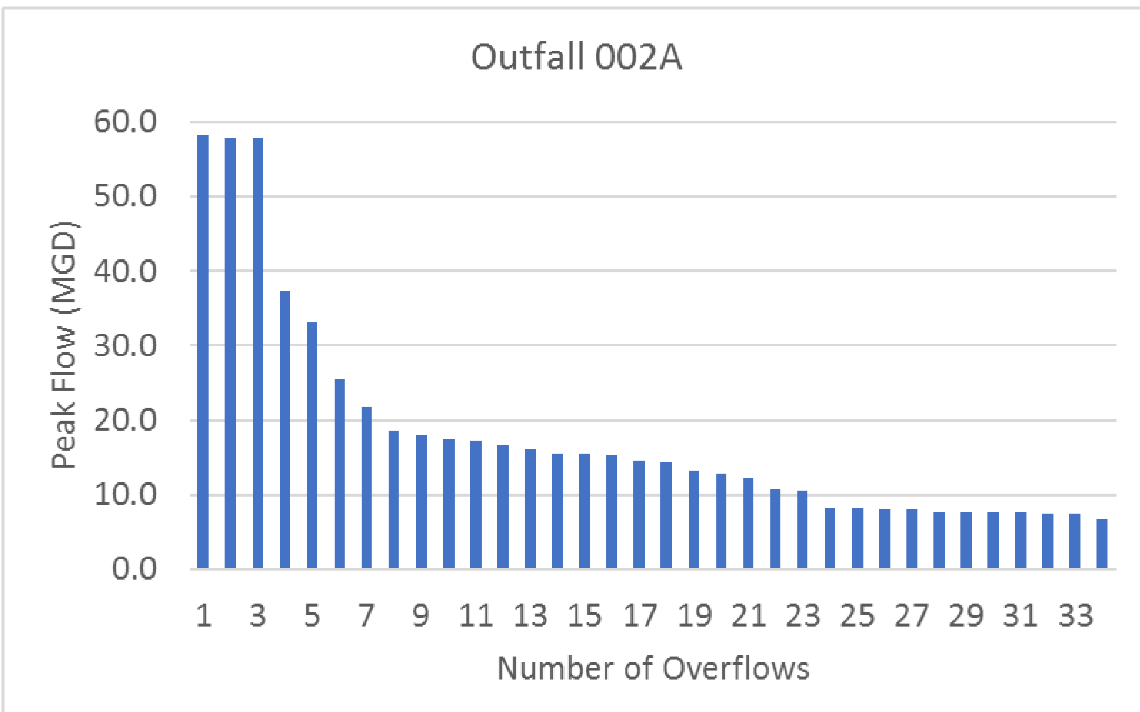
Outfall 002A CSO Frequencies (Volumes and Peak Flows) in Typical Year

Overflow Number	Volume (MG)	Peak Flow (MGD)
1	7.32	58.28
2	3.75	57.93
3	2.99	57.79
4	2.89	37.29
5	2.88	33.04
6	2.26	25.40
7	2.17	21.92
8	1.80	18.65
9	1.77	18.02
10	1.72	17.51
11	1.57	17.24
12	1.56	16.64
13	1.52	16.10
14	1.08	15.51
15	1.05	15.47
16	0.88	15.24
17	0.86	14.51
18	0.80	14.31
19	0.67	13.14
20	0.61	12.77
21	0.52	12.27
22	0.51	10.69
23	0.46	10.44
24	0.43	8.28
25	0.35	8.21
26	0.34	8.02
27	0.25	8.00
28	0.23	7.71
29	0.17	7.71
30	0.15	7.67
31	0.12	7.63
32	0.10	7.51
33	0.10	7.49
34	0.09	6.69

Volumes and Peak Flows were sorted separately



Outfall 002A
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Overflow Volume (MG)
Volume of 5th largest overflow = 2.9 MG
1
3
5
7
9
11
13
15
17
19
21
23
25
27
29
31
33
Number of Overflows

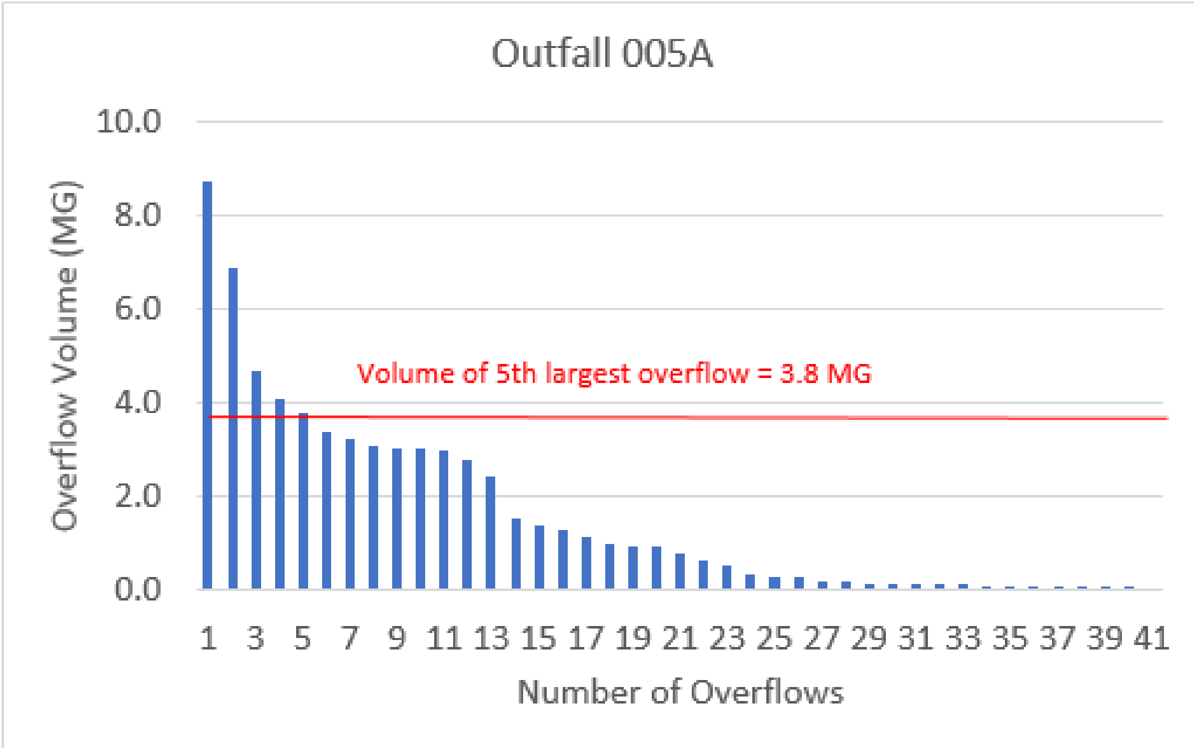


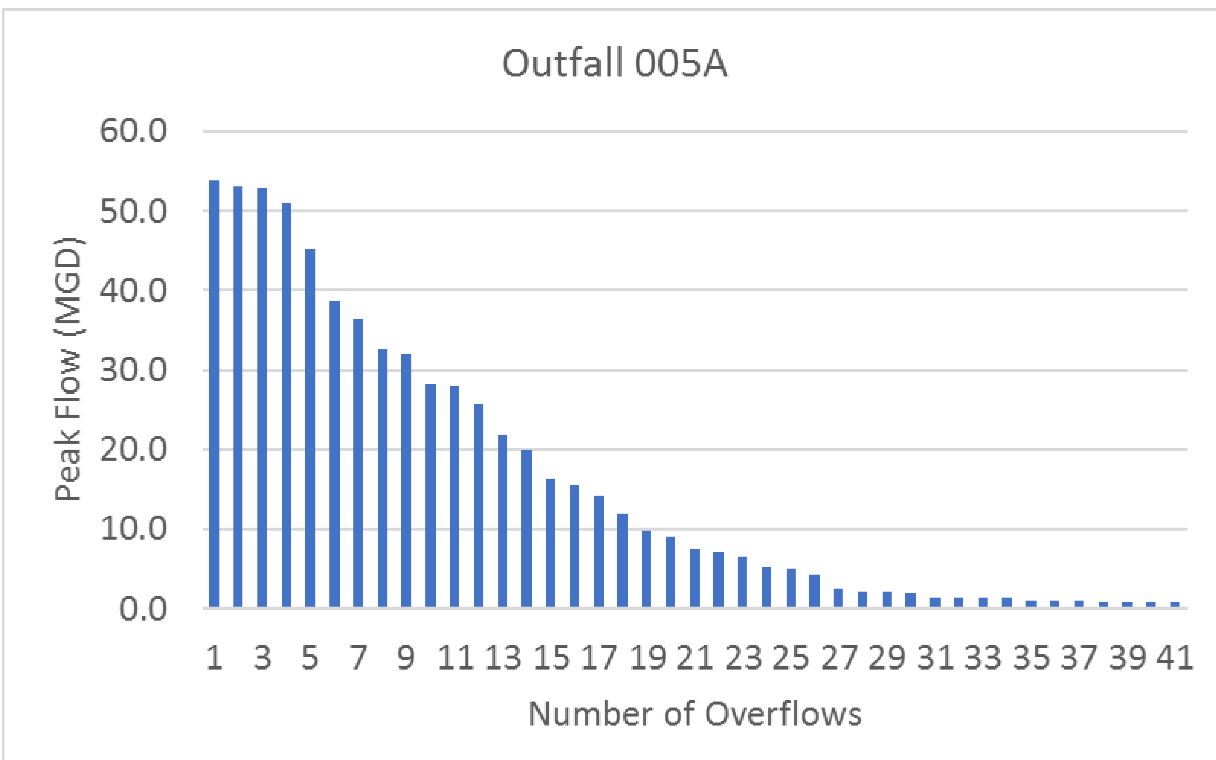
Outfall 002A
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Peak Flow (MGD)
1
3
5
7
9
11
13
15
17
19
21
23
25
27
29
31
33
Number of Overflows

Outfall 005A CSO Frequencies (Volumes and Peak Flows) in Typical Year

Overflow Number	Volume (MG)	Peak Flow (MGD)
1	8.73	53.96
2	6.85	53.12
3	4.67	52.91
4	4.09	50.94
5	3.79	45.20
6	3.36	38.70
7	3.23	36.41
8	3.08	32.54
9	3.05	32.01
10	3.02	28.19
11	3.00	28.01
12	2.80	25.63
13	2.42	21.92
14	1.54	20.06
15	1.36	16.29
16	1.31	15.53
17	1.14	14.28
18	0.99	11.89
19	0.95	9.79
20	0.92	9.02
21	0.80	7.62
22	0.62	7.21
23	0.55	6.49
24	0.33	5.26
25	0.30	5.06
26	0.27	4.30
27	0.21	2.63
28	0.17	2.26
29	0.13	2.20
30	0.13	1.91
31	0.13	1.42
32	0.13	1.37
33	0.13	1.36
34	0.10	1.32
35	0.10	1.09
36	0.09	1.02
37	0.08	1.02
38	0.07	0.88
39	0.06	0.87
40	0.06	0.86
41	0.05	0.81

Volumes and Peak Flows were sorted separately

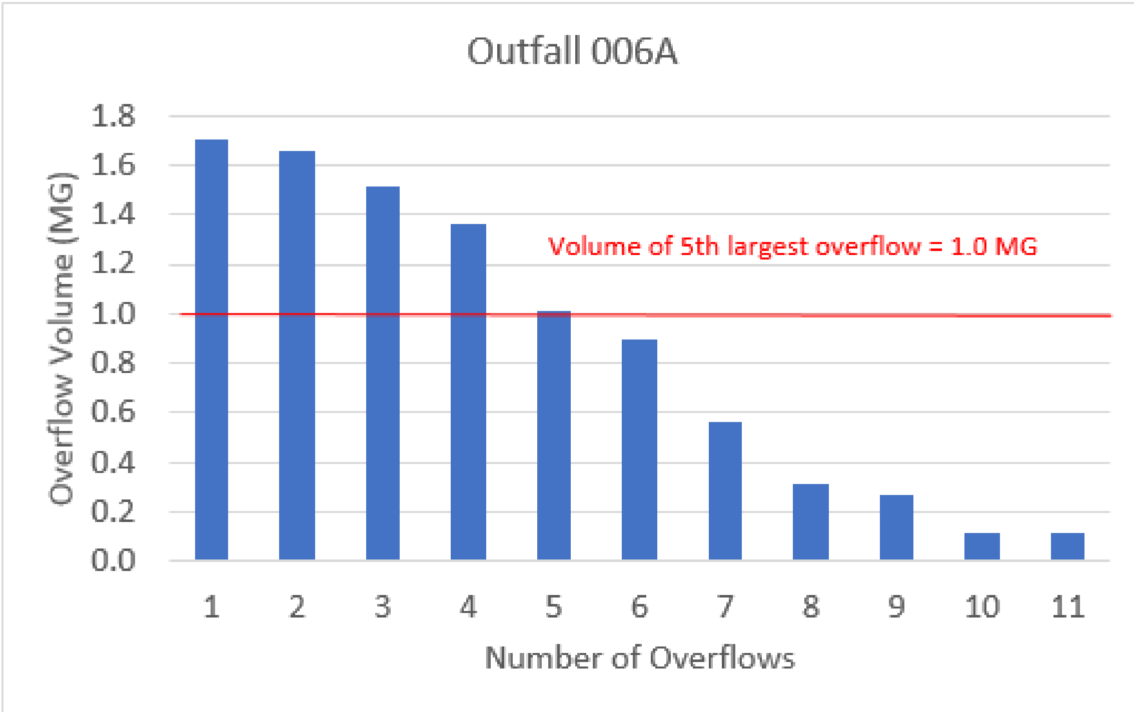

Outfall 005A
Volume of 5th largest overflow = 3.8 MG
Overflow Volume (MG)
10.0
8.0
6.0
4.0
2.0
0.0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41
Number of Overflows


Outfall 005A
Peak Flow (MGD)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41
Number of Overflows

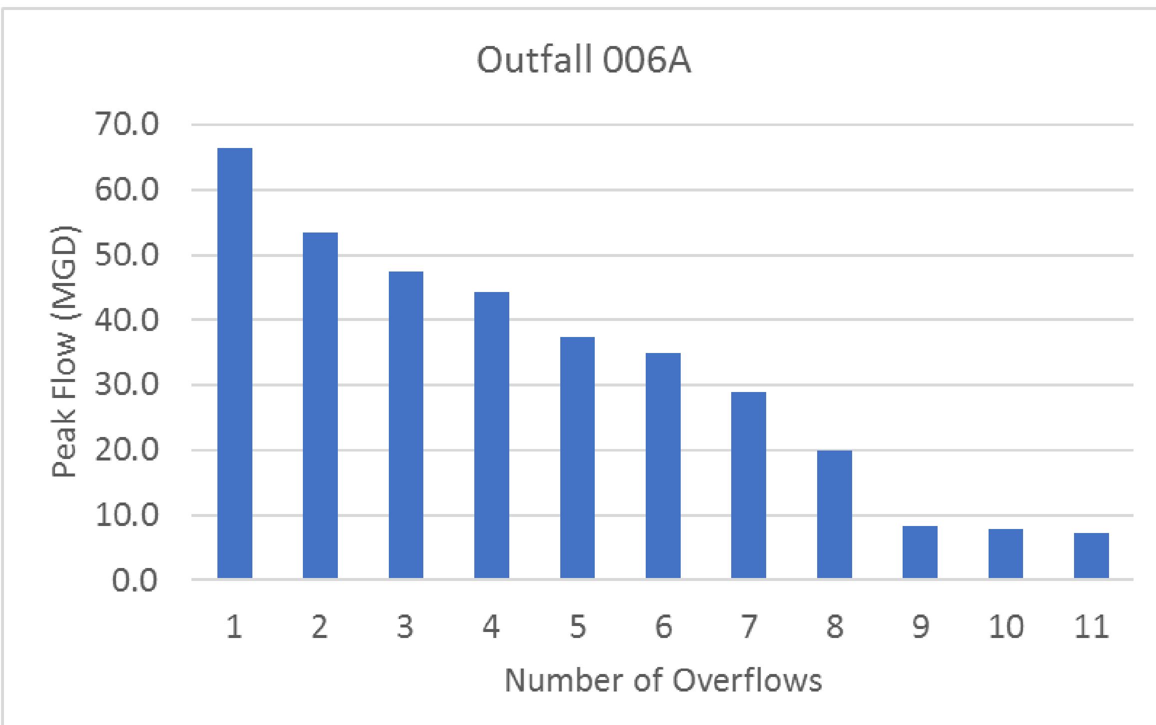
Outfall 006A CSO Frequencies (Volumes and Peak Flows) in Typical Year

Overflow Number	Volume (MG)	Peak Flow (MGD)
1	1.70	66.38
2	1.66	53.44
3	1.51	47.49
4	1.36	44.41
5	1.01	37.29
6	0.90	34.95
7	0.57	28.97
8	0.31	19.93
9	0.27	8.32
10	0.11	7.83
11	0.11	7.17

Volumes and Peak Flows were sorted separately



Outfall 006A
Overflow Volume (MG)
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Volume of 5th largest overflow = 1.0 MG
1
2
3
4
5
6
7
8
9
10
11
Number of Overflows

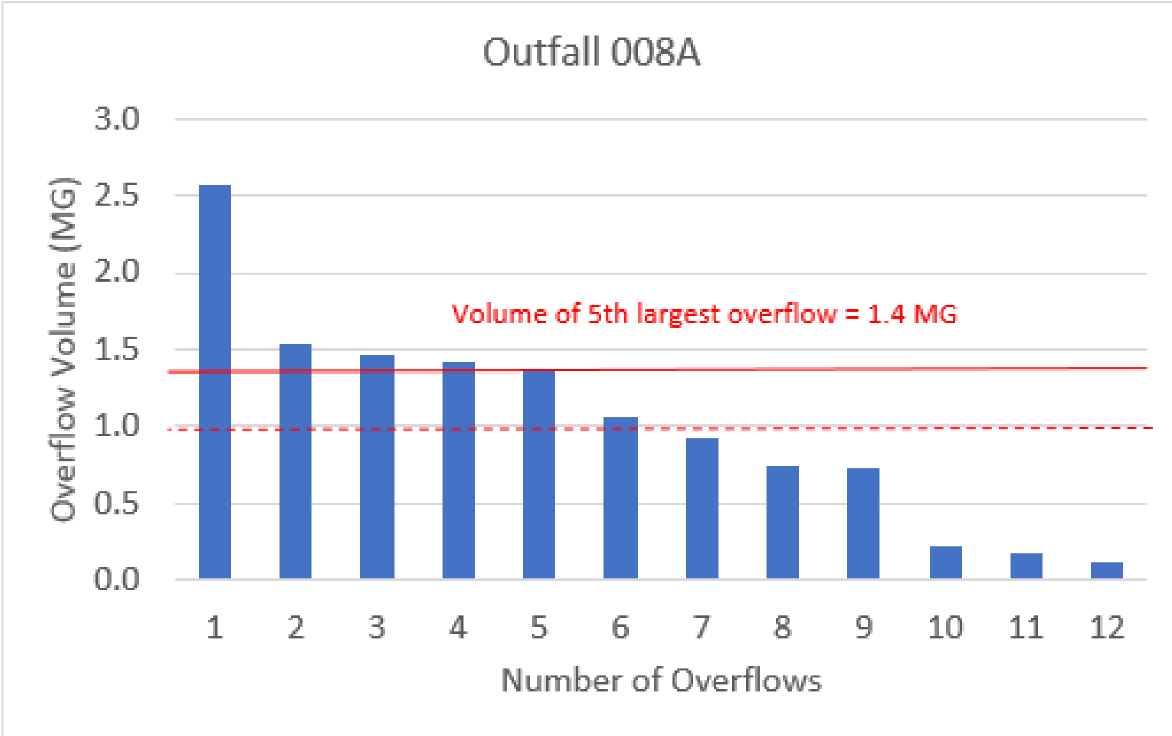


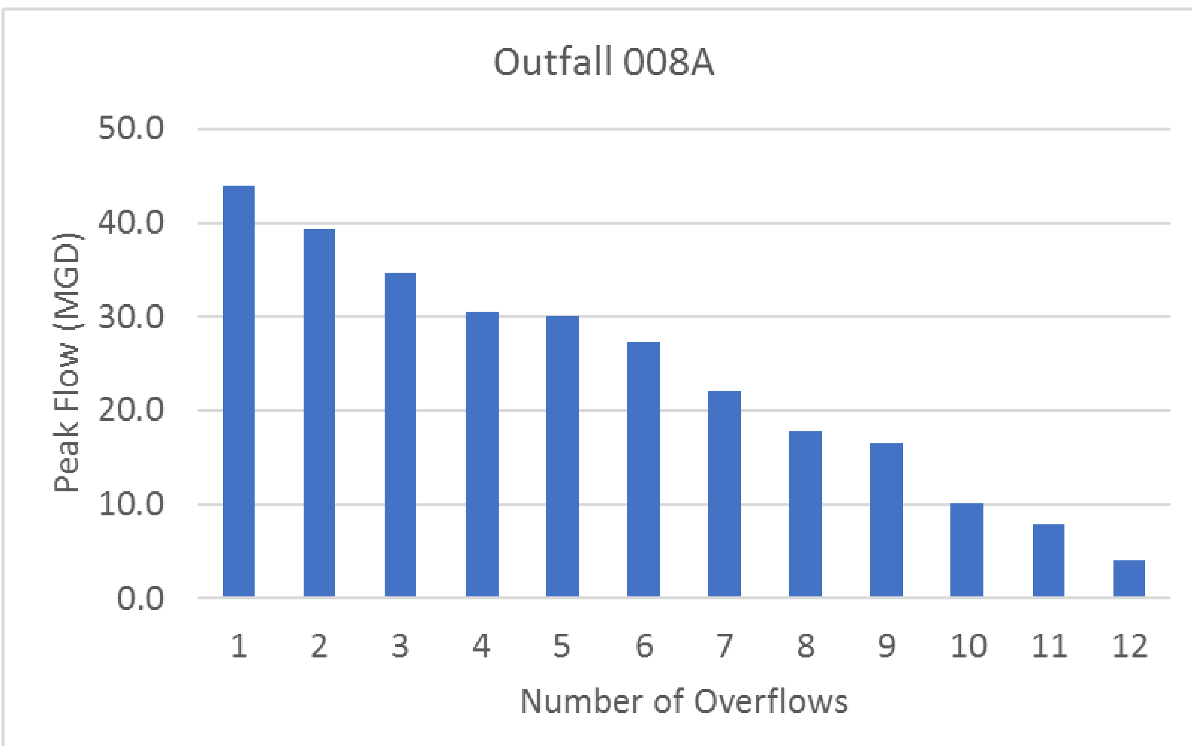
Outfall 006A
Peak Flow (MGD)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1
2
3
4
5
6
7
8
9
10
11
Number of Overflows

Outfall 008A CSO Frequencies (Volumes and Peak Flows) in Typical Year

Overflow Number	Volume (MG)	Peak Flow (MGD)
1	2.56	43.99
2	1.53	39.34
3	1.45	34.66
4	1.41	30.50
5	1.36	30.04
6	1.06	27.42
7	0.92	22.08
8	0.75	17.76
9	0.74	16.47
10	0.22	10.04
11	0.18	7.86
12	0.11	4.11

Volumes and Peak Flows were sorted separately

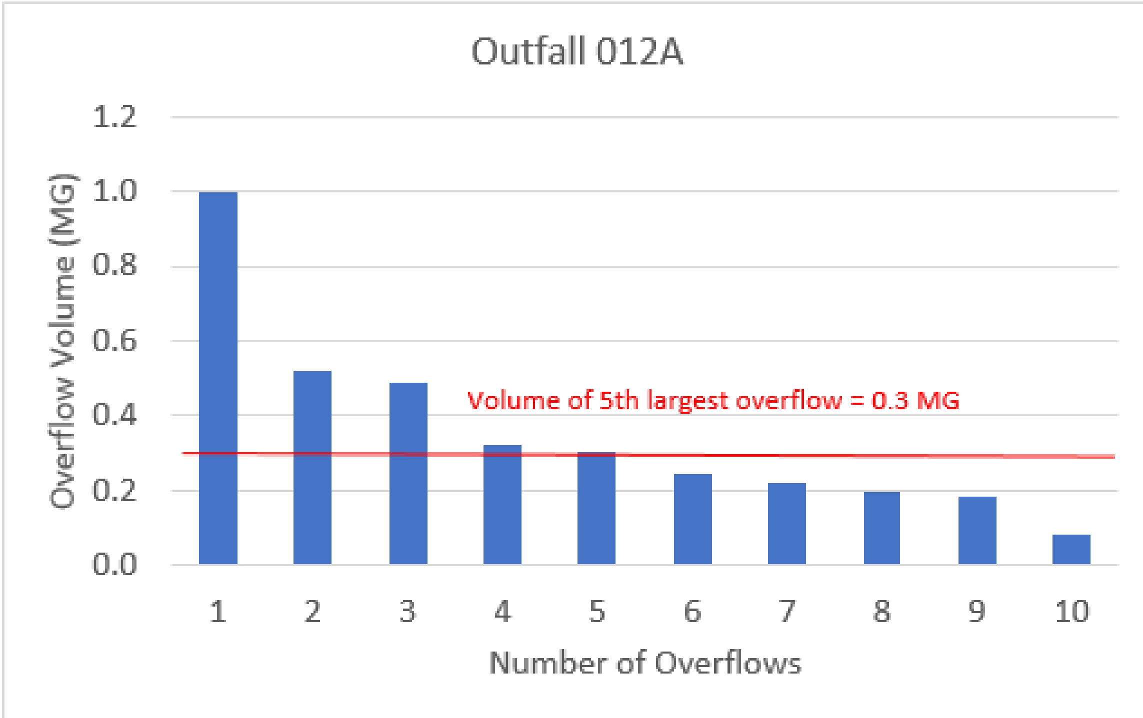

Outfall 008A
Overflow Volume (MG)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Volume of 5th largest overflow = 1.4 MG
1
2
3
4
5
6
7
8
9
10
11
12
Number of Overflows

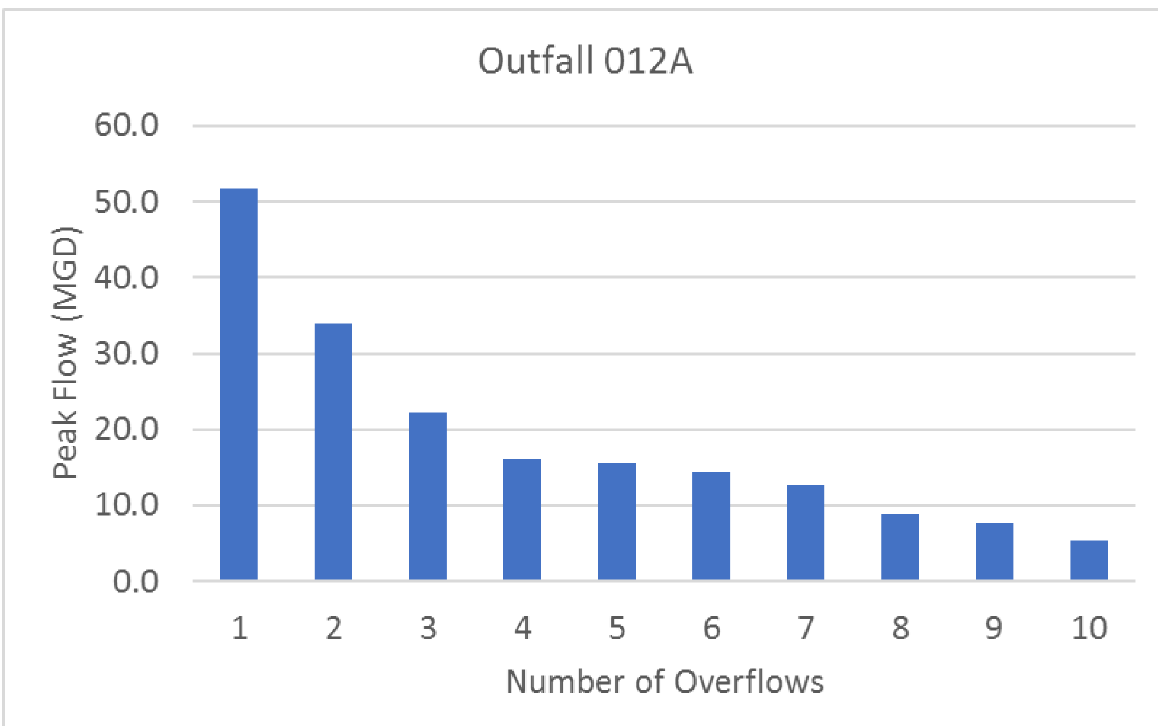

Outfall 008A
Peak Flow (MGD)
50.0
40.0
30.0
20.0
10.0
0.0
1
2
3
4
5
6
7
8
9
10
11
12
Number of Overflows

Outfall 012A CSO Frequencies (Volumes and Peak Flows) in Typical Year

Overflow Number	Volume (MG)	Peak Flow (MGD)
1	1.00	51.81
2	0.52	33.98
3	0.49	22.23
4	0.32	16.18
5	0.30	15.49
6	0.25	14.47
7	0.22	12.69
8	0.20	8.94
9	0.18	7.65
10	0.08	5.43

Volumes and Peak Flows were sorted separately


Outfall 012A
Overflow Volume (MG)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Volume of 5th largest overflow = 0.3 MG
1
2
3
4
5
6
7
8
9
10
Number of Overflows

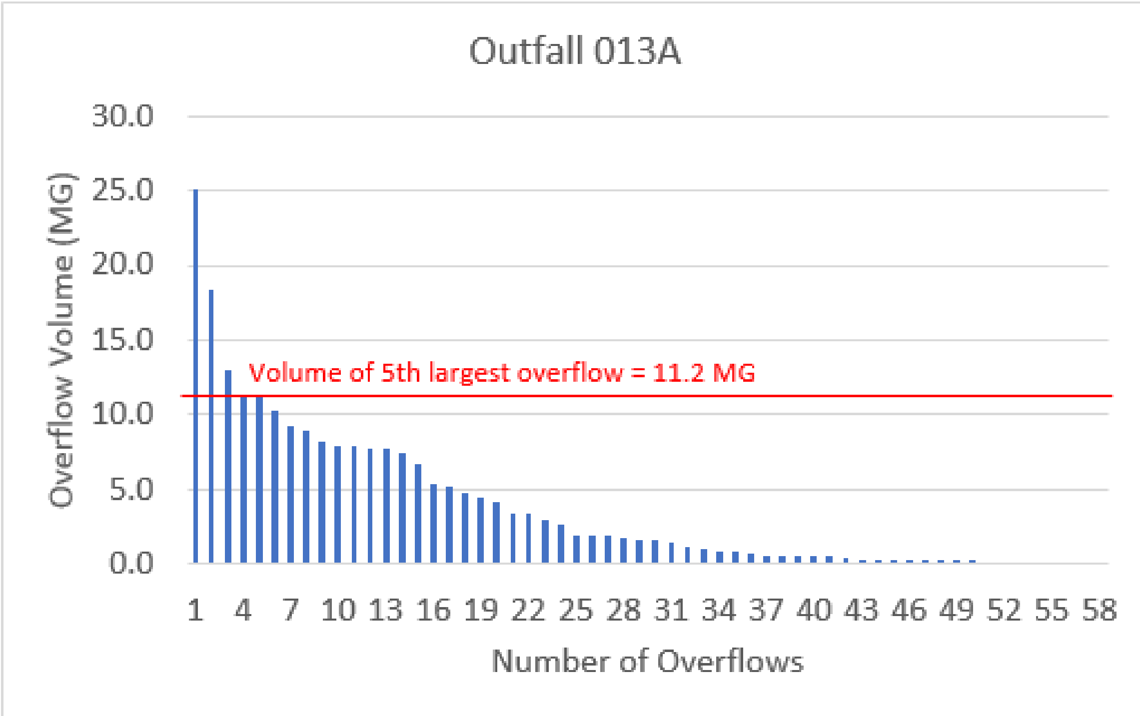

Outfall 012A
Peak Flow (MGD)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1
2
3
4
5
6
7
8
9
10
Number of Overflows

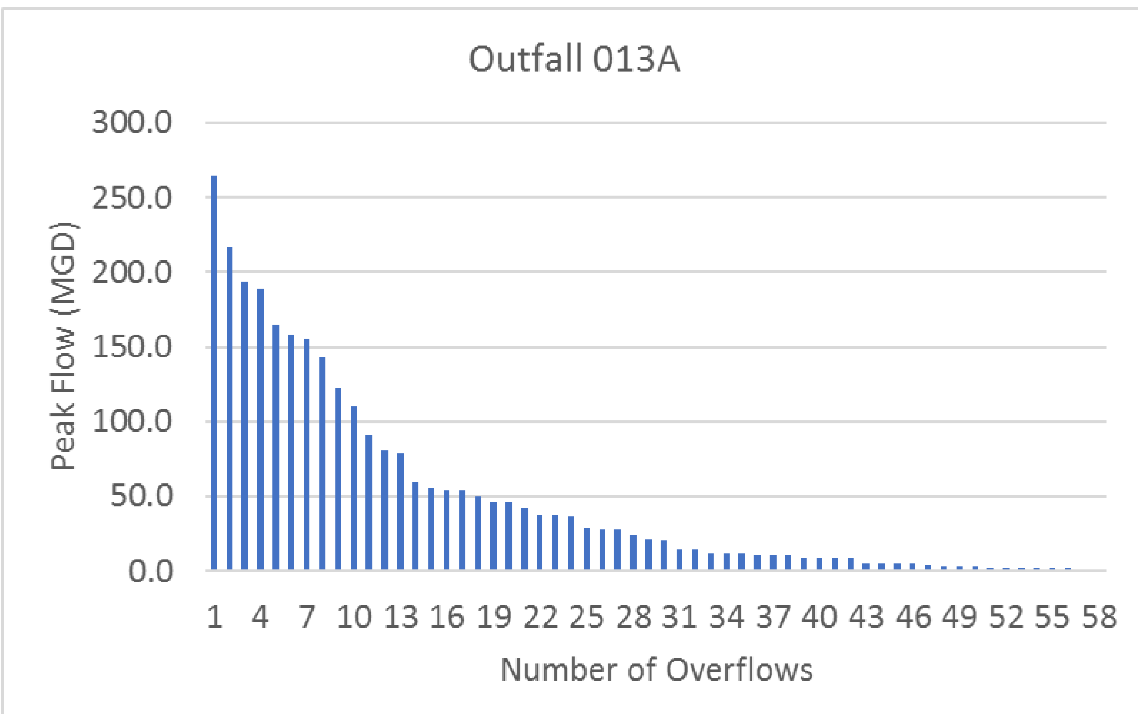
Outfall 013A CSO Frequencies (Volumes and Peak Flows) in Typical Year

Overflow Number	Volume (MG)	Peak Flow (MGD)
1	25.06	264.33
2	18.33	216.37
3	12.91	194.19
4	11.21	188.52
5	11.21	165.14
6	10.30	158.63
7	9.26	154.96
8	8.90	142.51
9	8.24	123.24
10	7.89	110.76
11	7.85	91.29
12	7.70	80.97
13	7.68	79.24
14	7.36	59.72
15	6.76	55.79
16	5.35	54.06
17	5.15	53.84
18	4.74	49.82
19	4.39	46.06
20	4.11	45.93
21	3.40	42.34
22	3.39	38.00
23	2.96	37.87
24	2.71	36.75
25	1.89	28.65
26	1.86	28.48
27	1.86	27.87
28	1.82	23.97
29	1.60	21.63
30	1.53	20.20
31	1.43	14.65
32	1.12	14.37
33	0.93	12.23
34	0.83	11.94
35	0.81	11.49
36	0.71	10.54
37	0.61	10.47
38	0.57	10.36
39	0.57	8.92
40	0.50	8.80
41	0.49	8.60
42	0.36	8.53
43	0.33	5.50
44	0.32	4.97
45	0.27	4.90
46	0.25	4.63

Overflow Number	Volume (MG)	Peak Flow (MGD)
47	0.24	3.92
48	0.20	3.56
49	0.20	3.46
50	0.19	2.93
51	0.16	2.62
52	0.16	2.53
53	0.13	2.45
54	0.12	2.44
55	0.12	2.14
56	0.09	1.82
57	0.09	1.55
58	0.05	0.78

Volumes and Peak Flows were sorted separately

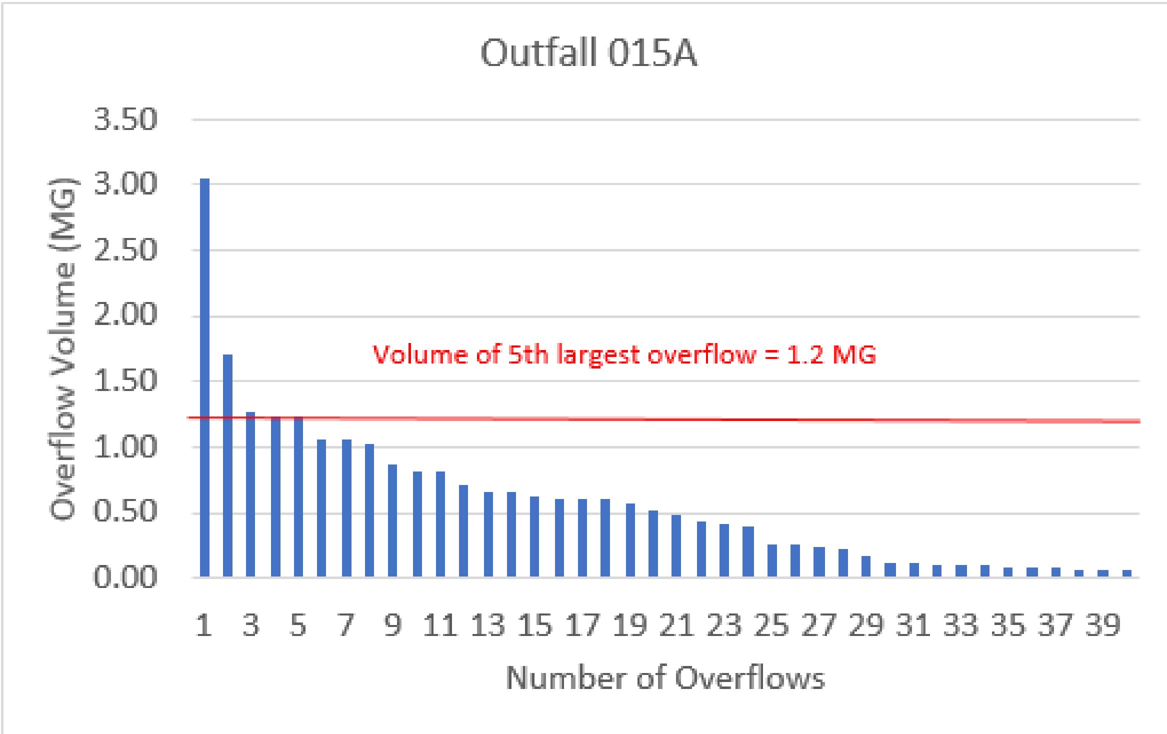

Outfall 013A
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Overflow Volume (MG)
Volume of 5th largest overflow = 11.2 MG
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49 52 55 58
Number of Overflows

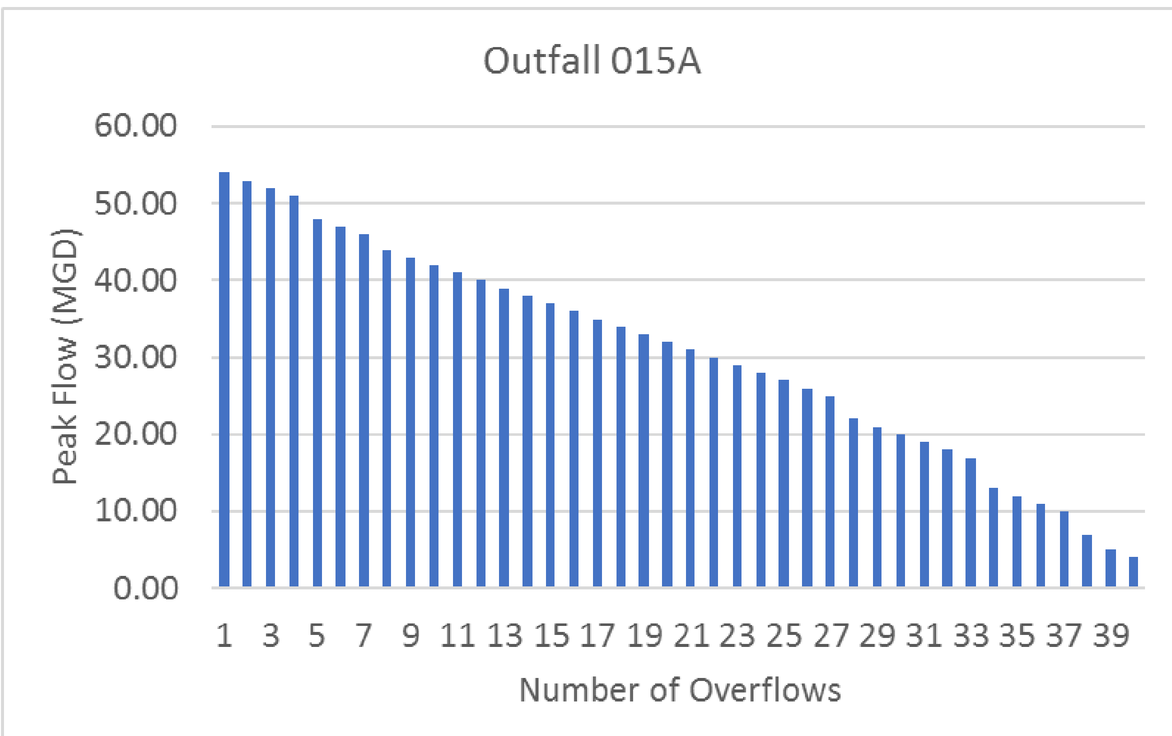

Outfall 013A
300.0
250.0
200.0
150.0
100.0
50.0
0.0
Peak Flow (MGD)
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49 52 55 58
Number of Overflows

Outfall 015A CSO Frequencies (Volumes and Peak Flows) in Typical Year

Overflow Number	Volume (MG)	Peak Flow (MGD)
1	1.06	47.00
2	1.06	46.00
3	1.03	44.00
4	0.87	43.00
5	0.82	42.00
6	0.82	41.00
7	0.70	40.00
8	0.66	39.00
9	0.66	38.00
10	0.62	37.00
11	0.61	36.00
12	0.60	35.00
13	0.60	34.00
14	0.57	33.00
15	0.52	32.00
16	0.48	31.00
17	0.43	30.00
18	0.42	29.00
19	0.39	28.00
20	0.26	27.00
21	0.25	26.00
22	0.25	25.00
23	0.22	22.00
24	0.16	21.00
25	0.12	20.00
26	0.12	19.00
27	0.10	18.00
28	0.10	17.00
29	0.09	13.00
30	0.09	12.00
31	0.08	11.00
32	0.08	10.00
33	0.07	7.00
34	0.06	5.00
35	0.06	4.00
36	1.06	47.00
37	1.06	46.00
38	1.03	44.00
39	0.87	43.00
40	0.82	42.00

Volumes and Peak Flows were sorted separately

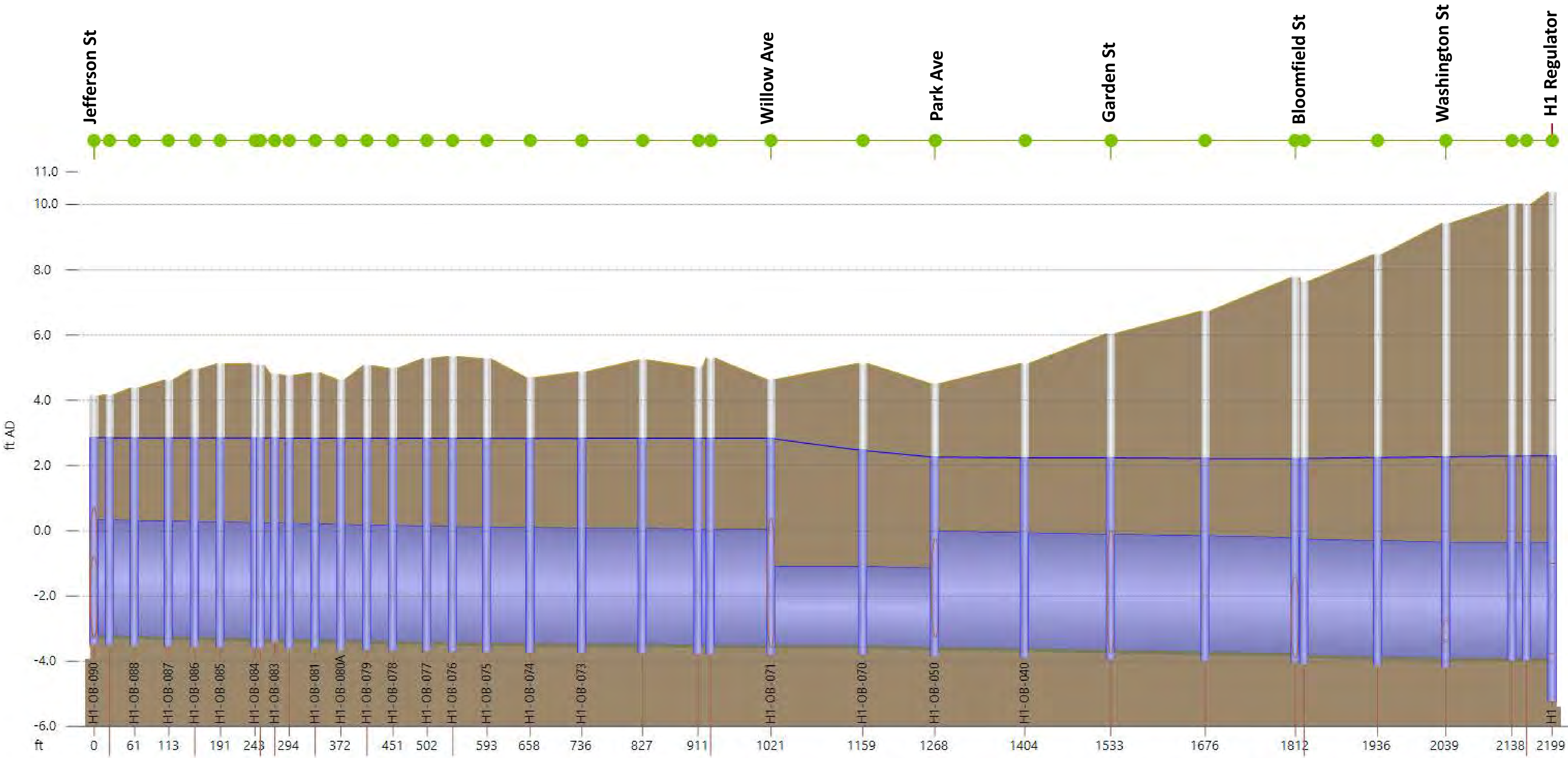

Outfall 015A
Overflow Volume (MG)
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Volume of 5th largest overflow = 1.2 MG
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39
Number of Overflows

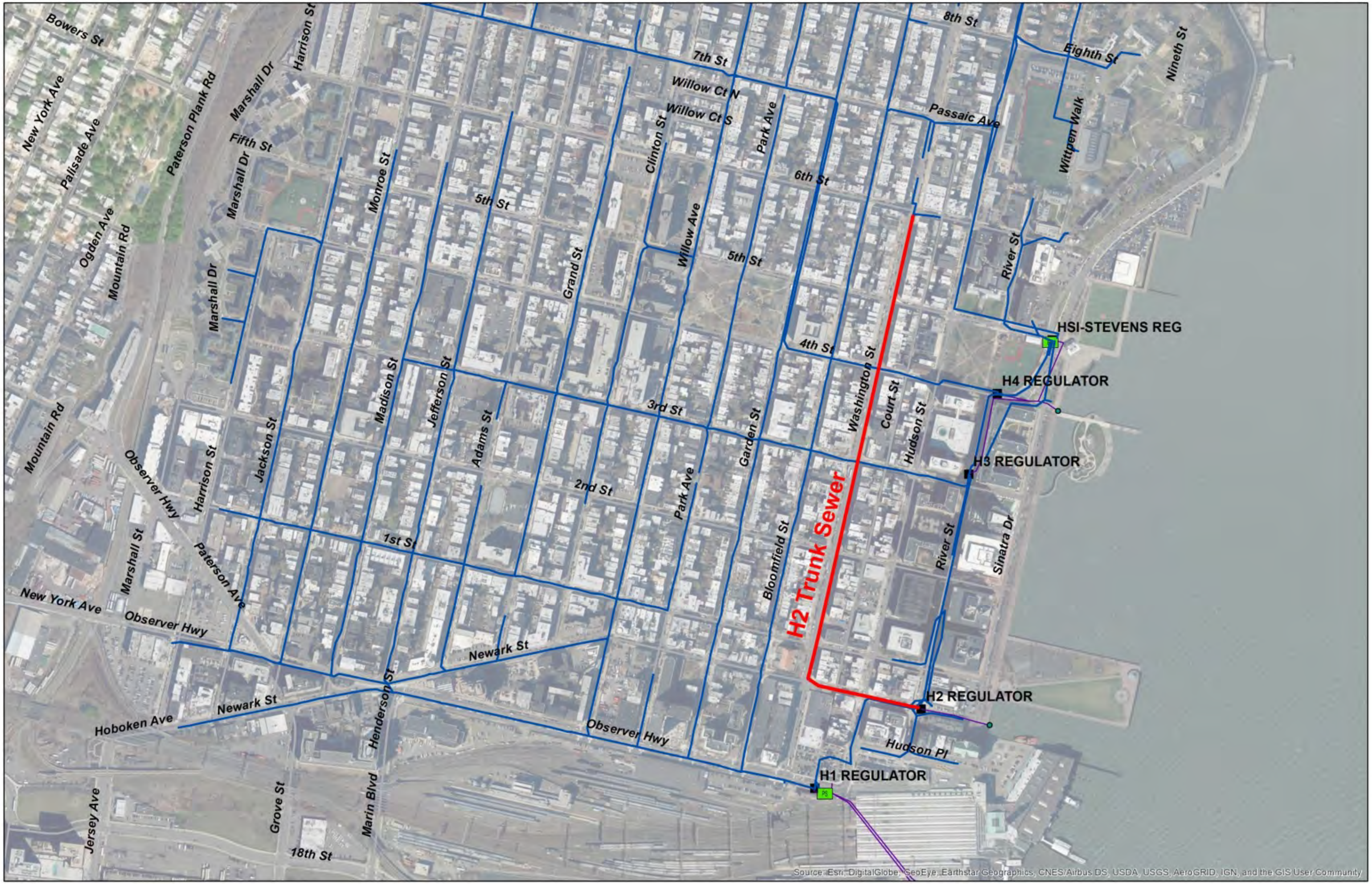

Outfall 015A
Peak Flow (MGD)
60.00
50.00
40.00
30.00
20.00
10.00
0.00
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39
Number of Overflows

H1 Trunk Sewer
H1 REGULATOR
H2 REGULATOR
H3 REGULATOR
PS
Marshall St
Jackson St
Paterson Ave
Harrison St
Monroe St
Madison St
Jefferson St
Adams St
Grand St
Clinton St
Willow Ave
Park Ave
Garden St
Bloomfield St
Washington St
Court St
Hudson St
Sinatra Dr
3rd St
2nd St
1st St
Observer Hwy
Newark St
Henderson St
River St
Hudson Pl
18th St
Marin Blvd
Grove St
16th St
Erie St
15th St
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

H1 Trunk Sewer

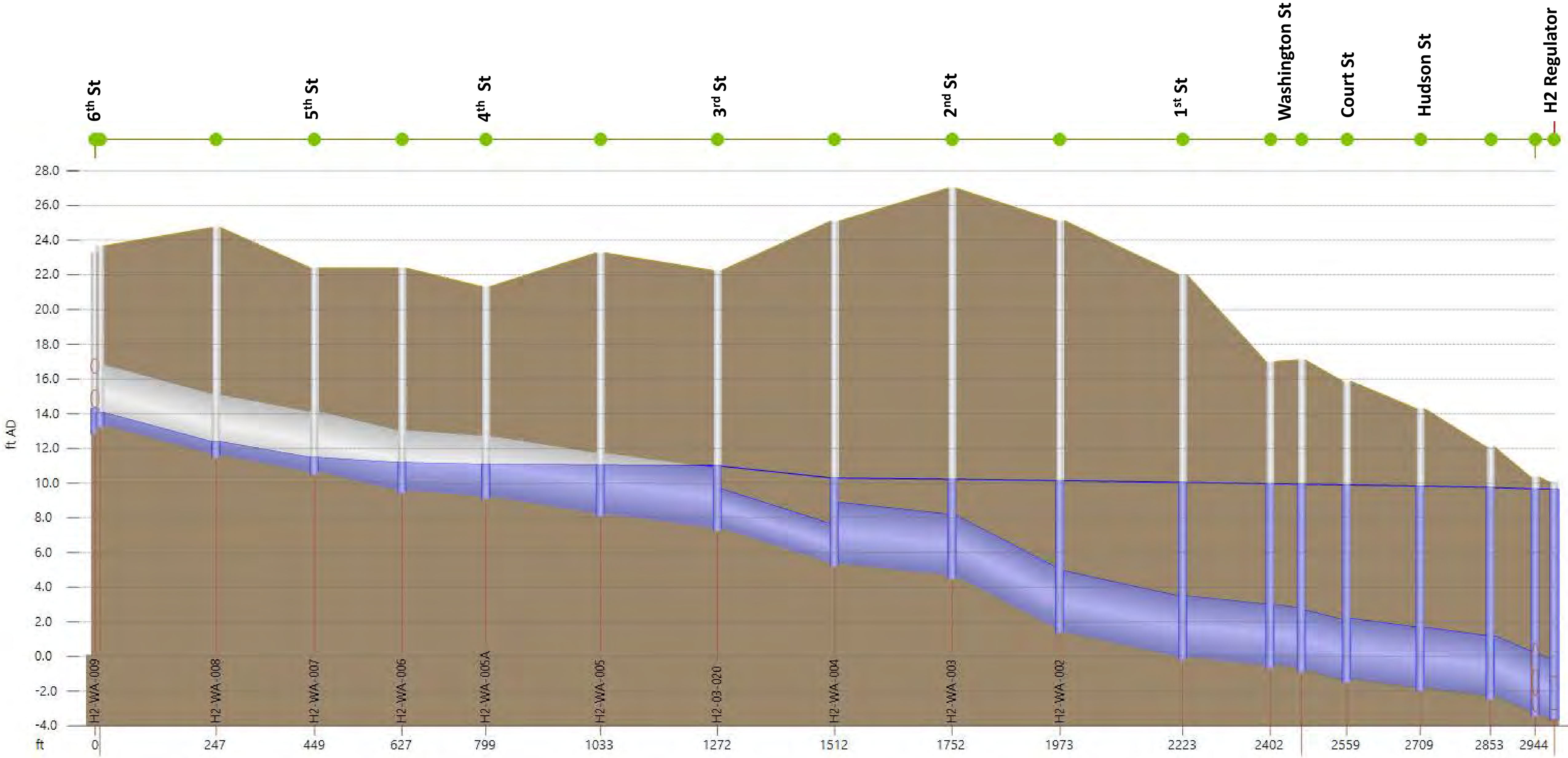
Max Typical Year

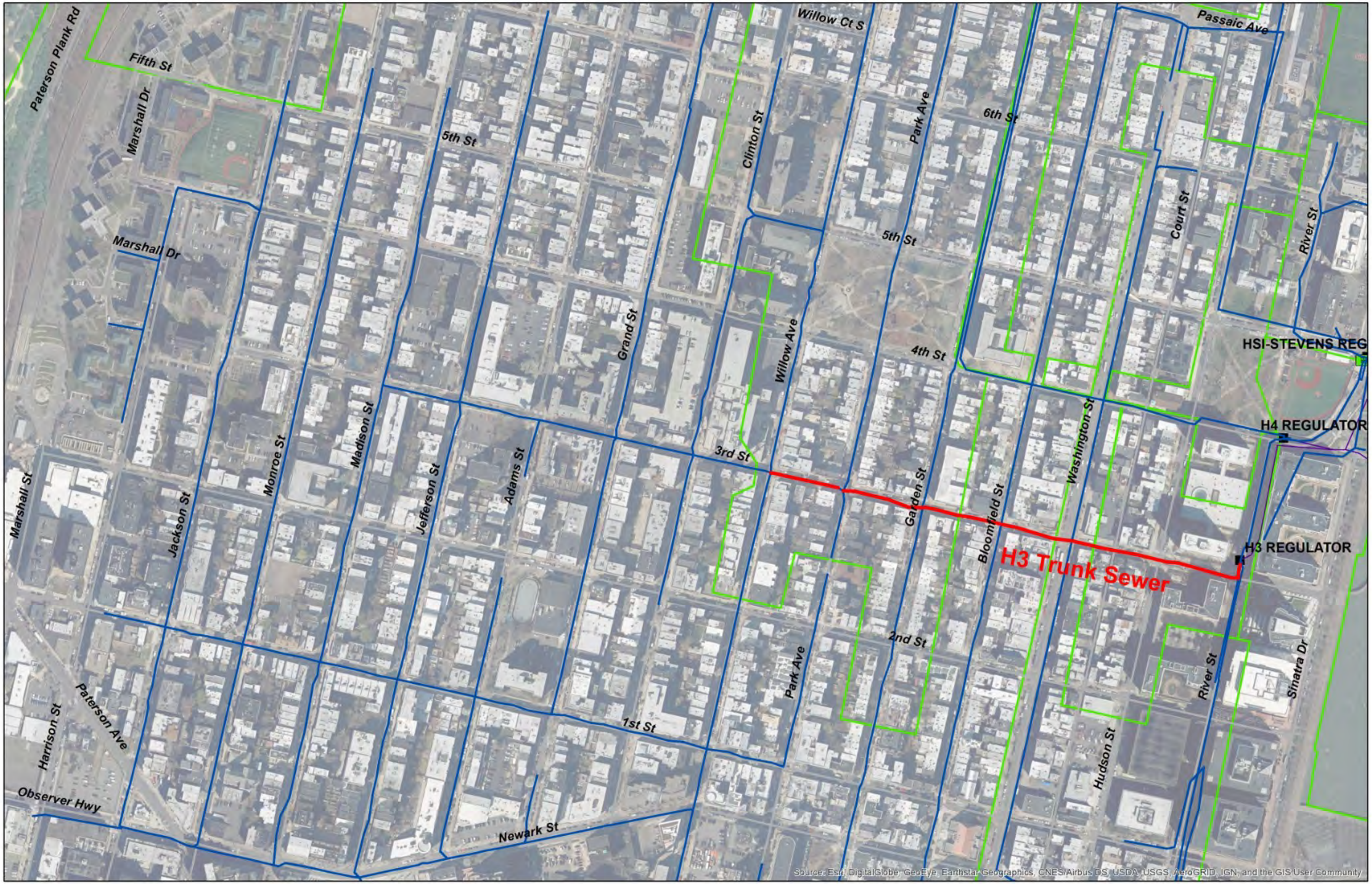



H2 Trunk Sewer
HSI-STEVENS REG
H4 REGULATOR
H3 REGULATOR
H2 REGULATOR
H1 REGULATOR
Bowers St
New York Ave
Palisade Ave
Paterson Plank Rd
Marshall Dr
Harrison St
Fifth St
Monroe St
5th St
Grand St
Clinton St
Willow Ct N
Willow Ct S
7th St
8th St
Eighth St
Nineth St
Park Ave
Passaic Ave
Wittpen Walk
6th St
Willow Ave
5th St
River St
4th St
Washington St
Court St
Hudson St
Madison St
Jefferson St
Adams St
3rd St
Garden St
Jackson St
Mountain Rd
Ogden Ave
Observer Hwy
2nd St
1st St
Bloomfield St
Sinatra Dr
Marshall St
Paterson Ave
New York Ave
Observer Hwy
Newark St
Henderson St
Hoboken Ave
Hudson Pl
Grove St
Marin Blvd
Jersey Ave
18th St
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

H2 Trunk Sewer

Max Typical Year

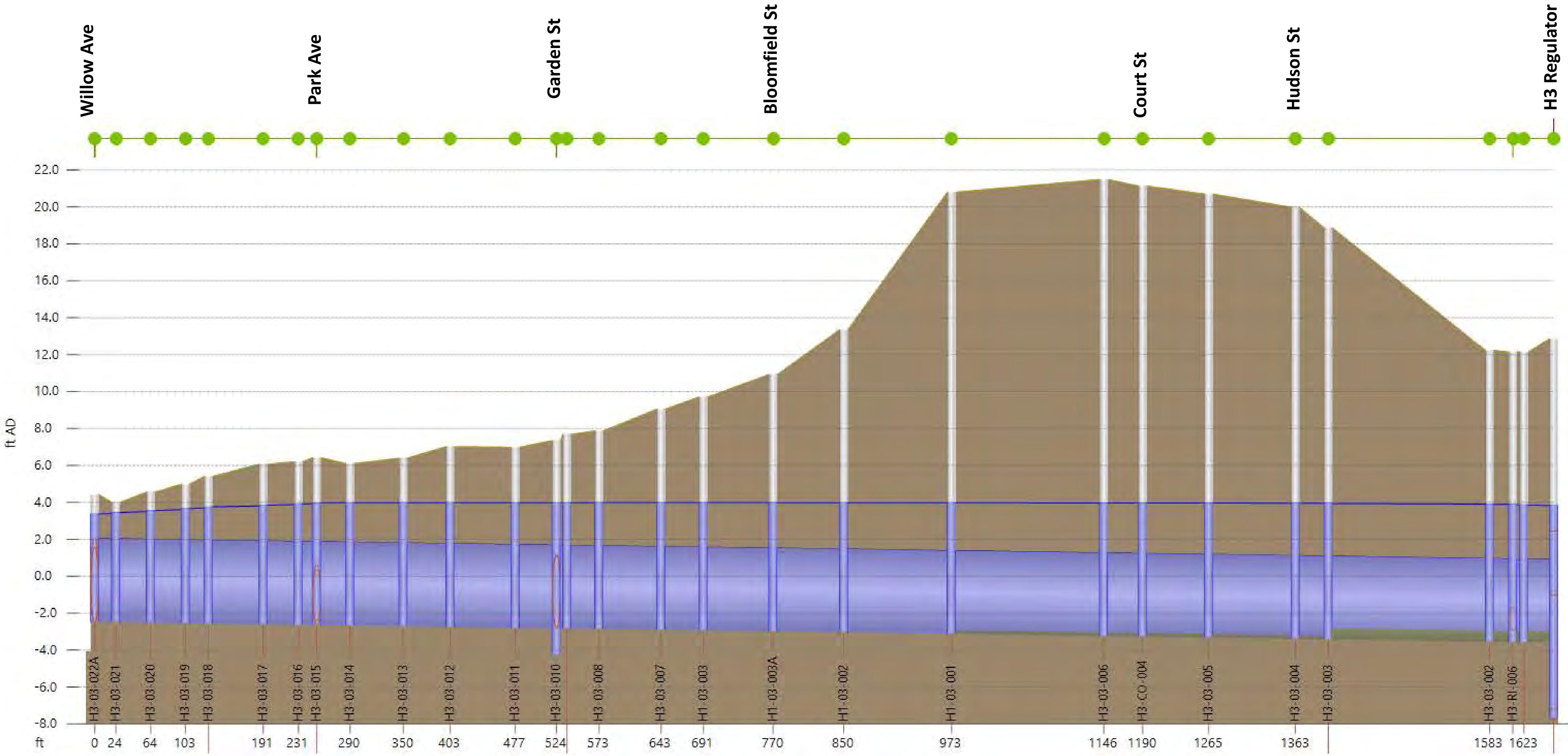


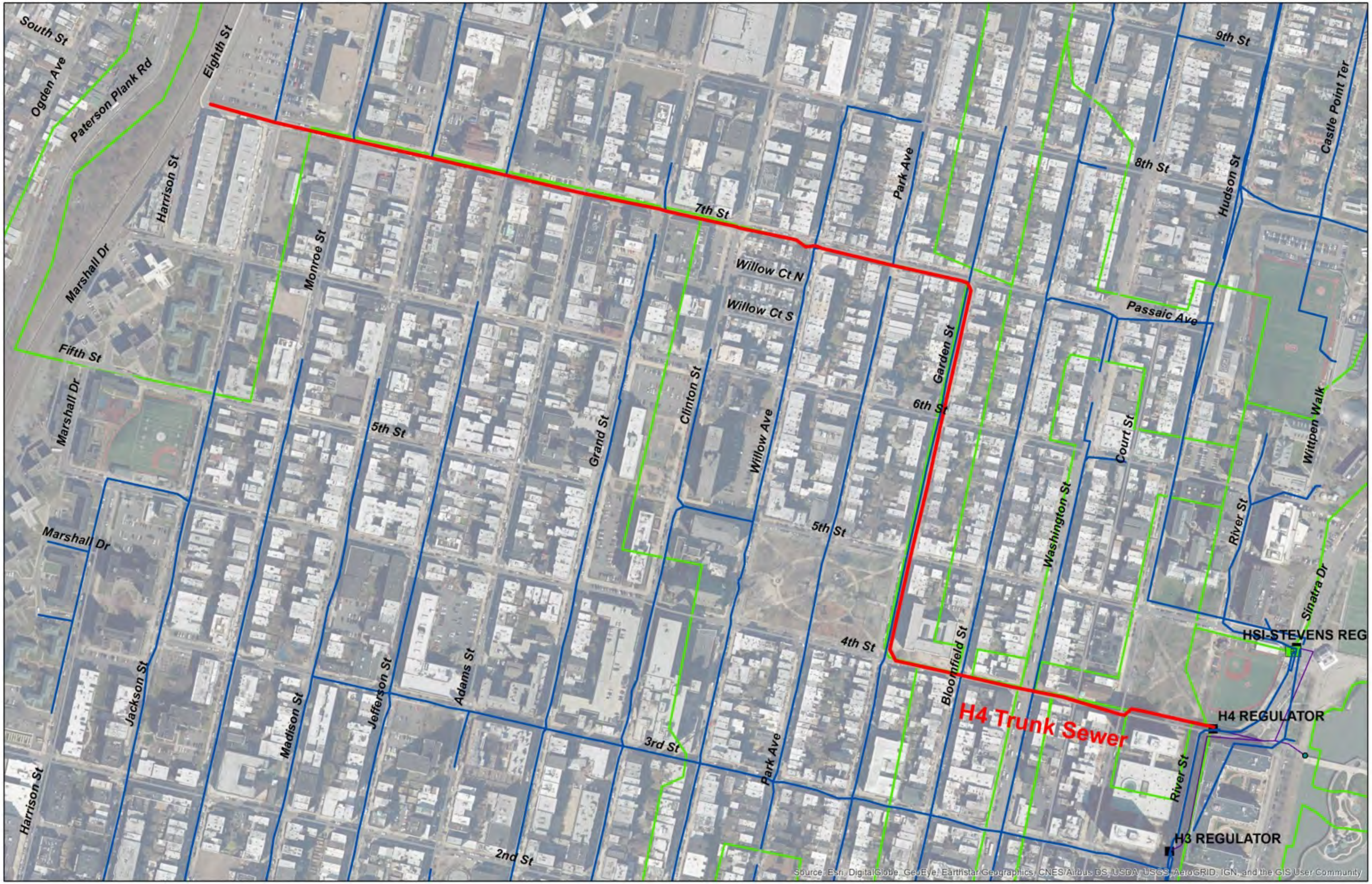


Paterson Plank Rd
Fifth St
Marshall Dr
Willow Ct S
Passaic Ave
6th St
5th St
Clinton St
Park Ave
Court St
River St
Marshall Dr
Grand St
Willow Ave
4th St
HSI-STEVENS REG
H4 REGULATOR
3rd St
Washington St
Madison St
Monroe St
Adams St
Jefferson St
Garden St
Bloomfield St
Marshall St
Jackson St
H3 REGULATOR
H3 Trunk Sewer
2nd St
Park Ave
River St
Sinatra Dr
Paterson Ave
Harrison St
1st St
Hudson St
Observer Hwy
Newark St
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

H3 Trunk Sewer

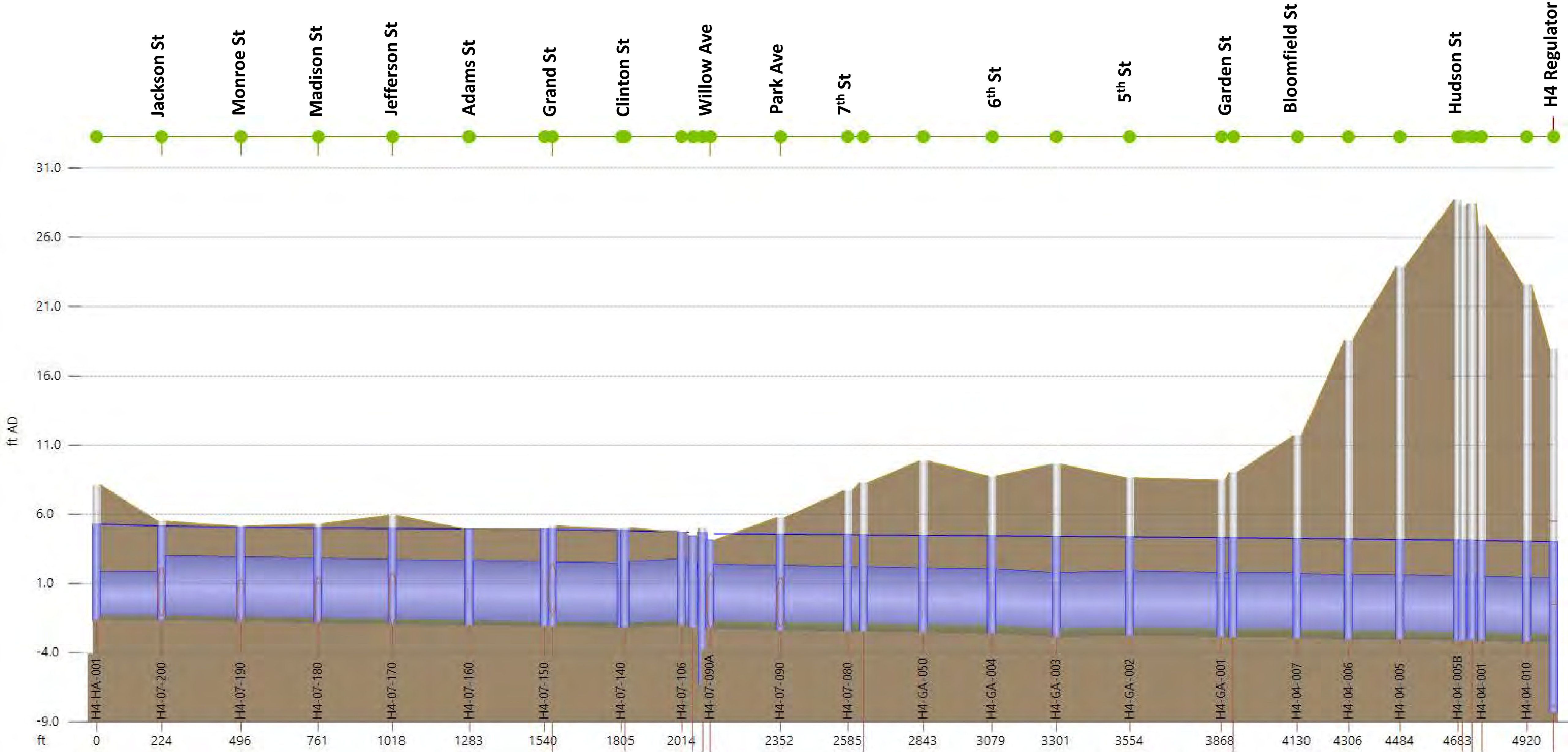
Max Typical Year




South St
Ogden Ave
Paterson Plank Rd
Eighth St
Harrison St
Marshall Dr
Monroe St
7th St
Willow Ct N
Willow Ct S
Park Ave
9th St
Castle Point Ter
8th St
Hudson St
Passaic Ave
Garden St
Fifth St
Marshall Dr
6th St
5th St
Clinton St
Willow Ave
Grand St
Court St
Witpen Walk
Washington St
River St
5th St
Marshall Dr
Sinatra Dr
HSI-STEVENS REG
4th St
Bloomfield St
H4 REGULATOR
H4 Trunk Sewer
Jackson St
Madison St
Jefferson St
Adams St
3rd St
Park Ave
River St
Harrison St
H3 REGULATOR
2nd St
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

H4 Trunk Sewer

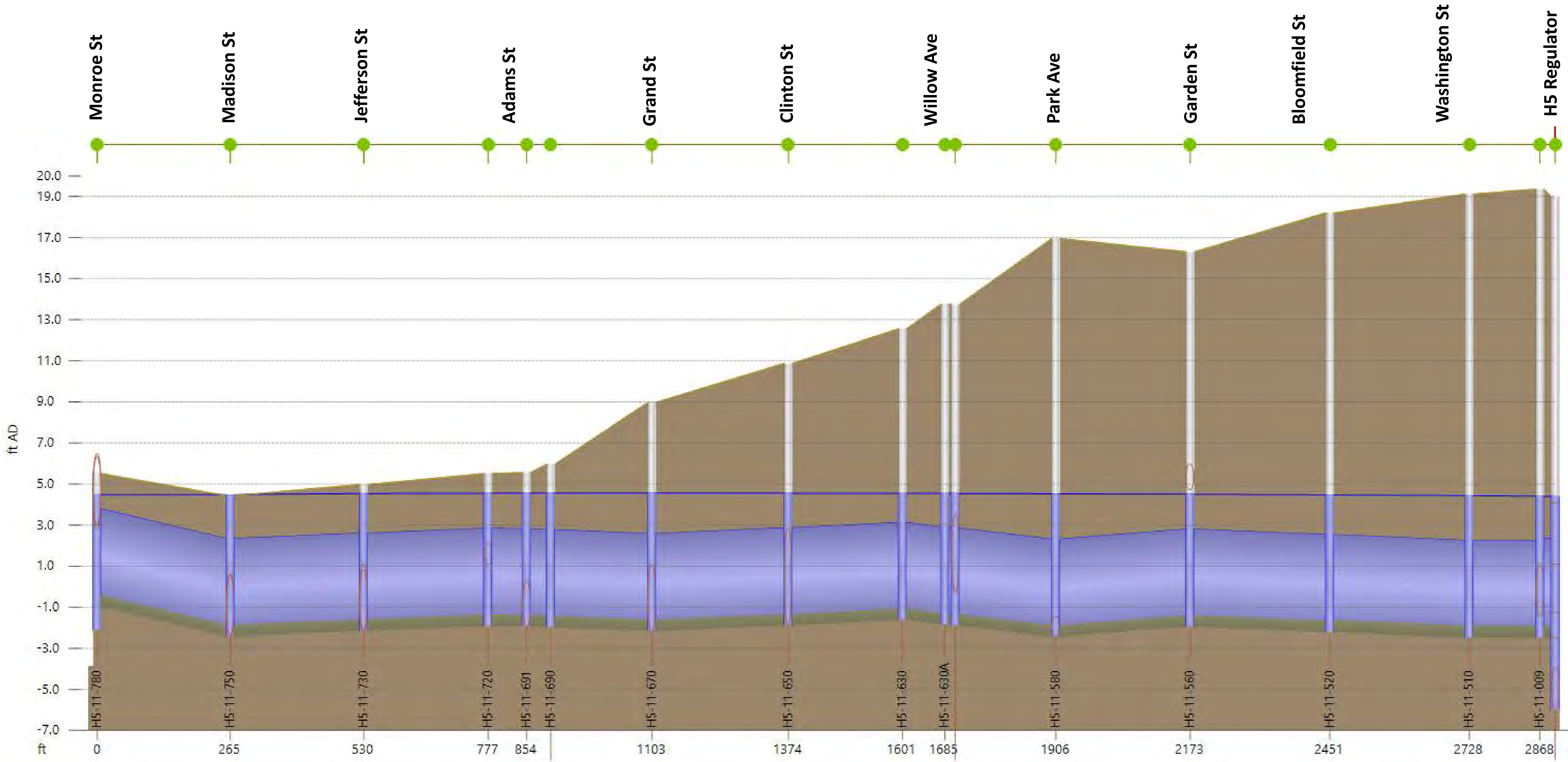
Max Typical Year

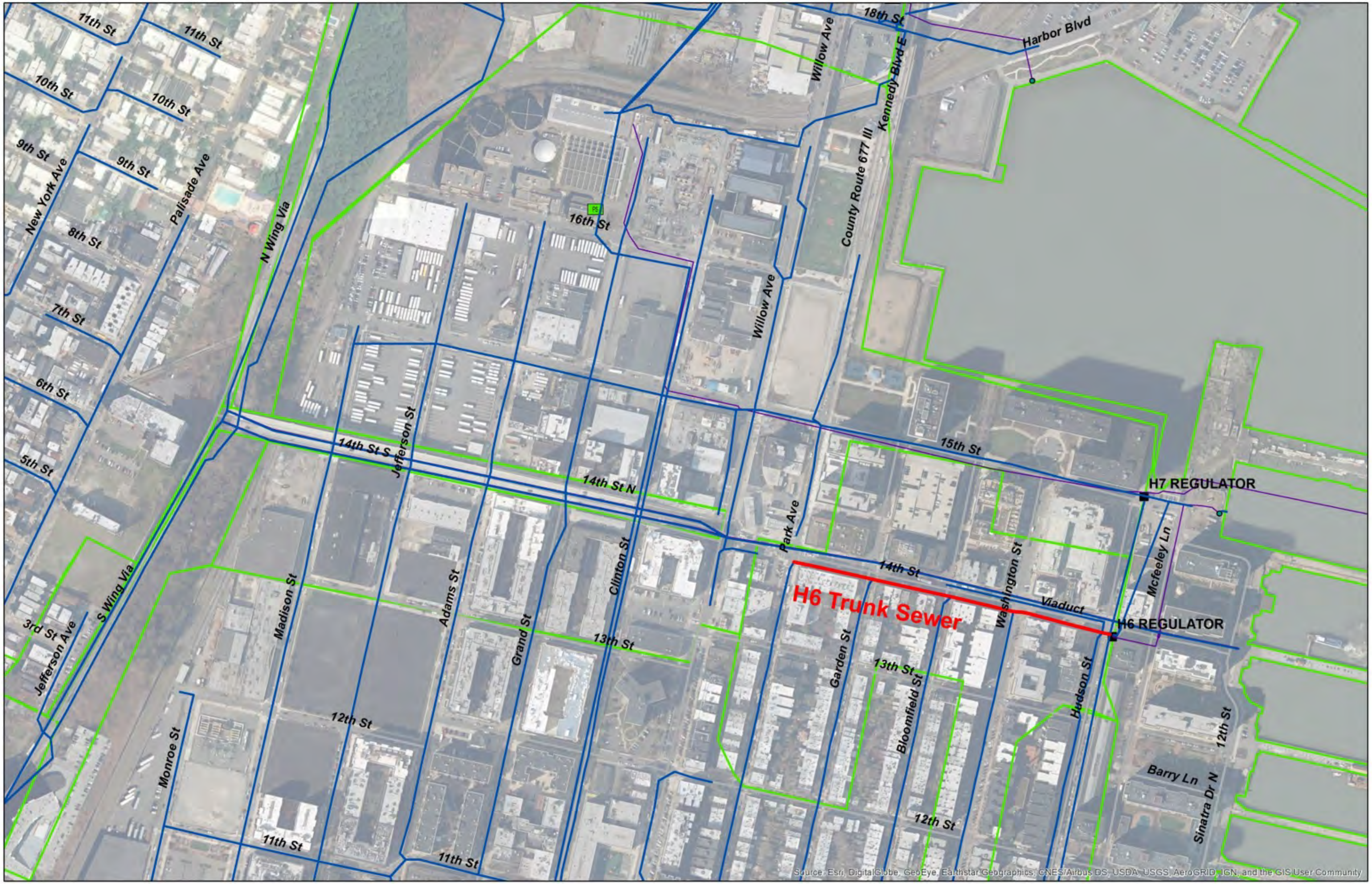


H5 Trunk Sewer
H5 REGULATOR
H6 REGULATOR
14th St
Viaduct
13th St
12th St
11th St
10th St
9th St
8th St
7th St
Nineth St
Maxwell Ln
Barry Ln
Mcfeeley Ln
Sinatra Dr
Sinatra Dr N
Washington St
Bloomfield St
Garden St
Hudson St
Castle Point Ter
Park Ave
Willow Ave
Clinton St
Grand St
Adams St
Jefferson St
Madison St
Monroe St
Jackson St
Eighth St
Ogden Ave
Palisade Ave
Paterson Plank Rd
New York Ave
3rd St
2nd St
Jefferson Ave
S Wing Via
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

H5 Trunk Sewer

Max Typical Year

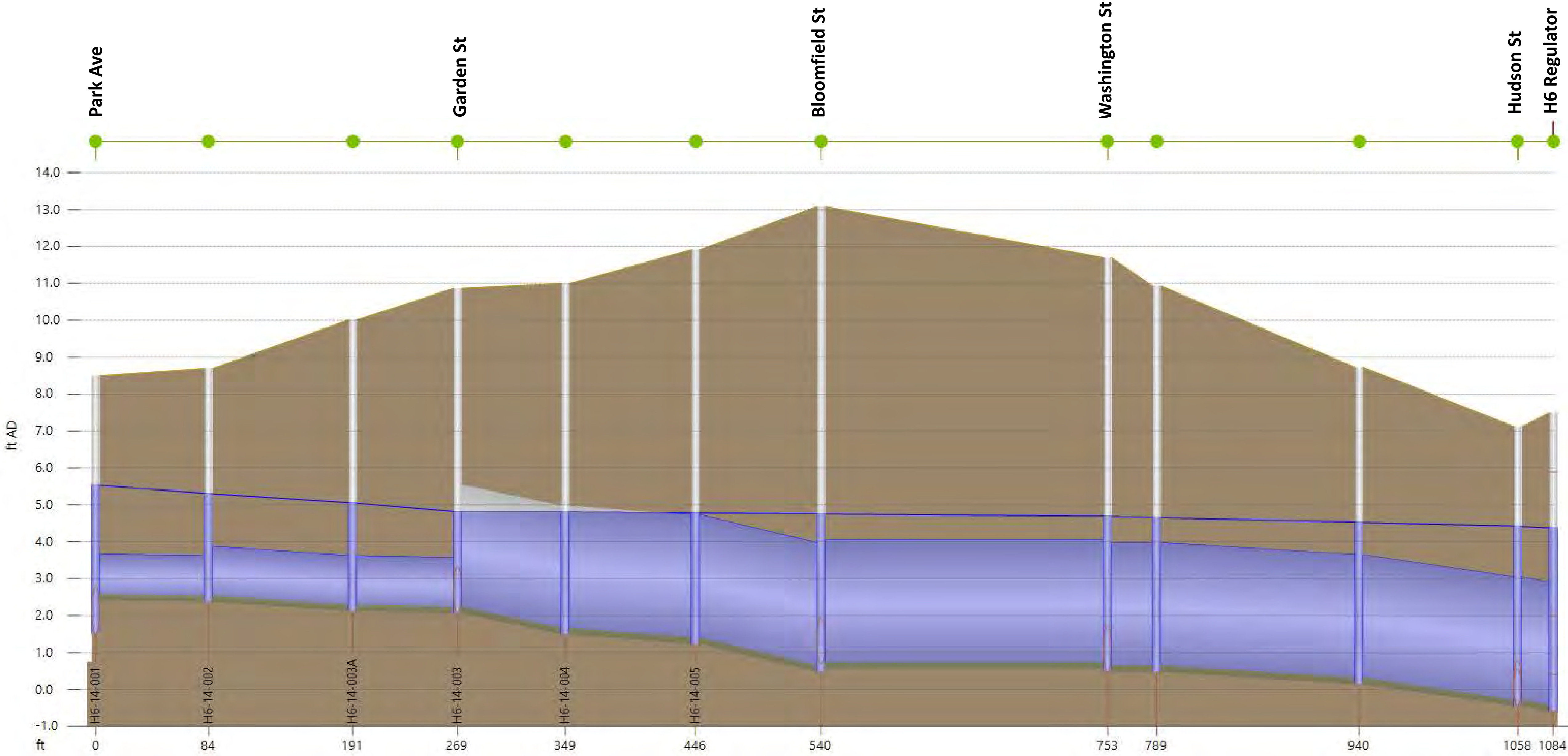


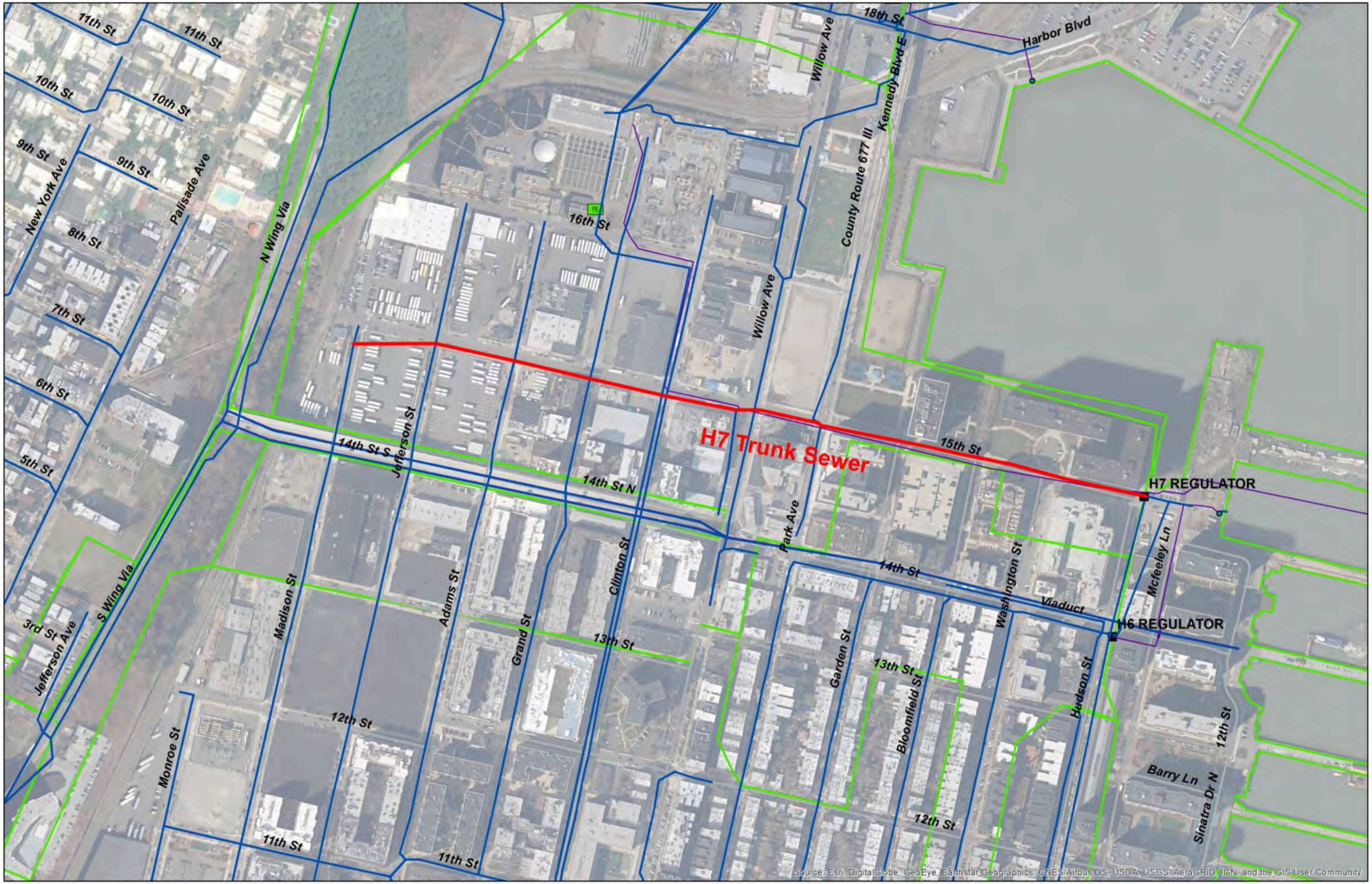


11th St
11th St
10th St
10th St
9th St
9th St
New York Ave
Palisade Ave
8th St
7th St
6th St
5th St
3rd St
Jefferson Ave
S Wing Via
N Wing Via
16th St
PS
18th St
Harbor Blvd
Willow Ave
Kennedy Blvd E
County Route 677 II
Willow Ave
15th St
H7 REGULATOR
14th St S
Jefferson St
14th St N
Park Ave
14th St
Viaduct
Mcfeeley Ln
H6 REGULATOR
H6 Trunk Sewer
Washington St
Clinton St
Adams St
Grand St
Madison St
13th St
13th St
Garden St
Bloomfield St
Hudson St
12th St
Monroe St
12th St
Barry Ln
Sinatra Dr N
12th St
11th St
11th St
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

H6 Trunk Sewer

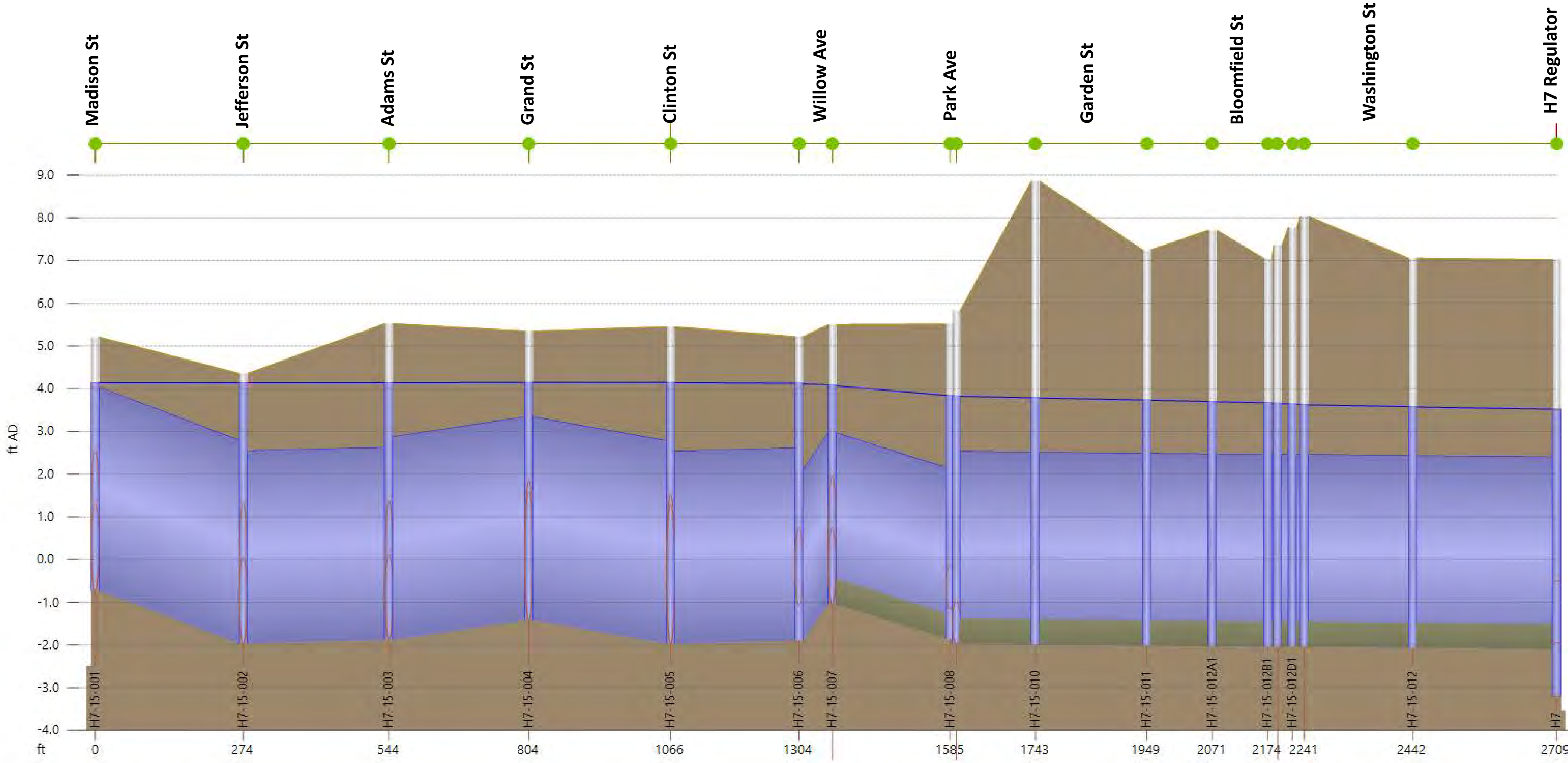
Max Typical Year




H7 Trunk Sewer
H7 REGULATOR
H6 REGULATOR
15th St
14th St S
14th St N
14th St
16th St
18th St
Harbor Blvd
Willow Ave
County Route 677 II
Kennedy Blvd E
Jefferson St
Park Ave
Washington St
Mcfeeley Ln
Viaduct
Madison St
Adams St
Grand St
Clinton St
13th St
Garden St
Bloomfield St
Hudson St
12th St
Barry Ln
Sinatra Dr N
Monroe St
11th St
S Wing Via
N Wing Via
Jefferson Ave
3rd St
5th St
6th St
7th St
8th St
9th St
10th St
New York Ave
Palisade Ave
PS
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

H7 Trunk Sewer

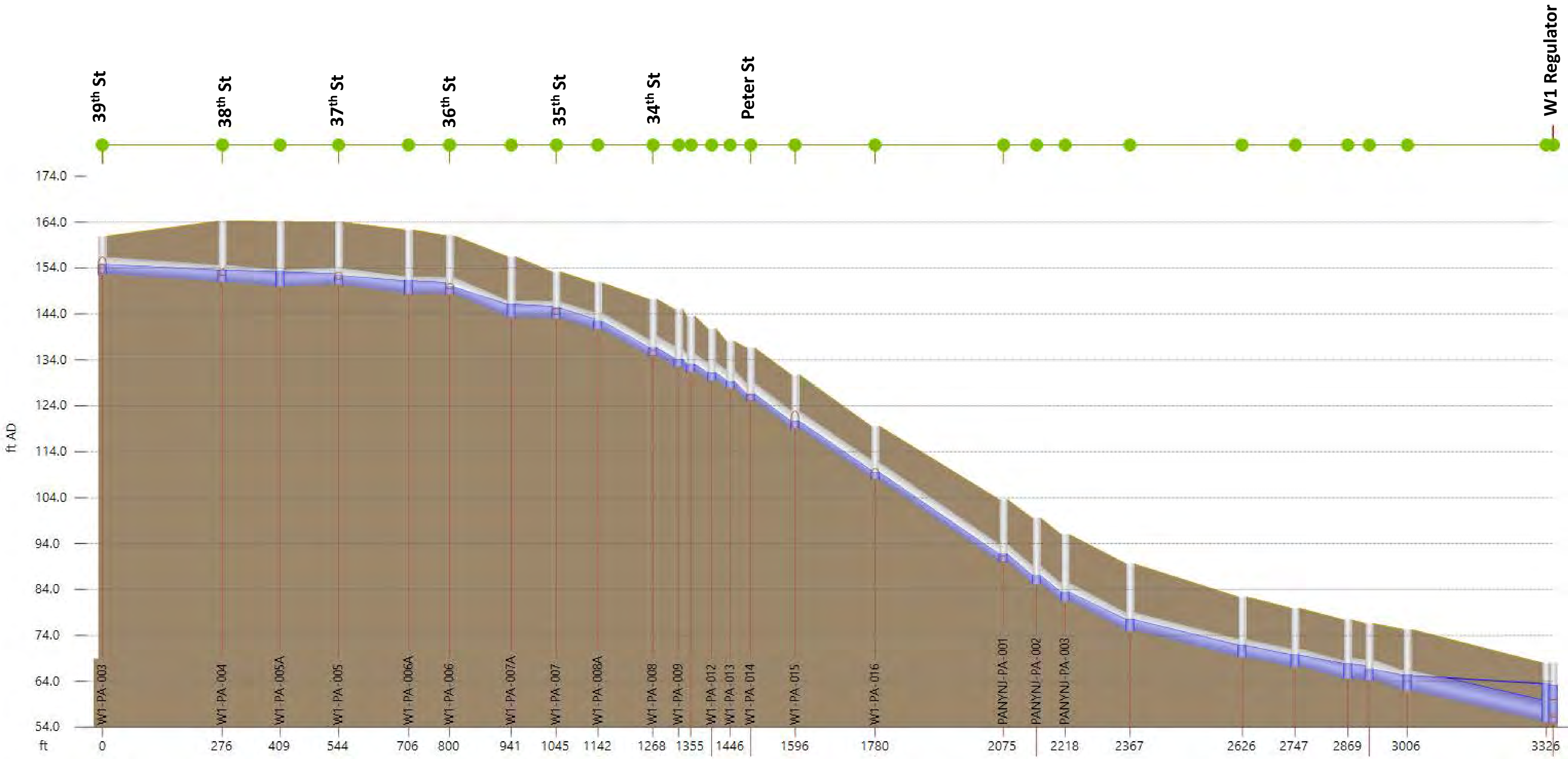
Max Typical Year

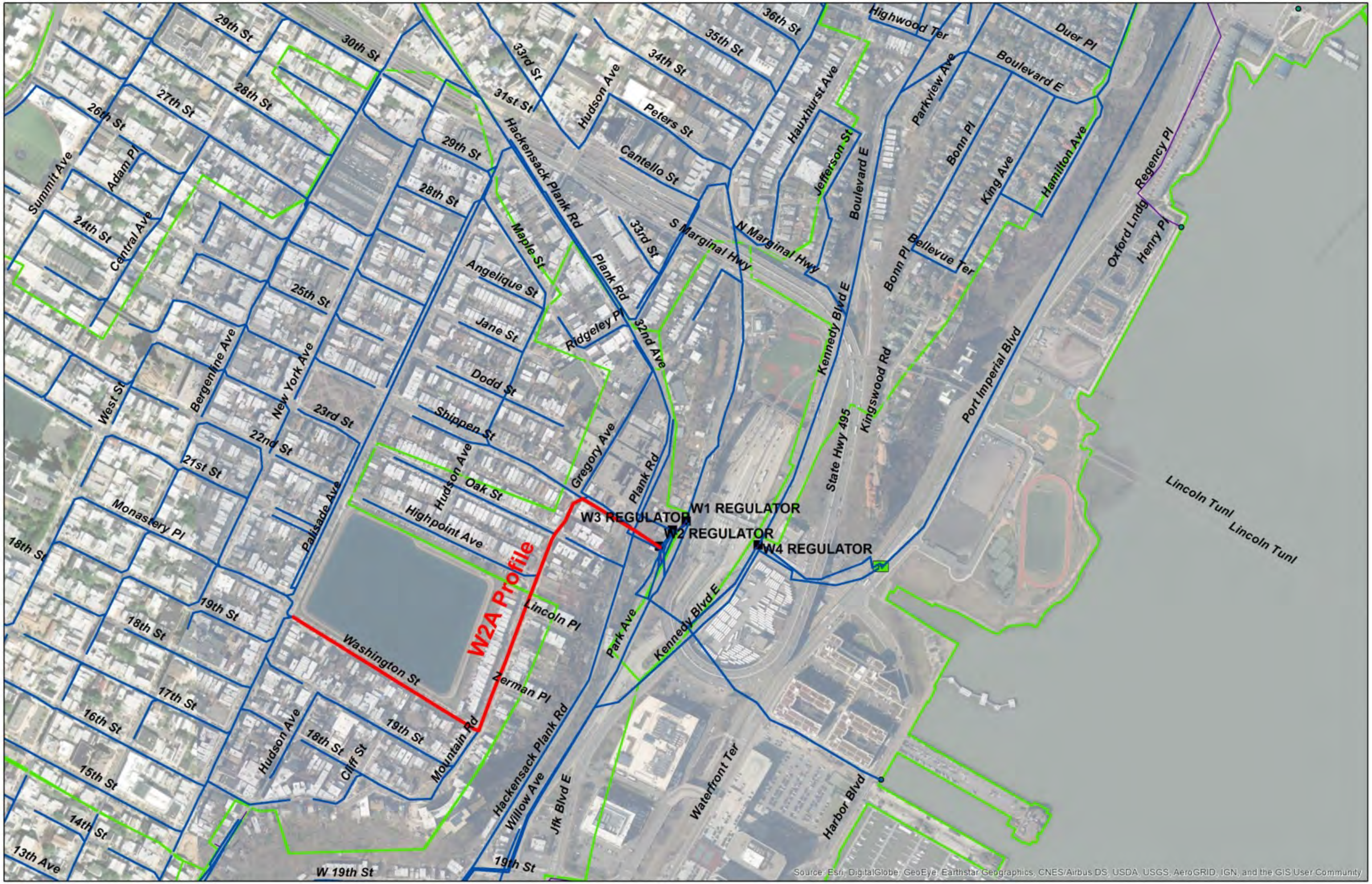


W1 Profile
W1 REGULATOR
W2 REGULATOR
W3 REGULATOR
W4 REGULATOR
PS
40th St
39th St
38th St
37th St
36th St
35th St
34th St
33rd St
32nd Ave
31st St
30th St
29th St
28th St
27th St
26th St
25th St
24th St
23rd St
22nd St
21st St
19th St
18th St
17th St
Henry St
Sip St
John F Kennedy Blvd
Jeanette St
Summit Ave
Central Ave
Adam Pl
West St
Bergenline Ave
Monastery Pl
New York Ave
Hackensack Plank Rd
Hudson Ave
Peters St
Cantello St
S Marginal Hwy
N Marginal Hwy
Hauxhurst Ave
Jefferson St
Boulevard E
Kennedy Blvd E
Highwood Ave
Highwood Ter
Parkview Ave
Bonn Pl
King Ave
Hamilton Ave
Bellevue Ter
Kingswood Rd
Port Imperial Blvd
Potter Pl
Clifton Ter
Liberty Pl
Eldorado Pl
Hudson Pl
Duer Pl
Pershing Rd
Carlyle Ct
Regency Pl
Oxford Lndg
Henry Pl
Maple St
Angelique St
Jane St
Dodd St
Shippen St
Ridgeley Pl
Plank Rd
Gregory Ave
Palisade Ave
Oak St
Highpoint Ave
Lincoln Pl
Washington St
Park Ave
State Hwy 495
Harbor Blvd
Lincoln Tunl
Lincoln Tunl
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

W1 Trunk Sewer

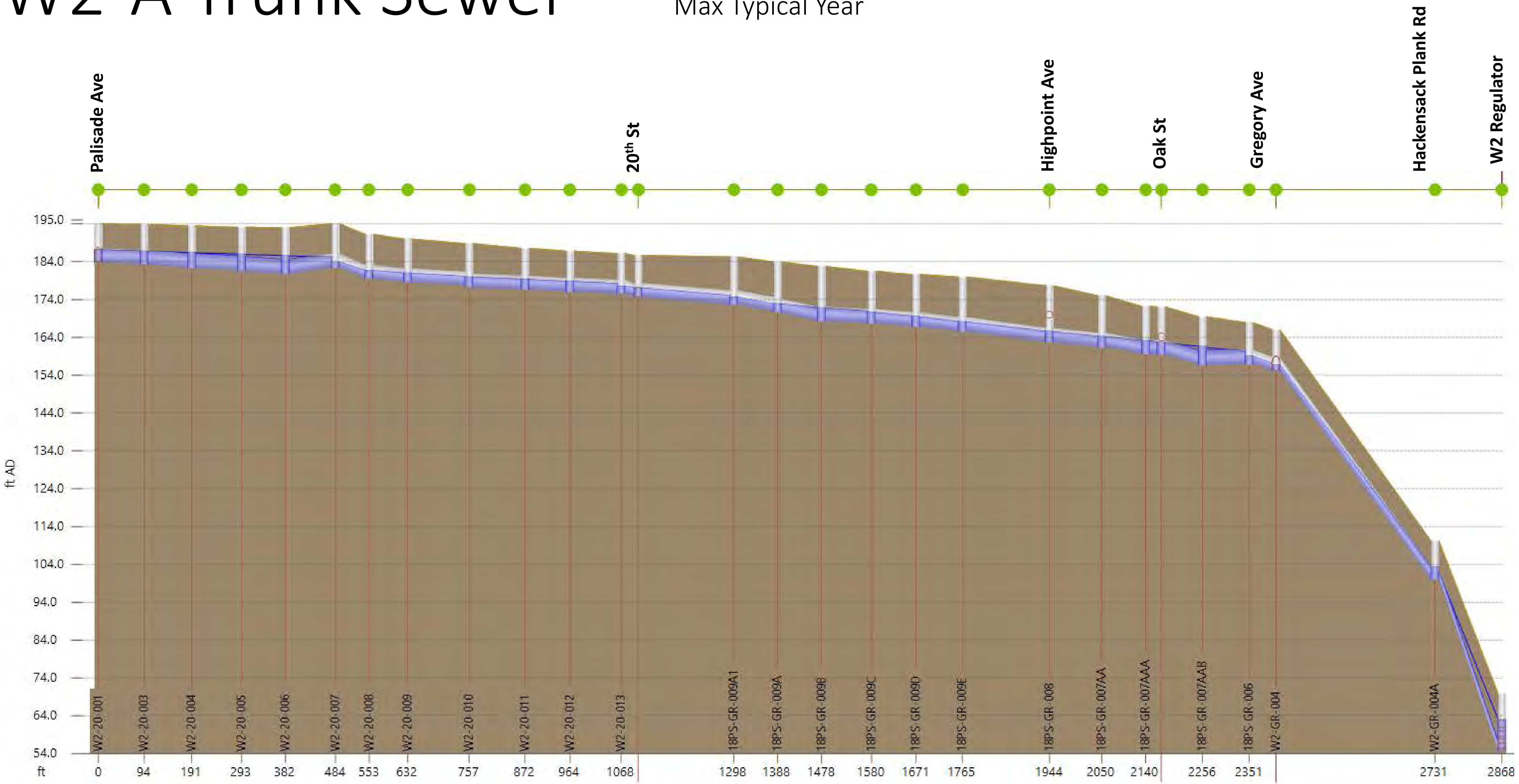
Max Typical Year

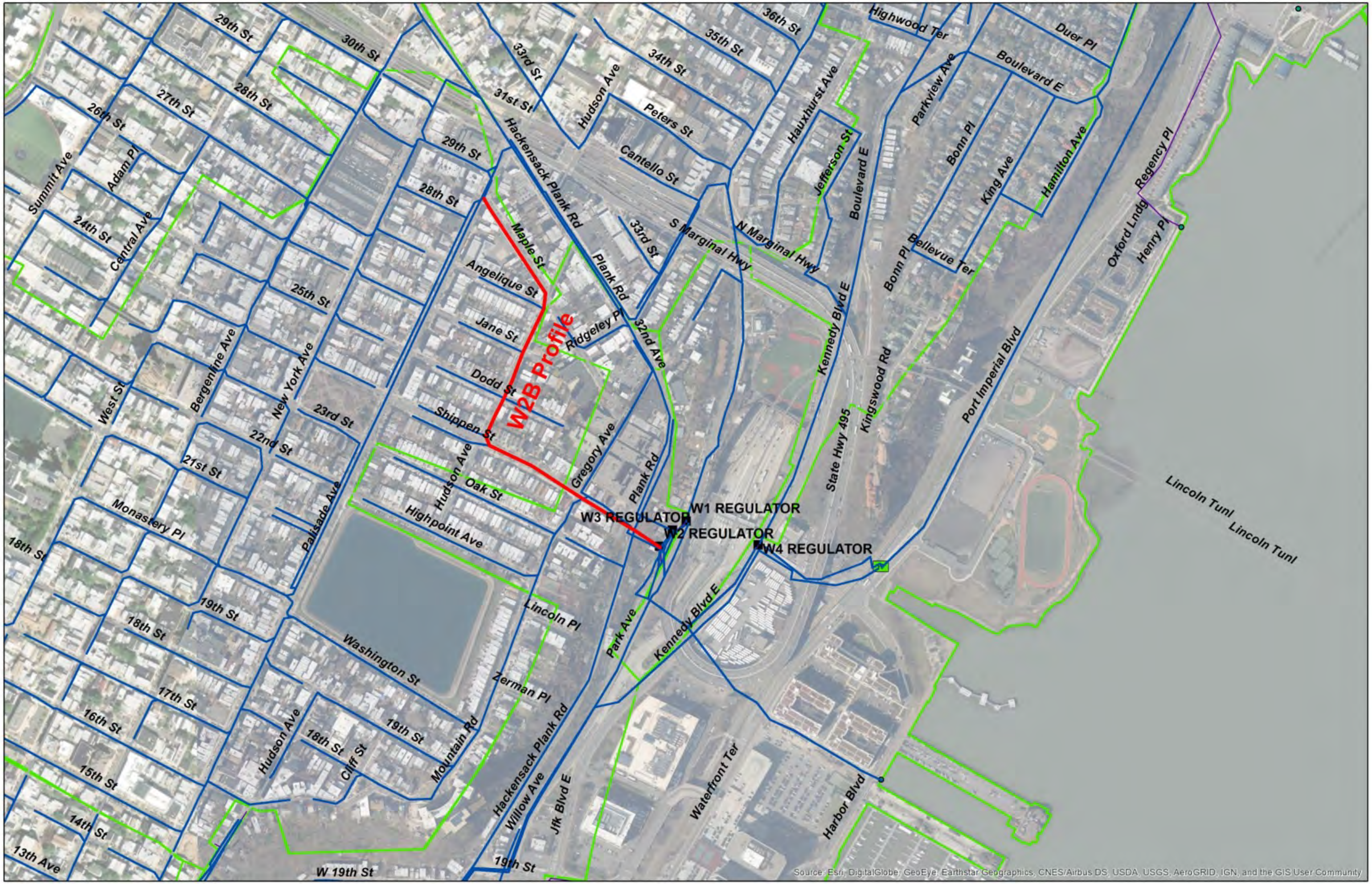



W1 REGULATOR
W3 REGULATOR
W2 REGULATOR
W4 REGULATOR
W2A Profile
29th St
30th St
33rd St
36th St
35th St
34th St
Highwood Ter
Duer Pl
Boulevard E
Parkview Ave
Hauxhurst Ave
Hudson Ave
Peters St
31st St
28th St
27th St
26th St
Hackensack Plank Rd
29th St
Cantello St
Jefferson St
Boulevard E
Bonn Pl
King Ave
Hamilton Ave
Regency Pl
Summit Ave
Adam Pl
28th St
24th St
Central Ave
Maple St
33rd St
S Marginal Hwy
N Marginal Hwy
Bellevue Ter
Bonn Pl
Oxford Lndg
Henry Pl
Angelique St
Plank Rd
25th St
Jane St
Ridgeley Pl
32nd Ave
Kennedy Blvd E
Kingswood Rd
Port Imperial Blvd
Bergenline Ave
West St
New York Ave
Dodd St
23rd St
Shippen St
22nd St
Gregory Ave
State Hwy 495
21st St
Hudson Ave
Oak St
Plank Rd
Palisade Ave
Monastery Pl
Highpoint Ave
Lincoln Tunl
Lincoln Tunl
18th St
19th St
18th St
Lincoln Pl
Park Ave
Kennedy Blvd E
Washington St
17th St
Zerman Pl
16th St
Mountain Rd
19th St
Hackensack Plank Rd
Hudson Ave
18th St
Cliff St
15th St
Willow Ave
Waterfront Ter
Jfk Blvd E
Harbor Blvd
14th St
13th Ave
W 19th St
19th St
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

W2-A Trunk Sewer

Max Typical Year

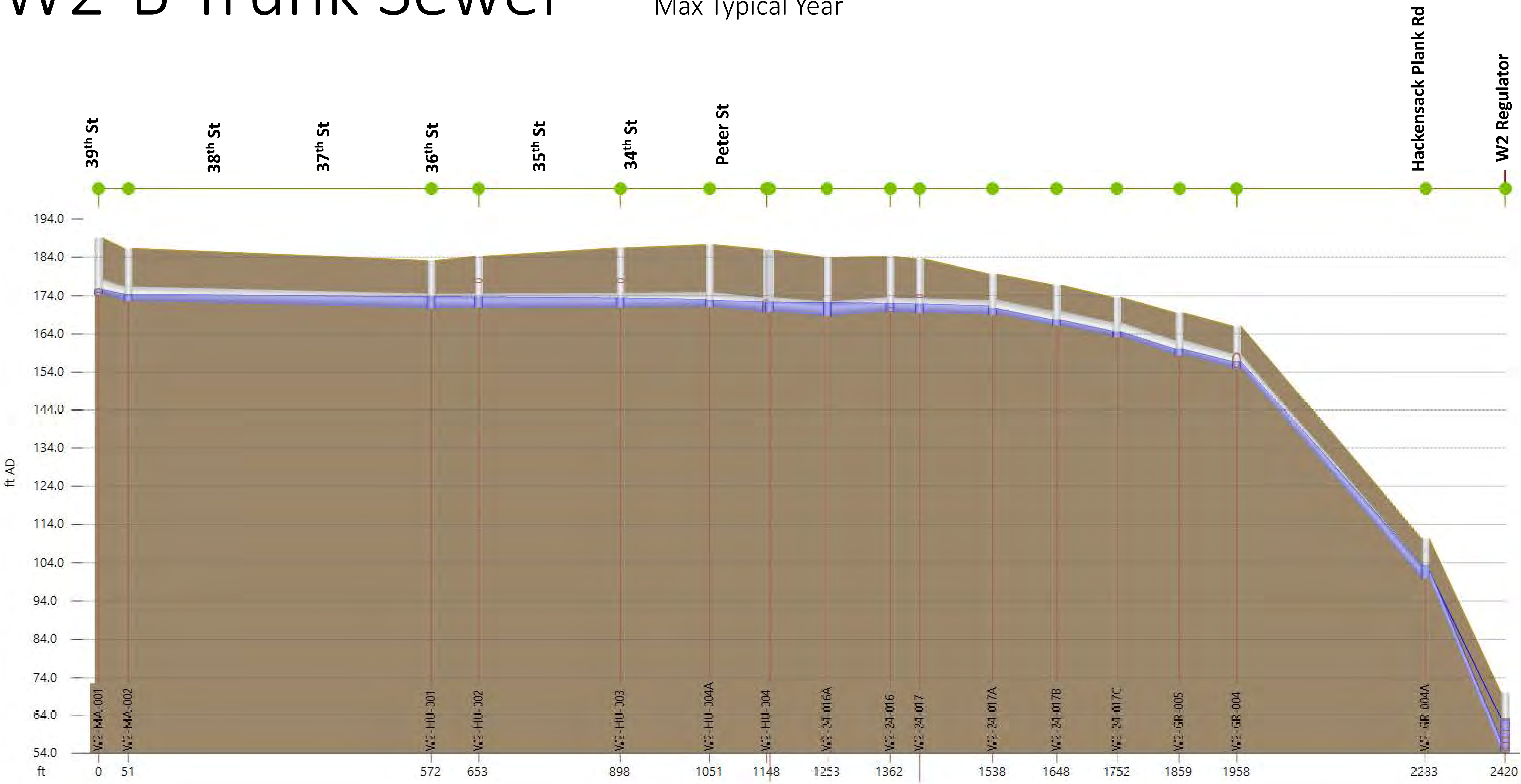


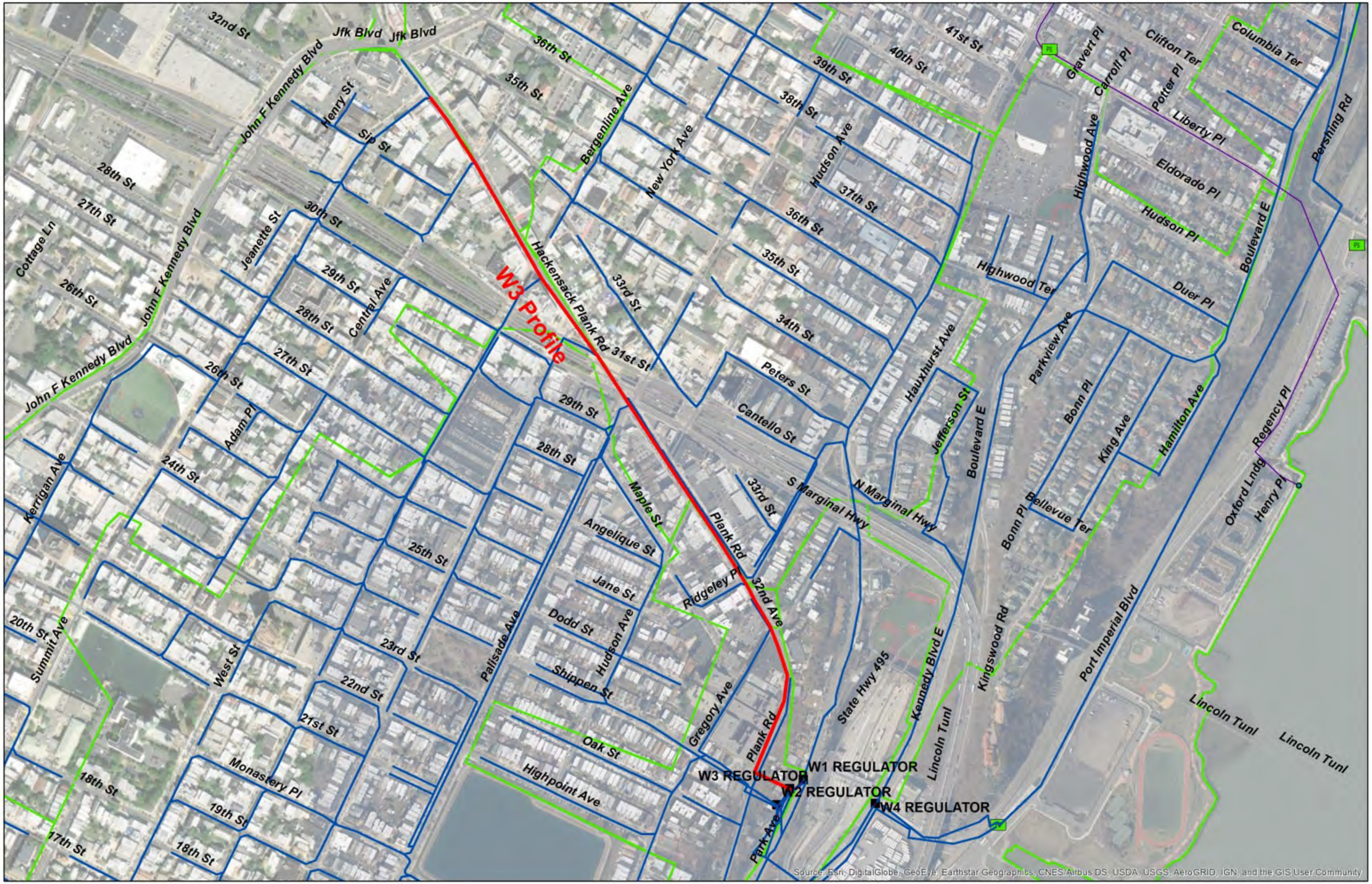


W2B Profile
W1 REGULATOR
W2 REGULATOR
W3 REGULATOR
W4 REGULATOR
Maple St
Angelique St
Jane St
Dodd St
Shippen St
Oak St
Highpoint Ave
Hudson Ave
Gregory Ave
Ridgeley Pl
Plank Rd
32nd Ave
Hackensack Plank Rd
S Marginal Hwy
N Marginal Hwy
Kennedy Blvd E
State Hwy 495
Kingswood Rd
Port Imperial Blvd
Lincoln Tunl
Lincoln Pl
Park Ave
Palisade Ave
Washington St
Zerman Pl
Mountain Rd
Willow Ave
Jfk Blvd E
Waterfront Ter
Harbor Blvd
19th St
W 19th St
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

W2-B Trunk Sewer

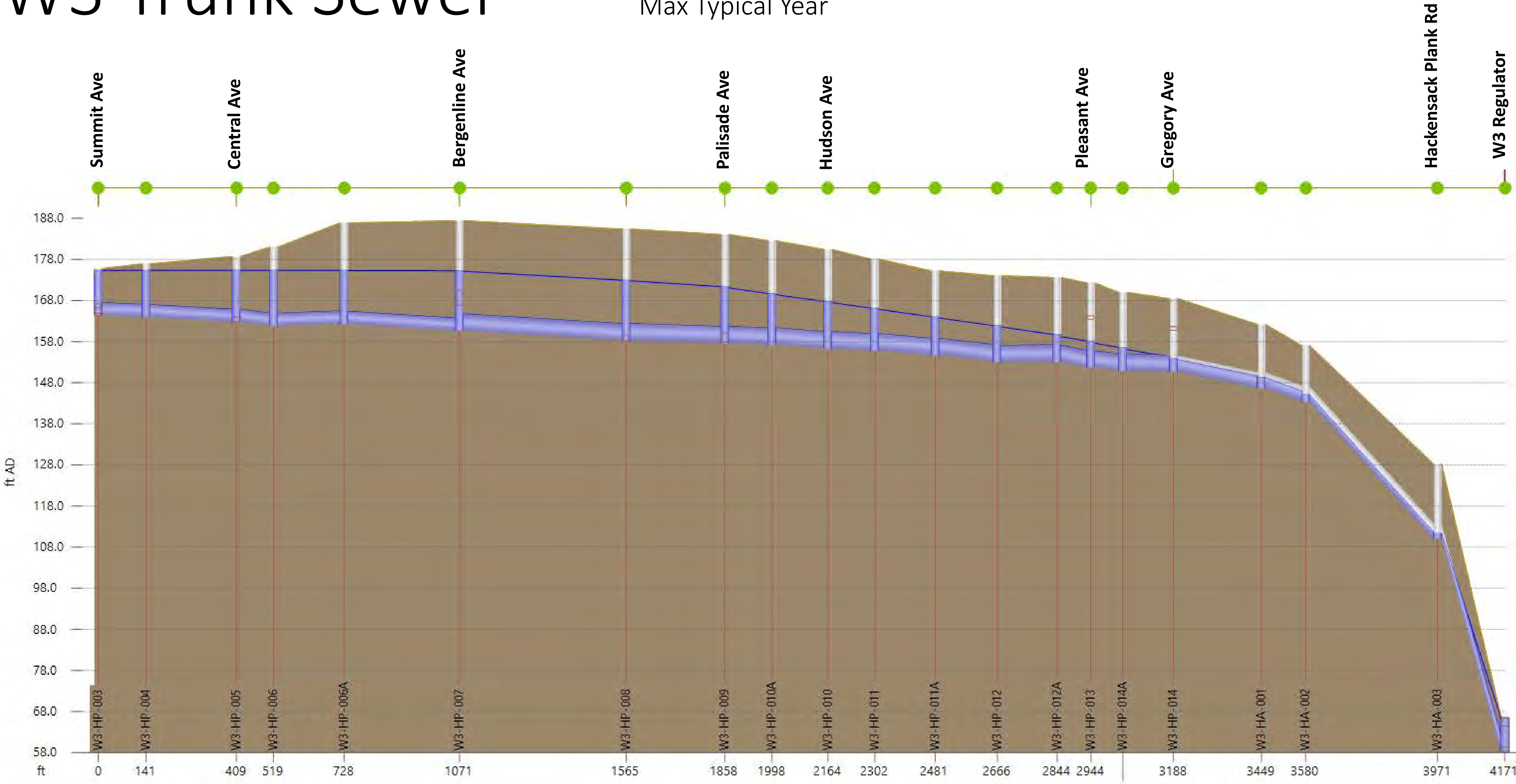
Max Typical Year

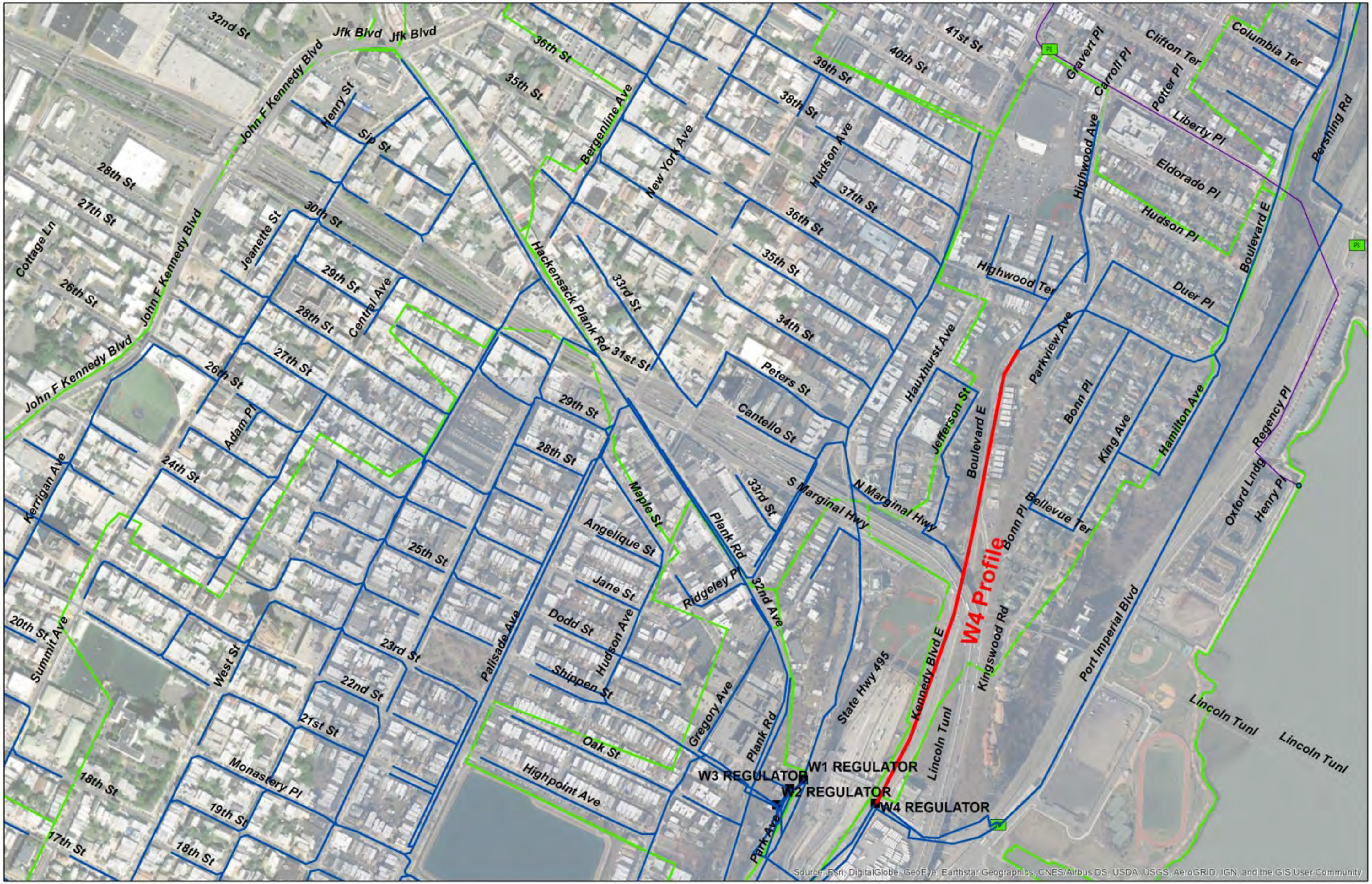



W3 Profile
W1 REGULATOR
W3 REGULATOR
W2 REGULATOR
W4 REGULATOR
Hackensack Plank Rd
Plank Rd
32nd Ave
Park Ave
Bergenline Ave
New York Ave
Hudson Ave
Palisade Ave
Kennedy Blvd E
Boulevard E
Port Imperial Blvd
Lincoln Tunl
State Hwy 495
S Marginal Hwy
N Marginal Hwy
John F Kennedy Blvd
Jfk Blvd
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

W3 Trunk Sewer

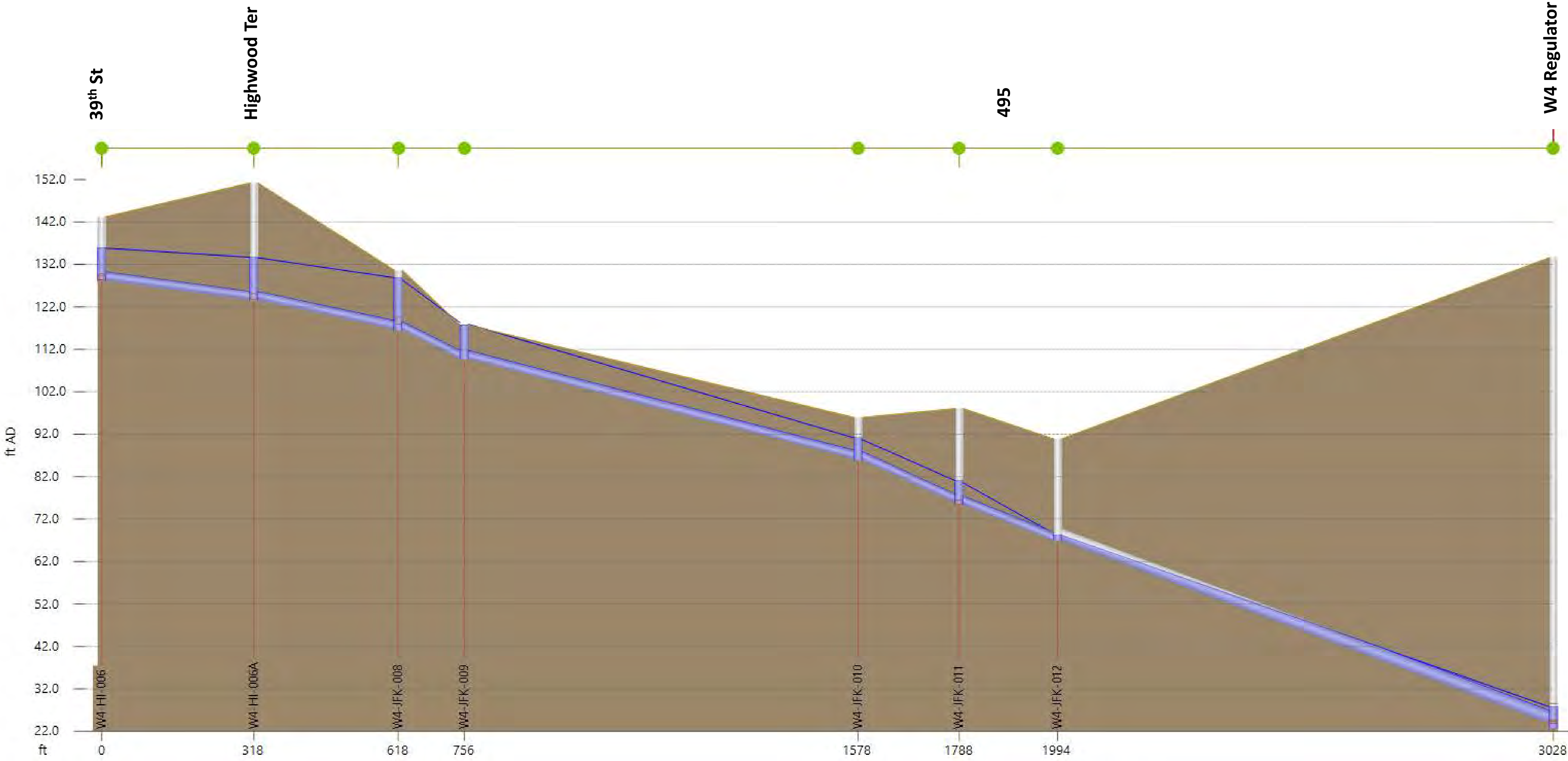
Max Typical Year




W4 Profile
W1 REGULATOR
W3 REGULATOR
W2 REGULATOR
W4 REGULATOR
32nd St
Jfk Blvd
John F Kennedy Blvd
36th St
35th St
39th St
40th St
41st St
38th St
37th St
36th St
35th St
34th St
Bergenline Ave
New York Ave
Hudson Ave
Hackensack Plank Rd
33rd St
31st St
30th St
29th St
28th St
27th St
26th St
24th St
25th St
23rd St
22nd St
21st St
20th St
18th St
19th St
17th St
Henry St
Sip St
Jeanette St
Central Ave
Cottage Ln
Adam Pl
Kerrigan Ave
Summit Ave
West St
Palisade Ave
Monastery Pl
Highpoint Ave
Oak St
Shippen St
Dodd St
Jane St
Angelique St
Maple St
Ridgeley Pl
Plank Rd
32nd Ave
Gregory Ave
Park Ave
State Hwy 495
Kennedy Blvd E
Lincoln Tunl
Kingswood Rd
Port Imperial Blvd
Peters St
Cantello St
S Marginal Hwy
N Marginal Hwy
Hauxhurst Ave
Jefferson St
Boulevard E
Parkview Ave
Bonn Pl
King Ave
Hamilton Ave
Bellevue Ter
Highwood Ter
Highwood Ave
Duer Pl
Hudson Pl
Eldorado Pl
Liberty Pl
Potter Pl
Carroll Pl
Gravert Pl
Clifton Ter
Columbia Ter
Pershing Rd
Regency Pl
Oxford Lndg
Henry Pl
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

W4 Trunk Sewer

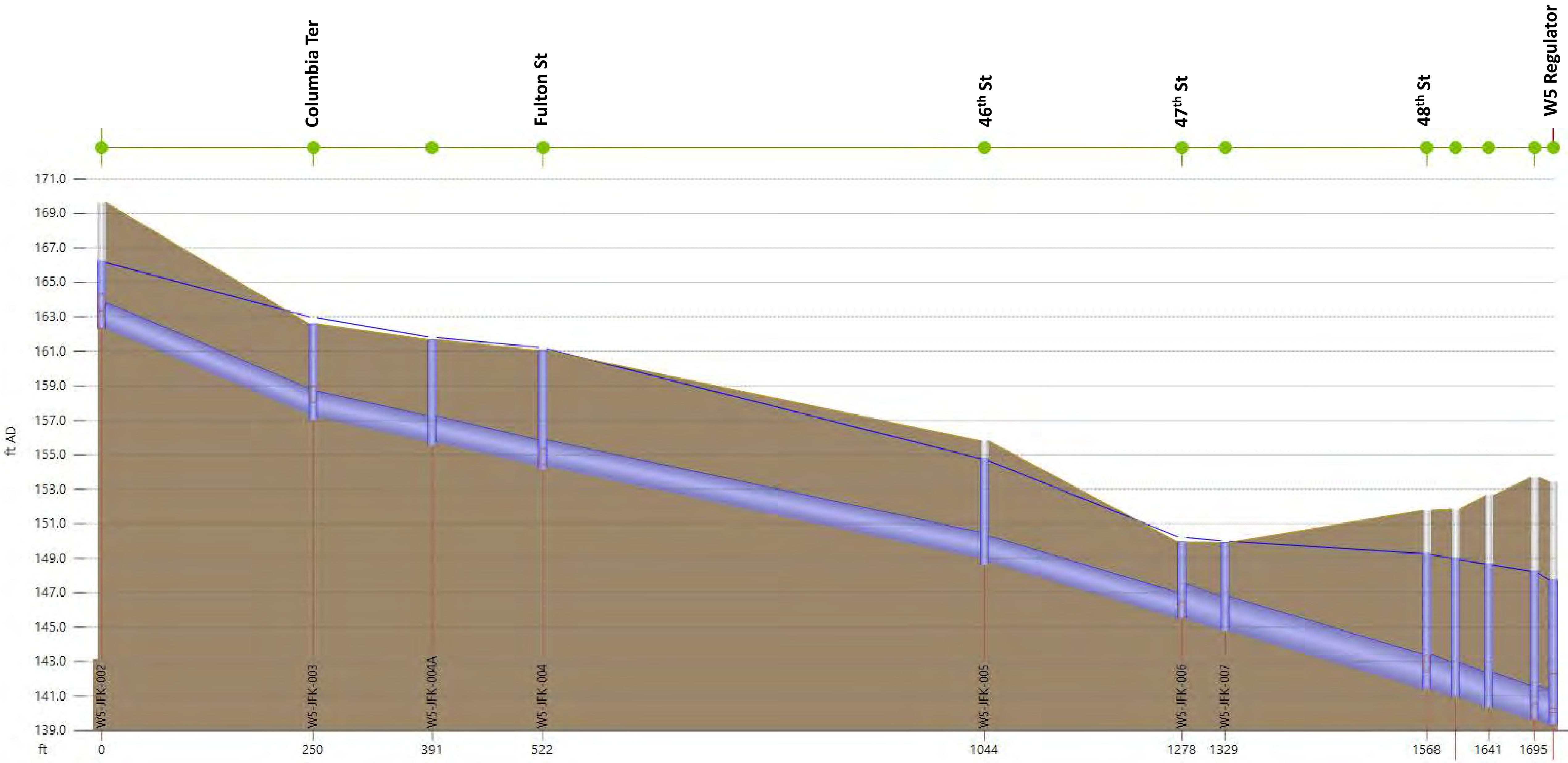
Max Typical Year




UC2-Regulator
W5 REGULATOR
UC1-Regulator
W5 Profile
43rd St
Hillside Ave
Cottage Pl
Golden Ln
46th St
47th St
51st St
50th St
J F Kennedy Blvd E
Port Imperial Blvd
44th St
45th St
John F Kennedy Blvd
Lincoln St
48th St
49th St
Roosevelt St
Brown St
Broadway
Park Ave
Ave At Port Imperial Ave
43rd St
44th St
42nd St
Cooper Pl
46th St
40th St
Fulton St
Louisa Pl
Palisade Ave
Hudson Ave
39th St
Clifton Ter
Columbia Ter
41st St
Bergenline Ave
36th St
Gravert Pl
Carroll Pl
Potter Pl
Port Imperial Blvd
38th St
35th St
Liberty Pl
New York Ave
Highwood Ave
Eldorado Pl
37th St
36th St
Hudson Pl
Boulevard E
Pershing Rd
35th St
Highwood Ter
Duer Pl
Carlyle Ct
33rd St
34th St
Hauxhurst Ave
Parkview Ave
31st St
Peters St
30th St
Hackensack Plank Rd
State Hwy 495
Cantello St
29th St
Jefferson St
Boulevard E
Bonn Pl
King Ave
Hamilton Ave
Regency Pl
State Hwy 495
S Marginal Hwy
28th St
Maple St
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

W5 Trunk Sewer

Max Typical Year



Adams Street STP Layout and Facilties

Adams Street STP Simplified Process Flow Diagram

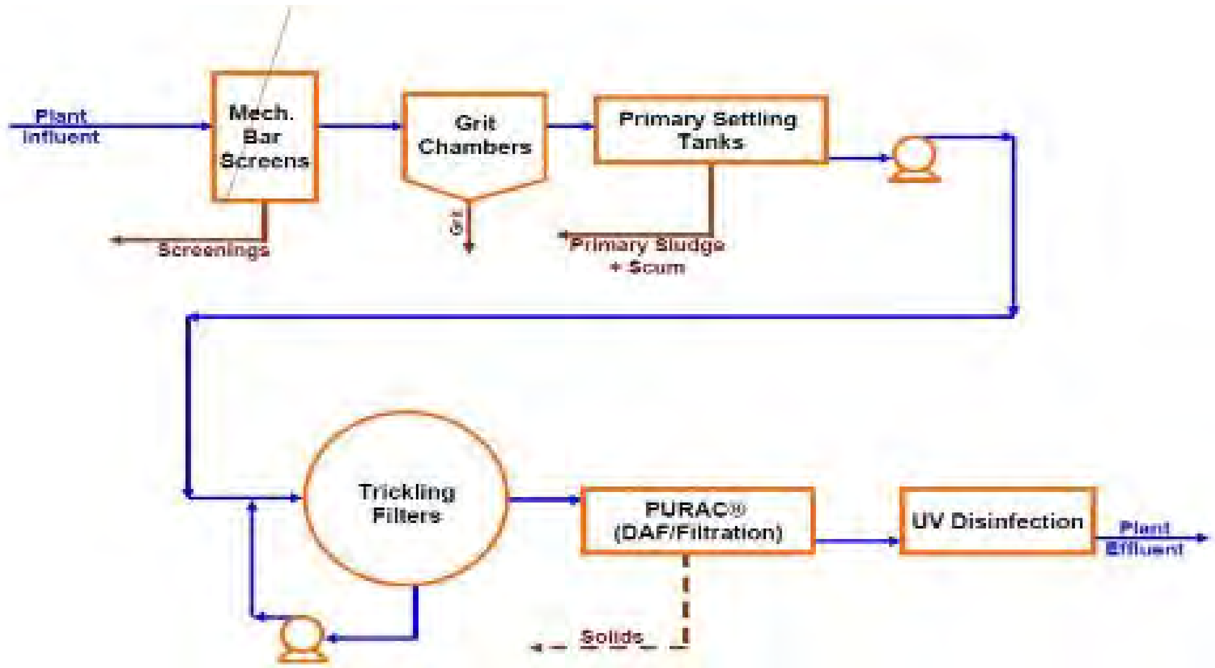


Figure 2: Adams Street WWTP Simplified Process Flow Diagram

Adams Street STP Fact Sheet

Plant Design Capacity

Parameter	Units	Annual Average (Projected)	Max. Month (Design)	Peak(Design)
Flow	mgd	20	24	40/48
BOD_5	mg/l	253	253	
	lbs/d	42,200	50,640	
TSS	mg/l	193	193	
	lbs/d	32,190	38,631	

1. 40 mgd represents peak hydraulic flow handled by all process units
2. 48 mgd represents peak hydraulic flow through plant (portion of flow will bypass the gravity sand filters
3. NJPDES Permit allows the Adams Street WWTP to treat up to 20.8 mgd on an average daily basis.

Plant Historical Data 2017-2018

	MGD									
	Average	**Median**	**Max. Month**	**Peak Week**	**Peak Day[1]**					
Plant Influent Flow	**12.98**	**12.15**	**15.95**	**19.61**	**29.18**					
	mg/L					**lb/day**				
	Average	**Median**	**Max. Month**	**Peak Week**	**Peak Day[1]**	**Average**	**Median**	**Max. Month**	**Peak Week**	**Peak Day[1]**
Plant Influent										
TSS	145	138	177	199	145	15,702	14,006	19,330	26,570	35,220
BOD	149	146	178	193	114	15,813	15,697	16,837	18,291	27,635
Primary Effluent										
TSS	102	97	124	140	101					
BOD	63	69	87	96	75					
Primary Clarifier Performance										
HLR (gpd/ft2)	371	348	456	561	835					
%TSS Removed[2]	30%	30%	30%	30%	30%					
%BOD Removed	58%	53%	51%	50%	34%					
Trickling Filters										
THL (gpm/mgd)	1.02	0.95	1.26	1.50	2.28					
SLR (lb/day/1000ft3)	47	43	57	70	105					
DAF/Flofilter Secondary Treatment Performance										
HLR (gpm/ft2)	1.02	0.96	1.26	1.55	2.30					
SLR (lb/day*ft2)[3]	1.376	1.224	2.054	2.853	3.082					
Final Effluent										
TSS	17	16	22	39	18	1,820	1,598	2,406	4,169	6,975
BOD	19	18	25	36	18	2,033	1,903	2,823	3,787	5,598
%TSS Removed	87.1%	87.0%	85.9%	82.1%	87.6%					
%BOD Removed	87.4%	87.7%	86.1%	81.5%	84.2%					

1 Wet Weather BOD and TSS averages for Flows Greater Than 16 mgd Used for Peak Day

2 Assumed 30 % Removal

3 Assumes Nine Flofilters in Service

Adams Street STP Treatment Capacity

Primary and Secondary Treatment Capacity is as follows:

- **Primary Treatment Capacity:** There are three (3) primary clarifiers each with a surface area of 11,100 sf. The average overflow rate for the existing clarifiers is 371 gpd/sf at approximately 13 mgd whereas the recommended design average overflow rate is typically 1200 gpd/sf for most tanks deeper than 12 feet. The primary clarifiers at the Adams Street WWTP are only 10 feet deep and relatively shallow and therefore derating the overflow rate to 1000 gpd/sf is a reasonable design criteria. **At an overflow rate of 1000 gpd/sf the primary clarifiers are rated for 33 mgd average flow. For peak hour flow the recommended design overflow rate is approximately 1800 gpd/sf. At 1800 gpd/sf the capacity of the clarifiers is 59 mgd with all three units in service. When one unit is out of service the capacity is approximately 40 mgd.**
- **Secondary Treatment Capacity:** There are ten (10) dissolved air floatation/filters in the secondary treatment system. The hydraulic capacity of each unit is limited to approximately 4 gpm/sf which equates to **32 mgd with one unit in backwash or out of service.** However, if the flow across the filters is allowed to bypass the filters by opening the emergency bypass valve it will allow up to 40 mgd capacity with one unit out of service. The use of this bypass feature is not currently allowed in the plants permit as it is a blended effluent. The historical effluent quality for BOD5 ranges between 19 mg/l at average flows of 13 mgd and 36 mg/l at peak week flows of 19.6 mgd. The TSS effluent quality ranges from 17 mg/l at average daily flows of 13 mgd and 39 mg/l at 19.6 mgd. Since the wet weather flows are much more dilute during peak hour periods the influent solids and BOD5 are much more dilute and effluent quality is better than the peak week condition. However, removals are typically degraded when the wastewater is too dilute.

Limiting factors in STP Capacity include:

- The capacity of the **grit removal system** is the limiting process in the Preliminary Treatment Building. There are two grit chambers and each is rated at 24 mgd. This capacity limits the preliminary treatment capacity to approximately 24 mgd when one unit is out of service.
- The **secondary treatment process (PURAC)** is currently planned for a major rehabilitation. The disinfection capacity and performance has been impacted due the recent performance degradation of the PURAC DAF/Flofilters.
- There are three (3) channels of **UV disinfection.** The hydraulic capacity of each channel is limited 15 mgd due to headlosses in the UV banks, baffles and control gates. When one channel is out of service the capacity is 30 mgd. However, the disinfection capacity is currently significantly below the required design capacity and is impacted due to the sand that has migrated through the failed underdrains in several DAF/Flofilter cells. Once the DAF/Flofilters are rehabilitated the UV disinfection capacity should be restored to the design flows.

Adams Street System Recent/Ongoing Projects

1. W1234 Solids/Floatables Screening Facility, Weehawken
2. Design Services H6/H7 Hydraulic Modeling Study, H8 Stormwater System Design for the Long Term Control Plan, Hoboken
3. St Augustine School, Union City

W1234 Solids/Floatables Screening Facility Factsheet

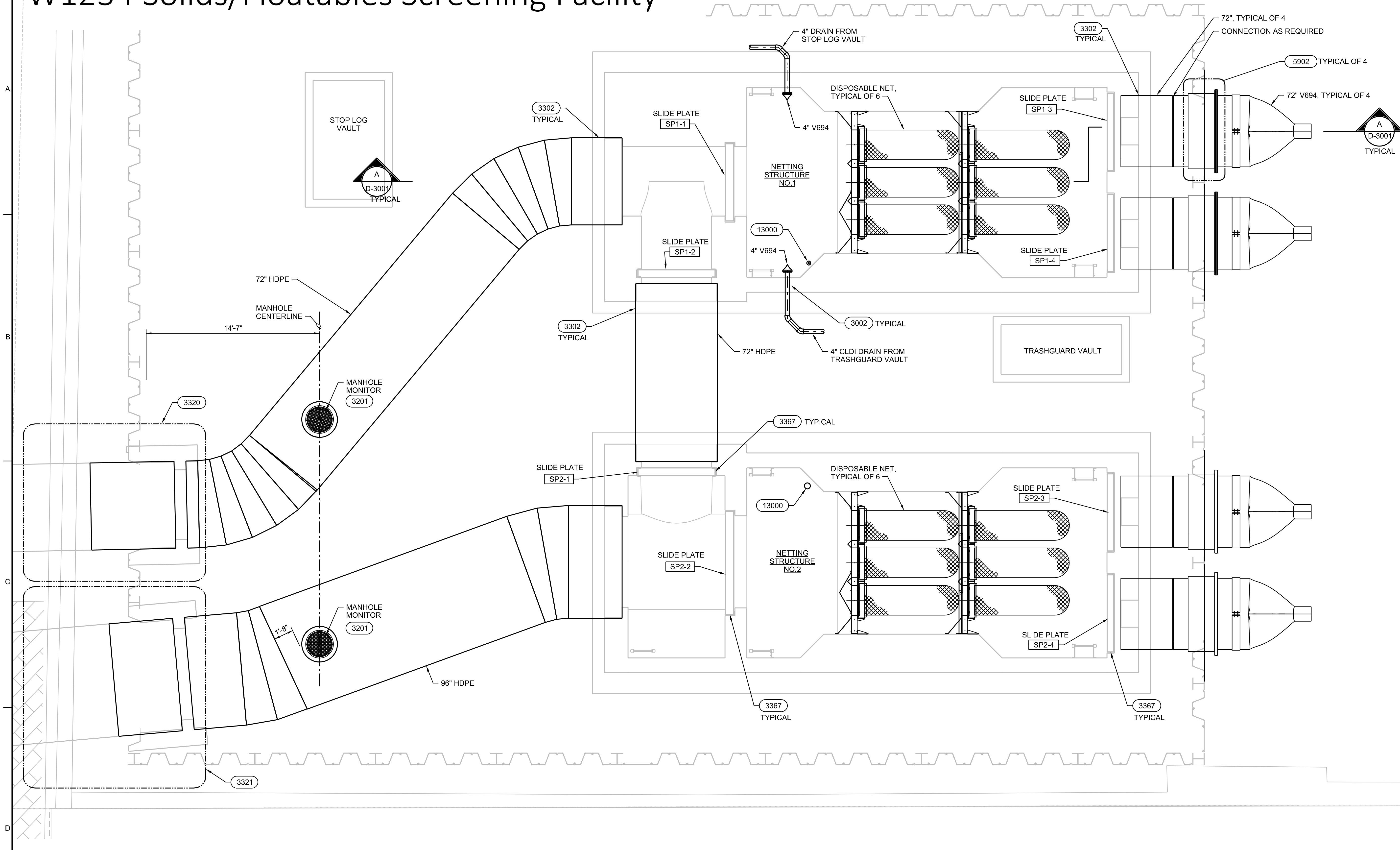
- Combined flow from the W1, W2, W3, and W4 drainage basins (38% of the Adams Street WWTP service area)
- S/F Facility
  - 2 parallel hydraulically connected discharges in the Hudson River
  - 2 netting structures located under a public access park pier facility
    - 6 nets per structure (3 below and 3 above) to capture solids/floatables greater than ½”
  - Facility Flow capacity = 480 mgd (240 mgd per netting structure)
    - Twice the 2-year storm flow of 238 mgd
    - 50% greater than 10-year storm flow of 318 mgd
    - 100% screening back-up capacity and 50% screening back-up capacity at the 2 year and 10 year storm flows

MELILLO+BAUER ASSOCIATES Landscape Architecture

CONCEPT PERSPECTIVE 2
WEEHAWKEN PIER
WEEHAWKEN, NJ
DATE: 05.30.2018 **SCALE**: NTS

DRAFT

W1234 Solids/Floatables Screening Facility



PIPING AND EQUIPMENT PLAN
1/4"=1'-0"

SHIVANI PATEL

N.J. PROFESSIONAL ENGINEER No. 24GE05092500
S PATEL

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NO.	DATE	REVISION	BY	APVD

DSGN M MOORE | DR | J HALEC | CHK | J TOBIA | APVD

NORTH HUDSON SEWERAGE AUTHORITY
W1234 SOLIDS/FLOATABLES SCREENING FACILITY
WEEHAWKEN, NEW JERSEY

CH2MHILL®

PROCESS MECHANICAL

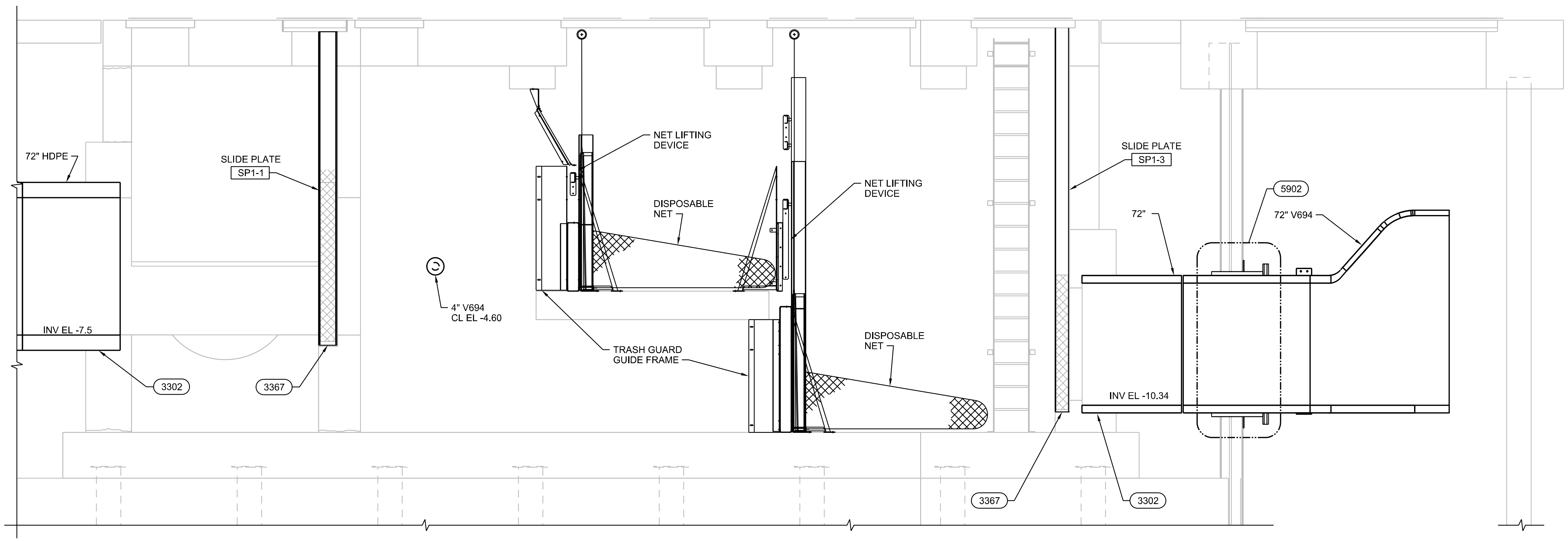
PIPING AND EQUIPMENT PLAN

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	AUGUST 2016
PROJ	491076
DWG	M-2001
SHEET	53 of 57

FILENAME: M-2001_491076.dgn PLOT DATE: 2016\07\21 PLOT TIME: 3:18:34 PM

W1234 Solids/Floatables Screening Facility



A SECTION
3/8"=1'-0"
D-2001

SHIVANI PATEL
N.J. PROFESSIONAL ENGINEER No. 24GE05092500

NO.	DATE	REVISION	BY	APVD

DSGN	DR	CHK	APVD
S PATEL	M MOORE	J HALEC	J TOBIA

NORTH HUDSON SEWERAGE AUTHORITY
W1234 SOLIDS/FLOATABLES SCREENING FACILITY
WEEHAWKEN, NEW JERSEY

CH2MHILL®

PROCESS MECHANICAL
SECTION I

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	AUGUST 2016
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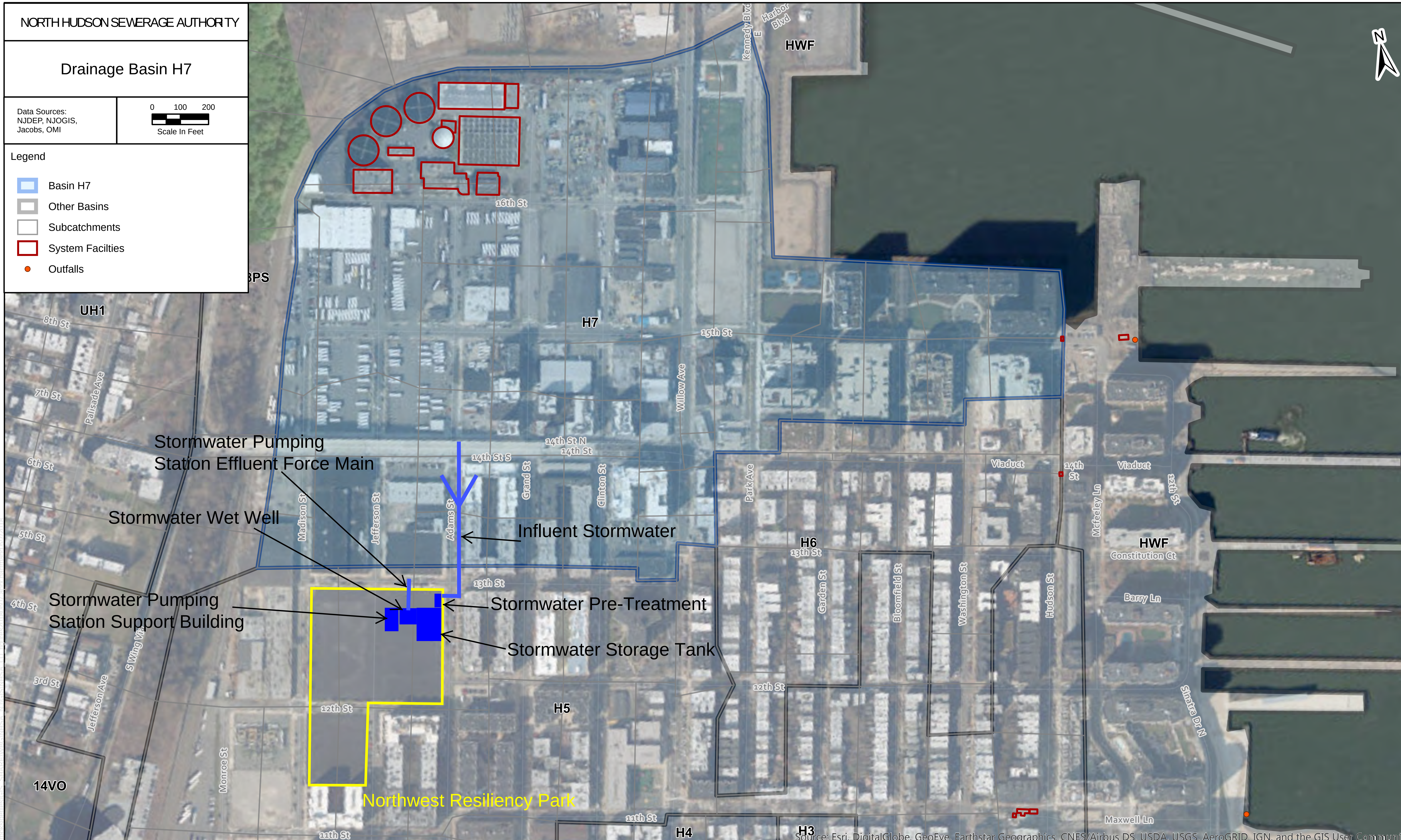
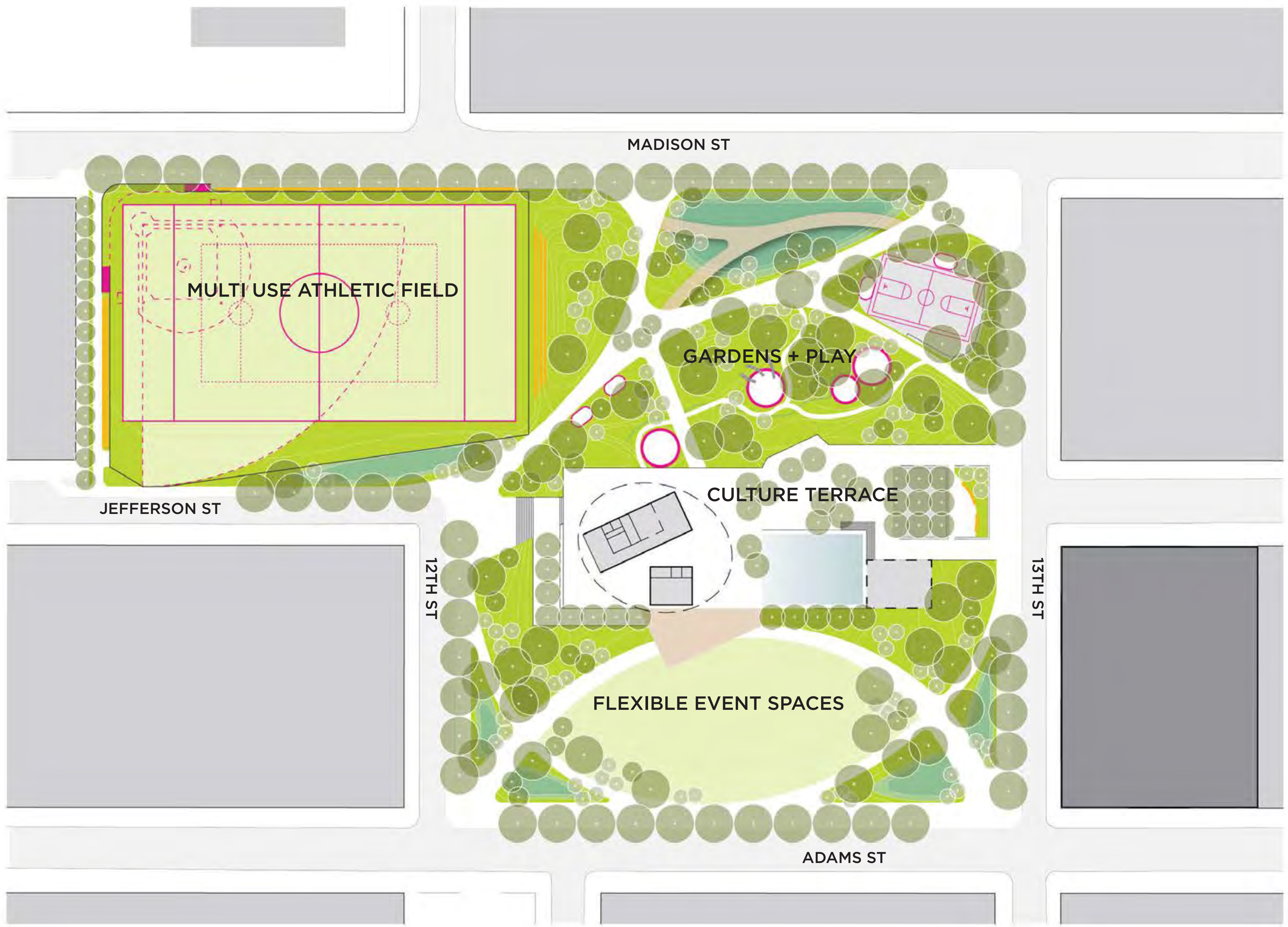
DWG	M-3001
SHEET	54 of 57

FILENAME: M-3001_491076.dgn PLOT DATE: 2016\07\21 PLOT TIME: 3:19:56 PM


NORTH HUDSON SEWERAGE AUTHORITY
Drainage Basin H7
Data Sources: NJDEP, NJOGIS, Jacobs, OMI
0 100 200
Scale In Feet
Legend
Basin H7
Other Basins
Subcatchments
System Facilities
Outfalls
Stormwater Pumping Station Effluent Force Main
Stormwater Wet Well
Influent Stormwater
Stormwater Pumping Station Support Building
Stormwater Pre-Treatment
Stormwater Storage Tank
Northwest Resiliency Park
H7
H6
H5
H4
H3
HWF
UH1
14VO
16th St
15th St
14th St S
14th St N
13th St
12th St
11th St
Madison St
Jefferson St
Adams St
Grand St
Clinton St
Willow Ave
Park Ave
Garden St
Bloomfield St
Washington St
Hudson St
Monroe St
Palisade Ave
Jefferson Ave
Kennedy Blvd
Harbor Blvd
Viaduct
Constitution Ct
Barry Ln
Maxwell Ln
Sinatra Dr N
Mcfeeley Ln
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Northwest Resiliency Park Concept Design



CROSS-PARK CONNECTIVITY

MULTI-USE LOOP TRAIL

MULTI-USE ATHLETIC FIELD:

- High school soccer field (165ft x 300ft)
- Little league baseball field (200ft oufield)
- Youth lacrosse (35yds x 60yds and 40yds x 90yds)

BASKETBALL BASIN

- Youth court (42ft x 74ft)

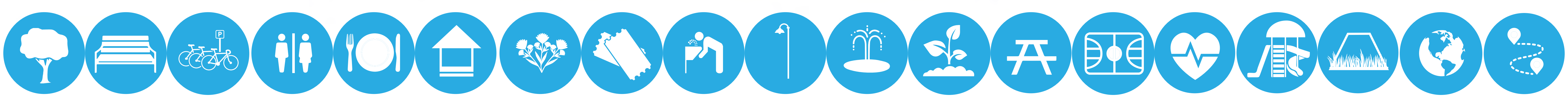
NATURE + ECOLOGY

COLLECTS PARK + STREET STORMWATER

MULTIPLICITY OF SPACES + EXPERIENCES

12TH ST CLOSED
MADISON, JEFFERSON, 13TH ST NARROWED
1/4 acre added to park

PARK BUILDING:
2,465 SF Large Interior (Cafe)
930 SF Small Interior (Community Room)
9,425 SF Covered Area



SAINT AUGUSTINE SCHOOL

Subwatershed: Hackensack River

Site Area: 54,169 sq. ft.

Address: 3920 New York Ave
Union City, NJ 07087

Block and Lot: Block 151, Lots 1-9,
5-24, & 26-28

A bioretention system can be installed to capture, treat, and infiltrate rooftop runoff. Parking spaces can be replaced with pervious pavement to capture and infiltrate stormwater. Two tree filter boxes can be installed along the street to treat runoff. A preliminary soil assessment suggests that more soil testing would be required before determining the soil's suitability for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
85	46,044	2.2	23.3	211.4	0.036	1.26

Recommended Green Infrastructure Practices	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Maximum Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cu. ft./second)	Estimated Size (sq. ft.)	Estimated Cost
Bioretention system	0.031	5	2,244	0.08	370	$1,850
Pervious pavement	0.085	14	6,201	0.23	1,270	$31,750
Tree filter box	n/a	6	n/a	n/a	32	$20,000

GREEN INFRASTRUCTURE RECOMMENDATIONS

Saint Augustine School

- bioretention system
- pervious pavement
- tree filter box
- drainage area
- property line
- 2015 Aerial: NJOIT, OGIS

0 30' 60'

North Hudson Sewerage Authority

Long Term Control Plan

CSO Alternatives Analysis Workshop

River Road WWTP

NJPDES Permit: NJ0025321

Date: June 15, 2018

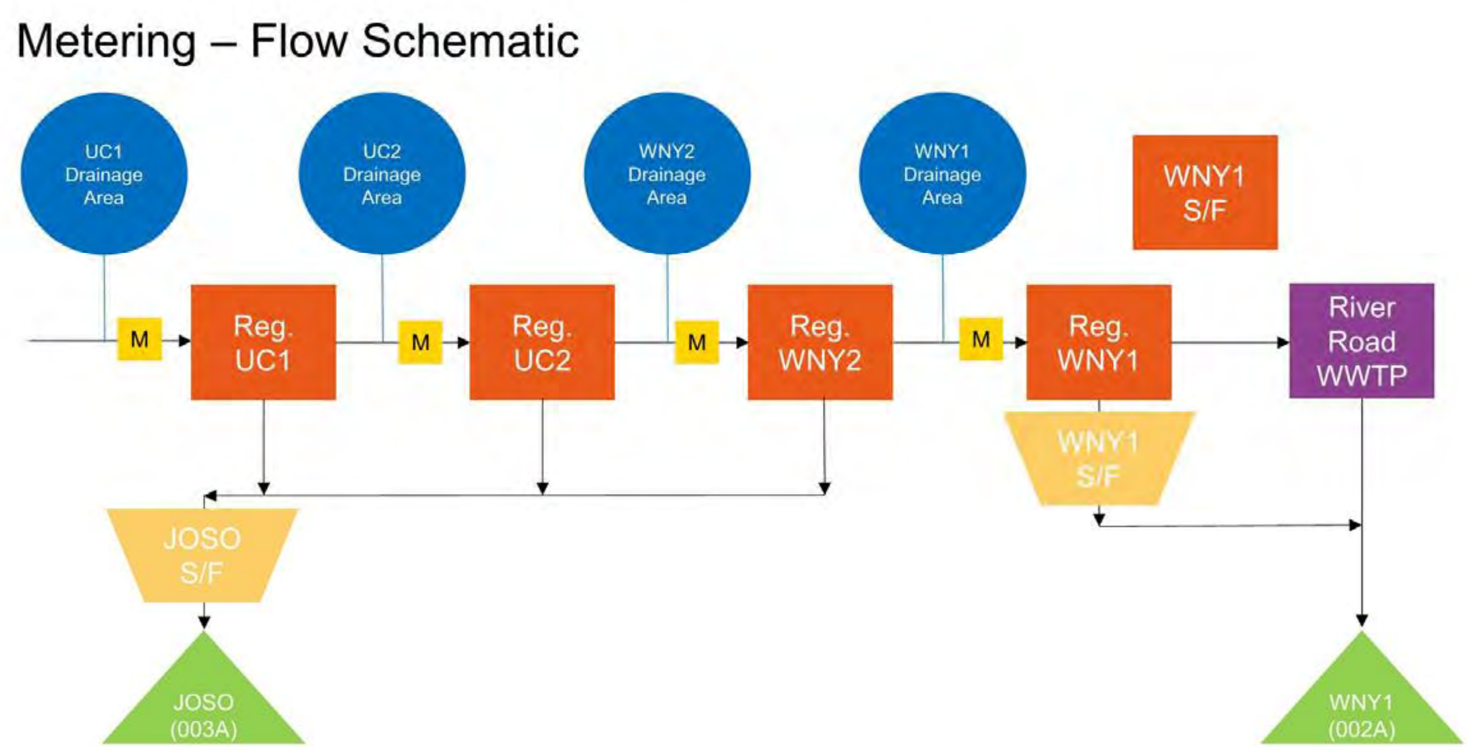
North Hudson Sewerage Authority

1600 Adams Street
Hoboken, NJ 07030
(201) 963-6043

www.nhudsonsa.com

1. **Collection system schematic**

Figure 1: River Road Collection System Schematic



2. CSO Frequencies (Volumes and Peak Flows) by Outfall in the Typical Year

Table 1: CSO Frequency and Total Overflow Volume in Typical Year

Outfall	CSO Frequency	Volume per Year (MG)
JOSO (003A)	32	49.8
WNY1 (002A)	56	238.4
	Total, MG	

Table 2 JOSO (003A) Overflows in Typical Year

Overflow Number	Volume (MG)	Peak Flow (MGD)
1	5.25	128.71
2	5.02	109.07
3	4.83	98.64
4	3.78	98.48
5	3.29	94.35
6	3.25	84.35
7	2.76	76.17
8	2.51	72.43
9	2.41	58.51
10	1.98	55.05
11	1.97	49.92
12	1.96	44.70
13	1.44	42.81
14	1.13	38.16
15	1.11	35.27
16	1.04	35.03
17	0.95	23.67
18	0.88	21.68
19	0.87	19.81
20	0.50	17.97
21	0.49	17.38
22	0.38	16.64
23	0.35	15.56
24	0.33	12.97
25	0.32	7.53
26	0.31	7.02
27	0.24	6.12
28	0.16	5.73
29	0.14	5.49
30	0.12	5.10
31	0.05	3.26
32	0.00	0.07

Volumes and Peak Flows were sorted separately

Figure 2: JOSO (003A) Volume of Overflows

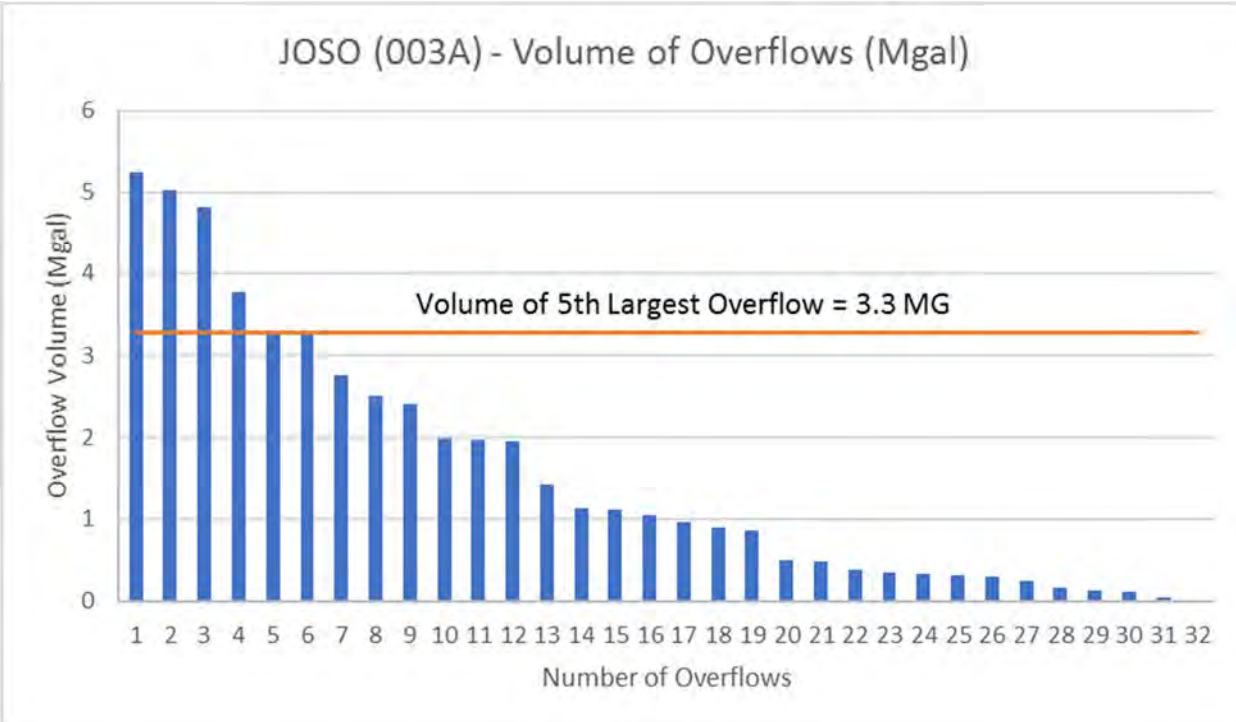


Figure 3: JOSO (003A) Peak Flow of Overflows

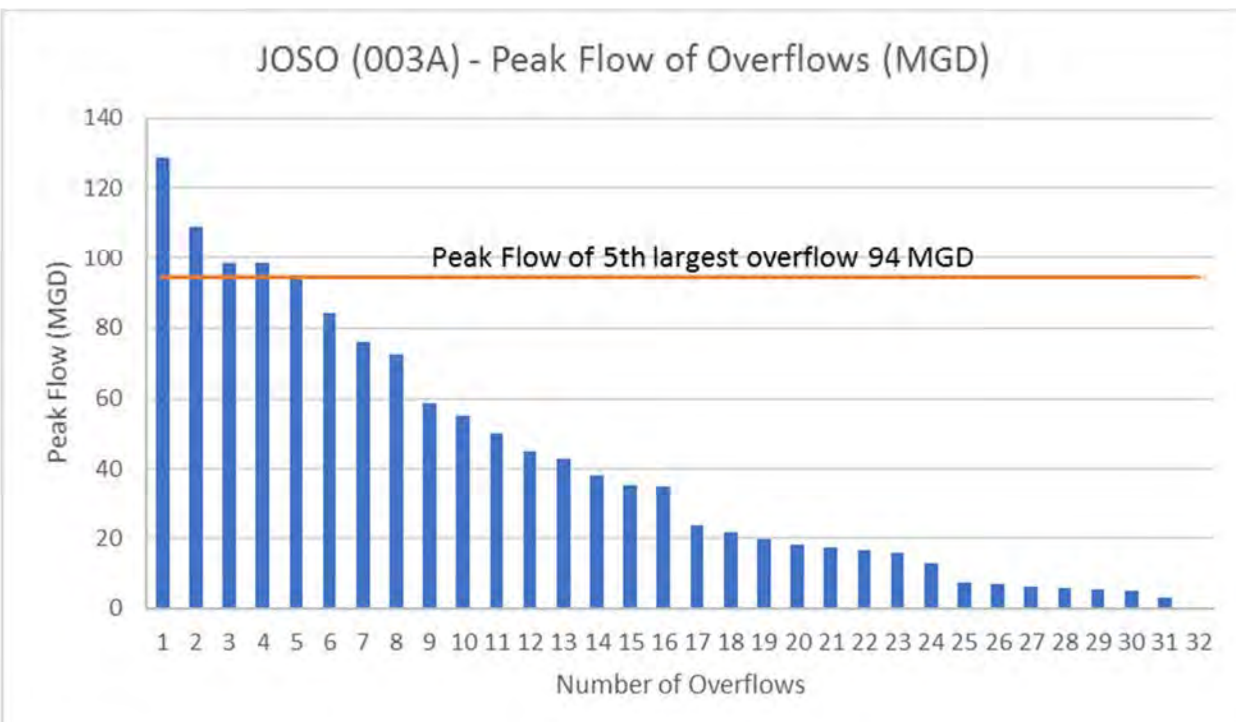


Table 3: WNY1 (002A) Overflows in Typical Year

Overflow Number	Volume (MG)	Peak Flow (MGD)
1	26.73	198.13
2	14.18	169.17
3	11.67	167.32
4	11.01	166.09
5	10.97	161.59
6	10.45	145.42
7	10.32	138.47
8	9.73	136.14
9	9.65	126.02
10	8.88	125.25
11	8.60	119.94
12	7.98	108.50
13	7.15	93.53
14	7.04	93.03
15	6.68	92.26
16	6.65	91.77
17	5.26	89.42
18	5.21	78.81
19	5.06	72.66
20	4.84	71.11
21	4.56	67.00
22	4.02	65.23
23	3.49	64.07
24	3.26	61.59
25	3.20	50.70
26	2.67	50.36
27	2.55	46.28
28	2.43	46.02
29	2.33	45.31
30	2.29	43.63
31	1.89	34.90
32	1.85	23.62
33	1.67	22.04
34	1.62	20.79
35	1.43	20.24
36	1.32	19.41
37	1.17	19.03

Volumes and Peak Flows were sorted separately

Overflow Number	Volume (MG)	Peak Flow (MGD)
38	0.97	18.10
39	0.92	17.73
40	0.89	17.44
41	0.86	16.09
42	0.80	14.80
43	0.80	14.46
44	0.72	13.76
45	0.64	11.65
46	0.52	11.53
47	0.41	11.48
48	0.38	8.71
49	0.17	7.95
50	0.16	7.70
51	0.15	7.01
52	0.14	4.05
53	0.02	1.65
54	0.02	1.60
55	0.02	1.32
56	0.01	0.79

Volumes and Peak Flows were sorted separately

Figure 4: WNY1(002A) Volume of Overflows

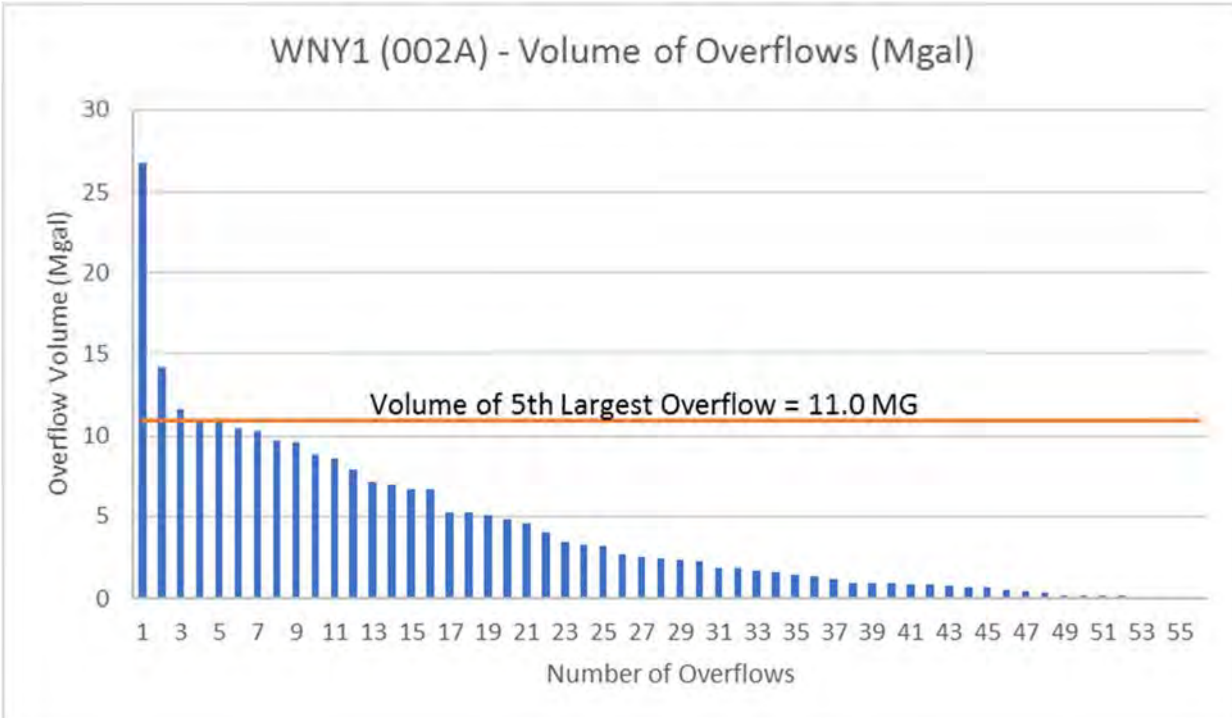
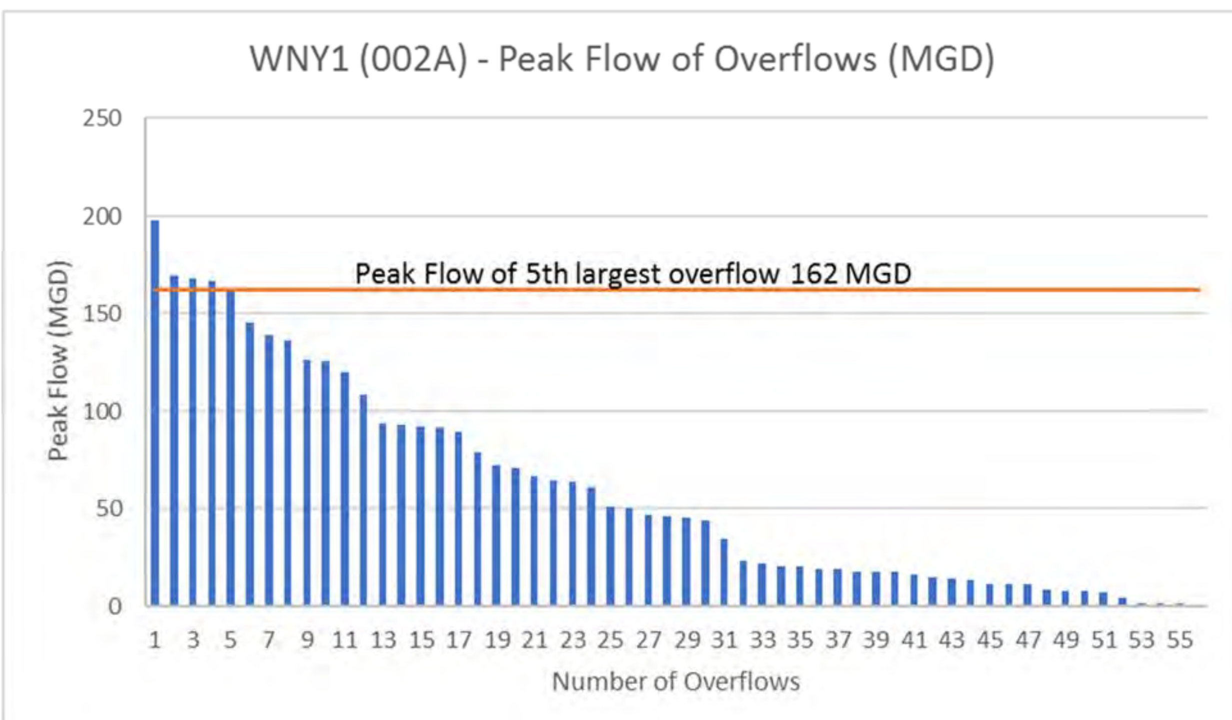


Figure 5: WNY1 (002A) Peak Flow of Overflows



3. Hydraulic Profiles in Major Interceptors and Combined Sewer Trunks

Figure 6: Trunk Sewer from UC1 to WNY1

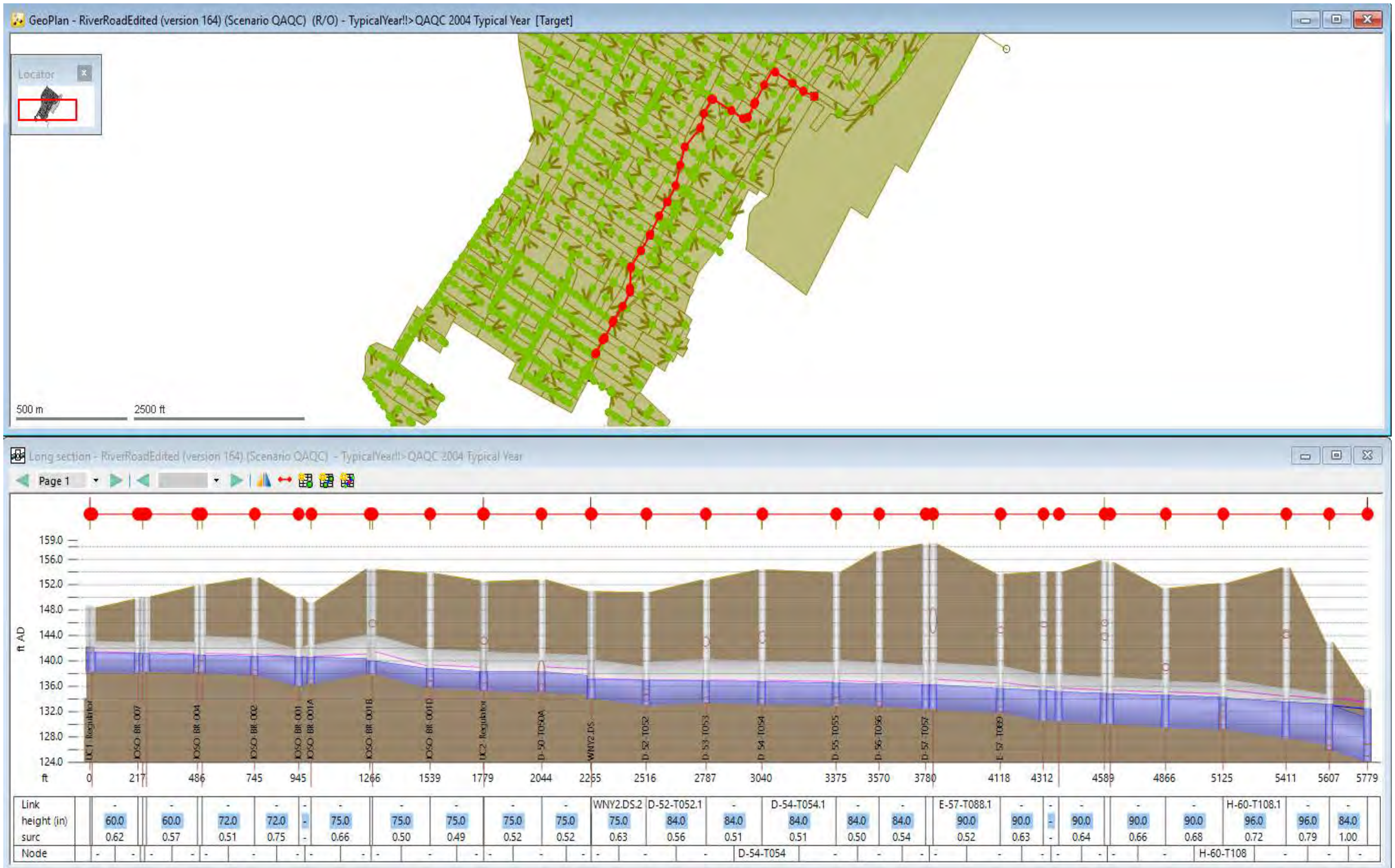


Figure 7: Interceptor Sewer from UC1 to WNY2

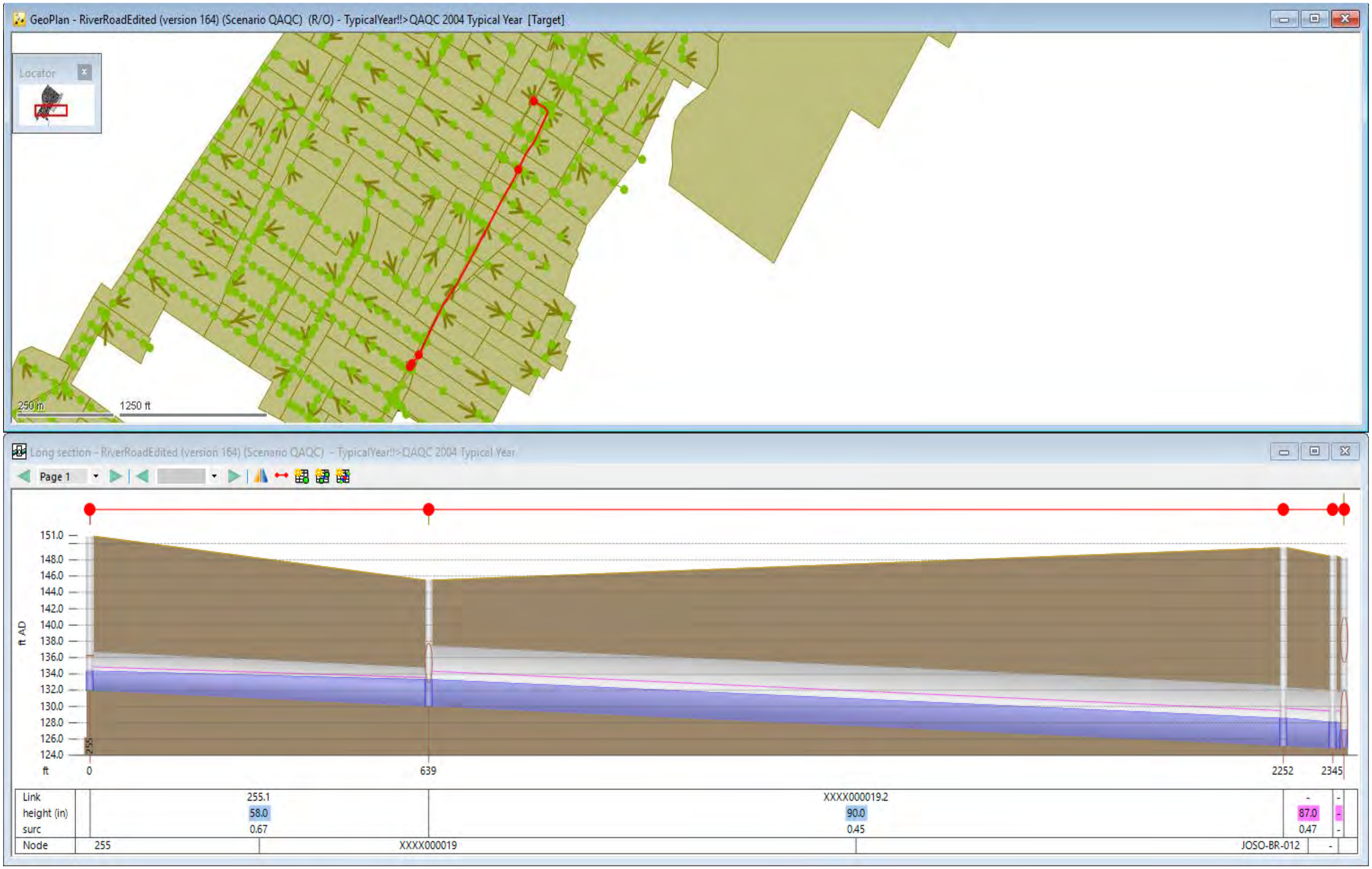


Figure 8 JOSO (003A) Outfall Sewer - UC1 to Outfall

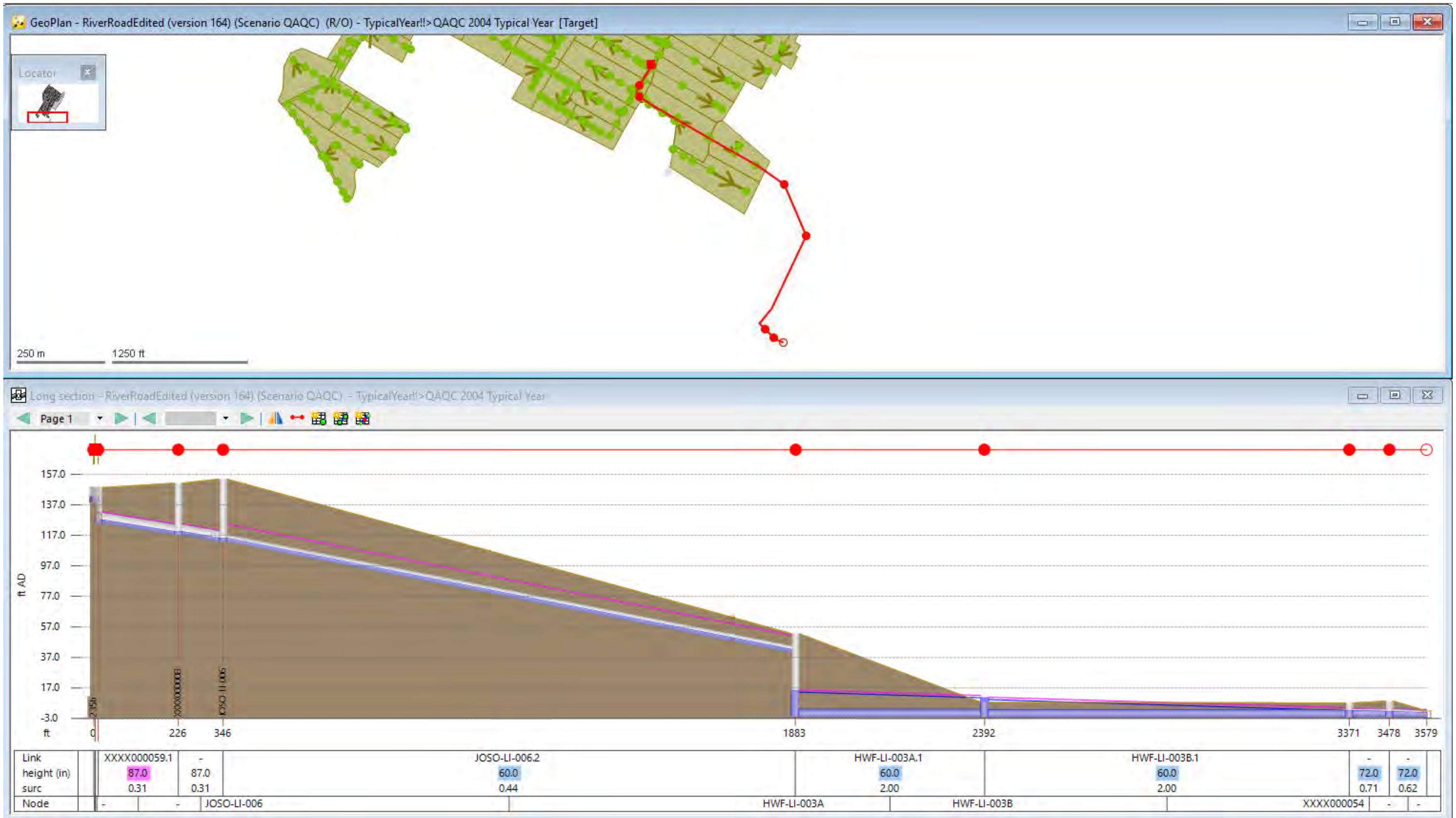


Figure 9: WNY1 Outfall Sewer - Overflow line from WNY 1 to Outfall (002A)

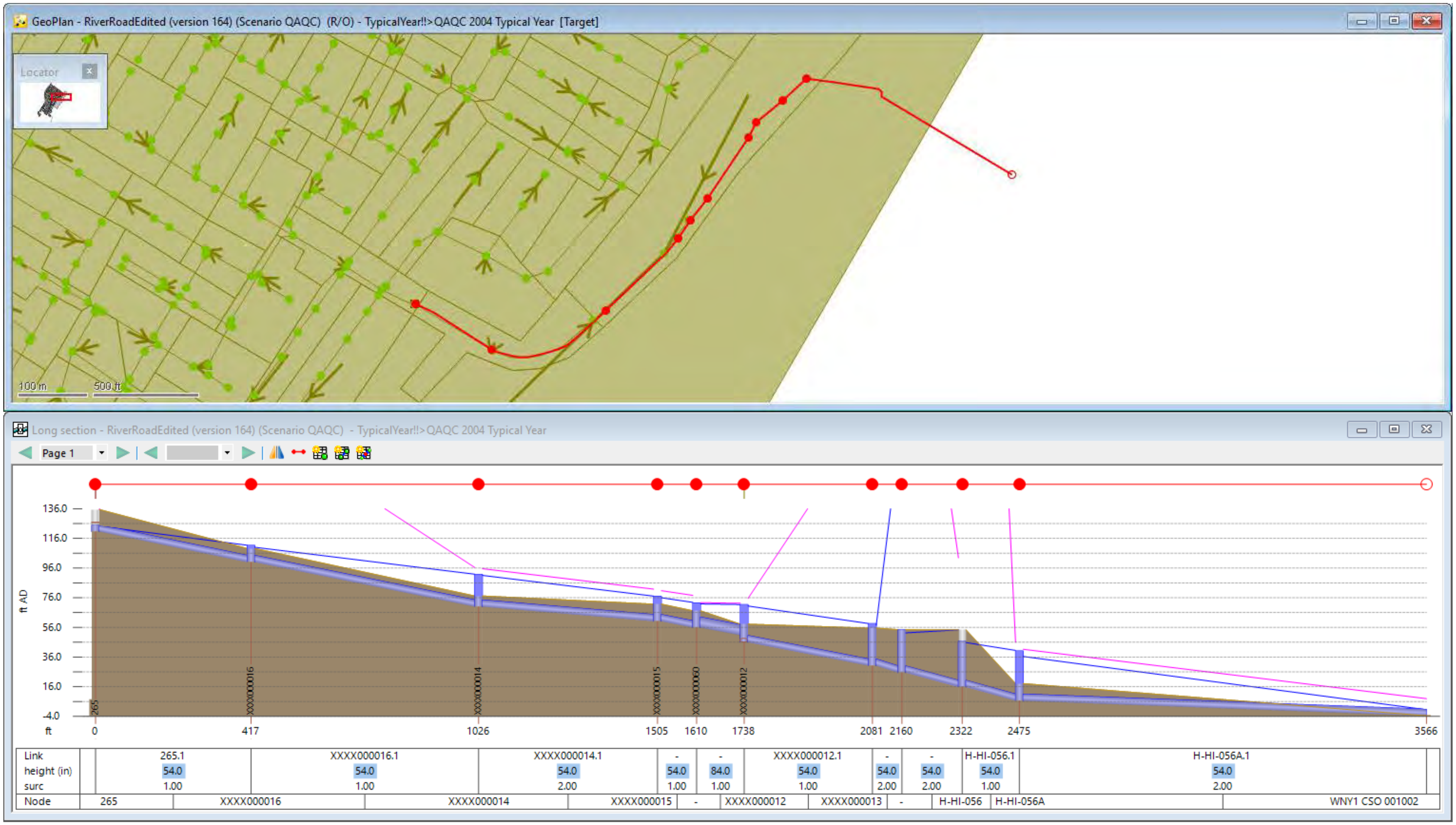
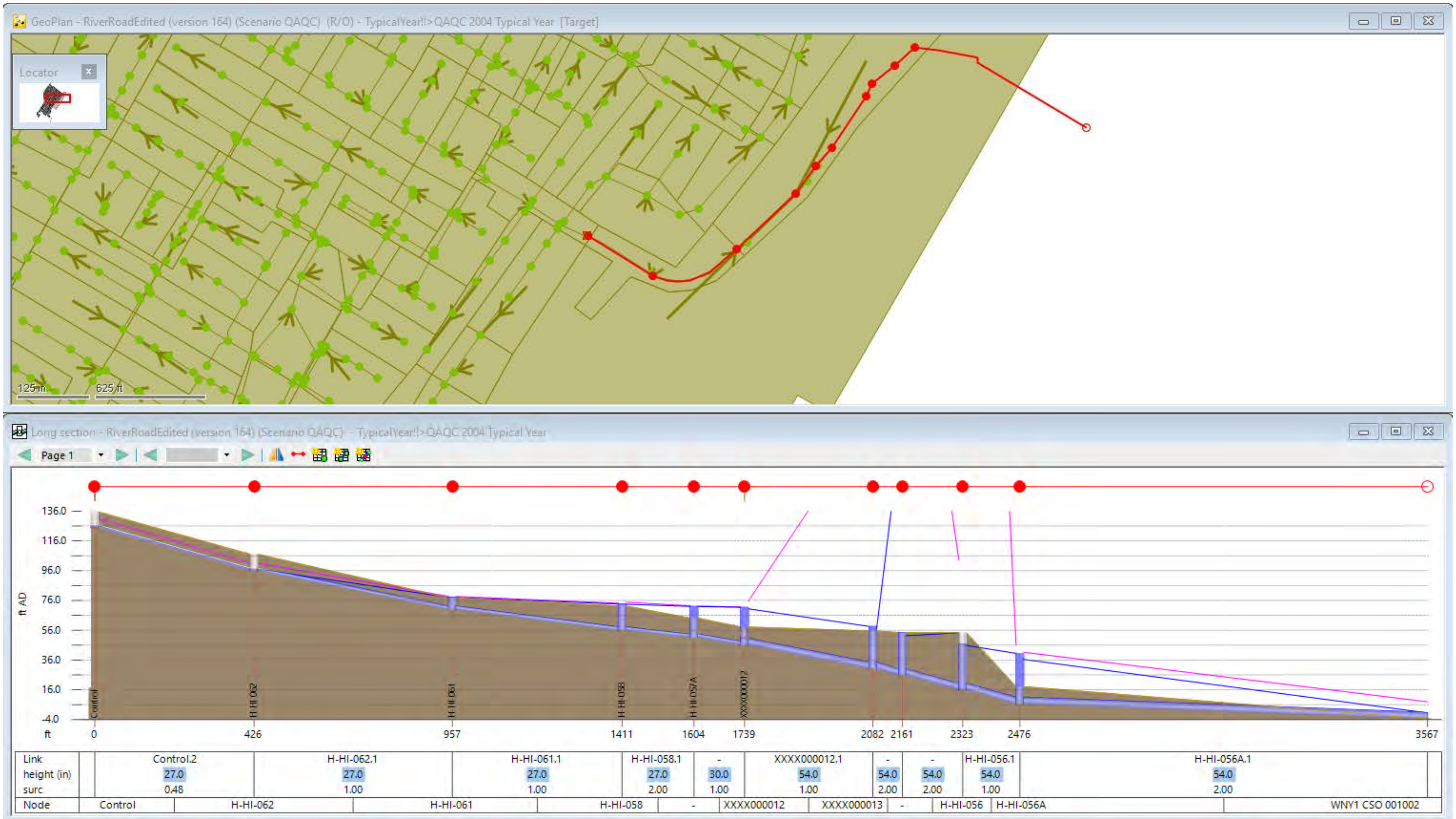


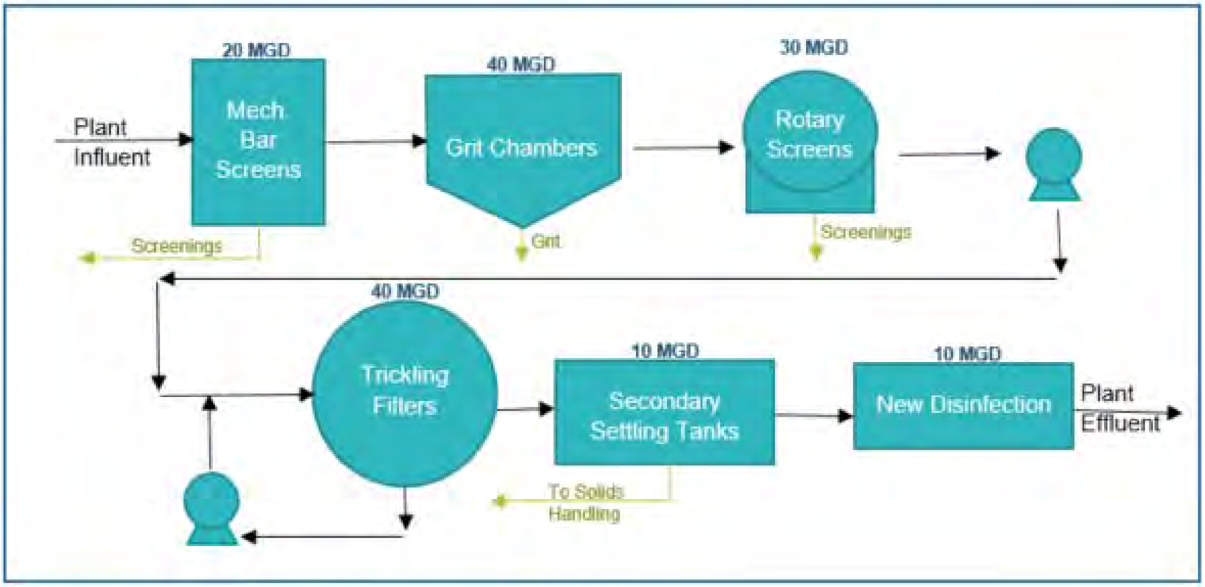
Figure 10: River Road Outfall Sewer – Main Line to/from Plant to WNY1 (002A)



4. River Road Wastewater Treatment Plant Characteristics

A. Plant Capacity:

Figure 11: River Road Treatment Plant Schematic



- Design dry weather flow = 10 MGD
- Min DWF = approx. 3 MGD
- Max Plant Flow = 24 MGD
- Primary treatment capacity = 0 MGD
  - o Primary treatment capacity is defined as “the maximum flow i.e. daily, weekly or monthly that can receive primary treatment at the existing primary treatment facilities”. Currently, there are no existing primary settling tanks at the River Road WWTP. Micro-screens that are designed for 10% BOD removal and 18% TSS removal are provided. Typical removal efficiencies for primary treatment facilities when treating municipal wastewater are 50 to 70% TSS removal and 25 to 40% BOD removal. Consequently, the micro-screens are not considered to be equivalent to primary treatment facilities, therefore primary treatment capacity = 0 MGD.
    - Mechanical bar screens = 20 MGD
    - Grit chambers = 40 MGD
    - Rotary screens = 30 MGD
    - Trickling Filters = 40 MGD
- Secondary treatment capacity = designed for 10 MGD, actual 8.1 MGD
- Disinfection capacity = 10 MGD
- Limiting factors in WWTP capacity:
  - o Plant is limited by the capacity of its secondary settling tanks (8.1 MGD). Secondary settling tanks were designed as primary settling tanks and have a shorter sidewall depth than is typically used for secondary settling tanks. Settling tanks are also overloaded and when an average loading rate is used their capacity would be 8.1 MGD.

B. Flow Rates and Performance:

Figure 12: Historic Flow Rates 2013-January 2017, River Road Wastewater Treatment

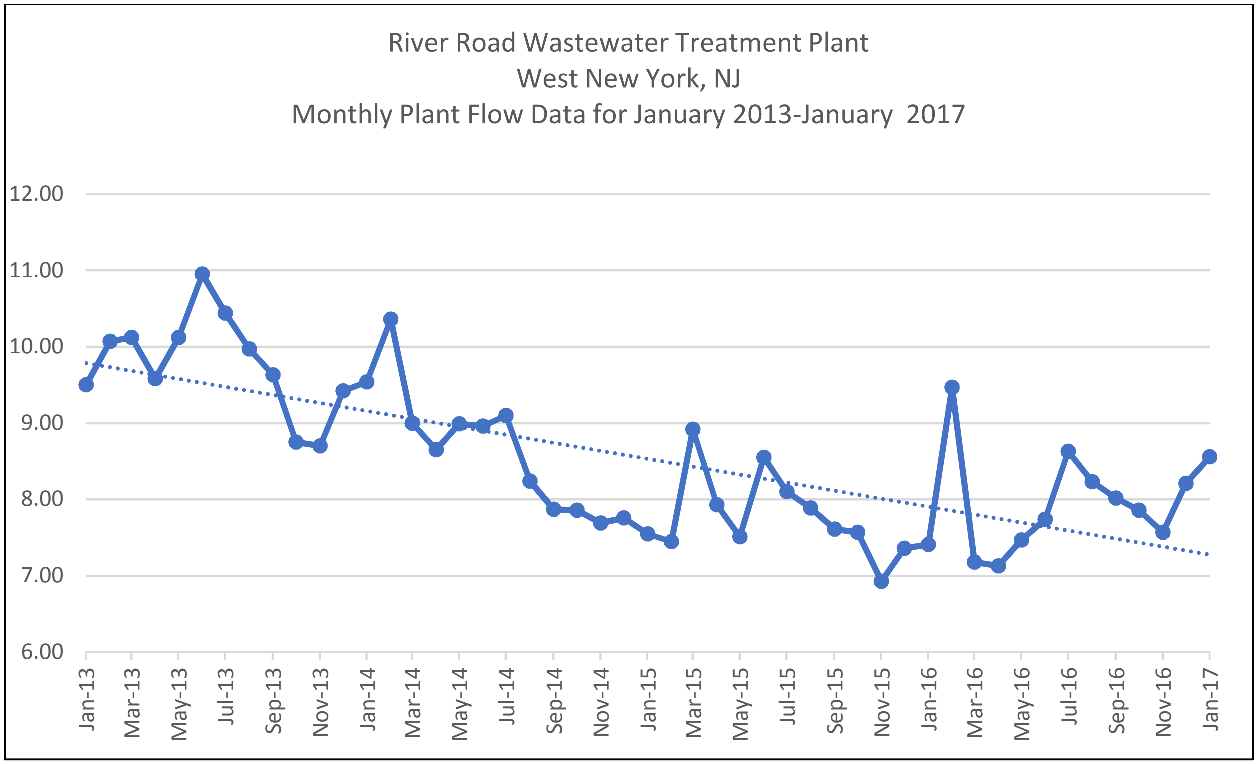


Table 4: River Road WWTP Performance Summary, FY2017

Parameter	**Permit Limit**	**WWTP Operation Data**		
		Annual	Minimum	Maximum
Flow	Report Only	8.01	7.13	9.47
pH Influent, Maximum	Report Only	8.42	8.1	8.9
pH Influent, Monthly Minimum	Report Only	7.1	6.8	8.9
pH Effluent, Monthly Maximum	9.00 SU	7.6	7.4	7.9
pH Effluent, Monthly Minimum	6.00 SU	6.85	6.4	7.3
TSS Effluent	30 MG/L Monthly Ave.	16.4	11	23
	85 Percent Removal Monthly Ave.	90.5	86	93
CBOD Effluent	25 mg/L Monthly Ave.	17.58	13	22
	85 Percent Removal Monthly Ave.	88.9	83	92
Oil and Grease	10 mg/L Monthly Ave.	4.66	0.70	9.8
Fecal Coliform	200 CFU Monthly Geometric Mean	11.83	1	30
	400 CFU Weekly Geometric Mean	76	3	442
Chlorine	0.13 MG/L Daily Max	0.07	0.02	0.29
Dissolved Oxygen, Minimum Weekly Average	4 MG/L Weekly Ave. Min	8.02	6.34	10.91

5. Green Stormwater Infrastructure Projects

6.

WEST NEW YORK PARKING AUTHORITY: 63RD STREET PARKING LOT

Subwatershed: Hudson River

Site Area: 14,271 sq. ft.

Address: 6305 Bergenline Avenue
West New York, NJ 07093

Block and Lot: Block 151, Lot 8

Parking spaces can be replaced with pervious pavement to capture and infiltrate stormwater. A preliminary soil assessment suggests that more soil testing would be required before determining the soil's suitability for green infrastructure.

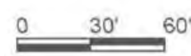
Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
94	13,483	0.7	6.8	61.9	0.011	0.37

Recommended Green Infrastructure Practices	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Maximum Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cu. ft./second)	Estimated Size (sq. ft.)	Estimated Cost
Pervious pavement	0.177	30	13,001	0.49	4,900	$122,500

GREEN INFRASTRUCTURE RECOMMENDATIONS

West New York Parking Authority: 63rd Street Parking Lot

- pervious pavement
- drainage area
- property line
- 2015 Aerial: NJOIT, OGIS



MOTT MACDONALD	111 Wood Avenue South Iselin NJ 08830-4112 United States of America Certificate No. 24GA28018600 T +1 (800) 832 3272 F +1 (973) 376 1072 W www.mottmacamericas.com	Client NORTH HUDSON SEWERAGE AUTHORITY HUDSON COUNTY, NEW JERSEY	Rev Date Drawn Description Ch'k'd App'd

Title		
PARK AVE AND 48TH STREET WEEHAWKEN, NEW JERSEY STORMWATER PLANTER CONCEPTUAL PLAN	Drawn KWG Checked KPW Approved KWG	Scale at ANSI B 1" = 20'
Drawing Number CONCEPT-01	Security STD	Status APR / Rev REV. 0

pw:\\388902-NHSA GREEN INFRASTRUCTURE PROJ\Drawings_Models\Conceptual\

Attachment 4
Adams Street Outfall Alternatives

Outfall	General Information	Available Open Space	Key Takeaways, Design Points and Control Alternatives
002A	• Typical year current conditions: 44 MG/yr, 34 activations/yr • Regulator H1 located near intersection of Observer Highway and Hudson Street; screening facility and wet weather pump station located on outfall adjacent to Regulator H1. • Dry weather flow travels through interceptor to 5th Street Pump Station. • Estimated 3 MG of storage needed for 4 overflows/typical year. • Twin 48-inch outfalls run under the NJ Transit Station. The outfalls were relined during the H1 wet weather pump station project. • H1 pump station capacity is 50 mgd and pumps at high tide. The outfall can discharge by gravity during low tide; the pump station operations are in the model. Monroe Street project is removing flow from H1. • Regulator H0 was eliminated. • Fats, oil and grease (FOG) issues on the collection system being partially addressed with new NHSA inspection program.	• Limited amount of open space near 002A; building on NJ Transit property is not possible. • Potential for linear storage under Observer Highway. • Parking lot on south side of Hoboken is an opportunity to store approximately 1 MG, but this parking lot is targeted for development. • Storage tank or sodium hypochlorite disinfection possibly could be constructed in parking lot north of H1 wet weather pump station.	• Evaluate sensitivity of diverting stormwater from housing authority area into a transit authority drainage ditch. • More opportunity to build exists in the south side of Hoboken. • Outfall length is approximately 630 feet. This would not provide enough detention time for disinfection. Would need to dose at the pump station and de-chlorinate at downstream end. There is the potential to dose with chlorine upstream. A study at West New York WWTP determined that the Hudson River has a chlorine demand, noting that de-chlorination may not be necessary.
003A	• NHSA intends to close Regulator H2 and remove from NJPDES.	• N/A	• NHSA intends to provide outfall for use by the Rebuild by Design Hudson River Project for discharging stormwater from new storm sewer system that is planned in this area outside the barrier.
005A	• Typical year current conditions: 65 MG/yr, 41 activations/yr • Three regulators feed the outfall: H3, H4 and HSI. Solids/floatables facility located on outfall downstream of the three regulators. • Dry weather flow travels through interceptor to 5th Street Pump Station. • Estimated 4 MG of storage needed for 4 overflows/typical year. • It is desired to catch all the flow from H4 as well because it is the majority of the overflow along with H3. • Evaluate if H4 flushing chambers are closed and test different scenarios in model. It is important to note if they are not closed.	• Potentially more cost effective to build out into the Hudson River instead of constructing a storage tank under Stevens Park. • Consider Sinatra Drive as a route for consolidating outfalls and work on the Hudson River farther down. Outfall 006A was measured at approximately 0.62 miles away from outfall 005A. Investigation on possible existing piles would be required.	• Attempt to mirror Pier C Park or make another park with a tank under the walkway. • Storage/treatment under Stevens Park may be viable option. One option may be a disinfection tank with contact time within/under Stevens Park. • Reconstructing Stevens Park is an opportunity to store flow. Could also consider tunnelling under the park without demolishing the park itself and interrupting public use.
006A	• Typical year current conditions: 10 MG/yr, 11 activations/yr • Regulator H5 located at intersection of Hudson and 11th Streets; screening facility located on outfall adjacent to Regulator H5. • Dry weather flow goes to 11th Street Pump Station. • Estimated 1 MG of storage needed for 4 overflows/typical year.	• Parcel of open land possibly available near a dry dock for construction, although the State and the City are arguing over uses they have already identified. • Sinatra Drive was mentioned as a potential route for consolidation/storage conduit, however there may be piles in that area. • Consider storage or treatment facility in the water.	• Peak flows are relatively high in relation to the overflow volumes, so it may be more cost-effective to store compared to end-of-pipe treatment. • H5 is a sensitive area due to kayak launch on other side of peninsula.
008A	• Typical year current conditions: 12 MG/yr, 11 activations/yr • Two regulators feed the outfall: H6 and H7. Solids/floatables facility located on outfall downstream of the two regulators. • Dry weather flow goes to 11th Street Pump Station. • Estimated 1.4 MG of storage needed for 4 overflows/typical year. • NHSA's H6/H7 CSO Project planning and design is ongoing. • HLSS being designed for H7, eliminating street runoff, conveyed to tank under the new park. Will optimize Regulators H6 and H7 to reduce overflows. • Need to assess whether the H6/H7 project reduces overflows to four per typical year. • Regulators H6 and H7 will be outside the Rebuild by Design barrier.	• Northwest Resiliency Park will be used for storage. • Developer wants to build on pier near outfall. • Limited available sites for storage.	• Regulators H6 and H7 will have to be optimized to reduce overflows after HLSS and tank are online. • Project may require new Adams Street WWTP outfall to provide capacity in existing WWTP outfall to discharge H7 stormwater flows. • Consider opportunities for stormwater reuse from storage tank.

Outfall	General Information	Available Open Space	Key Takeaways, Design Points and Control Alternatives
012A	• Typical year current conditions: 4 MG/yr, 10 activations/yr • 18th St PS regulator located near intersection of Park Avenue and 18th Street; • Dry weather flow goes to 18th Street Pump Station. • Estimated 0.3 MG of storage needed for 4 overflows/typical year. • 18th Street Pump Station force main was recently replaced. • The water quality impact of CSO is very little; water quality in Weehawken Cove is poor but is not driven by CSOs.	• Parking lot on north side of outfall is being developed and not available. • Limited land under park and parking lot to the south of the outfall along Weehawken Cove waterfront. • Possibility of letting new WWTP outfall create more flushing in Weehawken Cove.	• Maximize flow to WWTP with increased capacity and larger/second force main from 18th Street Pump Station. • Disinfect at 18th Street Pump Station. • 300,000 gallons may be stored at identified open spaces.
013A	• Typical year current conditions: 219 MG/yr, 58 activations/yr • Four regulators feed the outfall: W1, W2, W3 and W4. Solids/floatables facility is being constructed in the Hudson River at the end of outfall downstream of the four regulators. • Dry weather flow from W1, W2, W3 goes directly to Park Ave. siphon; dry weather flow from W4 goes to Baldwin Ave. PS, and is then pumped to the Park Ave. siphon head box. • Estimated 11 MG of storage needed for 4 overflows/typical year. • Drainage area is almost completely impervious with a large amount of wet weather flow generated. • Regulators W1, W2 and W3 are manually closed during high wet weather flows. • Single outfall pipe is aligned under bus lot and light rail. A junction box divides the flow through parallel outfalls to new end-of-pipe net S/F. • Storage at the top of the hill in drainage areas is unlikely. • Opportunity for GI in drainage areas is limited due to existing land uses. • Tank or tunnel storage taking overflows from W1, W2 and W3 may be possible to hold and release when WWTP can accept flows. Although advised to avoid construction on Park Avenue.	• Brownfields sites to the north. • Open lot on 44th St & Hudson Avenue. • Storage under Hackensack Plank Road and Park Avenue may be possible but construction on Park Avenue may want to be avoided. • Pathmark parking lot is potential site for storage (may also divert flow from River Road's JOSO to site). • Sufficient space for a chlorine contact tank with 15 minutes of detention time does not appear to be available at the bottom of the Palisades. A short detention time, high-rate disinfection system would perhaps need smaller space.	• Relocating regulators would require dry weather flow connections running from the top of the hill and down the steep rock cliff. This would allow for flow control upstream of the high-energy drop. Biggest issue would be constructing new dry weather flow connections. Benefit would be elimination of the need for manual control of dry weather flow at these locations. • Drop shaft at the top of the hill under Park Avenue to tunnel gently sloped and directed towards Adams Street WWTP. • New drop shafts will likely require vertical flow control. • Overflow detention can include disinfection upstream of the W1234 S/F. • Currently 24-inch and 12-inch siphon on backside of the WWTP. Can increase capacity of the siphon with a third barrel. That would take more flow from the north as a benefit. • Consider targeting an 85% solids capture for a storage/treatment facility
015A	• Typical year current conditions: 24 MG/yr, 40 activations/yr • Regulator W5 located along John F. Kennedy Bouldevard, between 48th and 49th Streets. Vortex separator facility located along outfall downstream of the regulator • Dry weather flow goes to Baldwin Avenue Pump Station. • Estimated 1 MG of storage needed for 4 overflows/typical year. • Metered flows and modelled overflows are much higher than expected for this drainage area compared to other areas of comparable size and drainage area characteristics.	• No existing space on top of Palisades at Regulator W5. • No existing space at vortex – would require excavation/hill removal. • No existing space along outfall to waterfront.	• NHSA intends to further investigate drainage area and possibly meter flows again to better characterize wet weather flows and overflows. • Add disinfection at vortex. • Confirm overflows through vortex and analyse the amount of chlorine contact time needed. Replace/upsize vortex if necessary to achieve required contact time.

Appendix D
Preliminary Screening Memorandum

North Hudson Sewerage Authority

Long Term Control Plan

Preliminary Screening of CSO Control Technologies: JOSO, WNY1, and River Road WWTP

NJPDES Permit: NJ0026085

Date: November 13, 2018

Prepared by:

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Morristown, NJ 07960

North Hudson Sewerage Authority

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Hoboken, NJ 07030
(201) 963-6043

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Preliminary Screening of CSO Control Technologies

DATE: November 13, 2018

PREPARED BY: CH2M

PROJECT: North Hudson Sewerage Authority Alternatives Analysis-River Road

Executive Summary

Under the New Jersey Pollutant Discharge Elimination System (NJPDES) permit for the River Road Wastewater Treatment Plant (WWTP), as part of the Long Term Control Plan, the North Hudson Sewerage Authority (Authority) must conduct an evaluation of alternatives for combined sewer overflow (CSO) technologies at the River Road WWTP and its outfalls. This technical memorandum presents the findings of the preliminary screening of these identified control technologies for the River Road drainage area. The purpose of this screening is to provide an initial evaluation on the alternatives by identifying anticipated constraints, site limitations, functionality and feasibility of the control technologies identified. The evaluation criteria presented in the Identification of Alternatives and Evaluation Criteria memorandum dated October 29, 2018 were used as a guide to summarize this analysis, which can be found at the end of this memo. Based on this preliminary screening, alternatives that would not allow compliance with the Final Permit will not be included in the next phase of evaluation ('Not for This Contract) in which conceptual layouts of the alternatives are presented and the Authority's InfoWorks ICM model is used to simulate the expected benefits of the alternatives.

Table 1 summarizes the results from the preliminary screening and indicates the alternatives that will proceed to the next phase of evaluation.

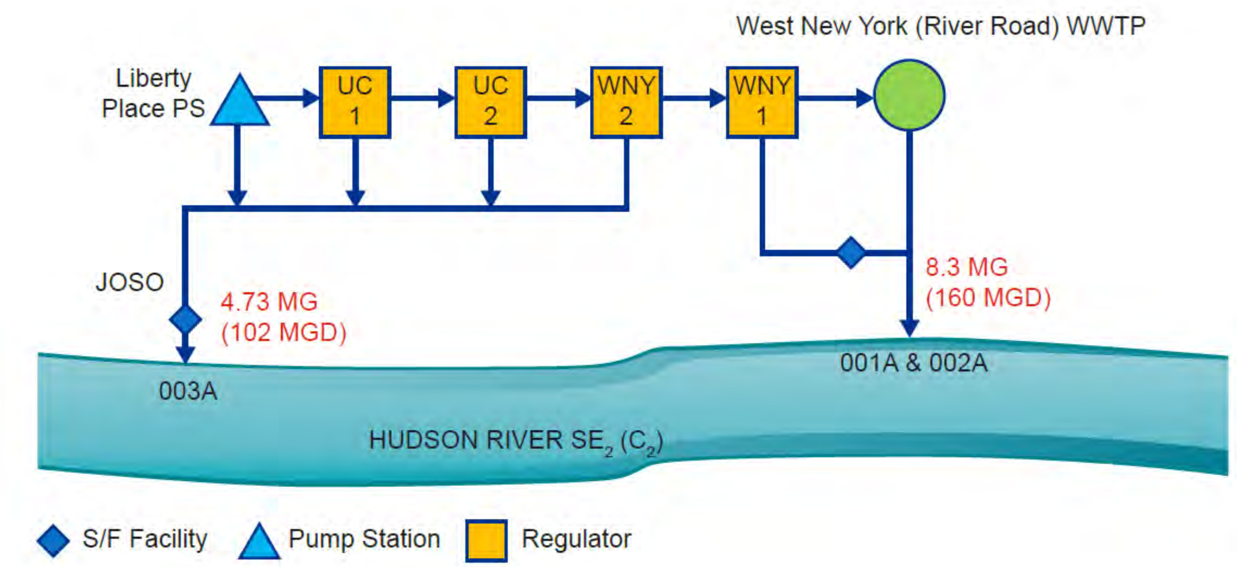
Table 1 - Preliminary Screening Alternatives Summary

Service Area	**Alternative**	**Proceed to full evaluation?**
JOSO	Raise regulator weirs at UC1, UC2 and/or WNY2	Yes
	Replace existing JOSO side-flow weirs with bending weirs	Yes
	CSO storage structure constructed in River	Not for this contract
WNY1	Linear Storage Along Anthony Defino Way	Yes
	CSO storage structure constructed in River	Yes
River Road WWTP	CSO Storage Adjacent to River Road WWTP	Not for this contract
	Replace Treatment Works with CoMag®/BioMag® Technology	CoMag® – Yes BioMag® - Not for this contract
	Replace microstrainers with ACTIFLO® technology	Yes
	Incorporate Cloth Media Filtration to Increase Treatment Capacity and Provide TSS Removal	Yes
	Gravity Storage Tank with Primary Level BOD and TSS Removal	Not for this contract
System-wide Alternatives	Green Infrastructure	Yes
	Inflow/Infiltration-Sewer Lining and Rehabilitation	Yes

Introduction

This technical memorandum presents the preliminary screening of control technologies listed in the Identification of Alternatives and Evaluation Criteria memorandum dated October 29, 2018 for the River Road System. Control technologies include flow control (e.g. storage) and treatment. It is noted that treatment alternatives are meant to be partial solutions which would be incorporated with upstream solutions such as storage or weir optimization. The objective of the treatment alternatives is to expand treatment capacity to accommodate dewatering from storage or improve percent capture in treating higher flows to the WWTP. The purpose of this memorandum is to identify the anticipated constraints, functionality and feasibility of all identified alternatives for the specified site. The intention is to refine the list of technologies to those that would fit the site-specific needs and would allow compliance with the Final Permit. Those final identified alternatives would then undergo the evaluation method defined in the Evaluation Criteria memo. This memorandum is an interim step towards producing the Development and Evaluation of Alternatives Report to be submitted to the New Jersey Department of Environmental Protection (NJDEP) by July 1, 2019. Figure 1 below depicts the System Block Diagrams of the River Road WWTP outfalls. This Figure provides an understanding of the relative locations and configuration of the Authority's infrastructure along the Hudson River based on the wastewater treatment plant service area as well as the volume of the 5th largest overflow developed from the model that will be used as a target to evaluate storage, capacity and treatment alternatives.

Figure 1 – River Road WWTP Service Area



Preliminary Screening

The following section details the preliminary screening of the alternatives from the Identification of Alternatives and Evaluation Criteria memorandum dated October 29, 2018 by drainage basin. The screening includes identifying the anticipated constraints, site limitations, functionality, and feasibility of each alternative. The evaluation criteria provided in Attachment 1 were used as a guide to describe any anticipated constraints, site limitations, functionality and feasibility of the alternatives.

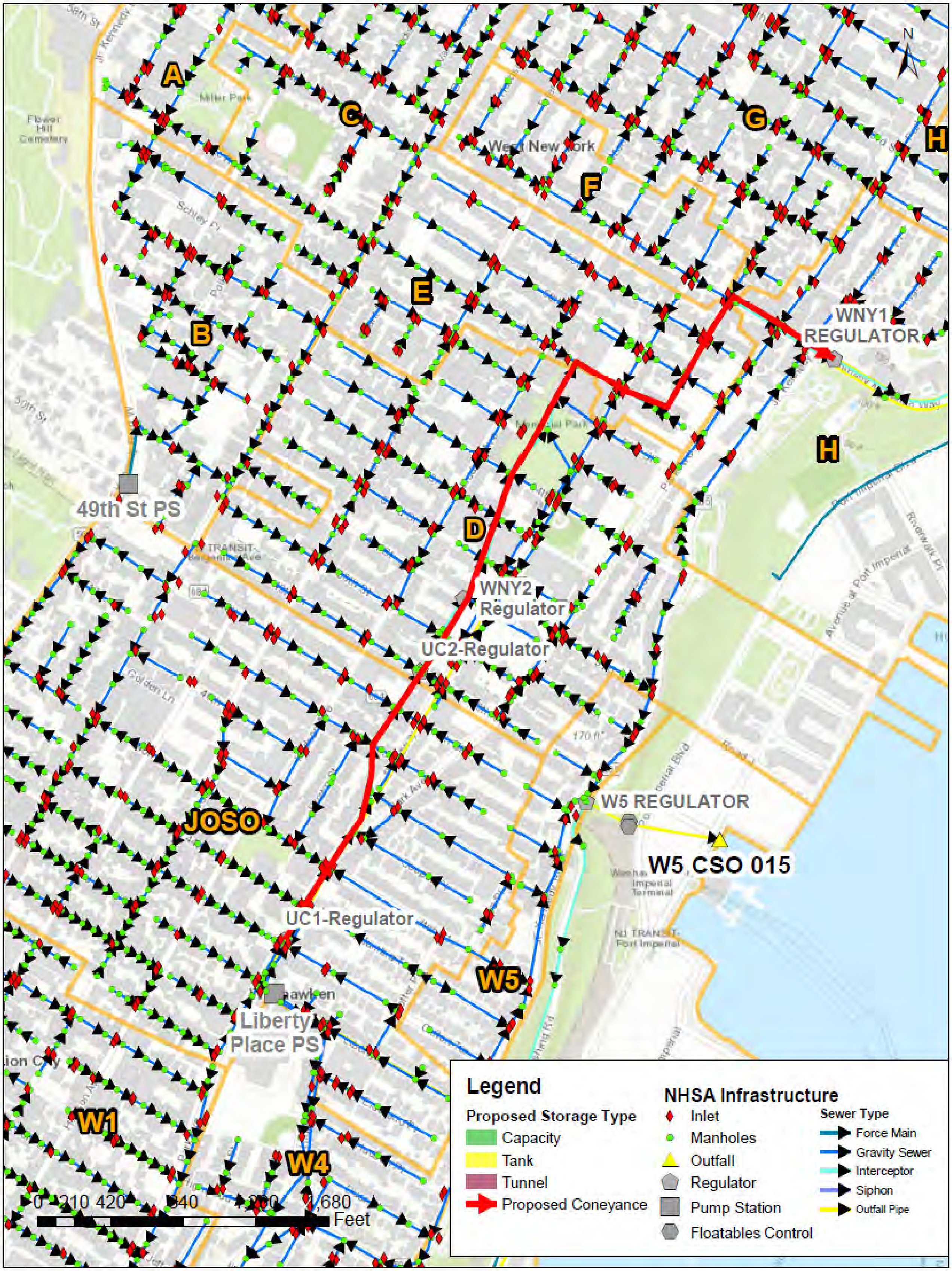
JOSO Basin

Raise Regulator Weirs at UC1, UC2 and/or WNY2

Diverting flows from the JOSO network to the WNY1 outfall is proposed. Figure 2 shows the approximate path of the diverted flow from the UC1, UC2 and WNY2 regulators thorugh the JOSO interceptor. The JOSO outfall currently has 3 regulators (UC-1, UC-2 and WNY2) in the network that direct wet weather flow to the JOSO relief sewer as needed. To avoid expensive, disruptive and challenging in-rock construction, an option is to raise these overflow weirs regulators to direct more flow to WNY1 (and less overflow to JOSO). This could be accomplished with minimal construction and/or break in service, and without the hassles of in-rock construction.

- *Anticipated Constraints and Site Limitations*:
    - Capacity at River Road WWTP - Diverting additional flow to the WNY1 regulator alone may not result in CSO reduction to the desired level; the River Road WWTP needs to have sufficient capacity to treat the increased flow, otherwise, it may result in a larger or an additional WNY1 outfall with solids/floatables reduction. Since discharge from the JOSO outfall already receives solids/floatables (S/F) reduction, its mere diversion to WNY1 may not be an improvement. To ensure the desired level of CSO reduction, diverting additional flow to the WNY1 regulator should be supplemented by increased capacity at the River Road WWTP to treat additional flow.
- *Functionality*:
    - The level of CSO reduction expected would need to be verified as well as the capacity of the WNY1 trunk sewer by modeling or other theoretical means. Modeling could also help determine which regulators need their weir raised, the additional weir height necessary and any unintended consequences. No additional hiring/training is anticipated to be required for the function of this alternative. This alternative is anticipated to reduce CSOs to the desired level by improving on existing conveyance methods while avoiding challenging in-rock construction and conveying increased flow to an existing WWTP for complete treatment.
- *Feasibility*:
    - Managing impact on traffic and the neighborhood during construction is anticipated to be limited because these improvements would be within existing structures owned by the Authority. Relatively small capital and O&M costs are expected compared to other storage or disinfection alternatives. These improvements are also anticipated to work effectively under a variety of flow conditions and during intermittent operation. This alternative is considered feasible.

Figure 2 – Proposed Conveyance from JOSO Regulators to WNY1 Regulator Site Plan



Replace existing JOSO side-flow weirs with bending weirs

It is proposed to replace the existing JOSO weirs with bending weirs to convey more flow to the River Road WWTP. The objective is to maximize upstream collection system storage and capacity during smaller storms to reduce CSOs, while allowing flows to be diverted to the CSO outfalls during larger storms.

- *Anticipated Constraints and Site Limitations:*
    - Plant Capacity - Like the alternative to raise regulator weirs, it is necessary to verify that the River Road WWTP has sufficient capacity to treat and discharge the additional flow that is diverted from JOSO. To ensure the desired level of CSO reduction, diverting additional flow to the River Road should be supplemented by increased capacity at the WWTP to treat the additional flow.
    - Construction - This alternative requires replacement of the existing side overflow weirs, which would result in temporary traffic disruption on Park Avenue, 49th Street and 51st Street. The duration of work would be shorter than the other alternatives listed within this memo.
- *Functionality:*
    - This alternative does not require any SCADA automation or external controls for operation, thus there is minimal complexity in operation. However, bending weirs are prone to clogging/jamming with debris such as aluminum cans. A top-opening bending weir would be preferable to a bottom-opening weir, as a top-opening weir provides easier access for cleaning. The capacity of the WNY1 trunk sewer will also need to be determined through modeling iterations.
- *Feasibility:*
    - If more flow is diverted from JOSO to the River Road WWTP as a result of the weir replacement, it may be necessary to upgrade the treatment components at the River Road WWTP to provide capacity to treat this additional flow, and to upgrade the River Road outfall to discharge the additional flow. As such, there may be additional potential for sewer backups and flooding, or the relocation of the CSO discharge elsewhere in the watershed or to an adjacent watershed. This alternative is anticipated to work effectively under a variety of flow conditions and during intermittent operation. This alternative is considered feasible.

CSO Storage Structure constructed in River

A storage alternative constructed in the Hudson River is proposed for the JOSO Basin. This may include a public/private partnership with a residential development that will ultimately utilize platform facility. Figure 3 shows the approximate available footprint of where the storage facility would be constructed. Based on the target volume of 4.7 MG and an assumed depth of 10 feet for a storage structure, an approximate area of 63,000 sq. ft. would be required. The overall dimensions of the structure can be modified to yield a larger or smaller area by adjusting the depth of the structure.

- *Anticipated Constraints and Site Limitations:*
    - Foundation - If the proposed structure would include a pier, achieving the proper foundation stability would require the use of multiple piles which can require complex methods and coordination.
    - Construction in Navigable Waters and Boat Traffic -
        - The proposed structure would extend beyond the current edge of all nearby existing structures with the exception of Days Point. Extending beyond the existing shoreline will require extensive permitting and would be required to meet stringent impact design criteria for boat and barge traffic so as to not disrupt currents and tides in the River. Permitting the structure as an "end of pipe" structure may allow for approval of surface water encroachments but the adjacency would need to be confirmed.
        - This alternative would require the use of a Cofferdam and dewatering during construction would present challenges and have significant costs
    - Sea Level Rise - This alternative being located on the shoreline presents design challenges to accommodate sea level rise. The designing of pumping system power and controls will need to meet flood damage protection criteria and sea level rise criteria which may conflict with the desire to not limit lines of sight for residents.
- *Functionality*:
    - The proposed storage structure would need to be at the water level equal with the surrounding grade to allow for a pedestrian park/development to be extended over the top of the structure. The required pumping system would also need to be enclosed in an architecturally consistent structure that does not limit lines of sight from residents. The access for structure maintenance would be from the existing lot along Henley Place
- *Feasibility*:
    - The proposed structure is adjacent to a new high end residential complex (Henley on Hudson). Not only will design and construction efforts need to be heavily structured and regulated, odor control measures taken after construction would be paramount. It is anticipated that the local residents along the shoreline would be difficult to gain approval as public stakeholders. While this alternative provides flexibility in the overall size of a structure, it is not considered feasible.

Figure 3 – Proposed CSO Storage Site Plan

WNY1 Basin

Linear Storage along Anthony Defino Way

Linear storage in the form of a tunnel between the WNY1 regulator and the outfall is proposed. Figure 4 shows the approximate alignment of the proposed tunnel at this stage. The available area allows for a 2,200 ft long tunnel which would require a diameter of 26 ft to achieve the required 8.3 MG of storage. Construction of the tunnel would require installation of a launching shaft and a receiving shaft at either end of the alignment. Filling of the tunnel would require some form of drop shaft to dissipate energy and emptying the tunnel would require the installation of a pump station.

- *Anticipated Constraints and Site Limitations:*
    - Available Space - The effectiveness of the tunnel hinges on the ability to provide the required storage within the available tunnel alignment. While the tunnel does not utilize surface space, large areas are required for laydown and construction. Following construction, permanent facilities are required for odor control, grit handling, screening and dewatering. The most convenient site for the tunnel is along the open space area south of Anthony Defino Way since it is adjacent to the River Road WWTP and is currently not utilized. The location introduces a number of site constraints.

      The launching shaft would be located at the base (northern end) of the open space area downstream of the River Road WWTP, thus flow would be pumped backwards (south) to the plant for treatment. Space is required in this area for laydown of equipment and materials, which may be challenging considering the steep slope. A drop shaft will be required at the downstream end of the tunnel, which will also require above grade facilities for odor control, grit removal, and possibly screenings. Air release will also be required along the tunnel.
    - Terrain - The steep ground surface (upstream end approximate ground elevation of 135 ft, and at the downstream the approximate ground elevation is 50 ft, a change of 85 feet) requires that the receiving shaft and storage tunnel be very deep to function properly.
    - Land Use - There are buildings on the north side of Anthony Defino Way that may impact the allowable methods for constructing the shaft including additional monitoring during construction, representing an additional risk to the project.
- *Functionality -*
    - This alternative requires a pump station to prevent deposition of solids, which increases cost, energy requirements, and operational considerations. It would also require SCADA monitoring and controls to level sensors, flow monitors, and overflow detectors. There is a risk of potential sewage backups in service laterals due to surcharging the system above previous hydraulic grades.
- *Feasibility -*
    - Tunnels have been shown to be a feasible alternative to provide temporary storage for a CSO. The feasibility of a tunnel for this application would depend on several factors. First is the cost, not just of the tunnel, but also the ancillary odor control, dewatering, screening and grit handling facilities. Extensive geotechnical investigations are required to determine the tunneling or mining methods to be used. Poor quality rock, excessive

groundwater and other factors can increase the price. In order to capture the volume of the 5th largest storm, a tunnel of about 2,200 feet in length with a diameter of about 26 feet would be required as shown in Figure 4. A tunnel of this diameter would require a tunnel boring machine (TBM) for construction and may need to be buried up to 60 feet below the surface to avoid utilities. Also, in order to remain within the public right-of-way the TBM must be able to follow the curve of Anthony Defino Way which would require a turning radius of approximately 250 ft. It may not be possible to obtain a TBM or the required diameter that would make the turn, and the cost of acquisition at about $20M for this TBM may be cost prohibitive for this length of tunnel.

Deep tunnels require specialized equipment, personnel and training to maintain and operate. While some tasks could be carried out by Authority personnel, periodic tunnel inspection and various maintenance tasks would require tunnel entry.

In order to discharge flow from the tunnel in an acceptable period of time expanding of the River Road WWTP may be required. As complex as this alternative may be it is considered feasible.

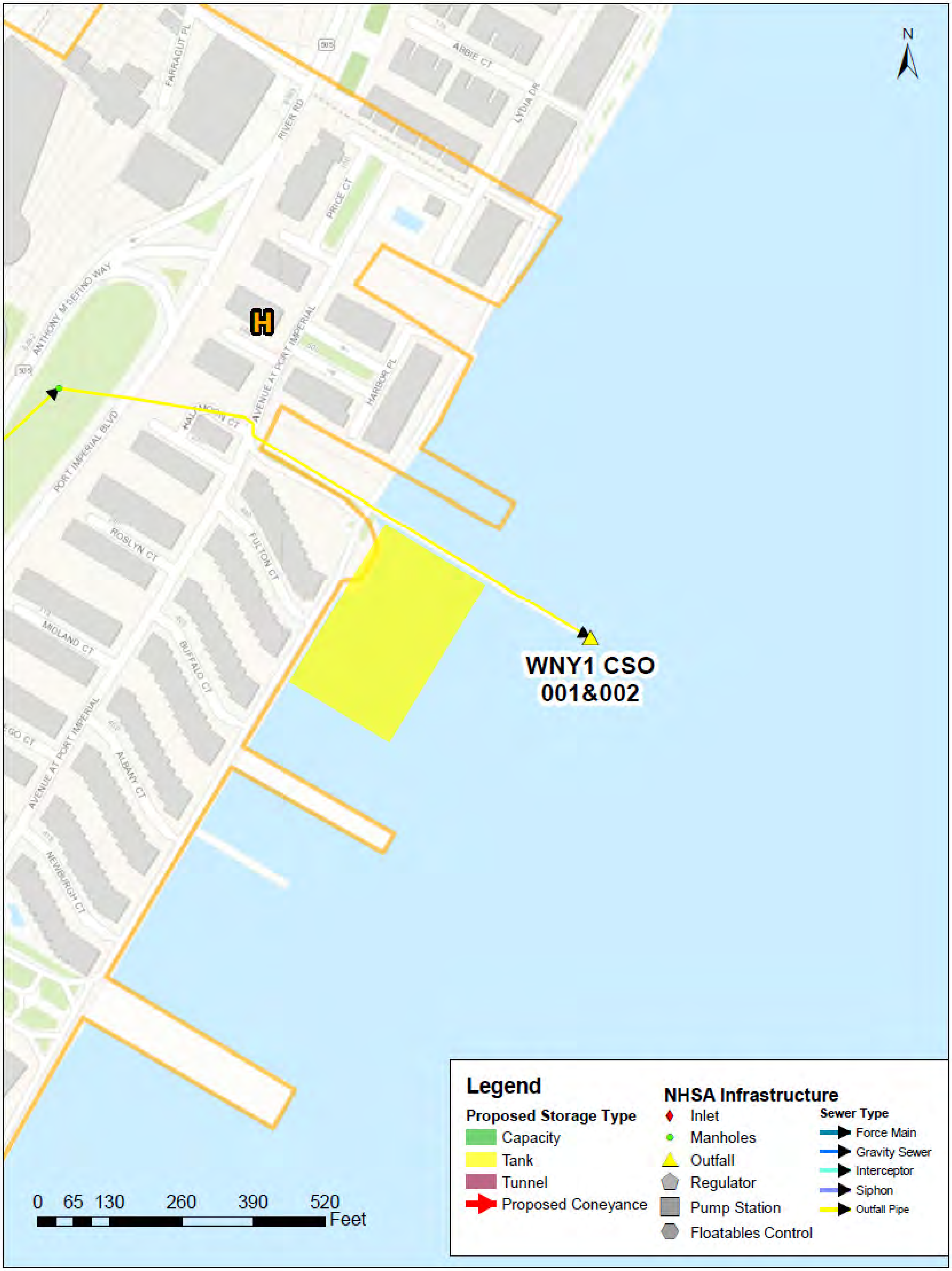
Figure 4 – Antony Defino Way Storage Tunnel Site Plan

CSO Storage Structure Constructed in River

A storage alternative constructed in the water is proposed for WNY1. This may include a public/private partnership with a residential development that will that will ultimately utilize platform facility. Figure 5 shows the approximate available footprint of where the storage practice would be constructed. Based on the target volume of 8.3 MG and an assumed depth of approximately 30 feet (height of the existing pier) the required area for a structure would be approximately 37,000 sq. ft. The overall dimensions of the structure can be modified to yield a larger or smaller area by adjusting the depth of the structure .

- *Anticipated Constraints and Site Limitations:*
    - Foundation - If the proposed structure would include a pier, achieving the proper foundation stability would require the use of multiple piles which can require complex construction methods and coordination.
    - Construction in Navigable Waters -
        - Permitting the structure as an "end of pipe" structure may allow for approval of surface water encroachments, but the adjacency would need to be confirmed.
        - This alternative would require the use of a Cofferdam and dewatering during construction which would present challenges and have significant costs.
    - Sea Level Rise - This alternative being located on the shoreline presents design challenges to accommodate sea level rise. The designing of pumping system power and controls will need to meet flood damage protection criteria and sea level rise criteria which may conflict with the desire to not limit lines of sight for residents.
- *Functionality:*
    - The proposed storage structure would need to be at high water level equal with the surrounding grade to allow for a pedestrian park/development to be extended over the top of the structure. The required pumping system would also need to be enclosed in an architecturally consistent structure that does not limit lines of sight from residents. The access for structure maintenance would be from the existing lot along Fulton Court which is private property.
- *Feasibility:*
    - The proposed structure is adjacent to a residential complex (The Landings at Port Imperial). Not only will design and construction efforts need to be heavily structured and coordinated, odor control measures taken after construction would be paramount. It is anticipated that the local residents along the shoreline would be difficult to gain approval as public stakeholders. However, due to the proximity to the River Road WWTP and the existing outfall, incorporating a park structure or other pier as an extension of the existing pier that houses the WNY1 outfall is an option that should be tested. This alternative is considered feasible.

Figure 5 – Proposed WNY1 CSO Storage Site Plan



N
WNY1 CSO
001&002
RIVER RD
PRICE CT
ABBIE CT
LYDIA DR
FARRAGUT PL
ANTHONY M DEFINO WAY
AVENUE AT PORT IMPERIAL
HARBOR PL
PORT IMPERIAL BLVD
ROSLYN CT
FULTON CT
MIDLAND CT
BUFFALO CT
ALBANY CT
NEWBURGH CT
Legend
Proposed Storage Type
Capacity
Tank
Tunnel
Proposed Coneyance
NHSA Infrastructure
Inlet
Manholes
Outfall
Regulator
Pump Station
Floatables Control
Sewer Type
Force Main
Gravity Sewer
Interceptor
Siphon
Outfall Pipe
0 65 130 260 390 520
Feet

River Road WWTP

CSO Storage Adjacent to River Road WWTP

Storage at an open space near the WWTP is proposed for this alternative. Figure 6 shows the approximate location of the open space for investigation. The available footprint of the site shown in the figure is approximately 30,000 sq ft. The location of this space is subject to change pending the next stage of evaluation.

- *Anticipated Constraints and Site Limitations:*
  - Terrain - There is an extremely large difference in gradient between the River Road WWTP and the Landings PS, and the River Road WWTP and JF Kennedy Blvd E. Excavating and constructing a storage tank in this location would be extremely challenging and expensive.
  - Available Space - Access to this site is very limited and traffic impacts could be significant as this site is wedged between JF Kennedy Blvd E and the River Road WWTP with no direct roadway access. Anthony M Defino Way serves the east side River Road WWTP and consists of single lanes in both directions. There is a small parking lot in front of the plant.
- *Functionality:*
  - The site location and resulting tank depth does not allow for a typical storage tank design. Access to the tank for maintenance vehicles and/or cranes would be very challenging at this location.
- *Feasibility:*
  - Hydraulically this alternative is not feasible because the existing terrain of the site forces the storage tank to be located at an elevation above the River Road WWTP. Excavating deeper and locating the tank at a lower elevation below the River Road WWTP is not considered feasible at this location.

Figure 6 – Proposed River Road WWTP CSO Storage Site Plan

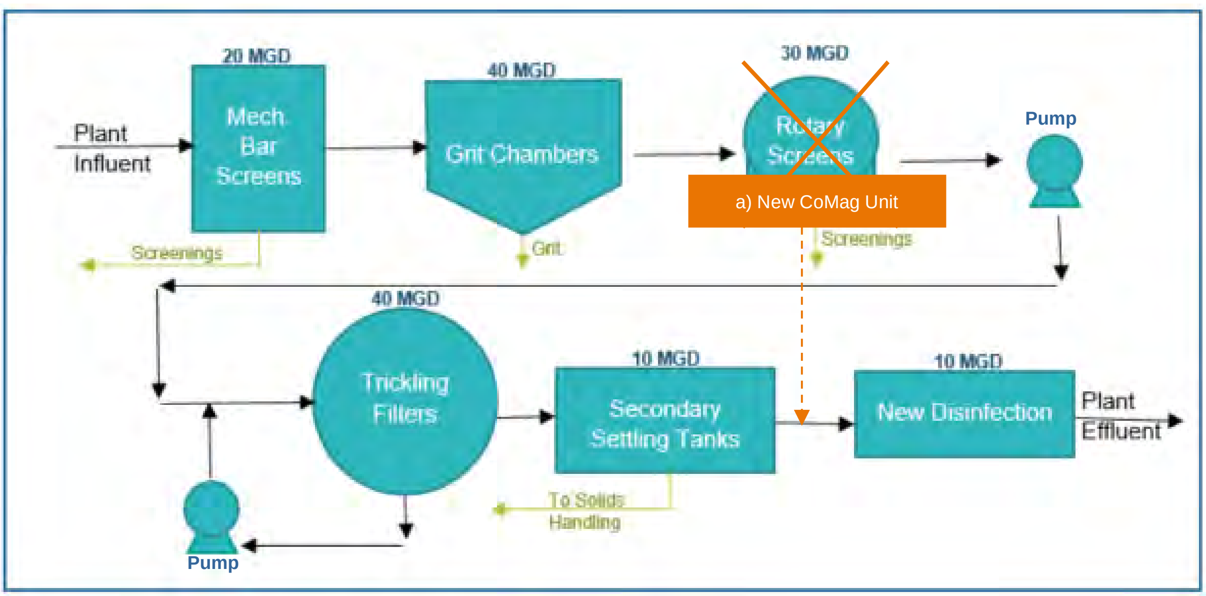
Treatment - CoMag® or BioMag®

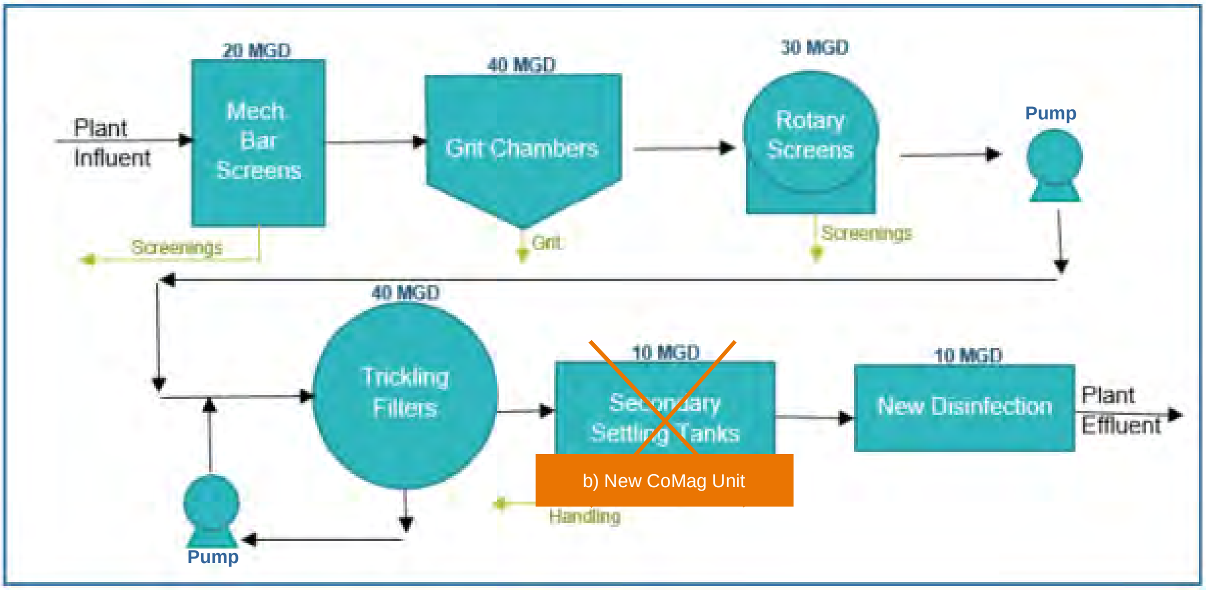
Modification of the current treatment works with CoMag® or BioMag® technologies is considered as an alternative to add additional treatment capacity to the WWTP. This capacity may be used to increase the percent capture of combined sewage or to treat dewatering flows from storage facilities. It is noted that this increased capacity may also necessitate a larger outfall and possible upgrades/modifications to the existing downstream disinfection system.

BioMag® is not typically used in a fixed film activated sludge process application (trickling filter plants) such as the River Road WWTP. As such, there are fewer pilot studies to provide design guidance. In order to use BioMag® in a typical application in conjunction with activated sludge treatment, significant space for additional facilities such as a suspended growth system, aeration basins, final clarifiers, blowers and associated facilities would be required. This is considered an impractical addition to the River Road WWTP, which has neither the available space nor the applicable treatment process to incorporate a BioMag® system, as such BioMag® is removed from further consideration for this application.

CoMag® is a ballasted settling process that could be implemented as a main stream or side-stream process to increase primary treatment capacity for bypass purposes. It could also be considered to replace the existing secondary settling tanks to increase overall plant capacity. If implemented as part of secondary treatment, it would be also necessary to consider an increase in disinfection capacity before discharge. Additional equipment/footprint is needed for the supplemental systems needed for the CoMag® process.

The figures below show where CoMag® could be added to the treatment train in the WWTP.





- *Anticipated Constraints and Site Limitations:*
    - Available Space- Installing a CoMag® system on the existing site will be a challenge due to the limited space available at the WWTP site, specifically in the existing headworks building where the proposed system would be located. Existing equipment would need to be relocated and reconfigured to accommodate the addition of the CoMag® system. It is anticipated that a CoMag® system may also require coarse screening and possibly fine screening upstream to ensure that larger debris does not impact the functionality of the system. More space is available if CoMag® is installed to replace the secondary settling tanks, however this may be limited by the capacity of the trickling filter. The CoMag® system also requires space for support systems such as a coagulant storage system and a feed storage system. A benefit of the CoMag® system is that the clarification tank size can be limited, thus it may be appropriate for applications in a small footprint. Installation of a CoMag® facility to increase treatment capacity may also require upgrades to downstream processes and the outfall to treat and discharge the additional flow.
    - Start Up Time- A significant constraint in the use of CoMag® technology in end of pipe applications is the startup time, which is in the range of 15-30 minutes. However, at the WWTP the system would be in continuous operation and would be able to treat the first flush, which carries the greatest pollutant loading. As such it is recommended that the CoMag® system be left on all the time, and a wet weather operational procedure developed to bring additional train on-line with increasing flow. The system requires significant operation and maintenance attention and there is some complexity in determining the appropriate chemical dosage, which must be controlled by the flow rate.
- *Functionality:*
    - CoMag® is not as widely used as other technologies for CSO and wet weather treatment applications. In terms of performance efficiency, the system is known to provide TSS removal rates of 75-95% and fecal coliform removal to < 200 Col/100 mL, site specific pilot testing is recommended. The system is gravity fed, compatible

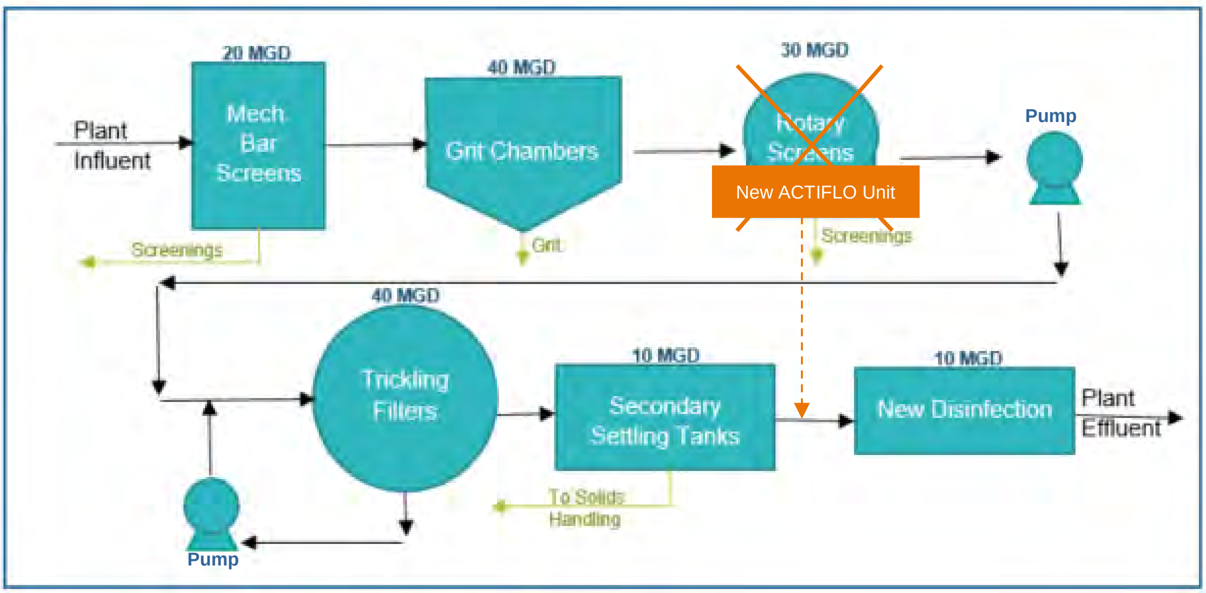
with previously developed site layouts, and there is flexibility in the system because the units can be added modularly. The amount of headloss must be considered in fitting it into the hydraulic grade line of the plant. The CoMag® system is able to provide settling rates which are faster than conventional treatments. They are considered a flexible process because of their ability to treat widely fluctuating flows and loads. In addition, magnetite is denser than the sand used in other ballasted flocculation processes, readily available (iron ore commodity), fully inert, not abrasive (particle size is 40-50 microns) and magnetically retrievable (high recovery rates). CoMag® systems have significant operational and maintenance requirements, as well as complexity in chemical dosage. As such the Authority must be willing to take on the additional operational and upkeep needs.

- *Feasibility:*
    - Consideration will need to be given to how the CoMag® system will be installed while keeping the plant in operation. Magnetite, which is used to settle chemical floc in the CoMag® system, is relatively inexpensive, ranging from $0.20 USD to $0.50 USD per pound delivered. Because the recovery rates of magnetite are high, the daily consumption is very low. If the treatment capacity of the WWTP is further increased in the future, an CoMag® system with higher capacity and cost may be required. While the BioMag® process is not considered to be feasible due to the current configuration of the plant as a trickling filter process, CoMag® is considered a feasible possible treatment alternative.

Replace Microstrainers with ACTIFLO®

Increasing the capacity of the WWTP by replacing the current microstrainers with ACTIFLO® technology is considered as an alternative to increase treatment capacity to the WWTP. Stacking the proposed units would also potentially allow for the increased capacity. This capacity may be used to increase the percent capture of combined sewage or to treat dewatering flows from storage facilities. Like CoMag, it could be implemented as a mainstream process to increase primary treatment to allow for bypass, which may also necessitate improvements to the disinfection system as well as a larger outfall.

The figure below shows where the ACTIFLO® unit could be added to the treatment train in the WWTP.



- *Anticipated Constraints and Site Limitations:*
  - Available Space- Installing an ACTIFLO® system on the existing site will be a challenge due to the limited space available at the WWTP site, specifically in the existing headworks building where the proposed system would be located. Existing equipment would need to be relocated and reconfigured to accommodate the addition of the ACTIFLO® system. It is anticipated that the system may also require coarse as well as fine screening upstream to ensure that larger debris does not impact the functionality of the system. The ACTIFLO® also requires space for support systems such as a coagulant, polymer, and sand storage systems. Based on the existing capacity of downstream processes, the ACTIFLO would likely be sized to a capacity of about 25 MGD. As such, based on the Updated Technical Guidance Manual, it may require footprint of approximately 60'9" x 22'. Installation of an ACTIFLO facility to increase secondary treatment capacity may also require upgrades to downstream processes such as disinfection and the outfall to treat and discharge the additional flow.
  - Start Up Time- A significant constraint in the use of ACTIFLO® technology in end of pipe applications is the startup time, which is in the range of 15-30 minutes. However, at the WWTP the system would be in continuous operation and would be able to treat the first flush, which carries the greatest pollutant loading. As such it is recommended that the CoMag system be left on all the time, and a wet weather operational procedure

developed to bring additional train on-line with increasing flow. The system requires significant operation and maintenance attention and there is some complexity in determining the appropriate chemical dosage, which must be controlled by the flow rate

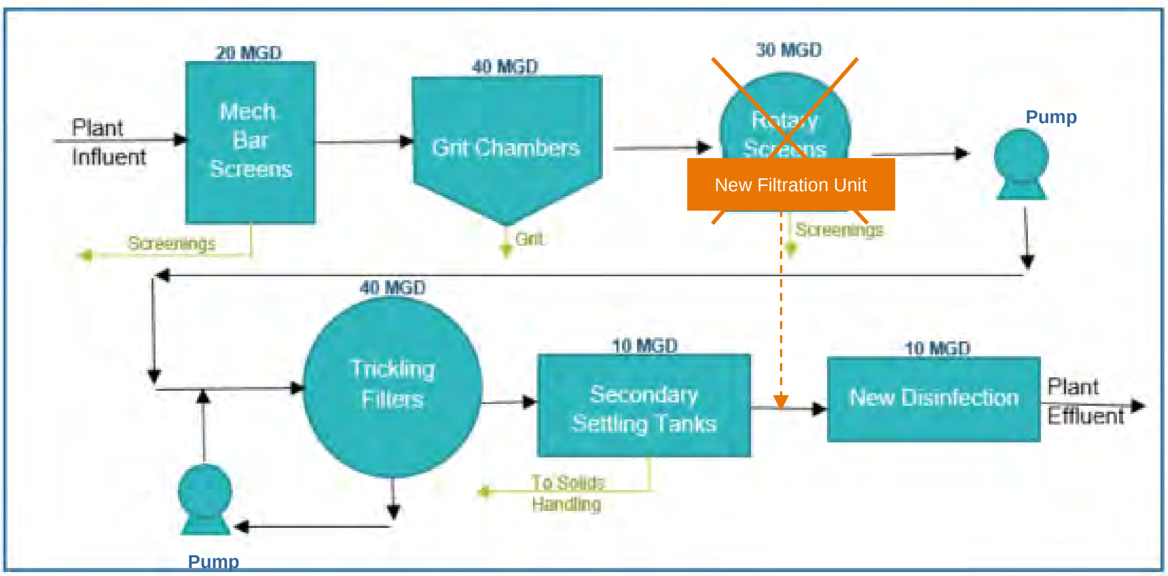
  - O&M- The system requires weekly inspections and preventive maintenance. If the system is being using intermittently, maintenance will be required to ensure that it is in working condition. These commitments would need to be agreed upon by plant staff.

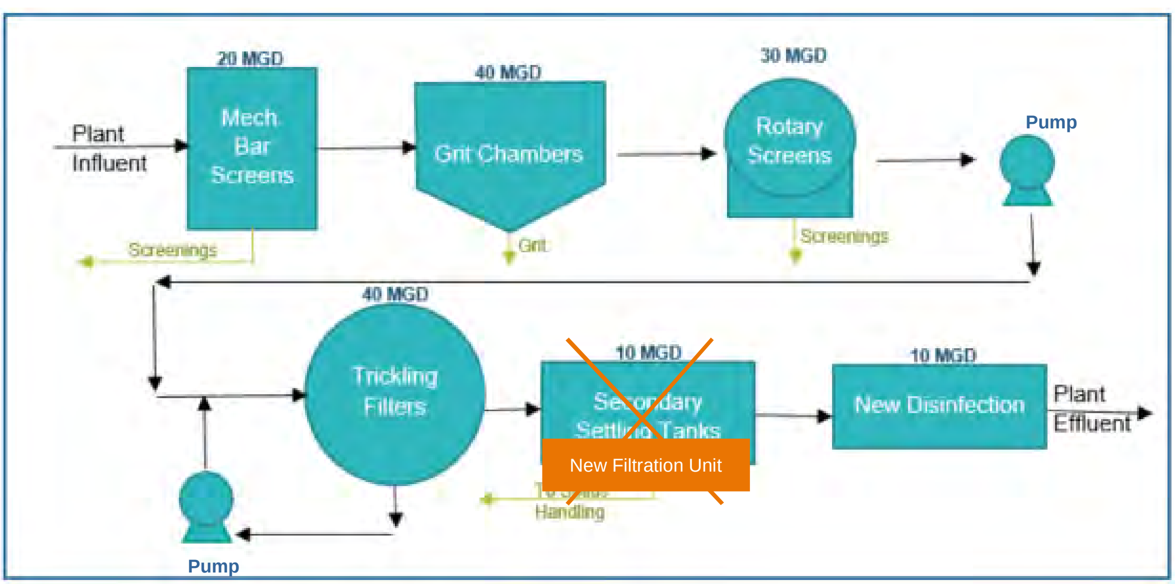
- *Functionality:*
  - ACTIFLO® is an established technology for CSO and wet weather treatment. In terms of performance efficiency, it is known to provide TSS removal rates of 80-95% and fecal coliform removal rates of 85-95%. It is very effective in removing pollutants, particularly because the addition of coagulant and polymer helps to remove smaller particles. It is noted that performance of the ACTIFLO® system deteriorates quickly for surface loading rates higher than 60 gallons per minute per square foot. The system is gravity fed, compatible with previously developed site layouts, and there is flexibility in the system because the units can be added modularly. The amount of headloss must be considered in fitting it into the hydraulic grade line of the plant. However, the system requires weekly inspections and preventive maintenance. If the system is being using intermittently, maintenance will be required to ensure that it is in working condition. The ACTIFLO® system has significant operational and maintenance requirements, as well as complexity in chemical dosage, as such the Authority must be willing to take on the additional operational and upkeep duties.
- *Feasibility:*
  - Consideration will need to be given to how the ACTIFLO® system will be installed while keeping the plant in operation. In order to provide treatment for 25 MGD, based on the Updated Technical Guidance Manual, the system is estimated to have a capital cost of approximately $10.1M. The annual cost of the system would be approximately $50,000 for energy and chemical costs and $38,000 for operation and maintenance labor costs. If the treatment capacity of the WWTP is further increased in the future, an ACTIFLO® system with higher capacity and cost may be required. Should these considerations be taken into account and the space be available, this alternative is considered feasible based on the plant's current need for additional TSS removal.

Incorporate High Rate Filtration to Increase Treatment Capacity and Provide TSS Removal

A high rate filtration system is considered as an alternative at the WWTP to increase treatment capacity and provide removal of total suspended solids (TSS). This capacity may be used to increase the percent capture of combined sewage or to treat dewatering flows from storage facilities. The filtration system may be a compressible media filtration process such as FlexFilter® or a cloth media filtration system such as AquaPrime® disk system.

The figures below show where filtration could be added to the treatment train in the WWTP. Filtration could be installed downstream of the existing mechanical bar screens to increase overall plant capacity. A system such as AquaPrime® or FlexFilter® could be in place of the rotary screens, with additional units brought on-line to blend with the trickling filter effluent prior to disinfection. Alternately, if implemented as part of secondary treatment, it would be necessary to increase capacity of the downstream disinfection system.





- *Anticipated Constraints and Site Limitations:*
  - Available Space- Installing a new filtration system on the existing site will be a challenge due to the limited space available at the WWTP site. Existing equipment may need to be relocated and reconfigured to accommodate this system. A filtration system may also require space for support systems such as blowers and backwash pumps. Based on the existing capacity of downstream processes, a filtration system would likely be sized to a capacity of about 25 MGD. As such, based on the Updated Technical Guidance Manual, a FlexFilter® may require dimensions of approximately 1,800 SF. AquaPrime® units are not included in the updated TGM but will provide some footprint efficiencies when compared with the FlexFilter®. If the treatment capacity of the WWTP is increased, upgrades to downstream processes and the outfall to treat and discharge the additional flow may be required.
  - Plant Operation-Consideration will need to be given to how a filtration system will be installed while keeping the plant in operation. The filters could be installed as standby units for wet weather service. Filtered effluent could be disinfected and blended with trickling filter plant effluent prior to discharge. Additionally, the AquaPrime® technology could replace the existing rotary (micro) screen units, and additional AquaPrime standby units could be provided to increase wet weather capacity.
  - Capacity at the WWTP-Based on the Updated Technical Guidance Manual a FlexFilter® may require dimensions of approximately 1,800 SF. AquaPrime® units are not included in the updated TGM but will provide some footprint efficiencies when compared with the FlexFilter®. If the treatment capacity of the WWTP is increased, upgrades to downstream processes such as disinfection and the outfall to treat and discharge the additional flow may be required.
- *Functionality:*
  - Compressible media filters such as the FlexFilter® are an established technology for CSO and wet weather treatment for plants of this size. The FlexFilter® is a simple gravity system requiring no moving parts. According to the Updated Technical Guidance Manual, it is typically operated at 4 gpm/sq. ft. hydraulic loading rate during the first flush portion of a CSO event and gradually increases the operating hydraulic loading rate as the CSO flow rate increases and solids concentration decrease. In terms of performance efficiency, FlexFilter® is known to provide TSS removal rates of 73% to 94% and 16% to 69% for BOD removal. Time is needed during operation for backwashing, especially at the higher end of the recommended filter loading rate as well as standby units for operation during backwash. A waste stream is produced which must be treated or disposed of. The FlexFilter is also noted for its operational complexity due to automated valves, hydraulically operated porous plate, air injection into the beds during backwashing, and monitoring needed for flow and headloss conditions. The amount of headloss required must be considered in fitting it into the hydraulic grade line of the plant.

    Cloth media filters such as AquaPrime® for wet weather treatment is a relatively new application of an older technology that is being more widely adopted in recent years. They are also gravity fed, but unlike the FlexFilter are able to remain in filtration mode during backwashing meaning standby units are necessarily required. Performance efficiency with the AquaPrime® is listed as slightly higher than the FlexFilter® with about 75% to 85% TSS removal and 45% to 60% for CBOD removal. The footprint of a cloth media filtration system is generally 50% smaller than an equivalent compressible media filtration system. The amount of headloss required must be considered in fitting it into the hydraulic grade line of the plant.

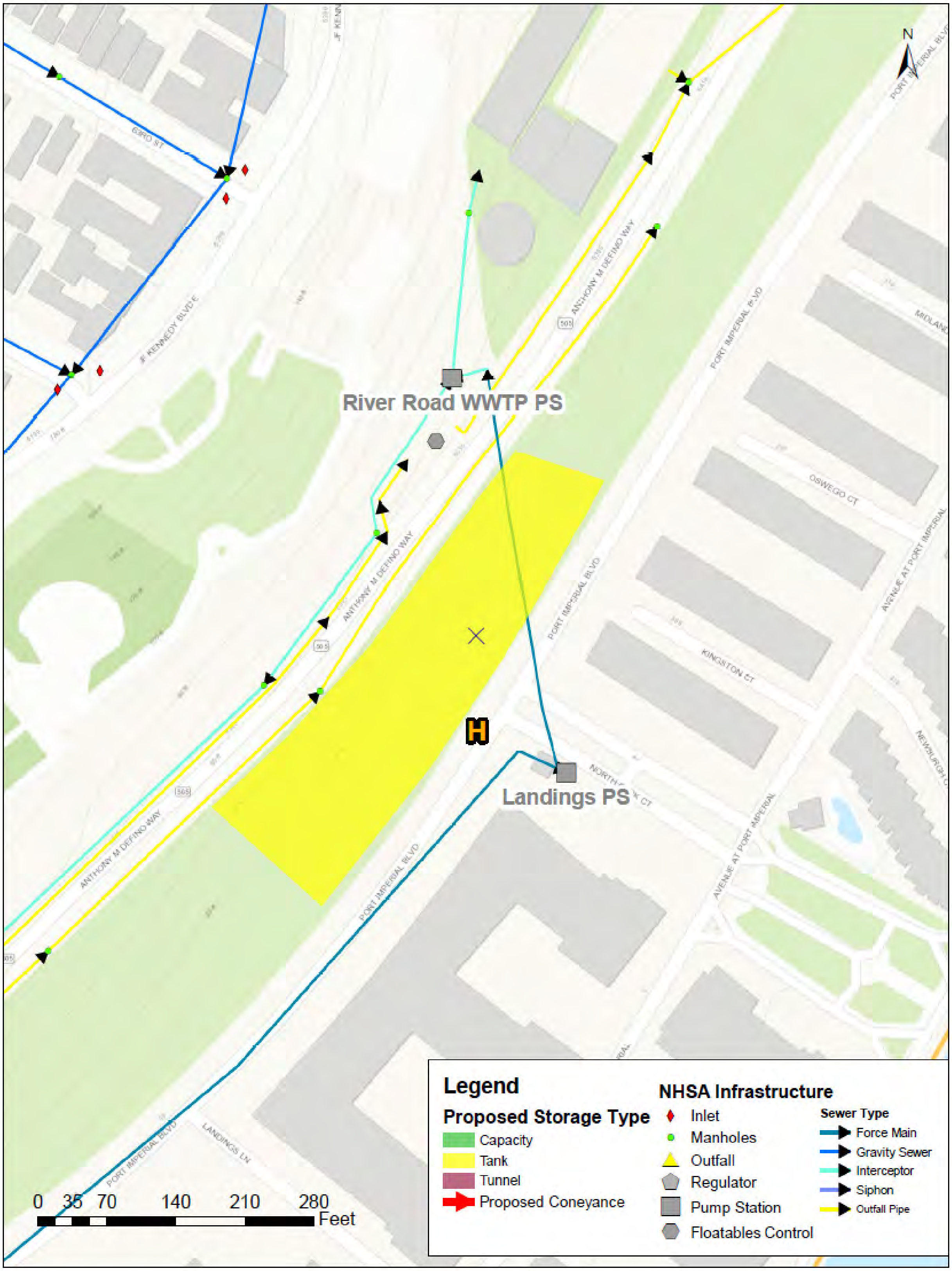
- *Feasibility:*
    - In order to provide treatment flow 25 MGD, based on the Updated Technical Guidance Manual, a FlexFilter system is estimated to have a capital cost of approximately $6.3M and annual cost of $33,000. Based on the plant's current need for additional TSS removal in order to aid the treatment plant with TSS removal, this alternative is considered feasible.

Gravity Storage Tank with Primary Level BOD and TSS Removal

A gravity storage tank with primary level BOD and TSS removal is recommended at the River Road WWTP for this alternative. Figure 10 shows the footprint of the identified open space. Based on the target volume of 11 MG, the storage tank would have a depth of approximately 20 feet and a length with an irregular curvature of approximately 515 feet.

- *Anticipated Constraints and Site Limitations:*
  - Available Space - There is very limited open space for a storage tank in the vicinity of the River Road WWTP. The only possible above ground storage location would be the 9.22 acre property located at Block 168, Lot 4 in West New York, immediately south of the River Road WWTP between Anthony M. Defino Way and Port Imperial Boulevard. There would be lead time as well as cost in acquiring the property, especially if it must be acquired via imminent domain.
- Terrain:
  - The site noted above is an irregularly shaped property (long and thin) with a steep slope ranging between 25% and 40%, and elevation drop of 80 feet across the southwestern end of the site and 20 feet elevation drop near the treatment plant. The underlying material is likely rock, thus there would be additional challenges as well as cost in partially burying this storage tank or making it a sub-surface tank. There may also be utilities underground which may need to be relocated if subsurface work is required. In order to provide storage for the 5th largest storm, the storage tank would have a footprint of approximately 20 feet in height, offset of 10 feet from the northern and southern adjacent roads, and an irregularly shaped tank with walls following the curvature of the parcel with an approximate tank length of 515 feet. An additional footprint of about 50 feet x 50 feet would be required to locate a pumping station and odor control facility.
- *Functionality:*
  - A storage tank will require a pump station and control system to empty the solids deposited in the tank for periodic cleanout. SCADA monitoring such as level sensors, rain gauges, flow monitors, and overflow detectors will be required to monitor flow depth in the tank. There may also be odor concerns in storing this flow in the tank. A benefit of using a storage tank is that it would have the capability to handle high flow and water quality variations, and can act as a sedimentation tank.
- *Feasibility:*
  - There are limitations in constructing a tank at the above noted site, due to the slope and space constraints, as well as subsurface rock material. Vertical shaft storage has also been considered. While it does have lower above ground site requirements than the other storage alternatives, vertical shaft storage would likely require a deep dewatering pump station as well as site challenges with tunneling down into the rock, and with sediment deposition in the shaft. Another challenge would be that O&M is in deep, confined spaces. There are a limited number of vertical shafts, thus this alternative is less widely understood and adopted. Due to the irregularity of the structure of the tank lending to decreased reliability, this alternative is not considered feasible.

Figure 10 – Proposed Primary Treatment Storage Structure Site Plan



System-Wide Alternatives

Green Infrastructure

Green Infrastructure (GI) is one type of source control technology that can help to manage stormwater, reduce CSOs, and improve water quality. GI technologies most common in urban areas like the River Road drainage basins include bioretention, bioswales, stormwater planters, permeable pavement, subsurface infiltration/storage, and stormwater tree pits. For less constrained sites with additional space, GI technologies such as infiltration basins, ponds, and constructed wetlands can prove to be effective, as well as cost-efficient. Conversely, for more constrained sites with limited at-grade opportunities, green (vegetated) roofs may be the only viable GI technology. When properly designed, constructed, and maintained, these technologies can provide significant levels of control over the course of a year through their performance in small to moderate-sized storms.

- *Anticipated Constraints and Site Limitations:*
  - Land Use -The overall River Road study area is divided into the following land uses:
    - Medium Density Residential/Mixed Use 0%
    - High Density Residential 65%
    - Commercial/Industrial/Transportation 27%
    - Open Space/Park/Other: 8%
    - Overall Imperviousness: 78%

  Based on a high-level assessment of these identified land uses in the study area, the following percentages of each land use area that can be feasibly managed by GI were assumed to be:

    - Up to 40% of the Medium Density Residential/Mixed Use area
    - Up to 15% of the High Density Residential area
    - Up to 30% of the Commercial/Industrial/Transportation area
    - Up to 60% of the Open Space/Park/Other area
    - Up to 23% of the overall study area

  From this assessment, a significant constraint of implementing GI within the service area is land use which includes limited open space. High Density Residential, which is the most limiting land use for GI implementation, represents the largest percentage of land use in this study area and also the one that has the least percentage of space to be feasibly managed by GI practices. Because of this, large, regional public GI projects/programs will likely be difficult to implement.

- *Functionality:*
  - The available types of GI that would function most effectively within the service area were analyzed. For the overall study area, the following assumed levels of implementation by GI technology were based on a high-level investigation of the various land uses and site conditions:

- Infiltration Basins/Ponds: 9%
- Constructed Wetlands: 11%
- Bioretention/Bioswales/Stormwater Planters: 43%
- Stormwater Tree Pits: 8%
- Subsurface Infiltration/Storage: 23%
- Permeable Pavements: 4%
- Green Roofs: 2%

In general, the most applicable GI technologies for the overall study area are Bioretention / Bioswales / Stormwater Planters, Subsurface Infiltration/Storage, and Constructed Wetlands, with lesser applicability for the other common types of GI. For the next phase, modeling scenarios will be conducted to estimate the possible CSO reduction from these methods of GI implementation based on different design storms.

- *Feasibility:*
  - The feasibility of implementing GI depends on multiple factors, including site conditions/usage, topography, the configuration of the collections system, land availability, property ownership, anticipated pollutant load, utility conflicts, size of drainage area, contaminated soils, and localized flooding. The slopes of the various drainage basins are generally favorable for GI implementation, as they range primarily from 0% to 6%, with only a few steeply sloped area (12.5% and 39.3%) at the northwest end of the service area where there are steep drops in elevation. These aspects will all be considered for locations recommended for green infrastructure. In addition to these estimated amounts of GI that can be feasibly managed for the service areas, sites that have previously been identified in a study for the Authority as opportunities for GI within West New York and Union City will be further evaluated for the evaluation as these are within the River Road service area.

Inflow/Infiltration

The Authority has reported increasing issues with dry weather flows at the River Road WWTP in recent years. This can be attributed to issues with inflow and infiltration (I/I) due to aging infrastructure. CCTV data that was conducted for all of the River Road drainage area indicated the severity of aging infrastructure within the service area. The analysis categorized each pipe, with a 4 or 5 on the PACP rating scale indicating that they are more susceptible to failure. Tables 2 and 3 analyze the results of the RedZone investigations to quantify the level of required rehab.

Table 2 - RedZone Results by Basin, Percentage of Sewer Aging Based on Total Length of RedZone Pipes

Drainage Basin	PACP Category				
	1	2	3	4	5
A*	-	-	-	100%	-
B*	12%	29%	31%	28%	-
C*	7%	-	6%	55%	32%
D*	8%	18%	17%	24%	32%
E*	22%	-	-	78%	-
G*	11%	4%	15%	58%	13%
H*	-	-	-	100%	-
JOSO	3%	11%	16%	47%	24%

*Sub Basin within the WNY1 Drainage Area

Table 3 - RedZone Results by Basin, Percentage of Sewer Aging Based on Total length of Pipes in Basins

Drainage Basin	PACP Category				
	1	2	3	4	5
A	-	-	-	2%	-
B	12%	4%	4%	3%	-
C	1%	-	1%	6%	3%
D	3%	8%	7%	10%	13%
E	1%	-	-	3%	-
G	2%	1%	3%	13%	3%
H	-	-	-	1%	-
JOSO	3%	11%	15%	46%	23%

*Sub Basin within the WNY1 Drainage Area

Based on the above information, scenarios will be run in the hydraulic collection systems model to remove the estimated amount of baseflow (dry weather flow) resulting from the pipes categorized as a 4 or 5. These results will provide an estimate of the effects of sewer lining or overall replacement for the aging infrastructure and provide a representative metric that shows improvements that sewer lining will have on the system

Summary

In Summary, Table 4 below identifies the final list of alternatives that will undergo the full evaluation process to simulate the conditions as they are expected to exist after construction and operation of the alternative. Those identified alternatives will also have a Class 5 conceptual cost estimate developed to provide the overall cost benefits for the anticipated amount of CSO control.

Table 4 - Preliminary Screening Alternatives Summary

Service Area	Alternative	Proceed to full evaluation?
JOSO	Raise regulator weirs at UC1, UC2 and/or WNY2	Yes
	Replace existing JOSO side-flow weirs with bending weirs	Yes
	CSO storage structure constructed in River	Not for this contract
WNY1	Linear Storage Along Anthony Defino Way	Yes
	CSO storage structure constructed in River	Yes
River Road WWTP	CSO Storage Adjacent to River Road WWTP	Not for this contract
	Replace Treatment Works with CoMag®/BioMag® Technology	CoMag® – Yes BioMag® - Not for this contract
	Replace microstrainers with ACTIFLO® technology	Yes
	Incorporate Cloth Media Filtration to Increase Treatment Capacity and Provide TSS Removal	Yes
	Gravity Storage Tank with Primary Level BOD and TSS Removal	Not for this contract
System-wide Alternatives	Green Infrastructure	Yes
	Inflow/Infiltration-Sewer Lining and Rehabilitation	Yes
	Inflow/Infiltration-Sewer Lining and Rehabilitation	Yes

Attachment 1

Evaluation Criteria

Table-Evaluation Criteria Summary

Category	Criteria	1	2	3	4
CSO Reduction	CSO Volume Reduction	Greater than 4 overflows per year	-	-	Maximum of 4 overflows per year
	Bacteria Reduction	Alternative does not eliminate or reduce bacteria discharges at outfall	-	Alternative results in reduction of bacteria discharges at outfall	Alternative eliminates bacteria discharges at outfall
	Water Quality Benefits	Will not meet water quality standards in the Hudson River	-	Will meet water quality standards in the Hudson River with help of another alternative	Will meet water quality standards in the Hudson River standing alone
	Support designated uses in Hudson River (Secondary contact recreation and fishing)	Will not attribute to improved water quality to support designated uses of the Hudson River	Will attribute to improved water quality to support partial designated uses of the Hudson River	Will attribute to improved water quality to support partial designated uses of Hudson River with help of another alternative	Will support all designated uses of the Hudson River standing alone
Feasibility	Availability of validation on main technology for the alternative	Scientific basis largely unproven/untested	Limited data provided, but technology claims cannot be corroborated using conventional scientific/engineering principles	Significant data to corroborate technology claims available but lacks consensus of the scientific community	Uses well known and accepted scientific principles or the Authority already uses technology with success
	Flexibility of the alternative to be adjusted or optimized with future changing flows	Alternative cannot be adjusted after initial implementation	Alternative can be adjusted with significant additional construction/cost in conjunction with adjustment to related alternative	Alternative can be adjusted with significant additional construction/cost	Alternative can be altered without significant additional construction/cost
	Flexibility of alternative to provide effective operation under variety of operating conditions.	Need for supplemental steps in the operation process – compatibility with disinfection process.	-	-	Limited number of steps in the treatment process. Effective performance under a variety of operating conditions. Tolerance of the alternative to variable loading conditions (flow, pollutant load) and compatibility with influent.
	Anticipated Operations from the Authority's personnel	Capabilities and/or staff resources are not readily available and require hiring	Capabilities and/or staff partially available and require training. Some hiring may be required.	Capabilities can be accomplished with existing staff, with additional training	No additional hires/training required
	Reliability	Alternative struggles with intermittent operation. Lack of performance history in application.	-	-	Alternative provides consistent performance while operating intermittently. Ability to operate after long idle periods.
Regulatory Compliance	Anticipated effects on project timeline through coordination with other agencies or the Authority's projects	High probability of project delay of one year or greater	Moderate potential for project delay	Minor probability or project delay of one year or greater	No anticipated cause for delay of this project or other projects
	Anticipated lead time for permitting	Permit lead time > 6 months	-	-	Permit lead time < 6 months
	Requirement of USACOE Permit	USACOE permit required for construction	-	-	USACOE permit not required for construction
	Requirement of NJPDES Permit	Requires a new NJPDES permit	-	Requires revision of an existing NJPDES Permit	New NJPDES permit or revisions to existing NJPDES permit not required
Location Constraints	Anticipated Land Acquisition	Permanent acquisition of publicly or privately owned land with owner known to be strongly resistant	Temporary acquisition of land for construction purposes where owner is known to be strongly resistant	Temporary acquisition of land for construction where owner is known to be compliant	Sufficient access is likely available at low cost and resistance, or land is already owned by the Authority
	Anticipated Traffic Impacts	Significant adverse impacts on primary road	Significant adverse impacts on primary road	Minor adverse impacts lasting more than 6 months on smaller road	Minor adverse impacts lasting less than 6 months
	Compatibility with Existing Infrastructure	Requires utility relocating for 1000 feet or counteracts previous investment	Requires utility relocating for less than 1000 feet	Localized/minor consequences-Utility relocation at spot locations	No impact/positive impact
	Anticipated Noise and Odor Impacts	Noise and odor impacts are significant or unable to be measured or mitigated	Noise and odor impacts are significant but are able to be mitigated with additional services	Noise and Odor Impacts are minor but able to be mitigated with additional services	Noise and Odor impacts are minimal or non-existent
	Physical Characteristics	Size or footprint of the alternative will significantly impact surrounding area	Size or footprint of the alternative will significantly impact surrounding area but can be mitigated	-	Size or footprint of the alternative will not impact surrounding areas

Category	Criteria	1	2	3	4
Cost	Capital (Includes New Equipment, staffing during and after wet weather events, and Design Costs and Present Worth)	(Range of prices to be defined once costs start being developed)			
	Operations and Maintenance (Includes chemicals, labor to maintain equipment, power cost and need for staffing during and after wet weather events.	(Range of prices to be defined once costs are developed)			
Community Impact	Public Acceptance	Public concerns expected	Moderate public concerns anticipated	Minor public concerns anticipated	No public response or positive public response anticipated
	Impact to Businesses	Permanent interruption to businesses with no mitigation	Permanent interruption with mitigation strategy	Temporary interruption with mitigation strategy	No interruption
	Quality of life after construction	Significant adverse impact on use of parks or public spaces for more than 6 months	Significant adverse impact on use of parks or public spaces for less than 6 months	Minor adverse impacts on parks or public spaces for less than 6 months	Negligible or no adverse impacts on use of parks or public spaces

North Hudson Sewerage Authority

Long Term Control Plan

Preliminary Screening of CSO Control Technologies: End of Pipe

NJPDES Permit: NJ0026085

Date: November 13, 2018

Prepared by:

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Preliminary Screening of CSO Control Technologies

DATE: November 13, 2018

PREPARED BY: CH2M

PROJECT: North Hudson Sewerage Authority Alternatives Analysis-End of Pipe

Executive Summary

Under the New Jersey Pollutant Discharge Elimination System (NJPDES) permit for Adams Street and River Road, as part of the System Characterization Report for the Adams Street Wastewater Treatment Plant (WWTP) and the River Road WWTP, the North Hudson Sewerage Authority (the Authority) must conduct an evaluation of alternatives for combined sewer overflow (CSO) technologies at all of the Authority's outfalls. This technical memorandum presents the findings of the preliminary screening of these identified end-of-pipe control technologies for all of the Authority's outfalls. The purpose of this screening is to provide an initial evaluation on the alternatives by identifying anticipated constraints, site limitations, functionality and feasibility of the control technologies identified. The evaluation criteria presented in the Identification of Alternatives and Evaluation Criteria memorandum dated October 29, 2018 were used as a guide to summarize this analysis, which can be found at the end of the memo. Based on this preliminary screening, alternatives that would not fit the site-specific needs or not allow compliance with the Final Permit will not be included in the next phase of evaluation in which conceptual layouts of the alternatives are presented and the Authority's InfoWorks ICM model is used to simulate the expected benefit of the alternatives.

Table 1 summarizes the results from the preliminary screening and indicates the alternatives that will proceed to the next phase of evaluation.

Table 1 – Preliminary Screening Results

Service Area	Alternative	Proceed to full evaluation?
H1	Disinfect at H1 WWPS	Yes
	Combine flows with Jersey City CSO in Long Slip Canal	Not for this contract
H3/H4/HSI	Chemical Storage and Feed at 5th Street Pump Station and route chemical to H3 CSO	Yes
	Disinfection under Stevens Park	Not for this contract
H5	Incorporate disinfection with structure in water	Yes
	Disinfect at H5 regulator adjacent to 11th Street PS	Yes
W1234	Disinfect at W1234 Outfall Manholes on Waterfront Terrace	Yes
	Disinfect at Junction Structure under the Lincoln Tunnel Helix	Yes
	Disinfect at one of the W1234 regulators on Park Avenue	Not for this contract
	Disinfect at W1234 S/F facility	Not for this contract
	Install chlorine contact tank at the bottom of the Palisades	Not for this contract
18th Street	Disinfect at 18th Street Pump Station	Yes
W5	Disinfect at at W5 S/F vortex facility	Yes
JOSO	Disinfect at Liberty Place Pump Station	Yes
	Disinfect at JOSO drop shaft	Not for this contract
WNY1	Disinfect at WNY1 S/F facility	Yes

Introduction

This technical memorandum identifies the end of pipe control technologies discussed at the Authority's Alternatives Analysis Workshop for all outfalls and defines the proposed evaluation criteria to apply to the overall implementation of each alternative. The purpose of this memorandum is to present the evaluation criteria and all identified alternatives for the specified site with only technologies that would fit the site-specific needs and would allow compliance with the Final Permit. Those final identified alternatives would then undergo further evaluation defined in the Evaluation Criteria memo. This memorandum is the initial step towards the Development and Evaluation of Alternatives Report to be submitted to the New Jersey Department of Environmental Protection by July 1, 2019. Figures 1 and 2 below depict the System Block Diagrams for the Authority's outfalls. These figures provide an understanding of the relative locations and configuration of the Authority's infrastructure along the Hudson River based on the WWTP service area.

Figure 1 – Adams Street WWTP Service Area

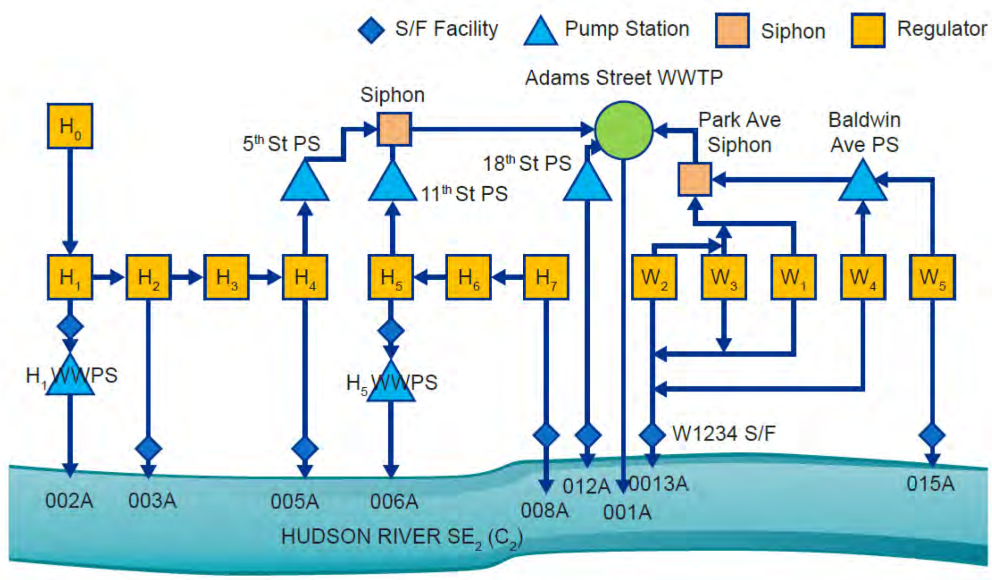
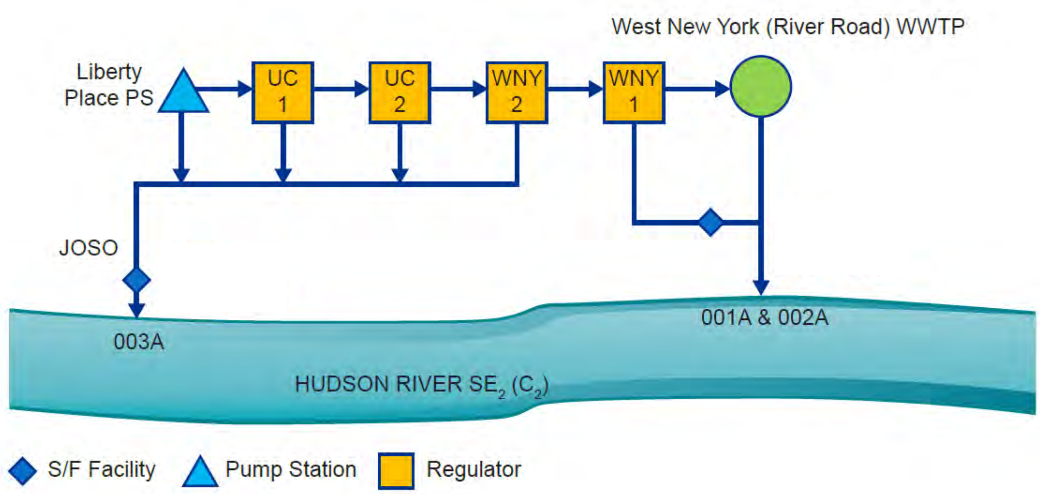


Figure 2- River Road WWTP Service Area



Preliminary Screening

The following section details the preliminary screening of the alternatives from the Identification of Alternatives and Evaluation Criteria memorandum dated October 29, 2018. The screening includes identifying the anticipated constraints, site limitations, functionality, and feasibility of each alternative. The evaluation criteria that will be used in the final evaluation are provided in Attachment 1 and were used as a guide to identify anticipated constraints, site limitations, functionality and feasibility of the alternatives.

Disinfection

As summarized in Table 1, disinfection was reviewed for the following service areas: H1, H3/H4/HSI, H5, W1234, 18th Street, W5, JOSO, and WNY1. Below is the evaluation for all of the facilities that is the same for each alternative. Deviations for each individual alternative is noted in the alternative.

- *Anticipated Constraints and Site Limitations:* Siting the disinfection building and the required contact time are the anticipated constraints for this alternative.
    - Available Space - A disinfection building to house disinfectant bulk storage tank, metering pumps, and electrical room would need be needed on site.
    - Land Acquisition - A land acquisition may be required to house the proposed facilities and is noted in each individual alternative.
    - Contact Time - The available contact time would need to be evaluated.
    - Traffic/Public Access – Consideration to the public is noted for each individual alternative.
- *Functionality*
    - Chemical Dose - The required sodium hypochlorite dose increases as the available contact time decreases. Available detention times in the existing system would need to be determined. However, as an example detention times of 15 minutes and 5 minutes and an assumed required CT of 225 mg/L minutes, sodium hypochlorite doses of 15 mg/L and 45 mg/L would be required.
    - Chemical Storage and Feed - The annual volumes to be treated are sufficiently large and a bulk storage tank would be preferred over totes or drums. The bulk storage tank size would be based on a single standard bulk delivery volume (e.g., 1.5 x a standard delivery volume of approximately 6,000 gallons) unless otherwise noted, however, if space constraints are present totes may be the recommended option. A building to house a single bulk storage tank, chemical metering pumps, and associated electrical room is assumed for preliminary screening. A second chemical to dechlorinate, or to neutralize an alternative disinfectant such as peracetic acid (PAA), may be required if the residual will be greater than the allowable permit limit. Available space for a second chemical addition at or near the outfall would be required.

      Involvement from plant staff will likely require periodic monitoring of sodium hypochlorite strength due to degradation and corresponding adjustment of dose and being present during chemical deliveries. Adjustment of dose can be automated based on analysis results monitored through the SCADA system. Caution should be taken as sodium hypochlorite has potential to degas and requires careful design provisions. Sodium hypochlorite disinfection has a proven reliability/functionality while PAA is less proven but is in use at some operating facilities. Should PAA be selected for disinfection, it would need to be tested to determine the required dose and expected residual versus time to determine the need for a neutralization chemical.

- *Feasibility*
    - While sodium hypochlorite is a proven disinfectant in a contact tank, it is not common practice to provide the disinfection at pump stations and outfalls. The available contact time would need to be verified and may be the limiting factor in implementing this alternative. There are also potential corrosive impacts of sodium hypochlorite on the existing facilities.

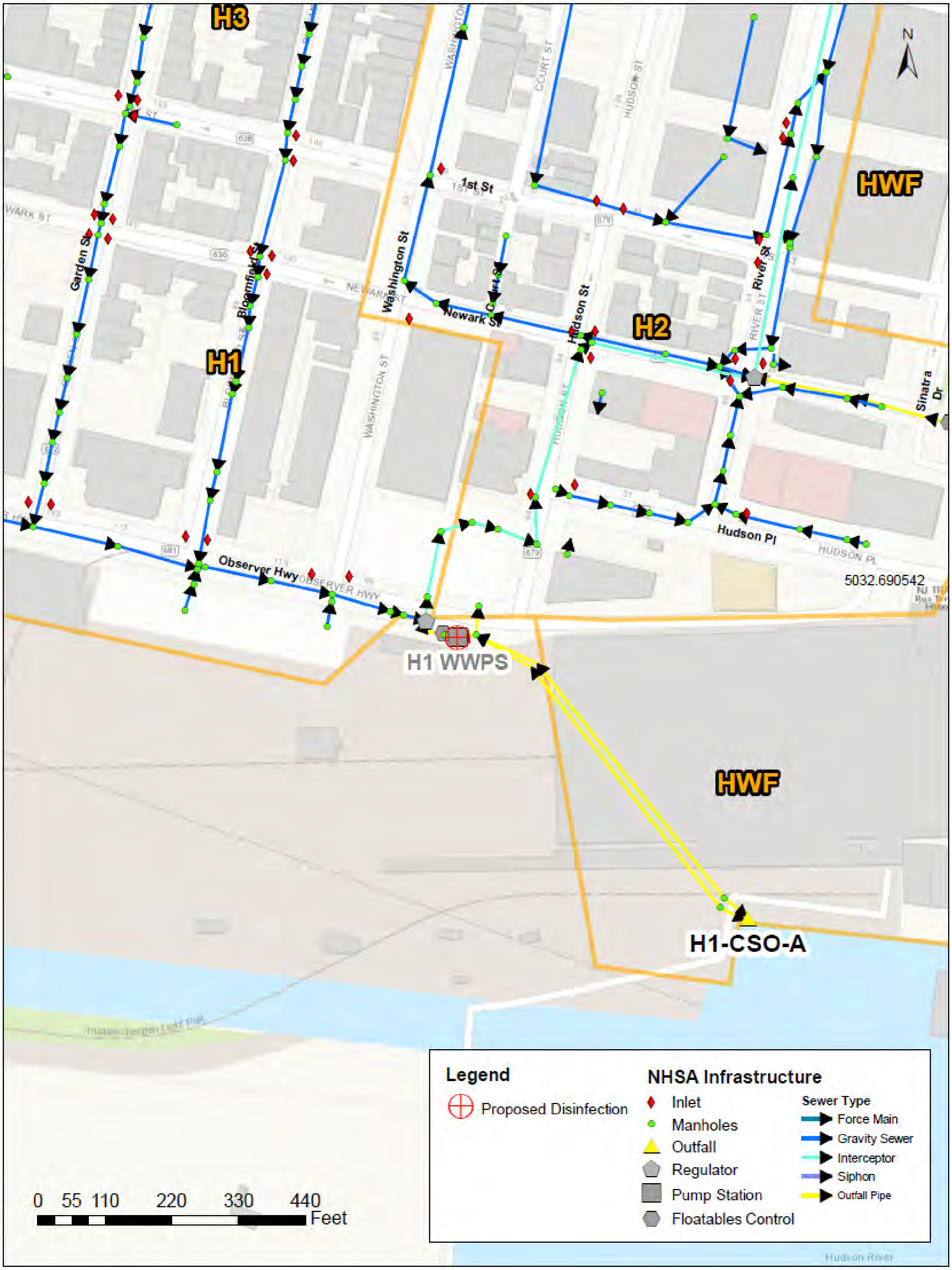
H1 Basin

Disinfect at H1 WWPS

Disinfection is proposed at the existing H1 Wet Weather Pump Station to meet the permit limitations for outfall 002A. Figure 3 shows the proposed location of this alternative. According to the System Characterization Report dated July 1, 2018 for the Adams Street WWTP, Outfall 002A has 34 CSO events and an annual CSO volume of 44 MG in a typical year. The H1 Wet Weather Pump Station has two low head pumps each rated for 50.4 MGD. The largest typical year CSO event is 7.32 MG with a corresponding peak flow rate of 58.28 MGD.

- *Anticipated Constraints and Site Limitations:* Siting the disinfection building and the required contact time are the anticipated constraints for this alternative.
    - Available Space – A 25 ft. x 36 ft. disinfection building would be required. There is very limited space downstream for a second chemical facility if required for dechlorination or neutralization.
    - Land Acquisition - A disinfection facility at this location would require an easement as part of the adjacent parking lot is on NJ Transit property.
    - Rebuild By Design - The Rebuild by Design program currently has plans to construct a floodwall on the south side of Observer Highway that will continue on the east side of Washington Street, stopping before Newark Street. Construction and overall design would need to be considered should construction of a tunnel proceed. Additional information on the Rebuild by Design plans can be found in the final section of this report.
    - Contact Time - The available contact time in the pump station and outfall pipeline would need to be evaluated.
    - Traffic/Public Access - Observer Highway at this location is highly congested and staging construction along this road over an extended period of time may create scheduling issues. This would require the project to be on a strict timeline.
- *Functionality-*
    - Chemical Dose - Available detention times in the pump station wet well and discharge pipe to the outfall would need to be determined.
- *Feasibility*
    - This alternative appears to be feasible provided there is sufficient contact time and the facilities can be sited.

Figure 3 - H1 WWPS Site Plan



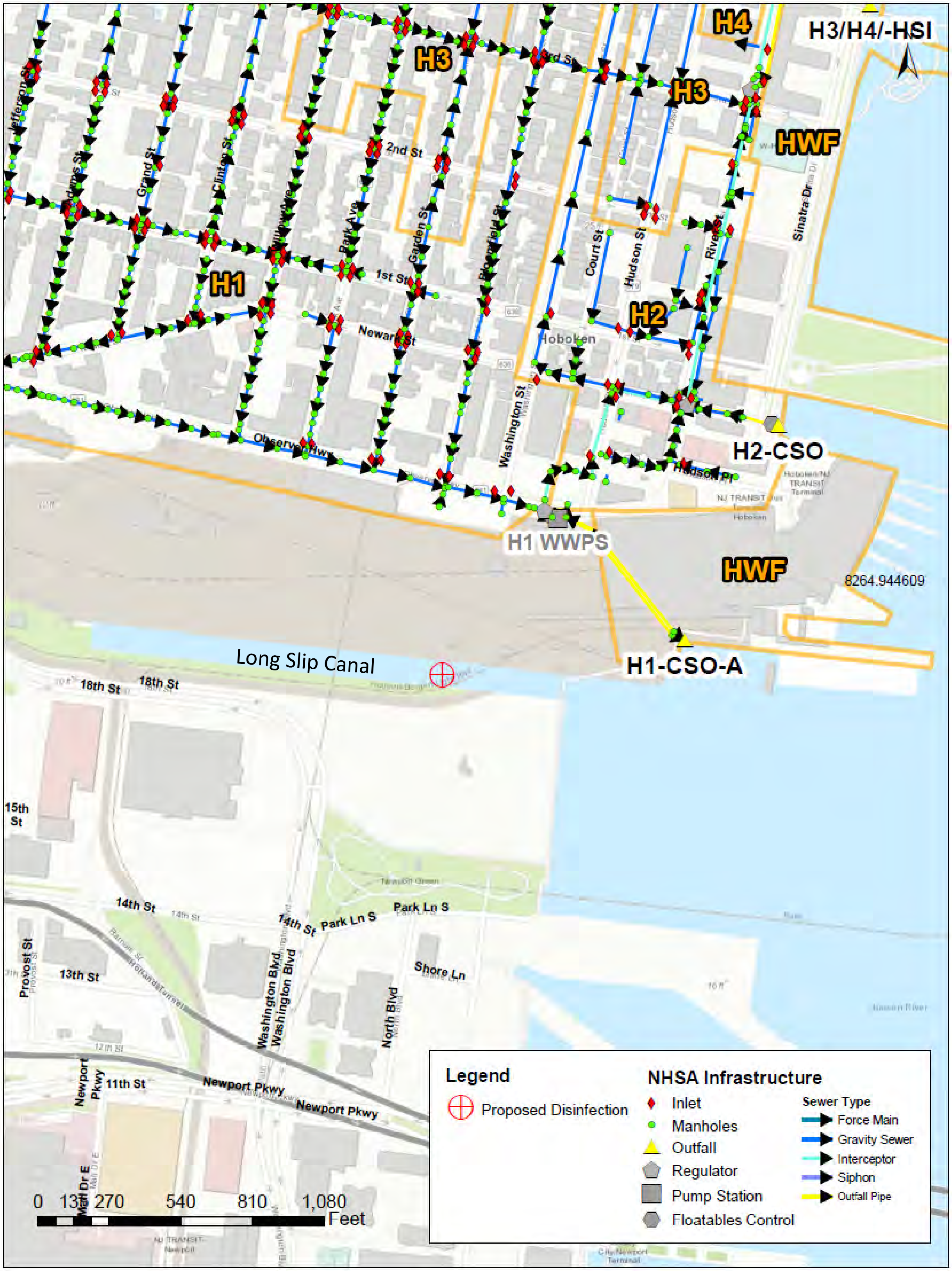
Combine Flows with Jersey City CSO in Long Slip Canal

As part of the NJ Transit Resilience Program, the Long Slip Fill and Rail Enhancement project will allow NJ Transit to operate train service longer and recover more quickly form storm events. The Long Slip canal is a 2000-foot former barge canal adjacent to the Hoboken Terminal. A CSO from Jersey City discharges at the end of this canal. It is proposed to combine this discharge with the discharge from H1 and utilize a contact basin or treatment facility to reach the required level of disinfection for the outfall. The following figure shows the outline of the canal in relation to the H1 outfall.

From the NJ Transit Resilience Program website, the canal will be filled to an elevation above the Federal Emergency Management Agency (FEMA) base flood elevation, and six new tracks will be constructed on the filled area to serve three high-level ADA-accessible boarding platforms. This project will advance as a result of a grant awarded by the Federal Transit Administration (FTA) through the Emergency Relief Program for resiliency projects in response to Superstorm Sandy. It is proposed to construct a disinfection treatment technology atop of a portion of the filled in canal that would allow two large CSO outfalls to be combined.

- Anticipated Constraints and Site Limitations-
  - Available Space-The specific plans for filling in the canal are unknown. Once the plans are finalized, the NJ Tranist Resilience program may have plans that do not allow for an adequate capacity disinfection treatment facility for this site.
  - Transit Coordination-To combine the flows, the existing route of the piping will need to be modified by either extending the Jersey City outfall pipe or routing the H1 piping back to the Jersey City outfall. For the latter choice, construction would be at or near NJ Transit facilities which may limit the available routes of pipes.
- Functionality-
  - Applying disinfection in a contact basin is favorable compared to applying disinfection in a pipeline. With the appropriate system, the approved methods of disinfection by hypochlorite could be an effective alternative.
- Feasibility-
  - Without information on the flows from the Jersey City CSO, it is difficult to determine if this alternative is feasible. Without knowing the current flows, it will not be possible to determine the benefits of implementing this alternative and for this reason, this alternative is not considered feasible for this contract. Should this method be considered in the future, it could show to be an ideal method of disinfection and create an effective method to treat a large amount of flow within permit compliance through collaboration with regional sewerage agencies.

Figure 4 – Long Slip Canal Site Plan



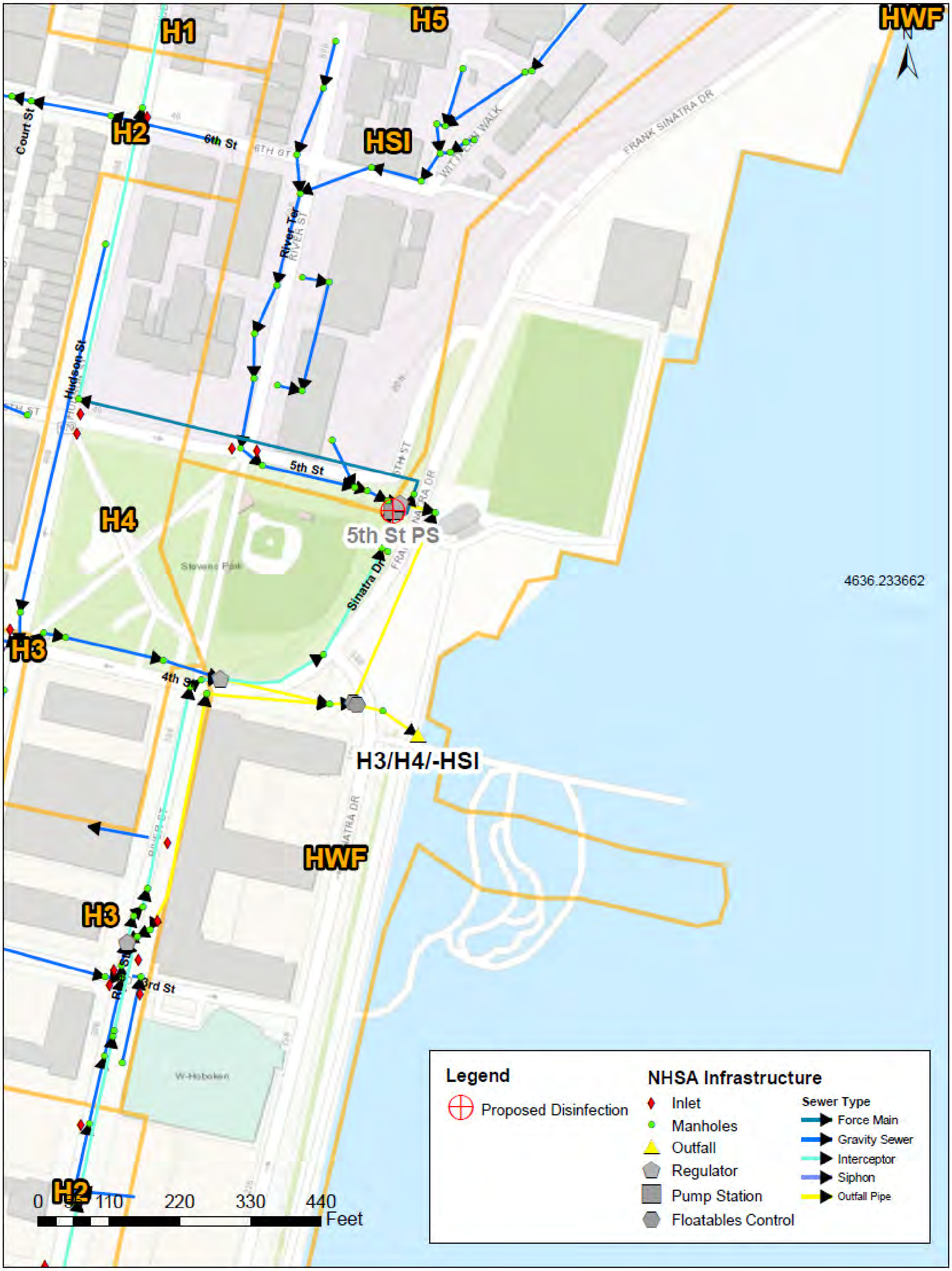
H3/H4/HSI Basin

Chemical Storage and Feed at 5th Street Pump Station and route chemical to H3 CSO

Disinfection is proposed between the existing H3 regulator and the junction with the H4 regulator, or after the two systems combine to meet the permit limitations for outfall 005A. The chemical disinfection storage and feed facility would be located at the 5th Street Pump Station and the disinfectant pumped to the CSO conveyance pipe. Figure 5 shows the proposed location of this alternative. According to the System Characterization Report for the Adams Street WWTP dated July 1, 2018, Outfall 005A has 41 CSO events and an annual CSO volume of 65 MG in a typical year from a combination of H3, H4, and HSI regulators. The largest typical year CSO event is slightly under 9 MG (combined H3, H4, and HSI) with a corresponding peak flow rate of slightly less than 55 MGD.

- *Anticipated Constraints and Site Limitations*- Construction impacts on traffic, the required contact time, and the need for a second chemical at the outfall are the anticipated constraints for this alternative:
    - Available Space – A 25 ft. x 36 ft. disinfection building would need to be sited adjacent to the 5th Street Pump Station, however, if there is room for powering the metering pumps and instruments from an existing electrical room then the building size could be reduced.
    - Land Acquisition - There is a small amount of space available to the south of the pump station, however, it would need to be confirmed if this property belongs to the Authority or would need to be acquired.
    - Contact Time - The available contact time in the outfall pipeline and S/F facility would need to be evaluated.
    - Traffic/Public Access - Installing a chemical feed pipeline along Frank Sinatra Drive could be disruptive to traffic and could require the project to be on a strict timeline. Alternatively, it may be possible to route the buried chemical pipe along the perimeter of Steven's Park to minimize traffic disruption.
- *Functionality*:
    - Chemical Dose - Available detention times in the H3 CSO discharge pipe that combines with regulator H4 and runs through the H3/H4/HSI S/F facility to the outfall would need to be determined.
- *Feasibility:*
    - This alternative appears to be feasible provided there is sufficient contact time.

Figure 5 – 5th Street Pump Station Site Plan



Disinfection under Stevens Park

The CSO from the existing H3 regulator would be diverted into an underground contact tank in Steven's Park. The chemicals (disinfection and dechlorinating/neutralizing agent) storage and feed facility could be located adjacent to the 5th Street Pump Station, or if there is space it could be located on the perimeter of Stevens Park adjacent to one of the bordering roads to provide the necessary truck access for chemical unloading. A contact tank would allow the dechlorination or neutralization of PAA if required, to occur in a small partitioned area at the effluent end of the contact tank. If located at the 5th Street Pump Station the chemicals would be pumped through the park to the contact tank. Figure 6 shows the proposed location of the alternative. According to the System Characterization Report for the Adams Street WWTP dated July 1, 2018, Outfall 005A has 41 CSO events and an annual CSO volume of 65 MG in a typical year from a combination of H3, H4, and HSI regulators. The largest typical year CSO event is slightly under 9 MG (combined H3, H4, and HSI) with a corresponding peak flow rate of slightly less than 55 MGD.

- *Anticipated Constraints and Site Limitations:*
  - Land Use - Construction would involve excavation and construction of an underground contact tank which would make a portion of the park unavailable for public use during construction. While the contact tank can be below grade and grass planted above it, hatches or manways would need to be provided for access to various components in the tank and the removal of existing mature trees in the area is not favored. Additionally, if the chemical feed facilities were installed at the perimeter of the park, there would be a permanent building consuming a portion of the park which may not be received well by the public.
  - Available Space – A maximum area of 80 ft. x 80 ft. would be required for a contact tank. Additionally, a 25 ft. x 60 ft. disinfection building to house two bulk storage tanks, metering pumps, and electrical and mechanical rooms would need to be sited adjacent to the 5th Street Pump Station or in the park adjacent to one of the roads for chemical unloading, however, if there is room for powering the metering pumps and instruments from an existing electrical room then the building size could be reduced. Additionally, the length of the building could be reduced somewhat if using a smaller tank or totes for the dechlorination/neutralization chemical.
  - Traffic/Public Access - Most of the pipe routing would be across the park. This would have less public impact than alternatives involving pipe routing following a road.
- *Functionality:*
  - Chemical Dose and Contact Tank Sizing - Peak 15 minute flow volume for the design storm would be required to determine the required contact volume. A 15 minute detention time at peak CSO flow would require 500,000 gallon contact tank. For a maximum 80 ft. x 80 ft. contact tank, a water depth of 10 ft would be required. Increasing the depth of the water would ultimately minimize the footprint of the tank.
- *Feasibility:*
  - The inclusion of a contact tank makes this alternative a proven approach to disinfection. It also eliminates the need for a remote dechlorination/neutralization chemical storage and feed facility near the end of the outfall. However, due to the existing mature trees in the area and the potential for roots to interfere with the disinfection facilities, this alternative is not considered feasible.

Figure 6 – Stevens Park Site Plan

H5 Basin

Incorporate Disinfection with Structure In Water

Disinfection is proposed by constructing a pier with a disinfection chamber below to meet the permit limitations for outfall 006A. The pier is expected to be located at a slightly different location to the existing Outfall 006A to facilitate the addition of a pier which would require the relocation of the outfall discharge point. Figure 7 shows the location of this proposed alternative. According to the System Characterization Report for the Adams Street WWTP dated July 1, 2018, Outfall 006A has 11 CSO events and an annual CSO volume of 9.5 MG in a typical year. The largest typical year CSO event is about 1.75 MG with a corresponding peak flow rate of about 67 MGD.

- *Anticipated Constraints and Site Limitations:* The spatial requirements for a contact basin and getting approval to build into the water are the primary anticipated constraints for this alternative.
    - Construction in Navigable Waters - As this alternative would be located in the river approvals by more than one governmental agency would be required.
    - Water Classification - The river near this discharge point is classified as a Category 1 water due to the kayak launch near the outfall which will likely create construction limitations in the area and increased coordination with the city and other agencies.
    - Available Space and Land Use – A maximum 6,400 sq-ft pier could be required for a maximum contact tank that has a maximum area of 80 ft. x 80 ft with a 10 ft. water depth that is located below the pier. Increasing the depth of the water would ultimately minimize the footprint of the tank. A 25 ft. x 54 ft. disinfection building would need to be sited on the pier or adjacent shoreline. While there is open space near the shoreline, the existing kayak launch may limit total available open space. The length and width of the building could be reduced if using totes., in lieu of storage tanks.
    - Conveyance - This alternative would require an updated alignment from the outfall that is currently located north of Maxwell Place and re-routing the outfall under the park would likely have significant setback that may not be well received by the public.
- *Functionality:*
    - Chemical Dose and Contact Tank Sizing - Peak 15 minute flow volume for the design storm would be required to determine the required contact volume. A 15 minute detention time at peak CSO flow would require 500,000 gallon contact tank. For a maximum 80 ft. x 80 ft. contact tank, a water depth of 10 ft would be required. Increasing the depth of the water would ultimately minimize the footprint of the tank.
    - Chemical Storage and Feed - The annual volume to be treated is small enough that either a small tank sized for partial loads or totes could be used. While this will increase unit cost compared to a bulk delivery, smaller delivered volumes are preferred at the anticipated consumption rates. While this is true for either PAA or sodium hypochlorite, the benefit of storing smaller volumes is especially relevant to sodium hypochlorite given degradation. The required dosing of sodium bisulfite for dechlorination or neutralization of PAA if required could be achieved with a small tank or totes as well.

- *Feasibility:*
    - The inclusion of a contact tank makes this alternative a proven approach to disinfection. It also eliminates the need for a remote dechlorination/neutralization chemical storage and feed facility at the outfall. Adequate space in the river and approval from governing agencies are the primary concerns with the feasibility of this alternative. A smaller building would be required on the pier or adjacent shoreline for dechlorination or PAA neutralization if required. The feasibility of this alternative depends on the acceptability of building a facility of this size in the river.

Figure 7 – H5 In Water Site Plan

Disinfect at H5 regulator adjacent to 11th Street Pump Station

Disinfection is proposed at the existing H5 regulator which is adjacent to the 11th Street Pump Station to meet the permit limits at outfall 006A. Figure 8 shows the location of this proposed alternative. According to the System Characterization Report for the Adams Street WWTP dated July 1, 2018, Outfall 006A has 11 CSO events and an annual CSO volume of 9.5 MG in a typical year. The H5 Wet Weather Pump Station has a capacity of 80 MGD with both 40 MGD pumps in service. The largest typical year CSO event is about 1.75 MG with a corresponding peak flow rate of about 67 MGD.

- *Anticipated Constraints and Site Limitations:* Construction impacts on traffic, being able to position the disinfection building in the median, the required contact time, and the need for a second chemical at the outfall are the anticipated constraints for this alternative.
    - Available Space - A 25 ft. x 36 ft. disinfection building that would be required can be located in the center median of 11th Street adjacent to the 11th Street Pump Station. If there is room for powering the metering pumps and instruments from an existing electrical room then the building size could be reduced. The length and width of the building could also be reduced by using totes.
    - Land Acquisition - A disinfection facility at this location would require acquisition or approvals from the City of Hoboken.
    - Contact Time - The available contact time in the pump station wet well and outfall pipeline would need to be evaluated. If the achievable contact time is insufficient this may be the limiting factor in this alternative.
- *Functionality*:
    - Chemical Dose - Available detention times in the H5 Wet Weather Pump Station and outfall pipe would need to be determined.
    - Chemical Storage and Feed - The annual volumes to be treated are small enough that either a small tank sized for partial loads or totes could be used. While this will increase unit cost compared to a bulk delivery, smaller delivered volumes are preferred at the anticipated consumption rates. While this is true for either PAA or sodium hypochlorite, the benefit of storing smaller volumes is especially relevant to sodium hypochlorite given degradation.
- *Feasibility:*
    - This alternative appears to be feasible provided there is sufficient contact time.

Figure 8 – H5 Regulator Site Plan

W1234 Basin

Disinfect at W1234 Outfall Manholes on Waterfront Terrace

Disinfection is proposed at the manholes on both the existing and new W1234 outfalls on Waterfront Terrace. Figure 9 shows the proposed dosing point. According to the System Characterization Report for the Adams Street WWTP dated July 1, 2018, Outfall 013A has 58 CSO events and an annual CSO volume of 219 MG in a typical year. The largest typical year CSO event is 25 MG with a corresponding peak flow rate of about 263 MGD.

- *Anticipated Constraints and Site Limitations:* Land acquisition and the required contact time are the anticipated constraints for this alternative.
  - Available Space and Land Use - A 25 ft. x 86 ft. disinfection building would be required and can be located at an adjacent parking lot and this would be a challenge. Given the proximity to the outfall, a common chemical storage feed facility is assumed.
  - Land Acquisition - Land acquisition would be required from the owner of the parking lot where the disinfection facilities are proposed.
  - Construction - Traffic on Riverview Drive may be affected if it is necessary to route chemical piping underneath it. Traffic on Waterfront Terrace will only be affected if the injection point is in or very close to the road.
  - Contact Time - The available contact time in the outfall pipeline would need to be evaluated. If the achievable contact time is insufficient this may be the limiting factor in this alternative.
- *Functionality*:
  - Chemical Dose - Available detention times in the discharge pipe to the outfall would need to be determined.
  - Chemical Storage and Feed- The annual volumes to be treated and the design storm events are sufficiently large to assume two 6000 gallon bulk storage tanks for screening purposes. A single tank may be possible with PAA since it does not degrade but testing would be required to determine the required dose. The outfall is close enough that the dechlorinating or neutralizing chemical storage and feed would also be assumed to be in the same building.
- *Feasibility:*
  - There appears to be available space within the nearby parking lot to site a common chemical and storage building, however acquiring this land would be a challenge. This alternative appears to be feasible if there is adequate contact time for disinfection.

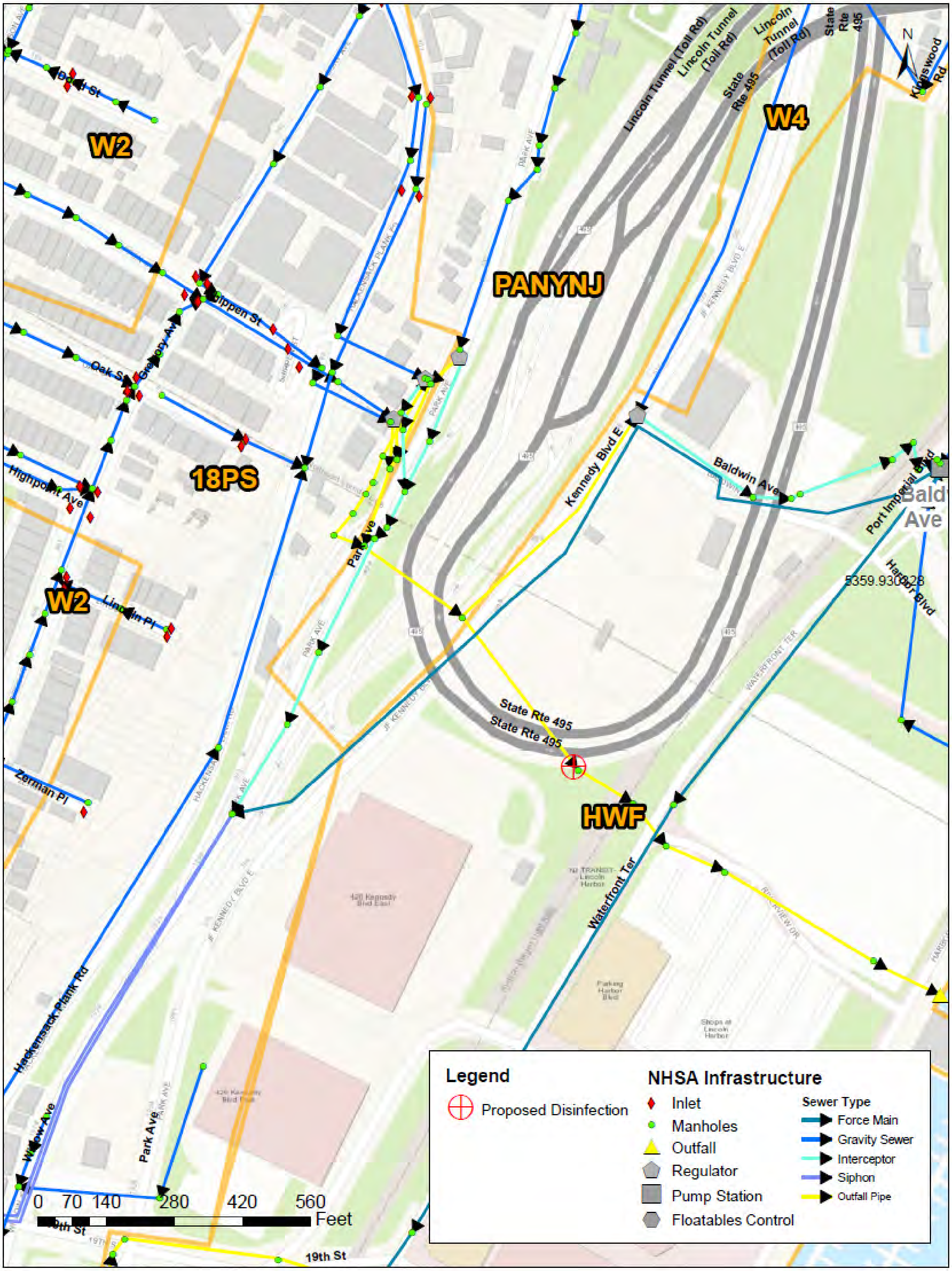
Figure 9 – W1234 Outfall Manholes Site Plan

Disinfect at Junction Structure under the Lincoln Tunnel Helix

Disinfection is proposed at the junction structure under the Lincoln Tunnel Helix in the existing New Jersey Transit bus parking lot. Figure 10 shows the approximate location of the dosing point. This alternative is very similar to applying disinfection at the W1234 outfall manholes on Waterfront Terrace except the proposed siting of the disinfection building would be approximately 225 feet northwest on the other side of Waterfront Terrace and the light rail line. Only the differences from disinfecting at the W1234 outfall manholes are noted below.

- *Anticipated Constraints and Site Limitations:*
  - Available Space and Land Use - A 25 ft. x 61 ft. disinfection building would be required.
  - Agency Coordination - The dosing point for this alternative is adjacent to the west border of the NJ Transit Bus parking lot, under the Lincoln Tunnel helix, and adjacent to the light rail train tracks. Design and construction near the facilities may be met with numerous challenges related to flexibility of the alignment, position of the alternative, and coordination with NJ Transit and the Port Authority of New York New Jersey (Port Authority).
  - Land Acquisition – An easement would be required with the Port Authority to obtain the land necessary to house the proposed facilities.
  - Existing Utilities - The presence of utilities in this area would need to be verified to ensure there are no interferences that would prevent siting at this location.
- *Functionality:*
  - Dosing further upstream could be advantageous if it is determined that there is inadequate contact time in the conveyance pipe for disinfection downstream at the outfall junction box. However, the light rail and road crossing could favor a separate building at the outfall for dechlorination/neutralization if that is required.
- *Feasibility:*
  - This alternative appears to be feasible if there is adequate contact time for disinfection.

Figure 10 – W1234 Junction Structure Site Plan



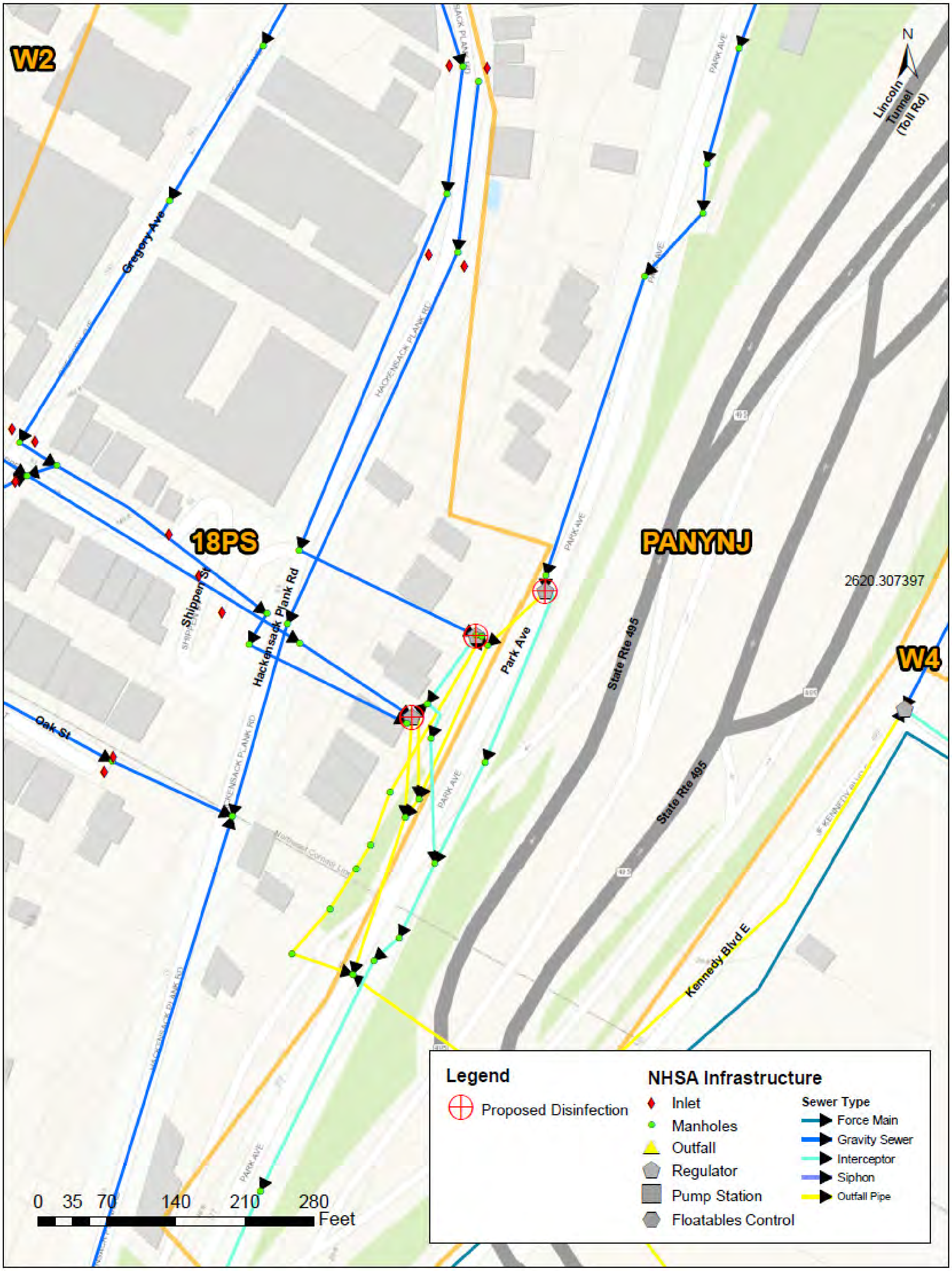
Disinfect at One of the W1234 Regulators on Park Avenue

Disinfection is proposed at one of the regulators along Park Avenue within the W1234 drainage area. Currently there are 3 regulators in close proximity to each other. Figure 11 shows the locations of these regulators and the approximate dosing point(s). This alternative is similar to applying disinfection at the 2 other W1234 options except the proposed siting of the disinfection building would be approximately 860 feet northwest of the junction structure under the Lincoln Tunnel helix if located along the west side of Park Avenue.

- *Anticipated Constraints and Site Limitations:*
  - Available Space - There is an undeveloped lot located 170 feet downstream of the regulators but near the outfall pipe on Park Avenue, however, building a 25 ft. x 61 ft. disinfection building on the west side of Park Avenue in this residential strip is not desirable. Alternatively, there is a narrow strip of forested land on the east side of Park Avenue at the southwest corner of the Highway 495 horseshoe bend, which appears to have enough room for the building with 10 foot setbacks from the bordering roads. This location is on an embankment which would complicate construction and the proximity to the roads would be disruptive to traffic during construction. Additionally, chemical unloading would obstruct one lane of Park Avenue.
  - Terrain - The west side of Park Avenue where W1, W2, and W3 regulators are located is dense residential units on a steep hillside. The only undeveloped space on the west side in the immediate vicinity of the regulators appears to be behind the SSG John D. Linde Fallen Soldiers Memorial which is a steep hillside. Chemical unloading at this location would need to be through a parking lot and would require a wider entrance gate.
  - Construction - Park Avenue is a main artery connecting Weehawken to Hoboken. Construction in this area would need to be on a strict timeline most likely conducted in phases to disrupt local traffic.
- *Functionality:*
  - This alternative involving dosing further upstream could be advantageous if it is determined that there is inadequate contact time in the conveyance pipe for applying disinfection at the helix structure or outfall junction box.

    Should there be a wet weather event resulting in a CSO from regulator W4 but not concurrently from one of the regulators W1, W2, or W3 then this alternative would not disinfect a CSO from W4 as the W4 regulator connection to the outfall is downstream of the potential chemical feed and storage facilities and injection points for this alternative.
- *Feasibility:*
  - Due to the undesirable terrain to construct the disinfection facilities, this alternative is not considered feasible.

Figure 11 – W1234 Regulators Site Plan



Disinfect at W1234 S/F Facility

Disinfection is proposed in the Solids/Floatables Screening Facility on the Hudson River that is currently under construction. The Solids/Floatables screening at this location will be accomplished with nets. Figure 12 shows the proposed dosing point. According to the System Characterization Report for the Adams Street WWTP dated July 1, 2018, Outfall 013A has 58 CSO events and an annual CSO volume of 219 MG in a typical year. The largest typical year CSO event is 25 MG with a corresponding peak flow rate of about 263 MGD.

- *Anticipated Constraints and Site Limitations:* The required contact time is the driving force for this alternative. Space for chemical storage is also too large to be located on the public access pier above the screening facility and would need to be located on shore.
    - Contact Time - A minimum acceptable contact time of 5 minutes is assumed to be required for adequate disinfection. At the design peak flow rate this would require a volume of 913,200 gallons. The volume in the netting facility is roughly estimated to be less than 90,000 gallons. Therefore, there would not be sufficient contact time in the facility.
    - Available Space and Land Use - A 25 ft. x 86 ft. disinfection building would be required and there does not appear to be room for this on the public access pier above the screening facility which would require locating the building on land.
    - Construction- Traffic on Riverview Drive may be affected if it is necessary to route chemical piping underneath the street. Traffic on Waterfront Terrace will only be affected if the injection point is in or very close to the road.
- *Functionality*:
    - Chemical Dose – A higher dose would not be expected to be effective to compensate for the lack of 5 minutes detention time.
    - Chemical Storage and Feed- The annual volumes to be treated and the design storm events are sufficiently large to assume two 6000 gallon bulk storage tanks for screening purposes. A single tank may be possible with PAA since it does not degrade but testing would be required to determine the required dose.
- *Feasibility:*
    - There is inadequate detention time in the screening facility for this alternative to be feasible and there is inadequate space for the disinfection building on the pier and siting the building in the parking lot across the street may be a challenge. Additionally, there are also potential corrosive impacts of hypochlorite in the S/F facility. Therefore, this alternative is not considered feasible.

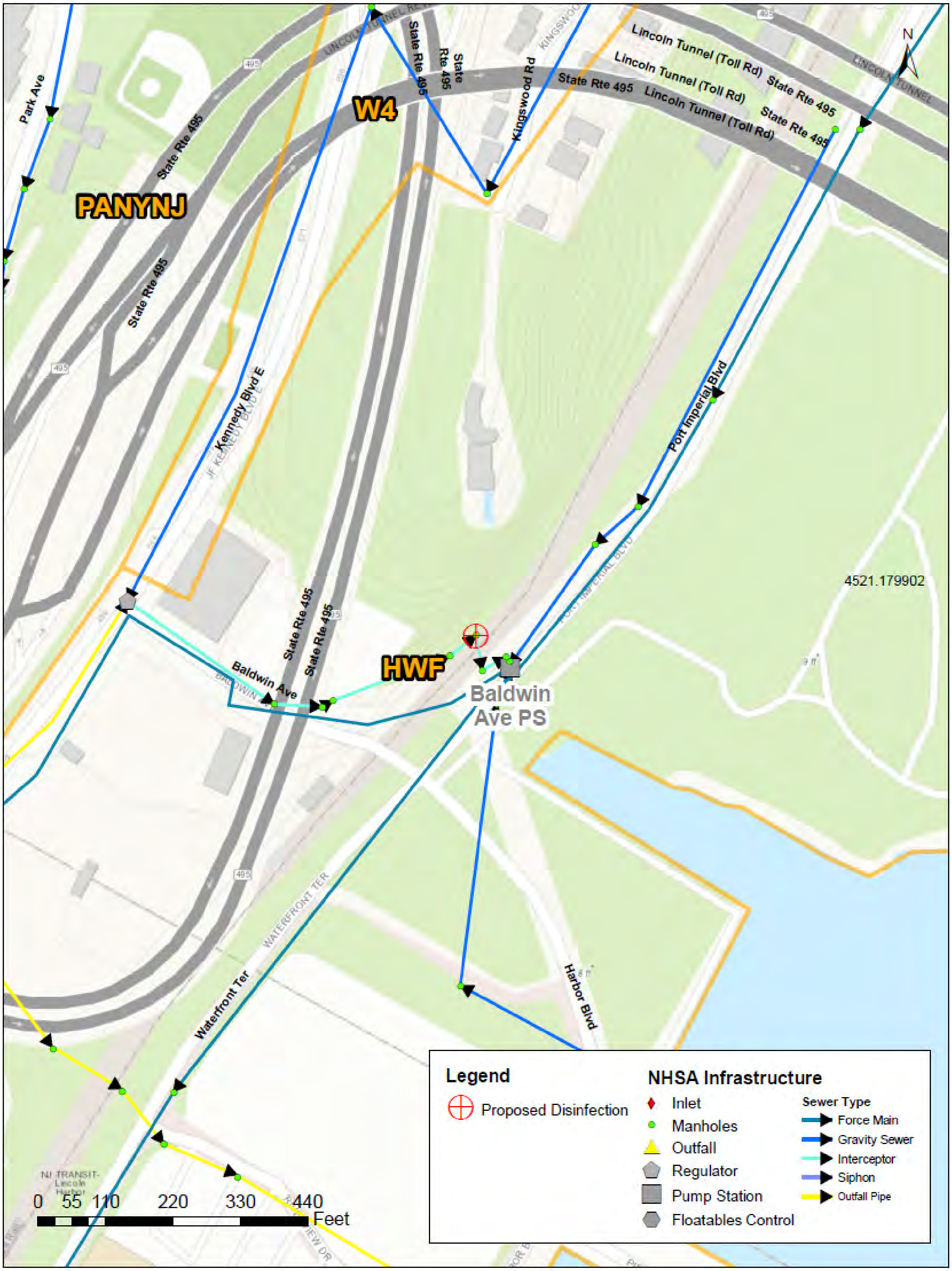
Figure 12 – W1234 Solids/Floatables Facility Site Plan

Install a chlorine contact tank at the bottom of the Palisades

A chlorine contact tank is proposed for the W1234 outfall at the bottom of the Palisades.   Figure 13 shows the proposed dosing point. According to the System Characterization Report for the Adams Street WWTP dated July 1, 2018, Outfall 013A has 58 CSO events and an annual CSO volume of 219 MG in a typical year. The largest typical year CSO event is 25 MG with a corresponding peak flow rate of about 263 MGD

- *Anticipated Constraints and Site Limitations:*
    - Available Space - At the bottom of the Palisades there is limited space for a disinfection facility due to the active parking lot adjacent to the light rail tracks.
    - Contact Time - A minimum acceptable contact time of 5 minutes is assumed to be required for adequate disinfection. At the design peak flow rate this would require a volume of 913,200 gallons. The approximate area of the open space at the bottom of the Palisades is 10,000 square feet which would require a contact basin with a depth of approximately 12 feet.
    - Agency Coordination - The dosing point for the alternative is adjacent to the Hudson Bergen Light Rail and within the Port Authority parking lot. Construction to reach the outfall pipe to effectively provide disinfection would not be ideal. Design and construction near the facilities may be met with numerous challenges related to flexibility of the alignment and position of this alternative.
- *Functionality:*
    - An existing interceptor owned by the Authority crosses the parking lot sited for this alternative which may aid in acquiring additional easements. However, a connection from the interceptor would then be required to the outfall pipe which would cross the Hudson Bergen Light Rail overpass.
- *Feasibility:*
    - A contact tank is favorable to disinfection within a pipeline. However, due to the limited space to construct a contact tank that will provide adequate contact time and required construction to route this flow to the outfall, this alternative is not considered feasible.

Figure 13-Proposed Dosing Point, Palisades



18th Street Basin

Disinfect at 18th Street Pump Station

Disinfection is proposed at the 18th Street pump station to meet the permit limits of Outfall 012A. Figure 14 shows the approximate location of the dosing point. The wet weather side of the pump station has two pumps each rated for 47.5 MGD. The largest typical year CSO event is 1 MG with a corresponding peak flow rate of about 52 MGD and an annual CSO volume of 3.6 MG.

- *Anticipated Constraints and Site Limitations:*
  - Available Space - There is limited space available for a 12 ft. x 25 ft. disinfection building adjacent to the 18th Street Pump Station. If the electrical equipment can be housed in an existing electrical room then the building size can be reduced. Dechlorination would require additional space downstream of the dosing point near the outfall which appears to be available but may require multiple approvals.
  - Contact Time - The available contact time in the pump station wet well and outfall pipeline would need to be evaluated. If the achievable contact time is insufficient this may be the limiting factor in this alternative.
- Functionality and Feasibility:
  - Chemical Dose – Available detention times in the pump station wet well and discharge pipe to the outfall would need to be determined.
  - Chemical Storage and Feed - The annual volumes to be treated are small enough that either a small tank sized for partial loads or totes could be used. While this will increase unit cost compared to a bulk delivery, smaller delivered volumes are preferred at the anticipated consumption rates. While this is true for either PAA or sodium hypochlorite, the benefit of storing smaller volumes is especially relevant to sodium hypochlorite given degradation.
  - This alternative appears to be feasible provided there is sufficient contact time and the facilities can be sited.

Figure 14 – 18th Street Pump Station Site Plan

W2
18PS
HWF
H7
18th St PS
3069.96996
W 19th St
Hackensack Plank Rd
St Lawrence Street Pl
Willow Ave
Clinton St
18th St
19th St
Park Ave
Harbor Blvd
N
0 40 80 160 240 320
Feet
Legend
Proposed Disinfection
NHSA Infrastructure
Inlet
Manholes
Outfall
Regulator
Pump Station
Floatables Control
Sewer Type
Force Main
Gravity Sewer
Interceptor
Siphon
Outfall Pipe

W5 Basin

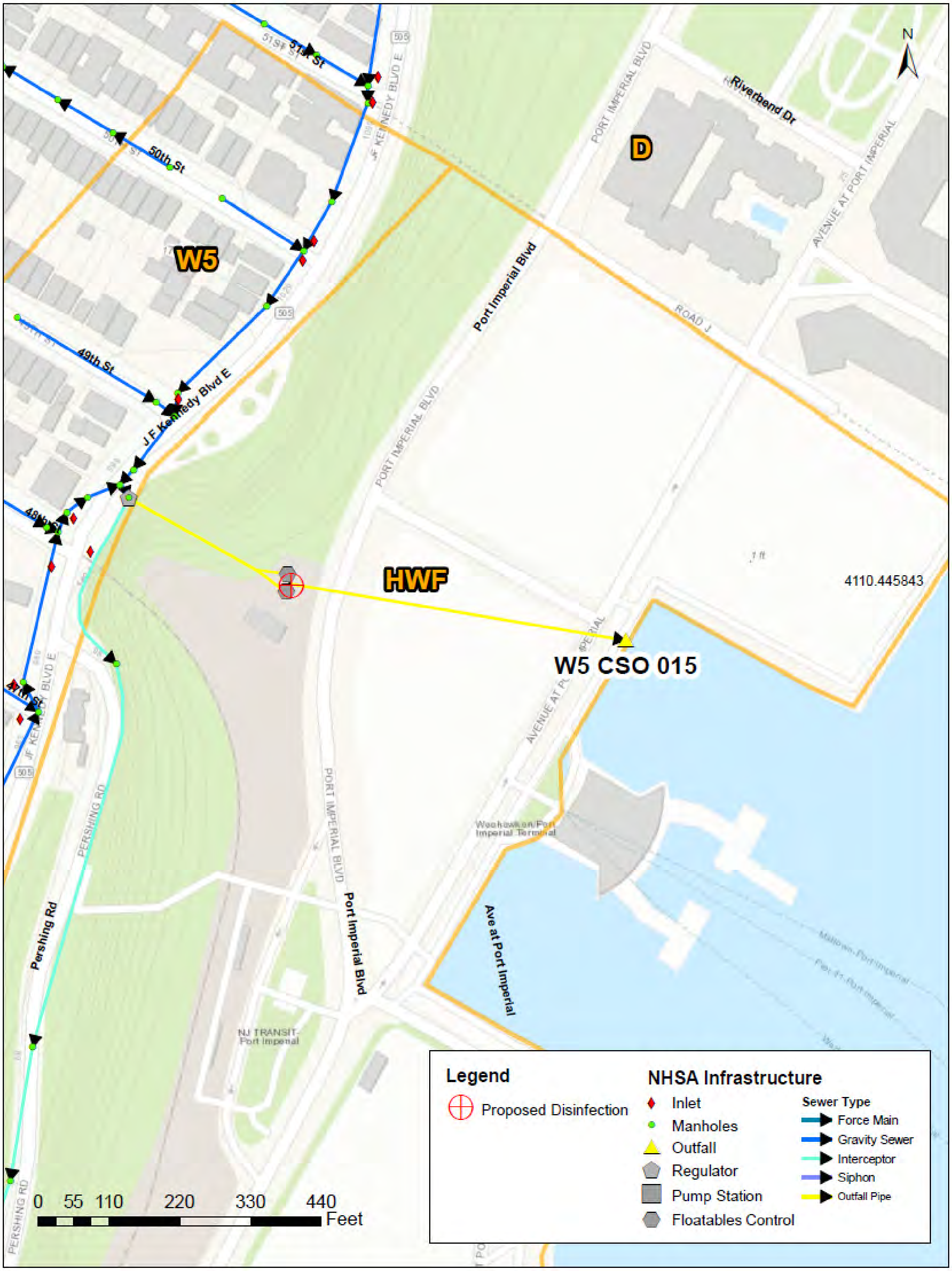
Disinfection at the W5 S/F vortex facility

Disinfection is proposed at the existing vortex facility to meet the permit limitations for outfall 015A. Figure 15 shows the location of the proposed alternative. According to the System Characterization Report for the Adams Street WWTP dated July 1, 2018, Outfall 015A has 40 CSO events and an annual CSO volume of 24 MG in a typical year. The largest typical year CSO event is under 3.1 MG with a corresponding peak flow rate of about 54 MGD.

- *Anticipated Constraints and Site Limitations:* The required contact time is the primary anticipated constraint for this alternative.
  - Available Space - A 25 ft. x 54 ft. disinfection building north of the W5 S/F Vortex Facility would be required. The length and width of the building could be reduced if using totes in lieu of storage tanks.
  - Land Acquisition - There is a space available to the north of the W5 S/F Vortex Facility, however, it would need to be confirmed if this property belongs to the Authority or would need to be acquired.
  - Contact Time - The available contact time in the S/F facility and outfall would need to be verified.
  - Traffic/Public Access - Obstruction of traffic would be expected to be limited to construction vehicles and equipment entering and leaving the site.
- *Functionality*:
  - Chemical Dose - Available detention times in the vortex facility and discharge pipe to the outfall would need to be determined.
  - Chemical Storage and Feed - The annual volumes to be treated are small enough that either a small tank sized for partial loads or totes could be used. While this will increase unit cost compared to a bulk delivery, smaller delivered volumes are preferred at the anticipated consumption rates. While this is true for either PAA or sodium hypochlorite, the benefit of storing smaller volumes is especially relevant to sodium hypochlorite given degradation. The required dosing of sodium bisulfite for dechlorination or neutralization of PAA if required could be achieved with a small tank or totes as well.

    The dechlorination/neutralization chemical could be stored in the same facility and piping routed the approximate 500 feet to the outfall or it could be separately located adjacent to the outfall. A small tank or totes would be appropriate for it as well.
- *Feasibility:*
  - This alternative appears to be feasible provided there is sufficient contact time and the facilities can be sited.

Figure 15 – W5 S/F Vortex Facility Site Plan



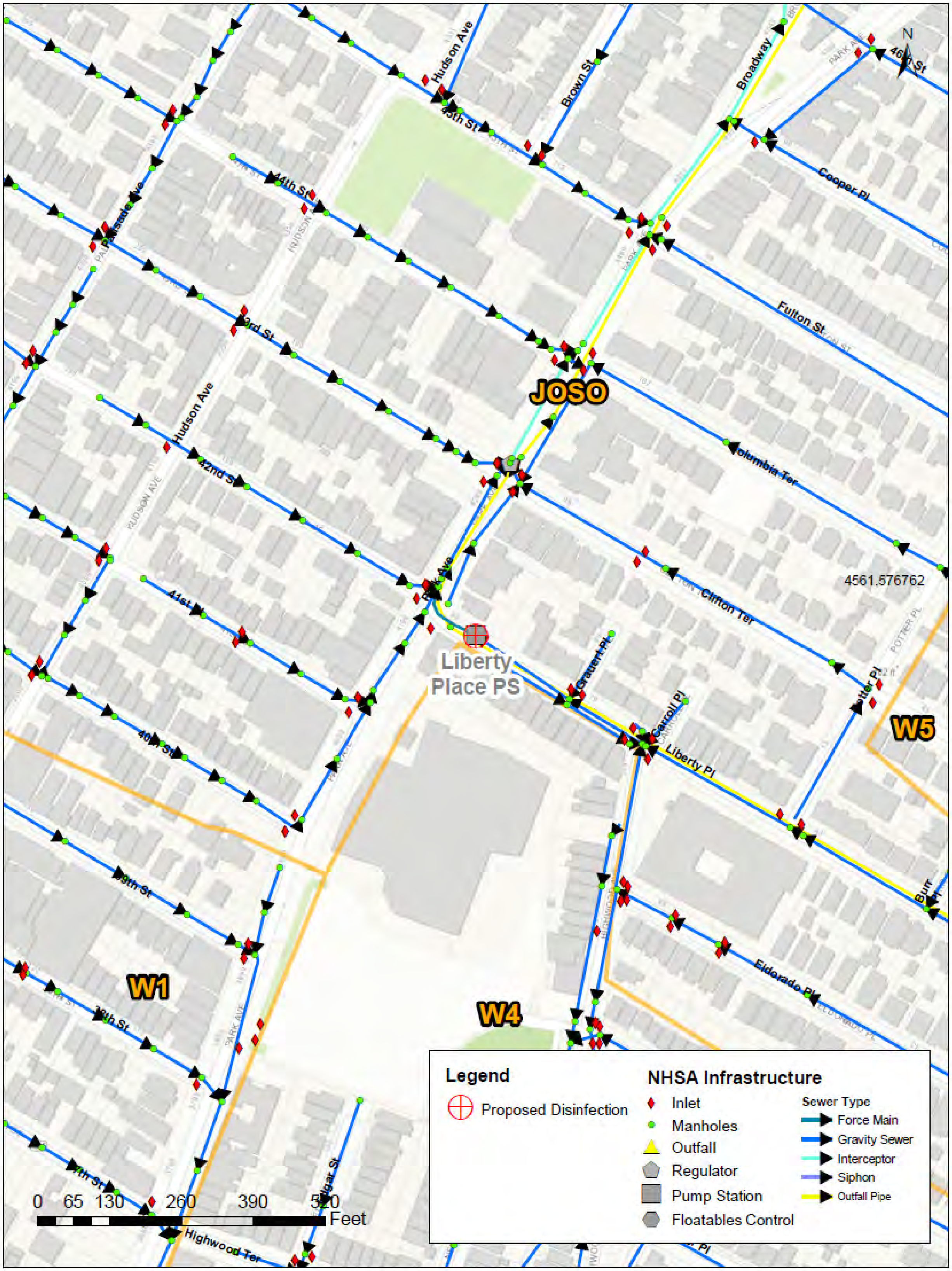
JOSO

Disinfect at the Liberty Place Pump Station

Disinfection is proposed at the Liberty Place pump station for the JOSO drainage area. Figure 16 shows the proposed dosing point. According to the System Characterization Report for the River Road WWTP dated July 1, 2018, Outfall 003A has 61 CSO events and an annual CSO volume of 95.2 MG in a typical year. The largest typical year CSO event is 10.8 MG with a corresponding peak flow rate of 142.5 MGD.

- *Anticipated Constraints and Site Limitations:* Construction staging at the corner parking lot adjacent to the pump station, the required contact time, and the need for a second chemical at the outfall are the anticipated constraints for this alternative.
    - Available Space - A 25 ft. x 36 ft. disinfection building would need to be sited adjacent to the pump station. There appears to be adequate space for the building behind 4204 Park Avenue although a longer narrower building layout appears to be required. Access to the building for construction and chemical unloading would be from Liberty Place via the parking lot behind the building at the northeast corner of Park Avenue and Liberty Place intersection. This would interfere with use of this parking lot during construction. Alternatively, the disinfection building could be located in this parking lot if the necessary portion of this parking lot is not needed by the corner building. Additionally, available space would need to be verified for a second chemical addition at or near the outfall to dechlorinate, or neutralize an alternative disinfectant such as PAA, if the residual will be greater than the allowable permit limit.
    - Land Acquisition - Property acquisition would be required for this.
    - Contact Time - The available contact time in the outfall and screening facility would need to be evaluated. If the achievable contact time is insufficient this may be the limiting factor in this alternative.
    - Traffic/Public Access- Construction staging would need to occur in the corner parking lot. This would limit obstruction of traffic to construction vehicles and equipment entering and leaving the site. Chemical unloading may need to be scheduled during non-business hours to not interfere with public use of the parking lot.
- *Functionality*:
    - Chemical Dose - Available detention times in the discharge pipe to the outfall and JOSO screening facility would need to be determined.
- *Feasibility:*
    - This alternative appears to be feasible provided there is sufficient contact time and the facilities can be sited.

Figure 16 – Liberty Place Pump Station Site Plan

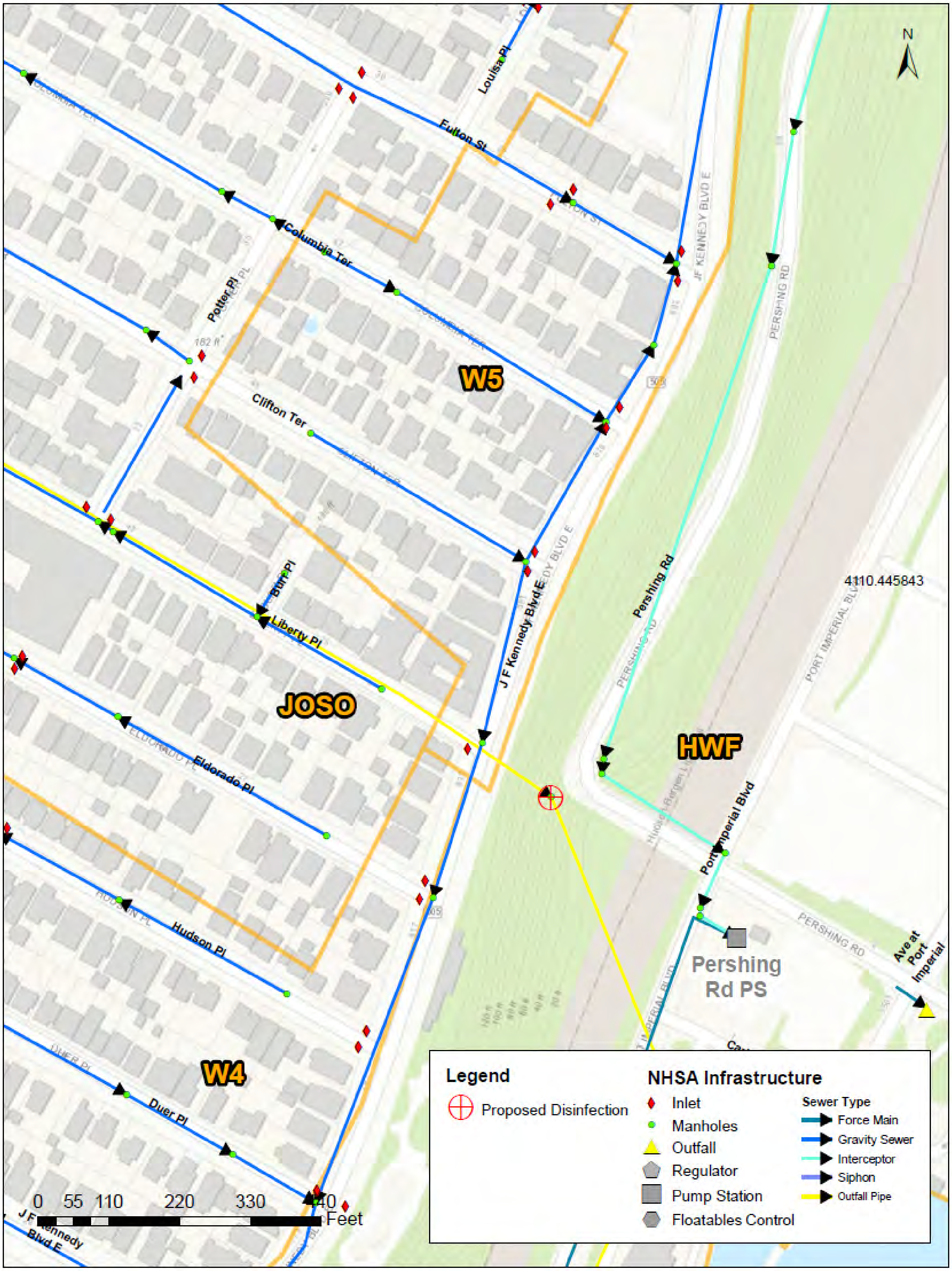


Disinfection at JOSO drop shaft

Disinfection is proposed at the JOSO drop shaft for the JOSO drainage area. Figure 17 shows the location of the proposed dosing point. According to the System Characterization Report for the Adams Street WWTP dated July 1, 2018, Outfall 003A has 61 CSO events and an annual CSO volume of 95.2 MG in a typical year. The largest typical year CSO event is 10.8 MG with a corresponding peak flow rate of 142.5 MGD.

- *Anticipated Constraints and Site Limitations:* Siting and constructing a building on a constrained site, the required contact time, and the need for a second chemical at the outfall are the anticipated constraints for this alternative.
    - Available Space - A 25 ft. x 36 ft. disinfection building would need to be sited near the drop shaft. The drop shaft exists because of the major elevation change from Liberty Street down to Pershing Road and Port Imperial Boulevard. There does not appear to be any available land to site the facility at the top of the shaft. Therefore, it would be necessary to site the building at the bottom of the shaft. The chemical could be injected at a turbulent point near the bottom of the shaft near the bend in Pershing Road. The closest available land on a flat surface is over 300 feet to the east and would require pipe crossings under light rail train tracks and Port Imperial Boulevard.
      Field inspection would be required to determine if there is sufficient buildable area in the heavily forested area at base of the hillside near the bottom of the drop shaft. Suitable access would be required from Pershing Road near the Liberty steps for construction equipment and for chemical delivery.
    - Contact Time - The available contact time in the outfall pipeline from the JOSO drop shaft would need to be verified.
    - Traffic/Public Access - Construction could impede traffic on Pershing Road. Chemical unloading could also impede traffic on Pershing Road unless there is adequate area for the delivery truck to pull off the road during unloading.
- *Functionality*:
    - Chemical Dose - Available detention times in the discharge pipe to the outfall would need to be determined.
- *Feasibility:*
    - This alternative is not considered feasible due to the possible construction beneath train tracks and minimal space for the disinfection facility.

Figure 17 – JOSO Drop Shaft Site Plan



WNY1 Basin

Disinfect at the WNY1 S/F Facility

Disinfection is proposed at the existing WNY1 solids/floatables facility. Figure 18 shows the location of the proposed dosing point. According to the System Characterization Report for the Adams Street WWTP dated July 1, 2018, WNY1 with Outfall 002A has 60 CSO events and an annual CSO volume of 190.4 MG in a typical year. The largest typical year CSO event is 20.3 MG with a corresponding peak flow rate of 194 MGD.

- *Anticipated Constraints and Site Limitations:* Construction staging adjacent to Anthony M Defino Way and the WNY1 Screening facility, the required contact time, and the need for a second chemical at the outfall are the anticipated constraints for this alternative.
    - Available Space - A nominal 25 ft. x 61 ft. disinfection building with 2 bulk storage tanks would need to be sited adjacent to the screening facility.
        - The screening facility is located against a rock cliff. A significant amount of rock blasting would be required to widen the available area to the south of the screening facility. A lesser amount of rock blasting would be required if a single bulk tank were determined to be sufficient.

      A 25 ft. x 61 ft. disinfection building would not fit to the north of the existing screening facility. However, if the parking lot area could be used, it appears that there is just enough room for a single bulk tank facility without blocking the service roads.
    - Contact Time - The available contact time in the outfall pipeline and screening facility would need to be evaluated.
    - Traffic/Public Access - Construction staging could require a lane closure on Anthony M Defino Way. The project may cause similar traffic constraints to those experienced during the construction of the WNY1 screening facility although the screening facility limits of road access to the north thereby requiring all construction equipment to access the site from the road. Chemical unloading could require lane closure although this would only be required a few times per year.
- *Functionality*:
    - Chemical Dose - Available detention times in the discharge pipe to the outfall and WNY1 screening facility would need to be determined.
    - Chemical Storage and Feed - The annual volumes to be treated and the design storm events are sufficiently large to assume two nominal 6000 gallon bulk storage tanks for screening purposes. A single tank may be possible with PAA since it does not degrade but testing would be required to determine the required dose.
- *Feasibility:*
    - Due to the proximity to the WWTP and the distance from residential areas, this alternative is considered feasible.

Figure 18 – WNY1 S/F Facility Site Plan

Summary

In Summary, Table 2 below identifies the final list of alternatives that will undergo the full evaluation process to simulate the conditions as they are expected to exist after construction and operation of the alternative. Those identified alternatives will also have a Class 5 conceptual cost estimate developed to provide ithe overall cost benefits for the anticipated amount of CSO control.

Table 2 - Preliminary Screening Alternatives Summary

Service Area	Alternative	Proceed to full evaluation?
H1	Disinfect at H1 WWPS	Yes
	Combine flows with Jersey City CSO in Long Slip Canal	Not for this contract
H3/H4/HSI	Chemical Storage and Feed at 5th Street Pump Station and route chemical to H3 CSO	Yes
	Disinfection under Stevens Park	Not for this contract
H5	Incorporate disinfection with structure in water	Yes
	Disinfect at H5 regulator adjacent to 11th Street PS	Yes
W1234	Disinfect at W1234 Outfall Manholes on Waterfront Terrace	Yes
	Disinfect at Junction Structure under the Lincoln Tunnel Helix	Yes
	Disinfect at one of the W1234 regulators on Park Avenue	Not for this contract
	Disinfect at W1234 S/F facility	Not for this contract
	Install chlorine contact tank at the bottom of the Palisades	Not for this contract
18th Street	Disinfect at 18th Street Pump Station	Yes
W5	Disinfect at at W5 S/F vortex facility	Yes
JOSO	Disinfect at Liberty Place Pump Station	Yes
	Disinfect at JOSO drop shaft	Not for this contract
WNY1	Disinfect at WNY1 S/F facility	Yes

Attachment 1

Evaluation Criteria

Table 1- Evaluation Criteria Summary

Category	Criteria	1	2	3	4
CSO Reduction	Bacteria Reduction	Alternative does not eliminate or reduce bacteria discharges of effluent	-	Alternative results in reduction of bacteria discharges of effluent	Alternative eliminates bacteria discharges of effluent
	Water Quality Benefits	Will not meet water quality standards in the Hudson River	-	Will meet water quality standards in the Hudson River with help of another alternative	Will meet water quality standards in the Hudson River standing alone
	Support designated uses in Hudson River (Secondary contact recreation and fishing)	Will not attribute to improved water quality to support designated uses of the Hudson River	Will attribute to improved water quality to support partial designated uses of the Hudson River	Will attribute to improved water quality to support partial designated uses of Hudson River with help of another alternative	Will support all designated uses of the Hudson River standing alone
Feasibility	Availability of validation on main technology for the alternative	Scientific basis largely unproven/untested	Limited data provided, but technology claims cannot be corroborated using conventional scientific/engineering principles	Significant data to corroborate technology claims available but lacks consensus of the scientific community	Uses well known and accepted scientific principles or the Authority already uses technology with success
	Flexibility of alternative to be adjusted or optimized with future changing flows	Alternative cannot be adjusted after initial implementation	Alternative can be adjusted with significant additional construction/cost in conjunction with adjustment to related alternative	Alternative can be adjusted with significant additional construction/cost	Alternative can be altered without significant additional construction/cost
	Flexibility of the alternative to provide effective treatment under variety of operating conditions.	Need for supplemental steps in the treatment process – compatibility with disinfection process.	-	-	Limited number of steps in the treatment process. Effective performance under a variety of operating conditions. Tolerance of the alternative to variable loading conditions (flow, pollutant load) and compatibility with influent.
	Anticipated Operations from the Authority's personnel	Capabilities and/or staff resources are not readily available and require hiring	Capabilities and/or staff partially available and require training. Some hiring may be required.	Capabilities can be accomplished with existing staff, with additional training	No additional hires/training required
	Reliability	Alternative struggles with intermittent operation. Relies on chemicals that are subject to degradation. Lack of performance history in application.	-	-	Alternative provides consistent performance while operating intermittently. Ability to operate after long idle periods.
Regulatory Compliance	Anticipated effects on project timeline through coordination with other agencies or the Authority's projects	High probability of project delay of one year or greater from interaction with agency	Moderate potential for project delay	Minor probability or project delay of one year or greater	No anticipated cause for delay of this project or other projects
	Anticipated lead time for permitting	Permit lead time > 6 months	-	-	Permit lead time < 6 months
	Requirement of USACOE Permit	USACOE permit required for construction	-	-	USACOE permit not required for construction
	Requirement of NJPDES Permit	Requires a new NJPDES permit	-	Requires revision of an existing NJPDES Permit	New NJPDES permit or revisions to existing NJPDES permit not required
Location Constraints	Anticipated Land Acquisition	Permanent acquisition of publicly or privately owned land with owner known to be strongly resistant	Temporary acquisition of land for construction purposes where owner is known to be strongly resistant	Temporary acquisition of land for construction where owner is known to be compliant	Sufficient access is likely available at low cost and resistance, or land is already owned by the Authority
	Anticipated Traffic Impacts	Significant adverse impacts on primary road	Significant adverse impacts on primary road	Minor adverse impacts lasting more than 6 months on smaller road	Minor adverse impacts lasting less than 6 months
	Compatibility with Existing Infrastructure	Requires utility relocating for 1000 feet or counteracts previous investment	Requires utility relocating for less than 1000 feet	Localized/minor consequences-Utility relocation at spot locations	No impact/positive impact
	Anticipated Noise and Odor Impacts	Noise and odor impacts are significant or unable to be measured or mitigated	Noise and odor impacts are significant but are able to be mitigated with additional services	Noise and Odor Impacts are minor but able to be mitigated with additional services	Noise and Odor impacts are minimal or non-existent
	Alternative Characteristics	Size or footprint of the alternative will significantly impact surrounding area	Size or footprint of the alternative will significantly impact surrounding area but can be mitigated	-	Size or footprint of the alternative will not impact surrounding areas
Cost	Capital (Includes New Equipment, staffing during and after wet weather events, and Design Costs and Present Worth)	(Range of prices to be defined once costs are developed)			

Category	Criteria	1	2	3	4
	Operations and Maintenance (Includes chemicals, labor to maintain equipment, power cost and need for staffing during and after wet weather events.)	(Range of prices to be defined once costs are developed)			
Community Impact	Public Acceptance	Public concerns expected	Moderate public concerns anticipated	Minor public concerns anticipated	No public response anticipated
	Impact to Businesses	Permanent interruption to businesses with no mitigation	Permanent interruption with mitigation strategy	Temporary interruption with mitigation strategy	No interruption
	Quality of life after construction	Significant adverse impact on use of parks or public spaces for more than 6 months	Significant adverse impact on use of parks or public spaces for less than 6 months	Minor adverse impacts on parks or public spaces for less than 6 months	Negligible or no adverse impacts on use of parks or public spaces